418 and 422 Guelph Line, Burlington, Ontario

Hydrogeological Investigation

Client:
Waldemar LP
3410 S Service Road
Burlington, Ontario
L7N 3T2

Attention: Mr. Kyle Bittman

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EXP Services Inc.
1595 Clark Boulevard
Brampton, ON, L6T 4V1
t: 905.793.9800
f: 905.793.0641

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Table of Contents

1. Introduction 3
1.2 Project Description 3
1.2 Project Objectives 3
1.3 Scope of Work 3
1.4 Review of Previous Reports 4
2 Hydrogeological Setting 5
2.1 Regional Setting 5
2.1.1 Regional Physiography 5
2.1.2 Regional Geology 5
2.1.3 Existing Water Well Survey 5
2.2 Site Setting 5
2.2.1 Site Topography 5
2.2.2 Local Surface Water Features 6
2.2.3 Local Geology and Hydrogeology 6
3 Results 7
3.1 Monitoring Well Details 7
3.2 Water Level Monitoring 7
3.3 Single Well Response Testing 9
3.4 Groundwater Quality 9
4 Construction Dewatering Assessment 11
4.1 Dewatering Flow Rate Estimate and Zone of Influence 12
4.2 Radius of Influence 12
4.3 Rainfall 12
4.4 Results of Construction Dewatering Rate Estimate 12
4.5 Construction MECP Water Taking Permit 13
5 Long-Term Dewatering and Groundwater Discharge Requirements 14
6 Environmental Impact 15
6.1 Surface Water Features 15

6.2 Groundwater Sources 15
6.3 Geotechnical Considerations 15
6.4 Groundwater Quality 15
6.5 Well Decommissioning 16
7 Conclusions and Recommendations 17
8 Limitations 18
9 References 19

List of Figures

Figure 1 – Site Location Plan
Figure 2 – Surficial Geology Map
Figure 3 – MECP Water Well Locations within 500 m
Figure 4 – Geological Cross Section
Figure 5 - Monitoring Well Locations
Figure 6 – Groundwater Contours

List of Appendices

Appendix A – MECP WWR Summary Table
Appendix B – Borehole Logs
Appendix C – SWRT Procedure and Results
Appendix D – Laboratory Certificates of Analysis
Appendix E – Construction Flow Rate Calculations

1. Introduction

1.2 Project Description

EXP Services Inc. (EXP) was retained by Waldemar LP. to prepare a Hydrogeological Investigation Report associated with the proposed development located at 418 and 422 Guelph Line, Burlington, Ontario (hereinafter referred to as the 'Site'). The proposed hydrogeological investigation is required to address the comments (Appendix A) received from the City of Burlington on the OPA and Zoning applications recently submitted by Waldemar LP. The Site location plan is shown on Figure 1.

The Site is located on the southwest side of Guelph Line, approximately 35 m southeast of New Street in Burlington, Ontario. The Site is approximately 0.38 ha (0.94 acres) in size and is occupied by a one-story commercial building with a basement and a two-storey residential structure with a basement.

EXP understands that Waldemar LP is planning to redevelop the property into high-rise (20+ storey) mixed use condominium with 2 level underground parking garage. A Geotechnical Engineering Investigation (SOLA Engineering, August 16, 2019) and Phase 2 ESA Study (EXP, October 3, 2019) were previously completed at the Site. The proposed hydrogeological investigation will utilize the results of the desk top studies and field investigations completed as part of both investigations.

The proposed hydrogeological investigation will address the requirements of the City of Burlington for completing OPA and Zoning Applications process and requirements of other regulatory agencies including Regional Municipality of Halton and Ministry of Environment, Conservation and Parks for water taking and dewatering effluent disposal.

1.2 Project Objectives

The main objectives of the Hydrogeological Investigation are as follows:

- Establish the local hydrogeological settings within the Site;
- Assess construction dewatering flow rates and potential impacts;
- Assess long term foundation sub-drain discharge volumes;
- Assess groundwater quality;
- Determine permitting requirements for dewatering and dewatering effluent disposal purposes; and,
- Prepare a Hydrogeological Investigation Report.

The hydrogeological report will be prepared to support the Ministry of the Environment, Conservation and Parks (MECP) Water Taking Permits (PTTW or EASR) if construction dewatering is required and if the estimated flow rates exceeds the permit threshold of 50,000 L/day. The assessments of construction dewatering, and foundation sub-drain discharge volumes will be conducted using analytical methods.

1.3 Scope of Work

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

- Reviewed available geological and hydrogeological information for the Site;
- Developed all existing monitoring wells and conduct Single Well Response Tests (SWRT) to assess hydraulic properties of the saturated soils at the Site;

- Conducted a geodetic elevation survey at all monitoring well locations and two (2) groundwater monitoring events (2 events);
- Collected one (1) groundwater sample for the Region of Halton Sanitary and Storm Sewer By-Law parameters at a selected monitoring well location;
- Evaluated the information collected during the field investigation program, including SWRT results, groundwater level measurements and groundwater water quality;
- Prepared site plans, cross sections and groundwater contour mapping for the Site;
- Estimated construction dewatering flow rates;
- Evaluated long term foundation sub-drain flow rates;
- Evaluated potential dewatering related effects on the surrounding environment; and,
- Prepared a Hydrogeological Investigation Report.

1.4 Review of Previous Reports

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

- SOLA Engineering Inc. (August 16, 2019), Geotechnical Investigation, Proposed Residential Development, 418 and 422 Guelph Line, Burlington, ON, prepared for Valour Capital management Inc.
- EXP Services Inc. (October 10, 2019), Phase Two Environmental Site Assessment, 418 and 422 Guelph Line, Burlington, ON, prepared for Waldemar LP

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is located within a physiographic region known as the Iroquois Plain, and the physiographic landform known as the Sand Plains. The South Slope lies to the north of the Iroquois Plain (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, toward Lake Ontario.

2.1.2 Regional Geology

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.

The bedrock in the area is categorized as Shale, limestone, dolostone and siltstone belong to Queenston Formation (Ministry of Northern Development and Mines, 2012).

Regional groundwater flow across the area is expected to be directed 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.

2.1.3 Existing Water Well Survey

Well Records from the Ministry of the Environment, Conservation and Parks (MECP) Water Well Record (WWR) Database were reviewed to determine the number of water wells present within a 500-m radius of the Site boundaries.

The MECP WWR database indicates that twenty two (22) well records within a 500 m radius from the Site centroid, where one (1) well record is identified onsite (Figure 3 and Appendix A).

The database indicates that the offsite wells are at an approximate distance of approximately ninety four (94) m or greater from the Site centroid. All offsite wells were reportedly identified as monitoring and observation wells, test holes and listed

The reported water levels ranged from depths of approximately 2.3 m to 4.0 meters below ground surface (mbgs).

The locations of the MECP WWR within 500 m of the Site are shown on Figure 3. A summary of the WWR is included in Appendix A.

2.2 Site Setting

2.2.1 Site Topography

The Site is in an urbanized land use setting and approximately 92 m above mean sea level. The topography is considered relatively flat, with a regional gradual southeasterly slope towards Lake Ontario, which is located approximately 800 m south of the Site.

2.2.2 Local Surface Water Features

No surface water features are located onsite. The Site is located within the Lake Ontario regional watershed and the closest surface water feature is Bronte Creek, which runs approximately 500 m northeast of the Site. Lake Ontario is approximately 800 m from the Site boundary to the southeast.

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 (SOLA Engineering, 2019) and Phase II ESA (EXP, 2019) they are summarized for the hydrogeological interpretations.

The detailed soil profiles encountered in each borehole and the results of moisture content determinations are presented on the attached borehole logs (Appendix B, Figure 4). It should be noted that 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 purpose of Hydrogeological Investigation and shall not be interpreted as exact planes of geological change.

The general stratigraphy at the Site, as observed in the boreholes, comprised of asphalt/top soil generally overlying layers of fill followed by sand, over lain by silty clay or bedrock.

Based on the results of previous investigations, the general subsurface soil stratigraphy consist of the following units from top to maximum depth of investigation onsite as follows:

Surface Material

Top soil with thickness of approximately 100 mm and Asphalt of about 50 – 100 mm was encountered at the ground surface of all boreholes.

Fill Material

Fill material was encountered below asphalt / top soil in majority of the boreholes extending to depths between approximately 0.05 and 2.13 mbgs. The fill comprised generally of sand with trace silt and gravel.

Native Material – Silty Sand to Silty Clay Till

In all boreholes, native soils were encountered below fill material. It comprised a layer of silty sand in all boreholes extending to depths varying from approximately 0.8 to 3.0 mbgs. Underlying silty sand, a silty clay till bed was found in all boreholes prior to encountering bedrock. In BH 106, a silty clay bed was encountered to underlie the silty sand bed.

The moisture content of the native material ranged between approximately 3.8% (BH108) and 23.6% (BH102), indicating generally moist to wet conditions.

Shale Bedrock

Inferred Shale bedrock of Queenston Formation was encountered in BHs 105, 106 and 108 upon refusal drilling ranging in elevations between 93.0 and 94.2 m (Local). Shale bedrock was proven in BHs 102, 103 and 104, ranging in elevations between 94.4 and 95.4 m (Local). Upper 2 to 5 m of the bedrock is highly weathered and fractured. It is in turn followed by a less weathered sub unit of rock which is in poor to good condition.

The shale bedrock is found to be interbedded with 10 to 50 mm thick limestone and occasional clay seams at depths between 9.47 and 9.55 m in BH 102.

3 Results

3.1 Monitoring Well Details

The monitoring well network installed as part of the previous Geotechnical and ESA Investigations at the Site consists of the following:

- Four (4) shallow overburden monitoring wells (BH/MW 1, BH/MW 2, BH/MW 3 S, and BH/MW 4) were installed by BIG Inc.;
- Six (6) shallow overburden monitoring wells (BH/MW 101, 102A and 103 through 106) were installed by S2S; and,
- Two (2) deeper bedrock monitoring wells (BH/MW 201 and 202) were installed by EXP.

Diameter of all monitoring wells installed at the Site is 50 mm. Borehole logs and monitoring well installation details are provided in Appendix B. The monitoring well locations are shown on Figure 5

3.2 Water Level Monitoring

As part of the Hydrogeological Investigation, static water levels in the monitoring wells installed at the Site were recorded in five (5) monitoring events, including September 13, 2017, May 14th, November 21st, 22nd and 25th, of 2019. A summary of all static water level data as it relates to the elevation survey is summarized in Table 3-1 below. Please note that ground surface and groundwater elevations are provided relative to a local benchmark.

The groundwater elevation recorded in the shallower overburden monitoring wells ranged from 97.87 m local (BH/MW 4 on November 21st, 2019) to 98.46 m local (BH/MW 105 on May 14th, 2019). The groundwater elevation recorded for the deeper bedrock monitoring wells ranged from 96.57 m local (BH/MW 202 on November 22, 2019) to 97.29 m local (BH/MW 201 on November 25, 2019).

Table 3-1: Summary of Measured Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (m Local)	Approximate Full Well Depth (mbgs)	Depth	13-Sep-17	14-May-19	21-Nov-19	22-Nov-19		25-Nov-19
BH/MW 1	100.73	5.024	mbgs	-	2.60	2.82	2.69		2.69
			m Local	-	98.14	97.92	98.04		98.04
BH/MW 2	101.38	5.517	mbgs	-	2.93	3.27	3.23		3.16
			m Local	-	98.45	98.11	98.15		98.22
BH/MW 3	100.9	4.706	mbgs	-	2.53	2.85	2.77		2.76
			m Local	-	98.38	98.05	98.13		98.14
BH/MW 4	99.92	4.349	mbgs	-	1.84	2.05	1.88		1.68
			m Local	-	98.08	97.87	98.04		98.24
BH/MW 101	100.26	5.189	mbgs	-	1.88	2.39	2.30		2.29

Monitoring Well ID	Ground Surface Elevation (m Local)	Approximate Full Well Depth (mbgs)	Depth	13-Sep-17	14-May-19	21-Nov-19	22-Nov-19		25-Nov-19
			m Local	-	98.38	97.87	97.96		97.97
BH/MW 102 A	101.31	5.898	mbgs	3.67	-	3.20	3.09		3.13
			m Local	97.64	-	98.11	98.22		98.18
BH/MW 103	99.77	4.796	mbgs	2.47	1.50	1.80	1.69		1.64
			m Local	97.30	98.28	97.97	98.08		98.13
BH/MW 104	100.94	5.135	mbgs	3.22	2.67	2.93	2.81		2.79
			m Local	97.72	98.27	98.01	98.13		98.15
BH/MW 105	101.11	5.697	mbgs	3.27	2.65	2.98	2.83		2.82
			m Local	97.84	98.46	98.13	98.28		98.29
BH/MW 106	99.76	4.768	mbgs	2.42	1.40	1.80	1.70		1.69
			m Local	97.34	98.37	97.96	98.06		98.07
BH/MW 201	100.94	12.362	mbgs	-	-	3.85	3.72		3.65
			m Local	-	-	97.09	97.22		97.29
BH/MW 202	99.92	12.268	mbgs	-	-	3.14	3.35		3.04
			m Local	-	-	96.78	96.57		96.88

Notes:
mbgs: meters below ground surface
m Local: meters related to local benchmark

A groundwater contour map is delineated for the shallow water-bearing zone for the Site (Figure 6). Accordingly, the groundwater flow directions in the shallow zones is interpreted to be southwest to southeast, towards Lake Ontario.

A geodetic survey of the wells is recommended for design purposes.

Based on the groundwater contour mapping, the horizontal groundwater gradient across the Site varies from 0.01 to 0.02 m/m. Nested monitoring wells are not available to determine the vertical groundwater gradient, however given that the recorded groundwater levels in all the shallow monitoring wells are above the water levels in deeper bedrock monitoring wells at the Site, it is considered that the site is under groundwater recharging conditions.

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

3.3 Single Well Response Testing

Ten (10) Single Well Response Tests (SWRT's) were completed on monitoring wells BH/MW1-3, BH/MW 101, 102A, 103, 105, 106, BH/MW 201 and 202 on November 25, 2019. The tests were completed to estimate the saturated hydraulic conductivity (K) of the soils at the well screen depths.

The static water level within each monitoring well was measured prior to the start of testing. In advance of performing SWRTs, each monitoring well underwent development to remove fines introduced into the screens following 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 conductivity (K) values estimated from the SWRTs are provided in Table 3-2.

Table 3-2: Summary of Hydraulic Conductivity Testing

Monitoring Well	Well Depth (mbgs)	Screen Interval (mbgs)		Soil Formation Screened	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH/MW 1	5.0	2.0	5.0		1.1E-05
BH/MW 2	5.5	2.5	5.5		5.0E-06
BH/MW 3	4.7	1.7	4.7		1.3E-05
BH/MW 101	5.2	2.2	5.2		1.5E-06
BH/MW 102 A	5.9	2.9	5.9	Sand	7.6E-06
BH/MW 103	4.8	1.8	4.8	Silty Sand to Silty Clay Till	8.2E-06
BH/MW 105	5.7	2.7	5.7	Sandy Silt to Silty Sand	3.5E-06
BH/MW 106	4.8	1.8	4.8	Fill to Silty Sand to Silty Clay	5.1E-06
BH/MW 201	12.4	10.9	12.4	Bedrock	9.5E-06
BH/MW 202	12.3	9.3	12.3	Bedrock	2.0E-06
				Highest Estimated K Value	1.3E-05
				Geometric Mean of Estimated K Values for Overburden	6.9E-06

SWRTs provide estimates of K for the geological formation in the immediate media zone surrounding the well screens and may not be representative of bulk formation hydraulic conductivity. As shown in Table 3-2, the highest K for the tested water-bearing zones is estimated to be 1.3 x 10^{-5} m/s, and the geometric mean of the K values is to be 6.9 x 10^{-6} m/s. The estimated hydraulic conductivity for bedrock wells ranged from 2.0 x 10^{-6} to 9.5 x 10^{-6} m/s.

