Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by 11421247 Canada Inc. (the client) to prepare a Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site Report associated with the proposed development located at 1740-1760 Saint Laurent Boulevard, Ottawa, Ontario (hereinafter referred to as the 'Site'). EXP understands that 11421247 Canada Inc. is completing this work in support of site re-development at 1740-1760 St. Lauret Boulevard in Ottawa, Ontario. EXP understands that a hydrogeological study is required to address comment B15 of the City of Ottawa's 1st Round of Technical Comments on the Site Plan Application (SPA).

It is our understanding that the Site is currently occupied by four (4) structures (St. Hubert Restaurant, 168 Sushi and Petro-Canada service station (two buildings) which will be demolished as part of the proposed development. The proposed development will consist of four (4) towers that will include two (2) 20 storey (Towers 1 and 3) and two (2) 13 storey (Towers 2 and 4) high-rise residential towers. The Towers 1 and 2 will include three-levels of shared underground parking garage with the lowest slab at approximately 9.75 m [(3 m x 3 levels) + 0.75 m for foundation subgrade) depth below the ground floor level based on preliminary design plan communicated to EXP. Towers 3 and 4 include two (2) levels (P2 level) of shared underground parking structure with lowest slab at approximately 6.75 mbgs. The Site location plan is shown in Figure 1. The four (4) towers will be constructed in two (2) phases, Towers 1 and 2 will be constructed first then Towers 3 and 4.

EXP conducted a Preliminary Geotechnical Investigation and Environmental Site Assessments (ESA) and this investigation is required to address City of Ottawa planning department comments. The pertinent information gathered from the noted investigations are utilized for this report.

1.2 Project Objectives

The main objectives of this Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site are as follows:

- Establish the local hydrogeological setting within the Site;
- Assess preliminary construction dewatering flow rates and potential impacts; and
- Prepare a Hydrogeological Investigation report to support a SPA and construction dewatering permitting requirement.

1.3 Scope of Work

To achieve the investigation objectives, EXP has completed the following scope of work:

- Reviewed available geological and hydrogeological information for the Site;
- Conducted Single Well Response Tests (SWRT) at accessible and functioning monitoring wells to evaluate hydraulic properties of the saturated stratigraphic units at the Site.
- Collected one (1) groundwater sample for laboratory testing for comparison to the City of Ottawa sanitary and storm Sewer By-Law discharge limits;
- Completed one (1) round of groundwater level measurements;
- Evaluated the information collected during the field investigation program, including borehole geological information, SWRT results, Water Well Records, groundwater level measurements and groundwater water quality;
- Estimated construction dewatering flow rates and long-term foundation drainage rates.
- Assessed potential impacts and recommend mitigation measures; and
- Prepared a Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site

This Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site report was prepared in accordance with the Ontario Water Resources Act, Ontario Regulation 387/04 and the City of Ottawa Hydrogeological and Terrain Analysis guidelines (March 2021).

1.4 Review of Previous Reports

The following reports were reviewed as part of this Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site:

2001 and 2002 - Phase I and Phase II ESA reports completed by AMEC Earth & Environmental Ltd. (AMEC).

- Phase I ESAs were conducted for the 1740 and 1760 St Laurent site & 1757 Russell Road, Ottawa, in November 2001 by AMEC for M.R. Denison Associates Ltd.
- In January 2002, a Phase II ESA was completed by AMEC for the 1740 and 1760 St Laurent site and 1757 Russell St. Ottawa. Nine boreholes were drilled at the gas station property and three monitoring wells were installed. As part of the work, groundwater samples were collected for analysis of benzene, toluene, ethylbenzene, xylenes (BTEX), total petroleum hydrocarbons (TPH) (gas/diesel), TPH (heavy oil, volatile organic compounds (VOC), and metals.
- Low level PHC concentrations were identified in the groundwater from the monitoring wells near the gas station, however all concentrations were less than their respective Table B criteria at the time.

2009 – Phase II ESA by Terrapex Inc.

- Ten boreholes were advanced five of which were completed as monitoring wells. One soil sample was collected at each borehole and one groundwater sample was collected from each monitoring well. All collected soil and groundwater samples were analyzed for BTEX and PHC and had concentrations of the analyzed parameters that were less than the Ontario Ministry of Environment, Conservation and Parks (MECP) Table 3 site condition standards (SCS) for commercial land use and fine-grained soil.
- No liquid phase petroleum product or free product was observed during drilling program.

2020 – Phase II by Terrapex Inc.

- Terrapex drilled eight boreholes in the vicinity of the gas station infrastructure for investigation of site soil conditions at 1740 St. Laurent Boulevard site. Soil samples were analyzed for BTEX and PHC.
- Collected groundwater samples from all the existing monitoring wells for analysis of BTEX and PHC.
- Based on the analysis of soil and groundwater samples, Terrapex concluded that concentrations of any of the analyzed parameters did not exceed any of the then MECP (2011) Table 3 SCS for the submitted samples.

2020 – Phase One ESA and Phase Two ESA by EXP

- A Phase One ESA was completed by EXP in December 2020 to update previous studies.
- A Phase Two ESA completed by EXP in October 2020 during which four boreholes were drilled
- Three soil samples and three groundwater samples were submitted for analysis of BTEX and PHC, metals and VOC.
- It was concluded in the report that the areas of the Site south and west of the gas station did not show any impacts from the operation of the gas station.

2 Regional Geological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is located within the physiographic region identified as Ottawa Valley Clay Plains. Another physiographic region identified as Till Plains (drumlinized) borders just the west of the Site.

2.1.2 Surficial and Bedrock Geology

The regional scale surficial geology which are identified as glacial till at the Site and glaciomarine and marine deposits (Ontario Geological Survey, 2011) south of the Site as mapped. The till is composed of undifferentiated, predominantly sandy silt to silt matrix, commonly rich in clasts, often high in total matrix carbonate content. The marine deposit is composed of silt and clay, originating as basin and quiet water deposits most likely in a glacial lake environment.

Regional bedrock geology, as identified, is composed of shale, limestone, dolostone and siltstone from Carlsbad Formation from middle to upper Ordovician time, which at depth is underlain by granite and metamorphic rocks of the Precambrian-aged Canadian Shield.

Surficial Geology and Bedrock Geology are shown in Figures 2 and 3, respectively.

2.1.3 Hydrogeology

On a very large-scale hydrogeological region mapping by Natural Resources Canada (2007) the area is located within the Saint Lawrence Lowlands area. The bedrock in the area forms the major water supply aquifer. The bedrock in the area is considered the major aquifer and there is potential of good hydraulic connectivity with the Ottawa River.

2.1.4 MECP Water Well Records

Water Well Records (WWRs) from the database maintained by the MECP were reviewed to determine the number of water wells within a 500 m search distance from the Site perimeter. The locations of the MECP WWR are shown in Figure 4. A summary of the WWR is included in Appendix A.

The MECP WWR database search indicated that a total of twenty-three (23) water wells are located within a distance of 500 m from the Site perimeter. This included five (5) wells recorded as drinking water supply wells. The remaining (18) records are for non-water supply wells that includes test, monitoring, observation and abandoned wells, and wells of unidentified usage and of unknown use.

The reported depth to groundwater for all well recorded as water supply wells vary between (12.2) and (44.2) meters below ground surface (mbgs). The noted groundwater or potentiometric surface based on recorded information from (56.8) and (36.2) ranges between (69.0) masl to (80.4) masl which after urbanization may be higher as the use of private water supply wells stopped over the years when municipal services became available.

Table 2-1 Summary of MECP Water Well Record Search

Well Usage (as recorded)	Number of Wells	Well Construction Period	Ground Elevation (masl)	Groundwater Elevation (masl)	Water Found Depth (mbgs)	Water Found Elevation (masl)	Well Completion Material
Water Supply	5	1948-1961	Min – 69.0 Max – 80.4	Min – 68.1 Max – 76.8	Min – 12.2 Max – 44.2	Min –36.2 Max –56.8	All the wells are completed in bedrock
Non-water supply wells (test wells, observation wells, monitoring wells, abandoned wells and unspecified wells)	18	2006-2016	No groundwater elevation information available	No groundwater elevation information available	No information available	No information available	No information available

The pumping test rates for the water supply wells varied between 9.1 liters/minute (LPM) to 36.4 LPM sustainable through 0.5-hour to 1-hour duration.

Some of the location information as recorded in the database are not correct or accurate (reliability code of 9 or higher identified as UTM RC in the water well report, lower the value higher the accuracy of the recorded well locations), however the reviewed MECP water well information provides a general understanding of the hydrogeological conditions within the searched area.

Since the area is municipally serviced and these water wells were installed in the between 1940s to 1960s, it is unlikely that the noted water supply wells are still active.

2.2 Site Setting

2.2.1 Site Topography

The Site is in an urbanized land use setting. The topography of the site gradually slopes down in a south to north direction and in an easterly direction towards St. Laurent Boulevard. Based on 2020 borehole ground surface elevations, the ground surface in the west end of the site slopes down from south to north from 72.37 masl to 71.07 masl and slopes down towards the east to St. Laurent Boulevard to 69.35 masl.

2.2.2 Local Surface Water Features

The Site is located within the Ottawa River West sub watershed. No surface water features exist on the Site. The nearest surface water feature is Green Creek, located approximately 1.7 km northeast of the Site boundary. Based on the MECP Website, the Site is not within the flood plain or within a regulated area.

2.2.3 Local Geology and Hydrogeology

A geotechnical investigation was completed at the site in August of 2020 and ten (10) boreholes were drilled. The following is a summary of site geology and hydrogeology based on review of geological mapping information and MECP water well records and borehole logs of wells drilled during site investigations. Figure 5 shows the borehole location plan and Figure 6 shows generalized cross-sections showing the stratigraphy of the Site.

Table 2-2 Site Stratigraphy

Geological Material	Soil Material	Top and Bottom Surface Elevation (masl)
Anthropogenic Material	Fill – overlain by pavement, silty sand with gravel to a mixture of silty sand, clayey silt and silty clay with gravel	66.1 to 70.6
Native Overburden	Sand Layer contains some silt and clay	68.3 to 68.9
	Silty Clay	64.9 to 70.6
	Sand, silt and clay	66.9 to 67.7
	Glacial Till contains varying amounts of gravel, sand, silt and clay	63.4 to 69.8
Bedrock	Shale of Carlsbad or Billings Formation	Top of bedrock encountered between 63.4 masl to 65.5 masl

2.2.3.1 Fill

Fill is encountered at the surface and extends to depths of 0.8 m to 4.5 mbgs (70.6 masl to 66.1 masl) and it is composed of silty sand with gravel to a mixture of silty sand, clayey silt and silty clay with gravel.

2.2.3.2 Sand Layer

A native sand layer was encountered at two borehole locations between 1.4 mbgs to 2.0 mbgs (68.9 masl to 68.3 mal). The sand contains some silt and clay and is loose.

2.2.3.3 Silty Clay

Native silty clay soil was encountered at seven (7) borehole locations. This soil type was encountered at 0.2 mbgs and extended to 4.5 mbgs (70.6 masl to 64.9 masl). This soil layer is brown moist to wet and very stiff to stiff and does not have any staining or odour.

2.2.3.4 Sand, Silt and Clay

Beneath the silty clay layer at BH MW19-04, a thin layer of sand, silt and clay was encountered between 2.3 mbgs to 3.1 mbgs (67.7 masl to 66.9 masl). This mixed soil layer brown, wet and loose and wet and does not show staining or have an odour.

2.2.3.5 Glacial Till

The glacial till was encountered at all borehole locations between depths of 1.6 mbgs to 4.5 mbgs (69.8 masl to 64.9 masl) and extends to 5.3 mbgs to 7.0 mbgs (65.5 masl to 63.4 masl). The till is composed of various amounts of gravel, sand, silt and clay with soil cementing matrix ranging from silty sand with gravel to clayey sand to silty clay. The SPT-N values of the till ranged between 2 to 51 indicating a very loose to very dense, soft to hard consistency, moist to wet.

2.2.3.6 Shale Bedrock

The shale bedrock identified as Carlsbad Formation was inferred based on auger and soil sampler refusal encountered at all the borehole locations. The top of the inferred bedrock was confirmed by coring (0.1 m to 1.4 m length) into the bedrock at all locations.

3 Groundwater Conditions

Groundwater as recorded at the Site is summarized below.

Table 3-1 Summary of Groundwater Elevations

BH ID	Ground Surface Elevation (masl)	Groundwater Elevation 03-Sep-20	Groundwater Elevation 26-Sep-23
MW 19-01	70.4	68.9	NA
MW 19-02	70.3	68.2	67.7
MW 19-03	70.3	67.9	67.9
MW 19-04	70.0	68.8	NA
BH 20-05(shallow)	72.4	69.3	NA
BH 20-05(Deep)	72.4	69.4	NA
BH 20-10	69.9	68.1	NA
BH 20-11	70.9	69.0	NA
BH 20-13	71.1	68.5	NA
BH 20-14	71.9	70.3	NA

Note: NA – Not Accessible or Not Available.

Elevations are rounded off to the nearest decimal digits.

The above is a summary of two snapshots (3-year interval) of groundwater levels measured at the Site, however they appear to be consistent. The minimum as recorded was 68.2 masl and maximum is 70.3 masl. During a recent site visit on September 26, 2023, only two monitoring wells were accessible. The remaining wells were not accessible or could not be located.

4 Hydraulic Conductivity Test

Hydraulic conductivity or single well response testing (SWRT) was conducted at MW19-02, MW19-03 and in a well without Well ID. The well is located near the vicinity of previously drilled BH20-10. Since the geology and well construction detail were not available for the well without any ID, the results of the test performed at this well will not be used.

Falling head and rising head tests were performed. In falling head test a solid slug of known volume is inserted or a known volume of distilled water is poured into the well to raise the water level temporarily. The well recovery was monitored using electronic dataloggers and manual water level measurements. In the rising head test a known volume of water is removed from the well and the well recovery is monitored.

Collected data was analyzed using AqteSolve Pro V 4.5 and Hvorslev (1951) solution for confined aquifer condition. The results are included in Appendix – C.

The following is a summary of the results of the SWRT performed.

Table 4-1 Summary of Estimated Hydraulic Conductivity

Test Well ID	Rising Head Test Estimated Hydraulic Conductivity (K) in m/sec, Hvorslev	Falling Head Test Estimated Hydraulic Conductivity (K) in m/sec, Hvorslev
MW19-02	2.98×10^{-6}	4.95×10^{-6}
MW19-03	6.25×10^{-6}	6.25×10^{-6}
Geometric Mean K =	4.90×10^{-6}	

The estimated hydraulic conductivity values are within the range of values estimated for the fractured bedrock material. Based on the estimated range of K values, three dewatering scenarios will be evaluated considering low-end, high-end and geometric mean K values for the Site.

5 Preliminary Construction Plan and Potential Groundwater Issues

It is our understanding that Towers 1 and 2 will have 3 levels and Towers 3 and 4 will have 2 levels of underground parking. The excavation will extend to the underside of foundations for the underground parking structures. The elevations will be 9.75 mbgs for the P3 level and 6.75 mbgs for the P2 level, including 0.75 m under the underside for placement of subbase grade. Considering the lowest ground surface elevation of 69.8 masl on the Site was measured at BH20-10, the excavations for P3 and P2 will extend to 63.1 masl and 60.1 masl, respectively. The maximum groundwater elevation as measured on September 26, 2023 at accessible monitoring wells was 67.8 masl. Considering the groundwater and required excavation elevations, drawdown in the range of 5 to 8 m from initial water levels will be required and construction dewatering and long-term foundation drainage may be required. Preliminary site plan is shown in Figures 7 and 8.

6 Dewatering Assessment

The dimensions of the proposed structure to support the dewatering assessment are summarized in Table 4-1 below. The foundation of the P3 and P2 parking structures will extend into the groundwater and into the fractured bedrock aquifer which is identified as confined at the site.

Table 6-1 Dimensions for Dewatering Assessment

Input Parameter	Input Parameters	Units	Notes
Perimeter of excavations	295 m – Towers 1 &2 355 m – Towers 3&4	-	Total areas of excavations – 4,580 sq m – Towers 1 & 2 7,450 sq m – Towers 3 & 4
Ground Elevation	69.86	masl	Lowest ground elevation (BH20-10) based on the ground surface elevations surveyed at drilled borehole locations
Deepest Foundation Excavation Elevation	P3 – 60.1 masl P2 – 63.1 masl	masl	Based on the lowest ground surface elevation 69.86 masl and includes 0.75 below the assumed underside of the foundation for placement of foundation subbase material
Groundwater Elevation Considered	67.8	masl	September 26, 2023, measured at MW19-03

It should be noted that the water level in September 2023 is from early fall season when water levels are usually at low levels. Spring and melting season water levels will be higher than this level and this shall be considered when scheduling construction as the assessed pumping volume will be different and higher.

6.1 Dewatering Flow Rate Estimate and Zone of Influence

The dewatering flow rates are estimated based on some key parameters such as groundwater levels, hydraulic conductivity value, size and depth of the excavations. It is expected that the initial dewatering rate will be higher to remove groundwater from within the formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint area as groundwater will have been removed, primarily from storage, resulting in lower seepage rates into the excavation and the pumping volume reaches an equilibrium state. For the dewatering assessment at a location, careful review of water level information, the highest inferred water level was used in the calculations. The required hydraulic conductivity (K) values used in the calculations is estimated from the results of SWRT data analysis.

The dewatering flow equation is based on the following general hydrogeological and construction considerations and assumptions:

- Aquifer top, bottom and initial ground water levels and aquifer type were established based on borehole logs and monitoring well information;
- The bottom of the aquifer is the limit of dewatering;
- In situations where the aquifer bottom was not encountered within the borehole depths, the aquifer was assumed to continue a few metres below the foundation elevation;
- The hydraulic conductivity ‘K’ for the aquifer is estimated by analyzing the SWRT data. Other aquifer parameter such as storage coefficient ‘S’ were estimated based on field evidence and aquifer type;
- The aquifer is assumed to be isotropic and homogenous in both the horizontal and vertical directions. In reality, the aquifers are anisotropic and heterogeneous in all directions;

- The aquifer is assumed to be infinite in extent. In reality, the extent of the aquifer is limited by high horizontal variability fracture zones and the variations in the overburden sediments;
- It was assumed that dewatering occurs across the full vertical extent of the aquifer (i.e., assumes fully penetrating wells). In practice, dewatering will occur only a limited thickness within the upper portion of the aquifer; and,
- Excavations will extend to 0.75 m below the underside of the foundations for placement of subgrade or bedding material and that is the target groundwater lowering elevation.

Dewatering in a source area will create a zone within which the groundwater will be lowered from its initial water level. Each zone of influence (ZOI) is dependent on the anticipated pumping duration, continuity of the aquifer, aquifer parameters (hydraulic conductivity, storativity) and required drawdown. For the purposes of this report, the limit of the ZOI is considered the distance beyond which the predicted drawdown will be 0.5 m or less. This drawdown cut-off criterion is considered reasonable and appropriate considering 0.5 m of drawdown is within the range of natural groundwater variation range. The estimated ZOIs are based on reasonable worst-case scenarios assumed for the dewatering evaluation. The dewatering equations are shown in Figure DW-1 in Appendix E.

For dewatering flow volume calculations, usually a Factor of Safety (FoS) approach is used and a sensitivity analysis is performed. In this approach, the flow volume requested for permit or EASR application will be 1.25 times of what is estimated by the modified non-equilibrium flow equation by Cooper and Jacob (Powers et al., 2007). The FoS approach provides a higher than calculated volume of flow and provides the dewatering contractor flexibility to compensate for unforeseen groundwater conditions that they may encounter during construction. For sensitivity analysis the flow rates will be assessed by applying a range of K values and the most reasonable rate will be used for permitting purposes.

6.2 Cooper-Jacob's Radius of Influence

The radius of influence (Rcj) for the construction dewatering was calculated based on Cooper-Jacob's equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible.
The estimated radius of influence due to pumping is based on Cooper-Jacob's formula as follows:

$$R_{cj} = \sqrt{2.25KDt/s}$$

Where:

Ro = Estimated radius of influence (m)
D = Aquifer thickness (original saturated thickness) (m)
K = Hydraulic conductivity (m/s)
S = Storage coefficient
t = Duration of pumping (s)

6.3 Stormwater

Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. Therefore, the dewatering rates at the Site should also include removing stormwater from the excavation. To estimate stormwater volume data available online IDF Curve Look-up - Ministry of Transportation (gov.on.ca) was reviewed. To estimate the additional stormwater volume a reasonable storm recurrence period and rain fall amount was used. For this site a rainfall of 17.8 mm over a 10-minute interval resulting from a once in ten-year storm event was used. This modelling approach resulted in 81,560 Litres of stormwater over excavations for Towers 1 and 2 and 132,610 litres of stormwater over excavations for Towers 3 and 4.

Since these are relatively large and deep excavations and considering the frequency of weather events, it is reasonable to include an estimate of stormwater volume resulting from direct precipitation over the excavated areas in the pumping scenario.

6.4 Results of Dewatering Rate Estimates

6.4.1 Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed construction plans include an excavation with shoring extending to the Site boundaries. EXP should be retained to review the assumptions outlined in this section, should the assumed shoring design change. Estimated dewatering rates are presented in Appendix E

Based on the assumptions provided in this report, and the sensitivity analysis performed the dewatering rate using the higher K value is reasonable. The results of the dewatering rate estimate are summarized as follows:

Table 6-2 Summary of Construction Dewatering Rates

Peak Dewatering Flow Rate (Litres/day) and Zone of Influence (ZOI) in m based on using higher value of K		
Description	**Dewatering Source Towers 1 and 2 P3 Level UG parking structure**	**Dewatering Source Towers 3 and 4 P2 Level UG parking structure**
Total Volume (L/day) Discharge of Groundwater (Construction dewatering) **(excluding precipitation)**	246,690 LPD	126,470 LPD
Grand Total Pumping Rate **(excluding precipitation)**	373,160 LPD	
Peak Volume (L/day) of Dewatering Discharge of Groundwater + Stormwater (Construction dewatering)	328,250 LPD	259,080 LPD
Dewatering Rate to be registered for the EASR	400,000 LPD	
Predicted ZOI (in m) due to short-term construction dewatering pumping	58 m	56 m

Three dewatering pumping scenarios were evaluated using minimum, geometric mean, and maximum hydraulic conductivity values estimated from single well response tests. Most reasonable pumping volume estimate is considered the one using the high-end K value (6.25 x 10-6 m/sec) of the four estimated hydraulic conductivity values. It is our understanding that the construction of the towers will occur in phases. The initial pumping rate will be high which over time will gradually reduce to a lower volume to a steady state rate. The above rate is for initial drawdown and lowering of water level to the target levels for each of the structures in around 3 day's timeframe. Over the longer time during construction the required pumping rates will be reduced. As soon as the target water level is reached the pumping rate can be decreased to maintain the water table. Using a sequential or phased construction approach dewatered ground condition could be achieved and maintained below EASR limit of 400,000 LPD.

The estimated pumping rate in the above table considers potential stormwater volume and that concurrent or pumping simultaneously from both the excavations are not possible. Pumping from only one area will be allowed. However, if dryer weather prevails during construction, pumping concurrently from both of the excavations is potentially possible provided the maximum rate of 400,000 LPD is not exceeded or the works shall be adjusted or limited so that the allowed rate is not exceeded at any time.

These rates were estimated based on the highest fall season water level. The spring season water levels are generally higher than this fall season. These rate estimates need to be re-evaluated when spring season water levels are available.

The pumping rates provided in Table 4-2 above are the result of using high end hydraulic conductivity value. The detail of the dewatering rate calculations and the results are provided Table DW-1 in Appendix E.

In terms of permitting requirements, it should be noted that with an estimated maximum pumping rate of 400,000 LPD, each of the underground parking structures can be dewatered separately but not simultaneously as in that case the total pumping rate from the Site will exceed the EASR limit and a Category 3 permit to take water (PTTW) will be required.

All gradings around the perimeter of the excavation should be graded away from the excavations. The contractor is responsible for the design of the dewatering systems (depth of wells, screen length, number of wells, spacing, sand pack around screens, prevent soil loss etc.) to ensure that dry conditions are always maintained within the excavation at all costs.

Discharge rates should be monitored using calibrated flow meters and records of dewatering progress, and daily precipitation as per MECP requirements. Discharge flow rates must be recorded via a totalizing flow meter and also manually by measuring the instantaneous flow during the day the pump is operational.

Dewatering should be monitored using dedicated monitoring wells within and around the perimeter of the excavation, and these wells should be monitored by manual measurements. Records of pumping, groundwater level monitoring and EASR registration should be maintained on site to track dewatering progress.

7 Potential Long-term Foundation Drainage

It is anticipated that dewatering pumping during construction will be required in the short-term, however foundation drainage in the long-term will be required for the proposed construction. Because the foundation of the proposed structures will be extending into the local groundwater table, it will be subjected to hydrostatic buoyancy pressure in the long-term. To reduce this pressure the groundwater will need to be removed using foundation drainage collection (FDC) subdrain system under the foundations. The groundwater will be collected in a sump pit and then pumped out to the city sewers if allowed. The following table summarizes the long-term foundation drainage rates for each of the towers.

Table 7-1 Summary of Long-Term Foundation Drainage Rates

Drainage Source ID	Long-Term Drainage Rate (LPD)
Towers 1 and 2 P3 parking	162,815
Towers 3 and 4 P2 parking	83,470

Unfortunately, we do not have long-term (at least for1-year) seasonal groundwater level information. These rates were estimated based on the highest of the fall season water level. The spring season water levels are generally higher than fall season. These rate estimates need to be re-evaluated when spring season water levels are available.

If the City does not approve long-term discharge (due to under-capacity of the services or any other reasons) into the City sewers, then alternative foundation design (watertight bathtub) may have to be considered.

The long-term foundation drainage rates in Table 7-1 are estimated rates which will be confirmed and updated based on actual pumping data from the site which will be available after construction dewatering commences.

8 Dewatering Permit

Considering the size (Towers 1 and 2 - 4,580 m^2, Towers 3 and 4 – 7,450 m^2) and depth of proposed excavations (6.8 to 9.8 mbgs), the estimated maximum pumping rates including allowance for stormwater volume during construction, and pumping from only one portion of the site (either Towers 1 and 2 or Towers 3 and 4 areas), an EASR registration is deemed adequate. Simultaneous pumping will exceed the EASR permit threshold limit of 400,000 LPD allowance and a Category 3 Permit to Take Water (PTTW) will be required which will allow pumping at rates higher than 400,000 LPD. However, for our study, we assumed that the construction will occur in phases and an EASR registration will be adequate to address groundwater issues during each phase of construction. For pumping rates between 50,000 and 400,000 LPD registration on the Environmental Activity and Sector Registration (EASR) with the MECP will be required. This type of permit is registered online and issued instantaneously for a fee of CAD $ 1,190.

Pumping at rates higher than 50,000 LPD for long-term drainage during the life of the building will require a permit issued by the MECP and will also need a Private Water Discharge Agreement (PWDA) with the City of Ottawa. If the City does not allow discharge into their sewers over the long-term, then alternative foundation design (raise the foundation, bathtub or water-tight foundation) shall be explored.

9 Groundwater Quality

One groundwater sample was collected from the Site during fieldwork in September 2023 for analysis by a Canadian Association of Laboratory Accreditation (CALA). The water sample was tested for comparison to City of Ottawa Sewer Use By-Law (2003-514) Schedule A, Table 1 and Table 2 parameters. The results indicate that the groundwater is fit to discharge into the sanitary sewers but not suitable to discharge to the storm sewers without treatment for manganese as the concentration (0.057 mg/L) was slightly elevated compared to the storm sewer use limit of 0.05 mg/L. The discharge needs to be treated to reduce the concentration of manganese before it can be discharged into the storm sewer. The results of the analysis are included in Appendix-D.

Manganese is a naturally occurring metal that is found in many types of rocks. It also is considered a background element in the groundwater in the region. In water, manganese tends to attach to particles in the water or settle into the sediment. It is likely that the noted slight exceedance may be treated effectively by utilizing best management practice measures (settling tanks, fine mesh filter bags, adding polymer agents or flocculants) for removal of total suspended solids (TSS).

Based on the review of available data (City of Ottawa Water Quality - Baseline Surface Water Monitoring Program data 1998-2017) for the region Water Quality – Baseline Surface Water Monitoring Program | Open Ottawa, the average concentration of dissolved manganese in surface water for the period is 1.99 mg/L.

