

Terraprobe

*Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing*

**PRELIMINARY HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
901 ESSA ROAD AND BROWN BEAR STREET
BARRIE, ONTARIO**

Prepared for: **Brown Bear Dev Ltd**
200 Consumers Rd. #212
Toronto, ON M2J 4R4

Attention: Mr. Mohammed Raja

File No. 3-22-0008-46

Issued: April 7, 2022

© Terraprobe Inc.

Terraprobe Inc.

Greater Toronto

11 Indell Lane
Brampton, Ontario L6T 3Y3
(905) 796-2650 Fax: 796-2250

Hamilton – Niagara

903 Barton Street, Unit 22
Stoney Creek, Ontario L8E
(905) 643-7560 Fax: 643-7559

Central Ontario

220 Bayview Drive, Unit 25
Barrie, Ontario L4N 4Y8
(705) 739-8355 Fax: 739-8369

Northern Ontario

1012 Kelly Lake Rd., Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax: 670-0558

www.terraprobe.ca

TABLE OF CONTENTS

SECTION	PAGE (S)
1.0 INTRODUCTION.....	1
2.0 SCOPE OF WORK	2
3.0 APPLICABLE REGULATIONS AND POLICIES	3
3.1 NOTTAWASAGA VALLEY CONSERVATION AUTHORITY (NVCA) POLICIES AND REGULATIONS (O. REG. 172/06).....	3
3.2 CLEAN WATER ACT 2006	3
3.3 PERMIT TO TAKE WATER (PTTW) SECTION 34 OF THE ONTARIO WATER RESOURCE ACT ...	4
3.4 HYDROGEOLOGICAL ASSESSMENT SUBMISSION GUIDELINES 2013	4
4.0 DESCRIPTION OF SITE CONDITIONS	5
4.1 SITE LOCATION AND DESCRIPTION	5
4.2 REGIONAL GEOLOGY AND PHYSIOGRAPHY	5
4.3 REGIONAL HYDROGEOLOGY	6
4.4 WATERSHED SETTING	6
4.5 LOCAL SURFACE WATER AND NATURAL HERITAGE FEATURES	6
4.6 LOCAL GROUND WATER RESOURCES	8
4.6.1 Barrie Well Supply	8
4.6.2 Results of Door-to-Door Survey	9
5.0 RESULTS OF SUBSURFACE INVESTIGATION	10
5.1 LOCAL SITE SETTING	10
5.1.1 Surficial Topsoil/ Earth Fill Material	10
5.1.2 Native Soils	11
5.2 MONITORING WELL INSTALLATION.....	11
5.3 GROUNDWATER MONITORING	12
5.4 ESTIMATION OF HYDRAULIC CONDUCTIVITY	12
5.4.1 Estimation from Grain Size Distribution	12
5.4.2 Estimation from In-situ Hydraulic Testing	13
5.4.3 Estimation from Literature	14
5.5 GROUNDWATER QUALITY	14
6.0 DISCUSSION AND ANALYSIS	15
6.1 WATER BALANCE ASSESSMENT	15



6.1.1	Water Balance Methodology.....	15
6.1.2	Water Balance Analysis:	16
6.2	GROUNDWATER CONTROL AND DEWATERING REQUIREMENTS	18
6.2.1	Construction Requirements and Methodology.....	18
6.2.2	Groundwater Extraction and Discharge Requirements	19
6.2.3	Permitting Requirements.....	21
6.2.4	Zone of Influence (ZOI).....	22
7.0	IMPACT ASSESSMENT	23
7.1	DISCHARGE OF PUMPED GROUNDWATER	23
7.2	IMPACTS TO NATURAL ENVIRONMENT	23
7.3	LOCAL WELLS AND ZONE OF INFLUENCE	23
7.4	GROUNDWATER QUALITY AND CONTAMINATION SOURCES	23
7.5	ANTHROPOGENIC TRANSPORT PATHWAYS.....	24
7.6	SETTLEMENT CONSIDERATIONS.....	24
8.0	MITIGATION MEASURES.....	25
8.1	MAINTENANCE OF GROUNDWATER RECHARGE	25
8.2	DEWATERING MONITORING, MITIGATION AND CONTINGENCY MEASURES	26
9.0	CLOSURE	27
	LIMITATIONS	29

FIGURES:

Figure 1 – Site Location Plan
Figure 2 – Borehole and Monitoring Well Location Plan
Figure 3 – Surficial Geology Map
Figure 4 – Physiography Map
Figure 5 – Topography Map
Figure 6 – Natural Heritage Feature Map
Figure 7 – MECP Water Well Records Map
Figure 8 – Groundwater Flow Direction
Figure 9 – Subsurface Profile

APPENDICES:

Appendix A Regulatory and Hydrogeological Mapping
Appendix B MECP Well Records
Appendix C Borehole Logs
Appendix D Grain Size Analysis
Appendix E Aquifer Response Tests
Appendix F Laboratory Certificates of Analysis
Appendix G Water Balance Analysis
Appendix H Dewatering Analysis



1.0 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by Brown Bear Dev Ltd. to conduct a preliminary hydrogeological study for Property located on the northwest corner of the intersection of Essa Road and Salem Road in Barrie, Ontario. The western portion of the site is known as ‘Block 281,’ and the eastern portion of the site has the current municipal address of 901 Essa Road, Barrie, Ontario. The general location of the Site is shown on **Figure 1**.

The western portion of the Property, ‘Block 281’ is roughly rectangular in shape with an area of approximately 0.35 hectares (0.87 acres), and is currently used as a construction staging area for the neighboring subdivision. The eastern portion of Property (901 Essa Road) covers an area of approximately 0.79 hectares (1.96 acres) and currently consists of a two-storey residential building, a single-storey workshop/structure, and gravel parking areas. Following the re-design and reconfiguration of Essa Road, the total remaining developable land of 901 Essa Road Property will be reduced to approximately 0.88 hectares (2.18 acres).

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated January 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three (3) levels of underground parking. It is understood that the proposed development will be fully serviced with municipal water and sewage.

The purpose of this report is to assess local and regional hydrogeological conditions and the potential impacts of the proposed development on the groundwater system and to provide information regarding the requirements for groundwater control for the development.

The report addresses the following areas:

- Identifying the geological and hydrogeological setting of the Site;
- Confirming shallow groundwater level and shallow groundwater flow direction beneath the Site;
- Calculations of water balance for existing (pre-development) and post-development conditions and assessment of infiltration rates to establish the requirements for maintaining groundwater recharge at the property;
- Assessing groundwater quality against applicable sewer discharge guidelines;
- Evaluate potential short-term construction dewatering needs for the Site;
- Identifying potential impacts to the nearby groundwater receptors, including water supply wells and natural heritage features pertaining to the Site;
- Providing mitigation plan on the potential impacts to the groundwater receptors associated to the Site; and,
- Providing recommendations on any needs for applying for Permit to Take Water (PTTW) or posting Environmental Activity and Sector Registry (EASR) with the Ministry of the Environment, Conservation and Parks (MECP).



2.0 SCOPE OF WORK

The scope of work for the study consisted of the following:

- **Review of available background information:** Available background information for the Site and the project was reviewed. This included the results of geotechnical investigations of the Property and available information regarding the proposed design and construction concepts for the development. In addition, information from public sources, including geologic mapping and MECP well record.
- **Borehole Drilling:** The field investigation was conducted on February 7, 8, 9 and 14, 2022, and consisted of drilling and sampling a total of five (5) exploratory boreholes (BH1 to BH5), extending to depths ranging from about 15.4 to 15.5 m below existing ground surface. The ground surface elevations at the borehole locations were surveyed by Terraprobe. Borehole elevations are provided relative to Geodetic Datum (NAD). The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T).
- **Well Installation:** To measure the groundwater level and investigate the quality of groundwater, all four (4) boreholes (BH1 to BH4) were instrumented with monitoring well as a part of the current investigation. Upon installation, an elevation survey of the monitoring wells relative to a local datum was completed so that relative groundwater flow direction can be assessed.
- **Groundwater sampling and analysis:** Groundwater quality was assessed in comparison with the City of Barrie Sewer Use By-Law limits to evaluate the potential discharge options.
- **Completion of hydraulic conductivity testing:** Groundwater levels within the monitoring wells installed by Terraprobe were monitored to confirm groundwater levels beneath the Site. Hydraulic conductivity testing was conducted within selected three (3) installed monitoring wells (BH1 to BH3) to confirm the hydraulic conductivity of the sub-soil profile within the screened intervals.
- **Dewatering Assessment:** Evaluated potential short-term construction dewatering and long-term foundation drainage needs for the Site utilizing the finite element model SLIDE.2017
- **Analysis of potential impacts of groundwater control:** Analysis was conducted to assess the potential impacts of groundwater control on local structures, water wells, and surface water features.
- **Water Balance Assessment:** Calculations of water balance for existing (pre-development) and post-development conditions and assessment of infiltration rates to establish the requirements for maintaining groundwater recharge at the property.

The above scope of work was prepared in accordance with all of the following: Ontario Water Resources Act, and Ontario Regulation 387/04.



3.0 APPLICABLE REGULATIONS AND POLICIES

3.1 Nottawasaga Valley Conservation Authority (NVCA) Policies and Regulations (O. Reg. 172/06)

Under Section 28 of the Conservation Authorities Act, local conservation authorities are mandated to protect the health and integrity of the regional greenspace system and to maintain or improve the hydrological and ecological functions performed by valley and stream corridors. The NVCA, through its regulatory mandate, is responsible for issuing permits under Ontario Regulation (**Ont. Reg. 172/06**), *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* for development proposal or Site alteration work to shorelines and watercourses within the regulated areas.

NVCA Regulated Area online mapping was reviewed. It is our understanding that the Site is not located within an NVCA Regulated Area. As such, it is **not** anticipated that a permit from the NVCA under Ont. Reg. 172/06 will be required for the proposed development.

3.2 Clean Water Act 2006

The NVCA watershed is within the South Georgian Bay Lake Simcoe Source Protection Region. The South Georgian Bay Lake Simcoe Source Protection Plan was established under the Clean Water Act, 2006, approved on January 26, 2015, and requires, among other things, that the municipal Official Plans be brought into conformity with the Source Protection Plan policies in accordance with Section 26 of the Planning Act. Focusing exclusively on municipal drinking water supply, a component of the provincially approved Source Protection Plan is the delineation of key groundwater related vulnerable areas: including Wellhead Protection Areas (WHPAs), Highly Vulnerable Aquifers (HVAs), And Significant Groundwater Recharge Areas (SGRAs). The objectives of source water protection are to identify areas where municipal drinking water sources may be at risk from quantity or quality threats, to assess the level of risk, and to put in place measures to eliminate or manage the threat.

Based on the review of MECP's Source Protection Information Atlas and Nottawasaga Valley Conservation Authority (NVCA) interactive mapping following information was obtained related to the subject property:

Associated Policy Area	Applicability
Conservation Authority	Nottawasaga Valley Conservation Authority
Source Protection Area	Nottawasaga Valley Source Protection Area
Watershed	Nottawasaga Valley Watershed
Subwater Shed	Bear Creeks – Middle Nottawasaga River Subwatershed
MECP District	City of Barrie
NVCA Regulated Area	No
Wellhead Protection Area (WHPA)	No
Significant Groundwater Recharge Area (SGRA).	Yes; Score: 6



Associated Policy Area	Applicability
Highly Vulnerable Aquifer (HVA)	Yes
Wellhead Protection Areas (WHPA - Q) or Recharge Management Area	WHPA Q2: Yes, Stress: Low
Intake Protection Zone (IPZ)	No
Intake Protection Zone Q (IPZ-Q)	No
Oak Ridges Moraine (ORM)	No
Niagara Escarpment Plan Area	No
Greenbelt Protection Act Area	No

Refer to **Appendix A** for associated regulatory mapping details.

3.3 Permit to Take Water (PTTW) Section 34 of the Ontario Water Resource Act

MECP website was reviewed for any active PTTW application records within a 1.0 km radius of the Site on March 23, 2022. Record review indicates that there is no active PTTW within 1.0 km from the Site.

3.4 Hydrogeological Assessment Submission Guidelines 2013

The Conservation Authority Guidelines for Development Applications (June 2013) was reviewed as a part of this assessment. This guidance document provides a list of recommended requirements for hydrogeological investigations. Nottawasaga Valley Conservation Authority (NVRCA) has adopted these guidelines for hydrogeological assessments. The methodology adopted for conducting this hydrogeological assessment is based on the Conservation Authority Guidelines.



4.0 DESCRIPTION OF SITE CONDITIONS

4.1 Site Location and Description

The Property is located on the northwest corner of the intersection of Essa Road and Salem Road in Barrie, Ontario. The western portion of the site is known as 'Block 281,' and the eastern portion of the site has the current municipal address of 901 Essa Road, Barrie, Ontario. The general location of the Site is shown on **Figure 1**.

The western portion of the Property, 'Block 281' is roughly rectangular in shape with an area of approximately 0.35 hectares (0.87 acres), and is currently used as a construction staging area for the neighboring subdivision. The eastern portion of Property (901 Essa Road) covers an area of approximately 0.79 hectares (1.96 acres) and currently consists of a two-storey residential building, a single-storey workshop/structure, and gravel parking areas. Following the re-design and reconfiguration of Essa Road, the total remaining developable land of 901 Essa Road Property will be reduced to approximately 0.88 hectares (2.18 acres).

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three levels of underground parking. It is understood that the proposed development will be fully serviced with municipal water and sewage.

Based on the advanced boreholes, the Site elevation varies from approximately $311.8 \pm$ masl to $312.6 \pm$ masl (meters above sea level) towards the west. Furthermore, based on the review of Oak Ridges Moraine Groundwater Program (OGRMP), it indicated that the Site lies on a topographic ridge between two Bear Creek headwater tributaries, and slopes northwest, north and northeast towards Bear Creek tributaries, located approximately 500 m northwest and 550 m north of the Property, which ultimately drains into Nottawasaga Bay located approximately 33 km northwest of the Property. **Figure 5** further indicates the topography of the Site. Regional groundwater flow direction is expected northwest and north towards Bear Creek tributary following local topography.

4.2 Regional Geology and Physiography

Based on published geological information for the area, the Site is located within the physiographic region known as the Peterborough Drumlin Field (31). The drumlins are composed of sand, gravel, and boulder till and are separated by low-lying wetland areas composed of fine-grained soils. (Chapman and Putnam 1984). Based on the Ontario Geological Survey (OGS) mapping, the surficial geology at the Site consists of Ice-contact stratified deposits of sand and gravel, minor silt, clay and till (6). **Figure 3** illustrates the mapped surficial geology for the Site and the surrounding area. **Figure 4** shows the location of the Site within the regional physiography map.

Bedrock was not contacted over the current subsurface investigation. However, the review of the Oak Ridges Moraine Groundwater Program (ORMGP) database indicates the underlying bedrock at the Site is Lindsay formation (fine- to coarse-grained, fossiliferous, commonly nodular, argillaceous limestone; upper member (Collingwood) is black, organic-rich, fissile, very fine-grained limestone). Based on the

review of the Oak Ridges Moraine Groundwater Program (OGRMP) cross-section tool, bedrock lies at an elevation of approximately 117 masl, and depth to bedrock at the Site is approximately 194 m below ground surface.

