Hydrogeological Investigation and Water Balance Assessment

688, 694, and 698 Brant Street, Burlington, Ontario

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by Elite 688 Brant Holdings Inc. to prepare a Hydrogeological Investigation and Water Balance Assessment Report associated with the proposed development located at 688, 694, and 698 Brant Street, Burlington, Ontario (hereinafter referred to as the 'Site'). The Site location plan is shown on Figure 1.

The Site has an area of approximately 0.76 hectares (1.89 acres). The Site is situated at 688, 694, and 698 Brant Street and is currently occupied by a mid-rise commercial building with a partial basement on the south portion (688 Brant Street), low rise residential building with full basement on the central portion (694 Brant Street), and a low-rise residential building with full basement on the north portion (698 Brant Street). The site is bound by Brant Street to the east, residential properties to the north and west, and commercial properties to the south. The exterior areas of the Site consist of asphalt paved parking areas to the north and west, and landscaped lawns east of the Site buildings.

It is EXP's understanding that the Site is proposed to be redeveloped for residential purposes with a proposed eleven (11) storey condominium building structure with three (3) levels of underground parking (P3).

The Site is entirely within Halton Region Source Protection Area (SPA) with entire site located within Highly Vulnerable Aquifer (HVA) area and within Intake Protection Zone (IPZ 2) with intrinsic vulnerability of 5.6. Therefore, the hydrogeological study and water balance assessment is required.

EXP conducted a Supplemental Geotechnical Investigation and Environmental Site Assessments in conjunction with this investigation. The pertinent information gathered from the noted investigations is utilized for this report.

1.2 Project Objectives

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

- Establish the local hydrogeological settings within the Site;
- Assess construction dewatering flow rates and potential impacts;
- Provide recommendations on long term groundwater management;
- Assess groundwater quality;
- Develop a water balance for pre- and post-development conditions using a Thornthwaite-Mather water balance approach an provide water balance deficits between pre- and post-development conditions;
- Assess potential impacts and provide preliminary guidance for mitigation measures;
- Conduct seasonal (one year) groundwater level monitoring on a bi-monthly basis; and
- Prepare a Hydrogeological Investigation and Water Balance Assessment Report.

1.3 Scope of Work

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

- Drilled and installed three (3) 50 mm diameter monitoring wells in bedrock (up to 13.5 mbgs each), pre-drilled three (3) shallow infiltration test holes (up to 1 mbgs each) and drilled and installed three (3) shallow 50 mm diameter monitoring wells in overburden (up to 4.8 mbgs each);

- Developed and conducted Single Well Response Tests (SWRT) on all three (3) monitoring wells to evaluate the hydraulic conductivity of the soils within the screened intervals;
- Conducted three (3) in-situ infiltration tests at shallow depths (up to 1 mbgs) at pre-drilled locations at broad scale across the site to provide infiltration rates across the Site;
- Conducted seasonal groundwater monitoring for a duration of one year on bi-monthly basis (on-going);
- Collected one (1) groundwater sample from a selected monitoring well for laboratory testing for parameters listed in the City of Burlington / Halton region Sanitary and Storm Sewer Use By-law;
- Estimated construction dewatering flow rates for proposed development;
- Evaluated permitting requirements for temporary water taking and dewatering effluent disposal from regulatory agencies;
- Reviewed private water supply wells on site and within 500 m of the property (database searches – desktop study);
- Evaluated the information collected during the field investigation program, including borehole geological information, SWRT results, infiltration test results, groundwater level measurements, and groundwater quality;
- Prepared site plans, cross-section, geological mapping, and groundwater contour mapping for the site;
- Reviewed available past 30 years of climatic data for the Site;
- Mapped existing areas in accordance with topography, soil cover, shallow soil types, and use a Thornthwaite-Mather approach to determine the water balance for pre- and post-development conditions (desk-top);
- Mapped surrounding natural features (desk-top);
- Provided a pre-development water balance based on existing conditions and climatic data;
- Provided a post-development water balance based on development plans;
- Estimated deficits between pre- and post-development conditions, and identify areas where mitigation measures can be implemented;
- Assessed existing infiltration rates based on a Thornthwaite and Mather method based on 30 years of climatic data and provided recommendations on mitigation measures and size Low Impact Development measures (LID); and
- Prepared a Hydrogeological Investigation and Water Balance Assessment Report.

1.4 Review of Previous Reports

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

- EXP Services Inc. (November 25, 2021), Preliminary Geotechnical Investigation, 688 Brant Street, Burlington, ON, prepared for Elite Developments.
- EXP Services Inc. (February 10, 2023), Phase One ESA, 688 Brant Street, Burlington, ON, prepared for Elite 688 Brant Holdings Inc.
- EXP Services Inc. (February 10, 2023), Phase Two ESA, 688 Brant Street, Burlington, ON, prepared for Elite 688 Brant Holdings Inc.
- EXP Services Inc. (February 27, 2023), Supplemental Geotechnical Investigation, 688 Brant Street, Burlington, ON, prepared for Elite Developments.

Any past and/or future geotechnical, hydrogeological, environmental and risk assessments, and updated development/architectural plans should be provided to update this hydrogeological report prior to submission of permits and approvals by the municipalities and agencies.

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is within a physiographic region known as the Iroquois Plain. The physiographic landform is named Sand Plains (Chapman & Putnam, 2007).

The Iroquois Plain was created along the shores of former Lake Iroquois, an ancient glacial lake. The noted Plain primarily consists of shallow water sandy deposits.

The topography of the Iroquois Plain is relatively flat with a gradual slope to the south, towards Lake Ontario.

2.1.2 Regional Geology and Hydrogeology

The surficial geology can be described as coarse textured (foreshore-basinal) glaciolacustrine deposits consisting of sand, gravel, minor silt and clay (Ministry of Northern Development and Mines, 2012). The surficial geology of the Site and surrounding areas is shown on Figure 2.

Based on the available regional geology maps, the subsurface stratigraphy of the Site from top to bottom is summarized in Table 2-1 (TRCA, 2008 and Oak Ridge Moraine Groundwater Program, 2018). The overburden thickness is approximately 4.0 meters (m).

Table 2-1: Summary of Subsurface Stratigraphy

Stratigraphic Unit	General Description	Top Elevation of Stratigraphic Unit (masl)
Undifferentiated Upper Sediments	Coarse textured (foreshore-basinal) glaciolacustrine deposits consisting of sand, gravel, minor silt and clay Ministry of Northern Development and Mines, 2012)	90.9
Halton Till or Equivalent (Aquitard)	This lithologic unit typically consists of sandy silt to clayey silt till interbedded with silt, clay, sand and gravel.	90.7
Bedrock (Queenston Formation)	Bedrock primarily consists of Upper Ordovician aged red shale and siltstone, minor green shale and siltstone, and variable calcareous siltstone to sandstone and limestone interbeds.	86.9

Regional groundwater across the area flows southeast, towards Lake Ontario (Oak Ridge Moraine Groundwater Program, 2018). 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. The available regional data suggests that water table is located within bedrock at approximate elevation 84.2 m.

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 forty-one (41) records within a 500 m radius from the Site centroid. No wells on the record are identified onsite (Figure 3 and Appendix A). Well distances are calculated relative to the Site centroid, therefore some distances in Appendix A exceed 500 m.

The database indicates that the offsite wells are at an approximate distance of one hundred and twenty-eight (128) m or greater from the Site centroid. All offsite wells were reportedly identified as monitoring and observation wells and test holes (27), abandoned wells (4) and/or listed with unknown use (10).

The reported water levels ranged from depths of 2.0 m to 7.0 meters below ground surface (mbgs).

2.2 Site Setting

2.2.1 Site Topography

The Site is in a commercial and residential land use setting. The topography is considered relatively flat with a regional gradual southeasterly slope towards Lake Ontario.

As indicated on the borehole logs included in Appendix B, the ground surface elevation of the Site ranges between approximately 91.23 to 91.53 meters above sea level (masl).

2.2.2 Local Surface Water Features

The Site is predominantly on a watershed divide between two watershed areas, with most southern portions of the site located in the Lower Hager Creek watershed and northern parts of the Site within Lower Rambo Creek watershed. No surface water features exist onsite. The nearest surface water features are Rambo Creek located approximately 250 m east of the Site and Lake Ontario located approximately 1.1 km southeast from the Site boundary (Conservation Halton Online Basemap - camaps.maps.arcgis.com).

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 geotechnical investigation report (EXP, 2023). 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 Investigation and Water Balance Assessment 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.

Asphalt (overlying granular fill) or surficial topsoil was encountered at all boreholes and was underlain by fill and/or native sand. The fill extended to depths ranging from approximately 0.8 to the maximum explored depth of 2.1 m below existing

grade at Borehole BH-5 (2023). The native soil consisted of sand or silty sand overlying various till deposits. Upper Ordovician aged red shale bedrock of the Queenston Formation was encountered underlying the till at depths ranging from approximately 4.6 to 6.1 m below existing grade.

Based on the results of the geotechnical and environmental investigations, the general subsurface soil stratigraphy consists of the following units from top to bottom:

Pavement Structure

Boreholes BH-1 to BH-4 (2021) and Boreholes BH-1, BH-2, and BH-4 (2023) were advanced through the existing pavement structure, which consisted of approximately 80 to 125 mm of asphalt overlying approximately 125 to 250 mm of granular fill. The granular fill generally consisted of crushed limestone.

Surficial Topsoil

Boreholes BH-5 (2021) and Boreholes BH-3 and BH-5 (2023) encountered a surficial layer of topsoil ranging in thickness from approximately 150 to 330 mm. It is noted that topsoil thicknesses may further vary across the site.

Fill

Fill was encountered in all boreholes, except Borehole BH-4 (2021), underlying the pavement structure or topsoil and extended to depths of approximately 0.8 to the maximum explored depth of 2.1 m at Borehole BH-5 (2023). The fill generally comprised clayey silt, sandy silt, or silty sand with some clay pockets, traces of gravel, asphalt, and rootlets, and varying proportions of red brick fragments. The fill was reddish brown, brown, or dark brown; and in a moist state, with moisture contents ranging from 8 to 19%.

Sand to Silty Sand

Native lacustrine sand or silty sand was encountered in all the boreholes below the granular fill and/or fill and extended to depths of approximately 2.3 to 4.6 m below existing grade. The sand contained trace to some silt and trace gravel and occasional trace shale fragments; was brown or grey; and in a moist to very moist state, with moisture contents ranging from 6 to 17%. SPT N values of the stratum ranged from 0 to 71 blows per 305 mm of penetration. The SPT N values indicate the stratum to be in a very loose to loose condition in the upper portion of the stratum, but generally became compact to very dense below 1.5 m.

Till

Various glacial till deposits were encountered in all boreholes underlying the native sand or silty sand. The till extended to the shale bedrock at depths ranging from 4.6 to 6.1 m below grade. The till generally comprised silt, silty clay, and/or silty sand to sandy silt with trace to some gravel, shale fragments, and clay. The till was reddish brown, brown, or grey; and in a damp to wet state, with moisture contents ranging from 5 to 20%. The stratum was compact to very dense and/or hard with SPT N values ranging from 16 to greater than 100 blows per 305 mm penetration.

Shale Bedrock (Queenston Formation)

Sampling spoon refusal on assumed bedrock surface was encountered in all boreholes except BH-5 (2023) at depths ranging from 4.6 to 6.1 m below grade (~Elev. 85.4 - 85.9). It should be noted that the contact elevations should not be interpreted as exact planes of bedrock since the auger will frequently penetrate some distance into the weathered rock before noticeable resistance is encountered. Further, the distinction between highly weathered shale and the overlying stratum, particularly if the latter contains abundant shale fragments, is not always clear and consequently, some of the soil resting on the surface of

the bedrock might be very weak and highly weathered shale. The bedrock was then confirmed by coring in Boreholes BH-1, BH-3, and BH-4 (2023) to approximate depths of 13.2 to 13.5 m below grade.

The Queenston Shale bedrock is highly weathered in the upper portion (becoming more sound with depth), and it exhibits characteristics more commonly encountered with soil than with rock (slake durability index less than 80%, higher moisture content, etc.). Hard limestone interbeds are also possible within the shale; these hard layers can result in contractual problems for excavations.

The borehole and monitoring well locations are shown on Figure 4. Geological cross-section was 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'). The cross section shows a simplified representation of soil conditions and soil deposits may be interconnected differently than represented. 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 current supplemental geotechnical, hydrogeological and environmental investigations at the Site. EXP advanced a total of ten (10) boreholes at the Site during 2023 investigations (current). These include three (3) sub-surface (up to 1 mbgs) boreholes for the in-situ infiltration testing, one (1) borehole (BH-5) for environmental purposes (up to 2.1 mbgs) for environmental purposes; and six (6) boreholes instrumented with monitoring wells (BH/MW-1S, BH/MW-1, BH/MW-2, BH/MW-3, BH/MW-4S and BH/MW-4) for the hydrogeological (deep wells) and environmental (shallow wells) purposes.

The monitoring well network on Site consists of the following:

- Three (3) shallow overburden monitoring wells (BH/MW-1S, BH/MW-2, and BH/MW-4S) were installed up to 4.8 mbgs deep each.
- Three (3) deep bedrock monitoring well (BH/MW- 1, BH/MW-3, BH/MW-4) were installed up to 13.5 mbgs deep each.

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 current hydrogeological investigation and water balance assessment, static water levels in all six (6) on-site monitoring wells installed outside of the existing buildings were recorded in two (2) monitoring events on January 24 and January 31 of 2023. 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 shallow overburden wells ranged from 88.52 masl (2.95 mbgs at BH/MW 4S on January 24, 2023) to 88.89 masl (2.62 mbgs at BH/MW 1S on January 31, 2023).

The groundwater elevation recorded for the deep bedrock wells ranged from 87.67 masl (3.80 mbgs on January 31, 2023) to 88.30 masl (3.17 mbgs on January 24, 2023), as measured at BH/MW 4D.

The seasonal (one-year) groundwater monitoring program is currently on-going. This report will be updated with monitoring results upon completion.

Table 3-1: Summary of Measured Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (masl)	Approximate Full Well Depth (mbgs)	Minimum GW Elevation (masl)	Maximum GW Elevation (masl)	Depth	24-Jan-23	31-Jan-23
BH1S	91.51	4.57	88.88	88.89	mbgs	2.63	2.62
					masl	88.88	88.89
BH1D	91.55	13.52	88.01	88.02	mbgs	3.53	3.54
					masl	88.02	88.01
BH2	91.23	4.79	88.53	88.60	mbgs	2.69	2.63
					masl	88.53	88.60
BH3	91.53	12.95	87.68	87.69	mbgs	3.85	3.84
					masl	87.68	87.69
BH4S	91.47	4.51	88.52	88.53	mbgs	2.95	2.94
					masl	88.52	88.53
BH4D	91.47	12.26	87.67	88.30	mbgs	3.17	3.80
					masl	88.30	87.67

Notes: mbgs - meters below ground surface
masl - meters above mean sea level
NA-not available / well destroyed or not accessible

One (1) map was created for the Site to show groundwater contours of the deep water-bearing zone, as measured on January 31 of 2023 monitoring event (Figure 6). Accordingly, the groundwater flow directions in the deep zone is interpreted to be in southeast direction of the Site, towards Lake Ontario, as expected.

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. The on-going seasonal groundwater level monitoring will further refine and provide more information on seasonal groundwater level fluctuations on Site.

3.3 Hydraulic Conductivity Testing

Three (3) Single Well Response Tests (SWRT's) were completed at all bedrock monitoring wells (BH/MW 1D, BH/MW 3, and BH/MW 4D) on January 31, 2023. The tests were completed to estimate the saturated hydraulic conductivity (K) of the soils at the well screen depths utilizing data loggers, preprogramed to take measurement on one second intervals.

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 construction. 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	Approximate Well Depth (mbgs)	Screen Interval (mbgs)		Soil Formation Screened	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH-1D	13.52	10.52	13.52	Shale bedrock	1.4E-06
BH-3	12.95	9.95	12.95	Shale bedrock	1.5E-06
BH-4D	12.26	9.26	12.26	Shale bedrock	1.1E-05
				Highest Estimated K Value	1.1E-05
				Geometric Mean of Estimated K Values for bedrock	2.9E-06
				Arithmetic Mean of Estimated K Values for bedrock	4.8E-06

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 in bedrock is 1.1E-05 m/s, the geometric mean of the K-values is 2.9E-06 m/s, and arithmetic mean of the estimated K-values is 4.8E-06 m/sec.

3.4 Groundwater Quality

To assess the suitability for discharging pumped groundwater into the sewers owned by the City of Burlington / Halton Region during dewatering activities, one (1) groundwater sample was collected from monitoring well BH/MW 1D on January 31 of 2023 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.

Table 3-3 summarizes exceedance(s) of the Sanitary (Halton Region) and Storm (City of Burlington) Sewer Use By-Law parameters.

When comparing the chemistry of the collected groundwater samples to Halton Region Sanitary Sewer Discharge Criteria, there were no parameter exceedances to be reported.

When comparing the chemistry of the collected groundwater samples to the City of Burlington Storm Sewer Discharge Criteria the following parameters reported an exceedance: Total Suspended Solids (TSS), Total Manganese (Mn) and Chloroform.

Reporting detection limits (RDLs) were below the Sewer Use By-Law parameter criteria.

Table 3-3: Summary of Analytical Results (Halton Region / City of Burlington)

Parameter	Units	Region of Halton Sanitary Sewer Discharge Limit	City of Burlington / Halton Region Storm Sewer Discharge Limit	Concentration BH/MW 1 D 31-Jan-23
Total Suspended Solids (TSS)	mg/L	350	15	**23**
Total Manganese (Mn)	mg/L	5	0.05	**0.21**
Chloroform	µg/L	40	2	**4.2**

Bold – Exceeds City of Burlington / Halton Region Storm Sewer Discharge Limit.
Bold & underlined – Exceeds Halton Region Sanitary Sewer Discharge Limit.

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 sanitary 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, it is recommended to implement a suitable pre-treatment, as required.

The water quality results presented in this report may not be representative of the long-term condition of groundwater quality onsite. As such, regular water quality monitoring is recommended for the post-construction phase.

An agreement to discharge into the sewers owned by Halton Region or City of Burlington be required prior to releasing dewatering effluent.

The Environmental Site Assessment Report(s) shall be reviewed for more information on the groundwater quality conditions at the Site.

3.5 Infiltration Testing

To examine the surficial soil at the Site for texture, weathering, and secondary permeability features and to measure the *in-situ* infiltration rate of the surficial soil, three (3) *in-situ* infiltration tests were completed on broad scale across the Site on January 24 of 2023 (IT-1, IT-2, and IT-3). Figure 4 shows the locations of completed infiltration tests.

A total of three (3) boreholes (IT-1, IT-2, and IT-3) were predrilled utilizing a drill rig up to approximately 1.0 m below existing ground at each location during the combined drilling program. All boreholes were completed as open holes and followed by completion of the *in-situ* infiltration tests (by adding water) as per Low Impact Development (LID) Stormwater Management Planning and Design Guide, Appendix C (CVC – TRCA, 2010).

The infiltration testing results are based on TRCA infiltration practice guideline for percolation testing at open hole were performed at each of three boreholes and are included in Appendix E.

The summary of measured *in-situ* infiltration rates as per the Low Impact Development (LID) Stormwater Management Planning and Design Guide (CVC - TRCA, 2010, Appendix C) are shown in Table 3-4 below.

Table 3-4: **Summary of measured Infiltration Rates and *In-Situ* Infiltration Tests Results**

Infiltration Test ID (adjacent Well ID)	Ground Surface Elevation (masl)	Test Hole Depth (mbgs)	~Bottom Elevation (masl)	Formation Tested	Measured Infiltration Rates (mm/hr)	Design Infiltration Rate* (mm/hr)	Percolation Time (min/cm)
IT-1 (BH-1D)	91.55	1	90.55	Silty Sand (Fill)	79	32	19
IT-2 (BH-3)	91.53	1	90.53	Sandy Silt (Fill)	84	34	18
IT-3 (BH-4D)	91.47	1	90.47	Silty Sand (Fill)	59	23	26
					MIN	23	18
					MAX	34	26
					Geometric Mean	29	21

Notes:

mbgs – meters below ground surface;

masl – meters above sea level;

Notes: *Safety Factor of 2.5 was applied to calculate the design infiltration rate (Low Impact Development (LID) Stormwater Management Planning and Design Guide, CVC – TRCA, 2010, Appendix C).

mm/hr– millimeters per hour;

min/cm – minutes per centimeter.

Based on the *in-situ* infiltration testing results, measured infiltration rates very between 59 and 84 mm/hr across the site. The mean measured infiltration rate for the tested soil layers at subsurface is calculated as 73 mm/hr. Using the geometric mean infiltration rate and a safety factor 2.5 (Low Impact Development (LID) Stormwater Management Planning and Design Guide, CVC – TRCA, 2010), the design infiltration rate was calculated to vary between 23 (min) and 34 (max) mm/hr for the entire Site with calculated geometric mean of design infiltration rates of 29 mm/hr.

It is recommended to complete confirmatory infiltration tests at proposed locations and base elevations for the LIDs, once design details become available.

4 Water Balance Assessment (Site Specific)

4.1 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. The model inputs include monthly mean temperature, total precipitation, runoff factor, soil-moisture storage capacity, rain temperature threshold, snow temperature threshold, maximum melt rate and the latitude of the Site. The model 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 run-off. 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:

$$\mathbf{P = ET + R + I + ST}$$

Where:
P = precipitation
ET = evapotranspiration
R = surface water run-off
I = Infiltration
ST = change in groundwater storage

For this assessment, the Thornthwaite and Mather method was used to estimate average infiltration rates. Based on the site conditions, as no recharge/infiltration to deep aquifer occurs, the component for infiltration in the Thornthwaite and Mater model was used to estimate infiltration, which corresponds to lateral movement of water in the unsaturated zone in the shallow sub-surface (first few meters) which discharges to surface water features.

The site-specific water balance assessment is included in Appendix F.

Infiltration is governed by the surficial soil types, topography and land cover (Figures 2, 7, 8 and 9, Appendix F). Areas where shallow water table as measured in shallow monitoring wells, is at surface, then the percolation rate of precipitation into the shallow soils is considered negligible. Such areas were not encountered at the Site.