3.4 Groundwater Quality

To assess the suitability for discharge of pumped groundwater to Region of Halton Sanitary and Storm Sewer during dewatering activities, one (1) groundwater sample was collected from monitoring well BH/MW 102A on November 22, 2019 using a bladder pump. Prior to the collection of noted water sample, approximately three (3) standing well volumes of groundwater were purged from the noted well.

The sample was 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 to a CALA certified independent laboratory, Bureau Veritas Laboratories, Mississauga, Ontario for analysis.

When compared to the Region of Halton Storm and Sanitary Sewer Discharge Criteria none of the parameters exceeded the by-law criteria. A copy of the Laboratory Certificate of Analysis is provided in Appendix D.

As part of Phase II ESA (EXP, 2019), groundwater sampling program was carried out and collected groundwater samples were analyzed for Table 3, full depth generic SCS (MECP 2011). As per analytical results, following exceedances were reported:

- Chloroform in groundwater samples MW4 (DUP MW44) and MW103;
- Cis-1,2-Dichloroethylene in groundwater samples BH/MW1, BH/MW2, MW3, MW4 (DUP MW44), MW101, MW102, MW102A (DUP MW1022A) and MW106;
- Tetrachloroethylene in groundwater samples BH/MW1, BH/MW2, MW3, MW4 (DUP MW44), MW101, MW102, MW102A (DUP MW1022A), MW103, MW104, MW105 and MW106;
- Trichloroethylene in groundwater samples BH/MW1, BH/MW2, MW3, MW4 (DUP MW44), MW101, MW102, MW102A (DUP MW1022A), MW103, MW104, MW105 and MW106; and,
- Vinyl Chloride in groundwater samples BH/MW1, MW3, MW102, MW102A (DUP MW1022A) and MW201

Out of these exceedances, pH level at BH102-1 exceeded the Storm sewer criteria and Toluene (at BH104-6), Benzene (at MW1), Tetrachloroethylene (at MW1, MW2 and MW4) and Trichloroethylene (at MW1) exceeded the Sanitary and Combined sewer by-law criteria.

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 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 the both Sanitary and Storm 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.

An agreement to discharge to the Region of Halton will be required prior to discharging dewatering effluent.

The Environmental Site Assessment Report (EXP, October 2019) shall be reviewed for more information on the groundwater quality conditions at the Site.

4 Construction Dewatering Assessment

It is our understanding that the proposed development consists of a twenty (20) storey high-rise structure with two (2) levels of underground parking.

The exact dimensions of the parking garage are not available to review at the time of preparation of this report. For the purpose of estimation construction (short-term) and long-term dewatering rates for the Site, it was assumed that the proposed underground parking garage covers the full extent of the property. And it was assumed that the bottom of the P2 basement slab is approximately 7.7 mbgs.

Table 4-1 presents the assumptions used to calculate the dewatering rate for the site.

Table 4-1 Dewatering Estimate Assumptions

Input Parameter	Assumption	Units	Notes
Ground Surface Elevation	99.0 to 101.5	m Local*	Approximate elevation based on the borehole logs, rounded
Top of Slab Elevation	93.0	M Local	Assumed 7 mbgs
Lowest Footing Elevation	91.5	M Local	Assumed to be approximately 1.5 m below the Top of Slab Elevation.
Dewatered Elevation Target	90.5	M Local	Assumed to be approx. 1 m below the lowest footing elevation.
Length of Excavation Area	70	m	Approximate length of Site for the proposed development, simplified
Width of Excavation Area	50	m	Approximate width of Site for the proposed development, simplified
Groundwater elevation	98.5	M Local	The highest recorded groundwater elevation measured across the site.
Hydraulic Conductivity (K)	1.3E-05	m/s	Highest K values estimated for the Site

* meters related to local benchmark

4.1 Dewatering Flow Rate Estimate and Zone of Influence

The Dupuit equation for steady 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:

$$Q_w = xK(H^2 - h^2)/Lo$$

Where:

Qw = Rate of pumping (m^3/sec)
X = Length of excavation (m)
K = Hydraulic conductivity (m/sec)
H = Head beyond the influence of pumping (static groundwater elevation) (m)
h = Head above the base of aquifer in an excavation (m)
Lo = Distance of Influence (m)

It is expected that the initial dewatering rate will be higher in order 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.

4.2 Radius of Influence

The zone of influence (ZOI) for the construction dewatering was calculated based on the Sichardt equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible. This empirical formula was developed to provide representative flow rates using the steady state flow dewatering equations, as discussed below.

The estimated ZOI (Ro) of pumping based on the Sichardt formula is described as follows:

$$\mathrm{R_o} = C(H - h)\sqrt{(K)}$$

Where:

Ro = Estimated radius of influence (m)
H = Head in aquifer (static water level or saturated depth) (m)
h = Dynamic water level (m)
K = Hydraulic Conductivity (m/sec)
C = Constant (3,000) for radial flow

4.3 Rainfall

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 direct input of rain water into the excavation.

A 15 mm precipitation event was utilized for the estimate. The calculations for the rainfall input estimate is included in Appendix E. During large precipitation events, the water should be retained on site to not exceed the allowable water taking and discharge limits as necessary.

4.4 Results of Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed excavation does not include shoring system. For the purpose of estimating construction (short-term) dewatering rates, it was considered that the full extent of the excavation is open.

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

Based on the assumptions provided in this report, the results of the dewatering rate estimate can be summarized as follows (Table 4.2):

Table 4.2: Short-Term Dewatering Rate Estimates

Area	Short-Term Dewatering Rate with Safety Factor and Rain Water Collection	ZOI (m)
Full Excavation	550 m^3/day	90

This peak dewatering flow rates accounts for accumulation of some precipitation, seasonal fluctuations in the groundwater table, flow from beddings of existing sewers, and variation in hydrogeological properties beyond those encountered during the course of this study. This peak dewatering flow rate also provides additional capacity for the dewatering contractor.

It is noted that the maximum flow estimate equation calculated with a high K value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering.

The required maximum groundwater level within the excavation is approximately 8 m and the estimated ZOI during construction dewatering is approximately 90 m (Table 4.2) from the excavation boundary. This suggests that, contaminated groundwater, can be drawn from outside towards the excavation across the adjacent properties. Therefore, it is recommended to install a watertight caisson system along the excavation boundary to prevent groundwater drawdown outside the excavation, during construction dewatering activities.

If a watertight caisson system is installed, the expected construction dewatering rate will be reduced and the dewatering ZOI outside the excavation boundary is expected to be negligible. As a result, contaminant movement outside the excavation area is also expected to be negligible.

Localized dewatering may be required for pits (elevator pits, sump pits) in the event that they extend deeper than dewatering target which is not considered as part of this assessment. Dewatering estimates should be reviewed once the pit dimensions are available.

Please note that it is the responsibility of the contractor to ensure dry conditions are always maintained within the excavation at all costs.

4.5 Construction MECP Water Taking Permit

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

It is recognized that the maximum flow estimate equation calculated with a high K value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering. Based on the dewatering estimate of approximately 550 m^3/day for this project, a Category 3 PTTW would be required to facilitate the construction dewatering program for the Site.

It is noted that an agreement to discharge to the Region of Halton will be required prior to discharging dewatering effluent.

5 Long-Term Dewatering and Groundwater Discharge Requirements

It is our understanding that the site development plan recommends a water tight foundation for the building, which will bear the hydrostatic pressure on basement floor and side walls during the post-construction phase. It is assumed that pits (elevator, sump pits) are also made as watertight structures (without drainage).

Since the proposed water tight foundation prevents groundwater seeping into the building, a sub-drain system and long-term dewatering will not be required to manage groundwater seepage during the post-construction phase. As such, discharging groundwater into the City's sewer system will not be required during the post development stage of the project.

6 Environmental Impact

6.1 Surface Water Features

The Site is located within the Lake Ontario watershed. No surface water features are located onsite. The nearest surface water feature is Lake Ontario, located approximately 800 meters southeast of the Site boundary.

Due to the limited extent of zone of influence and the distance of the nearest surface water feature, no impacts to 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 number of water supply wells present within a 500 m radius of the Site boundaries. Given that the estimated dewatering zone of influence is approximately 87 m from the Site boundary, and no water supply wells found within 500 m from the Site centroid, no dewatering related impact is expected on the water wells in the area.

6.3 Geotechnical Considerations

Under certain conditions, dewatering activities can cause settlements due to an increase in the effective stress in the dewatered soil during the construction phase of the project. A letter related to geotechnical issues (i.e. settlement) as it pertains to the Site is recommended to be completed under a separate cover.

Given that the long-term dewatering will not be required due to watertight foundation for the building, no ground settlement impacts are expected on the adjacent properties during the post-construction phase of the project.

6.4 Groundwater Quality

It is our understanding that 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 is required to be in compliance with the Region of Halton Sewer Use By-Law.

When compared the analytical results of the groundwater sample collected at BH/MW102A to the Region of Halton Storm and Sanitary Sewer Discharge Criteria, none of the parameters exceeded the by-law criteria. However, when the analytical results from previous groundwater sampling compared with the by-law criteria, pH level (at BH102-1) exceeded the Storm sewer criteria and Toluene (at BH104-6), Benzene (at MW1), Tetrachloroethylene (at MW1, MW2 and MW4) and Trichloroethylene (at MW1) exceeded the Sanitary and Combined sewer by-law criteria.

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 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 the both Sanitary and Storm By-Law limits, in addition to the reported exceedances. As such, 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.

Dewatering (short-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 conducted under static conditions. As a result. monitoring may be required during dewatering activities (short-term) to monitor potential migration, and this should be performed more frequently during early dewatering stages.

The proposed watertight foundation for the building eliminates long-term dewatering requirement at the Site. Absence of long-term dewatering will minimize modifications to the groundwater flow system around the proposed building. As a result, during the post-construction phase, there will be no increased risk to adjacent properties due to contaminated groundwater.

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

6.5 Well Decommissioning

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

7 Conclusions and Recommendations

Based on the findings of the Hydrogeological Investigation, the following summary of conclusions and recommendations is provided:

- Based on the assumptions outlined in this report, the estimated peak dewatering pumping rate for proposed construction activities is approximately 550 m^3/day. As the dewatering flow rate estimate is greater than 400 m^3/day, a Category 3 PTTW would be required to facilitate the construction dewatering program for the Site. The estimated construction dewatering ZOI is approximately 90 m from the Site boundary.
- Long-term dewatering will not be required to manage groundwater seepage during the post-construction phase.
- A geodetic survey of the wells is recommended for design purposes.
- The construction dewatering rate estimate is based on the assumptions outlined in this report, and that any variations in hydrogeological conditions beyond those encountered as part of this preliminary investigation may significantly influence the discharge volumes.
- For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed the both Sanitary and Storm By-Law limits in addition to reported exceedances during Phase II (EXP, October 2019). To control the concentrations 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.
- It is recommended to install a caisson system along the excavation boundary to prevent groundwater drawdown outside the excavation, during construction dewatering activities.
- It is noted that an agreement (short-term) to discharge to the Region of Halton will be required prior to discharging dewatering effluent.
- During the post development stage, discharging groundwater into the City's sewer system will not be required.
- During the post-construction phase of the project, there will be no increased risk to adjacent properties due to contaminated groundwater.
- In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

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

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 Waldemar LP. 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.





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

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

9 References

EXP Services Inc. (October 10, 2019), Phase Two Environmental Site Assessment, 418 and 422 Guelph Line, Burlington, ON, prepared for Waldemar LP

SOLA Engineering Inc. (August 16, 2019), Geotechnical Investigation, Proposed Residential Development, 418 and 422 Guelph Line, Burlington, ON, prepared for Valour Capital management Inc.

Oak Ridges Moraine Groundwater Program (October 2018). Accessed to the website (https://oakridgeswater.ca/).

Cashman and Preene (2013) Groundwater Lowering in Construction, 2nd Edition.

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

Toronto and Region Conservation (2008/2009), Humber/Don River State of the Watershed Report – Geology and Groundwater Resources.

Chapman, L.J. and Putnam, D.F. (2007). Physiography of Southern Ontario, 3rd Edition, Ontario Geological Survey.

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

Figures



EXP Services Inc.

t: +1.905.793.9800 | f: +1.905.793.0641
1595 Clark Boulevard
Brampton, ON L6T 4V1
Canada
www.exp.com

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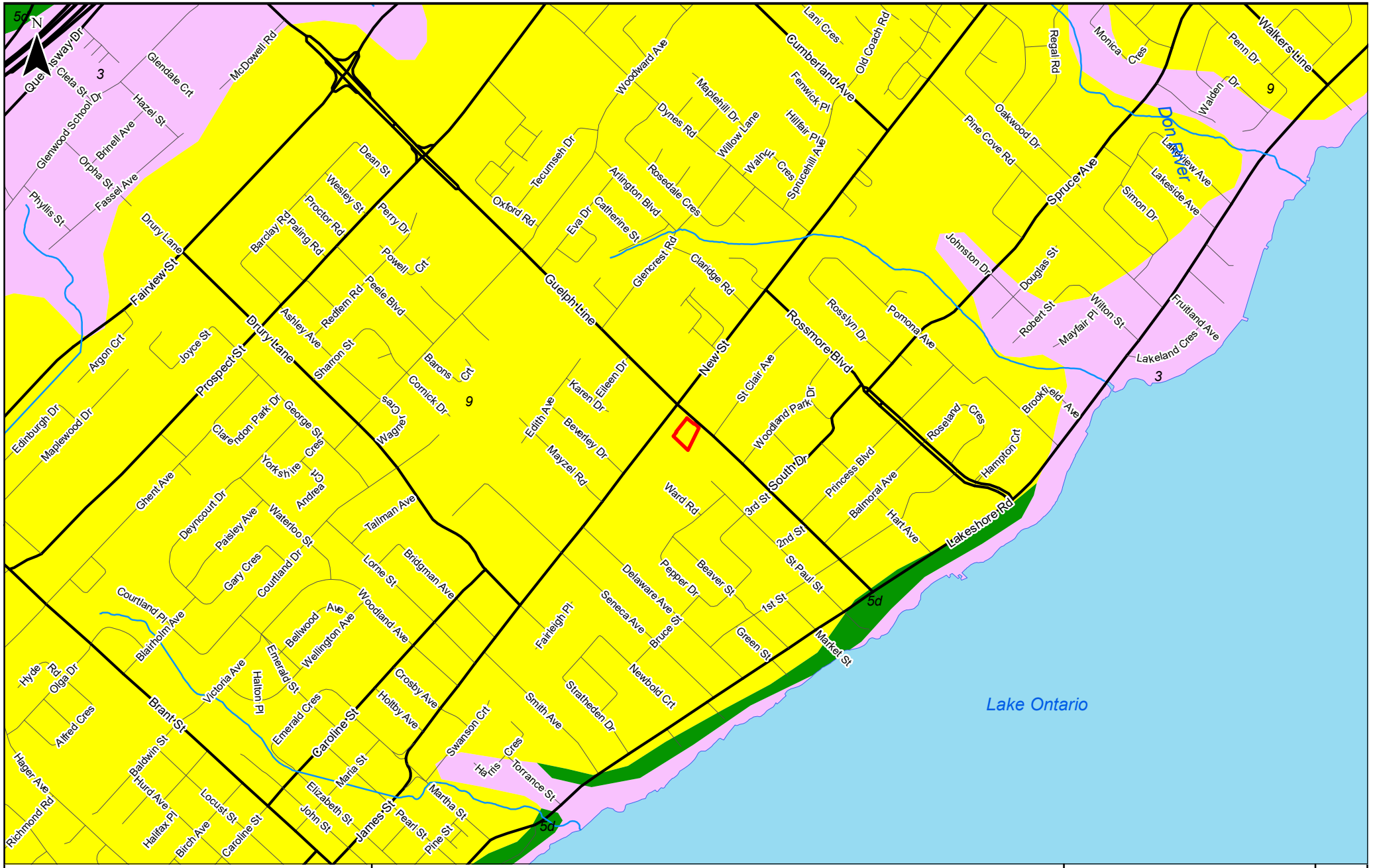
N

0 150 300 450 600 750 m

TITLE AND LOCATION:

SITE LOCATION PLAN
Hydrogeological Investigation
418 & 422 Guelph Line
Burlington, Ontario

PROJECT No.: HAM-00801683-B0	DWN: AC
SCALE: AS NOTED	CHKD: JS
DATE: DECEMBER 2019	FIG. No.: 1



SCALE:

0 200 400 600 800 1,000 m

SOURCE:

BASED ON ONTARIO GEOLOGICAL SURVEY DATA PUBLISHED IN 2010

LEGEND:

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

exp.