4.3 Regional Hydrogeology

The geology of an area determines the distribution and movement of groundwater (i.e., hydrogeology). Hydrostratigraphy refers to the spatial mapping of geological units based on their water-bearing properties (e.g., aquifers and aquitards). Due to the variety and spatial heterogeneity of the unconsolidated geological deposits within the NVCA watershed, the Hydrostratigraphy of the region is complex. The NVCA watershed is characterized by a series of four regional aquifers, denoted as A1 (Oak Ridges Moraine equivalent), A2 (Thorncliffe Formation equivalent), A3 and A4. Each of the regional aquifers are separated by an aquitard unit or confining bed which is a much less permeable geologic unit in comparison to an aquifer. Broadly, the regional groundwater flow paths correspond to the local surface drainage and flow towards the Nottawasaga River and its tributaries, or to Georgian Bay (NVCA Integrated Watershed Management Plan -2018)

4.4 Watershed Setting

Based on NVRCA Sub watershed mapping, the Property is located within the Bear Creek Sub-watershed of the Middle Nottawasaga River Watershed. All of the lands within the Nottawasaga Valley watershed ultimately drain into Nottawasaga Bay via one of the tributary rivers. The Bear Creek sub-watershed is one of the 3 sub-watersheds that make up the Middle Nottawasaga River watershed. Middle Nottawasaga River has a total combined length of 464.2 km (includes all branches) or about 8% of the total combined watercourse length of the entire Nottawasaga Valley watershed. With headwaters located in the eastern and southern part of the sub-watershed (south of Essa Road), it flows in a north/ northwesterly direction until draining into Nottawasaga Bay. The NVCA land uses are split between agriculture (approximately 47%), natural heritage (35% of the total area), and urban and built-up areas represents less than 5% of the NVCA watershed area; only 40% of urban lands are classified as 'impervious' (NVCA Integrated Watershed Management Plan -2018)

4.5 Local Surface Water and Natural Heritage Features

Mapping from the Ontario Ministry of Natural Resources and Forestry (MNR) was to determine if water bodies, wetland and woodland features were present on the Property and within the Study Area. The Ontario Ministry of Natural Resources National Heritage Information Centre database for listings of Areas of Natural or Scientific Interest (ANSIs) was reviewed. The natural heritage map is presented in **Figure 6**. The information is summarized below.



Water Bodies	Property	No water bodies were identified on the Property
	Study Area	The nearest surface water feature is Bear Creek tributary, located approximately 500 m northwest of the Property which ultimately drains into Nottawasaga Bay, located approximately 33 km northwest of the Property
Wetlands	Property	<u>Provincially Significant</u> - No Provincially Significant wetlands are present on the Property <u>Non- Provincially Significant</u> - No Non- Provincially Significant wetlands are present on the Property. <u>Unevaluated</u> - No Unevaluated wetlands are present on the Property.
	Study Area	<u>Provincially Significant</u> - The closest Provincially Significant Evaluated Wetland is present approximately 2.3 km east from the Property <u>Non- Provincially Significant</u> - The closest Non-Provincially Significant Evaluated Wetland is present approximately 1.5 km southwest from the Property <u>Unevaluated</u> - Unevaluated wetland is present within the Study Area, approximately 215 m southeast from the Property
Woodlands	Property	Woodland areas are identified on the western portion of the Property.
	Study Area	The closest woodland areas were identified in the adjacent to the northern boundary of the Property.
ANSIs	Property	<u>Provincially Significant Life Science ANSI</u> - No Life Science ANSIs were identified on the Property. <u>Provincially Significant Earth Science ANSI</u> - No Earth Science ANSIs were identified on the Property.
	Study Area	<u>Provincially Significant Life Science ANSI</u> - No Life Science ANSIs were identified in the Study Area. <u>Provincially Significant Earth Science ANSI</u> - No Earth Science ANSIs were identified in the Study Area.

Furthermore, as indicated earlier, the Property is not located within the Niagara Escarpment Plan Area, the Oak Ridges Moraine Plan Area and the Greenbelt Protection Act area



4.6 Local Ground Water Resources

MECP well record database was reviewed for well records located within a radius of 500 m from the approximate Site boundary. The locations of the well records in the Study Area are presented on **Figure 7**, with the details for each well summarized in **Appendix B**. A total of 38 wells were located within the 500 m radius. A summary of data obtained from record review is presented in Table below:

Number of the Well Records	38
Water Use (Final Status)	
Observation-Monitoring and Test holes	9 (24 %)
Abandoned-Other	10 (26 %)
Water Supply - Industrial	1 (3 %)
Water Supply - Domestic	15 (39 %)
Unknown/Other Status	3 (8 %)

The above summary indicates that 26 % of the wells in the study areas are registered as water supply wells completed in the year 1964 to 2005, with depths ranging from 6.0 mbgs to 50.9 mbgs. Moreover, no municipal water supply wells were found within 500 m radius of the Site.

4.6.1 Barrie Well Supply

Based on the review of *Lakes Simcoe and Couchiching-Black River SPA Part 1 2014 Updated Assessment Report, Chapter 8, City of Barrie*, it is indicated that the aquifers underlying the City of Barrie are part of a regionally extensive and complex aquifer system, within which four major sand and gravel aquifer units have been identified. Locally, these are referred to as the upper (Aquifer A1), intermediate (Aquifer A2) and lower (Aquifer A3 and A4) aquifers.

Aquifer A1 is largely unconfined under all of the central and most other parts of the City and is therefore susceptible to contamination from surface activities. The portions of the upper aquifer identified in the Oro-Medonte and upland areas immediately west of the City correspond to the regional Aquifer A1, which is mapped as ice contact stratified drift. Aquifer A2 is regionally extensive. The aquifer is complex within the central core area of Barrie, where it consists of inter-layered sand and silt/clay materials. The aquifer is overlain by 5 to 20 or more metres of confining materials in most areas, reported to consist of clayey and silty sediments. The lower aquifers, A3 and A4, are extensive sand and gravel aquifers, which form the source of the majority of Barrie's groundwater supply. These aquifers are in direct contact with one another under the central Barrie area, as well as further to the west. Based on the base elevation of the Kempenfelt Bay and the known elevation of the upper surface of Aquifer A3, it is interpreted that the aquifer is in contact with Kempenfelt Bay in areas to the east. Wells 3A, 5, and 12 are all constructed in the deeper Aquifer A4. Wells 7, 9, 11, 13, 14, 15, 17, and 18 are located approximately in the center of the combined A3/A4 aquifer, whereas the remaining wells (Wells 4 and 16) are located in the upper part of the Aquifer 3.



4.6.2 Results of Door-to-Door Survey

The private well survey requires to contact residents within the study area to collect information and water samples from private wells to assess groundwater uses in the area. Due to the current COVID-19 restrictions that have been imposed by the provincial government, and to ensure health and safety, the private well survey has been placed on hold.



5.0 RESULTS OF SUBSURFACE INVESTIGATION

The field investigation was conducted on February 7, 8, 9 and 14, 2022, and consisted of drilling and sampling a total of five (5) exploratory boreholes (BH1 to BH5) extending to depths ranging from about 15.4 to 15.5 m below existing ground surface. The borings were drilled by a specialist drilling contractor using a track/truck-mounted drill rig power auger and mud rotary drilling techniques and sampled at regular intervals with conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586).

The fieldwork (drilling, sampling, and testing) was observed full time and recorded by a Terraprobe field staff, who logged the boring and examined the samples as they were obtained. To measure the groundwater level and investigate the quality of groundwater, all four (4) boreholes (BH1 to BH4) were instrumented with monitoring well as a part of the current investigation. The monitoring well consisted of a 50 mm diameter PVC screen with a length of PVC riser pipe, 10-ft slotted screen. Upon installation, an elevation survey of the monitoring wells relative to a local datum was completed so that relative groundwater flow direction can be assessed.

The borehole and monitoring well locations are outlined on **Figure 2**. The soil samples were observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained. All samples obtained during the investigation were sealed into plastic jars and transported to our testing laboratory for detailed inspection and testing.

5.1 Local Site Setting

Based on the review of the geotechnical report **File No. 3-22-0008-01**; the subsurface soil stratigraphy is indicated below. The following stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on selected representative soil samples. The stratigraphic boundaries indicated on the Borehole Logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another. These boundaries should not be interpreted to represent exact planes of geological change. The subsurface conditions have been confirmed in a series of widely spaced boreholes and will vary between and beyond the borehole locations.

5.1.1 Surficial Topsoil/ Earth Fill Material

Surficial topsoil with thickness ranging from about 600 mm was encountered at the ground surface in BH 3, 4 and 5. Underlying the surficial topsoil at borehole BH1 and BH2, a layer of fill was encountered and extended to a depth of about 1.1 and 1.5 m below grade respectively. The earth fill material consisted of sand with trace to some gravel, trace silt, occasional rock fragments and some organics and brick fragments in the upper levels in borehole BH1.



5.1.2 Native Soils

Undisturbed native soil deposits underlie the topsoil / earth fill deposits, which extended to the full depth of investigation are as follows:

- **Gravelly Sand to Sand:** A layer of gravelly sand to sand was encountered below the earth fill in borehole BH1 and BH2, below surficial topsoil in boreholes BH3 to BH5 and extended to a depth ranging from 7.6 to 10.9 m below grade. Moisture contents of the gravelly sand to sand samples indicated generally moist conditions and becoming wet below 6.1 to 7.6 m depth below grade.
- **Silty Sand Glacial Till:** Silty sand glacial till is the predominant subsurface deposit present in the boreholes and was encountered below the gravelly sand to sand deposit in all boreholes. The silty sand till deposit extended to the depth explored in all boreholes, i.e., depth ranging from 15.4 to 15.5 m below grade. The till contained clayey silt zone at 11 m depth in borehole BH1 and occasional embedded permeable sand zones, and occasional rock fragments (cobbles) were noted in the deposit. Measured moisture contents of silty sand till soil samples indicate a generally moist to locally wet condition.

The detailed stratigraphic conditions are presented on the accompanying borehole logs provided in **Appendix C**. A subsurface profile of the Site is provided in **Figure 9**. Characterization of the various soil types, including grain size analysis, was conducted and is presented in **Appendix D**. Additional information pertaining to soil stratigraphy is discussed in the geotechnical report by Terraprobe under a separate cover (**File No. 3-22-0008-01**).

5.2 Monitoring Well Installation

Monitoring wells were installed in four (4) boreholes (BH1 to BH4) for groundwater monitoring and to investigate groundwater quality. The monitoring wells were constructed using 50-mm diameter PVC riser pipes and screens, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. Filter sand was placed around the well screen to approximately 0.6 m above the top of the screen. The wells were then backfilled with bentonite to approximately 0.3 m below the ground surface. All monitoring wells were surveyed using an R10 Trimble GPS relative to a geodetic datum. The details are provided below:

Well ID	Well Diameter (mm)	Ground Surface Elevation (masl)	Top of Screen		Bottom of Screen		Screened Geological Units (Native)
			Depth (mbgs)	Elev. (masl)	Depth (mbgs)	Elev. (masl)	
BH 1	50	312.1	12.2	299.9	15.2	296.9	Silty Sand (Till)
BH 2	50	312.6	12.2	300.4	15.2	297.4	Silty Sand (Till)
BH 3	50	312.1	12.2	299.9	15.2	296.9	Silty Sand (Till)
BH 4	50	311.8	12.2	299.6	15.2	296.6	Silty Sand (Till)

Note: masl: meters above sea level, mbgs: meters below ground surface



Additional details of the monitoring well installation is presented on the enclosed borehole logs provided in **Appendix C**.

5.3 Groundwater Monitoring

The groundwater elevations were monitored in the installed four (4) monitoring wells (BH1 to BH5). Groundwater measurements were conducted on February 17, 2022 (after the well development-stabilized water levels) as a part of in-situ hydrogeological testing at the Site. The groundwater elevations in the monitoring wells are presented below:

Well ID	Ground Surface Elevation (masl)	February 17, 2022	
		Groundwater Depth (mbgs)	Groundwater Elevation (masl)
BH 1	312.1	7.8	304.3
BH 2	312.6	8.0	304.6
BH 3	312.1	8.3	303.8
BH 4	311.8	8.3	303.5

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the above groundwater level recordings, it is noted that groundwater level varies from $303.5 \pm$ masl to $304.6 \pm$ masl in the lower glacial till deposit across the property. In order to establish shallow groundwater flow elevations and pattern it is recommended to install additional monitoring wells in the upper cohesionless gravelly sand to sand deposit.

Regional and local groundwater flow direction in the overburden appears to be northeast towards Bear Creek tributary and corresponds to the local topography of the Site. The local groundwater flow direction may fluctuate seasonally depending on the magnitude of precipitation and surface runoff, which will affect infiltration of surface water in particular at times such as significant snowmelt and rainfall events. In order to capture the seasonal groundwater fluctuations and flow patterns at the Site, additional groundwater monitoring is required. The groundwater elevations and flow direction are shown in **Figure 8**.

The monitoring wells installed at the Site need to be maintained in accordance with Ontario Water Resources Act, O. Reg. 903/90. When the wells are no longer required for monitoring or sampling, these wells will need to be appropriately decommissioned by a licensed well contractor as outlined in the Regulation.

5.4 Estimation of Hydraulic Conductivity

5.4.1 Estimation from Grain Size Distribution

In order to estimate the hydraulic conductivity (K) from the grain size distribution curves an excel based tool/program HydrogeoSieveXL (Devlin, J.F. 2015) is used that calculates the hydraulic conductivity from grain size distribution curves using 15 different methods. HydrogeoSieveXL was found to calculate K values essentially identical to those reported in the literature, using the published grain-size distribution

curves. This program is developed by J.F Devlin, Department of Geology, University of Kansas (Developed April 29, 2014, most recent update September, 2016). HydrogeoSieveXL presents the completed data table, a grain size distribution curve, an extensive list of grain size characteristics from which effective grain diameters are calculated, a histogram of grain size distribution presented in terms of conventional grain size classes and 15 estimates of K calculated from the formulas. Geometric and arithmetic means of the estimated K values are also calculated. The complete report for each sample is provided in along with the grain size results in **Appendix D**. The results of the estimates are summarized below:

Borehole No./Sample ID	Sampling Depth (mbgs)	Sampling Elevation (masl)	Soil Description (Native)	Estimated Hydraulic Conductivity (m/s) (Geometric Mean)
Borehole 1, Sample 6	4.8	307.3	SAND AND GRAVEL, trace silt	7.2×10^{-5}
Borehole 2, Sample 10	10.8	301.8	SAND, some silt, trace gravel, trace clay	3.0×10^{-6}
Borehole 4, Sample 12	13.8	298.0	SILTY SAND, trace clay, trace gravel	1.6×10^{-7}
Borehole 5, Sample 9	9.3	303.1	SILTY SAND, some gravel, trace clay	1.4×10^{-7}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the grain size distribution analysis, the hydraulic conductivity of the upper cohesionless gravelly sand to sand deposit is estimated in order of 10^{-5} m/s. Moreover, the hydraulic conductivity of the lower silty sand glacial till is estimated in order ranging from 10^{-6} m/s to 10^{-7} m/s.