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

4.2 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 RBG, Ontario (Station ID No. 6153300, Latitude 43°17'00.000" N, Longitude 79°53'00.000" W, Class A climate normals).

Meteorological data for 30 years from 1967 to 1996 was utilized for the assessment. Summary of input data is provided in Appendix F -1.

4.3 Pre- and Post-Development Site Characteristics

4.3.1 Pre-Development Site Characteristics

The Site is located in an urbanized land use setting where it has been identified as urban area with almost 100% cover by hard surfaces.

A summary of the existing (pre-development) land use features is provided in Table 4-1 below.

Table 4-1: Pre-Development (Existing) Land Use

Description	Pre-Construction (Existing) (m^2)
Total Site Area	**7,600**
Existing Building(s)	2,300
Landscape	1,100
Roads, sidewalk, parking (paved surfaces)	4,200
Site Area Available for Infiltration (pre-construction)	**1,100**

Under existing land use conditions, the total pervious area is approximately 14% of the total Site area.

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 the purpose of estimating the water balance.

4.3.2 Post-Development Site Characteristics

Table 4-2 provides a summary of the post development site characteristics.

Table 4-2: Post Development Site Characteristics

Description	Impervious Areas m^2	Pervious Areas m^2	Total Areas Post Construction (Proposed) m^2
Totals	**6,200**	**1,400**	**7,600**
Building	2,800	0	2,800
Paved (Roads, Sidewalks, Parking)	3,400	0	3,400
Landscape	0	1,400	1,400
Site Area Available for Infiltration (post-construction)		**1,400**	

Under post-development conditions, the total pervious area is increased to 18% of the total Site area (i.e. 4% increase compared to pre-construction conditions).

4.4 Pre-Development Water Balance Estimates

4.4.1 Climate Data Analysis

The mean annual water surplus was calculated using the Thornthwaite and Mather (1955) method. Monthly average precipitation values were obtained for 30 years from 1967 to 1996.

Soil moisture storage of 200 mm/yr was assumed for soils and considered representative of the preconstruction site conditions. The closest Latitude to the Site is 43°, which was used in the USGS model (2007).

Table 4-3 provides a summary of the climatic water balance analysis. Appendix F-1 provides a summary of model input. Appendix F-2 provides a summary of the model output.

Table 4-3: Summary of Climatic Water Balance Analysis in Pre-Development Conditions

Soil Moisture Storage (mm/yr)	Precipitation (mm/yr)	Potential ET (mm/yr)	Actual ET (mm/yr)	Surplus (mm/yr)
250 mm/yr Silty Sand to Sand	880.26	607.26	581.84	298.42

Note: ET = Evapotranspiration

The results of climatic water balance analysis for the Site indicates that a surplus of 298.42 mm/year of water is available for surface run-off and infiltration.

4.4.2 Infiltration

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

Appendix F-3 provides a summary of the assumptions made for the Site, as well as the estimated sub factors and total factor based on the Site conditions.

The estimated pre-development total infiltration factor of 0.48 represents the fraction of the water surplus available for infiltration. Therefore, the fraction of the available water surplus for run-off is 0.52.

The infiltration factor is utilized to calculate the amount of infiltration (in units of m^3/yr) at the Site by multiplying it by the average yearly water surplus estimate by the site area available for infiltration.

Using the infiltration factor of 0.44, a water surplus of 298.42 mm/yr, the pre-development infiltration rate for the entire Site is estimated to be approximately 144.14 mm/yr.

Infiltration sub-factors were determined for the purpose of estimating predevelopment infiltration rates.

4.4.3 Pre-Development Water Balance Analysis

The water balance analysis is based on available information on a regional scale and considered consistent for the Site.

Table 4-4 provides a summary of pre-development water balance analysis for the Site.

Table 4-4: Summary of Overall Pre-Development Water Balance Results

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/y)	Actual Evapo-transpiration (m^3/y)	Run-off (m^3/y)	Infiltration (m^3/y)
Entire Site	7,600	1,100	6,690	640	5,891	159
Percentage of Total Precipitation			100%	10%	88%	2%

The total Site area was used to estimate the total volume of annual precipitation for the Site. As summarized in Table 4-4, the pre-development water balance is as follows: approximately 10% of the total precipitation will be subjected to evapotranspiration, 88% to run-off and 2% to infiltration.

The predevelopment water balance, on a weighted average depth basis (in mm) can be expressed as follows:

P (880.26) = ET (84.21) + R (20.86) + I (775.19) + ST (0)

4.5 Post-Development Water Balance Estimates

Based on the proposed development drawings provided (Figure 8), the total area of impervious surfaces under the post-development conditions is approximately 6,200 m^2 representing approximately 82% of the Site area (total area: 7,600 m^2), (Table 4-2). The remaining 1,400 m^2 is available to contribute to infiltration during post development stage (18% of the total land area).

Lot level post development infiltration sub-factors were determined based on the method recommended by MOE (1995), similar to the method used for estimating infiltration sub-factors for pre-development site conditions.

For post-development infiltration sub-factors, the landscaped areas were assumed to be consistent with cultivated cover with an infiltration sub-factor of 0.48 (Appendix F-3).

Table 4-5 provides a summary of the overall post development water balance assessment.

Table 4-5: Summary of Overall Post Development Water Balance Forecast (Unmitigated)

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/y)	Actual Evapo-transpiration (m^3/y)	Run-off (m^3/y)	Infiltration (m^3/y)
Entire Site	7,600	1,400	6,690	815	5,674	202
Percentage of Total Precipitation			100%	12%	85%	3%

The total Site area was used to estimate the total volume of annual precipitation for the Site. As summarized in Table 4-5, the post-development water balance is as follows: approximately 12% of the total precipitation will be subjected to evapotranspiration, 85% to run-off and 3% to infiltration. Appendix F-4 presents the detailed summary of pre- and post-development water balance assessment results.

4.6 Infiltration

Based on the site-specific infiltration testing results (Section 3.5), the geometric mean of the measured infiltration rate for the tested soil layers at subsurface is calculated at 73 mm/hr (Appendix E). Using the geometric mean infiltration rate and a safety factor of 2.5 (Appendix C, Low Impact Development (LID) Stormwater Management Planning and Design Guide, Appendix C, CVC – TRCA, 2010), the design infiltration rate was calculated to vary between 23 (min) and 34 (max) mm/hr for the entire Site with calculated geometric mean of design infiltration rates of 29 mm/hr.

4.7 Impact Assessment and Proposed Mitigation Measures

If no remedial measures are implemented, it is expected that infiltration will be increased from approximately 159 m^3/yr in pre-development to 202 m^3/yr in post development, resulting in an infiltration increase of approximately 43 m^3/yr (Appendix F-4).

Considering there will be no infiltration deficits in post-development scenario, the proposed development will improve the pre-development conditions for the on-site infiltration and will result in approximately 43 m^3 of additional infiltration on annual basis on site in post-development scenario.

5 Dewatering Assessment

The dimensions of the proposed structure to support the dewatering assessment are summarized in Table 5-1 below.

Table 5-1 Development Dimensions for Dewatering Assessment

Input Parameter	Assumption	Units	Notes
Number of Subgrade Levels	3 Levels	-	P3 extents to entire property boundary
Ground Elevations	91.46	masl	Average ground surface elevation based on BHs
Top of Slab Elevation	79.76	masl	As per architectural drawings, 11.7 mbgs (Chamberlain, Jan 13, 2023)
Lowest Footing Elevation	78.76	masl	Assumed to be approximately 1.0 m below the top of slab elevation
Excavation Area (Length x Width)	~7,600 (92 x 83)	m^2 (m x m)	Approximate area (length x width) of Site for the proposed development

5.1 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:

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

$$r_e = \frac{a+b}{\pi} \qquad R_o = R_{cj} + r_e$$

Where:

Qw = Rate of pumping (m^3/s)
X = Length of excavation (m)
K = Hydraulic conductivity (m/s)
H = Hydraulic head beyond the influence of pumping (static groundwater elevation) (m)
h = Hydraulic head above the base of aquifer in an excavation (m)
R_0 = Radius of influence (m)
R_{cj} = Cooper-Jacob's radius of influence (m)
r_e = 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.

5.2 Cooper-Jacob's Radius of Influence

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

The estimated radius of influence due to pumping is based on Cooper-Jacob's formula as follows:

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

Where:

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

The calculated radius of influence is provided in Appendix G.

5.3 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 which originated 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 121.8 mm (refer to Appendix G).

5.4 Results of Dewatering Rate Estimates

5.4.1 Construction Dewatering Rate Estimate

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

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

Pits (elevator, sump pits) are assumed to have the same excavation depth and dewatering target as the main excavation; deeper pits may require localized dewatering and revised dewatering estimates.

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

Table 4-2 Summary of Construction Dewatering Rate

Peak Dewatering Flow Rate Including Rain Collection Volume	
Description	With 3 Levels of **Underground Parking (L/day)**
Total Volume (L/day) Short Term Discharge of Groundwater (Construction dewatering) with Safety Factor (including precipitation)	509,000
Total Volume (L/day) Short Term Discharge of Groundwater (Construction dewatering) without Safety Factor (including precipitation)	369,000
Total Volume (L/day) Short Term Discharge of Groundwater (construction dewatering) with Safety Factor (excluding precipitation) for EASR and PTTW	394,000

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

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.

Local dewatering may be required for pits (elevator pits, sump pits, raft) and for localized areas with permeable, soft, or wet soil conditions. Local dewatering is not considered to be part of this assessment, but the contractor should be ready to install additional system to manage such conditions. Dewatering estimates should be reviewed once the pit dimensions are available.

All grading around the perimeter of the excavation should be graded away from the shoring the systems and ramp/site access to redirect runoff away from excavation.

The dewatering assumptions are based on using shoring system without open cuts and sloped excavations.

If groundwater cutoff systems (ex: caisson walls, sheet piles) are installed, these should be designed for maximal hydrostatic pressure for shallow and deep water levels, without dewatering on the outer side of the groundwater cutoff. 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 soil conditions.

If groundwater cutoff systems 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 for the design of the dewatering systems (depth of wells, screen length, number of wells, spacing sand pack around screens, prevent soil loss etc.) to ensure that dry conditions are always maintained within the excavation at all costs.

Dewatering should be monitored using dedicated monitoring wells within and around the perimeter of the excavation, and these wells should be monitored using manual measurements and with electronic data loggers; records should be maintained on site to track dewatering progress. Discharge rates should be monitored using calibrated flow meters and records of dewatering progress, and daily precipitation as per MECP requirements should be maintained.

5.4.2 Post-Construction Dewatering Rate Estimate

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

The long-term dewatering was based on the same equations as construction dewatering shown in Section 4.1.

The calculation for the estimated flow to the future sub-drain system (with no cutoff walls) is provided in Appendix G. 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 preliminary flow rate estimate. Once the foundation drain is built, actual flow rate measurements of the sump discharge will be required to confirm the estimated flow rate.

Based on the assumptions provided in this report, the estimated sub-drain discharge volumes are summarized in Appendix G. 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.

Table 4-3: Summary of Long-Term Dewatering Rate

Long-Term Dewatering Flow Rate	With 3 Levels of Underground Parking (L/day)
Total Volume (L/day) Long-Term Drainage of groundwater (from foundation drainage, weeping tiles, sub slab drainage) with Safety Factor Included	100,000 (rounded)
Long-Term Dewatering Rate without Safety Factor	66,280

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 using shoring system without open cuts. Open cuts can act as preferential groundwater pathways in the long-term and cause foundation drainage volumes to increase.

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

5.5 MECP Water Taking Permits

5.5.1 Short-Term Discharge Rate (Construction Phase)

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50,000 L/day but less than 400,000 L/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 400,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

As of July 1, 2021, an amendment of O. Reg. 63/16 has come into effect and replaced the former subsection 7 (5) such that the EASR water taking limit of 400,000 L/day would apply to groundwater takings of each dewatered work area only, excluding stormwater.

The dewatering estimate including a safety factor is greater than 50,000 L/day and less than 400, 000 L/day as shown in Table 4-2. The MECP construction dewatering rate excludes the precipitation amount and is the rate used for the permit application. Based on the MECP construction dewatering 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. Altogether, the hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitute the Water Taking Plan which needs to be available onsite during the construction dewatering.

5.5.2 Long-Term Discharge Rate (Post Construction Phase)

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50,000 L/day, then an application for a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

Based on the dewatering estimate shown in Table 4-3 greater than 50,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required to facilitate the post-development phase.

The safety factor for construction (short-term) dewatering is selected higher than for long-term to account for anticipated greater groundwater volumes during initial dewatering. The applied analytical formula is adequate for long-term (steady state) conditions as it omits specific yield and time dependency. When the formula is used for short-term conditions a larger safety factor is recommended to cover a larger initial dewatering rate, which is required to remove stored groundwater. Moreover, a large initial construction dewatering rate is favorable, as it supports reducing the time to reach the dewatering target elevation.

6 Environmental Impact

6.1 Surface Water Features

The Site is located within the Lower Hager Creek watershed. No surface water features exist onsite. The nearest surface water features are Rambo Creek located approximately 250 m east of the Site and Lake Ontario located approximately 1.1 km southeast from the Site boundary (Conservation Halton Online Basemap).

Due to the limited extent of zone of influence and the wide distance to the nearest surface water feature, no detrimental impacts on surface water features are expected during construction activities.

6.2 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.

6.3 Source Protection

The Site is entirely within Halton Region Source Protection Area (SPA) with entire site located within Highly Vulnerable Aquifer (HVA) area and within Intake Protection Zone (IPZ 2) with intrinsic vulnerability of 5.6.

It is recommended to implement monitoring and mitigation plan during construction dewatering. This will include both water quality and water quantity monitoring. The functional monitoring wells can be used for the water level monitoring purposes. The monitoring will confirm the zone of influence from the dewatering system, assist in documenting changes over the time and help to evaluate whether any changes are a result of construction dewatering.

Dewatering should be monitored using dedicated monitoring wells within and around the perimeter of the excavation, and these wells should be monitored using manual measurements and with electronic data loggers; records should be maintained on site to track dewatering progress. Discharge rates should be monitored using calibrated flow meters and records of dewatering progress, and daily precipitation as per MECP requirements should be maintained.

It is also recommended that the quality of groundwater from dewatering system be monitored for suspended solids, metals and inorganic parameters listed the Sanitary and Storm Sewer By-Law limits and/or PWQO (if discharged to the environment), once weekly for the first month of construction dewatering. If the results demonstrate that groundwater consistently meets the applicable standards, the monitoring frequency can be reduced to monthly thereafter.

6.4 Geotechnical Considerations

As per the MECP technical requirement for PTTW and EASRs, 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.

6.5 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 to the Region of Halton and the City of Burlington / Halton Region Sewer Use By-Law.

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

For the Short-term (construction) discharge to the Storm sewer system and based on the water quality results, it is recommended to implement a suitable pre-treatment, as required.

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

The water quality results presented in this report may not be representative of the long-term condition of groundwater quality onsite.

An agreement to discharge into the sewers owned by the City of Burlington / Halton Region will be required prior to releasing dewatering effluent.

The Environmental Site Assessment Report(s) shall be reviewed for more information on the groundwater quality conditions at the Site.

6.6 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.

7 Conclusions and Recommendations

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

- The Site is located predominantly on a watershed divide between two watershed areas: the Lower Hager Creek watershed to the west and south and Lower Rambo Creek watershed to the north and east. The Site is located in the physiographic region known as Iroquois Plain and physiographic landform known as sand plain.
- The Site is entirely within Halton Region Source Protection Area (SPA) with entire site located within Highly Vulnerable Aquifer (HVA) area and within Intake Protection Zone (IPZ 2).
- The main overburden soil types encountered during on-site drilling program include sand or silty sand overlying various till deposits.
- Thickness of overburden sediments in the area has been mapped to vary between approximately 4.6 and 6.1 m.
- There are no surface water features exist onsite. The nearest surface water features are Rambo Creek located approximately 250 m east of the Site and Lake Ontario located approximately 1.1 km southeast from the Site boundary.
- The one-year seasonal groundwater monitoring is currently ongoing, and this report will be updated with results. The data to date suggests that the groundwater elevation recorded in the shallow overburden wells ranged from 88.52 masl (2.95 mbgs) to 88.89 masl (2.62 mbgs) while the groundwater elevation recorded for the deep bedrock wells ranged from 87.67 masl (3.80 mbgs) to 88.30 masl (3.17).
- The direction of deep groundwater flow is interpreted to be directed to southeast, towards Lake Ontario, as expected.
- The highest estimated bulk hydraulic conductivity for bedrock is approximately 1.2×10^{-5} m/s with geometric mean k-values estimated as 2.9×10^{-6} m/s and an arithmetic mean of the estimated K-values of 4.8×10^{-6} m/sec.
- When comparing the chemistry of the collected groundwater samples to Halton Region Sanitary Sewer Discharge Criteria, there were no parameter exceedances to be reported.
- When comparing the chemistry of the collected groundwater samples to the City of Burlington Storm Sewer Discharge Criteria the following parameters reported an exceedance: Total Suspended Solids (TSS), Total Manganese (Mn) and Chloroform.
- The in-situ measured infiltration rates in shallow subsurface (up to 1 mbgs) vary between 59 and 84 mm/hr across the site. The design infiltration rate (after applying a safety factor) varies between 23 (min) and 34 (max) mm/hr with measured geometric mean of design infiltration rates of 29 mm/hr.
- Based on site specific water balance assessment there will be an infiltration increase in post-development of 43 m^3/year.
- The construction dewatering and groundwater control will be required for building construction with three (3) levels of underground parking.
- The estimated peak dewatering rate for proposed construction activities can reach up to 509,000 L/day at any given time. This is the rate which will be required to be discharged to the municipal sewer system. If the municipal sewer system is not available at the time of construction, the discharge point will be the nearest environment.
- The estimated peak MECP dewatering rates (without precipitation) for proposed construction activities is approximately 394,000 L/day. As the dewatering flow rate estimate is between 50,000 L/day and 400,000 L/day, an EASR would be required to facilitate the construction dewatering program for the Site.
- The long-term flow rate of the foundation sub-drain system is estimated to be approximately 100,000 L/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. A PTTW will be required for the long-term discharges.

- The construction and long-term dewatering volumes are 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 discharge volumes.
- Given the anticipated ZOI and location of Rambo Creek, the short-term dewatering related impacts are not predicted to the surface water feature.
- No change in regional groundwater flow direction is anticipated.
- To ensure that discharge meets the required standards, and the effects of the dewatering are not widespread, both water quantity and water quality of groundwater must be documented and monitored during construction dewatering period.
- Since EASR will be required for construction dewatering, monitoring of the daily pumping volumes at each water taking source will be required along with the on-site precipitation events.
- The geotechnical assessment of dewatering impacts is required.
- 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. Altogether, the hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitute the Water Taking Plan which needs to be available onsite during the construction dewatering.
- The potential discharge from the dewatering system during the construction will be directed to the municipal sewer system. As such, the quality of groundwater discharge will have to conform to the applicable City of Burlington / Halton Region Sewer Use By-Law standards and discharge permit(s) will be required from the City of Burlington / Halton Region prior any dewatering effluent discharges.
- 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.

It should be noted that these conclusions and recommendations should be read in conjunction with the entirety of the report and are based on the assumption that the present design concept described throughout the report will proceed to construction. Any changes to the design concept may result in a modification to the recommendations provided in this report.

8 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.

This report was prepared for the exclusive use of Elite 688 Brant Holdings Inc. This report may not be reproduced in whole or in part, without the prior written consent of EXP, or used or relied upon in whole or in part by other parties for any purposes whatsoever. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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.



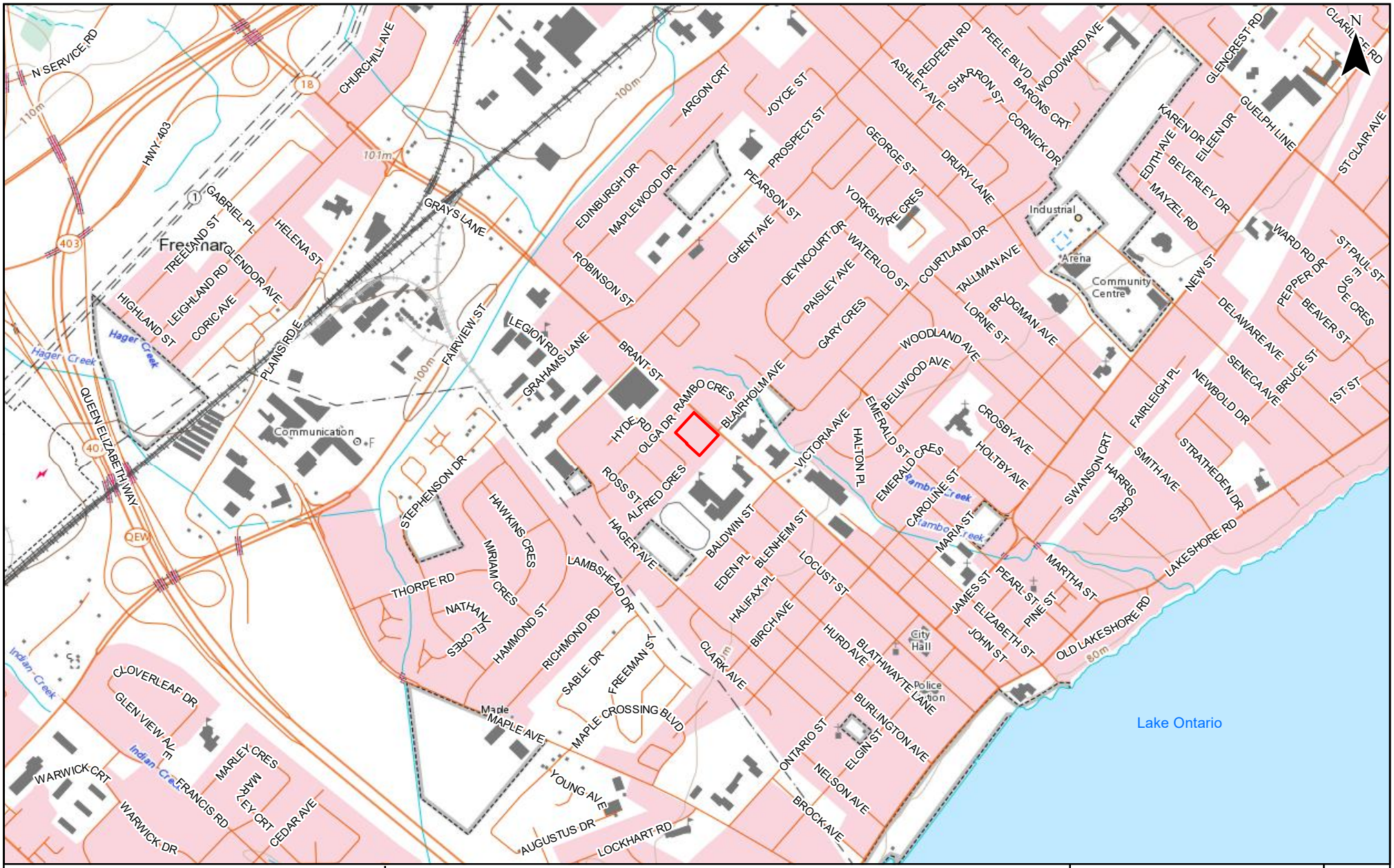
Nataliya Tkach, P.Geo., PMP, P.Eng., FGC
Senior Hydrogeologist
Environmental Services

Francois Chartier, M.Sc., P.Geo.
Discipline Manager, Hydrogeology
Environmental Services

9 References

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- EXP Services Inc. (February 10, 2023), Phase Two ESA, 688 Brant Street, Burlington, ON, prepared for Elite 688 Brant Holdings Inc.
- EXP Services Inc. (February 27, 2023), Supplemental Geotechnical Investigation, 688 Brant Street, Burlington, ON, prepared for Elite Developments.

