15450 Woodbine Avenue, Stouffville, ON

Hydrogeological Investigation

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by Galatia Lane Estates Inc. to prepare a Hydrogeological Investigation Report associated with the proposed development located at 15450 Woodbine Avenue, Stouffville, Ontario (hereinafter referred to as the 'Site').

The Site is rectangular in shape and is currently under agricultural (cropped fields) land use. It is our understanding that the proposed development plan will consist of a one (1) storey industrial building with associated paved parking, loading areas as well as an outdoor storage yard. An access road will be situated along the north end of the Site connecting the industrial building with Woodbine Avenue to the east. The Site location plan is shown on Figure 1.

EXP previously conducted a Preliminary Geotechnical Investigation in 2021 for this and the adjacent property at 15374 Woodbine Avenue. The pertinent information gathered from the noted investigations is utilized for this report.

1.2 Project Objectives

The main objectives of the Hydrogeological Investigation are as follows:

- Establish the local hydrogeological settings within the Site;
- Provide Preliminary recommendations on construction and long-term dewatering;
- Assess groundwater quality; and
- Prepare a Hydrogeological Investigation Report.

1.3 Scope of Work

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

- Review available geological and hydrogeological information for the Site;
- Eleven (11) boreholes will be advanced to depths ranging from 3 to 6 m below ground surface (mbgs), all with 50 mm diameter monitoring wells and 3 m screen sections installed. In particular:
  - Five (5) monitoring wells will be installed within the proposed building footprint to 6 mbgs;
  - Two (2) monitoring wells will be installed in the storage yard area to 6 mbgs;
  - One (1) monitoring well will be installed in the underground stormwater solution to 6 mbgs;
  - One (1) monitoring well will be installed in the access road between the site and Woodbine Avenue to 6 mbgs; and,
  - Two (2) monitoring wells will be installed in the raised septic bed area to 3 mbgs.
- Develop and conduct Single Well Response Tests (SWRT) on five (5) monitoring wells to evaluate hydraulic properties of the saturated soils at the Site at the proposed depth of the building foundations;
- Complete three (3) rounds of in field groundwater level measurements in all monitoring wells;
- Install dataloggers in five (5) selected monitoring wells to conduct a twelve month water level monitoring program;
- Collect one (1) groundwater sample for laboratory testing of the Town of Whitchurch-Stouffville and Region of York Sanitary and Storm Sewer By-Law parameters;

- Conduct infiltration testing on the two (2) shallow monitoring wells installed in the area of the proposed leaching beds at the Site;
- Evaluate the information collected during the field investigation program, including borehole geological information, Water Well Records (WWR), SWRT results, groundwater level measurements and groundwater water quality;
- Prepare site plans, cross sections, geological mapping and groundwater contour mapping for the Site;
- Provide preliminary recommendations on the requirements for short term construction dewatering;
- Provide recommendations on the Ministry of Environment, Conservation and Parks (MECP) Water Taking Permits and Region of York Sewer Discharge Agreements (SDA) for the construction and post-construction phases;
- Prepare a Hydrogeological Investigation Report.

The Hydrogeological Investigation was prepared in accordance with the Ontario Water Resources Act, and Ontario Regulation 387/04.

1.4 Review of Previous Reports

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

- EXP Services Inc. (2021-06-17). Preliminary Geotechnical Investigation, Proposed Residential Development, 15374 and 15450 Woodbine Avenue, Gormley, Ontario.
- EXP Services Inc. (2021-06-17). Phase II Environmental Site Assessment, 15374 and 15450 Woodbine Avenue, Gormley, Ontario.

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is within a physiographic region known as the Oak Ridges Moraine (Chapman & Putnam, 2007). The Oak Ridges Moraine is characterized as rolling sandy hills, hummocky topography and closed depressions that form the source of the headwaters to major streams (consisting of primarily surficial sand and gravel deposits) that slopes gently towards Lake Ontario (LSRCA 2010 – West Holland River Subwatershed Management Plan).

2.1.2 Regional Geology and Hydrogeology

Regionally, the Site is located in a region where the surficial/quaternary geology comprises of stone-poor, carbonate-derived silty to sandy till and coarse textured (Foreshore-basinal) glaciolacustrine deposits (Ministry of Northern Development and Mines, 2012 from ORMGP, 2022). The surficial geology of the Site and surrounding areas is shown on Figure 2.

Based on the available regional geology maps, the subsurface stratigraphy of the Site from top to bottom is summarized in Table 2-1 (Oak Ridge Moraine Groundwater Program (ORMGP, 2022). The overburden thickness is approximately 149 to 156 m (ORMGP, 2022). The surface elevation at the Site is relatively flat ranging from 278.1 to 282.5 metres above sea level (masl) from the borehole logs.

Table 2-1: Summary of Subsurface Stratigraphy

Stratigraphic Unit	General Description	Top Elevation of Stratigraphic Unit
Halton Till or Equivalent (Aquitard)	This lithologic unit typically consists of sandy silt to clayey silt till interbedded with silt, clay, sand and gravel.	306 to 307 masl
Oak Ridges Moraine or Equivalent (Aquifer)	This geology unit mainly consists of interbedded fine-grained sand and silt deposits where coarse-grained sand and gravel along with clay laminae are locally reported.	Not mapped
Newmarket Till (Aquitard)	This lithologic unit mainly consist of a massive and dense silty sand unit.	300 to 305 masl
Thorncliffe Formation (Aquifer)	This geology formation generally consists of glaciofluvial (sand, silty sand) or glaciolacustrine deposits (silt, sand, pebbly silt and clay).	253 to 255 masl
Sunnybrook Formation (Aquitard)	This lithologic unit was deposited near an ice sheet. It predominately consists of silt and clay.	192 to 194 masl
Scarborough Formation (Aquifer)	This geology unit is interpreted as deposits of a fluvial-deltaic system fed by large, braided melt-water rivers draining from an ice sheet. It consists of peat and sand overlaying silt and clay deposits.	178 to 180 masl
Blue Mountain Formation	Bedrock primarily consists of dark-grey to black shale with thin interbeds of limestone and calcareous siltstone. It belongs to the Ordovician Age, (Ministry of Northern Development and Mines, 2012).	152 to 154 masl

Regional groundwater across the area typically flows north, towards a tributary of Bogart Creek and the Holland River (East Branch), which eventually flows north towards Lake Simcoe. 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 existing subsurface infrastructure or dewatering activities.

2.1.3 Existing Water Well Survey

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

The MECP WWR database indicates that thirteen (13) well records within a 500 m radius from the Site boundary (Figure 3 and Appendix A).

None of the water well records were identified on the Site.

The database indicates that the offsite well records are at an approximate distance of 99 m or greater from the Site boundary. All offsite wells were reportedly identified as water supply well (2), monitoring and observation wells or test holes (3), abandoned and/or listed with unknown use (8).

The reported water level was found at depths ranging from 0.7 to 19.6 meters below ground surface (mbgs).

The two (2) off site water supply wells (ID 6907632 and 6907633) were reported in the Study area of the Site, each at a distance of 99 m (Figure 3). These wells were installed between 1946 and 1950. The property in the area of these water supply appears to be recently developed and is likely municipally serviced. However, the current status of these wells identified is not known, and the well abandonment records do not reference the water supply records or are consistent with the casing depth referenced. It is unlikely that the zone of influence from the shallow construction dewatering activities at the Site will affect the water takings in the surrounding area.

2.1.4 Wellhead Protection Areas (WHPA)

The Site was evaluated for groundwater source protection, well head protection, and aquifer vulnerability from Ontario Source Protection Information Atlas 2021 prepared by the MECP.

The Site is entirely located within the Lake Simcoe and Couchiching/Black River Source Protection Area (SPA). The Site is located in the area administered by the Lake Simcoe Region Conservation Authority (LSRCA) along with its neighbouring Conservation Authorities, are committed to preventing initial contamination of upstream source water including streams, lakes or underground aquifers from contaminating land use activities and de-icing activities. Reducing these activities would result in reduced downstream treatment requirements.

Well Head Protection Areas (WHPA) are areas that are identified as under the influence of significant groundwater use for drinking water supplies and where potential for influence from surface activities may directly impact the groundwater quality. The Site is not located within a Wellhead Protection Area (Appendix B).

The Site is not located within an area identified as “Highly Vulnerable Aquifers” as identified in the Ontario Source Protection Information Atlas 2021 prepared by the MECP (Appendix B). Nor is the Site located within an area identified as Groundwater Under Direct Influence (GUDI) (Appendix B).

Based on Schedule “I” of the Official Plan from the Town of Whitchurch Stouffville, the Site is not located any identified areas of high or low aquifer vulnerability (Appendix B).

The Site is not located within any areas of identified surface water vulnerability, however these areas do exist southwest of the Site, with a vulnerability score of 4 to 7.9 (Appendix B). The area appears to overlap with areas of Intake Protection Zone (IPZ) 3, located southwest of the Site (Appendix B).

The Site is located within a Significant Groundwater Recharge Area (SGRA) on the south to southeast portions of the Site, with scores of 2 to 4 (Appendix B). The groundwater in this area and its discharge supports cold water streams and wetlands that feed the ecological features. Management of groundwater in this area is considered paramount to the health of ecosystems. Management of surface activities that would minimize impacts on surface runoff and shallow groundwater would be an asset to the site development.

2.2 Site Setting

2.2.1 Site Topography

The Site is in a rural land use setting. The topography is gradually sloping to the south towards Lake Ontario.

As indicated on the borehole logs included in Appendix C, the surface elevation of the Site ranges between approximately 300. 43 to 309.44 masl from the borehole logs.

2.2.2 Local Surface Water Features

The Site is within the Lake Simcoe watershed (LSRCA, 2017). No surface water features exist onsite. The nearest surface water feature is a tributary of Bogart Creek, which is located approximately 195 m southwest of the Site.

2.2.3 Local Geology and Hydrogeology

A summary of subsurface soil stratigraphy is provided in the following paragraphs. The soi descriptions are summarized for the hydrogeological interpretations. As such, the information provided in this section shall not be used for construction design purposes.

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

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

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

FILL

Fill was encountered surficially in in all boreholes. The fill generally comprised of sandy silt to silt materials, with trace to some clay and intermittent sand seams. Trace organics and rootlets were encountered in the fill materials, and it was noted to be dark brown and in a moist condition. The fill extended from surface to depths of up to 5.4 mbgs.

SAND

Sand was encountered beneath the fill at boreholes BH210 and BH211 to depths of 3.8 to 4.4 mbgs (termination depth of BH211). The sand layer was generally found to be brown and in a moist condition.

SILTY SAND

A silty sand layer was encountered beneath the fill in borehole BH208 to a depth of 1.5 mbgs. The silty sand was found to be brown and in a moist condition.

CLAYEY SILT

A clayey silt layer was encountered beneath the fill in boreholes BH201, BH204 and BH207 to depths in the range of 3.0 to 6.1 mbgs. The clayey silt included occasional sand pockets and was found to be in a grey and saturated condition.

SILT

A silt layer was encountered in all boreholes (except borehole BH211), either beneath the fill layer (in boreholes BH202, BH203, BH205, BH206), beneath the silty sand (in borehole BH208) or below the clayey silt (in boreholes BH201, BH204 and BH207) to terminations depths in the range of 4.4 to 8.3 mbgs. Trace to some clay, and trace sand and gravel were occasionally encountered in the silt layer. The silt was brown to grey in colour, with grey soils encountered at depths of approximately 4.5 to 6.2 mbgs.

The borehole and monitoring well locations are shown on Figure 4. Geological cross-sections were generated based on the available borehole logs completed as part of the previous and current investigations and shown on Figures 5A and 5B (cross section A-A’ and cross section B-B’, respectively). The cross section shows a simplified representation of soil conditions and soil deposits may be interconnected differently than represented. Borehole logs used to generate the cross-sections are provided in Appendix C.

3 Results

3.1 Monitoring Well Details

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

- Nine (9) overburden monitoring wells (i.e. BH201 to BH209) were installed to depths ranging from 6.1 to 7.6 mbgs;

The diameter of all monitoring wells is 50 mm with 3.0m long well screens. All wells were installed with a above grade protective casing. Borehole logs and monitoring well installation details are provided in Appendix C. The monitoring well locations are shown on Figure 4.

3.2 Water Level Monitoring

As part of the Hydrogeological Investigation, static water levels in the monitoring wells installed January 2023 and were monitored on select dates from February 1 to March 2, 2023. The groundwater monitoring program will continue for a period of one-year. A summary of all static water level data as it relates to the elevation survey is given in Table 3-1 below.

Table 3-1: Summary of Measured Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (masl)	Well Depth (mbgs)	Depth	01-Feb-2023	02-Feb-2023	07-Feb-2023	21-Feb-2023	28-Feb-2023	02-Mar-2023
BH201	307.21	6.1	mbgs	-	Dry	-	4.66	3.50	3.24
			masl	-	N/A	-	302.55	303.71	**303.97**
BH202	300.43	6.1	mbgs	-	3.40	3.15	1.69	1.97	1.73
			masl	-	297.03	297.28	298.74	298.46	298.70
BH203	307.48	7.6	mbgs	Dry	-	-	Dry	Dry	Dry
			masl	N/A	-	-	N/A	N/A	N/A
BH204	309.44	7.6	mbgs	Dry	-	-	Dry	Dry	7.57
			masl	N/A	-	-	N/A	N/A	301.87
BH205	304.78	6.1	mbgs	Dry	-	-	2.51	5.53	2.71
			masl	N/A	-	-	302.27	299.25	302.07
BH206	308.76	7.6	mbgs	Dry	-	-	Dry	Dry	Dry
			masl	N/A	-	-	N/A	N/A	N/A
BH207	306.97	7.6	mbgs	Dry	-	-	Dry	Dry	Dry
			masl	N/A	-	-	N/A	N/A	N/A
BH208	302.02	6.1	mbgs	-	4.31	4.24	1.94	-	2.08
			masl	-	297.71	297.78	300.08	-	299.94
BH209	300.73	6.1	mbgs	5.68	-	-	3.61	3.81	3.79
			masl	295.05	-	-	297.12	296.92	296.94

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

'**green text**' – highest measured groundwater elevation

The groundwater elevation recorded in the monitoring wells after completion ranged from 296.92 masl (3.81 mbgs at BH209 on February 28, 2023) to 303.97 masl (3.24 mbgs at BH201 on March 2, 2023).

Figure 6 was created for the Site to show the shallow groundwater contours of the water levels recorded at the Site. Accordingly, the groundwater flow directions in the overburden wells on the Site are interpreted to flow towards the southwest. It should be noted that a groundwater divide exists at the eastern boundary of the Site, where groundwater east of the property boundary flows towards the east as identified in Borehole BH209 along the driveway to the Site.

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 groundwater flow. Seasonal groundwater level measurements should be conducted to provide additional information on seasonal groundwater level fluctuations.

3.3 Hydraulic Conductivity Testing

Single Well Response Tests (SWRT's) were completed on two (2) monitoring wells BH202 and BH208 on February 7, 2023 and on three (3) monitoring wells, BH201, BH205 and BH209 on March 2, 2023. 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 D.

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

Table 3-2: Summary of Hydraulic Conductivity Testing

Monitoring Well	Well Depth (mbgs)	Screen Interval (mbgs)		Soil Formation Screened	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH201	6.1	3.1	6.1	Silt	$3.1x10^{-7}$
BH202	6.1	3.1	6.1	Fill/Silt	$1.6x10^{-6}$
BH205	6.1	3.1	6.1	Fill/Silt	$6.6x10^{-8}$
BH208	6.1	3.1	6.1	Silt	$3.2x10^{-7}$
BH209	6.1	3.1	6.1	Sandy Silt Till	$7.5x10^{-9}$
				Geometric mean K Value	$3.2x10^{-7*}$

Notes:

1) '*' – The geomean value excludes BH209 as it is located outside the building footprint. However, the value is provided for informational purposes.

SWRTs provide K-estimates of the geological formation surrounding the well screens and may not be representative of bulk formation hydraulic conductivity. As shown in Table 3-2, the highest K-value of the tested water-bearing zone is $1.6x10^{-6}$ m/s at BH202, and the geometric mean of the overburden K-values is $3.2x10^{-7}$ m/s.

3.4 Groundwater Quality

To assess the suitability for discharging pumped groundwater into the sewers owned by the Region of York during dewatering activities, one (1) groundwater sample was collected from the monitoring wells in Borehole BH202 on February 28, 2023 using a peristaltic pump. The sample was labelled BH202. Prior to collecting the noted water sample, approximately three (3) standing well volumes of groundwater were purged from the referred well. The samples were collected unfiltered and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling. The groundwater samples were submitted for analysis to Bureau Veritas Laboratory (BV), a CALA certified independent laboratory in Mississauga, Ontario. Analytical results are provided in Appendix E.

Table 3-3 summarizes exceedance(s) of the Sanitary and Storm Sewer Use By-Law parameters and the PWQO.

Table 3-3: Summary of Analytical Results

Parameter	Units	Region of York Sanitary Sewer Discharge Limit	Region of York Storm Sewer Discharge Limit	PWQO	Concentration BH202 28-Feb-2023
Total Kjeldahl Nitrogen (TKN)	mg/L	100	1	-	**3.8**
Nonylphenol (Total)	mg/L	0.02	-	0.00004	*<0.001*
Bis(2-ethylhexyl)phthalate	ug/L	12	8.8	0.6	*<2.0*
Total PCB	ug/L	1	0.4	0.001	*<0.05*
Total Phosphorus (P)	ug/L	10,000	400	10	*<100*

Bold – Exceeds the Region of York Storm Sewer Discharge Limit.
Italics and underlined – RDL exceeds PWQO

When comparing the analytical results of the collected groundwater sample to the Region of York Sanitary Sewer discharge parameters there were no parameter exceedances.

When comparing the analytical results of the collected groundwater sample to the Region of York Storm Sewer discharge parameters the following parameters were reported with an exceedance: Total Kjeldahl Nitrogen (TKN).

The reporting detection limits (RDL) for the parameters tested were below the Sewer Use By-Law parameter criteria for Region of York Sanitary and Storm Sewer discharge.

When comparing the analytical results of the collected groundwater sample to the PWQO the following parameters were reported with an exceedance attributed to RDL exceeding in the criteria: Total Nonylphenols, Bis(2-ethylhexylphthalate), Total PCBs and Total Phosphorus. It should be noted the sample collected was for York Region Sewer discharge purposes, and is compared to PWQO as a preliminary assessment, however sample collection method and laboratory analyses may differ to meet PWQO objectives

For the short-term dewatering system (construction phase), it is anticipated that TSS levels in the pumped groundwater may become elevated and exceed both, Sanitary and Storm Sewer Use By-Law limits. To control the concentration of TSS, 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/dewatering contractor/process engineer

An agreement to discharge into the sewers owned by the Region of York will be required prior to releasing dewatering effluent. The treated water may also be discharged to the ground surface at the site upon approval by the Town of Whitchurch Stouffville and MECP or trucked off site for disposal at an appropriate facility.

3.5 Infiltration Testing

EXP completed two (2) infiltration tests (i.e. BH210 and BH211) within the proposed raised septic bed on February 7, 2023. Infiltration tests (IT) were performed at a depth of approximately 3.8 mbgs.

The stratigraphy of the shallow subsurface where the monitoring wells were screened for the infiltrating testing, comprised of sand in BH210 and of silty fill materials in BH211. Table 3-5 below summarizes the field saturated hydraulic conductivities (K-values) and design infiltration rates, as per the Low Impact Development (LID) Stormwater Management Planning and Design Guide, CVC – TRCA, 2010. The estimated field saturated K-values were correlated to infiltration rates based on the relationship provided in Table C2 (Appendix C) of the guideline.

Infiltration testing locations are shown on Figure 4.

Table 3-5: Summary of Infiltration Testing Results

Infiltration Test Location/ MW ID	Depth of Hole (mbgs)	Formation tested	Field Saturated Hydraulic Conductivity, K_{fs} (cm/s)	Measured Infiltration Rates (mm/hr)
BH210	3.8	Sand	6.0×10^{-4}	75
BH211	3.8	Fill	4.8×10^{-4}	70
Geometric Mean			5.4×10^{-4}	73
Design Infiltration Rate*				21

Notes:
*Safety Factor of 3.5 was applied to calculate the design infiltration rate (Low Impact Development (LID) Stormwater Management Planning and Design Guide, CVC – TRCA, 2010).

The estimated design infiltration rate based on percolation rate testing for the Site is 21 mm/hr. The results of infiltration tests completed are presented in Appendix F.

4 Dewatering Assessment

It is our understanding that the proposed development consists of an industrial building with no underground structures (slab-on-grade) and will be serviced with sewers, watermains and above ground parking (paved) areas. Based on information from the Client, it is assumed the proposed building floor slab will be at an elevation of 306.70 masl, while the west parking lot will be approximately 1.5 m below the floor slab (~305.20 masl).

To accommodate relatively dry and stable working conditions for on Site underground services installations (watermain and sewer systems) and proposed industrial building, the water levels will have to be lowered approximately 1 m below the bottom of lowest excavation. It is our understanding, that servicing will be completed using cut and cover technology and might require simultaneous construction dewatering / groundwater control. For the purpose of this assignment, it was assumed that a trench segment of approximately 30 m long, 5 m wide and 5 m deep will be opened for any servicing segment across the site at any given time.

Construction dewatering calculations for the proposed development are provided in Appendix G. Table 4-1 below presents the assumptions used to calculate the dewatering rates for services installations and buildings construction.

Table 4-1 East - Construction and Long Term Dewatering Estimate Assumptions

Input Parameter	Building	West Parking Lot	Servicing	Units	Notes
Ground Elevation	306.2	306.2	306.2	masl	Borehole elevations
Groundwater elevation	304.97	304.97	304.97	masl	The highest recorded groundwater elevation in these areas + 1 m for seasonal fluctuations (See Figure 6)
Number of Subgrade Levels	None	-	-	-	Based on information provided.
Top of Lowest Slab Elevation	306.70	-	-	masl	Information provided by Client.
Lowest Footing Elevation/Service Excavation Depth	303.20	305.20	301.70	masl	Assumed to be approximately 3.5 m below proposed slab elevation for structure; Parking lot 1.5 m below slab and servicing 5 m below slab.
Construction Dewatering Elevation Target	302.20	304.20	300.70	masl	Assumed to be approximately 1.0 m below the lowest footing/excavation depth
Long Term Dewatering Elevation Target	306.20	-	-	masl	0.5 m below top of lowest slab
Bottom Elevation of Water-Bearing Zone	293	293	293	masl	Assumed from borehole logs.

Total Excavation Area	12,250 m^2	5,600 m^2	(30 x 5m) 150 m^2	m^2	Approximate building area from Natale Architect Inc (Oct. 24, 2022)
Hydraulic Conductivity (K)	$3.2x10^{-7}$	$3.2x10^{-7}$	$1.6 x10^{-6}$ to $3.2x10^{-7}$	m/s	Geomean K-value for overburden in area

4.1 Dewatering Flow Rate Estimate and Zone of Influence (Building Construction and West Parking Lot)

The Dupuit - Forcheimer equation for steady linear 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 (Appendix G Table G-1). Dewatering flow rate is expressed as follows:

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

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

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)

R_s=Sichardt Radius of Influence (m)

R_o=Radius of influence (m)

re=Equivalent perimeter (m)

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

4.2 Dewatering Flow Rate Estimate and Zone of Influence (Site Servicing)

The Dupuit equation for steady state linear flow to both sides of a site or servicing trench 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/s)
X = Length of excavation (m)
K = Hydraulic conductivity (m/s)
H = Hydraulic head beyond the influence of pumping (static groundwater elevation) (m)
h = Hydraulic head above the base of aquifer in an excavation (m)
Lo = Distance of influence (m)

It is expected that the initial dewatering rate will be higher to remove groundwater from within the overburden formation within the excavation area. 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.

4.3 Radius of Influence

4.3.1 Cooper-Jacob's

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

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

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

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

Based on Cooper-Jacob's formula, the calculated distance of influence (Lo = Ro/2) is provided in Appendix G Table G-1.

4.3.2 Sichardt's

The radius of influence (Rs) for the site servicing dewatering was calculated based on Sichardt's 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 linear flow dewatering equations, as discussed below.

The radius of influence (Rs) for the site servicing dewatering was calculated based on Sichardt's 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 radius of influence due to pumping is based on Sichardt's formula as follows:

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

Where:
Rs = Estimated Sichardt's radius of influence (m)
H = Hydraulic head in aquifer (static water level or saturated depth) (m)
h = Dynamic water level (m)
K = Hydraulic conductivity (m/sec)
C = Constant (3,000)

Based on Sichardt's formula and the highest K-value, the calculated distance of influence (Lo = Ro/2) is provided in Appendix G Table G-2.

4.4 Stormwater

Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. Therefore, the dewatering rates at the Site should also include removing stormwater from the excavation.

A 15 mm precipitation event was utilized for estimating the stormwater volume. The calculation of the stormwater volume is included in Appendix G Table G-1.

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

During precipitation events greater than 15 mm (ex: 100-year storm), measures should be taken by the contractor to retain stormwater onsite in a safe manner to not exceed the allowable water taking and discharge limits, as necessary. A one hundred (100) year storm event over a 24-hour period is 57.3mm, which would produce approximately 702,000 L/day for the Site building, 321,000 L/day for the West Parking Lot and 8,600 L/day for Site servicing segments.

4.5 Results of Dewatering Rate Estimates

4.5.1 Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed construction plans include the excavation of footings within the building extents and infrastructure on the Site. EXP should be retained to review the assumptions outlined in this section.

Short-term (construction) dewatering calculations are presented in Appendix G (Tables G-1 and G-2).

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

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

Table 4-2 Summary of Construction Dewatering Rate

Description	Building (L/day)	West Parking Lot (L/day)	Servicing (L/day)
Estimated Short Term Dewatering Rate (without safety factor or precipitation)	20,180	5,390	23,100 to 51,700
From Precipitation Event of 15 mm in one day	183,840	84,000	2,250

Description	Building (L/day)	West Parking Lot (L/day)	Servicing (L/day)
With Factor of Safety 2 (excluding precipitation) for permit	40,350	10,770	46,200 to 103,400
With Factor of Safety 2 (including precipitation) for designs, and budgeting	224,190	94,770	48,500 to 105,600
Radius of Influence from sides of excavation (m)	21	21	4 to 8

The maximum flow estimate is based on the geometric mean hydraulic conductivity, highest groundwater level plus one metre and a safety factor, and as such it provides a relatively conservative construction dewatering rate evaluation. The dewatering volumes estimated for construction dewatering should be considered as potential peak volumes and will likely decline over time. This peak dewatering flow rate also provides additional capacity for the dewatering contractor. The peak dewatering flow rates does not account for flow from utility beddings and variations in hydrogeological properties beyond those encountered during this investigation.

