1600 Kern's Road, Burlington, Ontario

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Hydrogeological and Water Balance Investigation

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by Fieldgate Properties Limited. to prepare a Hydrogeological and Water Balance Investigation Report associated with the proposed development located at 1600 Kern's Road, Burlington, Ontario (hereinafter referred to as the 'Site').

The Site is currently occupying an area of approximately 0.75 hectares ("1.9 acres) that includes a developed single storey multi-unit commercial building. It is our understanding that the proposed development plan is to demolish the existing building and construct a proposed four (4) storey residential development with a single basement level (P1). The Site location plan is shown on Figure 1.

As underground parking is proposed, Halton Conservation (CH) requires a hydrogeological investigation to ensure the development will not impact Upper Hager Creek that runs just inside a part of the western boundary of the Site. The hydrogeological and water balance report has been prepared to satisfy the requirements of CH's. "Requirements of completion of hydrogeological studies to facilitate Conservation Halton's review, November 2014".

The Site is located outside the highly vulnerable areas, significant groundwater recharge area and wellhead protection areas mapped by the Conservation Halton.

EXP conducted a Geotechnical and Environmental Subsurface Investigation (EXP, 2018) for the Site where two (2) monitoring wells were installed as part of the investigation. Watters Environmental Group Inc conducted a Phase II Environmental Site Assessment (Watters, 2019) for the Site where three (3) monitoring wells were installed as part of the investigation. The pertinent information gathered from the noted investigations is utilized for this report.

1.2 Project Objectives

The objective of the Hydrogeological Investigation is to investigate the hydrogeological conditions at the Site to support the Ministry of the Environment, Conservation and Parks (MECP) technical requirements for water taking and permit applications and requirements of Conservation Halton.

The main objectives of the Hydrogeological and Water Balance Investigation are as follows:

- Establish local hydrogeological setting within the Site;
- Assess construction dewatering flow rates and potential impacts;
- Provide recommendations on long term groundwater management;
- Assess surface water / groundwater interaction.
- Pre and post development water balance assessment;
- Assess soil percolation/infiltration rates to support design of Low Impact Development Measures; and,
- Prepare the Hydrogeological and Water Balance Report.

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;
- Drilled and installed one (1), 2" diameter monitoring well to an approximate depth of 8 meter below ground surface (mbgs) at the proposed location for storm chamber;
- Developed and conducted Single Well Response Tests (SWRT) on six (6) monitoring wells to assess hydraulic properties of the saturated soils at the foundation level of the proposed building at the Site;
- Conducted one (1) infiltration / percolation rate test by predrilling with a drill rig machine at a selected location at a maximum depth of approximately 3.5 mbgs, which is the proposed depth of storm chamber;
- Completed two (2) rounds of groundwater level measurements at all monitoring wells;
- Collected one (1) groundwater sample for analyses of parameters, as listed in the City of Burlington / Regional Municipality of Halton Sanitary and Storm Sewer Use By-Law;
- Evaluated the information collected during the field investigation program, including borehole geological information, Water Well Records (WWR), SWRT results and groundwater water quality;
- Carry out pre and post water balance analysis;
- Assessed Low Impact Development (LID) areas. The LIDs have been sized based on the infiltration test result and post development water balance deficit;
- Prepared site plans, cross sections, geological mapping and groundwater contour mapping for the Site;
- Provided estimate of construction dewatering flow rates (Short Term);
- Provided preliminary estimates of sub-drain discharge volumes (Long Term);
- Provided recommendations on the Ministry of Environment, Conservation and Parks (MECP) Water Taking Permits and City of Burlington / Regional Municipality of Halton Sewer Discharge Agreements (SDA) for the construction and post-construction phases;
- Assessed potential impacts and recommend mitigation measures;
- Prepared a Hydrogeological and Water Balance Investigation Report including Water Balance assessment.

Please note that the foundations drain analysis will provide preliminary flow rates estimates based on analytical methods. Actual flow rate measurements of the sump discharge, once it is built, will be required to confirm these flow rate estimates for permitting purposes.

The Hydrogeological and Water Balance Investigation was prepared in accordance with the Ontario Water Resources Act Ontario Regulation 387/04. The scope of work outlined above was made to assess dewatering and did not include a review of Environmental Site Assessments (ESA).

1.4 Review of Previous Reports

The following reports were reviewed as part of this Hydrogeological and Water Balance Investigation:

- Watters Environmental Group Inc. (2020), Phase Two Environmental Site Assessment, 1600 Kerns Road, Burlington, ON, prepared for FGL Kerns Inc.
- Watters Environmental Group Inc. (2020), Phase One Environmental Site Assessment, 1600 Kerns Road, Burlington, ON, prepared for FGL Kerns Inc.
- EXP Services Inc. (2018), Geotechnical Investigation, 1600 Kerns Road, Burlington, ON, prepared for Fieldgate Properties Limited.
- EXP Services Inc. (2018), Environmental Subsurface Investigation, 1600 Kerns Road, Burlington, ON, prepared for Fieldgate Properties Limited.

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is within a physiographic region known as the Niagara Escarpment. The physiographic landform is named Escarpments (Chapman and Putnam, 1984).

The Niagara Escarpment extends from the Niagara River to the northern tip of the Bruce Peninsula, and continues through the Manitoulin Islands. (Chapman and Putnam, 1984). The noted escarpment topography primarily consists of vertical cliffs and valleys with rock-hewn red shale and dolostone non-glacial regions (Chapman and Putnam, 1984). The site sits along the edge of the Niagara Escarpment between the Dundas Valley to the south and Forks of Credit to the north, consisting of numerous creeks and valleys with alternate layers of sand and silty clay to red shale. (Chapman and Putnam, 1984).

2.1.2 Regional Geology and Hydrogeology

The surficial geology can be described as Glaciolacustrine-derived Silty to Clayey Silt on the north eastern section of the site and Paleozoic bedrock on the south western section of the site (Ontario Geological Survey, 2010). The surficial geology of the Site and surrounding areas is shown on Figure 2.

Upper Hager Creek is located west of the site. The Creek flows in a southerly direction. Based on the flow of the nearby creeks, the local groundwater flow inferred direction is south/southwest. Local deviation from the regional groundwater flow pattern may occur in response to changes in topography and/or soils, as well as the presence of surface water features and/or existing subsurface infrastructure.

2.1.3 Existing Water Well Survey

Water Well Records (WWRs) were compiled from the database maintained by the Ministry of the Environment, Conservation and Parks (MECP) and reviewed to determine the number of water wells documented within a 500-m radius of the Site boundaries. The locations of the MECP WWRs within 500 m of the Site are shown on Figure 3. A summary of the WWR is included in Appendix A.

The MECP WWR database indicates that two (2) records are within a 500 m radius from the Site centroid (Figure 3 and Appendix A).

The database indicates that the offsite wells are at an approximate distance of three hundred and forty-three (343) m or greater from the Site centroid. All offsite wells were reportedly identified as monitoring well / test hole.

2.2 Site Setting

2.2.1 Site Topography

The Site is in an urban area. The topography has a relatively flat gradual south slope towards Lake Ontario. The west section of the site steeply slopes down towards the Upper Hager Creek.

As indicated on the borehole logs included in Appendix B, the surface elevation of the Site ranges between approximately 127.86 to 138.92 meters above sea level (masl).

2.2.2 Local Surface Water Features

The Site is located within the North Shore watershed. Upper Hager Creek runs just inside a part of the western boundary of the Site. The Creek flows south to Lake Ontario. Lake Ontario is approximately 3.7 km south from the Site boundary.

2.2.3 Local Geology and Hydrogeology

A summary of subsurface soil stratigraphy is provided in the following paragraphs. The soil descriptions are based on the reports Geotechnical Investigation (EXP, 2018). They are summarized for the hydrogeological interpretations. As such, the information provided in this section shall not be used for construction design purposes.

The detailed soil profiles encountered in each borehole and the results of moisture content determinations are presented on the attached borehole logs (Appendix B). The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the Hydrogeological and Water Balance Investigation and shall not be interpreted as exact planes of geological change.

The "Notes on Sample Description" preceding the borehole logs form an integral part of and should be read in conjunction with this report. The following is a brief description of the soil conditions encountered during the investigation.

Based on the results from the above reports, the general subsurface soil stratigraphy consists of the following units from top to bottom:

Asphalt and Topsoil

A layer of asphalt was observed at boreholes BH 1 to BH 6, BH101, BH102, BH19-01 to BH 19-07 and BH/MW 1001 to approximately 0.15 m bgs.

A granular base was encountered below the asphalt to approximately 0.40 m bgs.

Fill

Reworked fill was encountered at boreholes BH/MW 1001, BH101, BH102, BH19-01(MW), BH19-03, BH 1 and BH6, directly beneath the asphalt and granular base. The fill generally consisted of clayey silt and was observed to depths between 0.21 and 11.2 m bgs.

Landfill Material

Landfill material was encountered to a maximum depth between approximately 3.1 to 11.2 m bgs in BH101, BH102, BH19-01 and BH 19-03. The fill generally consisted of sand, gravel, glass, brick, ceramics, and other solid waste materials.

Clayey Silt Till

Deposits of Clayey Silt Till were encountered in all boreholes. Till was observed at a depth between approximately 0 to 11.8 m bgs.

Shale Bedrock

Weathered shale was encountered below Clayey Silt Till deposits in BH 1, BH19-01 and BH102 at approximately 9.4 to 11.8 m bgs. The elevation for the bedrock encountered at each borehole is presented in the individual borehole logs.

The borehole and monitoring well locations are shown on Figure 4. Geological cross-sections were generated based on the available borehole logs completed as part of the previous and current investigations and shown on Figure 5 (Cross section A-A'). Borehole logs used to generate both cross-sections are provided in Appendix B.

3 Results

3.1 Monitoring Well Details

The monitoring well network was installed as part of the Hydrogeological, Geotechnical and Environmental Investigation at the Site. It consists of the following:

- One (1) overburden monitoring well (BH/MW 1001) was installed by EXP in January 2021;
- Three (3) overburden monitoring wells (BH 19-01, BH 19-02, BH19-04) were installed by Watters Environmental Group Inc. in 2020; and,
- Two (2) overburden monitoring wells (BH 5 and BH 6) were installed by EXP in 2018.

The diameter of all monitoring wells is 50 mm. All wells were installed with a flush mount protective casing. Borehole logs and monitoring well installation details are provided in Appendix B. The monitoring well locations are shown on Figure 4.

3.2 Water Level Monitoring

As part of the Hydrogeological and Water Balance Investigation, static water levels in the monitoring wells installed outside of the existing building were recorded in three (3) monitoring events, including January 26, February 5 and February 11, 2021. A summary of all static water level data as it relates to the elevation survey is given in Table 3-1 below.

The groundwater elevation recorded in the wells ranged from 129.68 masl (7.90 mbgs at BH 6 on January 26, 2021) to 136.32 masl (2.43 mbgs at BH19-04 on January 26, 2021).

Table 3-1: Summary of Measured Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (masl)	Approximate Full Well Depth (mbgs)	Unit	26-Jan-21	5-Feb-21	11-Feb-21
EXP - 2021						
BH/MW 1001	136.47	7.60	mbgs	Dry	2.14	2.47
			masl	-	134.33	134.01
EXP - 2018						
BH 5	138.16	9.14	mbgs	2.84	2.93	3.04
			masl	135.32	135.23	135.13
BH 6	137.58	7.90	mbgs	7.90	3.77	3.81
			masl	129.68	133.81	133.78
Watters Environmental Group Inc. - 2020						
BH/MW 19-01	138.57	6.05	mbgs	4.73	4.75	4.79
			masl	133.85	133.82	133.79
BH/MW 19-02	137.31	8.20	mbgs	3.36	3.57	3.86

Monitoring Well ID	Ground Surface Elevation (masl)	Approximate Full Well Depth (mbgs)	Unit	26-Jan-21	5-Feb-21	11-Feb-21
			masl	133.95	133.75	133.45
BH/MW 19-04	138.74	9.70	mbgs	2.43	2.78	3.18
			masl	136.32	135.97	135.57

Notes:
mbgs - meters below ground surface
masl - meters above mean sea level

A map was created for the Site to show groundwater contours for the overburden (Figures 6). Accordingly, the groundwater flow direction in the overburden is interpreted to be towards southwest of the Site, towards Upper Hager Creek.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions. This may also affect the direction and rate of flow. It is recommended to conduct seasonal groundwater level measurements to provide more information on seasonal groundwater level fluctuations.

3.3 Hydraulic Conductivity Testing

Six (6) Single Well Response Tests (SWRT's) were completed on monitoring wells BH 5, BH 6, BH 19-01, BH 19-02 and BH19-04 on January 26, 2021 and on monitoring wells BH/MW 1001, BH 5 and BH19-01 on February 4, 2021. The tests were completed to estimate the saturated hydraulic conductivity (K) of the soils at the well screen depths.

The static water level within each monitoring well was measured prior to the start of testing. In advance of performing SWRTs, each monitoring well underwent development to remove fines introduced into the screens following installation. The development process involved purging of the monitoring wells to induce the flow of fresh formation water through the screen. Each monitoring well was permitted to fully recover prior to performing SWRTs.

Hydraulic conductivity values were calculated from the SWRT and constant rate test data as per Hvorslev's solution included in the Aqtesolv Pro. V.4.5 software package. The semi-log plots for normalized drawdown versus time are included in Appendix C.

A summary of the hydraulic conductivities (K-values) estimated from the SWRTs are provided in Table 3-2.

Table 3-2: Summary of Hydraulic Conductivity Testing

Monitoring Well	Monitoring Well Depth (mbgs)	Screen Interval (mbgs)		Formation Screened	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH/MW 1001	7.60	4.60	7.60	Clayey Silt Till	8.7E-09
BH 5	9.14	6.14	9.14	Clayey Silt Till	1.1E-08
BH 6	7.90	4.90	7.90	Clayey Silt Fill / Clayey Silt /Sand and Gravel Layers (Creek bed deposits)	6.6E-05
BH 19-01	6.05	3.05	6.05	Clayey Silt Fill with Sand	3.1E-05
BH 19-02	8.20	5.20	8.20	Clayey Silt	2.7E-08
BH 19-04	9.70	6.70	9.70	Clayey Silt	1.5E-08
				Highest Estimated K Value	6.6E-05
				Geometric Mean of Estimated K Values	2.1E-07
				Weighted Average of K Values for fill and sand	1.1E-05

SWRTs provide K-estimates of the geological formation surrounding the well screens and may not be representative of bulk formation hydraulic conductivity. As shown in Table 3-2, the highest K-value of the tested water-bearing zone is 6.6E-5 m/s, and the geometric mean of the K-values is 2.1E-7 m/s.

Since the sandy formation was encountered in the western portion of the Site, the weighted average of sandy formation and till formations, 1.1E-05 m/s was used for dewatering rate estimates.

3.4 Groundwater Quality

To assess the suitability for discharging pumped groundwater into the sewers owned by the City of Burlington / Regional Municipality of Halton during dewatering activities, one (1) groundwater sample was collected from monitoring well BH 19-02 on February 5, 2021 using a peristaltic pump.

Prior to collecting the noted water sample, approximately three (3) standing well volumes of groundwater were purged from the referred well. The samples were collected unfiltered and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling. The groundwater samples were submitted for analysis to Bureau Veritas Laboratory, a CALA certified independent laboratory in Mississauga, Ontario. Analytical results are provided in Appendix D.

When comparing the chemistry of the collected groundwater samples to the Regional Municipality of Halton Storm, Sanitary and Combined Sewer Discharge Criteria (Table 1 and Table 2), there were no parameter exceedances to be reported.

Reporting detection limits (RDLs) were below the Sewer Use By-Law parameter criteria of Tables 1 and 2.

Phase Two Environmental Site Assessment (2018) by EXP was reviewed for exceedances in groundwater samples taken from the Site. Two (2) groundwater samples from two (2) monitoring wells (BH5 and BH6) were collected for groundwater analysis. When comparing the chemistry of the collected groundwater samples to the Halton Storm, Sanitary and Combined Sewer Discharge Criteria (Table 1 and Table 2), there were no parameter exceedances to be reported. Analytical results are provided in Appendix D.

For the short-term dewatering system (construction phase), it is anticipated that 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 treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system.

For the long-term dewatering discharge to the City of Burlington / Regional Municipality of Halton storm, sanitary and combined sewer system (post-development phase) and based on the water quality test results, the water is suitable to be discharged without a treatment system.

For the long-term dewatering discharge to the storm sewer system (post-development phase) and based on the water quality results, the water is suitable to be discharged without a treatment system. However, additional water quality testing may be required depending on the receiving water body.

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 Burlington / Regional Municipality of Halton will be required prior to releasing dewatering effluent.

3.5 Infiltration Rate Testing Results

EXP completed one (1) infiltration rate tests (IT 1) at the proposed location for the infiltration facility, within the Site area on January 20, 2021. This test was conducted in proximity of selected monitoring well BH/MW 1001.

Infiltration test (IT) were conducted in boreholes at depths ranging from approximately 3.5 mbgs, depending on the measured groundwater elevation at the testing location.

The stratigraphy encountered in the shallow subsurface is comprised of a sandy silt till matrix. Table 3.3 shows the summary of field saturated hydraulic conductivity (K) testing and design infiltration rates as per the Low Impact Development (LID) Stormwater Management Planning and Design Guide, CVC – TRCA, 2010, Appendix G. The estimated field saturated hydraulic conductivities were correlated to infiltration rates based on the approximate relationship provided in Appendix D of the guideline.

Infiltration rate testing locations are shown on Figure 4 and infiltration rate analysis is provided in Appendix E.

Table 3.3: Summary of Infiltration Testing Results

Infiltration Test Location/ MW ID	Depth of Hole (mbgs)	Formation tested	Field Saturated Hydraulic Conductivity, K_{fs} (m/s)	Infiltration Rates (mm/hr)
INF 1	3.2	Clayey Silt	9.4×10^{-8}	25
		Design Infiltration Rate*		**5**

Notes:
*Safety Factor of 4.5 was applied to calculate the design infiltration rate (Low Impact Development (LID) Stormwater Management Planning and Design Guide, CVC – TRCA, 2010, Appendix D).

The estimated design infiltration rate based on percolation rate testing for the Site is 5 mm/hr (Appendix E).

4 Water Balance Study

4.1 Background Information

It is our understanding that the proposed development plan is to demolish the existing building and construct a proposed three (3) to four (4) storey residential condominium development with a single basement level (P1). The Site location plan is shown on Figure 1.

The Site is in an urban area. The topography has a relatively flat gradual south slope towards Lake Ontario. The west section of the site steeply slopes down towards the Upper Hager Creek.

The surficial geology can be described as Glaciolacustrine-derived Silty to Clayey Silt on the north eastern section of the site and Paleozoic bedrock on the south western section of the site (Ontario Geological Survey, 2010). The surficial geology of the Site and surrounding areas is shown on Figure 2.

Upper Hager Creek is located on the western border of the site. The Creek flows in a southerly direction. The shallow groundwater elevations reflect a general southwestern groundwater flow direction, towards Upper Hager Creek located near the western boundary of the Site.

4.2 Methodology

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method used to analyze the allocation of water among various components of the hydrologic cycle. This methodology was used to complete the pre-construction (existing conditions) and post-development water balance. Inputs to the model are monthly temperature, precipitation and Site latitude. Outputs include monthly potential and actual evapotranspiration, soil moisture storage, soil moisture storage change, surplus, infiltration and runoff.

When precipitation (P) occurs, it can either runoff (R) through the surface water system, infiltrate (I) to the water table including an interflow component, or evapotranspiration (ET) from the earth's surface and vegetation. The difference between total precipitation (P) and the total of evaporation and evapotranspiration (ET) is defined to be the water surplus (S) which is available for both infiltration (recharge to the groundwater system including interflow) and for runoff. When long-term averages of P, R, I and ET are used, there is no net change in groundwater storage (ST). Annually, however, there is a potential for small changes in ST.

The annual water budget can be stated as follows:

$$P = ET + R + I + ST$$

Where:

P = precipitation
ET = evapotranspiration
R = surface water runoff
I = Infiltration
ST = change in groundwater storage

For this assessment, the Thornthwaite and Mather method was used to estimate average annual infiltration rates.

Infiltration is governed by the surficial soil types, topography and land cover.

For ease of calculation, a spreadsheet model was used for the computation. The Thornthwaite and Mather Model is based on the United Stated Geological Survey (USGS) graphical user interface (Thornthwaite Monthly Water-Balance program, 2007).

4.3 Meteorological Data

Meteorological data including average monthly precipitation and average temperatures were obtained from the National Climate Data and Information Archive (Environment Canada) for the Hamilton Airport (Station ID No. 6153194), which is the closest climate station to the Site having continues 30-year meteorological data.

Climate stations Hamilton RBG and Hamilton RBG CS are located closer than the Hamilton Airport climate station, however these two stations do not have 30-year climate data posted.

Meteorological data for 30 years from 1980 to 2010 was utilized for the assessment. Summary of input data is provided in Appendix F-1.

4.4 Pre- and Post-Development Site Characteristics

4.4.1 Pre-Development Site Characteristics

A summary of the existing (pre-development) landscape features is provided in Table 4.1:

Table 4.1: Pre-Development (Existing) Land Use

Description	Pre-Construction (Existing) (m^2)	Percentage (%)
Total Site Area	8,000	100
Existing Buildings	1,900	23.75
Paved Surfaces	3,200	40.00
Landscaped Area	1,000	12.50
Woodlot	1,700	21.25
Surface Water (Upper Hager Creek)	200	2.50
Site Area Available for Infiltration Contribution	2,700	33.75

It should be noted that the areas provided in Table 4.1 above were determined based on a review of available Site plans and these estimates are considered appropriate for estimating the water balance.

As evident from the information provided in Table 4.1, under pre-development conditions, approximately 33.75% of the Site area is pervious and available for groundwater infiltration (Figure 7).

4.4.2 Post-Development Site Characteristics

As provided in draft Site Plan, Table 4.2 provides a summary of the post-development Site characteristics.

Table 4.2: Post-Development Site Characteristics

Description	Impervious Areas (ex: Buildings, Roads) m^2	Pervious Areas / Areas available for Infiltration m^2	Total Areas Post-Construction (Proposed) m^2
ROW (roads, sidewalks, parking)-paved	1,200	0	1,200
Building Roofs (Condominium Building)	2,930	0	2,930
Landscaped	0	1,970	1,970
Woodlot	0	1,700	1,700
Surface Water (Upper Hager Creek)	200	0	200
Totals	**4,330**	**3,670**	**8,000**

Note: Full basement area is included in the areas identified as impermeable

Under post-development conditions, the total pervious area is increased to 45.9% of the total Site area (Figure 8).

4.5 Pre-Development Water Balance Estimates

4.5.1 Climate Data Analysis

The mean annual water surplus was calculated by using the Thornthwaite and Mather (1955) method. Monthly average precipitation values were obtained for 30 years (1980 to 2010) from the National Climate Data and Information Archive (Environment Canada) for the Hamilton A (Station ID No. 6153194). Hamilton Airport is approximately 20 km away from the Site.

Moisture storage of 200 mm/yr was assumed for soils and considered to be representative of pre-construction Site conditions. The closest Latitude to the Site is 43^0, which was used in the USGS model (2007).

Table 4.3 summarizes the climatic water balance analysis. Appendix F-1 and F-2 provide the model input and output, respectively.

Table 4.3: Summary of Climatic Water Balance Analysis in Pre-Development Conditions

Soil Moisture Storage (mm/yr)	Precipitation (mm/yr)	Actual ET (mm/yr)	Surplus (mm/yr)
200 mm/yr Clayey Silt	928.1	564.8	363.3

Note: ET = Evapotranspiration

The results of climatic water balance analysis for the Site suggest that a surplus of 363.3 mm/year of water is available for surface runoff and infiltration.

4.5.2 Infiltration

The infiltration is expected to be controlled by soil type, topography and soil cover type. Surplus water is portioned between runoff and infiltration based on the controlling factors provided by MOE (1995). It is noted that the controlling factors provided by the MOE were used for estimating infiltration factors.

Using this method, a total infiltration factor for the Site was estimated by using the individual sub-factors, which are representative of the topography, soil type and land cover conditions (Figures 2, 9A and 9B). Appendix H-3 provides a summary of the sub factors and total factor based on the Site conditions. The infiltration sub-factors were determined for estimating pre-development infiltration rates of the entire Site.

The estimated pre-development total infiltration factor of 0.323 (or 32.3 %) represents the fraction of the water surplus available for infiltration. The complementary fraction of the available water for runoff is 0.677. The infiltration factor is utilized to calculate the amount of annual infiltration (in units of m^3/yr) at the Site by multiplying it with the average yearly water surplus estimate and with the Site area available for infiltration.

Applying the infiltration factor of 0.323 and a water surplus of 363.3 mm/yr, the estimated pre-development infiltration rate of the whole Site is 117.35 mm/yr.

In areas with water table at surface, the infiltration rate was considered negligible for existing and proposed grade.

5 Pre-Development Water Balance Analysis

The water balance analysis is based on available information on a regional scale and considered representative for the Site. Table 5.1 provides a summary of water balance analysis for the Site.

Table 5.1: Summary of Overall Pre-Development Water Balance Results

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Total Precipitation (m^3/yr)	Actual Evapotranspiration (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)
Total Site	8,000	2,700	7,425	1,711	5,397	317
Percentage of Total Precipitation			100%	23.0%	72.7%	4.3%

The total property area was used to estimate the annual precipitation volume for the Site (Appendix H-4). As summarized in Table 5.1, the breakdown of the pre-development water balance is as follows: 23.0% of the total precipitation will be subject to evapotranspiration, 72.7% to runoff and 4.3% to infiltration.

The pre-development water balance, on a weighted average depth basis (in mm) is as follows:

P (928.10) = ET (564.80) + R (245.95) + I (117.35) + ST (0).

5.1 Post-Development Water Balance Estimates

5.1.1 Post-Development Water Balance

Based on the proposed development drawings, the total area of impervious surfaces under post-development conditions is approximately 4,330 m^2, representing approximately 54.1% of the Site area (total site area: 8,000 m^2), (Table 4.2). The remaining 3,670 m^2 is available to contribute to infiltration during the post-development stage (approximately 45.9% of the total land area).

Post-development infiltration sub-factors were determined in a similar manner as for estimating infiltration sub-factors for pre-development Site conditions, both based on the method recommended by MOE (1995). For post-development infiltration sub-factors, the landscaped areas were assumed to be consistent with cultivated cover with an infiltration sub-factor of 0.1 (Appendix F-3).

Table 5-2 presents a summary of the overall post-development water balance assessment.

Table 5-2: Summary of Overall Post-Development Water Balance Forecast

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Total Precipitation (m^3/yr)	Evapo-transpiration (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)
Total Site	8,000	3,670	7,425	2,259	4,712	455
Percentage of Total Precipitation			100%	30.4%	63.5%	6.1%

If no remedial measures are implemented to maintain infiltration, it is expected that the annual infiltration volume will be increased from approximately 317 m^3/yr to 455 m^3/yr in post-development, resulting in an excess of 138 m^3/yr (Appendix F-4).

Infiltration deficits based on pre- and post-development Site conditions can be utilized to guide mitigation measures under idealized soil and groundwater conditions. Due to the increase of areas available for infiltration by approximately 970 m^2, it is expected that the unmitigated infiltration rate increase of 138 m^3/yr can be maintained under the post-development Site conditions under sound conditions.

Under unmitigated post-development conditions, an increase in annual infiltration volume may occur, as compared to pre-development conditions. As a result, water contribution from infiltration to downgradient surface water features would increase.