5.4.2 Estimation from In-situ Hydraulic Testing

The hydraulic conductivity was also determined based on single well response tests (Bail Tests), as per the hydrogeological investigation completed on all selected three (3) monitoring wells (BH1 to BH3). The monitoring wells were developed in advance of the testing event, which involves the purging and removal of groundwater from the monitoring wells to remove remnants of clay, silt and other debris introduced into the monitoring well during construction and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata formation at the well screen depths. The Solinst Dataloggers (pressure transducers) were programmed to record the water levels at one (1) second of the interval throughout the tests. The data from the tests were analyzed using the Bouwer and Rice method (1976) included in the Aquifer Test V.7 software package. The results of the analysis are presented in **Appendix E**. The hydraulic properties of the strata applicable to the Site are as follows:



Monitoring Well ID	Top of Well Screen Elevation (masl)	Bottom of Well Screen Elevation (masl)	Screened Geological Units	Hydraulic Conductivity (m/s)
BH 1	299.9	296.9	Silty Sand (Till)	5.9×10^{-7}
BH 2	300.4	297.4	Silty Sand (Till)	1.4×10^{-6}
BH 3	299.9	296.9	Silty Sand (Till)	4.6×10^{-7}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the single well response tests, the hydraulic conductivity of the native silty sand glacial till is estimated in order ranging from 10^{-6} m/s to 10^{-7} m/s.

5.4.3 Estimation from Literature

According to Freeze and Cherry (1979), the typical hydraulic conductivity of the strata investigated at the site are:

Soil Unit	Estimated Hydraulic Conductivity Range (m/s)
Earth Fill	10^{-6}
Sand and Gravel	$10^{-2} - 10^{-5}$
Silty Sand Glacial Till (Native)	$10^{-6} - 10^{-12}$

Based on the analyses, the hydraulic conductivity calculated from the single well response testing and grain size analyses are consistent with the published values associated with the geological material tested.

5.5 Groundwater Quality

One (1) unfiltered groundwater sample was collected by Terraprobe and analyzed by a Canadian laboratory accredited and licensed by the Standards Council of Canada and or Canadian Association for Laboratory Accreditation. The sample was collected directly from monitoring well BH4 on February 24, 2022. The monitoring well BH4 was developed and purged prior to sample collection. The sample was compared to the following:

- Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172
- Storm Sewer Discharge - The City of Barrie - By-Law No. 2012-172

In summary, the groundwater quality results indicate the following:

- The unfiltered sample **exceeds** the permissible limits for Barrie Sewer Use - Sanitary Sewers Discharge for: Chloride (Guideline Limit: 1500 mg/L, Reported Detection Limit RDL: 1.2 mg/L, Result: **1550 mg/L**); and
- The unfiltered sample **meets** the permissible limits for Barrie Sewer Use - Storm Sewers Discharge for all the parameters analyzed.

The groundwater quality test results, and the certificate of analysis are presented in **Appendix F**.



6.0 DISCUSSION AND ANALYSIS

The impact assessment details that are applicable to the Property are discussed below:

6.1 Water Balance Assessment

The Site is located in the Recharge Management Area - Well Head Protection Area WHPA Q2. WHPA Q2- refers to the area where activities that reduce recharge may be a threat. An evaluation of water balance was completed in order to estimate the potential impacts that may occur due to proposed development in terms of recharge/discharge characteristics. The water balance is the amount of water entering and leaving a control volume during a given time period. The purpose of water balance analysis is to estimate the pre-development and post-development infiltration and run-off. The maintenance of pre-development 'recharge' is a general requirement in the Oak Ridges Moraine Conservation Plan, Nottawasaga Valley Protection Plan and the Provincial Policy Statement that is often captured in municipal Official Plans. The water balance analysis is conducted for the entire site considering it as one catchment and one drainage outlet.

6.1.1 Water Balance Methodology

One of the objectives during development should be to ensure that the overall volume of groundwater recharge is maintained or enhanced. A water balance for the Site was prepared to assess the distribution of rainfall, runoff, and infiltration for pre-development and post-development conditions. Based on the Canadian Climate Normals 1981-2010 Station for Barrie WPCC station (Climate ID: 6110557), the mean annual **precipitation** is considered as 933 mm/yr. The mean annual **actual evapotranspiration** is considered as 517 mm/yr. using Thornthwaite and Matther approach.

The volume of surplus water, i.e. $933 \text{ mm/yr.} - 517 \text{ mm/yr.} = 416 \text{ mm/yr.}$, that infiltrates into the soil was determined by applying an infiltration factor to the surplus volume based on topography, soil type and land cover as per Table 3.1, MOE SWMPD Manual (2003). Based on the Table 3.1 approach, the infiltration factor is estimated as 0.65, considering the topography as rolling topography (0.2), fine sand (0.4) and cover as urban lawn/ shallow rooted crop (0.05). The infiltration factors for the post-development conditions were considered the same as the pre-development conditions. Based on the MOE Manual, the water holding capacity for urban lawns/ shallow rooted crops and fine sand is 50 mm. For the purpose of modeling pre-development conditions within the Site, gravel driveways will be assumed impervious (such as asphalt).

Based on the above information, a conceptual model of groundwater flow and water balance was developed. A water balance was conducted for the post-development conditions for the entire Site, using the proposed land use statistics information and property development plan provided in the Presentation Set dated January 2022, titled Brown Bear Apartment by Chamberlain Architect Services Limited. The post-development water balance accounts for hard-surfaced areas created by buildings and pavements. The post-development conditions will result in a surplus of water available from run-off. The surplus of water available from roof runoff can be used for infiltration into the shallow groundwater system.



The following assumptions were applied for the pre-and post-development water balance:

- No infiltration will occur beneath the hard surface areas, including asphalt/concrete surfaced parking areas and walkways or driveways.
- It is assumed that there will be 10% of evaporation in hard-surface areas/impervious surfaces, and the remaining will contribute to run-off.
- Run-off from parking areas will be directed towards storm sewers and is not included in the infiltration calculations.
- Infiltration rates in open areas of the property (landscaped areas) will occur at rates similar to those for pre-development conditions.
- There will be no infiltration beneath hard-surface areas including, building, pavements, and walkways.

6.1.2 Water Balance Analysis:

Based on the Climate data, annual precipitation of 933 mm/yr., is considered and actual evapotranspiration of 517 mm/yr. There is a water surplus of 416 mm/yr., occurring at the Site that can either infiltrate into the subsurface or go as a run-off. As indicated above, the rate of infiltration was based on the Table 3.1, MOE SWMPD Manual (2003) and is considered as 270 mm/yr. The water balance for pre-development conditions for the entire Site is summarized in the Table below:

Summary of Site Statistics (Pre-development)

Land Use	Area (ha)	Area (m ²)
Building Footprint/Envelope	0.04	448
Hardscape/Impervious	0.19	1,919
Softscape/Pervious (Undeveloped Area)	0.65	6,494
Total	0.89	8,861

Pre- Development Water Balance (Entire Site)

	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Proposed Development	8,861	8,267	3,357	221	1,756	2,933

Development of an area affects the natural water balance of the Site. The most significant difference is the addition of impervious surfaces as a type of surface cover. Impervious surfaces prevent the infiltration of water into the soils. Net effect of the construction of impervious surfaces is that most of the precipitation that falls onto the impervious surfaces becomes surplus water and direct runoff. The natural permeability of the ground surface changes by reducing the currently undeveloped land/ open space and vegetation at the Site and replacing part of these areas with less permeable/ impervious surfaces such as building roofs, roads, and driveways. The development will result in an increased volume of runoff and a reduction in infiltration. Pre-development conditions result in approximately 1,756 m³ of water available for infiltration to the groundwater system, as mentioned in the above table.



Based on the post-development plan, a summary of proposed land use and water balance calculations for the post-development are provided below:

Summary of Site Statistics (Post-development)

Land Use	Area (ha)	Area (m ²)
Building Footprint/Envelope	0.36	3,630
Hardscape/Impervious	0.27	2,725
Softscape/Pervious (Undeveloped Area)	0.25	2,507
Total	0.89	8,861

Post- Development Water Balance without Mitigation (Entire Site)

	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Proposed Development	8,861	8,267	1,296	593	678	5,701

In the post-development, the water balance calculations show that development has the potential to reduce the natural infiltration by 1,078 m³/yr., and to increase the runoff by 2,768 m³/yr. Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a target of 80% of the predevelopment infiltration being maintained in the post-development conditions. Calculations for the Site are indicative of the post-development infiltration being at a level of about 39 % of the pre-development infiltration.

As such, opportunities to capture run-off and provide secondary infiltration in greenspace areas will be required to increase post-development infiltration. This indicates that with the proper storm, water management and mitigation measures are required to maintain the overall infiltration rates at the property.

Infiltration of rooftop runoff and vegetated surfaces may be permitted if current site conditions demonstrate no existing contamination. If roof top runoff water is re-infiltrated through stormwater management features, a total of 2,743 m³/yr. of water could be available for infiltration under post-development conditions (assuming 90% available of the roof run-off captured). The volume of roof run-off available is compared to the difference in infiltration between pre-development and post-development, as noted in the Table below:

Roof runoff Infiltration Deficit and Volume of Available Roof Run-off (Entire Site)

	Potential Post-Development Infiltration Deficit (m ³)	Volume of Roof Run-off Available (m ³)
Proposed Development	1,078	2,743

As noted, the volume of roof runoff exceeds the infiltration deficit. This indicates approximately 39% of the effective roof runoff captured will be required to compensate for the target 80% post-development infiltration deficit. This indicates that, with proper stormwater management and mitigation measures, the overall infiltration rates at the property can be maintained.

The water balance calculations are provided in **Appendix G**.



6.2 Groundwater Control and Dewatering Requirements

6.2.1 Construction Requirements and Methodology

Based on the architectural drawing set (Project Brown Bear Apartments, Salem & Essa Road Barrie, ON) dated January, 2022, prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing houses and construct a new 12-storey mixed residential and commercial use building supported over three (3) levels of underground parking.

Based on the review of the geotechnical investigation report prepared by Terraprobe **File No. 3-22-0008-01**, it is indicated it is understood that the lowest basement level P3 is expected to have a finished floor elevation set at a depth of about $9.95 \pm \text{m}$ (Elev. $302.3 \pm \text{m}$) below the existing grade (based on average ground surface elevation of $312.2 \pm \text{m}$). The spread footing foundations for the lowest level (P3) will likely be set at about 1.0 m below lowest FFE, i.e., Elev. $301.3 \pm \text{m}$ and below the prevailing groundwater table. The conventional spread footings are made to bear on the drained the dense to very dense sands or glacial till below Elev. $302.3 \pm \text{m}$.

All of the foundation excavations will extend below the prevailing groundwater table for P3 basement levels. Foundation excavations will penetrate through upper cohesionless gravelly sand to sand. The gravelly sand to sand deposit will yield free-flowing water when penetrated. The groundwater table must be dewatered to a minimum of 1.2 m below the deepest excavation prior to excavation to preserve the in-situ integrity of the native soils.

Based on the above groundwater level recordings, it is noted that groundwater level varies from $303.5 \pm \text{masl}$ to $304.6 \pm \text{masl}$ in the lower glacial till deposit across the property. In order to establish shallow groundwater flow elevations and pattern it is recommended to install additional monitoring wells in the upper cohesionless gravelly sand to sand deposit. Due to this limited information the design water level is based on the in-situ moisture conditions of the collected samples. Moisture contents of the gravelly sand to sand samples indicated wet conditions at Elev. $306.5 \pm \text{m}$ based on BH2 SS7. Considering one meter of seasonal fluctuation across the site, the design water level elevation is considered at Elev. $307.5 \pm \text{m}$ i.e., 4.75 mbgs as a preliminary estimate. This should be further confirmed by advancing shallow monitoring wells across the Site.

To better control groundwater during construction, a fully continuous interlocking concrete caisson wall socketed into the low-permeability cohesionless till may be considered as one potential approach to shoring the excavation. This shoring approach will provide a fully-continuous temporary groundwater cut-off barrier, which will enable the site to be dewatered during construction without inducing more flow into the excavation. The final shoring system and construction method were unknown at this stage. As such, a permeable shoring and an impermeable shoring (interlocked caisson wall) was assessed based on the current soil conditions and shallow groundwater table.

The continuous interlocking caisson wall shoring system is considered to support the entire excavation perimeter. Caisson toes (piles and fillers) should be advanced deep enough (i.e., **a minimum of 4 m below the bulk excavation**), precluding horizontal groundwater flow in the excavation. The depth of caisson wall toe embedment can be further refined based on vertical exit gradient and seepage considerations for the toe stability during the design detail stage. It is recommended that a professional

dewatering contractor be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to make an assessment of the factual data and to provide recommendations on dewatering system requirements.

If the proposed development is designed water tight structure, then a private water drainage system will not be required. However, the structure must then be designed to resist hydrostatic pressure and uplift forces. If the proposed development is not water tight structure, then a private water drainage system will be required which will consists of sub-slab drainage system or foundation drainage/weeping tile system in conjunction with a perimeter drainage system to avoid wet conditions in the P3 underground level. The permanent drainage system is intended to collect passive groundwater seepage flow from the surrounding soils. For the purpose of dewatering (long term) assessment, the sub drainage system is assumed to be at about 0.5 m below the slab of P3 underground parking.

Note: For further details on the geotechnical design considerations and constructability, please refer to the geotechnical report prepared by Terraprobe under a separate cover (**File No. 3-22-0008-01**)

The Site development details as discussed above are summarized as below:

Proposed Development						
Structure	Above Grade Levels	Below Grade Levels				Design Groundwater Level (masl)
		Level #	Lowest Finished Floor		Approximate Foundation Elevation (masl)*	
			Depth (mbgs)	Elevation (masl)		
Proposed building with 3-level underground parking structure (P3).	12	3	± 9.95	± 302.3	± 301.3	± 307.5

Note: masl: meters above sea level, mbgs: meters below ground surface

*1.0 m below lowest FFE conventional spread footings are made to bear on the drained the dense to very dense sands or glacial till.

6.2.2 Groundwater Extraction and Discharge Requirements

A finite element numerical analysis utilizing computer software (Slide 7.014, developed by Rocscience Inc.) was conducted to assess the water taking requirements (short term and long term) in support of the proposed development. The hydraulic parametrization of the generalized numerical model is based on the grain size analyses, field hydraulic testing and published data that incorporates the permeability of different strata encountered during the investigation. The finite element model results are presented in **Appendix H**. For the purpose of accessing groundwater seepage rates, following considerations were made:

- Bulk Excavation set to 0.5 m below the lowest FFE at Elev. 301.8 ± m;
- Underside of the foundations set to 1.0 m below the lowest FFE at Elev. 301.3 ± m;
- Design water level of Elev. 307.5 ± m to account for the highest observed water table elevation;
- Design dewatering target set 1.2 m below the P3 foundation's underside at Elev. 300.1 ± m
- Impermeable shoring system (interlocking drilled caissons) along the excavation perimeter, with pile tips (caisson shoring wall) minimum of 4 m below the bulk excavation set at



Elev. $297.8 \pm m$. The depth of the caisson wall toe embedment can be further refined based on vertical exit gradient consideration for the toe stability during the design detail stage;

- Short term dewatering assumes caissons hydraulic conductivity of 1×10^{-10} m/s and long term assumes caissons hydraulic conductivity of 1×10^{-8} m/s incorporating the decay of concrete over time;
- Safety factor S.F of 1.5 is applied on the groundwater flow with the inclusion of 27 mm design rainfall event based on of Intensity-duration-frequency (IDF) curves (Ontario Ministry of Transportation) for 2-hour period for a 2-year event;
- Steady State simulation was performed for dewatering assessment; and
- Hydraulic conductivity for earth fill, gravelly sand to sand deposit and silty sand (till) is assigned as 1×10^{-6} m/s, 1×10^{-5} m/s and 1.5×10^{-6} m/s respectively.

