Watersand North Phase II Sub-Division, 259 Salem Road, Barrie, Ontario

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Hydrogeological Investigation and Water Balance Assessment

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by Watersand Construction Ltd. c/o DG Group. to prepare a Hydrogeological Investigation and Water Balance Assessment Report associated with the proposed development located at Watersand North Phase II Sub-Division, 259 Salem Road, Barrie, Ontario (hereinafter referred to as the 'Site'). The Site area is in an irregular shape, extending from the north central to the southeastern portion of the sub-division area. The Site location plan is shown on Figure 1.

It is our understanding that the proposed development will consist of single-family residential dwelling, townhouses, and mixed-use buildings with one level of basement, as well as a parkland and stormwater management pond (SWMP). Moreover, the proposed development will be accommodated with underground services (i.e., sanitary and storm sewers as well as watermain systems) and paved municipal roads. The proposed development plan is provided in Appendix J.

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

1.2 Project Objectives

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

- Establish the local hydrogeological settings within the Site;
- Conduct seasonal water level monitoring in all monitoring wells for one (1) year (in progress);
- Assess groundwater quality;
- Assess construction dewatering flow rates and potential impacts (short-term);
- Assess post-construction dewatering flow rates (long-term);
- Develop site-specific water balance assessment for pre-and post-development phases using Thornthwaite-Mather method and evaluate the infiltration deficit and mitigation measures for post-development phase; and
- Prepare a Hydrogeological Investigation and Water Balance Assessment Report.

1.3 Scope of Work

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

- Reviewed available geological and hydrogeological information for the Site;
- Evaluated the information collected during the field investigation program, including borehole geological information, Water Well Records (WWR), infiltration testing results, groundwater level measurements and groundwater water quality;
- Developed and conducted Single Well Response Tests (SWRT) on all monitoring wells to assess hydraulic conductivities of the saturated soil horizons at the Site;
- Conducted four (4) infiltration tests in the shallow soil horizons to an approximate depth of one (1) meter below ground surface (mbgs) to assess percolation rates in support of the Low Impact Development (LID) design;
- Completed two (2) rounds of groundwater level measurements at all monitoring wells. As per the Lake Simcoe Conservation Authority's (LSCA) requirement, a one (1) year monitoring program on bi-monthly basis is currently in progress. This report will be updated upon the completion of the noted monitoring program;

- Collected one (1) groundwater sample for the laboratory testing of the City of Barrie's Sanitary and Storm Sewer By-Law parameters, and one (1) general chemistry for comparison to the Ontario's Provincial Water Quality Objectives (PWQO);
- Evaluated the information collected during the field investigation program, including borehole geological information, Water Well Records (WWR), SWRT results, infiltration test results, groundwater level measurements and groundwater water quality;
- Prepared site plans, cross section, geological mapping, and groundwater contour mapping for the Site; and
- Evaluated construction dewatering flow rates (short-term) and potential dewatering impacts on surround environment;
- Assessed post-construction dewatering flow rates (long-term) for the future sub-drain system;
- Provided recommendations on the Ministry of Environment, Conservation and Parks (MECP) Water Taking Permits and the City of Barrie's Sewer Discharge Agreements (SDA) for the construction phase;
- Reviewed Source Water Protection mapping, including Well Head Protection Areas (WHPA), Highly Vulnerable Aquifers (HVA), and Significant Groundwater Recharge Areas (SGRA);
- Conducted pre- and post-development water balance assessment using Thornthwaite and Mather method;
- Prepared pre- and post-site-specific water balance assessments for the Site and evaluated the preliminary sizing of mitigation measures (LIDs); and
- Prepared a Hydrogeological Investigation and Water Balance Assessment Report.

A review summary form will be issued for the Lake Simcoe Conservation Authority (LSCA) based on the results of this investigations under a separate cover.

The Hydrogeological Investigation and Water Balance Assessment was prepared in accordance with the Ontario Water Resources Act, Ontario Regulation 387/04, the City of Barrie's sewer by-law criteria and Provincial Water Quality Objectives. The scope of work outlined above was made to assess dewatering and did not include a review of Environmental Site Assessments (ESA).

1.4 Review of Previous Reports

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

- EXP Services Inc. (June 16, 2022), Geotechnical Investigation, Proposed Residential Subdivision, Watersand North Phase II, Barrie, ON, prepared for Watersand Constrcution Limited.

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

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is within a physiographic region known as the Peterborough Drumlin Field. The physiographic landform is named Till Plains (Drumlinized). The Peterborough Drumlin Field is surrounded by the Simcoe Lowlands from the east, north and west; Whereas Schomberg Clay Plains lies to the south of the Peterborough Drumlin Field (Chapman & Putnam, 2007).

2.1.2 Regional Geology and Hydrogeology

The predominant surficial geology can be described as ice-contact stratified deposits consisting of sand and gravel as well as stone-poor carbonate-derived silty to sandy till (Ministry of Northern Development and Mines, 2012). The surficial geology of the Site and surrounding areas are 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, 2022). The overburden thickness is approximately 194 m (Appendix H).

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.	311
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.	310-311
Newmarket Till (Aquitard)	This lithologic unit mainly consist of a massive and dense silty sand unit.	299-302
Thorncliffe Formation (Aquifer)	This geology formation generally consists of glaciofluvial (sand, silty sand) or glaciolacustrine deposits (silt, sand, pebbly silt and clay).	Not Mapped
Sunnybrook Formation (Aquitard)	This lithologic unit was deposited near an ice sheet. It predominately consists of silt and clay.	197-201
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 sand overlaying silt and clay deposits.	155
Lindsay Formation	Bedrock primarily consists of nodular to laminated limestone. It belongs to the Upper Ordovician, (Ministry of Northern Development and Mines, 2012).	115-166

Note: refer to Appendix H for details

Two geological features are identified near to the Site, including a closed depression and a bedrock thalweg. The closed depression, trending north-south, is at a short distance from the Site boundary to the east. The bedrock thalweg, trending northwest-southeast, is at an approximate distance of 1.7 km from the Site boundary (Appendix H).

Regional groundwater across the area flows towards Lake Simcoe and Georgian Bay (Appendix H). Based on the available regional groundwater contour map, groundwater mounding has been indicated at several locations on the west and northwestern sides of 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 and/or existing subsurface infrastructure.

2.1.3 Existing Water Well Survey

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

The MECP WWR database reportedly indicates thirty-six (36) records within a 500-m radius from the Site centroid where one (1) of the records is identified as onsite well.

The database indicates that the offsite wells are at an approximate distance of six-hundred and twelve (612) meters or greater from the Site centroid. All offsite wells were reportedly identified as water supply wells and observation wells or listed as abandoned.

A total of twenty-five (25) offsite water supply wells are identified. The offsite water supply wells are reportedly located at an approximate distance of 612 meters from the Site centroid. Moreover, the only onsite well record is identified as water supply well. The Well Identification numbers (Well IDs) of all water supply wells are highlighted in Appendix A.

The depth to water for all noted well records reportedly range from 2.1 to 48.8 meters below ground surface (mbgs).

The locations of the MECP WWR within 500-m of the Site centroid are shown on Figure 3. A table with the WWRs is included in Appendix A.

To confirm the active status of noted water supply wells, a door-to-door well survey is recommended.

2.2 Site Setting

2.2.1 Site Topography

The Site is in an un-urban land use setting. The topography is considered relatively flat with gradual northeasterly, south easterly and southwesterly slopes towards the local creeks which drain to Lake Simcoe in the east or Georgian Bay in the northwest (Appendix H).

As indicated on the borehole logs included in Appendix B, the surface elevation of the Site ranges between approximately 310.84 to 312.45 meters above sea level (masl).

2.2.2 Local Surface Water Features

A large portion of the Site area in the west is within the Bear Creek-Nottawasaga watershed; whereas a relatively small portion of the Site area in the east is within the Lake Simcoe watershed area. A boundary between the noted watersheds defines the corresponding source protection areas (Appendix I). No surface water features exist onsite. Two (2) seasonal ponds are identified at approximately 40 m and 412 m from the Site boundaries to the southeast and east, respectively. Both of noted ponds are within the Bear Creek-Nottawasaga watershed. Small tributaries of Bear Creek are identified at approximately 80 m and 160 m from the Site boundaries to the northeast and south, respectively. Upgradient of Lovers Creek is identified at approximately 315 m from the Site boundary to the northeast. Bear Creek and Lovers Creek eventually empty into Georgian Bay in the northwest and Lake Simcoe in the east, respectively.

The Site is surrounded by swamp wetlands where most of them are presented as unevaluated; however, a Provincially Significant Wetland is identified at approximately 750 meters to the northeast of the Site (Appendix I).

2.2.3 Local Geology and Hydrogeology

A summary of subsurface soil stratigraphy is provided in the following paragraphs. The soil descriptions are based on the geotechnical investigation report (EXP, 2022). They are summarized for the hydrogeological interpretations. As such, the information provided in this section shall not be used for construction design purposes.

The detailed soil profiles encountered in each borehole and the results of moisture content determinations are presented on the attached borehole logs (Appendix B). The interpreted hydrogeological cross-sections are presented in Figures 5A through 5C. The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the Hydrogeological Investigation and Water Balance Assessment and shall not be interpreted as exact planes of geological change.

The "Notes on Sample Description" preceding the borehole logs form an integral part of the logs 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:

Topsoil

A layer of topsoil, 80 to 300 mm in thickness, was encountered at the surface of all boreholes.

With respect to topsoil, it should be noted that topsoil measurements were carried out at the borehole locations only and could differ at other locations on the site. Consequently, topsoil quantities should not be established from the information provided at the borehole locations. If required, a more detailed test pit program should be carried out to quantify the amount of topsoil more accurately to be removed for construction purposes.

Clayey Silt

A clayey silt layer was encountered below the topsoil in Boreholes 102 and 104. The layer extended to the 8.1 m depth of drilling in Borehole 104 and was penetrated at 4.0 m depth (Elevation 308.1 m) in Borehole 102. The layer was typically firm to very stiff (N-Values of 11 to 24) and was locally soft at the top of Borehole 102 (N-Value of 3) and hard at the base of Borehole 104 (N-Value of 35). The layer contained trace to some sand and gravel and was noted as about the plastic limit (APL). Moisture contents were recorded at 16 to 31%.

Sand/Silty Sand/Sand and Silt/Sandy Silt

A major granular deposit (sand/silty sand/sand and silt/sandy silt) was encountered in all boreholes with the exception of Boreholes 102 and 104, dominating the site composition with the below noted till layer. Three samples of the granular deposit we submitted for grain size analysis and the results demonstrating the gradation distribution are presented on Figure 18, attached. Trace clay and gravel were observed throughout the unit. Sand and gravel layers and occasional silt seams were also noted locally. The granular layers were particularly dominant at the south end of the site, locally intercepted by the till deposit. At the north end of the property, the till and sand layers were more comparably represented. The layers were typically found in a compact to very dense state (N-Values greater than 10) below 1.5 to 3.0 m depth across the site. The layer was typically wet, with moisture contents recorded between approximately 3 and 25%.

Silt

A localized silt layer was encountered below the topsoil, clayey silt or sand in Boreholes 102 and 106 to 108. A sampling of the material was submitted for gradation and the results are presented on Figure 18, attached. The silt contained trace to some sand, trace clay and trace gravel. The layer was compact in Borehole 102 and 107 (N-Values of 10 to 24), and very dense in Boreholes 106 and 108 (N-Values greater than 50). The silt was moist to wet, with moisture contents of 13 to 29%.

Till

A till layer consisting of sandy silt/silty sand (locally clayey silt) was observed in Boreholes 101, 103, 105, 106, 109, and 114 to 116. The unit was intermixed with layers of the aforementioned granular soils (sand/silty sand/sand and silt/sandy silt). Variable clay and gravel content along with cobbles and boulders were noted. Wet sand seams were observed throughout the deposit. Two samples of the till material were submitted for grain size analysis, with results presented on Figure 19, attached. The till material was compact to very dense (N-Values of 16 to greater than 50) across the site. Moisture contents of the till were recorded at approximately 7 to 21 percent, with the moistures in the clayey silt till being slightly higher than the moisture retained in the sandy silt/silty sand deposits.

3 Results

3.1 Monitoring Well Details

Total of fourteen (14) monitoring wells were installed as part of the Geotechnical Investigations at the Site. The details of the noted monitoring network are described below.

- Six (6) shallow monitoring wells, including BH 101-S, BH 103-S, BH 105, BH 106-S, BH 110-S, and BH 111 were installed to an approximate depth ranging from 6.3 to 7.8 mbgs;
- Three (3) intermediate monitoring wells, including BH 108, BH 112, and BH 115-S were installed to an approximate dept ranging from 9 to 10.9 mbgs;
- Five (5) deep monitoring wells, including BH 101-D, BH 103-D, BH 106-D, BH 110-D, and BH 115-D were installed to an approximate depth ranging from 13.7 to 15.6 mbgs;
- Five (5) pair of wells, including BH 101 (S/D), BH 103 (S/D), BH 106 (S/D), BH 110 (S/D), BH 115 (S/D) were installed in a nested configuration;
- Each well is equipped with a 50-mm (2-inch) diameter PVC casing, a 3-meter-long screen, and an over-ground protective casing.

Borehole logs and monitoring well installation details are provided in Appendix B. The monitoring well locations are shown on Figure 4.

3.2 Water Level Monitoring

As part of the Hydrogeological Investigation and Water Balance Assessment, static water levels in all monitoring wells installed across the Site were recorded in two (2) monitoring events, including May 25 and June 8, 0222. A summary of all static water level data as it relates to the elevation survey is provided in Appendix C.

The groundwater elevations recorded for the shallow wells ranged from 308.22 masl (3.76 mbgs at BH 105 on June 8, 2022) to 311.98 masl (0.37 mbgs at BH 101-S on June 8, 2022). The groundwater elevations recoded for the intermediate wells ranged from 308. 47 masl (2.37 mbgs at BHBH 115-S on June 8, 2022) to 310.92 masl (1.29 mbgs at BH 108 on June 8, 2022). The groundwater elevations recorded for the deep wells ranged from 308.63 masl (2.21 mbgs at BH 115-D on June 8, 2022) to 311.79 masl (0.56 mbgs at BH 101-D) on June 8, 2022).

One (1) map was created for the Site to show groundwater contours for the water-bearing zones (Figures 6). Accordingly, the groundwater flow directions are interpreted to be north, northeast, east, southeast, and south of the Site. This may indicate a groundwater mound on the west side of the Site. The noted groundwater mound is shown on the regional groundwater contour map (Appendix H).

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

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

3.3 Hydraulic Conductivity Testing

Fourteen (14) Single Well Response Tests (SWRT's) were completed on all monitoring wells on June 8, 2022, where thirteen (13) of the tests could be utilized for data analysis. 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 3-1.

Table 3-1: Summary of Hydraulic Conductivity Testing

Monitoring Well	Well Depth (mbgs) *	Screen Interval (mbgs)		Screened Lithology **	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH 101-S	6.29	3.29	6.29	Sandy Silt Till / Sand	5.9E-06
BH 101-D	15.59	12.59	15.59	Clayey Silt Till	3.9E-07
BH 103-S	6.76	3.76	6.76	Silty Sand / Sandy Silt to Silty Sand Till	7.8E-07
BH 103-D	15.16	12.16	15.16	Sandy Silt to Silty Sand Till	1.2E-07
BH 106-S	7.51	4.51	7.51	Sand	1.6E-05
BH 106-D	13.74	10.74	13.74	Sand / Silt / Clayey Silt	4.3E-06
BH 108	9.04	6.04	9.04	Sandy Silt to Silty Sand / Sand	5.6E-07
BH 110-S	6.95	3.95	6.95	Sand	1.0E-06
BH 110-D	14.55	11.55	14.55	Sand	4.4E-06
BH 111	7.34	4.34	7.34	Sand	1.3E-04
BH 112	10.88	7.88	10.88	Sand	6.4E-06
BH 115-S	9.94	6.94	9.94	Sand	3.4E-06
BH 115-D	13.92	10.92	13.92	Sand / Sandy Silt to Silty Sand Till	1.7E-05
				Highest Estimated K Value	1.3E-04
				Arithmetic Mean of K Values	1.4E-05
				Arithmetic Mean plus One Standard Deviation of K Values	4.9E-05
				Geometric Mean of Estimated K Values	3.0E-06

Note:
*measured in the field
**based on the geotechnical borehole logs (EXP, 2022)
mbgs: meter below ground surface

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 3-1, the highest K-value of the tested water-bearing zone is 1.3E-4 m/s. The geometric and arithmetic means of the K-values are estimated 3E-6 m/s and 1.4E-5 m/s, respectively. The arithmetic mean plus one standard deviation from the mean is estimated 4.9E-5 m/s.

3.4 Groundwater Quality

To assess the suitability for discharging pumped groundwater into the sewers owned by the City of Barrie during dewatering activities, one (1) groundwater sample was collected from monitoring well BH 106-D (deep well) on June 8, 2022, using a peristaltic pump.

Moreover, one (1) groundwater sample was collected from BH 106-D on June 8, 2022, for Routine Comprehensive Package (RCAp) analysis, using peristaltic pump to assess the suitability for discharging pumped groundwater into the surface water. The results were compared to the Ontario's Provincial Water Quality Objectives (PWQO).

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

Based on the complete results for RCAp sample, as well as partial results for By-Law sample, there were no parameter exceedances to be reported.

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 as well as the PWQO. 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 and/or environment. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.

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

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

Based on the water quality results, should the discharge groundwater be released into the environment at the Site during both construction and post-construction phases, a suitable treatment system is to be implemented.

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

An agreement to discharge into the sewers owned by the City of Barrie 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.

4 Dewatering Assessment

The dimensions of the proposed structure to support the dewatering assessment are summarized in Table 4-1 below.

Table 4-1 Building Dimensions for Dewatering Assessment

Input Parameter		Assumption	Units	Notes
Number of Subgrade Levels		One Level	-	-
Ground Elevation		312.35	masl	The ground surface elevation where the highest groundwater elevation is recorded (BH 101-S)
Groundwater Elevation		311.98	masl	The highest groundwater elevation recorded for the Site (0.37 mbgs at BH 101-S on June 8, 2022)
Lowest Top Slab Elevation		309.3	masl	Assumed to be 1.5 m above the foundation elevation
Lowest Excavation Elevation	A Single Dwelling	307.8	masl	The lowest foundation is based on the geotechnical report (EXP, 2022); Whereas the excavation for underground services is anticipated to be extended 3.5 mbgs (EXP, 2021). For the latter, the excavation elevation is referenced to the ground elevation at BH 101-S.
	Underground Services	308.85		
Dewatering Elevation	A Single Dwelling	306.8	masl	Assumed to be one (1) meter below the lowest excavation elevation
	Underground Services	307.85		
Excavation Area (Length x Width)	A Single Dwelling	150 (15 x 10)	m^2 (m x m)	Approximate area (length x width) of Site for the proposed development
	Underground Services	100 (20 x 5)		

4.1 Dewatering Flow Rate Estimate and Zone of Influence

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

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

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

Where:

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

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

4.2 Cooper-Jacob's Radius of Influence

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

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

Where:

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

4.3 Stormwater

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

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

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

During precipitation events greater than 15 mm (ex: 100-year storm), measures should be taken by the contractor to retain stormwater onsite in a safe manner to not exceed the allowable water taking and discharge limits, as necessary. A two (2) and a one hundred (100) year storm event over a 24-hour period are 57 and 126 mm (Appendix F).

4.4 Results of Dewatering Rate Estimates

4.4.1 Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed construction plans include an excavation with shoring extending to the Site boundaries. EXP should be retained to review the assumptions outlined in this section, should the assumed shoring design change. Short-term (construction) dewatering calculations are presented in Appendix F. Based on the assumptions provided in this report, the results of the dewatering rate estimate can be summarized as follows:

Table 4-2 Summary of Construction Dewatering Rate

Peak Dewatering Flow Rates		
Description	One (1) Level of Basement **(L/day)**	Underground Services (L/day)
Total Volume of Short-Term Groundwater Discharge (Construction Dewatering) without Safety Factor (including precipitation)	361,000	307,000
Total Volume of Short-Term Groundwater Discharge (Construction Dewatering) with Safety Factor (including precipitation)	719,000	613,000
Total Volume of Short-Term Groundwater Discharge (Construction Dewatering) with Safety Factor (excluding Precipitation) for EASR and PTTW	717,000	611,000

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

Local dewatering may be required for pits (elevator pits, sump pits, raft) 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 the systems and ramp/site access to redirect runoff away from excavation.

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

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

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

4.4.2 Preliminary Post-Construction Dewatering Rate Estimate

It is our understanding that the development plan includes a permanent foundation sub-drain system that will ultimately discharge to the municipal sewer system if conventional footings are installed. The long-term dewatering was based on the same equations as construction dewatering shown in Section 4.1.

The calculation for the estimated flow to the future sub-drain system (with no cutoff walls) is provided in Appendix F. The dewatering target for the foundation drainage system is taken at 0.5 m below the lowest slab elevation.

The foundation drain analysis provides a flow rate estimate. Once the foundation drain is built, actual flow rate measurements of the sump discharge will be required to confirm the estimated flow rate.

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

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

Long-Term Dewatering Flow Rate	One (1) Level of Basement (L/day)
Total Volume of Long-Term Groundwater Drainage Rate *without* Safety Factor (from foundation drainage, weeping tiles, sub slab drainage)	59,000
Total Volume of Long-Term Groundwater Drainage Rate *with* Safety Factor (from foundation drainage, weeping tiles, sub slab drainage)	89,000

Note: it is assumed that the elevator pit will be water-proofed

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

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

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

4.5 MECP Water Taking Permits

4.5.1 Short-Term Discharge Rate (Construction Phase)

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

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

The dewatering estimate including a safety factor is greater than 400, 000 L/day as shown in Table 4-2. Based on the MECP's construction dewatering criteria, a Category 3 PTTW will be required to facilitate the construction dewatering program at the Site.

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

The PTTW, 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 PTTW will need to be updated to reflect these modifications. Altogether, the hydrogeological report, PTTW, Discharge Plan and geotechnical assessment constitute the Water Taking Plan which needs to be available onsite during the construction dewatering.

4.5.2 Preliminary Long-Term Discharge Rate (Post Construction Phase)

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

Based on the dewatering estimate shown in Table 4-3 is greater than 50,000 L/day, and as such a Category 3 Permit to Take Water (PTTW) will be required for the post-development phase. This rate should be confirmed for the post-construction phase.

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

5 Environmental Impact

5.1 Surface Water Features

A large portion of the Site area in the west is within the Bear Creek-Nottawasaga watershed; whereas a relatively small portion of the Site area in the east is within the Lake Simcoe watershed area. A boundary between the noted watersheds defines the corresponding source protection areas (Appendix I). No surface water features exist onsite. Two (2) seasonal ponds are identified at approximately 40 m and 412 m from the Site boundaries to the southeast and east, respectively. Both of noted ponds are within the Bear Creek-Nottawasaga watershed. Small tributaries of Bear Creek are identified at approximately 80 m and 160 m from the Site boundaries to the northeast and south, respectively. Upgradient of Lovers Creek is identified at approximately 315 m from the Site boundary to the northeast. Bear Creek and Lovers Creek eventually empty into Georgian Bay in the northwest and Lake Simcoe in the east, respectively.

The Site is surrounded by swamp wetlands where most of them are presented as unevaluated; however, a Provincially Significant Wetland is identified at approximately 750 meters to the northeast of the Site (Appendix I).

Due to the extent of zone of influence and proximity of the construction areas to the nearest surface water features, potential impacts on the quantity of surface water features are expected during construction activities. As such, it is recommended that the water quantity of the surface water features be monitored during the construction phase.

5.2 Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas (HVAs and SGRAs)

Based on the Ontario Source Protection Information Atlas and South Georgian Bay-Lake Simcoe Source Protection Region websites, the southeast and northwest portions of the Site are identified within a Highly Vulnerable Aquifer (HVA) areas which they coincide with Significant Groundwater Recharge Areas (SGRA) of Chategory-6 (Appendix I).

As such, construction dewatering activities across the Site may pose environmental risks to the shallow/deep aquifers. As such, it is recommended that the water quality of the aquifers be tested during the construction dewatering activities.

5.3 Wellhead Protection Areas (WHPA) and Recharge Management

Based on the Ontario Source Protection Information Atlas and South Georgian Bay-Lake Simcoe Source Protection Region websites, the Site is identified within Wellhead Protection Area of Q2-Category (WHPA-Q2). WHPA-Q2 refers to the areas where any changes in the recharge rates across the lands surrounding the water supply wells can potentially affect their dewatering rates.

Due to the extent of zone of influence and proximity of the construction areas to the water supply wells, it is likely that construction dewatering activities can potentially affect the noted wells in the vicinity of the Site. As such, a door-to-door well survey within a 500-m of the Site boundary is recommended during the construction dewatering activities.

5.4 Geotechnical Considerations

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

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

5.5 Groundwater Quality

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

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

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

Based on the water quality results, should the discharge groundwater be released into the environment at the Site during both construction and post-construction phases, a suitable treatment system is to be implemented.

An agreement to discharge into the sewers owned by the City of Barrie 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.

5.6 Well Decommissioning

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

6 Site-Specific Water Balance

6.1 Site Specific Infiltration Test Results and Estimated Design Infiltration Rate

6.1.1 Percolation Test Methodology

The percolation tests were performed as falling head tests in 50-mm diameter open holes with an approximate depth ranged from 0.7 to 0.9 mbgs. In the falling head test approach, each test hole was filled with water to ground surface (top of the hole). The dropping water levels were recorded with data-loggers, which were installed at each location. The field test results were analyzed using Reynolds' analytical solution (Reynolds, 2015). The percolation tests and data analysis were completed as per the Toronto and Region Conservation Authority's guidelines (TRCA, 2012 and TRCA, 2019).

6.1.2 Percolation Test Results and Estimated Design Infiltration Rate

EXP completed four (4) infiltration tests, including IT 101, IT 106, IT 108, and IT 115 at the Site. A Site Plan showing the noted test locations is included in the enclosed Figure 4. The infiltration test results are summarized in Table 6-1 below.

The design infiltration rates include a safety factor of 2.5 to account for some soil heterogeneity, which was applied according to Stormwater Management Criteria, Appendix C: Water Balance and Recharge (TRCA, 2012). The noted locations were selected to maximize coverage of the Site and examine the subsurface soil conditions at each of test locations.

Table 6-1: Summary of Infiltration Test Results

Test Location	Total Water Displacement (cm)	Total Test Duration (t) (min)	Estimated K_{fs} (m/s) *	Infiltration Rate (IR) (mm/hr) **	Percolation Time (min/cm)
IT 101	15.9	53.9	4.0E-07	36	58
IT 106	46.5	41.5	1.5E-06	51	41
IT 108	16.5	72.7	1.0E-07	25	84
IT 115	58.5	46.2	9.1E-07	45	47
Design Infiltration Rate with factor of safety of 3.5			---	11	-

Note:
* based on Reynold's method (2016).
** based on Appendix C of Stormwater Management (TRCA, 2012).

Based on the infiltration test results, the geometric mean of estimated design infiltration rates is 11 mm/hr after applying a safety factor of 3.5. Considering the estimated design infiltration rate of 11 mm/h and heterogeneous nature of the shallow soil horizon, a sub-drain system may be required to be installed below the infiltration systems as per the TRCA's guidelines for stormwater systems. The design infiltration rates can be used for designing LID systems to enhance post-development groundwater infiltration to help maintain the pre-development groundwater infiltration rate at the Site. The TRCA's infiltration rate calculation sheet and the respective LID calculations are provided in Appendices G-1 and G-2, respectively.

6.2 Pre- and Post-Development Site Characteristics

6.2.1 Pre-Development Site Characteristics

The Site currently consists of open grass lands. A summary of the existing (pre-development) landscape features is provided in Table 6-2 below.

Table 6-2: Pre-Development (Existing) Land Use

Description	Pre-Construction (Existing) (m^2)
Asphalt/Concrete (Paved Areas)	0
Existing Buildings	0
Landscape, Open Space (Area available for Infiltration)	299,400
Total Site Area	**299,400**

It should be noted that the pre-development areas provided in Table 6-2 were based on the information provided by Schaeffers Consulting Engineers in 2022. Accordingly, 100 % of the total area is pervious under pre-development conditions (Appendix J).

6.2.2 Post-Development Site Characteristics

Table 6-3 provides a summary of the post-development site characteristics based on the information provided by Schaeffers Consulting Engineers in 2022 (Appendix J).

Table 6-3: Post-Development Site Characteristics (Schaeffers, 2022)

Items	Area	
	ha	m^2
Residential Low-Density Lot Area	15.34	153,400
Residential Townhouse Lot Area	1.60	16,000
Mixed Use Area	3.01	30,100
Right-of-Way (18 m)	6.84	68,400
Park	1.40	14,000
Open Area	0.41	4,100
SWMP	1.34	13,400
Total	**29.94**	**299,400**

According to the provided information for the post-development phase, the total area allocated to the construction of buildings is estimated 199,500 m^2, including the residential low-density lot, residential townhouse lot, and mixed-used areas.

Table 6-4: Post-Development Site Characteristics with Assumptions

Description	Impervious Areas (ex: Buildings, Roads) m^2	Pervious Areas (ex: Landscape) m^2	Total Areas Post Construction (Proposed) m^2
Estimated Roof Top Area (Assumed to be 60 % of the Total Area for Buildings)	119,700	0	119,700
Estimated Landscaped Area (Assumed to be 25 % of the Total Area for Buildings)	0	49,875	0
Estimated Area for Driveway, Parking and Sidewalk (Assumed to be 15 % of the Total Area for Buildings)	29,925	0	29,925
Right-of-Way (18 m)	68,400	0	68,400
Park	0	14,000	14,000
Open Area	0	4,100	0
SWMP	13,400	0	13,400
Totals	**231,425**	**67,975**	**299,400**

Under post-development conditions, the pervious and impervious areas are anticipated to cover 23 % and 77 % of the Site area, respectively.

6.3 Methodology

6.3.1 Meteorological Data

Meteorological data including average monthly precipitation and average temperatures were obtained from the National Climate Data and Information Archive (Environment Canada) for the ESSA ONT HYDRO weather station (Station ID No.6112340).

Meteorological data of 31 years from 1970 to 2000 was utilized for this assessment. Summaries of the climate data is provided in Appendices G-3.

6.3.2 Modeling

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method used to analyze the allocation of water among various components of the hydrologic cycle. This methodology was used to complete the pre-construction (existing conditions) and post development water balance. The model inputs include monthly mean temperature, total precipitation, runoff factor, soil-moisture storage capacity, rain temperature threshold, snow temperature threshold, maximum melt rate and the latitude of the Site. The model outputs include monthly potential and actual evapotranspiration, soil moisture storage, soil moisture storage change, surplus, infiltration, and runoff.

When precipitation (P) occurs, it can either runoff (R) on the surface water system, infiltrate (I) into the ground and evaporate or transpire (ET) from the earth's surface and through the vegetation. The difference between total precipitation (P) and the total of evaporation and evapotranspiration (ET) is defined to be the water surplus (S) which is available for both infiltration

(recharge to the groundwater system including interflow) and for runoff. When long-term averages of P, R, I, and ET are used, no net change in groundwater storage (ST) is assumed. Annually, however, there is a potential for small changes in ST.

The annual water budget can be stated as follows:

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

Where:
P = precipitation
ET = evapotranspiration
R = surface water runoff
I = Infiltration
ΔST = change in groundwater storage

For this assessment, the Thornthwaite and Mather method was used to estimate average infiltration rates. Based on the site conditions, components for infiltration in the noted model were used to estimate infiltration, also accounting for the lateral movement of water in the unsaturated zone in the shallow sub-surface (first few meters) which discharges to surface water features.

Infiltration is governed by the surficial soil types, topography and land cover. On areas with shallow water table, the percolation rate of precipitation into the soils is reduced and considered negligible.

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

6.4 Climate Data Analysis and Estimating Infiltration Factors

6.4.1 Climate Data Analysis

The mean annual water surplus was calculated using the Thornthwaite and Mather (1955) method. Monthly average precipitation values were obtained for 31 years from 1970 to 2000. Soil moisture storage of 200 mm/yr was assumed for soils and considered representative of the preconstruction site conditions. The closest latitude to the Site is 44^0, which was used in the USGS model (2007). Table 6-5 provides a summary of the climatic water balance analysis. Summaries of the input and output climate data are provided in Appendixes G-3 and G-4, respectively.

Table 6-5: Summary of Climatic Water Balance Analysis in Pre-Development Conditions

Soil Moisture Storage (mm/yr)	Precipitation (mm/yr)	Actual ET (mm/yr)	Surplus (mm/yr)
200	889.3	539.5	349.8

Note: ET = Evapotranspiration

The results of climatic water balance analysis for the Site suggest that a water surplus of 349.8 mm/year is available to become surface runoff and infiltration.

6.4.2 Estimating Infiltration Factors

The infiltration is expected to be controlled by topography and soil cover type. Surplus water is portioned between runoff and infiltration based on the controlling factors provided by MOE (1995). It is noted that the controlling sub-factors provided by the MOE were determined to estimate pre-development infiltration rates.

A total infiltration factor for the Site was estimated using the individual sub-factors representative of the topography, soil type and land cover conditions. The surface geology and soil stratigraphy at the Site are presented in Figures 2 and Figures 5A through 5C, respectively. The existing land use and topography of the Site are shown on Figures 7 and 8, respectively. The proposed land use map and site grading plan area shown on Figures 9 and 10, respectively.

Considering the topography and soil type for the Site, the total weight infiltration factors for the pre-and post-development phases are estimated to be 0.65 and 0.47, respectively. The estimated pre-and post-development total infiltration factors represent the fraction of the water surplus available for infiltration. Appendix G-5 provides a summary of the sub factors and total weighted infiltration factor based on the Site conditions.

Using the infiltration factor of 0.65 and water surplus rate volume of 349.8 mm/yr for pre-development phase, the infiltration rate for the entire Site is estimated to be 227.37 mm/yr. The fraction of the available water surplus for runoff is 0.35 (= 1.00 – 0.54) and the annual runoff rate is 122.43 mm/yr (Appendix G-6).

Using the infiltration factor of 0.47 and water surplus rate volume of 349.8 mm/yr for post-development phase, the infiltration rate for the entire Site is estimated to be 163.71 mm/yr. The fraction of the available water surplus for runoff is 0.53 (= 1.00 – 0.47) and the annual runoff rate is 186.09 mm/yr (Appendix G-6).

6.5 Pre-Development Water Balance Estimates

6.5.1 Pre-Development Water Balance Analysis

The water balance analysis is based on available information on a regional scale and deemed consistent for the Site. Table 6-6 provides a summary of water balance analysis for the Site.

Table 6-6 Summary of Pre-Development Water Balance Analysis

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/yr)	Actual Evapo-transpiration (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)
Total Site	299,400	299,400	266,256	161,526	36,656	68,075
Percentage of Total Precipitation (%)			100%	60.6%	13.8%	25.6%

The total Site area was used to estimate the total volume of annual precipitation for the Site. As summarized in Table 6-6, the pre-development water balance is as follows: approximately 60.6 % of the total precipitation is subject to evapotranspiration, 13.8 % to runoff and 25.6 % to infiltration. The pre-development unmitigated water balance, on a weighted average depth basis (in mm/yr) is as follows:

$$P\ (889.3) = ET\ (539.5) + R\ (122.4) + I\ (277.4) + \Delta ST\ (0)$$

6.6 Post-Development Water Balance Estimates

6.6.1 Post-Development Water-Unmitigated

Based on the assumptions made for this assessment, the total area of impervious surfaces under post-development conditions is approximately 231,425 m^2 representing approximately 77 % of the Site area (total area: 299,400 m^2) (Table 6-3). The remaining 67,975 m^2 is assumed to be available to contribute to infiltration during post-development stage (23 % of the total land area).

The post-development water balance calculations are presented in Appendix G-6. Table 6-7 provides a summary of the water balance assessment.

Table 6-7: Summary of Overall Post-Development Water Balance Forecast-Unmitigated

Location	Total Site Area (m^2)	Area Available for Infiltration (m^2)	Precipitation (m^3/yr)	Evapotranspiration (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)
Total Site	299,400	67,975	266,256	43,902	209,032	13,322
Percentage of Total Precipitation (%)			100%	16.5%	78.5%	5%

The total Site area was used to estimate the total volume of annual precipitation for the Site. As summarized in Table 6-7, the post-development water balance is as follows: approximately 60.6 % of the total precipitation is subject to evapotranspiration, 13.8 % to runoff and 25.6 % to infiltration. The mitigated post-development water balance, on a weighted average depth basis (in mm/yr) is as follows:

$$P\ (889.3) = ET\ (146.6) + R\ (698.2) + I\ (44.5) + \Delta ST\ (0)$$

6.6.2 Post-Development Water-Mitigated

If no remedial measures are implemented to maintain infiltration, it is expected that infiltration will be reduced from approximately 68,075 m^3/year to 13,322 m^3/year in post-development, resulting in a deficit of 54,753 m^3/yr (Appendix G-6).

To maintain the estimated pre-development infiltration rate of 68,075 m^3/year, mitigation measures should be implemented to maintain the noted infiltration rate volume. The mitigation measures, known as the Low Impact Development (LID) system, are anticipated to consist of infiltration galleries and trenches:

In this approach, it is anticipated that infiltration galleries and/or infiltration trenches are utilized to infiltrate roof runoff into the subsurface. Considering a total deficit of 54,753 m^3/yr and the design infiltration rates of 11 mm/hr, the required area for proposed LID system is estimated 6,480 m^2. The noted proposed area is anticipated to capture 3,422 m^3 stormwater volume per a 2-week period from directing roof run-off, which is equivalent to 528 mm of precipitation per 2-week period per square meter area of the LID system. Accordingly, the estimated infiltration time for captured water in the proposed LID system is estimated 48 hours (Appendix G-7).

7 Conclusions and Recommendations

- Two (2) rounds of groundwater level measurements have been completed in all monitoring wells. As per the Conservation Authority's requirements, a one (1) year groundwater level monitoring program is currently in progress. The water levels will be recorded on a bi-monthly basis. The report will be updated upon the completion of the noted monitoring program.
- When comparing the chemistry of the collected groundwater sample to the City of Barrie's Sanitary and Storm Sewer Discharge Criteria, there were no parameter exceedances to be reported.
- When comparing the chemistry of the collected groundwater sample to the Ontario's Provincial Water Quality Objectives, there were no parameter exceedances to be reported.
- Based on the assumptions outlined in this report, the highest peak dewatering rates for the proposed construction activities for one (1) level of basement is estimated 719,000 L/day. This is the rate which will be required to be discharged to the municipal sewer system.
- The estimated MECP's dewatering rate for proposed construction activities is approximately 717,000 L/day. As the dewatering flow rate estimate is greater than 400,000 L/day, a Category 3 PTTW will be required to facilitate the construction dewatering program for the Site.
- The estimated construction dewatering volume 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.
- The preliminary highest long-term flow rate of the foundation sub-drain for one (1) level of basement is estimated to be approximately 89,000 L/day. The pumped groundwater from sub-drain systems is anticipated to be released into the sewer system. As such, a Category 3 PTTW will be required for the post-construction phase.
- The dewatering rates should be revisited once final design and schedule are available.
- 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, as well as the PWQOs subject to discharge location. 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.
- As per the MECP technical requirement for PTTW, the geotechnical assessment of the stability of the soils due to water taking (ex: settlement, soil loss, subsidence etc.) is required. The water taking should not have unacceptable interference on soils and underground structures (foundations, utilities etc.). A letter related to geotechnical issues as it pertains to the Site is required to be completed under a separate cover.
- An agreement to discharge into the sewers owned by the City of Barrie and/or conservation authority will be required prior to releasing dewatering effluent.
- 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.
- Considering a total deficit of 54,753 m^3/yr and the design infiltration rates of 11 mm/hr, the required area for proposed LID system is estimated 6,480 m^2. The noted proposed area is anticipated to capture 3,422 m3 stormwater volume per a 2-week period from directing roof run-off, which is equivalent to 528 mm of precipitation per 2-week period per square

meter area of the LID system. Accordingly, the estimated infiltration time for captured water in the proposed LID system is estimated 48 hours.

- 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 PTTW, 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 PTTW will need to be updated to reflect these modifications. Altogether, the hydrogeological report, PTTW, Discharge Plan and geotechnical assessment constitute the Water Taking Plan which needs to be available onsite during the construction dewatering.
- To evaluate the groundwater seepage rate at the excavation locations, it is recommended that test pits be excavated and/or pumping tests at the proposed excavation on the final designs.

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.

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

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

Sincerely,

EXP Services Inc.