A resampling and analysis of groundwater from the site is recommended to confirm the detection of manganese. The sample shall be filtered before the analysis for metals to determine treatment options.

10 Groundwater Discharge Management Plan

The groundwater quality analysis indicates that the discharge from the Site is suitable to discharge into the sanitary sewers but not suitable to discharge into the storm sewers without treatment for manganese, however it is worth noting that manganese is detected in the groundwater as background element in the region as the underlying rock is considered the source of manganese and other background metals detected in the groundwater in the region.

A private water discharge agreement will be required with the city to direct groundwater from the Site during both the short- and long-term dewatering operation into the City sewers provided the water quality complies to the applicable discharge guideline standards. Discharge water quality must comply with either Table 1 or Table 2 standards of the City of Ottawa Sewer use By-Law (2003-514) depending on the discharge location (storm or sanitary sewers).

Pre-construction and during construction groundwater sampling and analysis will be required to comply with the sewer use guidelines. If the water quality complies with the City of Ottawa Sewer Use By-Law guidelines (By-Law No. 2003-514) and the City issues a private water discharge agreement, then the discharge can be routed towards the city services. A discharge water quality management plan will need to be developed. This plan will be adaptive and will be effective during the dewatering period. Anytime any exceedances are identified the discharge to the city services will be suspended until corrective action is implemented and water quality indicates compliance.

Table 10-1 Groundwater Discharge Management Plan

Potential Issue	Monitoring Aspect	Sampling and Suggested Frequency	Potential Mitigation Approach
Discharge Water Quality Management Plan			
TSS in discharge TSS was 5 mg/L which is below the City of Ottawa sewer by-law standards however the method of excavation, low level rock blasting, has the potential to generate a large volume of particulates which when wet has the potential to exceed the limit.	Due to the nature of work (low level rock blasting and hauling using large and heavy construction equipment) TSS will be a potential issue during construction period specially during post-storm events.	The dewatering discharge – should be routed through a fine mesh filter bag as best management practice (BMP) approach. The discharge shall be sampled every day for the first week of pumping and in the post-storm time at the outlet location to monitor compliance. If the discharge is compliant than the sampling frequency could be expanded to two-times a week. If it indicates compliance then sampling frequency can be expanded to once-a-week. A field turbidity probe can also be used to calibrate with the laboratory measured TSS concentrations for frequent site discharge turbidity measurements.	As a basic BMP approach, the discharge must be routed through fine mesh filter bags. If the discharge is non-compliant with the applicable receptor guidelines, then additional treatment options such as a settling tank, on-site settling basin or envirotank™, floclog™ should be utilized to enhance the mitigation process.
Manganese in discharge Manganese was detected at slightly elevated (0.057 mg/L) concentrations which is higher than the storm sewer standard of 0.05 mg/L.	Manganese is an earth element and is found naturally in groundwater in low concentrations. The presence of this element does not impart any health-related issues on the environment other than aesthetic issues.	Visual inspection of the discharge area and downslope area of outlet location every week for signs of impact from manganese (black particles). *Note: No sensitive aquatic habitat has been identified within 100 m of the site.*	Additional treatment may be required to reduce the concentration of manganese.

Potential Issue	Monitoring Aspect	Sampling and Suggested Frequency	Potential Mitigation Approach
Erosion and Sediment Control Plan			
Erosion and Sediment Control Erosion is not anticipated to be an issue from the proposed dewatering operation. However, due to the nature of the work there is potential for high levels of particulates to be generated and transported from the site.	**Sediment Control** ***Adaptive*** sediment control measures must be in place to reduce transport of sediments offsite (through vehicular traffic to and from the site and storm runoff).	Basic sediment control measures such as installing silt fences around the work area and the site perimeter shall be applied. Siltsox™ or woodchip logs maybe used instead of silt fences at the perimeter to prevent sediment transport offsite. After every storm event, the site must be inspected for sediment control measures. The sediment control measures shall be in place before construction commences and shall be inspected prior to the beginning of construction. Thereafter, the measures shall be inspected every week or within 24 to 48 hours of a storm event and be maintained or upgraded or modified as necessary.	If there is excessive particulates/sediments generated from the site, that have the potential to be transported offsite via construction vehicular traffic, then a portable vehicle wheel wash system and a street sweeper may be employed for cleaning operations.

A discharge sampling and monitoring plan as recommended in Table 10-1 shall be in place during the anticipated short-term dewatering operation to ensure compliance of discharge water quality to the receptor standards. Erosion will not be an issue at the Site given the proposed dewatering operation, however the sediments that will be generated due to excavation has the potential to be an issue. An adaptive sediment control plan shall be developed and be implemented at the site during construction to control impacts from sediments as best management practice (BMP). So therefore, sediment control measures as outlined in the Table 10-1) will need to be installed at the site that will be inspected on regular intervals and within 24 to 48 hours after storm events.

11 Potential of Impact from Anticipated Dewatering

Any dewatering pumping operation will generate a zone within which the groundwater is lowered with the maximum drawdown at the pumping location even during short-term operation. The further the distance away from the pumping location the drawdown is less and eventually at a certain distance from the pumping location the zone of influence (ZOI) diminishes because of reaching equilibrium condition.

The lowering of groundwater has the potential to impact sensitive features such as utilities, environmental habitats, water wells and engineered structures that are located within the predicted ZOI and are founded on compressible soils. Most of the construction dewatering operations will occur only for short-term (1 month to 12 months duration) and the impacts will be temporary.

The proposed construction and related dewatering activities will be occurring in a highly urbanized area and there is less potential to impact water wells since municipal services are available and there are no active or in use private water wells in the area. Our preliminary assessment indicates that there are no sensitive environmental features within 500 m distance of the site.

A geotechnical assessment of consolidation and settlement of soils due to short-term groundwater lowering will be required to assess the potential of settlement of utilities.

11.1 Short-Term Construction Dewatering

For the short-term dewatering (construction phase), it is anticipated that total suspended solids (TSS) levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed both, Sanitary and Storm Sewer Use By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable and a basic best management practice (BMP) treatment method (source control and outlet control) be implemented (fine mesh filter bags settlement tank and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.

11.2 Long-Term Construction Dewatering

For the long-term dewatering discharge into the city of Ottawa sewer services in the post-development phase Since the foundation will be extending into the local groundwater table, there is potential for development of hydrostatic buoyancy pressure (uplift pressure). To counterbalance the uplift pressure a system of foundation drainage collection subdrains will be required to collect the groundwater and pump it out to reduce the buildup of uplift pressure.

Alternatively, if the City does not allow long-term discharge into their sewers, the building foundation may be designed as a water-tight bathtub like foundation to counterbalance the uplifting hydrostatic pressure.

11.3 Contaminant Migration

Dewatering (short and long-term) may induce migration of contaminants within the zone of influence and beyond due to changing hydraulic gradients, hydrogeological conditions beyond Site boundaries and preferential pathways in utility beddings etc. The water quality sampling conducted as part of this assessment was performed under static conditions. As a result, monitoring may be required during dewatering activities (short and long-term) to monitor potential migration, and this should be performed more frequently during early dewatering stages.

For the long-term dewatering discharge to the city sewer system (post-development phase) and based on the water quality results, it is recommended to implement a suitable pre-treatment, as required.

The water quality results presented in this report may not be representative of the long-term condition of groundwater quality onsite. As such, regular water quality monitoring is recommended for the post-construction phase as required by the City. An agreement to discharge into the sewers owned by the City of Ottawa will be required prior to releasing dewatering effluent.

11.4 Well Decommissioning

In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

12 Conclusions and Recommendations

Based on the findings of this Hydrogeological Assessment for 1740-1760 St Laurent Blvd., Ottawa, Ontario site, the following conclusions and recommendations are provided:

- Based on anticipated phasing of construction activities, an EASR is deemed adequate to pump only from one excavation area at a time considering stormwater volume. A Category 3 PTTW will be required for simultaneous or concurrent pumping from both the excavation areas. Alternatively concurrent pumping may be possible during dry weather days however pumping volume shall be limited to 400,000 LPD rate;
- The estimated pumping rates are based on low water season or fall (month of September) water levels. Water levels are usually high in the spring and snow melting season. So, if the construction is scheduled during spring season the estimated rates will need to be re-evaluated;
- As per Schedule A, Table 1 and 2 standards of the City of Ottawa Sewer use By-Law 2003-514 standards, the discharge from the site may be directed to the city sanitary sewers without treatment. However basic BMP measures must be in place to address potentially high levels of particulates (TSS) generated at the site due to the very nature of the construction activities. Before discharging pumped water into the city sewers, the tested parameters shall comply with the applicable standards;
- A recommended discharge management plan is provided in Section 10 and a detail of the recommended plan is provided in Table 10-1. This plan is adaptive and will be evaluated at regular intervals for its effectiveness;
- Since there are no sensitive environmental features nearby (private water well user, natural significant habitat) there would be no concern or issues;
- There is potential for shallow buried utilities and building foundations adjacent to the site which may be vulnerable to impacts (settlement or subsidence) due to temporary lowering of groundwater. A geotechnical assessment of consolidation and settlement may be required to assess the potential impact;
- In the absence of suitable groundwater monitoring wells new wells may have to be drilled for monitoring of water levels during construction; and
- The daily dewatering rates must be recorded by the dewatering contractor and provided to the hydrogeologist which will be used to update the foundation drainage volume estimates and to reassess and determine the long-term foundation drainage volume for the site.

The followings are recommended:

- A resampling and analysis of groundwater is recommended to confirm the exceedance of manganese. The sample shall be filtered prior to analysis for dissolved metals. Based on the results of the analysis a treatment specialist may be consulted for suggestions about potential treatment system that may be required for treatment of manganese;
- Determination of dewatering method is the responsibility of the specialist dewatering contractor however a dewatering plan must be prepared by the contractor and reviewed by the hydrogeologist on record before dewatering operation commences;
- The estimated rates (provided in (Table 7-1) for long-term foundation drainage will need to be updated based on pumping data from the site after construction dewatering commences; and
- Long-term (over 1-year period) groundwater monitoring is recommended to measure the seasonal variability of groundwater at the site. This information will allow a better estimation of dewatering pumping rates for construction scheduling. The estimated rates would be higher in the spring season and higher volume shall be anticipated from the site if the construction is scheduled during spring season.

The conclusions and recommendations provided above should be reviewed in conjunction with the entirety of the report. We assume that the present design concept described throughout the report will proceed to construction. This preliminary report

is solely intended for the site plan approval application. Any changes to the design concept may result in a modification to the recommendations provided in this report.

13 Limitations

This report is based on a limited investigation designed to provide information to support an assessment of the current hydrogeological conditions within the study area. The conclusions and recommendations presented within this report reflect Site conditions existing at the time of the assessment. EXP must be contacted immediately if any unforeseen Site conditions are experienced during construction activities. This will allow EXP to review the new findings and provide appropriate recommendations to allow the construction to proceed in a timely and cost-effective manner.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the geoscience/engineering profession. No other warranty or representation, either expressed or implied, is included or intended in this report.

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We trust that this information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact this office.

Sincerely,

EXP Services Inc.

Shahynaz Abdelmohsen,
Environmental Technician, Earth and Environmental Services

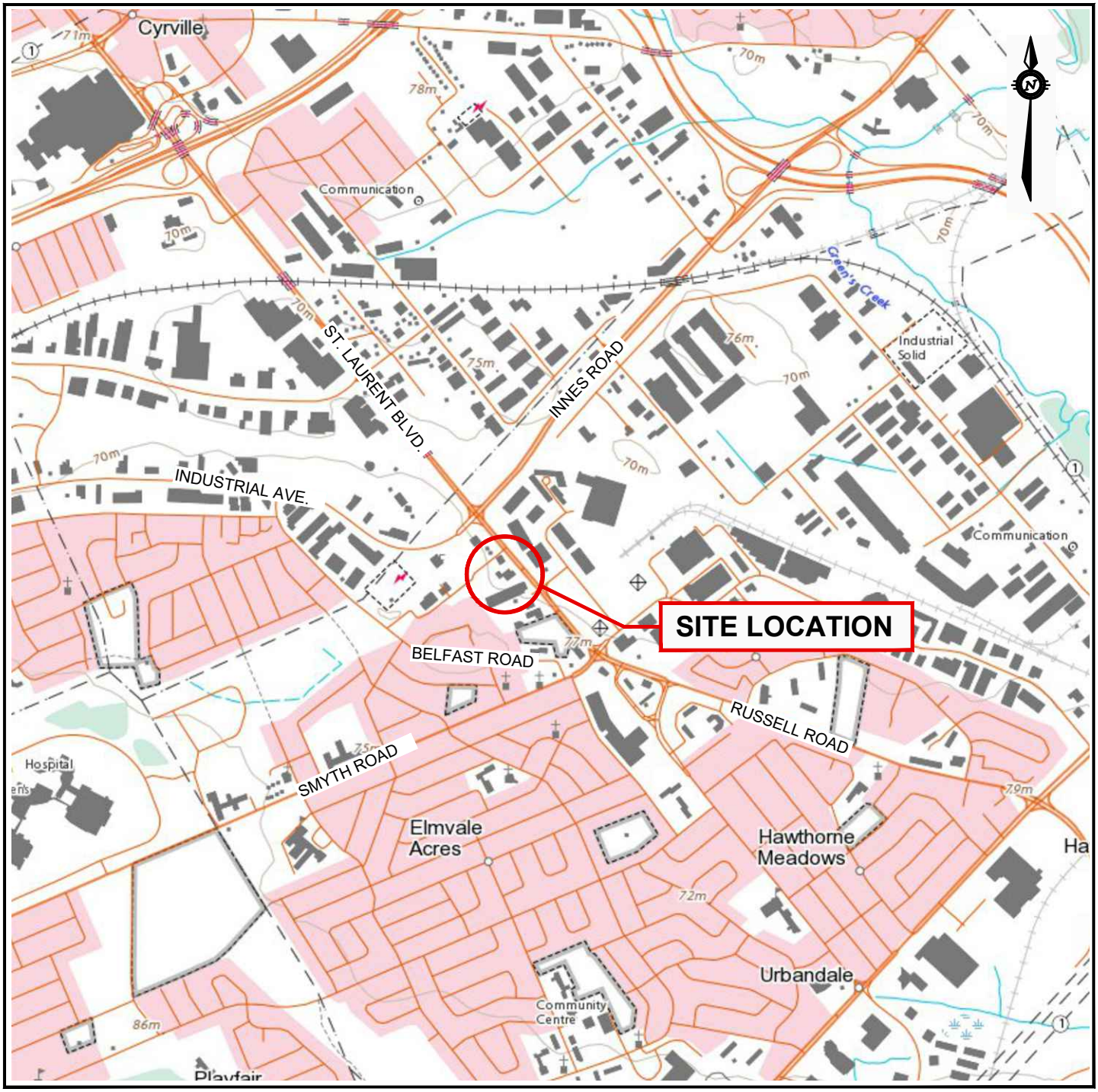
Delwar Ahmed, P. Geo.
Senior Hydrogeologist, Earth and Environmental Services

Mark McCalla, P. Geo.
Senior Geoscientist, Earth and Environmental Services

14 References

- Cashman and Preene (2013), Groundwater Lowering in Construction, 2nd Edition.
- Chapman, L.J. and Putnam, D.F. (2007), Physiography of Southern Ontario, 3rd Edition, Ontario Geological Survey.
- EXP Services Inc. (February 12, 2022), Preliminary Geotechnical Investigation, 450 Terminal Avenue, Ottawa, ON, prepared for Wal-Mart Canada Corp. (Walmart).
- J.P. Powers, A.B. Corwin, P.C. Schmall and W.E. Kaeck (2007). Construction Dewatering and Groundwater Control, Third Edition.
- Ministry of Northern Development, Mines, Natural Resources and Forestry, OGS Earth. Retrieved from: https://www.geologyontario.mndm.gov.on.ca/ogsearth.html
- Rideau Valley Conservation Authority, RVCA GIS Maps, Map of A Property, accessed to the website in March 2022: https://www.rvca.ca/regulations-planning/map-a-property
- AMEC (November 2001), Phase I Environmental Site Assessment 1740-1760 St. Laurent Boulevard and 1757 Russell Road, Ottawa, Ontario for M. R. Denison associates Ltd, 1750 St Laurent Boulevard, Ottawa, Ontario Ref: TZ97784)
- AMEC (January 2002), Phase II Environmental Site Assessment 1740-1760 St. Laurent Boulevard and 1757 Russell Road, Ottawa, Ontario for M. R. Denison associates Ltd, 1750 St Laurent Boulevard, Ottawa, Ontario (Ref: TZ97784.1)
- Terrapex Environmental Ltd (June 2009), Petro Canada, Phase II Environmental Site Assessment (ESA), 1740 St. Laurent Boulevard and 1757 Russell Road, Ottawa, Ontario
- EXP Services Inc. (October 2020), Phase I Environmental Site Assessment, 1740-1760 St. Laurent Boulevard, Ottawa, Ontario
- EXP Services Inc., (October 2020), So and Groundwater Sampling Program, Property Adjacent to 1740 St. Laurent Boulevard, Ottawa, Ontario

Figures



0 200m 400m 800m

HORIZONTAL 1:20,000

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100-2650 Queensview Drive
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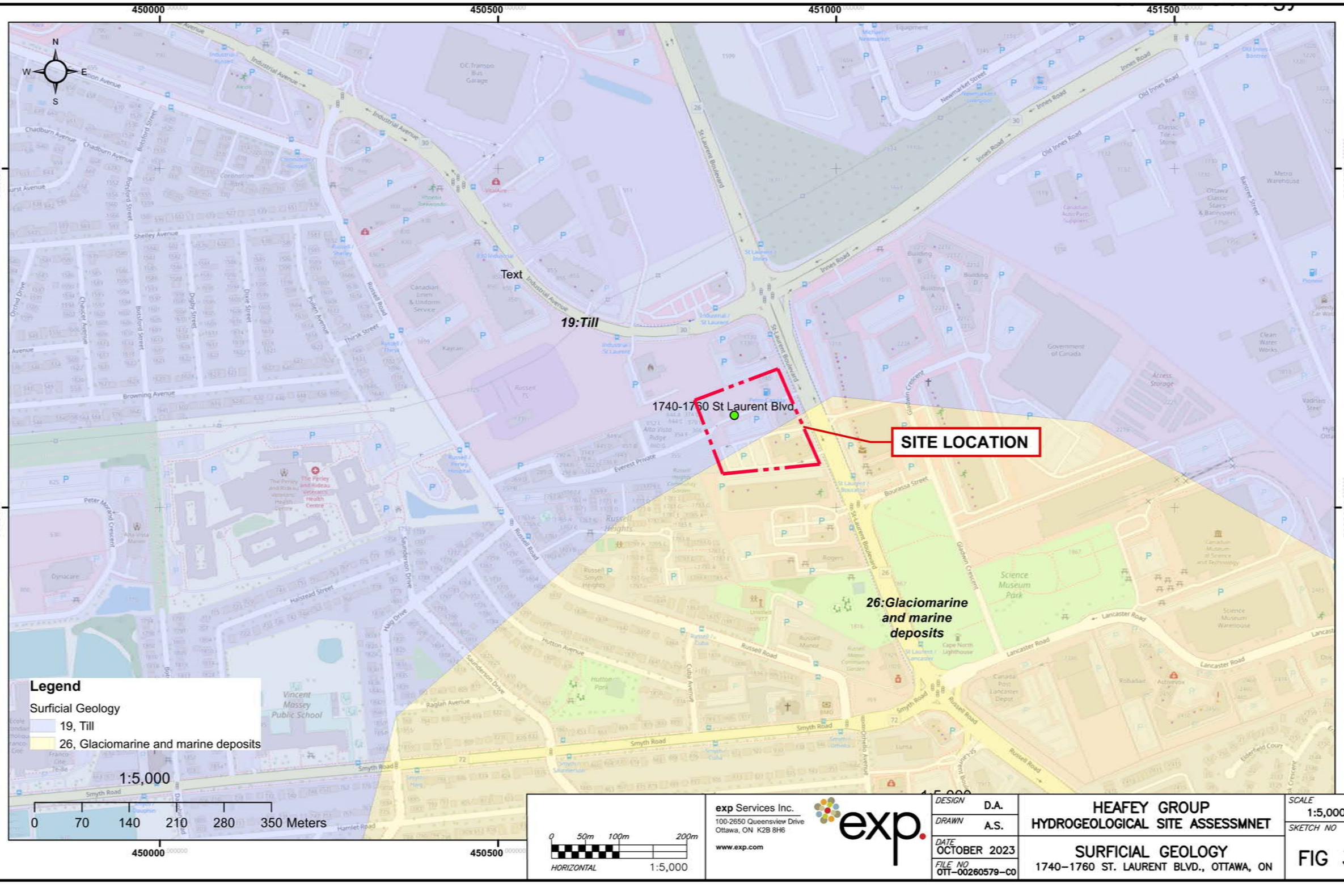
HEAFEY GROUP
HYDROGEOLOGICAL SITE ASSESSMNET

SITE LOCATION PLAN
1740-1760 ST. LAURENT BLVD., OTTAWA, ON

SCALE 1:20,000

SKETCH NO FIG 1



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SURFICIAL GEOLOGY
1740-1760 ST. LAURENT BLVD., OTTAWA, ON

SCALE 1:5,000
SKETCH NO
FIG 3

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450000 450500 451000 451500

5028500 5028000

N W E S

Text

55b Shale, limestone, dolostone, siltstone Georgian Bay Formation; Blue Mountain Formation; Billings Formation; Collingwood Member; Eastview Member UPPER ORDOVICIAN

1740-1760 St Laurent Blvd

SITE LOCATION

Legend

Bedrock Geology (Geopoly)

EPOCH_P

UPPER ORDOVICIAN

1:5,000

0 70 140 210 280 350 Meters

0 50m 100m 200m

HORIZONTAL 1:5,000

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BEDROCK GEOLOGY
1740-1760 ST. LAURENT BLVD., OTTAWA, ON

SCALE 1:5,000
SKETCH NO
FIG 4

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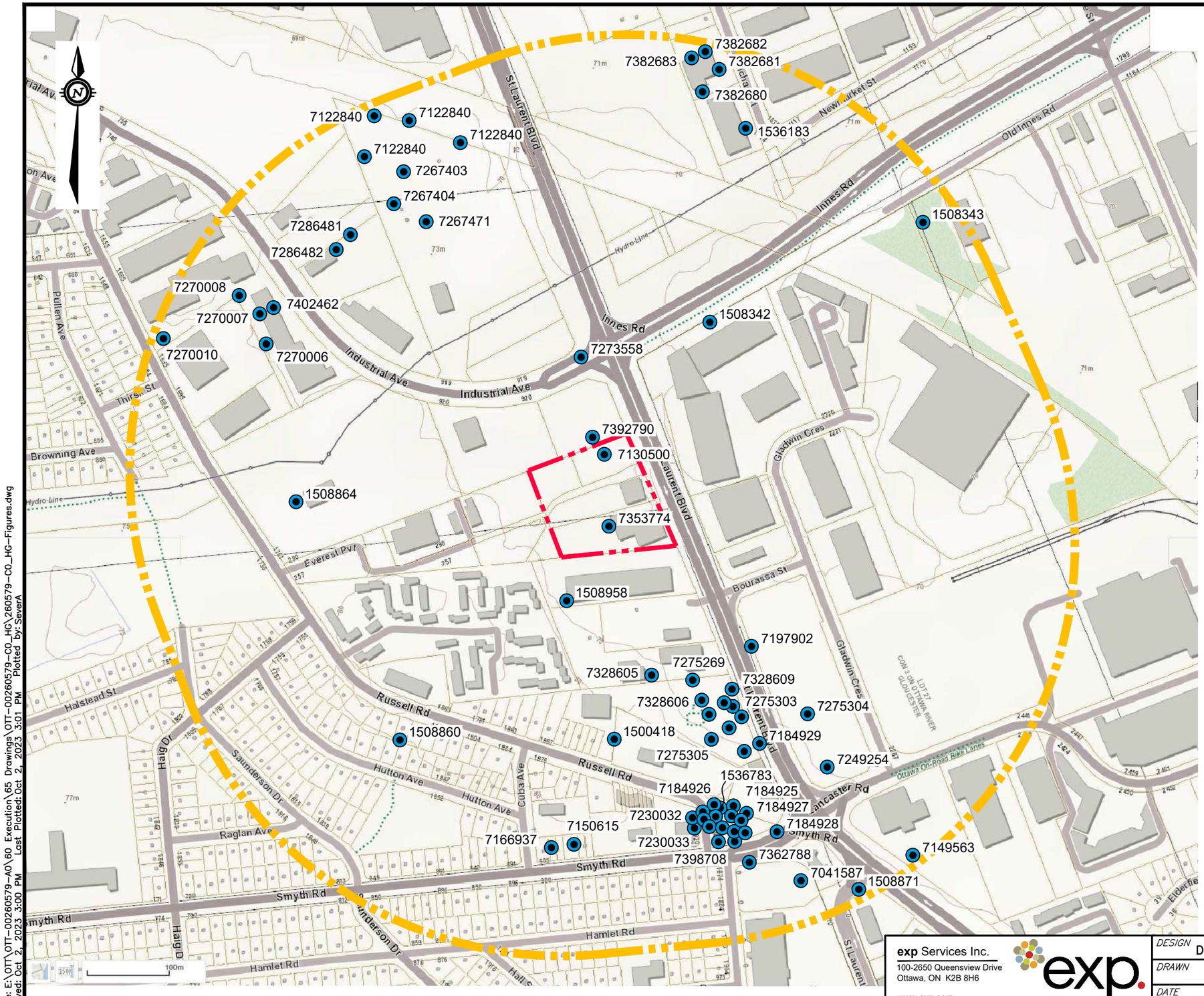

LEGEND

- SITE BOUNDARIES
- 500m (OF-SITE) RADIUS
- 7130500 RESIDENTIAL (MECP) WELL

0 50m 100m 200m

HORIZONTAL 1:5,000

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MECP WATER WELLS RECORDS
1740-1760 ST. LAURENT BLVD., OTTAWA, ON

SCALE 1:5,000

SKETCH NO FIG 4

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BH20–14
71.98
(70.28m)

BH20–13
71.07
(68.47m)

BH20–12
72.18

BH20–11
70.68
(68.98m)

BH20–10
69.86
(68.06m)

BH20–9
69.35

BH20–6
71.36

BH20–7
70.27

BH20–8
69.68

BH20–5
72.37
(69.37m)

MW19–01
70.40
(68.87m)

MW19–02
70.29
(68.23m)

MW19–03
70.30
(67.87m)

MW19–04
70.00
(68.77m)

A

A'

B

B'

TOWER 1
20 STORIES BUILDING
184 UNITS
LEVEL 1: 100 000 ARCH = 70 150 GEO

TOWER 2
13 STORIES BUILDING
154 UNITS
LEVEL P0: 100 465 ARCH = 70 915 GEO
LEVEL 1: 103 750 ARCH = 74 200 GEO

TOWER 3
20 STORIES BUILDING
200 UNITS
LEVEL 1: 99 540 ARCH = 69 990 GEO

TOWER 4
13 STORIES BUILDING
163 UNITS
LEVEL P0: 99 450 ARCH = 69 900 GEO
LEVEL 1: 103 700 ARCH = 74 150 GEO

43.42

20.21

privé Blackcomb Priv.

privé Mountaineer Priv.