Figures



SCALE:

0 150 300 450 600 750 m

LEGEND:

APPROXIMATE SITE BOUNDARY

SITE LOCATION PLAN

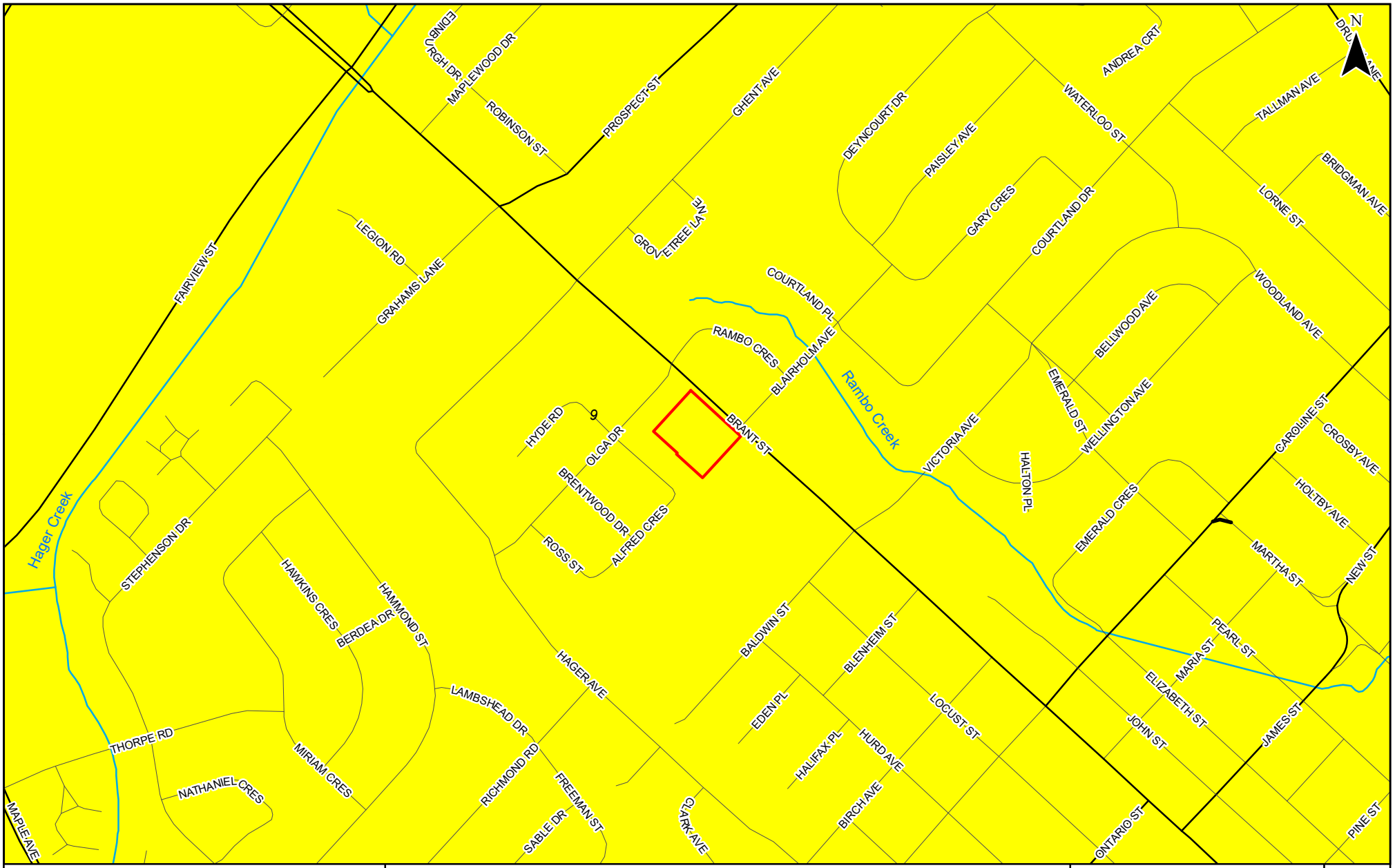
FIGURE: 1

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

DRAWN BY:	CHECKED BY:
AC	NT

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023



SCALE:

0 100 200 300 400 500 m

SOURCE:

BASED ON ONTARIO GEOLOGICAL SURVEY DATA PUBLISHED IN 2010

exp.

DRAWN BY:	CHECKED BY:
AC	NT

LEGEND:

- APPROXIMATE SITE BOUNDARY
- 9: COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS

SURFICIAL GEOLOGY

FIGURE: 2

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023



SCALE:

0 100 200 300 400 500 m

SOURCE:

BASED ON GOOGLE EARTH IMAGERY DATED 2021,
AVAILABLE WELL RECORD INFORMATION AS OF MARCH 2021

exp.

DRAWN BY:	CHECKED BY:
AC	NT

LEGEND:

- MONITORING WELL / TEST HOLE
- ABANDONED WELL
- UNCLASSIFIED / UNFINISHED WELL
- APPROXIMATE SITE BOUNDARY
- 500 m ZONE

MECP WATER WELL RECORDS MAP

FIGURE: 3

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023



SCALE:

0 10 20 30 40 50 m

LEGEND:

- BOREHOLE (EXP, 2023)
- BOREHOLE / MONITORING WELL (EXP, 2023)
- INFILTRATION TEST LOCATION (EXP, 2023)
- CROSS SECTION AXIS
- APPROXIMATE SITE BOUNDARY

DRAWN BY:	CHECKED BY:
AC	NT

BOREHOLE / MONITORING WELL LOCATION PLAN

FIGURE: 4

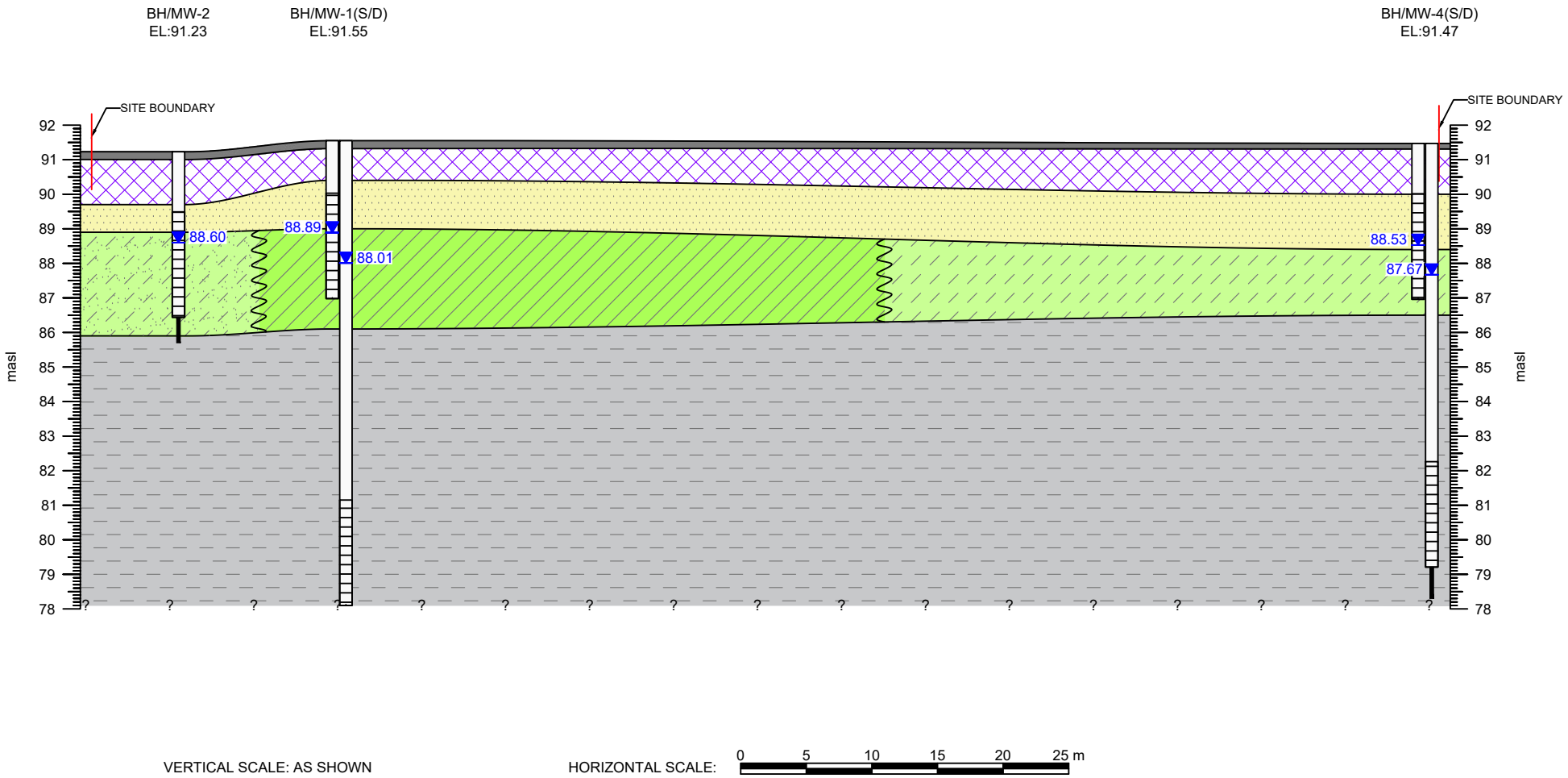
HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023

A
NORTH

A'
SOUTH



VERTICAL SCALE: AS SHOWN

HORIZONTAL SCALE: 0 5 10 15 20 25 m

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

BUILDINGS • EARTH & ENVIRONMENT • ENERGY • INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY

LEGEND:

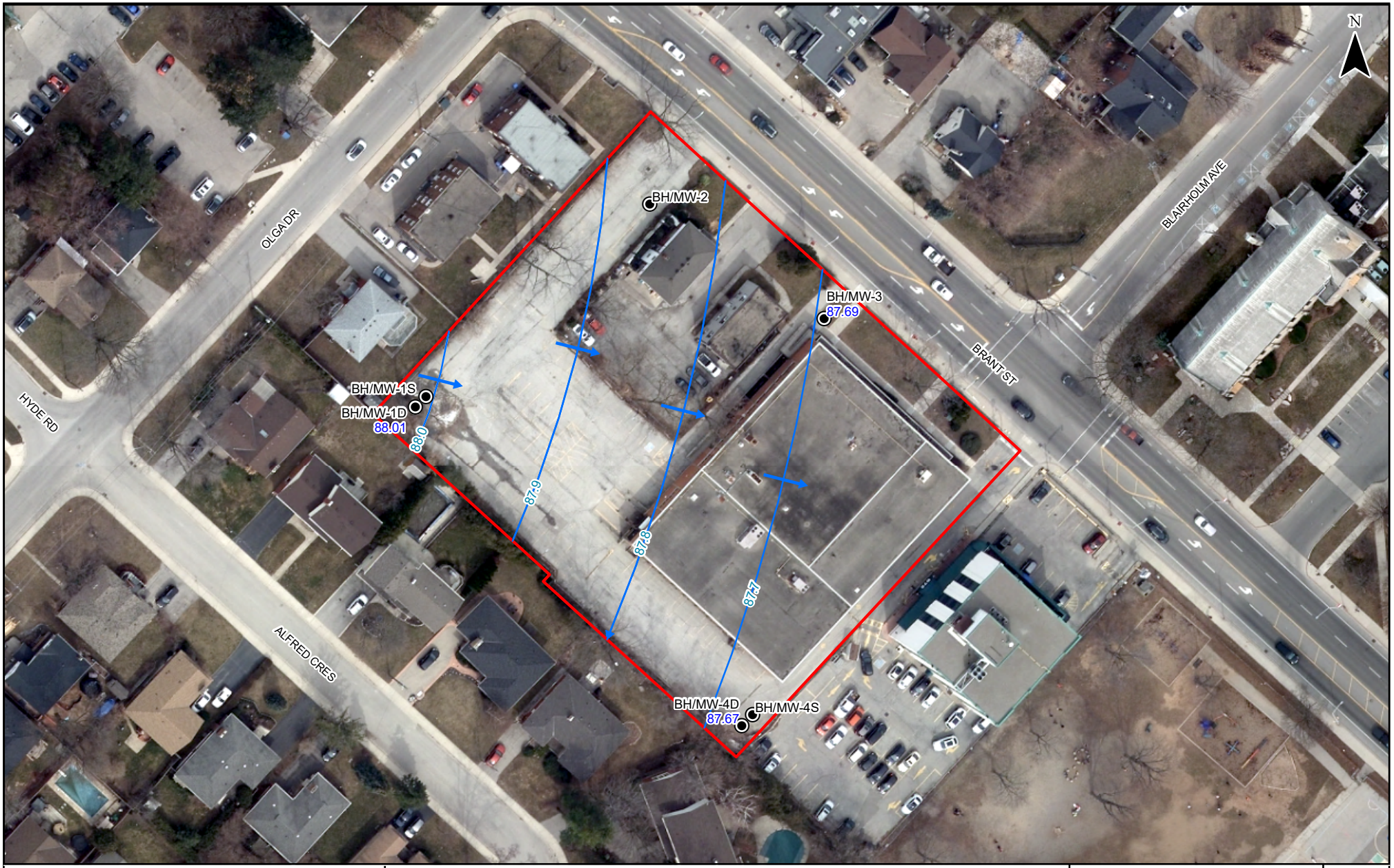
- PAVEMENT STRUCTURE
- FILL
- CLAYEY SILT TILL
- SILTY SAND TILL / SANDY SILT TILL
- SILT TILL
- SAND
- SHALE BEDROCK
- GROUNDWATER ELEVATION (masl) AS MEASURED ON JANUARY 31, 2023

TITLE AND LOCATION:

CROSS SECTION A-A'
HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NO.: GTR-21018895-B0	DWN.: JA
SCALE: AS NOTED	CK: NT
DATE: FEBRUARY 2023	FIG. NO.: 5

\\exp\data\BRM\GTR-21018895-B0\60 Execution\65 Drawings_Env\CAD\GTR-21018895-B0.dwg



SCALE:

0 10 20 30 40 50 m

LEGEND:

- BOREHOLE / MONITORING WELL (EXP, 2022)
- APPROXIMATE SITE BOUNDARY
- [XX.XX] GROUNDWATER CONTOUR (m asl) AS MEASURED ON JANUARY 31, 2023
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

exp.

DRAWN BY:	CHECKED BY:
AC	NT

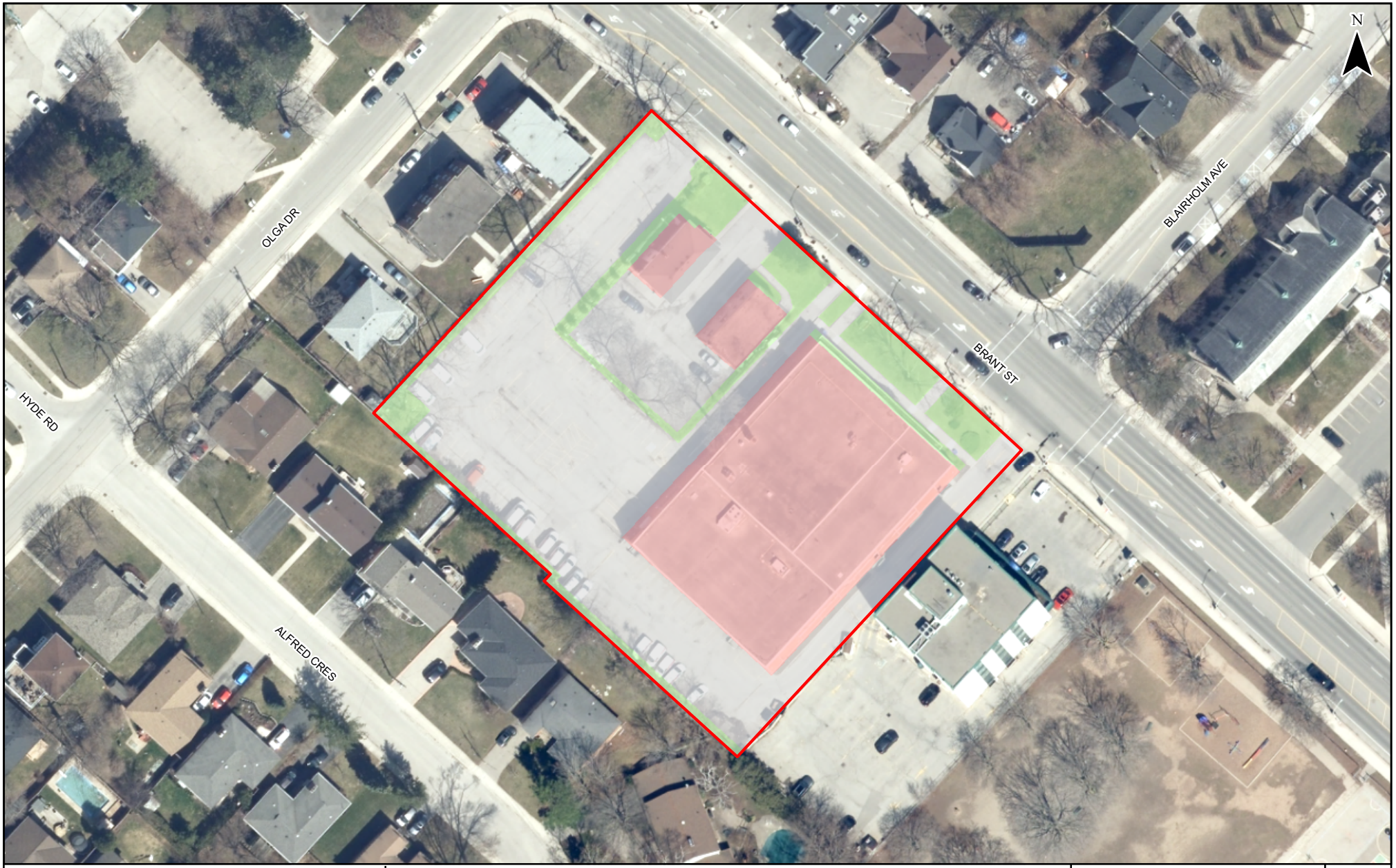
BEDROCK GROUNDWATER CONTOUR PLAN

FIGURE: 6

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023



SCALE:

0 10 20 30 40 50 m

LEGEND:

- BUILDING
- LANDSCAPE
- PAVED SURFACE
- APPROXIMATE SITE BOUNDARY

DRAWN BY:	CHECKED BY:
AC	NT

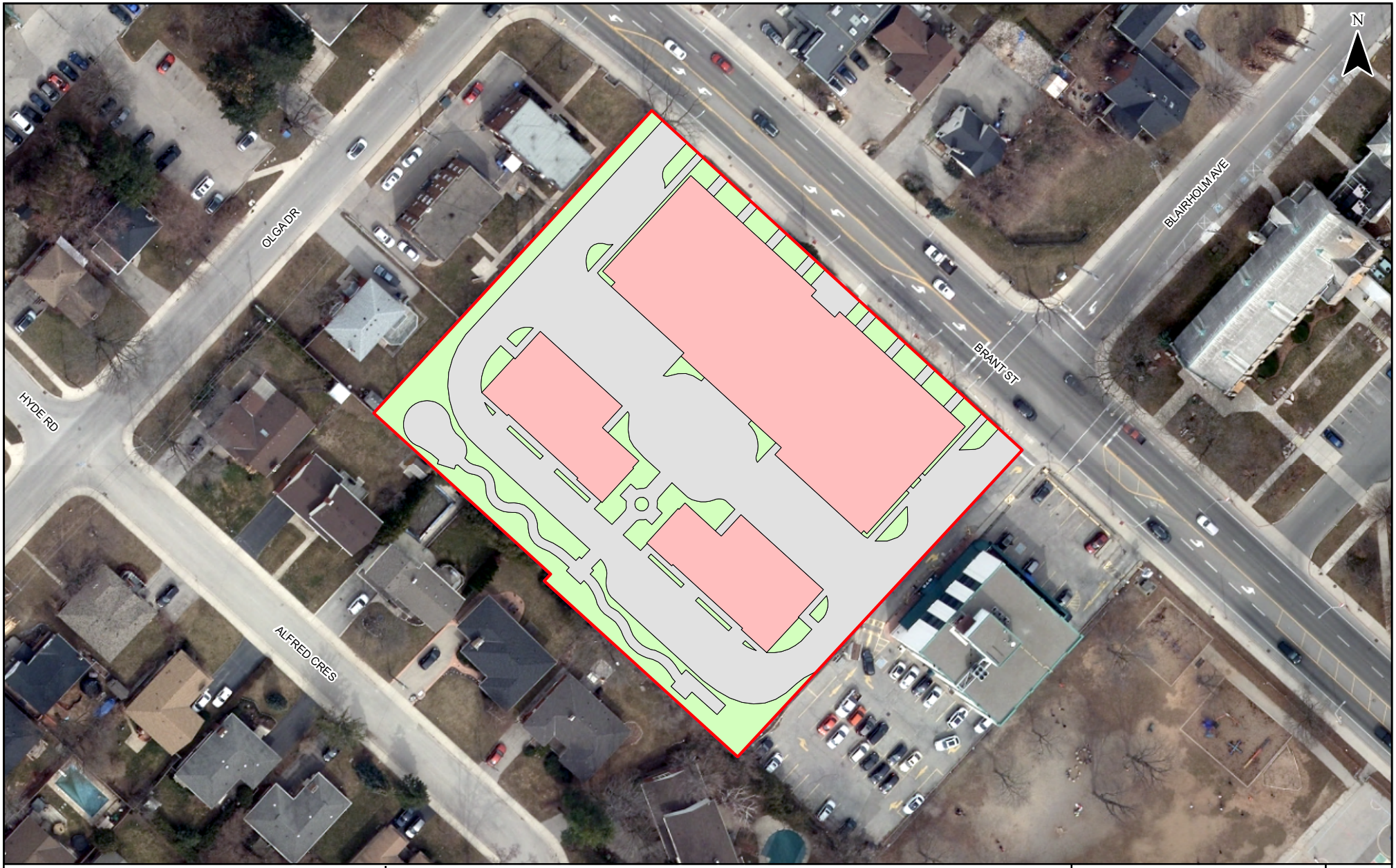
EXISTING LAND USE

FIGURE: 7

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023



SCALE:
0 10 20 30 40 50 m

SOURCE:
BASED ON SITE PLAN - 688 BRANT STREET.
CHAMBERLAIN ARCHITECTS, REVISED JANUARY 13, 2023.

exp.