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Senior Hydrogeologist
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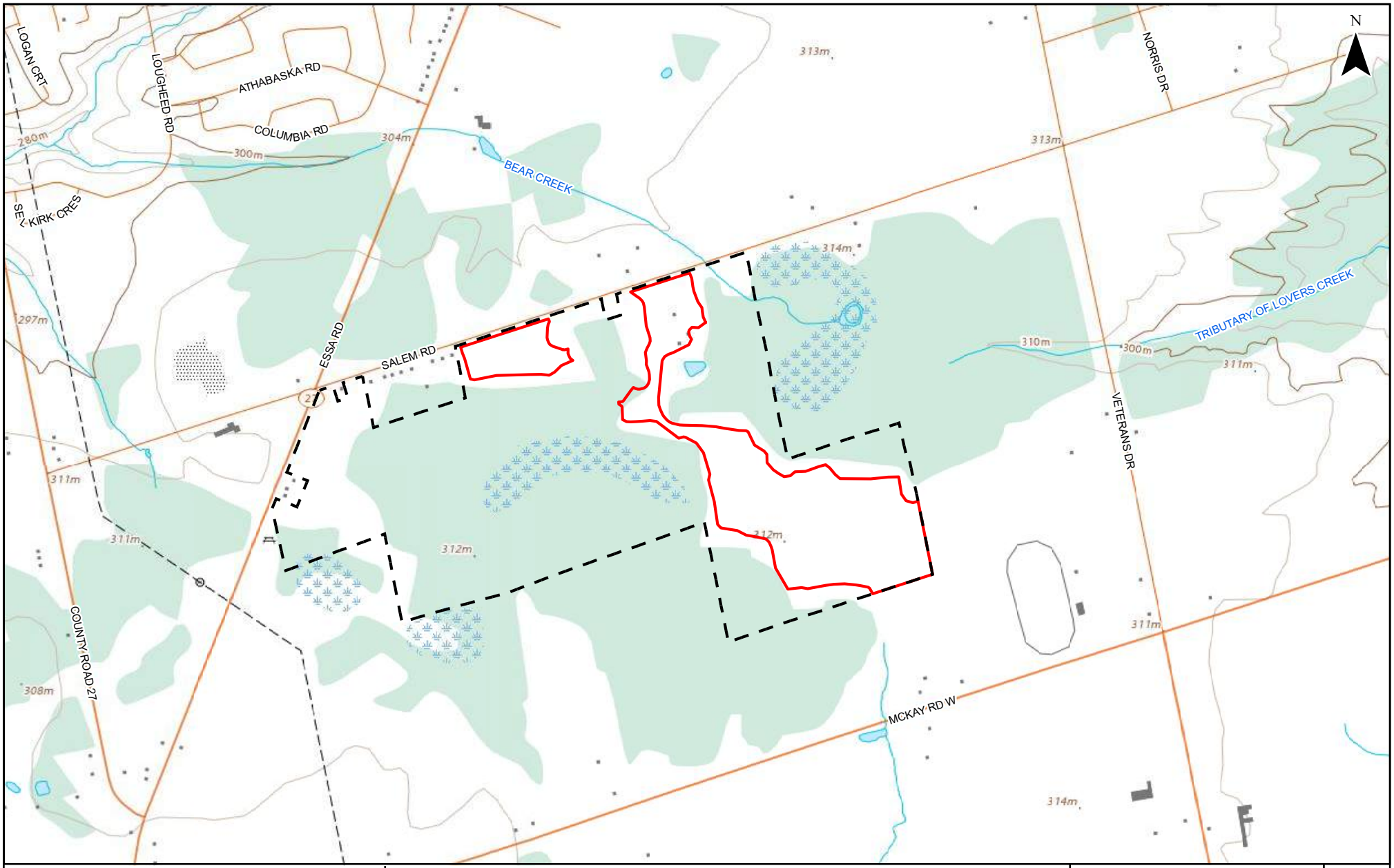
Figures



SCALE:

0 150 300 450 600 750 m

LEGEND:

APPROXIMATE SITE BOUNDARY

LIMIT OF SUBDIVISION

DRAWN BY:	CHECKED BY:
JA	PS

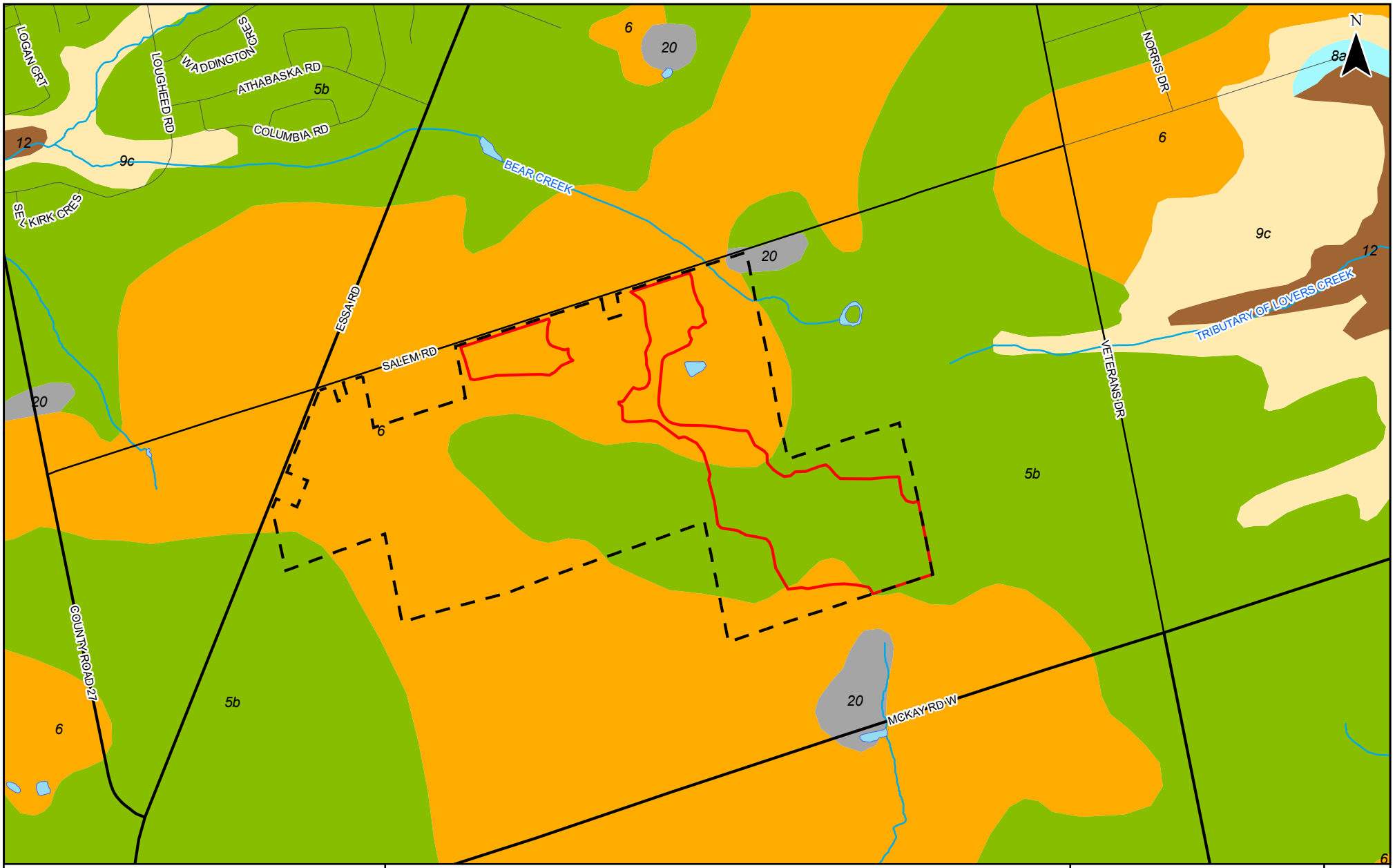
SITE LOCATION PLAN

FIGURE: 1

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



SCALE:
0 200 400 600 800 1,000 m

SOURCE:
BASED ON ONTARIO GEOLOGICAL SURVEY DATA PUBLISHED IN 2010

exp.

DRAWN BY:	CHECKED BY:
JA	PS

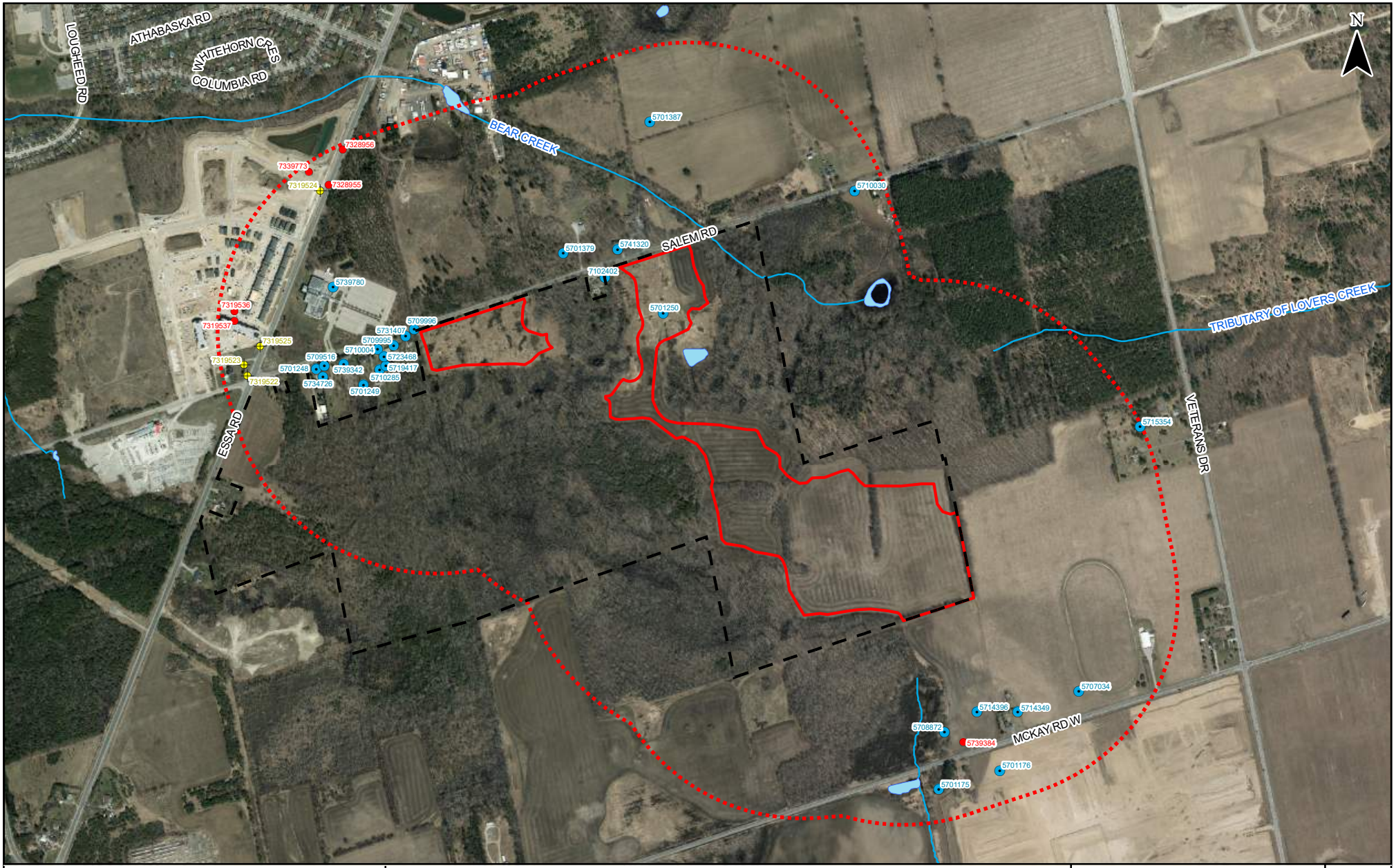
LEGEND:
- 20: ORGANIC DEPOSITS
- 12: OLDER ALLUVIAL DEPOSITS
- 9C: COARSE-TEXTURED (FORESHORE-BASINAL) GLACIOLACUSTRINE DEPOSITS
- 8A: FINE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- 6: ICE-CONTACT STRATIFIED DEPOSITS (FINE SAND TO GRAVEL)
- 5B: STONE-POOR, CARBONATE-DERIVED SILTY TO SANDY TILL
- APPROXIMATE SITE BOUNDARY
- LIMIT OF SUBDIVISION

SURFICIAL GEOLOGY

FIGURE: 2

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0 | DATE: JUNE 2022



SCALE:

0 150 300 450 600 750 m

SOURCE:

BASED ON GOOGLE EARTH IMAGERY DATED 2020,
AVAILABLE WELL RECORD INFORMATION AS OF MARCH 2021

exp.

DRAWN BY:	CHECKED BY:
JA	PS

LEGEND:

- MONITORING WELL / TEST HOLE
- WATER SUPPLY WELL
- ABANDONED WELL
- APPROXIMATE SITE BOUNDARY
- 500 m ZONE
- LIMIT OF SUBDIVISION

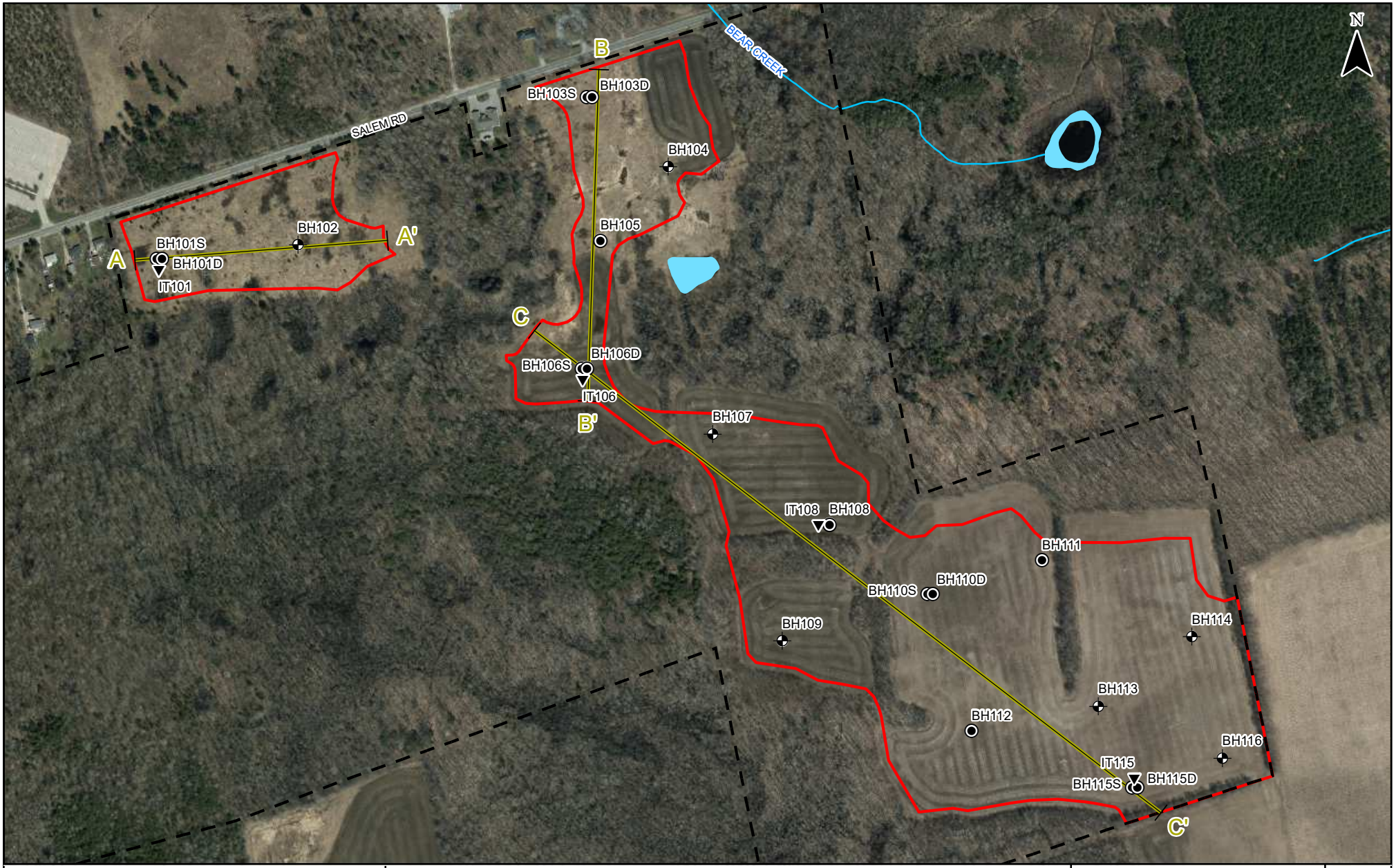
MECP WATER WELL RECORDS MAP

FIGURE: 3

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



SCALE:

0 60 120 180 240 300 m

LEGEND:

- BOREHOLE (EXP, 2022)
- BOREHOLE / MONITORING WELL (EXP, 2022)
- INFILTRATION TEST LOCATION (EXP, 2022)
- CROSS SECTION AXIS
- APPROXIMATE SITE BOUNDARY
- LIMIT OF SUBDIVISION

exp.

DRAWN BY:	CHECKED BY:
JA	PS

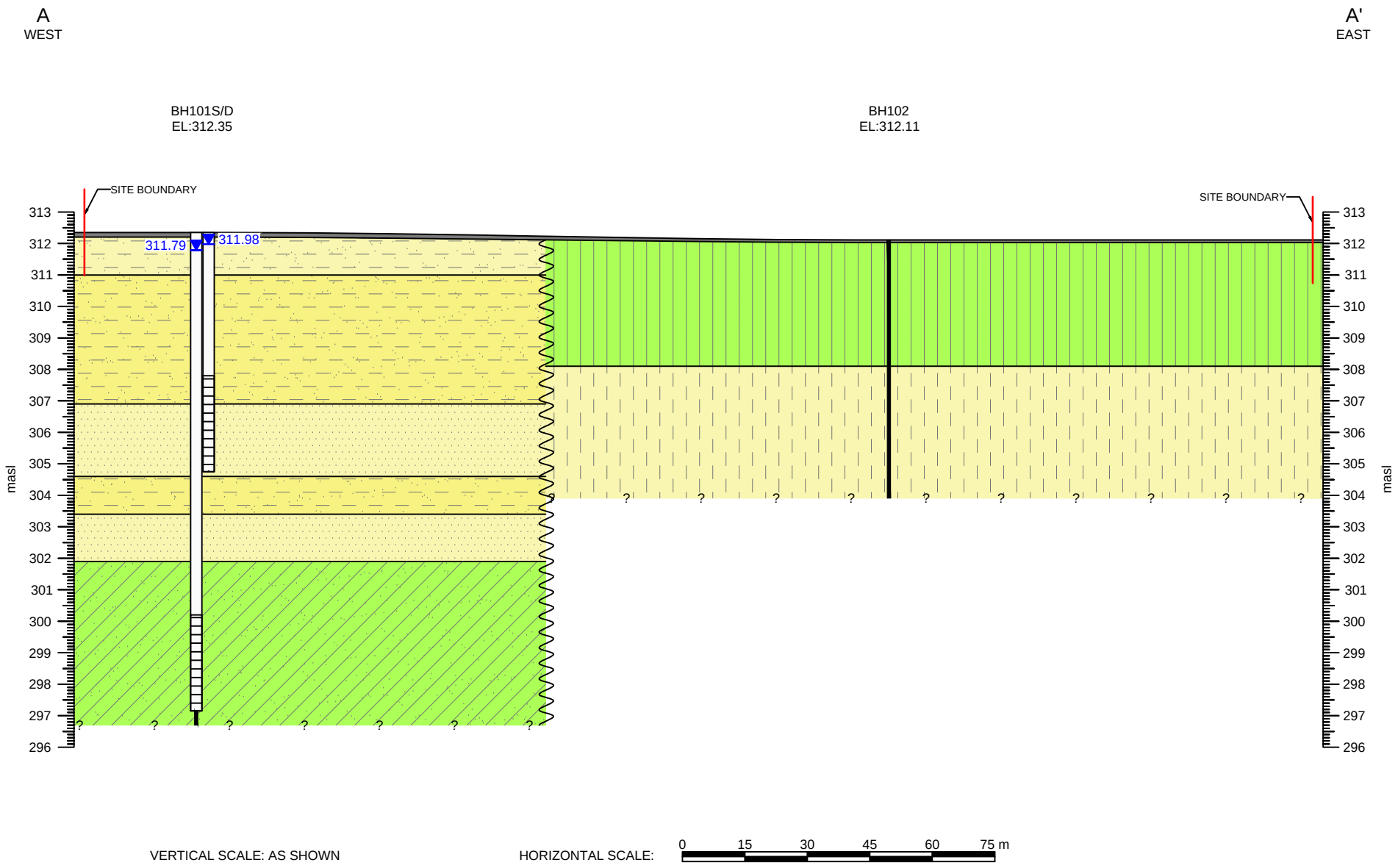
BOREHOLE / MONITORING WELL LOCATION PLAN

FIGURE: 4

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



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Brampton, ON L6T 4V1
Canada
www.exp.com

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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

LEGEND:

- TOPSOIL
- SAND
- SILT
- SANDY SILT / SILTY SAND
- CLAYEY SILT
- CLAYEY SILT TILL
- SANDY SILT TILL
- GROUNDWATER ELEVATION (masl) AS MEASURED ON JUNE 8, 2022

TITLE AND LOCATION:

CROSS SECTION A-A'

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NO.:	DWN.:
BAR-22008396-A0	JA
SCALE: AS NOTED	CK: PS
DATE: JUNE 2022	FIG. NO.: 5A

\\exp\data\BAR\BAR-22008396-A0\60 Execution\65 Drawings\CAD\BAR-22008396-A0.dwg

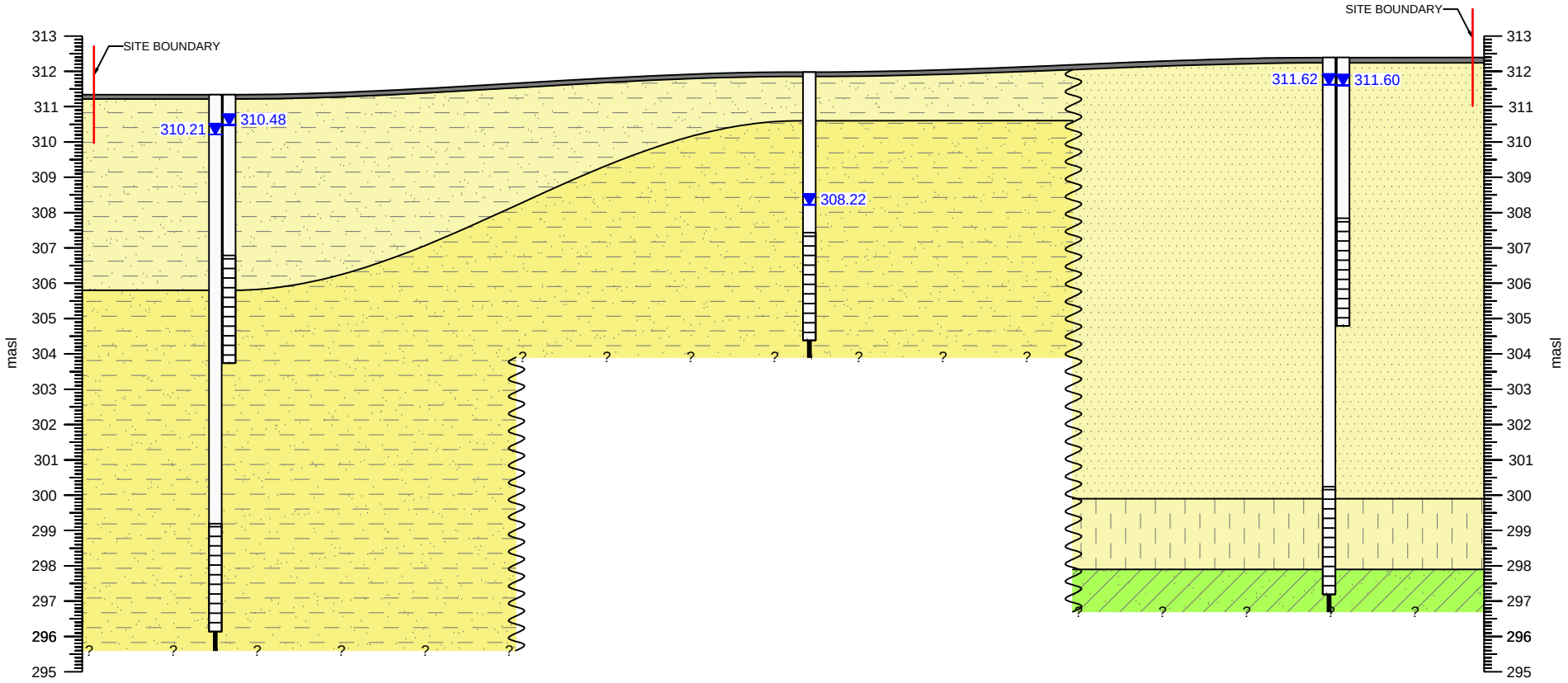
B
NORTH

B'
SOUTH

BH103S/D
EL:311.34

BH105
EL:311.98

BH106S/D
EL:312.39



VERTICAL SCALE: AS SHOWN

HORIZONTAL SCALE: 0 20 40 60 80 100 m

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LEGEND:

- TOPSOIL
- SAND
- SILT
- SANDY SILT / SILTY SAND
- CLAYEY SILT TILL
- SANDY SILT TILL
- GROUNDWATER ELEVATION (masl) AS MEASURED ON JUNE 8, 2022

TITLE AND LOCATION:

CROSS SECTION B-B'

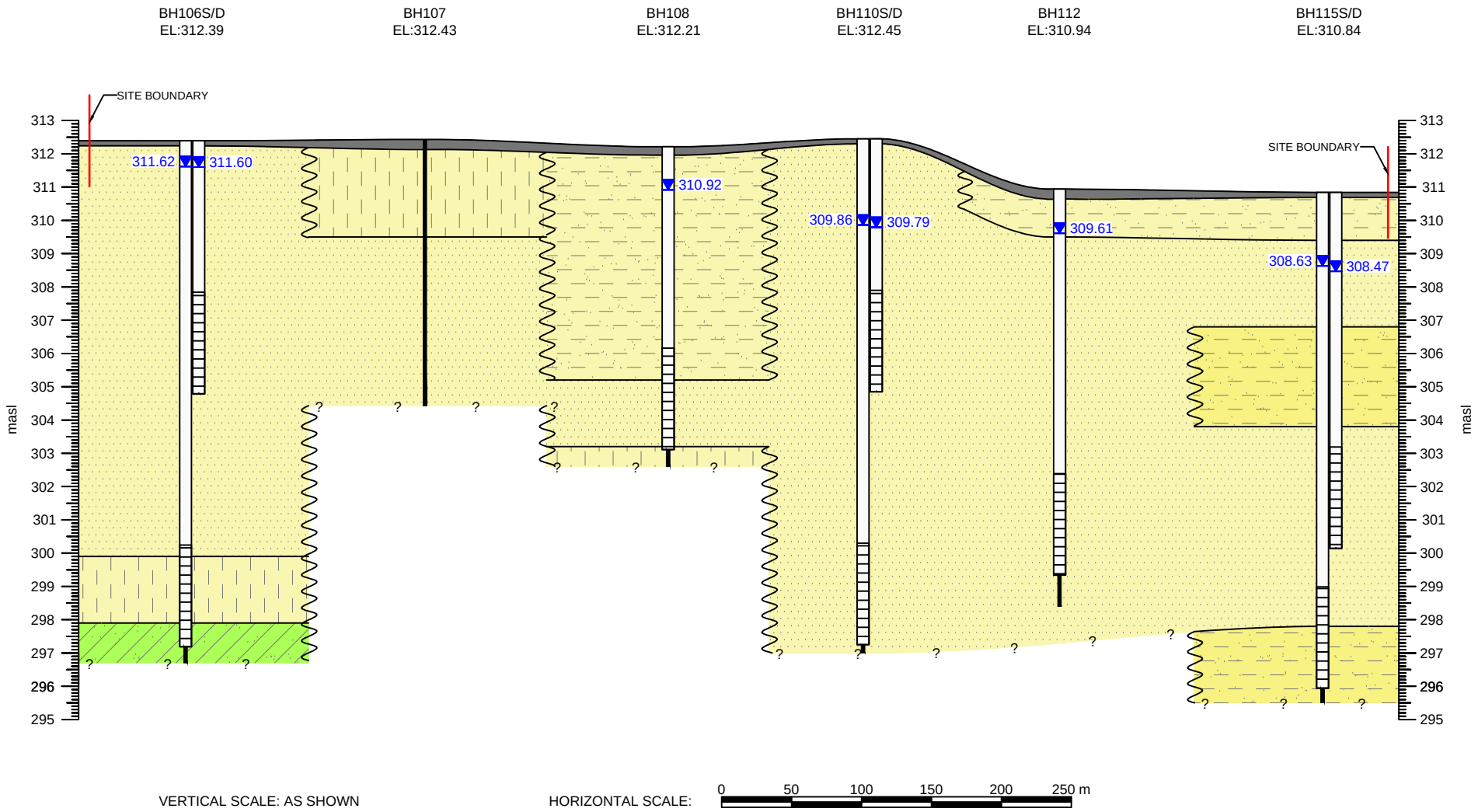
HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NO.:	DWN.:
BAR-22008396-A0	JA
SCALE: AS NOTED	CK: PS
DATE: JUNE 2022	FIG. NO.: 5B

\\exp\data\BAR\BAR-22008396-A0\60 Execution\65 Drawings\CAD\BAR-22008396-A0.dwg

C
NORTHWEST

C'
SOUTHEAST



VERTICAL SCALE: AS SHOWN

HORIZONTAL SCALE: 0 50 100 150 200 250 m

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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

LEGEND:

- TOPSOIL
- SAND
- SILT
- SANDY SILT / SILTY SAND
- CLAYEY SILT TILL
- SANDY SILT TILL
- GROUNDWATER ELEVATION (masl) AS MEASURED ON JUNE 8, 2022

TITLE AND LOCATION:

CROSS SECTION C-C'
HYDROGEOLOGICAL INVESTIGATION AND WATER BALANCE ASSESSMENT
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NO.:	DWN.:
BAR-22008396-A0	JA
SCALE: AS NOTED	CK: PS
DATE: JUNE 2022	FIG. NO.: 5C

\\exp\data\BAR\BAR-22008396-A0\60 Execution\65 Drawings\CAD\BAR-22008396-A0.dwg

SCALE:

0 60 120 180 240 300 m

LEGEND:

- BOREHOLE / MONITORING WELL (EXP, 2022)
- xx.xx GROUNDWATER ELEVATION (m asl) AS MEASURED ON JUNE 8, 2022
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- LIMIT OF SUBDIVISION
- APPROXIMATE SITE BOUNDARY

exp.

DRAWN BY:	CHECKED BY:
AC	PS

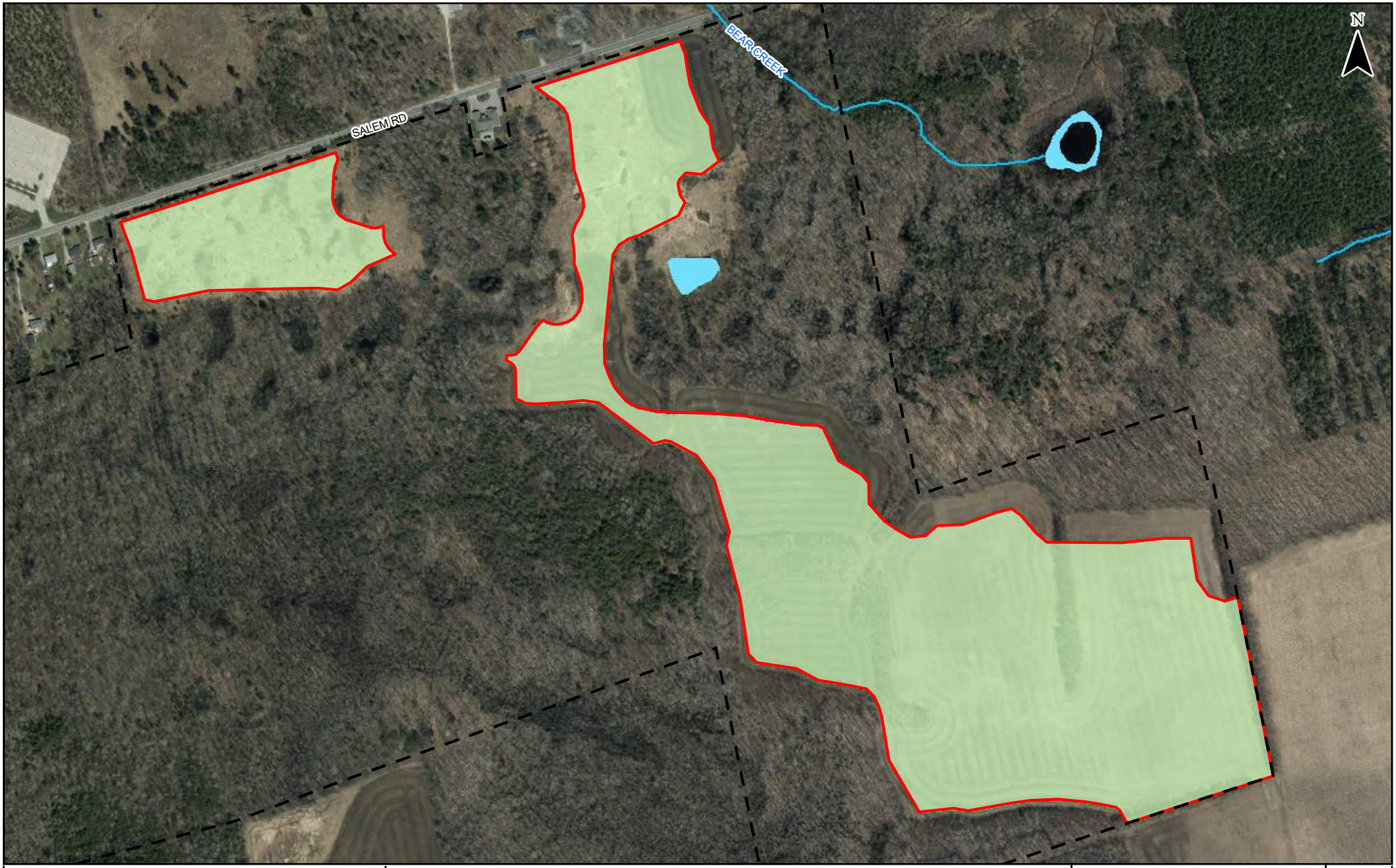
GROUNDWATER CONTOUR PLAN

FIGURE: 6

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



SCALE:

0 60 120 180 240 300 m

LEGEND:

AGRICULTURAL / LANDSCAPE

APPROXIMATE SITE BOUNDARY

LIMIT OF SUBDIVISION

exp.

DRAWN BY:	CHECKED BY:
AC	PS

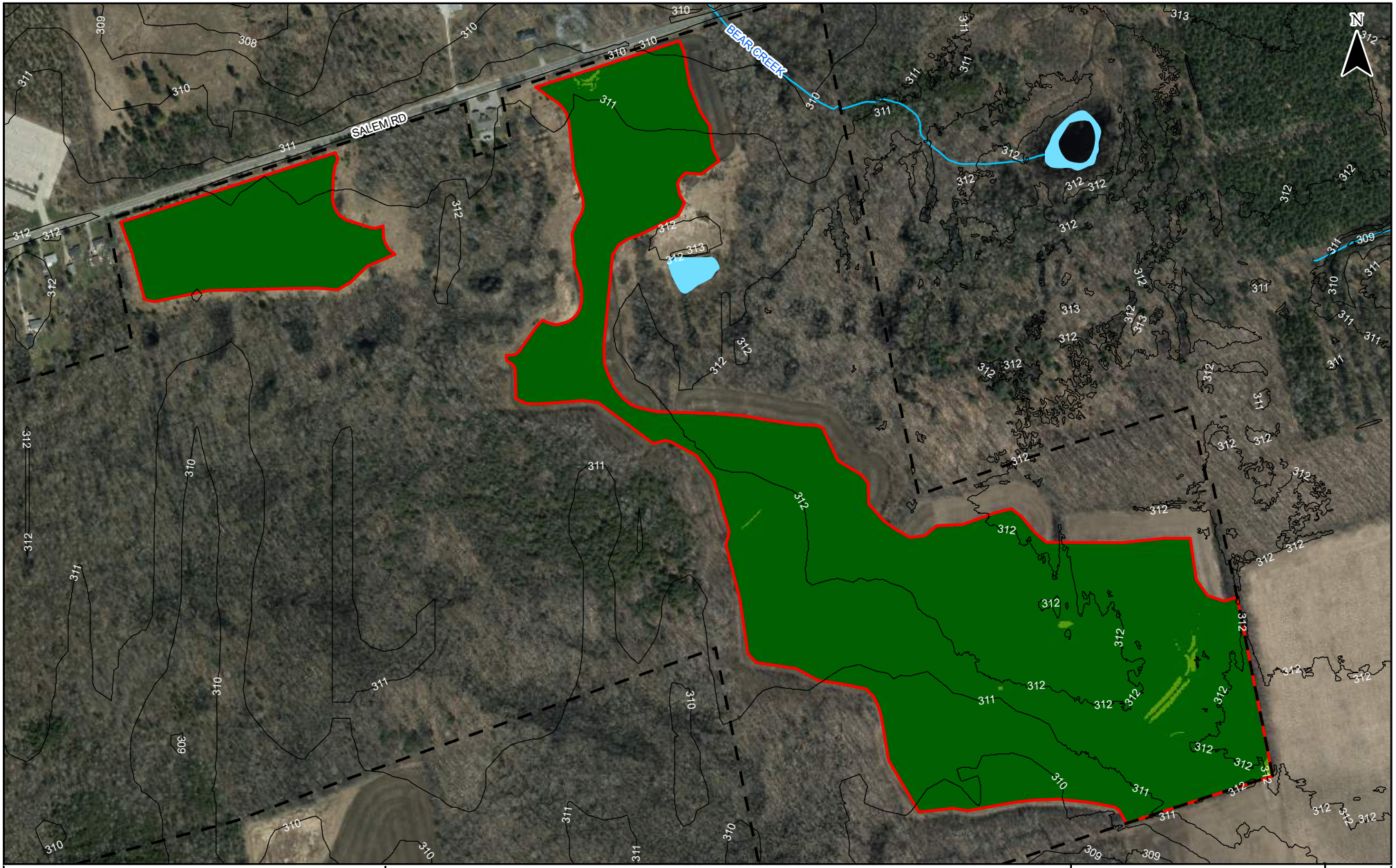
EXISTING LAND USE

FIGURE: 7

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



SCALE:

0 60 120 180 240 300 m

LEGEND:

TOPOGRAPHIC CONTOUR (m asl)

APPROXIMATE SITE BOUNDARY

LIMIT OF SUBDIVISION

EXISTING SLOPE (INFILTRATION FACTOR):

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

exp.

DRAWN BY:	CHECKED BY:
AC	PS

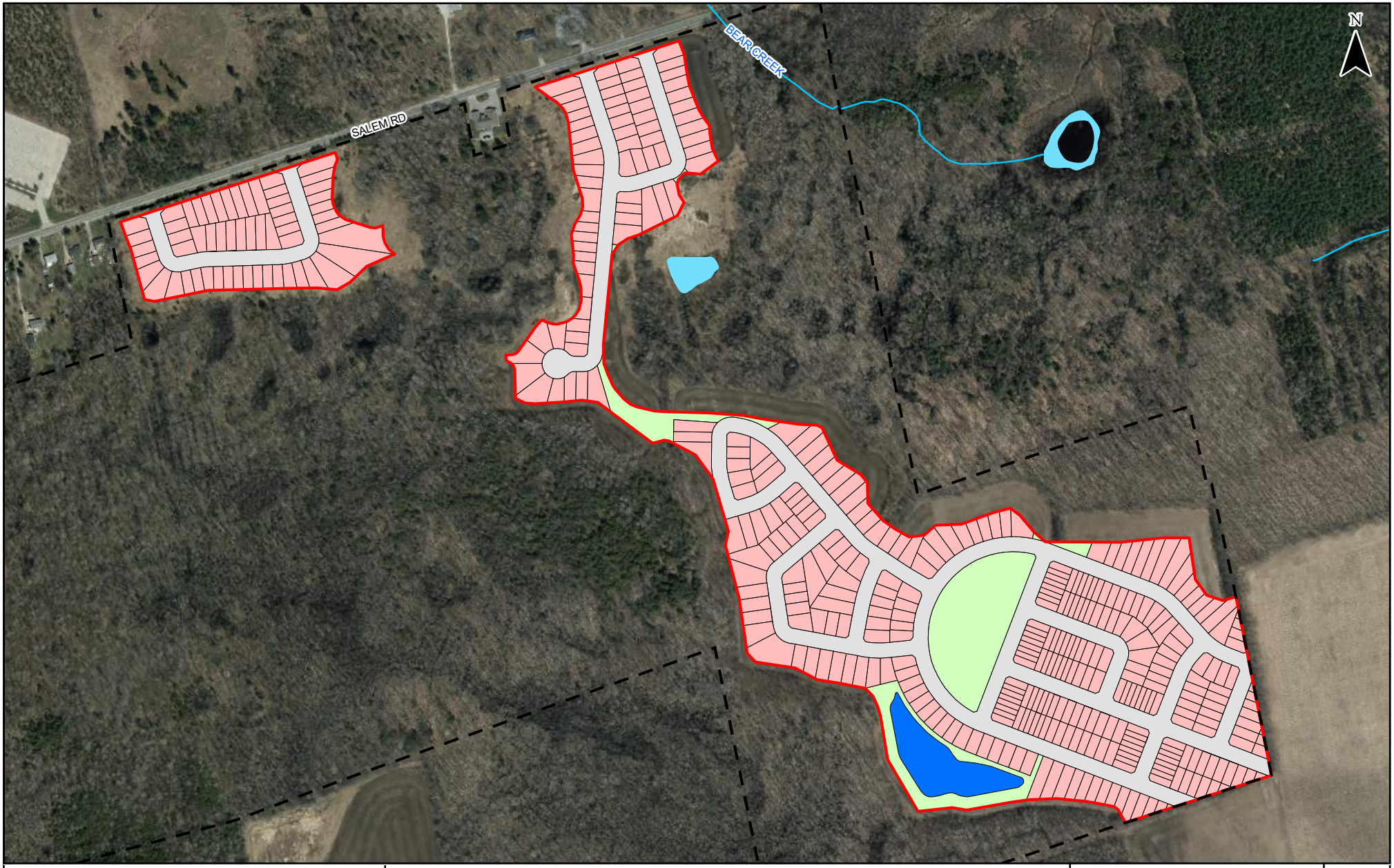
EXISTING SLOPE

FIGURE: 8

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



SCALE:
0 60 120 180 240 300 m

SOURCE:
BASED ON PRELIMINARY GRADING AND SERVICING PLAN, WATERSAND RESIDENTIAL SUBDIVISION PHASE 2 SALEM SECONDARY PLAN AREA. SCHAEFFERS, JANUARY 10 ,2022.

exp.

DRAWN BY: AC

CHECKED BY: PS

LEGEND:
- RESIDENTIAL
- PAVED ROAD
- LANDSCAPE
- STORMWATER MANAGEMENT POND
- APPROXIMATE SITE BOUNDARY
- LIMIT OF SUBDIVISION

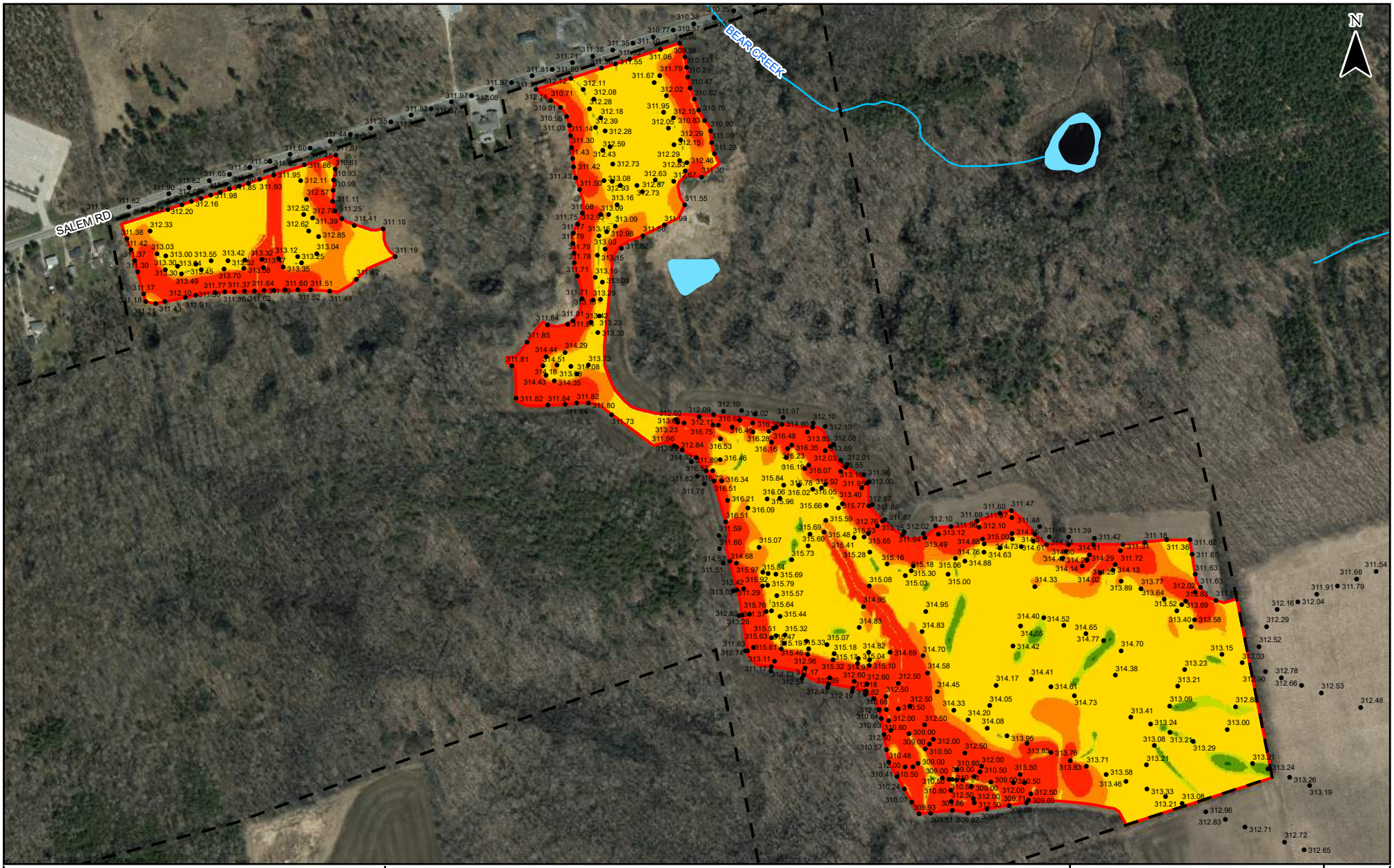
PROPOSED LAND USE

FIGURE: 9

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0

DATE: JUNE 2022



SCALE:

0 60 120 180 240 300 m

SOURCE:

BASED ON PRELIMINARY GRADING AND SERVICING PLAN.
WATERSAND RESIDENTIAL SUBDIVISION PHASE 2 SALEM SECONDARY PLAN AREA.
SCHAEFFERS, JANUARY 10 ,2022.

exp.