DRAWN BY:	CHECKED BY:
AC	JS

SURFICIAL GEOLOGY

FIGURE: 2

HYDROGEOLOGICAL INVESTIGATION
418 & 422 GUELPH LINE
BURLINGTON, ONTARIO

PROJECT NUMBER: HAM-00801683-B0

DATE: DECEMBER 2019



SCALE:
0 100 200 300 400 m

SOURCE:
BASED ON GOOGLE EARTH IMAGERY DATED 2018,
AVAILABLE WELL RECORD INFORMATION AS OF SEPTEMBER 2017

exp.

DRAWN BY:	CHECKED BY:
AC	JS

LEGEND:

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

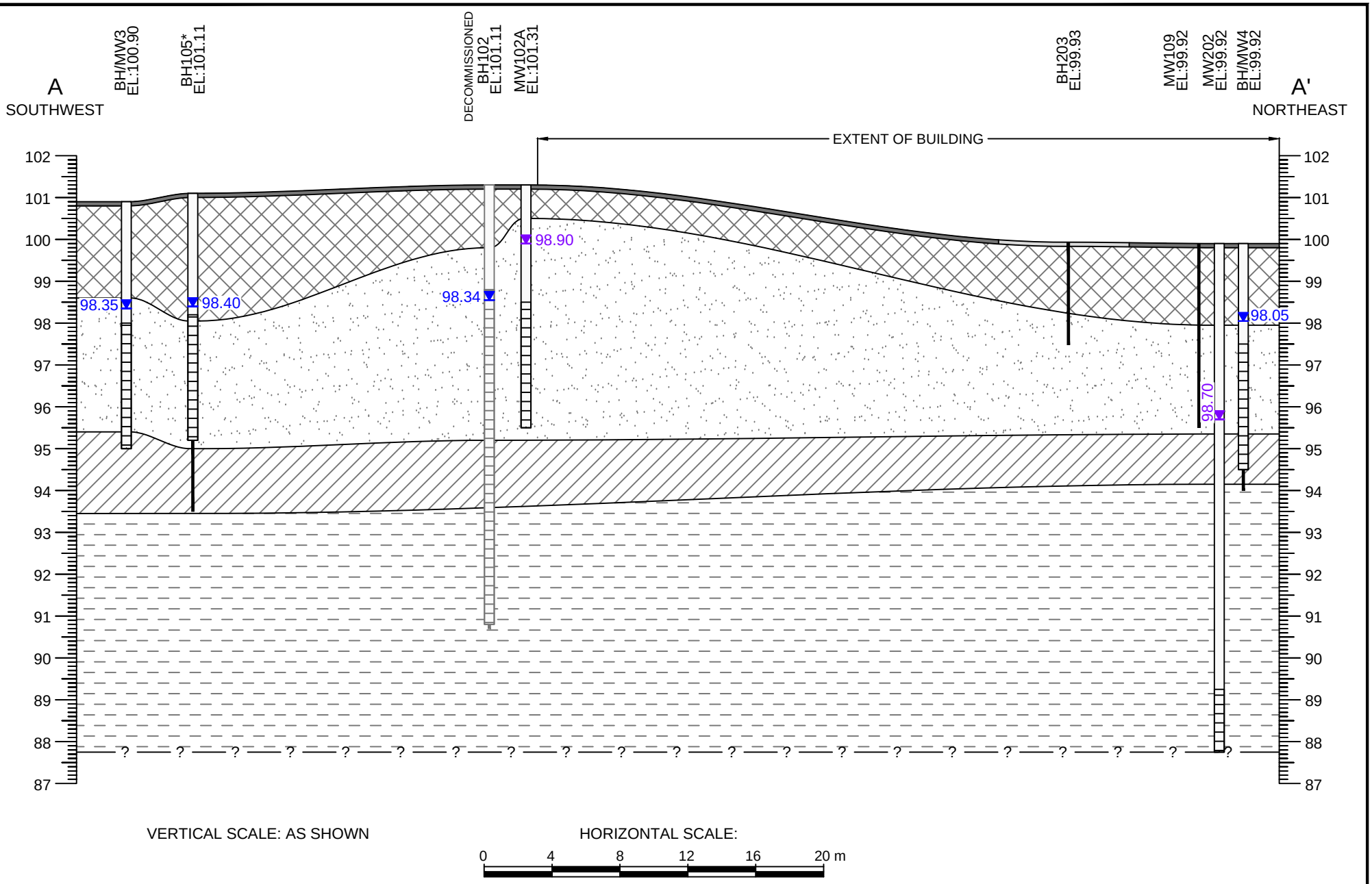
MECP WATER WELL RECORDS MAP

FIGURE: 3

HYDROGEOLOGICAL INVESTIGATION
418 & 422 GUELPH LINE
BURLINGTON, ONTARIO

PROJECT NUMBER: HAM-00801683-B0

DATE: DECEMBER 2019



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LEGEND:

- ASPHALT
- TOPSOIL
- FILL
- SAND
- SILTY SILT TILL
- BEDROCK
- GROUNDWATER ELEVATION AS MEASURED ON MAY 21, 2019
- GROUNDWATER ELEVATION AS MEASURED ON JUNE 20, 2019
- * FOR CHEMICAL CHARACTERIZATION ONLY

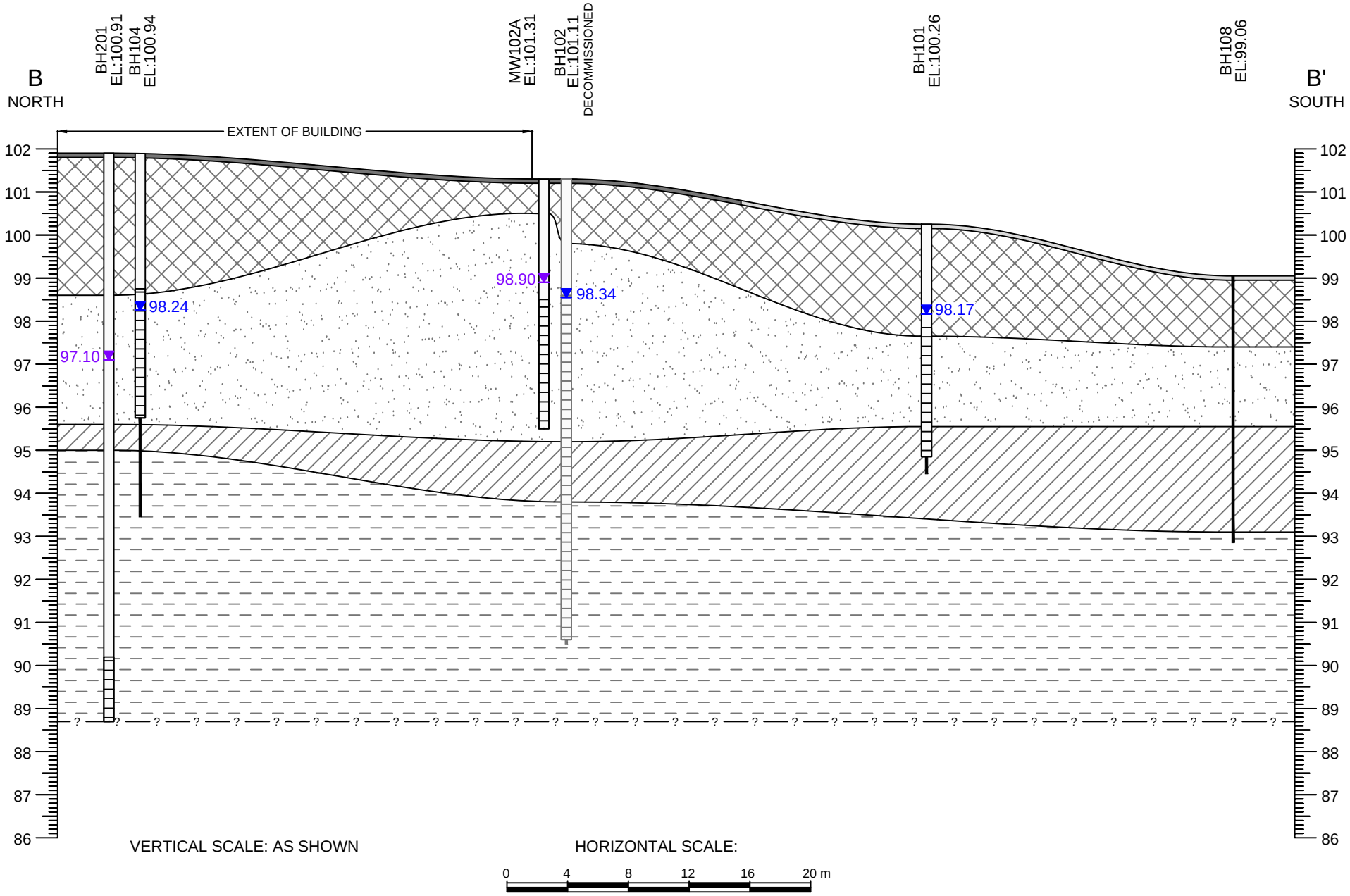
TITLE AND LOCATION:

CROSS SECTION A-A'

PHASE TWO ESA
418 AND 422 GUELPH LINE,
BURLINGTON, ONTARIO

PROJECT NO.: HAM-00801683-A0	DWN.: LE
SCALE: AS NOTED	CK: SH
DATE: JULY 2019	FIG. NO.: 4A

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LEGEND:

- ASPHALT
- TOPSOIL
- FILL
- SAND
- SILTY SILT TILL
- BEDROCK
- GROUNDWATER ELEVATION AS MEASURED ON MAY 21, 2019
- GROUNDWATER ELEVATION AS MEASURED ON JUNE 20, 2019
- * FOR CHEMICAL CHARACTERIZATION ONLY

TITLE AND LOCATION:

CROSS SECTION B-B'

PHASE TWO ESA
418 AND 422 GUELPH LINE,
BURLINGTON, ONTARIO

PROJECT NO.:	DWN.:
HAM-00801683-A0	LE
SCALE: AS NOTED	CK: SH
DATE: JULY 2019	FIG. NO.: 4B

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N

0 5 10 15 20 25 m

TITLE AND LOCATION:

BOREHOLE / MONITORING WELL
LOCATION PLAN
Hydrogeological Investigation
418 & 422 Guelph Line
Burlington, Ontario

PROJECT No.: HAM-00801683-B0	DWN: AC
SCALE: AS NOTED	CHKD: JS
DATE: DECEMBER 2019	FIG. No.: 5



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N

0 5 10 15 20 25 m

TITLE AND LOCATION:

GROUNDWATER CONTOUR PLAN
Hydrogeological Investigation
418 & 422 Guelph Line
Burlington, Ontario

PROJECT No.: HAM-00801683-B0	DWN: AC
SCALE: AS NOTED	CHKD: JS
DATE: DECEMBER 2019	FIG. No.: 6

Appendix A – MECP WWR Summary Table

Appendix A: MECP Well Records (within 500 m from Site Centroid)

418-422 Guelph Line, Burlington, Ontario

BRM-00801683-B0

On-Site										
BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	WATER FOUND (m BGS)	1st USE	FINAL STATUS
23047563	7047563	4/30/2007	598516	4799027	88.1	451 GUELPH LINE		32	2.0		Observation Wells
Off-Site											
BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	WATER FOUND (m BGS)	1st USE	FINAL STATUS
11319359	2810404	7/4/2005	598499	4799105	89.4	433 GUELPH LINE	BURLINGTON	94	2.7	Not Used	Observation Wells
1001484723	7101471	12/14/2007	598362	4799133	90.1	470 GUELPH LINE	BURLINGTON	175		Monitoring	Observation Wells
1002925568	7138442	12/18/2009	598515	4799211	90.0	3023 NEW STREET	Burlington	201		Monitoring and Test Hole	Monitoring and Test Hole
1002978934	7144743	1/27/2010	598362	4799127	90.1	466 GUELPH LINE	Burlington	171		Test Hole	Test Hole
1003478472	7159570	2/3/2011	598319	4799116	89.9	483 KAREN DR	Burlington	199		Test Hole	Test Hole
1003478476	7159572	2/2/2011	598319	4799101	89.8	479 KAREN DR	Burlington	191		Test Hole	Test Hole
1003505708	7162724	4/7/2011	598308	4799188	90.2	490 GUELPH LINE	BURLINGTON	252		Monitoring and Test Hole	Monitoring and Test Hole
1003505710	7162725	4/17/2011	598312	4799217	90.5	490 GUELPH LINE	BURLINGTON	271		Monitoring and Test Hole	Monitoring and Test Hole
1003555093	7167752	6/9/2011	598352	4799116	90.0	644 GUELPH LINE	Burlington	172	3.0	Monitoring	Observation Wells
1006223332	7269673	6/7/2016	598445	4799184	90.3	3001 NEW STREET	Burlington	178		Monitoring and Test Hole	Monitoring and Test Hole
1006223335	7269674	6/7/2016	598471	4799153	90.0	3001 NEW STREET	Burlington	143		Monitoring and Test Hole	Monitoring and Test Hole
1006223338	7269675	6/7/2016	598443	4799184	90.3	3001 NEW STREET	Burlington	178		Monitoring and Test Hole	Monitoring and Test Hole
1006223341	7269676	6/7/2016	598467	4799471	90.2	3001 NEW STREET	Burlington	460		Monitoring and Test Hole	Monitoring and Test Hole
11174665	2810048	8/19/2004	598460	4799130	90.0	540 GUELPH LINE	BURLINGTON	122	3.4		Observation Wells
11174698	2810081	9/28/2004	598333	4799115	90.0	480 GUELPH LINE RD	BURLINGTON	187	4.0		Observation Wells
11765290	7042758	2/5/2007	598328	4799145	90.1	470 AND 480 GUELPH LINE	BURLINGTON	209	2.3		Observation Wells
11760820	7035370	7/21/2006	598439	4799179	90.3	466 GUELPH LINE	BIRLINGTON	175			
1003593805	7170884	6/9/2011	598328	4799039	88.8			163			
1005128773	7227680	9/12/2014	598313	4799170	90.2			236			
1006290082	7274669	2/6/2012	598402	4799281	90.9			283			
1006395327	7285842	1/6/2017	598323	4799076	89.5			177			