5.2 Impact and Proposed Mitigation Measures

As shown in Appendix F-4, Due to the increase of areas available for infiltration by approximately 970 m^2, it is expected that the unmitigated infiltration rate increase of 138 m^3/yr can be maintained under the post-development Site conditions under sound conditions.

Due to the increase of groundwater infiltration during the post development phase of the project, compared to the pre-development groundwater infiltration rate, there will be no decrease in the groundwater discharge rates at the Upper Hager Creek.

Since the groundwater infiltration rate under the post development conditions is increased compared to the groundwater infiltration during the pre-construction phase, additional mitigation measures may not be required.

6 Construction Dewatering Assessment

It is our understanding that the proposed development plan is to construct a proposed three (3) to four (4) storey residential condominium development with a single basement level (P1). The Site location plan is shown on Figure 1.

As available information, EXP understands a caisson wall system will be installed covering the northern portion of the excavation.

Table 6-1 presents the assumptions used to calculate the dewatering rate for the Site.

Table 6-1 Dewatering Estimate Assumptions

Input Parameter	Assumption	Units	Notes
Ground Surface Elevation	139.0	masl	Approximate elevation based on the borehole logs and Site
Groundwater elevation	137.3	masl	The highest recorded groundwater elevation measured across the Site plus 1 meter to account for some seasonal fluctuation
Top of Slab Elevation	135.5	masl	Based on Concept Architectural Drawings (November 26, 2020)
Lowest Footing Elevation	134.0	masl	Assumed to be approximately 1.5 m below the top of slab elevation
Dewatering Target Elevation	133.0	masl	Assumed to be approximately 1.0 m below the lowest footing elevation
Bottom Elevation of Water-Bearing Zone	130.0	masl	Assumed
Excavation Area (Length x Width)	2,500 (50 x 50)	m^2 (m x m)	Approximate area (length x width) of Site for the proposed development (simplified)
Hydraulic Conductivity (K)	1.1E-05	m/s	Weighted Average of K values for sand and till formations

6.1 Dewatering Flow Rate Estimate and Zone of Influence

The Dupuit-Forcheimer equation for radial flow to both sides of an excavation through an unconfined aquifer resting on a horizontal impervious surface was used to obtain a flow rate estimate. Dewatering flow rate is expressed as follows:

$$Q_w = \frac{\pi K (H^2 - h^2)}{Ln\left[\frac{R_o}{r_e}\right]}$$

$$r_e = \frac{a+b}{\pi}$$

$$R_o = R_{cj} + r_e$$

Where:

Qw = Rate of pumping (m3/sec)
X = Length of excavation (m)
K = Hydraulic conductivity (m/sec)
H = Hydraulic head beyond the influence of pumping (static groundwater elevation) (m)
h = Hydraulic head above the base of aquifer in an excavation (m)
R0 = Radius of Influence (m)
Rcj = Cooper Jacob Radius of Influence (m)
re = Equivalent perimeter (m)
a = Length of the excavation area (m)
b = Width of the excavation area (m)

It is expected that the initial dewatering rate will be higher to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint as groundwater will have been removed, primarily from storage, resulting in lower seepage rates into the excavation.

6.2 Cooper-Jacob's Radius of Influence

The radius of influence (Rcj) for the construction dewatering was calculated based on Cooper-Jacob 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 formula as follows:

$$\mathrm{R}_{cj} = \sqrt{2.25KDt/s}$$

Where:

Ro = Estimated radius of influence (m)
D = Aquifer thickness (original saturated thickness) (m)
K = Hydraulic conductivity (m/sec)
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.

A 15 mm precipitation event was utilized for estimating the stormwater volume. The calculation of the stormwater volume is included in Appendix G.

The estimate of the stormwater volume only accounts for direct precipitation into the excavation. The dimensions of the excavation are considered in the dewatering calculations. Runoff from outside of the excavation's footprint is excluded and it should be directed away from the excavation.

During precipitation events greater than 15 mm (ex: 100-year storm), measures should be taken by the contractor to retain stormwater onsite in a safe manner to not exceed the allowable water taking and discharge limits, as necessary. A two (2) and a one hundred (100) year storm event over a 24-hour period are 56.2 and 122.1 mm, respectively, which would produce 449.6 and 976.8 m^3 of water.

6.4 Results of Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed construction plans include an excavation with shoring system covers the northern portion of the excavation. EXP should be retained to review the assumptions outlined in this section, should the assumed shoring design change.

Short-term (construction) dewatering calculations are presented in Appendix G.

Based on the assumptions provided in this report, the results of the dewatering rate estimate can be summarized as follows:

Table 6.2 Summary of Construction Dewatering Rate Estimates.

Peak Dewatering Flow Rate Including Rain Collection Volume and Zone of Influence	
Description	With 1 Level of Underground Parking (m^3/day)
Estimated Short Term Dewatering Rate (without safety factor)	140
From Precipitation Event of 15 mm in one day	40
Without Factor of Safety of 1.5 (including Precipitation) for designs, budgeting and permits	180
With Factor of Safety of 1.5 (including Precipitation) for designs, budgeting and permits	250
Radius of Influence (m) for the area without caisson wall	40

This peak dewatering flow rates does not account for flow from utility beddings and variations in hydrogeological properties beyond those encountered during this investigation.

It is expected that, during the construction dewatering activities, because of the proposed caisson wall system, the radius of influence in the northern portion of excavation is negligible (Appendix G).

Local dewatering may be required for pits (elevator pits, sump pits), if these extend deeper than the dewatering target. Local dewatering is not considered to be part of this assessment. Dewatering estimates should be reviewed once the pit dimensions are available.

All grading around the perimeter of the Site should be graded away from the shoring the systems. The dewatering assumptions are based on using shoring system with open cuts.

The maximum flow rate calculated with a high K-value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering.

If caisson walls are installed, these should be designed for full hydrostatic pressure for shallow and deep water levels, without dewatering on the outside. Soldier pile and lagging and caisson wall systems should be designed to account for shallow groundwater conditions and take into consideration that dewatering systems may not provide fully dewatered conditions.

If caisson walls are used for decreasing long-term dewatering rates, these should be designed as permanent structures to cutoff groundwater inflow in the long-term. All perforations should be sealed permanently (ex: tiebacks, breaches and cold joints) with no leakages and inspected. Fillers should extend into low permeability deposits (ex: sound bedrock or till) to cutoff groundwater from water bearing zones. Inspections should be conducted to confirm the depth of low permeability deposits along shoring system and that fillers are keyed into low permeability soil deposits.

All grading around the perimeter of the construction Site should be graded away from the shoring the system.

The contractor is responsible to ensure that dry conditions are always maintained within the excavation at all costs.

6.5 Construction MECP Water Taking Permit

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50 m^3/day but less than 400 m^3/day, then an online registration in the Environmental Activity and Sector Registry (EASR) with the MECP will be required. If groundwater dewatering rates onsite exceed 400 m^3/day, a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

It is recognized that the maximum flow estimate calculated with a high K-value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering. Based on the dewatering estimate of approximately 390 m^3/day for this project, an EASR will be required to facilitate the construction dewatering program of the Site.

A Discharge Plan (dewatering sketch, sewer discharge agreement) must be developed and applied for any discharges from the Site. Monitoring of both water quantity and water quality must be carried out for the entire duration of the construction dewatering phase. During this phase the Discharge Plan and the daily water taking records must be available onsite.

The EASR, Discharge Plan, hydrogeological investigation report, and geotechnical assessment of settlements must also be available at the construction Site during the entire construction dewatering. EXP should be notified immediately about any changes to the construction dewatering schedule or design, since the EASR will need to be updated to reflect these modifications. The hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitutes the Water Taking Plan which needs to be available onsite during the construction dewatering.

7 Sub-Drain Discharge Estimate

7.1 Long-Term Dewatering Rate Assessment

It is our understanding that the development plan includes a permanent foundation sub-drain system that will ultimately discharge to the municipal sewer system if conventional footings are installed.

To estimate the groundwater flow to the future sub-drain, the Dupuit-Forcheimer equation for steady-state radial flow to the entire excavation through an unconfined aquifer resting on a horizontal impervious surface was used (Section 4.1).

The calculation for the estimated flow to the future sub-drain system is provided in Appendix H. The dewatering target for the foundation drainage system is taken at 0.5 m below the lowest slab elevation.

The foundation drain analysis provides a flow rate estimate. Actual flow rate measurements of the sump discharge, once it is built, will be required to confirm these flow rates.

7.2 Sub-Drain Flow Rate Estimate

Based on the assumptions provided in this report, the estimated sub-drain discharge volumes are summarized in Appendix H. Seasonal and daily fluctuations are expected. These estimates may be affected by hydrogeological conditions beyond those encountered at this time, fluctuations in groundwater regimes, surrounding Site alterations, and existing and future infrastructures.

The long-term dewatering rates was estimated based on the installation of caisson wall along the north portion of the excavation (Appendix G).

Table 7.1: Summary of Long-Term Dewatering Rate

Long-Term Dewatering Flow Rate for P1 (m^3/day)	
Groundwater Model Estimated Long-Term Dewatering Rate	25
Long-Term Dewatering Rate with Safety Factor of 1.5 for design, budgeting and permitting	40

For the design of water foundations without perimeter and foundation drainage systems, shallower wells need to be considered to evaluate the shallow groundwater table. The hydrogeologist needs to be consulted during the design process.

Intermittent cycling of sump pumps and seasonal fluctuation in groundwater regimes should be considered for pump specifications. A safety factor was applied to the flow rate to account for water level fluctuations due to seasonal changes.

These estimates assume that pits (elevator and/or sump pits) are made as watertight structures (without drainage), if their depths extend below the dewatering target, as previously stated. The dewatering assumptions are based on without shoring system with open cuts. Open cuts can act as preferential groundwater pathways in the long-term and cause foundation drainage volumes to increase.

If caisson walls are used for decreasing long-term dewatering rates, these should be designed as permanent structures to allow for groundwater cutoff in the long-term. All perforations should be sealed permanently (ex: tiebacks, breaches and cold joints) with no leakages and inspected. Fillers should extend into low permeability deposits (ex: sound bedrock or till) to cutoff

groundwater from water bearing zones. Inspections should be conducted to confirm the depth of low permeability deposits along shoring system and that the fillers are keyed into low permeability soil deposits.

The sub-drain rate estimate is based on the assumptions outlined in this report. Any variations in hydrogeological conditions beyond those encountered as part of this investigation may significantly influence the sub-drain discharge volumes.

Once the sub-drain system is in place, it is recommended to install a flow meter at the sump(s) to record daily discharge volumes during the commissioning stage of the system.

7.3 Post-Development MECP Water Taking Permit

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50 m^3/day, then an application for a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

It is recognized that the maximum flow rate calculated with a high K-value, provides a conservative estimate to account for higher than expected flow rates during the post-development dewatering. Based on the dewatering estimate of approximately 40 m^3/day for this project, a Category 3 Permit to Take Water (PTTW) would not be required to facilitate the post-development phase.

8 Environmental Impact

8.1 Surface Water Features

The Site is located within the North Shore watershed. Upper Hager Creek runs just inside a part of the western boundary of the Site. The Creek flows south to Lake Ontario. Lake Ontario is approximately 3.7 km south from the Site boundary.

Outside the area of the proposed caisson wall, the dewatering zone of influence is expected to be negligible. For areas in the excavation without caisson wall system, the estimated maximum construction dewatering zone of influence is approximately 40 m from the site boundary. The closest distance to the Upper Hager Creek from the excavation boundary is approximately 20 m. However, the elevation of the closest stretch of Upper Hager Creek to the excavation boundary is approximately 6 m lower than the dewatering target water level elevation of 330 masl (excavation will be at least 6 m above the creek). As a result, no dewatering related impacts on Upper Hager Creek are expected during construction dewatering activities.

8.2 Groundwater Sources

Well Records from the MECP Water Well Record (WWR) Database were reviewed to determine the presence and number of water supply wells within a 500 m radius of the Site boundaries. Given that no water supply wells exist within the 500 m buffer, no dewatering related impact on water supply wells is expected in the area.

8.3 Geotechnical Considerations

As per the MECP technical requirement for EASR, the geotechnical assessment of the stability of the soils due to water taking (ex: settlement, soil loss, subsidence, etc.) is required. The water taking should not have unacceptable interference on soils and underground structures (foundations, utilities, etc.).

A letter related to geotechnical issues as it pertains to the Site is required to be completed under a separate cover.

8.4 Groundwater Quality

It is our understanding that the potential effluent from the dewatering system during the construction will be released to the municipal sewer system. As such, the quality of groundwater discharge is required to conform the City of Burlington / Regional Municipality of Halton Sewer Use By-Law.

For the short-term dewatering system (construction phase), it is anticipated that 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 treatment method be implemented (filtration or decantation facilities 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.

For the long-term dewatering discharge to the storm or sanitary sewer system (post-development phase), and based on the water quality test results, the water is suitable to be released without a treatment system.

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.

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 Burlington / Regional Municipality of Halton will be required prior to releasing dewatering effluent.

8.5 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.

9 Conclusions and Recommendations

Based on the findings of the Hydrogeological and Water Balance Investigation, the following conclusions and recommendations are provided:

- When comparing the chemistry of the collected groundwater samples to the Halton Storm, Sanitary and Combined Sewer Discharge Criteria (Table 1 and Table 2), there were no parameter exceedances to be reported.
- Based on the assumptions outlined in this report, the estimated peak dewatering pumping rate for proposed construction activities is approximately 250 m^3/day. As the dewatering flow rate estimate is between 50 and 400 m^3/day, an EASR will be required to facilitate the construction dewatering program for the Site.
- The long-term flow rate of the foundation sub-drain is estimated to be approximately 40 m^3/day. It is recommended that once the sub-drain system is in place, a flow meter be installed at the sump(s) to record daily discharge volumes during the commissioning stage of the system. Regular maintenance/cleaning of the sub-drain system is recommended to ensure its proper operation. Since the expected long-term dewatering rate is less than 50 m^3/day, MECP permitting will not be required for long-term discharge.
- The sub-drain rate estimate is based on the assumptions outlined in this report. Any variations in hydrogeological conditions beyond those encountered as part of this investigation may significantly influence the sub-drain discharge volumes. Once the sub-drain system is in place, it is recommended to install a flow meter at the sump(s) to record daily discharge volumes during the commissioning stage of the system.
- The construction dewatering and long-term estimate of sub-drain discharge volumes is based on the assumptions outlined in this report. Any variations in hydrogeological conditions beyond those encountered as part of this preliminary investigation may significantly influence the discharge volumes.
- For the short-term dewatering system (construction phase), it is anticipated that 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 treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system.
- The estimated design infiltration rate based on percolation rate testing for the Site is 5 mm/hr.
- It is expected that the annual infiltration volume will be increased from approximately 317 m^3/yr to 455 m^3/yr in post-development, resulting in an increase of 138 m^3/yr.
- Since the groundwater infiltration rate under the post development conditions is increased compared to the groundwater infiltration during the pre-construction phase, additional mitigation measures may not be required.
- For the long-term dewatering discharge to the storm or sanitary sewer system (post-development phase) and based on the water quality test results, the water is suitable to discharge without a treatment system.
- As per the MECP technical requirement for EARS, the geotechnical assessment of the stability of the soils due to water taking (ex: settlement, soil loss, subsidence etc.) is required. The water taking should not have unacceptable interference on soils and underground structures (foundations, utilities etc.). A letter related to geotechnical issues as it pertains to the Site is required to be completed under a separate cover.
- An agreement to discharge into the sewers owned by the City of Burlington / Regional Municipality of Halton will be required prior to releasing dewatering effluent.
- A Discharge Plan (dewatering sketch, sewer discharge agreement) must be developed and applied for any discharges from the Site. The Discharge Plan and monitoring for both water quantity and water quality must be carried at the Site during the entire construction dewatering phase. The daily water taking records must be maintained onsite for the entire

construction dewatering phase. The EASR, Discharge Plan, hydrogeological investigation report, and geotechnical assessment of settlements must always also be available at the construction Site for the entire construction dewatering. EXP should be notified immediately about any changes to the construction dewatering schedule or design, since EASR will need to be updated to reflect these modifications. The hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitutes the Water Taking Plan which needs to be available onsite for the duration of construction dewatering.

- 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.

The conclusions and recommendations provided above should be reviewed in conjunction with the entirety of the report. They assume that the present design concept described throughout the report will proceed to construction. This report is solely intended for the construction and long-term dewatering assessments. Any changes to the design concept may result in a modification to the recommendations provided in this report.

10 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.



Jay Samarakkody, M.Phil., P. Geo.
Senior Hydrogeologist
Environmental Services



Francois Chartier, M.Sc., P. Geo.
Head of Hydrogeology Group
Environmental Services

11 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.

Conservation Halton (November 2014). Requirements for completion of hydrogeological studies to facilitate Conservation Halton's reviews

J.P. Powers, A.B. Corwin, P.C. Schmall and W.E. Kaeck (2007). Construction Dewatering and Groundwater Control, Third Edition.

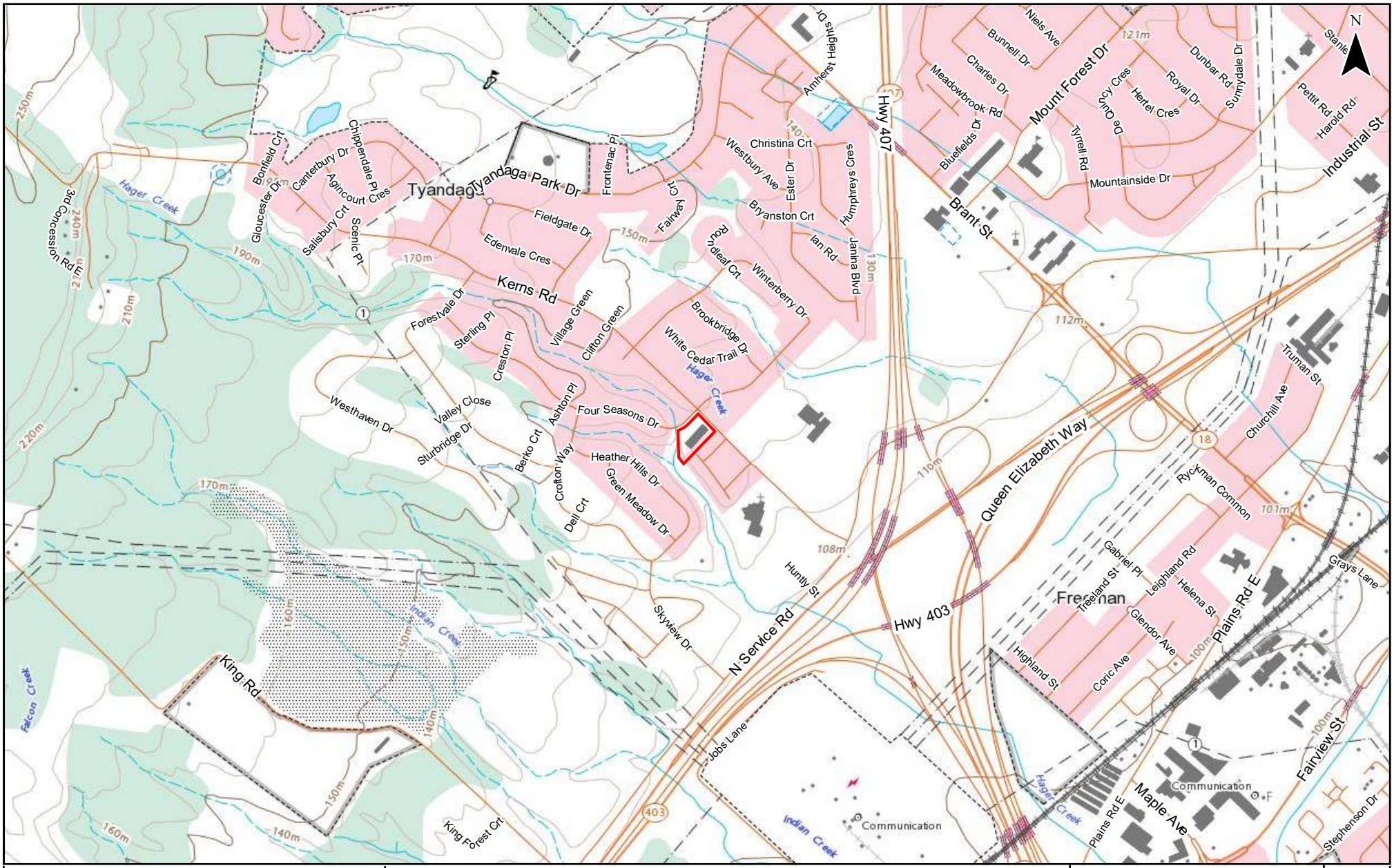
Ministry of Northern Development and Mines (May, 2012). OGS Earth. Retrieved from http://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth.

Watters Environmental Group Inc. (2020), Phase Two Environmental Site Assessment, 1600 Kerns Road, Burlington, ON, prepared for FGL Kerns Inc.

EXP Services Inc. (2018), Geotechnical Investigation, 1600 Kerns Road, Burlington, ON, prepared for Fieldgate Properties Limited.

EXP Services Inc. (2018), Environmental Subsurface Investigation, 1600 Kerns Road, Burlington, ON, prepared for Fieldgate Properties Limited.

Figures



SCALE:

0 150 300 450 600 750 m

LEGEND:

APPROXIMATE SITE BOUNDARY

SITE LOCATION PLAN

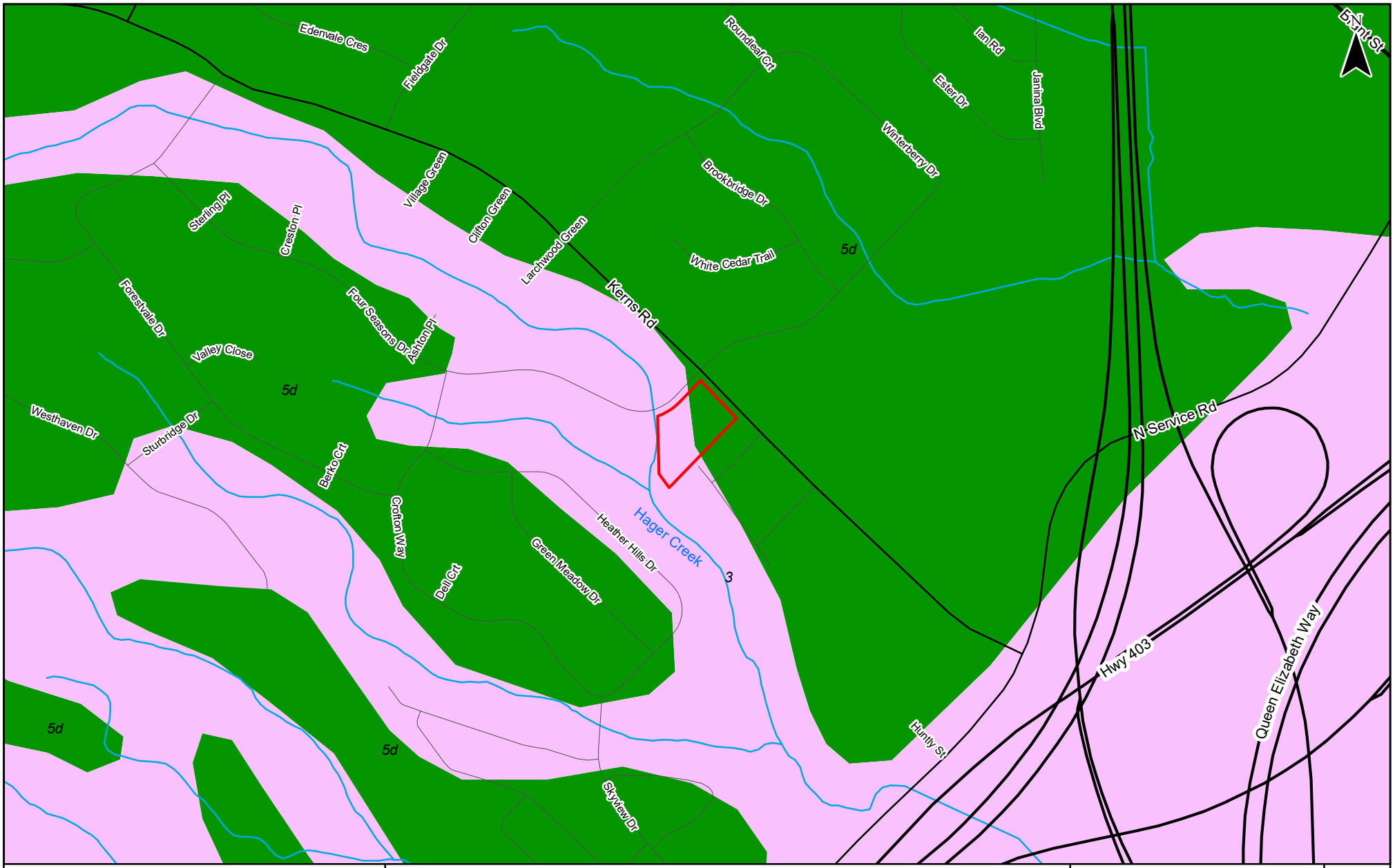
FIGURE: 1

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

DRAWN BY:	CHECKED BY:
AC	CS

PROJECT NUMBER: BRM-00801554-F0

DATE: JANUARY 2021



SCALE:

0 80 160 240 320 400 m

SOURCE:

BASED ON ONTARIO GEOLOGICAL SURVEY DATA PUBLISHED IN 2010

exp.