The actual dewatering volumes will vary over time subject to reaching steady state conditions, accumulation of precipitation, seasonal fluctuations in the groundwater table, flow from bedding materials of existing sewers, variation in hydrogeological properties beyond those encountered during this investigation, and construction sequence.

It is imperative to note that the contractors are solely responsible to ensure dry conditions are maintained within the excavation zone during the construction process at all costs. Safety measures must be considered when planning for construction, especially during the wet seasons. In the event of heavy rainfalls or snow melting seasons, it is advised to implement an appropriate drainage system to divert the storm water runoffs and maintain the excavation zone free of water.

To prevent trench bedding acting as preferential pathway for groundwater flow along the driveway for the Site, the use of 'trench plugs' in the granular around the pipe should be considered. Where the granular bedding is below water table, the typical spacing between the 'trench plugs' should be approximately 80 to 100 m along the full length of the trench.

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

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

The dewatering assumptions are based on using shoring system and/or open cuts with sloped excavations.

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

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

4.5.2 Post-Construction Dewatering Rate Estimate

It is our understanding that the proposed development is slab-on-grade with no subsurface structures and that long term dewatering is not required. Therefore, a long-term dewatering assessment is not warranted.

4.6 MECP Water Taking Permits

4.6.1 Short-Term Discharge Rate (Construction Phase)

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50,000 L/day but less than 400,000 L/day, then an online registration in the Environmental Activity and Sector Registry (EASR) with the MECP will be required. If groundwater dewatering rates onsite exceed 400,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

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

It is recognized that the maximum flow estimate calculated with an average K-value determined in the block area for lateral flow calculation and provides a conservative estimate to account for higher than expected flow rates during construction dewatering. The dewatering estimates including a safety factor and excluding precipitation is stated below. The MECP construction dewatering rate excludes the precipitation amount and is the rate used for the permit application. Based on the MECP construction dewatering a EASR would be required to facilitate the construction dewatering program of the Site if all the excavation work is completed concurrently.

Table 4-4: MECP Construction Dewatering Flow Rate

Scenario	Building - Flow Rate (L/day)	West Parking Lot (L/day)	Servicing (L/day)
MECP Construction Dewatering Flow Rate **With Safety Factor** of **2** (excluding rainwater collection)	40,350	10,770	46,200 to 103,400
TOTAL	97,360 to 154,520		

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

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

4.6.2 Long-Term Discharge Rate (Post Construction Phase)

It is our understanding that the proposed development is slab-on-grade with no subsurface structures and that long term dewatering is not required. Therefore, a long-term dewatering assessment is not warranted.

5 Assessment of Potential Impacts

Based on the findings of this report, an assessment of potential impacts of the proposed development is provided below.

5.1 Surface Water Resources

The Site is within the Lake Simcoe watershed (LSRCA, 2017). No surface water features exist onsite. The nearest surface water feature is a tributary of Bogart Creek, which is located approximately 195 m southwest of the Site.

The shallow dewatering system is designed to temporarily lower the water table and maintain relatively dry stable soil conditions in the completed excavation prior construction. The dewatering process is designed and controlled by the dewatering contractor to limit drawdown in areas away from the pumping system. The anticipated maximum theoretical zone of influence (ZOI) was calculated to be approximately 4 to 21 m from the sides of the excavation areas.

Based on the extent of zone of influence and the distance to the nearest surface water feature, impacts to surface water features are not anticipated.

5.2 Groundwater Resources

Well Records from the MECP Water Well Record (WWR) Database were reviewed to determine the presence and number of water supply wells within a 500 m radius of the Site boundaries. Given that water supply records exist within the 500 m buffer but at a distance of at least 99m, no shallow dewatering related impact on water supply wells is expected in the area.

Based on the relatively rural setting, it is understood that domestic wells might still be active. It is recommended to complete a door-to-door survey for all wells located within 500 m zone of the site, to confirm well uses in the area.

Given that the estimated hydraulic conductivity of the geological strata to a depth of approximately 6.1 m at the Site is relatively moderate and the depth of site excavations are expected to be shallow and limited and the dewatering related influence are also anticipated to be restricted to a limited depth and area. In general, no change in the overall direction of groundwater flow at the Site is expected as a result of temporary groundwater control activities during construction.

To prevent trench bedding acting as preferential pathway for groundwater flow at the Site the use of ‘trench plugs’ in the granular around the pipe along the driveway should be considered. Where the granular bedding is below water table, the

typical spacing between the 'trench plugs' should be approximately 80 to 100 m along the full length of the trench and at intersections.

5.3 Well Head Protection and Recharge Areas

The Site is not located within a WHPA.

The south and southeast portions of the Site are located within a SGRA area with scores of 2 to 4 (Appendix B). As construction dewatering and groundwater control activities are anticipated in the shallow subsurface less than 5 mbgs, it is unlikely that short-term dewatering related impacts are expected on the recharge areas within the Site. Consideration to infiltration of treated construction dewatering using EASR registered infiltration systems would off-set any temporary dewatering concerns to infiltration at the Site.

To mitigate the infiltration deficit in the post development scenario, installation of LIDs for roof top drainage water infiltration, where feasible, should be considered.

5.4 Identification of Vulnerable Areas

Based on LSRCA, Town of Whitchurch-Stouffville and MECP mapping available, the Site is not located within any areas identified as vulnerable aquifers, nor in any areas with identified surface water vulnerability or GUDI vulnerability (Appendix B).

5.5 Geotechnical Considerations

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

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

5.6 Point of Discharge

It is our understanding that the potential discharge from the dewatering system during the construction activities will be directed either to the environment or to municipal sewer system, if approved. As such, the quality of groundwater discharge will have to conform to the Region of York Sewer Use By-Law criteria and/or Provincial Water Quality Objectives (PWQO).

It is anticipated that levels of TSS and associated metals in the pumped groundwater may become elevated and may exceed the PWQO / York Region Sewer Use By-Law Criteria prior to discharge. During construction, a treatment system, such as settlement, filtration tanks or any other applicable treatment systems, will be required to lower sediment content in the dewatered effluent prior to discharge. A written approval to discharge the treated groundwater to the sewer system must be obtained from applicable agencies (ie. York Region, and/or LSRCA).

The specifications of the treatment system will need to be adjusted to the water quality by the treatment specialist/process engineer.

5.7 Quality Control and Conservation

It is our understanding that the potential effluent from the dewatering system during the construction might be released to the municipal sewer system or environments. As such, the quality of groundwater discharge is required to conform to the Region of York Sewer Use By-Law criteria and Provincial Water Quality Objectives (PWQO).

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

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

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

An agreement to discharge into the sewers owned by the York Region or LSRCA will be required prior to releasing dewatering effluent.

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

5.8 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.

6 Monitoring Program

To ensure that discharge meets the required standards, and the effects of the dewatering are not widespread, both water quantity and water quality of groundwater must be documented and monitored during the pre-construction, construction and post-construction periods. This will include both water quality and water quantity monitoring. The monitoring will confirm the zone of influence from the dewatering system, assist in documenting changes over the time and help to evaluate whether any changes are a result of construction dewatering.

During construction, the existing monitoring wells previously constructed and remain functional, can be used for water level monitoring purposes. Post construction monitoring of water levels and groundwater quality will be conducted again about 1 month after construction dewatering is completed. The monitoring results can be compiled and presented in a summary report that documents the work done, the results, any interference complaints and the mitigation completed.

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

The monitoring will include discharge monitoring at each point of discharge or for each batch discharge (should water be previously stored) prior release for turbidity, suspended solids (TSS), metals and inorganic parameters at the following frequency:

- once at initiation of construction dewatering;
- weekly for the first month of construction dewatering; and,
- monthly for the remainder of the dewatering period, if the results demonstrate that groundwater consistently meets the applicable standards.

This will be done at each discharge location. The field monitoring of TSS/turbidity will be completed daily for the first week of construction dewatering at each point of discharge prior to release. After correlation between on-site and laboratory TSS and turbidity, the results will be used along with future field monitoring results to determine discharge quality. Daily field monitoring of turbidity will continue until the end of construction dewatering along with sedimentation and erosion control observations. Should the future field turbidity results suggest unacceptable levels, additional confirmatory laboratory testing will be done and a mitigation strategy specific to the situation will be implemented (e.g. additional filtration etc.)

7 Conclusions and Recommendations

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

- MECP WWRs database indicates thirteen (13) water well records within a 500 m radius of the Site including two (2) water supply wells, three (3) monitoring/observation wells or test holes and eight (8) abandoned and/or listed with unknown use. The recorded water supply wells are approximately located at a distance of approximately 99 m from the Site boundary.
- Water supply wells may exist in the area. It is recommended to complete a door-to-door well survey for all wells located within a 500 m zone of the Site, to confirm water well uses in the area.
- The Site located in the physiographic region known as the Oak Ridges Moraine, characterized by rolling sandy hills, hummocky topography and closed depressions that form the source of the headwaters to major streams (consisting primarily of surficial sand and gravel deposits).
- The Site is entirely within the Lake Simcoe and Couchiching/Black River Source Protection Area (SPA). The Site is not located within any identified WHPA, areas of high or low aquifer vulnerability, surface vulnerability or GUDI, as identified in the MECP Source Protection Atlas or Whitchurch-Stouffville Official Plans. However, the south to southeast portions of the Site are identified as Significant Groundwater Recharge Areas (SGRA).
- The Site is located with the Lake Simcoe watershed. No surface water features exist on the Site. The nearest surface water body is a tributary of Bogart Creek, located approximately 195 m southwest of the Site.
- The main overburden soil type encountered during drilling was fill to depths of up to 5.4 mbgs, underlain by native deposits of sand, silty sand, clayey silt and/or silt to the depth of exploration.
- The groundwater elevation recorded in the monitoring wells after completion ranged from 296.92 masl (3.81 mbgs at BH209 on February 28, 2023) to 303.97 masl (3.24 mbgs at BH201 on March 2, 2023).
- The water level monitoring suggests the groundwater flow directions in the overburden wells on the Site are interpreted to flow towards the southwest. It should be noted a groundwater divide exists at the eastern boundary of the Site, and groundwater flow east of the site is towards the east.
- The highest measured K-value of the tested water-bearing zone is $1.6x10^{-6}$ m/sec. The geometric mean estimated bulk hydraulic conductivity (K) values is $3.2x10^{-7}$ m/s.
- Given that the estimated hydraulic conductivity of the geological strata to a depth of approximately 6.1 m at the Site is relatively moderate and the depth of site excavations are expected to be shallow and limited and the dewatering related influence are also anticipated to be restricted to a limited depth and area. In general, no change in the overall direction of groundwater flow at the Site is expected as a result of temporary groundwater control activities during construction.
- Based on the assumptions outlined in this report, the estimated total peak dewatering rate for proposed construction activities is approximately 224,190 L/day for construction of the Site building, 94,770 L/day for construction of the West Parking and 48,500 to 105,600 L/day for Site servicing segments. This is the rate which will be required for discharge to the municipal sewer system.
- The estimated peak MECP dewatering rate for proposed construction activities with an open cut or a lagging shoring system is estimated to be 40,335 L/day for construction of the Site building, 10,770 L/day for construction of the West Parking Lot and 46,200 to 103,400 L/day for Site servicing, based on assumptions in the report. As the total dewatering flow rate estimate (97,630 to 154,520 L/day) is less than 400,000 L/day, a EASR would be required to facilitate the construction dewatering program for the Site based on the assumptions used. Sequential construction of site services and foundations would reduce the overall dewatering requirements for the Site based on the assumptions used.
- No long-term dewatering is anticipated for the proposed development.

- To prevent trench bedding from acting as preferential pathway for groundwater flow at the Site, the use of 'trench plugs' in the granular around the pipe should be considered. Where the granular bedding is below water table, the typical spacing between the 'trench plugs' should be approximately 80-100 m along the full length of the trench.
- When comparing the analytical results of the collected groundwater sample to the Region of York Sanitary Sewer discharge parameters there were no parameter exceedances.
- When comparing the analytical results of the collected groundwater sample to the Region of York Storm Sewer discharge parameters the following parameters were reported with an exceedance: Total Kjeldahl Nitrogen (TKN).
- When comparing the analytical results of the collected groundwater sample to the PWQO the following parameters were reported with an exceedance attributed to RDL exceeding in the criteria: Total Nonylphenols, Bis(2-ethylhexylphthalate), Total PCBs and Total Phosphorus.
- For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed both, Sanitary and Storm Sewer Use By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.
- The potential discharge from the dewatering system during the construction will be directed either to the municipal sewer system or to the environment. As such, the quality of groundwater discharge will have to conform to the applicable Provincial Water Quality Objectives (PWQO) and / or the York Region Sewer Use By-Law Criteria.
- For discharge to be directed to the natural environment, the turbidity of the effluent should be below 8 NTU within 30 m of surface water body and Total Suspended Solids (TSS) below 25 mg/L. Therefore, the continuous monitoring of TSS and turbidity of the discharge is recommended during construction dewatering.
- To ensure that discharge meets the required standards, and the effects of the dewatering are not widespread, both water quantity and water quality of groundwater must be documented and monitored during the pre-construction, construction and post-construction periods.
- A monitoring and mitigation plan is presented. The monitoring will confirm the zone of influence from the dewatering system(s), assist in documenting changes over the time and help to evaluate whether any changes are a result of construction dewatering.
- As per the MECP technical requirement for PTTW and EASRs, the geotechnical assessment of the stability of the soils due to water taking (ex: settlement, soil loss, subsidence etc.) is required. The water taking should not have unacceptable interference on soils and underground structures (foundations, utilities etc.). A letter related to geotechnical issues as it pertains to the Site is required to be completed under a separate cover.
- The EASR, Discharge Plan, hydrogeological investigation report, and geotechnical assessment of settlements must also be available at the construction Site during the entire construction dewatering. Altogether, the hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitute the Water Taking Plan which needs to be available onsite during the construction dewatering.
- The construction dewatering and long-term estimate of sub-drain discharge volumes is based on the assumptions outlined in this report. Any variations in hydrogeological conditions beyond those encountered as part of this preliminary investigation may significantly influence the discharge volumes.
- In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

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

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.

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

Sincerely,

EXP Services Inc.

Rachel Baldwin, M.Sc., P. Geo.
Hydrogeologist
Earth and Environmental Group

Robert Ferris, P. Geo.,
Senior Environmental Scientist/Hydrogeologist
Earth and Environmental Group

9 References

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- Oak Ridges Moraine Conservation Plan (2002);
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- Town of Whitchurch Stouffville Official Plan (WSOP) (2020) – Low and High Aquifer Vulnerability (Schedule “I”) and Wellhead Protection Zones (Schedule “K”);
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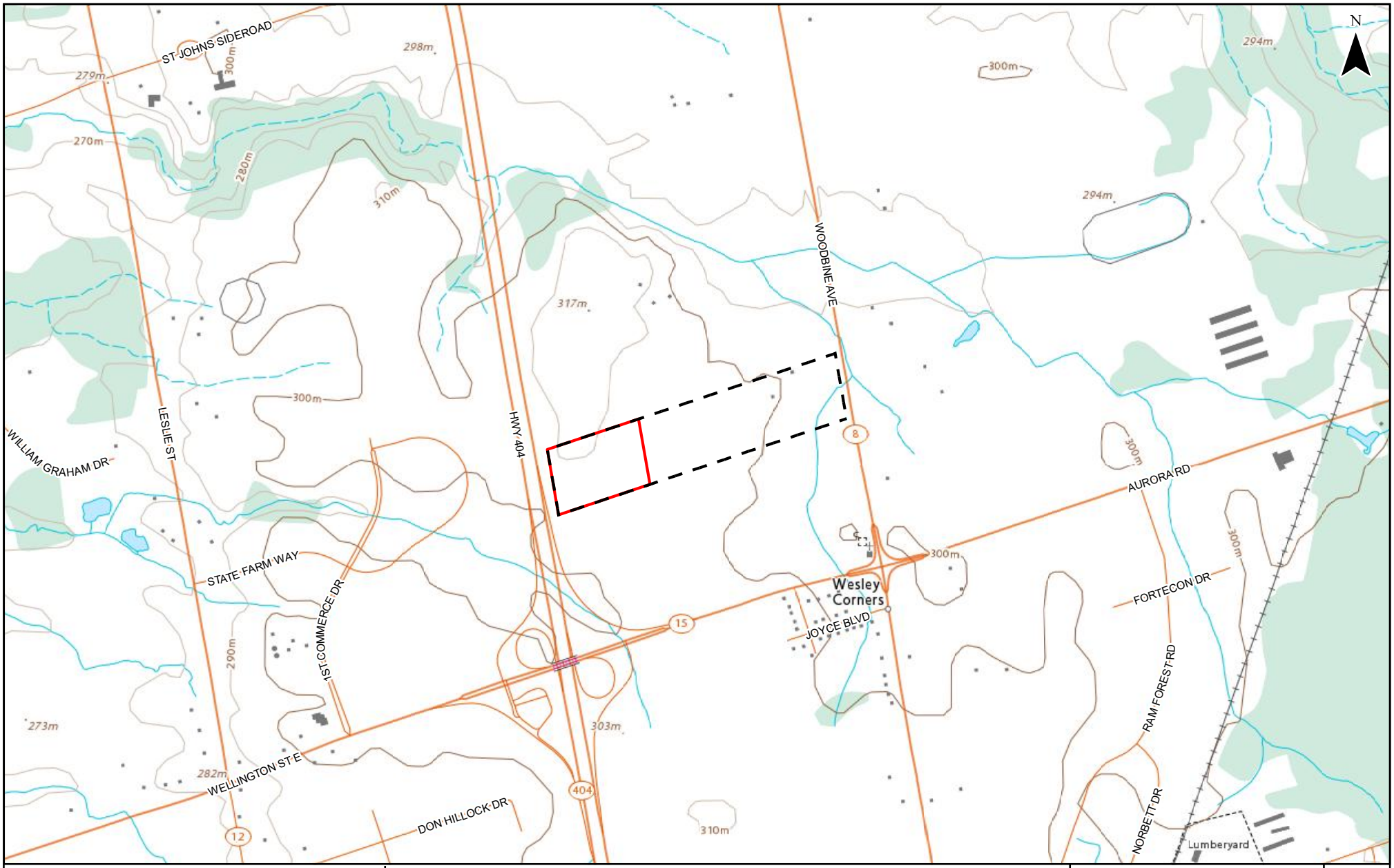
Figures



SCALE:

0 150 300 450 600 750 m

LEGEND:

APPROXIMATE SITE BOUNDARY

PROPERTY BOUNDARY

exp.

DRAWN BY:	CHECKED BY:
AC	RF

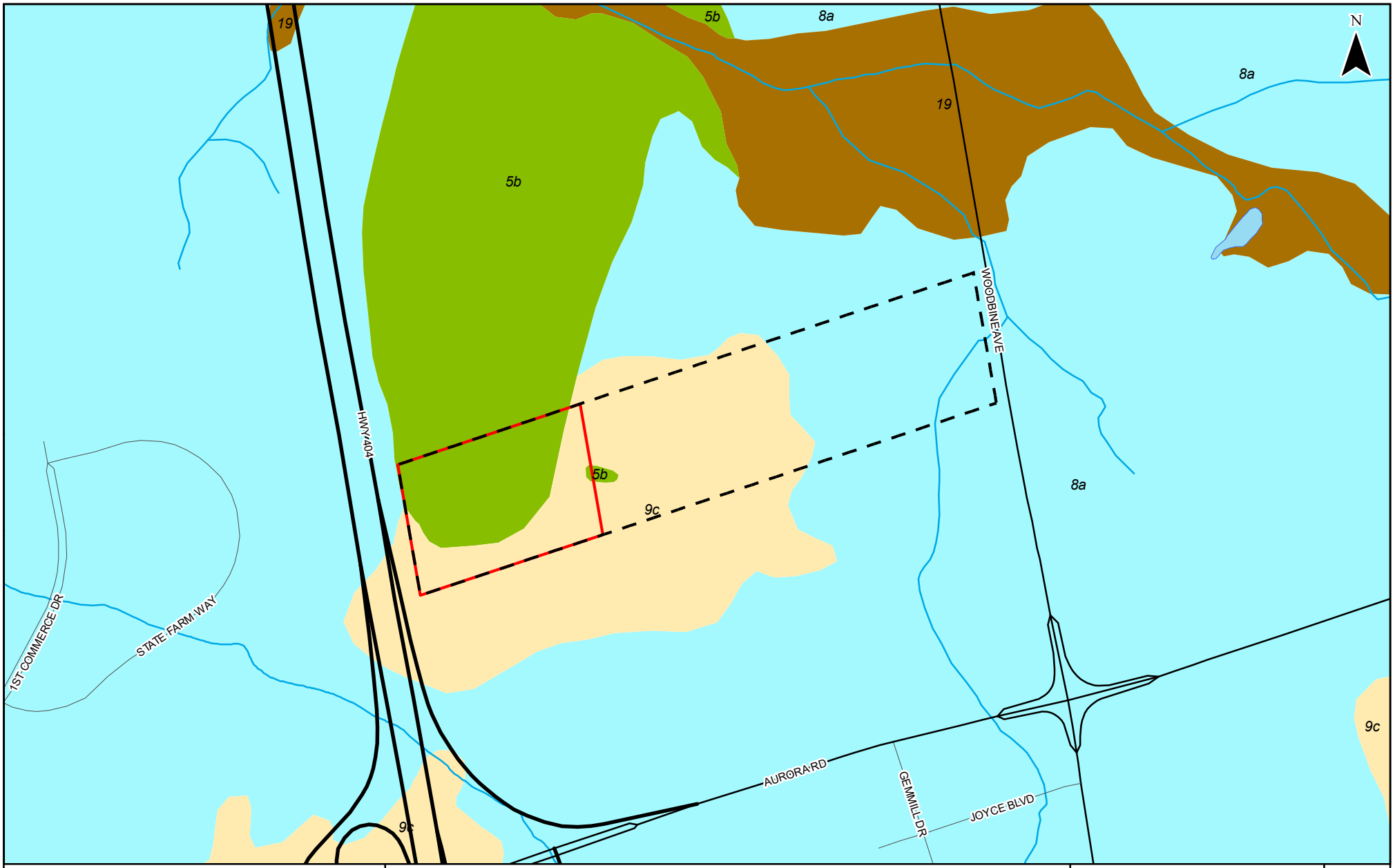
SITE LOCATION PLAN

FIGURE: 1

HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NUMBER: BRM-21010864-C0

DATE: JANUARY 2023



SCALE:

0 100 200 300 400 500 m

SOURCE:

BASED ON ONTARIO GEOLOGICAL SURVEY DATA PUBLISHED IN 2010

exp.

DRAWN BY:	CHECKED BY:
AC	RF

LEGEND:

- APPROXIMATE SITE BOUNDARY
- PROPERTY BOUNDARY
- 19: MODERN ALLUVIAL DEPOSITS
- 9C: COARSE-TEXTURED (FORESHORE-BASINAL) GLACIOLACUSTRINE DEPOSITS
- 8A: FINE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- 5B: STONE-POOR, CARBONATE-DERIVED SILTY TO SANDY TILL

SURFICIAL GEOLOGY

FIGURE: 2

HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NUMBER: BRM-21010864-C0

DATE: JANUARY 2023

SCALE:
0 100 200 300 400 500 m

SOURCE:
BASED ON GOOGLE EARTH IMAGERY DATED 2022,
AVAILABLE WELL RECORD INFORMATION AS OF MARCH 2021

exp.

DRAWN BY:	CHECKED BY:
AC	RF

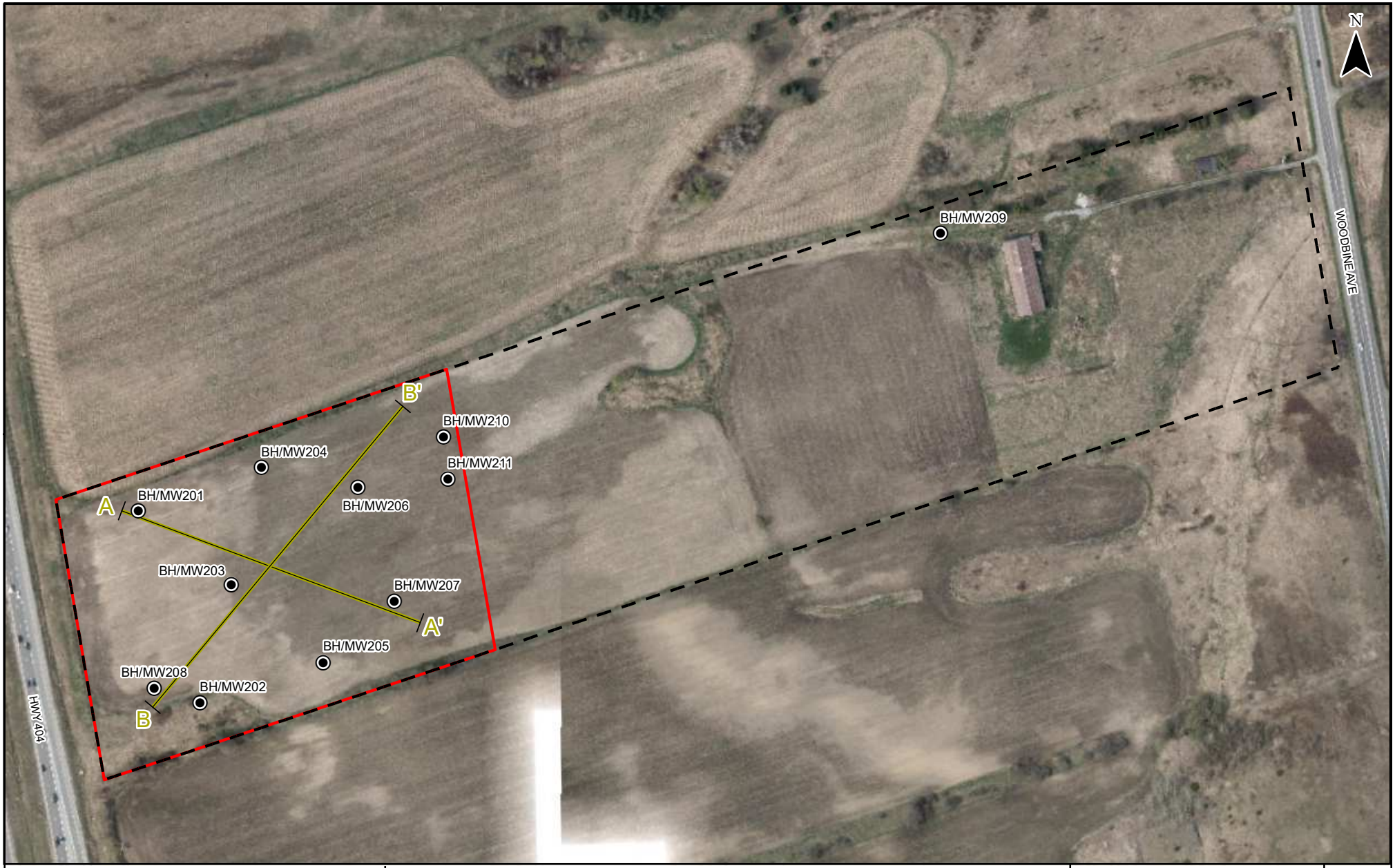
LEGEND:
- MONITORING WELL / TEST HOLE
- WATER SUPPLY WELL
- ABANDONED WELL
- UNCLASSIFIED / UNFINISHED WELL
- APPROXIMATE SITE BOUNDARY
- PROPERTY BOUNDARY
- 500 m ZONE

MECP WATER WELL RECORDS MAP

FIGURE: 3

HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NUMBER: BRM-21010864-C0 | DATE: JANUARY 2023



SCALE:

0 40 80 120 160 200 m

LEGEND:

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

exp.