Appendix B – Borehole Logs

Log of Borehole BH/MW102A

Project No. HAM-00801683-A0 | Drawing No. 1

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

Location: 418 & 422 Guelph Line, Burlington, ON

Refer to borehole location plan

Date Drilled: June 12, 2019

Drill Type: CME 75-3

Datum: Relative

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
			101.31	0	20 40 60	25 50 75				
		Asphalt	~101.3							
		Sand Fill								
		SAND Brown, trace silt, moist	~100.5	1		0 (H) 0 (I)		100	SS1	
				2		0 (H) 0 (I)		100	SS2	
		Wet	~98.3	3						
				4		0 (H) 0 (I)		100	SS3	
				5		0 (H) 0 (I)		100	SS4	
			~95.5	6						
		End of borele.		7						
		Borehole samples were from auger cuttings.		8						
		NOTES:		9						
		1) This drawing is to be read with the subject report and project number as presented above.		10						
		3) 50.8 mm diameter well installed.		11						
		4) Well screen installed from 2.74 - 5.79 m.		12						
				13						
				14						
				15						

ENV_EXP_HAM 418 & 422 GUELPH LINE, BURLINGTON.GPJ 12/19/19

Time	Water Level (m)	Depth to Cave (m)
June 20, 2019	3.054	

exp Services Inc.
Hamilton, Ontario
Telephone: 905-573-4000
Facsimile: 905-573-9693

Log of Borehole BH/MW201

Project No. HAM-00801683-A0 | Drawing No. 2

Project: Phase Two ESA | Sheet No. 1 of 2

Location: 418 & 422 Guelph Line, Burlington, ON

Refer to borehole location plan

Date Drilled: June 10 & 11, 2019

Drill Type: CME 75-3

Datum: Relative

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 (20, 40, 60)	Combustible Vapour Reading (ppm) (25, 50, 75)	SAMPLES	% RECOV	SAMPLE ID	ANALYSIS
			100.94							
		Asphalt ~100.9 Sand fill.		0						
				1		0 (H) 0 (I)		100	SS1	
				2		0 (H) 0 (I)		100	SS2	
		SAND Brown, trace silt, moist ~98.7 Wet		3		0 (H) 0 (I)		75	SS3	Grain Size
		~97.2		4		0 (H) 0 (I)		100	SS4	
		SILTY CLAY TILL Grey, trace red, trace granular, wet ~95.6		5		0 (H) 1 (I)		100	SS5	
		~95.0		6		0 (H) 0 (I)		100	SS6	VOC*
		BEDROCK Grey, trace brown, moist Borehole sampled down to 5.95 m and then augered from 5.95 to 12.2 m.		7						
				8						
				9						
				10						
				11						
				12						
		~88.7		13						
				14						
				15						

NOTES:
1) This drawing is to be read with the subject report and project number as presented above.
2) Borehole augered from 5.95 to 12.2 m bgs with a permantly installed casing from 0 - 6.1 m bgs.
3) 50.8 mm diameter well installed.
4) Well screen installed from 10.67 to

Continued Next Page

ENV_EXP_HAM 418 & 422 GUELPH LINE, BURLINGTON.GPJ 12/19/19

Time	Water Level (m)	Depth to Cave (m)
June 20, 2019	3.764	

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Facsimile: 905-573-9693

Log of Borehole BH/MW201

Project No. HAM-00801683-A0 Drawing No. 2

Project: Phase Two ESA Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value	Combustible Vapour Reading (ppm)	SAMPLES	% RECOV	SAMPLE ID	ANALYSIS
		12.2 m.	85.94	15	20 40 60	25 50 75				
				16						
				17						
				18						
				19						
				20						
				21						
				22						
				23						
				24						
				25						
				26						
				27						
				28						
				29						
				30						
				31						
				32						
				33						

ENV_EXP_HAM 418 & 422 GUELPH LINE, BURLINGTON.GPJ 12/19/19

exp Services Inc.
Hamilton, Ontario
Telephone: 905-573-4000
Facsimile: 905-573-9693

Time	Water Level (m)	Depth to Cave (m)
June 20, 2019	3.764	

Log of Borehole BH/MW202

Project No. HAM-00801683-A0 | Drawing No. 3

Project: Phase Two ESA | Sheet No. 1 of 2

Location: 418 & 422 Guelph Line, Burlington, ON

Refer to borehole location plan

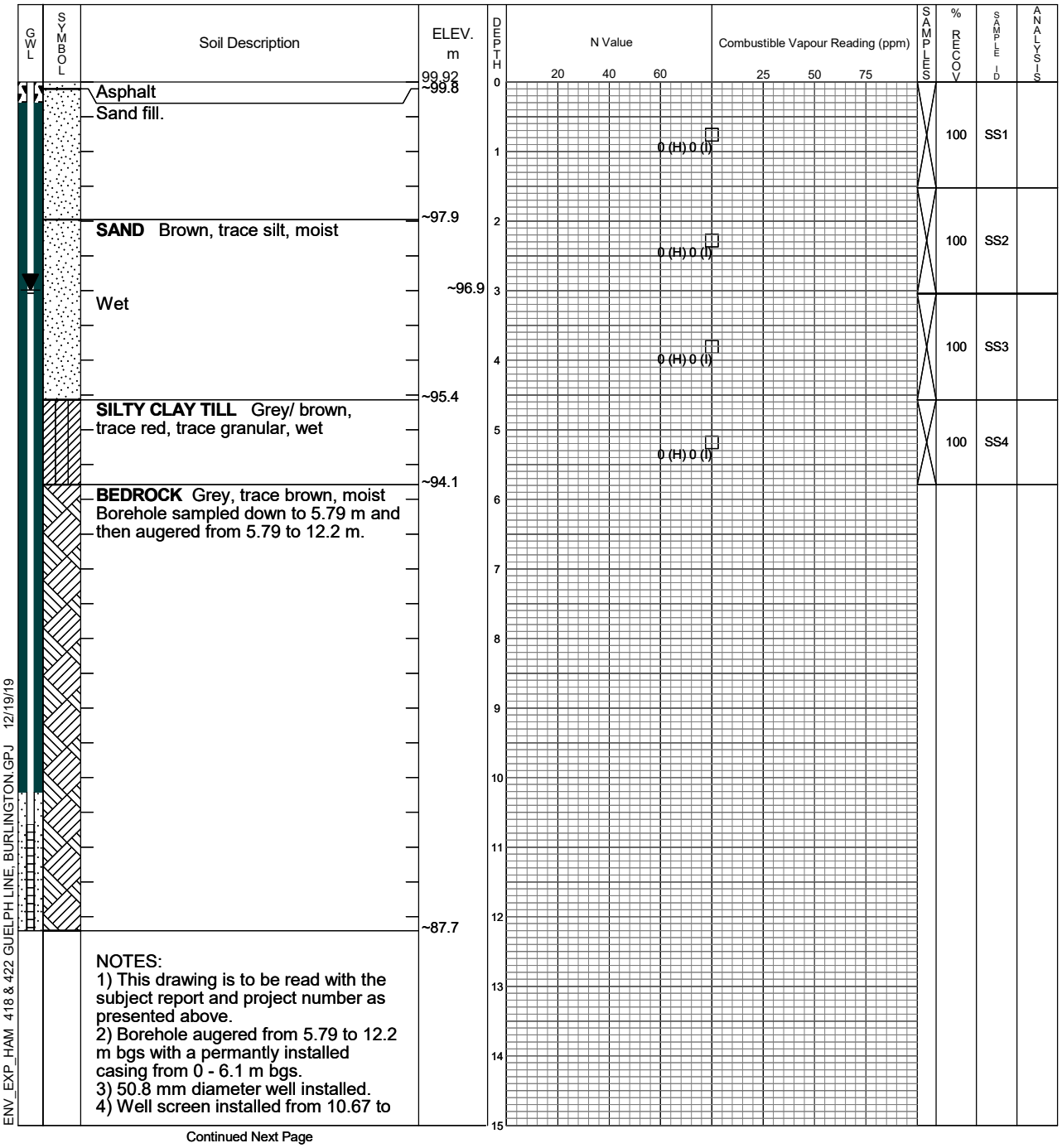
Date Drilled: June 10 & 11, 2019

Drill Type: CME 75-3

Datum: Relative

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		



Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
June 20, 2019	3.038	

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Telephone: 905-573-4000
Facsimile: 905-573-9693

Log of Borehole BH/MW202

Project No. HAM-00801683-A0 Drawing No. 3

Project: Phase Two ESA Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value	Combustible Vapour Reading (ppm)	SAMPLES	% RECOV	SAMPLE ID	ANALYSIS
		12.2 m.	84.92	15	20 40 60	25 50 75				
				16						
				17						
				18						
				19						
				20						
				21						
				22						
				23						
				24						
				25						
				26						
				27						
				28						
				29						
				30						
				31						
				32						
				33						

ENV_EXP_HAM 418 & 422 GUELPH LINE, BURLINGTON.GPJ 12/19/19

exp Services Inc.
Hamilton, Ontario
Telephone: 905-573-4000
Facsimile: 905-573-9693

Time	Water Level (m)	Depth to Cave (m)
June 20, 2019	3.038	

Log of Borehole BH203

Project No. HAM-00801683-A0 | Drawing No. 4

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

Location: 418 & 422 Guelph Line, Burlington, ON

Refer to borehole location plan

Date Drilled: June 12, 2019

Drill Type: Bosch Electric

Datum: Relative

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
			99.93	0	20 40 60	25 50 75				
		Topsoil, trace rootlets, brown, moist	~99.8			0 ppm		75	SS1	PHC* BTEX*
		SAND Brown, moist		1		0 ppm		75	SS2	
						0 ppm		83	SS3	
		Wet		2		0 ppm		83	SS4	Grain Size
			~97.5							
		Borehole completed to 2.44 m.		3						
		NOTES:		4						
		1) This drawing is to be read with the subject report and project number as presented above.		5						
				6						
				7						
				8						
				9						
				10						
				11						
				12						
				13						
				14						
				15						

ENV_EXP_HAM 418 & 422 GUELPH LINE, BURLINGTON.GPJ 12/19/19

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

exp Services Inc.
Hamilton, Ontario
Telephone: 905-573-4000
Facsimile: 905-573-9693

BOREHOLE LOG

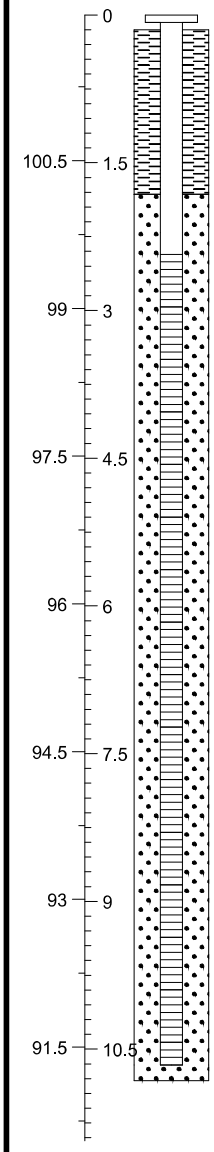
BOREHOLE NO.: 102

ENCLOSURE 2
PAGE 1 OF 1

PROJECT NO.: 10269 **DATE:** September 6, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 101.979 Local **CAVED AT DEPTH (M):** ---
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: JA **REVIEWED BY:** HG

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)



ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)
					BLOW COUNTS	"N" VALUE	
0			ASPHALTIC CONCRETE - 40 mm	10.1			
		1	GRANULAR BASE - sand and gravel	9.1	4-4-3-3	7	
			FILL - silty sand, trace gravel, dark brown, moist				
100.5 1.5		2		9	1-1-1-1-2	2	
			- trace rootlets				
		3		10.7	2-2-1-1	3	
		4		18.7	2-2-4-8	6	
99 3			SILTY SAND - brown, compact, moist				
		6		23.6	5-7-12-13	19	
97.5 4.5		6		22.9	5-7-7-10	14	
96 6		7	SILTY CLAY TILL - trace shale fragments, brown, hard, moist	9.9	15-38-50***/13	50*	
94.5 7.5		8	- limestone seams	7.7	50**/5	50*	
		R1	SHALE BEDROCK - QUEENSTON FORMATION, trace limestone seams, greyish red, highly weathered to moderately weathered, flat bedded, osccasionally gapped filled with clay lences, weak to medium strong TCR=95%, RQD=90%				
93 9		R2	- TCR=92%, RQD=81%				
91.5 10.5		R3	- TCR=85%, RQD=79%				
			END OF BOREHOLE at TARGETED DEPTH of 10.82 m				

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50***/13 denotes 50 plus blows for 13 cm of sampler penetration after 1st 30 cm;
50**/5 denotes 50 plus blows for 5 cm of sampler penetration;
RQD denotes rock quality designation

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 3
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 103

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** September 5, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 100.437 Local **CAVED AT DEPTH (M):** ---
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: HG **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)
0			TOPSOIL - 125 mm	26.4			
99 1.5		1	FILL - silty sand, trace gravel, trace organic, dark brown, moist	2.5	4-10-10-8	20	
		2	SILTY SAND - trace rootlest, dark brown, loose, moist	10.5	1-2-3-4	5	
		3		15.7	2-5-7-8	12	
		4	- wet	21.5	6-7-9-8	16	
97.5 3		5	- brown	20.3	6-11-12-12	23	
96 4.5		6	SILTY CLAY TILL - trace gravel, brownish grey, hard, moist	13.6	10-13-23-16	36	
94.5 6		7	SHALE BEDROCK - QUEENSTON FORMATION, trace limestone seams, red trace grey, completely to highy weathered, very weak to weak	5.6	50*/8	50*	
93 7.5		8	END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.51 m	10.2	50*/5	50*	
91.5 9							
90 10.5							

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50*/8 denotes more then 50 blows after 8 cm of sampler penetration;
50*/5 denotes more then 50 blows after 5 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 4
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 104

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:**
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 101.614 Local **CAVED AT DEPTH (M):** ---
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: JA **REVIEWED BY:** HG

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS BLOW COUNTS	STANDARD PENETRATION TESTS "N" VALUE	ELEV./ DEPTH (m)
0		1	ASPHALTIC CONCRETE - 40 mm GRANULAR BASE - sand and gravel	3.1 4.1	4-5-7-6	12	
100.5 1.5		2	FILL - silty sand, brown, moist	4.9	3-3-5-7	8	
		3	POSSIBLE FILL - silty sand, brown, moist SILTY SAND - brown, compact, moist	4.7	4-5-6-7	11	
99 3		4		20.1	5-12-17-19	29	
		5	- very dense, wet	17.1	15-24-26-27	50	
97.5 4.5		6		18.7	13-26-35-39	61	
96 6		7	SILTY CLAY TILL - trace gravel, trace shale fragments, redish brown, hard, moist	12.1 2.0	45- 50**/10	50*	
94.5 7.5		8	SHALE BEDROCK - QUEENSTON SHALE FORMATION, red trace grey, completely weathered to highy weathered, very weak to weak, occasional limestone thin seams		50*/5	50*	
93 9			END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.51 m				
91.5 10.5							

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50*/5 denotes 50 plus blows for 5 cm of sampler penetration;
50**/10 denotes 50 plus blows for 10 cm of sampler penetration after 1st 15 cm

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 5
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 105

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** September 6, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 101.780 Local **CAVED AT DEPTH (M):** ---
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: JA **REVIEWED BY:** HG

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS BLOW COUNTS	STANDARD PENETRATION TESTS "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
0			ASPHALTIC CONCRETE - 40 mm	2.3				
		1	GRANULAR BASE - sand and gravel	6.0	3-2-3-4	5		
		4	FILL - silty sand, brown, moist	6.0	1-2-1-2	3		
100.5 1.5			POSSIBLE FILL - silty sand, brown, moist					
		3	SILTY SAND - brown, loose, moist	11.2	1-2-2-1	4		
		4	SANDY SILT -light brown, loose, moist	13.9	1-1-3-3	4		
99 3		5	SILTY SAND - brown, compact, moist	22.9	4-6-9-11	15		
97.5 4.5		6		22.5	5-5-9-9	14		
96 6		7	SILTY CLAY TILL - trace gravel, reddish brown, hard, moist	10.5	18-40-35-42	75		
94.5 7.5		8	- inferred limestone cap	12.7	50***/8	50*		
			END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.69 m					
93 9								
91.5 10.5								