DRAWN BY:	CHECKED BY:
AC	CS

LEGEND:

- APPROXIMATE SITE BOUNDARY
- 5D: GLACIOLACUSTRINE-DERIVED SILTY TO CLAYEY TILL
- 3: PALEOZOIC BEDROCK

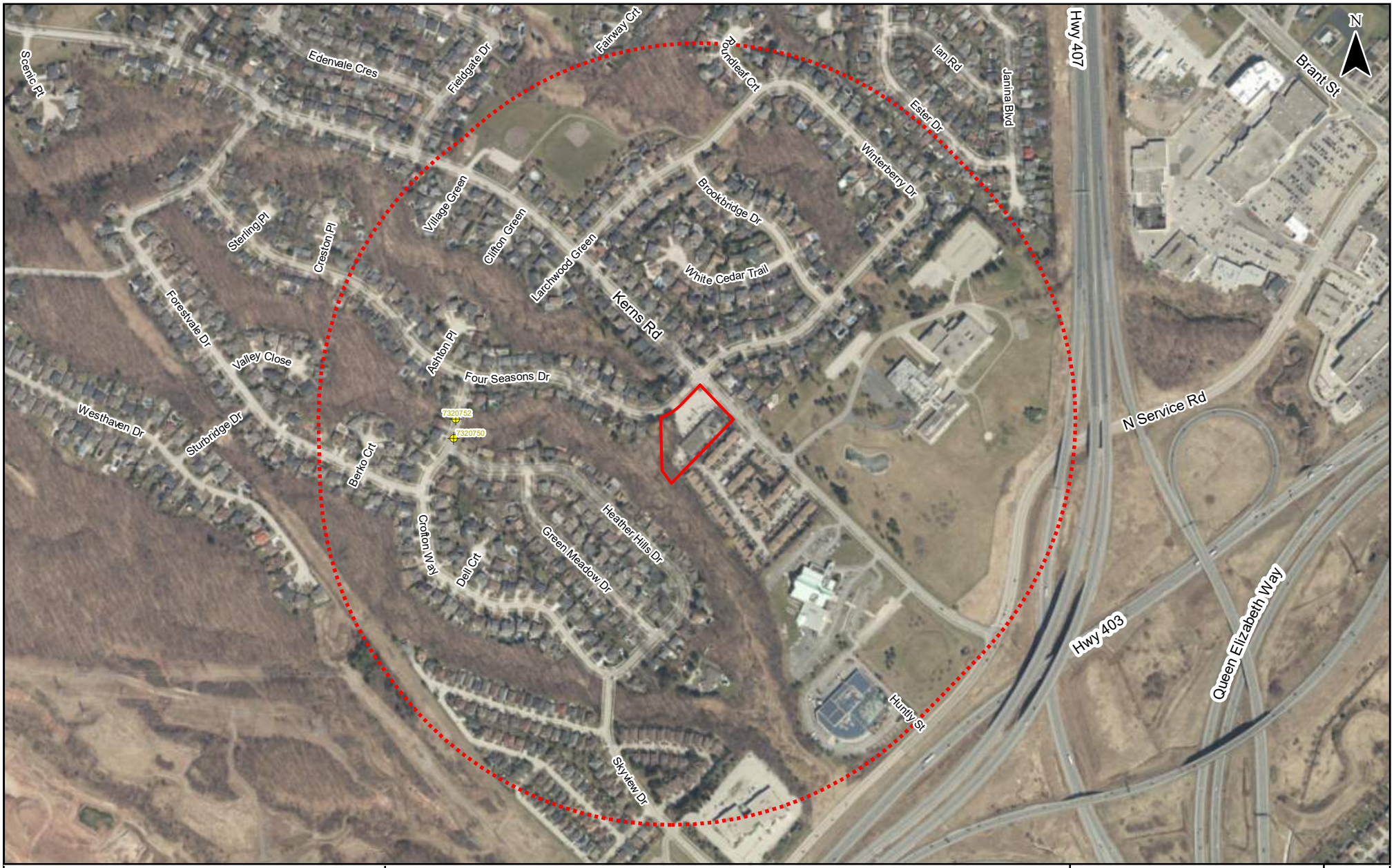
SURFICIAL GEOLOGY

FIGURE: 2

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: JANUARY 2021



SCALE:
0 90 180 270 360 450 m

SOURCE:
BASED ON GOOGLE EARTH IMAGERY DATED 2019,
AVAILABLE WELL RECORD INFORMATION AS OF SEPTEMBER 2019

exp.

DRAWN BY:	CHECKED BY:
AC	CS

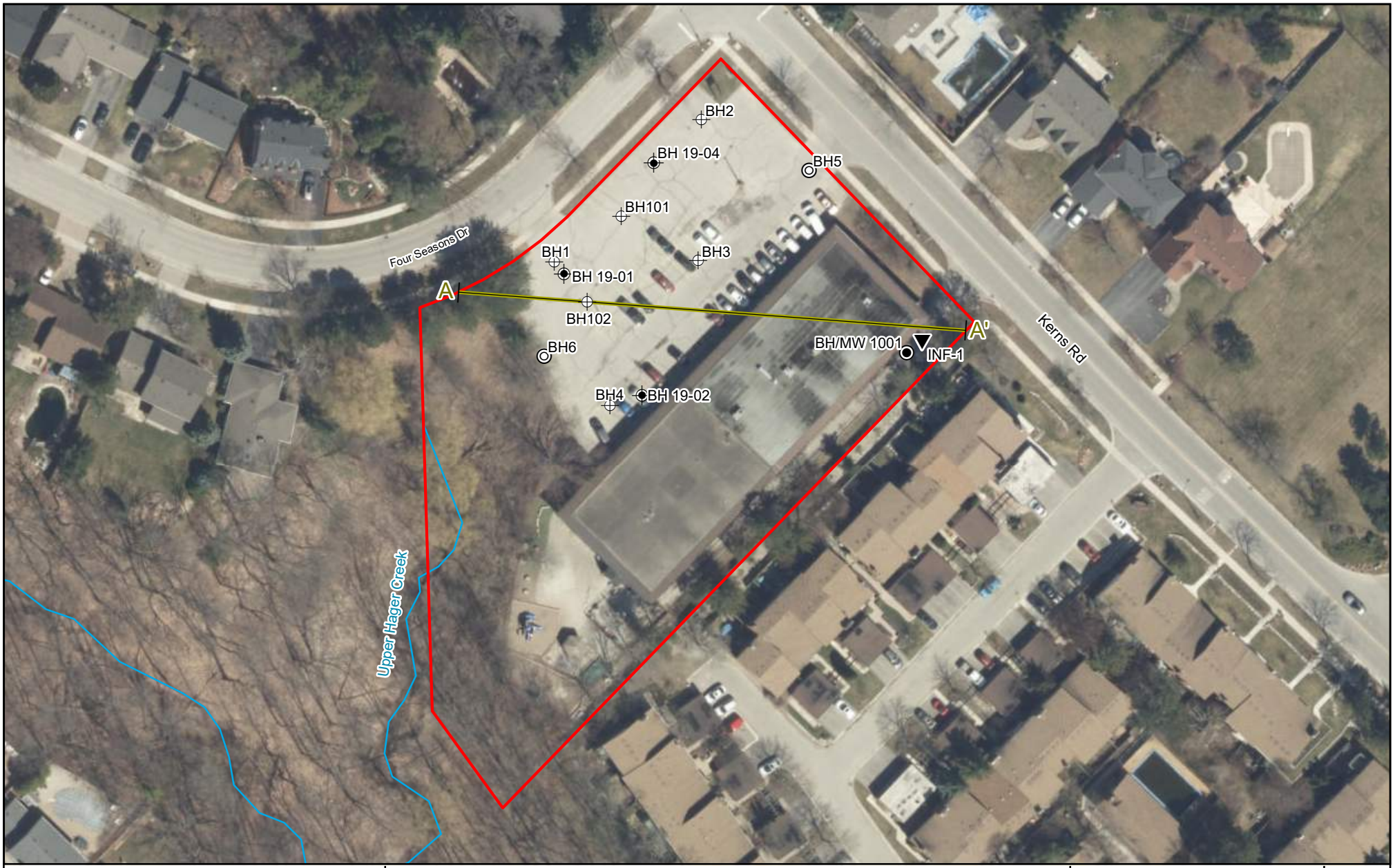
LEGEND:
MONITORING WELL / TEST HOLE
APPROXIMATE SITE BOUNDARY
500 m ZONE

MECP WATER WELL RECORDS MAP

FIGURE: 3

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0
DATE: JANUARY 2021



SCALE:

0 10 20 30 40 50 m

exp.

DRAWN BY:	CHECKED BY:
AC	CS

LEGEND:

- BOREHOLE (EXP, 2018)
- BOREHOLE / MONITORING WELL (EXP, 2018)
- BOREHOLE / MONITORING WELL (WE, 2020)
- BOREHOLE / MONITORING WELL (EXP, 2021)
- INFILTRATION TEST LOCATION (EXP, 2021)
- CROSS SECTION AXIS
- APPROXIMATE SITE BOUNDARY

BOREHOLE / MONITORING WELL LOCATION PLAN

FIGURE: 4

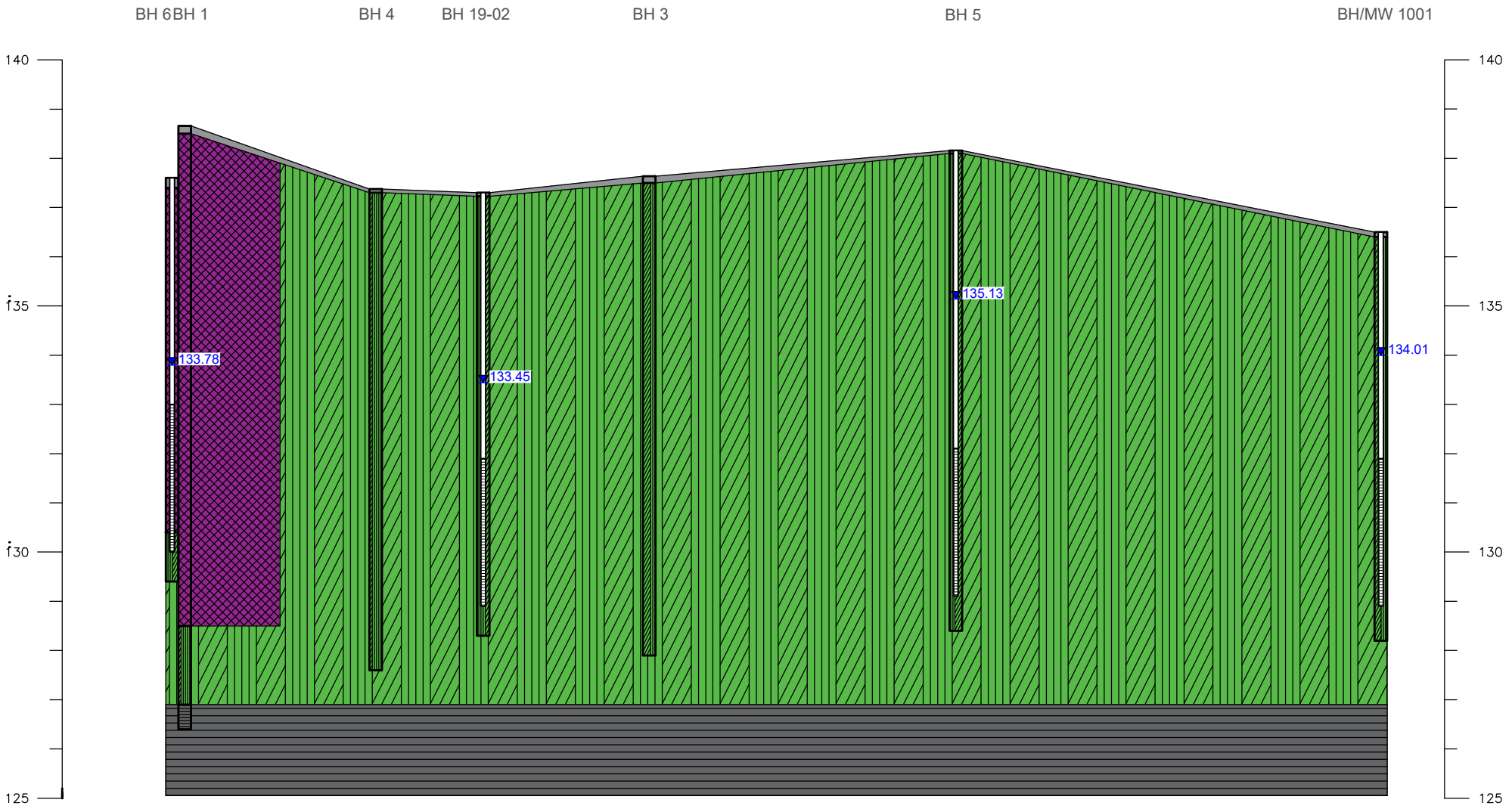
HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: JANUARY 2021

A
WEST

A'
EAST



exp Services Inc.
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1595 Clark Boulevard
Brampton, ON L6T 4V1
Canada

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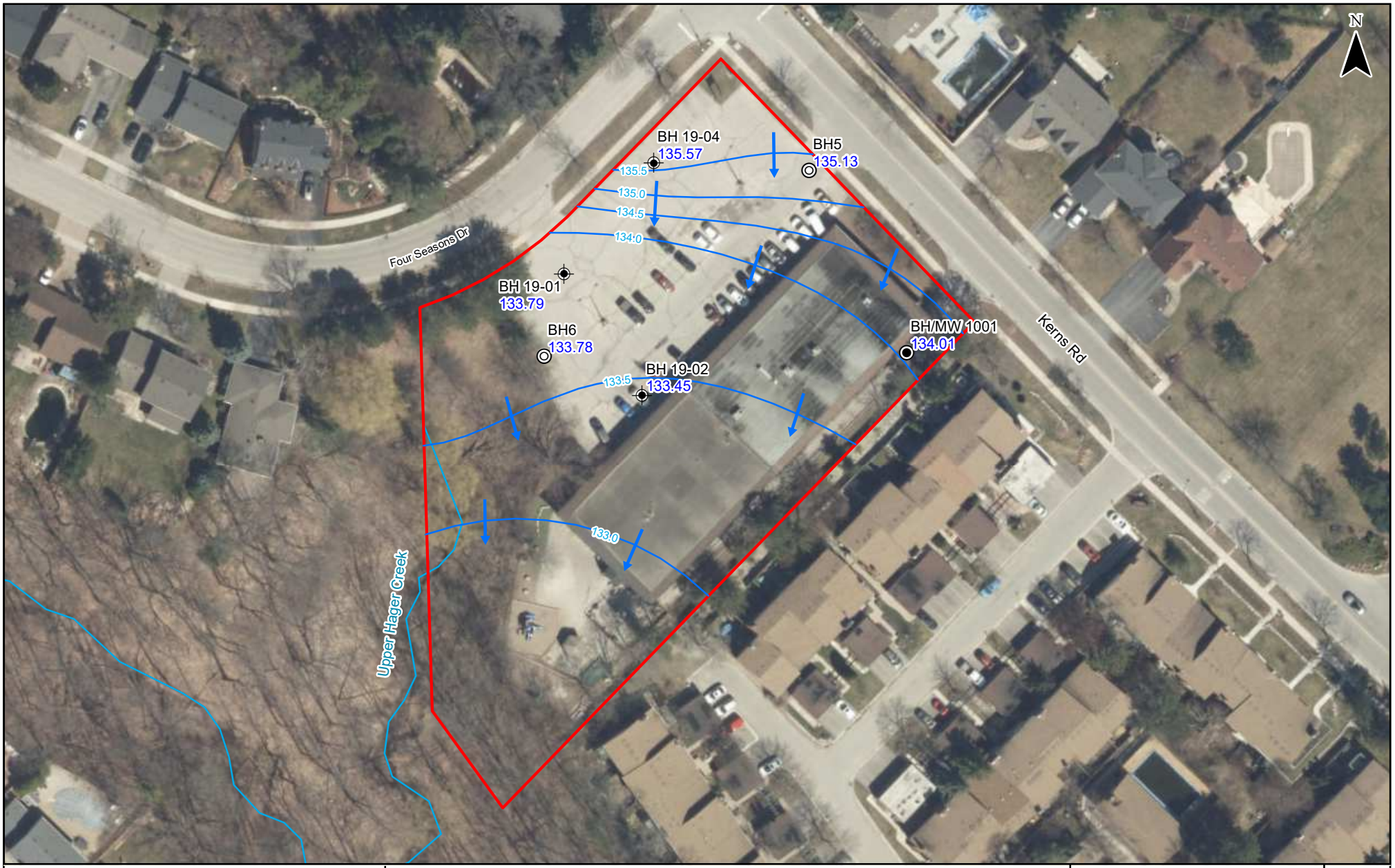
LEGEND:

- PAVEMENT STRUCTURE
- FILL
- CLAYEY SILT TILL/CLAYEY SILT
- SHALE BEDROCK
- GROUNDWATER ELEVATION AS MEASURED ON FEBRUARY 11, 2021.

TITLE AND LOCATION:

GEOLOGICAL CROSS-SECTION
HYDROGEOLOGICAL INVESTIGATION
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NO.:	DWN.:
BRM-00801554-F0	TH
SCALE:	CK:
AS NOTED	JS
DATE:	FIG. NO.:
FEBRUARY 2021	5



SCALE:

0 10 20 30 40 50 m

LEGEND:

- BOREHOLE / MONITORING WELL (EXP, 2018)
- BOREHOLE / MONITORING WELL (WE, 2020)
- BOREHOLE / MONITORING WELL (EXP, 2021)
- XX.XX GROUNDWATER ELEVATION (m asl) AS MEASURED ON FEBRUARY 11, 2021
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE SITE BOUNDARY

exp.

DRAWN BY:	CHECKED BY:
AC	CS

GROUNDWATER CONTOUR PLAN

FIGURE: 6

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: FEBRUARY 2021



SCALE:

0 10 20 30 40 50 m

LEGEND:

APPROXIMATE SITE BOUNDARY

LAND USE

BUILDING

LANDSCAPE

PAVED SURFACE

WOODLOT

exp.

DRAWN BY:	CHECKED BY:
AC	CS

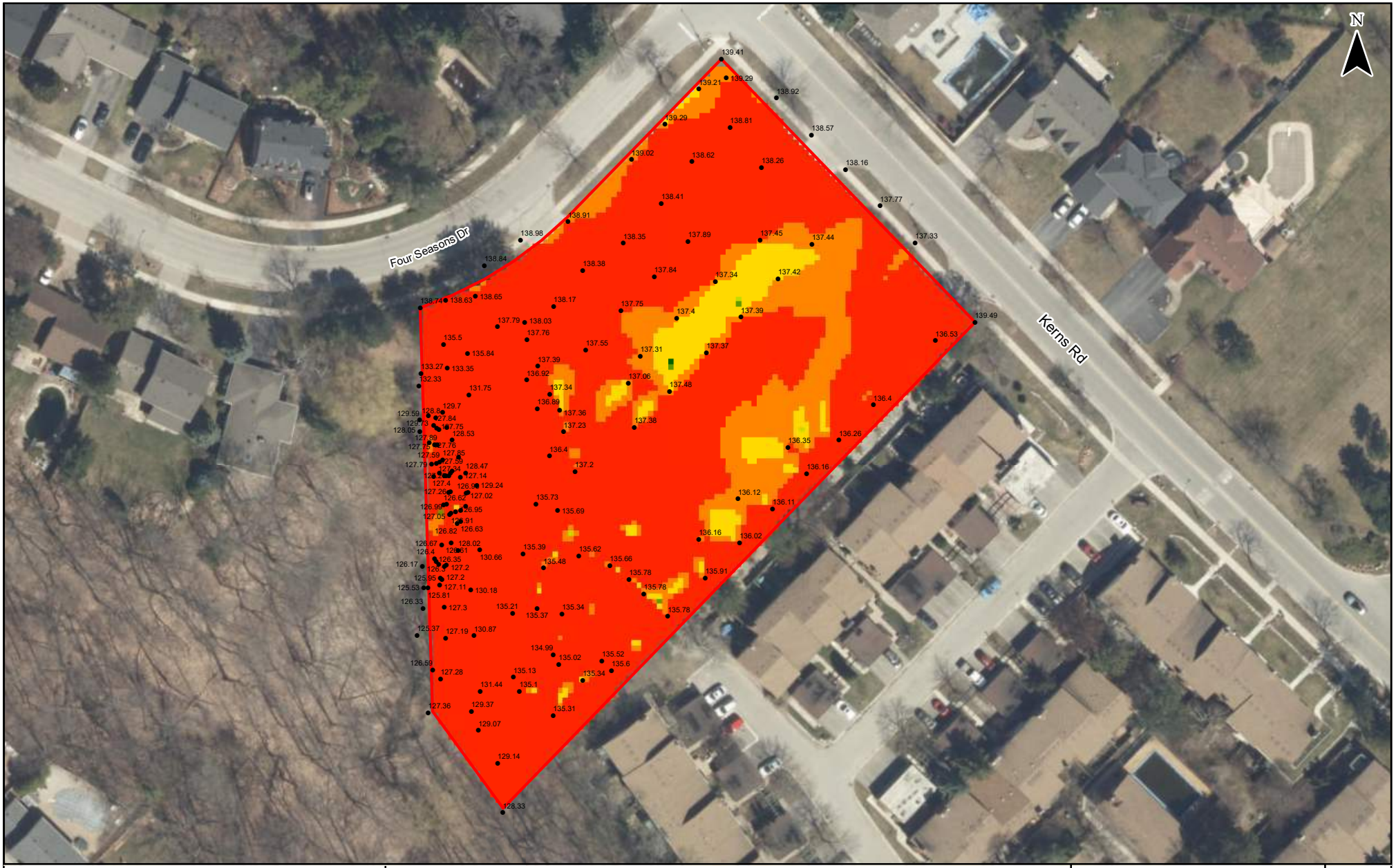
EXISTING LAND USE

FIGURE: 7

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: FEBRUARY 2021



SCALE:

0 10 20 30 40 50 m

SOURCE:

BASED ON SITE GRADING AND SERVICING PLAN - RETIREMENT HOME DEVELOPMENT -1600 KERNS ROAD. KWA CONSULTING, NOVEMBER 2020. PROJECT No,: 20500

exp.

DRAWN BY:	CHECKED BY:
AC	CS

LEGEND:

- EXISTING GRADE POINT (m asl)
- APPROXIMATE SITE BOUNDARY

EXISTING SLOPE (INFILTRATION FACTOR):

- <0.06% (0.30)
- 0.06 - 0.28% (0.25)
- 0.28 - 0.38% (0.20)
- 0.38 - 2.8% (0.15)
- 2.8 - 4.7% (0.10)
- >4.7% (0.05)

EXISTING SLOPE

FIGURE: 8

HYDROGEOLOGICAL INVESTIGATION AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: FEBRUARY 2021



SCALE:
0 10 20 30 40 50 m

SOURCE:
BASED ON SITE GRADING AND SERVICING PLAN - RETIREMENT HOME DEVELOPMENT -1600 KERNS ROAD. KWA CONSULTING, NOVEMBER 2020. PROJECT NO,: 20500

exp.

DRAWN BY: AC

CHECKED BY: CS

LEGEND:
- APPROXIMATE SITE BOUNDARY
- LIMITS OF UNDERGROUND

LAND USE
- BUILDING
- LANDSCAPE
- PAVED SURFACE
- WOODLOT

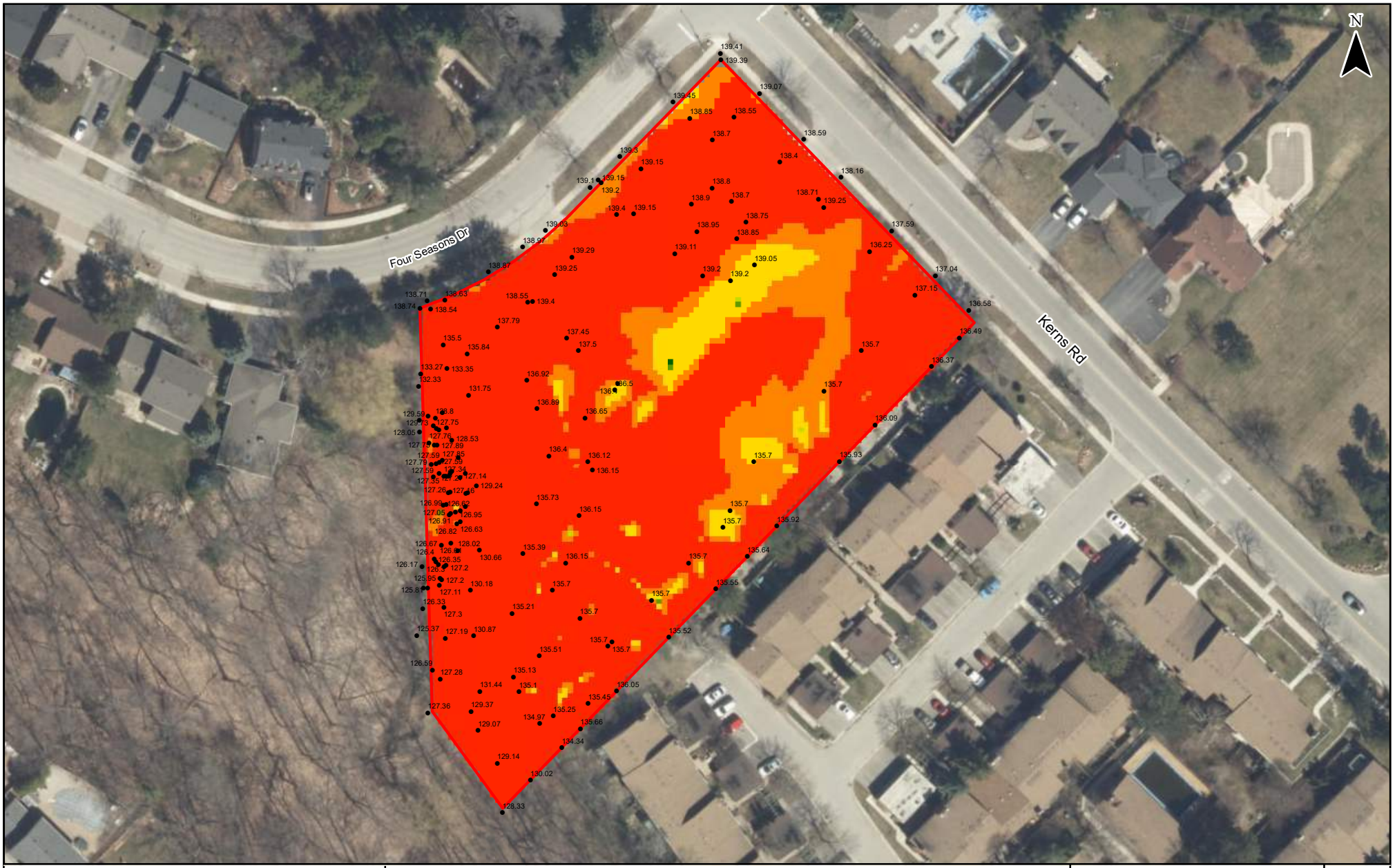
PROPOSED LAND USE

FIGURE: 9

HYDROGEOLOGICAL INVESTIGATION AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: FEBRUARY 2021



SCALE:

0 10 20 30 40 50 m

SOURCE:

BASED ON SITE GRADING AND SERVICING PLAN - RETIREMENT HOME DEVELOPMENT -1600 KERNS ROAD. KWA CONSULTING, NOVEMBER 2020. PROJECT No,: 20500

exp.