DRAWN BY:	CHECKED BY:
AC	RF

BOREHOLE / MONITORING WELL LOCATION PLAN

FIGURE: 4

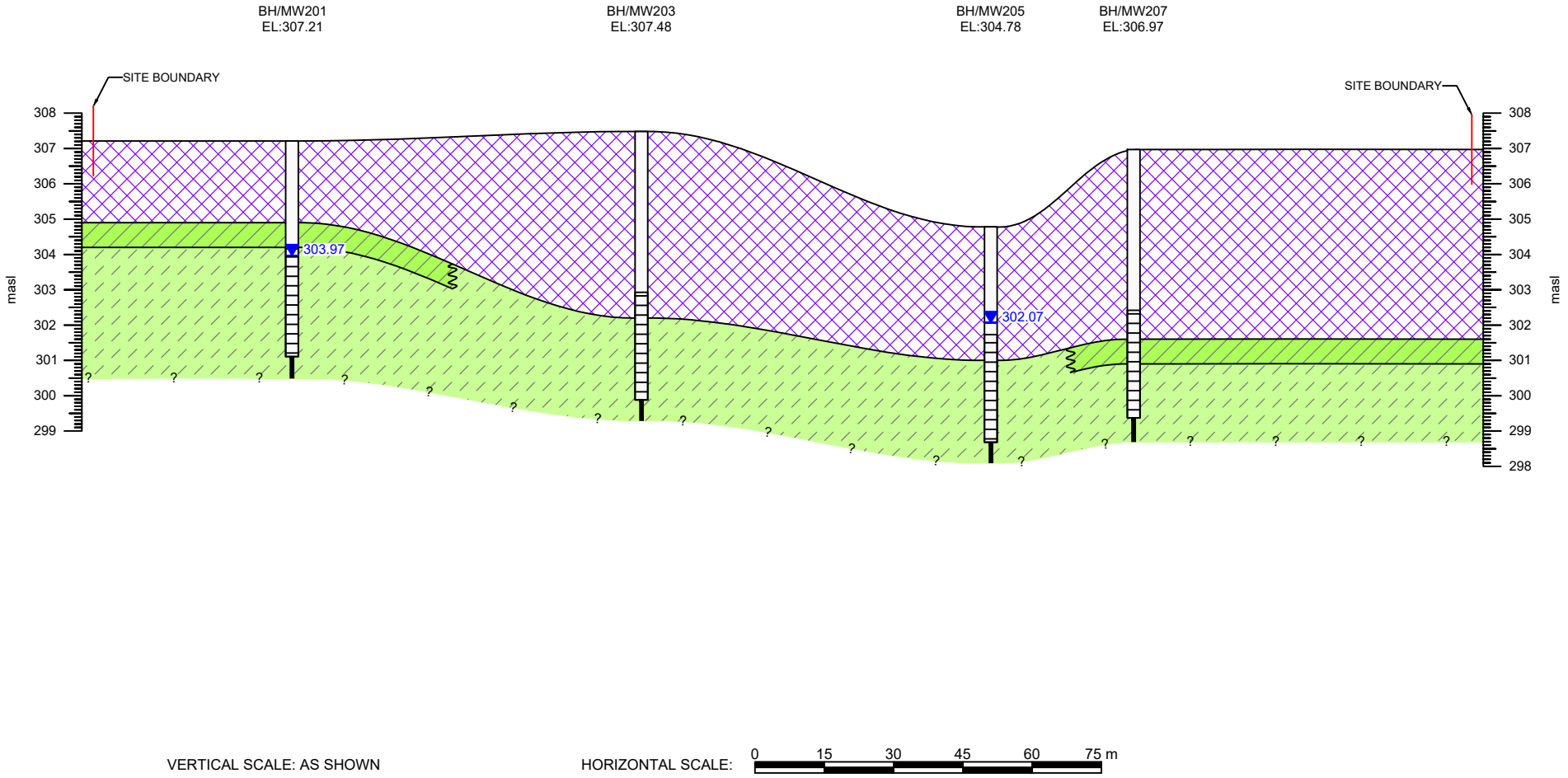
HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NUMBER: BRM-21010864-C0

DATE: JANUARY 2023

A
NORTHWEST

A'
SOUTHEAST



VERTICAL SCALE: AS SHOWN

HORIZONTAL SCALE: 0 15 30 45 60 75 m

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

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

LEGEND:
- FILL
- CLAYEY SILT
- SILT

GROUNDWATER ELEVATION (masl) AS MEASURED ON MARCH 2, 2023

TITLE AND LOCATION:

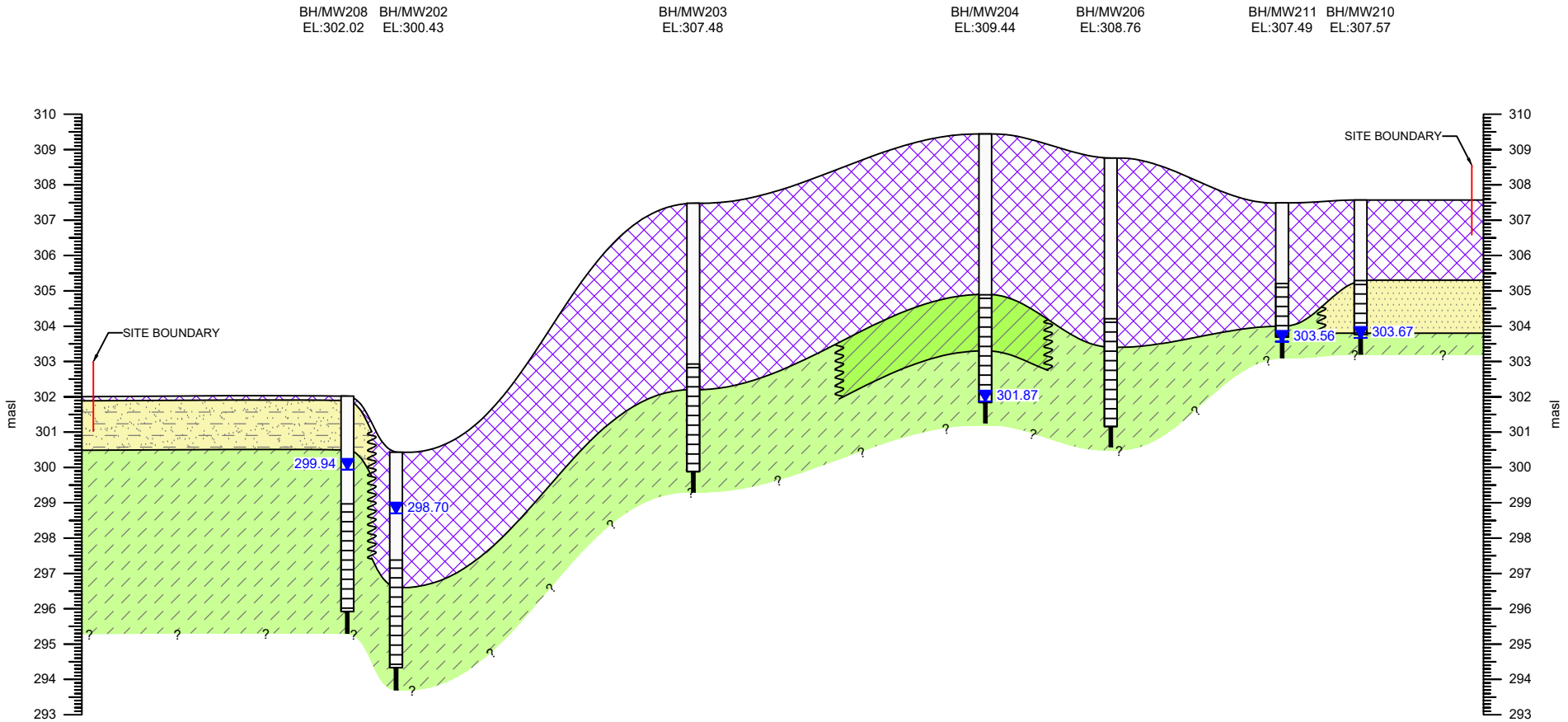
CROSS SECTION A-A'
HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NO.: BRM-21010864-C0	DWN.: JA
SCALE: AS NOTED	CK: RF
DATE: MARCH 2023	FIG. NO.: 5A

E:\BRM\BRM-21010864-C0\60 Execution\65 Drawings\Cross Sections\BRM-21010864-C0.dwg

B
SOUTHWEST

B'
NORTHEAST



VERTICAL SCALE: AS SHOWN

HORIZONTAL SCALE: 0 15 30 45 60 75 m

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t: +1.905.793.9800 | f: +1.905.793.0641
1595 Clark Boulevard
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Canada
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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

LEGEND:
- FILL
- CLAYEY SILT
- SILT
- SILTY SAND
- SAND

GROUNDWATER ELEVATION (masl) AS MEASURED ON MARCH 2, 2023

TITLE AND LOCATION:

CROSS SECTION B-B'
HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NO.: BRM-21010864-C0	DWN.: JA
SCALE: AS NOTED	CK: RF
DATE: MARCH 2023	FIG. NO.: 5B

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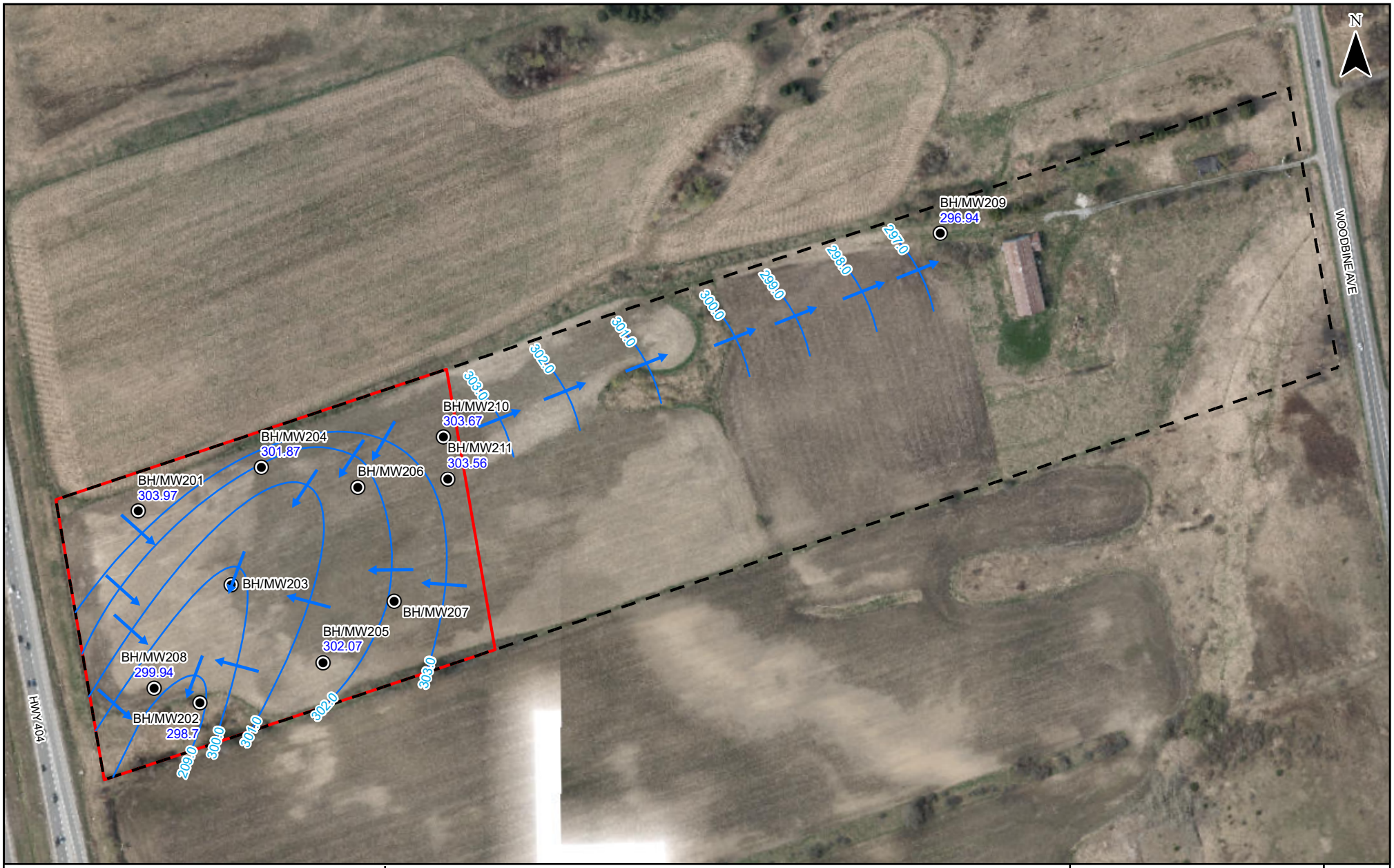


SCALE:

0 40 80 120 160 200 m

LEGEND:

- BOREHOLE / MONITORING WELL (EXP, 2023)
- XX.XX GROUNDWATER ELEVATION (m asl) AS MEASURED ON MARCH 2, 2023
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE SITE BOUNDARY

exp.

DRAWN BY:	CHECKED BY:
AC	RF

GROUNDWATER CONTOUR PLAN

FIGURE: 6

HYDROGEOLOGICAL INVESTIGATION
15450 WOODBINE AVENUE
STOUFFVILLE, ONTARIO

PROJECT NUMBER: BRM-21010864-C0

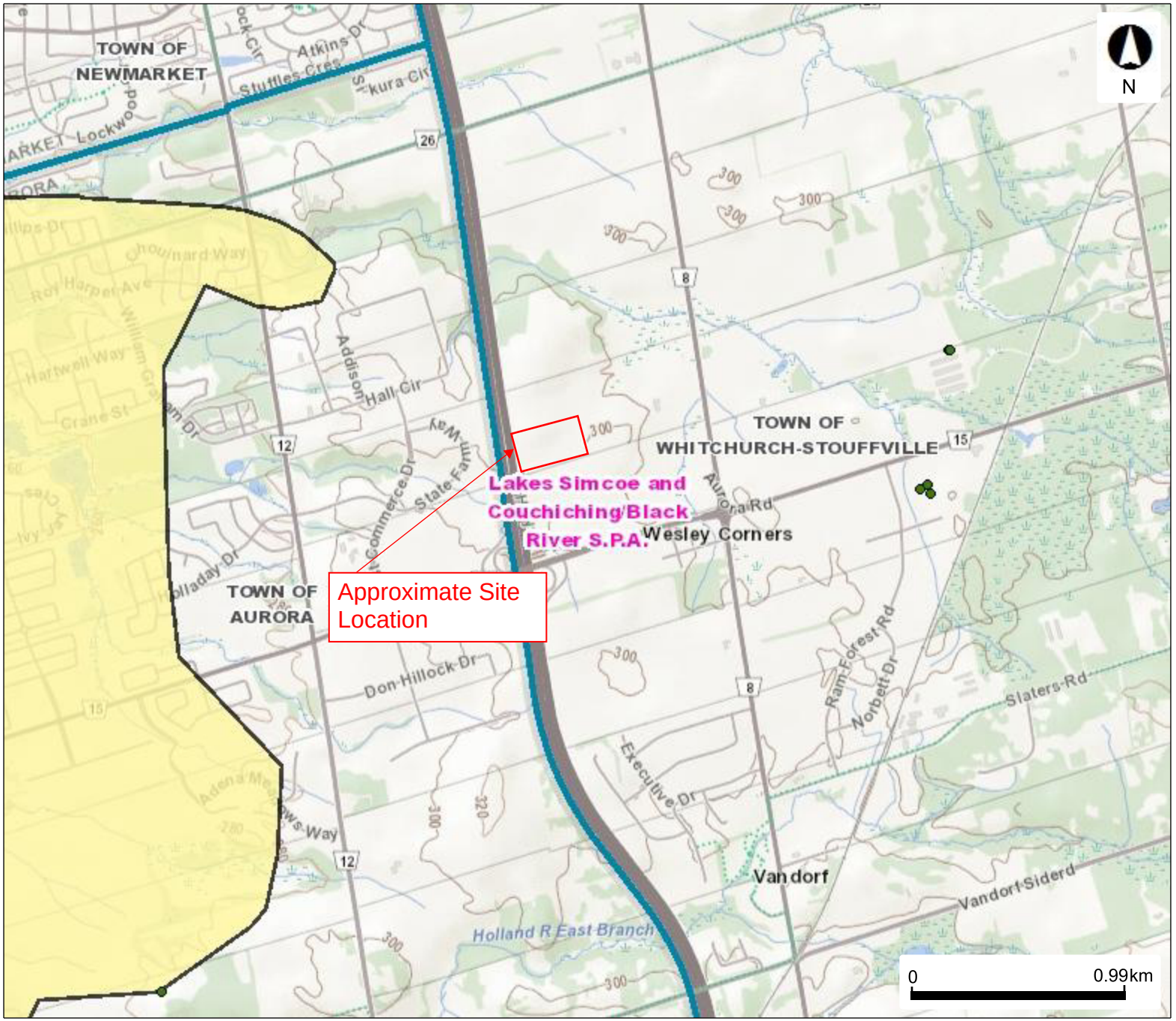
DATE: MARCH 2023

Appendix A – MECP WWR Summary Table

Off-Site															
BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	LOCATION ACCURACY	STREET	CITY	DISTANCE FROM SITE BOUNDARY (m)	CONSTRUCTION METHOD	WELL DEPTH (m bgs)	WATER FOUND (m bgs)	CASING DIAMETER (cm)	1st USE	2nd USE	FINAL STATUS
10498327	6907632	5/28/1946	627568	4875220	301.4	UTM very unreliable			99	Jetting	53.3	18.3	5.8	Livestock	Domestic	Water Supply
10498328	6907633	4/3/1950	627568	4875220	301.4	UTM very unreliable			99	Cable Tool	19.8	19.6	1.2	Livestock	Domestic	Water Supply
1005308621	7237731	12/4/2014	627334	4875299	301.8	margin of error : 30 m - 100 m	15625 LESLIE ST		333	Boring	4.6	0.7		Monitoring		Observation Wells
10548459	6927278	8/26/2003	627564	4875220	301.4	UTM very unreliable			102	Not Known				Not Used		Abandoned-Other
10548460	6927279	8/26/2003	627564	4875220	301.4	UTM very unreliable			102	Not Known				Not Used		Not A Well
10548461	6927280	8/26/2003	627564	4875220	301.4	UTM very unreliable			102	Not Known				Not Used		Abandoned-Other
10548462	6927281	8/26/2003	627564	4875220	301.4	UTM very unreliable			102	Not Known				Not Used		Not A Well
10548463	6927282	8/26/2003	627564	4875220	301.4	UTM very unreliable			102	Not Known				Not Used		Abandoned-Other
10548464	6927283	8/26/2003	627564	4875220	301.4	UTM very unreliable			102	Not Known				Not Used		Not A Well
11100797	6927483	10/16/2003	627564	4875221	301.4	UTM very unreliable			102	Not Known				Not Used		Abandoned-Other
1008541551	7377173	11/27/2020	627312	4875548	298.6	margin of error : 30 m - 100 m	350 First Commerce Dr		462	Direct Push				Monitoring		Observation Wells
1008600998	7384287	1/23/2020	627308	4875545	299.2	margin of error : 30 m - 100 m	. 350 First Commerce Dr, Aurora, ON L4G 7C7		463	Auger	6.1			Monitoring		Observation Wells
1006678345	7291739		627524	4875436	302.0	margin of error : 30 m - 100 m			234							

Appendix B – MECP Source Protection Atlas

MECP Source Protection Information Atlas



Legend

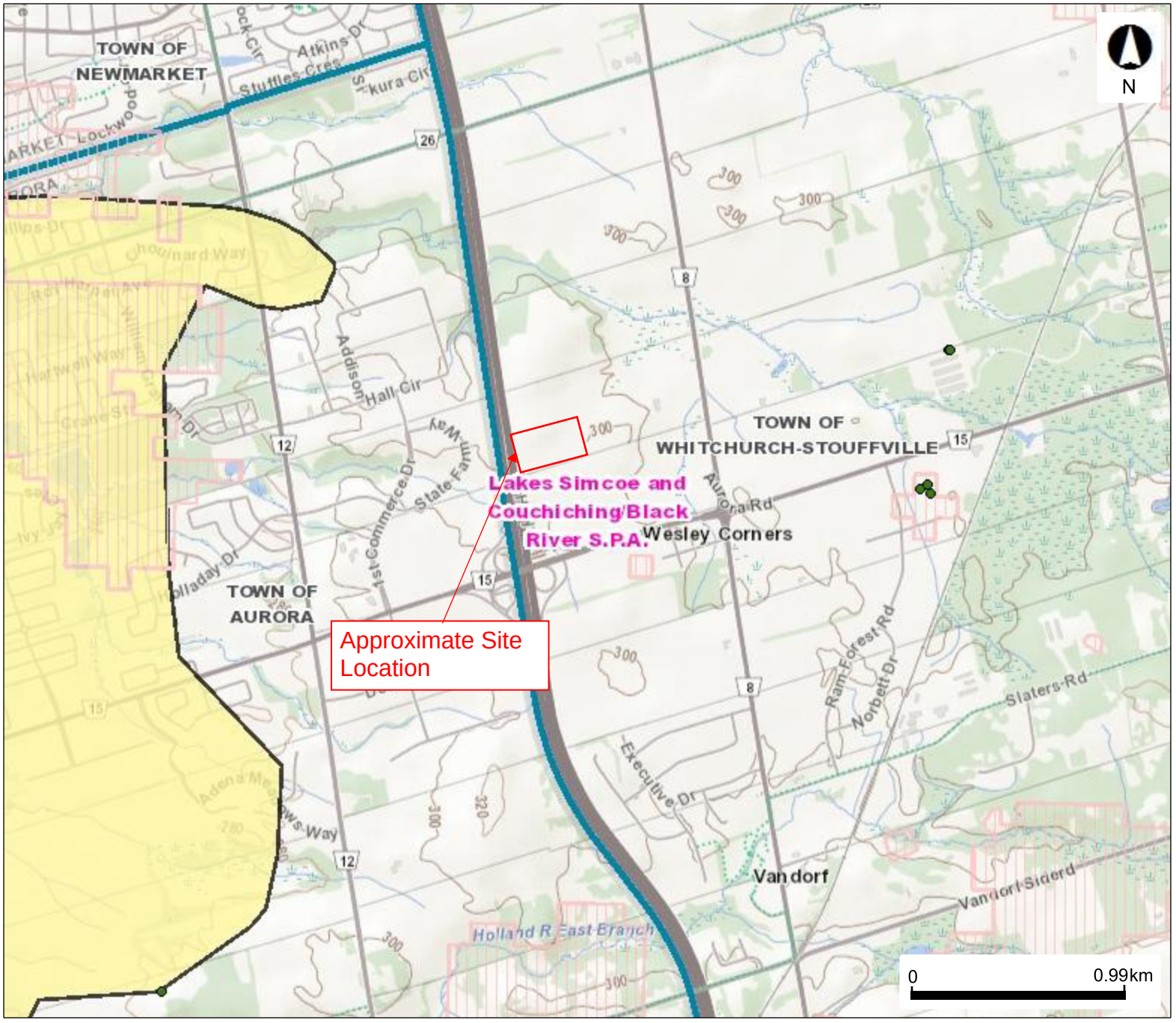
- Permits To Take Water: Active
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Vulnerable Scoring Area - Groundwater Under Direct Influence
  - 4.1 - 7.9
  - 8 - 8.9
  - 9 - 10
- Source Protection Areas
- Municipal Boundaries - Single and Lower Tier

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 2/22/2023
Map Center: 44.01611 N, -79.40308 W