DRAWN BY:	CHECKED BY:
AC	PS

LEGEND:

- PROPOSED ELEVATION POINT (m asl)
- APPROXIMATE SITE BOUNDARY
- LIMIT OF SUBDIVISION

PROPOSED SLOPE (INFILTRATION FACTOR):

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

PROPOSED SLOPE

FIGURE: 10

HYDROGEOLOGICAL INVESTIGATION
AND WATER BALANCE ASSESSMENT
WATERSAND NORTH PHASE II
259 SALEM ROAD
BARRIE, ONTARIO

PROJECT NUMBER: BAR-22008396-A0 DATE: JUNE 2022

Appendix A – MECP WWR Summary Table

On-Site

BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	LOCATION ACCURACY	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	CONSTRUCTION METHOD	WELL DEPTH (m bgs)	WATER FOUND (m BGS)	CASING DIAMETER (cm)	1st USE	2nd USE	FINAL STATUS
10379143	5701250	12/20/1963	602845	4907751	311.2	margin of error : 100 m - 300 m				Boring	12	4.3	86.4	Livestock	Domesti	Water Supply

Off-Site

BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	LOCATION ACCURACY	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	CONSTRUCTION METHOD	WELL DEPTH (m bgs)	WATER FOUND (m BGS)	CASING DIAMETER (cm)	1st USE	2nd USE	FINAL STATUS
10379068	5701175	8/25/1967	603520	4906583	308.7	margin of error : 100 m - 300 m			893	Boring	5	2.4	76.2	Domestic		Water Supply
10379069	5701176	7/24/1955	603670	4906629	310.7	UTM very unreliable			938	Cable Tool	40	40.2	10.2	Livestock	Domesti	Water Supply
10379141	5701248	8/12/1964	601994	4907615	311.4	margin of error : 100 m - 300 m			1120	Boring	12	8.5	76.2	Domestic		Water Supply
10379142	5701249	10/12/1965	602110	4907576	311.4	margin of error : 100 m - 300 m			998	Boring	6	2.7	76.2	Domestic		Water Supply
10379272	5701379	4/22/1966	602599	4907900	309.4	margin of error : 100 m - 300 m			725	Boring	5	2.1	76.2	Industrial		Water Supply
10379280	5701387	11/30/1965	602812	4908222	306.1	margin of error : 100 m - 300 m			902	Boring	13	12.2	76.2	Domestic		Water Supply
10384880	5707034	11/21/1969	603864	4906823	310.6	margin of error : 30 m - 100 m			948	Boring	13	12.5	76.2	Domestic		Water Supply
10386699	5708872	6/29/1972	603534	4906723	307.6	margin of error : 30 m - 100 m			781	Boring	20	18.9	76.2	Domestic		Water Supply
10387336	5709516	8/14/1972	602014	4907623	311.5	margin of error : 30 m - 100 m			1102	Cable Tool	51	42.7	10.2	Domestic		Water Supply
10387815	5709995	3/5/1973	602184	4907673	311.2	margin of error : 30 m - 100 m			953	Boring	11	6.1	76.2	Domestic		Water Supply
10387816	5709996	3/6/1973	602234	4907713	311.4	margin of error : 30 m - 100 m			920	Boring	9	4.6	76.2	Domestic		Water Supply
10387824	5710004	3/4/1973	602144	4907663	311.6	margin of error : 30 m - 100 m			988	Boring	7	3.7	76.2	Domestic		Water Supply
10387850	5710030	2/10/1973	603314	4908053	312.7	margin of error : 30 m - 100 m			728	Boring	7	3.0	76.2	Domestic		Water Supply
10388103	5710285	9/11/1973	602149	4907613	311.7	margin of error : 30 m - 100 m			969	Cable Tool	0	9.8	10.2	Domestic		Water Supply
10392081	5714349	5/14/1977	603714	4906773	310.5	margin of error : 100 m - 300 m			862	Cable Tool	51		15.2	Domestic		Water Supply
10392128	5714396	6/27/1977	603614	4906773	309.3	margin of error : 100 m - 300 m			792	Cable Tool	45	44.8	15.2	Domestic		Water Supply
10393069	5715354	7/20/1978	604014	4907473	311.8	margin of error : 100 m - 300 m			936	Cable Tool	43	35.4	12.7	Domestic		Water Supply
10397052	5719417	9/19/1984	602164	4907623	311.7	margin of error : 100 m - 300 m			957	Cable Tool	47	45.1	12.7	Domestic		Water Supply
10401078	5723468	6/22/1988	602160	4907646	311.7	margin of error : 100 m - 300 m			968	Cable Tool	45	42.7	15.2	Domestic		Water Supply
10408961	5731407	3/6/1995	602213	4907696	311.1	margin of error : 100 m - 300 m			934	Cable Tool	45	42.7	15.2	Domestic		Water Supply
10412256	5734726	11/16/1999	602011	4907596	311.5	margin of error : 30 m - 100 m			1099	Cable Tool	49	48.5	15.2	Domestic		Water Supply
11178586	5739342	7/23/2004	602062	4907627	311.4	margin of error : 10 - 30 m	4081 SALEM RD	BARRIE	1057	Cable Tool	24	21.9	15.9	Domestic		Water Supply
11325276	5739780	1/4/2005	602036	4907816	310.0	margin of error : 30 m - 100 m	SALEM RD	INNISFILL	1143	Cable Tool	49	44.0	15.9	Domestic		Water Supply
1001534966	7102402	1/21/2007	602702	4907840	310.6	margin of error : 10 - 30 m			612	Cable Tool	50	48.8	15.9	Domestic		Water Supply
11694959	5741320	11/2/2006	602733	4907909	310.5	margin of error : 10 - 30 m	3928 SALEM ROAD	BARRIE	650	Rotary (Air)	54		15.2	Domestic		Water Supply
1007291612	7319522	8/20/2018	601825	4907599	311.7	margin of error : 30 m - 100 m	ESSA RD	Barrie	1282	Rotary (Convent.)	5	2.4	0.0	Monitoring		Observation Wells
1007291615	7319523	8/20/2018	601817	4907625	311.0	margin of error : 30 m - 100 m	ESSA RD	Barrie	1295	Rotary (Convent.)	3	2.4	0.0	Monitoring		Observation Wells
1007291618	7319524	8/20/2018	602004	4908053	305.8	margin of error : 30 m - 100 m	ESSA RD	Barrie	1283	Rotary (Convent.)	3	2.1	0.0	Monitoring		Observation Wells
1007291621	7319525	8/20/2018	601857	4907671	311.2	margin of error : 30 m - 100 m	ESSA RD	Barrie	1266	Rotary (Convent.)	5	3.7	0.0	Monitoring		Observation Wells
1007291654	7319536	7/30/2018	601794	4907757	310.3	margin of error : 30 m - 100 m	851 ESSA RD	Barrie	1350		0		0.0	Not Used		Abandoned-Other
1007291657	7319537	7/30/2018	601794	4907733	310.3	margin of error : 30 m - 100 m	851 ESSA RD	Barrie	1343		0		0.0	Not Used		Abandoned-Other
1007383494	7328955	12/12/2018	602025	4908068	306.1	margin of error : 30 m - 100 m	Along Essa Road, South of Alhabasca Roac	Barnie	1274	Hslion Stien Auger	0	0.6	0.0	Monitoring		Abandoned-Other
1007383500	7328956	12/12/2018	602060	4908154	305.0	margin of error : 30 m - 100 m	LONG ESSA RD SOUTH OF ATHABASCA RO.	Barrie	1295	HOLLOW STERN AUGER	0	1.2	0.0	Monitoring		Abandoned-Other
11178628	5739384	11/26/2004	603581	4906699	310.6	margin of error : 10 - 30 m		INNISFIL	828		0		0.0	Not Used		Abandoned-Other
1007592852	7339773	6/17/2019	601977	4908099	304.2	margin of error : 30 m - 100 m	WEST OF ESSA RD N OF SALEM ROAD	Barrie	1331		0		0.0			Abandoned-Other

Appendix B – Borehole Logs

Log of Borehole 101

Project No. BAR-22008396-A0 Figure No. 2

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907662 N 602293 E

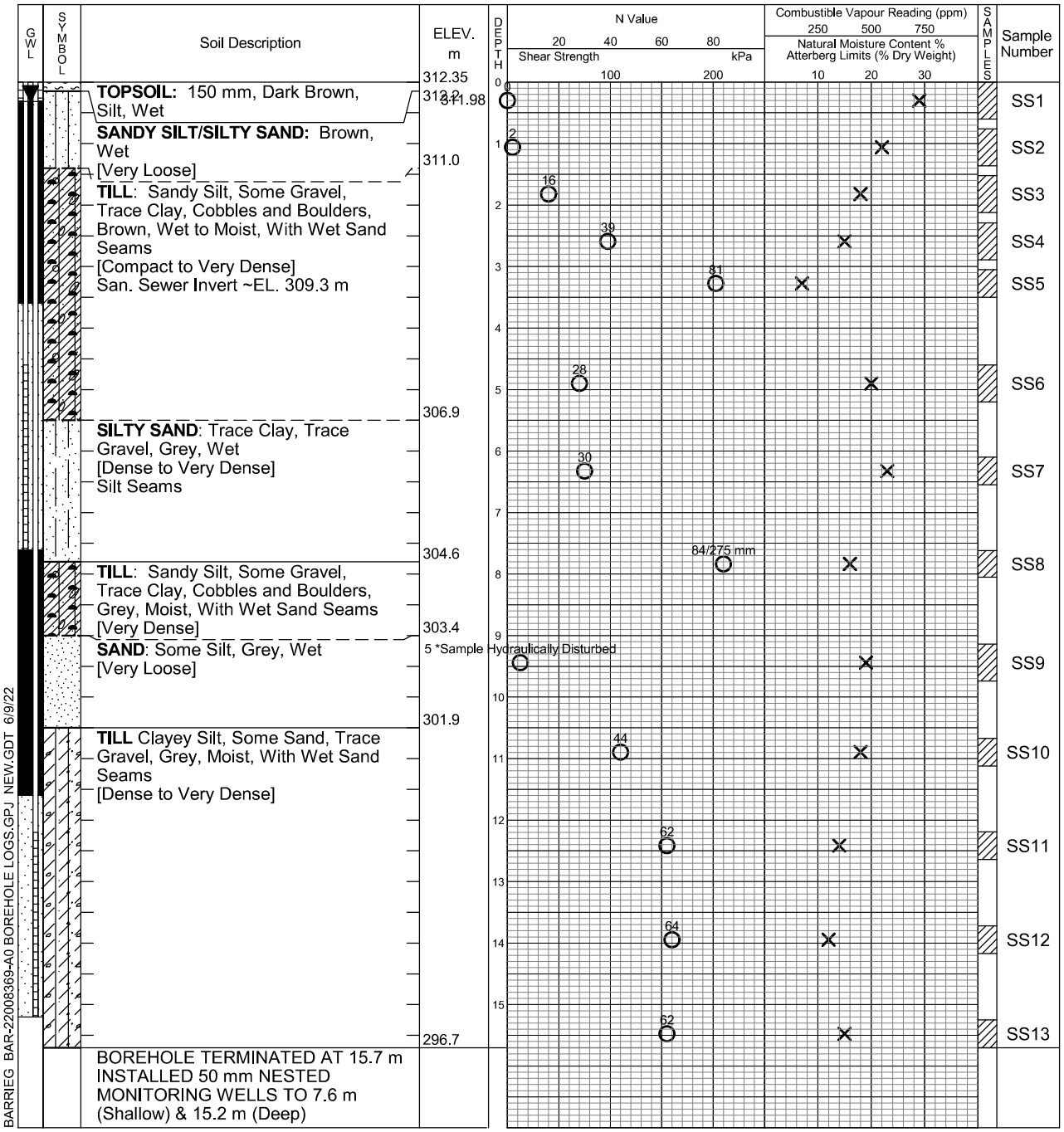
Date Drilled: April 12, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



5 *Sample Hydraulically Disturbed

BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

EXP Services Inc.
14 Cedar Pointe Drive
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f: +1.705.719.1109

Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	5.3/307.1	Install
May 25, 2022	0.69/311.66	(Shallow)
May 25, 2022	0.70/311.65	(Deep)
June 8, 2022	0.37/311.98	(Shallow)
June 8, 2022	0.56/311.79	(Deep)

Log of Borehole 102

Project No. BAR-22008396-A0 Figure No. 3

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907679 N 602459 E

Date Drilled: April 12, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			312.11	0	20 40 60 80 / 100 200	250 500 750 / 10 20 30		
		TOPSOIL: 80 mm, Dark Brown, Silt, Wet	312.0		3		SS1	SS1
		CLAYEY SILT: Trace Sand, Brown to Grey, APL [Soft to Very Stiff]		1	11		SS2	SS2
				2	22		SS3	SS3
					24		SS4	SS4
		San. Sewer Invert ~EL. 309.4 m		3	23		SS5	SS5
			308.1	4				
		SILT Some Sand, Trace Clay, Grey, Wet [Compact]		5	24		SS6	SS6
				6	23		SS7	SS7
				7				
			303.9	8	19		SS8	SS8
		BOREHOLE TERMINATED AT 8.2 m						

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.6/309.5	Open

Log of Borehole 103

Project No. BAR-22008396-A0 — Figure No. 4

Project: Proposed Watersand North Phase II Residential Development — Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907853 N 602799 E

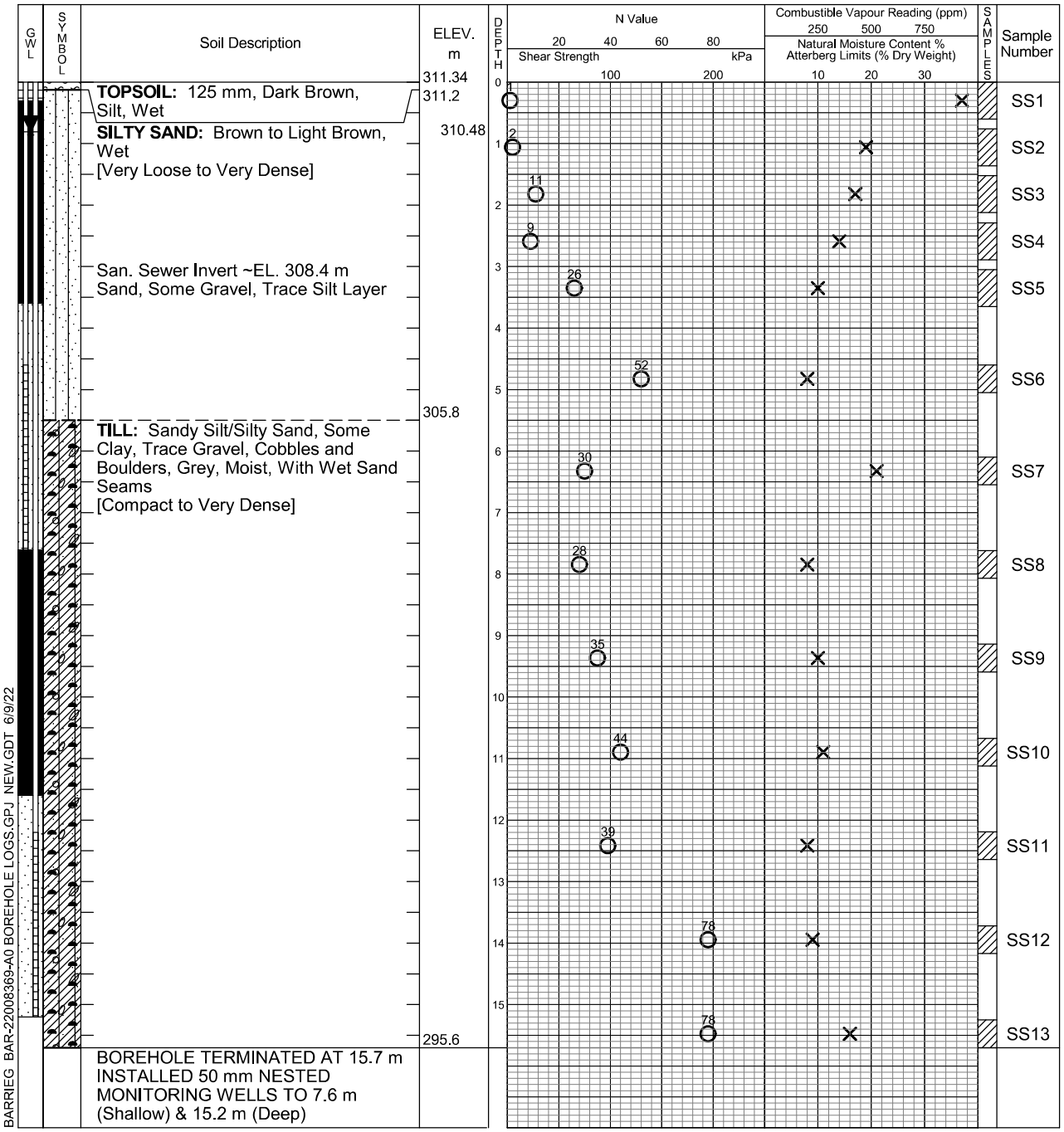
Date Drilled: April 13, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	5.6/305.7	Install
May 25, 2022	0.89/310.45	(Shallow)
May 25, 2022	1.10/310.24	(Deep)
June 8, 2022	0.86/310.48	(Shallow)
June 8, 2022	1.13/310.21	(Deep)

Log of Borehole 104

Project No. BAR-22008396-A0 Figure No. 5

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907771 N 602895 E

Date Drilled: April 13, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
		TOPSOIL: 250 mm, Dark Brown, Silt, Wet	311.91 311.7	0	6		SS1	SS1
		CLAYEY SILT: Some Sand, Trace to Some Gravel, Brown to Grey, APL [Firm to Hard] Till-like Layers		1	16		SS2	SS2
				2	19		SS3	SS3
					20		SS4	SS4
		San. Sewer Invert ~EL. 308.6 m		3	12		SS5	SS5
				4				
				5	17		SS6	SS6
				6	17		SS7	SS7
				7				
			303.8	8	35		SS8	SS8
		BOREHOLE TERMINATED AT 8.1 m						

N Value: 20 40 60 80; Shear Strength kPa: 100 200

Combustible Vapour Reading (ppm): 250 500 750; Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	No Water	Open

Log of Borehole 105

Project No. BAR-22008396-A0 Figure No. 6

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907684 N 602815 E

Date Drilled: April 13, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			311.98	0				
		TOPSOIL: 125 mm, Dark Brown, Silt, Very Moist	311.9					
		SILTY SAND: Brown, Moist [Loose to Compact]	310.87	1				
		TILL: Sandy Silt/Silty Sand, Some Gravel, Trace Clay, Cobbles and Boulders, Brown to Grey, Moist, With Wet Sand Seams [Compact] San. Sewer Invert ~EL. 309.7 m	310.6	2	5		SS1	
				3	15		SS2	
				4	14		SS3	
				5	18		SS4	
				6	18		SS5	
				7	15		SS6	
				8	16		SS7	
			303.9		19		SS8	
		BOREHOLE TERMINATED AT 8.1 m INSTALLED 50 mm MONITORING WELL TO 7.6 m						

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	7.0/305.0	Install
May 25, 2022	1.11/310.87	
June 8, 2022	3.76/308.22	

Log of Borehole 106

Project No. BAR-22008396-A0 Figure No. 7

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907533 N 602793 E

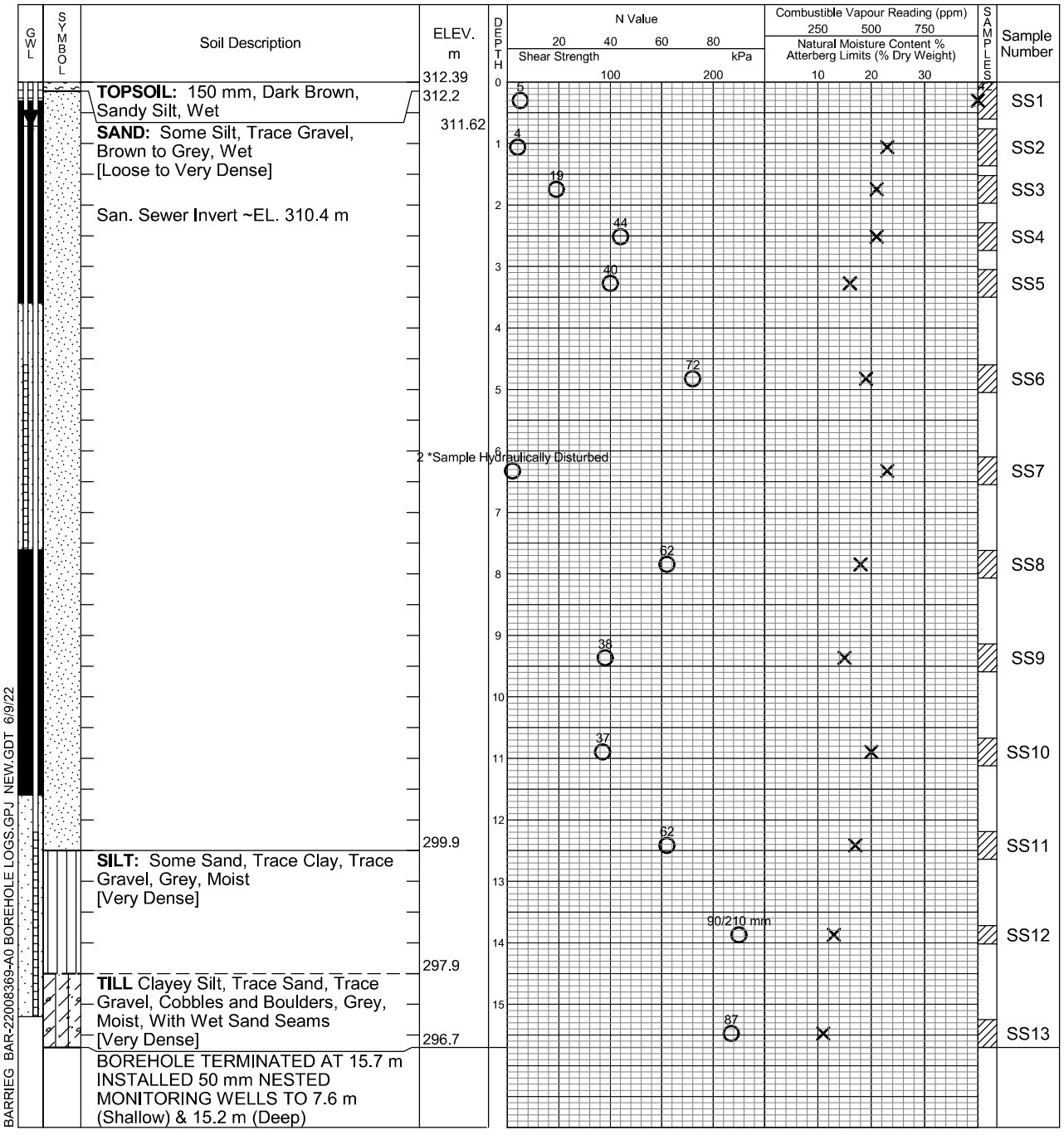
Date Drilled: April 14, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	6.5/305.9	Install
May 25, 2022	0.84/311.55	(Shallow)
May 25, 2022	0.87/311.52	(Deep)
June 8, 2022	0.79/311.60	(Shallow)
June 8, 2022	0.77/311.61	(Deep)

Log of Borehole 107

Project No. BAR-22008396-A0 | Figure No. 8

Project: Proposed Watersand North Phase II Residential Development | Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907456 N 602947 E

Date Drilled: April 21, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value (20 40 60 80) / Shear Strength kPa (100 200)	Combustible Vapour Reading (ppm) (250 500 750) / Natural Moisture Content % Atterberg Limits (% Dry Weight) (10 20 30)	SAMPLES	Sample Number
		TOPSOIL: 300 mm, Dark Brown, Silt, Wet	312.43 312.1	0	5		SS1	SS1
		SILT: Trace Sand, Trace Clay, Brown, Wet [Compact]		1	14		SS2	SS2
		Becoming Clayey Silt		2	10		SS3	SS3
					13		SS4	SS4
		SAND: Some Silt, Trace Gravel, Grey, Wet [Very Dense]	309.5	3	65		SS5	SS5
				4				
				5	2 *Sample Hydraulically Disturbed		SS6	SS6
		Becoming Sand, Some Gravel, Trace Silt		6	85/275 mm		SS7	SS7
				7				
			304.4	8	84/225 mm		SS8	SS8
		BOREHOLE TERMINATED AT 8.0 m San. Sewer Invert ~ EL. 313.4 m (~1 m above existing grade)						

BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	5.2/307.2	7.0

Log of Borehole 108

Project No. BAR-22008396-A0 Figure No. 9

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907349 N 603085 E

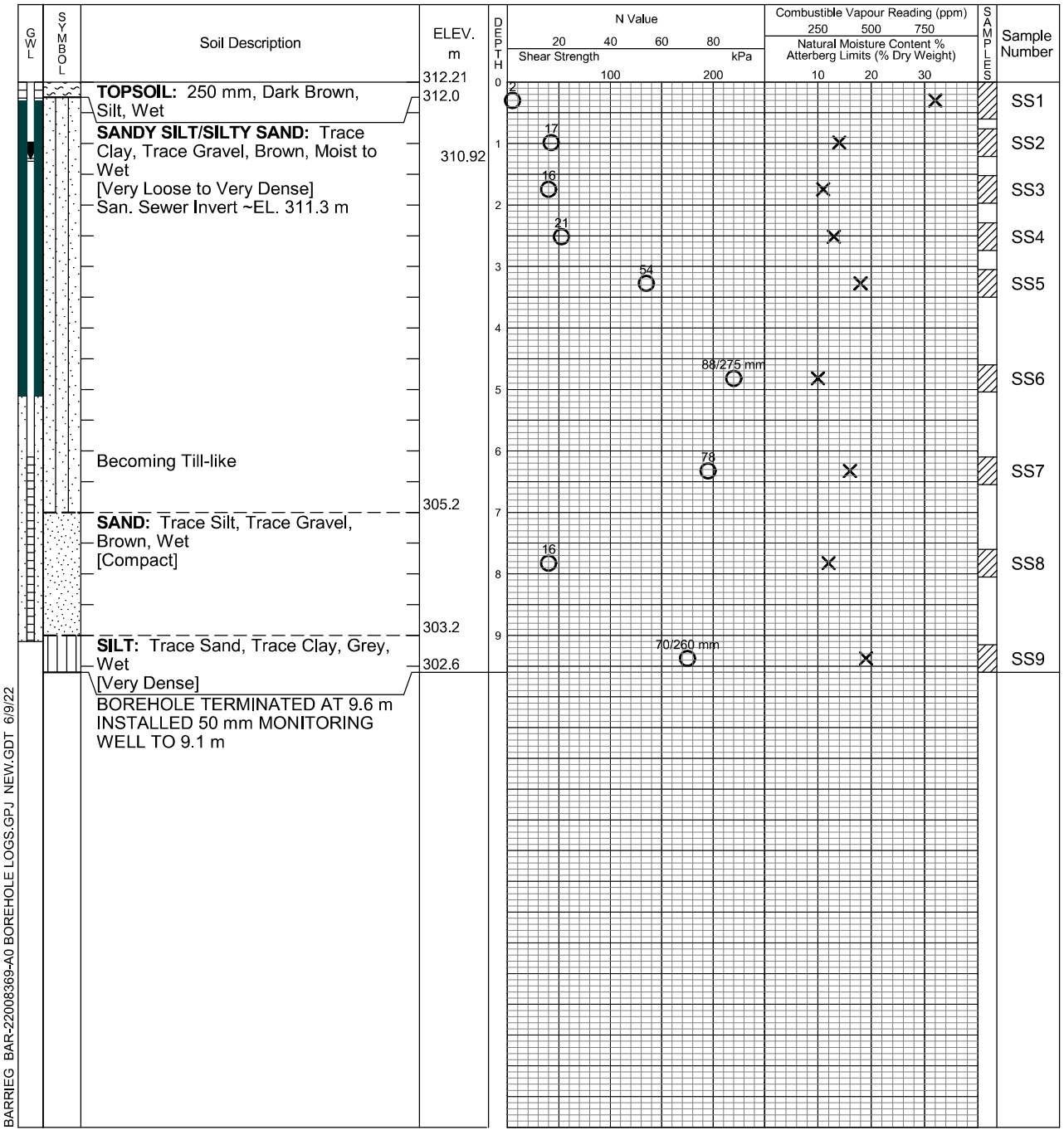
Date Drilled: April 21, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.1/309.1	Install
June 8, 2022	1.29/310.92	

Log of Borehole 109

Project No. BAR-22008396-A0 Figure No. 10

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907212 N 603029 E

Date Drilled: April 25, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			312.10	0				
		TOPSOIL: 150 mm, Dark Brown, Silt, Wet	312.0					
		SANDY SILT: Trace Clay, Trace Gravel, Brown, Moist [Very Loose]	311.4	1	2, 19			SS1, SS2
		TILL: Sandy Silt/Silty Sand, Trace Gravel, Trace Clay, Cobbles and Boulders, Brown to Grey, Moist, With Wet Sand Seams [Compact to Very Dense] San. Sewer Invert ~EL. 311.1 m		2	21, 23			SS3, SS4
				3	51			SS5
				4				
				5	59			SS6
				6	69			SS7
			305.1	7				
		SAND: Trace Silt, Trace Gravel, Brown, Wet [Very Dense]	304.0	8	57			SS8
		BOREHOLE TERMINATED AT 8.1 m						

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	5.6/306.5	7.6

Log of Borehole 110

Project No. BAR-22008396-A0 | Figure No. 11

Project: Proposed Watersand North Phase II Residential Development | Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907267 N 603200 E

Date Drilled: April 26, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
		TOPSOIL: 150 mm, Dark Brown, Silt, Wet	312.45 312.3	0	4			SS1
		SAND: Trace to Some Gravel, Trace to Some Silt, Brown to Grey, Moist [Loose to Very Dense]		1	26			SS2
				2	73			SS3
		San. Sewer Invert ~EL. 310.6 m			84			SS4
			310.02	3	59			SS5
		Becoming Wet		4				
				5	92/250 mm			SS6
				6	86/250 mm			SS7
				7				
				8	81/250 mm			SS8
				9	31			SS9
		Becoming Sand, Some Silt		10				
				11	89/210 mm			SS10
				12	73/275 mm			SS11
				13				
				14	90/225 mm			SS12
				15	74/275 mm			SS13
			297.0					
		BOREHOLE TERMINATED AT 15.5 m INSTALLED 50 mm NESTED MONITORING WELLS TO 7.6 m (Shallow) & 15.2 m (Deep)						

BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.9/308.6	Install
May 25, 2022	2.43/310.02	(Shallow)
May 25, 2022	2.44/310.01	(Deep)
June 8, 2022	2.66/309.79	(Shallow)
June 8, 2022	2.59/309.86	(Deep)

Log of Borehole 111

Project No. BAR-22008396-A0 Figure No. 12

Project: Proposed Watersand North Phase II Residential Development Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907307 N 603335 E

Date Drilled: April 25, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			311.90	0				
		TOPSOIL: 300 mm, Dark Brown, Sandy Silt, Wet	311.6					
		SAND: Trace to Some Silt, Trace Gravel, Brown to Grey, Moist [Loose to Very Dense]		1	3, 3		SS1, SS2	
				2	24		SS3	
		San. Sewer Invert ~EL. 309.9 m	309.96		40		SS4	
		Becoming Wet		3	81		SS5	
				4				
		Sand and Gravel, Trace Silt Layer		5	94/275 mm		SS6	
				6	55		SS7	
				7	78/295 mm		SS8	
			304.0					
		BOREHOLE TERMINATED AT 7.9 m INSTALLED 50 mm MONITORING WELL TO 7.3 m						

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.1/308.8	Install
May 25, 2022	1.94/309.96	
June 8, 2022	2.18/309.72	

Log of Borehole 112

Project No. BAR-22008396-A0 | Figure No. 13

Project: Proposed Watersand North Phase II Residential Development | Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907106 N 603252 E

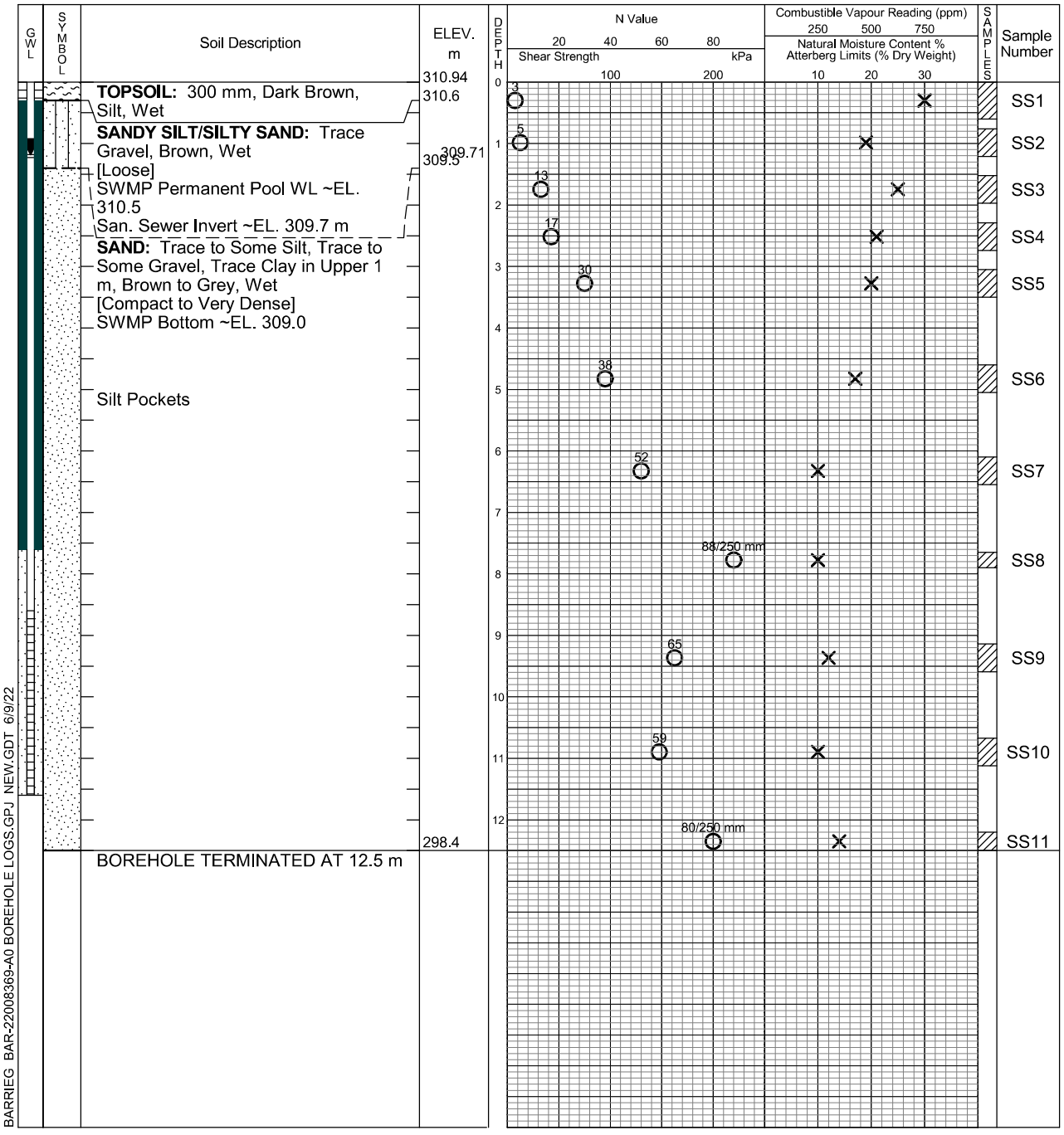
Date Drilled: April 25, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	5.0/305.9	Install
May 25, 2022	1.23/309.71	
June 8, 2022	1.33/309.61	

Log of Borehole 113

Project No. BAR-22008396-A0 | Figure No. 14

Project: Proposed Watersand North Phase II Residential Development | Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907135 N 603401 E

Date Drilled: April 25, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
		TOPSOIL: 200 mm, Dark Brown, Sandy Silt, Wet	311.84 311.6	0	4			SS1
		SANDY SILT/SILTY SAND: Trace Organics, Brown, Wet [Loose]	311.1	1	14			SS2
		SAND: Some Silt, Trace Gravel, Brown to Grey, Wet [Compact to Very Dense] San. Sewer Invert ~EL. 310.4 m Silt Pockets		2	36 70			SS3 SS4
				3	68			SS5
				4				
				5	51			SS6
				6	66/275 mm			SS7
		BOREHOLE TERMINATED AT 6.5 m	305.3					

BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.0/308.8	5.2

Log of Borehole 114

Project No. BAR-22008396-A0 | Figure No. 15

Project: Proposed Watersand North Phase II Residential Development | Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907217 N 603511 E

Date Drilled: April 25, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value (20 40 60 80) / Shear Strength kPa (100 200)	Combustible Vapour Reading (ppm) (250 500 750) / Natural Moisture Content % Atterberg Limits (% Dry Weight) (10 20 30)	SAMPLES	Sample Number
		TOPSOIL: 150 mm, Dark Brown, Silt, Wet	311.73 311.6	0	2		SS1	SS1
		SANDY SILT/SILTY SAND: Brown, Very Moist [Loose to Compact]	310.3	1	20		SS2	SS2
		TILL: Sandy Silt/Silty Sand, Trace Gravel, Cobbles and Boulders, Brown, Moist [Dense to Very Dense]	309.2	2	45		SS3	SS3
					58		SS4	SS4
		SAND: Trace to Some Silt, Trace to Some Gravel, Brown to Grey, Wet [Very Dense]		3	92/210 mm		SS5	SS5
		San. Sewer Invert ~EL. 308.8 m		4				
				5	66		SS6	SS6
				6	67/250 mm		SS7	SS7
				7				
			303.7		75/225 mm		SS8	SS8
		BOREHOLE TERMINATED AT 8.0 m		8				

BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

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f: +1.705.719.1109

Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.4/309.3	6.4

Log of Borehole 115

Project No. BAR-22008396-A0 | Figure No. 16

Project: Proposed Watersand North Phase II Residential Development | Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907039 N 603441 E

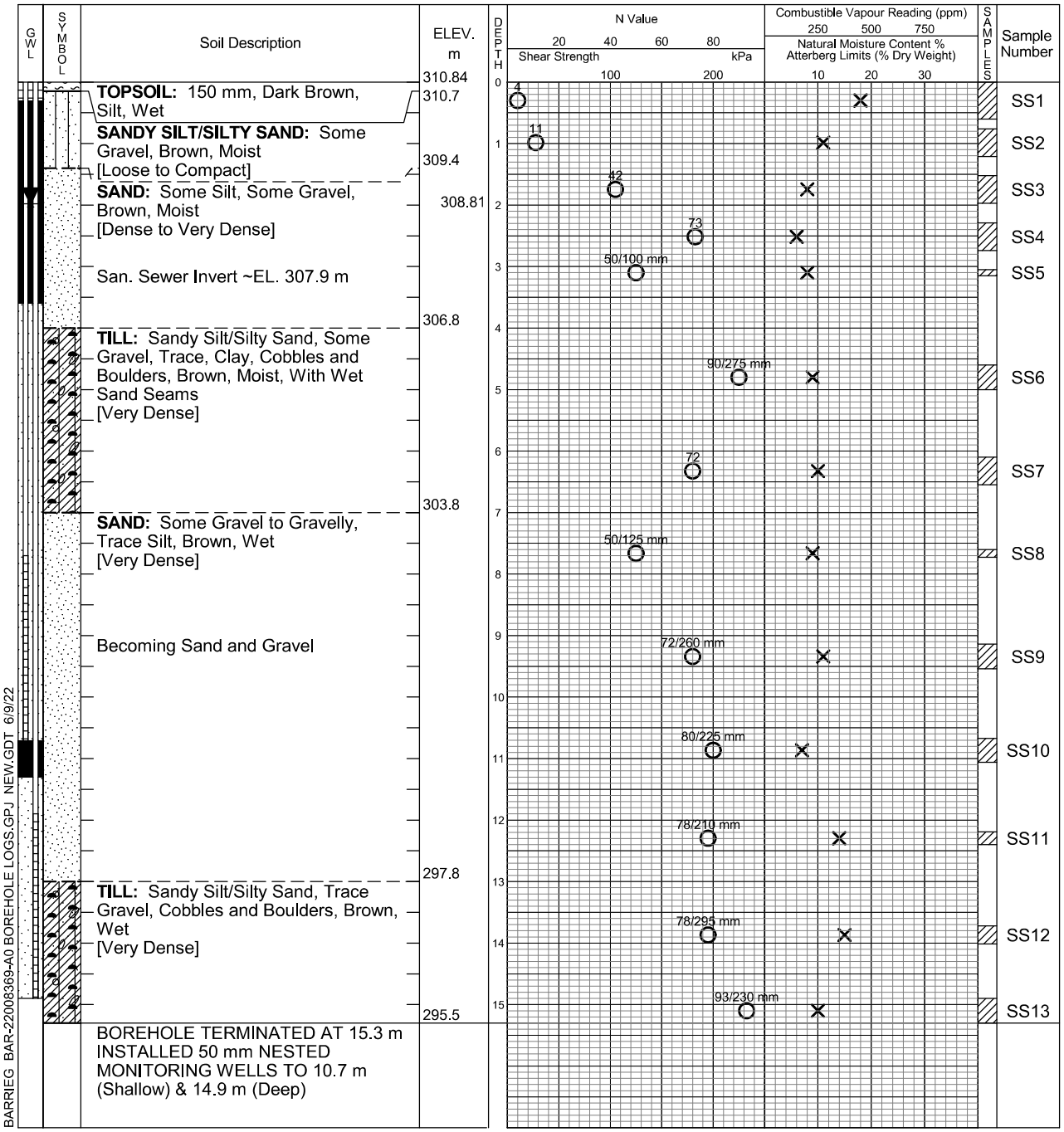
Date Drilled: April 22, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

EXP Services Inc.
14 Cedar Pointe Drive
Barrie, ON L4N 5R7
t: +1.705.719.1100
f: +1.705.719.1109

Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	6.5/304.3	Install
May 25, 2022	2.14/308.70	(Shallow)
May 25, 2022	2.03/308.81	(Deep)
June 8, 2022	2.37/308.47	(Shallow)
June 8, 2022	2.21/308.63	(Deep)

Log of Borehole 116

Project No. BAR-22008396-A0 — Figure No. 17

Project: Proposed Watersand North Phase II Residential Development — Sheet No. 1 of 1

City/ Municipality: 259 Salem Road, Barrie Ontario

Location: 17T 4907074 N 603547 E

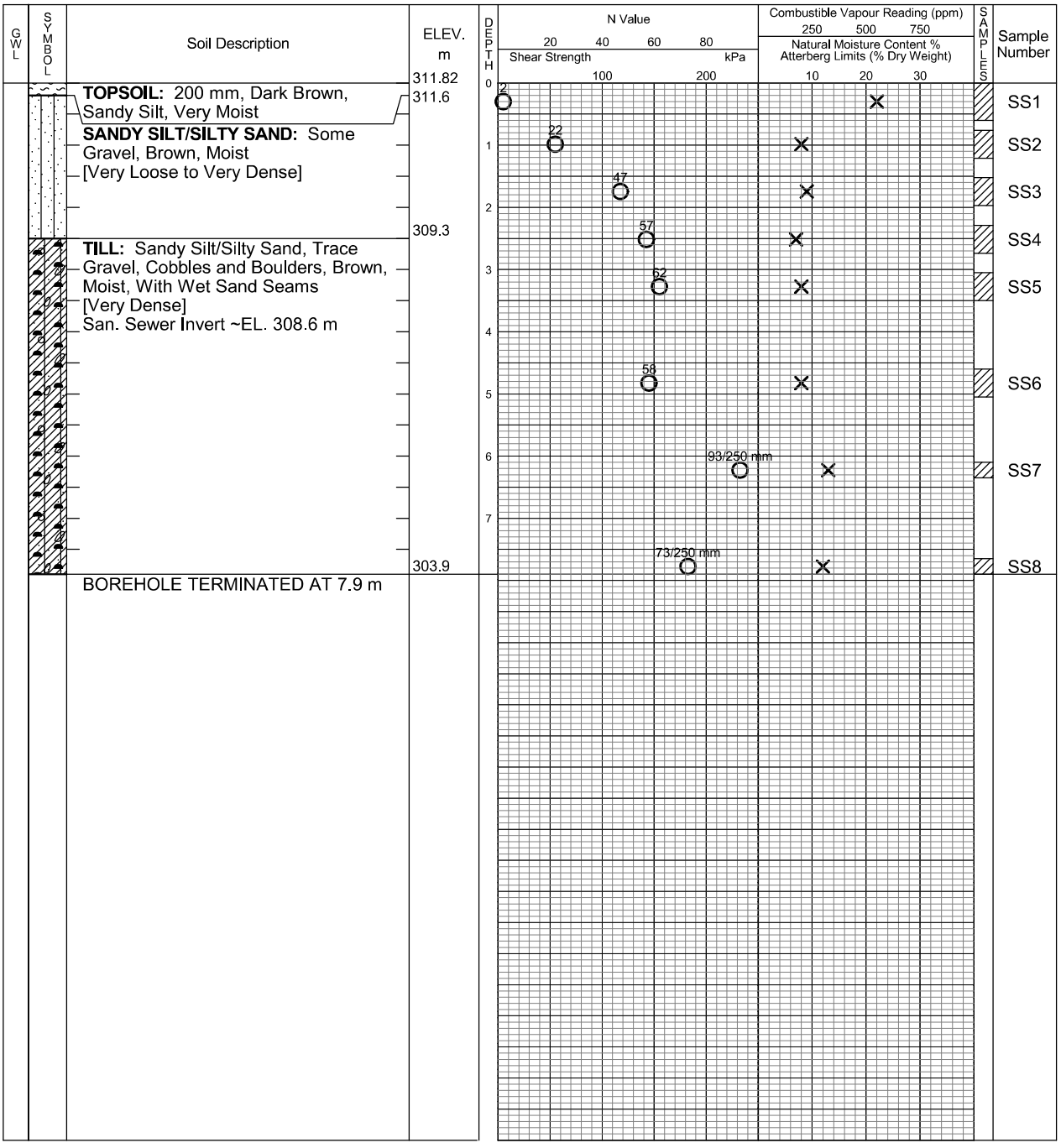
Date Drilled: April 21, 2022

Drill Type: Track-Mount, Hollow Stem Augers

Datum: Geodetic

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

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



BARRIEG BAR-22008369-A0 BOREHOLE LOGS.GPJ NEW.GDT 6/9/22

EXP Services Inc.
14 Cedar Pointe Drive
Barrie, ON L4N 5R7
t: +1.705.719.1100
f: +1.705.719.1109

Borehole data requires interpretation assistance from EXP before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	6.4/305.4	7.3

EXP Services Inc.
14 Cedar Pointe Drive, Unit 1510
Barrie, Ontario, Canada
L4N 5R7
Tel.: +1.705.719.1100
Fax: +1.705.719.1109
www.exp.com

Grain Size Analysis Report

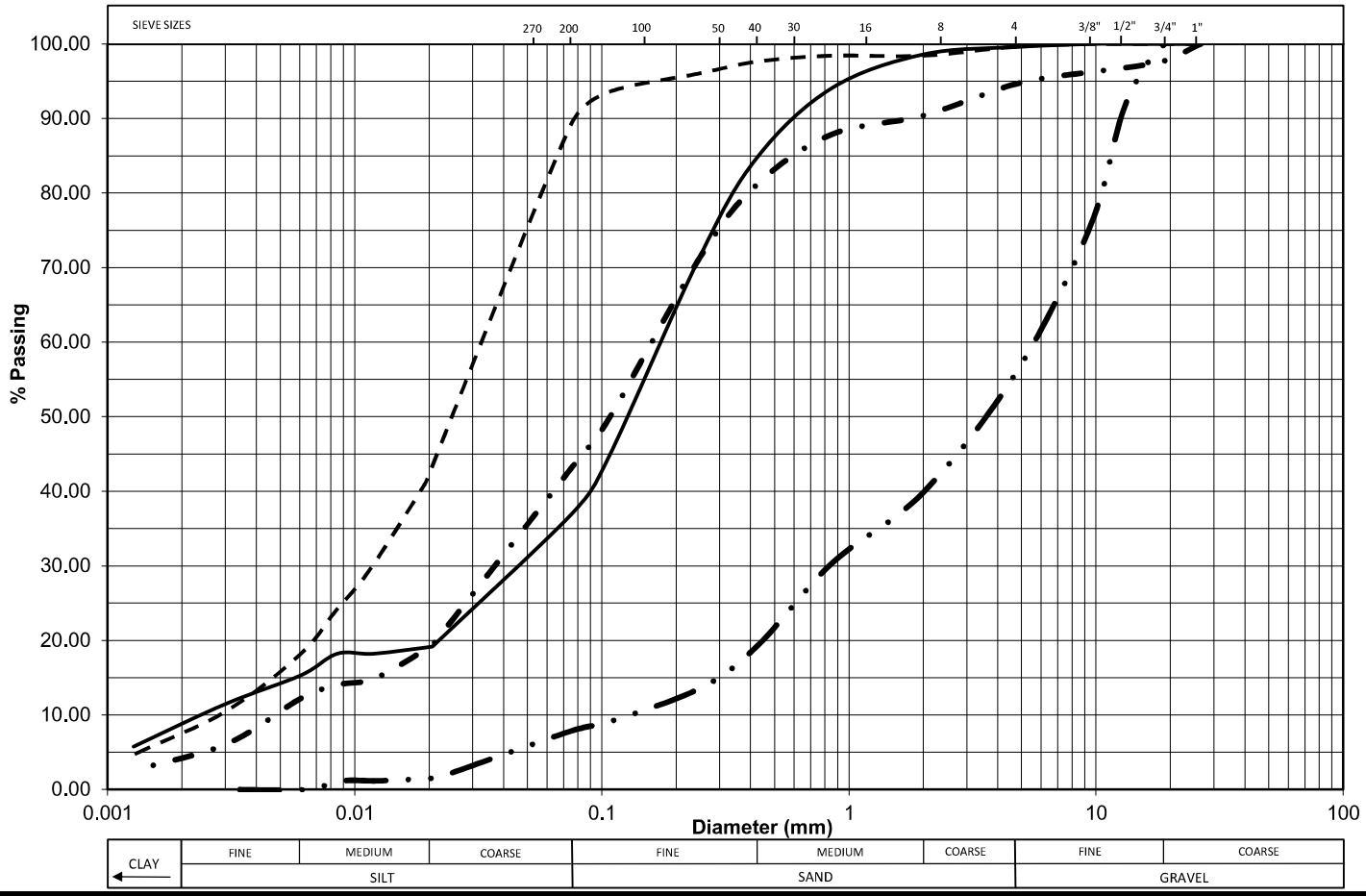
Project Name: Watersand North Phase II Residential Development
Project No.: BAR-22008396-A0
Client: Watersand Construction Ltd.