ST LAURENT BLVD

LEGEND

BH20–14 72.37	BOREHOLE NO. & LOCATION GROUND SURFACE ELEVATION
MW19–01 72.37	MONITORING WELL FROM "PHASE TWO ENVIRONMENTAL SITE ASSESSMENT FOR 1760 ST. LAURENT BOULEVARD, OTTAWA, ONTARIO", DATED DECEMBER 13, 2019 AND PREPARED BY EXP SERVICES INC. (PROJECT NO. OTT-00256275-B0)
(68.87m)	GROUNDWATER LEVEL (m)
	APPROXIMATE PROPERTY LINE
A	CROSS-SECTION MARK

0 5m 10m 30m
HORIZONTAL 1:750

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BOREHOLE LOCATION PLAN
1740–1760 ST. LAURENT BLVD., OTTAWA, ON

SCALE 1:750
SKETCH NO FIG 2

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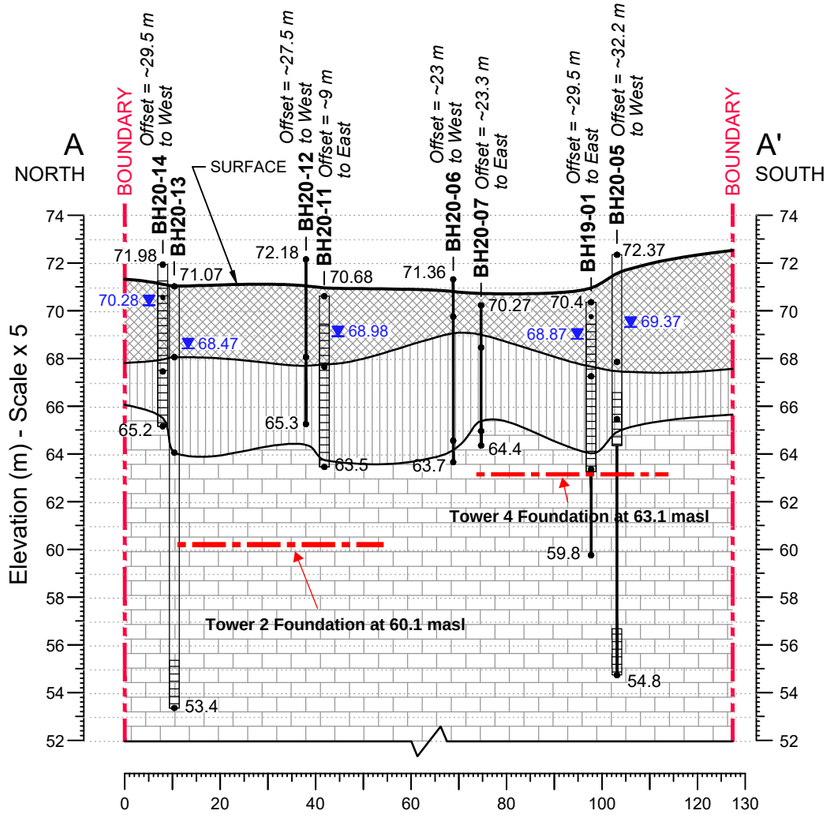
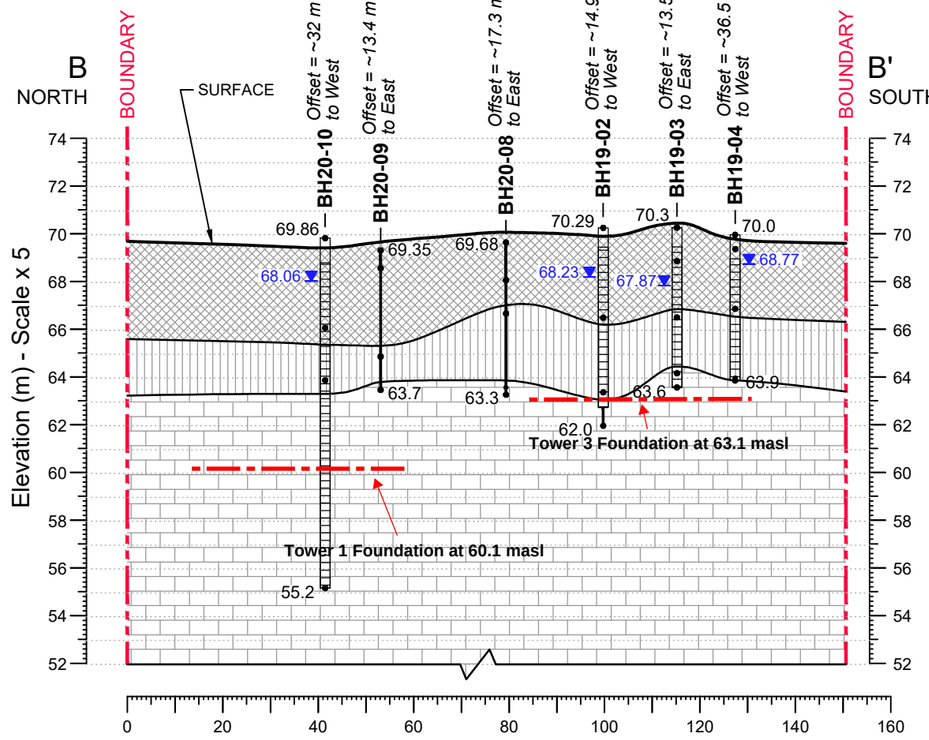


CROSS SECTION A-A'

Horizontal Distance (m) - Scale as indicated



CROSS SECTION B-B'

Horizontal Distance (m) - Scale as indicated

NOTE:
Towers 1 & 2 shares the same P3 UG structure with underside of foundation at 60.1 masl
Towers 3 & 4 shares the same P2 UG structure with underside of foundation at 63.1 masl
See Figure 8 for reference

LEGEND

- FILL / TOPSOIL
- GLACIAL TILL / SILT
- LIMESTONE BEDROCK
- BOREHOLE
- BOREHOLE / MONITORING WELL
- ← SCREEN
- 68.87 ▼ GROUNDWATER LEVEL

0 10m 20m 50m

HORIZONTAL 1:1250

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GEOLOGICAL CROSS-SECTIONS: A-A' & B-B'
1740-1760 ST. LAURENT BLVD., OTTAWA, ON

SCALE 1:1,250
SKETCH NO FIG 6

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PROJECT
ST. LAURENT DEVELOPMENT
1740-1760 St. Laurent boulevard
Ontario,ON K1G 1A2

OWNER
GROUPE Heafey GROUP
100 - 768, BOUL SAINT-JOSEPH, GATINEAU, QC J8Y 4B8

ARCHITECTURAL
PMA ARCHITECTES
LAPALME RHEAULT ARCHITECTES + ASSOCIÉS
53, SAINT-RAYMOND BOULEVARD, GATINEAU, QC J8Y 1R8

STRUCTURAL

MECHANICAL

CIVIL
exp.
2650, QUEENSVIEW DRIVE, SUITE 100, OTTAWA, ON K2B 8H6

LANDSCAPE
JAMES B. LENNOX & ASSOCIATES INC. LANDSCAPE ARCHITECTS

SURVEYOR
ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 CONCOURSE GATE, SUITE 500, NEPEAN, ON K2E 7S6

GENERAL CONTRACTOR

KEY PLAN

ARCHITECT SEAL

REVISIONS

NO	DESCRIPTION	DATE
1	FOR CITY REVIEW	2023-10-03

NOTE
IT IS THE RESPONSIBILITY OF THE APPROPRIATE CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON THE SITE AND TO REPORT ALL ERRORS AND/OR OMISSIONS TO THE ARCHITECT. ALL CONTRACTORS MUST COMPLY WITH ALL PERTINENT CODES AND BY-LAWS. DO NOT SCALE DRAWINGS.

DO NOT USE FOR CONSTRUCTION

DATE	DESIGNED
2023-10-03	P.POMERLEAU
	DRAWN: A.DUFOUR
PROJECT No: 20005	CHECKED: P.MARTIN

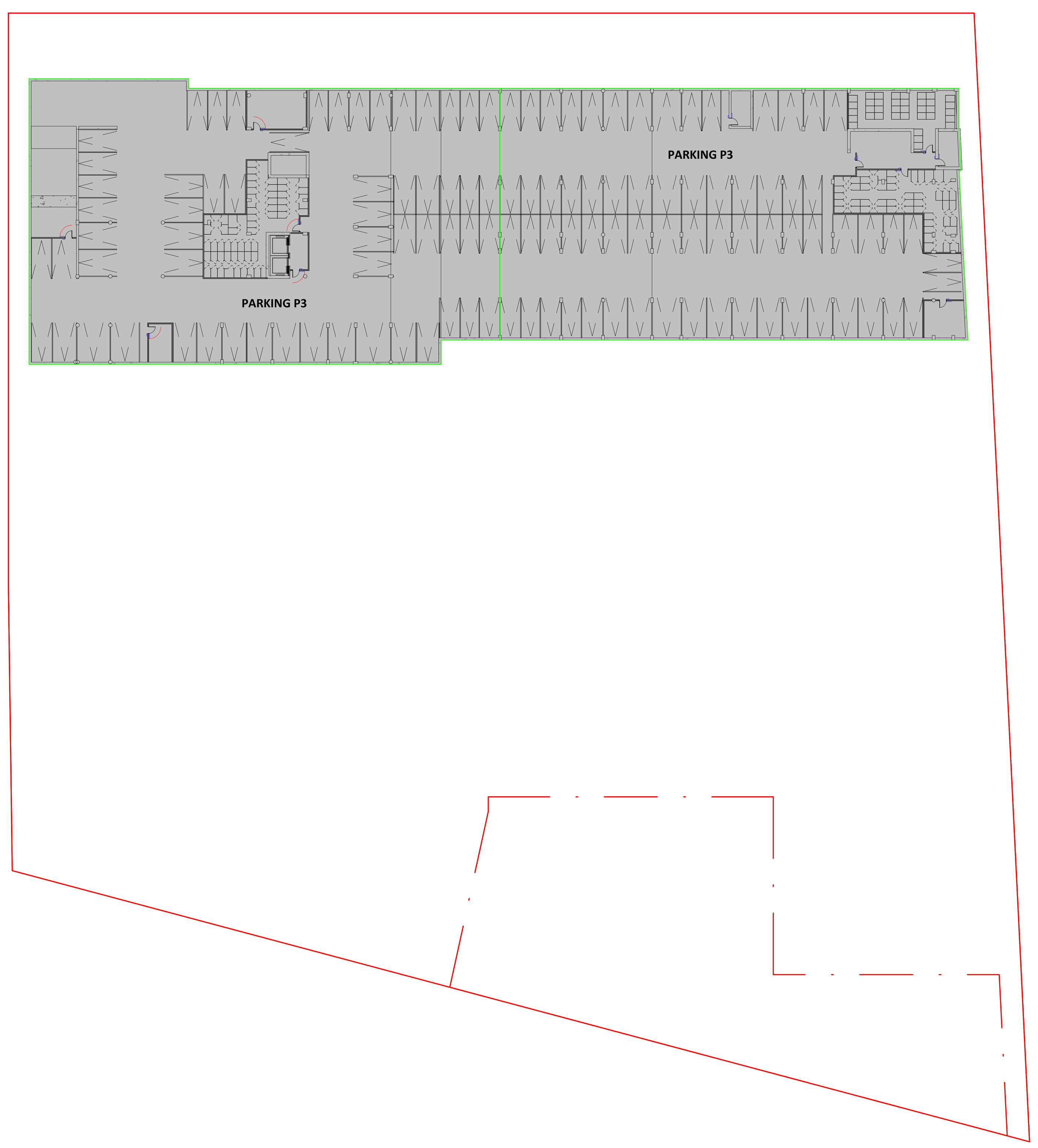
SHEET TITLE
SITE PLAN

SHEET No
A101

BIM 360://DEV ST-LAURENT OTTAWA/20005_A-SITE_R21.rvt

Figure 7

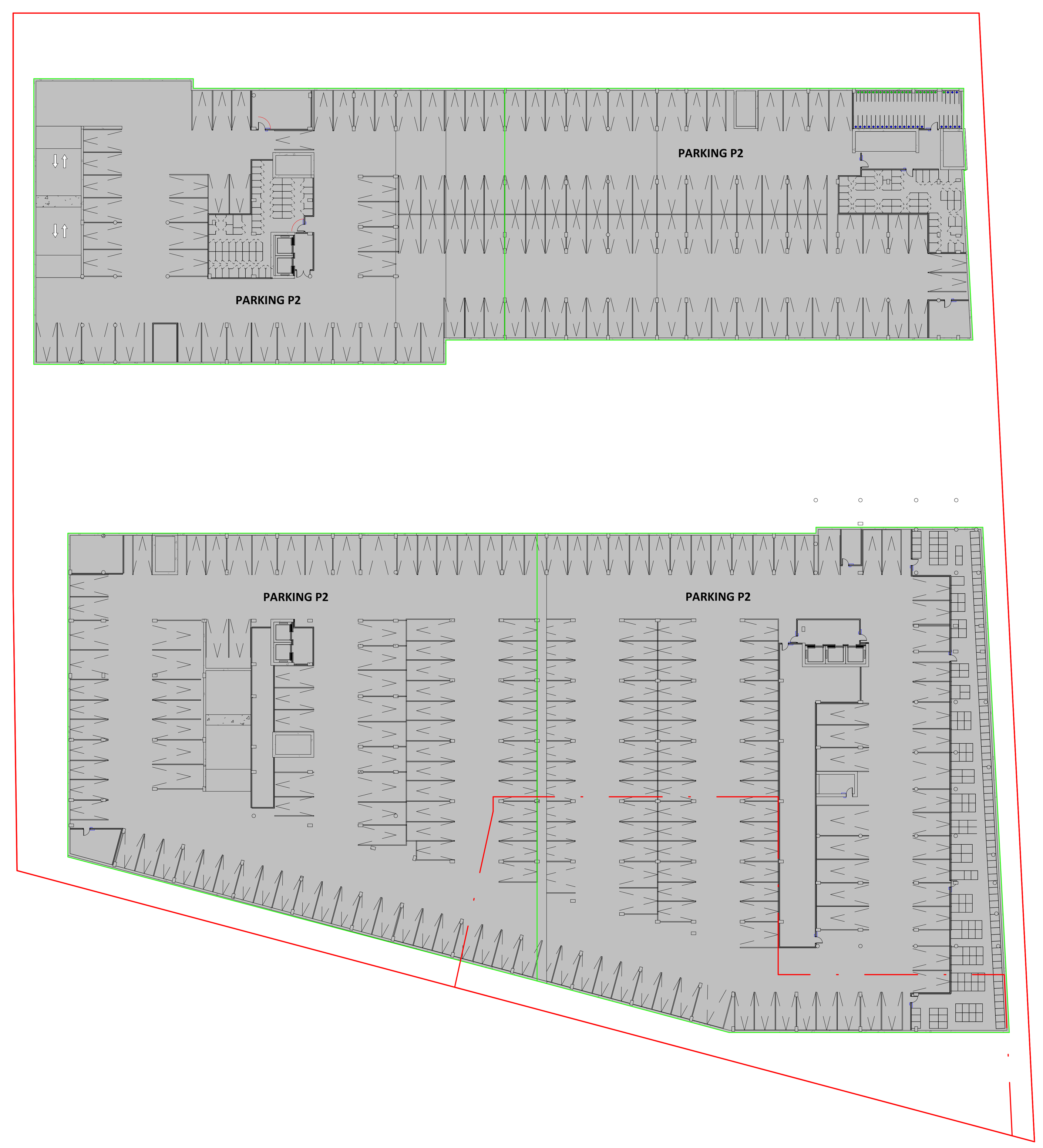
TOWER 2
LEVEL P3



TOWER 1
LEVEL P3

TOWER 2
LEVEL P2

TOWER 4
LEVEL P2

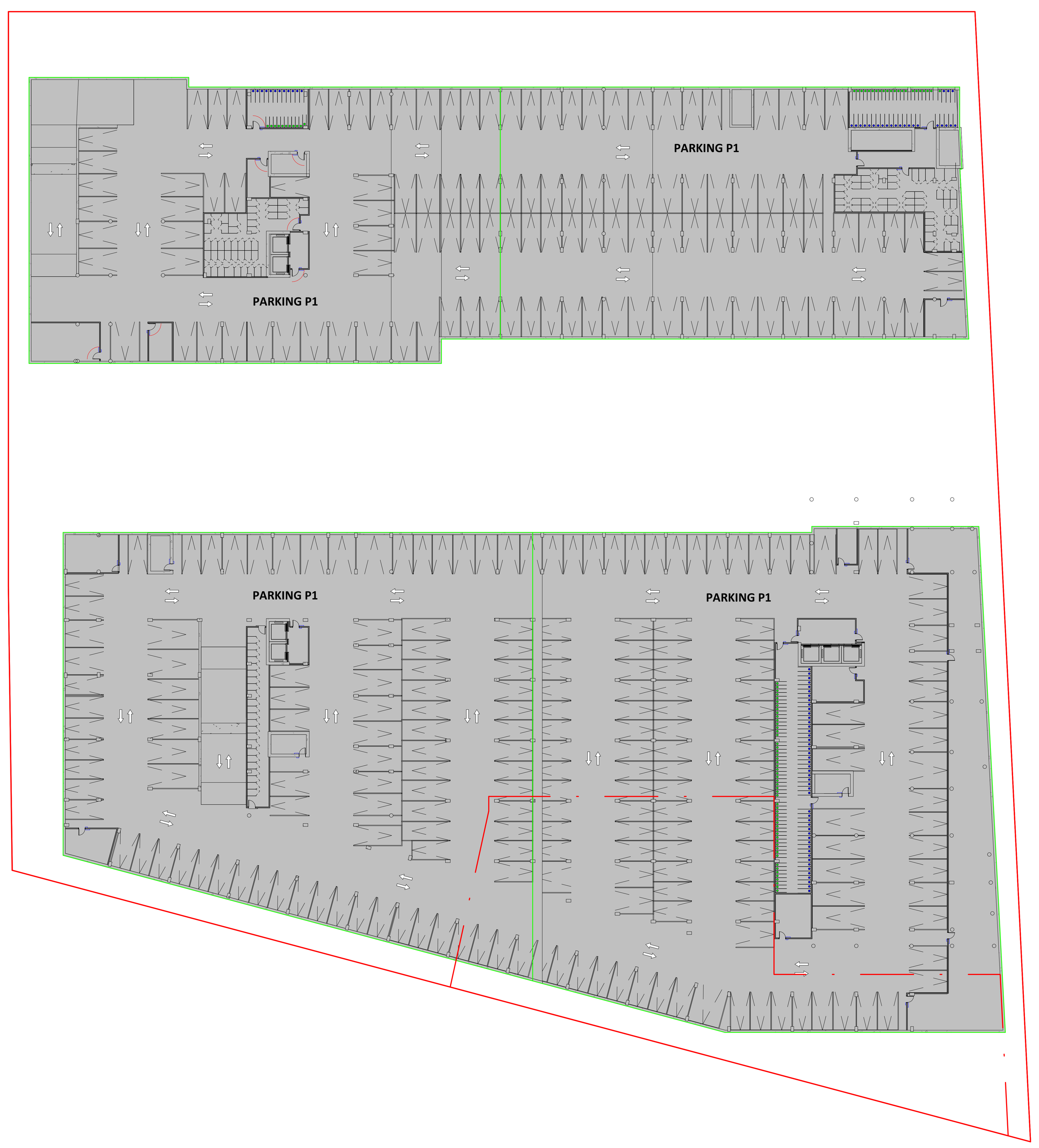


TOWER 1
LEVEL P2

TOWER 3
LEVEL P2

TOWER 2
LEVEL P1

TOWER 4
LEVEL P1

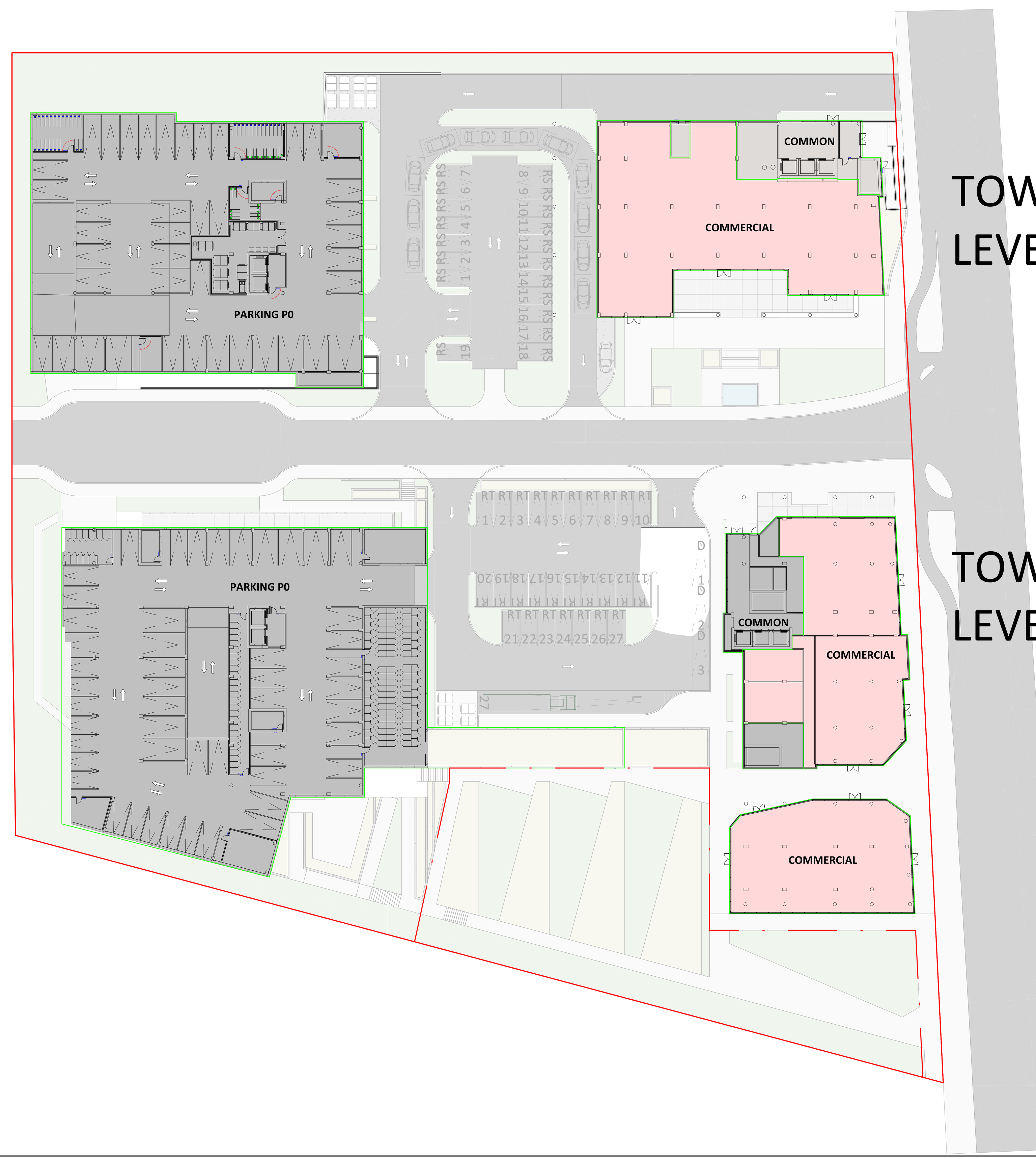


TOWER 1
LEVEL P1

TOWER 3
LEVEL P1

TOWER 2
LEVEL P0

TOWER 4
LEVEL P0



TOWER 1
LEVEL 1

TOWER 3
LEVEL 1

Figure 8

BIM 360://DEV ST-LAURENT OTTAWA/20005_A-SITE_R21.rvt

PROJECT
ST. LAURENT
DEVELOPMENT
1740-1760 St. Laurent boulevard
Ontario,ON K1G 1A2

OWNER
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53, SAINT-RAYMOND BOULEVARD,
GATINEAU, QC J8Y 1R8

STRUCTURAL

MECHANICAL

CIVIL
exp.
2650, QUEENSVIEW DRIVE, SUITE 100,
OTTAWA, ON K2B 8H6

LANDSCAPE
JAMES B. LENNOX & ASSOCIATES INC.
LANDSCAPE ARCHITECTS
3332 CARLING AVE. OTTAWA, ONTARIO K2H 5A8
Tel. (613) 722-5168 Fax. 1(866) 343-3942

SURVEYOR
ANNIS,
O'SULLIVAN,
VOLLEBEKK LTD.
SURVEYING
14 CONCOURSE GATE, SUITE 500,
NEPEAN, ON K2E 7S6

GENERAL CONTRACTOR

KEY PLAN

ARCHITECT SEAL

REVISIONS

NO	DESCRIPTION	DATE
1	FOR CITY REVIEW	2023-10-03

NOTE
IT IS THE RESPONSIBILITY OF THE APPROPRIATE CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON THE SITE AND TO REPORT ALL ERRORS AND/OR OMISSIONS TO THE ARCHITECT. ALL CONTRACTORS MUST COMPLY WITH ALL PERTINENT CODES AND BY-LAWS. DO NOT SCALE DRAWINGS.

DO NOT USE FOR CONSTRUCTION

DATE 2023-10-03
DESIGNED P.POMERLEAU
DRAWN P.POMERLEAU
PROJECT No 20005
CHECKED P.MARTIN

SHEET TITLE
STATISTICS

SHEET No
A003

D02-21-0137 and D07-12-21-0177

Appendix A – MECP WWR Summary Table

Water Well Records

Well Record # Based on Ministry of Environment Water Well Information Database June 30, 2022, available online.

1500418 Lot 015 Conc OTTAWA CITY (GLOUCESTER) / OTTAWA-CARLETON

Date 5/20/1948 DDMMYY | Elev 80.1 (masl) | Easting 450901 | Northing 5027822 | Well_Depth_m: 39.0144004821777 | UTM RC 9 | unknown UTM

Flowing? N
SWL 4.6 (mbgs) 75.5 (masl)
Pumping WL 22.9 (mbgs) 57.2 (masl)
Pump Rate 22.7 (LPM) 0 / 30
Spec. Cap. 1.24 (LPM/m) Hr / Min

/ Domestic | Water Supply
Water Found 39.0 (mbgs) 41.1 (masl) FRESH
Street
Town/City

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	80.1		
1.8	78.3		TOPSOIL /
7.3	72.8		CLAY /
11.3	68.8		FINE SAND /
39.0	41.1		ROCK / SLATE /

1508342 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 12/30/1952 DDMMYY | Elev 69.0 (masl) | Easting 451021 | Northing 5028347 | Well_Depth_m: 12.1920003890991 | UTM RC 5 | margin of error : 100 m - 300 m

Flowing? N
SWL 0.9 (mbgs) 68.1 (masl)
Pumping WL 2.7 (mbgs) 66.3 (masl)
Pump Rate 36.4 (LPM) 1 / 0
Spec. Cap. 19.89 (LPM/m) Hr / Min

Domestic / Livestock | Water Supply
Water Found 12.2 (mbgs) 56.8 (masl) MINERIAL
Street
Town/City

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	69.0		
0.6	68.4		TOPSOIL / CLAY /
12.2	56.8	BLACK	SHALE /

1508860 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 6/30/1950 DDMMYY | Elev 80.4 (masl) | Easting 450631 | Northing 5027822 | Well_Depth_m: 44.1959991455078 | UTM RC 5 | margin of error : 100 m - 300 m

Flowing? N
SWL 3.7 (mbgs) 76.8 (masl)
Pumping WL 8.5 (mbgs) 71.9 (masl)
Pump Rate 36.4 (LPM) 1 / 0
Spec. Cap. 7.46 (LPM/m) Hr / Min

/ Domestic | Water Supply
Water Found 44.2 (mbgs) 36.2 (masl) FRESH
Street
Town/City

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	80.4		
1.8	78.6		TOPSOIL / MEDIUM SAND /
14.9	65.5	BLUE	CLAY /
16.5	64.0	BLACK	MEDIUM SAND /
44.2	36.2	GREY	SLATE /

1508864 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 3/1/1954 DDMMYY | Elev 75.7 (masl) | Easting 450501 | Northing 5028122 | Well_Depth_m: 22.2504005432129 | UTM RC 5 | margin of error : 100 m - 300 m

Flowing? N
SWL 4.3 (mbgs) 71.4 (masl)
Pumping WL 8.5 (mbgs) 67.2 (masl)
Pump Rate 36.4 (LPM) 1 / 0
Spec. Cap. 8.52 (LPM/m) Hr / Min

/ Domestic | Water Supply
Water Found 22.3 (mbgs) 53.5 (masl) FRESH
Street
Town/City

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	75.7		
0.6	75.1		TOPSOIL / MEDIUM SAND /
2.7	73.0	RED	MEDIUM SAND /
7.0	68.7	BLUE	CLAY /
9.1	66.6		CLAY / STONES /
10.7	65.0	GREY	FINE SAND /
22.3	53.5	GREY	LIMESTONE /

1508958 Lot Conc — OTTAWA CITY / OTTAWA-CARLETON — Flowing? N

Date 8/8/1961 DDMMYY | Elev 74.3 (masl) | Easting 450841 | Northing 5027997 | Well_Depth_m: 30.4799995422363 | UTM RC 5 | margin of error : 100 m - 300 m

SWL 16.8 (mbgs) 57.5 (masl) | Pumping WL 29.0 (mbgs) 45.3 (masl) | Pump Rate 9.1 (LPM) 1 / 0 | Spec. Cap. 0.75 (LPM/m) Hr / Min

/ Commerical | Water Supply

Water Found 10.7 (mbgs) 63.6 (masl) FRESH

Street

Town/City

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	74.3		
7.6	66.7	BLUE	CLAY / /
		BLUE	CLAY / /
30.5	43.8	BLACK	SHALE / /
		BLACK	SHALE / /

1536783 Lot Conc — OTTAWA CITY / OTTAWA-CARLETON — Flowing?

Date 9/21/2006 DDMMYY | Elev 78.5 (masl) | Easting 451034 | Northing 5027736 | Well_Depth_m: 6 | UTM RC 3 | margin of error : 10 - 30 m

SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Observation Wells

Water Found (mbgs) (masl)

Street 969 SMYTH ROAD

Town/City OTTAWA

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	78.5		
0.6	77.9	BROWN	SAND / GRAVEL / FILL
4.2	74.3	GREY	SILT / /
6.0	72.5	GREY	CLAY / SILTY /

7041587 Lot Conc — GLOUCESTER TOWNSHIP / OTTAWA-CARLETON — Flowing?

Date 11/13/2006 DDMMYY | Elev 77.9 (masl) | Easting 451137 | Northing 5027644 | Well_Depth_m: 4.42000007629395 | UTM RC 3 | margin of error : 10 - 30 m

SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Test Hole

Water Found (mbgs) (masl)

Street 1910 ST LAURENT BLVD

Town/City OTTAWA

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	77.9		
0.2	77.8		/ /
0.7	77.3		SAND / GRAVEL / FILL
0.8	77.2	BROWN	SAND / FILL / LOOSE
4.4	73.5	GREY	CLAY / /

7130500 Lot 014 Conc — GLOUCESTER TOWNSHIP / OTTAWA-CARLETON — Flowing?

Date 5/6/2009 DDMMYY | Elev (masl) | Easting 450889 | Northing 5028181 | Well_Depth_m: 5.19999980926514 | UTM RC 2 | margin of error : 3 - 10 m

SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Test Hole | Test Hole

Water Found (mbgs) (masl)

Street 1740 ST. LAURENT BLVD.