DRAWN BY:	CHECKED BY:
AC	NT

LEGEND:
- BUILDING
- LANDSCAPE
- PAVED SURFACE
- APPROXIMATE SITE BOUNDARY

PROPOSED LAND USE

FIGURE: 8

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023



SCALE:
0 10 20 30 40 50 m

SOURCE:
TOPOGRAPHIC CONTOURS (2020) BASED ON PUBLIC SECTOR INFORMATION MADE AVAILABLE UNDER THE CITY OF BURLINGTON'S OPEN DATA LICENCE.

exp.

DRAWN BY:	CHECKED BY:
AC	NT

LEGEND:

TOPOGRAPHIC CONTOUR (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: 9

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
688, 694, 698 BRANT STREET
BURLINGTON, ONTARIO

PROJECT NUMBER: GTR-21018895-B0

DATE: FEBRUARY 2023

Appendix A – MECP WWR Summary Table

Off-Site																
BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	LOCATION ACCURACY	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	CONSTRUCTION METHOD	WELL DEPTH (m bgs)	WATER FOUND (m bgs)	CASING DIAMETER (cm)	1st USE	2nd USE	FINAL STATUS
11319126	2810171	2/9/2005	596252	4798292	93.5	margin of error : 30 m - 100 m	1380 GRAHAM'S LANE	BURLINGTON	491	Rotary (Convent.)	4.5	3.5	5.0			Observation Wells
11319169	2810214	3/21/2005	596212	4798276	94.2	margin of error : 30 m - 100 m		BURLINGTON	531	Boring	4.5	2.0		Not Used		Observation Wells
11319263	2810308	5/16/2005	596240	4798302	93.8	margin of error : 30 m - 100 m	1380 GRAHAM'S LANE	BURLINGTON	503	Other Method	4.6	2.5	2.0			Observation Wells
1003711328	7179514	1/19/2012	596238	4798370	94.2	margin of error : 30 m - 100 m	1380 GRAHAM'S LANE	Burlington	512	Rotary (Convent.)	5.1		5.2	Monitoring and Test Hole		Test Hole
1003711331	7179515	1/19/2012	596232	4798362	94.1	margin of error : 30 m - 100 m	1380 GRAHAM'S LANE	Burlington	517	Rotary (Convent.)	5.1		5.2	Monitoring and Test Hole		Monitoring and Test Hole
1003711334	7179516	1/19/2010	596245	4798354	94.4	margin of error : 30 m - 100 m	1380 GRAHAM'S LANE	Burlington	503	Direct Push	5.1		3.5	Monitoring and Test Hole		Monitoring and Test Hole
1003711669	7179605	1/19/2012	596248	4798355	94.4	margin of error : 30 m - 100 m	1380 GRAHAM'S LANE	Burlington	500	Rotary (Convent.)	5.5		5.2	Monitoring and Test Hole		Monitoring and Test Hole
1004155752	7187211		596799	4798762	91.8	margin of error : 30 m - 100 m	2096 HENT AVE	Burlington	484	Rotary (Convent.)	6.1		4.4	Monitoring		Observation Wells
1004155755	7187212		596775	4798734	92.1	margin of error : 30 m - 100 m	2084 GHGNT AVE	Burlington	454	Rotary (Convent.)	6.1		4.4	Monitoring		Observation Wells
1004770910	7220604	4/21/2014	596782	4798703	91.9	Approximate location: margin of error : 300 m - 1 km	2702 CHENT AVE.	BURLINGTON	424	Boring	5.2		4.6	Monitoring		
1004770967	7220605	4/21/2014	596782	4798703	91.9	Approximate location: margin of error : 300 m - 1 km	2702 CHENT AVE		424	Boring			4.6	Monitoring		
11765225	7042731	4/3/2007	596361	4798305	93.4	margin of error : 10 - 30 m	802 HAGER AVE	BURLINGTON	382	Other Method	4.0		5.0	Not Used		Observation Wells
1005492955	7244979	6/3/2015	596883	4798686	90.8	margin of error : 30 m - 100 m	2086 GRANT AVE	Burlington	429			2.1				Abandoned-Other
1005492958	7244980	6/3/2015	596883	4798686	90.8	margin of error : 30 m - 100 m	2086 GHENT AVE	Burlington	429	Boring	5.5			Monitoring		Observation Wells
1005492961	7244981	6/3/2015	596883	4798686	90.8	margin of error : 30 m - 100 m	2086 GHENT AVE	Burlington	429	Boring	5.5					Observation Wells
1005492964	7244982	6/3/2015	596825	4798636	90.9	margin of error : 30 m - 100 m	2086 GHENT AVE	Burlington	364							Abandoned-Other
1005793603	7251865	9/11/2015	596782	4798684	92.1	margin of error : 30 m - 100 m	2068 GHENT AVE.	BURLINGTON	405	Boring	6.1			Monitoring		
1005796728	7252011	9/4/2015	596736	4798745	92.4	margin of error : 30 m - 100 m	2071 GHENT AVENUE	Burlington	464	Boring	6.1			Monitoring		Observation Wells
1006369074	7283351	11/4/2016	596640	4798358	91.6	margin of error : 10 - 30 m	730 BRANT ST	Burlington	128	Boring	6.0			Test Hole	Monitoring	Monitoring and Test Hole
1006379479	7284939	3/7/2017	596319	4798254	92.8	margin of error : 30 m - 100 m	770 HAGGAR AV E	Burlington	425	Rotary (Convent.)	4.6			Test Hole	Monitoring	Monitoring and Test Hole
1006379482	7284940	3/7/2017	596309	4798244	92.7	margin of error : 30 m - 100 m	770 HAGGER AVE	Burlington	435	Rotary (Convent.)	4.6			Test Hole	Monitoring	Monitoring and Test Hole
1006835745	7300111	11/15/2017	597075	4798020	88.1	margin of error : 30 m - 100 m	560 BRANT STREET	BURLINGTON	423	Auger	6.1			Monitoring		Observation Wells
1006835788	7300112	11/15/2017	597058	4797996	88.0	margin of error : 30 m - 100 m	560 BRANT STREET	BURLINGTON	425	Auger	6.1	7.0		Monitoring		Observation Wells
1006835791	7300113	11/15/2017	597093	4798001	87.8	margin of error : 30 m - 100 m	560 BRANT STREET	BURLINGTON	449	Auger	4.6			Monitoring		Observation Wells
1007188815	7314898	7/4/2018	596295	4798451	93.5	margin of error : 30 m - 100 m	1416 GRAHAM LN	Burlington	479	AUGER	4.6			Monitoring		Observation Wells
1007434499	7331850	8/23/2018	596494	4798533	91.9	margin of error : 30 m - 100 m	280 BRANT ST	Burlington	354	Boring	6.1			Monitoring		Observation Wells
1007661408	7343297	8/13/2019	596347	4798549	93.4	margin of error : 30 m - 100 m	439 Graham's Lane	Burlington	478	Rotary (Convent.)	7.3			Monitoring and Test Hole		Monitoring and Test Hole
1007661411	7343298	8/13/2019	596377	4798547	92.6	margin of error : 30 m - 100 m	439 Graham's Lane	Burlington	452	Rotary (Convent.)	5.2			Monitoring and Test Hole		Monitoring and Test Hole
1007661414	7343299	8/13/2019	596358	4798561	93.4	margin of error : 30 m - 100 m	1439 Graham's Lane	Burlington	476	Rotary (Convent.)	4.9			Monitoring and Test Hole		Monitoring and Test Hole
1004730267	7219025	3/26/2014	597115	4798155	88.0	margin of error : 30 m - 100 m			393							
1006696174	7291911	6/12/2017	596224	4798347	94.2	margin of error : 30 m - 100 m			523							
1007464196	7332300		596425	4798027	90.5	margin of error : 30 m - 100 m			407							
1007815704	7349961		597192	4798008	87.4	margin of error : 30 m - 100 m			526							
1008181265	7354371	1/31/2020	596270	4798301	93.7	margin of error : 30 m - 100 m	802 Hagar Ave	Burlington	473					Monitoring		Abandoned-Other
1008181277	7354375	1/31/2020	596292	4798301	93.4	margin of error : 30 m - 100 m	802 Hager Ave	Burlington	451							Abandoned-Other
1008484022	7369392	9/4/2020	596527	4798496	91.1	margin of error : 30 m - 100 m			304							
1008484025	7369393	9/4/2020	596672	4798497	90.6	margin of error : 30 m - 100 m			227							
1008484028	7369394	9/4/2020	596539	4798591	91.9	margin of error : 30 m - 100 m			371							
1008484031	7369395	9/4/2020	596481	4798471	92.0	margin of error : 30 m - 100 m			323							
1008484034	7369396	9/4/2020	596532	4798495	91.1	margin of error : 30 m - 100 m			300							
1008531648	7374925	11/13/2020	596448	4798658	92.4	margin of error : 30 m - 100 m			478							

Appendix B – Borehole Logs

Log of Borehole BH-1

Project No. GTR-21018895-B1 Drawing No. 3

Project: Proposed Mid-Rise Residential Development Sheet No. 1 of 2

Location: 688 Brant Street, Burlington, ON

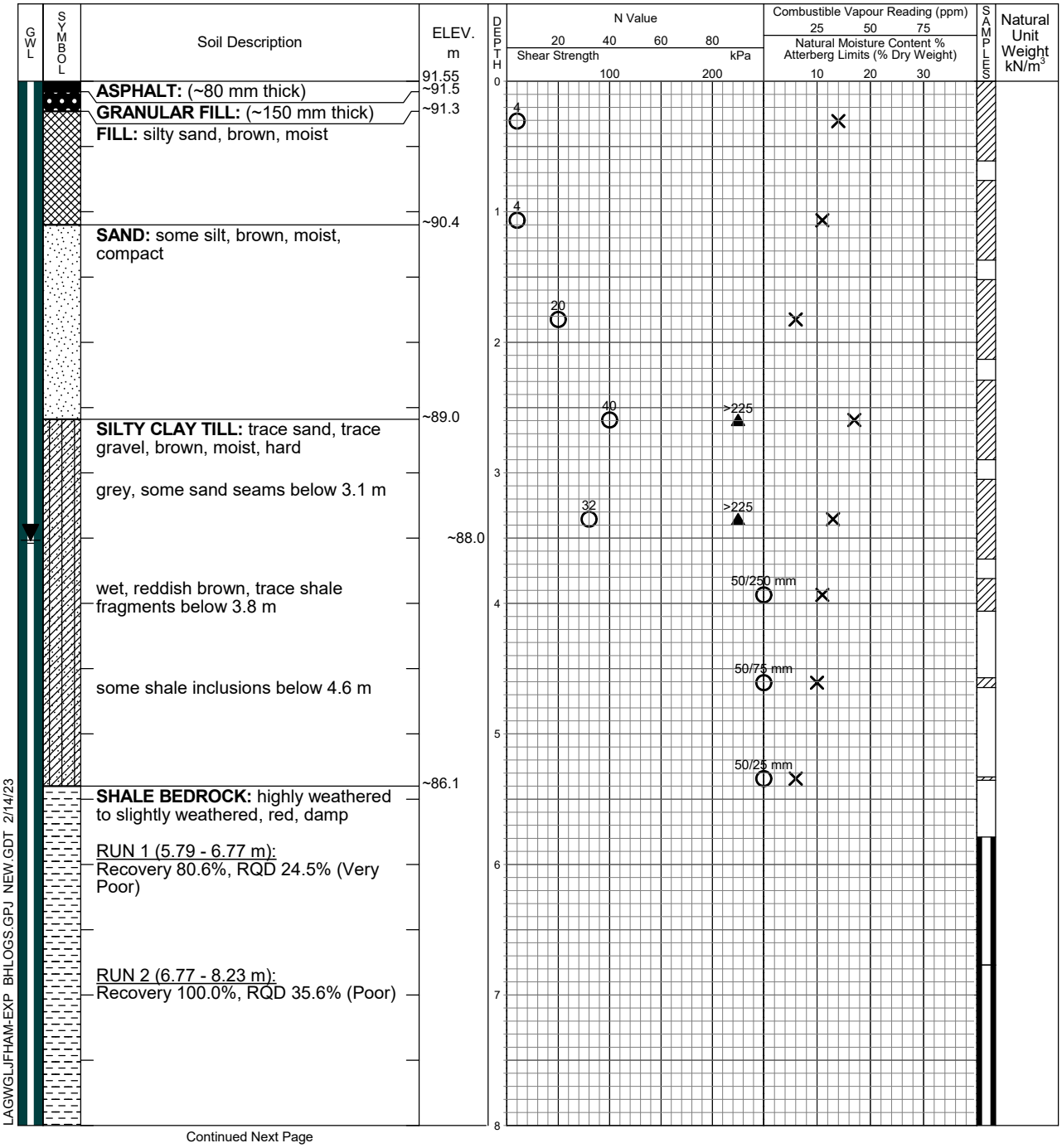
Date Drilled: January 12, 2023

Drill Type: D-120 Truck Mount, Solid Stem

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



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

Continued Next Page

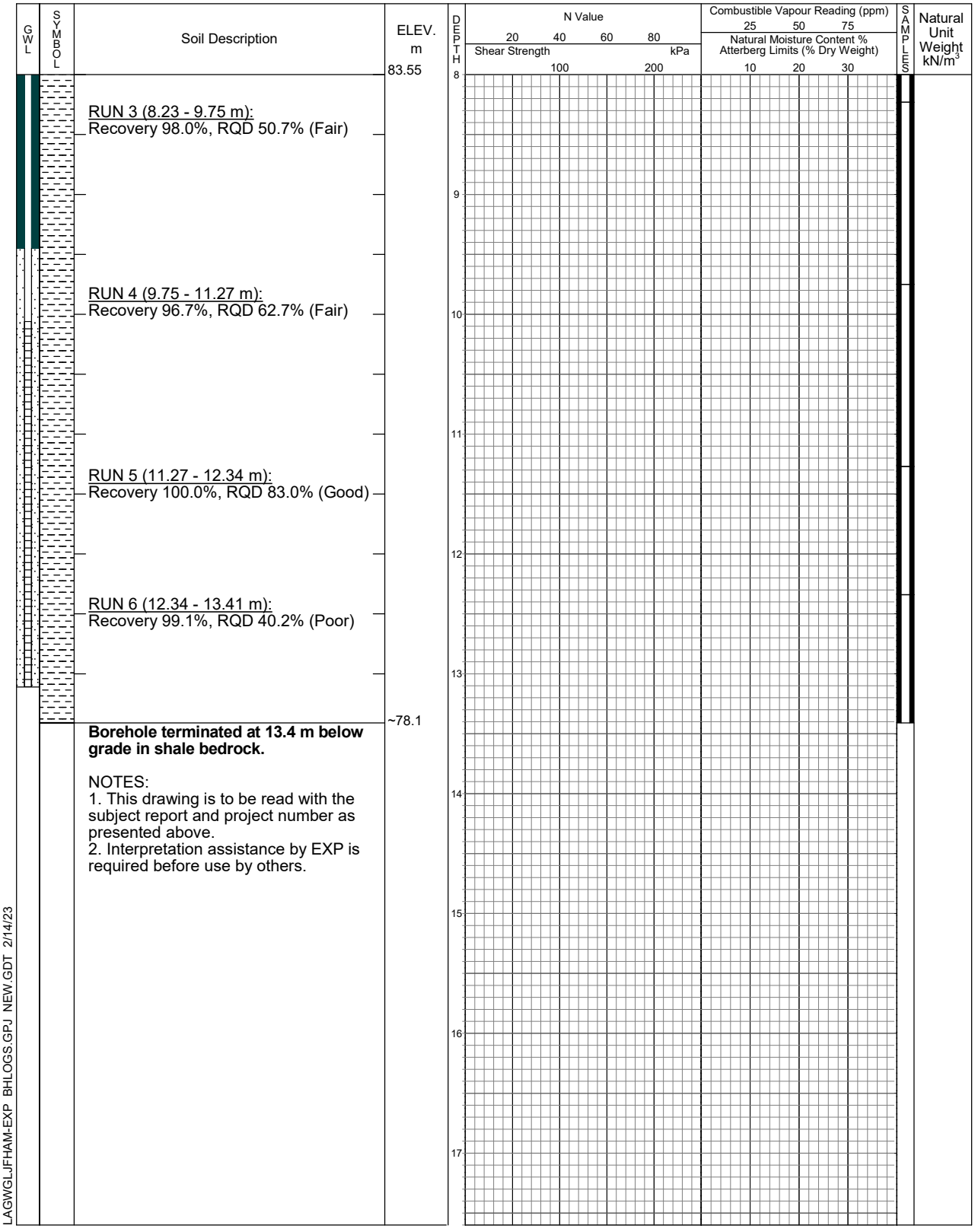
Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	3.54	-

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Log of Borehole BH-1

Project No. GTR-21018895-B1 Drawing No. 3

Project: Proposed Mid-Rise Residential Development Sheet No. 2 of 2



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	3.54	-

Log of Borehole BH-2

Project No. GTR-21018895-B1 Drawing No. 4

Project: Proposed Mid-Rise Residential Development Sheet No. 1 of 1

Location: 688 Brant Street, Burlington, ON

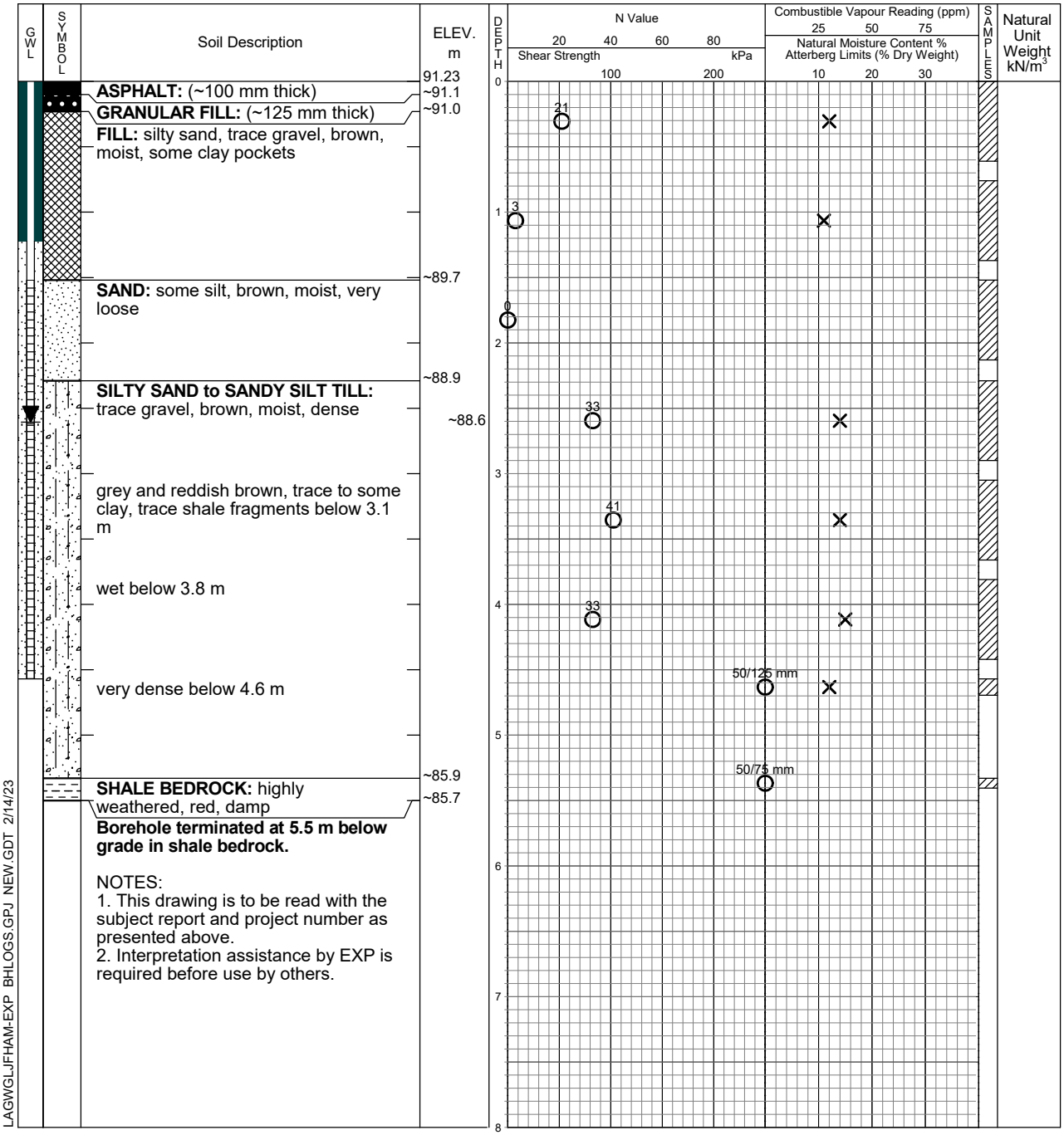
Date Drilled: January 12, 2023

Drill Type: D-120 Truck Mount, Solid Stem

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



NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.

LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	2.63	-

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Log of Borehole BH-3

Project No. GTR-21018895-B1 | Drawing No. 5

Project: Proposed Mid-Rise Residential Development | Sheet No. 1 of 2

Location: 688 Brant Street, Burlington, ON

Date Drilled: January 19, 2023

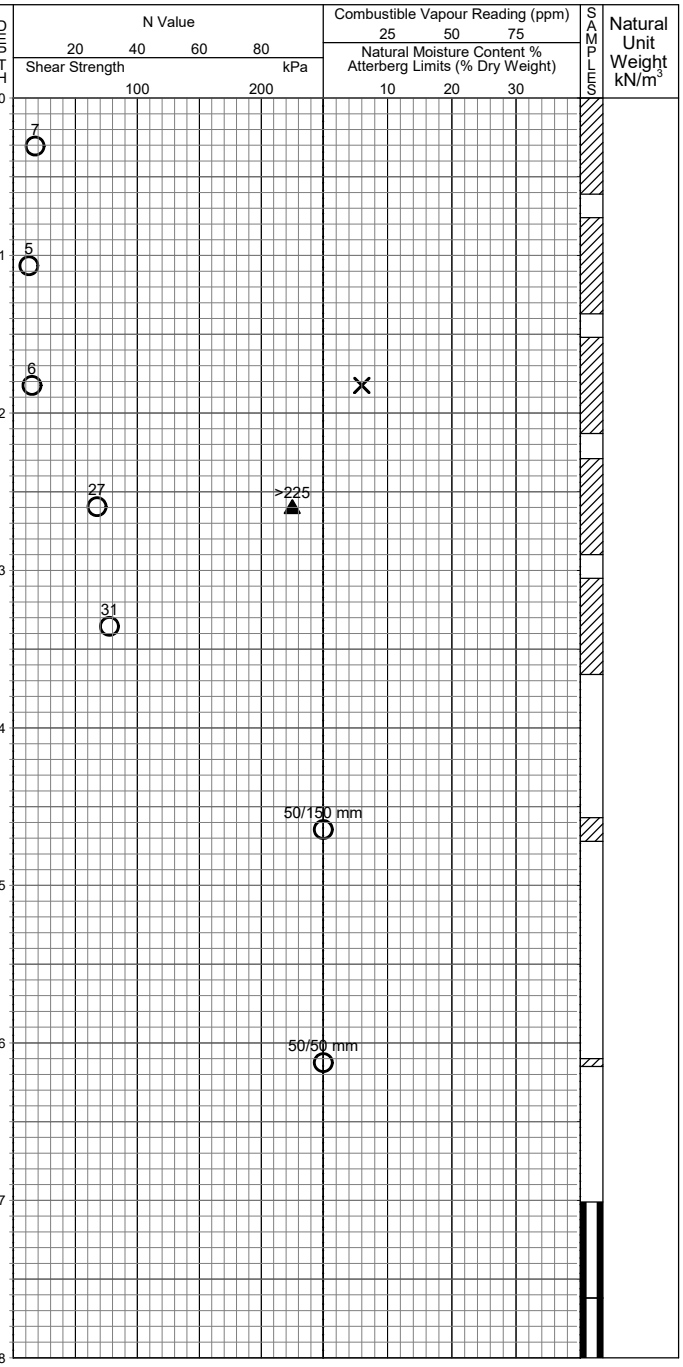
Drill Type: D-120 Track Mount, Solid Stem

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 ▲

GWL	SYMBOL	Soil Description	ELEV. m
		TOPSOIL: (~330 mm thick)	91.53
		FILL: sandy silt, some clay, brown to dark brown, moist, some organics/rootlets, trace brick fragments	~91.2
		SILTY SAND: brown, moist, compact	~90.0
		SILTY CLAY TILL: trace sand, trace gravel, brown to grey, damp to moist, hard	~89.2
		SANDY SILT TILL: grey, damp, dense	~88.5
▽		very dense, some shale inclusions below 4.6 m	~87.7
		SHALE BEDROCK: highly to slightly weathered, red, damp	~85.4
		RUN 1 (7.01 - 7.62 m): Recovery 100.0%, RQD 67.2% (Fair)	
		RUN 2 (7.62 - 9.27 m): Recovery 77.0%, RQD 44.2% (Poor)	



Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	3.84	-

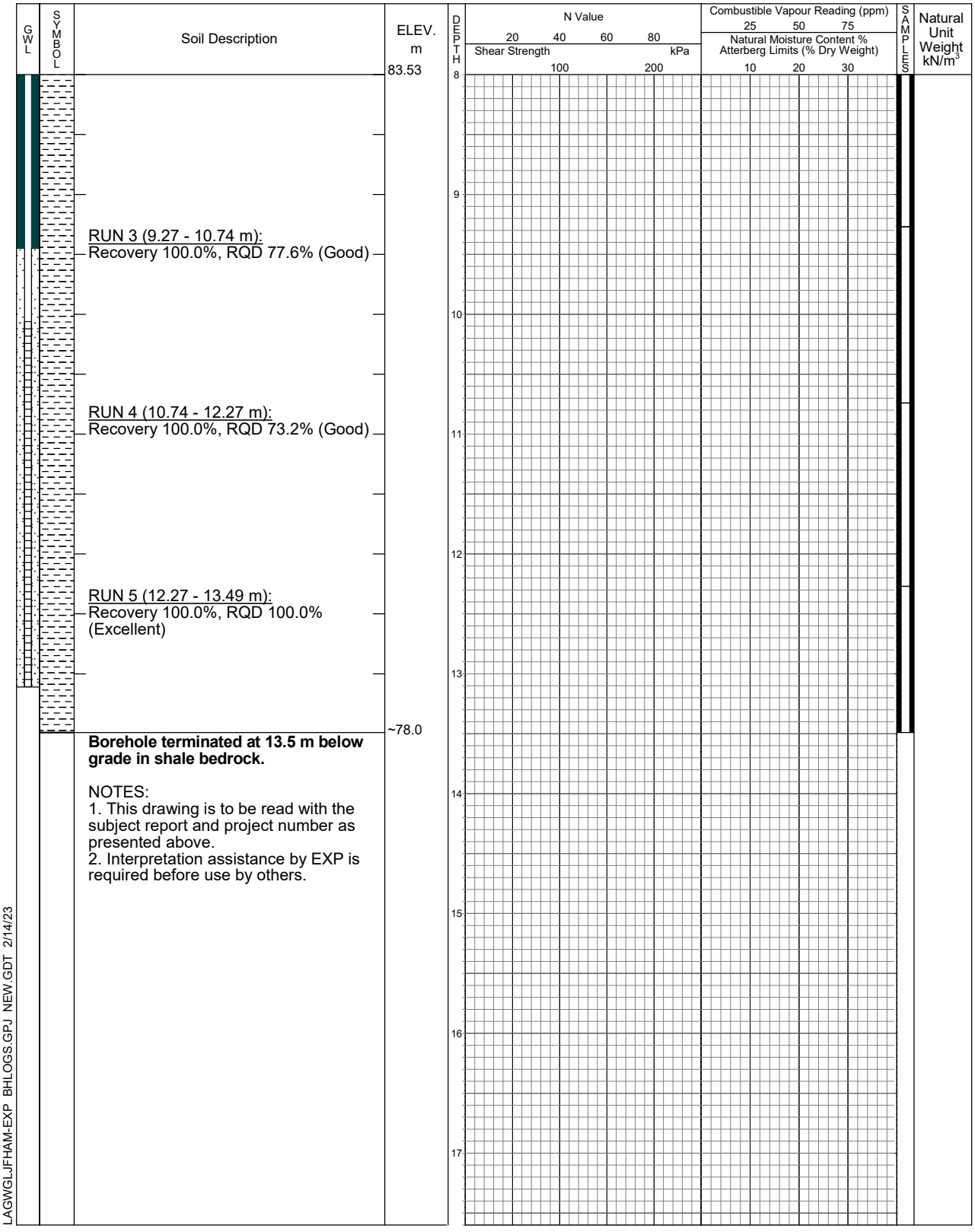
EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

Log of Borehole BH-3

Project No. GTR-21018895-B1 Drawing No. 5

Project: Proposed Mid-Rise Residential Development Sheet No. 2 of 2



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	3.84	-

Log of Borehole BH-4

Project No. GTR-21018895-B1 | Drawing No. 6

Project: Proposed Mid-Rise Residential Development | Sheet No. 1 of 2

Location: 688 Brant Street, Burlington, ON

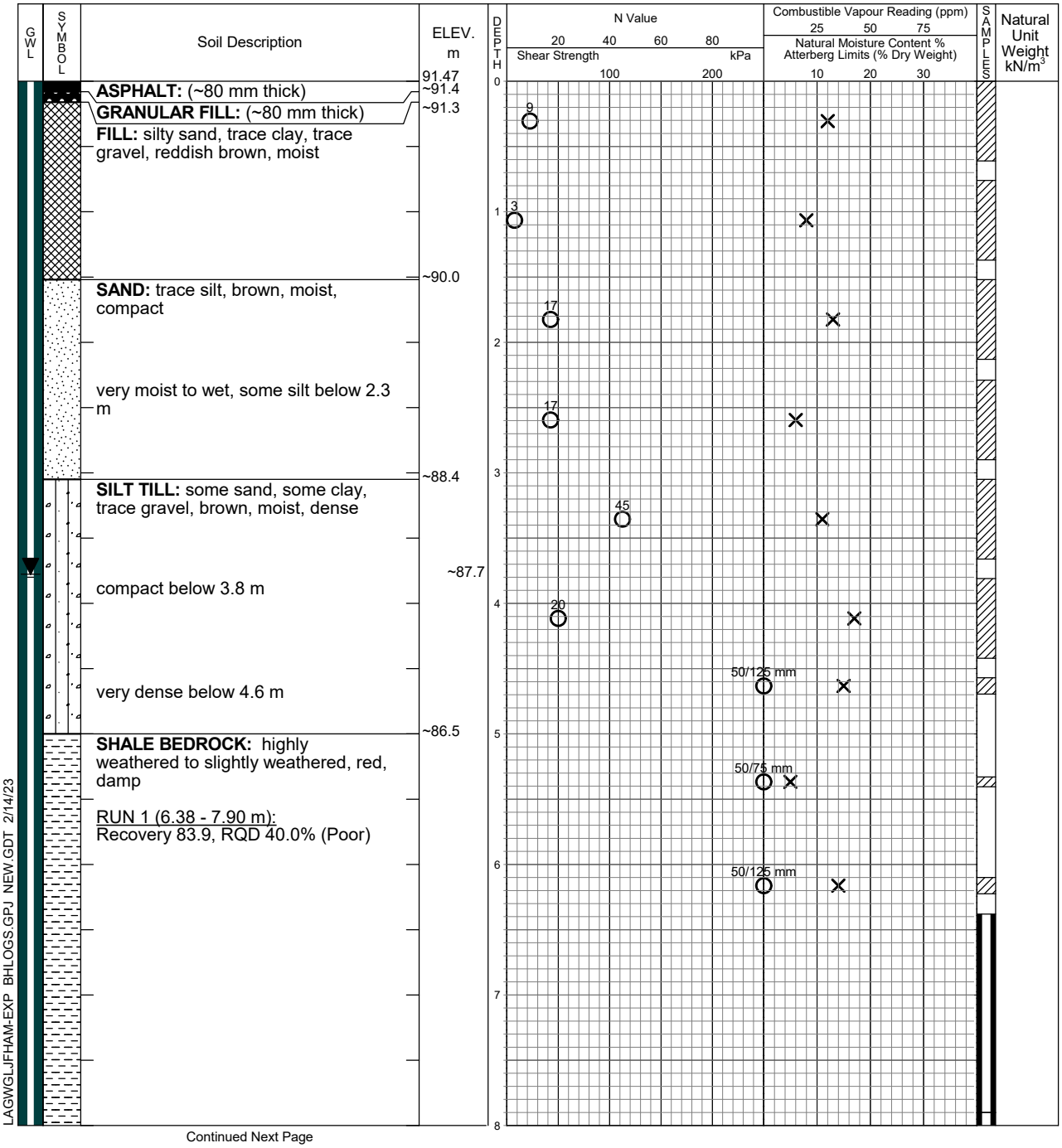
Date Drilled: January 16, 2023

Drill Type: D-120 Truck Mount, Solid Stem

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



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	3.80	-

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Log of Borehole BH-4

Project No. GTR-21018895-B1 Drawing No. 6

Project: Proposed Mid-Rise Residential Development Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		RUN 2 (7.90 - 9.37 m): Recovery 95.2%, RQD 26.1% (Poor)	83.47	8
		RUN 3 (9.37 - 10.92 m): Recovery 99.4%, RQD 47.1% (Poor)		9
		RUN 4 (10.92 - 12.50 m): Recovery 97.5%, RQD 50.0% (Fair)		10
		RUN 5 (12.50 - 13.18 m): Recovery 100.0%, RQD 75.0% (Good)		11
			~78.3	12
		Borehole terminated at 13.2 m depth below grade in shale bedrock.		13
		NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by EXP is required before use by others.		14
				15
				16
				17

N Value (20, 40, 60, 80)
Shear Strength kPa (100, 200)
Combustible Vapour Reading (ppm) (25, 50, 75)
Natural Moisture Content % Atterberg Limits (% Dry Weight) (10, 20, 30)
SAMPLES
Natural Unit Weight kN/m^3

LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave
January 31, 2023	3.80	-

Log of Borehole BH-5

Project No. GTR-21018895-B1 | Drawing No. 7

Project: Proposed Mid-Rise Residential Development | Sheet No. 1 of 1

Location: 688 Brant Street, Burlington, ON

Date Drilled: January 17, 2023

Drill Type: Pionjar

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		TOPSOIL: (~150 mm thick)	91.38	0
		FILL: sand, some silt, trace gravel, brown, moist, trace brick fragments and rootlets	~91.2	
		Borehole terminated at 2.1 m depth below grade.	~89.2	2

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.

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
SAMPLES
Natural Unit Weight kN/m³

LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 2/14/23

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	no cave

Log of Borehole BH/MW-1S

Project No. GTR-21018895-B0 | Drawing No. 1

Project: Phase Two ESA | Sheet No. 1 of 1

Location: 688-698 Brant Street, Burlington, ON

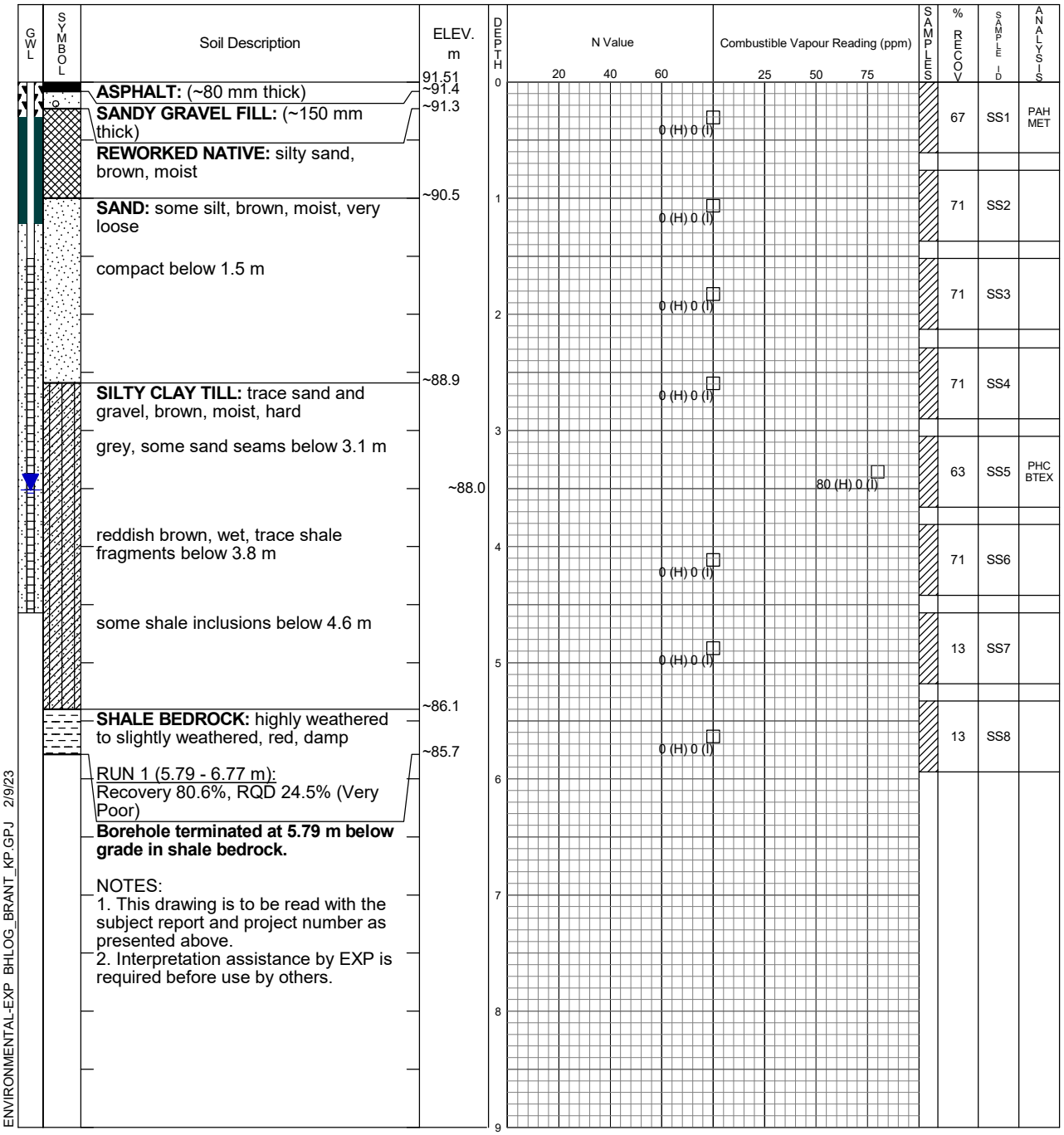
Date Drilled: January 12, 2023

Drill Type: D-120 Truck Mount, Solid Stem

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 BHLOG_BRANT_KP.GPJ 2/9/23

Time	Water Level (m)	Depth to Cave (m)
Jan.24, 2023	2.593	
Jan.31, 2023	2.620	

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

Log of Borehole BH/MW-2

Project No. GTR-21018895-B0 | Drawing No. 2

Project: Phase Two ESA | Sheet No. 1 of 1

Location: 688-698 Brant Street, Burlington, ON

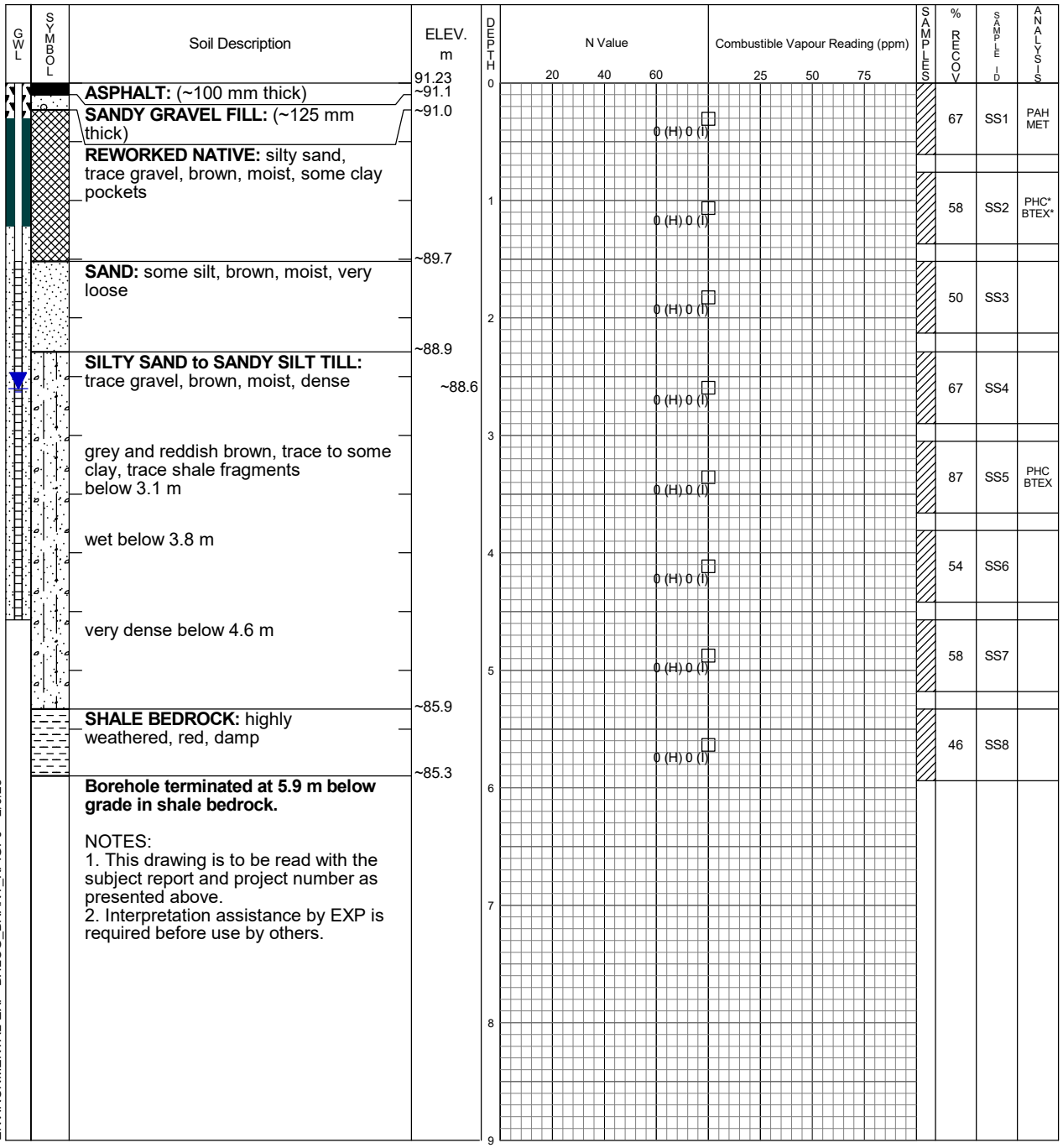
Date Drilled: January 12, 2023

Drill Type: D-120 Truck Mount, Solid Stem

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		



NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.