DRAWN BY:	CHECKED BY:
AC	CS

LEGEND:

- PROPOSED GRADE POINT (m asl)
- APPROXIMATE SITE BOUNDARY

PROPOSED SLOPE (INFILTRATION FACTOR):

<0.06% (0.30)	0.38 - 2.8% (0.15)
0.06 - 0.28% (0.25)	2.8 - 4.7% (0.10)
0.28 - 0.38% (0.20)	>4.7% (0.05)

PROPOSED SLOPE

FIGURE: 8

HYDROGEOLOGICAL INVESTIGATION AND WATER BALANCE STUDY
1600 KERNS ROAD
BURLINGTON, ONTARIO

PROJECT NUMBER: BRM-00801554-F0

DATE: FEBRUARY 2021

Appendix A – MECP WWR Summary Table

Appendix A
MECP Water Well Database Search Results

Off-Site														
BORE HOLE ID	WELL ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	CONSTRUCTION METHOD	WELL DEPTH (m bgs)	WATER FOUND (m bgs)	CASING DIAMETER (cm)	1st USE	FINAL STATUS
1007299728	7320750	7/18/2018	593811	4799280		1141 CROFTON WAY	Burlington	346	Auger	6.1			Monitoring	Observation Wells
1007299734	7320752	7/18/2018	593814	4799308		1141 CROFTEN WAY		343	Auger	6.1			Monitoring	Observation Wells

Appendix B – Borehole Logs

Log of Borehole 1

Project No. BRM-00801554-B0 | Drawing No. 2

Project: Geotechnical Investigation | Sheet No. 1 of 2

Location: 1600 Kerns Rd., Burlington

Date Drilled: October 12, 2018

Drill Type: CME 55, Solid Stem Augers

Datum: Geodetic

Auger Sample ☒ | Combustible Vapour Reading □

SPT (N) Value ○ ▨ | Natural Moisture ×

Dynamic Cone Test ——— | Plastic and Liquid Limit ⊢○

Shelby Tube ■ | Undrained Triaxial at % Strain at Failure ⊕

Field Vane Test S | Penetrometer ▲

Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
~ 140 mm **ASPHALTIC CONCRETE** over ~ 180 mm **GRANULAR BASE** over **FILL**: Reworked clayey silt, some gravel, medium grained sand pockets, glass fragments, brown to grey, black pockets, moist	138.67 ~138.5	0 1	7 7	×		21.5
Becoming brown to reddish brown sand and gravel, red brick, glass and ceramic fragments, moist	~136.5	2 3	4 3	×		
Becoming wet	~134.2 ~133.9	4 5 6	7 3 2	×		

Groundwater ▽

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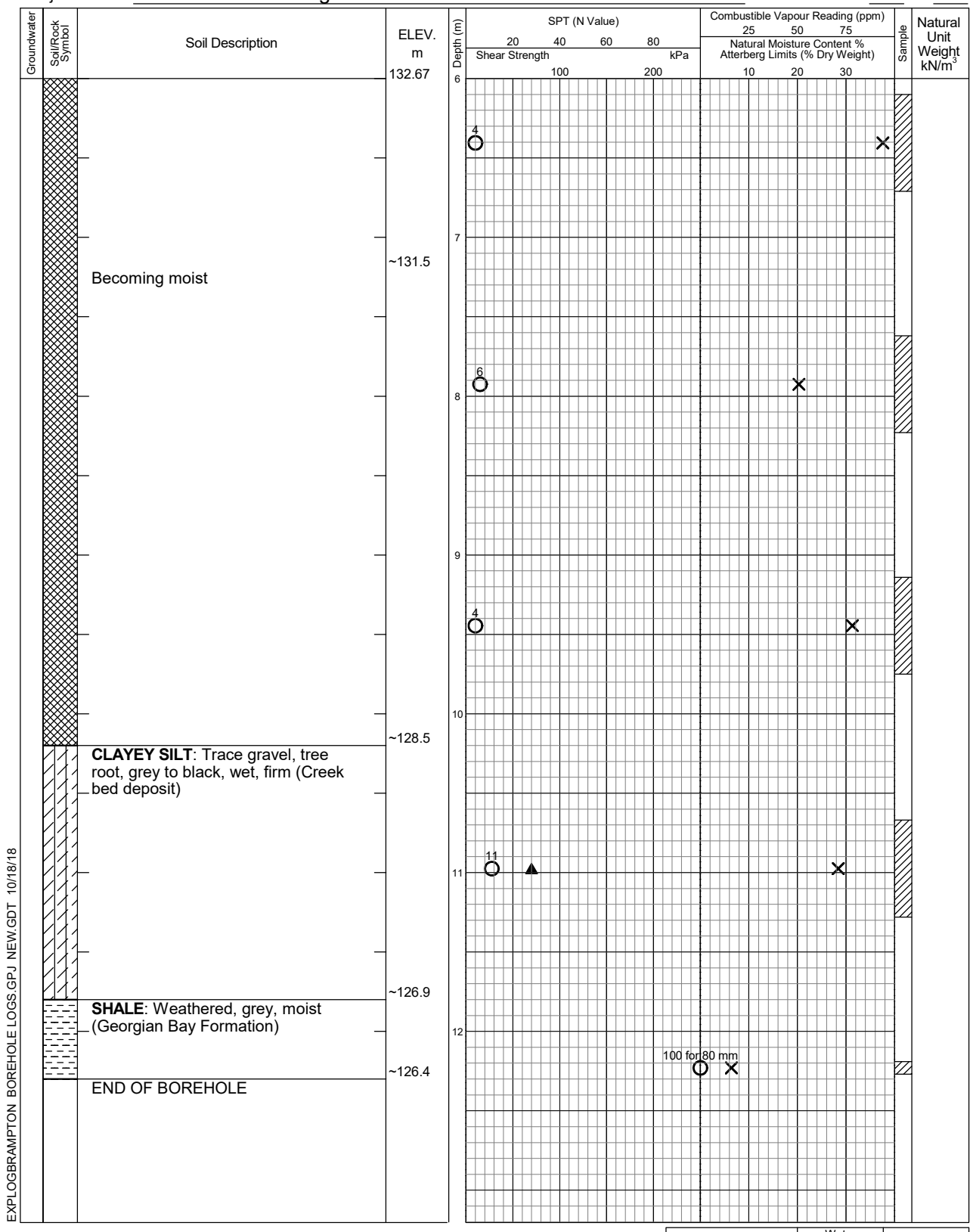
Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	4.82	8.61

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 1

Project No. BRM-00801554-B0 Drawing No. 2

Project: Geotechnical Investigation Sheet No. 2 of 2



EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	4.82	8.61

Log of Borehole 2

Project No. BRM-00801554-B0

Drawing No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 2

Location: 1600 Kerns Rd., Burlington

Date Drilled: October 12, 2018

Drill Type: CME 55, Solid Stem Augers

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~ 145 mm **ASPHALTIC CONCRETE** over ~ 190 mm **GRANULAR BASE** over **CLAYEY SILT TILL**: Fine sand seams, trace gravel, brown, moist, hard	138.92 ~138.8	0 1 2 3 4 5 6	7 23 42 46 41 47			22.1 22.4 22.3 22.7

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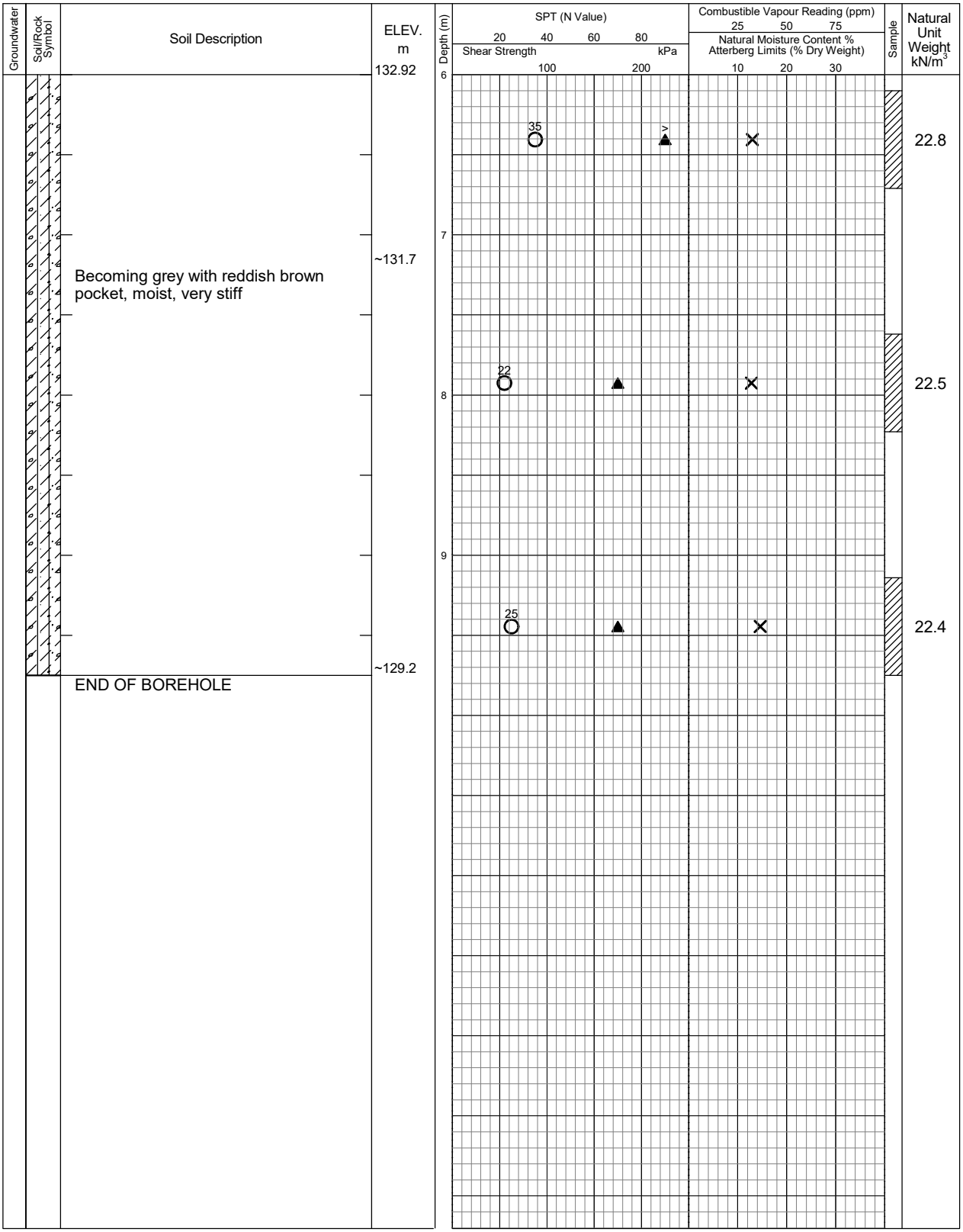
Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 2

Project No. BRM-00801554-B0 Drawing No. 3

Project: Geotechnical Investigation Sheet No. 2 of 2



EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open

Log of Borehole 3

Project No. BRM-00801554-B0 | Drawing No. 4

Project: Geotechnical Investigation | Sheet No. 1 of 2

Location: 1600 Kerns Rd., Burlington

Date Drilled: October 11, 2018

Drill Type: CME 55, Solid Stem Augers

Datum: Geodetic

Auger Sample ☒ | Combustible Vapour Reading □

SPT (N) Value ○ ▨ | Natural Moisture ×

Dynamic Cone Test — | Plastic and Liquid Limit ⊢○

Shelby Tube ■ | Undrained Triaxial at % Strain at Failure ⊕

Field Vane Test S | Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~ 100 mm **ASPHALTIC CONCRETE** over ~ 100 mm **GRANULAR BASE** over **CLAYEY SILT TILL**: Fine sand seams, trace gravel, occasional boulder fragments, brown, reddish brown pockets, moist, hard	137.63 ~137.5	0	19			21.5
				1	34			22.5
				2	38			22.5
				3	37			22.4
				4	40			23.2
				5	30			23.0
		Becoming grey with reddish brown pockets	~131.9	6				

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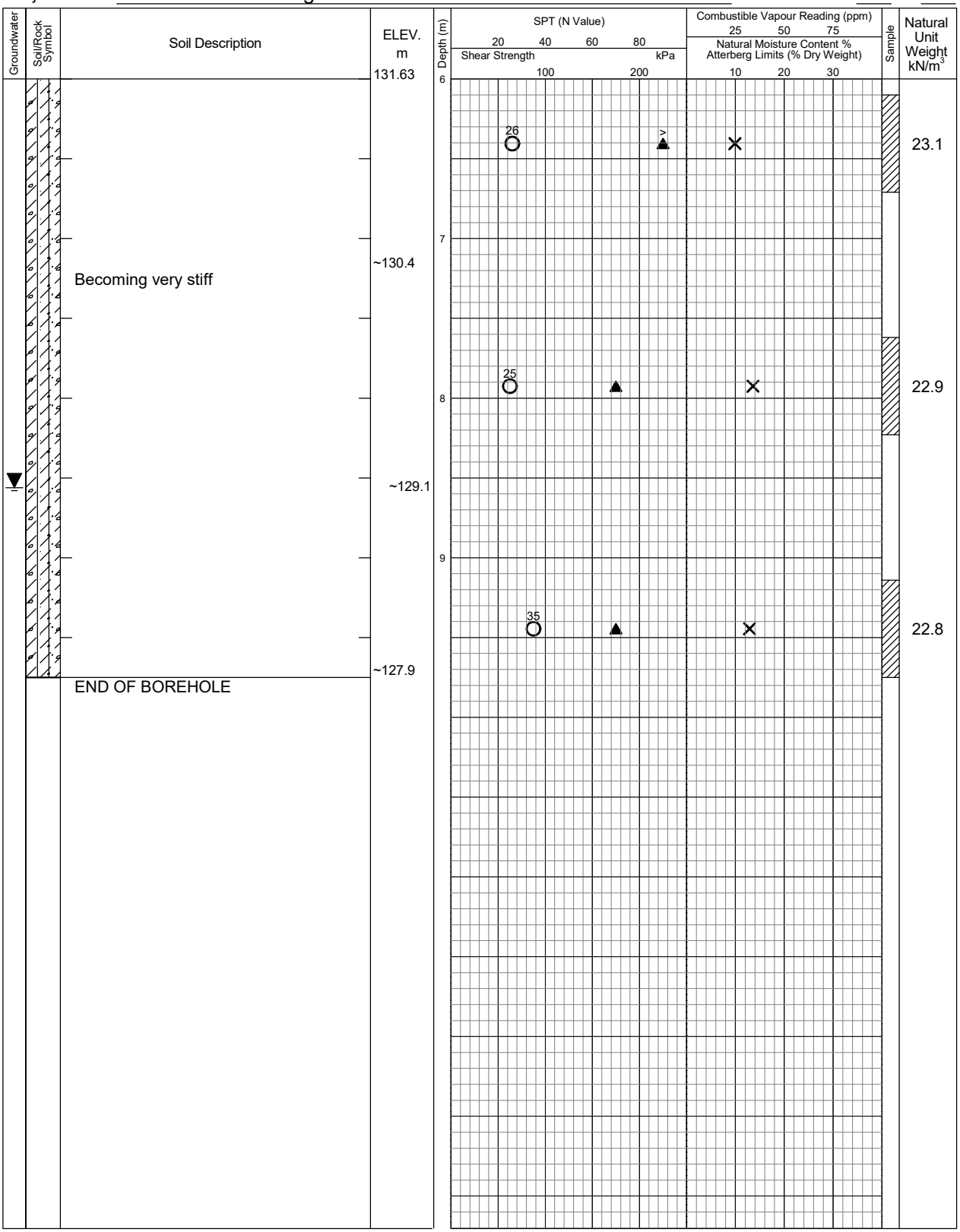
Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	8.58	9.19

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 3

Project No. BRM-00801554-B0 Drawing No. 4

Project: Geotechnical Investigation Sheet No. 2 of 2



Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	8.58	9.19

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 4

Project No. BRM-00801554-B0 | Drawing No. 5

Project: Geotechnical Investigation | Sheet No. 1 of 2

Location: 1600 Kerns Rd., Burlington

Date Drilled: October 11, 2018

Drill Type: CME 55, Solid Stem Augers

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Natural Unit Weight kN/m³
~ 90 mm **ASPHALTIC CONCRETE** over ~ 125 mm **GRANULAR BASE** over **CLAYEY SILT TILL**: Fine sand seams, trace gravel, occasional boulder fragments, brown, reddish brown and grey pockets, moist, hard	137.35 ~137.3	0	13		
		1	22		22.0
		2	26		22.1
		2.5	52		
		3	29		22.3
		4			
		4.5	30		22.3
Becoming grey with reddish brown pockets, stiff to very stiff	~131.8	5			
		6			

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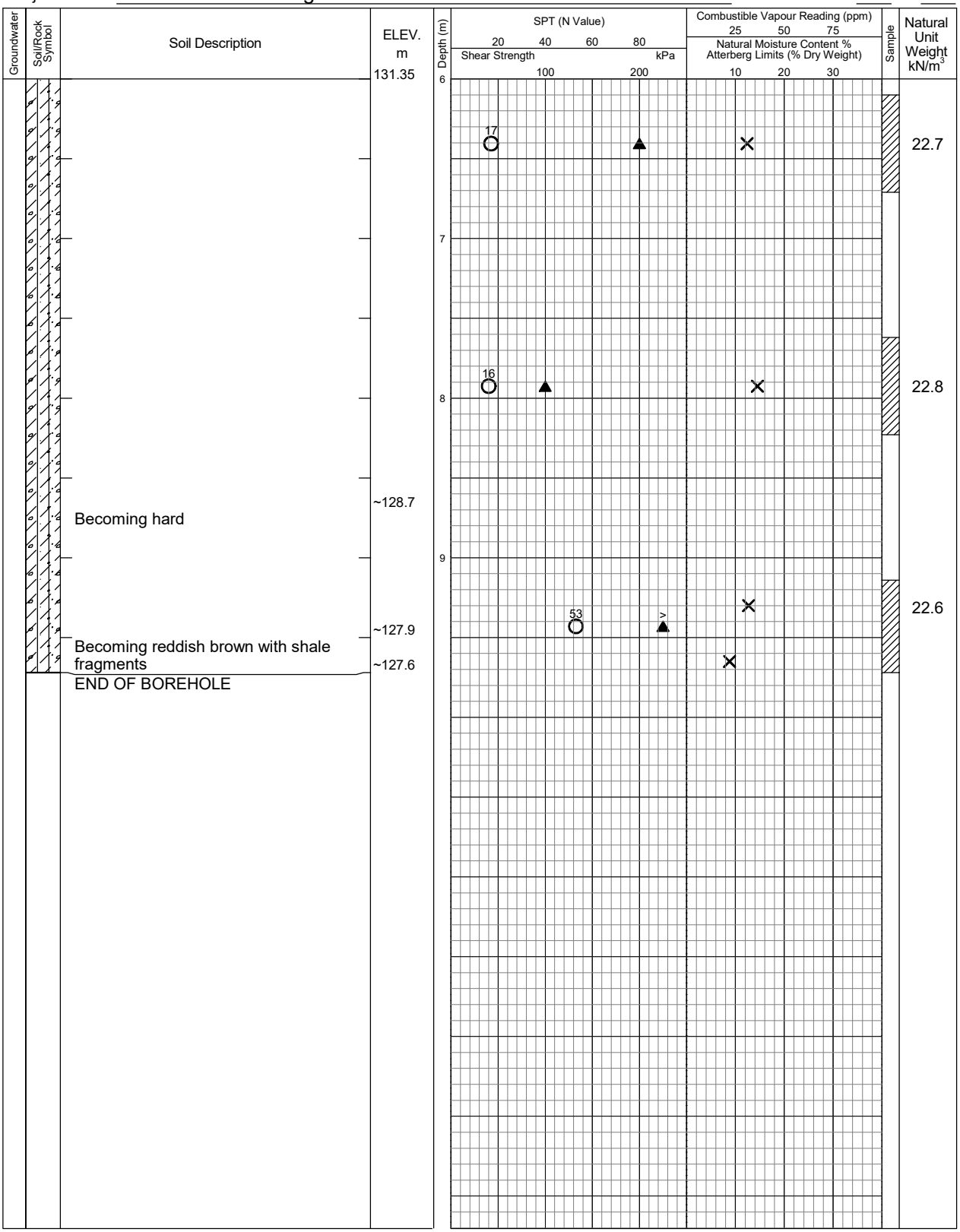
Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	Dry	9.7

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 4

Project No. BRM-00801554-B0 Drawing No. 5

Project: Geotechnical Investigation Sheet No. 2 of 2



Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	Dry	9.7

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 5

Project No. BRM-00801554-B0 | Drawing No. 6

Project: Geotechnical Investigation | Sheet No. 1 of 2

Location: 1600 Kerns Rd., Burlington

Date Drilled: October 11, 2018

Drill Type: CME 55, Solid Stem Augers

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 / Shear Strength 100 200 kPa	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Sample	Natural Unit Weight kN/m³
		~ 110 mm **ASPHALTIC CONCRETE** over ~ 290 mm **GRANULAR BASE** over **CLAYEY SILT TILL**: Fine sand seams, trace gravel, occasional boulder fragments, brown with reddish brown pockets, moist, hard	138.16 ~138.1	0	11			
				1	28			22.1
				2	44			22.5
				3	41			22.4
				4	40			22.9
				5	35			22.4
		Becoming grey with reddish brown pockets	~132.5	6				

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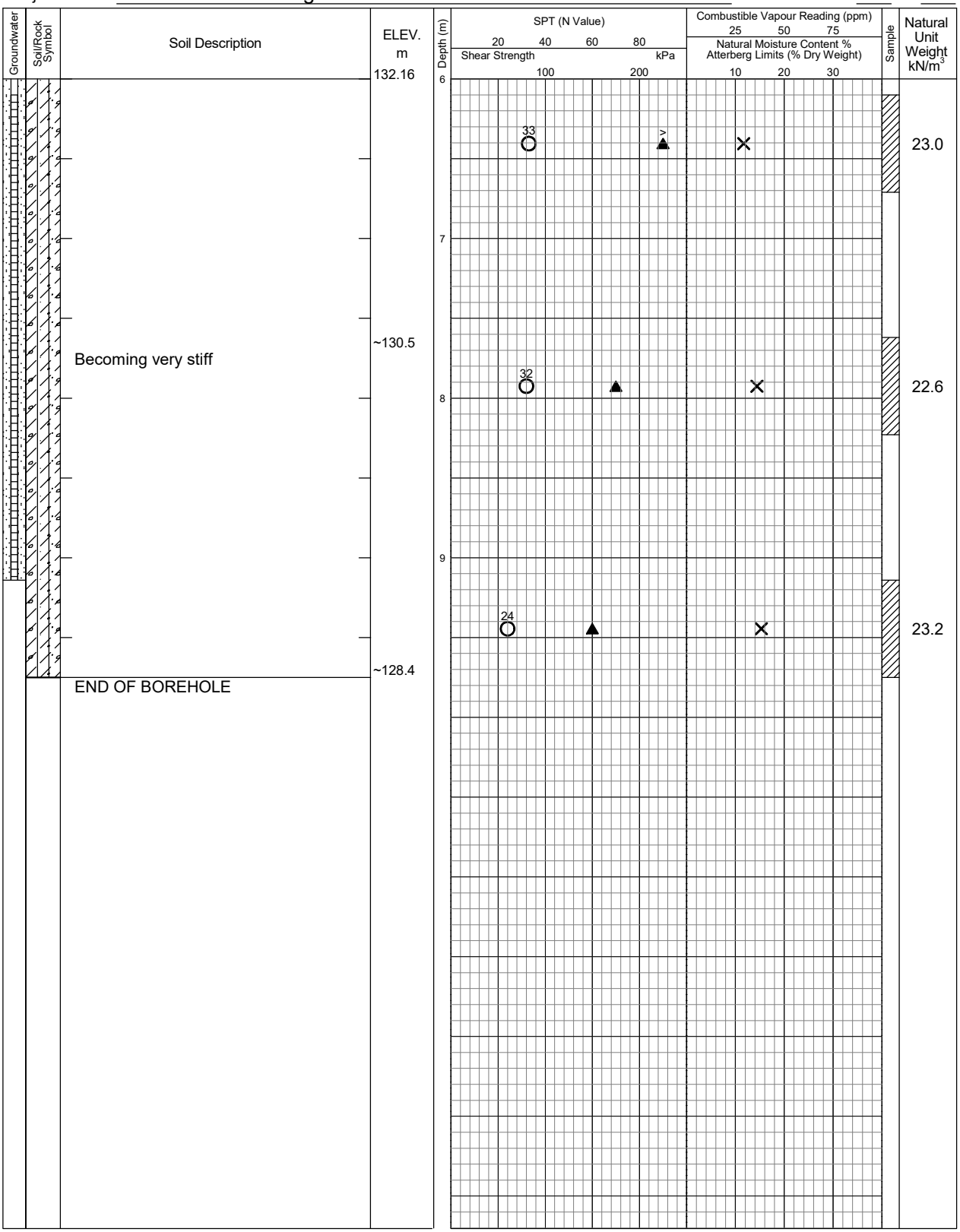
Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open
October 12, 2018	8.47	9.19
October 15, 2018	7.82	
October 16, 2018	6.31	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 5

Project No. BRM-00801554-B0 Drawing No. 6

Project: Geotechnical Investigation Sheet No. 2 of 2



EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open
October 12, 2018	8.47	9.19
October 15, 2018	7.82	
October 16, 2018	6.31	

Log of Borehole 6

Project No. BRM-00801554-B0

Drawing No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 2

Location: 1600 Kerns Rd., Burlington

Date Drilled: October 12, 2018

Drill Type: CME 55, Solid Stem Augers

Datum: Geodetic

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Combustible Vapour Reading

Natural Moisture

Plastic and Liquid Limit

Undrained Triaxial at % Strain at Failure

Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~ 135 mm **ASPHALTIC CONCRETE** over ~ 250 mm **GRANULAR BASE** over **FILL**: Clayey silt, trace gravel, brown to grey, reddish brown pockets, moist to wet	137.58 ~137.4	0 1 2 3 4 5 6	7 8 5 6 8 9			21.6
			~132.9					

Continued Next Page

Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	4.65	Open
October 12, 2018	3.29	7.69
October 15, 2018	3.57	
October 16, 2018	3.57	

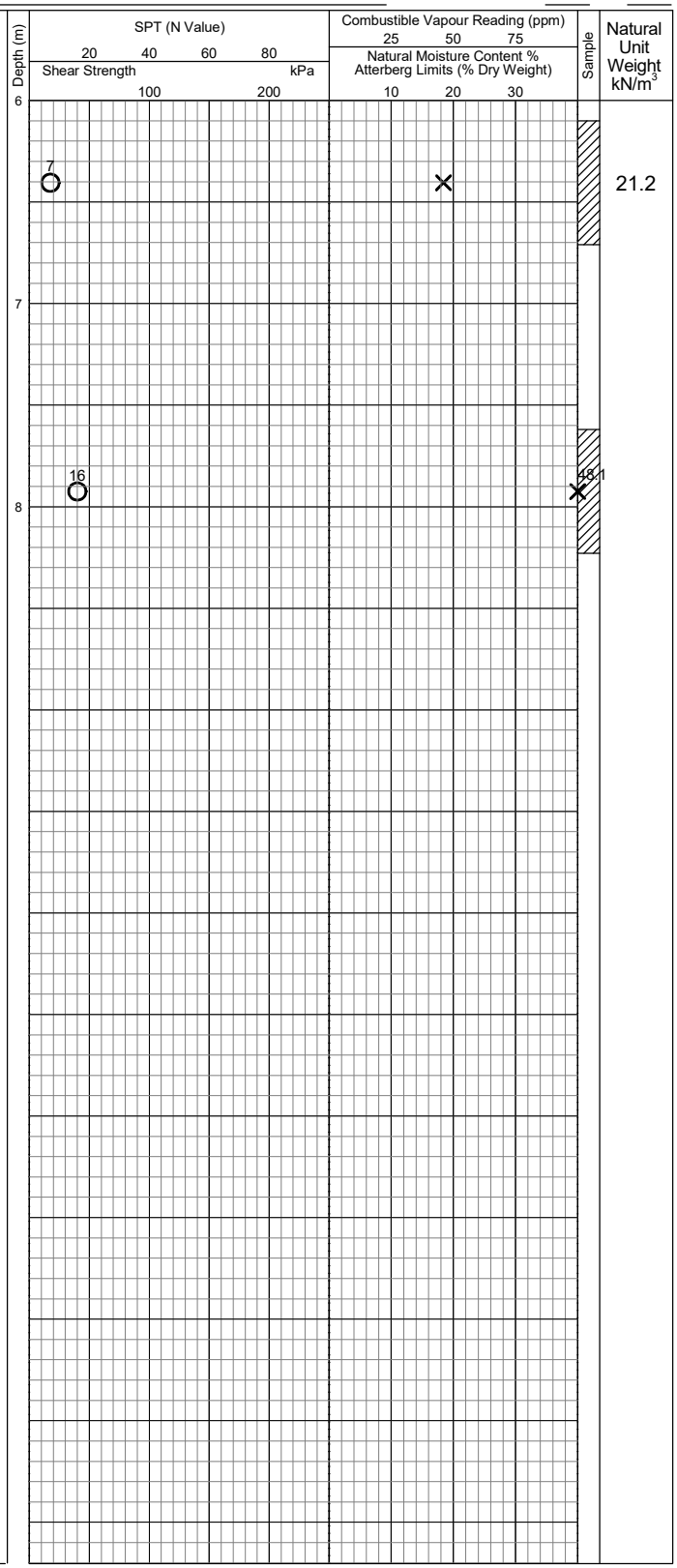
EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole 6