Figure No.: 18
Date Tested: May 10, 2022
Date Sampled: Apr. 12 to 25, 2022

SAMPLE INFORMATION

Material	Borehole No. and Sample No.	Sample Depth (m)	Material Description	Graph Line Type
1	BH101 SS7	6.1 - 6.5	SILTY SAND, Trace Clay, Trace Gravel	
2	BH106 SS12	13.7 - 14.0	SILT, Some Sand, Trace Clay, Trace Gravel	
3	BH108 SS7	6.1 - 6.5	SAND AND SILT, Trace Clay, Trace Gravel	
4	BH111 SS6	4.6 - 5.0	SAND AND GRAVEL, Trace Silt	

Sieve & Hydrometer Analysis



DISTRIBUTION:
Watersand Construction Ltd.

Prepared By:
DG
Dan Gilchrist

Checked By:
Richard Blair, P. Eng.

EXP Services Inc.
14 Cedar Pointe Drive, Unit 1510
Barrie, Ontario, Canada
L4N 5R7
Tel.: +1.705.719.1100
Fax: +1.705.719.1109
www.exp.com

Grain Size Analysis Report

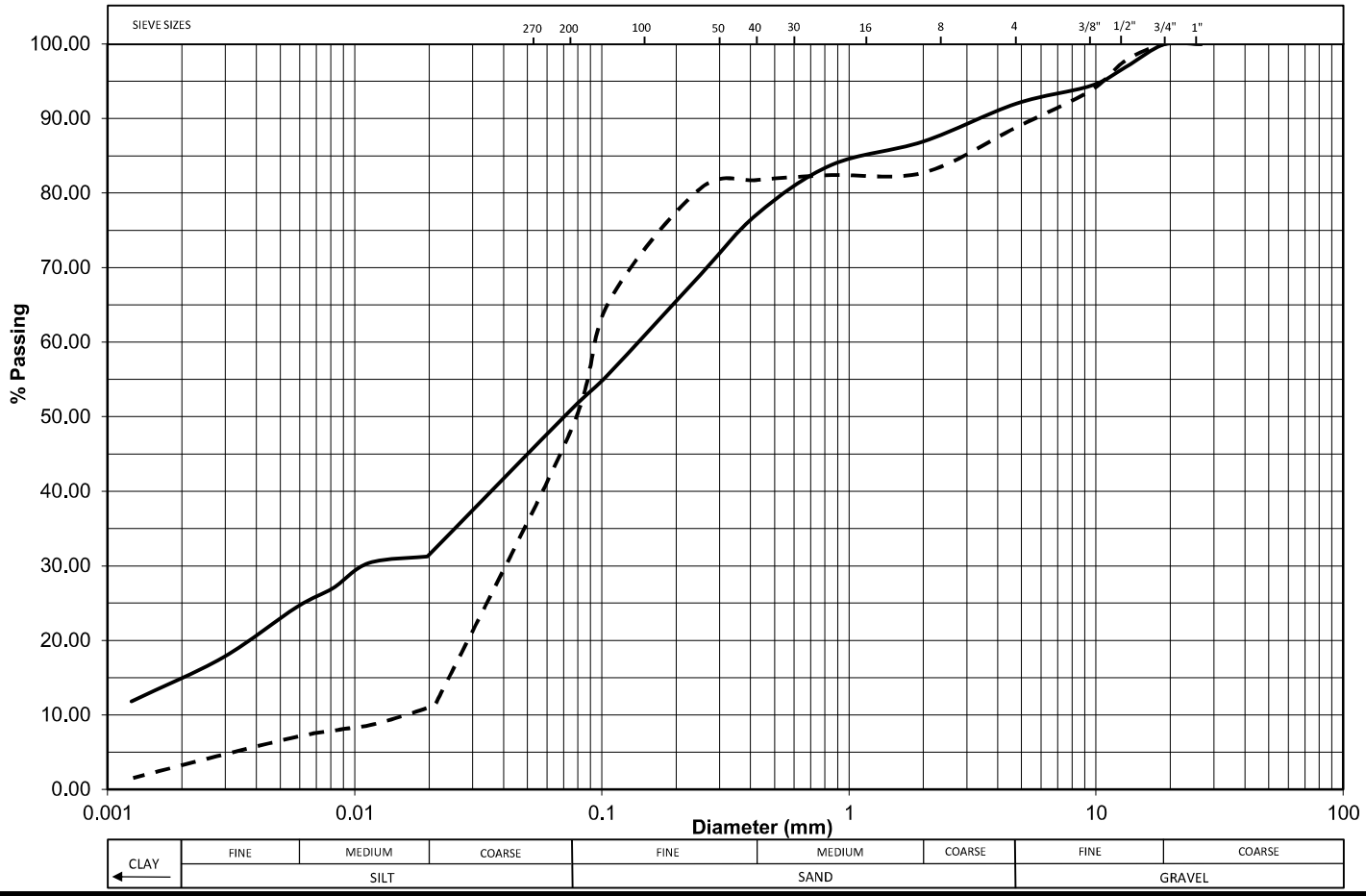
Project Name: Watersand North Phase II Residential Development
Project No.: BAR-22008396-A0
Client: Watersand Construction Ltd.

Figure No.: 19
Date Tested: May 10, 2022
Date Sampled: Apr. 12 to 25, 2022

SAMPLE INFORMATION

Material	Borehole No. and Sample No.	Sample Depth (m)	Material Description	Graph Line Type
1	BH103 SS12	13.7 - 14.1	TILL: Sand & Silt, Some Clay, Trace Gravel	
2	BH115 SS7	6.1 - 6.5	TILL: Silt & Sand, Some Gravel, Trace Clay	

Sieve & Hydrometer Analysis



DISTRIBUTION:
Watersand Construction Ltd.

Prepared By:
DG
Dan Gilchrist

Checked By:
Richard Blair, P. Eng.

Appendix C – Groundwater Elevation Summary Table

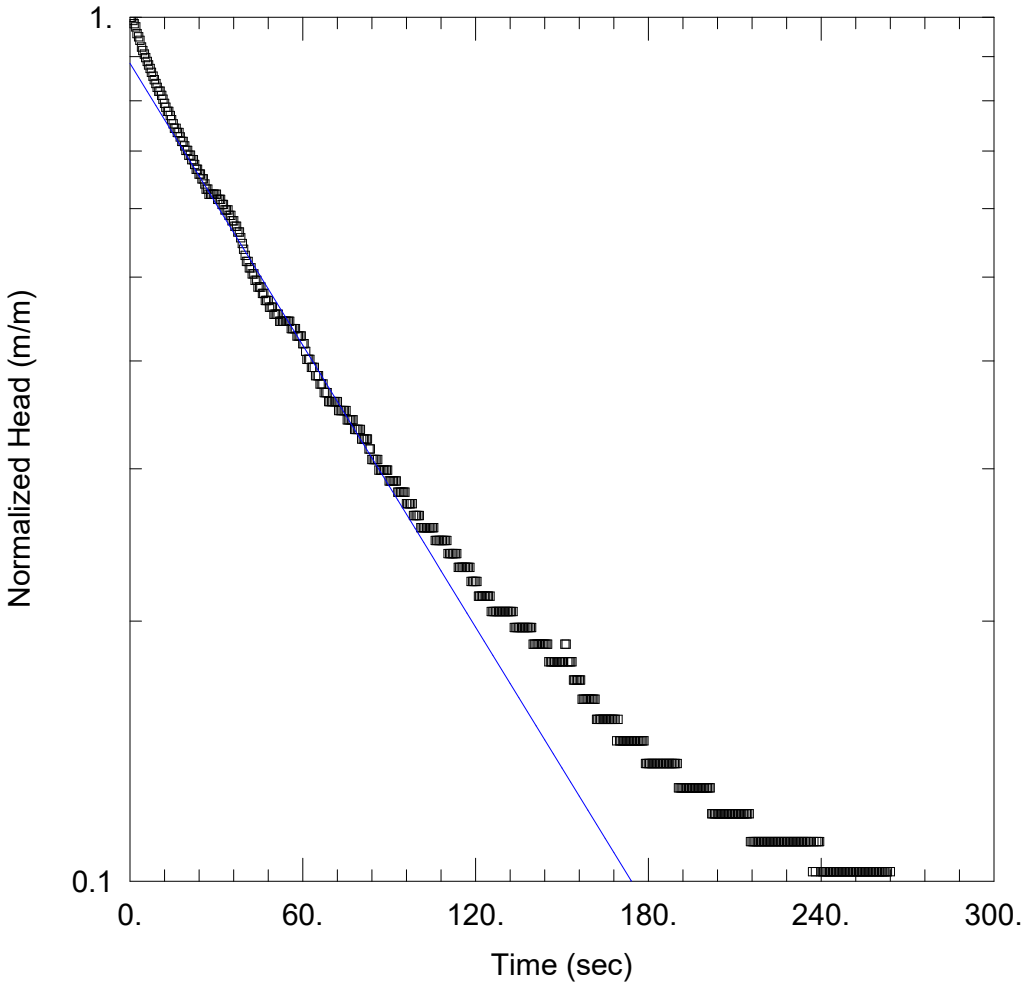
Appendix C: Groundwater Elevation Summary

Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

Monitoring Well ID	Ground Surface Elevation (masl)	Stick Up (m)	Approximate Full Well Depth (mbTOP)	Approximate Full Well Depth (mbgs)	Minimum GW Elevation (masl)	Maximum GW Elevation (masl)	Depth	25-May-22	8-Jun-22
BH 101-S	312.35	0.86	7.15	6.29	311.66	311.98	mbTOP	1.55	1.23
							mbgs	0.69	0.37
							masl	311.66	311.98
BH 101-D	312.35	0.86	16.45	15.59	311.65	311.79	mbTOP	1.56	1.42
							mbgs	0.70	0.56
							masl	311.65	311.79
BH 103-S	311.34	0.66	7.42	6.76	310.45	310.48	mbTOP	1.55	1.52
							mbgs	0.89	0.86
							masl	310.45	310.48
BH 103-D	311.34	0.67	15.83	15.16	310.21	310.24	mbTOP	1.77	1.80
							mbgs	1.10	1.13
							masl	310.24	310.21
BH 105	311.98	0.78	8.60	7.82	308.22	310.87	mbTOP	1.89	4.54
							mbgs	1.11	3.76
							masl	310.87	308.22
BH 106-S	312.39	0.76	8.27	7.51	311.55	311.60	mbTOP	1.60	1.55
							mbgs	0.84	0.79
							masl	311.55	311.60
BH 106-D	312.39	0.76	14.50	13.74	311.52	311.62	mbTOP	1.63	1.54
							mbgs	0.87	0.78
							masl	311.52	311.62
BH 108	312.21	0.79	9.83	9.04	310.92	310.92	mbTOP	-	2.08
							mbgs	-	1.29
							masl	-	310.92
BH 110-S	312.45	0.69	7.64	6.95	309.79	310.02	mbTOP	3.12	3.35
							mbgs	2.43	2.66
							masl	310.02	309.79
BH 110-D	312.45	0.80	15.35	14.55	309.86	310.01	mbTOP	3.24	3.39
							mbgs	2.44	2.59
							masl	310.01	309.86
BH 111	311.90	0.72	8.06	7.34	309.72	309.96	mbTOP	2.66	2.90
							mbgs	1.94	2.18
							masl	309.96	309.72
BH 112	310.94	0.74	11.62	10.88	309.61	309.71	mbTOP	1.97	2.07
							mbgs	1.23	1.33
							masl	309.71	309.61
BH 115-S	310.84	0.74	10.68	9.94	308.47	308.70	mbTOP	2.88	3.11
							mbgs	2.14	2.37
							masl	308.70	308.47
BH 115-D	310.84	0.74	14.66	13.92	308.63	308.81	mbTOP	2.77	2.95
							mbgs	2.03	2.21
							masl	308.81	308.63

Notes:
mbTOP - meters below top of the pipe
mbgs - meters below ground surface
masl - meters above mean sea level

Appendix D – SWRT Procedures and Results



BH 101 S_FALLING HEAD SWRT

Data Set: \...\BH 101 S.aqt
Date: 06/15/22 Time: 17:06:54

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 101 S
Test Date: 8 June, 2022

AQUIFER DATA

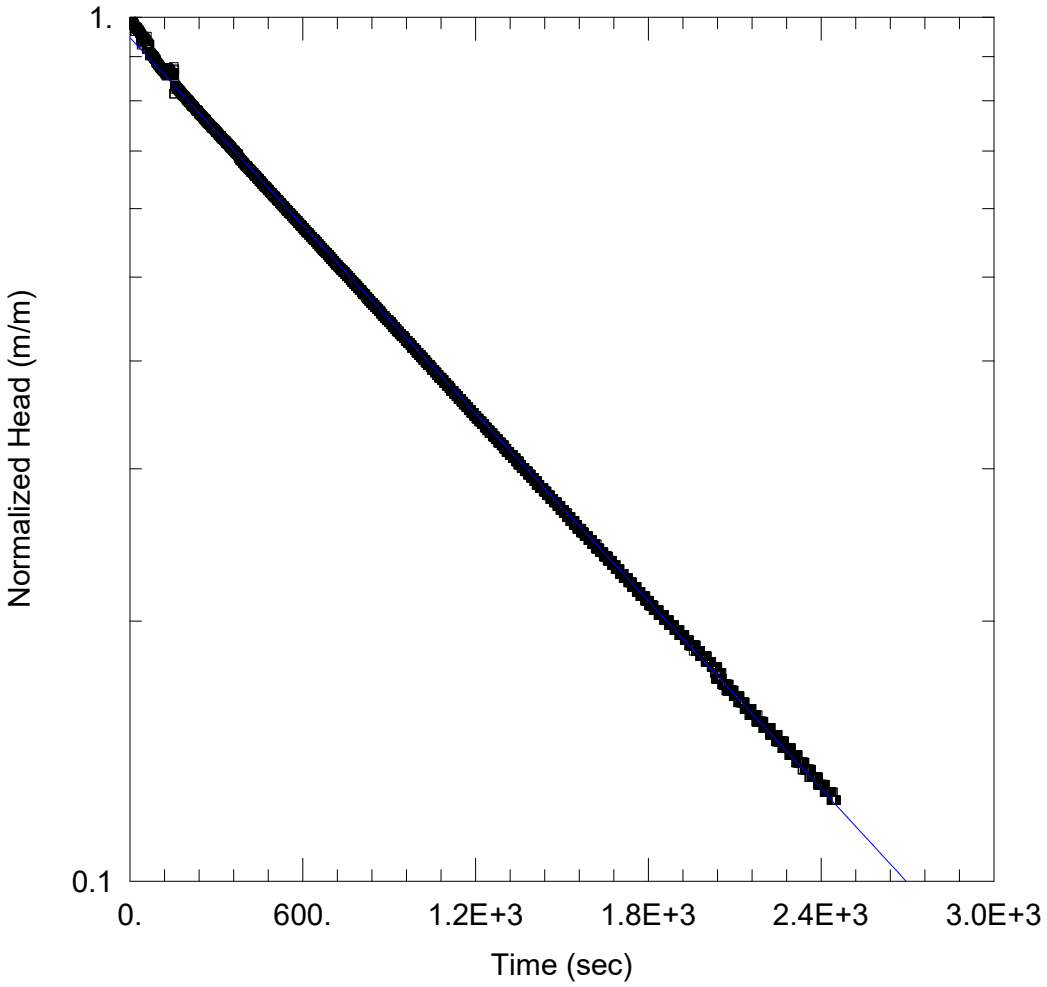
Saturated Thickness: 5.89 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 101 S)

Initial Displacement: 0.351 m
Total Well Penetration Depth: 5.89 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.89 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.878E-6 m/sec
y0 = 0.3103 m



BH 101 D_FALLING HEAD SWRT

Data Set: \...\BH 101 D.aqt
Date: 06/15/22 Time: 17:08:46

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 101 D
Test Date: 8 June, 2022

AQUIFER DATA

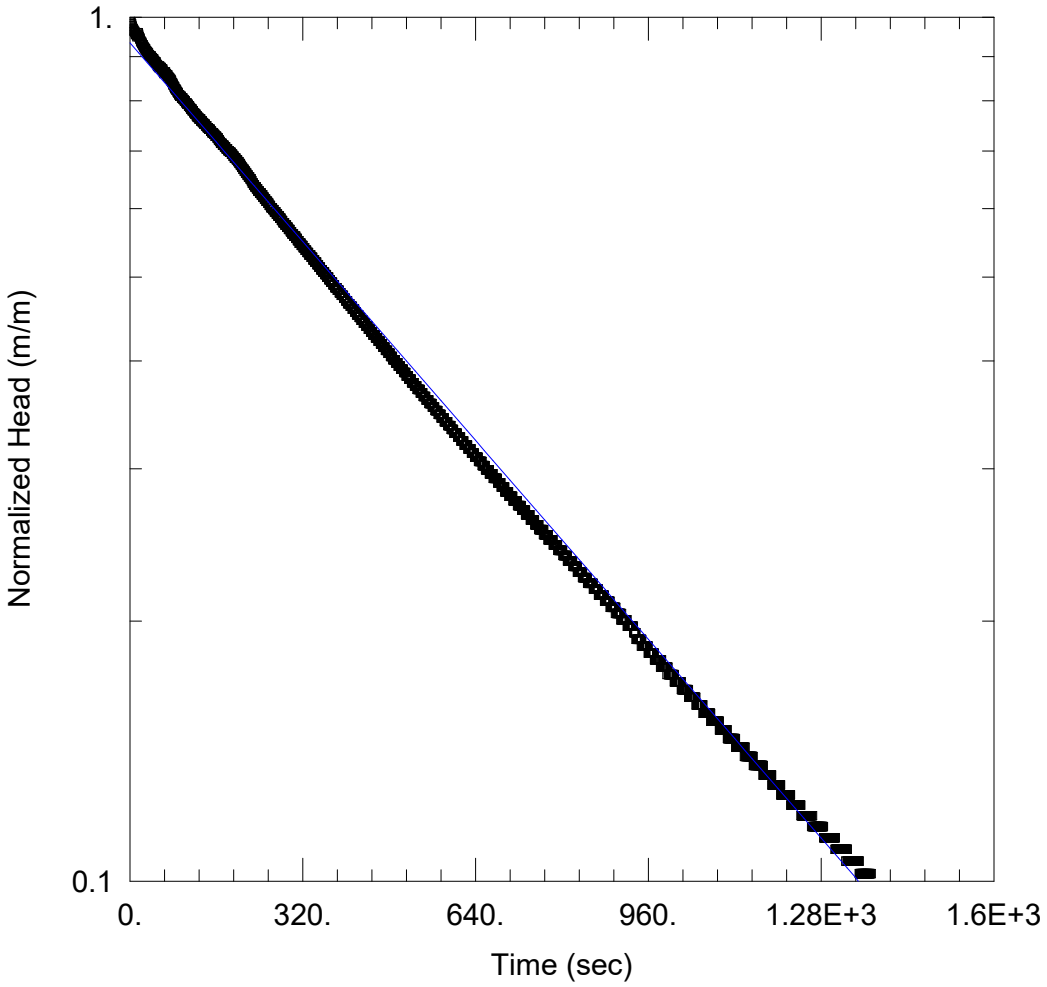
Saturated Thickness: 15.14 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 101 D)

Initial Displacement: 1.137 m
Total Well Penetration Depth: 15.14 m
Casing Radius: 0.0254 m
Static Water Column Height: 15.14 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.916E-7 m/sec
y0 = 1.077 m



BH 103 S_FALLING HEAD SWRT

Data Set: \...\BH 103 S.aqt
Date: 06/15/22 Time: 17:10:20

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 103 S
Test Date: 8 June, 2022

AQUIFER DATA

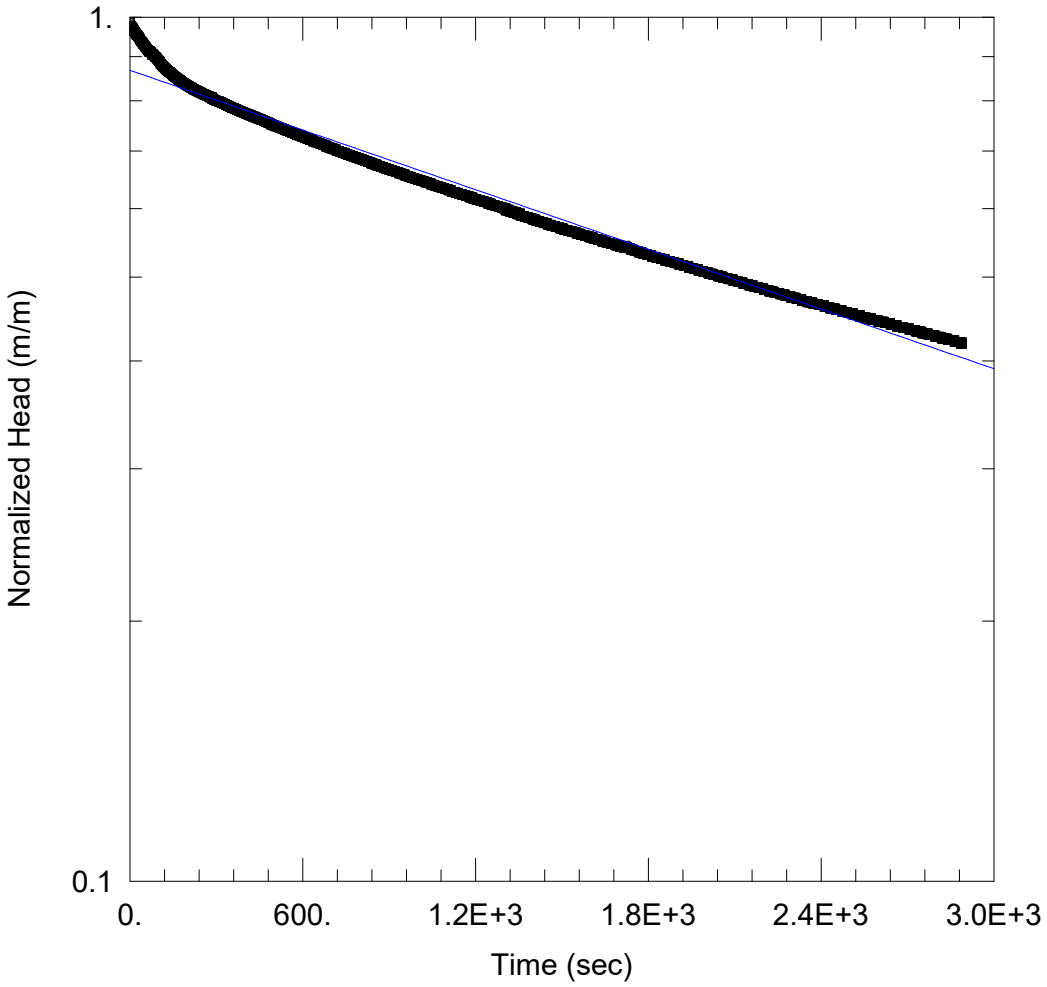
Saturated Thickness: 5.93 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 103 S)

Initial Displacement: 0.882 m
Total Well Penetration Depth: 5.93 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.93 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 7.774E-7 m/sec
y0 = 0.8236 m



BH 103 D_FALLING HEAD SWRT

Data Set: \...\BH 103 D.aqt
Date: 06/15/22 Time: 17:13:48

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 103 D
Test Date: 8 June, 2022

AQUIFER DATA

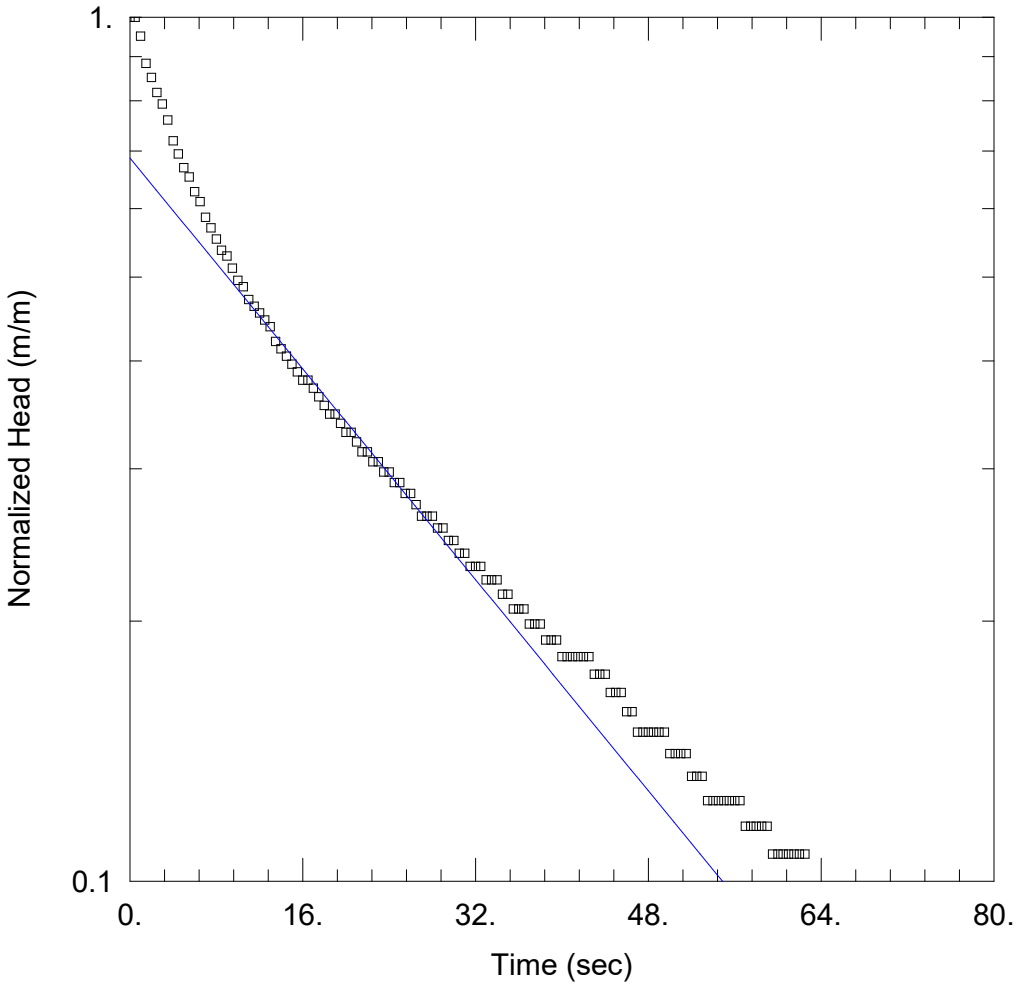
Saturated Thickness: 14.08 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 103 D)

Initial Displacement: 1.533 m
Total Well Penetration Depth: 14.08 m
Casing Radius: 0.0254 m
Static Water Column Height: 14.08 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.245E-7 m/sec
y0 = 1.33 m



BH 106 S_FALLING HEAD SWRT

Data Set: \...\BH 106 S.aqt
Date: 06/16/22 Time: 15:01:26

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 106 S
Test Date: 8 June, 2022

AQUIFER DATA

Saturated Thickness: 6.73 m Anisotropy Ratio (Kz/Kr): 1.

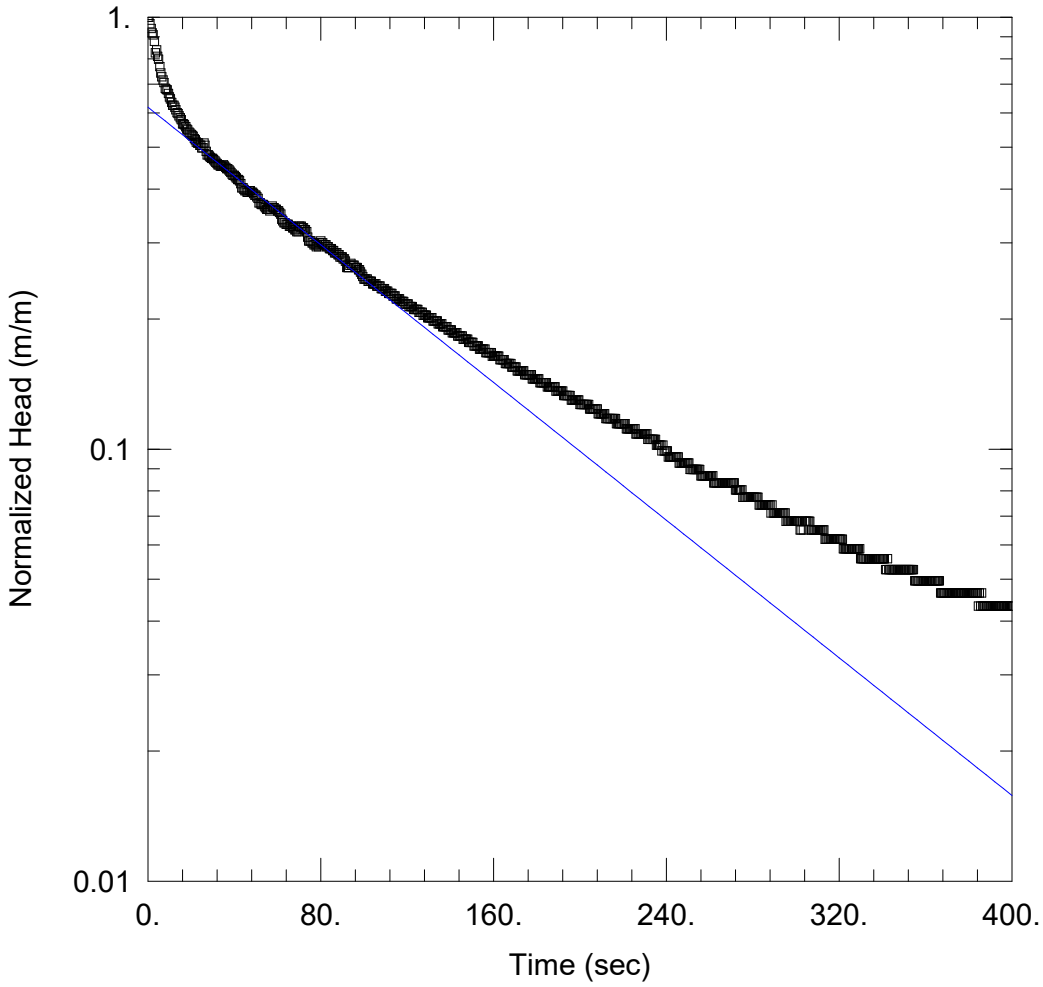
WELL DATA (BH 106 S)

Initial Displacement: 0.363 m
Total Well Penetration Depth: 6.73 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.73 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.649E-5 m/sec y0 = 0.2493 m



BH 106 D_FALLING HEAD SWRT

Data Set: \...\BH 106 D.aqt
Date: 06/15/22 Time: 17:24:11

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 106 D
Test Date: 8 June, 2022

AQUIFER DATA

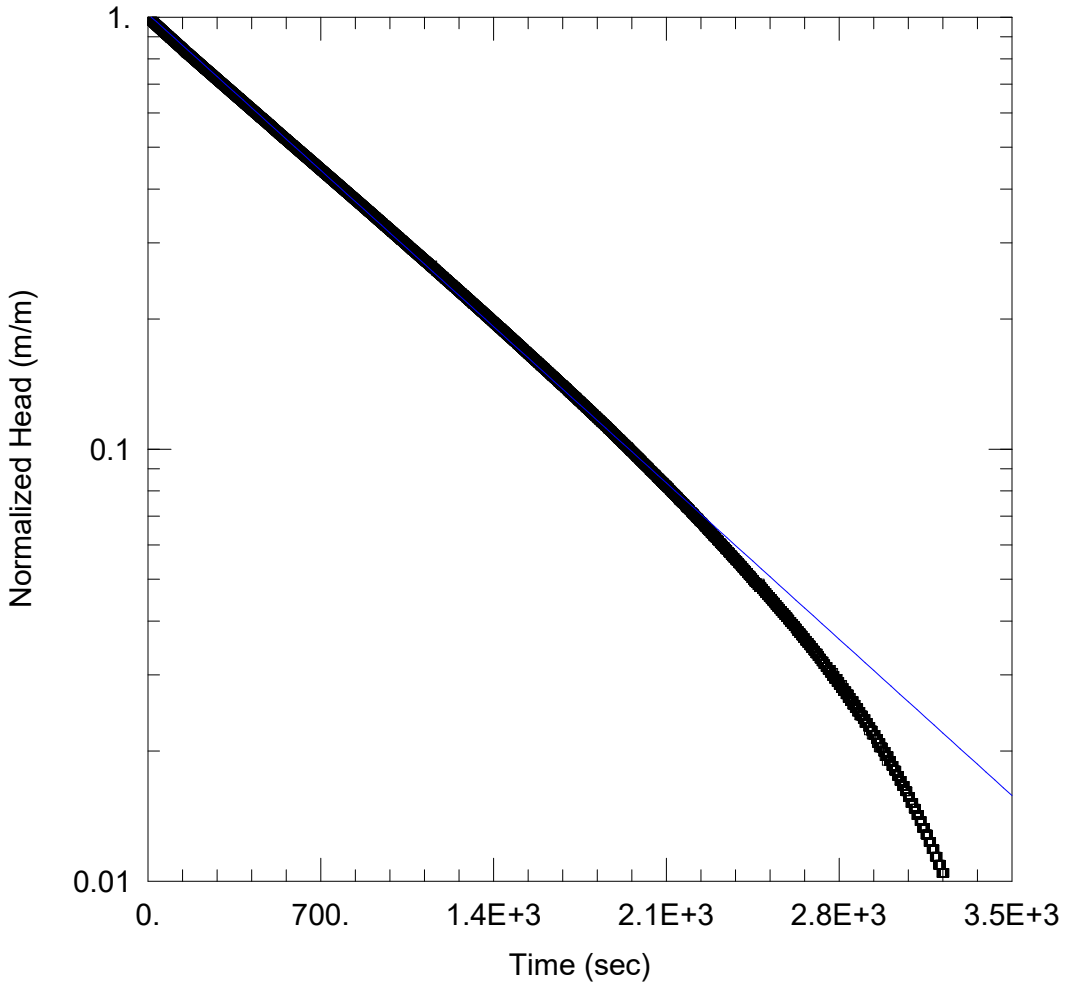
Saturated Thickness: 12.96 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 106 D)

Initial Displacement: 0.969 m
Total Well Penetration Depth: 12.96 m
Casing Radius: 0.0254 m
Static Water Column Height: 12.96 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.304E-6 m/sec
y0 = 0.5991 m



BH 108_RISING HEAD SWRT

Data Set: \...\BH 108.aqt
Date: 06/15/22 Time: 17:25:30

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 108
Test Date: 8 June, 2022

AQUIFER DATA

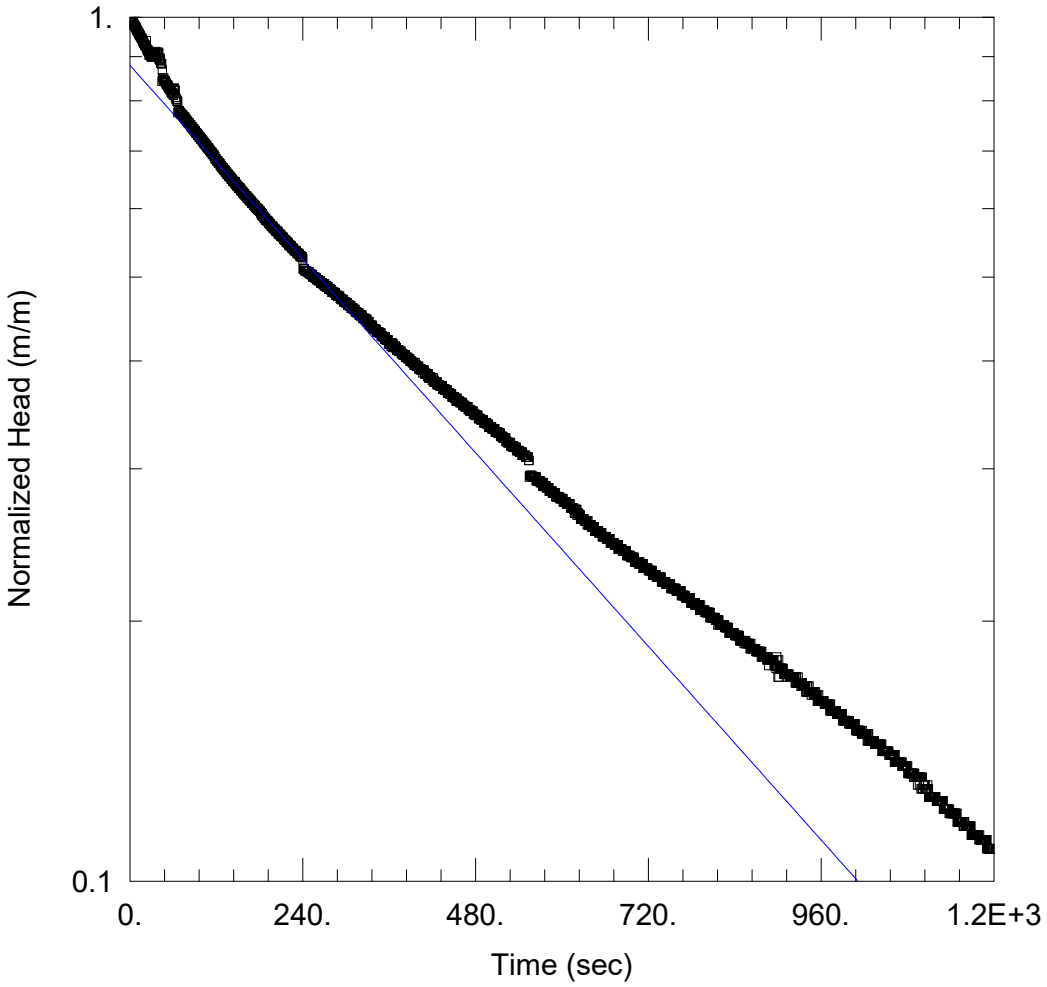
Saturated Thickness: 7.753 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 108)

Initial Displacement: 6.324 m
Total Well Penetration Depth: 7.753 m
Casing Radius: 0.0254 m
Static Water Column Height: 7.753 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.588E-7 m/sec
y0 = 6.429 m



BH 110 S_FALLING HEAD SWRT

Data Set: \...\BH 110 S.aqt
Date: 06/16/22 Time: 14:57:58

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 110 S
Test Date: 8 June, 2022