Notes: 50***/8 denotes 50 plus blows for 8 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 6
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 106

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** Septemner 5, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 100.433 Local **CAVED AT DEPTH (M):** ---
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: HG **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)
0			TOPSOIL - 150 mm				
		1	FILL - silty sand, trace asphalt, trace gravel, brown, moist	2.2	3-5-7-5	12	
				12.4			
		2		9.3	2-3-3-2	6	
99 1.5			- trace organic, brownish red				
		3		19.3	3-3-3-2	6	
			SILTY SAND - dark brown, compact, wet				
		4		23.5	8-10-13-14	23	
97.5 3							
		5	- trace gravel, brown, dense, wet	20.9	11-14-16-17	30	
96 4.5							
		6	SILTY CLAY - trace sand, trace shale fragments, brownish grey, hard, moist	14.6	11-14-17-23	31	
94.5 6							
		7		6.8	31-50**/10	50*	
93 7.5							
		8	END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.51 m		50*/5	50*	
91.5 9							
90 10.5							

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50**/10 denotes 50 plus blows for 10 cm of sampler penetration after 1st 15 cm;
50*/5 denotes 50 plus blows for 5 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 7
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 108

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** September 5, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 99.714 Local **CAVED AT DEPTH (M):** 2.43
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: HG **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

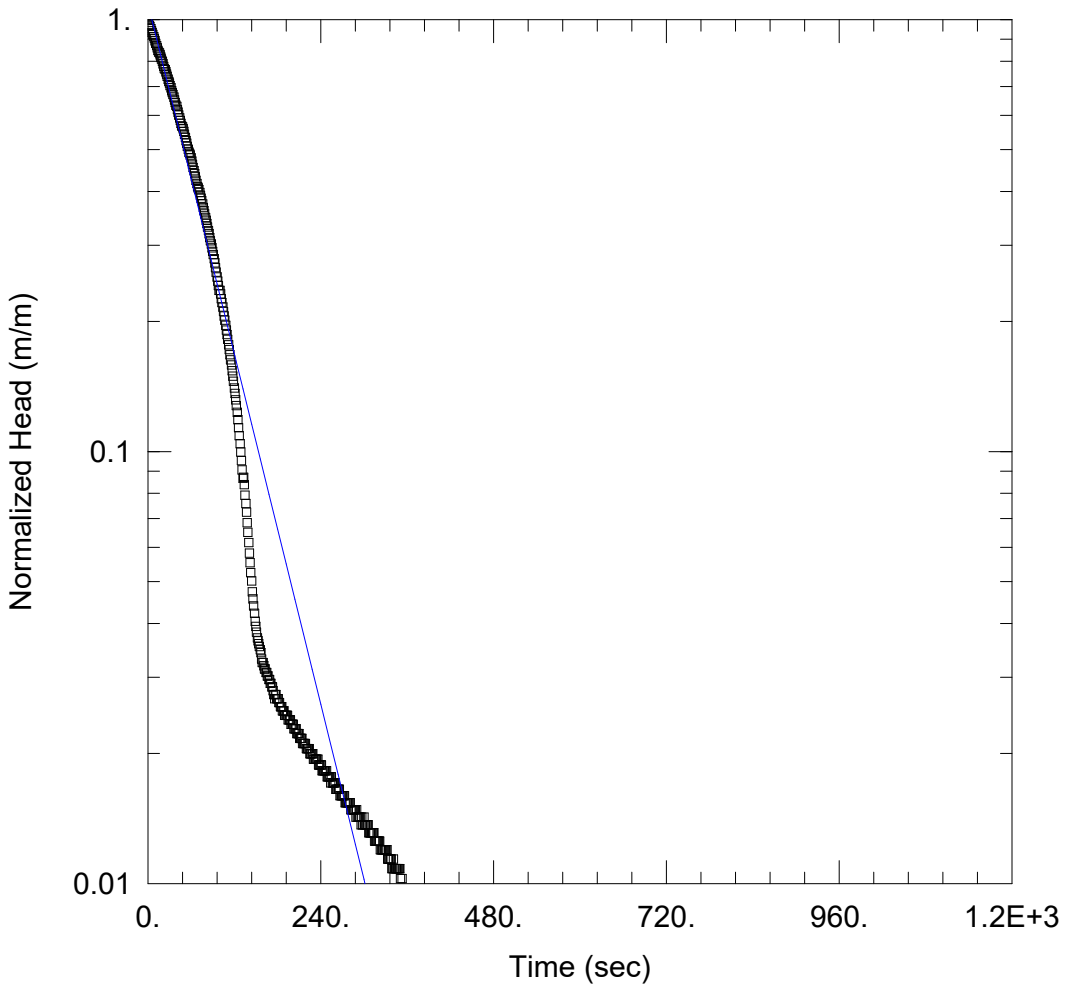
ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)
99 / 0		1	TOPSOIL - 100 mm	20.6			
			FILL - silty sand , trace gravel, trace rootlets, trace organic, reddish brown to brown, moist	3.2	2-8-8-10	16	
		2		23.4	2-2-3-4	5	
97.5 / 1.5		3	- some organic, brownish black, wet	22.5	2-2-3-4	5	
			SILTY SAND - brown, loose, wet	23.2			
		4	- dark brown	24.9	3-3-5-8	8	
96 / 3		5		24.4	4-5-7-11	12	
			SILTY CLAY TILL - trace gravel, brown, stiff to hard, moist	12.1			
94.5 / 4.5		6	- trace shale fragments	3.8	20-28-36-42	64	
93 / 6		7	- inferred limestone cap	3.8	50*/5	50*	
91.5 / 7.5			END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 5.99 m				
90 / 9							
88.5 / 10.5							

P.L.-L.L. M.C. "N" Value 20 40 60 80

Notes: 50*/5 denotes 50 plus blows for 5 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

Appendix C – SWRT Procedures and Results



RISING HEAD - SWRT - BH/MW 1

Data Set: I:\...\BHMW1.aqt
Date: 12/02/19 Time: 14:19:41

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 1
Test Date: November 25, 2019, 2019

AQUIFER DATA

Saturated Thickness: 2.395 m Anisotropy Ratio (Kz/Kr): 1.

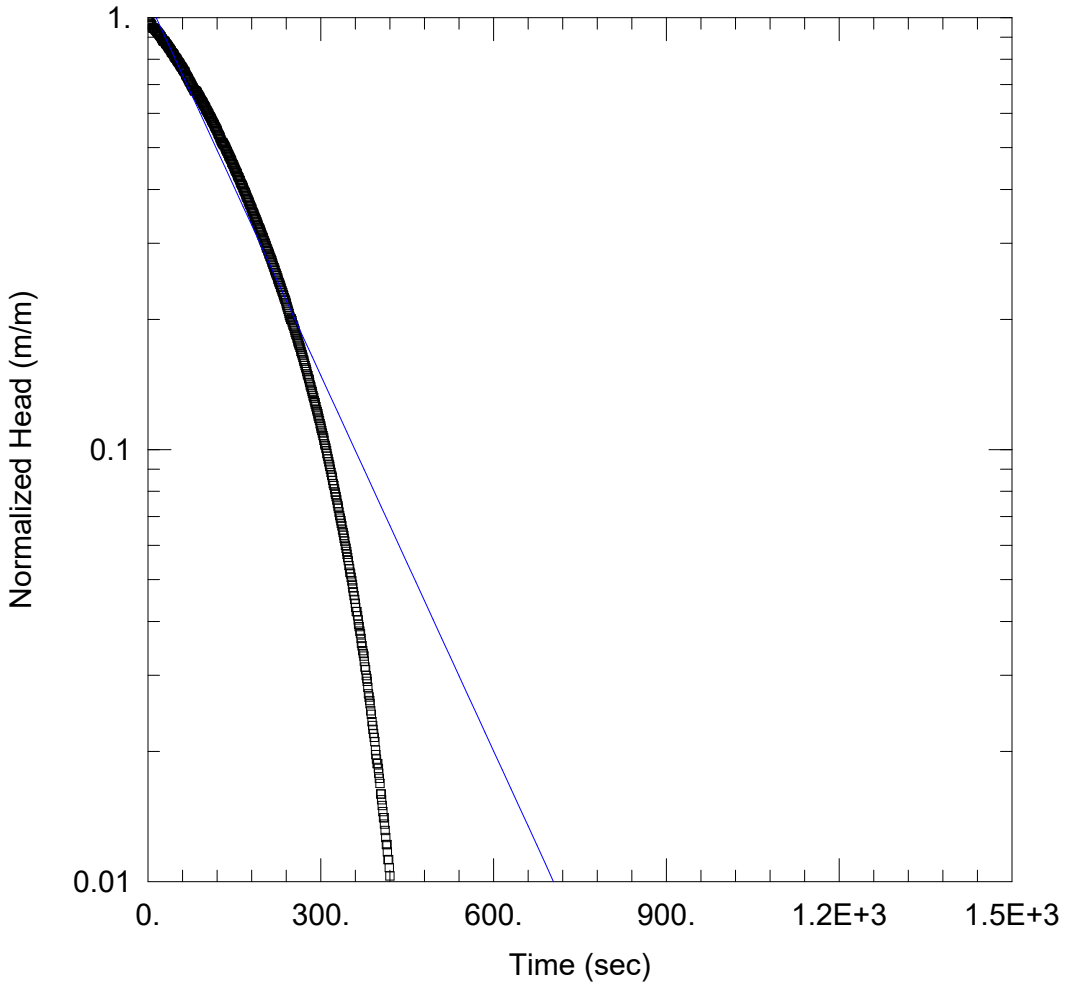
WELL DATA (BH/MW 1)

Initial Displacement: 1.754 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.395 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.11E-5 m/sec y0 = 1.907 m



RISING HEAD - SWRT - BH/MW 2

Data Set: I:\...\BHMW2.aqt
Date: 12/02/19 Time: 14:20:11

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 2
Test Date: November 25, 2019, 2019

AQUIFER DATA

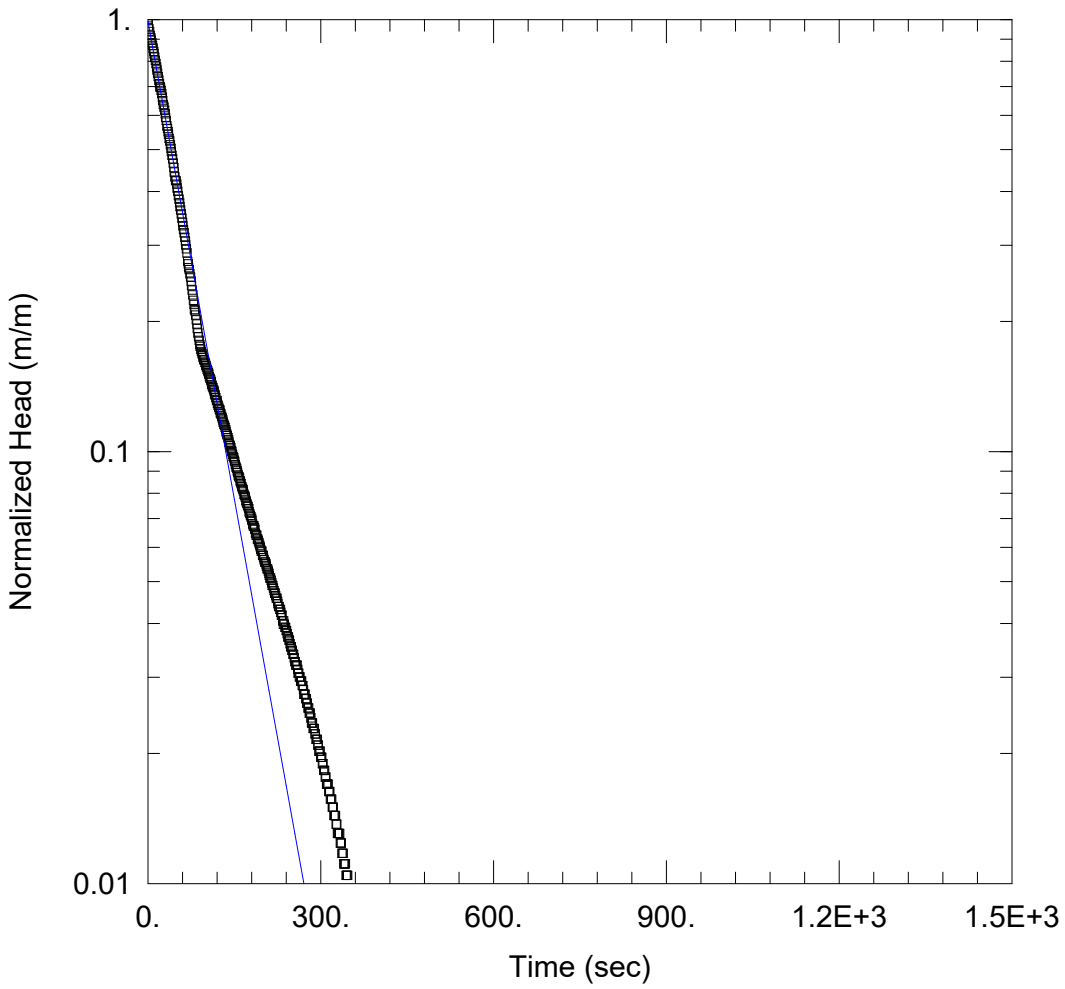
Saturated Thickness: 2.272 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 2)

Initial Displacement: 2.134 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.272 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.02E-6 m/sec
y0 = 2.345 m



RISING HEAD - SWRT - BH/MW 3

Data Set: I:\...\BHMW3.aqt
Date: 12/02/19 Time: 14:20:35

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 3
Test Date: November 25, 2019, 2019

AQUIFER DATA

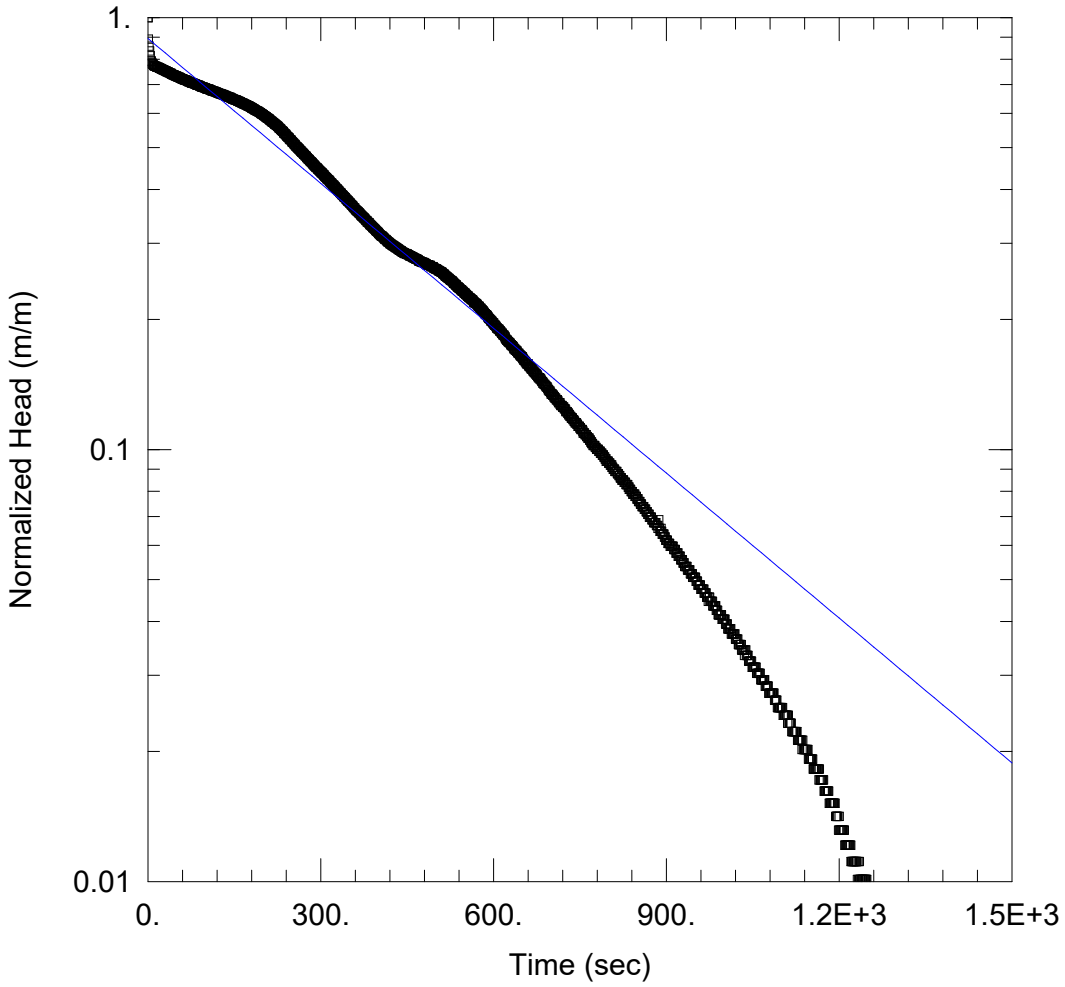
Saturated Thickness: 2.181 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 3)

Initial Displacement: 1.531 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.181 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.33E-5 m/sec
y0 = 1.513 m



RISING HEAD - SWRT - BH/MW 101

Data Set: I:\...\BHMW101.aqt
Date: 12/02/19 Time: 14:21:00

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 101
Test Date: November 25, 2019, 2019

AQUIFER DATA

Saturated Thickness: 2.933 m Anisotropy Ratio (Kz/Kr): 1.