MECP Source Protection Information Atlas Highly Vulnerable Aquifer Map



Legend

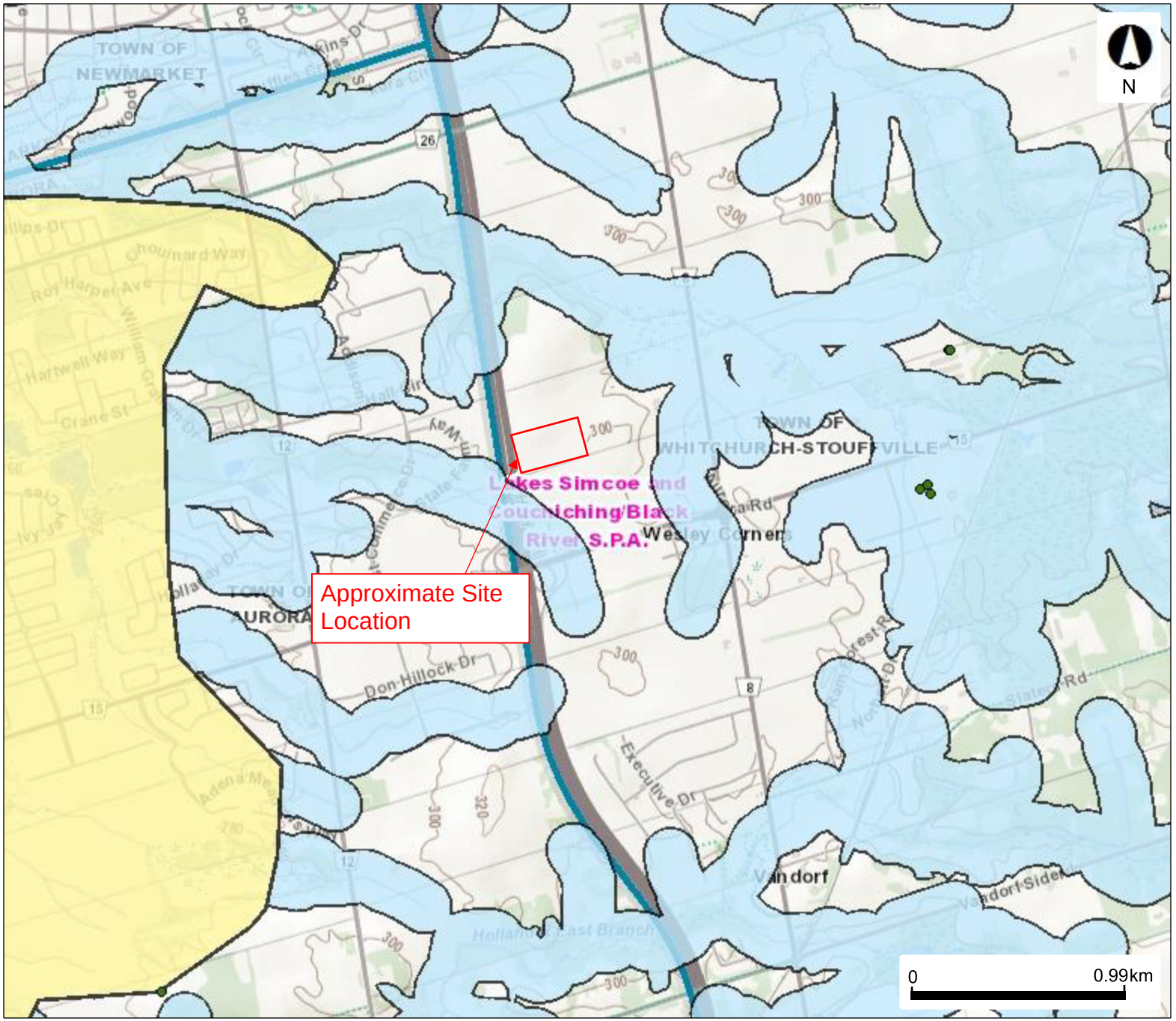
- Permits To Take Water: Active
- Highly Vulnerable Aquifers
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Source Protection Areas
- Municipal Boundaries - Single and Lower Tier

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 2/22/2023
Map Center: 44.01611 N, -79.40308 W

MECP Source Protection Information Atlas Intake Protection Zones



Legend

- Permits To Take Water: Active
- Intake Protection Zone Name
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Intake Protection Zone 2
- Intake Protection Zone 3
- Vulnerable Scoring Area - Surface Water
  - 0 - 3.9
  - 4 - 7.9
  - 8 - 8.9
  - 9 - 10
- Source Protection Areas
- Municipal Boundaries - Single and Lower Tier

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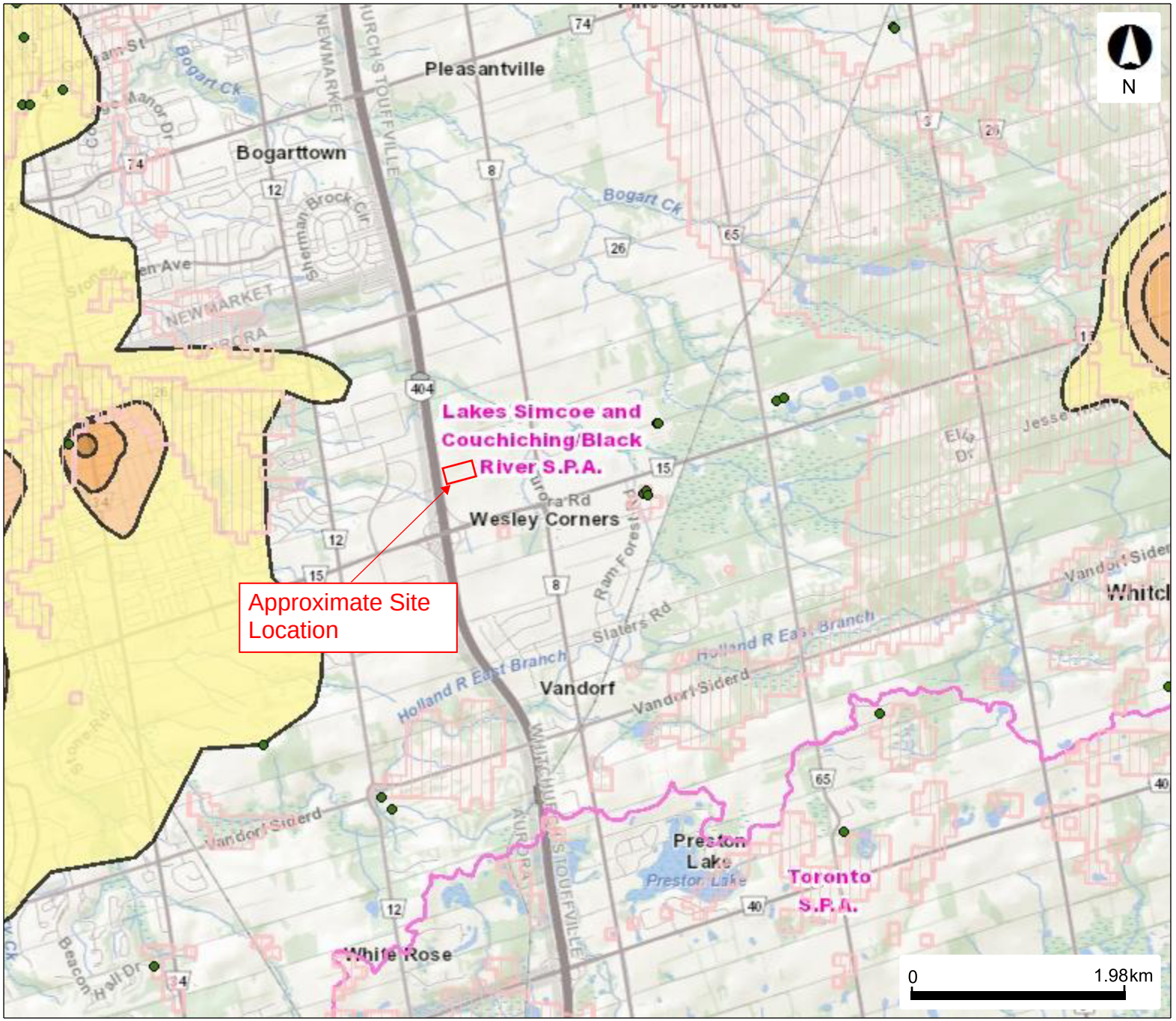
Ontario

Map Created: 2/22/2023
Map Center: 44.01611 N, -79.40308 W

MECP Source Protection Information Atlas



Legend

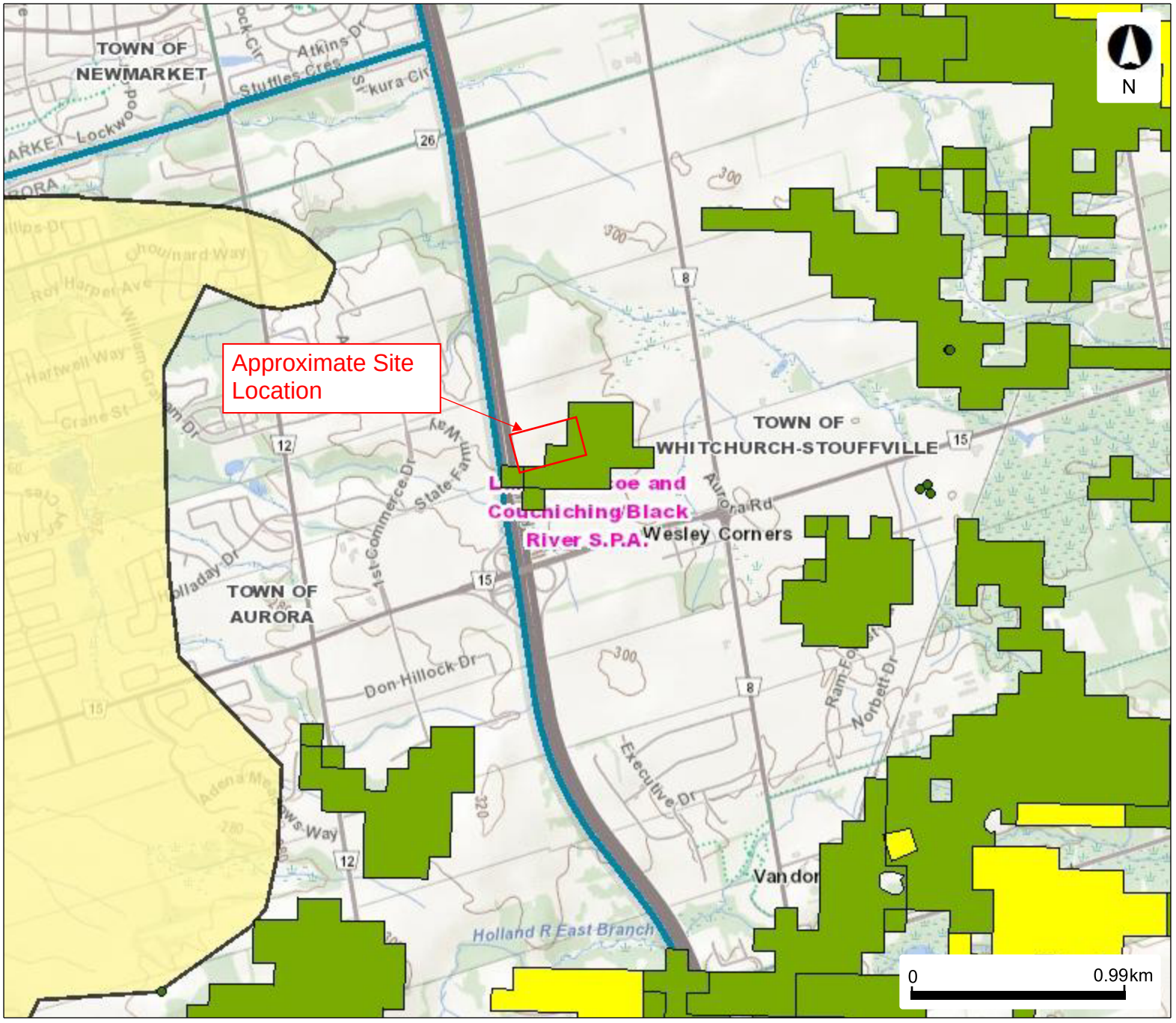
- Permits To Take Water: Active
- Issue Contributing Areas
- Highly Vulnerable Aquifers
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2
- Niagara Escarpment Plan (NEI
- Source Protection Areas

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 2/22/2023
Map Center: 44.01555 N, -79.39036 W

MECP Source Protection Information Atlas Significant Groundwater Recharge Map



Legend

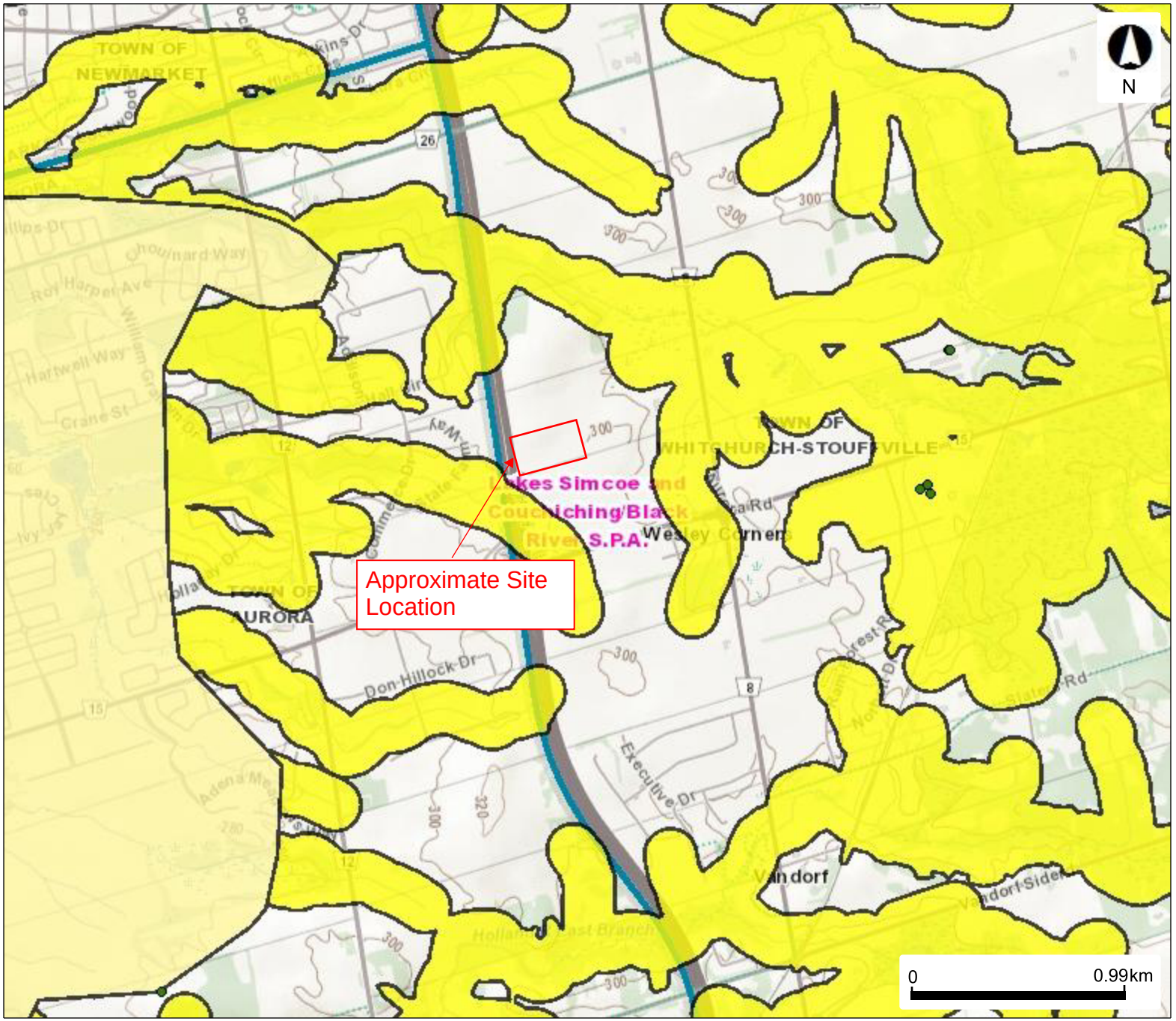
- Permits To Take Water: Active
- Intake Protection Zone Q
- Wellhead Protection Area Q1
- Wellhead Protection Area Q2
- Significant Groundwater Recharge Area
  - N/A
  - 0
  - 2
  - 4
  - 6
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Source Protection Areas
- Municipal Boundaries - Single and Lower Tier

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 2/22/2023
Map Center: 44.01611 N, -79.40308 W

MECP Source Protection Information Atlas Surface Water Vulnerability Map



Legend

- Permits To Take Water: Active
- Intake Protection Zone Name
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Vulnerable Scoring Area - Surface Water
  - 0 - 3.9
  - 4 - 7.9
  - 8 - 8.9
  - 9 - 10
- Source Protection Areas
- Municipal Boundaries - Single and Lower Tier

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 2/22/2023
Map Center: 44.01611 N, -79.40308 W

Town of East Gwillimbury

Town of Newmarket

Town of Aurora

Town of Richmond Hill

Town of Markham

Region of Durham

Davis Drive

Vivian Road

St John's Sideroad

Aurora Road

Vandorf Sideroad

Bloomington Road

Bethesda Sideroad

Stouffville Road

Woodbine Avenue

Warden Avenue

Kennedy Road

McCowan Road

Highway 48

Ninth Line

York/Durham Line

Highway 404

Tenth Line

SECONDARY PLAN AREA (BALLANTRAE - MUSSELMAN LAKE AND ENVIRONS)

HAMLET OF BLOOMINGTON

SECONDARY PLAN AREA (GORMLEY INDUSTRIAL AREA)

SECONDARY PLAN AREA (COMMUNITY OF STOUFFVILLE)

0 0.45 0.9 1.8 2.7 3.6 km

N W E S

LEGEND

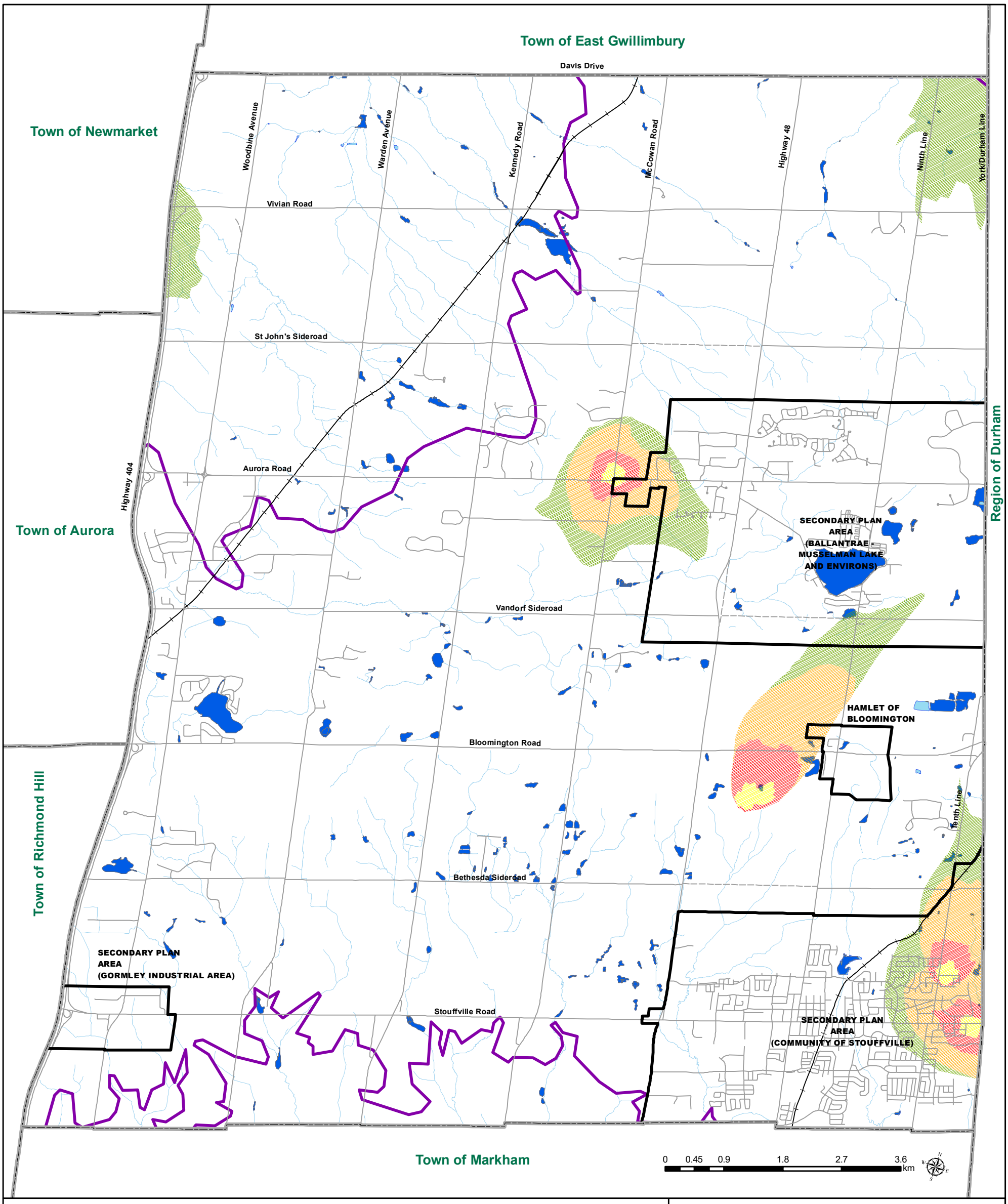
- TOWN BOUNDARY
- EXISTING CENTRELINES
- UNOPENED ROAD ALLOWANCE
- RAILWAYS
- LAKES
- RIVERS
- COMMUNITY AREAS
- OAK RIDGES MORAINE
- KETTLE LAKES
- AREAS OF HIGH AQUIFER VULNERABILITY
- AREAS OF LOW AQUIFER VULNERABILITY

TOWN OF
WHITCHURCH - STOUFFVILLE
OFFICIAL PLAN

Schedule "I"

Oak Ridges Moraine Plan Area
Areas of High Aquifer Vulnerability

Office Consolidation December, 2020



LEGEND

- TOWN BOUNDARY
- EXISTING CENTRELINES
- UNOPENED ROAD ALLOWANCE
- RAILWAYS
- LAKES
- RIVERS
- COMMUNITY AREAS
- OAK RIDGES MORAINE
- KETTLE LAKES
- 150 DAY WELLHEAD PROTECTION ZONE
- 2 YEAR WELLHEAD PROTECTION ZONE
- 10 YEAR WELLHEAD PROTECTION ZONE
- 25 YEAR WELLHEAD PROTECTION ZONE

TOWN OF
WHITCHURCH - STOUFFVILLE
OFFICIAL PLAN

Schedule "K"

Oak Ridges Moraine Plan Area
Wellhead Protection Zones

Office Consolidation December, 2020

Appendix C – Borehole Logs

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

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

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

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

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

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	"trace" (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	"some" (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	"and" (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance "N" Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance "N" Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

Log of BH201

Project No. BRM-21010864-C0 Drawing No. 2

Project: Hydrogeological Investigation Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

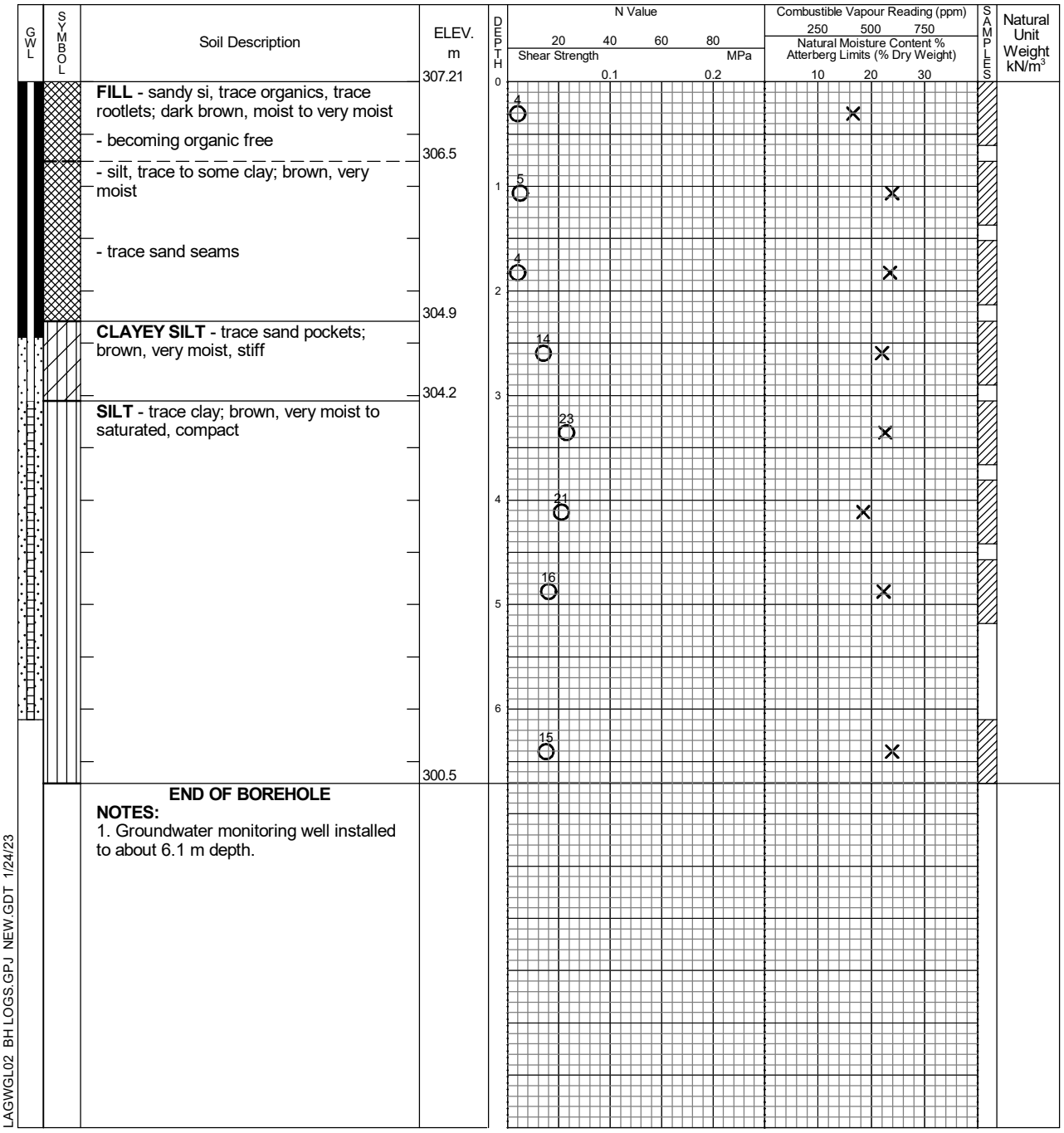
Date Drilled: January 11, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH202