The short-term control of ground water should take into account stormwater management from rainfall events. A dewatering system should take into account the removal of rainfall from the excavation. A value of 27 mm rainfall over a 2-hour period for a 2-year event was used to determine the incidental precipitation volumes to the proposed excavations based on the review of Intensity-duration-frequency (IDF) curves (Ontario Ministry of Transportation). Should the shoring system/methodology, construction procedures and foundation recommendations/requirements based on the geotechnical report differ, the groundwater seepage assessment will be revised, and an updated hydrogeological assessment report will be provided. The water taking requirements at the Property are as follows:

Conventional Drained Foundations - Permeable Shoring						
Scenario	Groundwater Seepage S.F. 1.5 Used		27 mm Design Rainfall Event		Total Volume	
	L/day	L/min	L/day	L/min	L/day	L/min
Short Term (Construction)	342,500	237.8	198,500	137.8	541,000	375.7
Long Term (Post Construction)	315,500	219.1	6,000	4.2	321,500	223.3
Conventional Drained Foundations - Impermeable Shoring						
Scenario	Groundwater Seepage S.F. 1.5 Used		27 mm Design Rainfall Event		Total Volume	
	L/day	L/min	L/day	L/min	L/day	L/min
Short Term (Construction)	88,000	61.1	198,500	137.8	286,500	198.96
Long Term (Post Construction)	72,500	50.3	6,000	4.2	78,500	54.5



As required by Ontario Regulation 63/16, a plan for discharge must consider the conveyance of stormwater from a 100-year storm. The additional volume based on the excavation area that will be generated in the occurrence of a 100-year storm event (102.7 mm) is approximately 755,000 L/day (524.3 L/min).

The finite element model results are presented in **Appendix H**.

6.2.3 Permitting Requirements

The Ministry of Environment, Conservation and Parks (MECP) regulates construction water taking over 400,000 L/day to obtain a Category 3 Permit to Take Water (PTTW) prior to any construction dewatering activities. Based on the estimated dewatering volumes of 541,000 L/day, a Category 3 PTTW prior to the dewatering activities for the proposed works will be required if the excavation activities will be completed using permeable shoring. The Ministry of Environment, Conservation and Parks (MECP) regulates construction water taking over 50,000 L/day and less than 400,000 L/day to obtain an Environmental Activity Sector Registry (EASR) Posting the MECP prior to any construction dewatering activities. Based on the estimated dewatering volumes of 286,500 L/day, an Environmental Activity Sector Registry (EASR) Posting from the MECP prior to the dewatering activities for the proposed works will be required if the excavation activities will be completed using impermeable shoring (interlocking caissons). Moreover, a Sewer Discharge Agreement must be obtained to permit discharge into the City's sewers prior to any temporary construction dewatering discharge.

Furthermore, as the estimated dewatering volumes in long term are greater than 50,000 L/day (for permeable and impermeable shoring), a long-term permit to take water PTTW will be required. However, a Sewer Discharge Permit must be obtained to permit discharge into the City's sewers. It will be necessary to confirm the location of the discharge points, and the capacity of the receiving sewer as part of the permit application. The permit will provide conditions for monitoring of flow and analysis of ground water quality. However, if the proposed development is designed water tight structure, then a private water drainage system will not be required. However, the structure must then be designed to resist hydrostatic pressure and uplift forces.

Groundwater taking estimates are based on the assumed construction duration, excavation dimensions, construction sequencing, and methodology, therefore should there be changes in these items, revised groundwater taking volumes will be required. It is contractor's responsibility to determine the type and extent of the dewatering system required. It should be noted that the actual required dewatering effort will depend on several factors, including excavation depth, sequencing, season and weather conditions and the length of time the excavation is left open. It should be noted that the interpretation of the dewatering estimates presented in this report and selection of an appropriate dewatering program is the responsibility of contractor. Installation of roadway protection system and any other shoring considerations is the sole responsibility of the contractor.



6.2.4 Zone of Influence (ZOI)

The Zone of Influence (ZOI) for dewatering, also known as Radius of Influence (R_o) with respect to maximum drawdown required was calculated based on the estimated groundwater taking rate and the hydraulic conductivity of the unit from which the groundwater will be taken at the Property. The ZOI was calculated using the Sichart's equation below:

Equation: $R_o = 3000 * dH * \sqrt{K}$

Where:

dH is the dewatering thickness (m) = Highest Observed Water level (m) - Dewatering Target (m)

K is the hydraulic conductivity (m/s) of water bearing deposit

The ZOI for the proposed building excavation with respect to groundwater at the Property is estimated to be $70 \pm \text{m}$, considering average hydraulic conductivity of 10^{-5} m/s for the native gravelly sand to sand deposit and dewatering thickness dH as $307.5 \text{ m} - 300.1 \text{ m} = 7.4 \text{ m}$

However, if an impermeable shoring system is considered for the proposed excavation and construction, the ZOI will be limited to the excavation box.



7.0 IMPACT ASSESSMENT

7.1 Discharge of Pumped Groundwater

This report provided the estimated quality of the water discharge. However, this report does not speak about the sewer capacities. The sewer capacity analysis will be provided under a separate cover by the civil consultant. The quality of the proposed groundwater discharge is provided in the Section 5.5. As noted in that section, the groundwater sample meets the Limits for City of Barrie Storm Sewer Discharge and exceeds City of Barrie Storm Sanitary Discharge. As such, no additional treatment will be required before the groundwater can be discharged to the Storm Sewer. However, treatment of exceeded parameters is required before the groundwater can be discharged to the Sanitary Sewer. The final design for any dewatering effluent is the responsibility of the retained contractor undertaking construction and a team designing the pre-treatment system.

7.2 Impacts to Natural Environment

There are no provincially significant, evaluated, surface water features and/or unevaluated wetlands within the close proximity of the Site or within the estimated zone of influence. Furthermore, if the excavation works will be advanced using an impermeable shoring system (caisson wall), the zone of influence will be limited to the excavation box. Any groundwater that will be taken from the site will be discharged (if required) into the City's sewer systems and not into any natural water body. As such, there will be no impact to the natural environment caused by the water takings at the Property.

7.3 Local Wells and Zone of Influence

The proposed development will be municipally serviced and there is no proposed on-site groundwater use for the development. Furthermore, based on the well record search no domestic and municipal water supply wells were found within the estimated zone of influence. It is further noted that the excavation and shoring activities will not be constructed within the municipal supply aquifer. During the construction period, the radius of influence will be limited in its lateral extent and will not extend horizontally to the location of the municipal production wellhead. It is unlikely that impacts from the proposed development will affect municipal water taking resources in the study area. However, it is recommended to complete the well survey program prior to the start of the construction to establish the local groundwater use in the study area. If the excavation activities are completed using the permeable shoring, it is recommended to monitor the local domestic wells within the study area during pre-construction, construction and post construction to determine the impact of dewatering on local resources.

7.4 Groundwater Quality and Contamination Sources

The area of the proposed development is located in the Highly Vulnerable Aquifer (HVA). HVAs are those areas where an aquifer may be more prone to contamination. These areas have been identified where there is little or no protection from an overlying aquitard (a protective layer of low permeability materials). The infiltration of rooftop runoff and vegetated surfaces may be permitted if current site conditions demonstrate no existing contamination. Depending on the land use, runoff from urban



developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, bacteria and viruses. For groundwater, generally with the exception of the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater flow through the soils. Under proposed development, the quality of water directed to pervious areas for infiltration is not expected to contain any contaminant of concerns. Considering the nature of the proposed development, it is anticipated that there will not be any contributing contaminants that may affect the background ground water quality in the area.

At the time of preparation of this report, Terraprobe is not aware of any Environmental Site Assessments (ESAs) conducted at the Property.

7.5 Anthropogenic Transport Pathways

Four (4) monitoring wells at depth 15.2 mbgs were installed during the site investigation conducted by Terraprobe to gather information regarding the groundwater quality and elevation at the Property and are not considered to be a risk to the groundwater resource. The monitoring wells installed at the Site need to be maintained in accordance with Ontario Water Resources Act, O. Reg. 903/90. However, the wells will be abandoned when no longer in use for monitoring (i.e., at the time of construction).

Moreover, it is found that three (3) observation wells (Map ID: 20, 21 and 22) completed in the 2018 are located on the Site with depths ranging from 3.1 mbgs to 4.6 mbgs. It is required to maintain or decommission these wells in accordance with O.Reg. 903 and Ministry of the Environment, Conservation and Parks (MECP) standards to ensure the structural integrity of the wells and to prevent them from becoming a transport pathway for any possible contamination.

7.6 Settlement Considerations

The site is bounded by existing municipal roadway Essa Road to the east, Salem Road to the south, Brown Bear Street to the west and a few sparse building structures to the north. No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. It is recommended that a professional geotechnical engineer is contacted in advance of earthwork, and the shoring requirements for the site will have to be examined in detail with respect to the site boundary constraints. The shoring requirements for the site will have to be examined in detail with respect to the proximity of existing structures and site boundary constraints. The site conditions must be carefully assessed by the shoring designer to select appropriate type of shoring system in light of the close proximity of the existing buildings. It is imperative that the shoring system provides adequate support to the existing building foundations.

A settlement monitoring plan should be submitted by contractor detailing the frequency of pre construction / post- construction baseline data collection and daily readings during construction, monitoring on the tracks, monitoring locations, alert and review levels, and reporting process for the issue of survey data including the establishment of stop work process and implementation of remedial measures. For further details on the geotechnical design considerations and constructability, please refer to the geotechnical report by Terraprobe under a separate cover (**File No. 3-22-0008-01**).



8.0 MITIGATION MEASURES

8.1 Maintenance of Groundwater Recharge

The Site is mapped as Significant Groundwater Recharge Area (SGRA). As per the Source Water Protection Technical Rules, SGRAs in the NVCA watershed occur where the estimated average annual groundwater recharge rates are greater than the threshold rate (232 mm/yr.). SGRAs occur predominantly within areas of sand and gravel. Significant groundwater recharge areas are widespread throughout the NVCA watershed, due to the sandy nature of the area (NVCA Integrated Watershed Management Plan - 2018). It is encouraged in areas deemed to be a SGRA that recharge rates are maintained where development or site alternation is proposed.

The existing groundwater recharge rates at the Site are approximated as 270 mm/yr. These recharge rates are based on the property specific conditions. This recharge occurs in a broad diffuse manner over the entire Site. Gravelly sand to sand underlain by silty sand glacial till is the predominant subsurface deposit present in the boreholes and was encountered below the surficial topsoil or earth fill consisting of sand with trace to some gravel, and trace silt deposit in all boreholes. The gravelly sand to sand extended to 7.6 to 10.9 m with permeability estimated in the order of 10^{-5} m/s indicating high permeabilities. This indicates a possible recharge contribution to the shallow groundwater. This should be addressed by maintaining the overall ground water recharge across the Site area. The management of groundwater recharge at the Site following development is recommended where it is feasible and should be designed using a Best Management Practice approach. Runoff from the proposed development will conform to the stormwater management report for the Site.

As per CVC-TRCA (2010), the recommended vertical separation between the base of the given infiltration augmentation option and the high groundwater table is at least one meter; however, distances of less than one meter of separation in soils having higher infiltration potential may still be effective. Based on the available water level recordings, it is noted that groundwater level in the overburden varies from Elev. 303.5 ± masl to 304.6 ± masl in the lower glacial till. In order to establish shallow groundwater flow elevations and pattern it is recommended to install additional monitoring wells in the upper cohesionless gravelly sand to sand deposit. The suitability of using the proper infiltration options should be provided in the Stormwater Management Report/Functional Servicing Report. Final design of the LID measures should be reviewed in conjunction with the storm water management plan for the Site. If low-impact development (LID) techniques are being considered as part of the post-development design, consideration should be given to conducting field percolation tests.

Furthermore, as indicated earlier, the water balance calculations show that development has the potential to reduce the natural infiltration by 1,078 m³/yr. Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a target of 80% of the predevelopment infiltration being maintained in the post-development conditions. Final design of the infiltration measures provided in the FSR report should address these infiltration targets estimated in water balance calculations.

Furthermore, the soils present on the property are of higher permeabilities which would provide potential pathways for groundwater discharge. The future development will also be connected to municipal



servicing through underground utility lines. The future development may disrupt the shallow groundwater flow, and its continuity should be maintained where practical. However, it is recommended that the excavation of the building foundation and any underground services or utilities across the site must be backfilled using material of similar permeabilities.

8.2 Dewatering Monitoring, Mitigation and Contingency Measures

The proposed monitoring during water taking activities is to include the following tasks, methods, and details at a minimum:

1. The daily record should include: the total time (in hours) spent pumping, the quantity and types of pumps used, and the measured flow rates;
2. Daily water taking monitoring shall be performed, including maintenance of a daily record of water taking volumes, rates and durations for each approved water taking source;
3. The daily record shall be maintained in graphical and digital formats and shall be made available for inspection by the MECP, upon request;
4. The flow rates for each pump used should be measured by installing a properly calibrated and functioning flow measuring device on each discharge hose;
5. The quality of groundwater to be removed during the construction activities should be re-assessed before and during construction dewatering activities according to the requirements that would be established under the municipal sewer use discharge agreement to determine if the water may be disposed of directly to the local sanitary sewer without treatment;
6. A log should be maintained of site activities and any significant events which may affect the volume or quality of discharge. This should include the following: description of the general depth and extent of excavation, noting of the duration and intensity of rainfall events, records of discharge durations and volumes, and noting of any unusual activities which may affect the quality or volume of ground water discharge; and
7. A settlement monitoring plan should be submitted by contractor detailing the frequency of pre-construction / post- construction baseline data collection and daily readings during construction, monitoring on the tracks, monitoring locations, alert and review levels, and reporting process for the issue of survey data including the establishment of stop work process and implementation of remedial measures.

If the conditions and/or limitations authorized in the EASR/PTTW are exceeded, contractor is advised to notify a local member (EASR/PTTW coordinator) of the MECP immediately. The following contingency actions are proposed to re-establish compliance with the EASR/PTTW in the event of unforeseen or unacceptable impacts as a result of the proposed water taking:

1. If the daily water taking volumes are found to exceed those authorized in the EASR, it is recommended that the local MECP staff be notified. The water taking volumes should be restricted to maintain compliance with the limits specified in the EASR until measures can be taken to decrease the volumes of water taking. We also recommend that contractor be required



to incorporate a contingency plan as part of the dewatering and groundwater management plan.