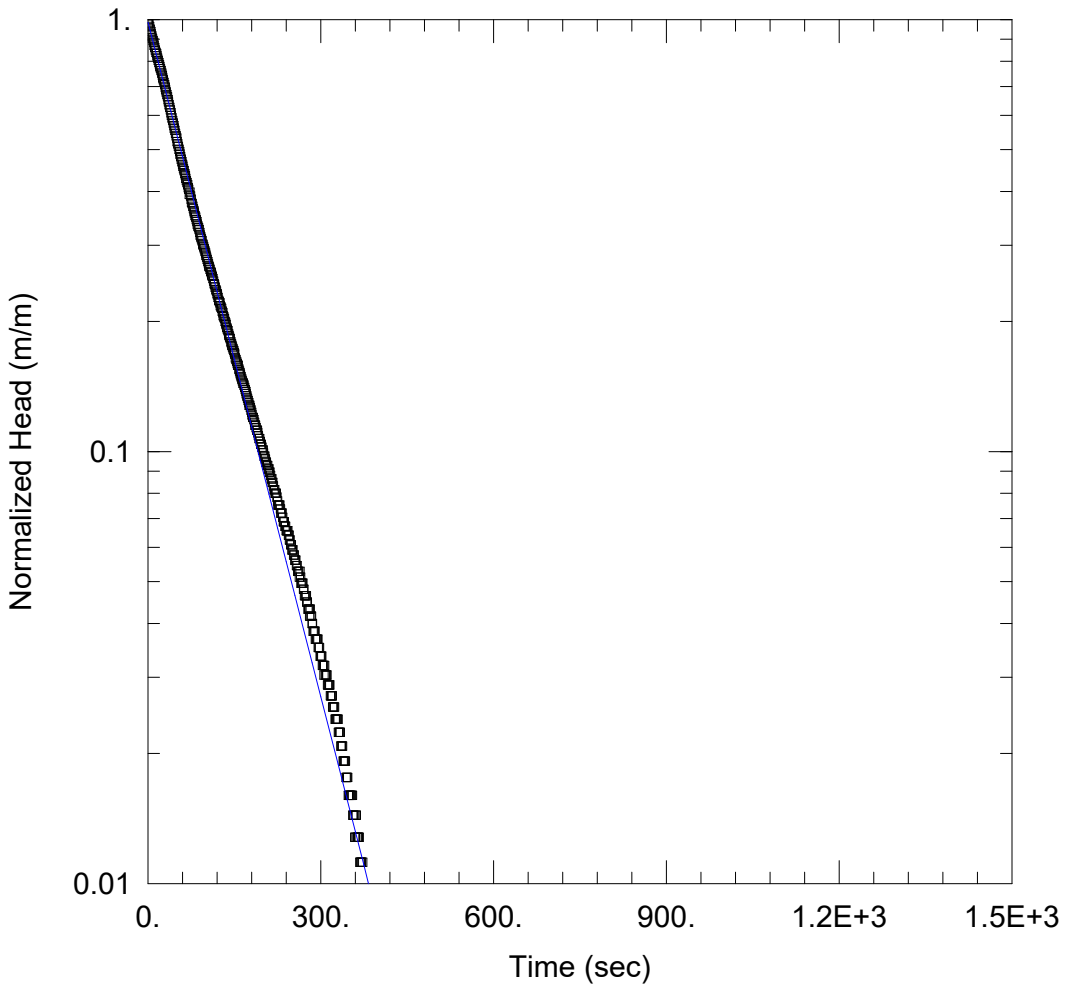
WELL DATA (BH/MW 101)

Initial Displacement: 0.989 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.933 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.5E-6 m/sec y0 = 0.8842 m



RISING HEAD - SWRT - BH/MW 102A

Data Set: I:\...\BHMW102A.aqt
Date: 12/02/19 Time: 14:21:25

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 102A
Test Date: November 25, 2019, 2019

AQUIFER DATA

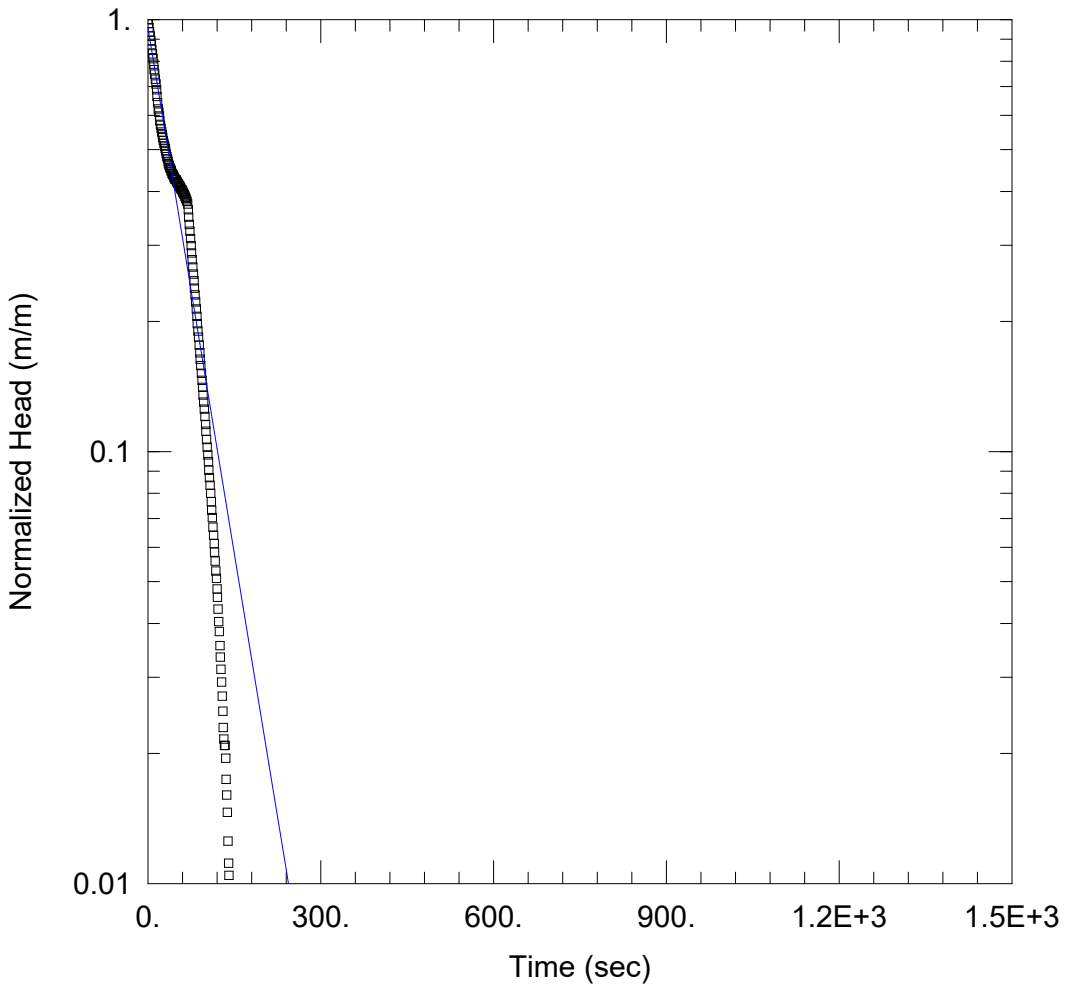
Saturated Thickness: 2.681 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 102A)

Initial Displacement: 0.625 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.681 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 7.64E-6 m/sec
y0 = 0.6164 m



RISING HEAD - SWRT - BH/MW 103

Data Set: C:\Users\simonc\Documents\BHMW3.aqt
Date: 12/02/19 Time: 14:07:25

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 103
Test Date: November 25, 2019, 2019

AQUIFER DATA

Saturated Thickness: 3.147 m Anisotropy Ratio (Kz/Kr): 1.

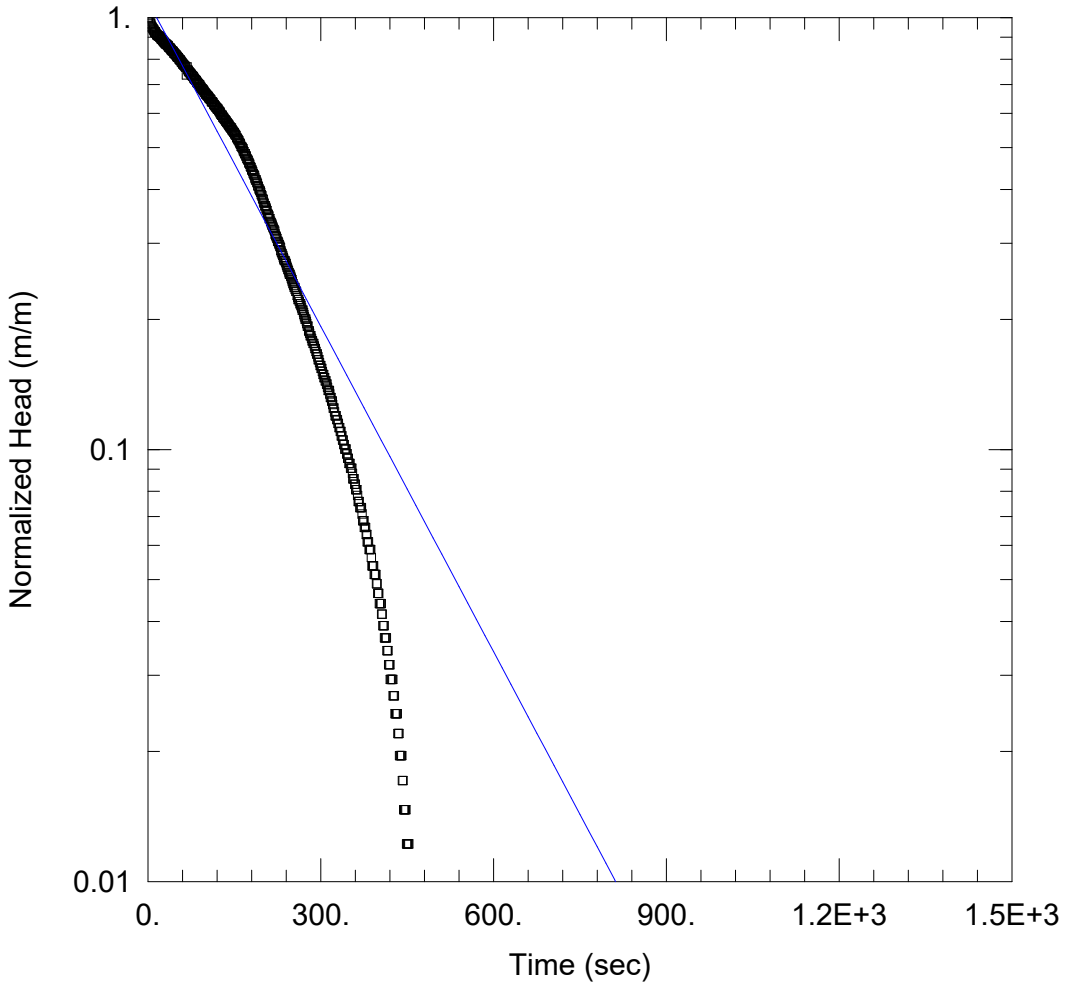
WELL DATA (BH/MW 103)

Initial Displacement: 1.436 m
Total Well Penetration Depth: 3.147 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.147 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 8.2E-6 m/sec y0 = 1.373 m



RISING HEAD - SWRT - BH/MW 105

Data Set: C:\Users\simonc\Documents\BHMW105.aqt
Date: 12/02/19 Time: 14:10:41

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 105
Test Date: November 25, 2019, 2019

AQUIFER DATA

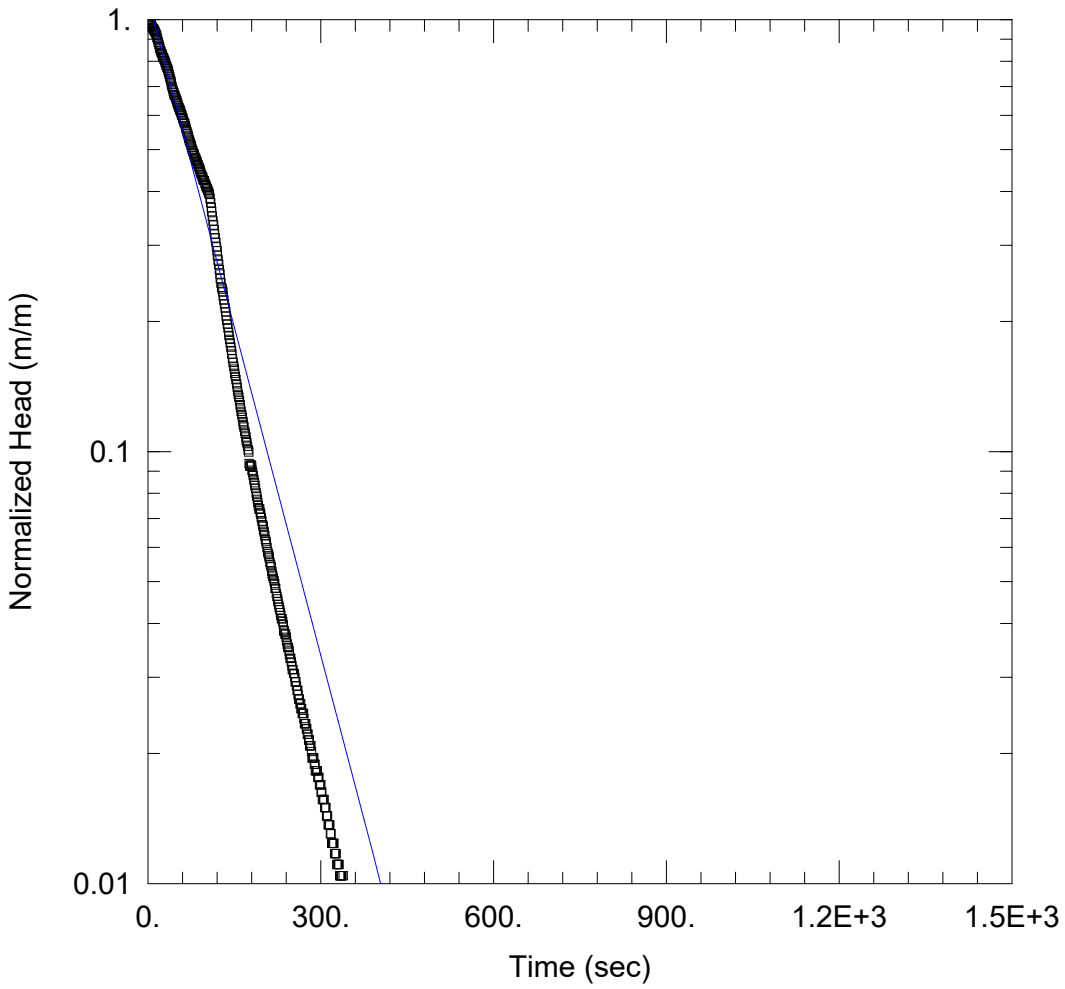
Saturated Thickness: 2.791 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 105)

Initial Displacement: 0.409 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.791 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.54E-6 m/sec
y0 = 0.4467 m



RISING HEAD - SWRT - BH/MW 106

Data Set: C:\Users\simonc\Documents\BHMW106.aqt
Date: 12/02/19 Time: 14:13:01

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 106
Test Date: November 25, 2019, 2019

AQUIFER DATA

Saturated Thickness: 3.352 m Anisotropy Ratio (Kz/Kr): 1.