ENVIRONMENTAL-EXP BHLOG_BRANT_KP.GPJ 2/9/23

Time	Water Level (m)	Depth to Cave (m)
Jan.24, 2023	2.692	
Jan.31, 2023	2.620	

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

Log of Borehole BH/MW-4S

Project No. GTR-21018895-B0 | Drawing No. 3

Project: Phase Two ESA | Sheet No. 1 of 1

Location: 688-698 Brant Street, Burlington, ON

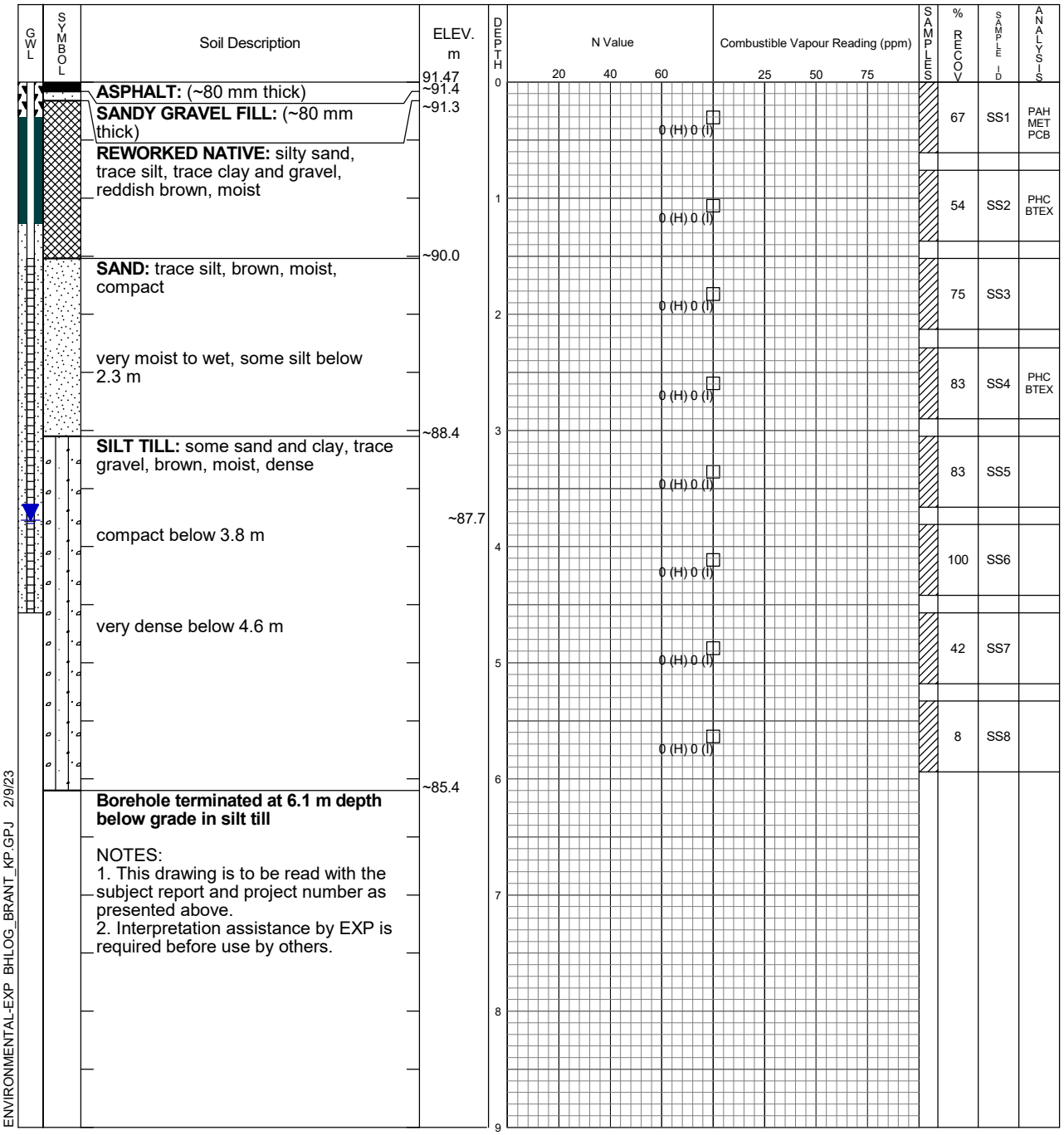
Date Drilled: January 16, 2023

Drill Type: D-120 Truck Mount, Solid Stem

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		



Time	Water Level (m)	Depth to Cave (m)
Jan.24, 2023	2.925	
Jan.31, 2023	2.940	

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

Log of Borehole BH-5

Project No. GTR-21018895-B0 | Drawing No. 4

Project: Phase Two ESA | Sheet No. 1 of 1

Location: 688-698 Brant Street, Burlington, ON

Date Drilled: January 17, 2023

Drill Type: Pionjar Drill

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		

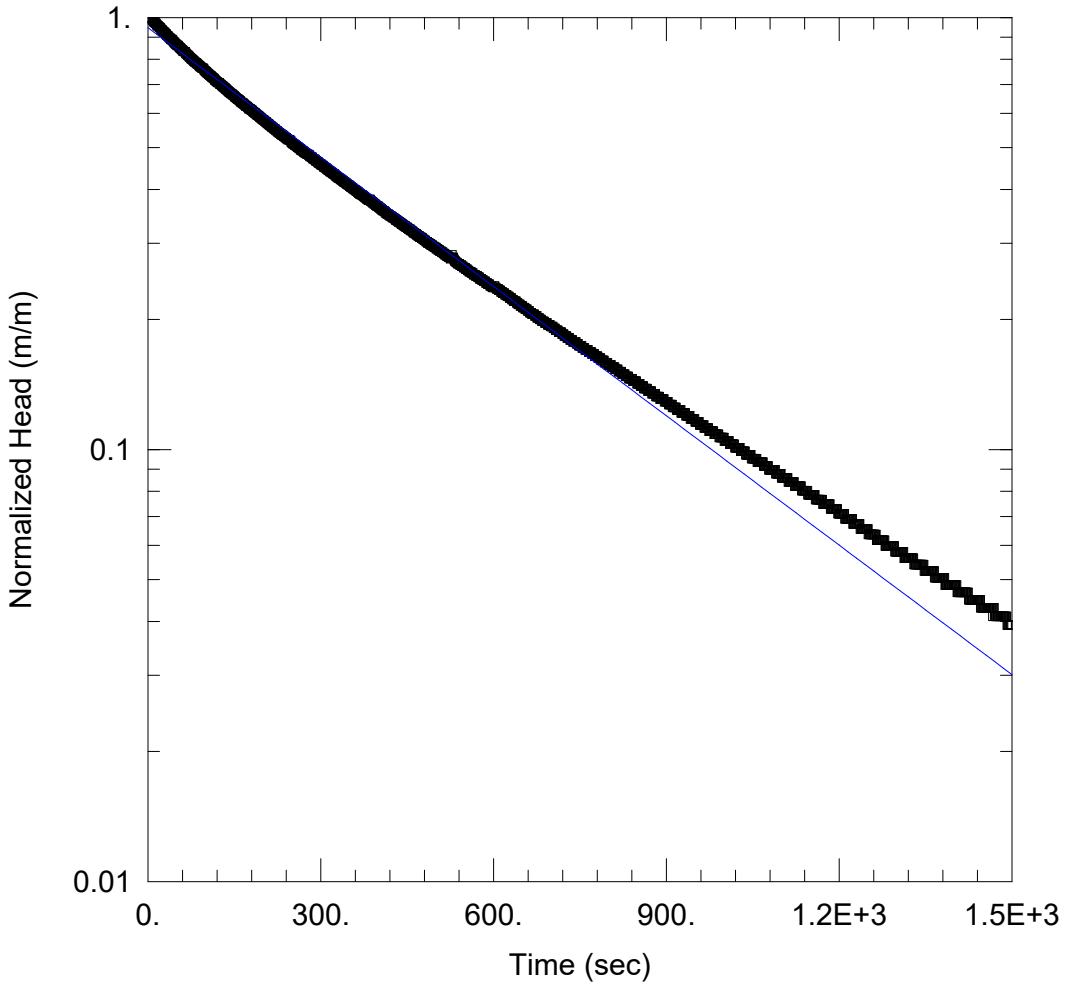
GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value	Combustible Vapour Reading (ppm)	SAMPLES	% RECOV	SAMPLE ID	ANALYSIS
		TOPSOIL: (~150 mm thick)	91.38	0	20 40 60	25 50 75				
		FILL: sand, some silt, trace gravel, brown, moist, trace brick fragments and rootlets	~91.2		0 (H) 0 (I)			83	SS1	PHC BTEX PCB
				1	0 (H) 0 (I)			80	SS2	MET
				2	0 (H) 0 (I)			100	SS3	
			~89.2							
		Borehole terminated at 2.1 m depth below grade.		3						
		NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by EXP is required before use by others.		4						
				5						
				6						
				7						
				8						
				9						

ENVIRONMENTAL-EXP BHLOG_BRANT_KP.GPJ 2/9/23

Time	Water Level (m)	Depth to Cave (m)

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

Appendix C – SWRT Procedures and Results



BH/MW 1D - FALLING HEAD TEST

Data Set: E:\...\BH-1D_Rev2.aqt
Date: 02/26/23 Time: 13:00:13

PROJECT INFORMATION

Company: EXP
Client: Brooklyn Construction
Project: GTR-21018895-B0
Location: 688, 694, and 698 Brant Street
Test Well: BH/MW 1D
Test Date: January 31, 2023

AQUIFER DATA

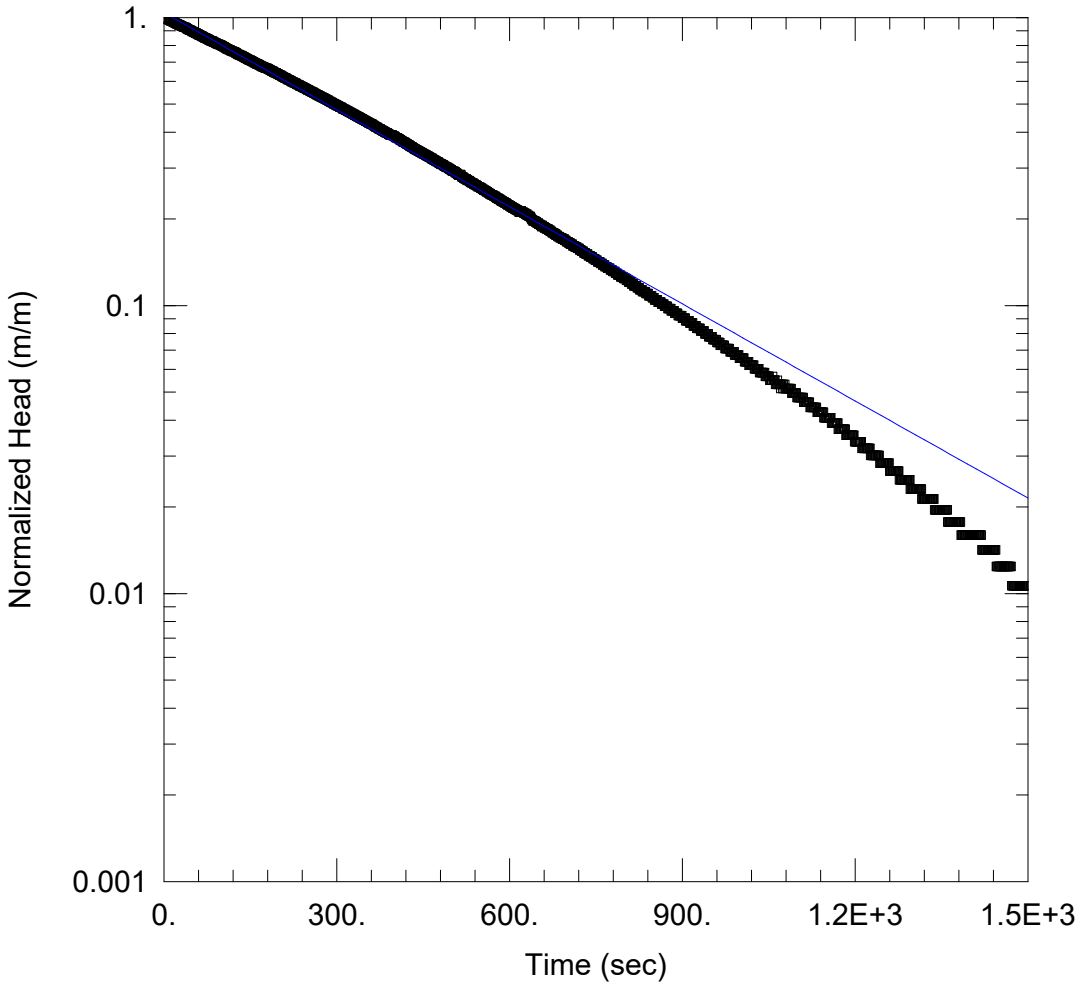
Saturated Thickness: 9.98 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH- 1D)

Initial Displacement: 1.605 m
Total Well Penetration Depth: 9.98 m
Casing Radius: 0.0254 m
Static Water Column Height: 9.98 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.351E-6 m/sec
y0 = 1.52 m



BH/MW 3 - FALLING HEAD TEST

Data Set: E:\...\BH-3_Rev2.aqt
Date: 02/26/23 Time: 12:57:57

PROJECT INFORMATION

Company: EXP
Client: Brooklyn Construction
Project: GTR-21018895-B0
Location: 688, 694, and 698 Brant Street
Test Well: BH/MW 3
Test Date: January 31, 2023

AQUIFER DATA

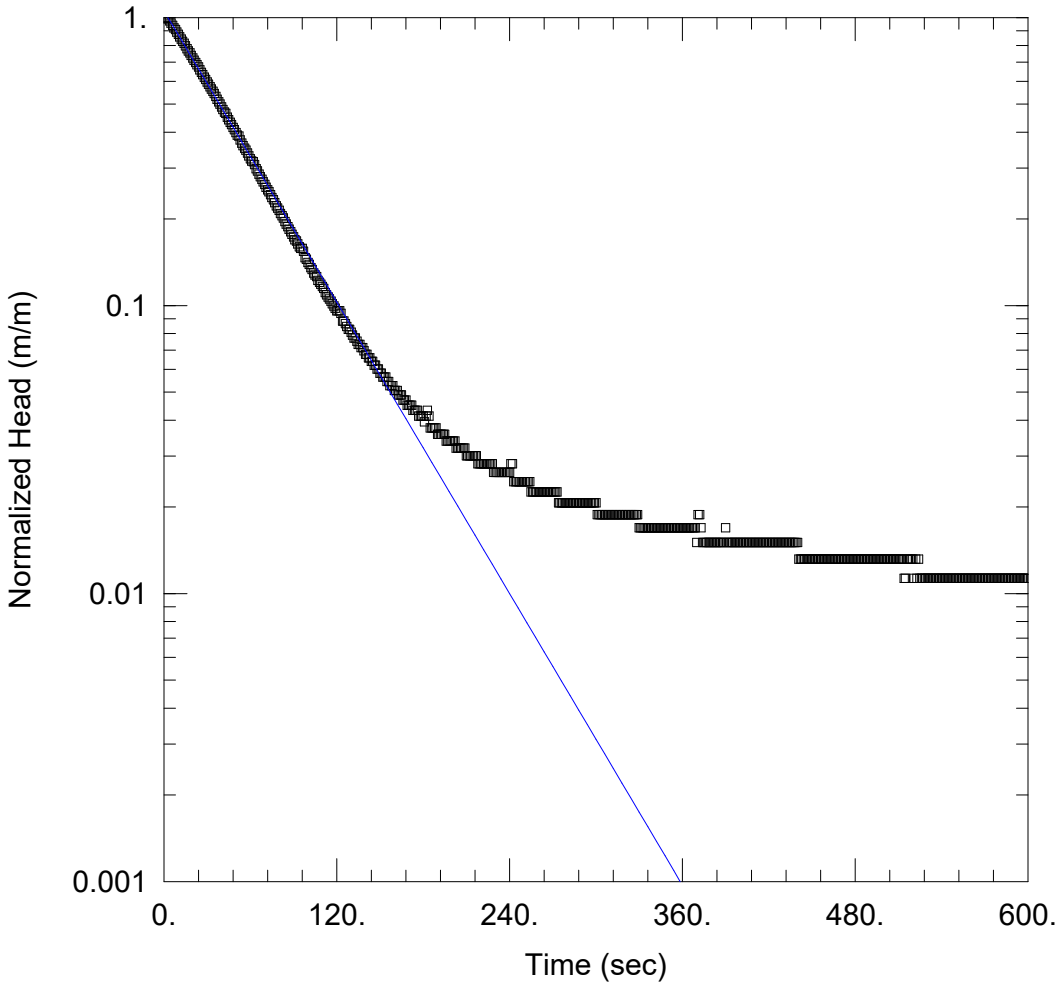
Saturated Thickness: 9.11 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH- 3)

Initial Displacement: 1.692 m
Total Well Penetration Depth: 9.11 m
Casing Radius: 0.0254 m
Static Water Column Height: 9.11 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.52E-6 m/sec
y0 = 1.759 m



BH/MW 4D - FALLING HEAD

Data Set: E:\...\BH-4D_Rev2.aqt
Date: 02/26/23 Time: 13:03:12

PROJECT INFORMATION

Company: EXP
Client: Brooklyn Construction
Project: GTR-21018895-B0
Location: 688, 694, and 698 Brant Street
Test Well: BH/MW 4D
Test Date: January 31, 2023

AQUIFER DATA

Saturated Thickness: 8.46 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH- 4D)

Initial Displacement: 1.596 m
Total Well Penetration Depth: 8.46 m
Casing Radius: 0.0254 m
Static Water Column Height: 8.46 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

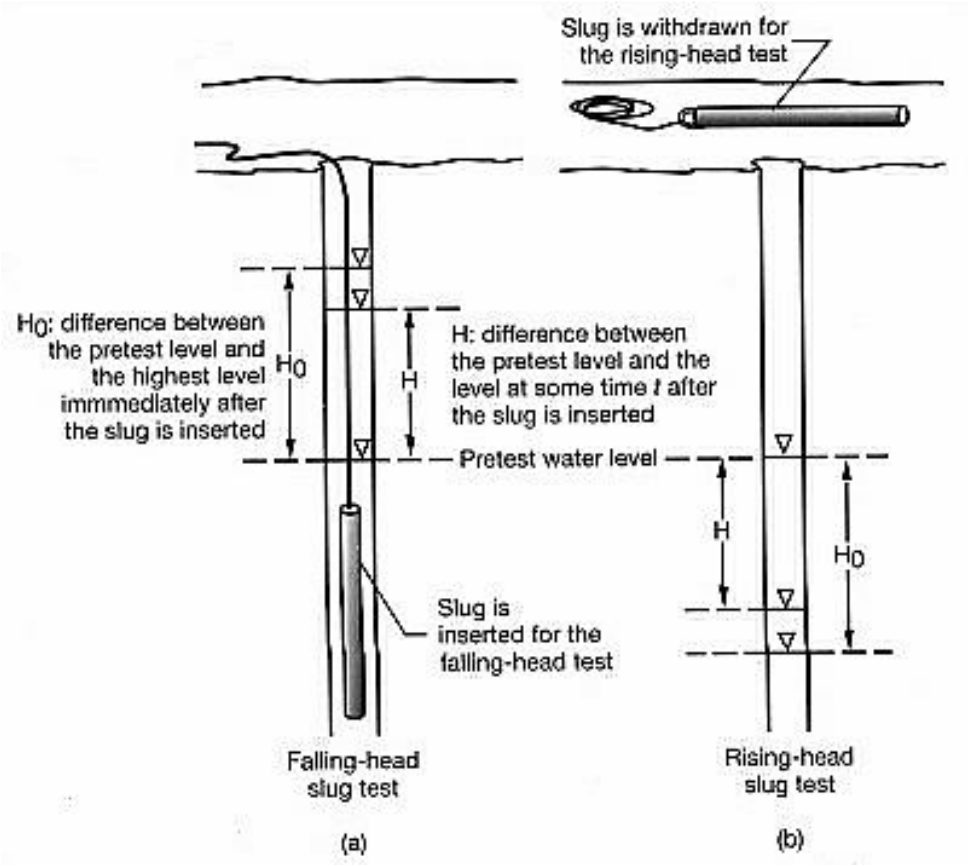
Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.141E-5 m/sec
y0 = 1.686 m

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 #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Your C.O.C. #: 913373-01-01

Attention: Nataliya Tkach

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

Report Date: 2023/02/07
Report #: R7500663
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C329244
Received: 2023/01/31, 15:33

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sewer Use By-Law Semivolatile Organics	1	2023/02/02	2023/02/02	CAM SOP 00301	EPA 8270 m
Biochemical Oxygen Demand (BOD)	1	2023/02/01	2023/02/06	CAM SOP-00427	SM 23 5210B m
Carbonaceous BOD	1	2023/02/01	2023/02/06	CAM SOP-00427	SM 23 5210B m
Chromium (VI) in Water	1	N/A	2023/02/02	CAM SOP-00436	EPA 7199 m
Total Cyanide	1	2023/02/01	2023/02/01	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2023/02/02	2023/02/02	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2023/02/02	2023/02/02	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by Axial ICP	1	2023/02/03	2023/02/03	CAM SOP-00408	EPA 6010D m
Total Metals Analysis by ICPMS	1	2023/02/03	2023/02/03	CAM SOP-00447	EPA 6020B m
E.coli, (CFU/100mL)	1	N/A	2023/01/31	CAM SOP-00552	
Total Nonylphenol in Liquids by HPLC	1	2023/02/01	2023/02/02	CAM SOP-00313	In-house Method
Nonylphenol Ethoxylates in Liquids: HPLC	1	2023/02/01	2023/02/02	CAM SOP-00313	In-house Method
Animal and Vegetable Oil and Grease	1	N/A	2023/02/02	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2023/02/02	2023/02/02	CAM SOP-00326	EPA1664B m,SM5520B m
Polychlorinated Biphenyl in Water	1	2023/02/02	2023/02/02	CAM SOP-00309	EPA 8082A m
pH	1	2023/02/02	2023/02/02	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2023/02/06	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2023/02/03	CAM SOP-00464	EPA 375.4 m
Total Kjeldahl Nitrogen in Water	1	2023/02/02	2023/02/03	CAM SOP-00938	OMOE E3516 m
Total PAHs (1)	1	N/A	2023/02/07	CAM SOP - 00301	
Mineral/Synthetic O & G (TPH Heavy Oil) (2)	1	2023/02/02	2023/02/02	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2023/02/02	2023/02/03	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2023/02/02	CAM SOP-00228	EPA 8260D

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

Your Project #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Your C.O.C. #: 913373-01-01

Attention: Nataliya Tkach

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

Report Date: 2023/02/07
Report #: R7500663
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C329244
Received: 2023/01/31, 15:33

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.