Project No. BRM-21010864-C0 | Drawing No. 3

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

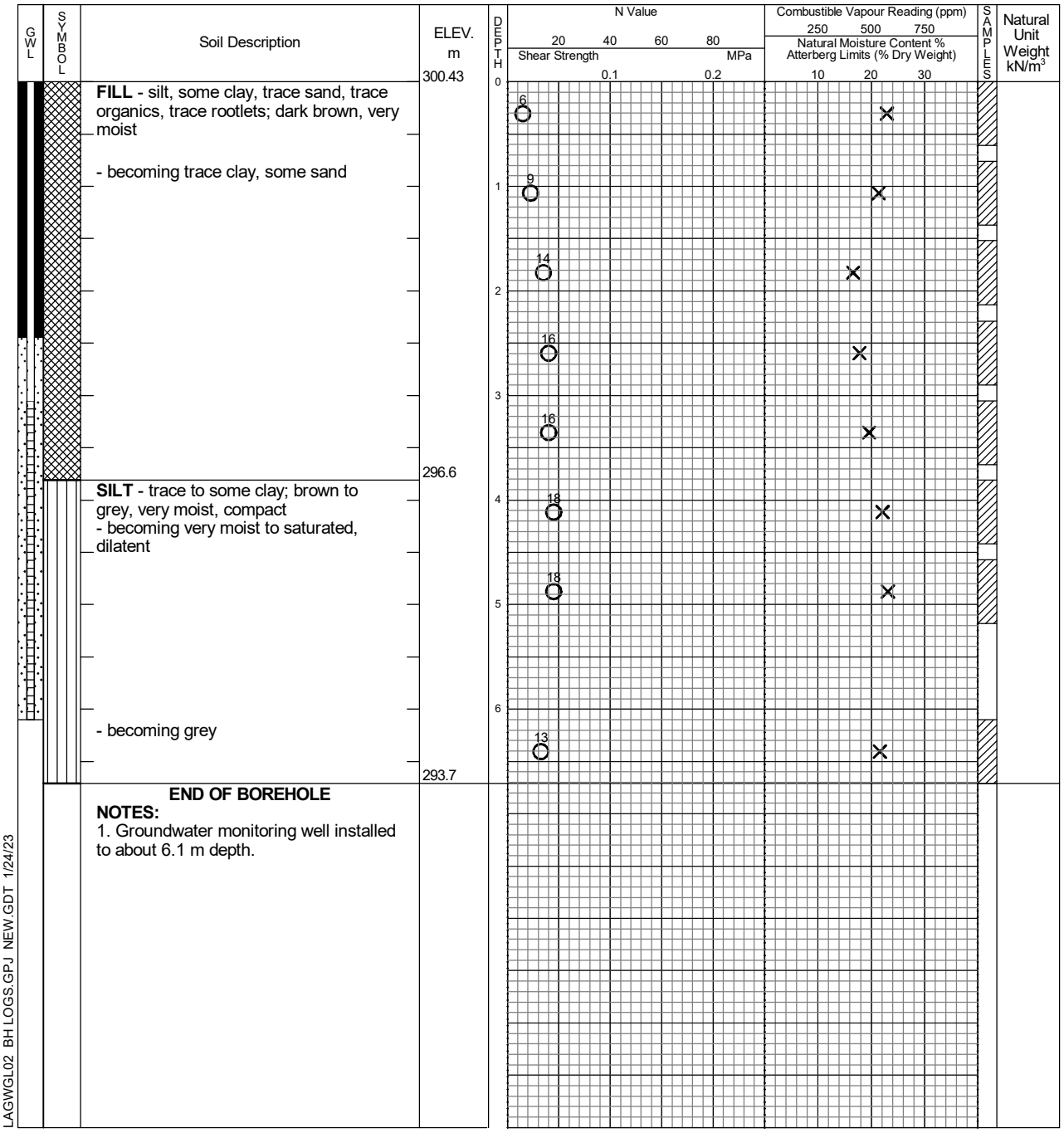
Date Drilled: January 13, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH203

Project No. BRM-21010864-C0 | Drawing No. 4

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

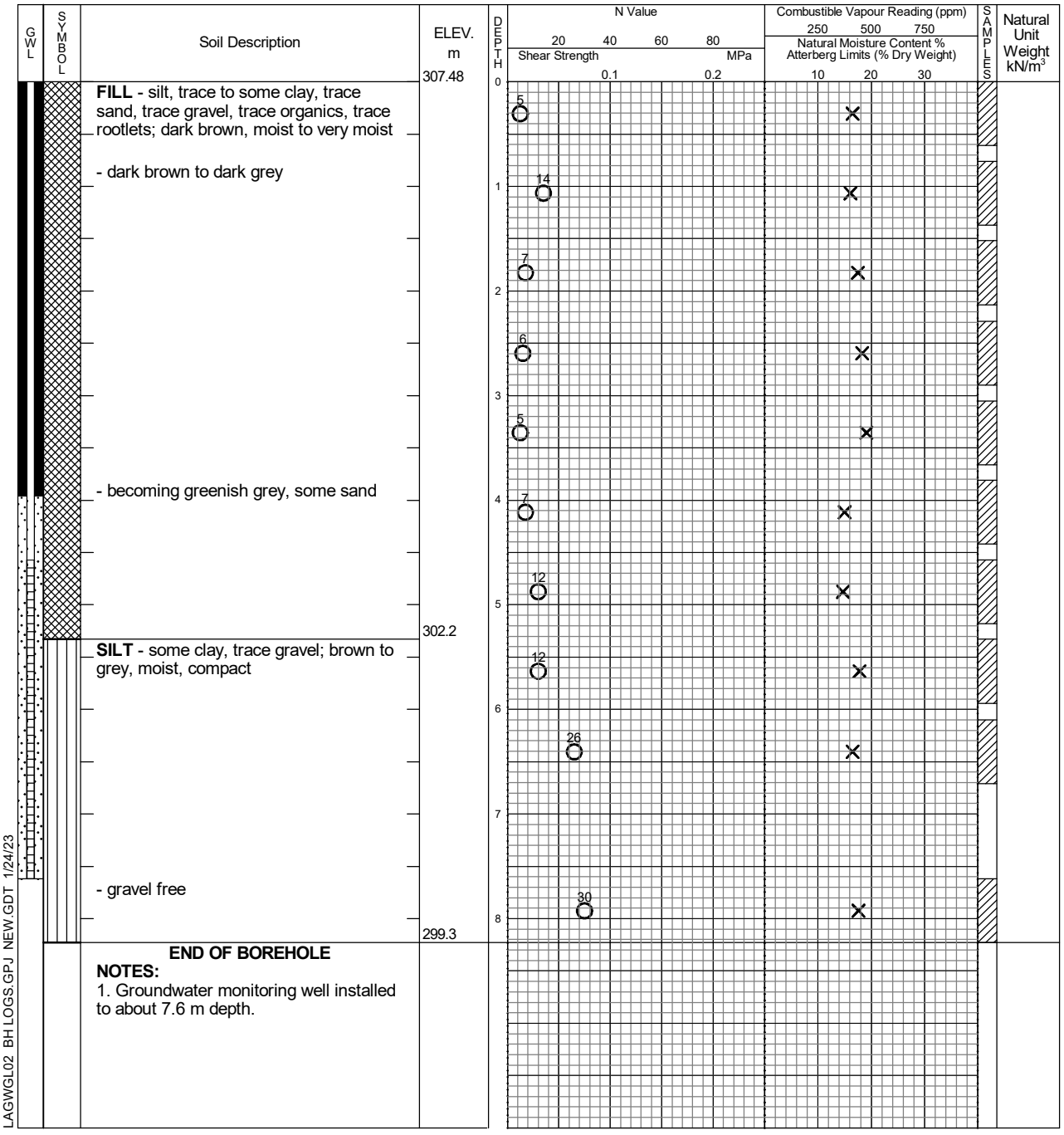
Date Drilled: January 11, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH204

Project No. BRM-21010864-C0 Drawing No. 5

Project: Hydrogeological Investigation Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

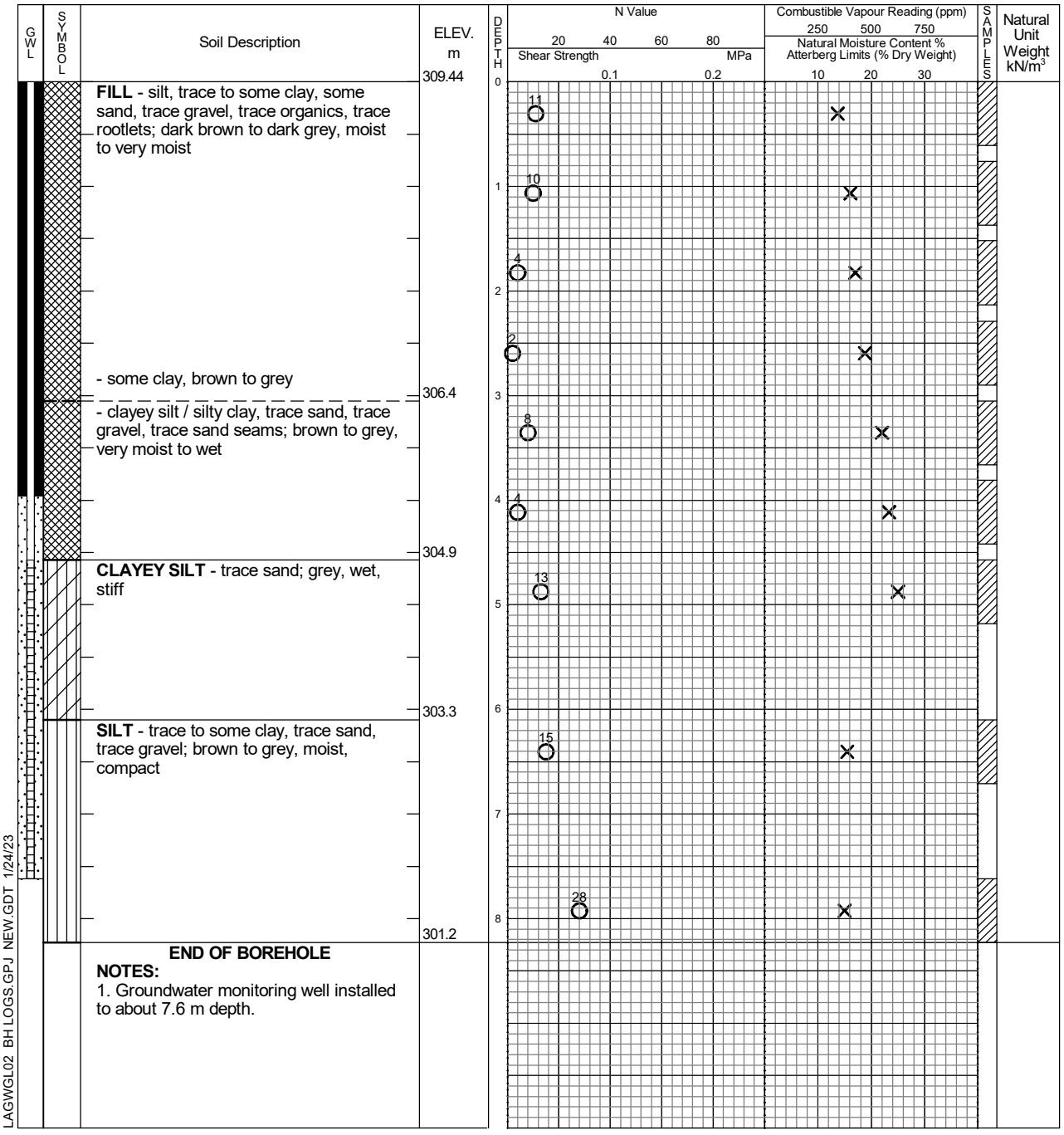
Date Drilled: January 11, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH205

Project No. BRM-21010864-C0 | Drawing No. 6

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

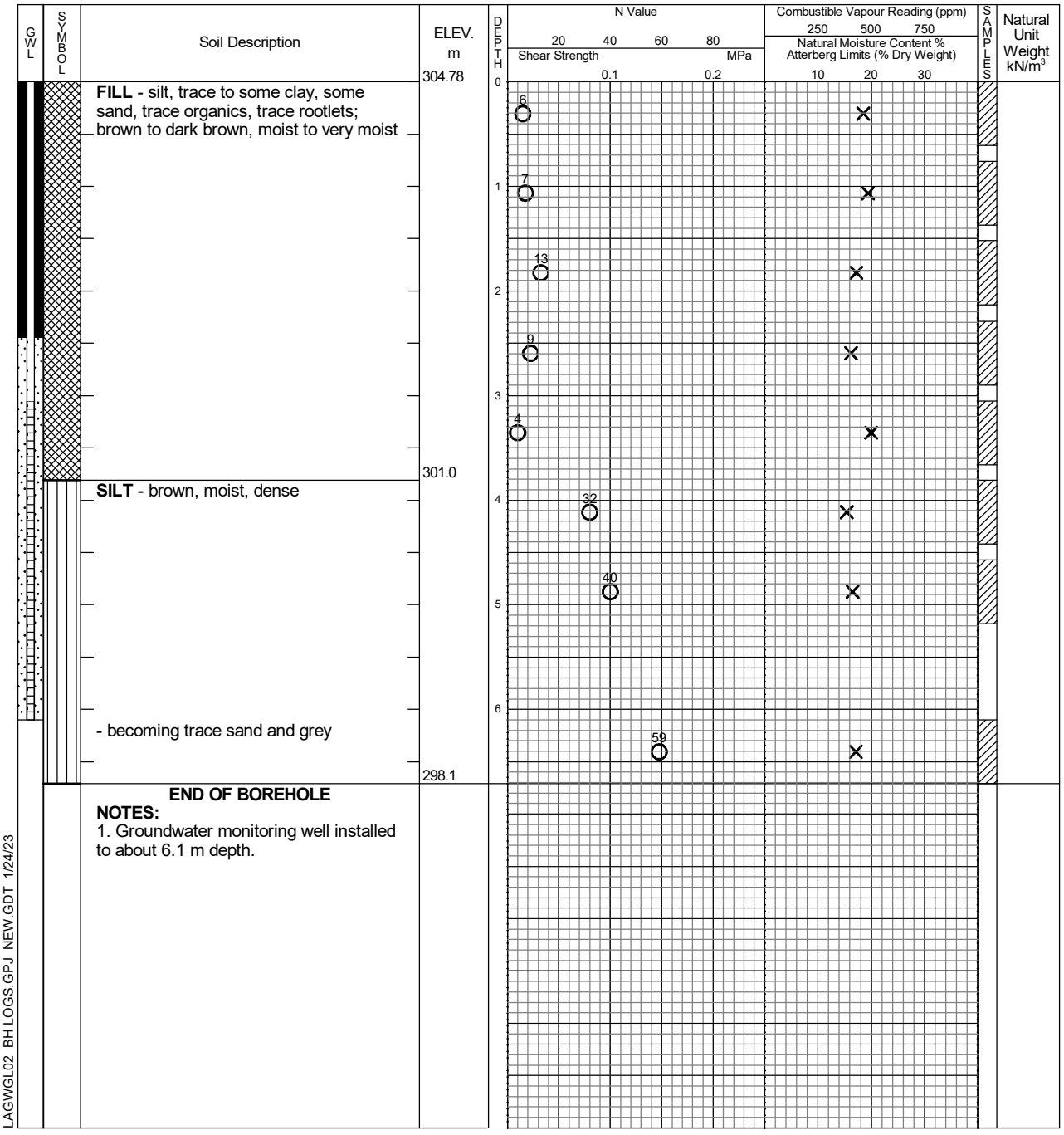
Date Drilled: January 13, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH206

Project No. BRM-21010864-C0 Drawing No. 7

Project: Hydrogeological Investigation Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

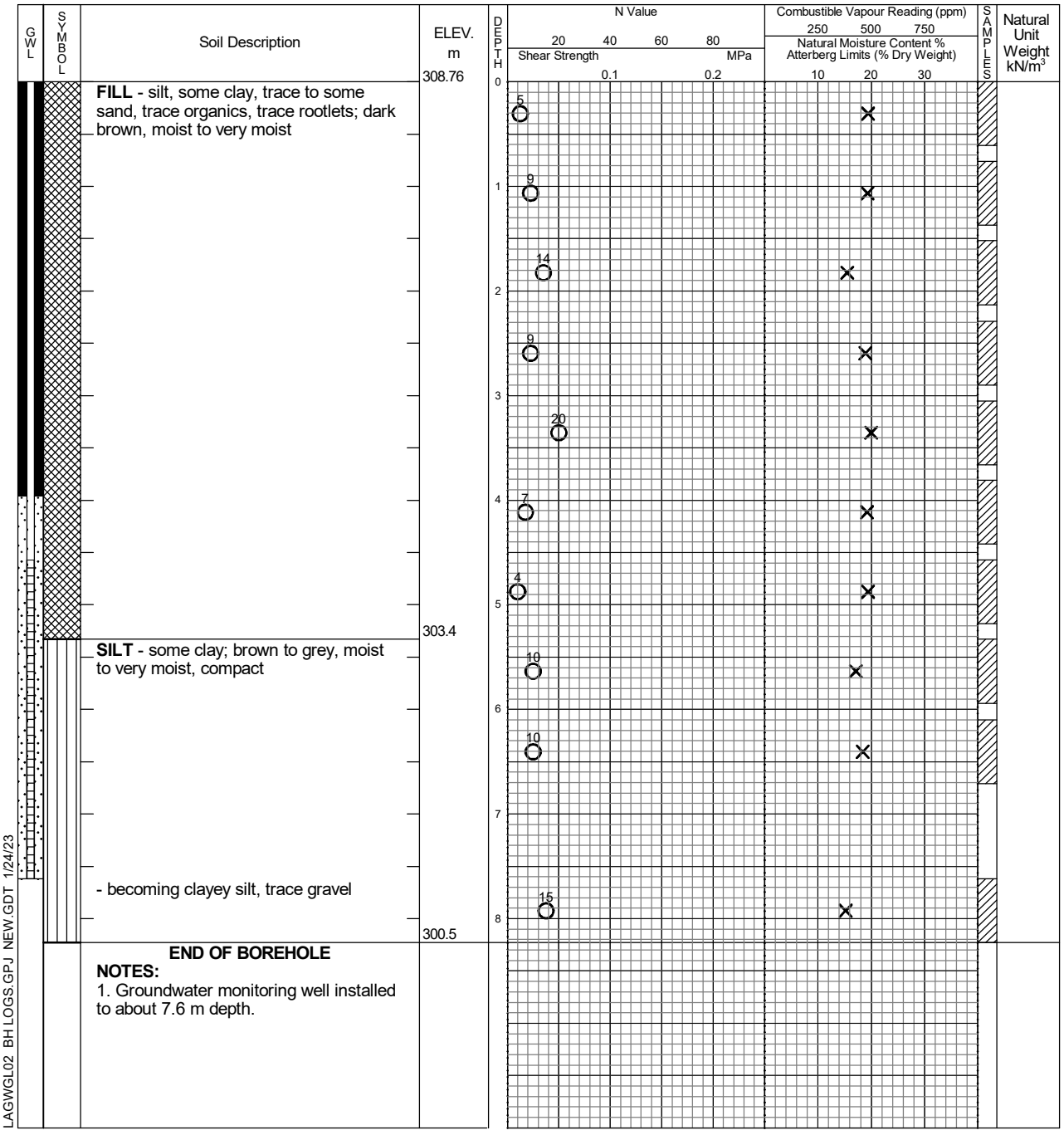
Date Drilled: January 11, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH207

Project No. BRM-21010864-C0 | Drawing No. 8

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

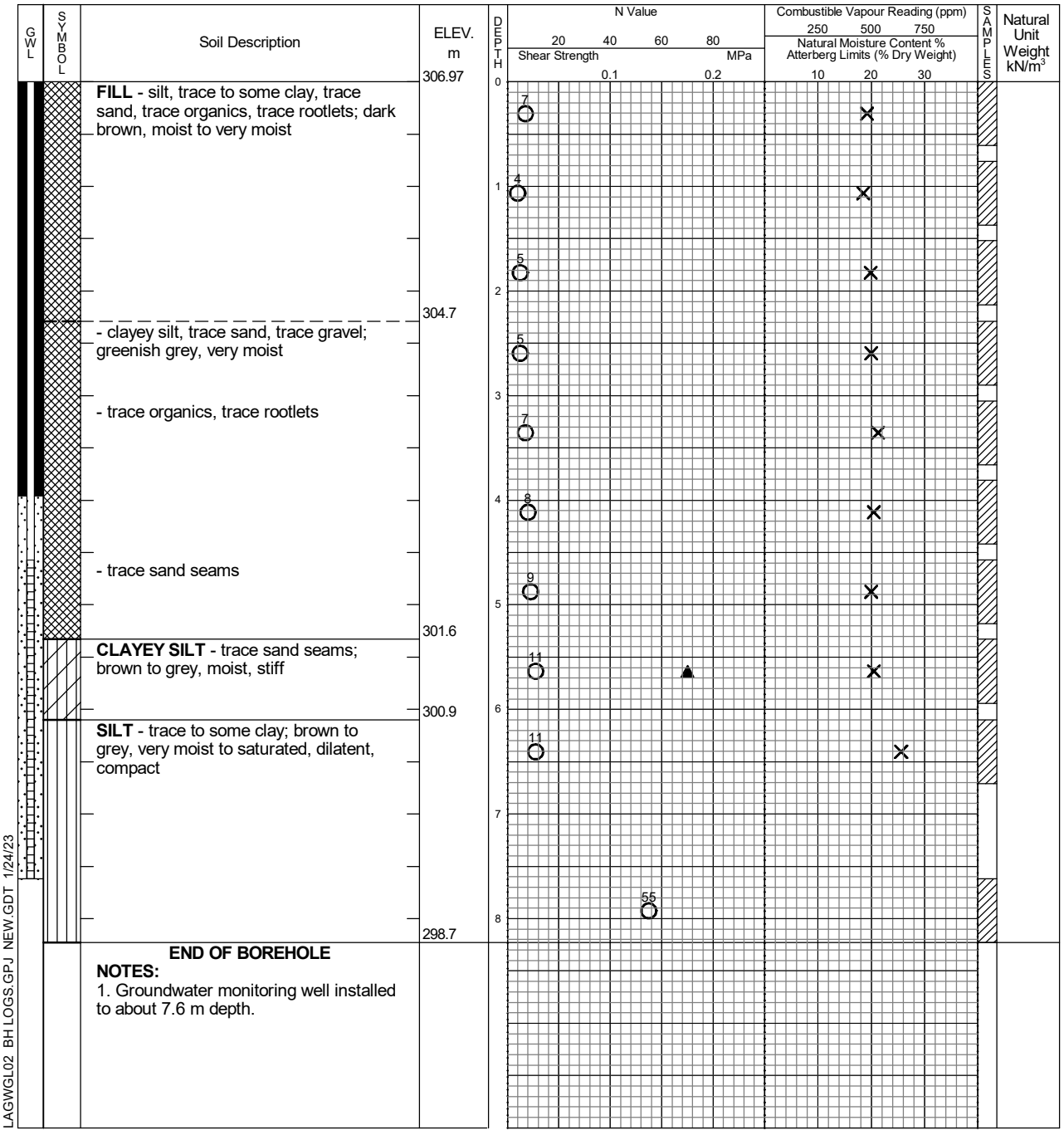
Date Drilled: January 10, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH208

Project No. BRM-21010864-C0 | Drawing No. 9

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

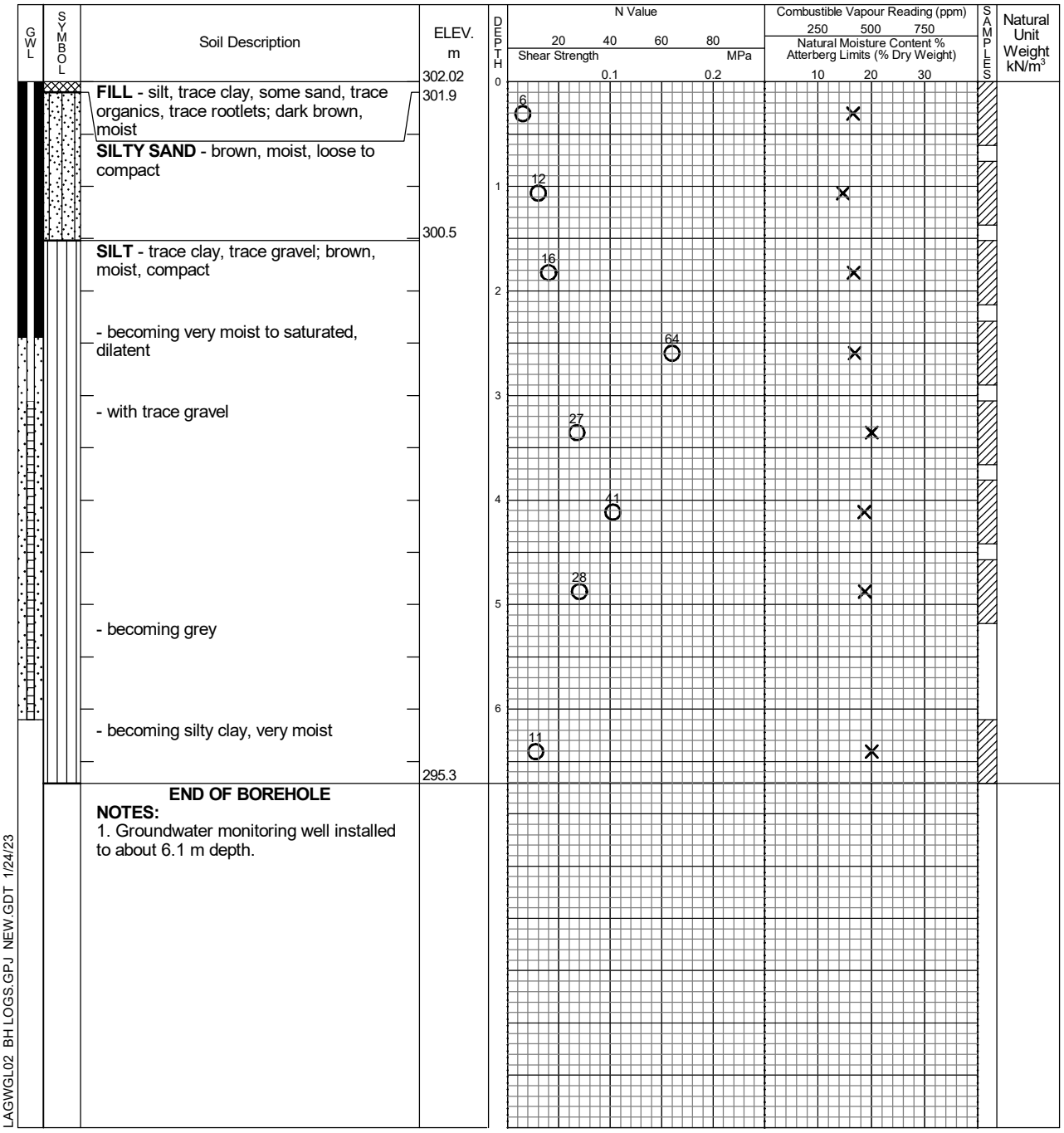
Date Drilled: January 13, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH209