Town/City Ottawa

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
0.1			OTHER / /
0.9		BROWN	SAND / SILTY / GRAVEL
1.7		BROWN	SAND / SILTY /
2.4		BROWN	CLAY / / SILTY
3.2		BROWN	CLAY / / SILTY
4.1		GREY	SAND / / CLAYEY
4.3		BLACK	COARSE SAND / /

			5.2	GREY	COARSE SAND /		/ CLAYEY	

7150615 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 6/3/2010 DDMMYY | Elev 79.2 (masl) | Easting 450850 | Northing 5027692 | Well_Depth_m: 5.59999990463257 | UTM RC 4 | margin of error : 30 m - 100 m

/ Test Hole | Test Hole | Water Found (mbgs) (masl) | Street 907 SMYTH RD. | Town/City OTTAWA

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	79.2			
0.2	79.0	BROWN	TOPSOIL /	/
0.6	78.6	BROWN	CLAY / SILT	/
0.8	78.5	BROWN	SAND /	/
5.0	74.2	GREY	CLAY / SILT	/
5.6	73.6		CLAY / SILT	/ GRAVEL

7166373 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 7/12/2011 DDMMYY | Elev (masl) | Easting 450822 | Northing 5027689 | Well_Depth_m: 3.70000004768372 | UTM RC 3 | margin of error : 10 - 30 m

/ | Abandoned-Other | Water Found 1.5 (mbgs) (masl) | Street SMYTH RD 905/907 | Town/City Ottawa

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0				
3.7		BROWN	SAND / FILL	/

7166937 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 4/12/2011 DDMMYY | Elev (masl) | Easting 450822 | Northing 5027689 | Well_Depth_m: 3.70000004768372 | UTM RC 3 | margin of error : 10 - 30 m

/ Test Hole | Test Hole | Water Found 1.5 (mbgs) (masl) | Street 905 SMYTH RD | Town/City

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0				
3.7		BROWN	SAND / FILL	/

7184925 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 6/18/2012 DDMMYY | Elev (masl) | Easting 451051 | Northing 5027738 | Well_Depth_m: 7.32000017166138 | UTM RC 4 | margin of error : 30 m - 100 m

/ Monitoring and Te | Monitoring and Test Hole | Water Found (mbgs) (masl) | Street 1929 RUSSELL ROAD | Town/City Ottawa

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0				
0.6		BLACK	TOPSOIL /	/ LOOSE
2.1		BROWN	CLAY /	/ HARD
4.0		GREY	CLAY /	/ HARD
7.3		GREY	CLAY /	/

7184926 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 6/18/2012 DDMMYY | Elev (masl) | Easting 451027 | Northing 5027739 | Well_Depth_m: 6.09999990463257 | UTM RC 4 | margin of error : 30 m - 100 m

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Monitoring and Te Monitoring and Test Hole

Water Found (mbgs) (masl)

Street 1929 RUSSEL ROAD

Town/City Ottawa

Depth (m)	Elev (masl)	Color		Soil Descriptions	
0.0					
0.6		BLACK	TOPSOIL /		/ LOOSE
2.1		BROWN	CLAY /		/ SOFT
4.0		GREY	CLAY /		/ HARD
6.1		GREY	CLAY /		/ HARD

7184927 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 6/18/2012 DDMMYY | Elev (masl) | Easting 451067 | Northing 5027728 | Well_Depth_m: 7.32000017166138 | UTM RC 4 | margin of error : 30 m - 100 m

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Monitoring and Te Monitoring and Test Hole

Water Found (mbgs) (masl)

Street 1929 RUSSEL ROAD

Town/City Ottawa

Depth (m)	Elev (masl)	Color		Soil Descriptions	
0.0					
			/		/
0.6		BLACK	TOPSOIL /		/ LOOSE
2.1		BROWN	CLAY /		/ HARD
4.0		GREY	CLAY /		/ HARD
7.3		GREY	CLAY /		/

7184928 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 6/18/2012 DDMMYY | Elev (masl) | Easting 451107 | Northing 5027707 | Well_Depth_m: 7.92999982833862 | UTM RC 4 | margin of error : 30 m - 100 m

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Monitoring and Te Monitoring and Test Hole

Water Found (mbgs) (masl)

Street 1929 RUSSEL ROAD

Town/City Ottawa

Depth (m)	Elev (masl)	Color		Soil Descriptions	
0.0					
0.6		BLACK	TOPSOIL /		/
7.9		BROWN	MEDIUM SAND /	SAND	/ LOOSE

7184929 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 6/16/2012 DDMMYY | Elev (masl) | Easting 451083 | Northing 5027817 | Well_Depth_m: 7.32000017166138 | UTM RC 4 | margin of error : 30 m - 100 m

Flowing? | SWL (mbgs) (masl) | Pumping WL (mbgs) (masl) | Pump Rate (LPM) / | Spec. Cap. (LPM/m) Hr / Min

/ Monitoring and Te Monitoring and Test Hole

Water Found (mbgs) (masl)

Street 1929 RUSSEL ROAD

Town/City Ottawa

Depth (m)	Elev (masl)	Color		Soil Descriptions	
0.0					
0.6		BLACK	TOPSOIL /		/ LOOSE
2.1		BROWN	CLAY /		/ HARD
4.0		GREY	CLAY /		/ HARD
7.3		GREY	CLAY /		/

7197902 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date DDMMYY Elev (masl) Easting 451073 Northing 5027940
Well_Depth_m: 3.66000008583069 UTM RC 4 margin of error : 30 m - 100 m

/ Monitoring Observation Wells
Water Found (mbgs) (masl)
Street CORNER OF ST. LAURANT BLVD. & BOURASSA S
Town/City OTTAWA

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color				
0.0			Soil Descriptions			
			/		/	
0.1			TOPSOIL /		/	FILL
0.6		BROWN	CLAY /	SAND	/	FILL
1.2		BROWN	SILT /	GRAVEL	/	FILL
1.8		BROWN	CLAY /	GRAVEL	/	FILL
2.4		BROWN	CLAY /	SAND	/	FILL
3.7		BROWN	CLAY /		/	

7230032 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 9/16/2014 DDMMYY Elev (masl) Easting 450999 Northing 5027723
Well_Depth_m: 7.61999988555908 UTM RC 4 margin of error : 30 m - 100 m

/ Monitoring and Te Monitoring and Test Hole
Water Found (mbgs) (masl)
Street 945 SMYTH RD
Town/City Ottawa

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color				
0.0			Soil Descriptions			
1.5		BROWN	SAND /		/	SOFT
4.6		GREY	SILT /	CLAY	/	SOFT
7.6		GREY	CLAY /		/	SOFT

7230033 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 9/16/2014 DDMMYY Elev (masl) Easting 451002 Northing 5027711
Well_Depth_m: 7.61999988555908 UTM RC 4 margin of error : 30 m - 100 m

/ Monitoring and Te Monitoring and Test Hole
Water Found (mbgs) (masl)
Street 945 SMYTH RD
Town/City Ottawa

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color				
0.0			Soil Descriptions			
1.5		BROWN	FINE SAND /		/	SOFT
4.6		GREY	SILT /	CLAY	/	SOFT
7.6		GREY	CLAY /		/	SOFT

7249254 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

Date 9/8/2015 DDMMYY Elev (masl) Easting 451169 Northing 5027787
Well_Depth_m: 6.09999990463257 UTM RC 4 margin of error : 30 m - 100 m

Monitoring / Test Hole Test Hole
Water Found (mbgs) (masl)
Street 2290 GLADWIN GRES.
Town/City OTTAWA

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color				
0.0			Soil Descriptions			
0.3		BROWN	/	SOFT	/	
5.5		GREY	CLAY /	SILT	/	SOFT
6.1		BLACK	SILT /	GRAVEL	/	SOFT

7267404 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 6/15/2016 DDMMYY | Elev (masl) | Easting 450624 | Northing 5028495 | Well_Depth_m: 3.96000003814697 | UTM RC 4 | margin of error : 30 m - 100 m

Monitoring / Test Hole | Monitoring and Test Hole
Water Found (mbgs) (masl)
Street 911 INDUSTRIAL AVE
Town/City OTTAWA

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
0.3		BLACK	OTHER / GRAVEL / HARD
2.1		GREY	CLAY / GRAVEL / LOOSE
3.0		GREY	CLAY / SILT / SOFT
4.0		GREY	SAND / SILT / SOFT

7267471 Lot Conc OTTAWA CITY / OTTAWA-CARLETON

Date 6/15/2016 DDMMYY | Elev (masl) | Easting 450664 | Northing 5028474 | Well_Depth_m: 4.88000011444092 | UTM RC 4 | margin of error : 30 m - 100 m

Monitoring / Test Hole | Monitoring and Test Hole
Water Found (mbgs) (masl)
Street 911 INDUSTRIAL AVE
Town/City OTTAWA

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
0.9		BROWN	GRAVEL / SAND / SOFT
2.4		GREY	SILT / CLAY / SOFT
3.3		GREY	SILT / CLAY / SOFT
4.9		GREY	SAND / SILT / SOFT

7270006 Lot Conc GLOUCESTER TOWNSHIP / OTTAWA-CARLETON

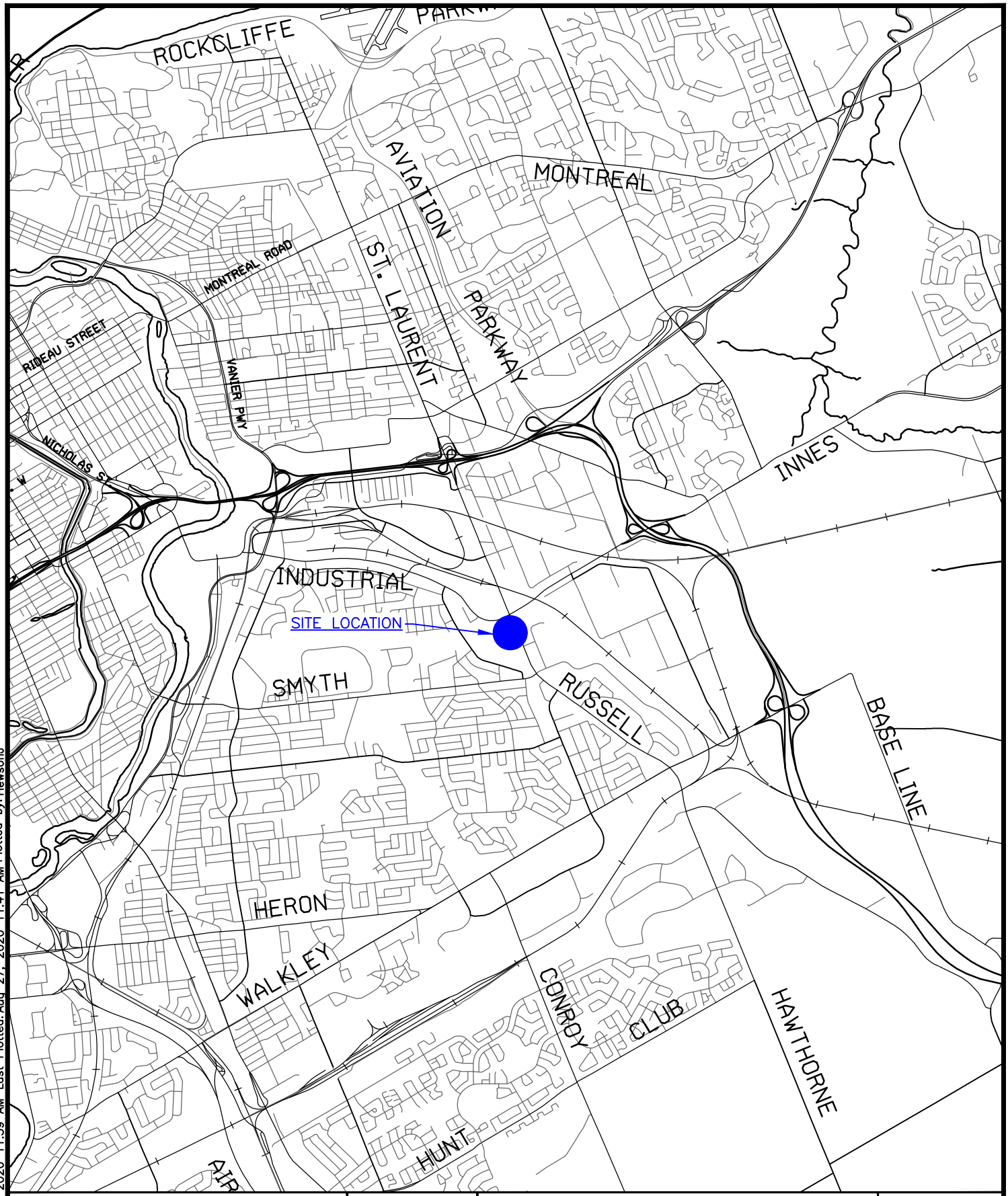
Date 8/9/2016 DDMMYY | Elev (masl) | Easting 450463 | Northing 5028321 | Well_Depth_m: 4.26999998092651 | UTM RC 4 | margin of error : 30 m - 100 m

Monitoring / Test Hole | Monitoring and Test Hole
Water Found (mbgs) (masl)
Street 740 INDUSTRIAL AVENUE
Town/City Ottawa

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hr / Min

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
0.3		BLACK	GRAVEL / / HARD
1.8		GREY	SAND / SILT / DENSE
4.0		GREY	CLAY / SILT / DENSE
4.3		GREY	TILL / GRAVEL / HARD

Appendix B – Borehole Logs



exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
www.exp.com

DESIGN	EXP
DRAWN	JH
DATE	AUG 2020
FILE NO	260579–A0

1740–1760 ST. LAURENT BOULEVARD
GEOTECHNICAL INVESTIGATION

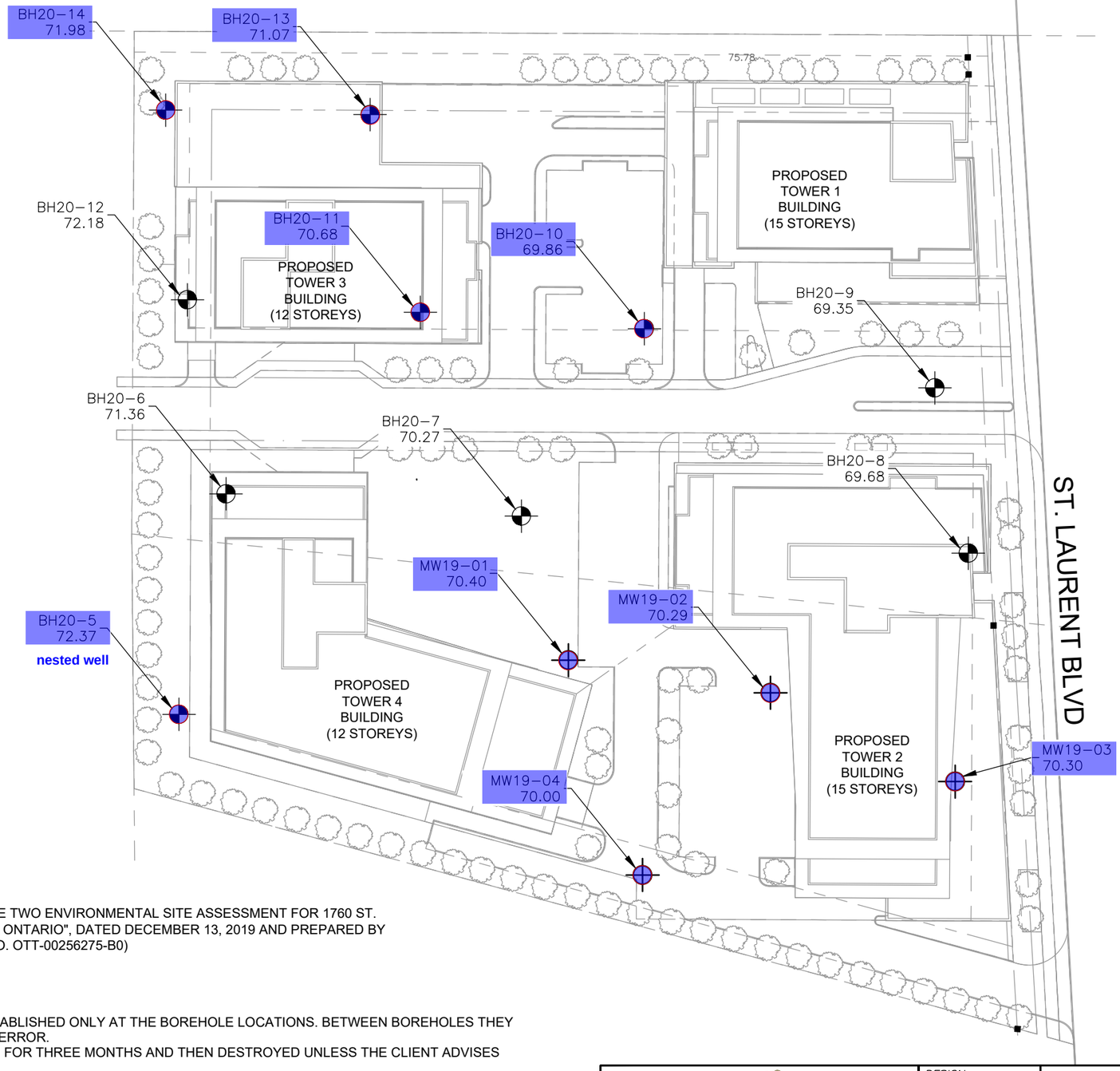
SITE LOCATION PLAN

SCALE 1:50,000

SKETCH NO FIG 1

0 5m 10m 30m

HORIZONTAL 1:750



LEGEND

BH20-14 72.37 — BOREHOLE NO. & LOCATION
GROUND SURFACE ELEVATION

MW19-01 72.37 — MONITORING WELL FROM "PHASE TWO ENVIRONMENTAL SITE ASSESSMENT FOR 1760 ST. LAURENT BOULEVARD, OTTAWA, ONTARIO", DATED DECEMBER 13, 2019 AND PREPARED BY EXP SERVICES INC. (PROJECT NO. OTT-00256275-B0)

NOTES:

1. THE BOUNDARIES AND SOIL/ROCK TYPES HAVE BEEN ESTABLISHED ONLY AT THE BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. ASPHALT QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE TEST PIT AND BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN OBTAINED FROM JANET ROSENBERG AND STUDIO, GLOBAL PLAN 1.

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
www.exp.com

DESIGN	EXP
DRAWN	JH
DATE	AUG 2020
FILE NO	260579-A0

1740-1760 ST. LAURENT BOULEVARD GEOTECHNICAL INVESTIGATION

BOREHOLE LOCATION PLAN

SCALE 1:750
SKETCH NO FIG 2

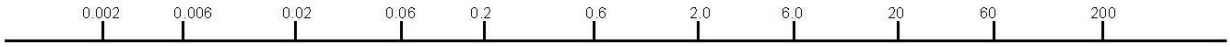
Filename: E:\OTT\OTT-00260579-A0\60 Execution\65 Drawings\260579 2020 BH PLAN.dwg
Last Saved: Sep 17, 2020 12:26 PM Last Plotted: Sep 17, 2020 12:28 PM Plotted by: HewsonJ

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole MW19-01

Project No: OTT-000256275-B0

Project: Phase II Environmental Site Assessment

Location: 1760 St. Laurent Boulevard, Ottawa

Figure No. 3

Page. 1 of 2

Date Drilled: November 18th, 2019

Drill Type: CME 55 Rubber Track

Datum: Geodetic Elevation

Logged by: MD Checked by: PS

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test ——— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~ 76 mm	70.4	0				
		SANDY GRAVEL FILL Brown and grey, moist, no odour or staining.	70.3 / 69.8					
		SILT WITH CLAY TO SILTY CLAY Trace fine gravel present, brownish grey, moist to wet, no odour or staining, (hard).	68.87	1	8	10.5	SS1	
				2	6	10.3	SS2	
					225 s = 4.5	11.3		
				3	4	11.5	SS3A	
						11.5	SS3B	
		SANDY GRAVELLY TILL With cobbles and boulders, brown turning dark grey, moist / wet, no odour or staining, (loose to very dense).	67.3		8	19.9	SS4A	
				4		35.0	SS4B	
					5	27.3	SS5	
				5	4	20.6	SS6	
					27	12.2	SS7	
				6		119 / 380 mm 27.0	SS8	
			63.4	7	50 / 76 mm	19.0	SS9	
		INFERRED WEATHERED SHALE BEDROCK	63.3					
		SHALE BEDROCK Dark grey to black, some horizontal fractures and silt seams, fair to good quality.		8			RUN1	
				9				
				10			RUN2	

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A flushmount monitoring well with a 51 mm slotted standpipe was installed in the borehole upon completion.
3. Field work was supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-000256275-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Nov. 22, 2019	1.7	-
Nov. 25, 2019	2.1	-
Sept. 3, 2020	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	7.57 - 9.07	100	71
2	9.07 - 10.59	100	84

Log of Borehole MW19-01

Project No: OTT-000256275-B0

Project: Phase II Environmental Site Assessment

Figure No. 3

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			60.4	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
			59.8	10				
		End of Borehole at 10.59 m Depth, Borehole Terminated						

LOG OF BOREHOLE LOGS OF BOREHOLES TEMPLATE - 1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/21/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A flushmount monitoring well with a 51 mm slotted standpipe was installed in the borehole upon completion.
3. Field work was supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-000256275-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Nov. 22, 2019	1.7	-
Nov. 25, 2019	2.1	-
Sept. 3, 2020	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	7.57 - 9.07	100	71
2	9.07 - 10.59	100	84

Log of Borehole MW19-02

Project No: OTT-000256275-B0

Project: Phase II Environmental Site Assessment

Location: 1760 St. Laurent Boulevard, Ottawa

Figure No. 4

Page. 1 of 1

Date Drilled: November 18th, 2019

Drill Type: CME 55 Rubber Track

Datum: Geodetic Elevation

Logged by: MD Checked by: PS

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test — | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

Geodetic Elevation m	Depth	SOIL DESCRIPTION	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
70.29	0	**ASPHALT** ~ 70 mm				
70.2		**SANDY GRAVEL FILL** Brown and grey, moist, no odour or staining, (compact).	24	17.1	SS1	
69.7	1	**FINE SAND WITH SOME SILT** Brown, moist, no odour or staining, (loose).	9	17.0	SS2	
68.9		**SILTY CLAY** Brown, moist, no odour or staining, (very stiff).	10	7.7	SS3	
68.23	2		4	31.7	SS4	
	3		110 s = 8.0		VANE5	
66.5		**CLAYEY TILL TO SANDY SILTY TILL** With cobbles and boulders, brownish grey turning dark grey, wet, no odour or staining, (loose to compact).	6	23.0 / 23.0	SS6A / SS6B	
	4		4	16.7	SS7	
	5		9	21.4	SS8	
	6		13	38.6	SS9	
63.4	7	**SHALE BEDROCK**	50 / 76 mm	21.0	SS10	
62.0	8	**Auger Refusal, Borehole Terminated at 8.33 m Depth**				

LOG OF BOREHOLE LOGS OF BOREHOLES TEMPLATE - 1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/21/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A flushmount monitoring well with a 51 mm slotted standpipe was installed in the borehole upon completion.
3. Field work was supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-000256275-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Nov. 22, 2019	2.2	-
Nov. 25, 2019	2.3	-
Sept. 3, 2020	2.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole MW19-03

Project No: OTT-000256275-B0

Project: Phase II Environmental Site Assessment

Location: 1760 St. Laurent Boulevard, Ottawa

Figure No. 5

Page. 1 of 1

Date Drilled: November 19th, 2019

Drill Type: CME 55 Rubber Track

Datum: Geodetic Elevation

Logged by: MD Checked by: PS

Split Spoon Sample | Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Shear Strength by Vane Test (S)

Combustible Vapour Reading | Natural Moisture Content | Atterberg Limits | Undrained Triaxial at % Strain at Failure | Shear Strength by Penetrometer Test

GWL	Symbol	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Samples	Natural Unit Wt. kN/m³
		ASPHALT	70.3	0				
		SANDY GRAVEL FILL Brown and grey, moist, no odour or staining, (compact).	70.2		18	29.5	SS1A	
			69.5				SS1B	
		SAND WITH SOME GRAVEL FILL Brown, moist, no odour or staining, (compact).		1	13	21.8	SS2A	
			68.9			29.4	SS2B	
		FINE SAND WITH SOME SILT AND CLAY Brown with some orange mottling at 1.4 to 1.5 m depth, moist, no odour or staining, (loose).			6	22.0	SS3A	
			68.3	2		29.5	SS3B	
			67.87			67.0		
		SILTY CLAY TO CLAY WITH SOME SILT Brown turning grey, moist, no odour or staining, (very stiff).			7	11.7	SS4	
				3	150 s = 4.7	16.5	VANE5	
			66.5					
		CLAYEY TILL With stratified layers of silt, cobbles and boulders, grey, wet, no odour or staining, (loose).		4	4	31.4	SS6	
				5	4	32.0	SS7	
					4	25.0	SS8	
			64.2	6	62 / 355 mm	65.0	S9A	
		INFERRED WEATHERED SHALE BEDROCK				70.0	SS9B	
			63.6					
		Auger Refusal, Borehole Terminated at 6.71 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES TEMPLATE - 1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/21/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A flushmount monitoring well with a 51 mm slotted standpipe was installed in the borehole upon completion.
3. Field work was supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-000256275-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Nov. 22, 2019	2.6	-
Nov. 25, 2019	2.7	-
Sept. 3, 2020	2.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole MW19-04

Project No: OTT-000256275-B0

Project: Phase II Environmental Site Assessment

Location: 1760 St. Laurent Boulevard, Ottawa

Figure No. 6

Page. 1 of 1

Date Drilled: November 19th, 2019

Drill Type: CME 55 Rubber Track

Datum: Geodetic Elevation

Logged by: MD Checked by: PS

Split Spoon Sample ☒ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test + S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~ 50 mm	70 / 69.9	0				
		SANDY GRAVEL FILL Brown and grey, moist, no odour or staining, (compact).	69.4		11	32.0	SS1	
		SILTY CLAY TO CLAY WITH SOME SILT Brown, moist turning moist/wet, no odour or staining, (very stiff to stiff).	68.77	1	6; 108 ▲	36.0	SS2	
					90 + s = 6			
				2		49.0	SS3	
		SAND SILT AND CLAY Stratified layers of sand silt and clay, brown, wet, no odour or staining, (loose).	67.7		6	41.0	SS4	
		SANDY SILTY GRAVELLY TILL Stratified layers of silt, cobbles and boulders, grey, wet, no odour or staining, (loose to compact).	66.9	3	8	48.0	SS5	
				4	8	43.5	SS6	
				5	6	55.0	SS7	
					24	35.0	SS8	
		INFERRED WEATHERED SHALE BEDROCK	64.0 / 63.9	6				
		Borehole Terminated at 6.05 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES TEMPLATE - 1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/21/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A flushmount monitoring well with a 51 mm slotted standpipe was installed in the borehole upon completion.
3. Field work was supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-000256275-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Nov. 22,2019	1.5	-
Nov. 25, 2019	2.1	-
Sept. 3, 2020	1.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH20-05