2. If groundwater fails to meet the Sewer Discharge Limits, on-Site treatment of groundwater to the Sewer Discharge Limits would be required before discharge. Alternatively, the groundwater may be discharged directly into containment vessels that can be taken off-site to an appropriate waste receiver or treatment.
3. If groundwater dewatering related ground settlements (e.g., unacceptable levels of ground settlements) occur, groundwater dewatering operations should be ceased or reduced. We recommend that contractor be required to incorporate a contingency plan in the settlement plan that details remedial actions to address the geotechnical issues.

9.0 CLOSURE

We trust this report meets with your requirements. Should you have any questions regarding the information presented, please do not hesitate to contact our office.

Yours truly,

Terraprobe Inc.



Muna Mirghani, P.Eng.
Project Manager



Usman Arshad, P.Eng., PMP
Project Manager-Hydrogeology



Samuel Oyedokun, P. Eng., PMP., QP_{ESA}
Associate, Senior Project Manager



REFERENCES

1. Chapman, L.J. and D.F. Putnam, 1984. The Physiography of Southern Ontario. Ontario.
2. Canadian Climate Normals 1981-2010 Station Data - Climate - Environment and Climate Change Canada (weather.gc.ca)
3. Devlin, J.F. 2015. HydrogeoSieveXL: an Excel-based tool to estimate hydraulic conductivity from grain-size analysis. Hydrogeology Journal.
4. Freeze, A. and Cherry, J., 1979. Groundwater, Prentice-Hall Inc., New Jersey.
5. Geological Survey. Ontario Geological Survey (OGS), 2003. Surficial Geology of Southern Ontario.
6. Geological Survey. Ontario Geological Survey (OGS), 2007. Bedrock Geology of Ontario.
7. Ministry of Natural Resources and Forestry, 2019. Natural Heritage Interactive Map.
8. NVCA (2018). Nottawasaga Valley Management Plan, Characterization Report, Nottawasaga Valley Conservation Authority. June 2018
9. Ministry of Environment, June 2003, Stormwater Management Planning and Design Manual.
10. MOEE (1995) Hydrogeological Technical Information Requirements for Land Development Applications, Ministry of Environment and Energy
11. NVCA (2015). South Georgian Bay Lake Simcoe Source Protection Plan, Lake Simcoe Conservation Authority. 2015
12. Oak Ridges Moraine Groundwater Program (ORMGP) mapping
13. Regional Municipality of York (2014), Lakes Simcoe and Couchiching-Black River SPA Part 1 2014 Updated Assessment Report, Chapter 8, City of Barrie
14. Source Water Protection Atlas interactive mapping:
<https://www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/>
15. Terraprobe Inc., (2022) Preliminary Geotechnical Investigation and Engineering Report Proposed Mixed Use Development, 901 Essa Road, and Brown Bear Street, Barrie, Ontario, File No. 3-22-0008-01



LIMITATIONS

This report was prepared by **Terraprobe Inc.**, for the use of **Brown Bear Dev Ltd.**, and is intended to provide an assessment of the hydrogeological condition the property located at **901 Essa Road, Barrie**. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Terraprobe accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, including consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The assessment should not be considered a comprehensive audit that eliminates all risks. The information presented in this report is based on information collected during the completion of the subsurface investigation conducted by Terraprobe Inc. It is based on conditions at the property at the time of the site inspection. The subsurface conditions were assessed based on information collected at specific borehole and monitoring well locations. The actual subsurface conditions between the sampling points may vary.

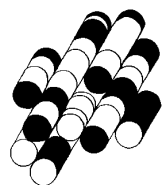
There is no warranty expressed or implied by this report regarding the condition of the property. Professional judgment was exercised in gathering and analyzing information collected by our staff, as well as that submitted by others. The conclusions presented are the product of professional care and competence, and cannot be construed as an absolute guarantee.

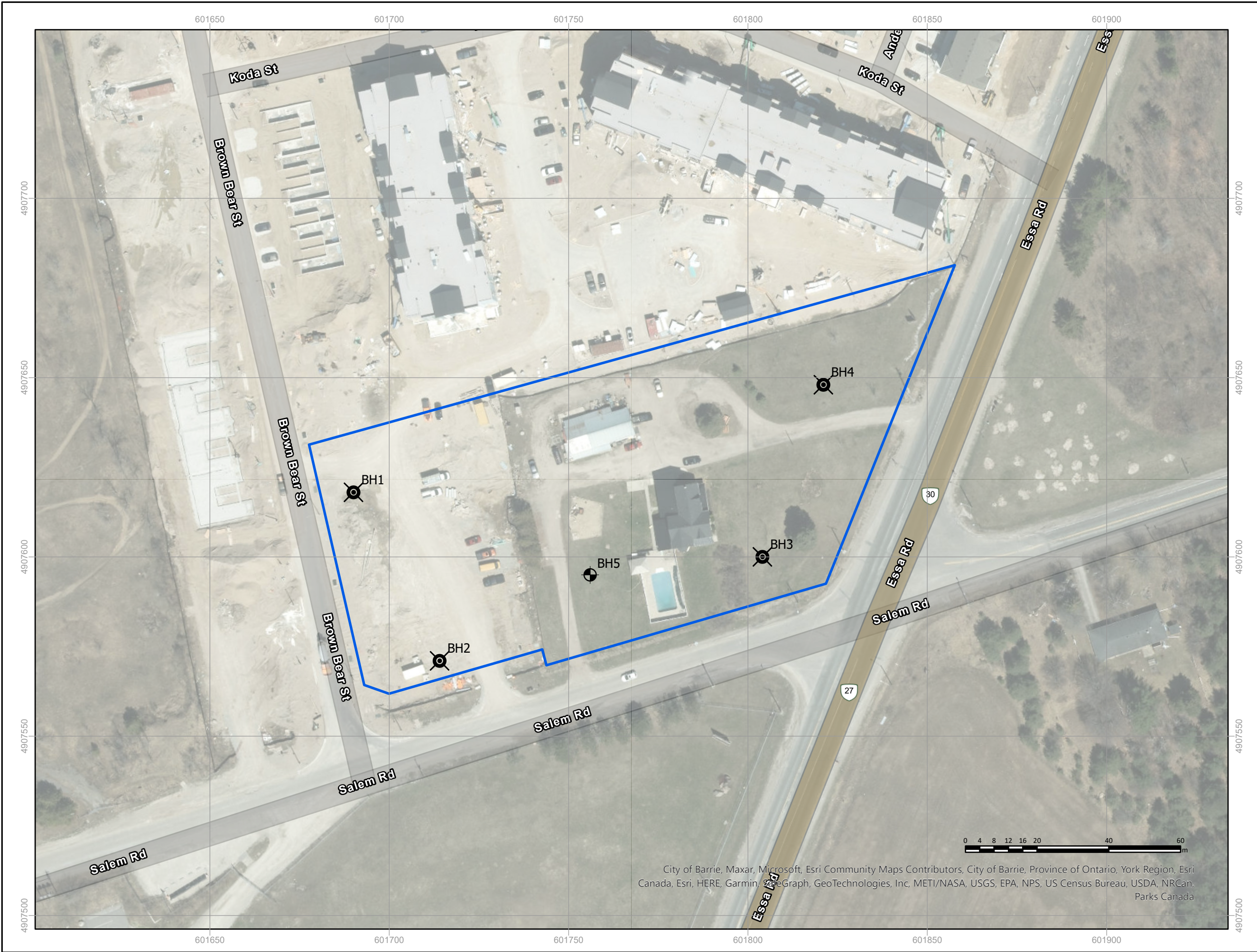
In the event that during future work new information regarding the condition of the property is encountered, or the proposed development is changed from that which was provided to Terraprobe with respect to the property, Terraprobe should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.



FIGURES

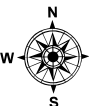
TERRAPROBE INC.







Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing



References:
ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/
Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User
Community, Basemaps

Key Map



City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

-  Approximate Site Boundary
-  Approximate Monitoring Well Location
-  Approximate Borehole Location

Project Title:

Preliminary Hydrogeological Assessment

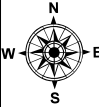
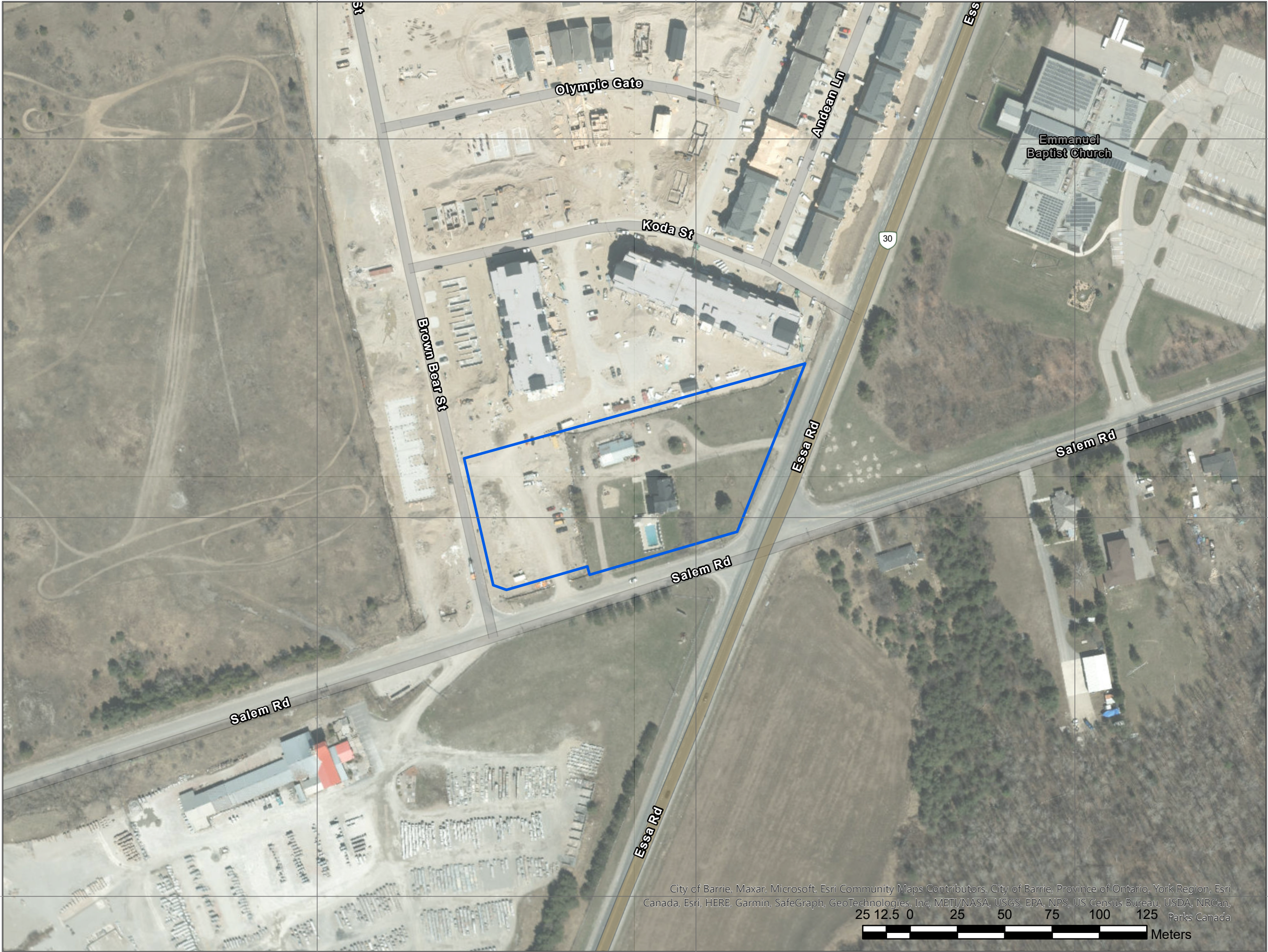
Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

Borehole and Monitoring Well Plan

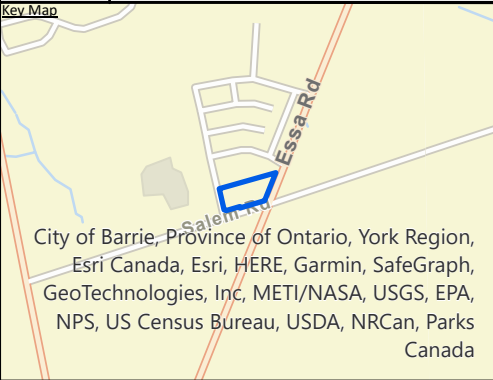
Designed By: MM	File No.: 3-22-0008-46
Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 2
Date: March 2022	



References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Basemaps

Key Map



City of Barrie, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

Notes:

Legend:

Approximate Site Boundary

Project Title:

Preliminary Hydrogeological Assessment

Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

Site Location Plan

Designed By:

MM

File No.:

3-22-0008-46

Drawn By:

SSK

Scale:

As Shown

Reviewed By:

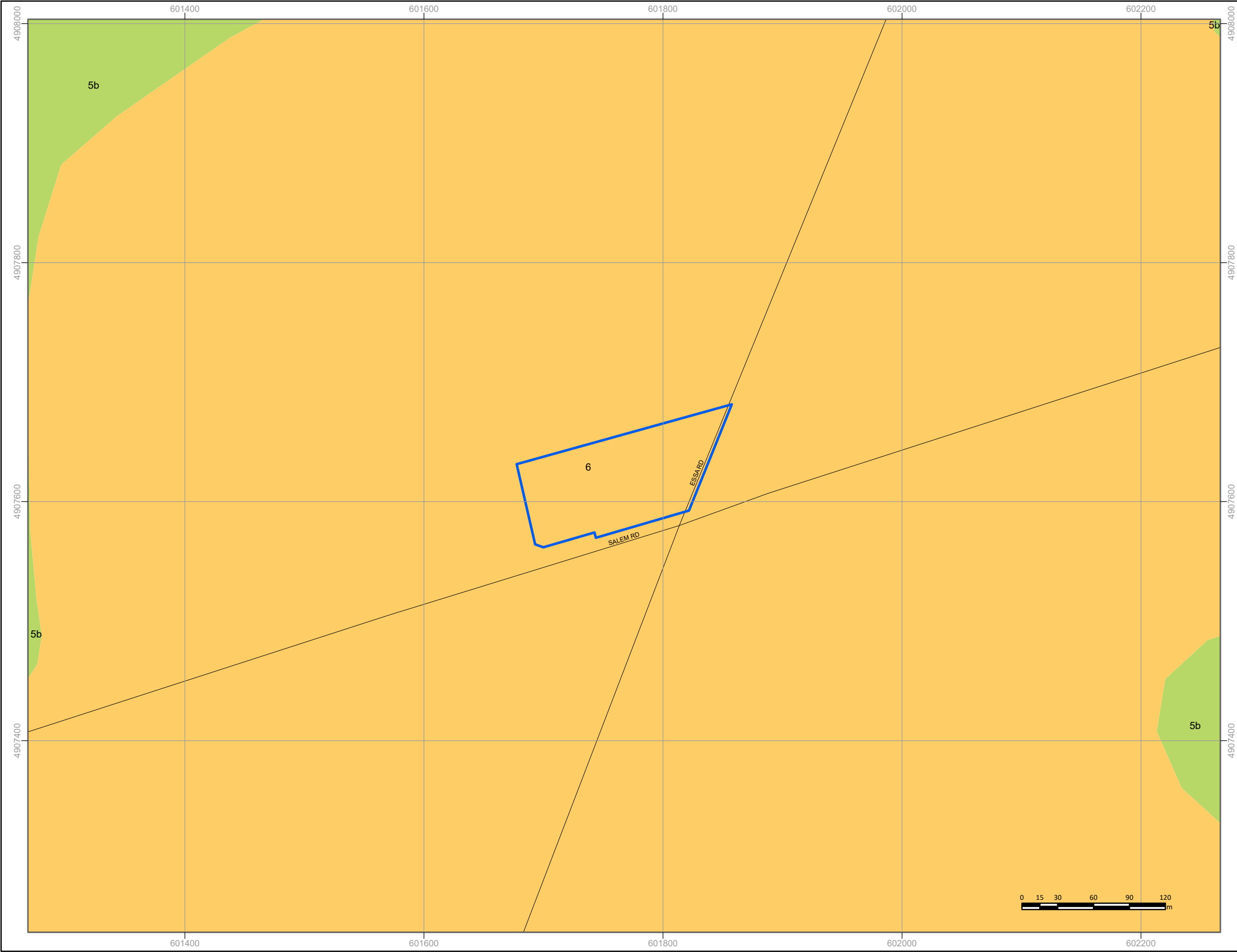
UA

Figure No.:

1

Date:

March 2022





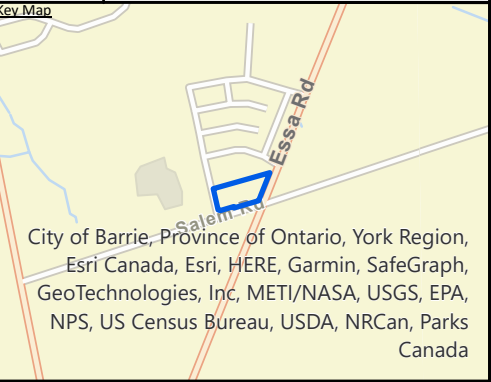
Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing



References:

Service Layer Credits: © Surface Geology Map was Produced by Terraprobe Inc. under license from the Ministry of North Development, Mines and Forestry (MNDMF). Copyright (c) is held by the Queen's Printer for Ontario. Surficial geology of southern Ontario, 2003, Ontario Geological Survey, Miscellaneous Release— Data 128 – Revised.