Project No. BRM-21010864-C0 | Drawing No. 10

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

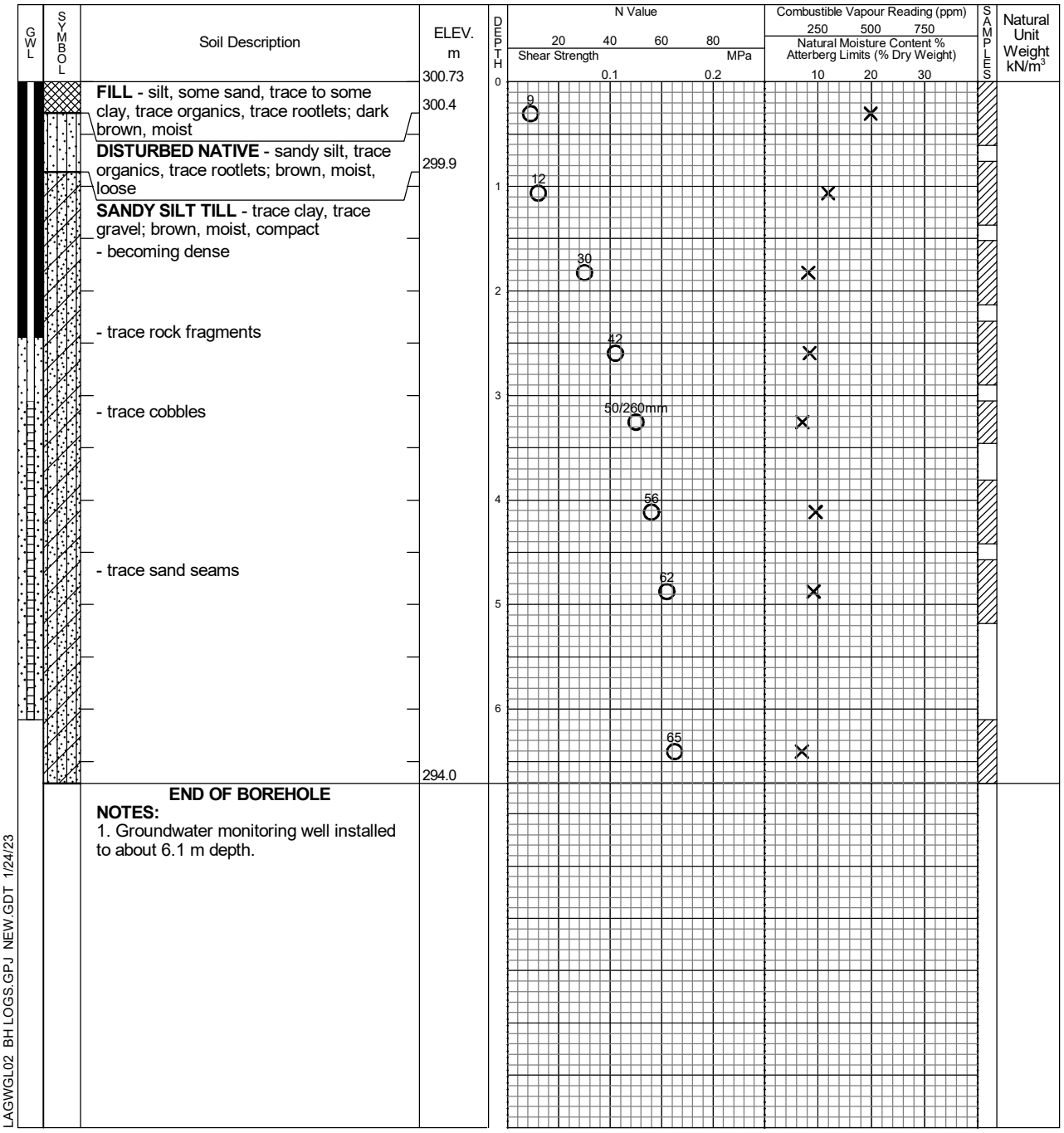
Date Drilled: January 10, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



NOTES:
1. Groundwater monitoring well installed to about 6.1 m depth.

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Log of BH210

Project No. BRM-21010864-C0 | Drawing No. 11

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

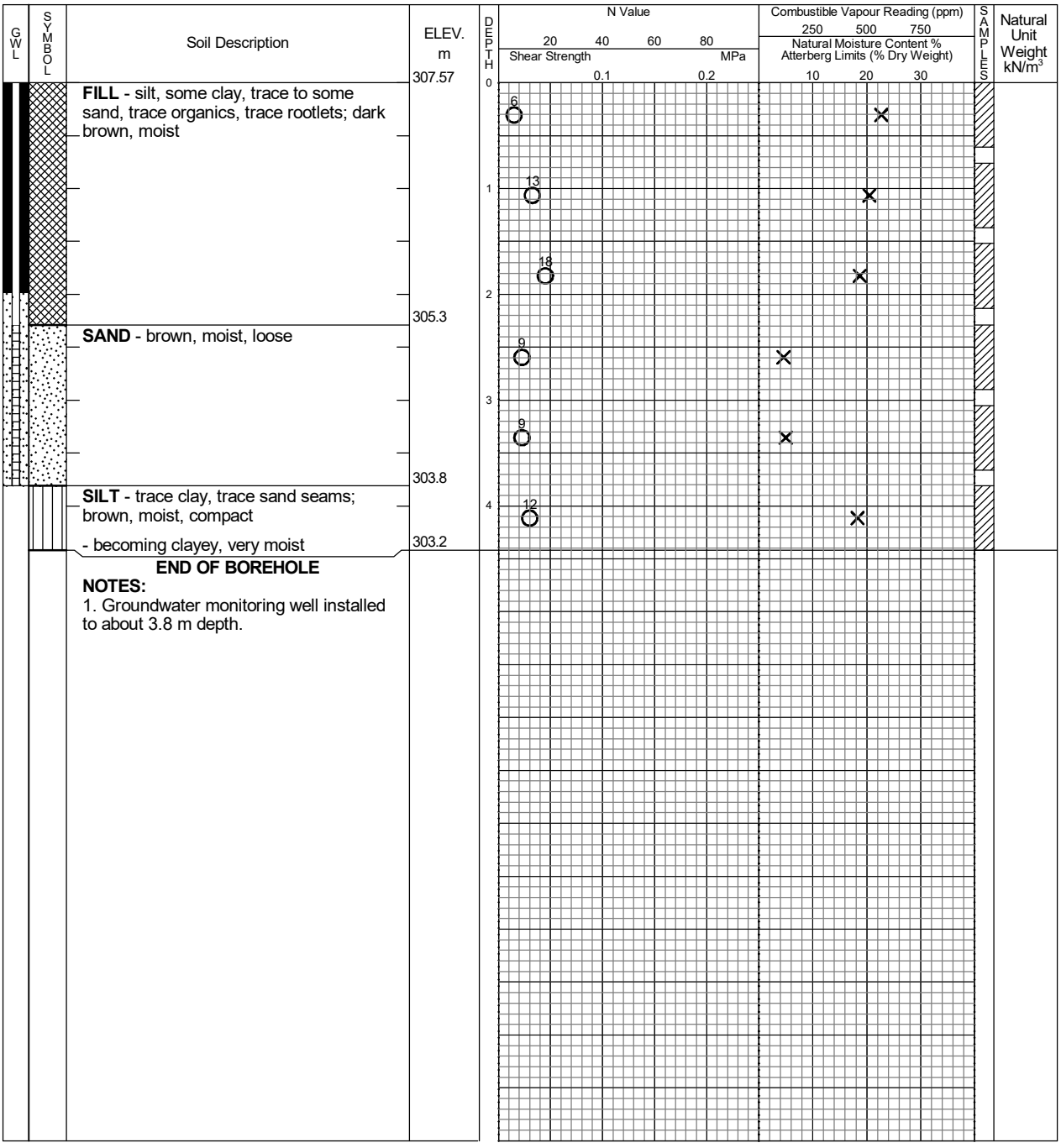
Date Drilled: January 10, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

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



NOTES:
1. Groundwater monitoring well installed to about 3.8 m depth.

LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Log of BH211

Project No. BRM-21010864-C0 | Drawing No. 12

Project: Hydrogeological Investigation | Sheet No. 1 of 1

Location: 15450 Woodbine Avenue, Stouffville, Ontario

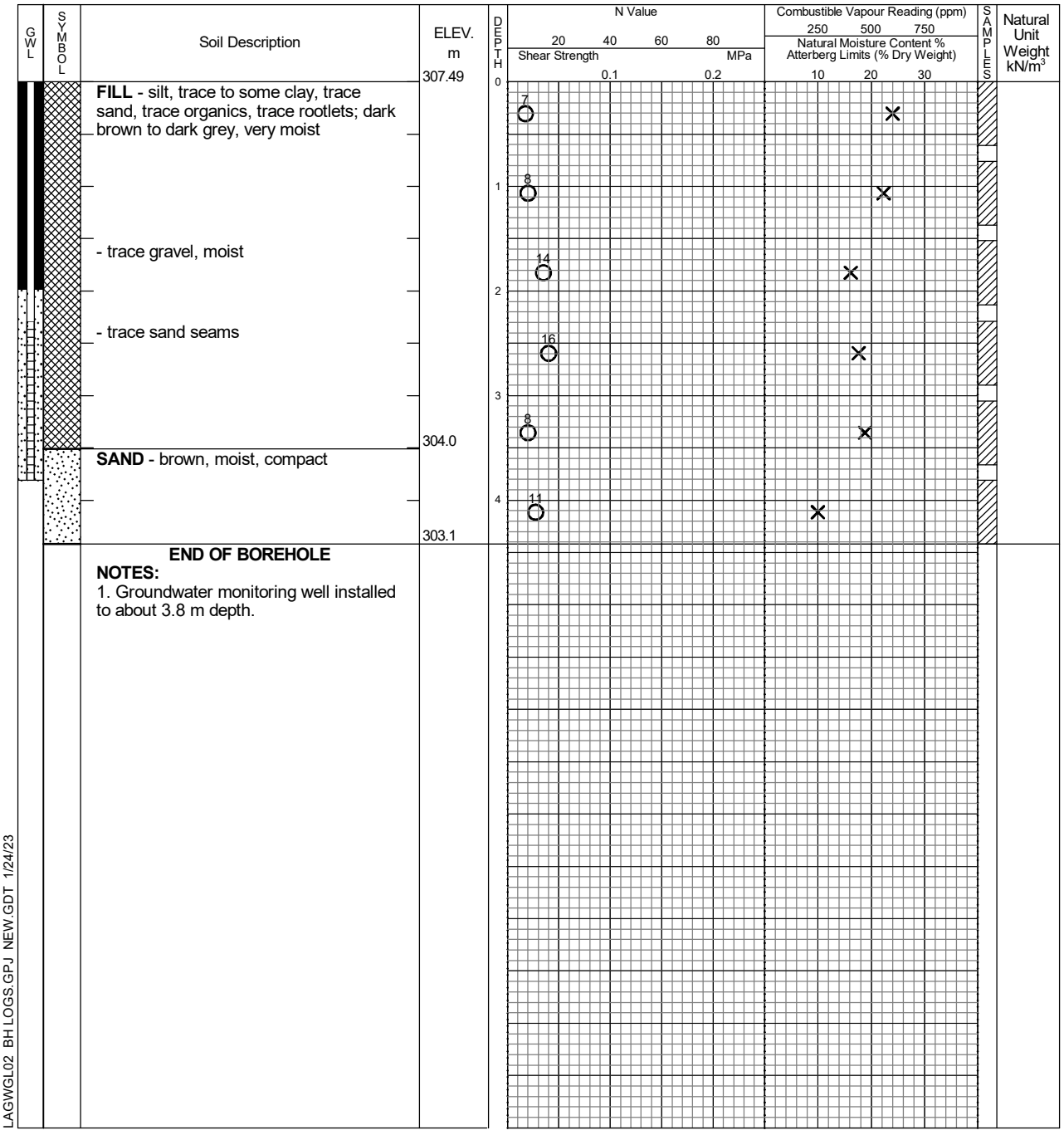
Date Drilled: January 10, 2023

Drill Type: CME 75 Track

Datum: Geodetic

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

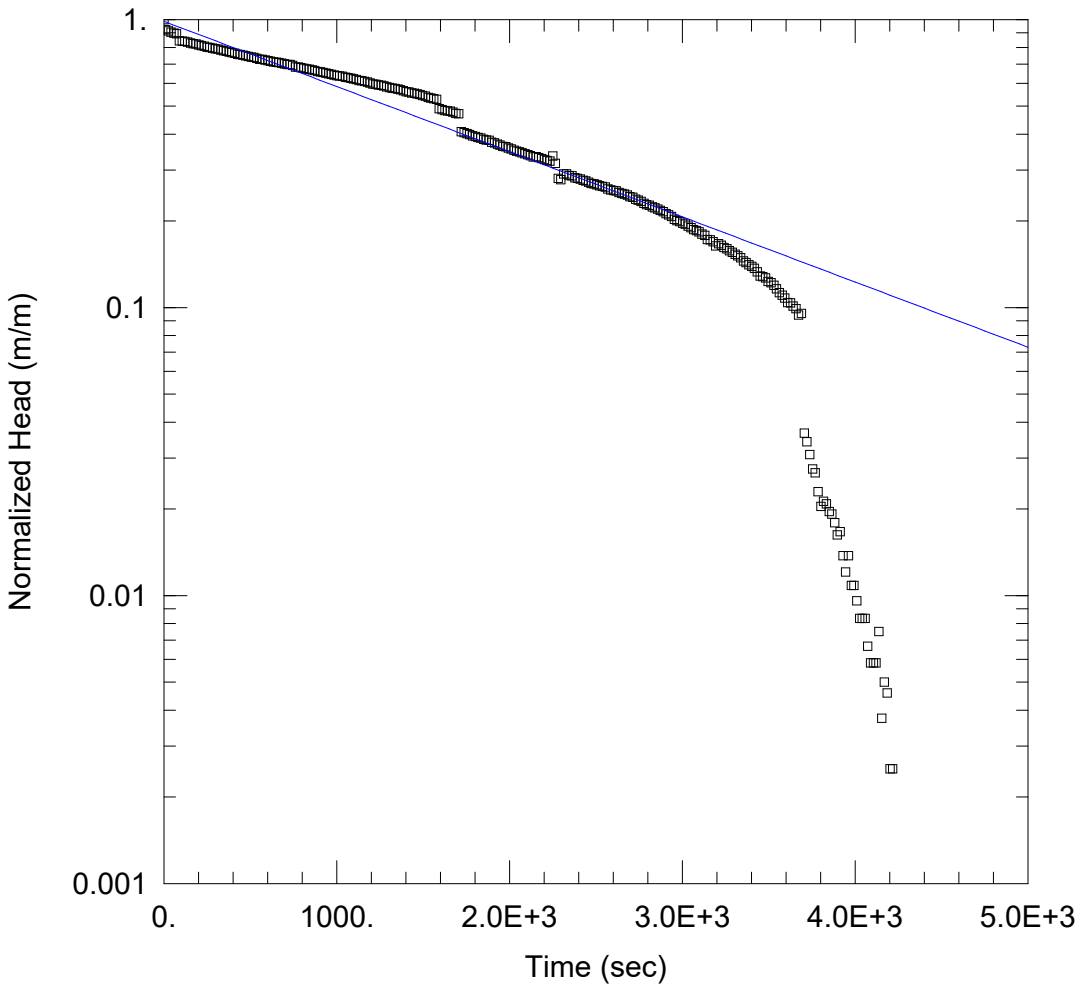
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGL02 BH LOGS.GPJ NEW.GDT 1/24/23

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	

Appendix D – SWRT Procedures and Results



WELL TEST ANALYSIS

Data Set:
Date: 03/09/23 Time: 13:42:50

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Treasure Hill
Project: BRM-21010864-C0
Location: 15450 Woodbine Ave, Stouffvill
Test Well: BH201
Test Date: March 2, 2023

AQUIFER DATA

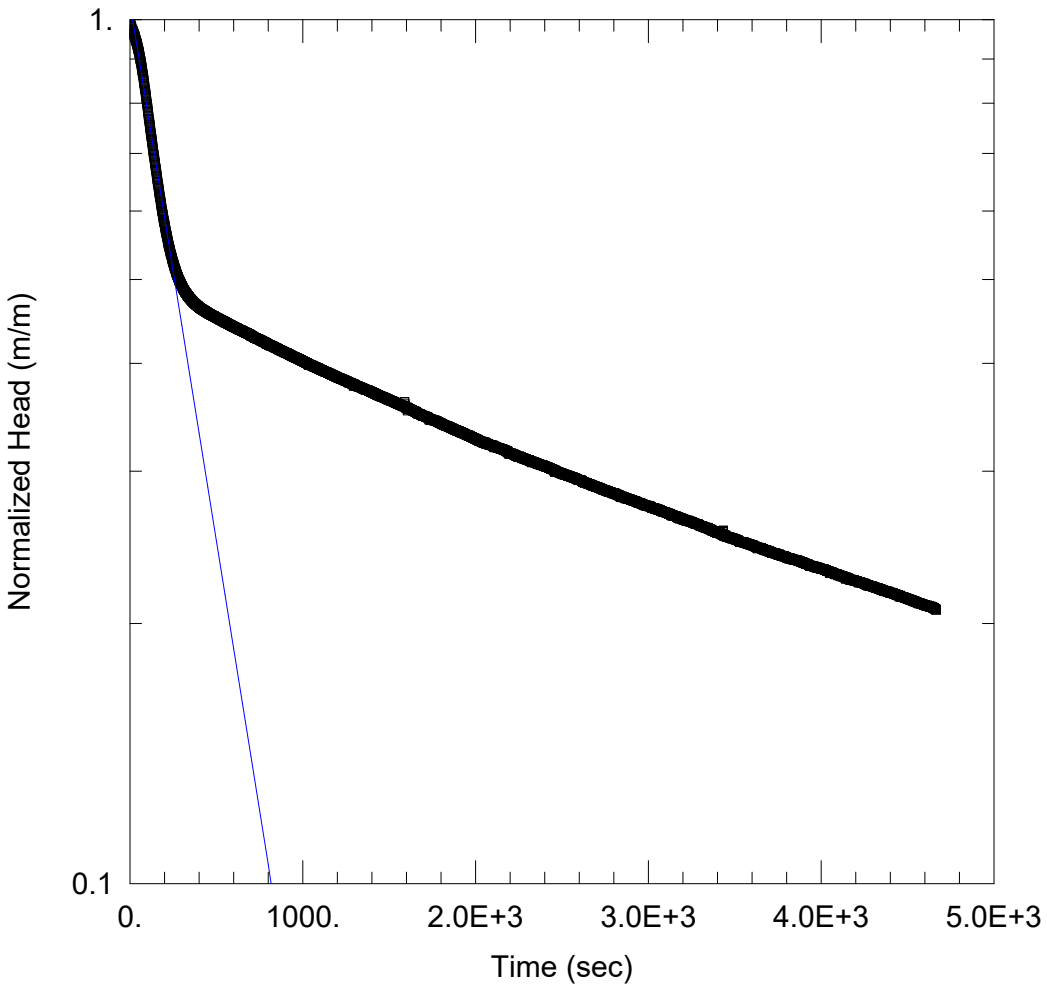
Saturated Thickness: 2.8 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH201)

Initial Displacement: 0.24 m
Total Well Penetration Depth: 3.21 m
Casing Radius: 0.025 m
Static Water Column Height: 2.8 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.081E-7 m/sec
y0 = 0.2364 m



WELL TEST ANALYSIS

Data Set: E:\...\BH202R.aqt
Date: 02/22/23 Time: 10:14:59

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Treasure Hill
Project: BRM-21010864-C0
Location: 15450 Woodbine Ave, Stouffvill
Test Well: BH202
Test Date: February 7, 2023

AQUIFER DATA

Saturated Thickness: 2.97 m Anisotropy Ratio (Kz/Kr): 1.

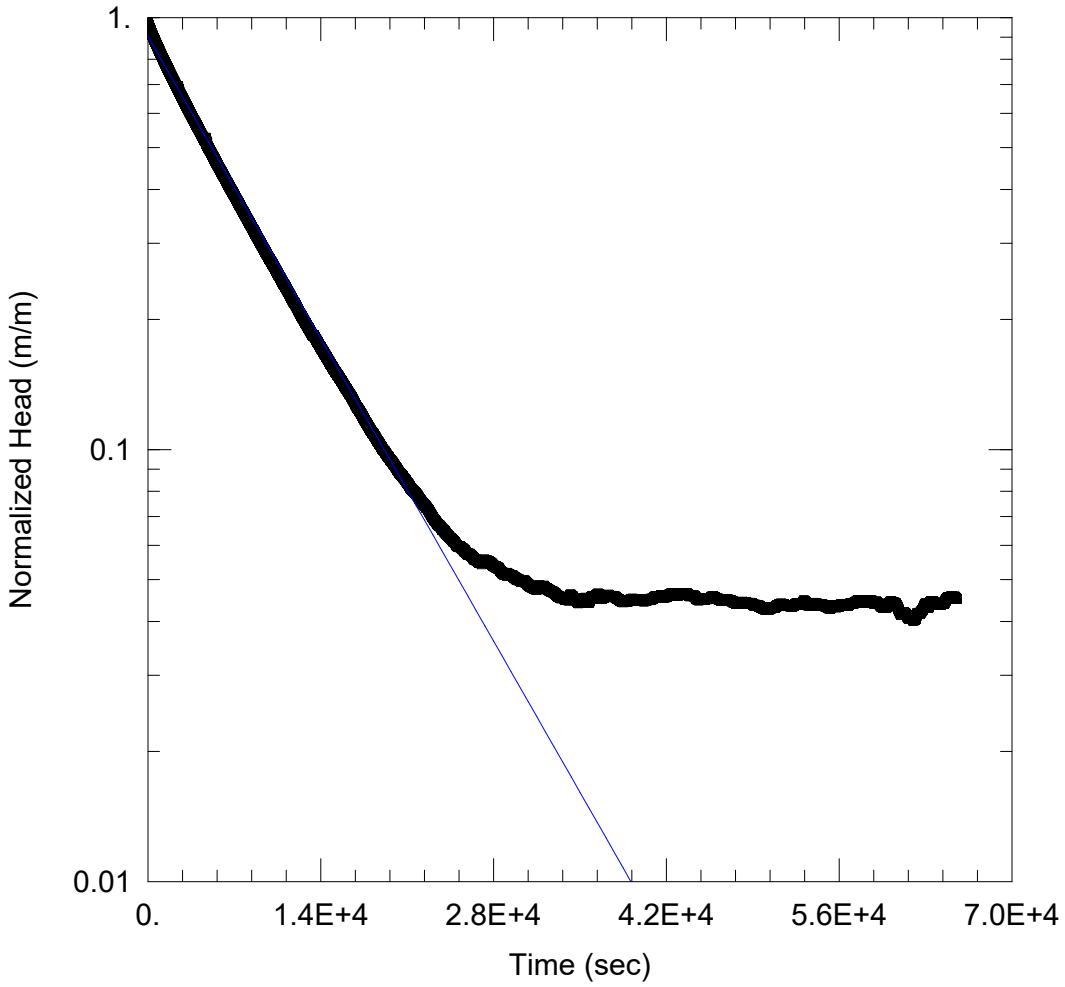
WELL DATA (BH202)

Initial Displacement: 1.52 m
Total Well Penetration Depth: 3.03 m
Casing Radius: 0.025 m
Static Water Column Height: 2.97 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.601E-6 m/sec y0 = 1.592 m



WELL TEST ANALYSIS

Data Set:
Date: 03/09/23 Time: 12:08:47

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Treasure Hill
Project: BRM-21010864-C0
Location: 15450 Woodbine Ave, Stouffvill
Test Well: BH205
Test Date: March 2, 2023

AQUIFER DATA

Saturated Thickness: 3.3 m Anisotropy Ratio (Kz/Kr): 1.

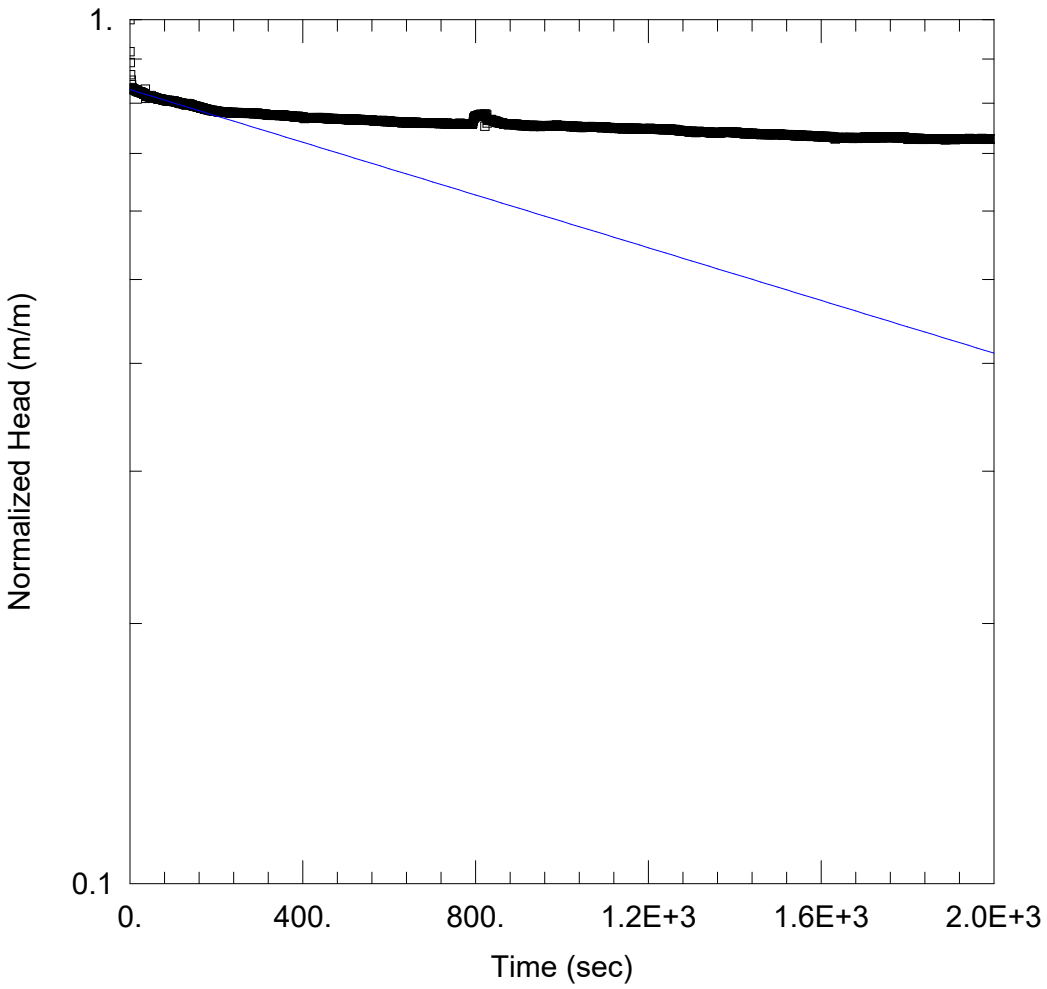
WELL DATA (BH205)

Initial Displacement: 1.65 m
Total Well Penetration Depth: 3.35 m
Casing Radius: 0.025 m
Static Water Column Height: 3.3 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.573E-8 m/sec y0 = 1.493 m



WELL TEST ANALYSIS

Data Set: E:\...\BH208R.aqt
Date: 02/22/23 Time: 10:25:56

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Treasure Hill
Project: BRM-21010864-C0
Location: 15450 Woodbine Ave, Stouffvill
Test Well: BH208
Test Date: February 7, 2023

AQUIFER DATA

Saturated Thickness: 1.8 m Anisotropy Ratio (Kz/Kr): 1.