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 7

Page. 1 of 2

Date Drilled: 'August 21, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ☒ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test + S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value (20 40 60 80) / Shear Strength kPa (50 100 150 200)	Combustible Vapour Reading (ppm) (250 500 750) / Natural Moisture Content % Atterberg Limits (% Dry Weight) (20 40 60)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE ~ 40 mm thick	72.37	0				
		GRANULAR FILL (BASE) ~ 150 mm thick Silty sand with crushed gravel, grey, damp	72.3					
		FILL Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (loose to compact/firm to very stiff)	72.2		20	×	SS1	
				1	14	×	SS2	20.2
					9	×	SS3	
				2	9	×	SS4	24.0
			69.37	3	4	×	SS5	
				4	11	×	SS6	
		GLACIAL TILL Clayey sand with gravel, cobbles and boulders, dark grey, moist, (compact to dense/stiff to hard)	67.9					
				5	10	×	SS7	
					14	×	SS8	
				6	45	×	SS9	
			65.5	7	50 for 100 mm	×	SS10	
		INFERRED WEATHERED SHALE BEDROCK	64.7					
		SHALE BEDROCK Grey to dark grey, (poor to good quality)		8			RUN1	
		200 mm thick rubble zone (broken rock) with clay seams at 7.7 m depth		9			RUN2	
				10				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Two (2) - 19 mm diameter standpipes installed to 7.6 m and 17.6 m depths as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Aug. 21, 2020	2.5	5.5
Sept. 3, 2020	3.1/3.0	
Sept. 10, 2020	3.2/3.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	7.7 - 8.6	97	76
2	8.6 - 10.1	100	70
3	10.1 - 11.6	100	67
4	11.6 - 13.2	100	19
5	13.2 - 14.7	100	47
6	14.7 - 16.1	100	15
7	16.1 - 17.6	100	71

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

Log of Borehole BH20-05

Project No: OTT-00260579-A0

Project: Residential Development

Figure No. 7

Page. 2 of 2

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		SHALE BEDROCK Grey to dark grey, (poor to good quality) *(continued)*	62.37	10	20 40 60 80 50 100 150 200	250 500 750 20 40 60		
		200 mm thick clay layer at 10.7 m depth		11			RUN3	
		250 mm thick rubble zone (broken rock) at 12.3 m depth		12			RUN4	
				13				
				14			RUN5	
		Rubble zone (broken rock) from 14.7 m to 16.3 m depths		15			RUN6	
		50 mm thick clay seam at 16.2 m depth		16				
				17			RUN7	
			54.8					
		Borehole Terminated at 17.6 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Two (2) - 19 mm diameter standpipes installed to 7.6 m and 17.6 m depths as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Aug. 21, 2020	2.5	5.5
Sept. 3, 2020	3.1/3.0	
Sept. 10, 2020	3.2/3.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	7.7 - 8.6	97	76
2	8.6 - 10.1	100	70
3	10.1 - 11.6	100	67
4	11.6 - 13.2	100	19
5	13.2 - 14.7	100	47
6	14.7 - 16.1	100	15
7	16.1 - 17.6	100	71

Log of Borehole BH20-06

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 8

Page. 1 of 1

Date Drilled: 'August 20, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE ~ 75 mm thick	71.36	0				
		GRANULAR FILL (BASE) ~ 150 mm thick Silty sand with gravel, brown, damp	71.3					
		FILL Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (loose/firm)	71.2		4		SS1	
				1	4		SS2	
			69.8		9		SS3	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, dark grey, moist, (compact to dense/ stiff to hard)		2	14		SS4	
				3	26		SS5	24.2
				4	36		SS6	
				5	23		SS7	
					38		SS8	
				6	32		SS9	24.5
			64.6					
		INFERRED WEATHERED SHALE BEDROCK		7	50 for 100 mm		SS10	
			63.7		50 for 50 mm		SS11	
		Auger Refusal at 7.7 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH20-07

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 9

Page. 1 of 1

Date Drilled: 'August 20, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE ~ 35 mm thick	70.27	0				
		GRANULAR FILL (BASE) ~ 150 mm thick Silty sand with crushed gravel, grey, damp	70.2					
		SILTY CLAY Brown, moist, (very stiff)	70.1		5		SS1	
				1	4 — 132		SS2	18.6
			68.5		7		SS3	
		GLACIAL TILL Clayey sand with gravel, cobbles and boulders, brown, moist, (loose to compact/stiff)		2	12		SS4	
		GLACIAL TILL Clayey sand with gravel, shale fragments, cobbles and boulders, dark grey, moist to wet, (loose to compact/stiff)	67.2	3	12		SS5	
				4	8		SS6	
		with a 150 mm thick silty sand layer at 4.6 m depth		5	10		SS7	
		INFERRED WEATHERED SHALE BEDROCK	65.0		50 for 100 mm		SS8	
		Auger Refusal at 5.9 m Depth	64.4					

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

Log of Borehole BH20-08

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 10

Page. 1 of 1

Date Drilled: 'August 20, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test — | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE ~ 50 mm thick	69.68	0				
		GRANULAR FILL (BASE) ~ 450 mm thick Silty sand with crushed gravel, grey, damp	69.6 69.2					
		FILL Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (compact/stiff to very stiff)		1	13 16		SS1 SS2	
		SILTY CLAY Low plasticity, brown, moist, (firm)	68.1	2	4 48		SS3 SS4	17.5
		GLACIAL TILL Silty clay with gravel, low plasticity, cobbles and boulders, grey to dark grey, (very loose to compact/soft to stiff)	66.7	3	2 36 10		SS4 SS5	
				4	5		SS6	
				5	2 13		SS7 SS8	
		INFERRED WEATHERED SHALE BEDROCK	63.6 63.3	6	50 for 75 mm		SS9	
		Auger Refusal at 6.4 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH20-09

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 11

Page. 1 of 1

Date Drilled: 'August 25, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE ~ 60 mm thick	69.35	0				
		GRANULAR FILL (BASE) ~ 200 mm thick	69.3					
		Silty sand with crushed gravel, grey, damp	69.1					
		FILL	68.6					
		Silty sand with gravel, brown, moist		1	8		SS1	
		SILTY CLAY						
		Brown, moist, (stiff)		2	6, 72		SS2	18.2
			66.9				SS3	
		SILTY CLAY		3	7, 48			
		With silt partings, grey, wet, (soft to firm)			5		SS4	
				4	2		SS5	
			64.9					
		GLACIAL TILL		5	13		SS6	
		Clayey sand with gravel, cobbles and boulders, grey, wet, (compact/stiff)						
			63.5					
		Auger Refusal at 5.9 m Depth						

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
completion	2.5	5.8

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

Log of Borehole BH20-10

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 12

Page. 1 of 2

Date Drilled: 'August 24, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○—|
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE ~ 60 mm thick	69.86	0				
		GRANULAR FILL (BASE) ~ 300 mm thick Silty sand with crushed gravel, grey, damp	69.8 69.5					
		FILL Silty sand with gravel, brown, moist	69.1					
▽		**FILL** Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (loose to compact/firm to very stiff)	68.06	1 2 3 4	11 8 28 5 9	×	SS1 SS2 SS3 SS4 SS5	18.4 18.6
		GLACIAL TILL Clayey sand with gravel, cobbles and boulders, grey, wet, (loose to compact/stiff)	66.1	5	13	×	SS6	
		INFERRED WEATHERED SHALE BEDROCK	63.9 63.8	6	50 for 50 mm	×	SS7	
		SHALE BEDROCK Grey to dark grey, (poor to excellent quality) Rubble zone (broken rock) in upper 125 mm		7 8 9 10			RUN1 RUN2 RUN3	

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well installed to a 4.2 m depth as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Aug. 24, 2020	2.3	6.0
Sept. 3, 2020	1.8	
Sept. 10, 2020	1.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	6.1 - 7.2	100	36
2	7.2 - 8.7	100	68
3	8.7 - 10.2	98	98
4	10.2 - 11.7	100	95
5	11.7 - 13.2	100	92
6	13.2 - 14.7	100	96

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

Log of Borehole BH20-10

Project No: OTT-00260579-A0

Project: Residential Development

Figure No. 12

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		SHALE BEDROCK Grey to dark grey, (poor to excellent quality) Rubble zone (broken rock) in upper 125 mm *(continued)*	59.86	10 11 12 13 14	20 40 60 80 50 100 150 200	250 500 750 20 40 60	RUN4 RUN5 RUN6	
		Borehole Terminated at 14.7 m Depth	55.2					

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well installed to a 4.2 m depth as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Aug. 24, 2020	2.3	6.0
Sept. 3, 2020	1.8	
Sept. 10, 2020	1.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	6.1 - 7.2	100	36
2	7.2 - 8.7	100	68
3	8.7 - 10.2	98	98
4	10.2 - 11.7	100	95
5	11.7 - 13.2	100	92
6	13.2 - 14.7	100	96

Log of Borehole BH20-11

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 13

Page. 1 of 1

Date Drilled: 'August 25, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand with gravel, brown, damp	70.68	0				
			69.9					
		FILL Silty sand, brown and grey, moist to wet, (loose/firm)		1	6		SS1	
			68.98	2	4		SS2	
					4		SS3	
			67.7	3				
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, grey, wet, (loose to dense/stiff to hard)			9		SS4	
				4	15		SS5	
				5	13		SS6	
					41		SS7	
				6	48		SS8	
			63.5	7				
		Auger Refusal at 7.2 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well installed to a 4.2 m depth as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Aug. 25, 2020	3.0	-
Sept. 3, 2020	1.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH20-12

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 14

Page. 1 of 1

Date Drilled: 'August 25, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (very loose to loose/soft to stiff)	72.18	0	9	×	SS1	
				1				
				2	8	×	SS2	
				3	2	×	SS3	
			68.1	4				
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, grey, wet, (compact/stiff to very stiff)		5	14	×	SS4	
				6	24	×	SS5	
			65.3					
		Auger Refusal at 6.9 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
completion	3.0	6.7

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH20-13

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 15

Page. 1 of 2

Date Drilled: August 20 and 21, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (compact to dense/very stiff to hard)	71.07	0	21		SS1	
				1	35		SS2	
				2	15		SS3	20.9
▽			68.47	2	20		SS4	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, grey, wet, (loose to very dense/firm to hard)	68.1	3	7		SS5	
				4	13		SS6	23.9
				5	51		SS7	
				5	25		SS8	
				6	19		SS9	
		INFERRED WEATHERED SHALE BEDROCK	64.1	7				
		SHALE BEDROCK Grey to dark grey, (very poor to excellent quality) Very poor quality bedrock with numerous clay seams and rubble zone (broken rock) from 7.6 m to 14.9 m depths	63.5	8			RUN1	
				9			RUN2	
				10				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe installed to a 17.7 m depth as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
-	-	-
Sept. 3, 2020	2.6	
Sept. 10, 2020	2.6	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	7.6 - 8.8	22	0
2	8.8 - 10.3	71	0
3	10.3 - 11.8	92	13
4	11.8 - 13.4	92	6
5	13.4 - 14.7	67	0
6	14.7 - 16.3	100	77
7	16.3 - 17.7	100	100

Log of Borehole BH20-13

Project No: OTT-00260579-A0

Project: Residential Development

Figure No. 15

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		SHALE BEDROCK Grey to dark grey, (very poor to excellent quality) Very poor quality bedrock with numerous clay seams and rubble zone (broken rock) from 7.6 m to 14.9 m depths *(continued)*	61.07	10	20 40 60 80 50 100 150 200	250 500 750 20 40 60	RUN3	
				11				
				12			RUN4	
				13				
				14			RUN5	
				15				
				16			RUN6	
				17				
			53.4				RUN7	
		Borehole Terminated at 17.7 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe installed to a 17.7 m depth as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
-	-	-
Sept. 3, 2020	2.6	
Sept. 10, 2020	2.6	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	7.6 - 8.8	22	0
2	8.8 - 10.3	71	0
3	10.3 - 11.8	92	13
4	11.8 - 13.4	92	6
5	13.4 - 14.7	67	0
6	14.7 - 16.3	100	77
7	16.3 - 17.7	100	100

Log of Borehole BH20-14

Project No: OTT-00260579-A0

Project: Residential Development

Location: 1740 - 1760 St. Laurent Boulevard, Ottawa, On.

Figure No. 16

Page. 1 of 1

Date Drilled: 'August 25, 2020

Drill Type: CME-75 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: ML Checked by: SMP

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand with gravel, brown, damp	71.98	0	28		SS1	
		FILL Mixture of silty sand, clayey silt and silty clay with gravel, brown and grey, moist to wet, (compact/stiff)	71.2	1	14		SS2	
		SILTY CLAY Brown, wet, (very stiff)	70.6	2	16, 180		SS3	19.4
					7, 192		SS4	
		SILTY CLAY Low plasticity, grey, wet, (stiff)	69.0	3	2, 72		SS5	18.6
				4	1		SS6	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, grey, wet, (compact to dense/stiff to hard)	67.5	5	11		SS7	
				6	43		SS8	
					37		SS9	
		Auger Refusal at 6.8 m Depth	65.2					

LOG OF BOREHOLE LOGS OF BOREHOLES - 1740&1760 ST LAURENT.GPJ TROW OTTAWA.GDT 9/22/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well installed to a 4.2 m depth as shown.
3. Fieldwork supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00260579-A0

WATER LEVEL RECORDS

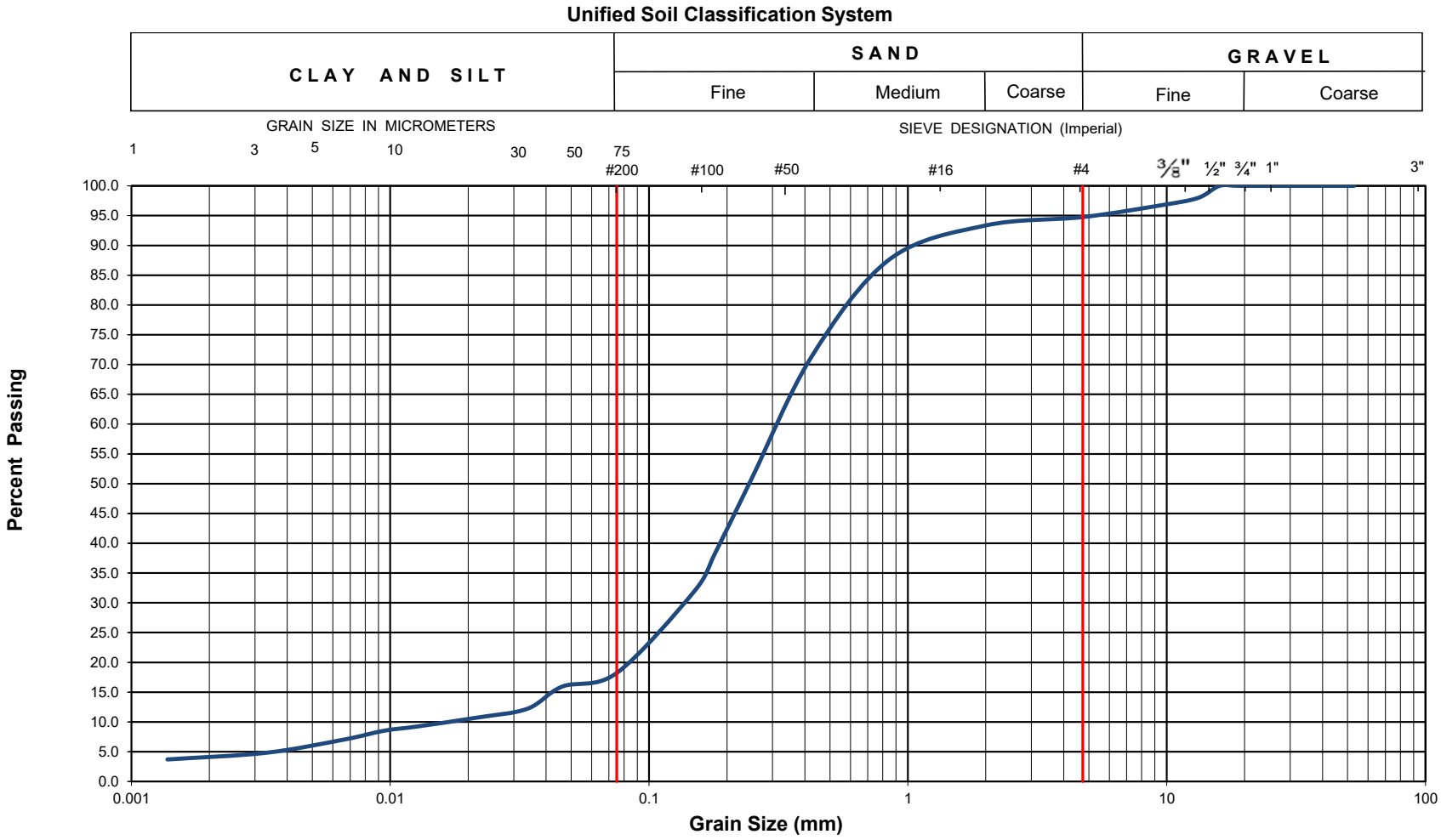
Date	Water Level (m)	Hole Open To (m)
Aug. 25, 2020	3.0	-
Sept. 3, 2020	1.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

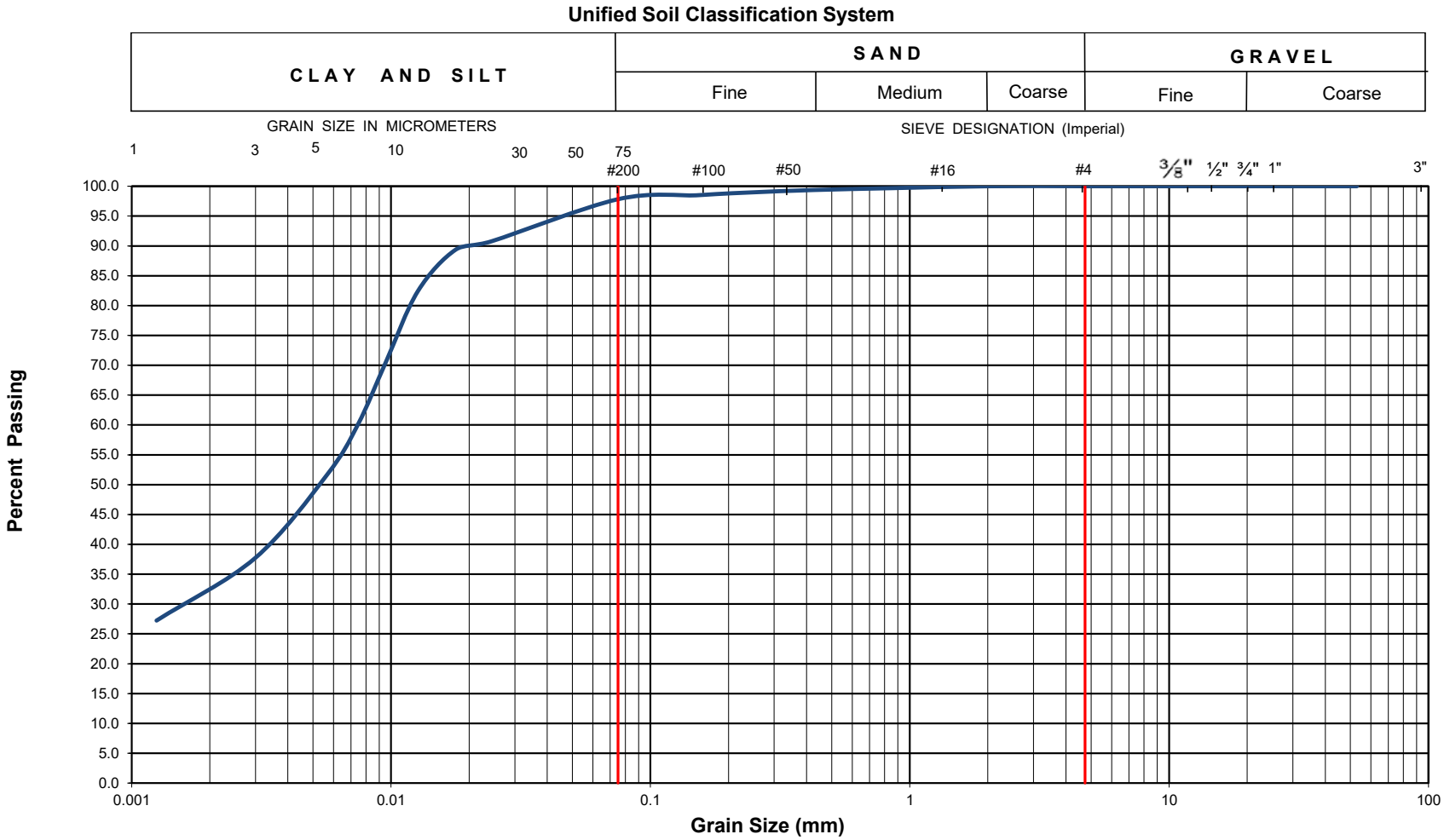
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd. Ottawa,Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-11**	**Sample No.:**	**SS2**	**Depth (m) :**	**1.5-2.1**		
Sample Description :		**% Silt and Clay**	**18**	**% Sand**	**77**	**% Gravel**	**5**	**Figure :**	**17**
Sample Description :		**FILL: Silty Sand (SM)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

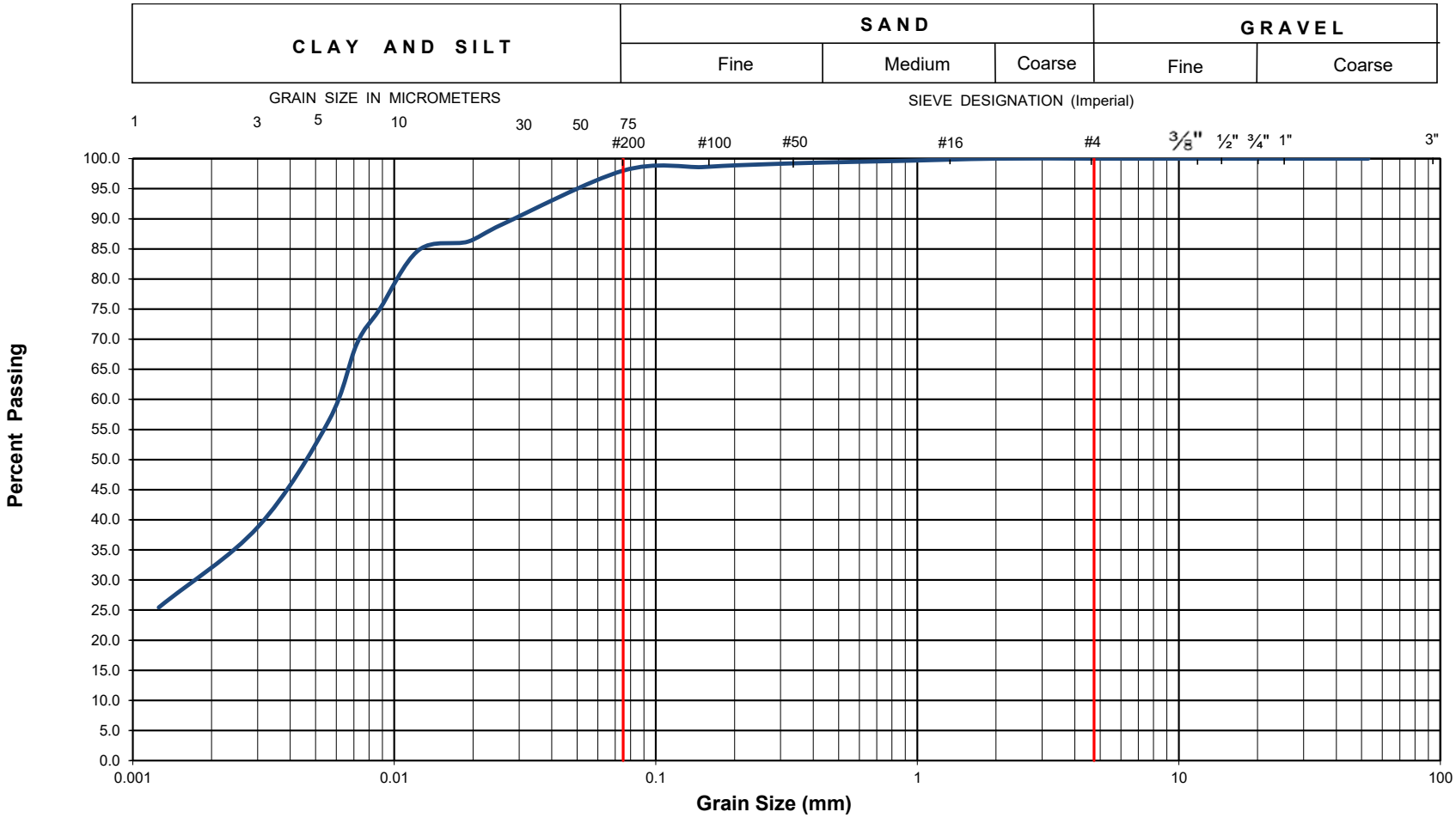


EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd. Ottawa, Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-08**	**Sample No.:**	**SS4**	**Depth (m) :**	**2.3-2.9**		
Sample Description :		**% Silt and Clay**	**98**	**% Sand**	**2**	**% Gravel**	**0**	**Figure :**	**18**
Sample Description :	**BROWN SILTY CLAY CRUST: Low Plasticity (CL)**								

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

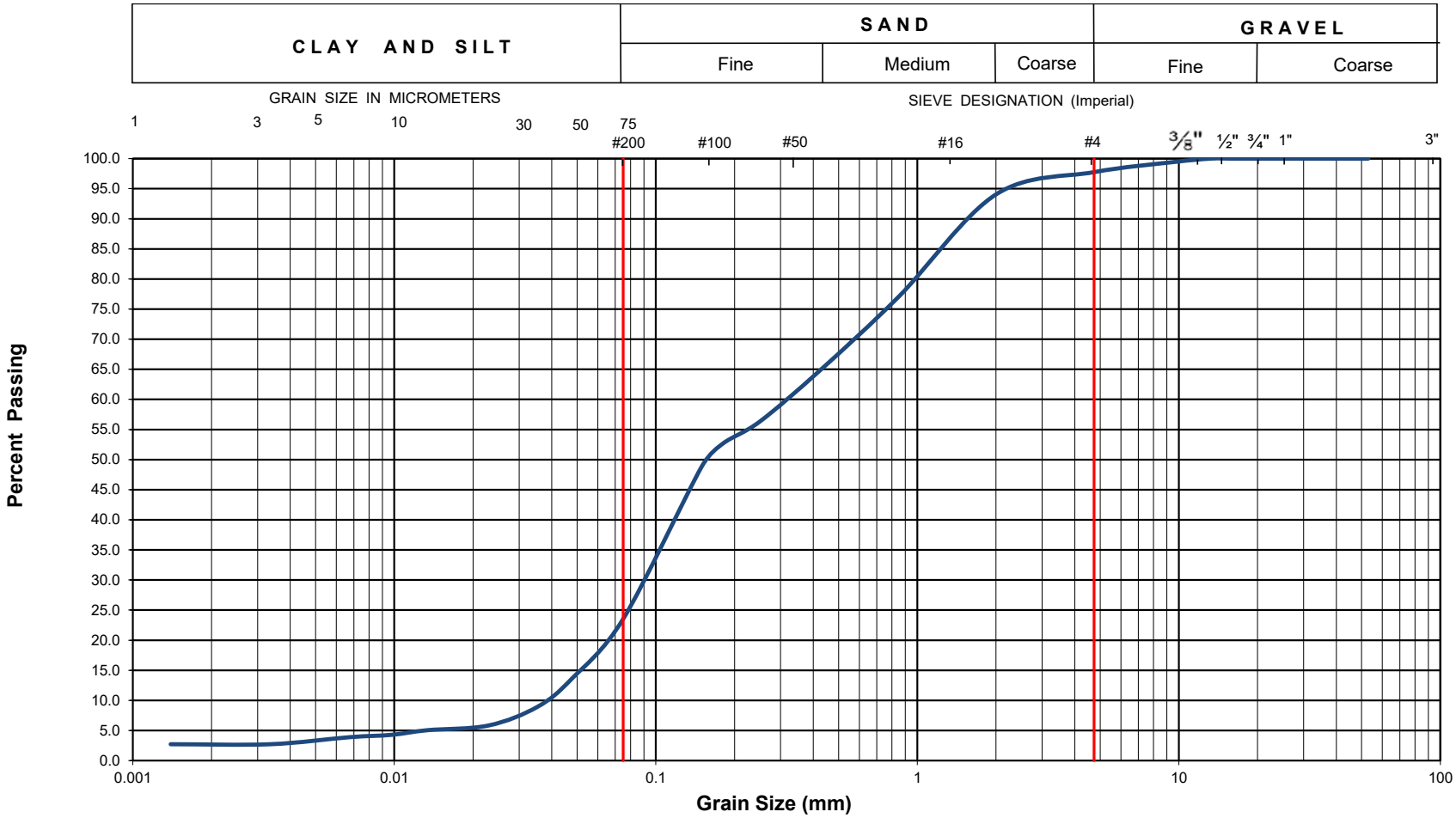


EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd, Ottawa, Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-14**	**Sample No.:**	**SS6**	**Depth (m) :**	**3.8-4.4**		
Sample Description :		**% Silt and Clay**	**98**	**% Sand**	**2**	**% Gravel**	**0**	**Figure :**	**19**
Sample Description :		**GREY SILTY CLAY: Low Plasticity (CL)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