Project No. BRM-00801554-B0 Drawing No. 7

Project: Geotechnical Investigation Sheet No. 2 of 2

Soil Description	ELEV. m
	131.58
	~130.4
CLAYEY SILT: Sand and gravel layers, decayed tree roots, silt pockets, grey to black, wet, compact (Creek bed deposit)	
	~129.4
END OF BOREHOLE	



Elapsed Time	Water Level (m)	Hole Open to (m)
On Completion	4.65	Open
October 12, 2018	3.29	7.69
October 15, 2018	3.57	
October 16, 2018	3.57	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 10/18/18

Log of Borehole BH/MW 1001

Project No. BRM-00801554-F0 Drawing No. 1

Project: Hydrogeological Investigation Sheet No. 1 of 1

Location: 1600 Kerns Road, Burlington, ON

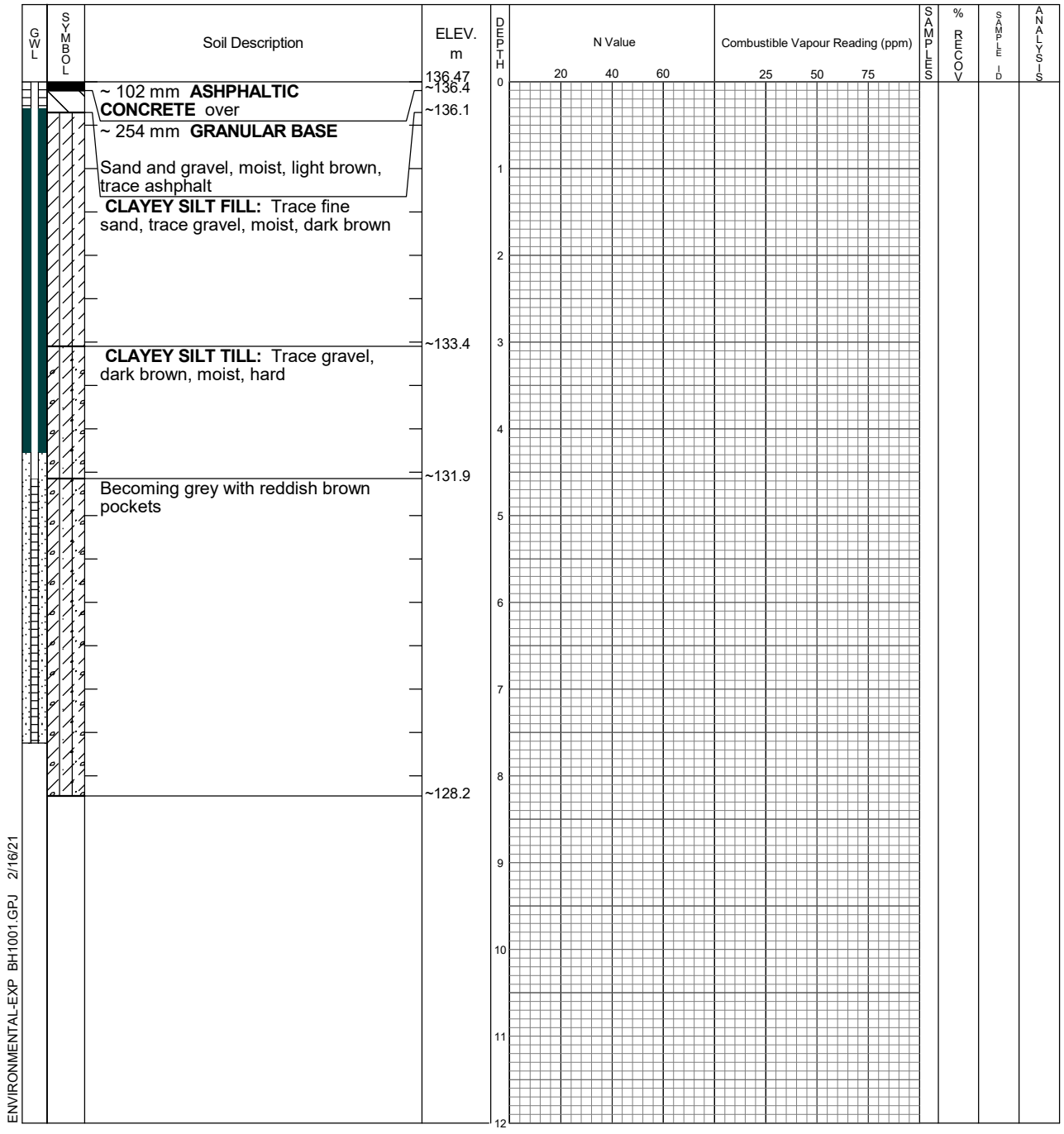
Date Drilled: Jan 26, 2021

Drill Type: Truck Mount - CME 75 - Solid Augers

Datum: Geodetic

Chemical Analysis

BTEX	Benzene, Toluene, Ethylbenzene and Xylenes	*	Duplicate Sample
ING	Metals and Inorganics	PCB	Polychlorinated Biphenyls
MET	Metals	PHC	Petroleum Hydrocarbons (F1-F4)
PAH	Polycyclic Aromatic Hydrocarbons	VOC	Volatile Organic Compounds
PEST	Organochlorine Pesticides		



ENVIRONMENTAL-EXP BH1001.GPJ 2/16/21

exp Services Inc.
Brampton, Ontario
Telephone: 905-793-9800
Facsimile: 905-793-0641

Time	Water Level (m)	Depth to Cave (m)
Jan 26, 2021	Dry	
February 5, 2021	2.14	
February 11, 2021	2.47	

WATTERS ENVIRONMENTAL GROUP INC.®
9135 Keele Street, Unit A1
Concord, Ontario L4K 0J4
www.wattersenvironmental.com
416-361-2407

Borehole No: BH19-01(MW)

Project No.: 19-0087.02.02

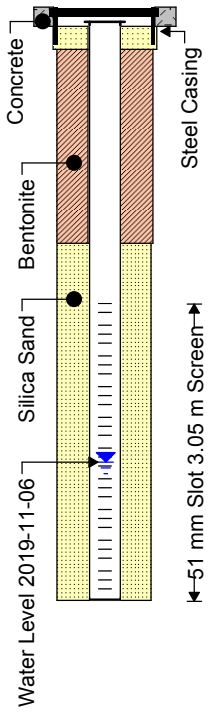
Client: Fieldgate Properties Limited

Location: 1600 Kerns Road, Burlington, Ontario

Ground Elevation: 0 **Total Depth:** 11.79 m / 38.67 ft

Logged By: T.A. **Project Manager:** K.S. & B.W.

SUBSURFACE PROFILE				SAMPLE						
Depth (ft / m)	Symbol	Description	Depth/Elev.	Number	Type	Blow Count	Recovery %	Vapour (CCG/PID)	Lab Submitted	Monitoring Well Completion Details
0 / 0		Ground Surface	0.00							
		14 cm Asphalt	0.00							
1 /		18 cm Granular Base		1	SS	6-4-4-4	75	0/1		
2 / 1		FILL, clayey silt, toposil pockets, glass fragments, ceramic fragments, brown and grey, some black, moist, loose		2	SS	2-2-2-2	100	0/1	X	
3 /										
4 /		sand, some silt, some brick, glass and		3	SS	2-2-3-3	60	0/1		
5 /										
6 / 2		ceramic fragments, red, moist loose		4	SS	1-1-1-2	50	0/1		
7 /										
8 /				5	SS	2-2-1-2	40	0/1		
9 /										
10 / 3				6	SS	4-3-3-2	15	0/1		
11 /										
12 /				7	SS	2-2-1-2	25	0/1	X	
13 / 4										
14 /										
15 /										
16 / 5		wet		8	SS	1-0-1-1	15	0/1		
17 /										
18 /										
19 /				9	SS	1-1-3-2	15	0/1		
20 / 6										
21 /										
22 /				10	SS	1-2-3-2	25	0/1		
23 / 7										
24 /										
25 /				11	SS	3-3-4-4	25	0/1		
26 /										
27 / 8										
28 /				12	SS	1-2-3-2	25	0/1		
29 /										
30 /				13	SS	3-5-9-10	40	0/1		
31 / 9										
32 /										
33 /				14	SS	5-7-16-20	50	0/1	X	
34 / 10										
35 /										
36 /		some wood		15	SS	10-15-35-21	75	0/1		
37 / 11			-11.29							
38 /		SILTY CLAY to WEATHERED SHALE, red to grey, moist, hard	11.29 -11.79	16	SS	48-50-70 for 50 mm	75	0/1	X	
39 /		End of Borehole	11.79							



Drilled By: Pontil Drilling, CME 75 Truck Mount Rig

Drill Method: Hollow Augers and Split Spoon Sampling

Drill Date: 2019-10-17

Hole Size: 20 cm diameter

Screening Tool: Eagle II

Sheet: 1 of 1

WATTERS ENVIRONMENTAL GROUP INC.®
9135 Keele Street, Unit A1
Concord, Ontario L4K 0J4
www.wattersenvironmental.com
416-361-2407

Borehole No: BH19-02(MW)

Project No.: 19-0087.02.02

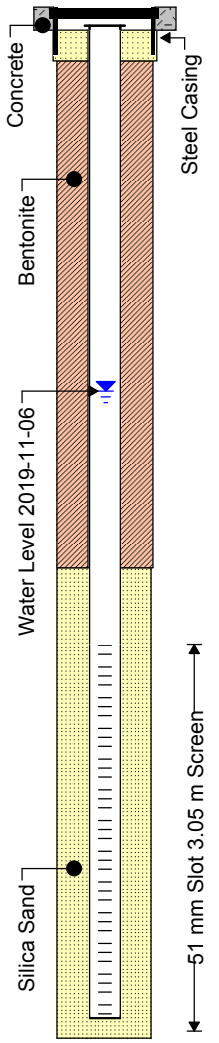
Client: Fieldgate Properties Limited

Location: 1600 Kerns Road, Burlington, Ontario

Ground Elevation: 0 **Total Depth:** 9.14 m / 30 ft

Logged By: T.A. **Project Manager:** K.S. & B.W.

SUBSURFACE PROFILE				SAMPLE						
Depth (ft / m)	Symbol	Description	Depth/Elev.	Number	Type	Blow Count	Recovery %	Vapour (CCG/PID)	Lab Submitted	Monitoring Well Completion Details
0 / 0		Ground Surface	0.00							
		10 cm Asphalt	0.00							
1		10 cm Granular Base		1	SS	3-7-9-10	82	0/0	X	
2 / 1		CLAYEY SILT, trace gravel, trace sand, trace oxidized fissures, brown veined grey, moist, stiff, no stains, no odours		2	SS	4-7-13-13	90	0/1		
3										
4				3	SS	6-11-16-17	90	0/1	X	
5 / 2										
6				4	SS	4-8-11-17	57	0/0		
7										
8 / 3				5	SS	4-6-12-15	90	0/1	X	
9										
10				6	SS	6-12-11-15	100	0/1		
11 / 4										
12				7	SS	4-7-12-17	90	0/1		
13										
14				8	SS	3-4-7-11	100	0/1		
15 / 5		grey, stiff								
16				9	SS	2-5-5-10	74	0/1		
17										
18				10	SS	5-6-8-8	100	0/1		
19 / 6										
20				11	SS	2-5-6-7	82	0/1		
21										
22				12	SS	5-6-11-11	100	0/1		
23 / 7										
24										
25										
26 / 8										
27										
28										
29			-8.99							
30 / 9		End of Borehole	8.99							
31										



Drilled By: Pontil Drilling, CME 75 Truck Mount Rig

Drill Method: Hollow Augers and Split Spoon Sampling

Drill Date: 2019-10-15

Hole Size: 20 cm diameter

Screening Tool: Eagle II

Sheet: 1 of 1

WATTERS ENVIRONMENTAL GROUP INC.®
9135 Keele Street, Unit A1
Concord, Ontario L4K 0J4
www.wattersenvironmental.com
416-361-2407

Borehole No: BH19-04(MW)

Project No.: 19-0087.02.02

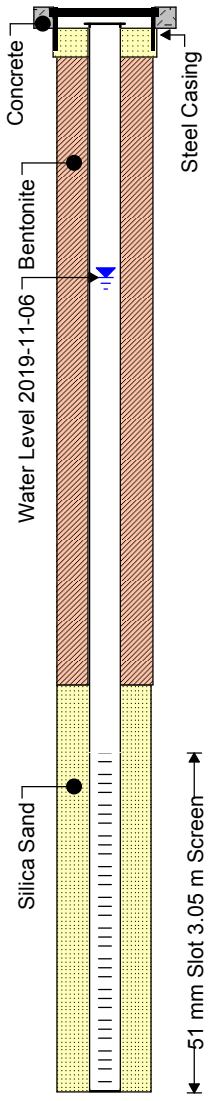
Client: Fieldgate Properties Limited

Location: 1600 Kerns Road, Burlington, Ontario

Ground Elevation: 0 **Total Depth:** 9.91 m / 32.5 ft

Logged By: T.A. **Project Manager:** K.S. & B.W.

SUBSURFACE PROFILE				SAMPLE						
Depth (ft / m)	Symbol	Description	Depth/Elev.	Number	Type	Blow Count	Recovery %	Vapour (CCG/PID)	Lab Submitted	Monitoring Well Completion Details
0 / 0		Ground Surface	0.00							
		11 cm Asphalt 16 cm Granular Base	0.00							
1 / 0				1	SS	3-4-5-9	65	0/1	X	
2 / 1		CLAYEY SILT, trace gravel, trace sand, trace oxidized fissures, brown, veined grey, moist, stiff to very stiff, no stains, no odours		2	SS	5-10-14-17	82	0/0		
3 / 2				3	SS	7-12-14-20	90	0/0		
4 / 3				4	SS	7-12-20-19	82	0/1		
5 / 4				5	SS	7-12-20-19	100	0/1		
6 / 5				6	SS	7-13-15-15	100	0/1	X	
7 / 6				7	SS	5-10-16-20	100	0/1		
8 / 7		grey, stiff		8	SS	7-12-15-14	100	0/1		
9 / 8				9	SS	5-9-15-14	100	0/1		
10 / 9				10	SS	3-7-8-8	100	0/1	X	
				11	SS	3-7-8-9	100	0/1		
				12	SS	3-6-10-10	100	0/1		
				13	SS	4-7-7-14	100	0/1	X	
10 / 10		End of Borehole	-9.75 9.75							



Drilled By: Pontil Drilling, CME 75 Truck Mount Rig

Drill Method: Hollow Augers and Split Spoon Sampling

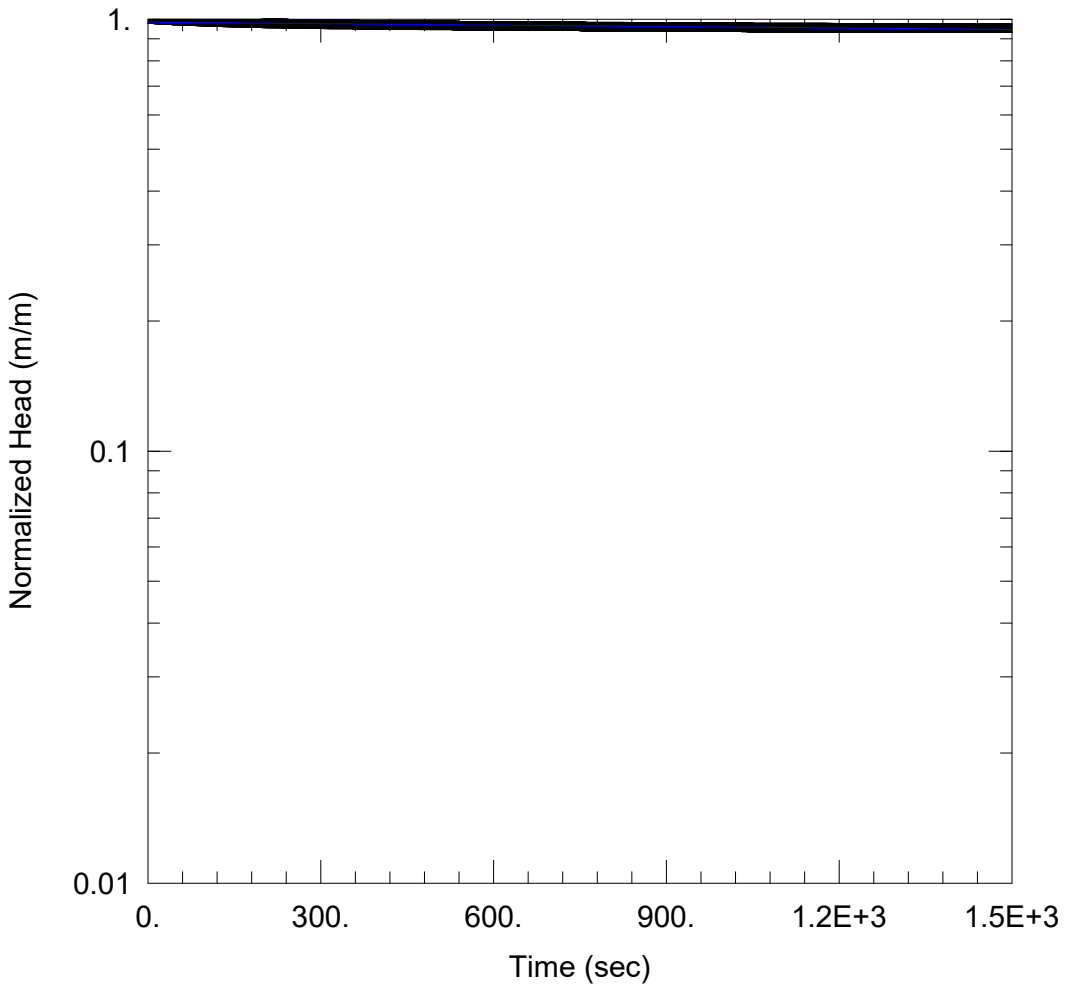
Drill Date: 2019-10-16

Hole Size: 20 cm diameter

Screening Tool: Eagle II

Sheet: 1 of 1

Appendix C – SWRT Procedures and Results



SWRT - RISING HEAD - BH 5

Data Set: \...\BH 5.aqt
Date: 01/28/21 Time: 13:35:10

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Fieldgate Properties Limited
Project: BRM-00801554-F0
Location: 1600 Kerns Road, Burlington
Test Well: BH 5
Test Date: Jan 26, 2021

AQUIFER DATA

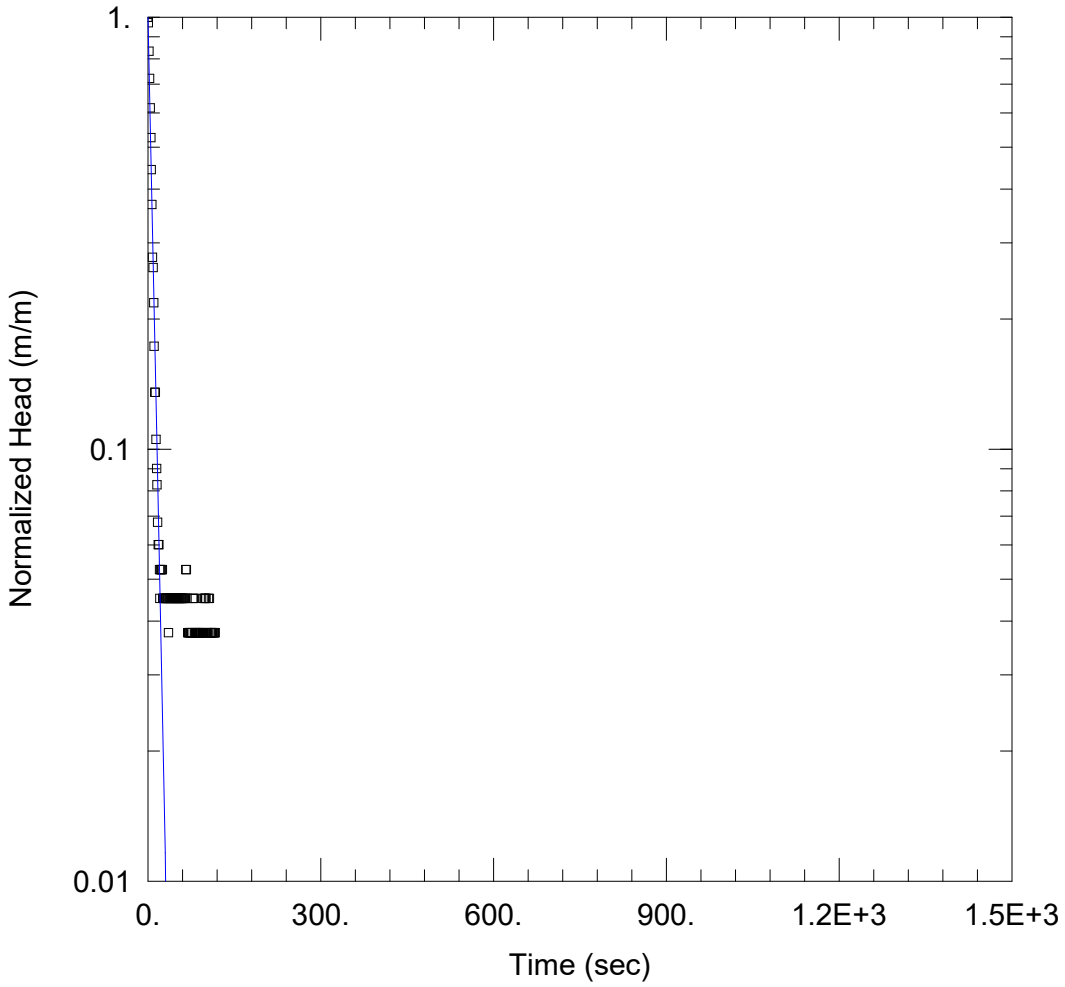
Saturated Thickness: 6.3 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 5)

Initial Displacement: 6.342 m
Total Well Penetration Depth: 6.3 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.3 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.13E-8 m/sec
y0 = 6.238 m



SWRT - RISING HEAD - BH 6

Data Set: \...\BH 6.aqt
Date: 02/08/21 Time: 15:58:46

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Fieldgate Properties Limited
Project: BRM-00801554-F0
Location: 1600 Kerns Rd, Burlington, ON
Test Well: BH 6
Test Date: Feb 5, 2021

AQUIFER DATA

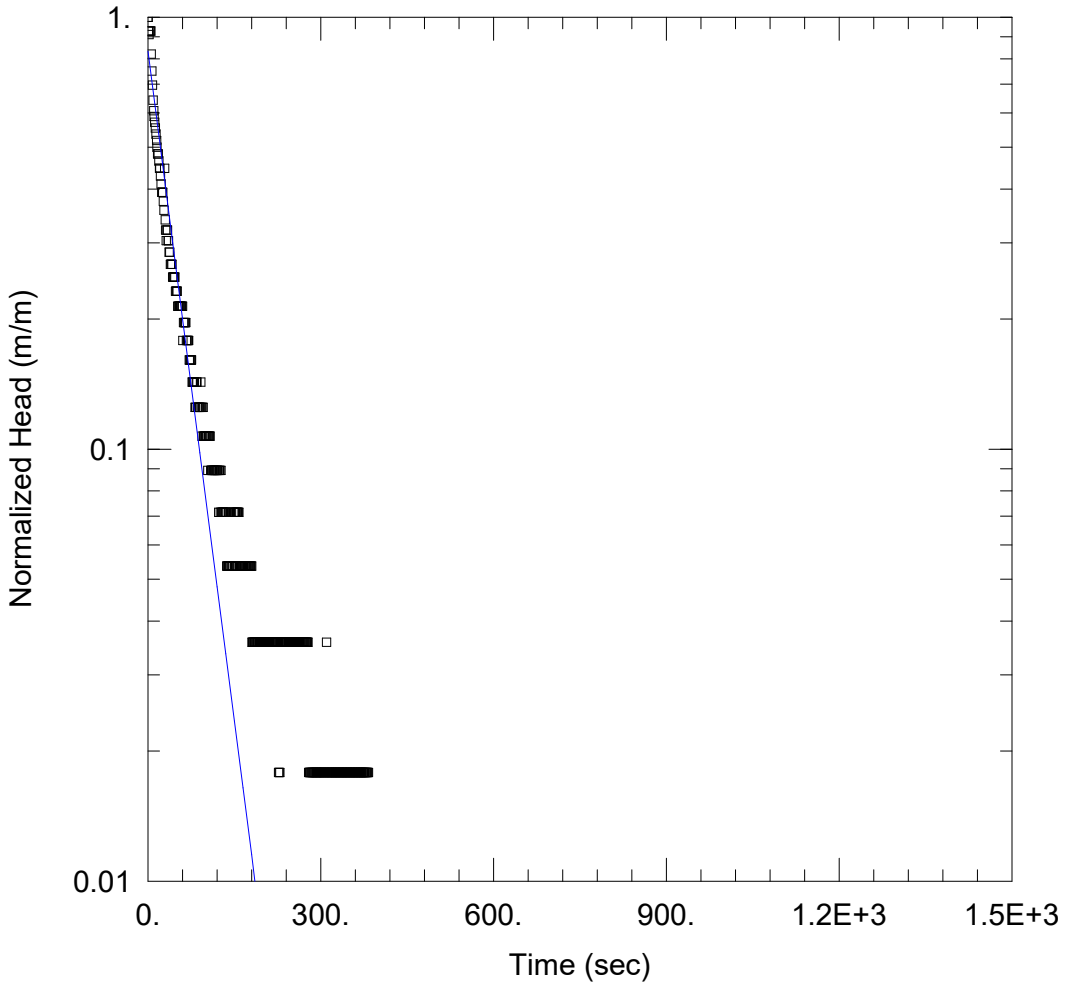
Saturated Thickness: 4.13 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 6)

Initial Displacement: 0.399 m
Total Well Penetration Depth: 4.13 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.13 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 6.62E-5 m/sec
y0 = 0.4298 m



SWRT - FALLING HEAD - BH 19-01

Data Set: \...\BH 19-01.aqt
Date: 02/08/21 Time: 16:05:38

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Fieldgate Properties Limited
Project: BRM-00801554-F0
Location: 1600 Kerns Rd, Burlington, ON
Test Well: BH 19-01
Test Date: Feb 5, 2021