AQUIFER DATA

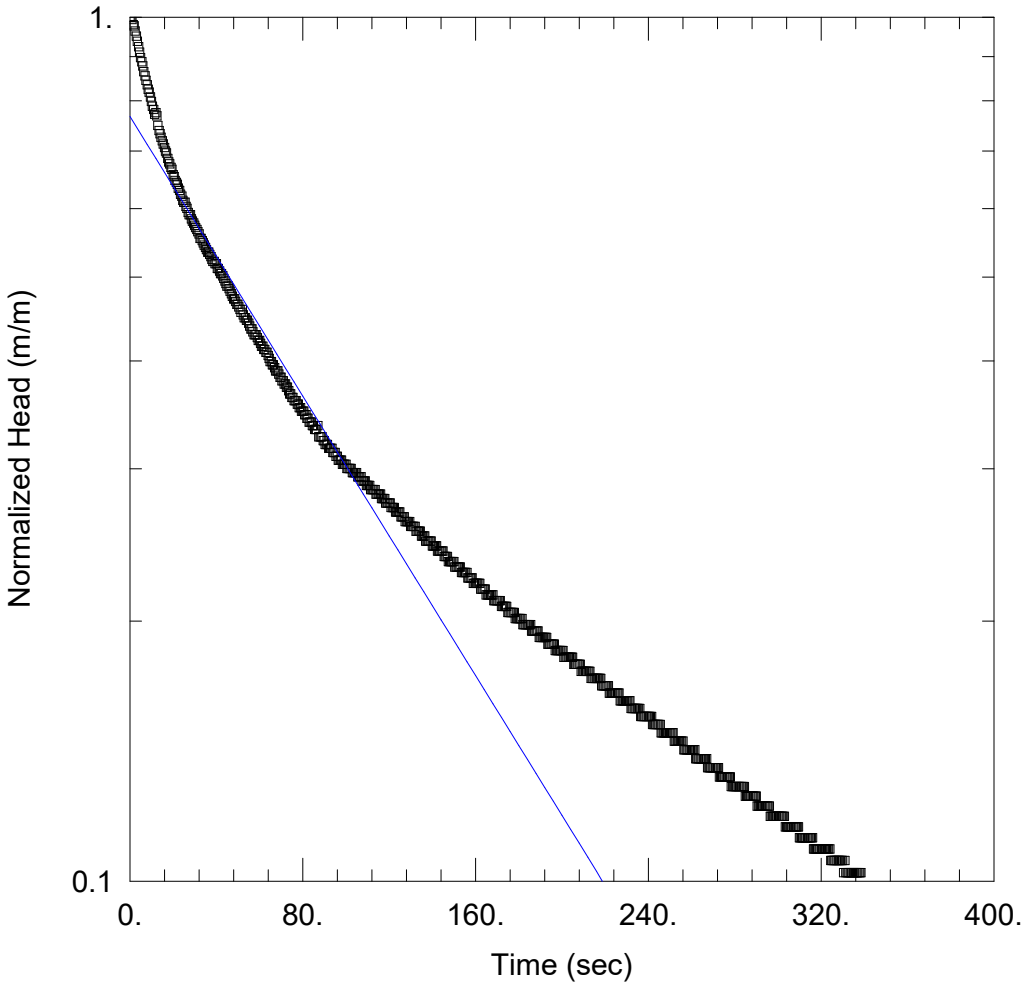
Saturated Thickness: 4.29 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 110 S)

Initial Displacement: 0.743 m
Total Well Penetration Depth: 4.29 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.29 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.01E-6 m/sec
y0 = 0.6533 m



BH 110 D_FALLING HEAD SWRT

Data Set: \...\BH 110 D.aqt
Date: 06/15/22 Time: 17:30:50

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 110 D
Test Date: 8 June, 2022

AQUIFER DATA

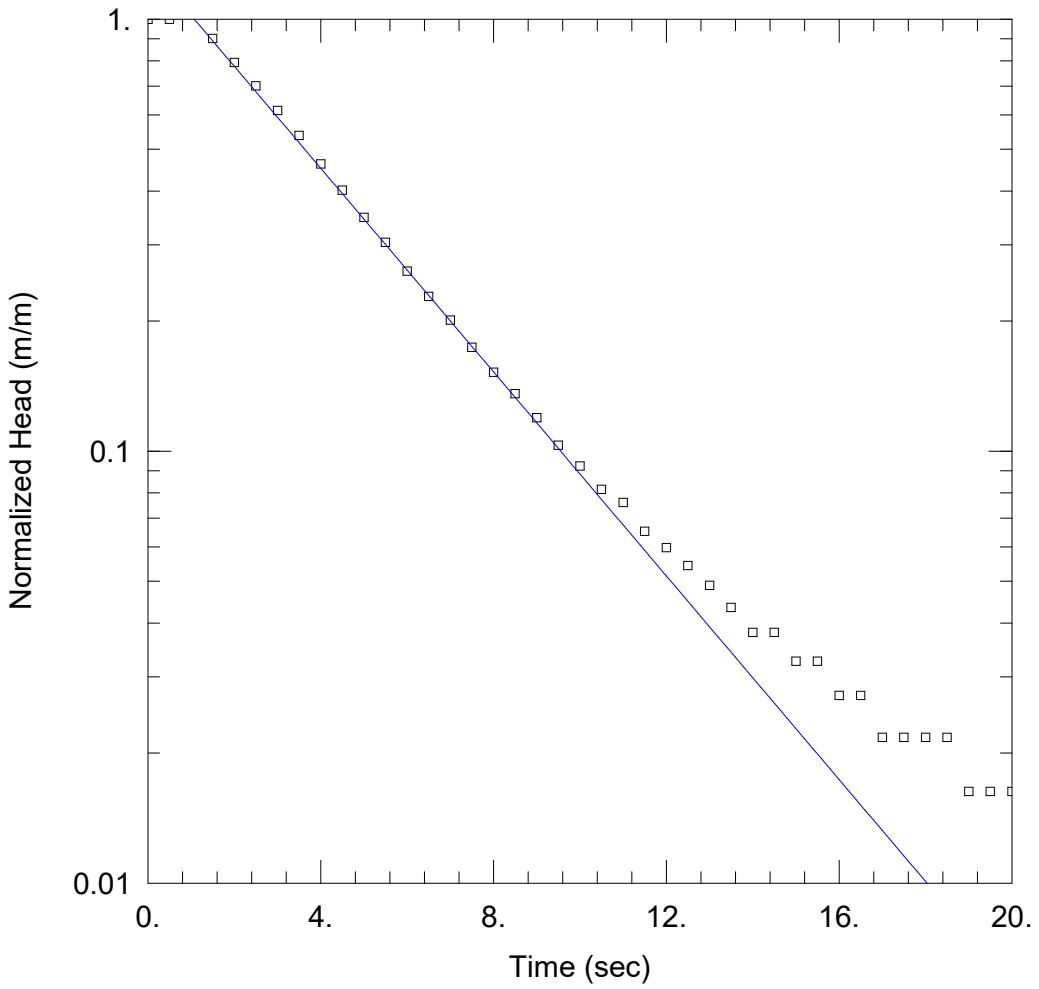
Saturated Thickness: 11.96 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 110 D)

Initial Displacement: 0.909 m
Total Well Penetration Depth: 11.96 m
Casing Radius: 0.0254 m
Static Water Column Height: 11.96 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.372E-6 m/sec
y0 = 0.6973 m



BH 111_FALLING HEAD SWRT

Data Set: \...\BH 111.aqt
Date: 06/16/22 Time: 09:57:27

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 111
Test Date: 8 June, 2022

AQUIFER DATA

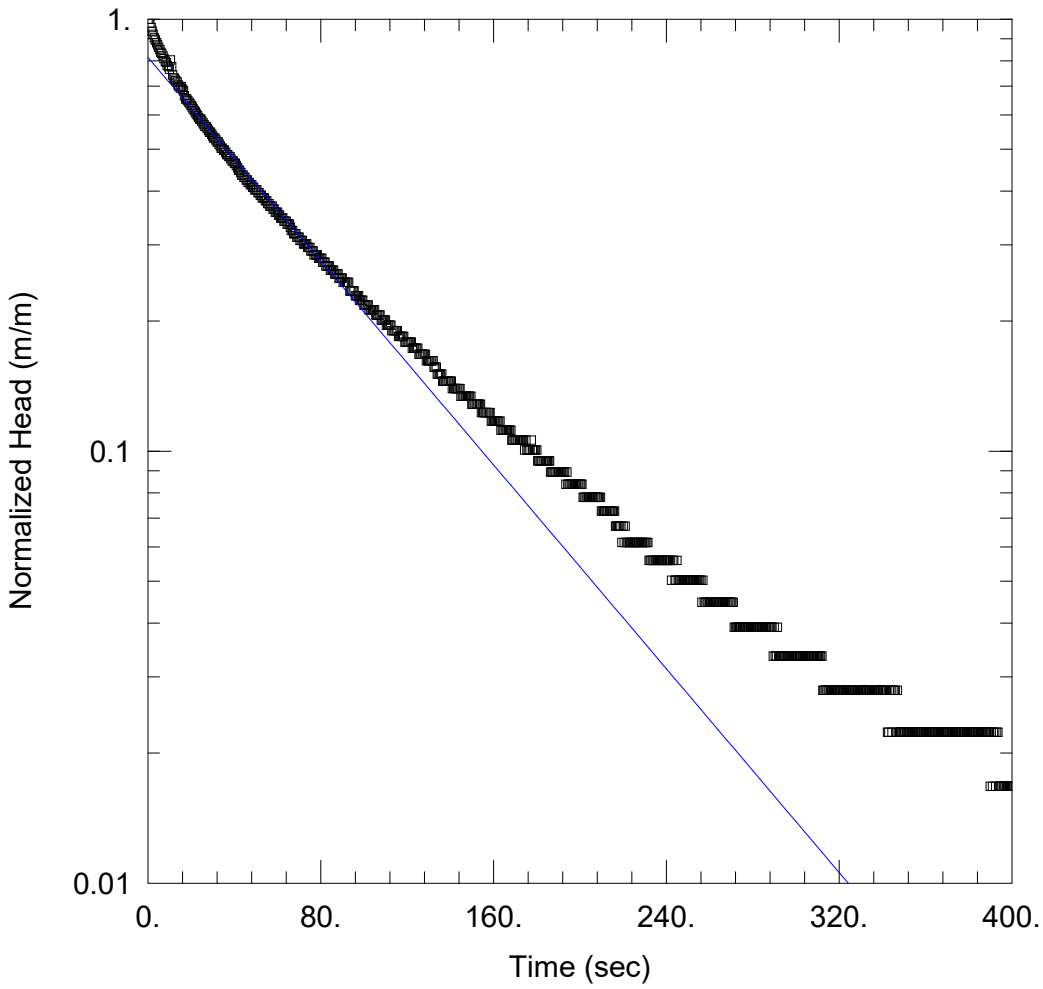
Saturated Thickness: 5.157 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 111)

Initial Displacement: 0.552 m
Total Well Penetration Depth: 5.157 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.157 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0001274 m/sec
y0 = 0.738 m



BH 112_FALLING HEAD SWRT

Data Set: \...\BH 112.aqt
Date: 06/16/22 Time: 09:59:57

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 112
Test Date: 8 June, 2022

AQUIFER DATA

Saturated Thickness: 9.546 m Anisotropy Ratio (Kz/Kr): 1.

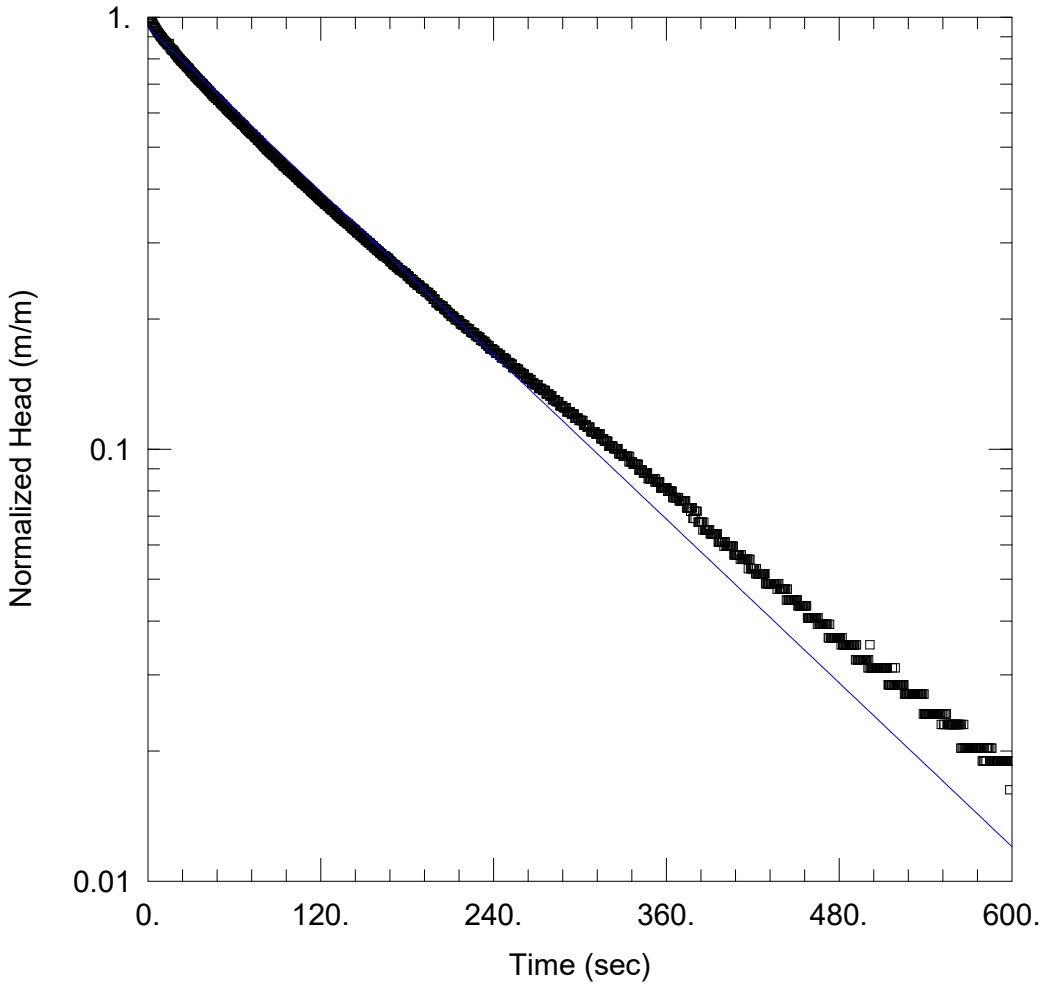
WELL DATA (BH 112)

Initial Displacement: 0.537 m
Total Well Penetration Depth: 9.546 m
Casing Radius: 0.0254 m
Static Water Column Height: 9.546 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.375E-6 m/sec y0 = 0.4381 m



BH 115 S_FALLING HEAD SWRT

Data Set: \...\BH 115 S.aqt
Date: 06/16/22 Time: 10:01:26

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 115 S
Test Date: 8 June, 2022

AQUIFER DATA

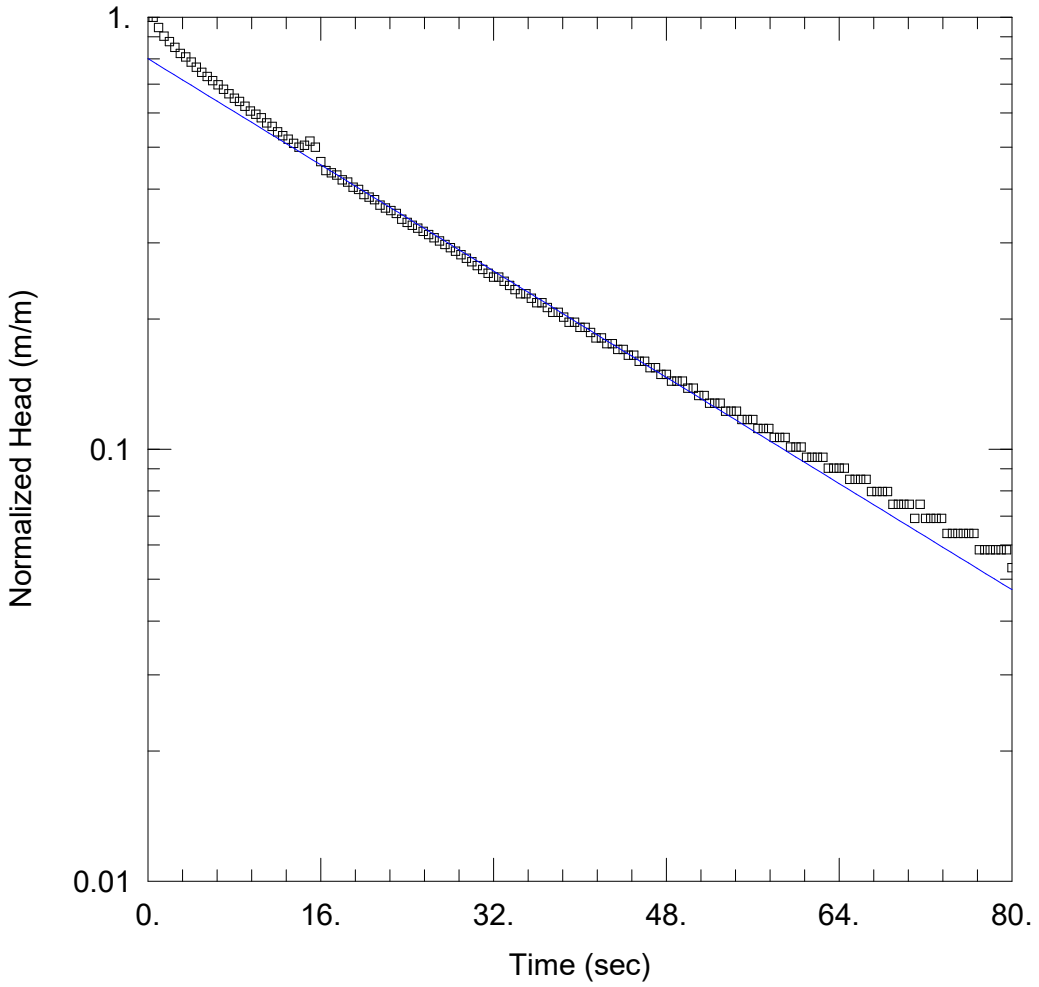
Saturated Thickness: 7.57 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 115 S)

Initial Displacement: 0.738 m
Total Well Penetration Depth: 7.57 m
Casing Radius: 0.0254 m
Static Water Column Height: 7.57 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.414E-6 m/sec
y0 = 0.6966 m



BH 115 D_FALLING HEAD SWRT

Data Set: \...\BH 115 D.aqt
Date: 06/16/22 Time: 10:18:51

PROJECT INFORMATION

Company: EXP Services Inc
Client: Watersand Construction Ltd.
Project: BAR-22008396-A0
Location: 259 Salem Rd, Waterdand North
Test Well: BH 115 D
Test Date: 8 June, 2022

AQUIFER DATA

Saturated Thickness: 11.71 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 115 D)

Initial Displacement: 0.564 m
Total Well Penetration Depth: 11.71 m
Casing Radius: 0.0254 m
Static Water Column Height: 11.71 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

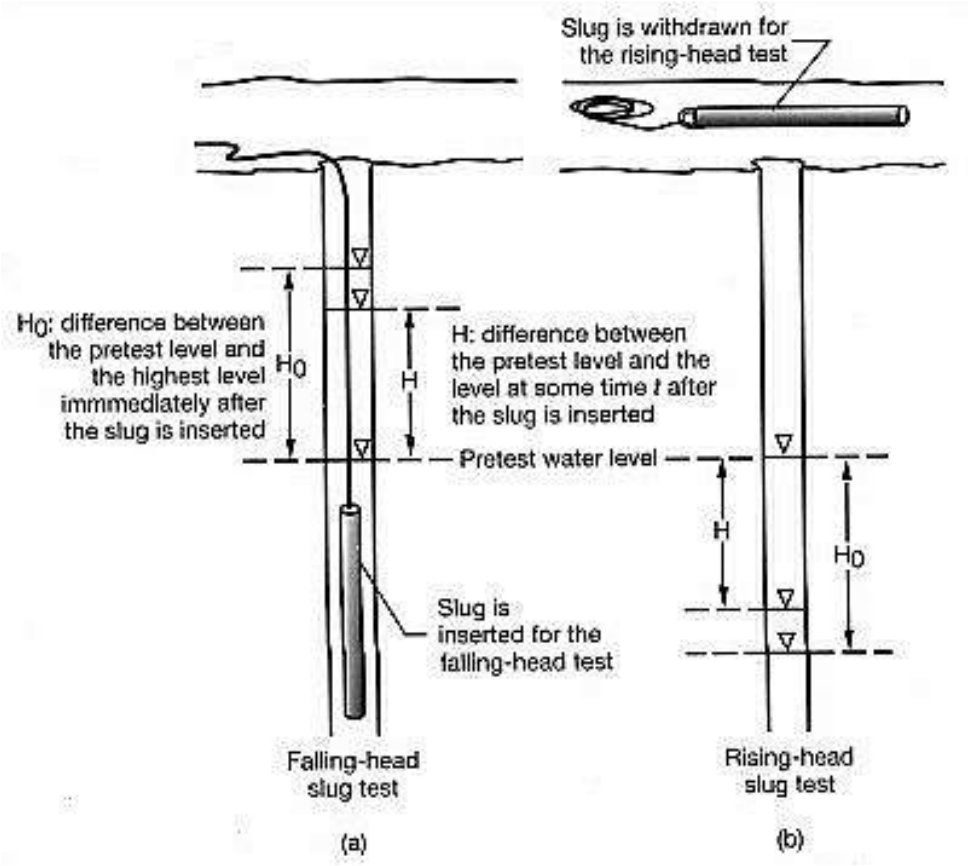
K = 1.66E-5 m/sec y0 = 0.4519 m

Single Well Response Test Procedure

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

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

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



Initials ___

Slug Test Procedure

Equipment Required

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

Testing Procedure

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

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

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

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

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

Bail Test Procedure

Equipment Required

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

Procedure

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

Appendix E – Laboratory's Certificates of Analysis

Your P.O. #: ENV- BRM
Your Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your C.O.C. #: 881191-01-01

Attention: Francois Chartier

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

Report Date: 2022/06/30
Report #: R7192734
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2F7448
Received: 2022/06/08, 18:46

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Biochemical Oxygen Demand (BOD)	1	2022/06/11	2022/06/16	CAM SOP-00427	SM 23 5210B m
Chloride by Automated Colourimetry	1	N/A	2022/06/13	CAM SOP-00463	SM 23 4500-Cl E m
Chemical Oxygen Demand	1	N/A	2022/06/14	CAM SOP-00416	SM 23 5220 D m
Total Cyanide	1	2022/06/11	2022/06/11	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2022/06/11	2022/06/13	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2022/06/14	2022/06/14	CAM SOP-00453	EPA 7470A m
Dissolved Metals by ICPMS	1	N/A	2022/06/14	CAM SOP-00447	EPA 6020B m
Total Metals Analysis by ICPMS	1	N/A	2022/06/14	CAM SOP-00447	EPA 6020B m
Total Extractable Elements by ICP-MS (1, 3)	1	2022/06/28	2022/06/28	STL SOP-00071	MA.200–Mét. 1.2 R5 m
Elements by ICPMS Low Level (total) (2)	1	2022/06/23	2022/06/24	BBY7SOP-00003 / BBY7SOP-00002	EPA 6020b R2 m
Animal and Vegetable Oil and Grease	1	N/A	2022/06/15	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2022/06/15	2022/06/15	CAM SOP-00326	EPA1664B m,SM5520B m
OC Pesticides (Selected) & PCB (4)	1	2022/06/14	2022/06/15	CAM SOP-00307	EPA 8081A/8082B m
PAH Compounds in Water by GC/MS (SIM)	1	2022/06/14	2022/06/15	CAM SOP-00318	EPA 8270D m
pH	1	2022/06/11	2022/06/13	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2022/06/14	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2022/06/13	CAM SOP-00464	EPA 375.4 m
Sulphide	1	N/A	2022/06/14	CAM SOP-00455	SM 23 4500-S G m
Total Kjeldahl Nitrogen in Water	1	2022/06/14	2022/06/14	CAM SOP-00938	OMOE E3516 m
Total PAHs: Barrie/Mississauga Sewer Use (5)	1	N/A	2022/06/15	CAM SOP - 00301	
Mineral/Synthetic O & G (TPH Heavy Oil) (6)	1	2022/06/15	2022/06/15	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2022/06/13	2022/06/14	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2022/06/13	CAM SOP-00228	EPA 8260C m

Remarks:

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

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are

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Your Project #: BAR-22008396-A0
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exp Services Inc
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reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

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

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) This test was performed by Bureau Veritas Montreal, 889 Montée de Liesse , Ville St-Laurent, QC, H4T 1P5
(2) This test was performed by Bureau Veritas Burnaby, 4606 Canada Way , Burnaby, BC, V5G 1K5
(3) Non-accredited test method
(4) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane
(5) Total PAHs include only those PAHs specified in the sewer use by-by-law.
(6) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

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

Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

BARRIE SAN. SEWER INCL. RH (2021-002)

Bureau Veritas ID				SVR382			SVR382		
Sampling Date				2022/06/08 12:00			2022/06/08 12:00		
COC Number				881191-01-01			881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch	BH106D Lab-Dup	RDL	QC Batch
Calculated Parameters									
Total Animal/Vegetable Oil and Grease	mg/L	-	150	ND	0.50	8044935			
Inorganics									
Total BOD	mg/L	15	300	ND	2	8047149	ND	2	8047149
Total Chemical Oxygen Demand (COD)	mg/L	-	600	71	4.0	8049341			
Fluoride (F-)	mg/L	-	10	0.11	0.10	8047610			
Total Kjeldahl Nitrogen (TKN)	mg/L	-	100	0.16	0.10	8050870			
pH	pH	6.0:9.5	6.0:9.5	7.98		8047612			
Phenols-4AAP	mg/L	-	0.1	ND	0.0010	8052411	ND	0.0010	8052411
Total Suspended Solids	mg/L	15	350	10	10	8049344			
Dissolved Sulphate (SO4)	mg/L	-	1500	14	1.0	8047445			
Sulphide	mg/L	-	1	ND	0.020	8050164			
Total Cyanide (CN)	mg/L	-	1.2	ND	0.0050	8047611			
Dissolved Chloride (Cl-)	mg/L	-	1500	2.8	1.0	8047444			
Metals									
Total Aluminum (Al)	ug/L	-	50000	175	3.0	8076819			
Total Antimony (Sb)	ug/L	-	5000	0.087	0.020	8076819			
Total Arsenic (As)	ug/L	-	1000	0.647	0.020	8076819			
Total Barium (Ba)	ug/L	-	5000	65.5	0.050	8076819			
Total Bismuth (Bi)	ug/L	-	5000	ND	0.010	8076819			
Total Cadmium (Cd)	ug/L	1	700	ND	0.0050	8076819			
Total Chromium (Cr)	ug/L	80	2000	0.38	0.10	8076819			
Total Cobalt (Co)	ug/L	-	5000	0.216	0.010	8076819			
Total Copper (Cu)	ug/L	10	2000	0.36	0.10	8076819			
Total Iron (Fe)	ug/L	-	50000	237	5.0	8076819			
Total Lead (Pb)	ug/L	50	700	0.100	0.020	8076819			
Total Manganese (Mn)	ug/L	-	5000	45.0	0.10	8076819			

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: The City of Barrie Discharges to Storm Sewers By Law 2021-002
Criteria-2: The City of Barrie Discharges to Sanitary Sewers By Law 2021-002
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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

Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

BARRIE SAN. SEWER INCL. RH (2021-002)

Bureau Veritas ID				SVR382			SVR382		
Sampling Date				2022/06/08 12:00			2022/06/08 12:00		
COC Number				881191-01-01			881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch	BH106D Lab-Dup	RDL	QC Batch
Total Molybdenum (Mo)	ug/L	-	5000	1.67	0.050	8076819			
Total Nickel (Ni)	ug/L	50	2000	0.43	0.10	8076819			
Total Phosphorus (P)	ug/L	-	10000	15.7	5.0	8076819			
Total Selenium (Se)	ug/L	-	1000	ND	0.040	8076819			
Total Silver (Ag)	ug/L	-	400	ND	0.010	8076819			
Total Tin (Sn)	ug/L	-	5000	0.60	0.20	8076819			
Total Vanadium (V)	ug/L	-	5000	0.71	0.20	8076819			
Total Zinc (Zn)	ug/L	40	2000	3.7	1.0	8076819			
Total Rhodium (Rh)	ug/L	-	5000	ND	0.50	8084324			
Total Gold (Au)	ug/L	-	5000	ND	0.10	8076819			
Total Platinum (Pt)	ug/L	-	5000	ND	0.10	8076819			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	ND	0.50	8053400			
Total Oil & Grease Mineral/Synthetic	mg/L	-	15	ND	0.50	8053403			
Metals									
Mercury (Hg)	mg/L	-	0.01	ND	0.00010	8050745			
Calculated Parameters									
Total PAHs	ug/L	-	5	ND	0.20	8044961			
Polyaromatic Hydrocarbons									
Acenaphthene	ug/L	-	-	ND	0.050	8051892			
Acenaphthylene	ug/L	-	-	ND	0.050	8051892			
Anthracene	ug/L	-	-	ND	0.050	8051892			
Benzo(a)anthracene	ug/L	-	-	ND	0.050	8051892			
Benzo(a)pyrene	ug/L	-	-	ND	0.0090	8051892			
Benzo(b/j)fluoranthene	ug/L	-	-	ND	0.050	8051892			
Benzo(g,h,i)perylene	ug/L	-	-	ND	0.050	8051892			
Benzo(k)fluoranthene	ug/L	-	-	ND	0.050	8051892			

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: The City of Barrie Discharges to Storm Sewers By Law 2021-002
Criteria-2: The City of Barrie Discharges to Sanitary Sewers By Law 2021-002
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BARRIE SAN. SEWER INCL. RH (2021-002)

Bureau Veritas ID				SVR382			SVR382		
Sampling Date				2022/06/08 12:00			2022/06/08 12:00		
COC Number				881191-01-01			881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch	BH106D Lab-Dup	RDL	QC Batch
Chrysene	ug/L	-	-	ND	0.050	8051892			
Dibenzo(a,h)anthracene	ug/L	-	-	ND	0.050	8051892			
Fluoranthene	ug/L	-	-	ND	0.050	8051892			
Fluorene	ug/L	-	-	ND	0.050	8051892			
Indeno(1,2,3-cd)pyrene	ug/L	-	-	ND	0.050	8051892			
1-Methylnaphthalene	ug/L	-	-	ND	0.050	8051892			
2-Methylnaphthalene	ug/L	-	-	ND	0.050	8051892			
Naphthalene	ug/L	-	-	ND	0.050	8051892			
Phenanthrene	ug/L	-	-	ND	0.030	8051892			
Pyrene	ug/L	-	-	ND	0.050	8051892			
Volatile Organics									
Benzene	ug/L	-	10	ND	0.40	8046354			
1,2-Dichlorobenzene	ug/L	-	50	ND	0.80	8046354			
1,4-Dichlorobenzene	ug/L	-	80	ND	0.80	8046354			
Ethylbenzene	ug/L	-	60	ND	0.40	8046354			
Methylene Chloride(Dichloromethane)	ug/L	-	90	ND	4.0	8046354			
1,1,2,2-Tetrachloroethane	ug/L	-	60	ND	0.80	8046354			
Tetrachloroethylene	ug/L	-	60	ND	0.40	8046354			
Toluene	ug/L	-	20	ND	0.40	8046354			
Trichloroethylene	ug/L	-	50	ND	0.40	8046354			
p+m-Xylene	ug/L	-	-	ND	0.40	8046354			
o-Xylene	ug/L	-	-	ND	0.40	8046354			
Total Xylenes	ug/L	-	300	ND	0.40	8046354			
Pesticides & Herbicides									
Hexachlorobenzene	ug/L	-	0.1	ND	0.005	8050619			
Surrogate Recovery (%)									
2,4,5,6-Tetrachloro-m-xylene	%	-	-	61		8050619			

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: The City of Barrie Discharges to Storm Sewers By Law 2021-002
Criteria-2: The City of Barrie Discharges to Sanitary Sewers By Law 2021-002
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Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

BARRIE SAN. SEWER INCL. RH (2021-002)

Bureau Veritas ID				SVR382			SVR382		
Sampling Date				2022/06/08 12:00			2022/06/08 12:00		
COC Number				881191-01-01			881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch	BH106D Lab-Dup	RDL	QC Batch
Decachlorobiphenyl	%	-	-	81		8050619			
D10-Anthracene	%	-	-	92		8051892			
D14-Terphenyl (FS)	%	-	-	88		8051892			
D8-Acenaphthylene	%	-	-	88		8051892			
4-Bromofluorobenzene	%	-	-	94		8046354			
D4-1,2-Dichloroethane	%	-	-	104		8046354			
D8-Toluene	%	-	-	92		8046354			

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

RDL = Reportable Detection Limit
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Lab-Dup = Laboratory Initiated Duplicate
Criteria: The City of Barrie Discharges to Storm Sewers By Law 2021-002
Criteria-2: The City of Barrie Discharges to Sanitary Sewers By Law 2021-002

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exp Services Inc
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Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

BARRIE STORM SEWER BYLAW (2021-002)

Bureau Veritas ID				SVR382		
Sampling Date				2022/06/08 12:00		
COC Number				881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch
Metals						
Total Cadmium (Cd)	ug/L	1	700	ND	0.090	8050842
Total Chromium (Cr)	ug/L	80	2000	ND	5.0	8050842
Total Copper (Cu)	ug/L	10	2000	ND	0.90	8050842
Total Lead (Pb)	ug/L	50	700	ND	0.50	8050842
Total Nickel (Ni)	ug/L	50	2000	ND	1.0	8050842
Total Zinc (Zn)	ug/L	40	2000	ND	5.0	8050842

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

RDL = Reportable Detection Limit
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Criteria: The City of Barrie Discharges to Storm Sewers By Law 2021-002
Criteria-2: The City of Barrie Discharges to Sanitary Sewers By Law 2021-002
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Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID				SVR383		
Sampling Date				2022/06/08 12:00		
COC Number				881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch
Metals						
Dissolved Aluminum (Al)	ug/L	-	50000	ND	4.9	8050116
Dissolved Antimony (Sb)	ug/L	-	5000	ND	0.50	8050116
Dissolved Arsenic (As)	ug/L	-	1000	ND	1.0	8050116
Dissolved Barium (Ba)	ug/L	-	5000	65	2.0	8050116
Dissolved Beryllium (Be)	ug/L	-	-	ND	0.40	8050116
Dissolved Bismuth (Bi)	ug/L	-	5000	ND	1.0	8050116
Dissolved Boron (B)	ug/L	-	-	13	10	8050116
Dissolved Cadmium (Cd)	ug/L	1	700	ND	0.090	8050116
Dissolved Calcium (Ca)	ug/L	-	-	68000	200	8050116
Dissolved Chromium (Cr)	ug/L	80	2000	ND	5.0	8050116
Dissolved Cobalt (Co)	ug/L	-	5000	ND	0.50	8050116
Dissolved Copper (Cu)	ug/L	10	2000	ND	0.90	8050116
Dissolved Iron (Fe)	ug/L	-	50000	ND	100	8050116
Dissolved Lead (Pb)	ug/L	50	700	ND	0.50	8050116
Dissolved Lithium (Li)	ug/L	-	-	ND	5.0	8050116
Dissolved Magnesium (Mg)	ug/L	-	-	8800	50	8050116
Dissolved Manganese (Mn)	ug/L	-	5000	42	2.0	8050116
Dissolved Molybdenum (Mo)	ug/L	-	5000	1.7	0.50	8050116
Dissolved Nickel (Ni)	ug/L	50	2000	ND	1.0	8050116
Dissolved Phosphorus (P)	ug/L	-	-	ND	100	8050116
Dissolved Potassium (K)	ug/L	-	-	1600	200	8050116
Dissolved Selenium (Se)	ug/L	-	1000	ND	2.0	8050116
Dissolved Silicon (Si)	ug/L	-	-	8600	50	8050116
Dissolved Silver (Ag)	ug/L	-	400	ND	0.090	8050116
Dissolved Sodium (Na)	ug/L	-	-	7300	100	8050116
Dissolved Strontium (Sr)	ug/L	-	-	210	1.0	8050116

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

RDL = Reportable Detection Limit
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ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID				SVR383		
Sampling Date				2022/06/08 12:00		
COC Number				881191-01-01		
	UNITS	Criteria	Criteria-2	BH106D	RDL	QC Batch
Dissolved Tellurium (Te)	ug/L	-	-	ND	1.0	8050116
Dissolved Thallium (Tl)	ug/L	-	-	ND	0.050	8050116
Dissolved Tin (Sn)	ug/L	-	5000	ND	1.0	8050116
Dissolved Titanium (Ti)	ug/L	-	-	ND	5.0	8050116
Dissolved Tungsten (W)	ug/L	-	-	ND	1.0	8050116
Dissolved Uranium (U)	ug/L	-	-	0.22	0.10	8050116
Dissolved Vanadium (V)	ug/L	-	5000	ND	0.50	8050116
Dissolved Zinc (Zn)	ug/L	40	2000	ND	5.0	8050116
Dissolved Zirconium (Zr)	ug/L	-	-	ND	1.0	8050116

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

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: The City of Barrie Discharges to Storm Sewers By Law 2021-002
Criteria-2: The City of Barrie Discharges to Sanitary Sewers By Law 2021-002
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

TEST SUMMARY

Bureau Veritas ID: SVR382
Sample ID: BH106D
Matrix: Water

Collected: 2022/06/08
Shipped:
Received: 2022/06/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Biochemical Oxygen Demand (BOD)	DO	8047149	2022/06/11	2022/06/16	Gurjot Kaur
Chloride by Automated Colourimetry	KONE	8047444	N/A	2022/06/13	Alina Dobreanu
Chemical Oxygen Demand	SPEC	8049341	N/A	2022/06/14	Viorica Rotaru
Total Cyanide	SKAL/CN	8047611	2022/06/11	2022/06/11	Nimarta Singh
Fluoride	ISE	8047610	2022/06/11	2022/06/13	Surinder Rai
Mercury in Water by CVAA	CV/AA	8050745	2022/06/14	2022/06/14	Jaswinder Kaur
Total Metals Analysis by ICPMS	ICP/MS	8050842	N/A	2022/06/14	Azita Fazaeli
Total Extractable Elements by ICP-MS	ICP/MSMS	8084324	2022/06/28	2022/06/28	Brandon Kinnear
Elements by ICPMS Low Level (total)	ICP/MS	8076819	2022/06/23	2022/06/24	Adnan Dzebic
Animal and Vegetable Oil and Grease	BAL	8044935	N/A	2022/06/15	Automated Statchk
Total Oil and Grease	BAL	8053400	2022/06/15	2022/06/15	Mitul Patel
OC Pesticides (Selected) & PCB	GC/ECD	8050619	2022/06/14	2022/06/15	Mahmudul Khan
PAH Compounds in Water by GC/MS (SIM)	GC/MS	8051892	2022/06/14	2022/06/15	Mitesh Raj
pH	AT	8047612	2022/06/11	2022/06/13	Surinder Rai
Phenols (4AAP)	TECH/PHEN	8052411	N/A	2022/06/14	Mandeep Kaur
Sulphate by Automated Colourimetry	KONE	8047445	N/A	2022/06/13	Chandra Nandlal
Sulphide	ISE/S	8050164	N/A	2022/06/14	Taslima Aktar
Total Kjeldahl Nitrogen in Water	SKAL	8050870	2022/06/14	2022/06/14	Massarat Jan
Total PAHs: Barrie/Mississauga Sewer Use	CALC	8044961	N/A	2022/06/15	Automated Statchk
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	8053403	2022/06/15	2022/06/15	Mitul Patel
Total Suspended Solids	BAL	8049344	2022/06/13	2022/06/14	Shaneil Hall
Volatile Organic Compounds in Water	GC/MS	8046354	N/A	2022/06/13	Dina Wang

Bureau Veritas ID: SVR382 Dup
Sample ID: BH106D
Matrix: Water

Collected: 2022/06/08
Shipped:
Received: 2022/06/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Biochemical Oxygen Demand (BOD)	DO	8047149	2022/06/11	2022/06/16	Gurjot Kaur
Phenols (4AAP)	TECH/PHEN	8052411	N/A	2022/06/14	Mandeep Kaur

Bureau Veritas ID: SVR383
Sample ID: BH106D
Matrix: Water

Collected: 2022/06/08
Shipped:
Received: 2022/06/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Metals by ICPMS	ICP/MS	8050116	N/A	2022/06/14	Prempal Bhatti

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Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

GENERAL COMMENTS

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

Package 1	7.7°C

Sample SVR382 [BH106D] : 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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QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8046354	4-Bromofluorobenzene	2022/06/13	103	70 - 130	102	70 - 130	97	%				
8046354	D4-1,2-Dichloroethane	2022/06/13	100	70 - 130	98	70 - 130	102	%				
8046354	D8-Toluene	2022/06/13	104	70 - 130	107	70 - 130	92	%				
8050619	2,4,5,6-Tetrachloro-m-xylene	2022/06/15	77	50 - 130	50	50 - 130	53	%				
8050619	Decachlorobiphenyl	2022/06/15	117	50 - 130	99	50 - 130	81	%				
8051892	D10-Anthracene	2022/06/14	97	50 - 130	104	50 - 130	101	%				
8051892	D14-Terphenyl (FS)	2022/06/14	97	50 - 130	103	50 - 130	96	%				
8051892	D8-Acenaphthylene	2022/06/14	88	50 - 130	97	50 - 130	99	%				
8046354	1,1,2,2-Tetrachloroethane	2022/06/13	94	70 - 130	94	70 - 130	ND, RDL=0.40	ug/L	NC	30		
8046354	1,2-Dichlorobenzene	2022/06/13	97	70 - 130	99	70 - 130	ND, RDL=0.40	ug/L	NC	30		
8046354	1,4-Dichlorobenzene	2022/06/13	112	70 - 130	115	70 - 130	ND, RDL=0.40	ug/L	NC	30		
8046354	Benzene	2022/06/13	95	70 - 130	96	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8046354	Ethylbenzene	2022/06/13	90	70 - 130	92	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8046354	Methylene Chloride(Dichloromethane)	2022/06/13	99	70 - 130	98	70 - 130	ND, RDL=2.0	ug/L	NC	30		
8046354	o-Xylene	2022/06/13	89	70 - 130	95	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8046354	p+m-Xylene	2022/06/13	96	70 - 130	98	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8046354	Tetrachloroethylene	2022/06/13	96	70 - 130	98	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8046354	Toluene	2022/06/13	98	70 - 130	99	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8046354	Total Xylenes	2022/06/13					ND, RDL=0.20	ug/L	NC	30		
8046354	Trichloroethylene	2022/06/13	106	70 - 130	107	70 - 130	ND, RDL=0.20	ug/L	NC	30		
8047149	Total BOD	2022/06/16					ND,RDL=2	mg/L	NC	30	99	80 - 120
8047444	Dissolved Chloride (Cl-)	2022/06/13	NC	80 - 120	105	80 - 120	ND, RDL=1.0	mg/L	0.071	20		
8047445	Dissolved Sulphate (SO4)	2022/06/13	81	75 - 125	107	80 - 120	ND, RDL=1.0	mg/L	1.5	20		
8047610	Fluoride (F-)	2022/06/13	116	80 - 120	105	80 - 120	ND, RDL=0.10	mg/L	18	20		
8047611	Total Cyanide (CN)	2022/06/11	97	80 - 120	97	80 - 120	ND, RDL=0.0050	mg/L	NC	20		
8047612	pH	2022/06/13			102	98 - 103			0.73	N/A		
8049341	Total Chemical Oxygen Demand (COD)	2022/06/14	100	80 - 120	97	80 - 120	6.6, RDL=4.0	mg/L	8.3	20		
8049344	Total Suspended Solids	2022/06/14					ND, RDL=10	mg/L	0	25	98	85 - 115
8050116	Dissolved Aluminum (Al)	2022/06/14	106	80 - 120	97	80 - 120	ND, RDL=4.9	ug/L				