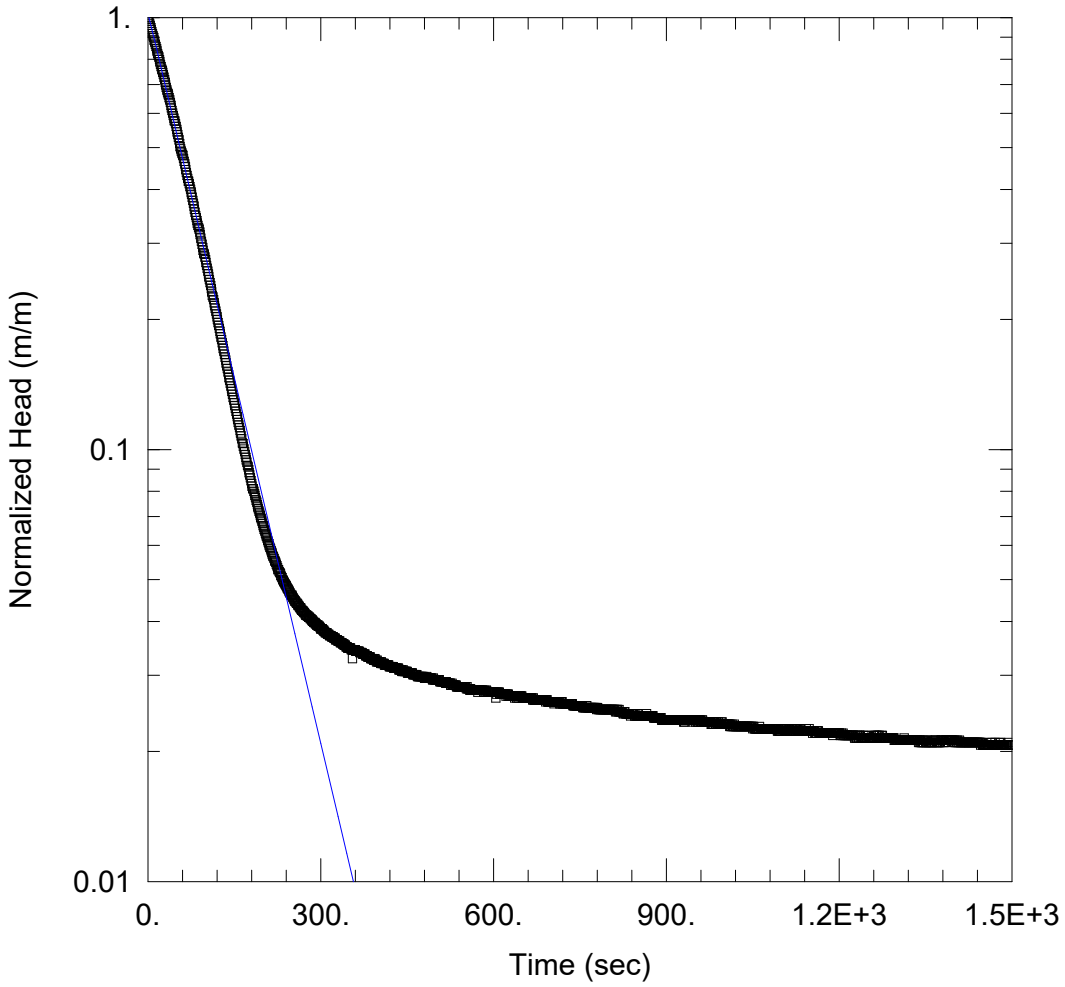
WELL DATA (BH/MW 106)

Initial Displacement: 1.535 m
Total Well Penetration Depth: 3.352 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.352 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 5.11E-6 m/sec
y0 = 1.707 m



RISING HEAD - SWRT - BH/MW 201

Data Set: I:\...\BHMW201.aqt
Date: 12/02/19 Time: 15:30:57

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 201
Test Date: November 25, 2019, 2019

AQUIFER DATA

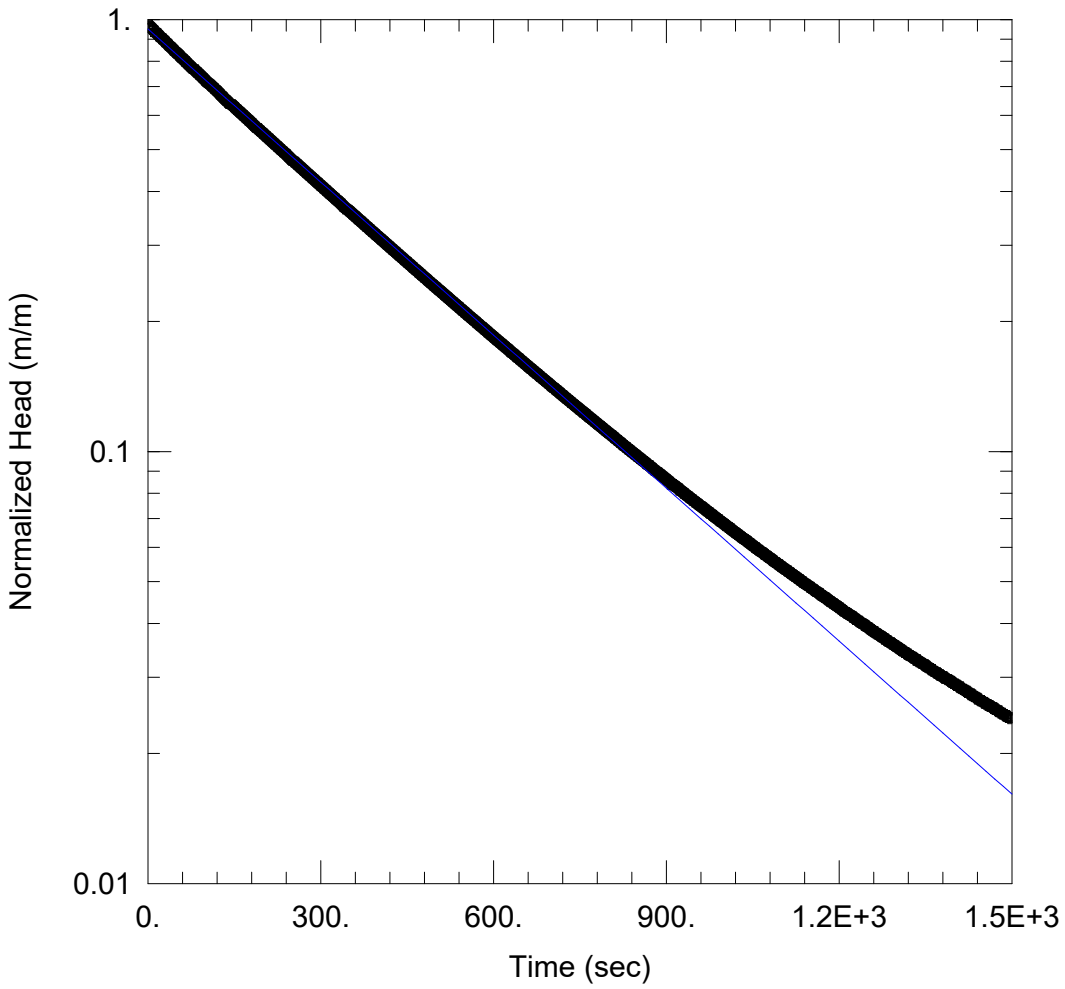
Saturated Thickness: 8.564 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 201)

Initial Displacement: 3.72 m
Total Well Penetration Depth: 8.564 m
Casing Radius: 0.0254 m
Static Water Column Height: 8.564 m
Screen Length: 1.5 m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 9.46E-6 m/sec
y0 = 3.825 m



RISING HEAD - SWRT - BH/MW 202

Data Set: I:\...\BHMW202.aqt
Date: 12/02/19 Time: 15:32:21

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Wademar LP
Project: BRM-00801683
Location: 418 & 422 Guelph Line
Test Well: BH/MW 202
Test Date: November 25, 2019, 2019

AQUIFER DATA

Saturated Thickness: 9.142 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 202)

Initial Displacement: 6.714 m
Total Well Penetration Depth: 9.142 m
Casing Radius: 0.0254 m
Static Water Column Height: 9.142 m
Screen Length: 1.5 m
Well Radius: 0.1016 m

SOLUTION

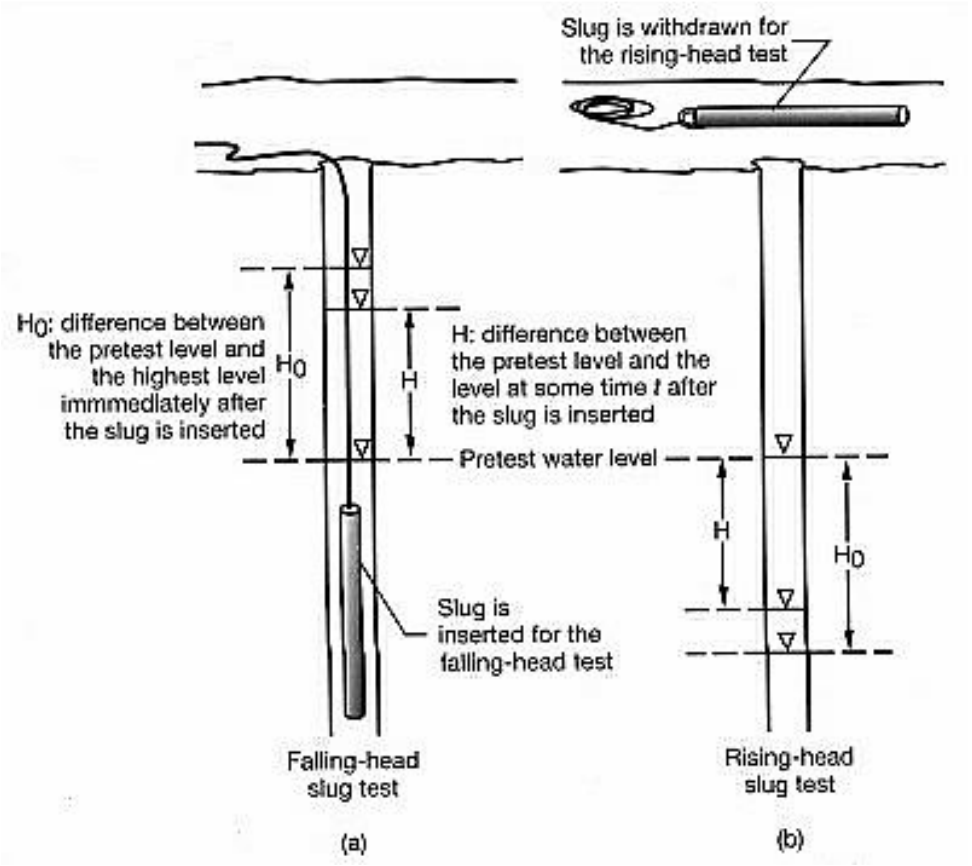
Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.98E-6 m/sec
y0 = 6.381 m

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 Certificates of Analysis

Your P.O. #: BRM-ENV
Your Project #: HAM-801683-B0
Site Location: Guelph Line
Your C.O.C. #: 748565-01-01

Attention: Stephanie Hsia

exp Services Inc
80 Bancroft St
Hamilton, ON
CANADA L8E 2W5

Report Date: 2019/12/02
Report #: R5988366
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9X2504
Received: 2019/11/25, 15:38

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonaceous BOD	1	2019/11/26	2019/12/01	CAM SOP-00427	SM 23 5210B m
Total Cyanide	1	2019/11/27	2019/11/27	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2019/11/26	2019/11/27	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2019/11/27	2019/11/27	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by Axial ICP	1	2019/11/27	2019/11/27	CAM SOP-00408	EPA 6010D m
Animal and Vegetable Oil and Grease	1	N/A	2019/11/29	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2019/11/29	2019/11/29	CAM SOP-00326	EPA1664B m,SM5520A m
PAH Compounds in Water by GC/MS (SIM)	1	2019/11/28	2019/11/29	CAM SOP-00318	EPA 8270D m
pH	1	2019/11/26	2019/11/27	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2019/11/27	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2019/11/27	CAM SOP-00464	EPA 375.4 m
Total Kjeldahl Nitrogen in Water	1	2019/11/27	2019/11/27	CAM SOP-00938	OMOE E3516 m
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	1	2019/11/29	2019/11/29	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2019/11/26	2019/11/27	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2019/11/28	CAM SOP-00228	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs 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.