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) Total PAHs include only those PAHs specified in the sewer use by-by-law.
(2) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas
07 Feb 2023 17:22:56

Please direct all questions regarding this Certificate of Analysis to:
Patricia Legette, Project Manager
Email: Patricia.Legette@bureauveritas.com
Phone# (905)817-5799

==========

This report has been generated and distributed using a secure automated process.
Bureau Veritas 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 Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

Bureau Veritas Job #: C329244
Report Date: 2023/02/07

exp Services Inc
Client Project #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Sampler Initials: MH

BURLINGTON STORM SEWER (WATER)

Bureau Veritas ID				UYF017			UYF017		
Sampling Date				2023/01/31 10:30			2023/01/31 10:30		
COC Number				913373-01-01			913373-01-01		
	UNITS	Criteria	Criteria-2	BH/MW1D	RDL	QC Batch	BH/MW1D Lab-Dup	RDL	QC Batch
Inorganics									
Total BOD	mg/L	-	15	7	2	8480558			
Miscellaneous Parameters									
Nonylphenol Ethoxylate (Total)	mg/L	-	0.01	ND	0.005	8481971			
Nonylphenol (Total)	mg/L	-	0.001	ND	0.001	8481969			
Metals									
Chromium (VI)	ug/L	-	40	ND	0.50	8483030			
Total Arsenic (As)	ug/L	1000	20	2.4	1.0	8485611			
Total Cadmium (Cd)	ug/L	1000	8	ND	0.090	8485611			
Total Chromium (Cr)	ug/L	3000	80	ND	5.0	8485611			
Total Copper (Cu)	ug/L	3000	40	1.1	0.90	8485611			
Total Lead (Pb)	ug/L	3000	120	ND	0.50	8485611			
Total Manganese (Mn)	ug/L	5000	50	**210**	2.0	8485611			
Total Nickel (Ni)	ug/L	3000	80	3.1	1.0	8485611			
Total Phosphorus (P)	ug/L	10000	400	ND	100	8485611			
Total Selenium (Se)	ug/L	5000	20	ND	2.0	8485611			
Total Silver (Ag)	ug/L	5000	120	ND	0.090	8485611			
Total Zinc (Zn)	ug/L	3000	40	6.9	5.0	8485611			
Semivolatile Organics									
Naphthalene	ug/L	140	-	ND	0.3	8482810	ND	0.3	8482810
Di-N-butyl phthalate	ug/L	-	15	ND	2	8482810	ND	2	8482810
Bis(2-ethylhexyl)phthalate	ug/L	-	8.8	ND	2	8482810	ND	2	8482810
3,3'-Dichlorobenzidine	ug/L	-	0.8	ND	0.8	8482810	ND	0.8	8482810
Pentachlorophenol	ug/L	-	2	ND	1	8482810	ND	1	8482810
Phenanthrene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Anthracene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Fluoranthene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Pyrene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810

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: Halton Sanitary & Combined Sewer Bylaw (2-03)
Criteria-2: The City of Burlington Storm Sewer Discharge By-Law 86-2022
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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

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

BURLINGTON STORM SEWER (WATER)

Bureau Veritas ID				UYF017			UYF017		
Sampling Date				2023/01/31 10:30			2023/01/31 10:30		
COC Number				913373-01-01			913373-01-01		
	UNITS	Criteria	Criteria-2	BH/MW1D	RDL	QC Batch	BH/MW1D Lab-Dup	RDL	QC Batch
Benzo(a)anthracene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Chrysene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Benzo(b/j)fluoranthene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Benzo(k)fluoranthene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Benzo(a)pyrene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Indeno(1,2,3-cd)pyrene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Dibenzo(a,h)anthracene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Benzo(g,h,i)perylene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Dibenzo(a,i)pyrene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Benzo(e)pyrene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Perylene	ug/L	-	-	ND	0.2	8482810	ND	0.2	8482810
Dibenzo(a,j) acridine	ug/L	-	-	ND	0.4	8482810	ND	0.4	8482810
7H-Dibenzo(c,g) Carbazole	ug/L	-	-	ND	0.4	8482810	ND	0.4	8482810
1,6-Dinitropyrene	ug/L	-	-	ND	0.4	8482810	ND	0.4	8482810
1,3-Dinitropyrene	ug/L	-	-	ND	0.4	8482810	ND	0.4	8482810
1,8-Dinitropyrene	ug/L	-	-	ND	0.4	8482810	ND	0.4	8482810
Calculated Parameters									
Total PAHs (18 PAHs)	ug/L	-	-	ND	1	8479435			
PCBs									
Aroclor 1016	ug/L	-	-	ND	0.05	8482708			
Aroclor 1221	ug/L	-	-	ND	0.05	8482708			
Aroclor 1232	ug/L	-	-	ND	0.05	8482708			
Aroclor 1242	ug/L	-	-	ND	0.05	8482708			
Aroclor 1248	ug/L	-	-	ND	0.05	8482708			
Aroclor 1254	ug/L	-	-	ND	0.05	8482708			
Aroclor 1260	ug/L	-	-	ND	0.05	8482708			
Aroclor 1262	ug/L	-	-	ND	0.05	8482708			
Aroclor 1268	ug/L	-	-	ND	0.05	8482708			

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

Bureau Veritas Job #: C329244
Report Date: 2023/02/07

exp Services Inc
Client Project #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Sampler Initials: MH

BURLINGTON STORM SEWER (WATER)

Bureau Veritas ID				UYF017			UYF017		
Sampling Date				2023/01/31 10:30			2023/01/31 10:30		
COC Number				913373-01-01			913373-01-01		
	UNITS	Criteria	Criteria-2	BH/MW1D	RDL	QC Batch	BH/MW1D Lab-Dup	RDL	QC Batch
Total PCB	ug/L	-	0.4	ND	0.05	8482708			
Microbiological									
Escherichia coli	CFU/100mL	-	200	<10	10	8479757			
Surrogate Recovery (%)									
2,4,6-Tribromophenol	%	-	-	90		8482810	87		8482810
2-Fluorobiphenyl	%	-	-	75		8482810	71		8482810
D14-Terphenyl (FS)	%	-	-	88		8482810	86		8482810
D5-Nitrobenzene	%	-	-	80		8482810	71		8482810
D8-Acenaphthylene	%	-	-	89		8482810	86		8482810
Decachlorobiphenyl	%	-	-	78		8482708			

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: Halton Sanitary & Combined Sewer Bylaw (2-03)
Criteria-2: The City of Burlington Storm Sewer Discharge By-Law 86-2022
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Bureau Veritas Job #: C329244
Report Date: 2023/02/07

exp Services Inc
Client Project #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Sampler Initials: MH

HALTON SANITARY & COMBINED BYLAW (2-03)

Bureau Veritas ID				UYF017			UYF017		
Sampling Date				2023/01/31 10:30			2023/01/31 10:30		
COC Number				913373-01-01			913373-01-01		
	UNITS	Criteria	Criteria-2	BH/MW1D	RDL	QC Batch	BH/MW1D Lab-Dup	RDL	QC Batch
Calculated Parameters									
Total Animal/Vegetable Oil and Grease	mg/L	150	-	ND	0.50	8478193			
Inorganics									
Total Carbonaceous BOD	mg/L	300	-	6	2	8480561			
Fluoride (F-)	mg/L	10	-	0.47	0.10	8483735			
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	5.6	0.20	8483341			
pH	pH	6.0:10.0	6.5:8.5	7.98		8483738			
Phenols-4AAP	mg/L	1	0.008	ND	0.0010	8485832	ND	0.0010	8485832
Total Suspended Solids	mg/L	350	15	**23**	10	8482858			
Dissolved Sulphate (SO4)	mg/L	1500	-	1100	5.0	8483687			
Total Cyanide (CN)	mg/L	2	0.02	ND	0.0050	8480778			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	ND	0.50	8484224			
Total Oil & Grease Mineral/Synthetic	mg/L	-	-	ND	0.50	8484227			
Metals									
Total Aluminum (Al)	mg/L	50	-	ND	1	8485134			
Total Antimony (Sb)	mg/L	5	-	ND	0.2	8485134			
Total Arsenic (As)	mg/L	1	0.02	**ND (1)**	0.1	8485134			
Total Beryllium (Be)	mg/L	5	-	ND	0.005	8485134			
Total Cadmium (Cd)	mg/L	1	0.008	**ND (1)**	0.02	8485134			
Total Chromium (Cr)	mg/L	3	0.08	**ND (1)**	0.1	8485134			
Total Cobalt (Co)	mg/L	5	-	ND	0.02	8485134			
Total Copper (Cu)	mg/L	3	0.04	**ND (1)**	0.1	8485134			
Total Iron (Fe)	mg/L	50	-	0.9	0.2	8485134			
Total Lead (Pb)	mg/L	3	0.12	ND	0.1	8485134			
Total Manganese (Mn)	mg/L	5	0.05	**0.20**	0.01	8485134			
Mercury (Hg)	mg/L	0.05	0.0004	ND	0.00010	8483479			

No Fill	No Exceedance
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Black	Exceeds both criteria/levels

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Criteria: Halton Sanitary & Combined Sewer Bylaw (2-03)
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(1) RDL exceeds criteria

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

HALTON SANITARY & COMBINED BYLAW (2-03)

Bureau Veritas ID				UYF017			UYF017		
Sampling Date				2023/01/31 10:30			2023/01/31 10:30		
COC Number				913373-01-01			913373-01-01		
	UNITS	Criteria	Criteria-2	BH/MW1D	RDL	QC Batch	BH/MW1D Lab-Dup	RDL	QC Batch
Total Molybdenum (Mo)	mg/L	5	-	ND	0.05	8485134			
Total Nickel (Ni)	mg/L	3	0.08	ND	0.05	8485134			
Total Phosphorus (P)	mg/L	10	0.4	**ND (1)**	0.5	8485134			
Total Selenium (Se)	mg/L	5	0.02	**ND (1)**	0.2	8485134			
Total Silver (Ag)	mg/L	5	0.12	ND	0.1	8485134			
Total Tin (Sn)	mg/L	5	-	ND	0.2	8485134			
Total Titanium (Ti)	mg/L	5	-	ND	0.05	8485134			
Total Zinc (Zn)	mg/L	3	0.04	**ND (1)**	0.05	8485134			
Volatile Organics									
Benzene	ug/L	10	2	ND	0.40	8481058			
Chloroform	ug/L	40	2	**4.2**	0.40	8481058			
1,4-Dichlorobenzene	ug/L	80	6.8	ND	0.80	8481058			
Ethylbenzene	ug/L	160	2	ND	0.40	8481058			
Methylene Chloride(Dichloromethane)	ug/L	2000	5.2	ND	4.0	8481058			
Tetrachloroethylene	ug/L	1000	4.4	ND	0.40	8481058			
Toluene	ug/L	16	2	ND	0.40	8481058			
Trichloroethylene	ug/L	400	7.6	ND	0.40	8481058			
Surrogate Recovery (%)									
4-Bromofluorobenzene	%	-	-	100		8481058			
D4-1,2-Dichloroethane	%	-	-	105		8481058			
D8-Toluene	%	-	-	96		8481058			

No Fill	No Exceedance
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Criteria: Halton Sanitary & Combined Sewer Bylaw (2-03)
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(1) RDL exceeds criteria

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

Bureau Veritas Job #: C329244
Report Date: 2023/02/07

exp Services Inc
Client Project #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Sampler Initials: MH

TEST SUMMARY

Bureau Veritas ID: UYF017
Sample ID: BH/MW1D
Matrix: Water

Collected: 2023/01/31
Shipped:
Received: 2023/01/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sewer Use By-Law Semivolatile Organics	GC/MS	8482810	2023/02/02	2023/02/02	Adriana Zurita
Biochemical Oxygen Demand (BOD)	DO	8480558	2023/02/01	2023/02/06	Gurjot Kaur
Carbonaceous BOD	DO	8480561	2023/02/01	2023/02/06	Gurjot Kaur
Chromium (VI) in Water	IC	8483030	N/A	2023/02/02	Theodora Luck
Total Cyanide	SKAL/CN	8480778	2023/02/01	2023/02/01	Kruti Jitesh Patel
Fluoride	ISE	8483735	2023/02/02	2023/02/02	Surinder Rai
Mercury in Water by CVAA	CV/AA	8483479	2023/02/02	2023/02/02	Japneet Gill
Total Metals Analysis by Axial ICP	ICPX	8485134	2023/02/03	2023/02/03	Medhat Nasr
Total Metals Analysis by ICPMS	ICP/MS	8485611	2023/02/03	2023/02/03	Nan Raykha
E.coli, (CFU/100mL)	PL	8479757	N/A	2023/01/31	Sonja Elavinamannil
Total Nonylphenol in Liquids by HPLC	LC/FLU	8481969	2023/02/01	2023/02/02	Dennis Boodram
Nonylphenol Ethoxylates in Liquids: HPLC	LC/FLU	8481971	2023/02/01	2023/02/02	Dennis Boodram
Animal and Vegetable Oil and Grease	BAL	8478193	N/A	2023/02/02	Automated Statchk
Total Oil and Grease	BAL	8484224	2023/02/02	2023/02/02	Kishan Patel
Polychlorinated Biphenyl in Water	GC/ECD	8482708	2023/02/02	2023/02/02	Svitlana Shaula
pH	AT	8483738	2023/02/02	2023/02/02	Surinder Rai
Phenols (4AAP)	TECH/PHEN	8485832	N/A	2023/02/06	Mandeep Kaur
Sulphate by Automated Colourimetry	KONE	8483687	N/A	2023/02/03	Massarat Jan
Total Kjeldahl Nitrogen in Water	SKAL	8483341	2023/02/02	2023/02/03	Rajni Tyagi
Total PAHs	CALC	8479435	N/A	2023/02/07	Automated Statchk
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	8484227	2023/02/02	2023/02/02	Kishan Patel
Total Suspended Solids	BAL	8482858	2023/02/02	2023/02/03	Shaneil Hall
Volatile Organic Compounds in Water	GC/MS	8481058	N/A	2023/02/02	Manpreet Sarao

Bureau Veritas ID: UYF017 Dup
Sample ID: BH/MW1D
Matrix: Water

Collected: 2023/01/31
Shipped:
Received: 2023/01/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sewer Use By-Law Semivolatile Organics	GC/MS	8482810	2023/02/02	2023/02/02	Adriana Zurita
Phenols (4AAP)	TECH/PHEN	8485832	N/A	2023/02/06	Mandeep Kaur

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GENERAL COMMENTS

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

Package 1	5.0°C

Sample UYF017 [BH/MW1D] : VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Metals: Due to the sample matrix, the sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

			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
8481058	4-Bromofluorobenzene	2023/02/02	105	70 - 130	104	70 - 130	103	%				
8481058	D4-1,2-Dichloroethane	2023/02/02	102	70 - 130	98	70 - 130	98	%				
8481058	D8-Toluene	2023/02/02	101	70 - 130	100	70 - 130	98	%				
8482708	Decachlorobiphenyl	2023/02/02	96	60 - 130	115	60 - 130	111	%				
8482810	2,4,6-Tribromophenol	2023/02/02	62	10 - 130	94	10 - 130	66	%				
8482810	2-Fluorobiphenyl	2023/02/02	49	30 - 130	79	30 - 130	88	%				
8482810	D14-Terphenyl (FS)	2023/02/02	84	30 - 130	91	30 - 130	93	%				
8482810	D5-Nitrobenzene	2023/02/02	58	30 - 130	96	30 - 130	94	%				
8482810	D8-Acenaphthylene	2023/02/02	57	30 - 130	93	30 - 130	95	%				
8480558	Total BOD	2023/02/06					ND,RDL=2	mg/L	3.6	30	98	80 - 120
8480561	Total Carbonaceous BOD	2023/02/06					ND,RDL=2	mg/L	22	30	102	85 - 115
8480778	Total Cyanide (CN)	2023/02/01	99	80 - 120	103	80 - 120	ND, RDL=0.0050	mg/L	NC	20		
8481058	1,4-Dichlorobenzene	2023/02/02	109	70 - 130	114	70 - 130	ND, RDL=0.40	ug/L	NC	30		
8481058	Benzene	2023/02/02	89	70 - 130	92	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8481058	Chloroform	2023/02/02	97	70 - 130	100	70 - 130	ND, RDL=0.20	ug/L	1.5	30		
8481058	Ethylbenzene	2023/02/02	92	70 - 130	97	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8481058	Methylene Chloride(Dichloromethane)	2023/02/02	96	70 - 130	97	70 - 130	ND, RDL=2.0	ug/L	NC	30		
8481058	Tetrachloroethylene	2023/02/02	92	70 - 130	97	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8481058	Toluene	2023/02/02	92	70 - 130	96	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8481058	Trichloroethylene	2023/02/02	102	70 - 130	108	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8481969	Nonylphenol (Total)	2023/02/02	80	50 - 130	64	50 - 130	ND, RDL=0.001	mg/L	NC	40		
8481971	Nonylphenol Ethoxylate (Total)	2023/02/02	NC (1)	50 - 130	76	50 - 130	ND, RDL=0.005	mg/L	NC	40		
8482708	Aroclor 1016	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Aroclor 1221	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Aroclor 1232	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Aroclor 1242	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Aroclor 1248	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Aroclor 1254	2023/02/02					ND, RDL=0.05	ug/L				

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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
8482708	Aroclor 1260	2023/02/02	103	60 - 130	112	60 - 130	ND, RDL=0.05	ug/L				
8482708	Aroclor 1262	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Aroclor 1268	2023/02/02					ND, RDL=0.05	ug/L				
8482708	Total PCB	2023/02/02	103	60 - 130	112	60 - 130	ND, RDL=0.05	ug/L	NC	40		
8482810	1,3-Dinitropyrene	2023/02/02	80	30 - 130	96	30 - 130	ND, RDL=0.4	ug/L	NC	40		
8482810	1,6-Dinitropyrene	2023/02/02	79	30 - 130	91	30 - 130	ND, RDL=0.4	ug/L	NC	40		
8482810	1,8-Dinitropyrene	2023/02/02	77	30 - 130	90	30 - 130	ND, RDL=0.4	ug/L	NC	40		
8482810	3,3'-Dichlorobenzidine	2023/02/02	62	30 - 130	88	30 - 130	ND, RDL=0.8	ug/L	NC	40		
8482810	7H-Dibenzo(c,g) Carbazole	2023/02/02	85	30 - 130	95	30 - 130	ND, RDL=0.4	ug/L	NC	40		
8482810	Anthracene	2023/02/02	56	30 - 130	82	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Benzo(a)anthracene	2023/02/02	84	30 - 130	90	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Benzo(a)pyrene	2023/02/02	85	30 - 130	97	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Benzo(b/j)fluoranthene	2023/02/02	82	30 - 130	95	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Benzo(e)pyrene	2023/02/02	81	30 - 130	91	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Benzo(g,h,i)perylene	2023/02/02	93	30 - 130	105	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Benzo(k)fluoranthene	2023/02/02	81	30 - 130	85	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Bis(2-ethylhexyl)phthalate	2023/02/02	73	30 - 130	80	30 - 130	ND,RDL=2	ug/L	NC	40		
8482810	Chrysene	2023/02/02	84	30 - 130	94	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Dibenzo(a,h)anthracene	2023/02/02	86	30 - 130	98	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Dibenzo(a,i)pyrene	2023/02/02	70	30 - 130	81	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Dibenzo(a,j) acridine	2023/02/02	93	30 - 130	108	30 - 130	ND, RDL=0.4	ug/L	NC	40		
8482810	Di-N-butyl phthalate	2023/02/02	64	30 - 130	100	30 - 130	ND,RDL=2	ug/L	NC	40		
8482810	Fluoranthene	2023/02/02	71	30 - 130	80	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Indeno(1,2,3-cd)pyrene	2023/02/02	81	30 - 130	94	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Naphthalene	2023/02/02	47	30 - 130	71	30 - 130	ND, RDL=0.3	ug/L	NC	40		
8482810	Pentachlorophenol	2023/02/02	68	30 - 130	63	30 - 130	ND,RDL=1	ug/L	NC	40		
8482810	Perylene	2023/02/02	78	30 - 130	89	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Phenanthrene	2023/02/02	55	30 - 130	81	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482810	Pyrene	2023/02/02	72	30 - 130	80	30 - 130	ND, RDL=0.2	ug/L	NC	40		
8482858	Total Suspended Solids	2023/02/03					ND, RDL=10	mg/L	13	20	96	85 - 115
8483030	Chromium (VI)	2023/02/02	100	80 - 120	102	80 - 120	ND, RDL=0.50	ug/L	NC	20		