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8050116	Dissolved Antimony (Sb)	2022/06/14	108	80 - 120	101	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8050116	Dissolved Arsenic (As)	2022/06/14	107	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L	2.4	20		
8050116	Dissolved Barium (Ba)	2022/06/14	NC	80 - 120	99	80 - 120	ND, RDL=2.0	ug/L	4.1	20		
8050116	Dissolved Beryllium (Be)	2022/06/14	110	80 - 120	100	80 - 120	ND, RDL=0.40	ug/L	NC	20		
8050116	Dissolved Bismuth (Bi)	2022/06/14	95	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L				
8050116	Dissolved Boron (B)	2022/06/14	110	80 - 120	99	80 - 120	ND, RDL=10	ug/L	11	20		
8050116	Dissolved Cadmium (Cd)	2022/06/14	104	80 - 120	100	80 - 120	ND, RDL=0.090	ug/L	NC	20		
8050116	Dissolved Calcium (Ca)	2022/06/14	NC	80 - 120	97	80 - 120	ND, RDL=200	ug/L				
8050116	Dissolved Chromium (Cr)	2022/06/14	102	80 - 120	97	80 - 120	ND, RDL=5.0	ug/L	NC	20		
8050116	Dissolved Cobalt (Co)	2022/06/14	103	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8050116	Dissolved Copper (Cu)	2022/06/14	112	80 - 120	102	80 - 120	ND, RDL=0.90	ug/L	NC	20		
8050116	Dissolved Iron (Fe)	2022/06/14	106	80 - 120	103	80 - 120	ND, RDL=100	ug/L				
8050116	Dissolved Lead (Pb)	2022/06/14	95	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8050116	Dissolved Lithium (Li)	2022/06/14	110	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
8050116	Dissolved Magnesium (Mg)	2022/06/14	NC	80 - 120	104	80 - 120	ND, RDL=50	ug/L				
8050116	Dissolved Manganese (Mn)	2022/06/14	NC	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L				
8050116	Dissolved Molybdenum (Mo)	2022/06/14	115	80 - 120	102	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8050116	Dissolved Nickel (Ni)	2022/06/14	98	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	NC	20		
8050116	Dissolved Phosphorus (P)	2022/06/14	124 (1)	80 - 120	112	80 - 120	ND, RDL=100	ug/L				
8050116	Dissolved Potassium (K)	2022/06/14	118	80 - 120	106	80 - 120	ND, RDL=200	ug/L				
8050116	Dissolved Selenium (Se)	2022/06/14	102	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L	NC	20		
8050116	Dissolved Silicon (Si)	2022/06/14	108	80 - 120	96	80 - 120	ND, RDL=50	ug/L				
8050116	Dissolved Silver (Ag)	2022/06/14	99	80 - 120	100	80 - 120	ND, RDL=0.090	ug/L	NC	20		
8050116	Dissolved Sodium (Na)	2022/06/14	NC	80 - 120	101	80 - 120	ND, RDL=100	ug/L	1.5	20		
8050116	Dissolved Strontium (Sr)	2022/06/14	NC	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L				
8050116	Dissolved Tellurium (Te)	2022/06/14	106	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L				
8050116	Dissolved Thallium (Tl)	2022/06/14	100	80 - 120	101	80 - 120	ND, RDL=0.050	ug/L	NC	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8050116	Dissolved Tin (Sn)	2022/06/14	107	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L				
8050116	Dissolved Titanium (Ti)	2022/06/14	105	80 - 120	95	80 - 120	ND, RDL=5.0	ug/L				
8050116	Dissolved Tungsten (W)	2022/06/14	105	80 - 120	104	80 - 120	ND, RDL=1.0	ug/L				
8050116	Dissolved Uranium (U)	2022/06/14	100	80 - 120	101	80 - 120	ND, RDL=0.10	ug/L	NC	20		
8050116	Dissolved Vanadium (V)	2022/06/14	106	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8050116	Dissolved Zinc (Zn)	2022/06/14	98	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20		
8050116	Dissolved Zirconium (Zr)	2022/06/14	114	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L				
8050164	Sulphide	2022/06/14	88	80 - 120	94	80 - 120	ND, RDL=0.020	mg/L	NC	20		
8050619	Hexachlorobenzene	2022/06/15	88	50 - 130	77	50 - 130	ND, RDL=0.005	ug/L	NC	30		
8050745	Mercury (Hg)	2022/06/14	92	75 - 125	92	80 - 120	ND, RDL=0.00010	mg/L	NC	20		
8050842	Total Cadmium (Cd)	2022/06/14	101	80 - 120	101	80 - 120	ND, RDL=0.090	ug/L	NC	20		
8050842	Total Chromium (Cr)	2022/06/14	98	80 - 120	97	80 - 120	ND, RDL=5.0	ug/L	NC	20		
8050842	Total Copper (Cu)	2022/06/14	101	80 - 120	98	80 - 120	ND, RDL=0.90	ug/L	17	20		
8050842	Total Lead (Pb)	2022/06/14	94	80 - 120	94	80 - 120	ND, RDL=0.50	ug/L	NC	20		
8050842	Total Nickel (Ni)	2022/06/14	97	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L				
8050842	Total Zinc (Zn)	2022/06/14	101	80 - 120	101	80 - 120	ND, RDL=5.0	ug/L	NC	20		
8050870	Total Kjeldahl Nitrogen (TKN)	2022/06/14	99	80 - 120	102	80 - 120	ND, RDL=0.10	mg/L	11	20	100	80 - 120
8051892	1-Methylnaphthalene	2022/06/14	111	50 - 130	107	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	2-Methylnaphthalene	2022/06/14	111	50 - 130	104	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Acenaphthene	2022/06/14	106	50 - 130	101	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Acenaphthylene	2022/06/14	102	50 - 130	99	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Anthracene	2022/06/14	112	50 - 130	105	50 - 130	ND, RDL=0.050	ug/L	NC	30		

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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
8051892	Benzo(a)anthracene	2022/06/14	115	50 - 130	108	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Benzo(a)pyrene	2022/06/14	92	50 - 130	89	50 - 130	ND, RDL=0.0090	ug/L	NC	30		
8051892	Benzo(b/j)fluoranthene	2022/06/14	101	50 - 130	101	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Benzo(g,h,i)perylene	2022/06/14	104	50 - 130	101	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Benzo(k)fluoranthene	2022/06/14	99	50 - 130	97	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Chrysene	2022/06/14	108	50 - 130	104	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Dibenzo(a,h)anthracene	2022/06/14	99	50 - 130	89	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Fluoranthene	2022/06/14	123	50 - 130	115	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Fluorene	2022/06/14	110	50 - 130	103	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Indeno(1,2,3-cd)pyrene	2022/06/14	105	50 - 130	101	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Naphthalene	2022/06/14	99	50 - 130	96	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8051892	Phenanthrene	2022/06/14	112	50 - 130	106	50 - 130	ND, RDL=0.030	ug/L	NC	30		
8051892	Pyrene	2022/06/14	123	50 - 130	115	50 - 130	ND, RDL=0.050	ug/L	NC	30		
8052411	Phenols-4AAP	2022/06/14	98	80 - 120	96	80 - 120	ND, RDL=0.0010	mg/L	NC	20		
8053400	Total Oil & Grease	2022/06/15			98	85 - 115	ND, RDL=0.50	mg/L	2.0	25		
8053403	Total Oil & Grease Mineral/Synthetic	2022/06/15			95	85 - 115	ND, RDL=0.50	mg/L	3.6	25		
8076819	Total Aluminum (Al)	2022/06/25	103	80 - 120	104	80 - 120	ND, RDL=3.0	ug/L				

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8076819	Total Antimony (Sb)	2022/06/25	99	80 - 120	100	80 - 120	ND, RDL=0.020	ug/L				
8076819	Total Arsenic (As)	2022/06/25	105	80 - 120	104	80 - 120	ND, RDL=0.020	ug/L				
8076819	Total Barium (Ba)	2022/06/25	NC	80 - 120	100	80 - 120	ND, RDL=0.050	ug/L				
8076819	Total Bismuth (Bi)	2022/06/25	98	80 - 120	104	80 - 120	ND, RDL=0.010	ug/L				
8076819	Total Cadmium (Cd)	2022/06/25	98	80 - 120	102	80 - 120	ND, RDL=0.0050	ug/L				
8076819	Total Chromium (Cr)	2022/06/25	99	80 - 120	101	80 - 120	ND, RDL=0.10	ug/L				
8076819	Total Cobalt (Co)	2022/06/25	94	80 - 120	98	80 - 120	ND, RDL=0.010	ug/L				
8076819	Total Copper (Cu)	2022/06/25	94	80 - 120	99	80 - 120	ND, RDL=0.10	ug/L				
8076819	Total Iron (Fe)	2022/06/25	106	80 - 120	105	80 - 120	ND, RDL=5.0	ug/L				
8076819	Total Lead (Pb)	2022/06/25	100	80 - 120	107	80 - 120	ND, RDL=0.020	ug/L				
8076819	Total Manganese (Mn)	2022/06/25	97	80 - 120	101	80 - 120	ND, RDL=0.10	ug/L				
8076819	Total Molybdenum (Mo)	2022/06/25	NC	80 - 120	107	80 - 120	ND, RDL=0.050	ug/L				
8076819	Total Nickel (Ni)	2022/06/25	94	80 - 120	101	80 - 120	ND, RDL=0.10	ug/L				
8076819	Total Phosphorus (P)	2022/06/25	103	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
8076819	Total Platinum (Pt)	2022/06/25	94	80 - 120	103	80 - 120	ND, RDL=0.10	ug/L				
8076819	Total Selenium (Se)	2022/06/25	104	80 - 120	103	80 - 120	ND, RDL=0.040	ug/L				
8076819	Total Silver (Ag)	2022/06/25	96	80 - 120	101	80 - 120	ND, RDL=0.010	ug/L				
8076819	Total Tin (Sn)	2022/06/25	102	80 - 120	102	80 - 120	ND, RDL=0.20	ug/L				
8076819	Total Vanadium (V)	2022/06/25	100	80 - 120	101	80 - 120	ND, RDL=0.20	ug/L				
8076819	Total Zinc (Zn)	2022/06/25	98	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L				

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8084324	Total Rhodium (Rh)	2022/06/28			85	70 - 130	ND, RDL=0.50	ug/L				

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) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

VALIDATION SIGNATURE PAGE

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

Cristina Carriere, Senior Scientific Specialist

David Huang, BBY Scientific Specialist

Zineb El Ouali
Membre OCQ#2021-051

Zineb El Ouali, Analyst 1

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 Signature Page.

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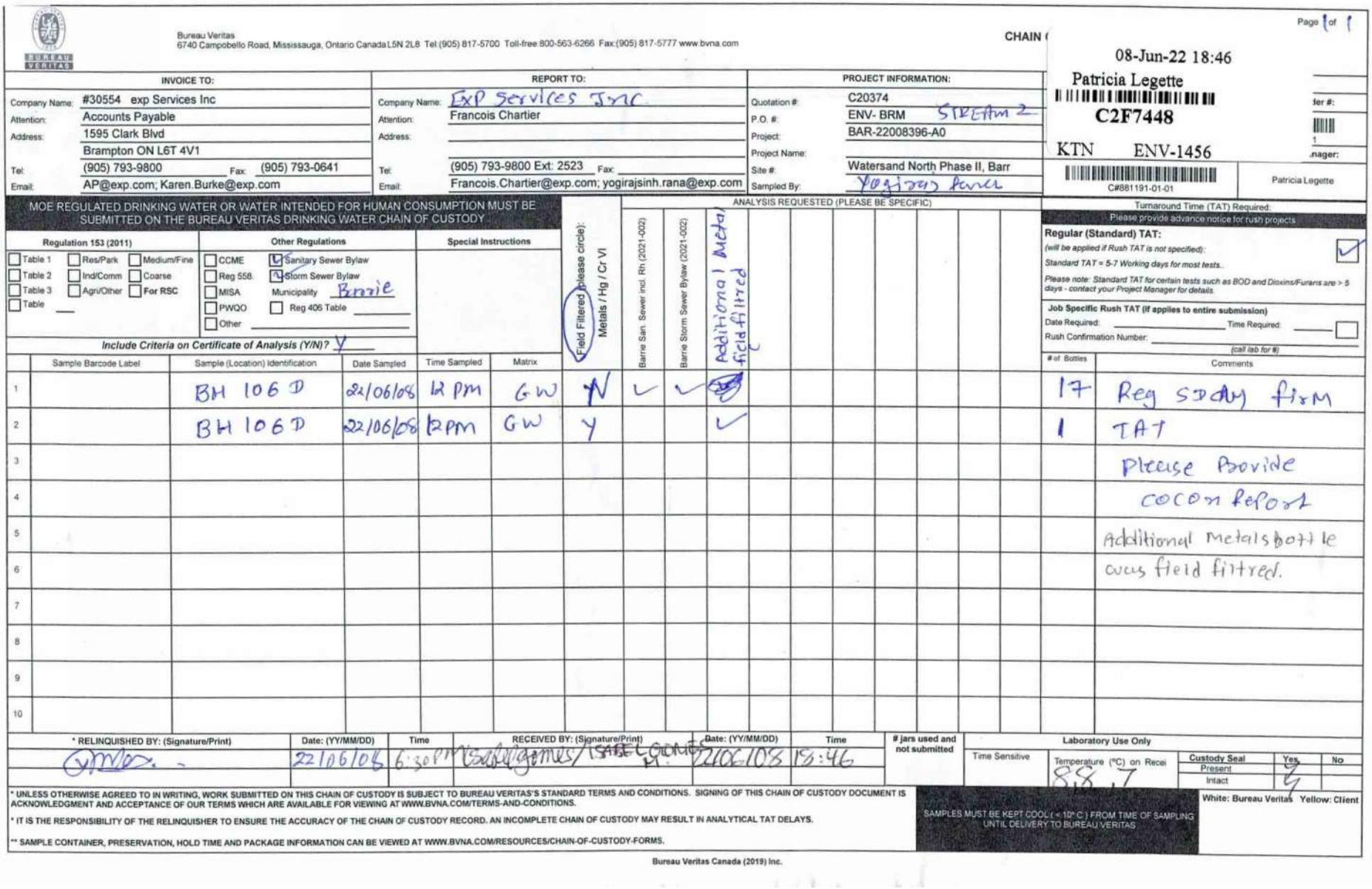

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CHAIN (

Page 1 of 1

08-Jun-22 18:46
Patricia Legette
C2F7448
KTN ENV-1456
C#881191-01-01
Patricia Legette

INVOICE TO:
Company Name: #30554 exp Services Inc
Attention: Accounts Payable
Address: 1595 Clark Blvd, Brampton ON L6T 4V1
Tel: (905) 793-9800 Fax: (905) 793-0641
Email: AP@exp.com; Karen.Burke@exp.com

REPORT TO:
Company Name: Exp Services Inc
Attention: Francois Chartier
Address:
Tel: (905) 793-9800 Ext: 2523 Fax:
Email: Francois.Chartier@exp.com; yogirajsinh.rana@exp.com

PROJECT INFORMATION:
Quotation #: C20374
P.O. #: ENV- BRM STREAM 2
Project: BAR-22008396-A0
Project Name:
Site #: Watersand North Phase II, Barr
Sampled By: Yogirajsinh Rana

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

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

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

Special Instructions

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Barrie San. Sewer incl. Rh (2021-002)	Barrie Storm Sewer Bylaw (2021-002)	Additional Metals field filtered	# of Bottles	Comments
1		BH 106 D	22/06/08	12 PM	GW	N	✓	✓	✓	17	Reg 558 Storm Sewer Bylaw
2		BH 106 D	22/06/08	12PM	GW	Y			✓	1	TAT
3											Please Provide
4											COCON Report
5											Additional Metals bottle
6											was field filtred.
7											
8											
9											
10											

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 #)

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
[signature]	22/06/08	6:30PM	[illegible]	22/06/08	15:46	

Laboratory Use Only
Time Sensitive
Temperature (°C) on Recei: 8.8, 7
Custody Seal Present: Yes ✓ No
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/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/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

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

White: Bureau Veritas Yellow: Client

Bureau Veritas Canada (2019) Inc.

Bureau Veritas Job #: C2F7448
Report Date: 2022/06/30

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YP

Exceedance Summary Table – Barrie Storm Sewer

Result Exceedances

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

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

Exceedance Summary Table – Barrie Sanitary Sewer

Result Exceedances

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

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

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Your P.O. #: ENV- BRM
Your Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your C.O.C. #: 881178-01-01

Attention: Francois Chartier

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

Report Date: 2022/06/14
Report #: R7166876
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2F7287
Received: 2022/06/08, 18:37

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2022/06/11	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2022/06/13	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2022/06/13	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	1	N/A	2022/06/13	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2022/06/10	CAM SOP-00446	SM 23 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2022/06/13	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2022/06/13	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2022/06/13		
Anion and Cation Sum	1	N/A	2022/06/13		
Total Ammonia-N	1	N/A	2022/06/13	CAM SOP-00441	USGS I-2522-90 m
Nitrate & Nitrite as Nitrogen in Water (2)	1	N/A	2022/06/13	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	1	2022/06/10	2022/06/11	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2022/06/14	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2022/06/13		Auto Calc
Sat. pH and Langelier Index (@ 4C)	1	N/A	2022/06/13		Auto Calc
Sulphate by Automated Colourimetry	1	N/A	2022/06/13	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2022/06/13		Auto Calc

Remarks:

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

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

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

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Your P.O. #: ENV- BRM
Your Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your C.O.C. #: 881178-01-01

Attention: Francois Chartier

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

Report Date: 2022/06/14
Report #: R7166876
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2F7287
Received: 2022/06/08, 18:37

otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
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.
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For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Job #: C2F7287
Report Date: 2022/06/14

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YR

RCAP - COMPREHENSIVE (WATER)

Bureau Veritas ID			SVP999			SVP999		
Sampling Date			2022/06/08 12:00			2022/06/08 12:00		
COC Number			881178-01-01			881178-01-01		
	UNITS	Criteria	BH 106 D	RDL	QC Batch	BH 106 D Lab-Dup	RDL	QC Batch
Calculated Parameters								
Anion Sum	me/L	-	4.36	N/A	8040465			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	200	1.0	8040466			
Calculated TDS	mg/L	-	240	1.0	8040469			
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	3.0	1.0	8040466			
Cation Sum	me/L	-	4.49	N/A	8040465			
Hardness (CaCO3)	mg/L	-	210	1.0	8040301			
Ion Balance (% Difference)	%	-	1.47	N/A	8040461			
Langelier Index (@ 20C)	N/A	-	0.950		8040467			
Langelier Index (@ 4C)	N/A	-	0.701		8040468			
Saturation pH (@ 20C)	N/A	-	7.26		8040467			
Saturation pH (@ 4C)	N/A	-	7.50		8040468			
Inorganics								
Total Ammonia-N	mg/L	-	ND	0.050	8045720			
Conductivity	umho/cm	-	330	1.0	8045668			
Dissolved Organic Carbon	mg/L	-	1.8	0.40	8045149	1.7	0.40	8045149
Orthophosphate (P)	mg/L	-	ND	0.010	8045856			
pH	pH	6.5:8.5	8.21		8045660			
Dissolved Sulphate (SO4)	mg/L	-	14	1.0	8045849			
Alkalinity (Total as CaCO3)	mg/L	-	200	1.0	8045657			
Dissolved Chloride (Cl-)	mg/L	-	2.8	1.0	8045830			
Nitrite (N)	mg/L	-	0.023	0.010	8045746			
Nitrate (N)	mg/L	-	ND	0.10	8045746			
Nitrate + Nitrite (N)	mg/L	-	ND	0.10	8045746			

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: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
N/A = Not Applicable
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C2F7287
Report Date: 2022/06/14

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YR

RCAP - COMPREHENSIVE (WATER)

Bureau Veritas ID			SVP999			SVP999		
Sampling Date			2022/06/08 12:00			2022/06/08 12:00		
COC Number			881178-01-01			881178-01-01		
	UNITS	Criteria	BH 106 D	RDL	QC Batch	BH 106 D Lab-Dup	RDL	QC Batch
Metals								
Dissolved Aluminum (Al)	ug/L	-	ND	4.9	8044880			
Dissolved Antimony (Sb)	ug/L	20	ND	0.50	8044880			
Dissolved Arsenic (As)	ug/L	100	ND	1.0	8044880			
Dissolved Barium (Ba)	ug/L	-	68	2.0	8044880			
Dissolved Beryllium (Be)	ug/L	11	ND	0.40	8044880			
Dissolved Boron (B)	ug/L	200	21	10	8044880			
Dissolved Cadmium (Cd)	ug/L	0.2	ND	0.090	8044880			
Dissolved Calcium (Ca)	ug/L	-	70000	200	8044880			
Dissolved Chromium (Cr)	ug/L	-	ND	5.0	8044880			
Dissolved Cobalt (Co)	ug/L	0.9	ND	0.50	8044880			
Dissolved Copper (Cu)	ug/L	5	ND	0.90	8044880			
Dissolved Iron (Fe)	ug/L	300	ND	100	8044880			
Dissolved Lead (Pb)	ug/L	5	ND	0.50	8044880			
Dissolved Magnesium (Mg)	ug/L	-	7900	50	8044880			
Dissolved Manganese (Mn)	ug/L	-	40	2.0	8044880			
Dissolved Molybdenum (Mo)	ug/L	40	1.7	0.50	8044880			
Dissolved Nickel (Ni)	ug/L	25	ND	1.0	8044880			
Dissolved Phosphorus (P)	ug/L	-	ND	100	8044880			
Dissolved Potassium (K)	ug/L	-	1600	200	8044880			
Dissolved Selenium (Se)	ug/L	100	ND	2.0	8044880			
Dissolved Silicon (Si)	ug/L	-	8900	50	8044880			
Dissolved Silver (Ag)	ug/L	0.1	ND	0.090	8044880			
Dissolved Sodium (Na)	ug/L	-	6600	100	8044880			
Dissolved Strontium (Sr)	ug/L	-	210	1.0	8044880			
Dissolved Thallium (Tl)	ug/L	0.3	ND	0.050	8044880			
Dissolved Titanium (Ti)	ug/L	-	ND	5.0	8044880			

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: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C2F7287
Report Date: 2022/06/14

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YR

RCAP - COMPREHENSIVE (WATER)

Bureau Veritas ID			SVP999			SVP999		
Sampling Date			2022/06/08 12:00			2022/06/08 12:00		
COC Number			881178-01-01			881178-01-01		
	UNITS	Criteria	BH 106 D	RDL	QC Batch	BH 106 D Lab-Dup	RDL	QC Batch
Dissolved Uranium (U)	ug/L	5	0.22	0.10	8044880			
Dissolved Vanadium (V)	ug/L	6	ND	0.50	8044880			
Dissolved Zinc (Zn)	ug/L	30	ND	5.0	8044880			

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: Ontario Provincial Water Quality Objectives
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Bureau Veritas Job #: C2F7287
Report Date: 2022/06/14

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YR

TEST SUMMARY

Bureau Veritas ID: SVP999
Sample ID: BH 106 D
Matrix: Water

Collected: 2022/06/08
Shipped:
Received: 2022/06/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	8045657	N/A	2022/06/11	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	8040466	N/A	2022/06/13	Automated Statchk
Chloride by Automated Colourimetry	KONE	8045830	N/A	2022/06/13	Alina Dobreanu
Conductivity	AT	8045668	N/A	2022/06/13	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	8045149	N/A	2022/06/10	Anna-Kay Gooden
Hardness (calculated as CaCO3)		8040301	N/A	2022/06/13	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	8044880	N/A	2022/06/13	Rupinder Gill
Ion Balance (% Difference)	CALC	8040461	N/A	2022/06/13	Automated Statchk
Anion and Cation Sum	CALC	8040465	N/A	2022/06/13	Automated Statchk
Total Ammonia-N	LACH/NH4	8045720	N/A	2022/06/13	Raiq Kashif
Nitrate & Nitrite as Nitrogen in Water	LACH	8045746	N/A	2022/06/13	Samuel Law
pH	AT	8045660	2022/06/10	2022/06/11	Surinder Rai
Orthophosphate	KONE	8045856	N/A	2022/06/14	Chandra Nandlal
Sat. pH and Langelier Index (@ 20C)	CALC	8040467	N/A	2022/06/13	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	8040468	N/A	2022/06/13	Automated Statchk
Sulphate by Automated Colourimetry	KONE	8045849	N/A	2022/06/13	Chandra Nandlal
Total Dissolved Solids (TDS calc)	CALC	8040469	N/A	2022/06/13	Automated Statchk

Bureau Veritas ID: SVP999 Dup
Sample ID: BH 106 D
Matrix: Water

Collected: 2022/06/08
Shipped:
Received: 2022/06/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Organic Carbon (DOC)	TOCV/NDIR	8045149	N/A	2022/06/10	Anna-Kay Gooden

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GENERAL COMMENTS

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

Package 1	2.3°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8044880	Dissolved Aluminum (Al)	2022/06/13	105	80 - 120	103	80 - 120	ND, RDL=4.9	ug/L		
8044880	Dissolved Antimony (Sb)	2022/06/13	108	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L		
8044880	Dissolved Arsenic (As)	2022/06/13	101	80 - 120	94	80 - 120	ND, RDL=1.0	ug/L		
8044880	Dissolved Barium (Ba)	2022/06/13	106	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L		
8044880	Dissolved Beryllium (Be)	2022/06/13	103	80 - 120	99	80 - 120	ND, RDL=0.40	ug/L		
8044880	Dissolved Boron (B)	2022/06/13	105	80 - 120	98	80 - 120	ND, RDL=10	ug/L	0.32	20
8044880	Dissolved Cadmium (Cd)	2022/06/13	103	80 - 120	101	80 - 120	ND, RDL=0.090	ug/L		
8044880	Dissolved Calcium (Ca)	2022/06/13	NC	80 - 120	102	80 - 120	ND, RDL=200	ug/L	0.23	20
8044880	Dissolved Chromium (Cr)	2022/06/13	100	80 - 120	93	80 - 120	ND, RDL=5.0	ug/L		
8044880	Dissolved Cobalt (Co)	2022/06/13	98	80 - 120	92	80 - 120	ND, RDL=0.50	ug/L		
8044880	Dissolved Copper (Cu)	2022/06/13	101	80 - 120	97	80 - 120	ND, RDL=0.90	ug/L		
8044880	Dissolved Iron (Fe)	2022/06/13	101	80 - 120	94	80 - 120	ND, RDL=100	ug/L		
8044880	Dissolved Lead (Pb)	2022/06/13	95	80 - 120	92	80 - 120	ND, RDL=0.50	ug/L		
8044880	Dissolved Magnesium (Mg)	2022/06/13	NC	80 - 120	94	80 - 120	ND, RDL=50	ug/L	0.12	20
8044880	Dissolved Manganese (Mn)	2022/06/13	102	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L		
8044880	Dissolved Molybdenum (Mo)	2022/06/13	109	80 - 120	101	80 - 120	ND, RDL=0.50	ug/L		
8044880	Dissolved Nickel (Ni)	2022/06/13	96	80 - 120	91	80 - 120	ND, RDL=1.0	ug/L		
8044880	Dissolved Phosphorus (P)	2022/06/13	114	80 - 120	115	80 - 120	ND, RDL=100	ug/L	NC	20
8044880	Dissolved Potassium (K)	2022/06/13	106	80 - 120	97	80 - 120	ND, RDL=200	ug/L	0.89	20
8044880	Dissolved Selenium (Se)	2022/06/13	101	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L		
8044880	Dissolved Silicon (Si)	2022/06/13	108	80 - 120	103	80 - 120	ND, RDL=50	ug/L		
8044880	Dissolved Silver (Ag)	2022/06/13	101	80 - 120	96	80 - 120	ND, RDL=0.090	ug/L		
8044880	Dissolved Sodium (Na)	2022/06/13	NC	80 - 120	92	80 - 120	ND, RDL=100	ug/L	1.9	20
8044880	Dissolved Strontium (Sr)	2022/06/13	103	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L		
8044880	Dissolved Thallium (Tl)	2022/06/13	95	80 - 120	91	80 - 120	ND, RDL=0.050	ug/L		
8044880	Dissolved Titanium (Ti)	2022/06/13	111	80 - 120	102	80 - 120	ND, RDL=5.0	ug/L		
8044880	Dissolved Uranium (U)	2022/06/13	99	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L		
8044880	Dissolved Vanadium (V)	2022/06/13	103	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L		
8044880	Dissolved Zinc (Zn)	2022/06/13	95	80 - 120	91	80 - 120	ND, RDL=5.0	ug/L	0.0037	20
8045149	Dissolved Organic Carbon	2022/06/10	93	80 - 120	95	80 - 120	ND, RDL=0.40	mg/L	3.2	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8045657	Alkalinity (Total as CaCO3)	2022/06/10			95	85 - 115	ND, RDL=1.0	mg/L	1.8	20
8045660	pH	2022/06/10			101	98 - 103			0.081	N/A
8045668	Conductivity	2022/06/10			102	85 - 115	ND, RDL=1.0	umho/cm	1.5	25
8045720	Total Ammonia-N	2022/06/13	96	75 - 125	98	80 - 120	ND, RDL=0.050	mg/L	NC	20
8045746	Nitrate (N)	2022/06/13	99	80 - 120	101	80 - 120	ND, RDL=0.10	mg/L	2.3	20
8045746	Nitrite (N)	2022/06/13	104	80 - 120	106	80 - 120	ND, RDL=0.010	mg/L	8.4	20
8045830	Dissolved Chloride (Cl-)	2022/06/13	NC	80 - 120	101	80 - 120	ND, RDL=1.0	mg/L	0.31	20
8045849	Dissolved Sulphate (SO4)	2022/06/13	NC	75 - 125	107	80 - 120	ND, RDL=1.0	mg/L	0.25	20
8045856	Orthophosphate (P)	2022/06/14	124	75 - 125	98	80 - 120	ND, RDL=0.010	mg/L	3.3	25

N/A = Not Applicable

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

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

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.

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

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

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Bureau Veritas Job #: C2F7287
Report Date: 2022/06/14

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YR

VALIDATION SIGNATURE PAGE

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

Brad Newman, B.Sc., C.Chem., Scientific Service 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 Signature Page.

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IMMEDIATE

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

Page of

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#30554 exp Services Inc	Company Name:	EXP Services Inc	Quotation #:	C20374	Bureau Veritas Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Francois Chartier	P.O. #:	ENV- BRM STREAM 3		881178
Address:	1595 Clark Blvd	Address:		Project:	BAR-22008396-A0	COC #:	Project Manager:
	Brampton ON L6T 4V1			Project Name:		C#881178-01-01	Patricia Legette
Tel:	(905) 793-9800 Fax: (905) 793-0641	Tel:	(905) 793-9800 Ext: 2523 Fax:	Site #:	Watersand North Phase II, Barrie		
Email:	AP@exp.com; Karen.Burke@exp.com	Email:	Francois.Chartier@exp.com; yogirajsinh.rana@exp.com	Sampled By:	Yogiraj Rana		

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

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

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

Special Instructions

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

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

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	# of Bottles	Comments
1		BH 106 D	22/06/08	12PM	GW	Y	✓	5	Regular 5 Day turn TAT Please Provide COC on Report
2									
3									
4									
5									
6									
7									
8									
9									
10									

08-Jun-22 18:37
Patricia Legette
C2F7287

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
	22/06/08	6:30pm	Isabel Gomes / ISABEL GOMES	22/06/08	18:37		Time Sensitive	Temperature (°C) on Recei	Custody Seal Present	Yes	No
								4.3, 0	Intact	Y	

RJM ENV-1685

* 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/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/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

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

White: Bureau Veritas Yellow: Client

Bureau Veritas Canada (2019) Inc.

Bureau Veritas Job #: C2F7287
Report Date: 2022/06/14

exp Services Inc
Client Project #: BAR-22008396-A0
Site Location: Watersand North Phase II, Barrie, ON
Your P.O. #: ENV- BRM
Sampler Initials: YR

Exceedance Summary Table – Prov. Water Quality Obj.

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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Appendix F – Construction and Post-Construction Flow Rate Calculations

APPENDIX F: Dewatering Flow Rates

Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

Table F-1: Construction and Post-Construction Dewatering Assessments

Parameters	Symbols	Unit	Construction		Post-Construction
			One Level of Basement	Underground Services	One Level of Basement
Geological Formation	-	-	Glacial Deposit	Glacial Deposit	Glacial Deposit
INPUTS					
Ground Elevation	-	mASL	312.45	312.45	312.45
Highest Groundwater Elevation	-	mASL	**311.98**	**311.98**	**311.98**
Lowest Top Slab Elevation	-	mASL	**309.30**	**-**	**309.30**
Lowest Excavation Elevation	-	mASL	**307.80**	**308.85**	-
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	10.18	10.18	10.18
Dewatering Target Elevation	-	mASL	306.80	307.85	308.80
Height of Target Water Level Above the Base of Water-Bearing Zone	**h_w**	m	5.00	6.05	7.00
Drawdown	**s**	m	5.18	4.13	3.18
Dupuit Check (> 45%)		m	49%	59%	69%
Base of Aquifer / Water Bearing Zone	-	mASL	**301.80**	**301.80**	**301.80**
Hydraulic Conductivity	**K**	m/s	**4.9E-05**	**4.9E-05**	**1.4E-05**
Length of Excavation	-	m	**15.00**	**20.00**	**15.00**
Width of Excavation	-	m	**10.00**	**5.00**	**10.00**
Equivalent Radius (equivalent perimeter)	**r_e**	m	7.96	7.96	7.96
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**	**Cooper-Jacob**	**Cooper-Jacob**
Time (days)			**30.00**	**30.00**	**365.00**
Time (seconds)	**t**	s	2592000	2592000	31536000
Specific Yield	**Sy**		**0.15**	**0.15**	**0.15**
OUTPUTS					
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	139	139	260
Radius of Influence	**Ro**	m	147	147	268
Dewatering Flow Rate (unconfined radial flow component)	**Q**	m^3/day	**358**	**306**	**59**
Factor of Safety	**fs**	-	2.00	2.00	1.50
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	**717**	**611**	**89**
Precipitation Event	-	mm/day	15	15	-
Volume from Precipitation	-	m^3/day	2	2	-
Total Volume (L/day) Discharge of Groundwater (Construction dewatering) **without Safety Factor** (including precipitation	-	m^3/day	**361**	**307**	**-**
Total Volume (L/day) Discharge of Groundwater (Construction dewatering) **with Safety Factor** (including precipitation)	-	m^3/day	**719**	**613**	**-**
Precipitation Event 2 year storm	-	mm/day	57	57	
Volume from Precipitation	-	m^3/event	9	6	
Precipitation Event 100 year storm	-	mm/day	126	126	
Volume from Precipitation	-	m^3/event	19	13	

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 – Water Balance Calculations

Appendix G-1: Infiltration Testing Results
Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

Location:	Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
Date:	8-Jun-22
Weather:	Sunny to Cloudy
Analyst:	TM

Borehole radius (cm):	2.5
Soil class:	Default

Measurement	Start depth of water (cm)	End depth of water (cm)	Start time (*decimal min)	End time (*decimal min)	Change in head (cm)	Perc test result (min/cm)	Perc test (hr/mm)	mean head (m)	K_{fs} (mm/hr)	Kfs (cm/sec)	Kfs (m/sec)
IT 101	35.7	19.8	0.0	53.9	15.9	3.4	0.0056	0.278	1.4	4.0E-05	4.0E-07
IT 106	51.3	4.8	0.0	41.5	46.5	0.9	0.0015	0.281	5.36	1.5E-04	1.5E-06
IT 108	69.6	53.1	0.0	72.7	16.5	4.4	0.0073	0.613	0.4	1.0E-05	1.0E-07
IT 115	73.8	15.3	0.0	46.2	58.5	0.8	0.0013	0.446	3.26	9.1E-05	9.1E-07

Appendix G-2: Low Impact Design (LID) Calculations for Infiltration Gallery
Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

Test Location	Hydraulic Conductivity (K_{fs}) (cm/s)	Infiltration Rate (IR) (mm/hr)	Discrete Design Infiltration Rate(DIR) (mm/hr)	Percolation Time (min/cm)
IT 101	4E-05	36	10	58
IT 106	1E-04	51	15	41
IT 108	1E-05	25	7	84
IT 115	9E-05	45	13	47

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	4.83E-05	38	1.5	3.5
Assumed Underlying Geology Unit (1.5 m below the bottom of trench)	1.00E-05	25		

Design Infiltration Rate(DIR) (mm/hr)	Minimum	7	**Percolation Time (min/cm)**	41
	Maximum	15		84
	Geometric Mean	**11**		**55**

Note:
Analytical Solutions (CVC and TRCA 2010)

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

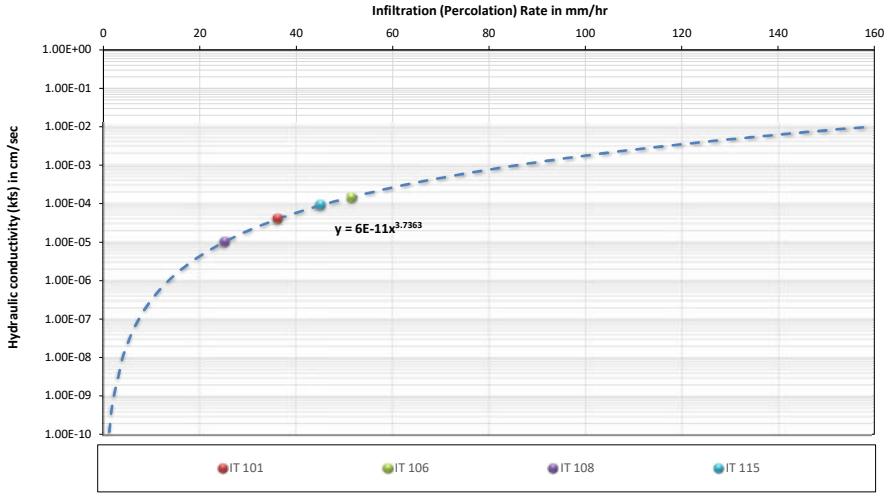
Kfs: hydraulic conductivity (cm/sec)

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-3: Model Input

Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

Year	Month	Ave. T (^{0}C)	Ave P (mm)
1970-2000	1	-7.9	75.6
1970-2000	2	-6.9	51.0
1970-2000	3	-2.1	54.0
1970-2000	4	5.6	60.6
1970-2000	5	12.4	69.1
1970-2000	6	17.4	82.1
1970-2000	7	20.1	75.9
1970-2000	8	19.2	92.7
1970-2000	9	14.8	95.2
1970-2000	10	8.6	72.5
1970-2000	11	2.3	79.9
1970-2000	12	-4.2	80.7

Note:
ESSA ONT HYDRO
Climate Station ID: 6112340

Appendix G-4: Model Output

Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

Month	PET	P	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus
1	7.7	75.6	19.0	196.6	7.6	0.0	77.1	19.7
2	9.3	51.0	32.8	197.1	9.3	0.0	86.0	32.3
3	18.1	54.0	77.5	200.0	18.1	0.0	44.4	74.6
4	36.0	60.6	68.5	200.0	36.0	0.0	0.5	68.5
5	68.6	69.1	1.0	188.0	68.6	0.0	0.0	13.0
6	99.1	82.1	-17.0	166.0	97.3	1.8	0.0	6.8
7	115.3	75.9	-39.4	131.7	108.4	6.9	0.0	1.7
8	92.9	92.7	-0.2	135.7	88.0	4.9	0.0	0.7
9	54.0	95.2	41.2	162.3	53.4	0.6	0.0	15.3
10	29.3	72.5	43.2	183.1	29.2	0.1	0.0	22.4
11	14.7	79.9	64.2	194.3	14.7	0.0	1.1	53.0
12	8.9	80.7	40.9	198.9	8.9	0.0	31.9	36.3
Annual Rate (mm/yr)	553.9	889.3	331.7	179.5	539.5	14.3	241.0	344.4

Note:

ESSA ONT HYDRO

Climate Station ID: 6112340

Appendix G-5: Lot-Level Average Infiltration Factors
Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

1. Average Infiltration Factor – Pre Development Conditions

Category	Weighted Infiltration Factor
Topography/Slope	0.30
% 59 Stone-Poor Carbonate-Derived Silty to Sandy till and % 41 Ice-Contact Stratified Deposits (Fine Sand to Gravel)	0.25
Landscaped Area	0.10
Total weighted Infiltration factor	**0.65**

2. Average Infiltration Factor – Post Development Conditions

Unmitigated

Category	Weighted Infiltration Factor
Topography/Slope	0.118
% 59 Stone-Poor Carbonate-Derived Silty to Sandy till and % 41 Ice-Contact Stratified Deposits (Fine Sand to Gravel)	0.25
Landscaped Area	0.10
Total weighted Infiltration factor	**0.47**

Notes:

Landscaped area considered equivalent to Cultivated Cover

Appendix G-6: Summary of Pre and Post-Development Water Balance (Unmitigated)
Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

1. Climate Data

	Pre-Development mm/a		Post-Development Un-Mitigated mm/a
Precipitation	889.30		889.30
Evapotranspiration	539.50		539.50
Water Surplus	349.80		349.80
Infiltration Rate	227.37		163.71
Runoff	122.43		186.09

2. Pre-Developed Study Area Statistics

Landscaped Areas	299,400	sq.m.
Existing Buildings	0	sq.m.
Roads, Driveways, Sidewalks, Parking Areas (Paved Areas)	0	sq.m.
TOTAL	299,400	sq.m.

3. Proposed Lot Coverage -

Roof Top (60 % of Total Area for Buildings)	119,700	sq.m.
Driveway, Parking and Sidewalk (15 % of Total Area for Buildings)	29,925	sq.m.
Landscaped Area (25 % of Total Area for Buildings)	49,875	sq.m.
ROW 18 m	68,400	sq.m.
Park	14,000	sq.m.
Open Area	4,100	sq.m.
SWMP	13,400	sq.m.
TOTAL	299,400	sq.m.