AQUIFER DATA

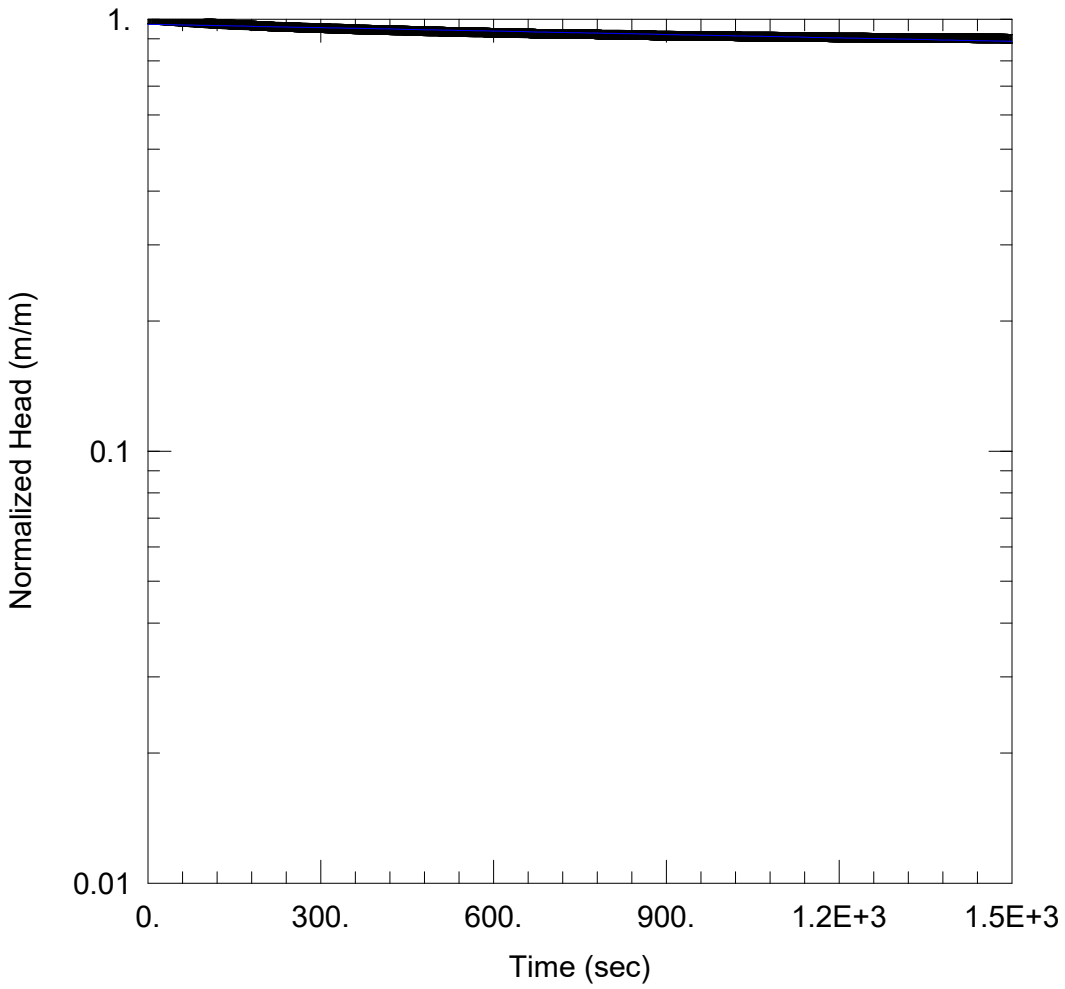
Saturated Thickness: 1.325 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 19-01)

Initial Displacement: 0.168 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 1.325 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.07E-5 m/sec
y0 = 0.1402 m



SWRT - RISING HEAD - BH 19-02 (MW)

Data Set: \...\BH19-02(MW).aqt
Date: 01/28/21 Time: 13:44:41

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Fieldgate Properties Limited
Project: BRM-00801554-F0
Location: 1600 Kerns Road, Burlington
Test Well: BH 19-02 (MW)
Test Date: Jan 26, 2021

AQUIFER DATA

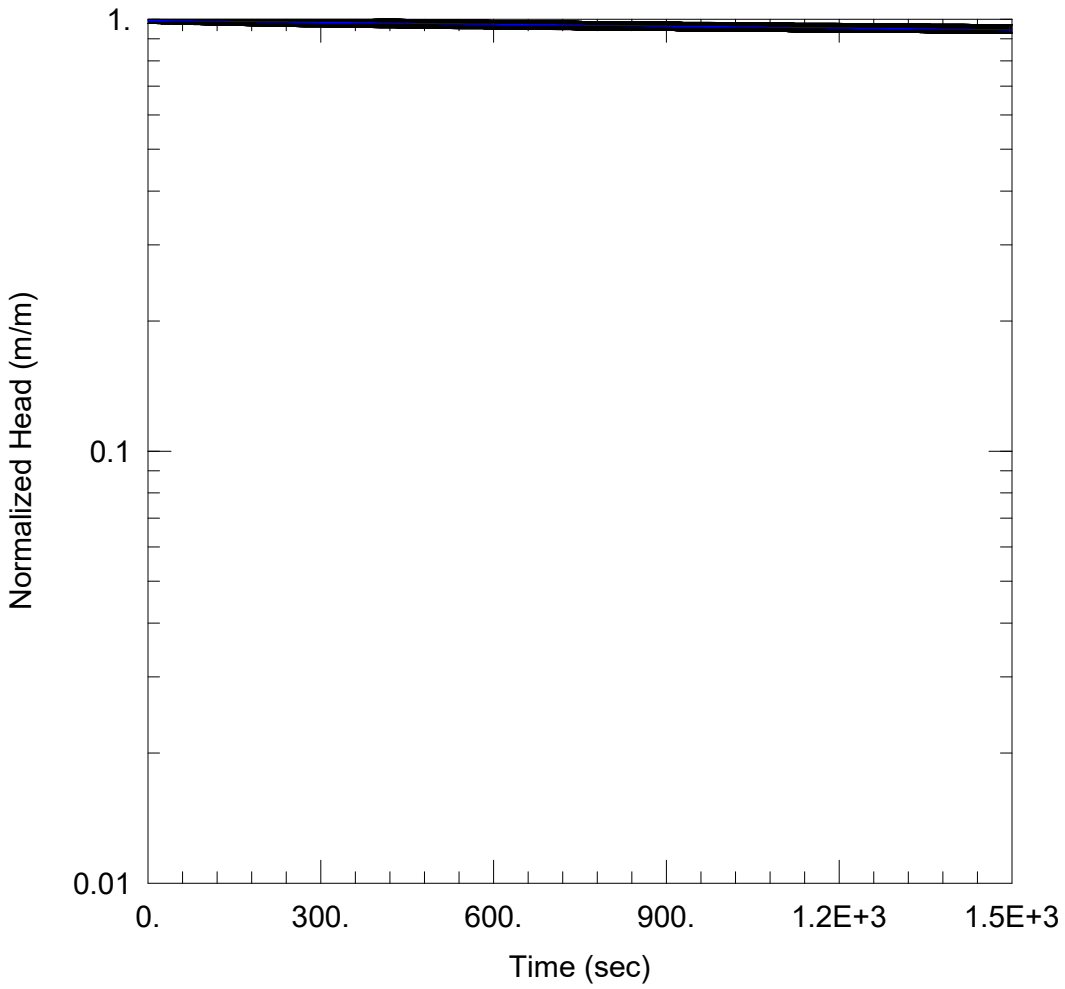
Saturated Thickness: 4.83 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 19-02 (MW))

Initial Displacement: 3.489 m
Total Well Penetration Depth: 4.84 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.84 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 2.65E-8 m/sec
y0 = 3.394 m



SWRT - RISING HEAD - BH 19-04 (MW)

Data Set: \...\BH19-04(MW).aqt
Date: 01/28/21 Time: 13:47:10

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Fieldgate Properties Limited
Project: BRM-00801554-F0
Location: 1600 Kerns Road, Burlington
Test Well: BH 19-04 (MW)
Test Date: Jan 26, 2021

AQUIFER DATA

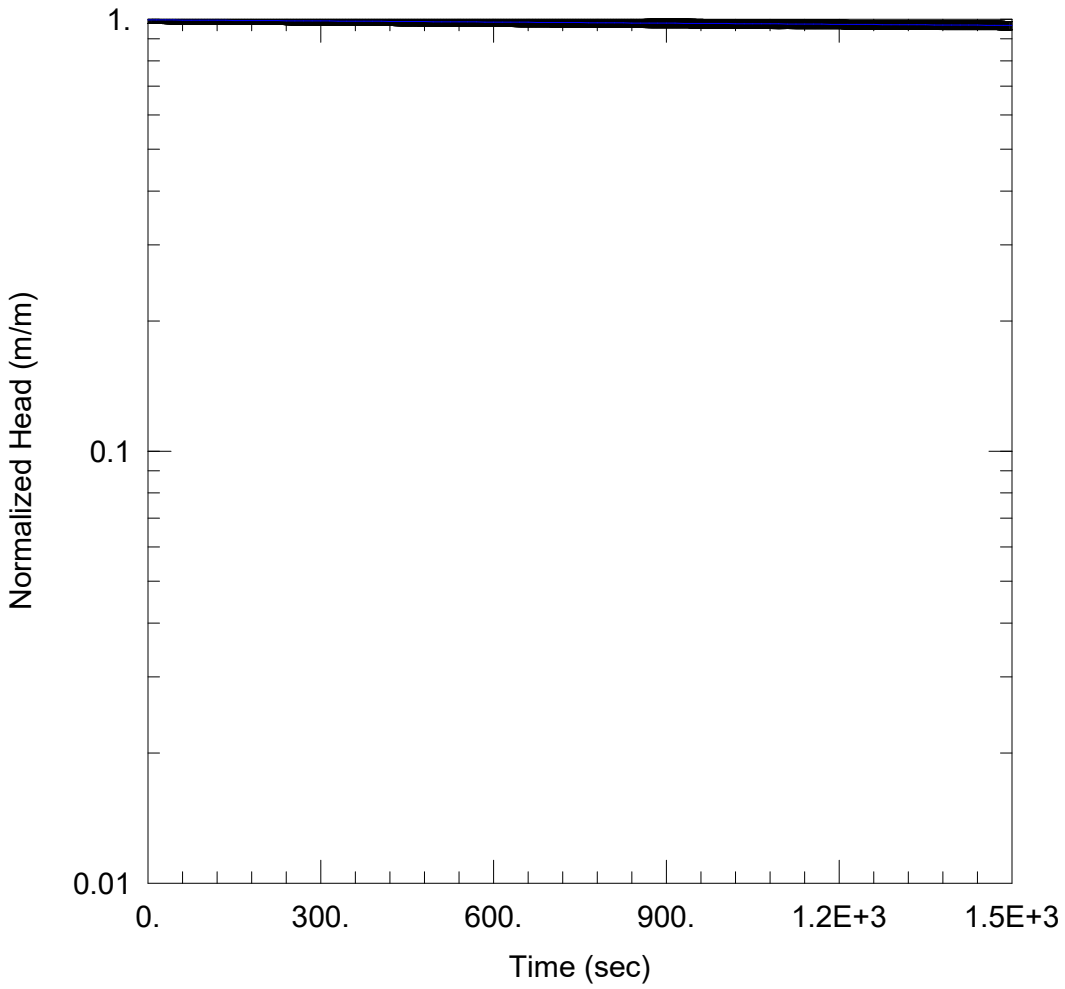
Saturated Thickness: 7.275 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 19-04 (MW))

Initial Displacement: 5.667 m
Total Well Penetration Depth: 7.275 m
Casing Radius: 0.0254 m
Static Water Column Height: 7.275 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.45E-8 m/sec
y0 = 5.626 m



SWRT - RISING HEAD - MW 1001

Data Set: \...\MW 1001.aqt
Date: 02/08/21 Time: 16:02:46

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Fieldgate Properties Limited
Project: BRM-00801554-F0
Location: 1600 Kerns Rd, Burlington, ON
Test Well: MW 1001
Test Date: Feb 5, 2021

AQUIFER DATA

Saturated Thickness: 5.46 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW 1001)

Initial Displacement: 4.854 m
Total Well Penetration Depth: 5.46 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.46 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

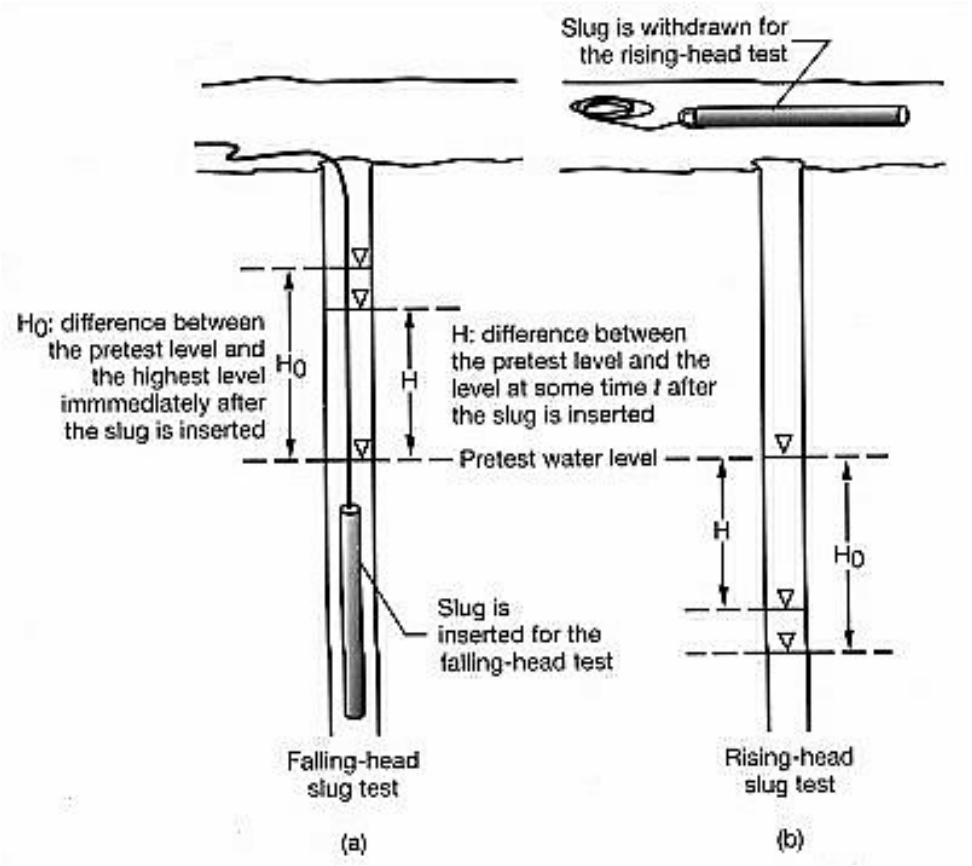
Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 8.65E-9 m/sec
y0 = 4.835 m

Single Well Response Test Procedure

A Single Well Response Test (SWRT), also known as a bail test or a slug test, is conducted in order to determine the saturated hydraulic conductivity (K) of an aquifer. The method of the SWRT is to characterize the change of groundwater level in a well or borehole over time.

In order to ensure consistency and repeatability, all **exp** employees are to follow the procedure outlined in this document when conducting SWRTs.

The figure below depicts a schematic of a slug and bail test and the respective water level changes.



Initials ___

Slug Test Procedure

Equipment Required

- Copy of a signed health and safety plan
- Copy of the work program
- PPE as required by Site-Specific HASP
- Copy of the monitoring well location plan/site plan
- Waterproof pen and bound field note book
- SWRT field data Entry form
- Disposable gloves
- Duct tape
- Deionized water
- Alconox (phosphate free detergent)
- Spray bottles
- Electronic water level meter and spare batteries
- Solid PVC or stainless steel slug of known volume or clean water
- String (nylon)
- Water pressure transducer (data logger) and baro-logger
- Watch or stop watch with second hand
- Plastic sheeting

Testing Procedure

1. Remove cap from well and collect static water level
2. Remove waterra tubing/bailer and place in garbage bag. Record static water level measurement again.
3. Lower the slug into the well and record the dynamic water level.
4. Record the drawdown (for the slug test) at set five (5) second intervals for the first five (5) minutes, then reduce to every one (1) minute.
5. Continue recording the drawdown until 95% recovery is reached. To calculate this value: Find the difference between the dynamic water level and the static water level, then multiply by 95% (.95). Add the resulting value to the dynamic water level.

   (Static Water Level – Dynamic Water Level).95 + Static Water Level = 95% Recovery Value
6. Once complete, replace the waterra tubing/bailer and re-secure the well cap.

Note: If the well is deep, more than one slug may be inserted by attaching the slugs to a series.

Slugs must be washed with methanol, then lab grade soap, and then rinsed with de-ionized water after each use.

Based on the recorded observations, the hydraulic conductivity (in m/s) of the aquifer will be determined. In order to determine the hydraulic conductivity; the well diameter, radius of the borehole and length of the screen will also be required.

Bail Test Procedure

Equipment Required

- 20 L (5 gal) Graduated pail
- Stop watch or watch with seconds
- Garbage bags
- Water level meter
- Field sheets/log book
- Latex Gloves
- Bailer and Rope

Procedure

1. Remove cap from well and collect static water level.
2. If using a **bailer**:
    a. Affix the rope to the bailer.
    b. Remove the waterra tubing and place in garbage bag
    c. Record static water level measurement again.
    d. Record how much water was removed by either counting the number of full bailers or emptying removed water into a container.
    e. Quickly lower the bailer into the well and remove.
    f. Continue this process until the water level will reduce no further.
    g. Record the dynamic water level.
3. If using **waterra** to bail the water:
    a. Pump the water into graduated bucket until the water level will reduce no further.
    b. Record how much water has been removed.
    c. Record the dynamic water level.
4. Record the recovery at set five (5) second intervals for the first (5) minutes, then reduce to every one (1) minute.
5. Continue recording the drawdown/recovery until 95% recovery is reached.
6. Once complete, replace any waterra tubing that may have been removed from the well and re-secure the well cap.

Appendix D – Laboratory's Certificates of Analysis

Your Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Your C.O.C. #: 811835-01-01

Attention: Jay Samarakkody

exp Services Inc
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2021/02/11
Report #: R6514517
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C132501
Received: 2021/02/05, 14:35

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonaceous BOD	1	2021/02/06	2021/02/11	CAM SOP-00427	SM 23 5210B m
Total Cyanide	1	2021/02/10	2021/02/10	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2021/02/06	2021/02/08	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2021/02/08	2021/02/08	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by Axial ICP	1	2021/02/08	2021/02/08	CAM SOP-00408	EPA 6010D m
E.coli, (CFU/100mL)	1	N/A	2021/02/05	CAM SOP-00552	MOE LSB E3371
Animal and Vegetable Oil and Grease	1	N/A	2021/02/10	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2021/02/10	2021/02/10	CAM SOP-00326	EPA1664B m,SM5520B m
PAH Compounds in Water by GC/MS (SIM)	1	2021/02/09	2021/02/10	CAM SOP-00318	EPA 8270D m
pH	1	2021/02/06	2021/02/08	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2021/02/08	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2021/02/08	CAM SOP-00464	EPA 375.4 m
Total Kjeldahl Nitrogen in Water	1	2021/02/08	2021/02/09	CAM SOP-00938	OMOE E3516 m
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	1	2021/02/10	2021/02/10	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2021/02/06	2021/02/08	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2021/02/07	CAM SOP-00228	EPA 8260C m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Your Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Your C.O.C. #: 811835-01-01

Attention: Jay Samarakkody

exp Services Inc
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2021/02/11
Report #: R6514517
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C132501
Received: 2021/02/05, 14:35

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bureauveritas.com
Phone# (519)652-9444

==========

This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C132501
Report Date: 2021/02/11

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

HALTON SANITARY & COMBINED SEWER (2-03)

BV Labs ID				OTZ123			OTZ123		
Sampling Date				2021/02/05 10:38			2021/02/05 10:38		
COC Number				811835-01-01			811835-01-01		
	UNITS	Criteria	Criteria B	BH 19-02	RDL	QC Batch	BH 19-02 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Total Animal/Vegetable Oil and Grease	mg/L	150	-	ND	0.50	7186857			
Inorganics									
Total Carbonaceous BOD	mg/L	300	-	ND	2	7188421			
Fluoride (F-)	mg/L	10	-	0.21	0.10	7188730			
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	ND	0.10	7190186	ND	0.10	7190186
pH	pH	6.0:10.0	6.5:8.5	7.86		7188749			
Phenols-4AAP	mg/L	1	-	ND	0.0010	7189392			
Total Suspended Solids	mg/L	350	-	14	10	7188675			
Dissolved Sulphate (SO4)	mg/L	1500	-	100	1.0	7188729			
Total Cyanide (CN)	mg/L	2	-	ND	0.0050	7194187			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	ND	0.50	7194478			
Total Oil & Grease Mineral/Synthetic	mg/L	-	-	ND	0.50	7194483			
Metals									
Total Aluminum (Al)	mg/L	50	-	ND	0.1	7189582			
Total Antimony (Sb)	mg/L	5	-	ND	0.02	7189582			
Total Arsenic (As)	mg/L	1	-	ND	0.01	7189582			
Total Beryllium (Be)	mg/L	5	-	ND	0.0005	7189582			
Total Cadmium (Cd)	mg/L	1	-	ND	0.002	7189582			
Total Chromium (Cr)	mg/L	3	-	ND	0.01	7189582			
Total Cobalt (Co)	mg/L	5	-	ND	0.002	7189582			
Total Copper (Cu)	mg/L	3	-	ND	0.01	7189582			
Total Iron (Fe)	mg/L	50	-	0.24	0.02	7189582			
Total Lead (Pb)	mg/L	3	-	ND	0.01	7189582			
Total Manganese (Mn)	mg/L	5	-	0.14	0.001	7189582			
Mercury (Hg)	mg/L	0.05	-	ND	0.00010	7189828			
Total Molybdenum (Mo)	mg/L	5	-	0.006	0.005	7189582			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria,Criteria B: Halton Sanitary and Storm sewer by-law
ND = Not detected

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C132501
Report Date: 2021/02/11

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

HALTON SANITARY & COMBINED SEWER (2-03)

BV Labs ID				OTZ123			OTZ123		
Sampling Date				2021/02/05 10:38			2021/02/05 10:38		
COC Number				811835-01-01			811835-01-01		
	UNITS	Criteria	Criteria B	BH 19-02	RDL	QC Batch	BH 19-02 Lab-Dup	RDL	QC Batch
Total Nickel (Ni)	mg/L	3	-	ND	0.005	7189582			
Total Phosphorus (P)	mg/L	10	-	ND	0.05	7189582			
Total Selenium (Se)	mg/L	5	-	ND	0.02	7189582			
Total Silver (Ag)	mg/L	5	-	ND	0.01	7189582			
Total Tin (Sn)	mg/L	5	-	ND	0.02	7189582			
Total Titanium (Ti)	mg/L	5	-	ND	0.005	7189582			
Total Zinc (Zn)	mg/L	3	-	ND	0.005	7189582			
Polyaromatic Hydrocarbons									
Naphthalene	ug/L	140	-	ND	0.050	7193106			
Volatile Organics									
Benzene	ug/L	10	-	ND	0.40	7188641			
Chloroform	ug/L	40	-	ND	0.40	7188641			
1,4-Dichlorobenzene	ug/L	80	-	ND	0.80	7188641			
Ethylbenzene	ug/L	160	-	ND	0.40	7188641			
Methylene Chloride(Dichloromethane)	ug/L	2000	-	ND	4.0	7188641			
Tetrachloroethylene	ug/L	1000	-	ND	0.40	7188641			
Toluene	ug/L	16	-	ND	0.40	7188641			
Trichloroethylene	ug/L	400	-	ND	0.40	7188641			
Surrogate Recovery (%)									
D10-Anthracene	%	-	-	105		7193106			
D14-Terphenyl (FS)	%	-	-	94		7193106			
D8-Acenaphthylene	%	-	-	89		7193106			
4-Bromofluorobenzene	%	-	-	96		7188641			
D4-1,2-Dichloroethane	%	-	-	107		7188641			
D8-Toluene	%	-	-	93		7188641			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria,Criteria B: Halton Sanitary and Storm sewer by-law
ND = Not detected

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C132501
Report Date: 2021/02/11

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

HALTON STORM SEWER BYLAW (2-03)

BV Labs ID			OTZ123		
Sampling Date			2021/02/05 10:38		
COC Number			811835-01-01		
	UNITS	Criteria B	BH 19-02	RDL	QC Batch
Microbiological					
Escherichia coli	CFU/100mL	200	<10	10	7187892

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria B: Halton Sanitary and Storm sewer by-law

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C132501
Report Date: 2021/02/11

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

TEST SUMMARY

BV Labs ID: OTZ123
Sample ID: BH 19-02
Matrix: Water

Collected: 2021/02/05
Shipped:
Received: 2021/02/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Carbonaceous BOD	DO	7188421	2021/02/06	2021/02/11	Nusrat Naz
Total Cyanide	SKAL/CN	7194187	2021/02/10	2021/02/10	Aditiben Patel
Fluoride	ISE	7188730	2021/02/06	2021/02/08	Surinder Rai
Mercury in Water by CVAA	CV/AA	7189828	2021/02/08	2021/02/08	Prempal Bhatti
Total Metals Analysis by Axial ICP	ICPX	7189582	2021/02/08	2021/02/08	Archana Patel
E.coli, (CFU/100mL)	PL	7187892	N/A	2021/02/05	Soham Patel
Animal and Vegetable Oil and Grease	BAL	7186857	N/A	2021/02/10	Automated Statchk
Total Oil and Grease	BAL	7194478	2021/02/10	2021/02/10	Saumya Modh
PAH Compounds in Water by GC/MS (SIM)	GC/MS	7193106	2021/02/09	2021/02/10	Mitesh Raj
pH	AT	7188749	2021/02/06	2021/02/08	Surinder Rai
Phenols (4AAP)	TECH/PHEN	7189392	N/A	2021/02/08	Bramdeo Motiram
Sulphate by Automated Colourimetry	KONE	7188729	N/A	2021/02/08	Deonarine Ramnarine
Total Kjeldahl Nitrogen in Water	SKAL	7190186	2021/02/08	2021/02/09	Louise Harding
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	7194483	2021/02/10	2021/02/10	Saumya Modh
Total Suspended Solids	BAL	7188675	2021/02/06	2021/02/08	Shaneil Hall
Volatile Organic Compounds in Water	GC/MS	7188641	N/A	2021/02/07	Blair Gannon

BV Labs ID: OTZ123 Dup
Sample ID: BH 19-02
Matrix: Water

Collected: 2021/02/05
Shipped:
Received: 2021/02/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Kjeldahl Nitrogen in Water	SKAL	7190186	2021/02/08	2021/02/09	Louise Harding

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C

Sample OTZ123 [BH 19-02] : VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

BV Labs Job #: C132501
Report Date: 2021/02/11

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7188641	4-Bromofluorobenzene	2021/02/07	103	70 - 130	103	70 - 130	99	%				
7188641	D4-1,2-Dichloroethane	2021/02/07	105	70 - 130	100	70 - 130	100	%				
7188641	D8-Toluene	2021/02/07	102	70 - 130	101	70 - 130	94	%				
7193106	D10-Anthracene	2021/02/10	107	50 - 130	114	50 - 130	112	%				
7193106	D14-Terphenyl (FS)	2021/02/10	101	50 - 130	108	50 - 130	104	%				
7193106	D8-Acenaphthylene	2021/02/10	100	50 - 130	104	50 - 130	93	%				
7188421	Total Carbonaceous BOD	2021/02/11					ND,RDL=2	mg/L	0.37	30	88	85 - 115
7188641	1,4-Dichlorobenzene	2021/02/07	107	70 - 130	100	70 - 130	ND, RDL=0.40	ug/L	NC	30		
7188641	Benzene	2021/02/07	93	70 - 130	87	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7188641	Chloroform	2021/02/07	98	70 - 130	91	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7188641	Ethylbenzene	2021/02/07	88	70 - 130	84	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7188641	Methylene Chloride(Dichloromethane)	2021/02/07	101	70 - 130	91	70 - 130	ND, RDL=2.0	ug/L	NC	30		
7188641	Tetrachloroethylene	2021/02/07	89	70 - 130	84	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7188641	Toluene	2021/02/07	95	70 - 130	88	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7188641	Trichloroethylene	2021/02/07	102	70 - 130	97	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7188675	Total Suspended Solids	2021/02/08					ND, RDL=10	mg/L	NC	25	95	85 - 115
7188729	Dissolved Sulphate (SO4)	2021/02/08	110	75 - 125	101	80 - 120	ND, RDL=1.0	mg/L	0.51	20		
7188730	Fluoride (F-)	2021/02/08	107	80 - 120	100	80 - 120	ND, RDL=0.10	mg/L	7.1	20		
7188749	pH	2021/02/08			102	98 - 103			4.4	N/A		
7189392	Phenols-4AAP	2021/02/08	102	80 - 120	99	80 - 120	ND, RDL=0.0010	mg/L	0.83	20		
7189582	Total Aluminum (Al)	2021/02/08	108	80 - 120	106	80 - 120	ND, RDL=0.1	mg/L				
7189582	Total Antimony (Sb)	2021/02/08	106	80 - 120	105	80 - 120	ND, RDL=0.02	mg/L				
7189582	Total Arsenic (As)	2021/02/08	106	80 - 120	105	80 - 120	ND, RDL=0.01	mg/L				
7189582	Total Beryllium (Be)	2021/02/08	107	80 - 120	104	80 - 120	ND, RDL=0.0005	mg/L				
7189582	Total Cadmium (Cd)	2021/02/08	107	80 - 120	106	80 - 120	ND, RDL=0.002	mg/L				
7189582	Total Chromium (Cr)	2021/02/08	110	80 - 120	107	80 - 120	ND, RDL=0.01	mg/L				
7189582	Total Cobalt (Co)	2021/02/08	102	80 - 120	102	80 - 120	ND, RDL=0.002	mg/L				