Key Map



City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

-  Approximate Site Boundary
-  5b: Stone-poor, carbonate-derived silty to sandy till
-  6: Ice-contact stratified deposits
-  Collector

Project Title:

Preliminary Hydrogeological Assessment

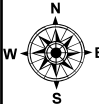
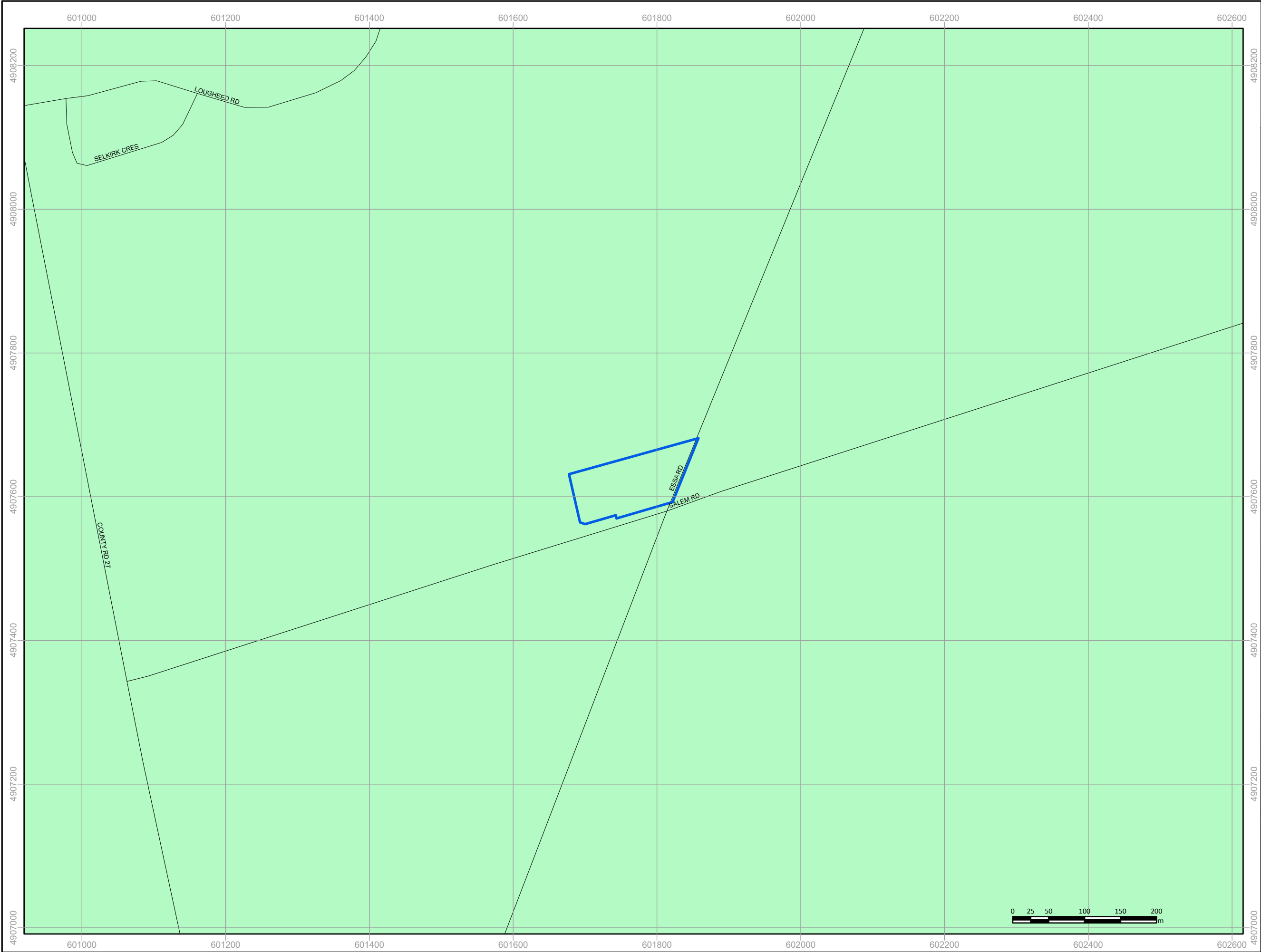
Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

Surficial Geology Map

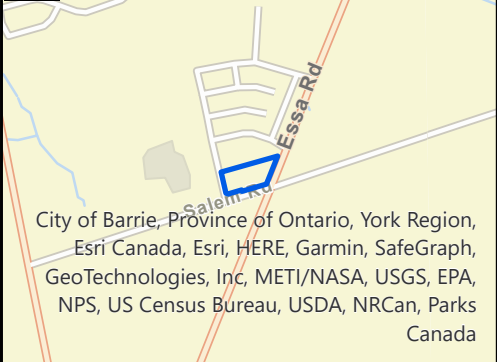
Designed By: MM	File No.: 3-22-0008-46
Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 3
Date: March 2022	



References:

Service Layer Credits: © Physiography Map was Produced by Terraprobe Inc. under license from the Ministry of North Development and Mines (MNDM). Copyright (c) is held by the Queen's Printer for Ontario, Physiography of Southern Ontario Ontario, 2007, Ontario Geological Survey, Miscellaneous Release— Data 228.

Key Map



Notes:

Legend:

- Approximate Site Boundary
- Collector
- Local / Street
- 31, Peterborough Drumlin Field

Project Title:

Preliminary Hydrogeological Assessment

Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

Physiography Map

Designed By:

MM

File No.:

3-22-0008-46

Drawn By:

SSK

Scale:

As Shown

Reviewed By:

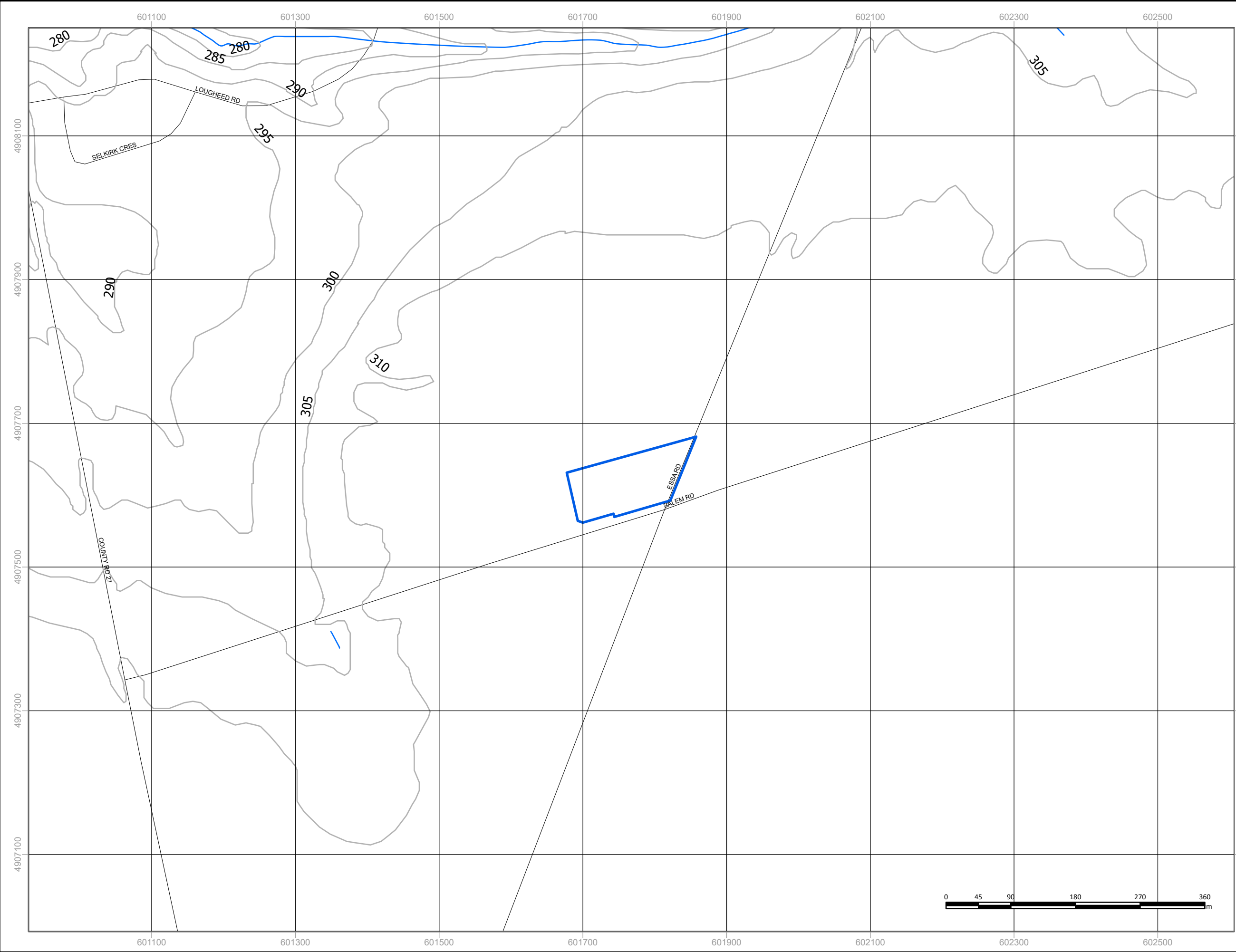
UA

Figure No.:

4

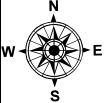
Date:

March 2022



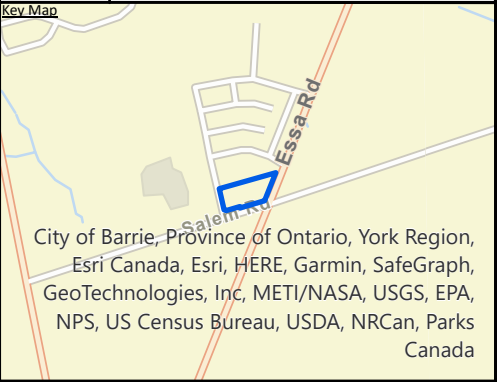


Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing



References:
Service Layer Credits: © Topography, Water Body and Watercourse Map was Produced by Terraprobe Inc. under license from the Ministry of Ministry of Natural Resources and Forestry (MNR). Copyright (c) is hold by the Queen's Printer for Ontario 2015.

Key Map



City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

-  Approximate Site Boundary
-  City of Barrie; Topographic Contours
-  Collector
-  Local / Street
-  Water Course

Project Title:

Preliminary Hydrogeological Assessment

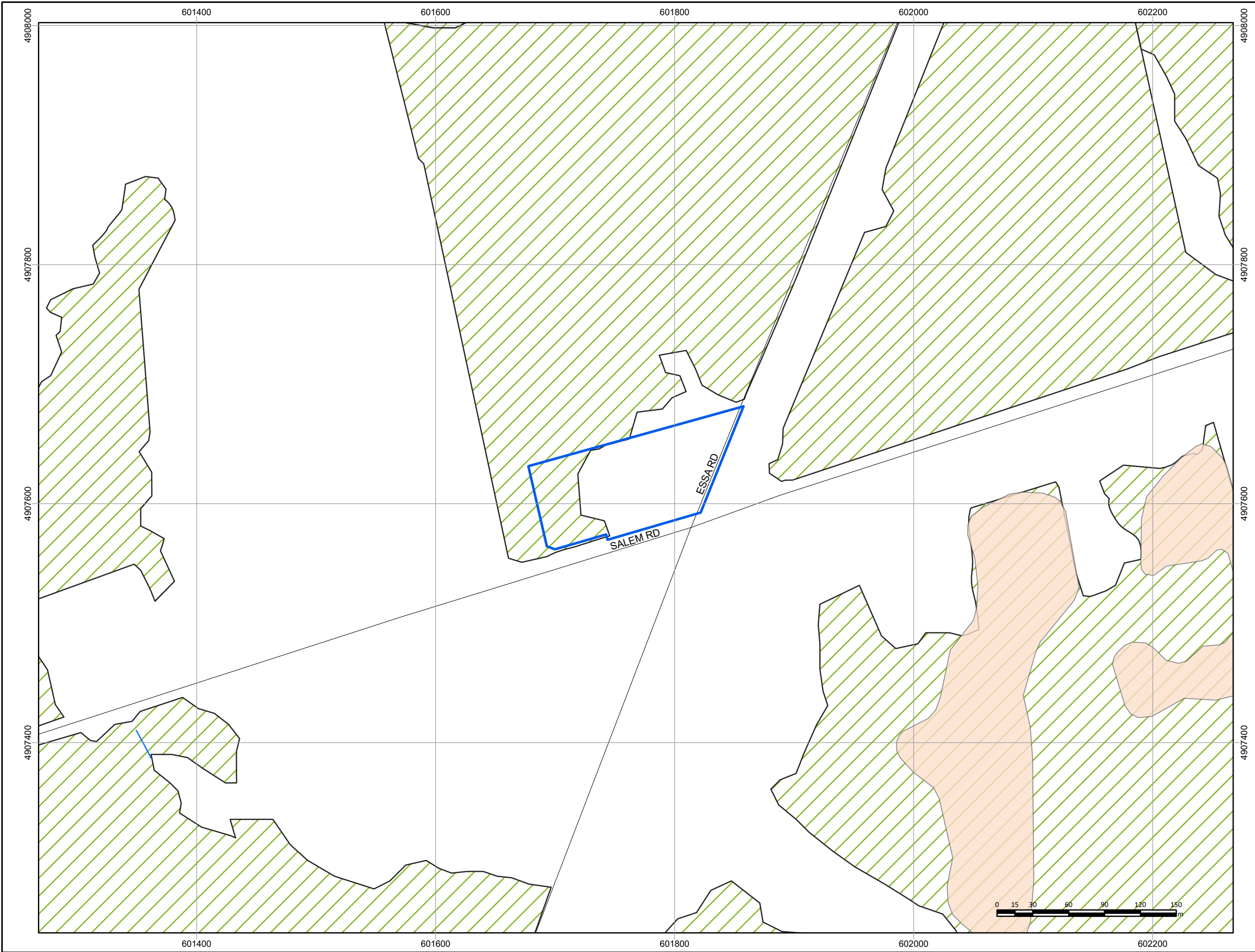
Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

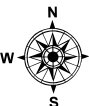
Topography Map

Designed By: MM	File No.: 3-22-0008-46
Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 5
Date: March 2022	

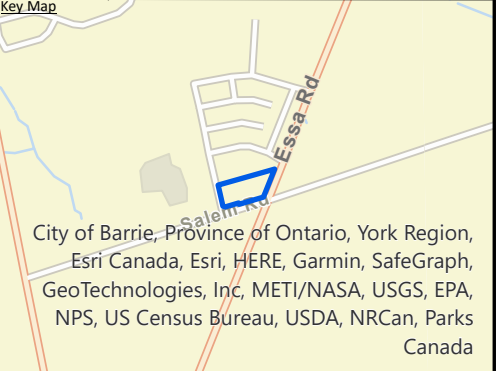




Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing



References:
Service Layer Credits: © Natural Heritage Map was Produced by Terraprobe Inc. under license from the Ministry of North Development and Mines (MNOM). Copyright (c) is held by the Queen's Printer for Ontario.