4. Annual Pre-Development Water Balance

Land Use	**Area (sq.m.)**	**Precipitation (cu.m.)**	**Actual Evapotranspiration (cu.m.)**	**Infiltration Rate (cu.m.)**	**Run-off (cu.m.)**
Total Impervious	0	0	0	0	0
Undeveloped	299,400	266,256	161,526	68,075	36,656
Total	299,400	266,256	161,526	68,075	36,656
	Pre-development Rates in mm/year		**539.5**	**227.4**	**122.4**

5. Annual Post-Development Water Balance Un-Mitigated

Land Use	**Area (sq.m.)**	**Precipitation (cu.m.)**	**Actual Evapotranspiration (cu.m.)**	**Infiltration Rate (cu.m.)**	**Run-off (cu.m.)**
Roofs	119,700	106,449	0	0	106,449
Roads, Driveways, Sidewalks, Parking Areas	98,325	87,440	0	0	87,440
Landscaped Areas, Parks and Open Space	67,975	60,450	36,673	11,128	12,650
SWMP	13,400	11,917	7,229	2,194	2,494
TOTAL	299,400	266,256	43,902	13,322	209,032
	Post-development Rates in mm/year		**146.6**	**44.5**	**698.2**

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

	Precipitation (cu.m.)	**Actual Evapotranspiration (cu.m.)**	**Run-off (cu.m.)**	**Infiltration Rate for Areas with Shallow Groundwater Table (cu.m.)**
Pre-Development	266,256	161,526	36,656	68,075
Post Development	266,256	43,902	209,032	13,322
			Pre-development Infiltration Rate	**227.4**
			Post-development Infiltration Rate Un-Mitigated	**44.5**
			Deficit Post Development Un-Mitigated	**-54,753**

Appendix G-7: Estimate of Infiltration Area of LID System
Proposed Watersand North Phase II, 259 Salem Road, Barrie, Ontario
BAR-22008396-A0

1. Design Infiltration Rate

Item	Value	Unit
Geometric mean of design infiltration rates	11.00	mm/h
	264.00	mm/day
	0.26	$m/day/m^2$
	0.53	$m/48\ hrs/m^2$

2. Climate Data

Total precipitation based on weather station records	889.30	mm/yr
Total rain in an eight (8) month precipitation period	592.87	mm/yr
Based on a 32-week precipitation period	37.05	mm/week
	0.037	m/2 week/m2

3. Roof and Resulted Runoff Volume

Total roof area	119,700	m^2
Rooftop runoff volume in an eight (8) month precipitation perio	70,966	m^3/yr
Total rooftop runoff volume per 2 week	4,435	$m^3/2$ week

4. Estimated Deficit Volume

Estimated deficit based on water balance calculations	54,753	m^3/yr
Deficit over available water (roof runoff) for infiltration	77%	-
Storage to infiltrate to meet deficit	3,422	$m^3/2$ week

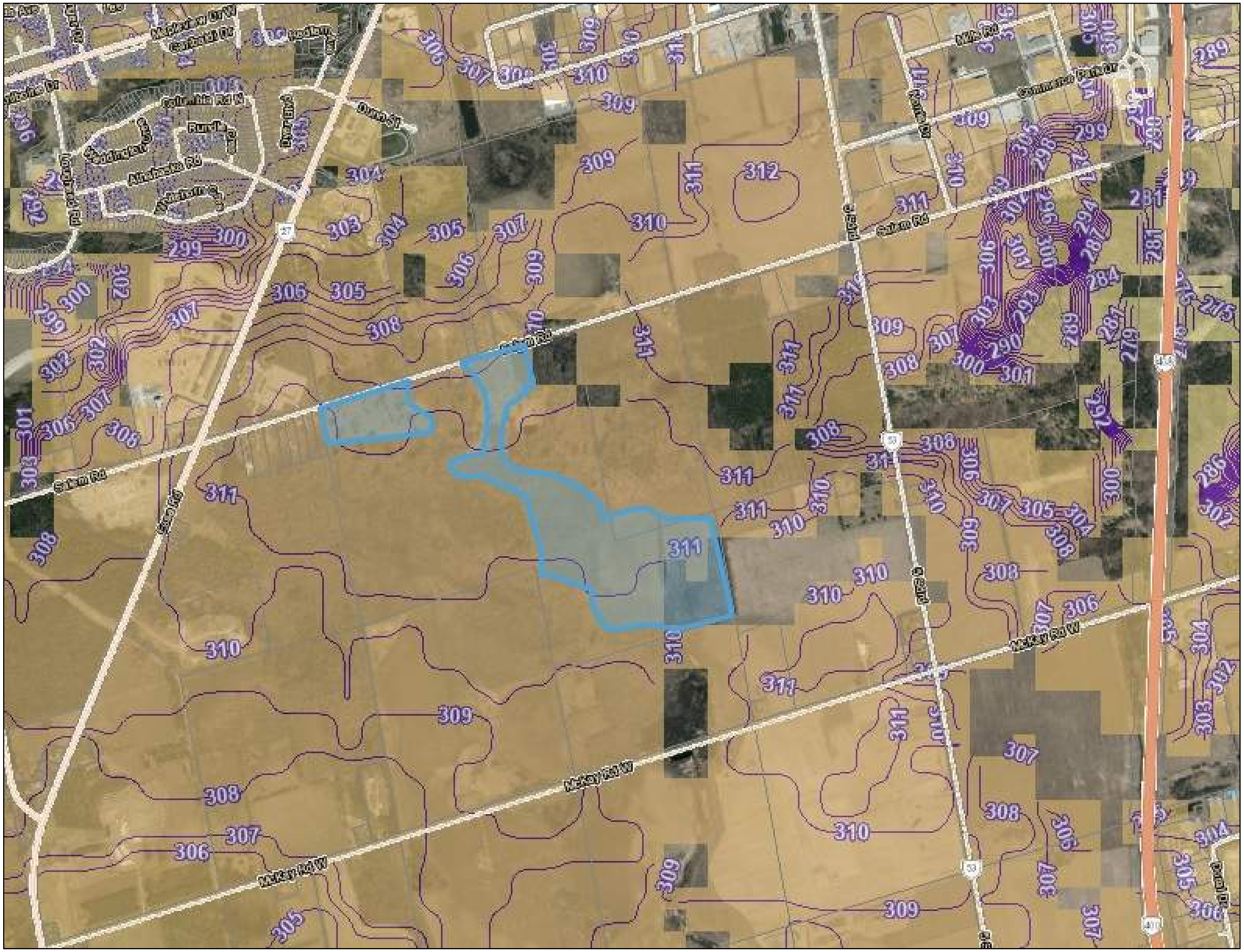
5. LID Area

Area of infiltration system required to mitigate infiltrate deficit (rounded)	**6,480**	m^2
mm of Rain per 2 week per m^2 of LID to be infiltrated	528	$mm/2\ week/m^2$ of LID
Drawdown time in hours	48	hrs

Note: only roof water to be infiltrated (clean water)

Appendix H – Oak Ridges Moraine Groundwater Program

Top of Halton_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Top of Halton Till (or equiv.) (mASL)

York Region

1.4 0 0.69 1.4 Km

1: 27,016

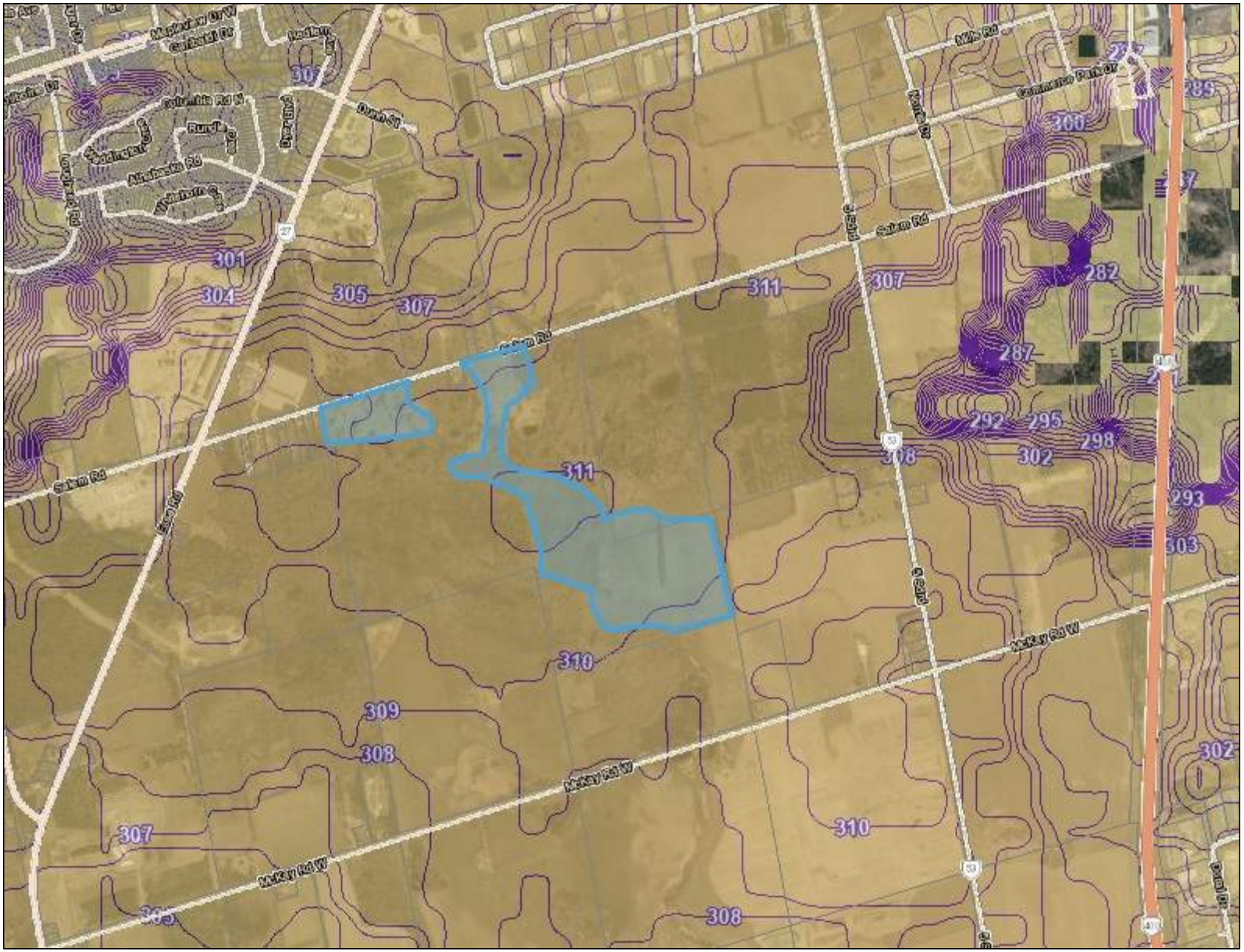
Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Top of ORAC_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Top of Oak Ridges (or equiv.) (mASL)

1.4 0 0.69 1.4 Km

1: 27,016

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

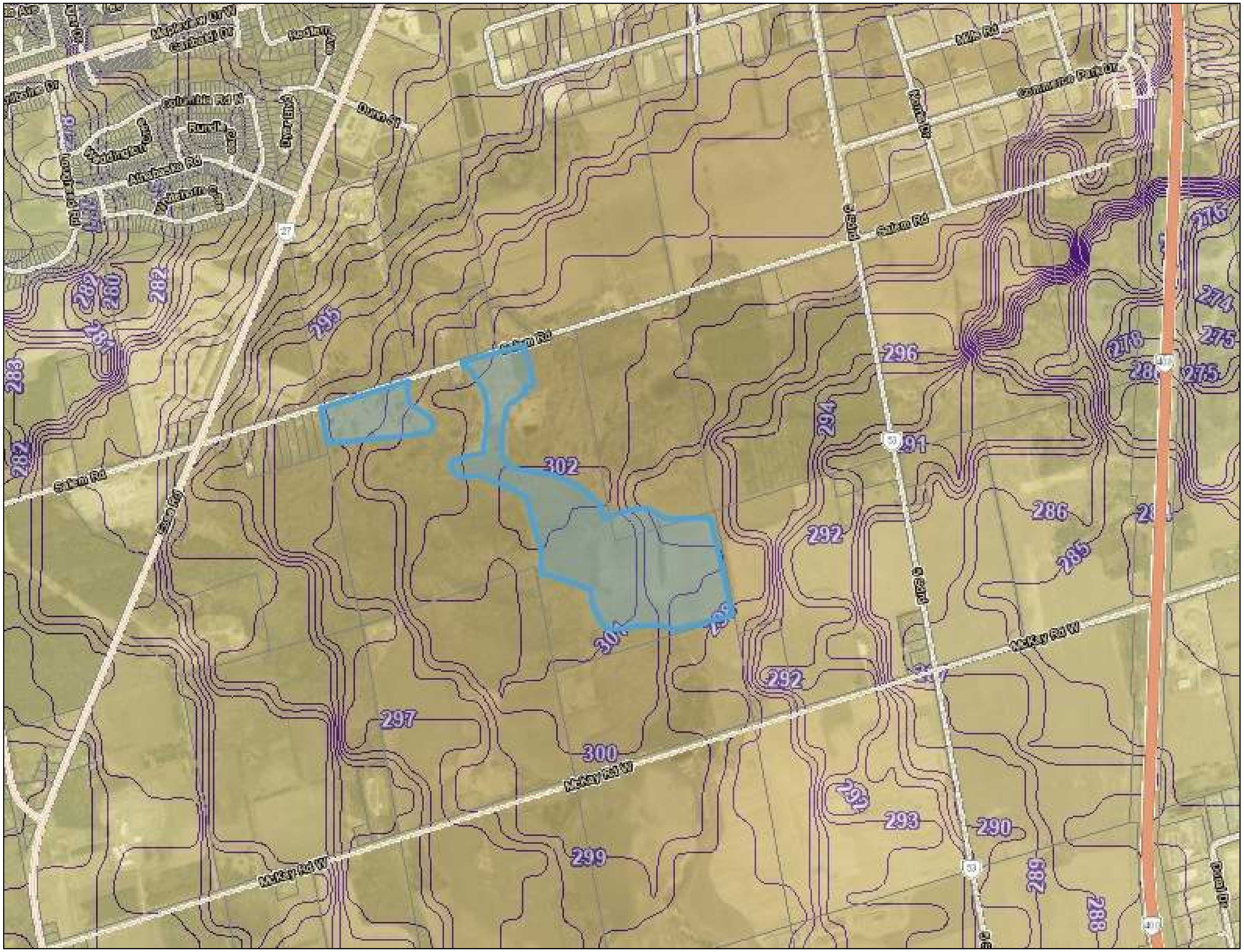
This map is for information purposes only and the Oak Ridges Moraine Groundwater Program takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Top of Upper Newmarket_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Top of Upper Newmarket Till (mASL)

York Region

1.4 0 0.69 1.4 Km

1: 27,016

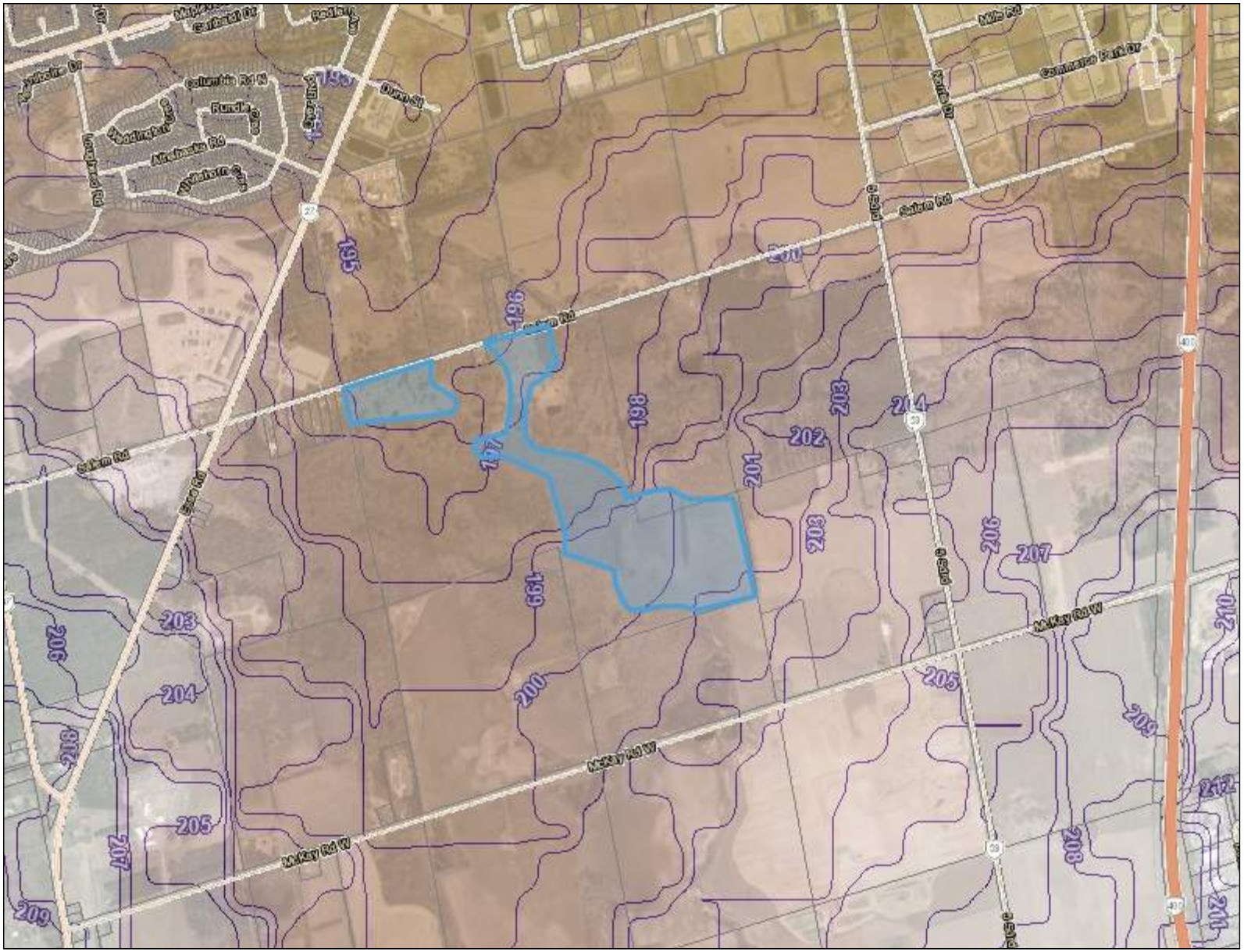
Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Top of Sunnybrook_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Top of Sunnybrook Drift (or equiv.) (mAS

York Region

1.4 0 0.69 1.4 Km

1: 27,016

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

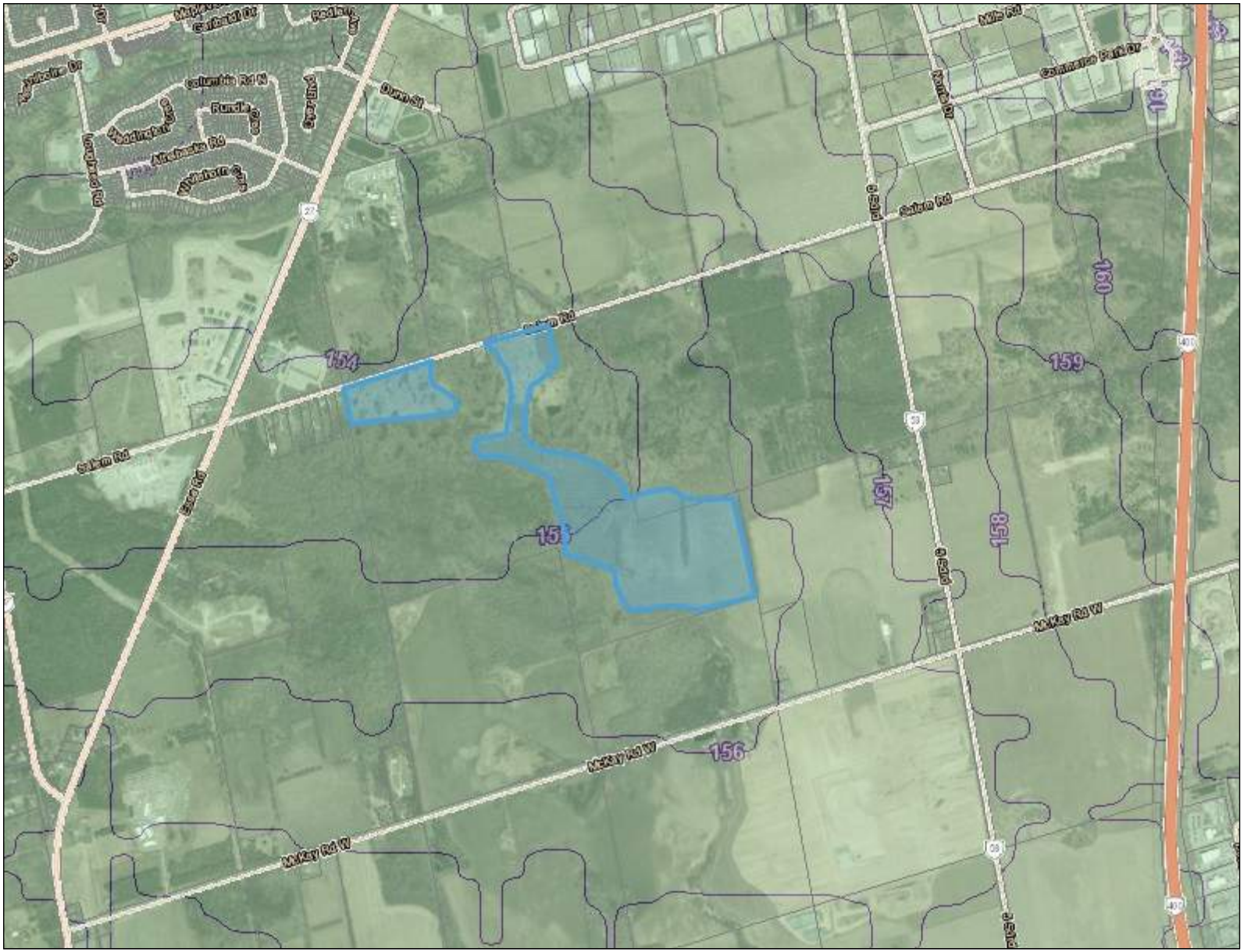
This map is for information purposes only and the Oak Ridges Moraine Groundwater Program takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Top of Scarborough_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Top of Scarborough Fm. (mASL)

York Region

1.4 0 0.69 1.4 Km

1: 27,016

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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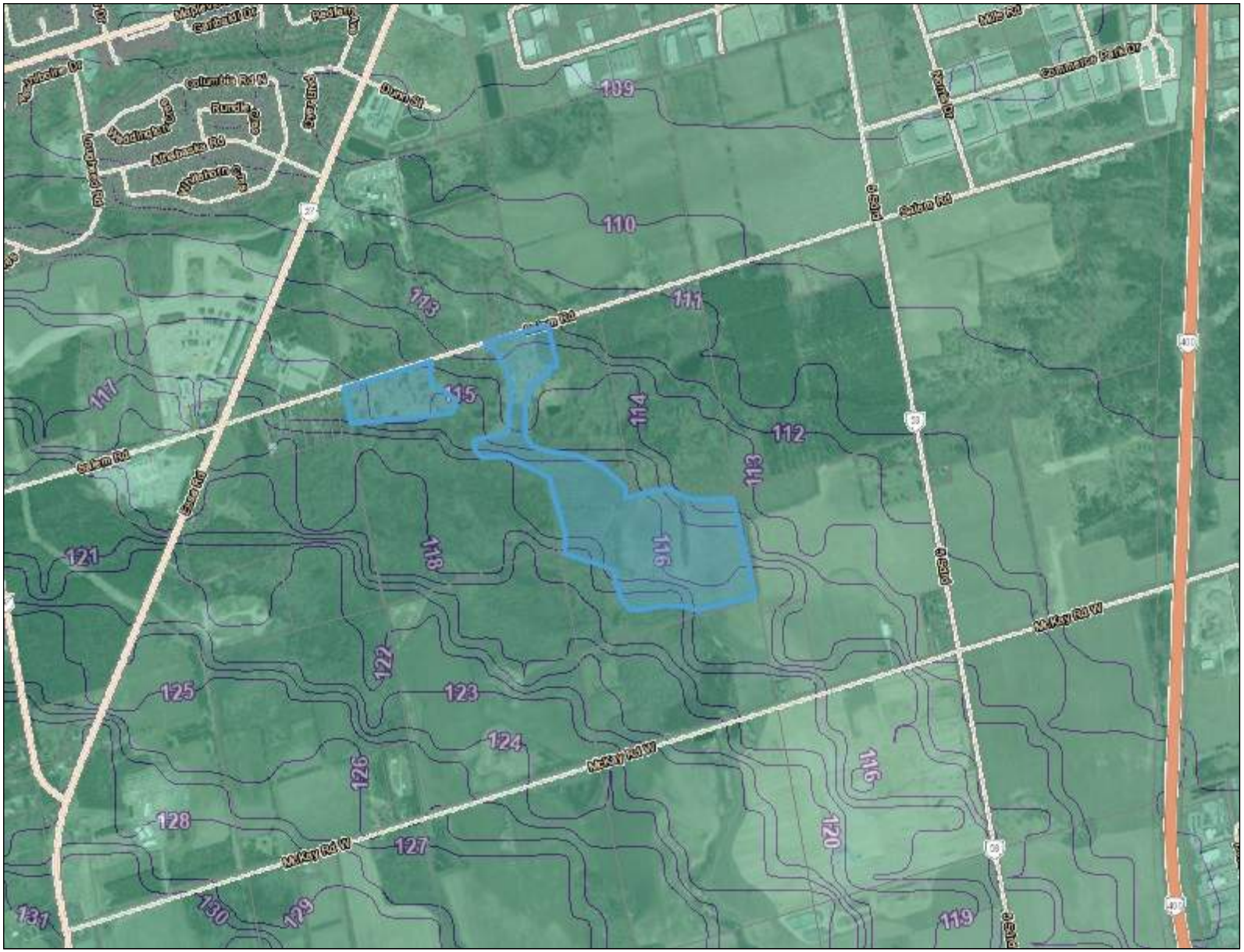
SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Top of Bedrock_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Bedrock (mASL)

1.4 0 0.69 1.4 Km

1: 27,016

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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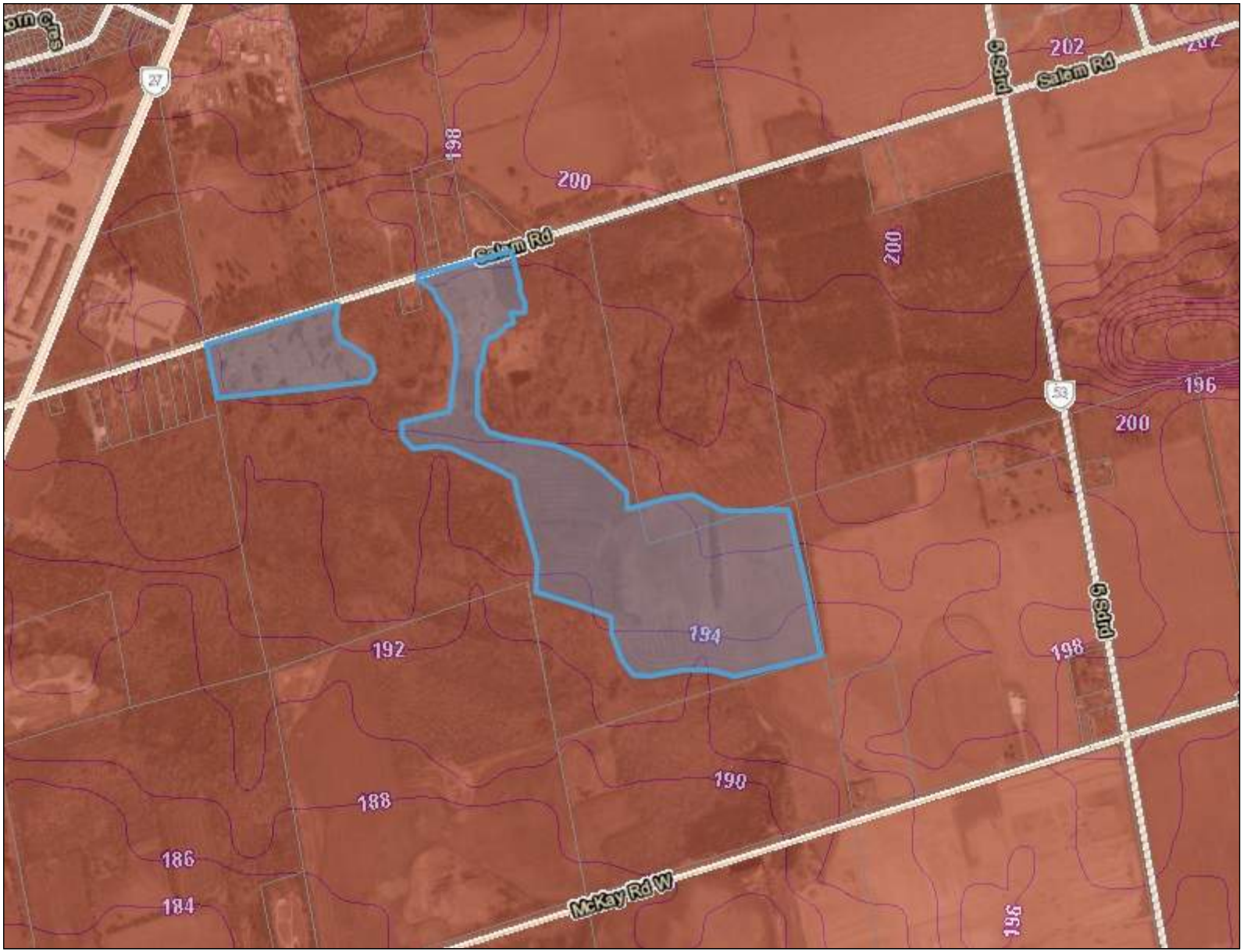
SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Thickness of Overburden_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Quaternary Sediment Thickness (Depth t (ORMGP)

York Region

0.9 0 0.46 0.9 Km

1: 18,056

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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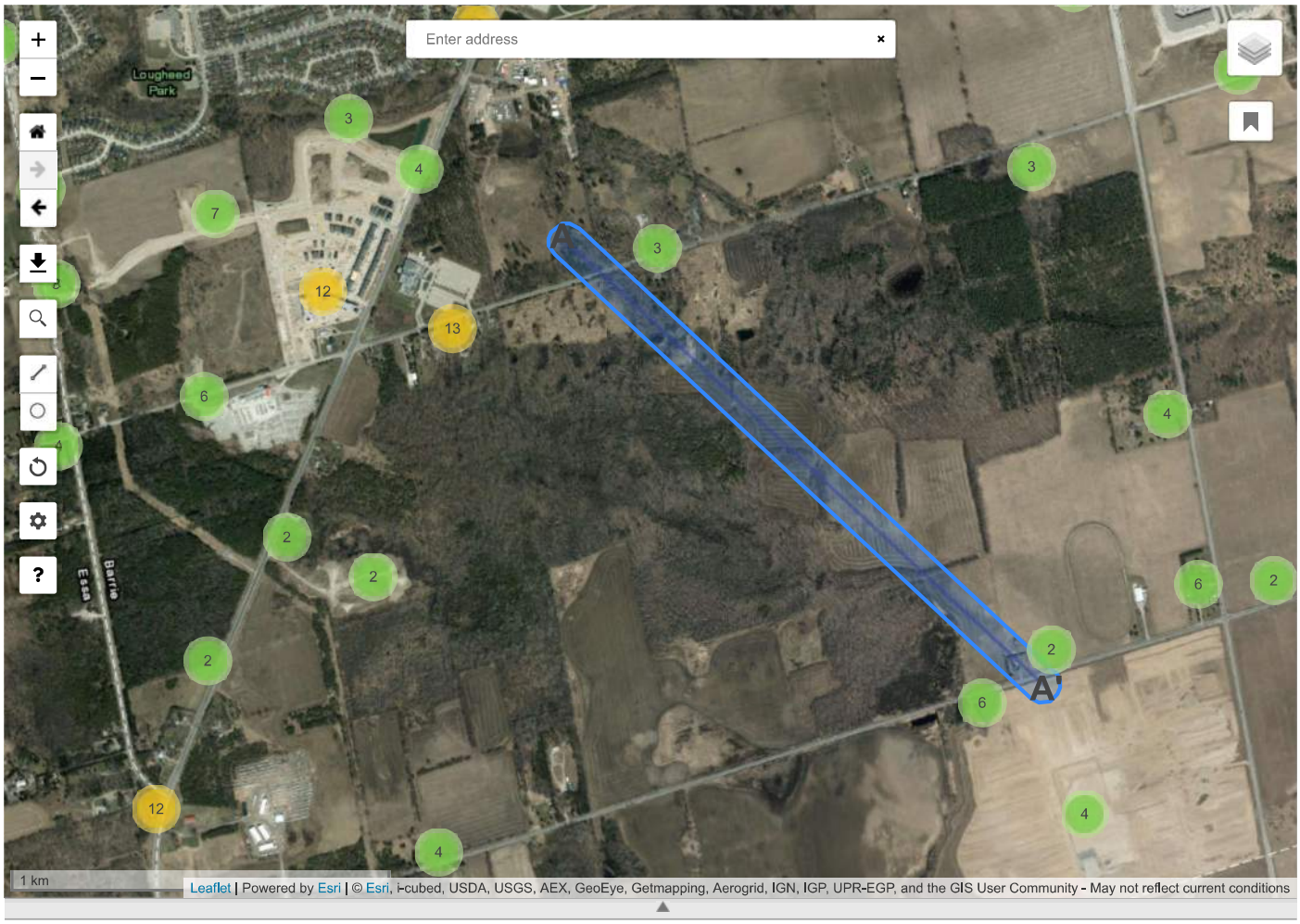
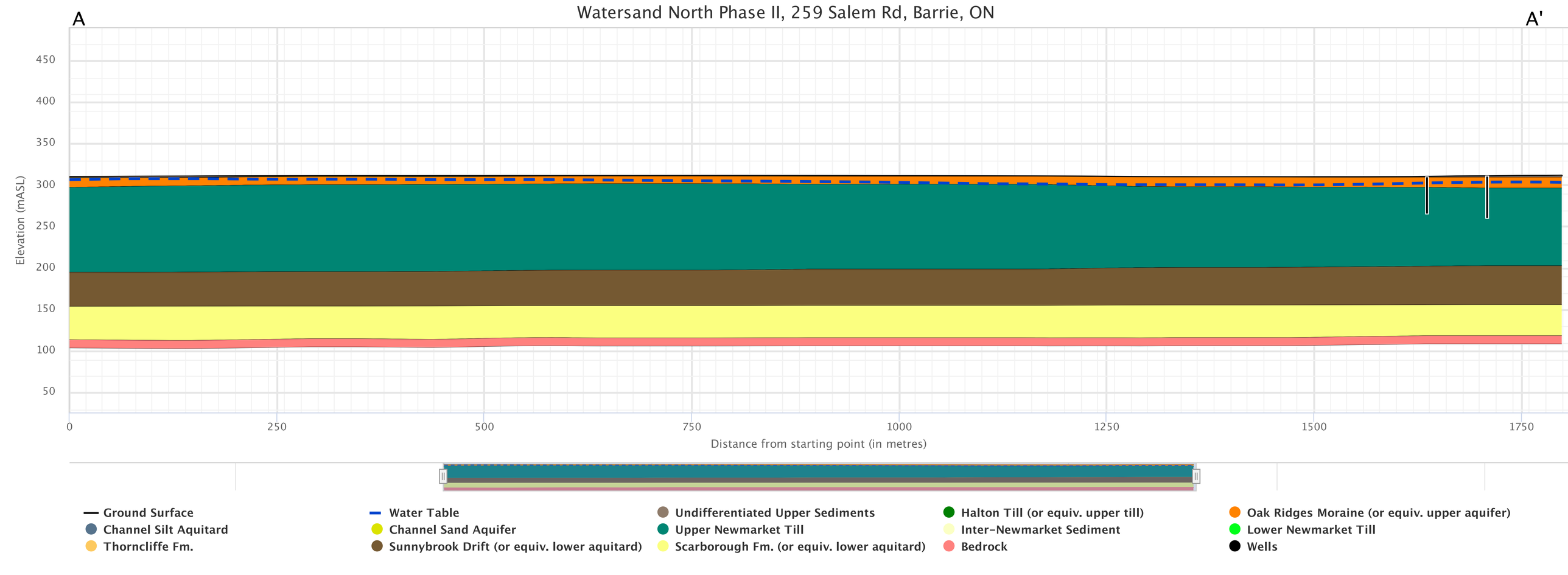
SOURCE: ORMGP, 2022; MNRF, 2022;

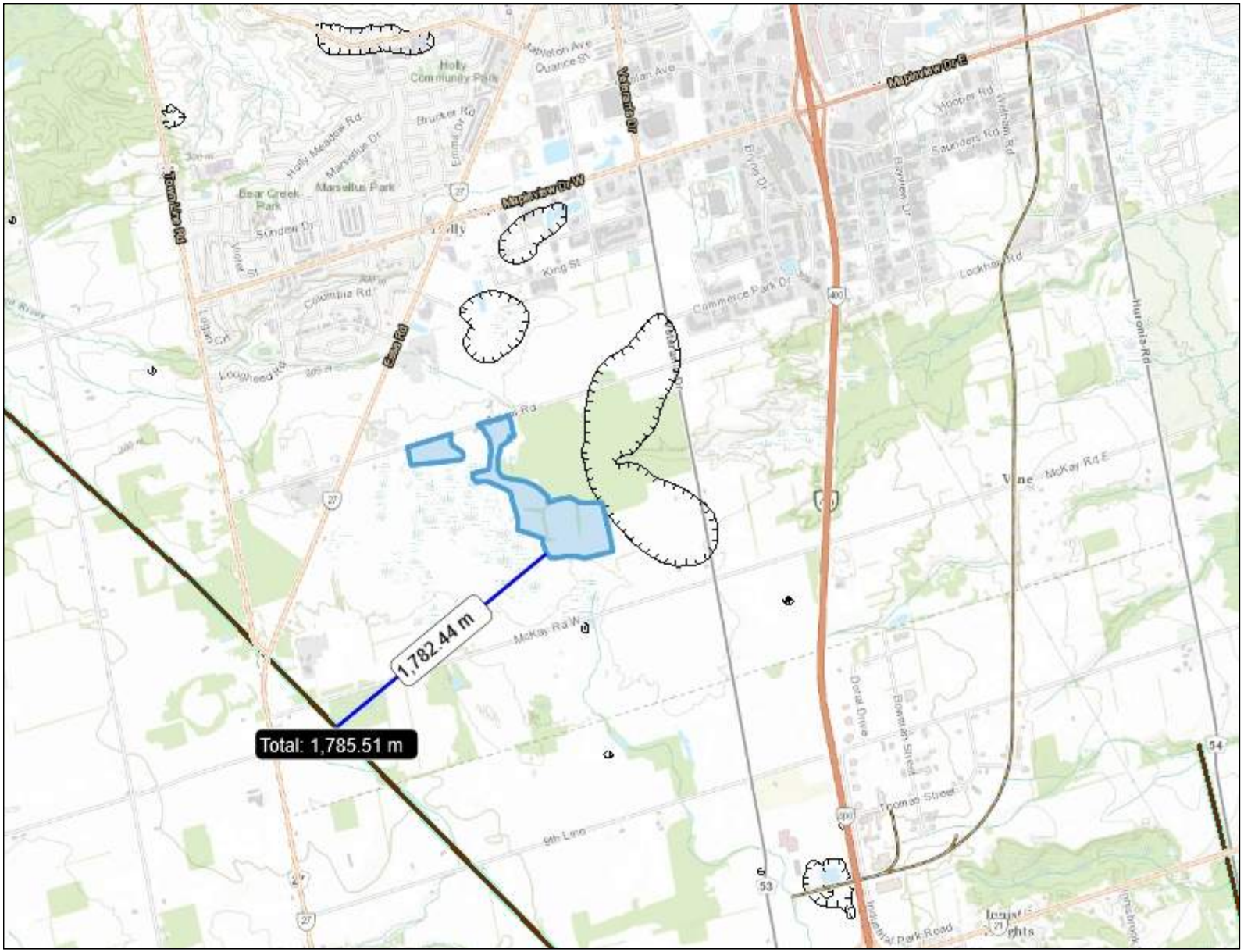
PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022


Enter address
Loughead Park
Barrie
A
A'
1 km
Leaflet | Powered by Esri | © Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community - May not reflect current conditions


Watersand North Phase II, 259 Salem Rd, Barrie, ON
A
A'
Elevation (mASL)
450
400
350
300
250
200
150
100
50
0
250
500
750
1000
1250
1500
1750
Distance from starting point (in metres)
Ground Surface
Water Table
Undifferentiated Upper Sediments
Halton Till (or equiv. upper till)
Oak Ridges Moraine (or equiv. upper aquifer)
Channel Silt Aquitard
Channel Sand Aquifer
Upper Newmarket Till
Inter-Newmarket Sediment
Lower Newmarket Till
Thorncliffe Fm.
Sunnybrook Drift (or equiv. lower aquitard)
Scarborough Fm. (or equiv. lower aquitard)
Bedrock
Wells

Geological Features_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Address Points - City of Peterborough
- Address Points - York
- Address Points - City of Barrie
- Address Points - Peel
- Address Points - Durham
- Address Points - Hastings County
- Address Points - City of Toronto
- Assessment Parcel Partners
- Bedrock Thalweg
- Closed Depressions

York Region

2.7 0 1.37 2.7 Km

1: 54,031

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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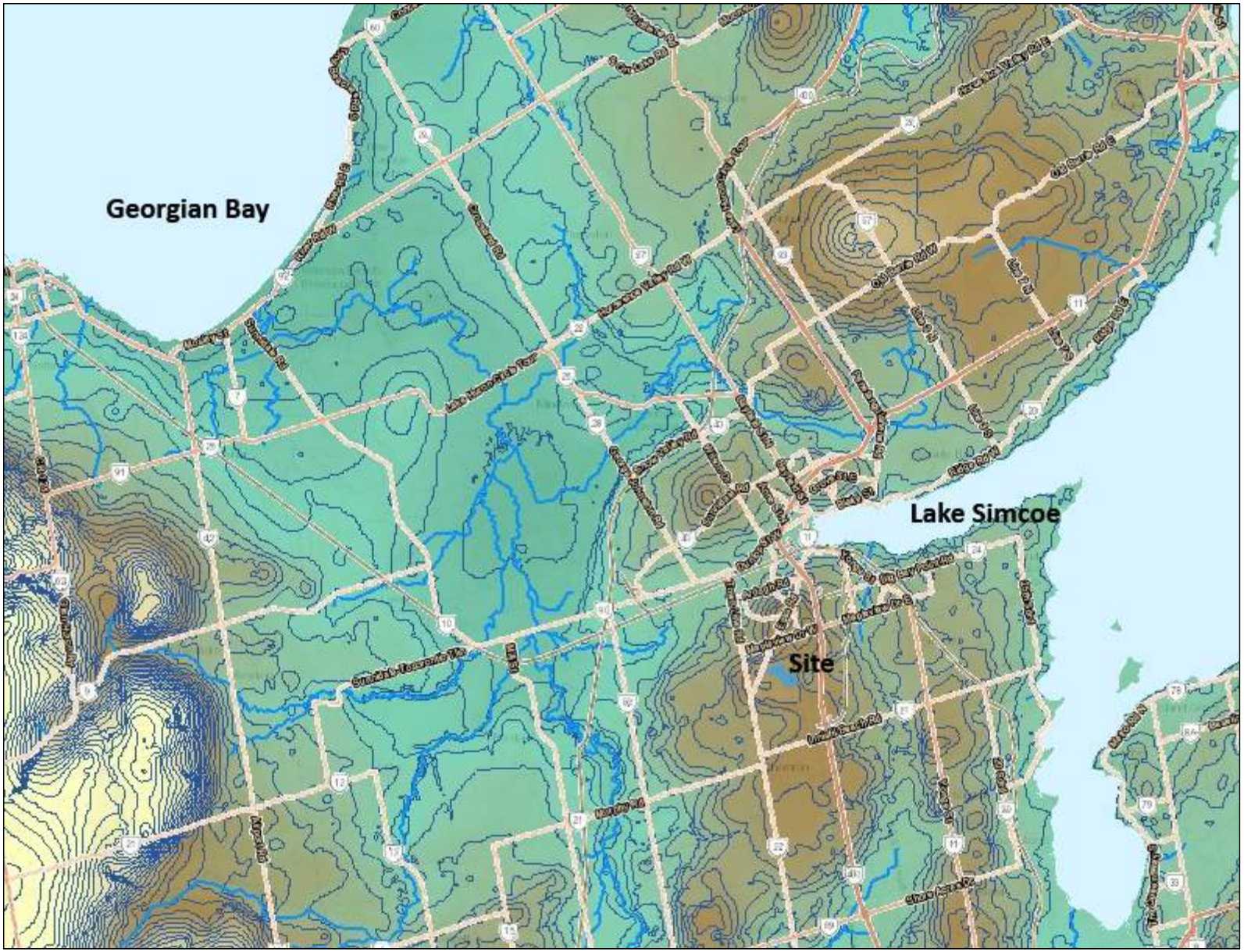
SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Regional Groundwater Contour Map_Watersand Phase II, 259 Salem Rd., Barrie, ON



Legend

- Water Bodies
- Streams (Strahler > Class 3)
- Water Table 1 (WT1) (mASL)

York Region

22.0 0 10.98 22.0 Km

1: 432,249

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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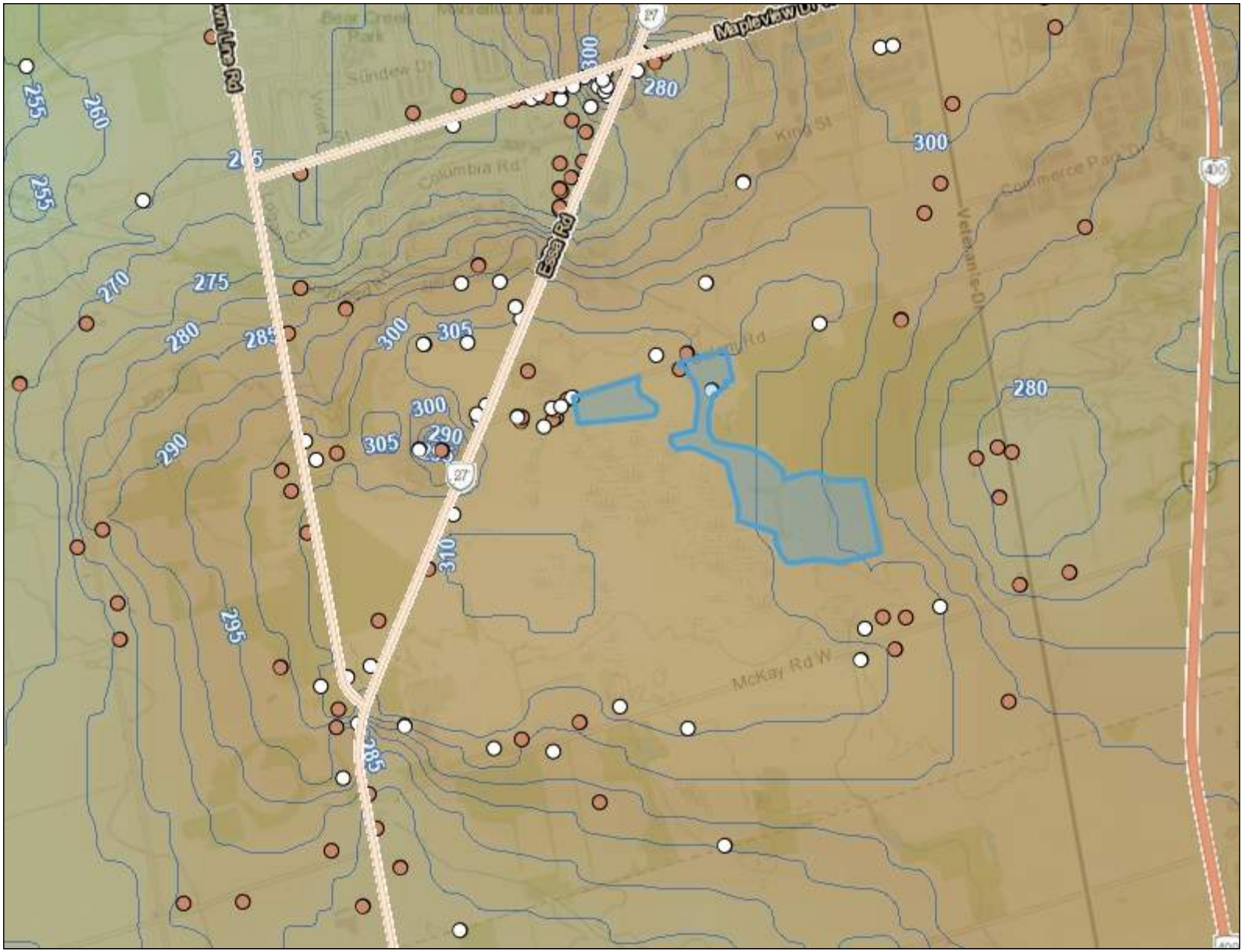
SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 6, 2022