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7189582	Total Copper (Cu)	2021/02/08	108	80 - 120	106	80 - 120	ND, RDL=0.01	mg/L				
7189582	Total Iron (Fe)	2021/02/08	106	80 - 120	107	80 - 120	ND, RDL=0.02	mg/L				
7189582	Total Lead (Pb)	2021/02/08	102	80 - 120	102	80 - 120	ND, RDL=0.01	mg/L				
7189582	Total Manganese (Mn)	2021/02/08	106	80 - 120	104	80 - 120	ND, RDL=0.001	mg/L				
7189582	Total Molybdenum (Mo)	2021/02/08	103	80 - 120	102	80 - 120	ND, RDL=0.005	mg/L				
7189582	Total Nickel (Ni)	2021/02/08	101	80 - 120	102	80 - 120	ND, RDL=0.005	mg/L				
7189582	Total Phosphorus (P)	2021/02/08	102	80 - 120	103	80 - 120	ND, RDL=0.05	mg/L				
7189582	Total Selenium (Se)	2021/02/08	108	80 - 120	106	80 - 120	ND, RDL=0.02	mg/L				
7189582	Total Silver (Ag)	2021/02/08	106	80 - 120	104	80 - 120	ND, RDL=0.01	mg/L				
7189582	Total Tin (Sn)	2021/02/08	103	80 - 120	103	80 - 120	ND, RDL=0.02	mg/L				
7189582	Total Titanium (Ti)	2021/02/08	103	80 - 120	101	80 - 120	ND, RDL=0.005	mg/L				
7189582	Total Zinc (Zn)	2021/02/08	103	80 - 120	103	80 - 120	ND, RDL=0.005	mg/L				
7189828	Mercury (Hg)	2021/02/08	92	75 - 125	95	80 - 120	ND, RDL=0.00010	mg/L	NC	20		
7190186	Total Kjeldahl Nitrogen (TKN)	2021/02/09	107	80 - 120	104	80 - 120	ND, RDL=0.10	mg/L	NC	20	100	80 - 120
7193106	Naphthalene	2021/02/10	91	50 - 130	85	50 - 130	ND, RDL=0.050	ug/L	NC	30		
7194187	Total Cyanide (CN)	2021/02/10	99	80 - 120	102	80 - 120	ND, RDL=0.0050	mg/L	NC	20		
7194478	Total Oil & Grease	2021/02/10			96	85 - 115	ND, RDL=0.50	mg/L	2.1	25		

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7194483	Total Oil & Grease Mineral/Synthetic	2021/02/10			90	85 - 115	ND, RDL=0.50	mg/L	2.2	25		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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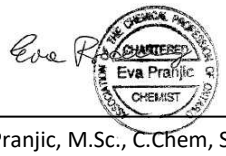
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C132501
Report Date: 2021/02/11

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Soham Patel, Analyst I

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

MICRO

Bureau Veritas Laboratories
740 Campobello Road, Mississauga, Ontario, Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvlabs.com

Page of

CHAIN OF CUSTODY RECORD

Stream 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#30554 exp Services Inc	Company Name:	Exp Services Inc	Quotation #:	B91717	BV Labs Job #:	Bottle Order #:
Attention:	Central Services	Attention:	Jay Samarakkody	P.O. #:	ENV-BRM		811835
Address:	1595 Clark Blvd Brampton ON L6T 4V1	Address:	edwin.russell@exp.com Chantel.Simon	Project:	BRM-00801554-F0	COC #:	Project Manager:
Tel:	(905) 793-9800 Fax: (905) 793-0641	Tel:	Fax:	Project Name:		C#811835-01-01	Christine Gripton
Email:	AP@exp.com; Karen.Burke@exp.com	Email:	jay.samarakkody@exp.com	Site #:	1600 Kerns Road, Burlington, O		
				Sampled By:	Edwin Russell		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☐ Coarse
- ☐ Table 3 ☐ Agri/Other ☐ For RSC
- ☐ Table ___

Other Regulations
- ☐ CCME ☑ Sanitary Sewer Bylaw
- ☐ Reg 558 ☑ Storm Sewer Bylaw
- ☐ MISA Municipality Halton
- ☐ PWQO ☐ Reg 406 Table ___
- ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? Yes

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Halton Sanitary & Combined Sewer (2-03)	Halton Storm Sewer Bylaw (2-03)	# of Bottles	Comments
1		BH 19-02	21/2/5	10:38	GW	✓			15	
2										
3										
4										
5										
6										
7										
8										
9										
10										

05-Feb-21 14:35
Christine Gripton
C132501

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Edwin Russell	21/2/5	2:20pm	E. Alexander FEDOR	2021/02/05	14:35	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal Present	Yes	No
	7/4/4 ON ICE	Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C132501
Report Date: 2021/02/11

exp Services Inc
Client Project #: BRM-00801554-F0
Site Location: 1600 Kerns Road, Burlington, ON
Sampler Initials: E.C

Exceedance Summary Table – Halton Storm and Sanitary

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
No Exceedances						

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

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Maxxam
A Bureau Veritas Group Company

Your Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Your C.O.C. #: 115539

Attention: David Mably

exp Services Inc
Brampton Branch
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2018/12/04
Report #: R5511397
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8V8387
Received: 2018/11/28, 16:54

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum	2	N/A	2018/12/03	CAM SOP-00301	EPA 8270D m
Chloride by Automated Colourimetry	2	N/A	2018/11/30	CAM SOP-00463	EPA 325.2 m
Chromium (VI) in Water	2	N/A	2018/12/03	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	2	N/A	2018/11/30	CAM SOP-00457	OMOE E3015 m
Petroleum Hydro. CCME F1 & BTEX in Water	2	N/A	2018/11/30	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (1)	2	2018/11/30	2018/12/01	CAM SOP-00316	CCME PHC-CWS m
Mercury	2	2018/12/01	2018/12/03	CAM SOP-00453	EPA 7470A m
Dissolved Metals by ICPMS	2	N/A	2018/12/03	CAM SOP-00447	EPA 6020B m
PAH Compounds in Water by GC/MS (SIM)	2	2018/11/30	2018/12/01	CAM SOP-00318	EPA 8270D m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Your C.O.C. #: 115539

Attention: David Mably

exp Services Inc
Brampton Branch
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2018/12/04
Report #: R5511397
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8V8387

Received: 2018/11/28, 16:54

(1) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tanya Fidlin, Project Manager
Email: tfidlin@maxxam.ca
Phone# (905)817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Job #: B8V8387
Report Date: 2018/12/04

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

O.REG 153 METALS & INORGANICS PKG (WTR)

Maxxam ID		IKK722		IKK723		
Sampling Date		2018/11/28 13:00		2018/11/28 15:00		
COC Number		115539		115539		
	UNITS	**BH5**	**RDL**	**BH6**	**RDL**	**QC Batch**
Inorganics						
WAD Cyanide (Free)	ug/L	<1	1	<1	1	5864682
Dissolved Chloride (Cl-)	mg/L	120	1.0	690	6.0	5862993
Metals						
Chromium (VI)	ug/L	1.0	0.50	<0.50	0.50	5863280
Mercury (Hg)	ug/L	<0.1	0.1	<0.1	0.1	5866738
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	5864280
Dissolved Arsenic (As)	ug/L	<1.0	1.0	3.1	1.0	5864280
Dissolved Barium (Ba)	ug/L	38	2.0	120	2.0	5864280
Dissolved Beryllium (Be)	ug/L	<0.50	0.50	<0.50	0.50	5864280
Dissolved Boron (B)	ug/L	120	10	3800	10	5864280
Dissolved Cadmium (Cd)	ug/L	<0.10	0.10	0.13	0.10	5864280
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	5864280
Dissolved Cobalt (Co)	ug/L	0.92	0.50	4.6	0.50	5864280
Dissolved Copper (Cu)	ug/L	3.7	1.0	7.1	1.0	5864280
Dissolved Lead (Pb)	ug/L	<0.50	0.50	16	0.50	5864280
Dissolved Molybdenum (Mo)	ug/L	11	0.50	5.8	0.50	5864280
Dissolved Nickel (Ni)	ug/L	2.3	1.0	8.9	1.0	5864280
Dissolved Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	5864280
Dissolved Silver (Ag)	ug/L	<0.10	0.10	<0.10	0.10	5864280
Dissolved Sodium (Na)	ug/L	88000	100	410000	100	5864280
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	5864280
Dissolved Uranium (U)	ug/L	3.4	0.10	2.0	0.10	5864280
Dissolved Vanadium (V)	ug/L	<0.50	0.50	4.0	0.50	5864280
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	34	5.0	5864280

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B8V8387
Report Date: 2018/12/04

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

O.REG 153 PAHS (WATER)

Maxxam ID		IKK722		IKK723		
Sampling Date		2018/11/28 13:00		2018/11/28 15:00		
COC Number		115539		115539		
	UNITS	**BH5**	**QC Batch**	**BH6**	**RDL**	**QC Batch**
Calculated Parameters						
Methylnaphthalene, 2-(1-)	ug/L	<0.071	5862880	<0.071	0.071	5863530
Polyaromatic Hydrocarbons						
Acenaphthene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Acenaphthylene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Anthracene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Benzo(a)anthracene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Benzo(a)pyrene	ug/L	<0.010	5866082	<0.010	0.010	5866082
Benzo(b/j)fluoranthene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Benzo(g,h,i)perylene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Benzo(k)fluoranthene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Chrysene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Dibenz(a,h)anthracene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Fluoranthene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Fluorene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	5866082	<0.050	0.050	5866082
1-Methylnaphthalene	ug/L	<0.050	5866082	<0.050	0.050	5866082
2-Methylnaphthalene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Naphthalene	ug/L	0.41	5866082	<0.050	0.050	5866082
Phenanthrene	ug/L	0.051	5866082	<0.030	0.030	5866082
Pyrene	ug/L	<0.050	5866082	<0.050	0.050	5866082
Surrogate Recovery (%)						
D10-Anthracene	%	105	5866082	92		5866082
D14-Terphenyl (FS)	%	76	5866082	61		5866082
D8-Acenaphthylene	%	99	5866082	93		5866082

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B8V8387
Report Date: 2018/12/04

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

O.REG 153 PETROLEUM HYDROCARBONS (WATER)

Maxxam ID		IKK722	IKK723		
Sampling Date		2018/11/28 13:00	2018/11/28 15:00		
COC Number		115539	115539		
	UNITS	**BH5**	**BH6**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons					
Benzene	ug/L	<0.20	<0.20	0.20	5864252
Toluene	ug/L	<0.20	<0.20	0.20	5864252
Ethylbenzene	ug/L	<0.20	<0.20	0.20	5864252
o-Xylene	ug/L	<0.20	0.21	0.20	5864252
p+m-Xylene	ug/L	<0.40	<0.40	0.40	5864252
Total Xylenes	ug/L	<0.40	<0.40	0.40	5864252
F1 (C6-C10)	ug/L	<25	<25	25	5864252
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	5864252
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	5866078
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	200	5866078
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	5866078
Reached Baseline at C50	ug/L	Yes	Yes		5866078
Surrogate Recovery (%)					
1,4-Difluorobenzene	%	104	101		5864252
4-Bromofluorobenzene	%	102	101		5864252
D10-Ethylbenzene	%	95	93		5864252
D4-1,2-Dichloroethane	%	97	97		5864252
o-Terphenyl	%	108	106		5866078

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B8V8387
Report Date: 2018/12/04

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

TEST SUMMARY

Maxxam ID: IKK722
Sample ID: BH5
Matrix: Water

Collected: 2018/11/28
Shipped:
Received: 2018/11/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5862880	N/A	2018/12/03	Automated Statchk
Chloride by Automated Colourimetry	KONE	5862993	N/A	2018/11/30	Alina Dobreanu
Chromium (VI) in Water	IC	5863280	N/A	2018/12/03	Lang Le
Free (WAD) Cyanide	SKAL/CN	5864682	N/A	2018/11/30	Louise Harding
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	5864252	N/A	2018/11/30	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5866078	2018/11/30	2018/12/01	Jeevaraj Jeevaratrnam
Mercury	CV/AA	5866738	2018/12/01	2018/12/03	Medhat Nasr
Dissolved Metals by ICPMS	ICP/MS	5864280	N/A	2018/12/03	Thao Nguyen
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5866082	2018/11/30	2018/12/01	Mitesh Raj

Maxxam ID: IKK723
Sample ID: BH6
Matrix: Water

Collected: 2018/11/28
Shipped:
Received: 2018/11/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5863530	N/A	2018/12/03	Automated Statchk
Chloride by Automated Colourimetry	KONE	5862993	N/A	2018/11/30	Alina Dobreanu
Chromium (VI) in Water	IC	5863280	N/A	2018/12/03	Lang Le
Free (WAD) Cyanide	SKAL/CN	5864682	N/A	2018/11/30	Louise Harding
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	5864252	N/A	2018/11/30	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5866078	2018/11/30	2018/12/01	Jeevaraj Jeevaratrnam
Mercury	CV/AA	5866738	2018/12/01	2018/12/03	Medhat Nasr
Dissolved Metals by ICPMS	ICP/MS	5864280	N/A	2018/12/03	Thao Nguyen
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5866082	2018/11/30	2018/12/01	Mitesh Raj

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exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.7°C

Sample IKK722 [BH5] : Hexavalent Chromium > Total/Dissolved Chromium: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5864252	1,4-Difluorobenzene	2018/11/30	102	70 - 130	103	70 - 130	103	%		
5864252	4-Bromofluorobenzene	2018/11/30	103	70 - 130	102	70 - 130	100	%		
5864252	D10-Ethylbenzene	2018/11/30	94	70 - 130	94	70 - 130	90	%		
5864252	D4-1,2-Dichloroethane	2018/11/30	95	70 - 130	96	70 - 130	94	%		
5866078	o-Terphenyl	2018/12/01	108	60 - 130	114	60 - 130	105	%		
5866082	D10-Anthracene	2018/11/30	102	50 - 130	104	50 - 130	103	%		
5866082	D14-Terphenyl (FS)	2018/11/30	105	50 - 130	106	50 - 130	103	%		
5866082	D8-Acenaphthylene	2018/11/30	95	50 - 130	96	50 - 130	96	%		
5862993	Dissolved Chloride (Cl-)	2018/11/30	NC	80 - 120	102	80 - 120	<1.0	mg/L	0.78	20
5863280	Chromium (VI)	2018/12/03	98	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
5864252	Benzene	2018/11/30	93	70 - 130	93	70 - 130	<0.20	ug/L	NC	30
5864252	Ethylbenzene	2018/11/30	87	70 - 130	89	70 - 130	<0.20	ug/L	NC	30
5864252	F1 (C6-C10) - BTEX	2018/11/30					<25	ug/L	NC	30
5864252	F1 (C6-C10)	2018/11/30	101	70 - 130	99	70 - 130	<25	ug/L	NC	30
5864252	o-Xylene	2018/11/30	86	70 - 130	85	70 - 130	<0.20	ug/L	NC	30
5864252	p+m-Xylene	2018/11/30	87	70 - 130	88	70 - 130	<0.40	ug/L	NC	30
5864252	Toluene	2018/11/30	91	70 - 130	92	70 - 130	<0.20	ug/L	NC	30
5864252	Total Xylenes	2018/11/30					<0.40	ug/L	NC	30
5864280	Dissolved Antimony (Sb)	2018/12/03	116	80 - 120	109	80 - 120	<0.50	ug/L	NC	20
5864280	Dissolved Arsenic (As)	2018/12/03	108	80 - 120	104	80 - 120	<1.0	ug/L	NC	20
5864280	Dissolved Barium (Ba)	2018/12/03	111	80 - 120	105	80 - 120	<2.0	ug/L	7.2	20
5864280	Dissolved Beryllium (Be)	2018/12/03	106	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
5864280	Dissolved Boron (B)	2018/12/03	106	80 - 120	100	80 - 120	<10	ug/L	0.59	20
5864280	Dissolved Cadmium (Cd)	2018/12/03	110	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
5864280	Dissolved Chromium (Cr)	2018/12/03	104	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
5864280	Dissolved Cobalt (Co)	2018/12/03	105	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
5864280	Dissolved Copper (Cu)	2018/12/03	109	80 - 120	104	80 - 120	<1.0	ug/L	14	20
5864280	Dissolved Lead (Pb)	2018/12/03	103	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
5864280	Dissolved Molybdenum (Mo)	2018/12/03	113	80 - 120	107	80 - 120	<0.50	ug/L	NC	20
5864280	Dissolved Nickel (Ni)	2018/12/03	102	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5864280	Dissolved Selenium (Se)	2018/12/03	110	80 - 120	104	80 - 120	<2.0	ug/L	NC	20

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Maxxam Job #: B8V8387
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QUALITY ASSURANCE REPORT(CONT'D)

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5864280	Dissolved Silver (Ag)	2018/12/03	105	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
5864280	Dissolved Sodium (Na)	2018/12/03	NC	80 - 120	97	80 - 120	<100	ug/L	0.27	20
5864280	Dissolved Thallium (Tl)	2018/12/03	103	80 - 120	97	80 - 120	<0.050	ug/L	NC	20
5864280	Dissolved Uranium (U)	2018/12/03	105	80 - 120	100	80 - 120	<0.10	ug/L	5.1	20
5864280	Dissolved Vanadium (V)	2018/12/03	108	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
5864280	Dissolved Zinc (Zn)	2018/12/03	104	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
5864682	WAD Cyanide (Free)	2018/11/30	100	80 - 120	101	80 - 120	<1	ug/L	NC	20
5866078	F2 (C10-C16 Hydrocarbons)	2018/12/01	113	50 - 130	115	60 - 130	<100	ug/L	NC	30
5866078	F3 (C16-C34 Hydrocarbons)	2018/12/01	116	50 - 130	116	60 - 130	<200	ug/L	NC	30
5866078	F4 (C34-C50 Hydrocarbons)	2018/12/01	112	50 - 130	113	60 - 130	<200	ug/L	NC	30
5866082	1-Methylnaphthalene	2018/12/01	102	50 - 130	99	50 - 130	<0.050	ug/L	NC	30
5866082	2-Methylnaphthalene	2018/12/01	93	50 - 130	89	50 - 130	<0.050	ug/L	NC	30
5866082	Acenaphthene	2018/12/01	92	50 - 130	91	50 - 130	<0.050	ug/L	NC	30
5866082	Acenaphthylene	2018/12/01	93	50 - 130	93	50 - 130	<0.050	ug/L	NC	30
5866082	Anthracene	2018/12/01	93	50 - 130	94	50 - 130	<0.050	ug/L	NC	30
5866082	Benzo(a)anthracene	2018/12/01	94	50 - 130	92	50 - 130	<0.050	ug/L	NC	30
5866082	Benzo(a)pyrene	2018/12/01	93	50 - 130	94	50 - 130	<0.010	ug/L	NC	30
5866082	Benzo(b/j)fluoranthene	2018/12/01	94	50 - 130	98	50 - 130	<0.050	ug/L	NC	30
5866082	Benzo(g,h,i)perylene	2018/12/01	84	50 - 130	86	50 - 130	<0.050	ug/L	NC	30
5866082	Benzo(k)fluoranthene	2018/12/01	89	50 - 130	86	50 - 130	<0.050	ug/L	NC	30
5866082	Chrysene	2018/12/01	96	50 - 130	96	50 - 130	<0.050	ug/L	NC	30
5866082	Dibenz(a,h)anthracene	2018/12/01	80	50 - 130	80	50 - 130	<0.050	ug/L	NC	30
5866082	Fluoranthene	2018/12/01	102	50 - 130	101	50 - 130	<0.050	ug/L	NC	30
5866082	Fluorene	2018/12/01	95	50 - 130	95	50 - 130	<0.050	ug/L	NC	30
5866082	Indeno(1,2,3-cd)pyrene	2018/12/01	86	50 - 130	88	50 - 130	<0.050	ug/L	NC	30
5866082	Naphthalene	2018/12/01	91	50 - 130	87	50 - 130	<0.050	ug/L	NC	30
5866082	Phenanthrene	2018/12/01	97	50 - 130	97	50 - 130	<0.030	ug/L	NC	30
5866082	Pyrene	2018/12/01	100	50 - 130	100	50 - 130	<0.050	ug/L	NC	30

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QUALITY ASSURANCE REPORT(CONT'D)

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5866738	Mercury (Hg)	2018/12/03	91	75 - 125	91	80 - 120	<0.1	ug/L	NC	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

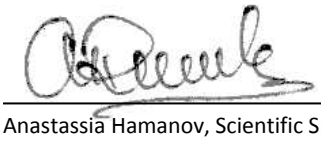
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Report Date: 2018/12/04

exp Services Inc
Client Project #: BRM-00801554-A0
Site Location: KERNS RD., BURLINGTON
Sampler Initials: BT

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Anastassia Hamanov, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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28-Nov-18 16:54
Tanya Fidlin
B8V8387
URE ENV-411

Presence of Visible Particulate/Sediment

Maxxam Analytics
CAM FCD-01013/5

When there is >1cm of visible particulate/sediment, the amount will be recorded in the field below

Bottle Types

			Inorganics					Organics											Hydrocarbons							Volatiles				Other
	Sample ID	All	CrVI	CN	General	Hg	Metals (Diss.)	Organic 1 of 2	Organic 2 of 2	PCB 1 of 2	PCB 2 of 2	Pest/ Herb 1 of 2	Pest/ Herb 2 of 2	SVOC/ ABN 1 of 2	SVOC/ ABN 2 of 2	PAH 1 of 2	PAH 2 of 2	Dioxin /Furan	F1 Vial 1	F1 Vial 2	F1 Vial 3	F1 Vial 4	F2-F4 1 of 2	F2-F4 2 of 2	F4G	VOC Vial 1	VOC Vial 2	VOC Vial 3	VOC Vial 4	
1	BH5	P																											
2	BH6	S				TS																							
3																													
4																													
5																													
6																													
7																													
8																													
9																													
10																													

Comments: except DISM, HGVIC and chrom VI bottle for Id BH5
except DISM and chrom VI bottle for Id BH6.

Legend:	
P	Suspended Particulate
TS	Trace Settled Sediment (just covers bottom of container or less)
S	Sediment greater than (>) Trace, but less than (<) 1 cm

Recorded By: (signature/print) Rosen Rosen Kinneval.

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/3

CHAIN OF CUSTODY RECORD 115539 Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: exp #17488	Company Name: exp	Quotation #: 545998	[X] Regular TAT (5-7 days) Most analyses
Contact Name: Cetal Services	Contact Name: David Hubly/Ben Triolo	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 1595 Clark Blvd. Brampton, ON	Address: R. Watts	Project #: BRM-00801554-A0	Rush TAT (Surcharges will be applied) [ ] 1 Day [ ] 2 Days [ ] 3-4 Days
Phone: Fax:	Phone: david.hubly@exp.com Fax: ben.triolo@exp.com	Site Location: Kirns Rd. Burlington	
Email: Karen.burke@exp.com; AP@exp.com	Email: rwatts@uttersenvironmental.com	Site #: Sampled By: BT/NM	Date Required:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Rush Confirmation #:

LABORATORY USE ONLY

CUSTODY SEAL: Present (Y) / N Intact

COOLER TEMPERATURES: 9/8/6

COOLING MEDIA PRESENT: (Y) / N

Regulation 153

[ ] Table 1 [ ] Res/Park [ ] Med/ Fine
[ ] Table 2 [ ] Ind/Comm [ ] Coarse
[ ] Table 3 [ ] Agri/ Other
[X] Table 9
FOR RSC (PLEASE CIRCLE) Y / (N)

Other Regulations

[ ] CCME [ ] Sanitary Sewer Bylaw
[ ] MISA [ ] Storm Sewer Bylaw
[ ] PWQO Region
[ ] Other (Specify)
[ ] REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / (N)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) (Metals, CrVI)	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PHC F1-F4	PAH						HOLD- DO NOT ANALYZE	COMMENTS
1	BH5	2018/11/28	1pm	GW	9	X				X			X	X							
2	BH6	↓	3pm	GW	9	X				X			X	X							some sediment
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
Ben Triolo	2018/11/28	16:53		2018/11/28	16:54

28-Nov-18 16:54
Tanya Fidlin
B8V8387
URE ENV-411

Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Maxxam's standard Terms and Conditions. Signing of this Chain of Custody document is acknowle available for viewing at www.maxxam.ca/terms. Sample container, preservation, hold time and packages information can be viewed at http://maxxam.ca/wp-content/uploads/Ontario-COC.pdf.