City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

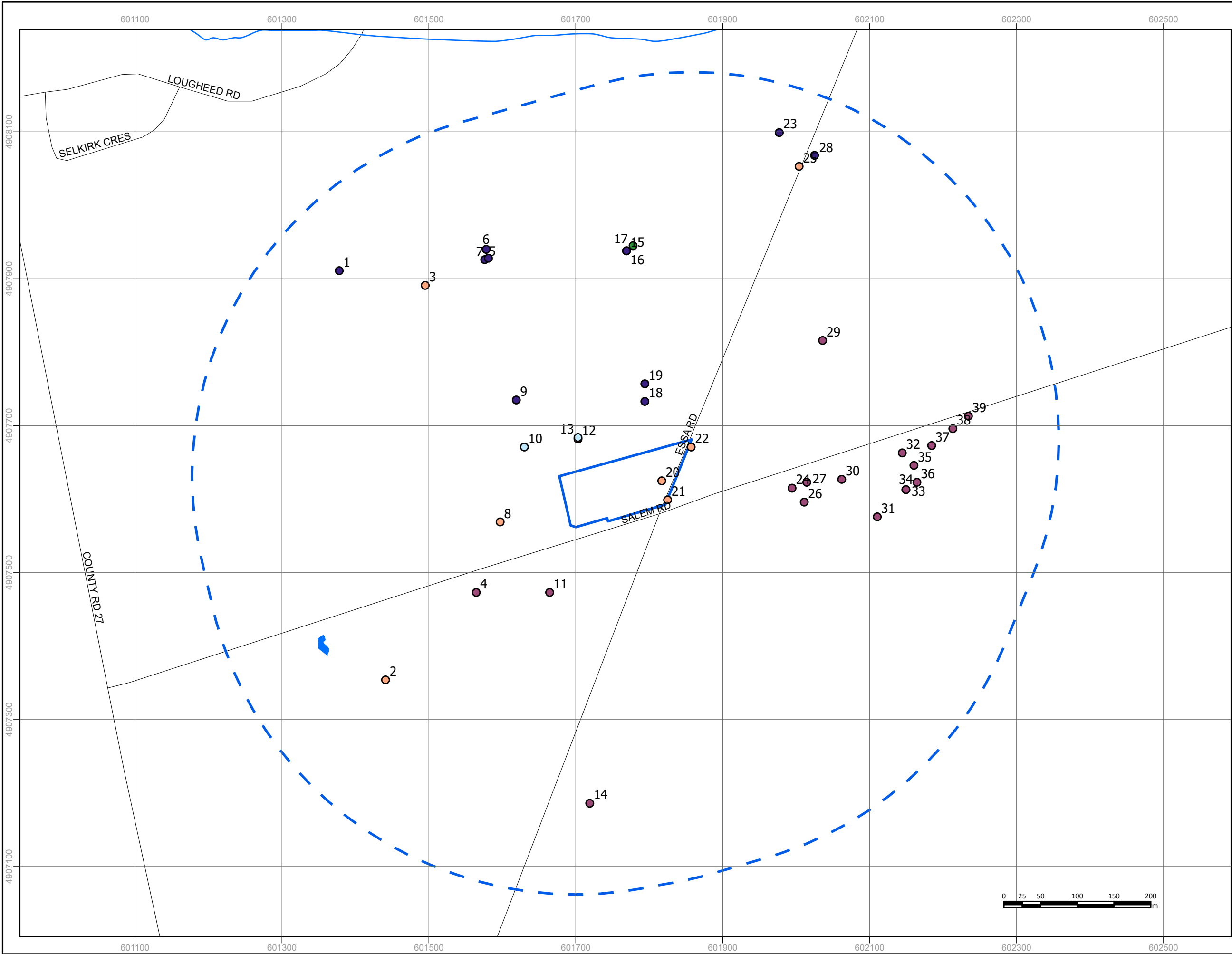
-  Approximate Site Boundary
-  Collector
-  Water Course
-  Wetland Features-Not evaluated
-  Wooded Area

Project Title:
Preliminary Hydrogeological Assessment

Site Location:
901 Essa Road, Barrie, Ontario

Figure Title:
Natural Heritage Feature Map

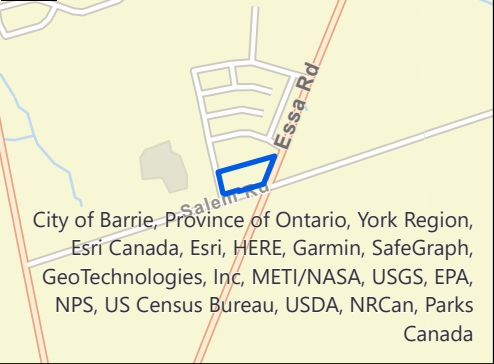
Designed By: MM	File No.: 3-22-0008-46
Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 6
Date: March 2022	



References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community produced by Terraprobe Inc. Copyright (c) Queen's Printer 2020. Water Well Information System Ministry of the Environment, Conservation and Parks, 2020

Key Map



Notes:

Legend:

- Approximate Site Boundary
- Approximate Study Area; 500m
- Water Course
- Collector
- Local / Street
- Unknown
- Abandoned-Other
- Observation Wells
- Other Status
- Water Supply

Project Title:

Preliminary Hydrogeological Assessment

Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

MECP Well Records Map

Designed By:

MM

File No.:

3-22-0008-46

Drawn By:

SSK

Scale:

As Shown

Reviewed By:

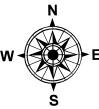
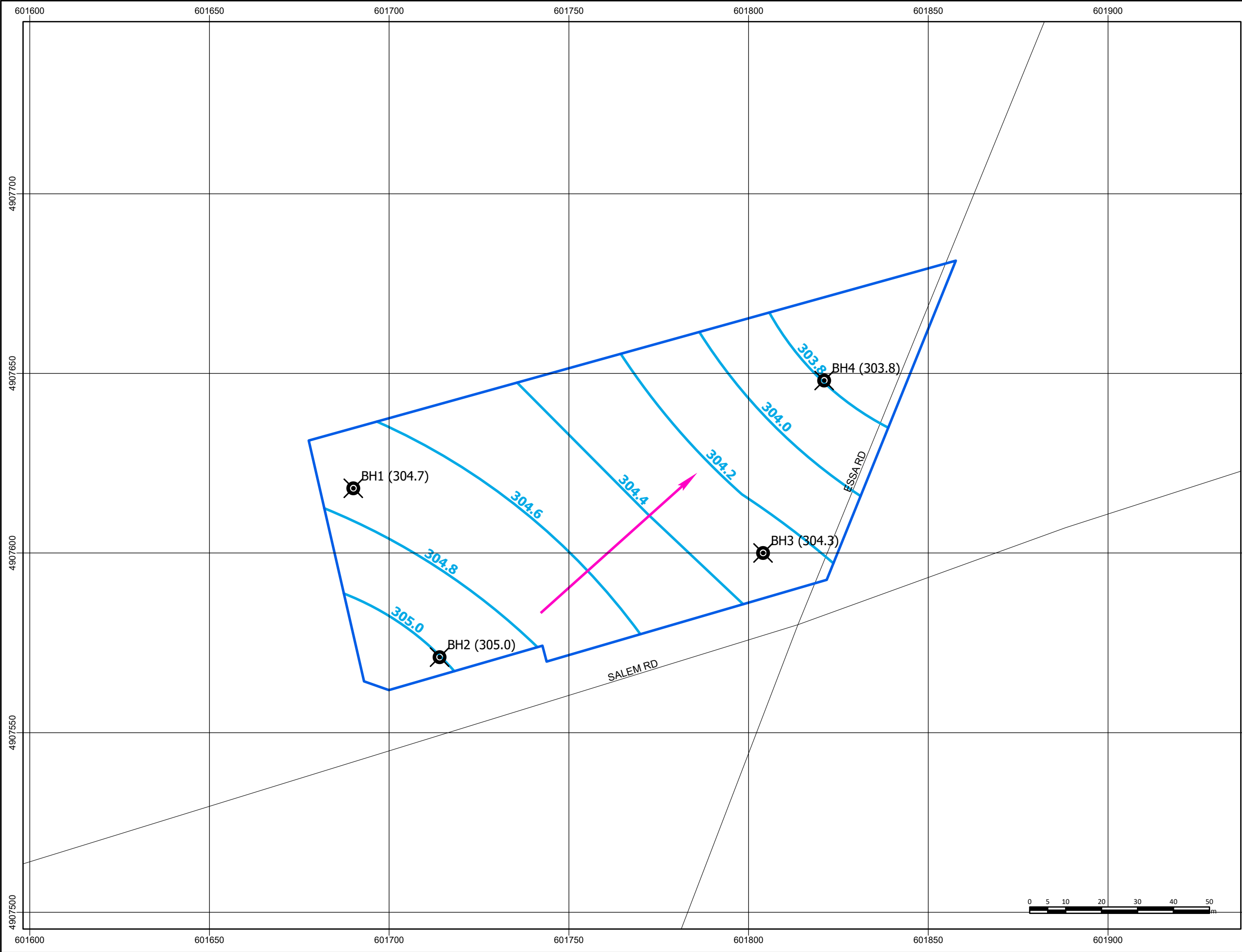
UA

Figure No.:

7

Date:

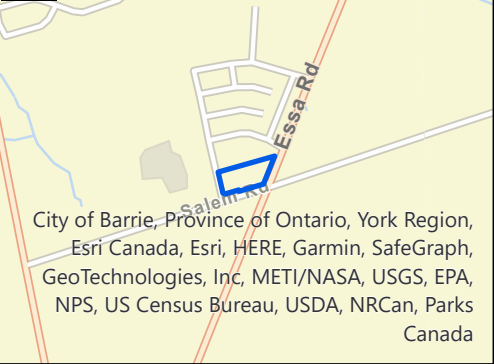
March 2022



References:

Service Layer Credits: © Topography, Water Body and Watercourse Map was Produced by Terraprobe Inc. under license from the Ministry of Ministry of Natural Resources and Forestry (MNR). Copyright (c) is hold by the Queen's Printer for Ontario 2015.

Key Map



Notes:

Legend:

- Approximate Site Boundary
- Collector
- Interpreted Groundwater Contours
- Interpreted Groundwater Flow Direction
- Approximate Monitoring Well Location (Groundwater Elevation as on Feb 18, 2022)

Project Title:
Preliminary Hydrogeological Assessment

Site Location:
901 Essa Road, Barrie, Ontario

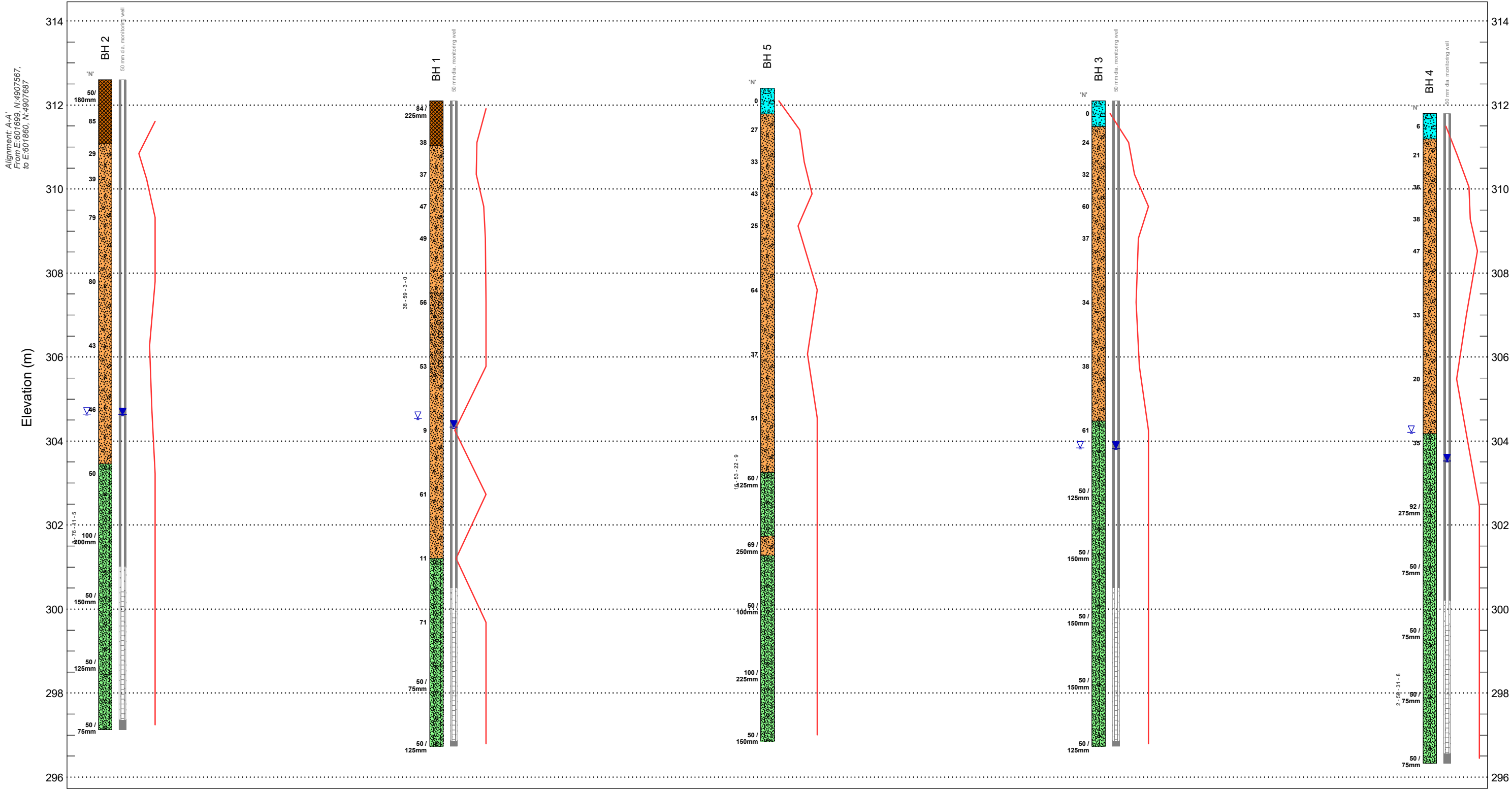
Figure Title:
Groundwater Flow Direction