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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
8483341	Total Kjeldahl Nitrogen (TKN)	2023/02/02	115	80 - 120	102	80 - 120	ND, RDL=0.10	mg/L	10	20	98	80 - 120
8483479	Mercury (Hg)	2023/02/02	101	75 - 125	104	80 - 120	ND, RDL=0.00010	mg/L	NC	20		
8483687	Dissolved Sulphate (SO4)	2023/02/03	NC	75 - 125	98	80 - 120	ND, RDL=1.0	mg/L	1.6	20		
8483735	Fluoride (F-)	2023/02/02	93	80 - 120	98	80 - 120	ND, RDL=0.10	mg/L	0.94	20		
8483738	pH	2023/02/02			102	98 - 103			0.25	N/A		
8484224	Total Oil & Grease	2023/02/02			99	85 - 115	ND, RDL=0.50	mg/L	0.51	25		
8484227	Total Oil & Grease Mineral/Synthetic	2023/02/02			97	85 - 115	ND, RDL=0.50	mg/L	0.52	25		
8485134	Total Aluminum (Al)	2023/02/03	NC	80 - 120	98	80 - 120	ND, RDL=0.1	mg/L				
8485134	Total Antimony (Sb)	2023/02/03	NC	80 - 120	100	80 - 120	ND, RDL=0.02	mg/L				
8485134	Total Arsenic (As)	2023/02/03	NC	80 - 120	99	80 - 120	ND, RDL=0.01	mg/L				
8485134	Total Beryllium (Be)	2023/02/03	NC	80 - 120	93	80 - 120	ND, RDL=0.0005	mg/L				
8485134	Total Cadmium (Cd)	2023/02/03	NC	80 - 120	100	80 - 120	ND, RDL=0.002	mg/L	NC	20		
8485134	Total Chromium (Cr)	2023/02/03	NC	80 - 120	95	80 - 120	ND, RDL=0.01	mg/L	NC	20		
8485134	Total Cobalt (Co)	2023/02/03	NC	80 - 120	96	80 - 120	ND, RDL=0.002	mg/L				
8485134	Total Copper (Cu)	2023/02/03	NC	80 - 120	94	80 - 120	ND, RDL=0.01	mg/L	NC	20		
8485134	Total Iron (Fe)	2023/02/03	NC	80 - 120	98	80 - 120	ND, RDL=0.02	mg/L	NC	20		
8485134	Total Lead (Pb)	2023/02/03	NC	80 - 120	95	80 - 120	ND, RDL=0.01	mg/L	NC	20		
8485134	Total Manganese (Mn)	2023/02/03	NC	80 - 120	93	80 - 120	ND, RDL=0.001	mg/L				
8485134	Total Molybdenum (Mo)	2023/02/03	NC	80 - 120	96	80 - 120	ND, RDL=0.005	mg/L	NC	20		
8485134	Total Nickel (Ni)	2023/02/03	NC	80 - 120	95	80 - 120	ND, RDL=0.005	mg/L	NC	20		
8485134	Total Phosphorus (P)	2023/02/03	NC	80 - 120	98	80 - 120	ND, RDL=0.05	mg/L	NC	20		
8485134	Total Selenium (Se)	2023/02/03	NC	80 - 120	99	80 - 120	ND, RDL=0.02	mg/L				
8485134	Total Silver (Ag)	2023/02/03	NC	80 - 120	92	80 - 120	ND, RDL=0.01	mg/L				
8485134	Total Tin (Sn)	2023/02/03	NC	80 - 120	95	80 - 120	ND, RDL=0.02	mg/L				

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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
8485134	Total Titanium (Ti)	2023/02/03	NC	80 - 120	92	80 - 120	ND, RDL=0.005	mg/L				
8485134	Total Zinc (Zn)	2023/02/03	NC	80 - 120	93	80 - 120	ND, RDL=0.005	mg/L	NC	20		
8485611	Total Arsenic (As)	2023/02/03	102	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L	NC	20		
8485611	Total Cadmium (Cd)	2023/02/03	104	80 - 120	101	80 - 120	ND, RDL=0.090	ug/L	NC	20		
8485611	Total Chromium (Cr)	2023/02/03	98	80 - 120	95	80 - 120	ND, RDL=5.0	ug/L	NC	20		
8485611	Total Copper (Cu)	2023/02/03	102	80 - 120	101	80 - 120	ND, RDL=0.90	ug/L	NC	20		
8485611	Total Lead (Pb)	2023/02/03	100	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8485611	Total Manganese (Mn)	2023/02/03	98	80 - 120	96	80 - 120	ND, RDL=2.0	ug/L	3.8	20		
8485611	Total Nickel (Ni)	2023/02/03	97	80 - 120	95	80 - 120	ND, RDL=1.0	ug/L	NC	20		
8485611	Total Phosphorus (P)	2023/02/03	104	80 - 120	103	80 - 120	ND, RDL=100	ug/L	NC	20		
8485611	Total Selenium (Se)	2023/02/03	107	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L	NC	20		
8485611	Total Silver (Ag)	2023/02/03	106	80 - 120	102	80 - 120	ND, RDL=0.090	ug/L	NC	20		
8485611	Total Zinc (Zn)	2023/02/03	102	80 - 120	101	80 - 120	ND, RDL=5.0	ug/L	NC	20		

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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
8485832	Phenols-4AAP	2023/02/06	103	80 - 120	101	80 - 120	ND, RDL=0.0010	mg/L	NC	20		

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 (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).

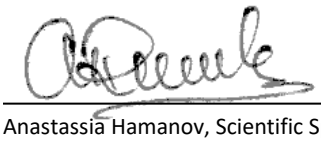
(1) MATRIX SPIKE: Due to background interference, recovery in the Matrix Spike was not calculated (NC).The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation.

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist



Sonja Elavinamannil, Master of Biochemistry, Team Lead

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Page of

31-Jan-23 15:33
Patricia Legette
C329244

Bottle Order #: 913373
Project Manager: Patricia Legette
C#913373-01-01

SPJ ENV-1141

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#30554 exp Services Inc	Company Name:		Quotation #:	C20374 (STAT 24-27)
Attention:	Accounts Payable	Attention:	Nataliya Tkach	P.O. #:	
Address:	1595 Clark Blvd Brampton ON L6T 4V1	Address:		Project:	GTR-21018895-B0
				Project Name:	
Tel:	(905) 793-9800 Fax: (905) 793-0641	Tel:	(905) 793-9800 Ext: 3621 Fax:	Site #:	688 Brant St, Burlington, ON
Email:	AP@exp.com; Karen.Burke@exp.com	Email:	Nataliya.Tkach@exp.com, MICHAEL.HOLMES@EXP.	Sampled By:	MH

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS 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 BURLINGTON/HALTON
- ☐ PWQO ☐ Reg 406 Table ___
- ☐ Other ___

Special Instructions

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

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	Burlington/Halton Sanitary & Storm Sewer Bylaw	# of Bottles	Comments
1		BH/MW ID	JAN 31, 23	10:30	GW	N	✓	20	*5 DAY FIRM TAT
2									*PLEASE PROVIDE COC ON
3									REPORT
4									
5									
6									
7									
8									
9									
10									

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
MICHAEL HOLMES	23/01/31	14:00		23/01/31	15:33	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	5.7 1.6	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S 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.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-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.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

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

White: Bureau Veritas Yellow: Client

Bureau Veritas Canada (2019) Inc.

Bureau Veritas Job #: C329244
Report Date: 2023/02/07

exp Services Inc
Client Project #: GTR-21018895-B0
Site Location: 688 Brant St, Burlington, ON
Sampler Initials: MH

Exceedance Summary Table – Halton Sanitary Sewer

Result Exceedances

Sample ID	Bureau Veritas 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.

Exceedance Summary Table – Burlington Storm Sewer

Result Exceedances

Sample ID	Bureau Veritas ID	Parameter	Criteria	Result	DL	UNITS
BH/MW1D	UYF017-16	Chloroform	2	4.2	0.40	ug/L
BH/MW1D	UYF017-12	Total Manganese (Mn)	50	210	2.0	ug/L
BH/MW1D	UYF017-12	Total Manganese (Mn)	0.05	0.20	0.01	mg/L
BH/MW1D	UYF017-08	Total Suspended Solids	15	23	10	mg/L

Detection Limit Exceedances

Sample ID	Bureau Veritas ID	Parameter	Criteria	Result	DL	UNITS
BH/MW1D	UYF017-12	Total Arsenic (As)	0.02	<0.1	0.1	mg/L
BH/MW1D	UYF017-12	Total Cadmium (Cd)	0.008	<0.02	0.02	mg/L
BH/MW1D	UYF017-12	Total Chromium (Cr)	0.08	<0.1	0.1	mg/L
BH/MW1D	UYF017-12	Total Copper (Cu)	0.04	<0.1	0.1	mg/L
BH/MW1D	UYF017-12	Total Phosphorus (P)	0.4	<0.5	0.5	mg/L
BH/MW1D	UYF017-12	Total Selenium (Se)	0.02	<0.2	0.2	mg/L
BH/MW1D	UYF017-12	Total Zinc (Zn)	0.04	<0.05	0.05	mg/L

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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Appendix E – *In-Situ* Infiltration Test Results

Location:	688 Brant Street, Burlington
Date:	24-Jan-23
Weather:	Overcast
Analyst:	MH

Borehole radius (cm):	11	10				
Soil class:	Weak capillarity		36.0	2.074	0.093	0.754

Measurement	Start depth of water (cm)	End depth of water (cm)	Start time (*decimal min)	End time (*decimal min)	Elapsed time (min)	Change in head (cm)	Perc test result (min/cm)	Perc test (hr/mm)	mean head (m)	H/a (unitless)	2H^2 (m2)	2H/* (unitless)	C (unitless)	Ca2 (m2)	Denom	K_{fs} (mm/hr)
IT-1 (BH/MW -1)	85.2	10.5	0.0	61.4	61.43	74.7	0.8	0.0014	0.479	4.350	0.458	0.027	1.5283	0.01849	0.000689408	26.8
IT-2 (BH/MW -3)	88.8	0.6	0.0	61.5	61.45	88.2	0.7	0.0012	0.447	4.470	0.400	0.025	1.5547	0.01710	0.000512725	33.4
IT-3 (BH/MW -4)	68.1	43.5	0.0	51.1	51.07	24.6	2.1	0.0035	0.558	5.073	0.623	0.031	1.6818	0.02035	0.002332326	8.7

Seconds	decimal minute

*It will be easiest to take field measurements in minutes and seconds. Then round to the nearest 6 seconds when using the electronic version of the form for calculations. E.g. 2 minutes and 25 seconds becomes 2.4 minutes.

688, 694, and 698 Brant Street, Burlington, Ontario
GTR-21018895-C0
Low Impact Design (LID) Calculations

Test Location	Hydraulic Conductivity (K_{fs}) (cm/s)	Infiltration Rate (IR) (mm/hr)	Discrete Design Infiltration Rate(DIR) (mm/hr)	Percolation Time (min/cm)
IT-1 (BH/MW -1)	7.5E-04	79	32	19
IT-2 (BH/MW -3)	9.3E-04	84	34	18
IT-3 (BH/MW -4)	2.4E-04	59	23	26

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	5.51E-04	73	1.0	2.5
Underlying Geology Unit (1.5 m below the bottom of LID)	5.51E-04	73		

Design Infiltration Rate(DIR) (mm/hr)	Minimum	23	**Percolation Time (min/cm)**	18
	Maximum	34		26
	Geometric Mean	**29**		**21**

Note:
Analytical Solutions (CVC and TRCA 2010)

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

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

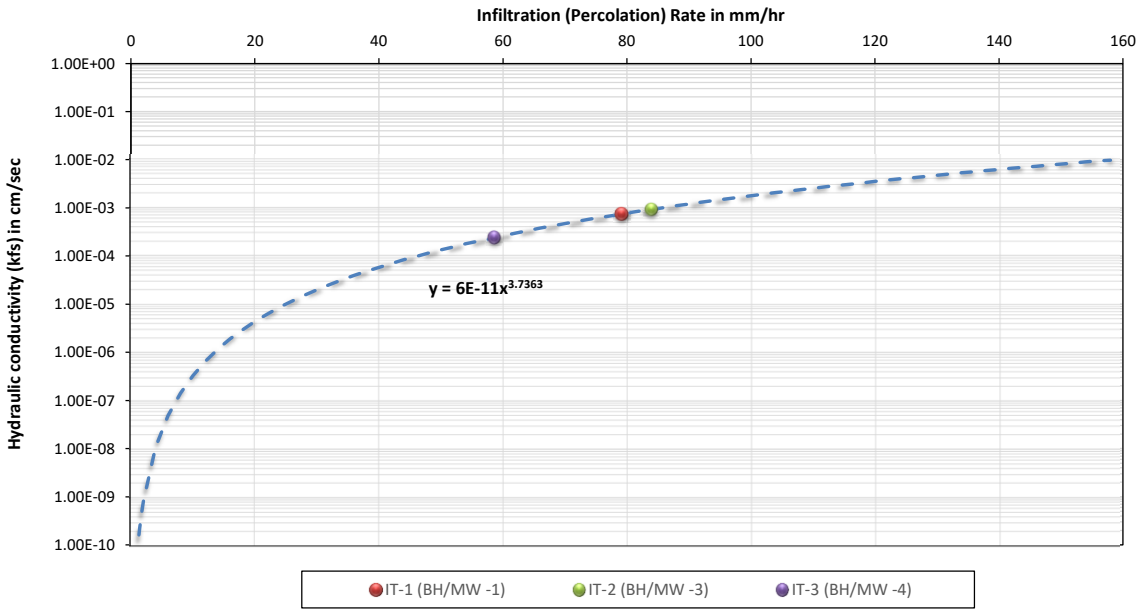
Kfs: hydraulic conductivity (cm/sec)

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 Assessment (Site Specific)

Appendix F-1: Model Input

688, 694, and 698 Brant Street, Burlington, Ontario
GTR-21018895-C0

Period	Month	Average Temperature (^{0}C)	Average Precipitation (mm)
1967-1996	1	-5.02	60.81
1967-1996	2	-4.51	51.76
1967-1996	3	0.38	72.42
1967-1996	4	6.92	74.70
1967-1996	5	13.11	79.86
1967-1996	6	18.71	72.27
1967-1996	7	21.90	73.33
1967-1996	8	21.04	83.13
1967-1996	9	16.54	82.41
1967-1996	10	10.16	71.44
1967-1996	11	4.19	79.99
1967-1996	12	-1.71	78.14

Note:

Station Name	Hamilton RBG, Ontario
Station ID	6153300
Longitude	79°53'00.000" W
Latitude	43°17'00.000" N
Elevation	102.10 m masl

Appendix F-2: Model Output

688, 694, and 698 Brant Street, Burlington, Ontario

GTR-21018895-C0

Month	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus
January	9.41	60.81	21.84	195.59	9.35	0.05	49.02	19.70
February	10.92	51.76	27.34	198.32	10.92	0.00	62.52	24.62
March	21.01	72.42	65.63	200.00	21.01	0.00	48.30	63.95
April	38.84	74.70	60.02	200.00	38.84	0.00	24.15	60.02
May	70.74	79.86	21.34	194.60	70.74	0.00	11.92	26.74
June	105.58	72.27	-26.21	163.56	104.52	1.06	4.82	5.90
July	127.40	73.33	-49.67	121.31	118.84	8.56	0.42	1.14
August	103.31	83.13	-19.76	111.19	91.74	11.56	0.00	1.94
September	60.13	82.41	22.28	125.49	56.07	4.06	0.00	12.02
October	32.48	71.44	38.96	155.84	32.36	0.12	0.00	8.74
November	16.84	79.99	62.80	185.92	16.84	0.00	0.35	32.73
December	10.61	78.14	48.09	195.06	10.61	0.00	19.76	38.94
Annual rate (mm/yr)	**607.26**	**880.26**			**581.84**		**221.26**	**298.42**

Note:

Station Name	Hamilton RBG, Ontario	
Station ID	6153300	
Longitude	79°53'00.000" W	
Latitude	43°17'00.000" N	
Elevation	102.10 m	masl

APPENDIX F-3
Average Infiltration Factors

688, 694, and 698 Brant Street, Burlington, Ontario
GTR-21018895-C0

F-3-1. Average Infiltration Factor – Pre Development Conditions

Un-Mitigated

Category	Weighted Infiltration Factor
Topography/Slope	0.133
Soil Type Coarse-textured glaciolacustrine deposits (Sand)	0.25
Cover urban lands	0.10
Total weighted Infiltration factor	**0.48**

F-3-2. Average Infilteration Factor – Post Development Conditions

Un-Mitigated

Category	Weighted IInfiltration Factor
Topography/Slope	0.13
Soil Type Coarse-textured glaciolacustrine deposits (Sand)	0.25
Cover urban lands	0.10
Total weighted Infiltration factor	**0.48**

Notes:
Urban area considered equivalent to Cultivated Cover
Assumed existing and proposed slopes are similar

Appendix F-4
Summary of Pre and Post-Development Water Balance
688, 694, and 698 Brant Street, Burlington, Ontario
GTR-21018895-C0

F-4-1. Climate Data

Item	Pre-Development mm/year		Post-Development mm/year
Precipitation	880.26		880.26
Evapotranspiration	581.84		581.84
Water Surplus	298.42		298.42
Infiltration Rate	144.14		144.14
Runoff	154.28		154.28

F-4-2. Pre-Developed Area Statistics

Landscape	1,100	sq.m.	14%
Paved Surfaces	4,200	sq.m.	55%
Existing Buildings	2,300	sq.m.	30%
TOTAL	7,600	sq.m.	100%

F-4-3. Post Development Area Statistics
Residential Development

Landscape	1,400	sq.m.	18%
Roads, sidewalks, parking - Paved	3,400	sq.m.	45%
Proposed Building	2,800		37%
TOTAL	7,600	sq.m.	100%

F-4-4. Annual Pre-Development Water Balance

Land Use	Area (sq.m.)	Precipitation (cu.m.)	Actual Evapotranspiration (cu.m.)	Infiltration Rate (cu.m.)	Run-off (cu.m.)
Landscape	1,100	968	640	159	170
Paved Surfaces	4,200	3,697	0	0	3,697
Existing Buildings	2,300	2,025	0	0	2,025
TOTAL	7,600	6,690	640	159	5,891
	Pre-development Infiltration Rate		**84.21**	**20.86**	**775.19**
		100%	10%	2%	88%

F-4-5. Annual Post-Development Water Balance

Land Use	Area (sq.m.)	Precipitation (cu.m.)	Actual Evapotranspiration (cu.m.)	Infiltration Rate (cu.m.)	Run-off (cu.m.)
Landscape	1,400	1,232	815	202	216
Roads, sidewalks, parking - Paved	3,400	2,993	0	0	2,993
Proposed Building	2,800	2,465	0	0	2,465
TOTAL	7,600	6,690	815	202	5,674
	Post-development Infiltration Rate		**107.18**	**26.55**	**746.53**
		100%	12%	3%	85%

F-4-6. Comparison of Pre-Development and Post-Development

Item	Precipitation (cu.m.)	Actual Evapotranspiration (cu.m.)	Run-off (cu.m.)	Corrected Infiltration Rate for Areas with Shallow Groundwater Table (cu.m.)
Pre-Development	6,690	640	5,891	159
Post Development	6,690	815	5,674	202
			Pre-development Infiltration Rate	**20.9**
			Post-development Infiltration Rate	**26.6**
			Deficit Post Development	**-43**

Appendix G – Construction and Post-Construction Flow Rate Calculations

APPENDIX G: Dewatering Flow Rates

688, 694, and 698 Brant Street, Burlington, Ontario
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Table G-1: Construction and Post Construction Dewatering Assessments

Parameters	Symbols	Unit	Construction	Post Construction
Geological Formation	-	-	Bedrock	Bedrock
INPUTS				
Ground Elevation	-	mASL	**91.46**	**91.46**
Highest Groundwater Elevation	-	mASL	**89.30**	**89.30**
Lowest Top Slab Elevation	-	mASL	**79.76**	**79.76**
Lowest Foundation Invert Elevation	-	mASL	**78.76**	-
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	11.80	11.80
Dewatering Target Elevation	-	mASL	77.76	79.26
Height of Target Water Level Above the Base of Water-Bearing Zone	**h_w**	m	0.26	1.76
Drawdown	**s**	m	11.54	10.04
Dupuit Check (> 45%)		m	2%	15%
Base of Aquifer / Water Bearing Zone	-	mASL	**77.50**	**77.50**
Hydraulic Conductivity	**K**	m/s	**4.8E-06**	**2.9E-06**
Length of Excavation	-	m	**92.00**	**92.00**
Width of Excavation	-	m	**83.00**	**83.00**
Equivalent Radius (equivalent perimeter)	**r_e**	m	55.70	55.70
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**	**Cooper-Jacob**
Time (days)			**30.00**	**730.00**
Time (seconds)	**t**	s	2592000	63072000
Specific Yield	**Sy**		**0.10**	**0.10**
OUTPUTS				
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	57.24	218.90
Radius of Influence	**Ro**	m	112.94	274.61
Dewatering Flow Rate (unconfined radial flow component)	**Q**	m^3/day	**254.42**	**66.28**
Factor of Safety	**fs**	-	2	1.5
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	**394**	**99**
Precipitation Event	-	mm/day	15	-
Volume from Precipitation	-	m^3/day	115	-
Total Volume (L/day) Discharge of Groundwater (Construction dewatering) **without Safety Factor** (including precipitation	-	m^3/day	**369**	**-**
Total Volume (L/day) Discharge of Groundwater (Construction dewatering) **with Safety Factor** (including precipitation)	-	m^3/day	**509**	**-**

Precipitation Event 2 year storm	-	mm/day	56.2
Volume from Precipitation	-	m^3/event	429
Precipitation Event 100 year storm	-	mm/day	121.8
Volume from Precipitation	-	m^3/event	930

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)