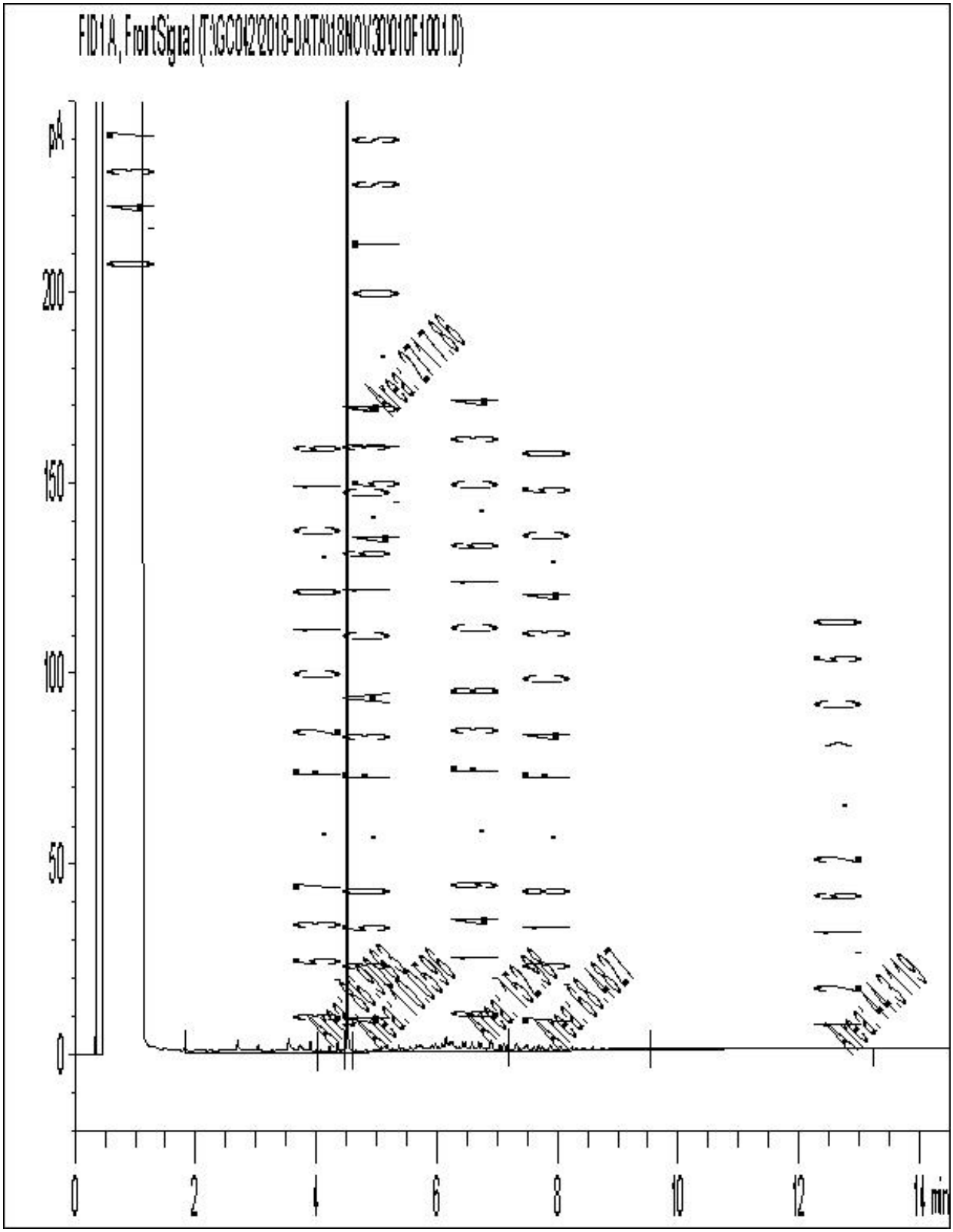
COC-1004 (03/17)

White: Maxxam ~ Yellow: Client

Maxxam Job #: B8V8387
Report Date: 2018/12/04
Maxxam Sample: IKK722

exp Services Inc
Client Project #: BRM-00801554-A0
Project name: KERNS RD., BURLINGTON
Client ID: BH5

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

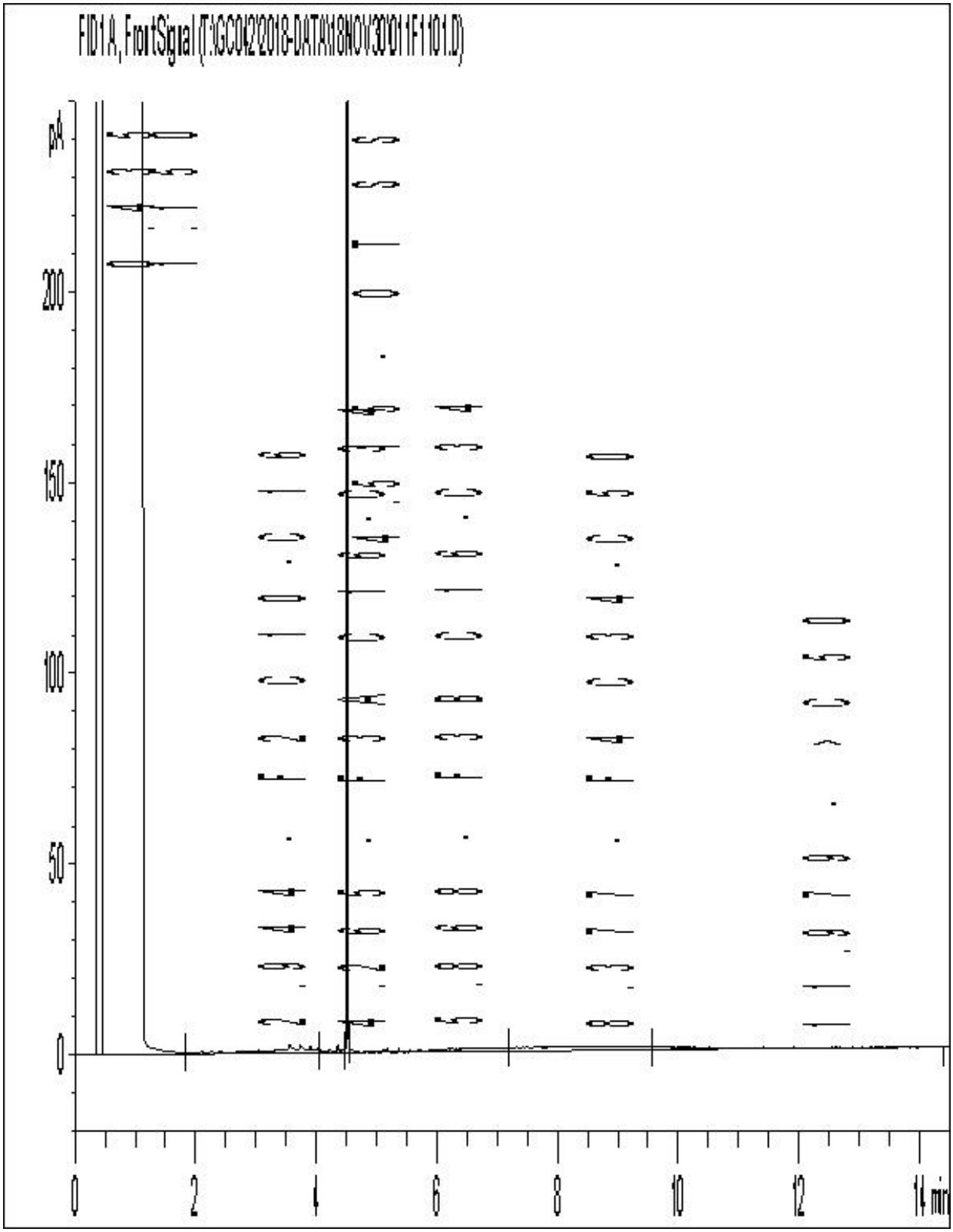


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B8V8387
Report Date: 2018/12/04
Maxxam Sample: IKK723

exp Services Inc
Client Project #: BRM-00801554-A0
Project name: KERNS RD., BURLINGTON
Client ID: BH6

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Appendix E – Infiltration Rate Testing Results

1600 Kerns Road, Burlington, Ontario
BRM-00801554-F0
Low Impact Design (LID) Calculations for Infiltration Gallery

Test Location	Hydraulic Conductivity (K_{fs}) (cm/s)	Infiltration Rate (IR) (mm/hr)	Discrete Design Infiltration Rate(DIR) (mm/hr)	Percolation Time (min/cm)
INF1	9.4E-06	25	5	110

Geology Units	Geometric Mean of K_{fs} (cm/s)	Infiltration Rate (I) (mm/hr)*	Ratio of Mean Measured Infiltration Rates	Safety Correction Factor (SCF)
Overlying Geology Unit	9.40E-06	24.6	6.5	**4.5**
Lowest K for the lower soil layers (at BH/MW 1001)	8.70E-09	4		

Design Infiltration Rate(DIR) (mm/hr)	Minimum	5	**Perculation Time (min/cm)**	110
	Maximum	5		110
	Geometric Mean	**5**		**110**

Note:
Analytical Solutions (CVC and TRCA 2010)

$$Infiltration\ Rate\ (IR) = \left(\frac{K_{fs}}{6x10^{-11}}\right)^{\frac{1}{3.7363}}$$

$$Design\ Infiltration\ Rate\ (DIR) = \frac{IR}{SCF}$$

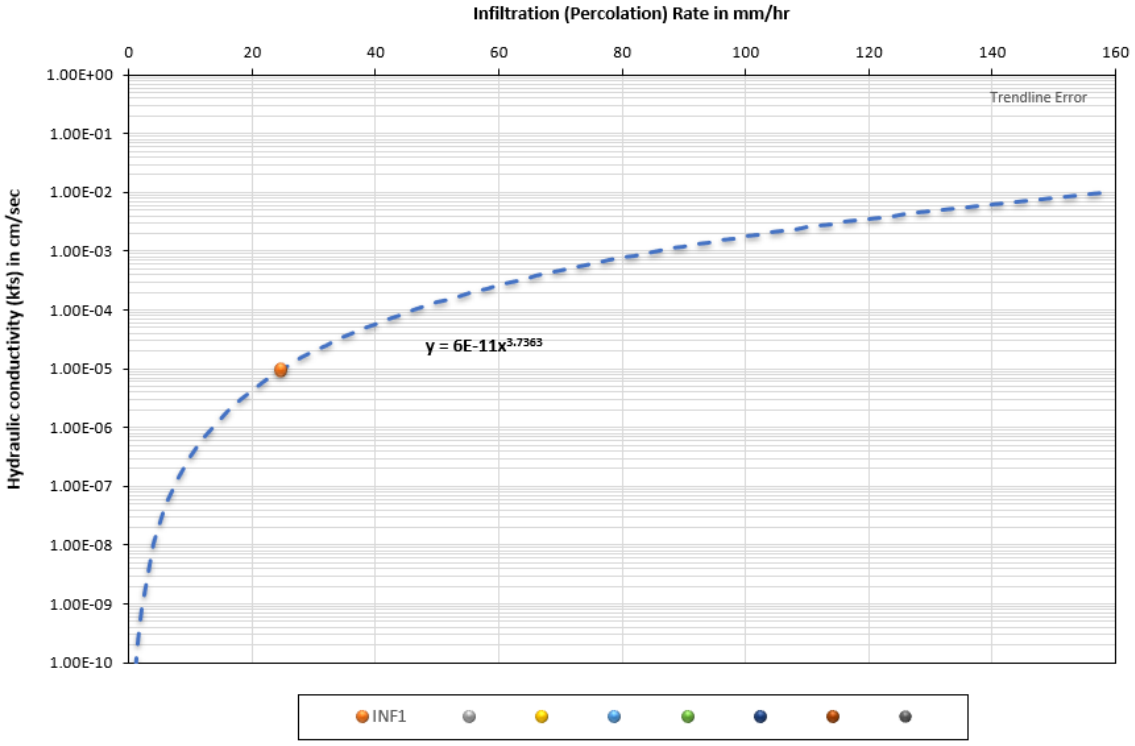
Kfs: hydraulic conductivity (cm/sec)

IR: infiltration rate (mm/hr)

DIR: design infiltration rate (mm/hr)

SCF: Safety Correction Factor (based on the chart recommended by CVC and TRCA, 2010)

Figure : Approximate relationship between infiltration rate and hydraulic conductivity (LID SWM planning and Design Guide, Appendix C1)



Appendix F – Water Balance Analysis

Attachment F-1: Model Input

1600 Kern's Road, Burlington

BRM-00801554-F0

Year	Month	Ave. T (^{0}C)	Ave P (mm)
1980-2010	1	-5.5	63.3
1980-2010	2	-4.7	56.8
1980-2010	3	-0.2	69.8
1980-2010	4	6.7	80.1
1980-2010	5	12.8	78.9
1980-2010	6	18.2	84.8
1980-2010	7	20.9	99.1
1980-2010	8	20.0	78.5
1980-2010	9	15.8	81.9
1980-2010	10	9.3	77.0
1980-2010	11	3.6	83.1
1980-2010	12	-2.4	72.4

Note:

Climate Station Name: HAMILTON A

Climate Station ID: 6153194

Attachment F-2: Model Output

1600 Kern's Road, Burlington

BRM-00801554-F0

Month	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus
January	9.3	65.6	25.6	196.3	9.3	0.0	52.8	24.6
February	10.8	56.8	29.8	197.5	10.8	0.0	70.7	27.8
March	20.3	69.8	62.7	200.0	20.3	0.0	57.6	60.2
April	38.3	80.1	70.6	200.0	38.3	0.0	28.8	70.6
May	69.5	78.9	23.8	194.7	69.5	0.0	14.4	29.1
June	102.3	84.8	-9.0	170.7	101.1	1.3	5.9	16.3
July	119.5	99.1	-15.9	150.6	115.4	4.2	1.4	8.3
August	96.9	78.5	-17.0	132.9	88.3	8.6	0.0	9.2
September	57.6	81.9	24.3	149.7	54.9	2.7	0.0	10.2
October	30.7	77.0	46.3	175.2	30.4	0.3	0.0	21.1
November	16.3	83.1	66.4	191.6	16.3	0.0	0.5	49.9
December	10.2	72.4	39.7	196.1	10.2	0.0	23.0	35.2
Annual Rate (mm/yr)		**928.1**			**564.8**			**363.3**

Note:

Climate Station Name: HAMILTON A

Climate Station ID: 6153194

Attachment F-3
Lot-level Average Infiltration Factors

1600 Kern's Road, Burlington
BRM-00801554-F0

1. Average Infiltration Factor – Pre Development Conditions

Category	Weighted Infiltration Factor
Topography/Slope	0.062
Soil Type Glociolacustrine derived silty clay till	0.20
Cover 35% Cultivated Lands	0.06
Total weighted Infiltration factor	**0.323**

2. Average Infilteration Factor – Post Development Conditions

Un-Mitigated

Category	Weighted IInfiltration Factor
Topography/Slope	0.072
Soil Type 57% Modern and Older Alluvial Deposits, 43% Glacial deposits (Silt to Clay)	0.20
Cover 68% Cultivated Lands	0.07
Total weighted Infiltration factor	**0.341**

Notes:

Landscaped area considered equivalent to Cultivated Cover

Attachment F-4
Summary of Pre and Post-Development Water Balance (Unmitigated)

1600 Kern's Road, Burlington
BRM-00801554-F0

1. Climate Data

Description	Pre-Development mm/year		Post-Development Un-Mitigated mm/year
Precipitation	928.10		928.10
Evapotranspiration	564.80		564.80
Water Surplus	363.30		363.30
Infiltration Rate	117.35		123.89
Runoff	245.95		239.41

2. Pre-Developed Study Area Statistics

Surface Water Features	200	m^2
Open spaces/ Wood Lot, Landscaped	2,700	m^2
Paved Surface (parking, roadways)	3,200	m^2
Existing Buildings	1,900	m^2
TOTAL	8,000	m^2

3. Proposed Lot Coverage -

Building Roofs	2,930	m^2
Driveways, parking	1,200	m^2
Landscape, woodlots	3,670	m^2
Surface Water Features	200	m^2
TOTAL	8,000	m^2

4. Annual Pre-Development Water Balance

Land Use	**Area m^2**	**Precipitation m^2**	**Actual Evapotranspiration m^3**	**Infiltration Rate * m^3**	**Run-off m^3**
Surface Water Features	**200**	186	186		
Total Impervious (buildings and Parking Lots)	5,100	4,733	0	0	4,733
Total Pervious (woodlots and landscaped)	2,700	2,506	1,525	317	664
Total	8,000	7,425	1,711	317	5,397
			Pre-development Infiltration Rate	**39.6**	**mm/a**
		100	23.0	4.3	72.7

5. Annual Post-Development Water Balance Un-Mitigated

Land Use	**Area m^2**	**Precipitation m^3**	**Actual Evapotranspiration m^3**	**Infiltration Rate * m^3**	**Run-off m^3**
Surface Water Features	**200**	186	186	0	**0**
Building Roofs	2,930	2,719	0	0	2,719
ROW (drive ways, parking)	1,200	1,114	0	0	1,114
Total Pervious (Woodlot, landscaped)	3,670	3,406	2,073	455	879
TOTAL	8,000	7,425	2,259	455	4,712
		Post-development Infiltration Rate Un-Mitigated		**56.8**	**mm/a**
		100	30.4	6.1	63.5

6. Comparison of Pre-Development and Post-Development Un-Mitigated

	Precipitation m^3	**Actual Evapotranspiration m^3**	**Run-off m^3**	**Infiltration Rate m^3**
Pre-Development	7,425	1,711	5,397	317
Post Development	7,425	2,259	4,712	455
			Pre-development Infiltration Rate (mm/year)	**40**
			Post-development Infiltration Rate Un-Mitigated (mm/year)	**57**
			Deficit Post Development Un-Mitigated (m^3/year)	**-138**

Appendix G – Construction Flow Rate Calculations

APPENDIX G: Short-Term Flow Rate

1600 Kerns Road, Burlington, ON
BRM-00801554-F0

Table G-1: Flow from Under-Slab Drain System

Parameters	Symbols	Unit	Value
Geological Formation	-	-	Glacial Deposit
Ground Elevation	-	mASL	139.0
Lowest Top Slab Elevation	-	mASL	135.5
Highest Groundwater Elevation	-	mASL	137.3
Lowest Footing Elevation	-	mASL	134.0
Base of the Water-Bearing Zone	-	mASL	130.0
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	7.3
Dewatering Target Elevation	-	mASL	133.0
Height of Target Water Level Above the Base of Water-Bearing Zone	**h_w**	m	3.0
Hydraulic Conductivity	**K**	m/s	1.1E-05
Length of Excavation (area without caisson wall)	-	m	50
Width of Excavation (area without caisson wall)	-	m	25
Equivalent Radius (equivalent perimeter)	**r_e**	m	23.87
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**
Time (30 days)	**t**	s	1728000
Specific Yield	**Sy**		0.20
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	39.51
Radius of Influence	**Ro**	m	63.38
Dewatering Flow Rate (unconfined radial flow component)	**Q**	m^3/day	140
Factor of Safety	**fs**	-	1.50
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	210
Precipitation Event	-	mm/day	15
Volume from Precipitation (for 50 m x 50 m)	-	m^3/day	40
Dewatering Flow Rate **Without Safety Factor** (including stormwater collection)	-	m^3/day	180
Dewatering Flow Rate **With Safety Factor** (including stormwater collection)	-	m^3/day	250

Notes:
mASL - meters above sea level

Analytical Solution for Estimating Radial Flow from an Unconfined Aquifer to a Fully-Penetrating Excavation

$$Q_w = \frac{\pi K(H^2 - h^2)}{Ln\,[\frac{R_o}{r_e}]}$$

(Based on the Dupuit-Forcheimer Equation)

$$r_e = \frac{a+b}{\pi} \qquad R_o = R_{cj} + r_e \qquad R_{cj} = \sqrt{2.25KDt/S}$$

Where:

Q_w = Flow rate per unit length of excavation (m^3/s)

K = Hydraulic conductivity (m/s)

H = Height of static water table above base of water-bearing zone (m)

h_w = Height of target water level above the base of water-bearing zone (m)

Rcj=Cooper Jacob Radius of Influence (m)

R_o=Radius of influence (m)

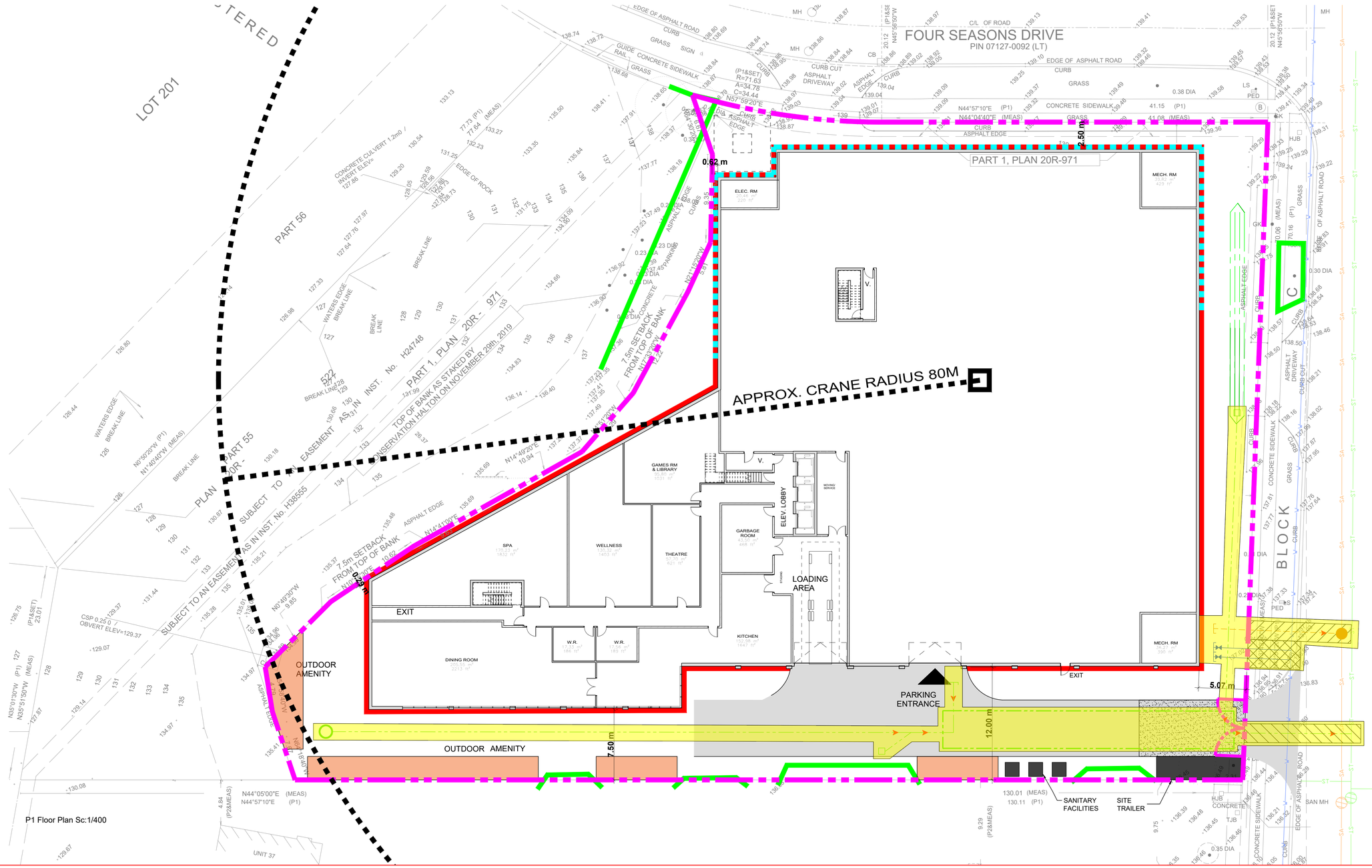
re=Equivalent perimeter (m)

LEGEND

- TREE PROTECTION
- LIMITS OF CONSTRUCTION/ SECURITY FENCING (6'-0" CONSTRUCTION FENCING)
- SHORING (INTERNAL RAKERS WHERE TIEBACKS CONFLICT)
- TOWER CRANE/SWING
- LIMITS OF UNDERGROUND
- PROPOSED SERVICES
- MATERIAL STORAGE
- CONSTRUCTION MUDMAT WASHDOWN AREA
- TEMP ROAD CLOSURE (STORM)
- TEMP ROAD CLOSURE (SANITARY)
- TEMP ROAD CLOSURE (WATER)
- ENTRANCE GATE

NOTES

1) AS NOTED BY CITY OF BURLINGTON CAPITAL WORKS, "ALL ELEMENTS OF THE UNDERGROUND PARKING STRUCTURE (I.E. WALLS, FOUNDATION DRAINS, SHORING, ETC.) ARE REQUIRED TO BE WITHIN THE LIMITS OF THE SUBJECT PROPERTY"
   i) ALL PERMANENT AND TEMPORARY STRUCTURES ARE WITHIN PROPERTY LINES, TEMPORARY SHORING WILL NOT ENTER R.O.W. AND WILL BE CANTILEVERED OR USE INTERNAL RAKERS.
   ii) WHERE SHORING IS NOT REQUIRED (SOUTHERN HALF OF SITE) AS EX. GRADING LOWERS MOVING SOUTHWARD SLOPING AT THE PERIMITER OF THE EXCAVATION WILL ALSO BE REMAIN WITHIN THE PROPERTY LINES
2) CLOSURES: NO LANE CLOSURES ARE ANTICIPATED AT THIS TIME.
3) CONSTRUCTION STAGING: NO CONSTRUCTION STAGING ANTICIPATED ON CITY RIGHT OF WAY
4) HAUL ROUTE: IN REVIEW WITH CITY OF BURLINGTON
5) CRANE LOCATION & RADIUS - APPROXIMATE LOCATION AND RADIUS INDICATED ON PLANS
6) NO TRADES PARKING OR TRUCK STAGING IS PERMITTED ON THE MUNICIPAL RIGHT OF WAY.
7) BURLINGTON HYDRO HAS BEEN CONTACTED, SERVICE ESTIMATES HAVE BEEN PROVIDED FOR REVIEW
8) UNION GAS (ENBRIDGE GAS) HAS BEEN CONTACTED AND HAS EXPRESSED NO CONCERNS REGARDING FUTURE DEVELOPMENT
9) PER CITY OF BURLINGTON CAPITAL WORKS, "PRECONDITION SURVEY OF AREA BUILDINGS PRIOR TO START OF EXCAVATION AND VIBRATION MONITORING FOR THE DURATION OF CONSTRUCTION, WILL BE REQUIRED, LIMITS OF STUDY AREA TO BE DETERMINED."



Construction Management and Mobility Plan
Scale: 1 : 200

1
CMMP1

No.:	Revision:	Date:

No :	Issued For:	Date:

Drawing Title:

Construction Management and Mobility Plan

Project:
FIELDGATE PROPERTIES

1600 KERNS RETIREMENT HOME

1600 KERNS ROAD, BURLINGTON, ON

Scale:	1 : 200
Drawn by:	J.D.
Checked by:	J.D.
Project No.:	1600K
Date:	21/03/01

Drawing No.:

CMMP1

Appendix H – Long-Term Flow Rate Calculations

APPENDIX H: Long-Term Flow Rate

1600 Kerns Road, Burlington, ON
BRM-00801554-F0

Table H-1: Flow from Under-Slab Drain System

Parameters	Symbols	Unit	Value
Geological Formation	-	-	Glacial Deposit
Ground Elevation	-	mASL	139.0
Lowest Top Slab Elevation	-	mASL	135.5
Highest Groundwater Elevation	-	mASL	137.3
Lowest Footing Elevation	-	mASL	134.0
Base of the Water-Bearing Zone	-	mASL	130.0
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	7.3
Dewatering Target Elevation	-	mASL	135.0
Height of Target Water Level Above the Base of Water-Bearing Zone	**h_w**	m	5.0
Hydraulic Conductivity	**K**	m/s	1.11E-05
Length of Excavation (area without caisson wall)	-	m	50
Width of Excavation (area without caisson wall)	-	m	50
Equivalent Radius (equivalent perimeter)	**r_e**	m	31.83
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**
Time (180 days)	**t**	s	15552000
Specific Yield	**Sy**		0.20
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	119.07
Radius of Influence	**Ro**	m	150.90
Dewatering Flow Rate (unconfined radial flow component)	**Q**	m^3/day	54.77
Factor of Safety	**fs**	-	1.5
Dewatering Flow Rate (multiplied by factor of safety) (caisson wall north half)	**Q.fs**	m^3/day	41
Dewatering Flow Rate **Without Safety Factor**	-	m^3/day	25
Dewatering Flow Rate **With Safety Factor**	-	m^3/day	40

Notes:
mASL - meters above sea level

Analytical Solution for Estimating Radial Flow from an Unconfined Aquifer to a Fully-Penetrating Excavation

$$Q_w = \frac{\pi K (H^2 - h^2)}{Ln\,[\frac{R_o}{r_e}]}$$

(Based on the Dupuit-Forcheimer Equation)

$$r_e = \frac{a+b}{\pi} \qquad R_o = R_{cj} + r_e \qquad \mathrm{R}_{cj} = \sqrt{2.25KDt/S}$$

Where:

Q_w = Flow rate per unit length of excavation (m^3/s)

K = Hydraulic conductivity (m/s)

H = Height of static water table above base of water-bearing zone (m)

h_w = Height of target water level above the base of water-bearing zone (m)

Rcj=Cooper Jacob Radius of Influence (m)

R_o=Radius of influence (m)

re=Equivalent perimeter (m)