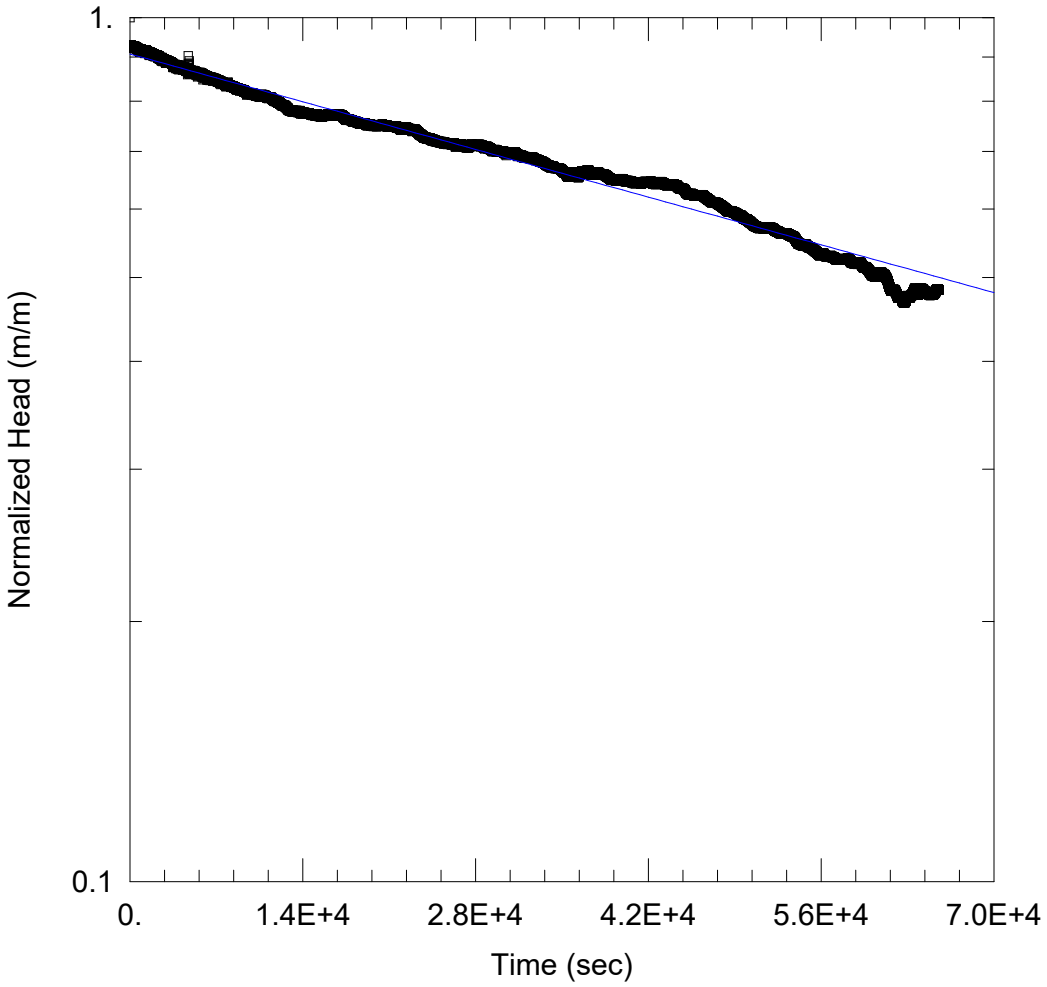
WELL DATA (BH208)

Initial Displacement: 0.4 m
Total Well Penetration Depth: 4.22 m
Casing Radius: 0.025 m
Static Water Column Height: 1.8 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 3.231E-7 m/sec y0 = 0.3319 m



WELL TEST ANALYSIS

Data Set:
Date: 03/09/23 Time: 12:13:46

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Treasure Hill
Project: BRM-21010864-C0
Location: 15450 Woodbine Ave, Stouffvill
Test Well: BH209
Test Date: March 2, 2023

AQUIFER DATA

Saturated Thickness: 2. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH209)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 4.02 m
Casing Radius: 0.025 m
Static Water Column Height: 2. m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 7.519E-9 m/sec y0 = 0.2722 m

Single Well Response Testing

Standard Operating Procedure No: 2012-8
Version 1.0
Revision Date: September, 2012

Prepared By:

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Standard Operating Procedure - Single Well Response Tests (SWRT)

1.0 Introduction

This standard operating procedure describes the use of **SWRT** (also commonly known as a slug test) to obtain estimates of the saturated hydraulic conductivity (K) in a groundwater formation. The in-situ determination of the saturated hydraulic conductivity and other hydraulic properties in an aquifer is important for characterizing groundwater flow.

Single well response tests are short–duration tests that provide estimates of the horizontal hydraulic conductivity of the geological formation in the immediate area around the well screen.

These tests involve the creation of an instantaneous change in water level and monitoring the response of the water level until it recovers to near static conditions. The instantaneous change in water level is accomplished by displacing a know volume of water through the introduction or withdrawal of water or a solid object (referred to as a 'slug') of known volume and monitoring the changes in the water level over time.

Monitoring the decrease in water level following the introduction of a slug is referred to a falling head test.

Monitoring the rise in water levels following the withdrawal of a slug is referred to as a rising head test.

It is critical to ensure:

- that the monitoring well was constructed appropriately and construction details are known;
- that the monitoring well to be tested is completely developed;
- that the well screen is free of any soil material.

If the well has not been developed recently, the well should be developed prior to commencing the SRWT.

SWRT Strengths

- Can be applied for low conductive layers where a pumping test is not feasible;
- Volume of purged water is minimal; therefore, does not need large amount of water disposal (important when testing potentially contaminated sites);
- Can be completed with minimal cost and a short period of time; and,
- No observation wells required.

SWRT Weaknesses

- Hydraulic Conductivity is given only for the immediately well area; and,
- If the formation is disturbed during MW installation, observed hydraulic conductivity maybe biased high.

2.0 Applicable Regulations/Guidelines

The following regulations and guidelines apply to this SOP:

- ASTM D4044-96 – Standard Test method for (Field Procedures) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers
- ASTM D4104-96 e-1 – Standard Test Method (Analytical Procedures) for determining Transmissivity of Non-leaky Confined Aquifers by Over-damped Well Response to Instantaneous Change in Head (Slug Test).
- ASTM 5785-95 - Standard Test Method (Analytical Procedures) for determining Transmissivity of Non-leaky Confined Aquifers by Under-damped Well Response to Instantaneous Change in Head (Slug Test).

3.0 Related SOPs

Prior to commencing SWRT procedures, field personnel are required to refer the following additional SOPs:

- Monitoring Well Development (No. 2012-6); and,
- Groundwater Sampling (No. 2012-7).

4.0 Attachments

- Static Water Level Measurement and Data Logger Installation Form (Attachment 1); and,
- Single Well Response Test Field Data Entry Form (Attachment 2).

5.0 Planning & Preparation

Prior to conducting an intrusive investigation program, the follow tasks/activities are required:

- review the project specific Health and Safety Plan (HASP) noting all Site-specific hazards and personnel protective equipment requirements.
- review the approved scope of work and other relevant project documentation regarding:
    - the project objectives;
    - site conditions;
    - specific issues of concern;
    - field methodologies:
    - sampling requirements including data quality objectives: and,
    - quality assurance/quality control (QA/QC) measures.
- review any maps, borehole logs or other information relevant to the Site.
- obtain any available well logs and/or previous water level/water quality information on all the wells to be tested.

  Required well information includes the following:

    - borehole diameter (inner diameter of the well);
    - well depth;
    - static water levels;
    - screen interval/depth;
    - gravel pack interval/depth; and,
    - geological unit screened.
- prepare an equipment check list and assemble all necessary equipment, forms, sampling containers, reagents, calibration standards.
- if not already on site, arrange for the provision of drums/containers for the collecting and storage of groundwater.
- gather equipment required to complete the SWRT. Rent and pick-up any equipment required to complete the test (see section 6.0 for a complete list of equipment).
- if using data loggers: check all the equipment for proper calibration; DLs to be reset; set the measuring interval to at least five (5) seconds, more frequent water level measurements; if a rapid water level change is expected, it is preferred to set-up the measuring interval to one (1) second.
- arrange access to the site, obtain any keys required to open wells or entrance gates.
- inform client, land owner, regulatory authorities etc. as appropriate; obtain any access/working permits to the site (e.g. City permit to work along the roads).

Note:

When dealing with contaminated sites, pre-plan the testing sequence: 'clean' wells should be tested prior to 'contaminated wells' to avoid cross contamination.

6.0 Equipment/Documentation List:

The equipment to conduct a SWRT program is to include the following:

- Copy of a signed health and safety plan
- Copy of the approved Scope of Work
- 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
- Closed containers to collect decontamination fluids

7.0 Field Procedures

Single Well Response Tests can be performed using electronic water level meters to manually record water levels or pressure transducers (data loggers) with subsequent data transfer to a computer for analysis. In the case of a falling head slug test, it is critical that the static water level is above the top of the well screen interval, otherwise the test is measuring the response of the unsaturated sand pack and not of the surrounding saturated formation.

Slug tests should be performed on undisturbed wells. A minimum of one week should be allowed between completion of a well and conducting a slug test.

The well should be developed and the water level recovered to within 3 cm of its static level prior to performing the slug test.

The field procedures provided are proposed, assuming that the well has been previously developed. If the monitoring well is not properly developed, the test results may not be reliable.

General

- Inspect the monitoring wells and record static water levels moving from up-gradient to down-gradient.
- If the tests are being performed in an area of know groundwater contamination, proceed from the least contaminated to the most contaminated well.
- The volume of the slug should be sufficient to create minimum 50 cm (0.5 m) change in water level
- Prepare a decontamination area with two layers of 6 mil plastic sheeting and containers to collect wash and rinse waters.
- Decontaminate the slug prior to initial use and between monitoring well locations. The slug should be decontaminated by washing first with a mixture of municipal water and phosphate free detergent, followed by rinses with municipal water, ethyl alcohol, isopropyl alcohol or Alconox and deionized water.
- The disposable rope used to lower the slug at each monitoring well location should be changed between wells.

The general procedure for completing a SWRT using three different methods is summarized below followed by a more detailed discussion on how to record water levels (manually and electronically).

Note:

The volume of the slug (or water) should be sufficient to change the water level at least 0.5 m. If the SWL is within the gravel pack, the volume calculation must account for the porosity (0.3 in general) of the sand pack. For bail-down tests, the volume of water removed must be recorded.

SWRT Methods

a) SWRT Using a Solid Slug

- Identify the well, clean the work area if required, measure static water level and time, total well depth, and record data logger serial number.
- Install the data logger at a sufficient depth below the water table, so that the slug will not strike the data logger upon insertion into the well; record the data logger depth.
- Set the slug just above the water table.
- If using a baro logger, install just below the top of the casing (ie. 1 meter below the casing).
- Pre-measure the length of string holding the slug - the slug must be completely submerged in water once dropped into the well.
- Release the slug instantaneously into water.
- Measure water level manually at intervals specified on the field form along with the time elapsed and the time of day (the time of day is required to correspond measurements with the data logger).
- Leave the slug in the well until water column has recovered by at least 90%.

  Once 90% recovery is achieved, the slug and data logger can be removed.

b) SWRT By Injecting a Slug of Water

- Identify the well, clean the work area if required, measure:
    - static water level and time;
    - total well depth; and,
    - record data logger serial number.
- Calculate the required volume of water to raise the water table for approximately 1.0 to 2.0 m from the static water level.

  It is preferred to add enough water to raise the water level by at least 0.5 m from the static water level.

  If the SWL is within the gravel pack, the volume calculation must account for the porosity (0.3 in general) of the sand pack.
- Add a known volume of water rapidly to the well.
- Measure water level manually at intervals specified on the field form along with the time elapsed and the time of day (the time of day is required to correspond measurements with the data logger).
- Leave the data logger in the well until water column has recovered by at least 90%.
- Take one last manual measurement of the water level and remove the data logger from the well.

c) SWRT By Removing A Known Volume of Water (Bail-down Test)

- Identify the well, clean the work area if required, measure static water level and time, total well depth, and record data logger serial number.
- Pre-determine the data logger installation depth and keep the data logger ready to install, as it will be installed immediately after bailing the well.
- Remove water from the well using a bailer (this must be done as quickly as possible!).
- Pour the removed water into a container – the volume of water removed must be measured once the test is completed.
- Install the data logger to the pre-determined depth, record the depth.
- Measure water level manually at intervals specified on the field form along with the time elapsed and the time of day (the time of day is required to correspond measurements with the data logger).
- Leave the data logger in the well until the water column has recovered by at least 90%.
- Take one last manual water level measurement and remove the data logger from the well, documenting the time of removal.

Note:

A bailer that has the proper diameter can be used to rapidly remove required amount of water from the well.

Procedures for Water Level Measurements

a) Manual Measurements (Electronic Water Level Meter)

- Decontaminate the electronic water level meter prior to use.
- For a falling head test, position the slug just above the static water level and the water level meter immediately above the slug.

  Quickly release the slug to create an instantaneous water level change and ensure that the slug is completely submerged.
- Upon release of the slug, quickly re-position the water level meter to record the water level and assign the level as the time zero reading.
- Start the stop watch and record the water level and the elapsed time at successive intervals as indicated on the field form.

  The recording intervals and the initial response period will be determined by the aquifer specific conditions.

  If the aquifer response is extremely quick, the measurement increments should be adjusted accordingly.
- If water is to be introduced into the well, ensure that it is from a clean source and transported in a clean container.
- Continue to record water levels for the falling head test until the water level has recovered to within 90% of its initial level.
- Upon 90% recovery, remove the water level probe and quickly remove the slug from the well to conduct the rising head test.
- Quickly re-position the water level meter to record the zero time water level.
- Record water levels over 10 second intervals or the shortest time interval as possible during the initial response period.
- Continue to record water levels for the rising head test until the water column has recovered by at least 90%.
- Be sure to document the monitoring well location, the date and time of the slug test, the model and make of the pressure transducer and data logger, the slug volume, the tests performed, depth to water and any comments in a slug test form or in a bound field notebook.

b) Level Logger Measurements (Pressure Transducers)

- Check the response and range of the pressure transducer and review the operations of the date recorder.

  Ensure that the transducer pressure range is appropriate for the water column depth.

- Decontaminate the pressure transducer and cable.
- Prior to positioning of the pressure transducer, line the edges of the well casing to protect the transducer cable.
- Set up the data logger and enter required data to initiate data logging according to the manufactures instructions.
- Position the pressure transducer at a depth where it will not be struck by the slug and at least 60 cm above the bottom of the well.

  It is critical that the data logger depth be recorded in order to calibrate the readings once the test is completed.

- Set the pressure transducer to record water levels at 1 second intervals and at shorter intervals for more coarse textured media.
    - Record water levels to the nearest 0.5 cm
    - Record the time of day to the nearest second.

  The number of measurements and intervals will depend on the formation specific conditions.

- Take manual water level measurements using an electronic water level meter at regular intervals to confirm the pressure transducer readings.
- For the falling head test, position the slug just above the static water level and quickly release the slug to create an instantaneous water level change.

  Ensure that the slug is completely submerged.

- If water is to be introduced into the well, ensure that it is from a clean source and transported in a clean container.
- Continue to record water levels for the falling head test until the water column has recovered to at least 90% of the documented static water level.
- Upon 90% recovery, quickly remove the slug from the well to conduct the rising head test.
- Continue to record water levels for the rising head test until the water column has recovered by at least 90% of the documented static water level.
- Continue to record water levels manually using an electronic water level meter (to calibrate / confirm the data logger readings).
- On completion of the rising head test, remove the data logger and download the water level and time data from to a computer.
- Be sure to document:
    - the monitoring well location;
    - the date and time of the Single Well Response Test:
    - the make and model of any equipment used (pressure transducer, data logger);
    - the slug volume;
    - the tests performed;

- depth to water;and,
- any comments in a slug test form or in a bound field notebook.

Additional Notes:

- *All manual measurements used to calibrate data logger data should correspond with the time of day (as the data logger will record levels that correspond to time of day).*
- *Ensure the starting time and measuring intervals of the data logger are properly aligned (start at the same time of day).*

Further Readings:

C.W. Fetter *Applied Hydrogeology*

END OF SOP

Appendix E – Laboratory's Certificates of Analysis

Your Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Your C.O.C. #: 921878-10-01

Attention: Simon Lan

exp Services Inc
Markham Branch
220 Commerce Valley Dr W
Suite 500
Markham, ON
CANADA L3T 0A8

Report Date: 2023/03/09
Report #: R7540229
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C358707
Received: 2023/03/01, 14:55

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
ABN Compounds in Water by GC/MS	1	2023/03/08	2023/03/08	CAM SOP-00301	EPA 8270 m
Carbonaceous BOD	1	2023/03/02	2023/03/07	CAM SOP-00427	SM 23 5210B m
Total Cyanide	1	2023/03/02	2023/03/02	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2023/03/02	2023/03/03	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2023/03/03	2023/03/03	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	1	2023/03/03	2023/03/03	CAM SOP-00447	EPA 6020B m
Total Nonylphenol in Liquids by HPLC	1	2023/03/06	2023/03/07	CAM SOP-00313	In-house Method
Nonylphenol Ethoxylates in Liquids: HPLC	1	2023/03/06	2023/03/07	CAM SOP-00313	Bureau Veritas
Animal and Vegetable Oil and Grease	1	N/A	2023/03/02	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2023/03/02	2023/03/02	CAM SOP-00326	EPA1664B m,SM5520B m
Polychlorinated Biphenyl in Water	1	2023/03/02	2023/03/02	CAM SOP-00309	EPA 8082A m
pH	1	2023/03/02	2023/03/03	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2023/03/02	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Turbidimetry	1	N/A	2023/03/03	CAM SOP-00464	SM 23 4500-SO42- E m
Total Kjeldahl Nitrogen in Water	1	2023/03/03	2023/03/08	CAM SOP-00938	OMOE E3516 m
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	1	2023/03/02	2023/03/02	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2023/03/03	2023/03/06	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2023/03/03	CAM SOP-00228	EPA 8260D

Remarks:

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

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

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

Your Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Your C.O.C. #: 921878-10-01

Attention: Simon Lan

exp Services Inc
Markham Branch
220 Commerce Valley Dr W
Suite 500
Markham, ON
CANADA L3T 0A8

Report Date: 2023/03/09
Report #: R7540229
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C358707
Received: 2023/03/01, 14:55

implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

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:
Patricia Legette, Project Manager
Email: Patricia.Legette@bureauveritas.com
Phone# (905)817-5799

==========

This report has been generated and distributed using a secure automated process.
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

Bureau Veritas Job #: C358707
Report Date: 2023/03/09

exp Services Inc
Client Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Sampler Initials: JD

YORK SANITARY & STORM SEWER (2021-102)

Bureau Veritas ID				VEG837			VEG837		
Sampling Date				2023/02/28			2023/02/28		
COC Number				921878-10-01			921878-10-01		
	UNITS	**Criteria**	**Criteria-2**	**BH202**	**RDL**	**QC Batch**	**BH202 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters									
Total Animal/Vegetable Oil and Greas	mg/L	-	150	0.80	0.50	8528123			
Inorganics									
Total Carbonaceous BOD	mg/L	15	300	<2	2	8530489			
Fluoride (F-)	mg/L	-	10	<0.10	0.10	8531629			
Total Kjeldahl Nitrogen (TKN)	mg/L	1	100	**3.8**	1.0	8533354			
pH	pH	6.0:9.0	6.0:10.5	7.47		8531634			
Phenols-4AAP	mg/L	0.008	1	<0.0010	0.0010	8531736			
Total Suspended Solids	mg/L	15	350	<10	10	8531699	<10	10	8531699
Dissolved Sulphate (SO4)	mg/L	-	1500	66	1.0	8531489			
Total Cyanide (CN)	mg/L	0.020	2	<0.0050	0.0050	8530462			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	1.3	0.50	8531514			
Total Oil & Grease Mineral/Synthetic	mg/L	-	15	0.50	0.50	8531521			
Miscellaneous Parameters									
Nonylphenol Ethoxylate (Total)	mg/L	-	0.2	<0.025	0.025	8535527			
Nonylphenol (Total)	mg/L	-	0.02	<0.001	0.001	8535524			
Metals									
Mercury (Hg)	mg/L	0.0004	0.01	<0.00010	0.00010	8532708			
Total Aluminum (Al)	ug/L	-	50000	18	4.9	8532737			
Total Antimony (Sb)	ug/L	-	5000	<0.50	0.50	8532737			
Total Arsenic (As)	ug/L	20	1000	<1.0	1.0	8532737			
Total Cadmium (Cd)	ug/L	8	700	<0.090	0.090	8532737			
Total Chromium (Cr)	ug/L	80	2000	<5.0	5.0	8532737			
Total Cobalt (Co)	ug/L	-	5000	0.79	0.50	8532737			
Total Copper (Cu)	ug/L	50	3000	1.1	0.90	8532737			
Total Lead (Pb)	ug/L	120	1000	<0.50	0.50	8532737			
Total Manganese (Mn)	ug/L	150	5000	74	2.0	8532737			
Total Molybdenum (Mo)	ug/L	-	5000	4.3	0.50	8532737			
Total Nickel (Ni)	ug/L	80	2000	3.3	1.0	8532737			

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

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Regional Municipality of York By-Law No 2021-102, Limits for Storm Sewer/Land Drainage Discharge
Criteria-2: Regional Municipality of York By-Law No 2021-102, Limits for Sanitary Sewer Discharge

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

YORK SANITARY & STORM SEWER (2021-102)

Bureau Veritas ID				VEG837			VEG837		
Sampling Date				2023/02/28			2023/02/28		
COC Number				921878-10-01			921878-10-01		
	UNITS	**Criteria**	**Criteria-2**	**BH202**	**RDL**	**QC Batch**	**BH202 Lab-Dup**	**RDL**	**QC Batch**
Total Phosphorus (P)	ug/L	400	10000	<100	100	8532737			
Total Selenium (Se)	ug/L	20	1000	<2.0	2.0	8532737			
Total Silver (Ag)	ug/L	120	5000	<0.090	0.090	8532737			
Total Tin (Sn)	ug/L	-	5000	1.9	1.0	8532737			
Total Titanium (Ti)	ug/L	-	5000	<5.0	5.0	8532737			
Total Zinc (Zn)	ug/L	40	2000	<5.0	5.0	8532737			
Semivolatile Organics									
Bis(2-ethylhexyl)phthalate	ug/L	8.8	12	<2.0	2.0	8540171			
Di-N-butyl phthalate	ug/L	15.0	80	<2.0	2.0	8540171			
Volatile Organics									
Benzene	ug/L	2.0	10	<0.40	0.40	8531364			
Chloroform	ug/L	2.0	40	<0.40	0.40	8531364			
1,2-Dichlorobenzene	ug/L	5.6	50	<0.80	0.80	8531364			
1,4-Dichlorobenzene	ug/L	6.8	80	<0.80	0.80	8531364			
cis-1,2-Dichloroethylene	ug/L	5.6	4000	<1.0	1.0	8531364			
trans-1,3-Dichloropropene	ug/L	5.6	140	<0.80	0.80	8531364			
Ethylbenzene	ug/L	2.0	160	<0.40	0.40	8531364			
Methylene Chloride(Dichloromethane	ug/L	5.2	2000	<4.0	4.0	8531364			
Methyl Ethyl Ketone (2-Butanone)	ug/L	-	8000	<20	20	8531364			
Styrene	ug/L	-	200	<0.80	0.80	8531364			
1,1,2,2-Tetrachloroethane	ug/L	17.0	1400	<0.80	0.80	8531364			
Tetrachloroethylene	ug/L	4.4	1000	<0.40	0.40	8531364			
Toluene	ug/L	2.0	270	<0.40	0.40	8531364			
Trichloroethylene	ug/L	8.0	400	<0.40	0.40	8531364			
p+m-Xylene	ug/L	-	-	<0.40	0.40	8531364			
o-Xylene	ug/L	-	-	<0.40	0.40	8531364			
Total Xylenes	ug/L	4.4	1400	<0.40	0.40	8531364			
PCBs									
Total PCB	ug/L	0.4	1	<0.05	0.05	8530128			

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

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Bureau Veritas Job #: C358707
Report Date: 2023/03/09

exp Services Inc
Client Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Sampler Initials: JD

YORK SANITARY & STORM SEWER (2021-102)