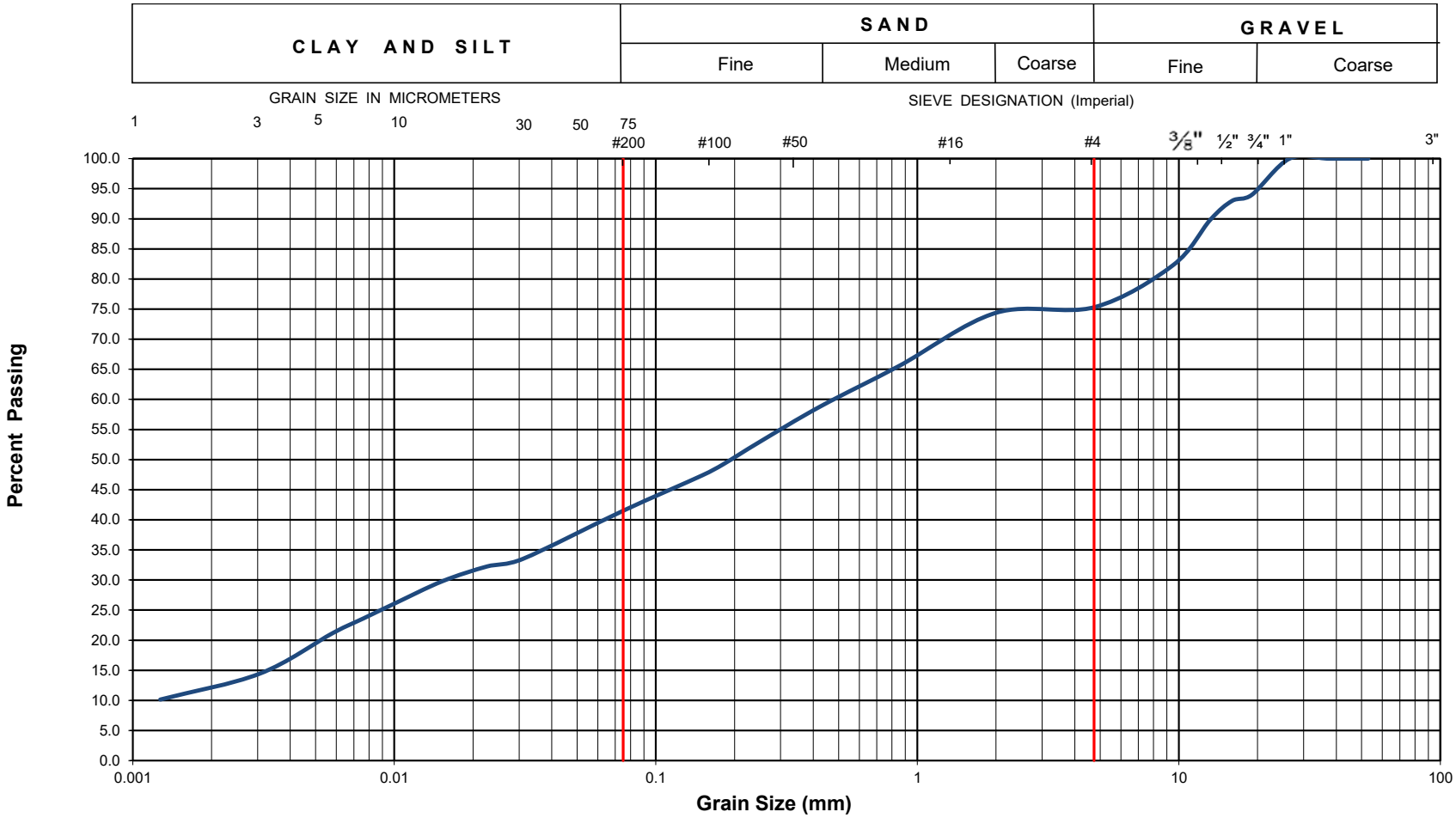


EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd. Ottawa, Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-06**	**Sample No.:**	**SS8**	**Depth (m) :**	**5.3-5.9**		
Sample Description :		**% Silt and Clay**	**24**	**% Sand**	**74**	**% Gravel**	**2**	**Figure :**	**20**
Sample Description :		**GLACIAL TILL: Silty Sand (SM)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

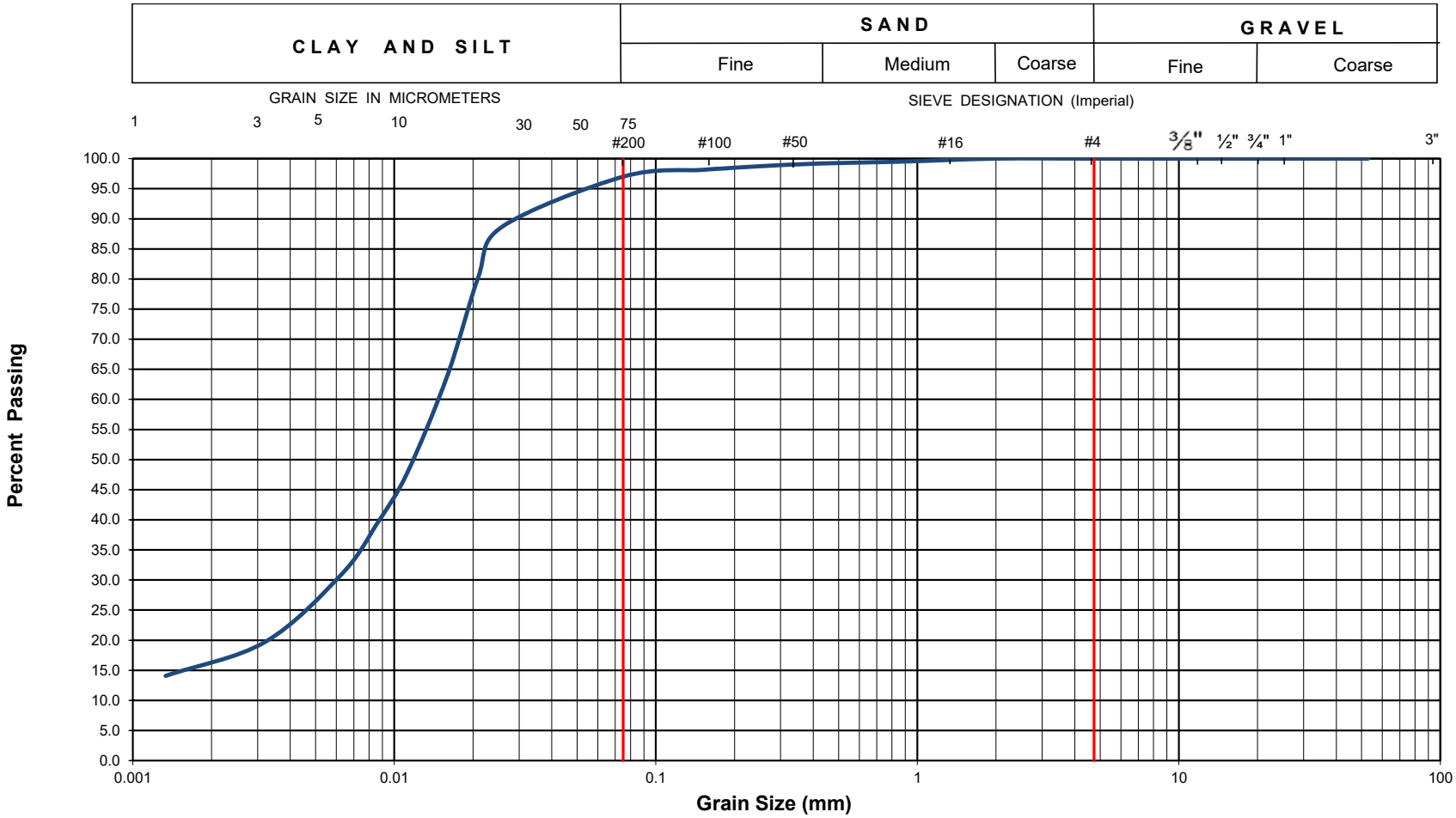


EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd. Ottawa, Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-07**	**Sample No.:**	**SS4-SS6**	**Depth (m) :**	**2.3-4.4**		
Sample Description :		**% Silt and Clay**	**42**	**% Sand**	**33**	**% Gravel**	**25**	**Figure :**	**21**
Sample Description :		**GLACIAL TILL: Clayey Sand with Gravel (SC)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

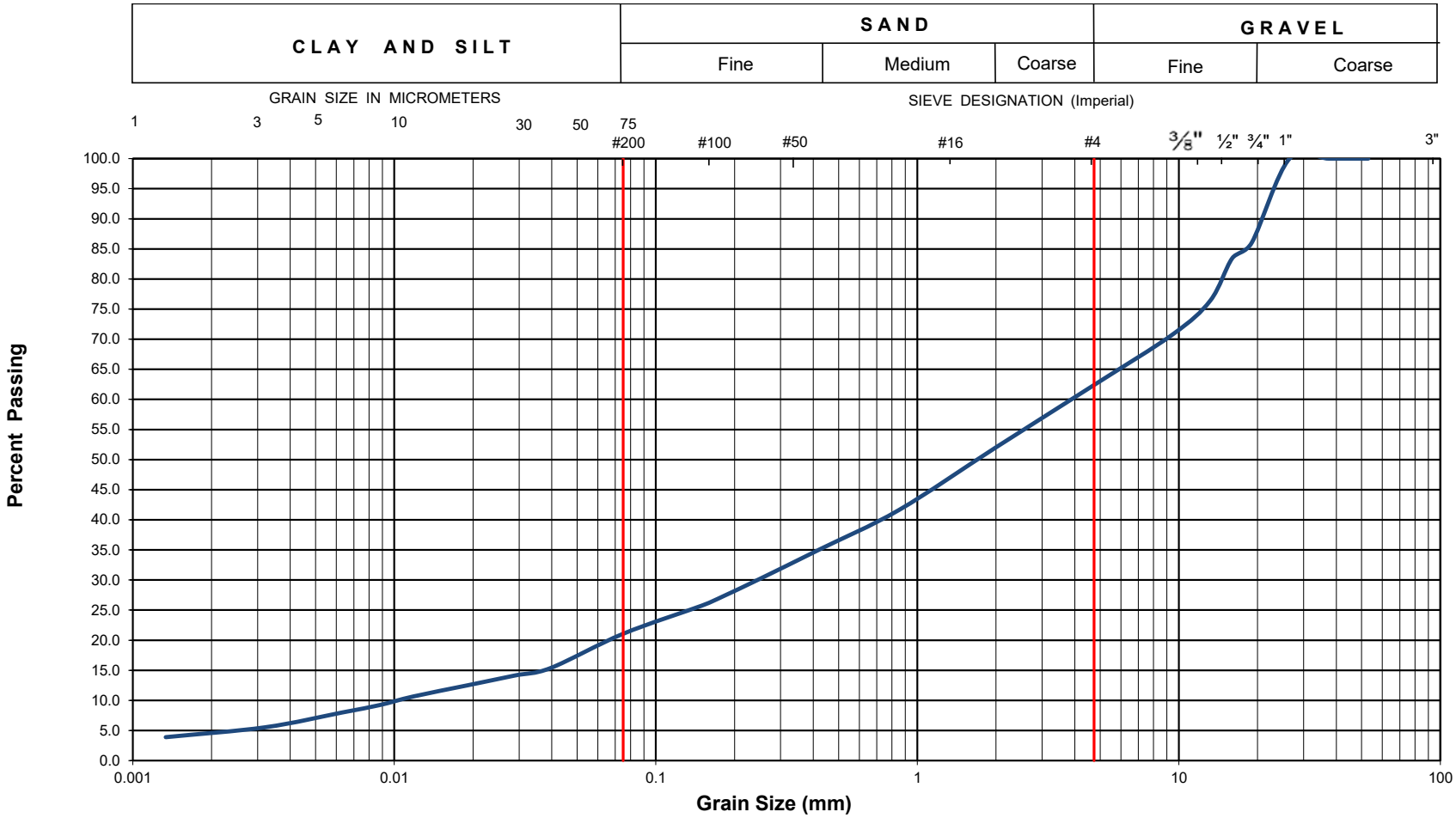


EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd. Ottawa, Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-08**	**Sample No.:**	**SS6**	**Depth (m) :**	**3.8-4.4**		
Sample Description :		**% Silt and Clay**	**97**	**% Sand**	**3**	**% Gravel**	**0**	**Figure :**	**22**
Sample Description :	**GLACIAL TILL: Silty Clay of Low Plasticity (CL-ML)**								

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

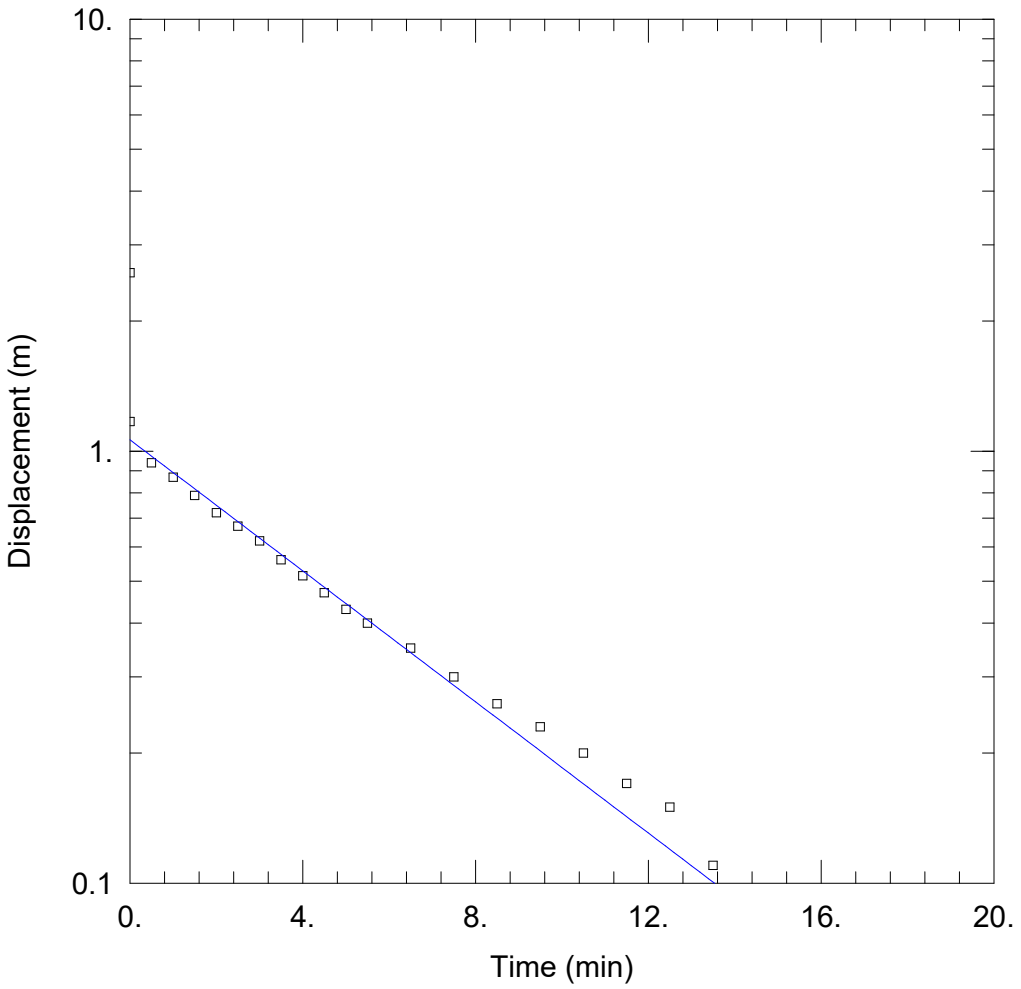
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System



EXP Project No.:	**OTT-00260579**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Heafy Group**	**Project Location :**	**1740-1760 St. Laurent Blvd. Ottawa, Ontario**						
Date Sampled :	**August 25, 2020**	**Borehole No:**	**BH20-14**	**Sample No.:**	**SS8**	**Depth (m) :**	**5.3-5.9**		
Sample Description :		**% Silt and Clay**	**21**	**% Sand**	**41**	**% Gravel**	**38**	**Figure :**	**23**
Sample Description :		**GLACIAL TILL: Silty Sand with Gravel (SM)**							

Appendix C – SWRT Results



WELL TEST ANALYSIS

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt BH19-02 RH.aqt
Date: 10/06/23 Time: 11:56:20

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Well: MW19-02 FH
Test Date: September 26, 2023

AQUIFER DATA

Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW19-02 RH)

Initial Displacement: 2.59 m Static Water Column Height: 6.2 m
Total Well Penetration Depth: 6.3 m Screen Length: 3. m
Casing Radius: 0.05 m Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev
K = 4.955E-6 m/sec y0 = 1.062 m

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-02 FH.aqt
Date: 10/06/23
Time: 12:28:31

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Date: September 26, 2023
Test Well: MW19-02 FH

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW19-02 FH

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.59 m
Static Water Column Height: 6.2 m
Casing Radius: 0.05 m
Well Radius: 0.07 m
Well Skin Radius: 0.1 m
Screen Length: 3. m
Total Well Penetration Depth: 6.3 m

No. of Observations: 20

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	1.17	5.	0.43
0.5	0.94	5.5	0.4
1.	0.87	6.5	0.35
1.5	0.79	7.5	0.3
2.	0.72	8.5	0.26
2.5	0.67	9.5	0.23
3.	0.62	10.5	0.2
3.5	0.56	11.5	0.17
4.	0.515	12.5	0.15
4.5	0.47	13.5	0.11

SOLUTION

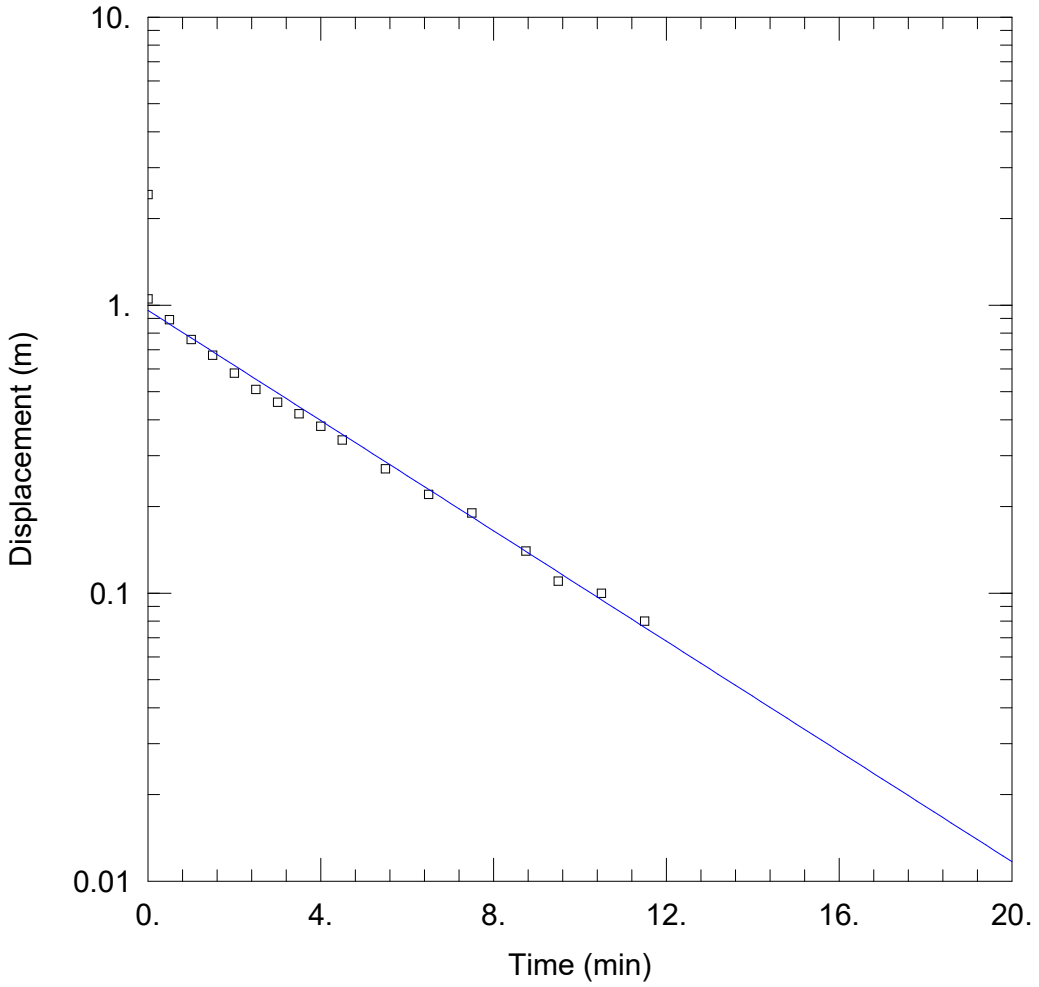
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1887

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.955E-6	m/sec
y0	1.062	m

K = 0.0004955 cm/sec
T = K*b = 6.937E-6 m²/sec (0.06937 sq. cm/sec)



MULTI WELL SLUG TEST

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-03 FH.aqt
Date: 10/06/23 Time: 12:18:59

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Well: MW19-03 FH
Test Date: September 26, 2023

AQUIFER DATA

Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW19-03 FH)

Initial Displacement: 2.42 m
Total Well Penetration Depth: 6.3 m
Casing Radius: 0.05 m
Static Water Column Height: 4.27 m
Screen Length: 3. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 6.253E-6 m/sec y0 = 0.9589 m

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-03 FH.aqt
Title: Multi Well Slug Test
Date: 10/06/23
Time: 12:22:53

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Date: September 26, 2023
Test Well: MW19-03 FH

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW19-03 FH

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.42 m
Static Water Column Height: 4.27 m
Casing Radius: 0.05 m
Well Radius: 0.07 m
Well Skin Radius: 0.1 m
Screen Length: 3. m
Total Well Penetration Depth: 6.3 m

No. of Observations: 17

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	1.05	4.5	0.34
0.5	0.89	5.5	0.27
1.	0.76	6.5	0.22
1.5	0.67	7.5	0.19
2.	0.58	8.75	0.14
2.5	0.51	9.5	0.11
3.	0.46	10.5	0.1
3.5	0.42	11.5	0.08
4.	0.38		

SOLUTION

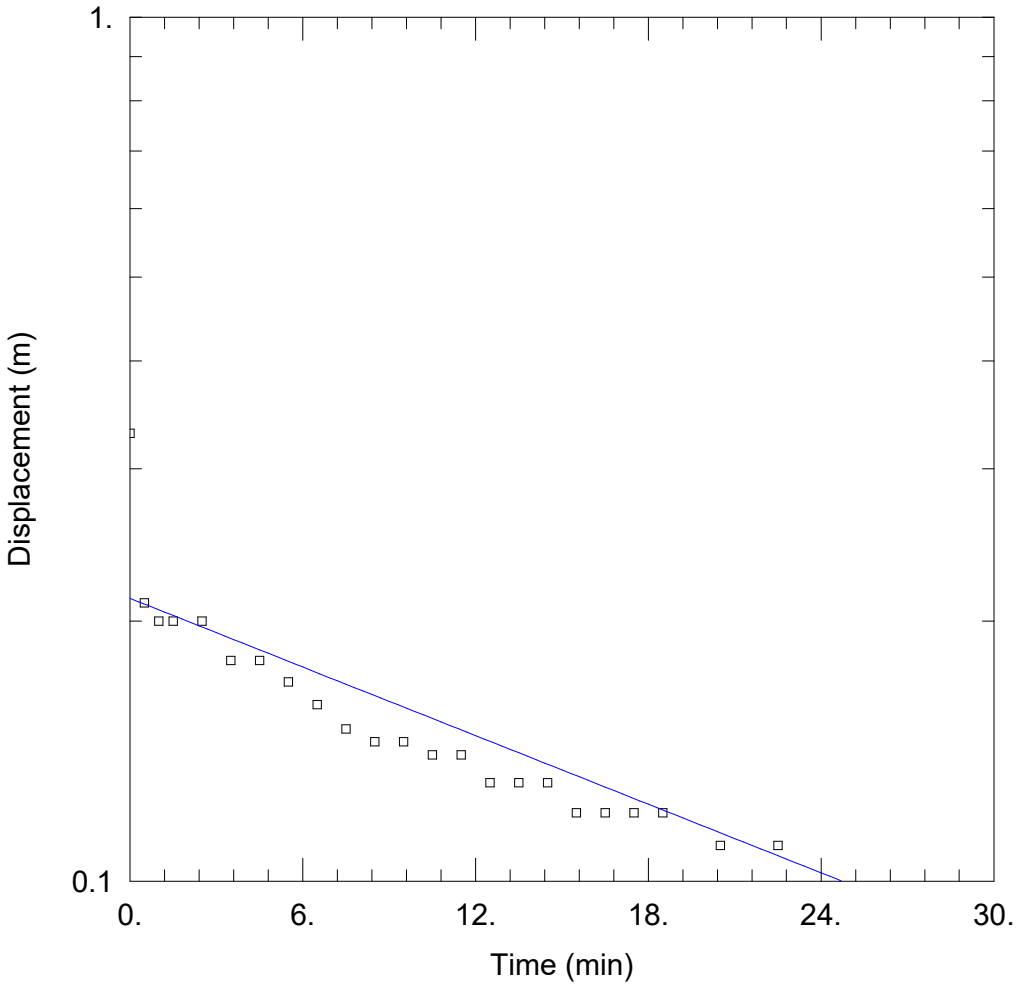
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1887

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.253E-6	m/sec
y0	0.9589	m

K = 0.0006253 cm/sec
T = K*b = 8.754E-6 m²/sec (0.08754 sq. cm/sec)



MULTI WELL SLUG TEST

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt UNK ID FH.aqt
Date: 10/06/23 Time: 12:26:44

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Well: UNK ID
Test Date: September 26, 2023

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (UNK ID FH)

Initial Displacement: 2.42 m
Total Well Penetration Depth: 6.3 m
Casing Radius: 0.05 m
Static Water Column Height: 4.27 m
Screen Length: 3. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 8.653E-7 m/sec
y0 = 0.2125 m

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt UNK ID FH.aqt
Title: Multi Well Slug Test
Date: 10/06/23
Time: 12:27:08

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Date: September 26, 2023
Test Well: UNK ID

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: UNK ID FH

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.42 m
Static Water Column Height: 4.27 m
Casing Radius: 0.05 m
Well Radius: 0.07 m
Well Skin Radius: 0.1 m
Screen Length: 3. m
Total Well Penetration Depth: 6.3 m

No. of Observations: 23

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	0.33	10.5	0.14
0.5	0.21	11.5	0.14
1.	0.2	12.5	0.13
1.5	0.2	13.5	0.13
2.5	0.2	14.5	0.13
3.5	0.18	15.5	0.12
4.5	0.18	16.5	0.12
5.5	0.17	17.5	0.12
6.5	0.16	18.5	0.12
7.5	0.15	20.5	0.11
8.5	0.145	22.5	0.11
9.5	0.145		