Groundwater Contour Map_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Shallow Wells (<20 m deep)
- Deep Wells (>40 m deep)
- Water Bodies
- Streams (Strahler > Class 3)
- Water Table 1 (WT1) (mASL)

1.8 0 0.92 1.8 Km

1: 36,112

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

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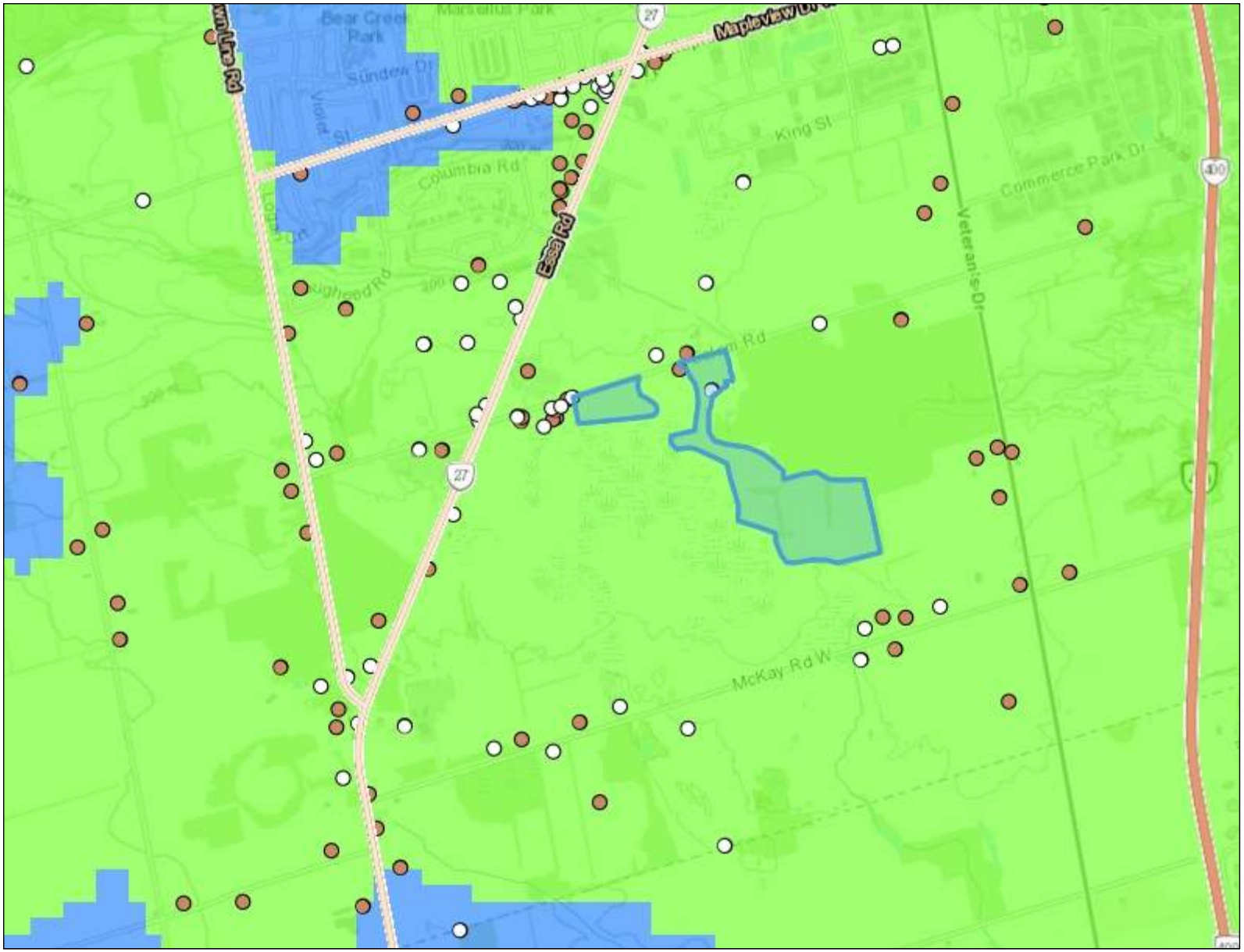
SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Downward Groundwater Gradient_Watersand Phase II, 295 Salem Rd, Barrie, ON



Legend

- Shallow Wells (<20 m deep)
- Deep Wells (>40 m deep)
- Water Bodies
- Streams (Strahler > Class 3)
- Vertical Gradient (WT1 minus PS0)
- Upward Gradient (PS0>WT1)
- Downward Gradient (WT1 > PS0)

1.8 0 0.92 1.8 Km

1: 36,112

Map Compiled by the Oak Ridges Moraine Groundwater Program.101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

This map is for information purposes only and the Oak Ridges Moraine Groundwater Program takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

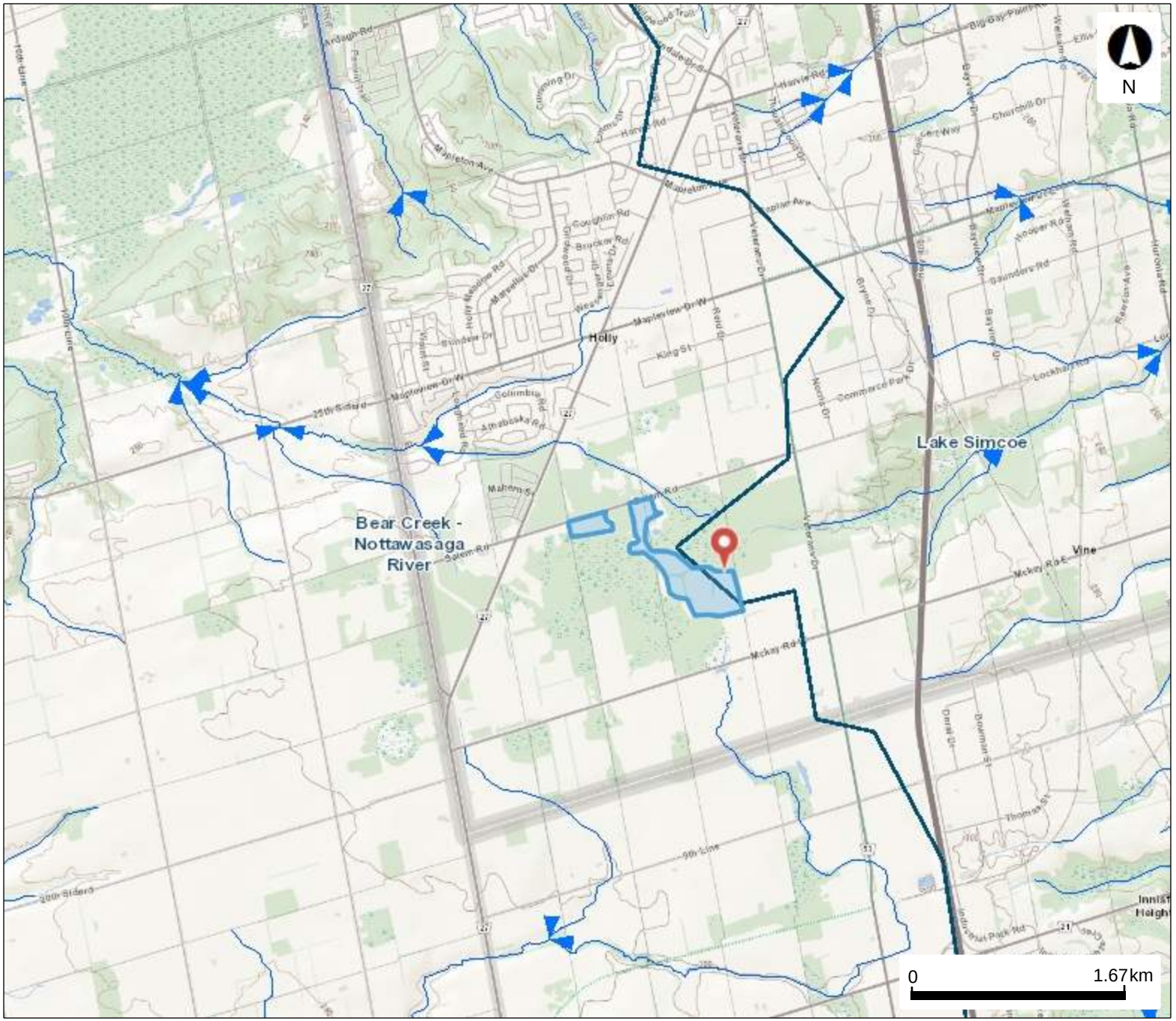
SOURCE: ORMGP, 2022; MNRF, 2022;

PROJECTION: WGS_1984_Web_Mercator_Auxiliary_Sphere

DATE PRINTED: June 2, 2022

Appendix I – Conservation Authority

Watershed Areas_Watersand North Phase II, 259 Salem Rd., Barrie, ON



Legend

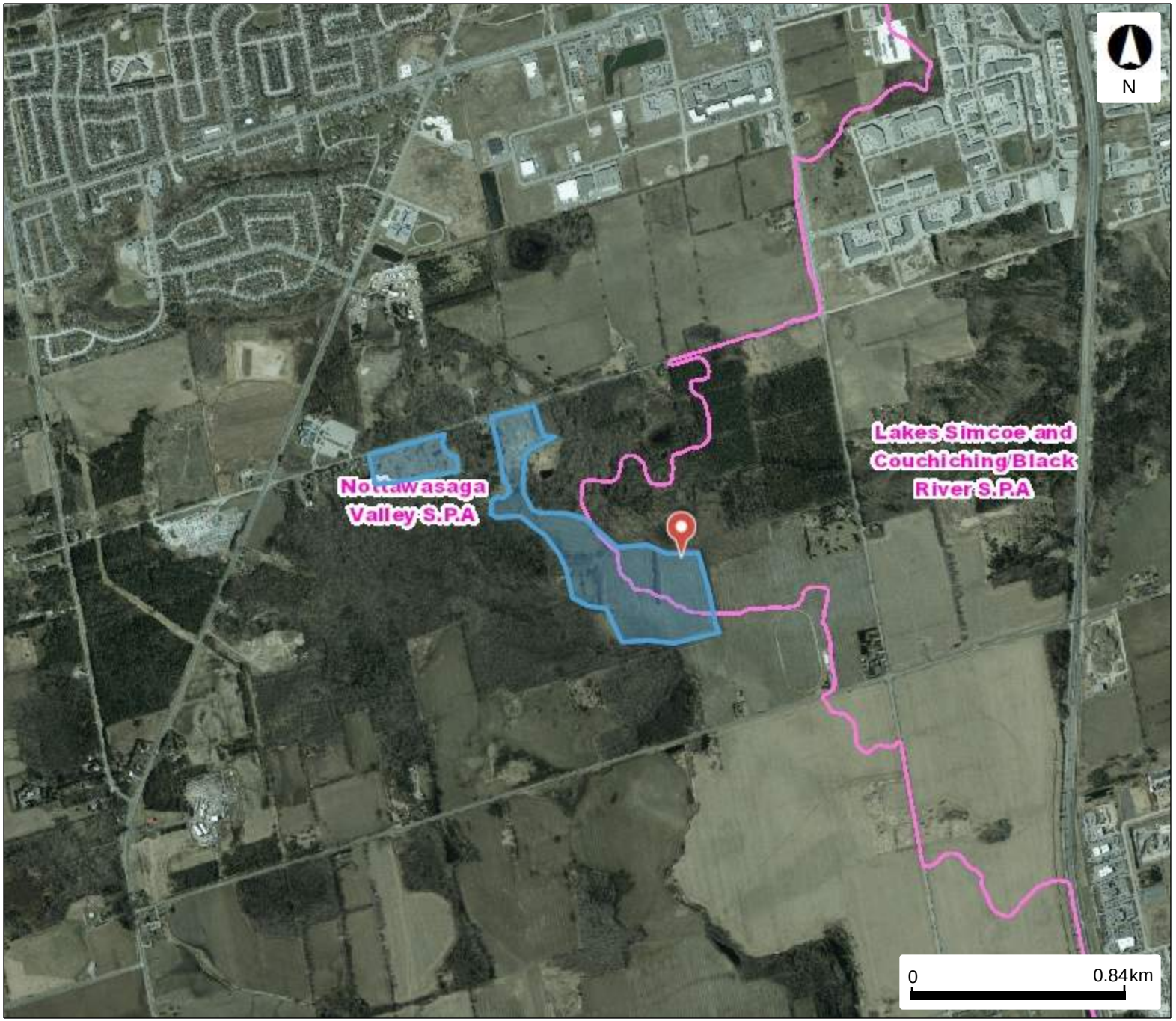
- Watercourse Direction
- Quaternary

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: 6/3/2022
Map Center: 44.31625 N, -79.71617 W

Source Protection Areas_Watersand North Phase II, 259 Salem Rd., Barrie, ON



Legend

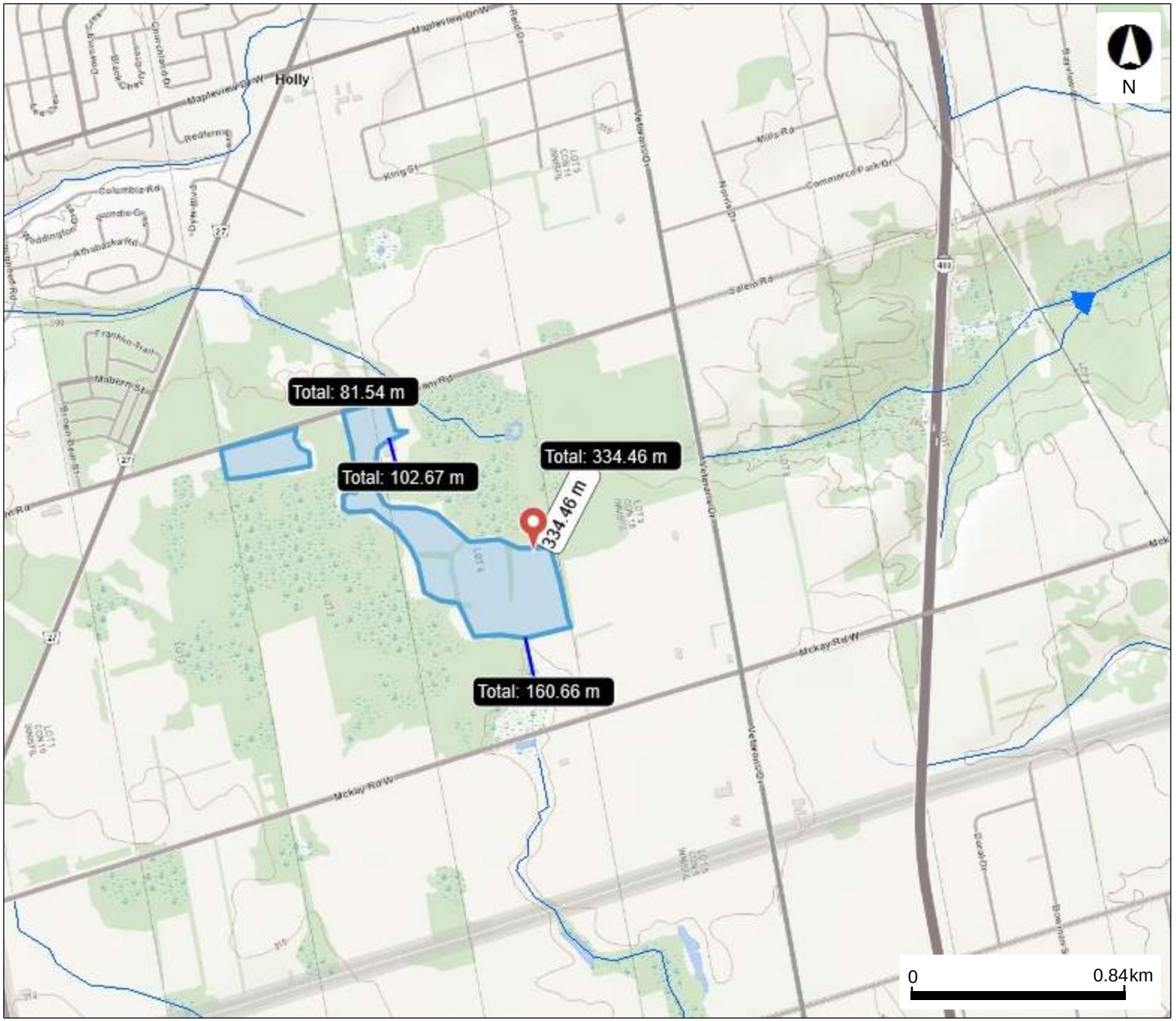
- Source Protection Areas
- Assessment Parcel with Addre

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: 6/3/2022
Map Center: 44.31352 N, -79.70739 W

Surface Water Features_Watersand North Phase II, 259 Salem Rd., Barrie, ON



Legend

- Watercourse Direction
- Assessment Parcel with Addre

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: 6/3/2022
Map Center: 44.31334 N, -79.70018 W

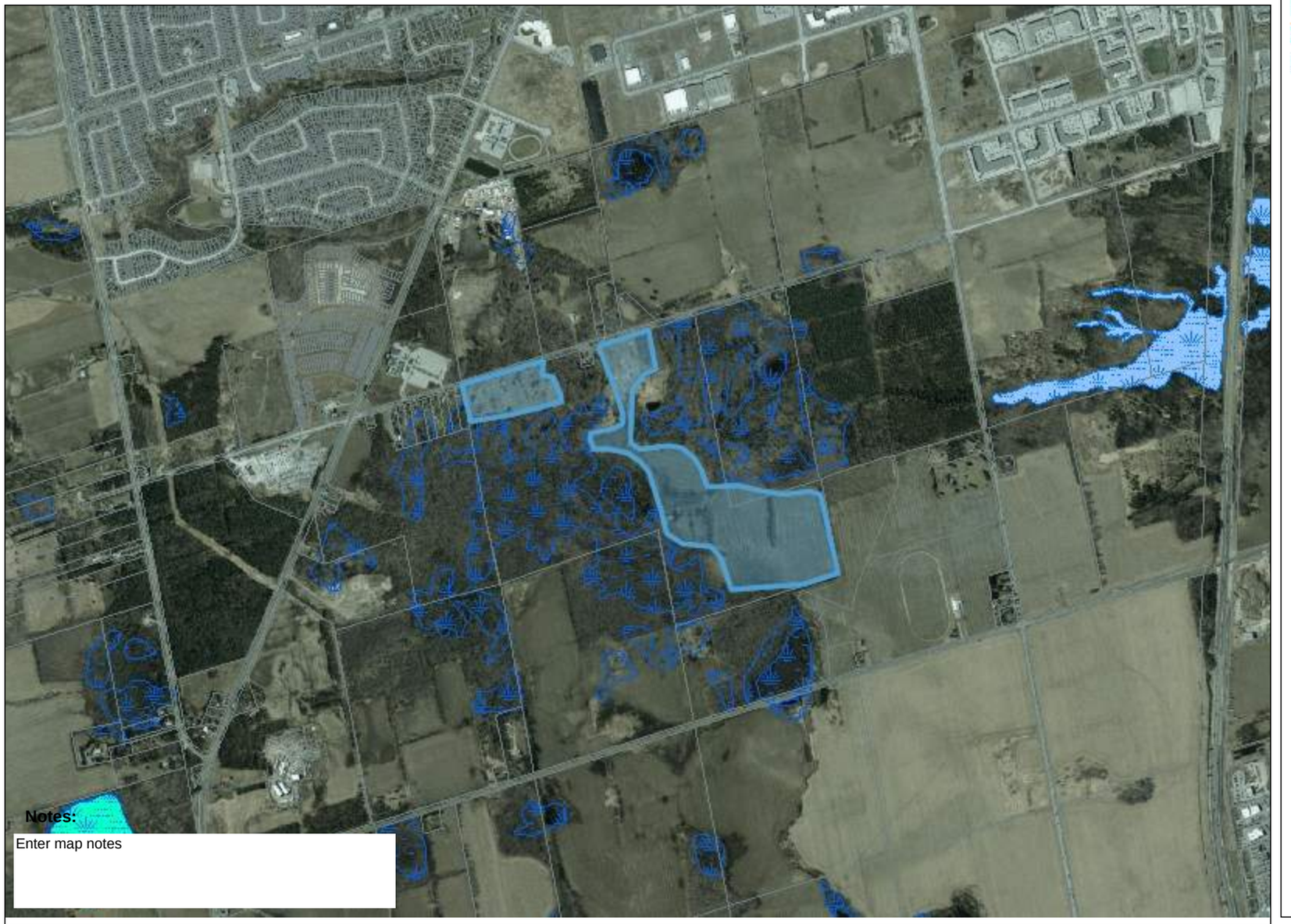
Ontario

Ministry of Natural Resources and Forestry

Make-a-Map: Natural Heritage Areas

Wetland_Watersand North Phase II, 259 Slaem Rd. Barrie, ON

Map created:6/3/2022



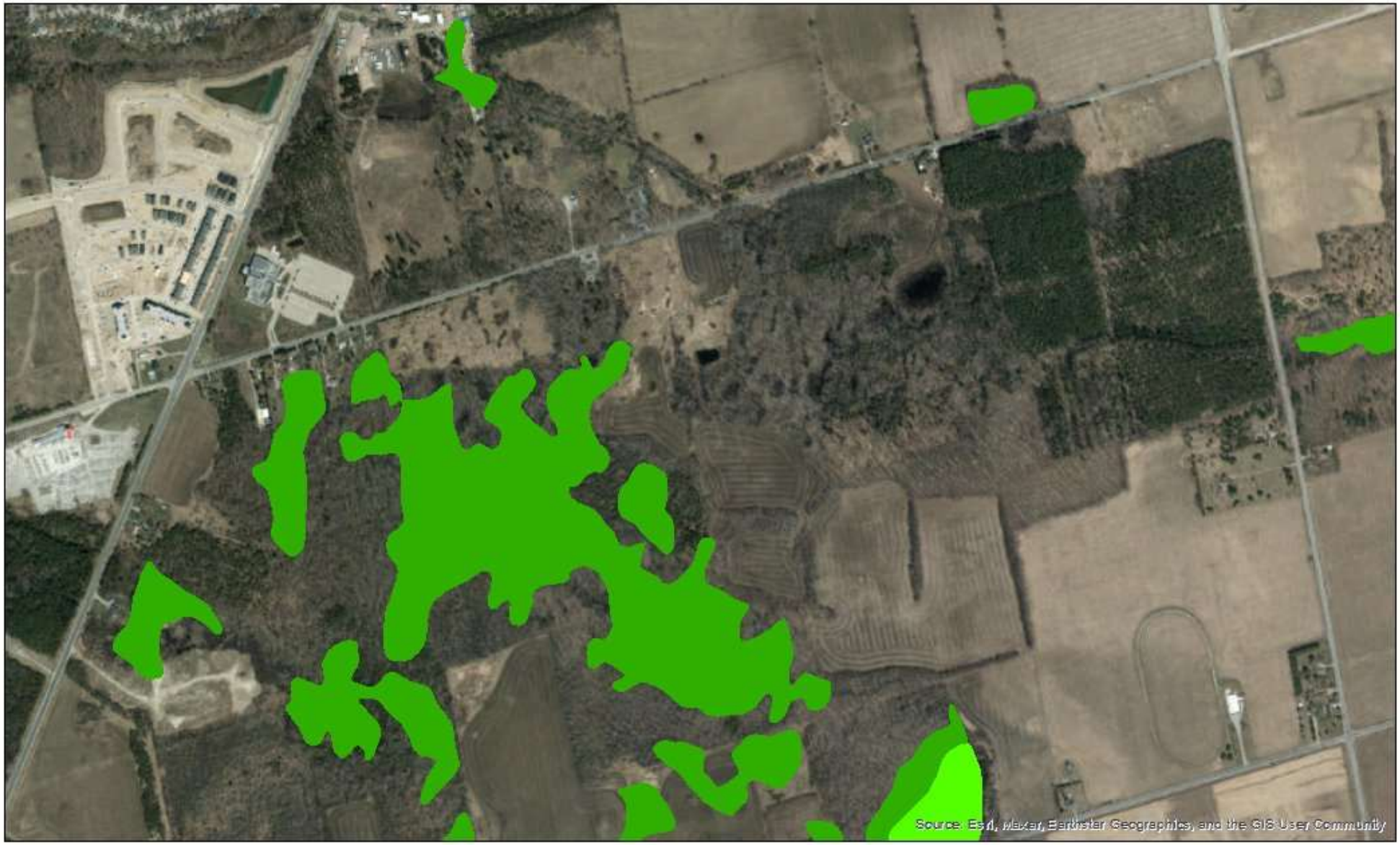
Legend

- Assessment Parcel
- Evaluated Wetland
- Provincially Significant/considérée d'importance provinciale
- Non-Provincially Significant/non considérée d'importance provinciale
- Unevaluated Wetland

1.1 0 0.54 1.1 Kilometres

Absence of a feature in the map does not mean they do not exist in this area.

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 Natural Resources and Forestry(OMNRF) shall not be liable in any way for the use of, or reliance upon, this map or any information on this map.



Canadian Wetland Inventory Status Map

Wetland Classes

- Bog \ Bog
- Fen \ Fen
- Marsh \ Marais
- Swamp / Marécage
- Shallow/Open Water / Eau peu profonde/étang

CWI Inventory Status

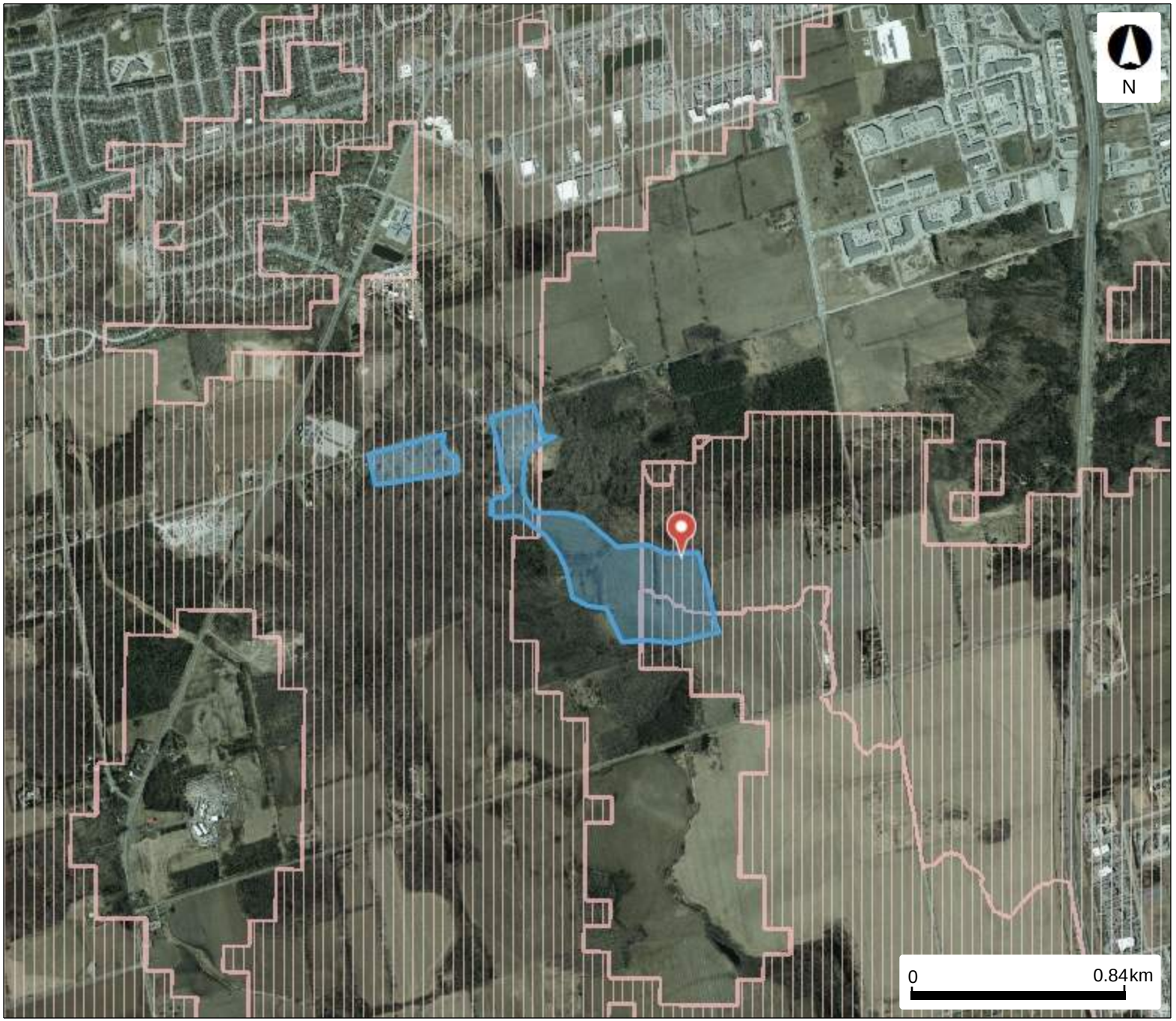
- Complete \ Near Complete
- In Progress

N

0 0.225 0.45 0.9 Kilometers

Date: 6/3/2022

HVA_Watersand North Phase II, 259 Salem Rd., Barrie, ON



Legend

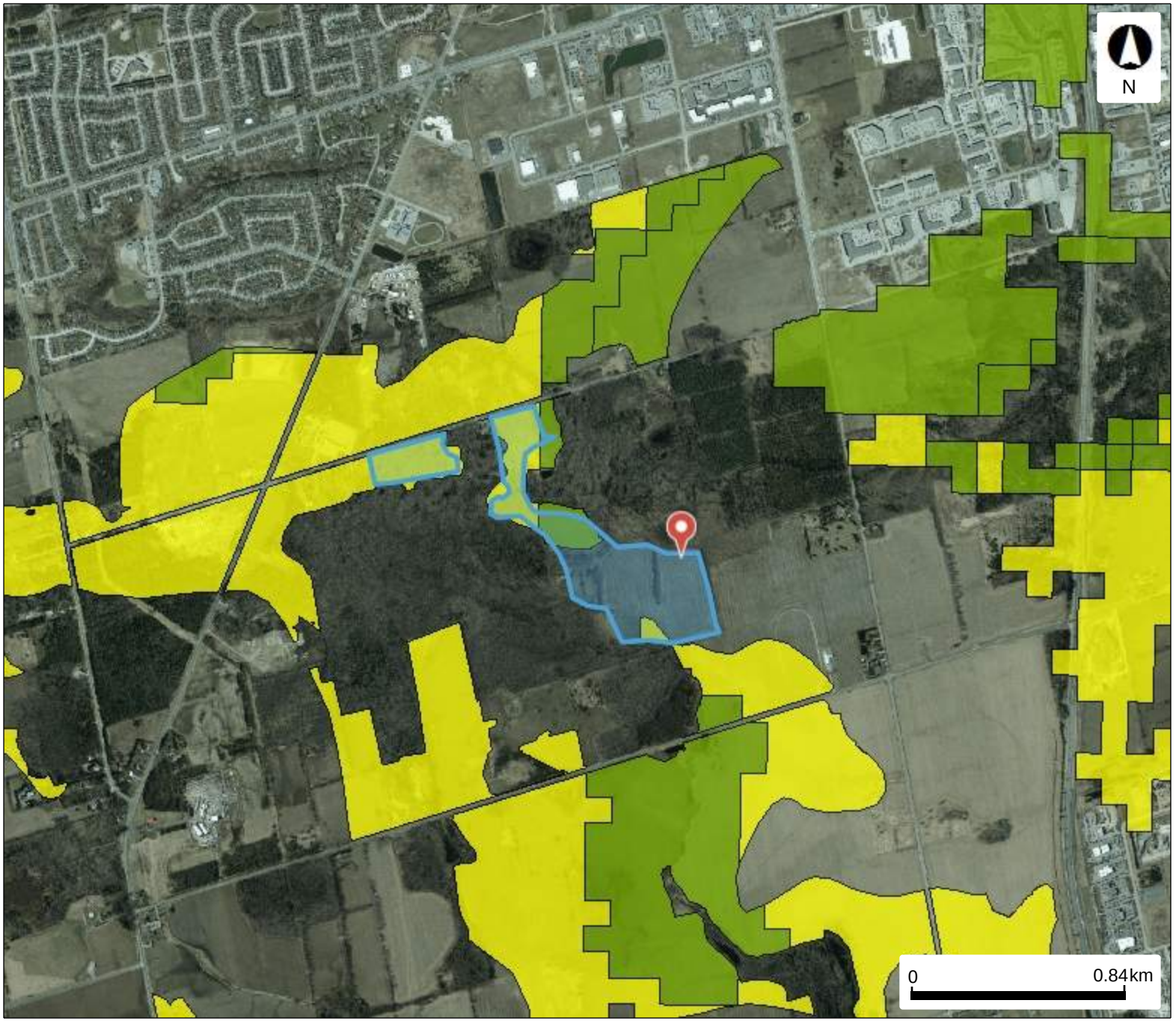
- Highly Vulnerable Aquifers
- Assessment Parcel with Addre

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: 6/3/2022
Map Center: 44.31352 N, -79.70739 W

SGWRA_Watersand North Phase II, 259 Salem Rd., Barrie, ON



Legend

Significant Groundwater Recharge Area

- 0
- 2
- 4
- 6

Assessment Parcel with Addre

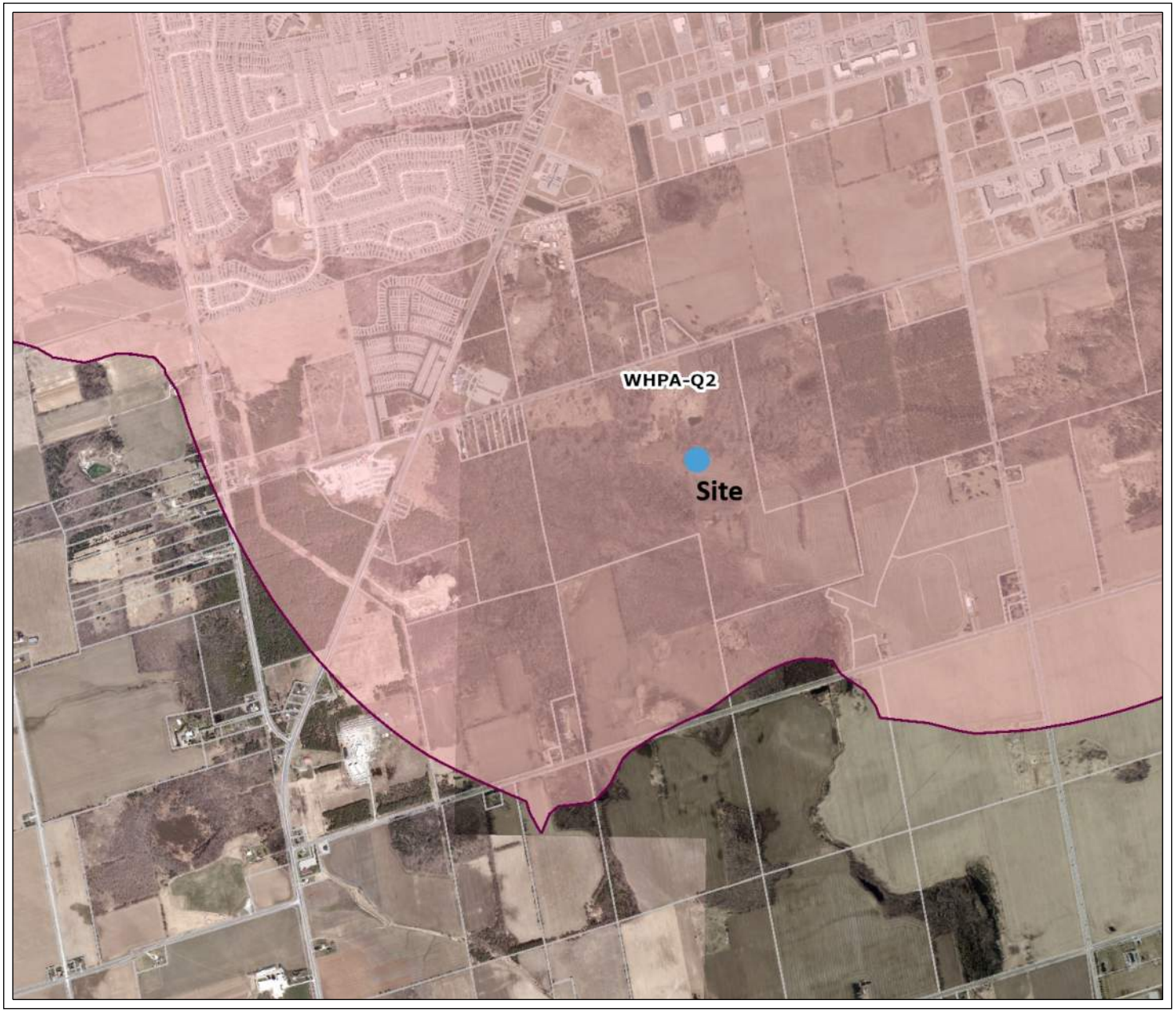
This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 6/3/2022
Map Center: 44.31352 N, -79.70739 W

South Georgian Bay Lake Simcoe Source Protection Region

WHPA_Watersand North Phase II, 259 Salem Rd. Barrie, ON



Features

WHPA Q Policy Area
- WHPA-Q1
- WHPA-Q1/Q2
- WHPA-Q2

WHPA Q Risk Level
- Significant
- Moderate
- Low

Assessment Parcel

Roads
- Hwy 400 Series
- Highway, Arterials
- Local Road

Printed On:
6/3/2022

WGS_1984_Web_Mercator_Auxiliary_Sphere

Mapped By:

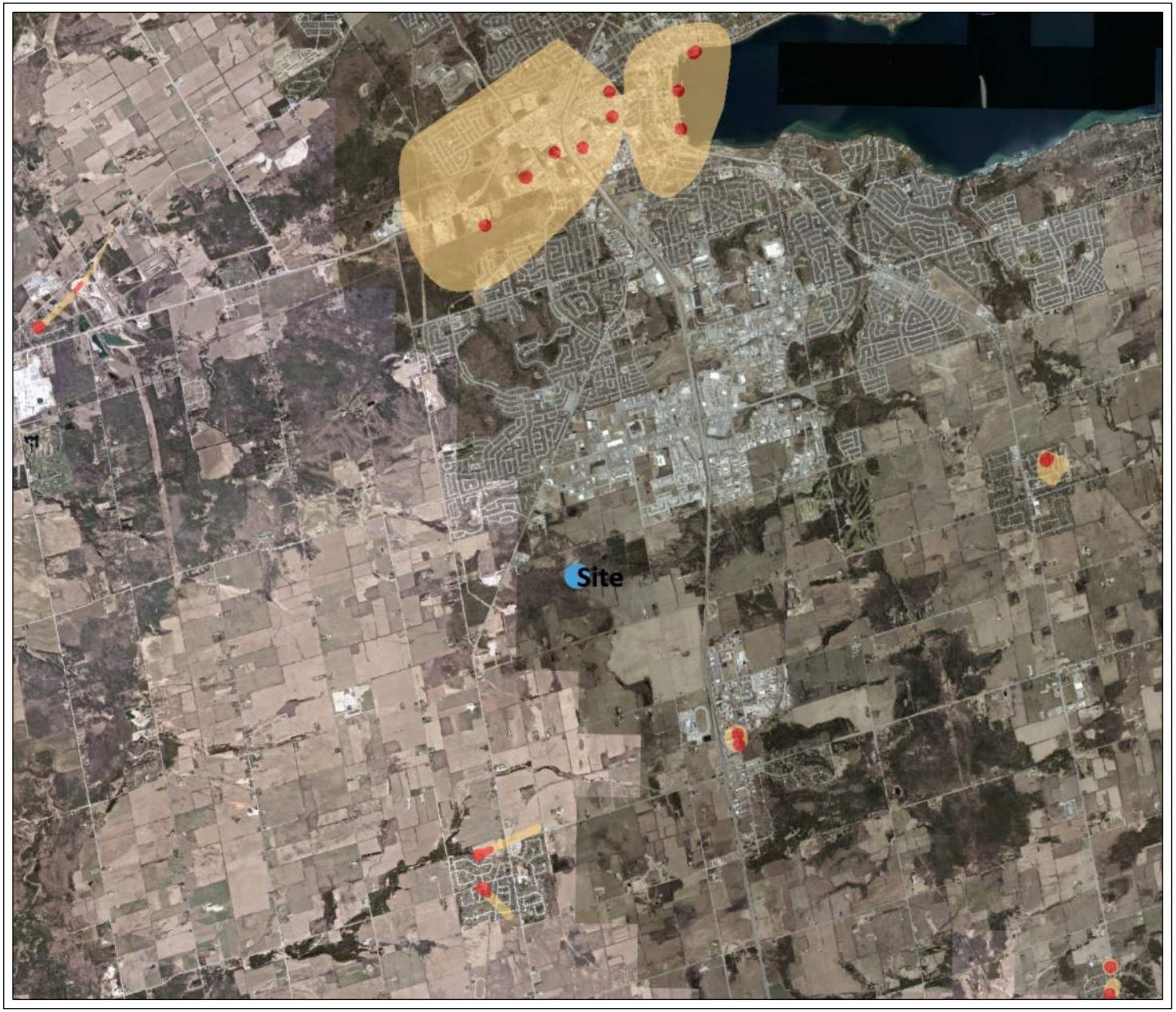
Scale 1: 24,071

Meters

1,223 0 611 1,223

South Georgian Bay Lake Simcoe Source Protection Region

Groundwater Policy Area_Watersand North Phase II, 259 Salem Rd. Barrie, ON



Features

Groundwater Policy Area

- Vul Score (8-10)
- DNAPL

Roads

- Hwy 400 Series
- Highway, Arterials
- Local Road

Printed On:
6/3/2022

WGS_1984_Web_Mercator_Auxiliary_Sphere

Mapped By:

Scale 1: 96,285

Meters

4,891 0 2,446 4,891

Appendix J – Post-Development Estimated Areas (Schaeffers)

SCHAEFFERS
CONSULTING ENGINEERS

Watersand Phase 2 North Parcel
Post-Development Drainage Area & Runoff Coefficient Based on the Higher of Calculated, Conservation Authority, and City's Criteria

SUBJECT SITE CONDITIONS

For Total Site
Composite Runoff Coefficient

Area Reference	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential Lot Area	15.34	0.65	0.64	9.97	9.86	0.45	6.90
Residential Townhouse Lot Area	1.60	0.75	0.79	1.20	1.26	0.45	0.72
Mixed Used	3.01	0.79	0.84	2.36	2.52	0.00	0.00
ROW 18m	6.84	0.70	0.72	4.81	4.92	0.72	4.92
Park	1.40	0.35	0.21	0.49	0.30	0.21	0.30
Open Area	0.41	0.25	0.07	0.10	0.03	0.07	0.03
Pond E1	1.34	0.55	0.50	0.74	0.67	0.50	0.67
Total Area	**29.93**	**0.66**	**0.65**	**19.67**	**19.55**	**0.45**	**13.54**