Bureau Veritas ID				VEG837			VEG837		
Sampling Date				2023/02/28			2023/02/28		
COC Number				921878-10-01			921878-10-01		
	UNITS	**Criteria**	**Criteria-2**	**BH202**	**RDL**	**QC Batch**	**BH202 Lab-Dup**	**RDL**	**QC Batch**
Surrogate Recovery (%)									
2,4,6-Tribromophenol	%	-	-	51		8540171			
2-Fluorobiphenyl	%	-	-	60		8540171			
2-Fluorophenol	%	-	-	22		8540171			
D14-Terphenyl	%	-	-	91		8540171			
D5-Nitrobenzene	%	-	-	59		8540171			
D5-Phenol	%	-	-	14		8540171			
Decachlorobiphenyl	%	-	-	93		8530128			
4-Bromofluorobenzene	%	-	-	91		8531364			
D4-1,2-Dichloroethane	%	-	-	106		8531364			
D8-Toluene	%	-	-	92		8531364			

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

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Regional Municipality of York By-Law No 2021-102, Limits for Storm Sewer/Land Drainage Discharge
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Bureau Veritas Job #: C358707
Report Date: 2023/03/09

exp Services Inc
Client Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Sampler Initials: JD

TEST SUMMARY

Bureau Veritas ID: VEG837
Sample ID: BH202
Matrix: Water

Collected: 2023/02/28
Shipped:
Received: 2023/03/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
ABN Compounds in Water by GC/MS	GC/MS	8540171	2023/03/08	2023/03/08	Kathy Horvat
Carbonaceous BOD	DO	8530489	2023/03/02	2023/03/07	Frank Zhang
Total Cyanide	SKAL/CN	8530462	2023/03/02	2023/03/02	Kruti Jitesh Patel
Fluoride	ISE	8531629	2023/03/02	2023/03/03	Kien Tran
Mercury in Water by CVAA	CV/AA	8532708	2023/03/03	2023/03/03	Thuy Linh Nguyen
Total Metals Analysis by ICPMS	ICP/MS	8532737	2023/03/03	2023/03/03	Arefa Dabhad
Total Nonylphenol in Liquids by HPLC	LC/FLU	8535524	2023/03/06	2023/03/07	Furneesh Kumar
Nonylphenol Ethoxylates in Liquids: HPLC	LC/FLU	8535527	2023/03/06	2023/03/07	Furneesh Kumar
Animal and Vegetable Oil and Grease	BAL	8528123	N/A	2023/03/02	Automated Statchk
Total Oil and Grease	BAL	8531514	2023/03/02	2023/03/02	Kishan Patel
Polychlorinated Biphenyl in Water	GC/ECD	8530128	2023/03/02	2023/03/02	Svitlana Shaula
pH	AT	8531634	2023/03/02	2023/03/03	Kien Tran
Phenols (4AAP)	TECH/PHEN	8531736	N/A	2023/03/02	Mandeep Kaur
Sulphate by Automated Turbidimetry	KONE	8531489	N/A	2023/03/03	Massarat Jan
Total Kjeldahl Nitrogen in Water	SKAL	8533354	2023/03/03	2023/03/08	Jency Sara Johnson
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	8531521	2023/03/02	2023/03/02	Kishan Patel
Total Suspended Solids	BAL	8531699	2023/03/03	2023/03/06	Shaneil Hall
Volatile Organic Compounds in Water	GC/MS	8531364	N/A	2023/03/03	Manpreet Sarao

Bureau Veritas ID: VEG837 Dup
Sample ID: BH202
Matrix: Water

Collected: 2023/02/28
Shipped:
Received: 2023/03/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Suspended Solids	BAL	8531699	2023/03/03	2023/03/06	Shaneil Hall

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GENERAL COMMENTS

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

Package 1	1.0°C

Sample VEG837 [BH202] : VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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Bureau Veritas Job #: C358707
Report Date: 2023/03/09

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Sampler Initials: JD

			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
8530128	Decachlorobiphenyl	2023/03/02	92	60 - 130	79	60 - 130	91	%				
8531364	4-Bromofluorobenzene	2023/03/03	102	70 - 130	102	70 - 130	95	%				
8531364	D4-1,2-Dichloroethane	2023/03/03	102	70 - 130	99	70 - 130	106	%				
8531364	D8-Toluene	2023/03/03	103	70 - 130	106	70 - 130	93	%				
8540171	2,4,6-Tribromophenol	2023/03/08	82	10 - 130	89	10 - 130	71	%				
8540171	2-Fluorobiphenyl	2023/03/08	73	30 - 130	68	30 - 130	75	%				
8540171	2-Fluorophenol	2023/03/08	41	10 - 130	47	10 - 130	36	%				
8540171	D14-Terphenyl	2023/03/08	91	30 - 130	95	30 - 130	93	%				
8540171	D5-Nitrobenzene	2023/03/08	77	30 - 130	88	30 - 130	83	%				
8540171	D5-Phenol	2023/03/08	26	10 - 130	29	10 - 130	23	%				
8530128	Total PCB	2023/03/02	93	60 - 130	82	60 - 130	<0.05	ug/L	NC	40		
8530462	Total Cyanide (CN)	2023/03/02	86	80 - 120	99	80 - 120	<0.0050	mg/L	NC	20		
8530489	Total Carbonaceous BOD	2023/03/07					<2	mg/L	NC	30	90	85 - 115
8531364	1,1,2,2-Tetrachloroethane	2023/03/03	88	70 - 130	93	70 - 130	<0.40	ug/L	NC	30		
8531364	1,2-Dichlorobenzene	2023/03/03	88	70 - 130	95	70 - 130	<0.40	ug/L	NC	30		
8531364	1,4-Dichlorobenzene	2023/03/03	100	70 - 130	107	70 - 130	<0.40	ug/L	NC	30		
8531364	Benzene	2023/03/03	83	70 - 130	83	70 - 130	<0.20	ug/L	NC	30		
8531364	Chloroform	2023/03/03	89	70 - 130	89	70 - 130	<0.20	ug/L	0.79	30		
8531364	cis-1,2-Dichloroethylene	2023/03/03	92	70 - 130	92	70 - 130	<0.50	ug/L	0.60	30		
8531364	Ethylbenzene	2023/03/03	83	70 - 130	88	70 - 130	<0.20	ug/L	NC	30		
8531364	Methyl Ethyl Ketone (2-Butanone)	2023/03/03	105	60 - 140	108	60 - 140	<10	ug/L	NC	30		
8531364	Methylene Chloride(Dichloromethane)	2023/03/03	91	70 - 130	91	70 - 130	<2.0	ug/L	NC	30		
8531364	o-Xylene	2023/03/03	81	70 - 130	91	70 - 130	<0.20	ug/L	NC	30		
8531364	p+m-Xylene	2023/03/03	88	70 - 130	95	70 - 130	<0.20	ug/L	NC	30		
8531364	Styrene	2023/03/03	96	70 - 130	106	70 - 130	<0.40	ug/L	NC	30		
8531364	Tetrachloroethylene	2023/03/03	75	70 - 130	85	70 - 130	<0.20	ug/L	2.9	30		
8531364	Toluene	2023/03/03	88	70 - 130	93	70 - 130	<0.20	ug/L	NC	30		
8531364	Total Xylenes	2023/03/03					<0.20	ug/L	NC	30		
8531364	trans-1,3-Dichloropropene	2023/03/03	102	70 - 130	97	70 - 130	<0.40	ug/L	NC	30		
8531364	Trichloroethylene	2023/03/03	92	70 - 130	94	70 - 130	<0.20	ug/L	4.7	30		
8531489	Dissolved Sulphate (SO4)	2023/03/03	NC	75 - 125	91	80 - 120	<1.0	mg/L	1.1	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8531514	Total Oil & Grease	2023/03/02			99	85 - 115	<0.50	mg/L	0.51	25		
8531521	Total Oil & Grease Mineral/Synthetic	2023/03/02			97	85 - 115	<0.50	mg/L	0.52	25		
8531629	Fluoride (F-)	2023/03/03	86	80 - 120	99	80 - 120	<0.10	mg/L	0.48	20		
8531634	pH	2023/03/03			102	98 - 103			1.6	N/A		
8531699	Total Suspended Solids	2023/03/06					<10	mg/L	NC	20	98	85 - 115
8531736	Phenols-4AAP	2023/03/02	101	80 - 120	103	80 - 120	<0.0010	mg/L	NC	20		
8532708	Mercury (Hg)	2023/03/03	101	75 - 125	105	80 - 120	<0.00010	mg/L	NC	20		
8532737	Total Aluminum (Al)	2023/03/03	NC	80 - 120	107	80 - 120	<4.9	ug/L				
8532737	Total Antimony (Sb)	2023/03/03	108	80 - 120	103	80 - 120	<0.50	ug/L				
8532737	Total Arsenic (As)	2023/03/03	101	80 - 120	100	80 - 120	<1.0	ug/L				
8532737	Total Cadmium (Cd)	2023/03/03	96	80 - 120	98	80 - 120	<0.090	ug/L				
8532737	Total Chromium (Cr)	2023/03/03	100	80 - 120	98	80 - 120	<5.0	ug/L				
8532737	Total Cobalt (Co)	2023/03/03	96	80 - 120	97	80 - 120	<0.50	ug/L				
8532737	Total Copper (Cu)	2023/03/03	102	80 - 120	101	80 - 120	<0.90	ug/L				
8532737	Total Lead (Pb)	2023/03/03	91	80 - 120	98	80 - 120	<0.50	ug/L				
8532737	Total Manganese (Mn)	2023/03/03	96	80 - 120	96	80 - 120	<2.0	ug/L				
8532737	Total Molybdenum (Mo)	2023/03/03	105	80 - 120	97	80 - 120	<0.50	ug/L				
8532737	Total Nickel (Ni)	2023/03/03	91	80 - 120	94	80 - 120	<1.0	ug/L				
8532737	Total Phosphorus (P)	2023/03/03	108	80 - 120	102	80 - 120	<100	ug/L				
8532737	Total Selenium (Se)	2023/03/03	103	80 - 120	107	80 - 120	<2.0	ug/L				
8532737	Total Silver (Ag)	2023/03/03	89	80 - 120	92	80 - 120	<0.090	ug/L				
8532737	Total Tin (Sn)	2023/03/03	103	80 - 120	100	80 - 120	<1.0	ug/L				
8532737	Total Titanium (Ti)	2023/03/03	112	80 - 120	101	80 - 120	<5.0	ug/L				
8532737	Total Zinc (Zn)	2023/03/03	95	80 - 120	101	80 - 120	<5.0	ug/L				
8533354	Total Kjeldahl Nitrogen (TKN)	2023/03/08	99	80 - 120	104	80 - 120	<0.10	mg/L	NC	20	99	80 - 120
8535524	Nonylphenol (Total)	2023/03/07	105	50 - 130	104	50 - 130	<0.001	mg/L	NC	40		
8535527	Nonylphenol Ethoxylate (Total)	2023/03/07	NC (1)	50 - 130	93	50 - 130	<0.025	mg/L	NC	40		
8540171	Bis(2-ethylhexyl)phthalate	2023/03/09	96	30 - 130	95	30 - 130	<2.0	ug/L	NC	40		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8540171	Di-N-butyl phthalate	2023/03/09	103	30 - 130	110	30 - 130	<2.0	ug/L	NC	40		

N/A = Not Applicable

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

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

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

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

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

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

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

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

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

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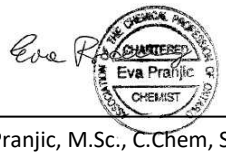
Bureau Veritas Job #: C358707
Report Date: 2023/03/09

exp Services Inc
Client Project #: BRM-21010864-C0
Site Location: 15450 WOODBINE AVENUE, ON
Sampler Initials: JD

VALIDATION SIGNATURE PAGE

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



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

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by {0}, {1} responsible for {2} {3} laboratory operations.

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Page 1 of 1

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#17485 exp Services Inc	Company Name:	EXP	Quotation #:	C20328	Bureau Veritas Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Simon Lee; James Duncan	P.O. #:			921878
Address:	220 Commerce Valley Dr W Suite 500	Address:		Project:	15450 Woodbine Avenue		
	Markham ON L3T 0A8			Project Name:	BRM-210108G4-CO	COC #:	Project Manager:
Tel:	(905) 695-3217 Fax:	Tel:	Fax:	Site #:		C#921878-10-01	Patricia Legette
Email:	AP@exp.com; karen.burke@exp.com	Email:	simon.lee@exp.com; james.duncan@exp.com	Sampled By:	SP		

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

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☐ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558 ☒ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality York	
☐ Table ___	☐ PWQO ☐ Reg 406 Table	
	☐ Other	

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

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	Sewer Use Bylaw Region of York	# of Bottles	Comments
1		BH202	2023/02/28	AM	GW	NO	X	17	
2									
3									
4									
5									
6									
7									
8									
9									
10									

01-Mar-23 14:55
Patricia Legette
C358707
AKO ENV-1319

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
James Duncan	2023/03/01	11:00 AM	KANGI SOLADHARA	2023/03/01	14:55	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	1.0, 2	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-TERMS-AND-CONDITIONS.

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

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

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

White: Bureau Veritas Yellow: Client

BV: 634521

Bureau Veritas Canada (2019) Inc.

Exceedance Summary Table – York Storm SUB 2021

Result Exceedances

Sample ID	Bureau Veritas ID	Parameter	Criteria	Result	DL	UNITS
BH202	VEG837-10	Total Kjeldahl Nitrogen (TKN)	1	3.8	1.0	mg/L

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

Exceedance Summary Table – York Sanitary SUB 2021

Result Exceedances

Sample ID	Bureau Veritas ID	Parameter	Criteria	Result	DL	UNITS
No Exceedances						

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

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Project No. BRM-21010864-C0
Hydrogeological Assessment
15450 Woodbine Avenue, Stouffville, Ontario

SUMMARY OF GROUNDWATER SAMPLE AGAINST PROVINCIAL WATER QUALITY OBJECTIVES

			SAMPLE ID:	BH202	
			SAMPLING DATE:	2023/02/28	
Report Group	**Parameter Name**	**PWQO**	**Units**	**Result**	**DL**
Nonyl Phenol and Nonyl Phenol Ethoxylate	Nonylphenol Ethoxylate (Total)		mg/L	<0.025	0.025
Nonyl Phenol and Nonyl Phenol Ethoxylate	Nonylphenol (Total)	0.00004	mg/L	<0.001	0.001
	Total Animal/Vegetable Oil and Grease		mg/L	0.8	0.5
	Total Oil & Grease		mg/L	1.3	0.5
	Total Oil & Grease Mineral/Synthetic	0.5	mg/L	0.5	0.5
Semi-Volatile Organics by GC-MS	Bis(2-ethylhexyl)phthalate	0.6	ug/L	<2.0	2
Semi-Volatile Organics by GC-MS	Di-N-butyl phthalate	4	ug/L	<2.0	2
Polychlorinated Biphenyls by GC-ECD	Total PCB	0.001	ug/L	<0.05	0.05
	Fluoride (F-)		mg/L	<0.10	0.1
	pH	6.5:8.5	pH	7.47	N/A
	Dissolved Sulphate (SO4)		mg/L	66	1
	Total Suspended Solids		mg/L	<10	10
Elements by Atomic Spectroscopy	Total Aluminum (Al)		ug/L	18	4.9
Elements by Atomic Spectroscopy	Total Antimony (Sb)	20	ug/L	<0.50	0.5
Elements by Atomic Spectroscopy	Total Arsenic (As)	100	ug/L	<1.0	1
Elements by Atomic Spectroscopy	Total Cadmium (Cd)	0.2	ug/L	<0.090	0.09
Elements by Atomic Spectroscopy	Total Chromium (Cr)		ug/L	<5.0	5
Elements by Atomic Spectroscopy	Total Cobalt (Co)	0.9	ug/L	0.79	0.5
Elements by Atomic Spectroscopy	Total Copper (Cu)	5	ug/L	1.1	0.9
Elements by Atomic Spectroscopy	Total Lead (Pb)	5	ug/L	<0.50	0.5
Elements by Atomic Spectroscopy	Total Manganese (Mn)		ug/L	74	2
Elements by Atomic Spectroscopy	Total Molybdenum (Mo)	40	ug/L	4.3	0.5
Elements by Atomic Spectroscopy	Total Nickel (Ni)	25	ug/L	3.3	1
Elements by Atomic Spectroscopy	Total Phosphorus (P)	10	ug/L	<100	100
Elements by Atomic Spectroscopy	Total Selenium (Se)	100	ug/L	<2.0	2
Elements by Atomic Spectroscopy	Total Silver (Ag)	0.1	ug/L	<0.090	0.09
Elements by Atomic Spectroscopy	Total Tin (Sn)		ug/L	1.9	1
Elements by Atomic Spectroscopy	Total Titanium (Ti)		ug/L	<5.0	5
Elements by Atomic Spectroscopy	Total Zinc (Zn)	30	ug/L	<5.0	5
	Total Carbonaceous BOD		mg/L	<2	2
	Total Cyanide (CN)		mg/L	<0.0050	0.005
	Total Kjeldahl Nitrogen (TKN)		mg/L	3.8	1
	Phenols-4AAP	0.001	mg/L	<0.0010	0.001
Elements by Atomic Spectroscopy	Mercury (Hg)	0.0002	mg/L	<0.00010	0.0001
Volatile Organics by GC/MS	Benzene	100	ug/L	<0.40	0.4
Volatile Organics by GC/MS	Chloroform		ug/L	<0.40	0.4
Volatile Organics by GC/MS	1,2-Dichlorobenzene	2.5	ug/L	<0.80	0.8
Volatile Organics by GC/MS	1,4-Dichlorobenzene	4	ug/L	<0.80	0.8
Volatile Organics by GC/MS	cis-1,2-Dichloroethylene	200	ug/L	<1.0	1
Volatile Organics by GC/MS	trans-1,3-Dichloropropene	7	ug/L	<0.80	0.8
Volatile Organics by GC/MS	Ethylbenzene	8	ug/L	<0.40	0.4
Volatile Organics by GC/MS	Methylene Chloride(Dichloromethane)	100	ug/L	<4.0	4
Volatile Organics by GC/MS	Methyl Ethyl Ketone (2-Butanone)	400	ug/L	<20	20
Volatile Organics by GC/MS	Styrene	4	ug/L	<0.80	0.8
Volatile Organics by GC/MS	1,1,2,2-Tetrachloroethane	70	ug/L	<0.80	0.8
Volatile Organics by GC/MS	Tetrachloroethylene	50	ug/L	<0.40	0.4
Volatile Organics by GC/MS	Toluene	0.8	ug/L	<0.40	0.4
Volatile Organics by GC/MS	Trichloroethylene	20	ug/L	<0.40	0.4
Volatile Organics by GC/MS	p+m-Xylene	2	ug/L	<0.40	0.4
Volatile Organics by GC/MS	o-Xylene	40	ug/L	<0.40	0.4
Volatile Organics by GC/MS	Total Xylenes		ug/L	<0.40	0.4

NOTES:

1) PWQO - Ontario Provincial Water Quality Objectives

2) Sample collected was for York Region Sewer discharge purposes, and is compared to PWQO as a preliminary assessment, however sample collection method and laboratory analyses may differ to meet PWQO objectives

3) Indicates RDL exceeds criteria:

Disclaimer: This is not an official certficate of analysis. For QC data and comments, please refer to the original reports issued by Bureau Veritas.

Appendix F – Infiltration Testing

15450 Woodbine Avenue, Stouffville
BRM-21010864-C0
Low Impact Design (LID) Calculations for Infiltration Gallery

Test Location	Hydraulic Conductivity (K_{fs}) (cm/s)	Infiltration Rate (IR) (mm/hr)	Discrete Design Infiltration Rate(DIR) (mm/hr)	Percolation Time (min/cm)
BH210	6.0E-04	75	21	28
BH211	4.8E-04	70	20	30

Geology Units	Geometric Mean of K_{fs} (cm/s)	Infiltration Rate (I) (mm/hr)*	Ratio of Mean Measured Infiltration Rates	Safety Correction Factor (SCF)
Overlying Geology Unit	5.37E-04	73	2.1	3.5
Underlying Geology Unit (1.5 m below the bottom of trench)	3.20E-05	34		

Design Infiltration Rate(DIR) (mm/hr)	Minimum	20.1	**Percolation Time (min/cm)**	28
	Maximum	21.4		30
	Geometric Mean	**20.7**		**29**

Note:
Analytical Solutions (CVC and TRCA 2010)

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

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

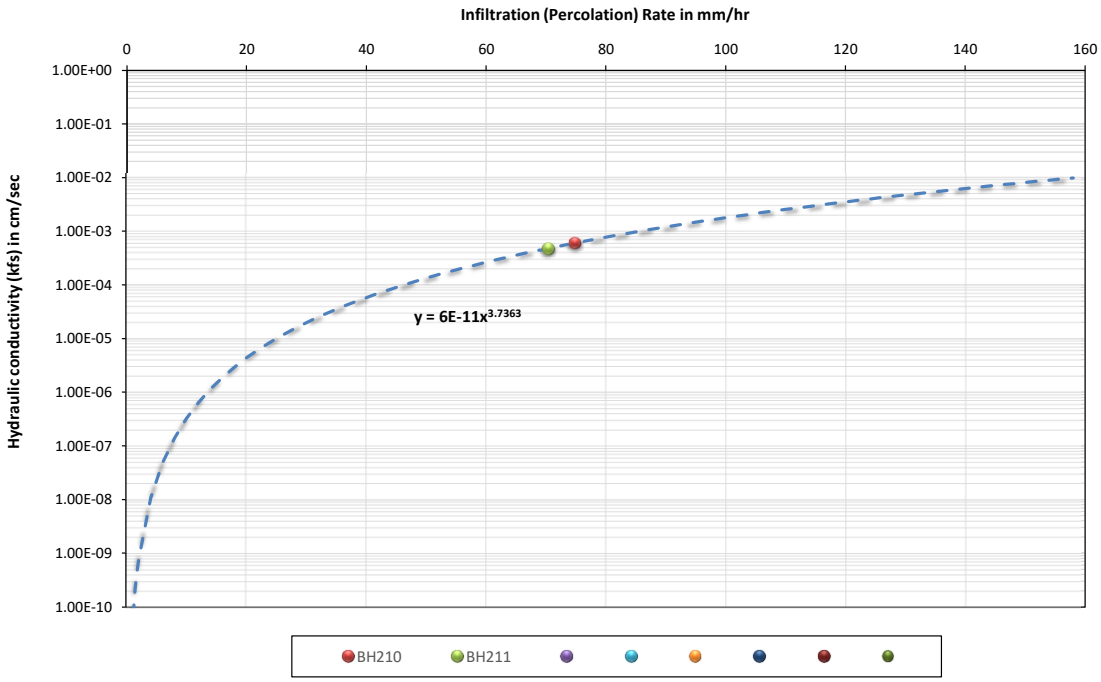
Kfs: hydraulic conductivity (cm/sec)

IR: infiltration rate (mm/hr)

DIR: design infiltration rate (mm/hr)

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

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



Appendix G – Construction Flow Rate Calculations

APPENDIX G: Short-Term Flow Rate - Site Building

15450 Woodbine Avenue, Stouffville, ON
BRM-21010864-C0

Table G-1: Radial Flow

Parameters	Symbols	Unit	Building	West Parking Lot
Geological Formation	-	-	Glacial Deposit	Glacial Deposit
Ground Elevation	-	mASL	306.22	306.22
Lowest Top Slab Elevation	-	mASL	306.70	-
Highest Groundwater Elevation	-	mASL	304.97	304.97
Lowest Footing Elevation / Excavation Depth	-	mASL	303.20	305.20
Base of the Water-Bearing Zone	-	mASL	293	293
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	12.27	12.27
Dewatering Target Elevation	-	mASL	302.20	304.20
Height of Target Water Level Above the Base of Water-Bearing Zone	**h_w**	m	9.50	11.50
Hydraulic Conductivity	**K**	m/s	3.20E-07	3.20E-07
Length of Excavation	-	m	137	160
Width of Excavation	-	m	89	35
Equivalent Radius (equivalent perimeter)	**r_e**	m	72.1	62.1
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**	**Cooper-Jacob**
Time (30 days)	**t**	s	5184000	5184000
Specific Yield	**Sy**		0.10	0.10
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	21	21
Radius of Influence	**Ro**	m	94	83
Dewatering Flow Rate (unconfined radial flow component)	**Q**	m^3/day	**20.18**	**5.39**
Factor of Safety	**fs**	-	2	2
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	**40.35**	**10.77**
Precipitation Event	-	mm/day	15	15
Volume from Precipitation	-	m^3/day	183.84	84.00
Dewatering Flow Rate With Safety Factor (including stormwater collection)	-	m^3/day	**224.19**	**94.77**

Notes:
mASL - meters above sea level

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

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

(Based on the Dupuit-Forcheimer Equation)

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

Where:

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

K = Hydraulic conductivity (m/s)

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

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

Rcj=Cooper Jacob Radius of Influence (m)

R_o=Radius of influence (m)

re=Equivalent perimeter (m)

APPENDIX G: Construction Dewatering Calculations - Site Servicing

15450 Woodbine Avenue, Stouffville, ON
BRM-21010864-C0

Table G-2: Flow all Sides of the Excavation

Parameters	Symbols	Unit	Highest K Value	Geomean K Value
Ground Surface Elevation	-	mASL	306.22	306.22
Highest Groundwater Elevation	-	mASL	304.97	304.97
Lowest Excavation Elevation		mASL	301.70	301.70
Dewatered Elevation Target	-	mASL	300.70	300.70
Top of the Water-Bearing Zone	-	mASL	304.97	304.97
Base of the Water-Bearing Zone	-	mASL	293	293
Height of Water Table Above the Base of Water-Bearing Zone	**H**	m	12.27	12.27
Height of Dewatering Target Above the Base of Water-Bearing Zone	**h_w**	m	8.00	8.00
Hydraulic Conductivity	**K**	m/s	1.60E-06	3.20E-07
Length of Excavation	-	m	30	30
Width of Excavation	-	m	5	5
Method to Calculate Radius of Influence	-	-	**Sichardt**	**Sichardt**
Radius of Influence	**Ro**	m	16	7
Distance to Linear Source from Sides of excavation	**Lo=Ro/2**	m	8	4
Dewatering Flow Rate (unconfined linear flow component)	**Q**	m^3/day	**51.7**	**23.1**
Factor of Safety	**FS**	-	2	2
Dewatering Flow Rate (multiplied by factor of safety)	**Q.FS**	m^3/day	103.4	46.2
Precipitation Event	-	mm/day	15	15
Volume from Precipitation	-	m^3/day	2.25	2.25
Dewatering Flow Rate **With Safety Factor** (excluding rainwater collection)	-	m^3/day	**103.4**	**46.2**
Dewatering Flow Rate **With Safety Factor** (including rainwater collection)	-	m^3/day	**105.6**	**48.5**

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)