SOLUTION

Slug Test
Aquifer Model: Confined

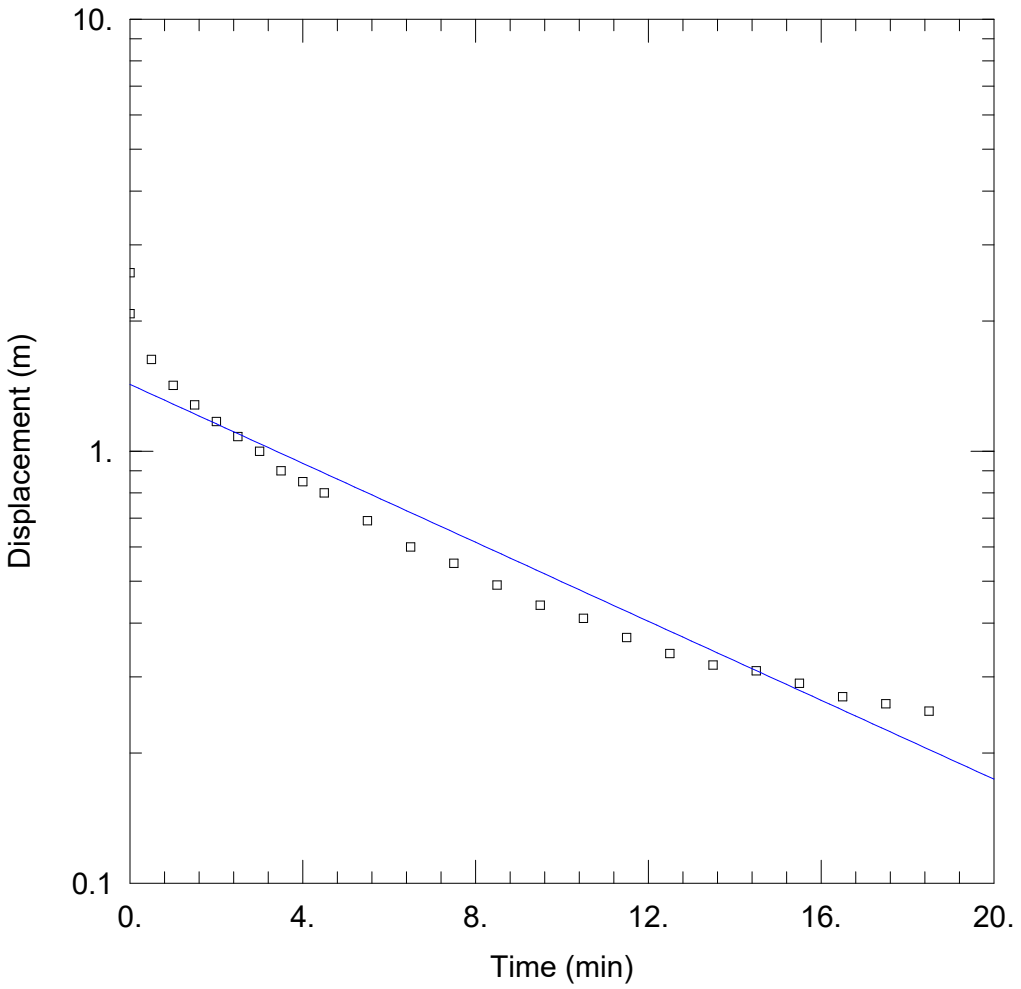
Solution Method: Hvorslev
Log Factor: 0.1887

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	8.653E-7	m/sec
y0	0.2125	m

K = 8.653E-5 cm/sec
T = K*b = 1.211E-6 m²/sec (0.01211 sq. cm/sec)



MULTI WELL SLUG TEST

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-02 RH.aqt
Date: 10/06/23 Time: 14:36:04

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Well: MW19-02 RH
Test Date: September 26, 2023

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW19-02 RH)

Initial Displacement: 2.59 m
Total Well Penetration Depth: 6.3 m
Casing Radius: 0.05 m
Static Water Column Height: 6.2 m
Screen Length: 3. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.985E-6 m/sec
y0 = 1.427 m

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-02 RH.aqt
Title: Multi Well Slug Test
Date: 10/06/23
Time: 14:36:26

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Date: September 26, 2023
Test Well: MW19-02 RH

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW19-02 RH

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.59 m
Static Water Column Height: 6.2 m
Casing Radius: 0.05 m
Well Radius: 0.07 m
Well Skin Radius: 0.1 m
Screen Length: 3. m
Total Well Penetration Depth: 6.3 m

No. of Observations: 24

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	2.08	7.5	0.55
0.5	1.63	8.5	0.49
1.	1.42	9.5	0.44
1.5	1.28	10.5	0.41
2.	1.17	11.5	0.37
2.5	1.08	12.5	0.34
3.	1.	13.5	0.32
3.5	0.9	14.5	0.31
4.	0.85	15.5	0.29
4.5	0.8	16.5	0.27
5.5	0.69	17.5	0.26
6.5	0.6	18.5	0.25

SOLUTION

Slug Test
Aquifer Model: Confined

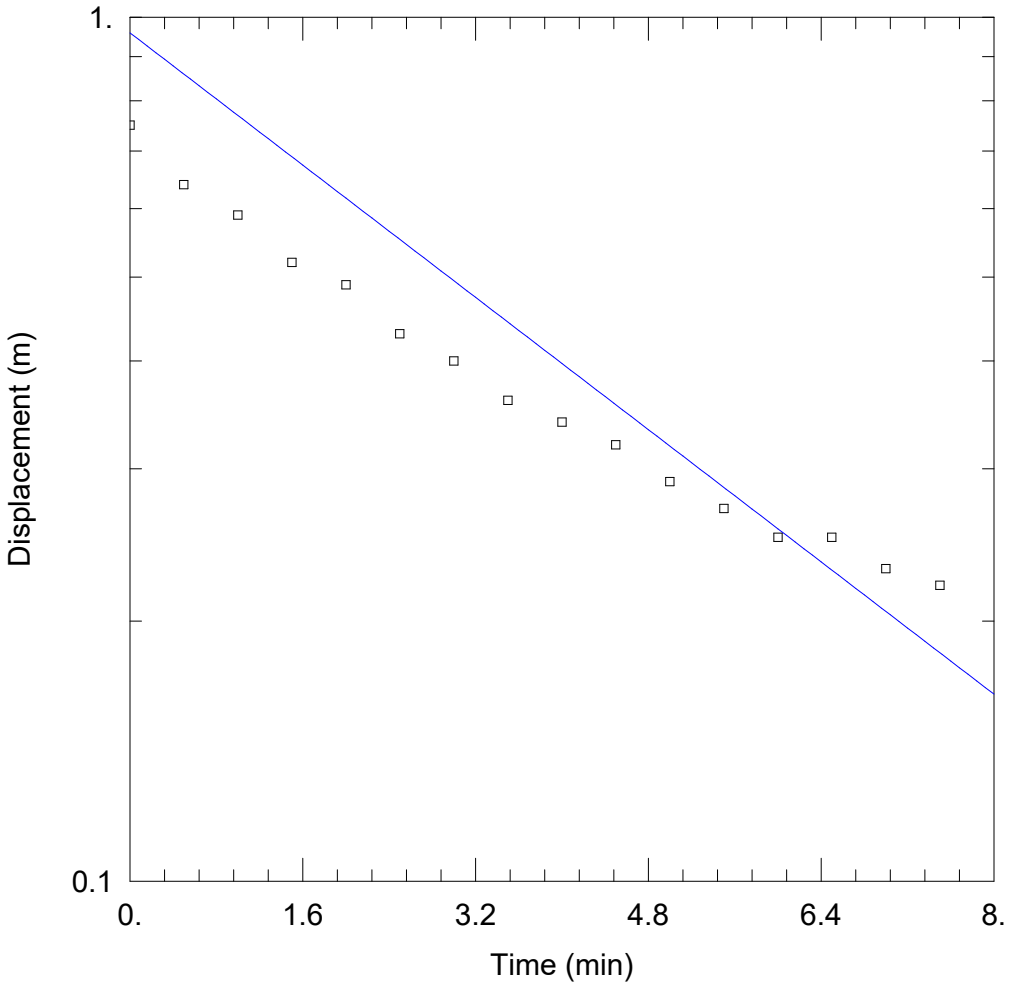
Solution Method: Hvorslev
Log Factor: 0.1887

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.985E-6	m/sec
y0	1.427	m

K = 0.0002985 cm/sec
T = K*b = 4.179E-6 m²/sec (0.04179 sq. cm/sec)



MULTI WELL SLUG TEST

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-03 FH.aqt
Date: 10/06/23 Time: 14:39:00

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Well: MW19-03
Test Date: September 26, 2023

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW19-03 RH)

Initial Displacement: 2.42 m
Total Well Penetration Depth: 6.3 m
Casing Radius: 0.05 m
Static Water Column Height: 4.27 m
Screen Length: 3. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 6.253E-6 m/sec
y0 = 0.9589 m

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt MW19-03 FH.aqt
Title: Multi Well Slug Test
Date: 10/06/23
Time: 14:39:37

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Date: September 26, 2023
Test Well: MW19-03

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW19-03 RH

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.42 m
Static Water Column Height: 4.27 m
Casing Radius: 0.05 m
Well Radius: 0.07 m
Well Skin Radius: 0.1 m
Screen Length: 3. m
Total Well Penetration Depth: 6.3 m

No. of Observations: 16

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	0.75	4.	0.34
0.5	0.64	4.5	0.32
1.	0.59	5.	0.29
1.5	0.52	5.5	0.27
2.	0.49	6.	0.25
2.5	0.43	6.5	0.25
3.	0.4	7.	0.23
3.5	0.36	7.5	0.22

SOLUTION

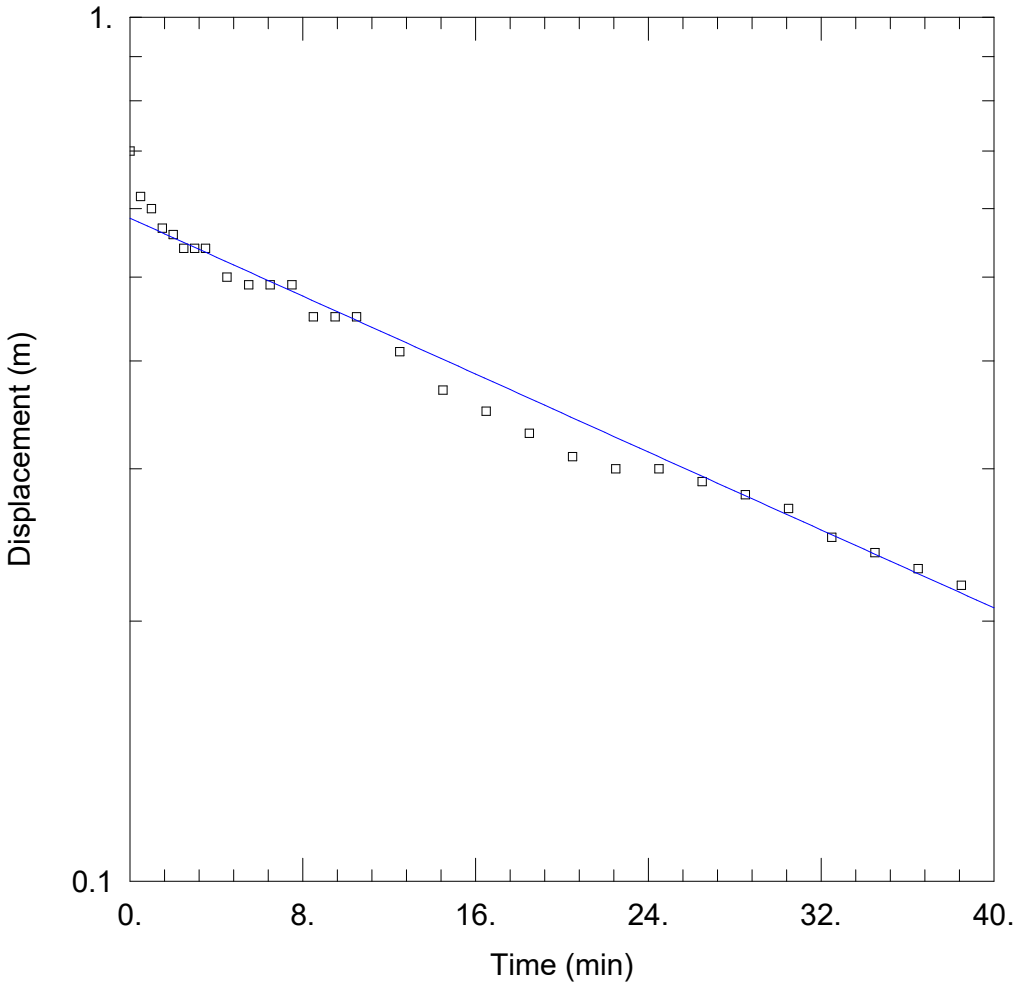
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1887

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.253E-6	m/sec
y0	0.9589	m

K = 0.0006253 cm/sec
T = K*b = 8.754E-6 m²/sec (0.08754 sq. cm/sec)



MULTI WELL SLUG TEST

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt UNK ID FH.aqt
Date: 10/06/23 Time: 14:41:24

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Well: UNK ID
Test Date: September 26, 2023

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (UNK ID RH)

Initial Displacement: 2.42 m
Total Well Penetration Depth: 6.3 m
Casing Radius: 0.05 m
Static Water Column Height: 4.27 m
Screen Length: 3. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 7.365E-7 m/sec
y0 = 0.5851 m

Data Set: C:\Users\AhmedD\OneDrive - EXP\Desktop\St Laurent Blvd\AqtSolve\Aqt UNK ID FH.aqt
Title: Multi Well Slug Test
Date: 10/06/23
Time: 14:41:56

PROJECT INFORMATION

Company: EXP Services Inc.
Project: OTT-00260579-B0
Location: 1740 St Laurent Blvd
Test Date: September 26, 2023
Test Well: UNK ID

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: UNK ID RH

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.42 m
Static Water Column Height: 4.27 m
Casing Radius: 0.05 m
Well Radius: 0.07 m
Well Skin Radius: 0.1 m
Screen Length: 3. m
Total Well Penetration Depth: 6.3 m

No. of Observations: 29

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	0.7	12.5	0.41
0.5	0.62	14.5	0.37
1.	0.6	16.5	0.35
1.5	0.57	18.5	0.33
2.	0.56	20.5	0.31
2.5	0.54	22.5	0.3
3.	0.54	24.5	0.3
3.5	0.54	26.5	0.29
4.5	0.5	28.5	0.28
5.5	0.49	30.5	0.27
6.5	0.49	32.5	0.25
7.5	0.49	34.5	0.24
8.5	0.45	36.5	0.23
9.5	0.45	38.5	0.22
10.5	0.45		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1887

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	7.365E-7	m/sec
y0	0.5851	m

K = 7.365E-5 cm/sec
T = K*b = 1.031E-6 m²/sec (0.01031 sq. cm/sec)

Appendix D – Laboratory Certificates of Analysis

Table 1A: Metals and General Physical Parameters

	Client ID:		City of Ottawa	City of Ottawa	1740 SLB
	Sample ID:		Sewer Use By-Law	Sewer Use By-Law	23-026159-1
	Date Collected:		Sanitary	Storm	26-Sep-23
Parameter	**Units**	**R.L.**	**Limits**	**Limits**	
pH @25°C	pH units		5.5 to 11	6 to 9	7.23
Fluoride	mg/L	0.1	10		<0.7
Sulphate	mg/L	1	1500		279
BOD5	mg/L	3	300	25	<3
Total Suspended Solids	mg/L	3	350	15	5
Phosphorus (Total)	mg/L	0.01	10	0.4	<0.01
Total Kjeldahl Nitrogen	mg/L	0.1	100		0.4
Sulphide	mg/L	0.01	2		<0.01
Cyanide (Total)	mg/L	0.005	2	0.02	<0.005
Phenolics	mg/L	0.001	1	0.008	<0.002
Aluminum (Total)	mg/L	0.01	50		0.14
Bismuth (Total)	mg/L	0.02	5		<0.02
Boron (Total)	mg/L	0.005	25		0.195
Cadmium (Total)	mg/L	0.005	0.02	0.008	<0.005
Chromium (Total)	mg/L	0.002	5	0.08	<0.002
Cobalt (Total)	mg/L	0.005	5		<0.005
Copper (Total)	mg/L	0.002	3	0.04	<0.002
Lead (Total)	mg/L	0.02	5	0.12	<0.02
Manganese (Total)	mg/L	0.001	5	0.05	***0.057***
Molybdenum (Total)	mg/L	0.01	5		<0.01
Nickel (Total)	mg/L	0.01	3	0.08	<0.01
Silver (Total)	mg/L	0.005	5	0.12	<0.005
Tin (Total)	mg/L	0.05	5		<0.05
Titanium (Total)	mg/L	0.005	5		<0.005
Vanadium (Total)	mg/L	0.005	5		<0.005
Zinc (Total)	mg/L	0.005	3	0.04	<0.005
Antimony (Total)	mg/L	0.0005	5		<0.0005
Arsenic (Total)	mg/L	0.0005	1		<0.0005
Selenium (Total)	mg/L	0.005	5		<0.005
Mercury	mg/L	2E-05	0.001		<0.00002

BOLD Exceedance compared to Storm Sewer Guidelines Table 2, Schedule A

R.L. = Reporting Limit

Table 1B: VOC Parameters

	Client ID:		City of Ottawa	City of Ottawa	1740 SLB
	Sample ID:		Sewer Use By-Law	Sewer Use By-Law	23-026159-1
	Date Collected:		Sanitary	Storm	26-Sep-23
Parameter	**Units**	**R.L.**	Limits	Limits	
Benzene	mg/L	0.0005	0.01	0.002	<0.0005
Bromodichloromethane	mg/L	0.002	0.35		<0.002
Bromoform	mg/L	0.005	0.63		<0.005
Bromomethane	mg/L	0.0005	0.11		<0.0005
Carbon Tetrachloride	mg/L	0.0002	0.057		<0.0002
Chlorobenzene	mg/L	0.0005	0.057		<0.0005
Chloroethane	mg/L	0.003	0.27		<0.003
Chloroform	mg/L	0.001	0.08	0.002	<0.001
Chloromethane (Methyl Chloride)	mg/L	0.002	0.19		<0.002
Dibromochloromethane	mg/L	0.002	0.057		<0.002
Ethylene Dibromide	mg/L	0.0002			<0.0002
Dichlorobenzene,1,2-	mg/L	0.0005	0.088	0.0056	<0.0005
Dichlorobenzene,1,3-	mg/L	0.0005	0.036		<0.0005
Dichlorobenzene,1,4-	mg/L	0.0005	0.017	0.0068	<0.0005
Dichloroethane,1,1-	mg/L	0.0005	0.2		<0.0005
Dichloroethane,1,2-	mg/L	0.0005	0.21		<0.0005
Dichloroethylene,1,1-	mg/L	0.0005	0.04		<0.0005
Dichloroethylene,1,2-cis-	mg/L	0.0005	0.2	0.0056	<0.0005
Dichloroethylene,1,2-trans-	mg/L	0.0005	0.2		<0.0005
Dichloropropane,1,2-	mg/L	0.0005	0.85		<0.0005
Dichloropropene,1,3-cis-	mg/L	0.0005	0.07		<0.0005
Dichloropropene,1,3-trans-	mg/L	0.0005	0.07		<0.0005
Ethylbenzene	mg/L	0.0005	0.057	0.002	<0.0005
Dichloromethane (Methylene Chloride)	mg/L	0.005	0.211	0.0052	<0.005
Styrene	mg/L	0.0005	0.04		<0.0005
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	0.04	0.017	<0.0005
Tetrachloroethylene	mg/L	0.0005	0.05	0.0044	<0.0005
Toluene	mg/L	0.0005	0.08	0.002	<0.0005
Trichloroethane,1,1,1-	mg/L	0.0005	0.054		<0.0005
Trichloroethane,1,1,2-	mg/L	0.0005	0.8		<0.0005
Trichloroethylene	mg/L	0.0005	0.054	0.0076	<0.0005
Trichlorofluoromethane (Freon 11)	mg/L	0.005	0.02		<0.005
Trimethylbenzene,1,3,5-	mg/L	0.0001	0.003		<0.0001
Vinyl Chloride	mg/L	0.0002	0.4		<0.0002
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	mg/L	0.0011			<0.0011
Xylene, o-	µg/L	0.5			<0.5
Oil & Grease (Total)	mg/L	1			11.8
Oil and Grease (Mineral)	mg/L	1	15		<1.0
Oil and Grease (Anim/Veg)	mg/L	1	150		11.8
Poly-Chlorinated Biphenyls (PCB's)	µg/L	0.05		4	<0.05

R.L. = Reporting Limit

Table 1C: SVOC Parameters					
	Client ID:		City of Ottawa	City of Ottawa	1740 S.L.B
	Sample ID:		Sewer Use By-Law	Sewer Use By-Law	23-026588-1
	Date Collected:		Sanitary	Storm	30-Sep-23
Parameter	**Units**	**R.L.**			
Acenaphthene	µg/L	0.05			<0.05
Acenaphthylene	µg/L	0.05			<0.05
Anthracene	µg/L	0.05			<0.05
Benzo[a]anthracene	µg/L	0.05			<0.05
Benzo(a)pyrene	µg/L	0.01			<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1
Benzo(g,h,i)perylene	µg/L	0.05			<0.05
Benzo(k)fluoranthene	µg/L	0.05			<0.05
Butyl Benzyl Phthalate	µg/L	1			<1
Bis(2-Chloroethoxy)methane	µg/L	2	0.036		<2
Bis(2-Chloroethyl)ether	µg/L	0.2			<0.2
Chrysene	µg/L	0.05			<0.05
Dibenzo(a,h)anthracene	µg/L	0.05			<0.05
Di-n-Butyl Phthalate	µg/L	1	0.057		<1
Dichlorophenol,2,4-	µg/L	0.2	0.044		<0.2
Diethyl Phthalate	µg/L	1	0.2		<1
Di-n-Octyl Phthalate	µg/L	1	0.03		<1
Fluoranthene	µg/L	0.05			<0.05
Fluorene	µg/L	0.05	0.059		<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05
Indole	µg/L	2	0.05		<2
Methylnaphthalene,1-	µg/L	0.05	0.032		<0.05
Methylnaphthalene,2-(1-)	µg/L	1			<1
Methylnaphthalene,2-	µg/L	0.05	0.022		<0.05
Naphthalene	µg/L	0.05	0.059	6.4	<0.05
Phenanthrene	µg/L	0.05	included in Total PAHs		<0.05
Pyrene	µg/L	0.05	included in Total PAHs		<0.05
Total PAH	µg/L	0.1	0.015	6	<0.1
Hexachlorobenzene	µg/L	0.01	0.001	0.04	<0.01

R.L. = Reporting Limit

GENERAL SAMPLE SUBMISSION FORM

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Proudly Canadian.

SAMPLES SUBMITTED TO: Kingston ☐ Ottawa ☑ Richmond Hill ☐ Barrie ☐ Windsor ☐

TESTING REQUIREMENTS: ☐ O'Reg 153/04 ☐ O'Reg 406/19 ☐ RPI ☐ Coarse ☐ MISA ☑ Other: Sewer Use - San. (Ottawa) | Table (1 - 9) ____ Table (1 - 9.1) ____ ☐ ICC ☐ Medium/Fine ☐ PWQO | Record of Site ____ SPLP Table (1-9.1) ____ ☐ Agricultural ☐ O'Reg 558 TCLP ☐ Landfill Monitoring

REPORT NUMBER (Lab Use): 23109126 / 23-026159

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? ☐ Yes ☑ No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Organization: EXP Services Inc.	Address: 2650 Queensview dr. Ottawa	Invoicing Address (if different):
Contact: Delwar Ahmed		
Tel: 613 688 1899 Fax: Cell 289 404 3187		
Email: delwar.ahmed@exp.com	Quote #:	Project Name or #: OTT-00260579
Additional Info (email, cell, etc): mackenzie.russell@exp.com	P.O. #:	Additional Info:

ANALYSES REQUESTED: General Chem; Total Metals; VOCs; SVOCs; PAHs; PCB

Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page) *Must be arranged in advance

☐	Platinum*	200% Surcharge
☐	Gold*	100% Surcharge
☐	Silver	50% Surcharge
☐	Bronze	25% Surcharge
☑	Standard	5-7 days
☐	Specific Date:	____

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Lab No.	Sample Source and/or Sample Identification	S.P.L. (Watertrax)	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	X	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered Y/N
1	1740 SLB		GW	23-09-26	16:35	✓ ✓ ✓ ✓ ✓				12	N
	SVOC + OCP not needed										

VERIFIED

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	Mackenzie Russell	
Sign:		
	Date (yy-mm-dd)/Time:	23-09-26 / 17:00 Date (yy-mm-dd)/Time:

SHIPPING INFORMATION: ☐ Courier (Client account) ☐ Courier (Caduceon account) ☑ Drop Off ☐ Caduceon (Pick-up) | Invoice ____ # of Pieces ____

REPORTING / INVOICING: ☐ Report by Fax ☑ Report by Email ☑ Invoice by Email ☐ Invoice by Mail

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

Received By (print):	Sabina	Signature:	
Date Received (yy-mm-dd):	Sept. 26	Time Received:	5:00
Laboratory Prepared Bottles:	☑ Yes ☐ No		
Sample Temperature °C:	9.6	Labeled by:	

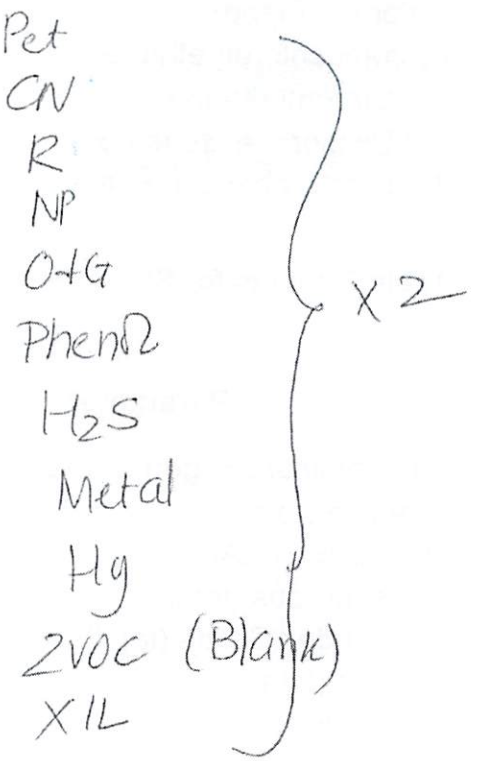
Comments: Sewer Use by-law (2003-514), Schedule A, Tables 1 & 2
1L Ambers, O+G, pet, R, NP, H_2S, M, CN, Hg, phenol, 2VOC-BL

Page 1 of 1

G 110101

Table 1. Limits for Sanitary and Combined Sewers I

Parameter	Limit (mg/L)
Biochemical Oxygen Demand	300
Cyanide (total)	2
Fluoride	10
Total Kjeldahl Nitrogen	100
Oil & Grease . Animal & Vegetable	150
Oil & Grease . Mineral & Synthetic	15
Phenolics (4AAP)	1
Phosphorous (total)	10
Sulphates	1500
Sulphides	2
Suspended Solids (total)	350
Aluminum (total)	50
Antimony (total)	5
Arsenic (total)	1
Bismuth (total)	5
Boron (total)	25
Cadmium (total)	0.02
Chromium (total)	5
Cobalt (total)	5
Copper (total)	3
Lead (total)	5
Manganese (total)	5
Mercury (total)	0.001
Molybdenum (total)	5
Nickel (total)	3
Selenium (total)	5
Silver (total)	5
Tin (total)	5
Titanium (total)	5
Vanadium	5
Zinc (total)	3
Benzene	0.01
Bromodichloromethane	0.35
Bromoform	0.63



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QUOTATION FOR ANALYTICAL SERVICES

Quote #:
Organization:
Contact:
Telephone:
Email:
Project #:
Address: City of Ottawa Sewer Use By-law 2003-514
Invoice To:
Date: Valid Until:

Item #	Quantity	Analysis Request	Matrix	Unit Cost, $	Amount, $
Schedule A Sanitary and Combined Sewer Discharge					
1	1	General Chemistry (pH, BOD5, TSS, CN, F, TP/TKN, Total Oil & Grease (Animal/Vegetable/Mineral/Synthetic), Phenols (4AAP), SO4, S^{2-})	WW	173.45	173.45
2	1	Metals (Al, Sb, As, Bi, B, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sn, Ti, V, Zn)	WW	52.50	52.50
3	1	VOC's (Benzene, Bromodichloromethane, Bromoform, Bromomethane, Carbon Tetrachloride, Chloroform, Chloromethane, Chlorobenzene, 1,2-Dichlorobenzene, Dibromochloromethane, cis-1,3 Dichloropropylene, 1,2-Dibromoethane, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 1,1-Dichlorethane, 1,2-Dichloroethane, 1,1-Dicloroethylene, Trans-1,2-Dichloroethylene, 1,1,1-Trichlorethane, 1,1,2-Trichlorethane Cis-1,2-Dichloroethylene, 1,2-Dichloropropane, Methylene Chloride, Ethylbenzene, Tetrachloroethylene, Trichlorofluromethane, 1,3,5Trimethylbenzene, Toluene, Trichloroethylene, Xylenes (total) Styrene, Trans-1,3 Dichloropropylene, 1,1,2,2-Tetrachloroethane, Vinyl Chloride, Chloroethane)	WW	87.15	87.15
4	1	SVOC's and PAH's (Bis(2-Chloreth)meth, Bis(2-ethylhexyl Phthalate), Butyl Benzyl Phthalate, 2,4-Dichlorophenol, Diethyl Phthalate, Dibutyl Phthalate, Dioctylphthalate, Fluorene, Hexachlorobenzene, Indole, 1-Methyl-Naphthalene, 2-Methyl-Naphthalene, Naphthalene, PAH (Total)	WW	$204.75	$204.75
5	1	Dioxins and Furans (sub-contracted)	WW	1300.00	1300.00
6	1	Formaldehyde (sub-contracted)	WW	275.00	260.00
7	1	Nitrosodimethylamine (NDMA) (sub-contracted)	WW	500.00	500.00
8	1	Nonylphenols & Nonylphenol Ethoxylates (sub-contracted)	WW	330.00	330.00
-	-	Sample Supplies Surcharge	Surcharge	5%	$145.39
-	1	Sample Disposal Surcharge	Surcharge	$2.00	$2.00
				Subtotal	$3,055.24
				HST	$397.18
				Total Cost	$3,452.42

Steve Garrett
Director of Laboratory Services
Caduceon Environmental Laboratories
E-mail: sgarrett@caduceonlabs.com

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 110101 **REPORT No: 23-026159 - Rev. 0**

Report To:
EXP Services Inc - Ottawa
2650 Queensview Drive
Suite 100
Ottawa, ON K2B 8H6

Attention: Delwar Ahmed

CADUCEON Environmental Laboratories
2378 Holly Lane
Ottawa, ON K1V 7P1

DATE RECEIVED: 2023-Sep-26
DATE REPORTED: 2023-Oct-04
SAMPLE MATRIX: Ground Water

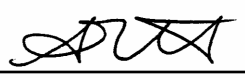
CUSTOMER PROJECT: OTT-00260579
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	1	OTTAWA	VKASYAN	2023-Sep-27	A-IC-01	SM 4110B
BOD5 (Liquid)	1	KINGSTON	JWOLFE	2023-Sep-29	BOD-001	SM 5210B
Cond/pH/Alk Auto (Liquid)	1	OTTAWA	SBOUDREAU	2023-Sep-27	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
Cyanide Total (Liquid)	1	KINGSTON	JMACINNES	2023-Sep-29	CN-001	SM 4500-CN-E
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2023-Sep-28	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	1	OTTAWA	APRUDYVUS	2023-Sep-28	D-ICP-01	SM 3120B
Mercury (Liquid)	1	OTTAWA	TBENNETT	2023-Oct-02	D-HG-02	SM 3112B
Oil & Grease (Liquid)	1	KINGSTON	MLANE	2023-Sep-28	O&G-001	SM 5520
PCB's (Liquid)	1	KINGSTON	CSUMMERHAYS	2023-Oct-02	PCB-001	EPA 8081
Phenols (Liquid)	1	KINGSTON	JMACINNES	2023-Oct-04	PHEN-01	MECP E3179
Sulphide (Liquid)	1	KINGSTON	EHINCH	2023-Sep-28	H2S-001	SM 4500-S2
TP & TKN (Liquid)	1	KINGSTON	KDIBBITS	2023-Sep-29	TPTKN-001	MECP E3516.2
TSS (Liquid)	1	KINGSTON	AMANIYA	2023-Sep-28	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	JEVANS	2023-Sep-29	C-VOC-02	EPA 8260

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Steve Garrett
Director of Laboratory Services

				Client I.D.	1740 SLB
				Sample I.D.	23-026159-1
				Date Collected	2023-Sep-26
Parameter	**Units**	**R.L.**	**Limits**		-
pH @25°C	pH units	-	11.0	SAN	7.23
Fluoride	mg/L	0.1	10	SAN	<0.7
Sulphate	mg/L	1	1500	SAN	279
BOD5	mg/L	3	300	SAN	<3
Total Suspended Solids	mg/L	3	350	SAN	5
Phosphorus (Total)	mg/L	0.01	10	SAN	<0.01
Total Kjeldahl Nitrogen	mg/L	0.1	100	SAN	0.4
Sulphide	mg/L	0.01	2	SAN	<0.01
Cyanide (Total)	mg/L	0.005	2	SAN	<0.005
Phenolics	mg/L	0.001	1	SAN	<0.002
Aluminum (Total)	mg/L	0.01	50	SAN	0.14
Bismuth (Total)	mg/L	0.02	5	SAN	<0.02
Boron (Total)	mg/L	0.005	25	SAN	0.195
Cadmium (Total)	mg/L	0.005	0.02	SAN	<0.005
Chromium (Total)	mg/L	0.002	5	SAN	<0.002
Cobalt (Total)	mg/L	0.005	5	SAN	<0.005
Copper (Total)	mg/L	0.002	3	SAN	<0.002
Lead (Total)	mg/L	0.02	5	SAN	<0.02
Manganese (Total)	mg/L	0.001	5	SAN	0.057
Molybdenum (Total)	mg/L	0.01	5	SAN	<0.01
Nickel (Total)	mg/L	0.01	3	SAN	<0.01



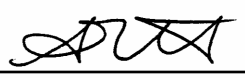
Steve Garrett

Director of Laboratory Services

Parameter	Units	R.L.	Limits		Client I.D.: 1740 SLB Sample I.D.: 23-026159-1 Date Collected: 2023-Sep-26
					-
Silver (Total)	mg/L	0.005	5	SAN	<0.005
Tin (Total)	mg/L	0.05	5	SAN	<0.05
Titanium (Total)	mg/L	0.005	5	SAN	<0.005
Vanadium (Total)	mg/L	0.005	5	SAN	<0.005
Zinc (Total)	mg/L	0.005	3	SAN	<0.005
Antimony (Total)	mg/L	0.0005	5	SAN	<0.0005
Arsenic (Total)	mg/L	0.0005	1	SAN	<0.0005
Selenium (Total)	mg/L	0.005	5	SAN	<0.005
Mercury	mg/L	0.00002	0.001	SAN	<0.00002

Steve Garrett
Director of Laboratory Services

Parameter	Units	R.L.	Limits	Client I.D. / Sample I.D. / Date Collected	1740 SLB / 23-026159-1 / 2023-Sep-26 / -
Benzene	mg/L	0.0005	0.01	SAN	<0.0005
Bromodichloromethane	mg/L	0.002	0.35	SAN	<0.002
Bromoform	mg/L	0.005	0.63	SAN	<0.005
Bromomethane	mg/L	0.0005	0.11	SAN	<0.0005
Carbon Tetrachloride	mg/L	0.0002	0.057	SAN	<0.0002
Chlorobenzene	mg/L	0.0005	0.057	SAN	<0.0005
Chloroethane	mg/L	0.003	0.27	SAN	<0.003
Chloroform	mg/L	0.001	0.08	SAN	<0.001
Chloromethane (Methyl Chloride)	mg/L	0.002	0.19	SAN	<0.002
Dibromochloromethane	mg/L	0.002	0.057	SAN	<0.002
Ethylene Dibromide	mg/L	0.0002	0.028	SAN	<0.0002
Dichlorobenzene,1,2-	mg/L	0.0005	0.088	SAN	<0.0005
Dichlorobenzene,1,3-	mg/L	0.0005	0.036	SAN	<0.0005
Dichlorobenzene,1,4-	mg/L	0.0005	0.017	SAN	<0.0005
Dichloroethane,1,1-	mg/L	0.0005	0.2	SAN	<0.0005
Dichloroethane,1,2-	mg/L	0.0005	0.21	SAN	<0.0005
Dichloroethylene,1,1-	mg/L	0.0005	0.04	SAN	<0.0005
Dichloroethylene,1,2-cis-	mg/L	0.0005	0.2	SAN	<0.0005
Dichloroethylene,1,2-trans-	mg/L	0.0005	0.2	SAN	<0.0005
Dichloropropane,1,2-	mg/L	0.0005	0.85	SAN	<0.0005
Dichloropropene,1,3-cis-	mg/L	0.0005	0.07	SAN	<0.0005



Steve Garrett
Director of Laboratory Services

				Client I.D.	1740 SLB
				Sample I.D.	23-026159-1
				Date Collected	2023-Sep-26
Parameter	**Units**	**R.L.**	**Limits**		-
Dichloropropene,1,3-trans-	mg/L	0.0005	0.07	SAN	<0.0005
Ethylbenzene	mg/L	0.0005	0.057	SAN	<0.0005
Dichloromethane (Methylene Chloride)	mg/L	0.005	0.211	SAN	<0.005
Styrene	mg/L	0.0005	0.04	SAN	<0.0005
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	0.04	SAN	<0.0005
Tetrachloroethylene	mg/L	0.0005	0.05	SAN	<0.0005
Toluene	mg/L	0.0005	0.08	SAN	<0.0005
Trichloroethane,1,1,1-	mg/L	0.0005	0.054	SAN	<0.0005
Trichloroethane,1,1,2-	mg/L	0.0005	0.8	SAN	<0.0005
Trichloroethylene	mg/L	0.0005	0.054	SAN	<0.0005
Trichlorofluoromethane (Freon 11)	mg/L	0.005	0.02	SAN	<0.005
Trimethylbenzene,1,3,5-	mg/L	0.0001	0.003	SAN	<0.0001
Vinyl Chloride	mg/L	0.0002	0.4	SAN	<0.0002
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	mg/L	0.0011	0.32	SAN	<0.0011
Xylene, o-	µg/L	0.5			<0.5
Oil & Grease (Total)	mg/L	1.0			11.8
Oil and Grease (Mineral)	mg/L	1.0	15	SAN	<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0	150	SAN	11.8

Steve Garrett

Director of Laboratory Services

Parameter	Units	R.L.	Limits		Client I.D.: 1740 SLB Sample I.D.: 23-026159-1 Date Collected: 2023-Sep-26
					-
Poly-Chlorinated Biphenyls (PCB's)	µg/L	0.05			<0.05

: City of Ottawa
SAN: Sanitary Sewer By Law

Steve Garrett
Director of Laboratory Services

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TESTING REQUIREMENTS

- ☐ O.Reg 153 — Table ____ ☐ Medium/Fine ☐ Coarse
- ☐ RPI ☐ ICC ☐ Agricultural (O.Reg 153)
- ☐ Yes ☐ No Record of Site Condition (O.Reg 153)
- ☐ Provincial Water Quality Objectives
- ☑ Sewer Use By-Law: _____
- ☐ MISA Guidelines
- ☐ O.Reg 558 Leachate Analysis
- Disposal Site: _____
- ☐ Landfill Monitoring
- ☐ Other: _____

REPORT NUMBER (Lab Use)
23109130
23-026588

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? ☑ Yes ☐ No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Indicate Laboratory Samples are submitted to: ☐ Kingston ☑ Ottawa ☐ Richmond Hill ☐ Windsor ☐ Barrie ☐ London

Organization: Exp Service Inc.	Address and Invoicing Address (if different): 2650 Queensview Dr. / Ottawa
Contact: Delwar Ahmed	
Tel: 613-688-1899	
Fax: cell 289-404-3187	Quote No.:
Email: delwar.Ahmed@exp.com	P.O. No.:
	Project Name: OTT-00260579
	Additional Info:

ANALYSES REQUESTED (Print Test in Boxes)

SVOC	OC pesticide											Suspected Highly Contaminated
✓	✓											

TURNAROUND SERVICE REQUESTED (see back page)

- ☐ Platinum 200% Surcharge
- ☐ Gold 100% Surcharge
- ☐ Silver 50% Surcharge
- ☐ Bronze 25% Surcharge
- ☑ Standard 5-7 days
- ☐ Specific Date: _____

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Lab No:	Sample Identification	S.P.L.	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	✓	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered(Y/N)
	1740 S-L-B		GW	23-09-30	11:15	✓ ✓				2	NO

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	Shahyna Z	Shahyna Z
Sign:	Shahyna	Shahyna
	Date (yy-mm-dd)/Time:	Date (yy-mm-dd)/Time:

SHIPPING INFORMATION

- Client's Courier ☐
- Caduceon's Courier ☐
- Drop Off ☑
- Caduceon (Pick-up) ☐
- Invoice ☐
- # of Pieces

REPORTING / INVOICING

- Report by Fax ☐
- Report by Email ☑
- Invoice by Email ☑
- Invoice by Mail ☐

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

- Received By (print): Asma Hirsi Signature: Asma H
- Date Received (yy-mm-dd): 23-09-30 Time Received: 11:28
- Laboratory Prepared Bottles: ☑ Yes ☐ No
- Sample Temperature °C: 18.1
- Labeled by:

Comments: City of ottawa Sewer by law

2x 1L (blank)

Page ____ of ____

G 90848

White: Lab Copy / Yellow: Invoicing Copy / Pink: Client Copy

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Canadian owned.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 90848 **REPORT No: 23-026588 - Rev. 1**

Report To:
EXP Services Inc - Ottawa
2650 Queensview Drive
Suite 100
Ottawa, ON K2B 8H6

Attention: Delwar Ahmed

CADUCEON Environmental Laboratories
2378 Holly Lane
Ottawa, ON K1V 7P1

DATE RECEIVED: 2023-Sep-30
DATE REPORTED: 2023-Oct-05
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: OTT-00260579
P.O. NUMBER:

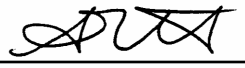
Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
OC Pesticides (Liquid)	1	KINGSTON	CSUMMERHAYS	2023-Oct-05	PESTCL-001	EPA 8081
SVOC - Semi-Volatiles (Liquid)	1	KINGSTON	PRANA	2023-Oct-04	NAB-W-001	EPA 8270D

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

			Client I.D.	1740 S.L.B
			Sample I.D.	23-026588-1
			Date Collected	2023-09-30
Parameter	**Units**	**R.L.**		-
Acenaphthene	µg/L	0.05		<0.05
Acenaphthylene	µg/L	0.05		<0.05
Anthracene	µg/L	0.05		<0.05
Benzo[a]anthracene	µg/L	0.05		<0.05
Benzo(a)pyrene	µg/L	0.01		<0.01
Benzo(b)fluoranthene	µg/L	0.05		<0.05
Benzo(b+k)fluoranthene	µg/L	0.1		<0.1
Benzo(g,h,i)perylene	µg/L	0.05		<0.05
Benzo(k)fluoranthene	µg/L	0.05		<0.05
Butyl Benzyl Phthalate	µg/L	1		<1

Steve Garrett
Director of Laboratory Services

		Client I.D.	1740 S.L.B
		Sample I.D.	23-026588-1
		Date Collected	2023-09-30
Parameter	**Units**	**R.L.**	-
Bis(2-Chloroethoxy)methane	µg/L	2	<2
Bis(2-Chloroethyl)ether	µg/L	0.2	<0.2
Chrysene	µg/L	0.05	<0.05
Dibenzo(a,h)anthracene	µg/L	0.05	<0.05
Di-n-Butyl Phthalate	µg/L	1	<1
Dichlorophenol,2,4-	µg/L	0.2	<0.2
Diethyl Phthalate	µg/L	1	<1
Di-n-Octyl Phthalate	µg/L	1	<1
Fluoranthene	µg/L	0.05	<0.05
Fluorene	µg/L	0.05	<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05	<0.05
Indole	µg/L	2	<2
Methylnaphthalene,1-	µg/L	0.05	<0.05
Methylnaphthalene,2-(1-)	µg/L	1	<1
Methylnaphthalene,2-	µg/L	0.05	<0.05
Naphthalene	µg/L	0.05	<0.05
Phenanthrene	µg/L	0.05	<0.05
Pyrene	µg/L	0.05	<0.05
Total PAH	µg/L	0.1	<0.1



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Director of Laboratory Services

		Client I.D.	1740 S.L.B
		Sample I.D.	23-026588-1
		Date Collected	2023-09-30
Parameter	**Units**	**R.L.**	-
Hexachlorobenzene	µg/L	0.01	<0.01

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Director of Laboratory Services

Appendix E – Dewatering and Drainage Flow Rate Calculations

Figure DW-2: Dewatering Flow Estimation Equations

Basic Dewatering Equations Used Consistent Units

Equation for Confined Aquifer		**Refer to Table 6.1, p. 67, Po**
Radial Flow Confined Aquifer Q_{cr} = $[2\pi KB(H-h)]/ln(R_o/r_w)$		<---Radial flow = contributions from end
Trench Flow Confined Aquifer Q_{ct} = 2xKB(H-h)/L		<---Trench flow = contributions from both
where	K = hydraulic conductivity in **m/day**	
	B = saturated thickness of the aquifer in **m**	
	H = initial GW elevation measured from ref. datum in **m**	<---Initial GW elevation
	h = Target GW elevation in the well measured from ref. datum in	<---Target to lower the GW to!
	R_o = radius of influence in **m**	<--- Sichart & Kryelis Eq. R_o= 3000(H-h) **and K in m/sec.R_o** will be in **metres**. Alternative equation by Bear (Bear, J., 1 McGraw-Hill, New York, 569p) R_o=1.5(T **m^2/day**, **t** is pumping duration in **days**, **S** coefficient. **R_o** will be in **metres**.
	r_w = radius of of the well in **m**	
	L = distance of influence for trench flow in **m**	<--- Similar to R_o = ZOI for radial flow
Q = volume in m^3/day		
Equation for Unconfined Aquifer		
Radial Flow Unconfined Aquifer Q_{ur} = $\pi K(H^2-h^2)]/ln(R_o/r_w)$		<---Radial flow = contributions from end
Trench Flow Unconfined Q_{ut} = $xK(H^2-h^2)/L$		<---Trench flow = contributions from both
These eqs have been used in dewatering calculations.		

Refer to Figs 6.7 and 6.8, p.70, Powers et al., 2007

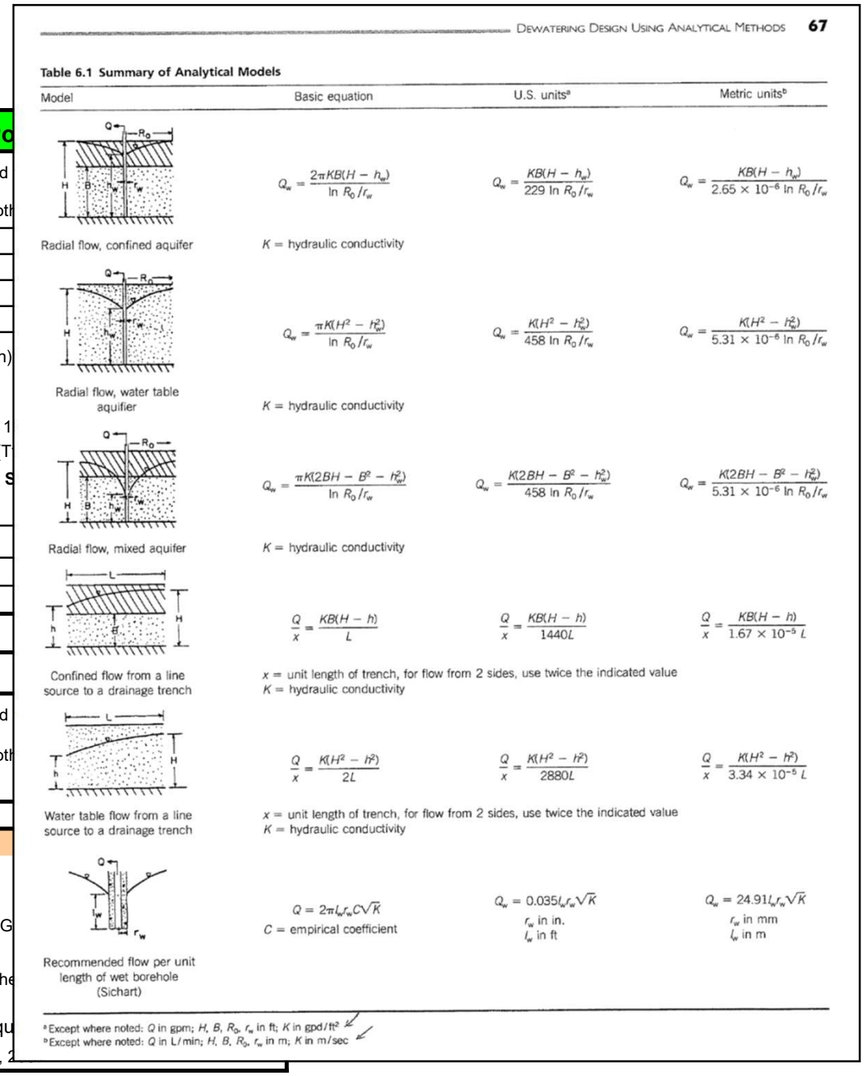
Equivalent Radius Approximation

Circular System **$r_s = (ab/\pi)^{\wedge 0.5}$** <--- Circular system with aspect ratio a/b close to 1[Figure 6.7(a), p-70, Construction Dewatering & G Powers et al].

Rectangular System **$r_s = a+b/\pi$** <--- Where the system is rectangular with unequal dimensions of length 'a' and width 'b' and when the 6.7(b), p-70, Construction Dewatering & Groundwater Control, 3rd Ed, 2007, Powers et al].

If the well array is as shown in Fig. 6.7 substitute r_w with r_s and use the equation for radial flow shown above based on confined or unconfined aqu

Where the aspect ratio is > 1.5 or large and the well array is double sided as shown in Fig. 6.8, use the equations 6.10a nd 6.10b shown on p. 71 of Powers et. al., 2



DEWATERING DESIGN USING ANALYTICAL METHODS 67

Table 6.1 Summary of Analytical Models

Model	Basic equation	U.S. units[a]	Metric units[b]
Radial flow, confined aquifer	$Q_w = \frac{2\pi KB(H-h_w)}{\ln R_0/r_w}$	$Q_w = \frac{KB(H-h_w)}{229 \ln R_0/r_w}$	$Q_w = \frac{KB(H-h_w)}{2.65\times10^{-6} \ln R_0/r_w}$
Radial flow, water table aquifer	$Q_w = \frac{\pi K(H^2-h_w^2)}{\ln R_0/r_w}$	$Q_w = \frac{K(H^2-h_w^2)}{458 \ln R_0/r_w}$	$Q_w = \frac{K(H^2-h_w^2)}{5.31\times10^{-6} \ln R_0/r_w}$
Radial flow, mixed aquifer	$Q_w = \frac{\pi K(2BH-B^2-h_w^2)}{\ln R_0/r_w}$	$Q_w = \frac{K(2BH-B^2-h_w^2)}{458 \ln R_0/r_w}$	$Q_w = \frac{K(2BH-B^2-h_w^2)}{5.31\times10^{-6} \ln R_0/r_w}$
Confined flow from a line source to a drainage trench	$\frac{Q}{x} = \frac{KB(H-h)}{L}$	$\frac{Q}{x} = \frac{KB(H-h)}{1440L}$	$\frac{Q}{x} = \frac{KB(H-h)}{1.67\times10^{-5}L}$
Water table flow from a line source to a drainage trench	$\frac{Q}{x} = \frac{K(H^2-h^2)}{2L}$	$\frac{Q}{x} = \frac{K(H^2-h^2)}{2880L}$	$\frac{Q}{x} = \frac{K(H^2-h^2)}{3.34\times10^{-5}L}$
Recommended flow per unit length of wet borehole (Sichart)	$Q = 2\pi l_w r_w C\sqrt{K}$ C = empirical coefficient	$Q_w = 0.035 l_w r_w \sqrt{K}$ r_w in in. l_w in ft	$Q_w = 24.91 l_w r_w \sqrt{K}$ r_w in mm l_w in m

For all models: x = unit length of trench, for flow from 2 sides, use twice the indicated value; K = hydraulic conductivity

[a] Except where noted: Q in gpm; H, B, R_0, r_w in ft; K in gpd/ft²
[b] Except where noted: Q in L/min; H, B, R_0, r_w in m; K in m/sec

Figure 6.7

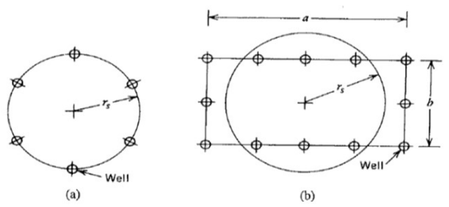


Figure 6.7 Approximation of equivalent radius r_s (a) Circular systems. (b) Rectangular systems.

Figure 6.8

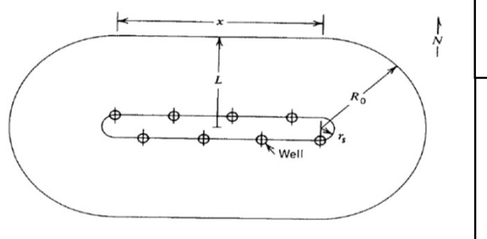


Figure 6.8 Approximate analysis of long, narrow systems.

Equations 6.10a and 6.10b

$$Q = \frac{2\pi KB(H-h)}{\ln R_0/r_s} + 2\left[\frac{xKB(H-h)}{L}\right] \quad (6.10a)$$

$$Q = \frac{\pi K(H^2-h^2)}{\ln R_0/r_s} + 2\left[\frac{xK(H^2-h^2)}{2L}\right] \quad (6.10b)$$

Table DW-1: Summary of Short- Term Construction Dewatering and and Long-Term Drainage Volume, 1740-1760 St Laurent Blvd., Ottawa, ON

REFERENCE AREA	Towers 1 and 2 P3 1740-1760 St Laurent Blvd	Towers 3 and 4 P2 1740-1760 St Laurent Blvd
DEWATERING SYSTEM CONFIGURATION =	Linear dewatering system High end K	Linear dewatering system High end K
Aquifer Type =	Confined	Confined
Foundation Elevation (assumed) =	60.11	63.11
Active Dewatering Segment Length (m) =	295	355
Aquifer Top Elevation (masl) =	64.2	64.2
Aquifer Bottom Elevation (masl) =	59	59
K (m/day) =	0.5403	0.5403
K (m/sec) =	6.25E-06	6.25E-06
Initial GW Elevation (masl) =	67.8	67.8
GW Elevation at Invert (masl) =	59.61	62.11
Drawdown (m) =	8.19	5.69
Excavation Bottom Elevation (masl) =	59.61	62.11
Target GW Elevation (masl) =	59.61	62.11
Ro from Sichart & Kryieleis (1982) =	61	43
Zone of Influence (m) =	61	43
Radius of the well rw =	0.25	0.25
Storage Coefficient 'S' =	0.005	0.005
Pumping Duration 't' in days =	3	3
rw (m) =	0.25	0.25
Initial State Distance of Influence 'L' in m =	58	56
t (day) =	3	3
S =	0.005	0.005
ESTIMATED INITIAL STATE =	246,690	126,470
PTTW Category =	EASR	EASR
STEADY STATE/LONG-TERM DRAINAGE RATE=	162,815	83,470
Maximum Dewatering Rate (excludngStormwater) (LPD) =	373,160	
Stormwater Volume from 17.8 mm of rainfall over a 10-min interval from a 10-yr storm event =	81,560	132,610
Total Volume for each Excacavtion Area (includes Stormwater) (LPD) =	328,250	259,080
Total without Stormwater Voume (LPD) =		
Maximum Total Permit Application Dewatering Rate (inc. Stormwater) (LPD) =	587,330	