Your P.O. #: BRM-ENV
Your Project #: HAM-801683-B0
Site Location: Guelph Line
Your C.O.C. #: 748565-01-01

Attention: Stephanie Hsia

exp Services Inc
80 Bancroft St
Hamilton, ON
CANADA L8E 2W5

Report Date: 2019/12/02
Report #: R5988366
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9X2504
Received: 2019/11/25, 15:38

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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

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

BV Labs Job #: B9X2504
Report Date: 2019/12/02

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

HALTON SANITARY & COMBINED SEWER (2-03)

BV Labs ID				LKE047		
Sampling Date				2019/11/22 12:15		
COC Number				748565-01-01		
	UNITS	**Criteria**	**Criteria-2**	**MW102A**	**RDL**	**QC Batch**
Calculated Parameters						
Total Animal/Vegetable Oil and Grease	mg/L	150	-	2.8	0.50	6461299
Inorganics						
Total Carbonaceous BOD	mg/L	300	-	<2	2	6463111
Fluoride (F-)	mg/L	10	-	0.14	0.10	6464687
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	0.17	0.10	6465883
pH	pH	6.0:10.0	6.5:8.5	7.53		6464695
Phenols-4AAP	mg/L	1	-	<0.0010	0.0010	6465308
Total Suspended Solids	mg/L	350	-	68	10	6463397
Dissolved Sulphate (SO4)	mg/L	1500	-	210	1.0	6464645
Total Cyanide (CN)	mg/L	2	-	<0.0050	0.0050	6465786
Petroleum Hydrocarbons						
Total Oil & Grease	mg/L	-	-	2.8	0.50	6470121
Total Oil & Grease Mineral/Synthetic	mg/L	-	-	<0.50	0.50	6470157
Metals						
Total Aluminum (Al)	mg/L	50	-	1.3	0.1	6465796
Total Antimony (Sb)	mg/L	5	-	<0.02	0.02	6465796
Total Arsenic (As)	mg/L	1	-	<0.01	0.01	6465796
Total Beryllium (Be)	mg/L	5	-	<0.0005	0.0005	6465796
Total Cadmium (Cd)	mg/L	1	-	<0.002	0.002	6465796
Total Chromium (Cr)	mg/L	3	-	<0.01	0.01	6465796
Total Cobalt (Co)	mg/L	5	-	0.002	0.002	6465796
Total Copper (Cu)	mg/L	3	-	<0.01	0.01	6465796
Total Iron (Fe)	mg/L	50	-	2.5	0.02	6465796
Total Lead (Pb)	mg/L	3	-	<0.01	0.01	6465796
Total Manganese (Mn)	mg/L	5	-	0.75	0.001	6465796
Mercury (Hg)	mg/L	0.05	-	<0.0001	0.0001	6465404
Total Molybdenum (Mo)	mg/L	5	-	<0.005	0.005	6465796
Total Nickel (Ni)	mg/L	3	-	<0.005	0.005	6465796
Total Phosphorus (P)	mg/L	10	-	<0.05	0.05	6465796
Total Selenium (Se)	mg/L	5	-	<0.02	0.02	6465796
Total Silver (Ag)	mg/L	5	-	<0.01	0.01	6465796

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Halton Sanitary & Combined Sewer Bylaw (2-03)
Criteria-2: Halton Storm Sewer ByLaw

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

BV Labs Job #: B9X2504
Report Date: 2019/12/02

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

HALTON SANITARY & COMBINED SEWER (2-03)

BV Labs ID				LKE047		
Sampling Date				2019/11/22 12:15		
COC Number				748565-01-01		
	UNITS	**Criteria**	**Criteria-2**	**MW102A**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/L	5	-	<0.02	0.02	6465796
Total Titanium (Ti)	mg/L	5	-	0.026	0.005	6465796
Total Zinc (Zn)	mg/L	3	-	0.063	0.005	6465796
Polyaromatic Hydrocarbons						
Naphthalene	ug/L	140	-	<0.050	0.050	6468648
Volatile Organics						
Benzene	ug/L	10	-	<0.40	0.40	6449814
Chloroform	ug/L	40	-	<0.40	0.40	6449814
1,4-Dichlorobenzene	ug/L	80	-	<1.0	1.0	6449814
Ethylbenzene	ug/L	160	-	<0.40	0.40	6449814
Methylene Chloride(Dichloromethane)	ug/L	2000	-	<4.0	4.0	6449814
Tetrachloroethylene	ug/L	1000	-	62	0.40	6449814
Toluene	ug/L	16	-	<0.40	0.40	6449814
Trichloroethylene	ug/L	400	-	70	0.40	6449814
Surrogate Recovery (%)						
D10-Anthracene	%	-	-	111		6468648
D14-Terphenyl (FS)	%	-	-	97		6468648
D8-Acenaphthylene	%	-	-	98		6468648
4-Bromofluorobenzene	%	-	-	98		6449814
D4-1,2-Dichloroethane	%	-	-	101		6449814
D8-Toluene	%	-	-	98		6449814

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Halton Sanitary & Combined Sewer Bylaw (2-03)
Criteria-2: Halton Storm Sewer ByLaw

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BV Labs Job #: B9X2504
Report Date: 2019/12/02

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

TEST SUMMARY

BV Labs ID: LKE047
Sample ID: MW102A
Matrix: Water

Collected: 2019/11/22
Shipped:
Received: 2019/11/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Carbonaceous BOD	DO	6463111	2019/11/26	2019/12/01	Navjot Kaur Gill
Total Cyanide	SKAL/CN	6465786	2019/11/27	2019/11/27	Gnana Thomas
Fluoride	ISE	6464687	2019/11/26	2019/11/27	Surinder Rai
Mercury in Water by CVAA	CV/AA	6465404	2019/11/27	2019/11/27	Medhat Nasr
Total Metals Analysis by Axial ICP	ICPX	6465796	2019/11/27	2019/11/27	Archana Patel
Animal and Vegetable Oil and Grease	BAL	6461299	N/A	2019/11/29	Automated Statchk
Total Oil and Grease	BAL	6470121	2019/11/29	2019/11/29	Francis Afonso
PAH Compounds in Water by GC/MS (SIM)	GC/MS	6468648	2019/11/28	2019/11/29	Mitesh Raj
pH	AT	6464695	2019/11/26	2019/11/27	Surinder Rai
Phenols (4AAP)	TECH/PHEN	6465308	N/A	2019/11/27	Bramdeo Motiram
Sulphate by Automated Colourimetry	KONE	6464645	N/A	2019/11/27	Deonarine Ramnarine
Total Kjeldahl Nitrogen in Water	SKAL	6465883	2019/11/27	2019/11/27	Rajni Tyagi
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	6470157	2019/11/29	2019/11/29	Francis Afonso
Total Suspended Solids	BAL	6463397	2019/11/26	2019/11/27	Mandeep Kaur
Volatile Organic Compounds in Water	GC/MS	6449814	N/A	2019/11/28	Blair Gannon

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

BV Labs Job #: B9X2504
Report Date: 2019/12/02

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

GENERAL COMMENTS

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

Package 1	2.0°C

Sample LKE047 [MW102A] : VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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

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

BV Labs Job #: B9X2504
Report Date: 2019/12/02

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

			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
6449814	4-Bromofluorobenzene	2019/11/27	101	70 - 130	102	70 - 130	99	%				
6449814	D4-1,2-Dichloroethane	2019/11/27	96	70 - 130	91	70 - 130	94	%				
6449814	D8-Toluene	2019/11/27	100	70 - 130	99	70 - 130	94	%				
6468648	D10-Anthracene	2019/11/28	110	50 - 130	113	50 - 130	111	%				
6468648	D14-Terphenyl (FS)	2019/11/28	102	50 - 130	111	50 - 130	101	%				
6468648	D8-Acenaphthylene	2019/11/28	101	50 - 130	105	50 - 130	100	%				
6449814	1,4-Dichlorobenzene	2019/11/27	91	70 - 130	87	70 - 130	<0.50	ug/L	NC	30		
6449814	Benzene	2019/11/27	91	70 - 130	88	70 - 130	<0.20	ug/L	NC	30		
6449814	Chloroform	2019/11/27	90	70 - 130	86	70 - 130	<0.20	ug/L	NC	30		
6449814	Ethylbenzene	2019/11/27	92	70 - 130	90	70 - 130	<0.20	ug/L	NC	30		
6449814	Methylene Chloride(Dichloromethane)	2019/11/27	87	70 - 130	82	70 - 130	<2.0	ug/L	0.43	30		
6449814	Tetrachloroethylene	2019/11/27	87	70 - 130	85	70 - 130	<0.20	ug/L	0.31	30		
6449814	Toluene	2019/11/27	90	70 - 130	87	70 - 130	<0.20	ug/L	NC	30		
6449814	Trichloroethylene	2019/11/27	91	70 - 130	89	70 - 130	<0.20	ug/L	NC	30		
6463111	Total Carbonaceous BOD	2019/12/01					<2	mg/L	21	30	102	85 - 115
6463397	Total Suspended Solids	2019/11/27					<10	mg/L	NC	25	101	85 - 115
6464645	Dissolved Sulphate (SO4)	2019/11/27	111	75 - 125	102	80 - 120	<1.0	mg/L	2.1	20		
6464687	Fluoride (F-)	2019/11/27	112	80 - 120	102	80 - 120	<0.10	mg/L	0.99	20		
6464695	pH	2019/11/27			102	98 - 103			0.48	N/A		
6465308	Phenols-4AAP	2019/11/27	98	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20		
6465404	Mercury (Hg)	2019/11/27	94	75 - 125	99	80 - 120	<0.0001	mg/L	NC	20		
6465786	Total Cyanide (CN)	2019/11/27	95	80 - 120	99	80 - 120	<0.0050	mg/L	NC	20		
6465796	Total Aluminum (Al)	2019/11/27	NC	80 - 120	102	80 - 120	<0.1	mg/L	0.17	20		
6465796	Total Antimony (Sb)	2019/11/27	106	80 - 120	105	80 - 120	<0.02	mg/L	NC	20		
6465796	Total Arsenic (As)	2019/11/27	105	80 - 120	101	80 - 120	<0.01	mg/L	NC	20		
6465796	Total Beryllium (Be)	2019/11/28	102	80 - 120	100	80 - 120	<0.0005	mg/L				
6465796	Total Cadmium (Cd)	2019/11/27	104	80 - 120	102	80 - 120	<0.002	mg/L	NC	20		
6465796	Total Chromium (Cr)	2019/11/27	101	80 - 120	101	80 - 120	<0.01	mg/L	NC	20		
6465796	Total Cobalt (Co)	2019/11/27	97	80 - 120	100	80 - 120	<0.002	mg/L	NC	20		
6465796	Total Copper (Cu)	2019/11/27	99	80 - 120	99	80 - 120	<0.01	mg/L	NC	20		

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

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
6465796	Total Iron (Fe)	2019/11/28	NC	80 - 120	103	80 - 120	<0.02	mg/L				
6465796	Total Lead (Pb)	2019/11/27	97	80 - 120	102	80 - 120	<0.01	mg/L	NC	20		
6465796	Total Manganese (Mn)	2019/11/27	99	80 - 120	103	80 - 120	<0.001	mg/L	0.51	20		
6465796	Total Molybdenum (Mo)	2019/11/27	103	80 - 120	102	80 - 120	<0.005	mg/L	14	20		
6465796	Total Nickel (Ni)	2019/11/27	97	80 - 120	101	80 - 120	<0.005	mg/L	NC	20		
6465796	Total Phosphorus (P)	2019/11/27	105	80 - 120	103	80 - 120	<0.05	mg/L	8.5	20		
6465796	Total Selenium (Se)	2019/11/27	105	80 - 120	103	80 - 120	<0.02	mg/L	NC	20		
6465796	Total Silver (Ag)	2019/11/27	100	80 - 120	100	80 - 120	<0.01	mg/L	NC	20		
6465796	Total Tin (Sn)	2019/11/27	101	80 - 120	103	80 - 120	<0.02	mg/L	NC	20		
6465796	Total Titanium (Ti)	2019/11/27	103	80 - 120	101	80 - 120	<0.005	mg/L	7.3	20		
6465796	Total Zinc (Zn)	2019/11/27	103	80 - 120	107	80 - 120	<0.005	mg/L	16	20		
6465883	Total Kjeldahl Nitrogen (TKN)	2019/11/27	99	80 - 120	102	80 - 120	<0.10	mg/L	3.0	20	98	80 - 120
6468648	Naphthalene	2019/11/28	100	50 - 130	87	50 - 130	<0.050	ug/L	NC	30		
6470121	Total Oil & Grease	2019/11/29	92	75 - 125	97	85 - 115	<0.50	mg/L	23	25		
6470157	Total Oil & Grease Mineral/Synthetic	2019/11/29	87	75 - 125	95	85 - 115	<0.50	mg/L	NC	25		

N/A = Not Applicable

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

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

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

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

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

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

NC (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).

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

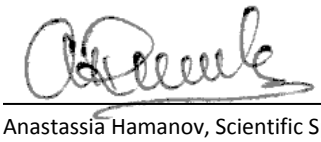
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9X2504
Report Date: 2019/12/02

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

VALIDATION SIGNATURE PAGE

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



Anastassia Hamanov, Scientific Specialist

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

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Report Date: 2019/12/02

exp Services Inc
Client Project #: HAM-801683-B0
Site Location: Guelph Line
Your P.O. #: BRM-ENV
Sampler Initials: SG

Exceedence Summary Table – Halton Sanitary Sewer

Result Exceedences

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	Units
No Exceedences						

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

Exceedence Summary Table – Halton Storm Sewer

Result Exceedences

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	Units
No Exceedences						

The exceedence 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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CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#17493 exp Services Inc	Company Name:		Quotation #:	B91716	BV Labs Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Stephanie Hsia	P.O. #:	~~HAM-ENV~~ BRM-ENV		748565
Address:	80 Bancroft St Hamilton ON L8E 2W5	Address:		Project:	HAM-801683-B0	COC #:	Project Manager:
Tel:	(905) 573-4000 Fax:	Tel:	Fax:	Project Name:		C#748565-01-01	Christine Gripton
Email:	denise.vedell@exp.com, elizabeth.reyes@exp.com; Kar	Email:	stephanie.hsia@exp.com	Site #:	Guelph Line		
				Sampled By:	SG		

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

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☑ Sanitary Sewer Bylaw ☐ Reg 558 ☑ Storm Sewer Bylaw ☐ MISA Municipality Halton ☐ PWQO ☐ Other	

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	Halton Sanitary & Combined Sewer (2-03)								# of Bottles	Comments
1		MW102A	19/11/22	1215PM	GW		✓								14	
2																
3																
4																
5																
6																
7																
8																
9																
10																

25-Nov-19 15:38
Christine Gripton
B9X2504
KVG ENV-1107

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only			
Andy Chen	19/11/25	11:00am	[illegible]	2019/11/25	15:38		Time Sensitive	Temperature (°C) on Recei 6/3/3	Custody Seal Present ✓ Intact	Yes ✓ / No

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

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

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

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

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Appendix E – Construction Flow Rate Calculations

APPENDIX E: Construction Dewatering Calculations

418 & 422 Guelph Line, Burlington, ON
BRM-00801683-B0

Table E-1: Flow all Sides of the Excavation

Parameters	Symbols	Unit	Value
Ground Elevation	-	m Local	99.0 - 101.5
Highest Groundwater Elevation	-	m Local	98.50
Lowest Footing Elevation		m Local	91.50
Dewatered Elevation Target	-	m Local	90.50
Top of the Water-Bearing Zone	-	m Local	98.50
Base of the Water-Bearing Zone	-	m Local	89.50
Height of Water Table Above the Base of Water-Bearing Zone	**H**	m	9.00
Height of Dewatering Target Above the Base of Water-Bearing Zone	**h_w**	m	1.00
Hydraulic Conductivity	**K**	m/s	1.30E-05
Length of Excavation	-	m	70.00
Width of Excavation	-	m	50.00
Method to Calculate Radius of Influence	-	-	**Sichardt**
Radius of Influence from Sides of Excavation	**Ro**	m	86.53
Distance to Linear Source from Sides of excavation	**Lo=Ro/2**	m	43.27
Dewatering Flow Rate (unconfined linear flow component)	**Q**	m^3/day	249.22
Factor of Safety	**FS**	-	2.00
Dewatering Flow Rate (multiplied by factor of safety)	**Q.FS**	m^3/day	498.43
Precipitation Event	-	mm/day	15
Volume from Precipitation	-	m3/day	**52.5**
Dewatering Flow Rate **Without Safety Factor** (including rainwater collection)	-	m3/day	**300**
Dewatering Flow Rate **With Safety Factor** (including rainwater collection)	-	m3/day	**550**

Notes:

mASL - meters above sea level

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

$$Q_w = Kx\frac{H^2 - {h_w}^2}{L_o}$$

(Based on the Dupuit Equation)

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)

L_o=Distance of Influence (m)

x=Length of excavation (m)