Designed By: MM	File No.: 3-22-0008-46
---------------------------	----------------------------------

Drawn By: SSK	Scale: As Shown
-------------------------	---------------------------

Reviewed By: UA	Figure No.: 8
---------------------------	-------------------------

Date: March 2022



LITHOLOGY GRAPHIC LEGEND

- | | |
|-----------------|---------|
| Fill | Topsoil |
| Gravelly Sand | |
| Sand and Gravel | |
| Silty Sand Till | |

Boreholes Equally Spaced

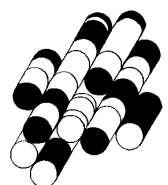
INTERPRETIVE LEGEND

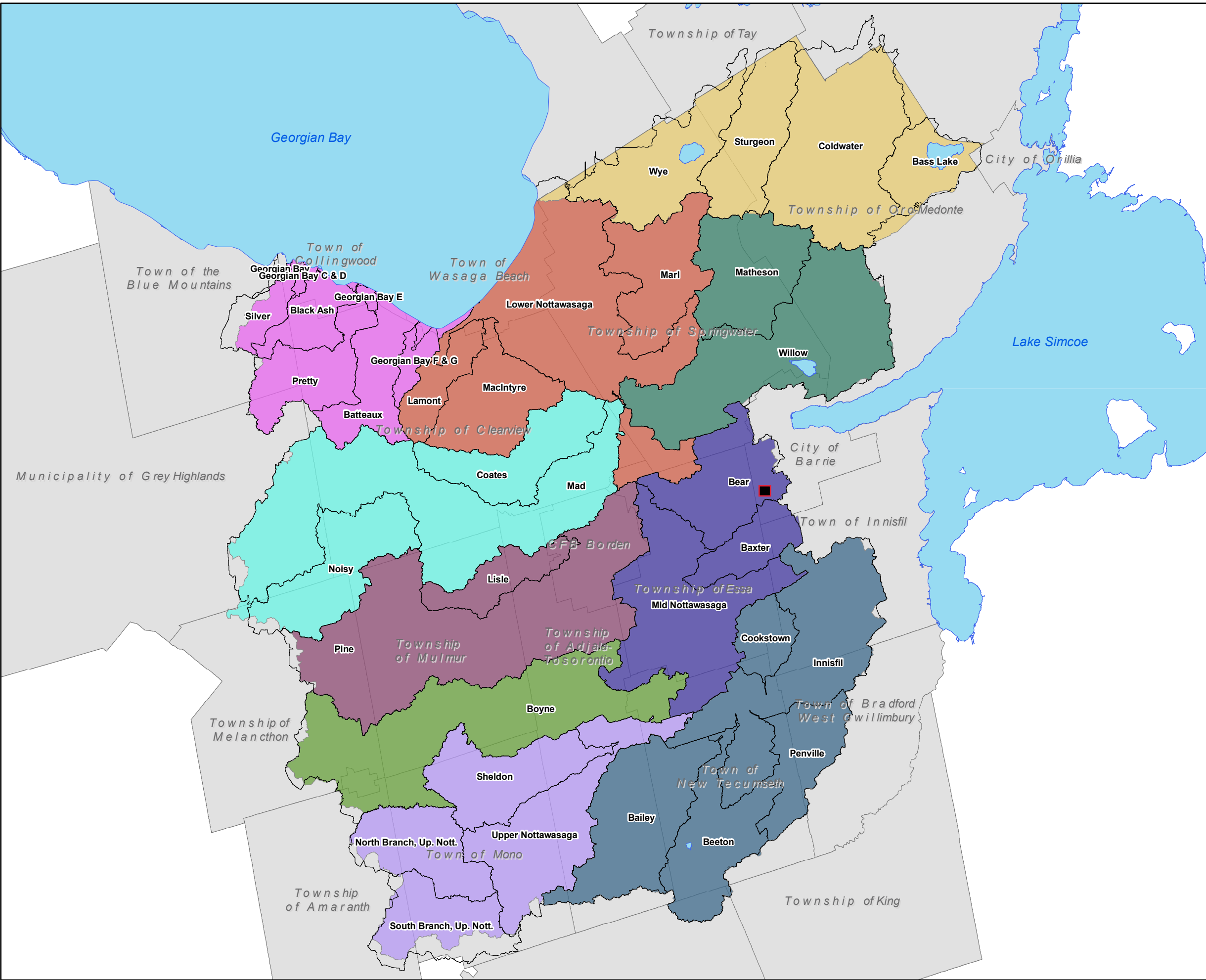
- WL on completion of drilling
 Stabilized WL, most recent

- | | |
|-----------------------------------|---|
| FILL | COHESIONLESS TILLS |
| GRAVELS (gravel to gravelly sand) | COHESIVE SOILS (clayey silt to clay, incl. tills) |
| SILT TO SAND (not till) | DISTURBED/REWORKED SOILS |

APPENDIX A

TERRAPROBE INC.





NVCA Watersheds

Figure 3.1-1

Legend

- Lakes
- Drainage Areas
- Municipal Boundary

Subwatershed

- Blue Mountains Watersheds
- Boyne River Subwatershed
- Innisfil Creek Subwatershed
- Lower Nottawasaga River Reach
- Mad River Subwatershed
- Middle Nottawasaga River Reach
- Pine River Subwatershed
- Severn Sound Watersheds
- Upper Nottawasaga River Subwatershed
- Willow Creek Subwatershed



NAD 1983 UTM 17

1:350,000

Project: NVCA IWMP

Date: 2018-05-30

Data Sources: NVCA, 2017: Subwatersheds,
Municipal Boundary





Nottawasaga Valley
Conservation Authority

Regulated Areas

23-Mar-2022

Information Resources for Regulated Properties

[Do I need a permit?](#)

[Submit a Property Inquiry](#)

[Google Driving Directions](#)

[Info Regarding Covid-19](#)

Email the Regulations Department
permits@nvca.on.ca

NVCA Contact Information

(705) 424-1479

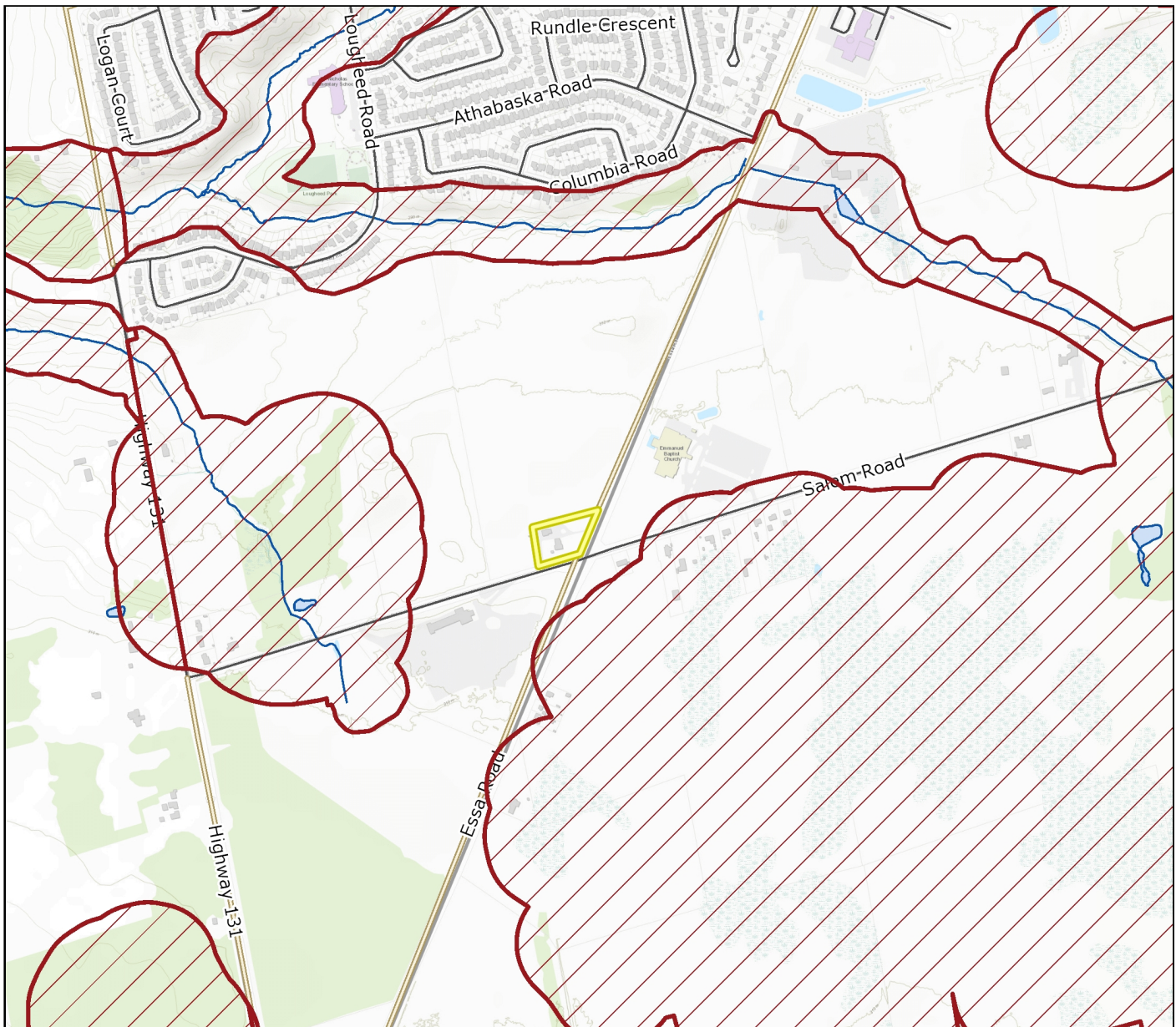
8195 8th Line,
Utopia, ON L0M 1T0

www.nvca.on.ca

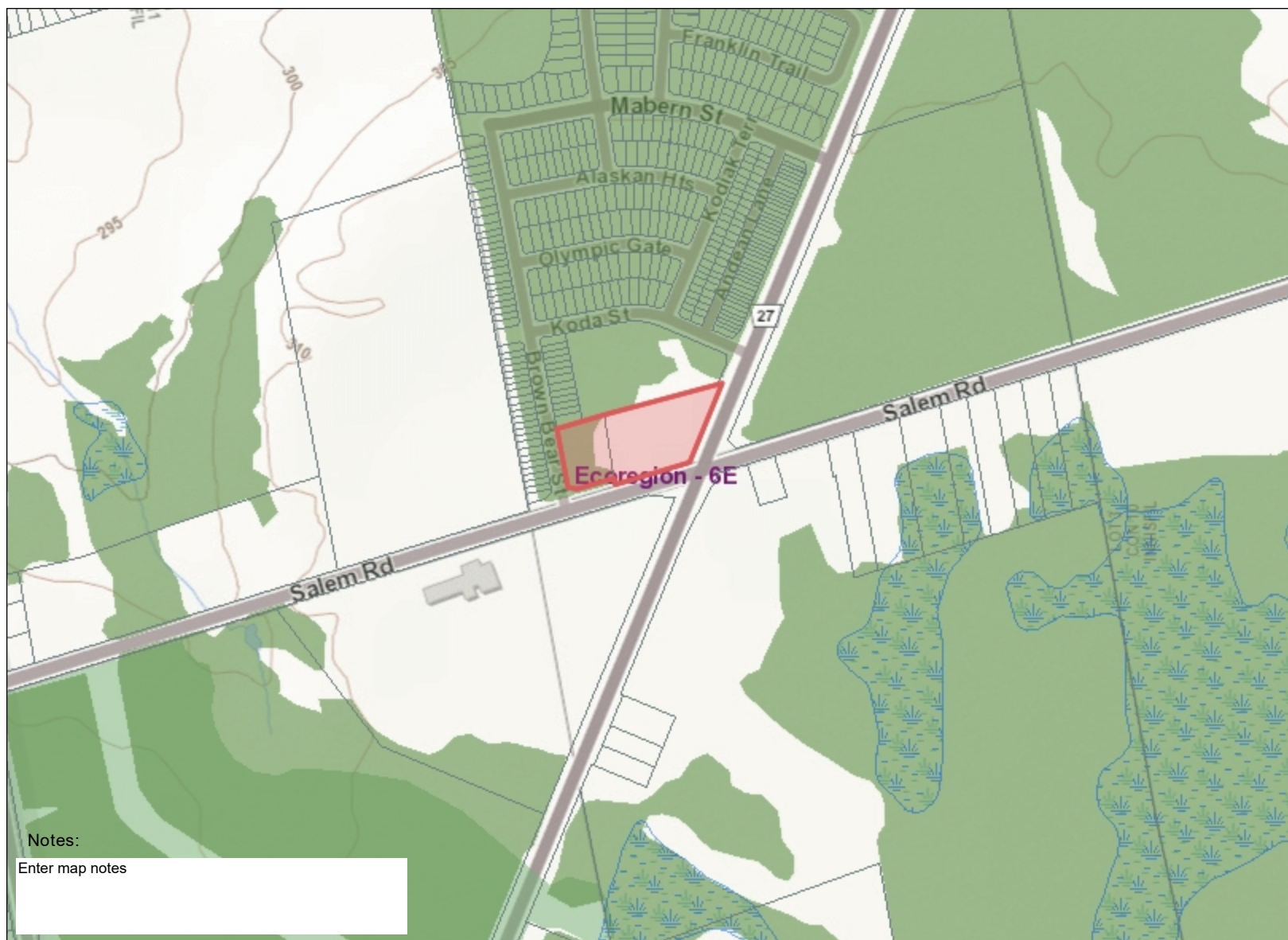
Monday to Friday

8:30 a.m. to 4:30 p.m.

except between 12:00 p.m. - 1:00 p.m.

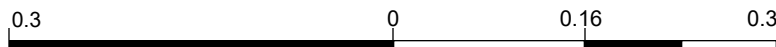


This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of the information displayed in this map product are strongly cautioned to verify all information before making any decisions. Produced by Nottawasaga Valley Conservation Authority under license with the MNRF. Reproduction of this map is prohibited without written permission from the Nottawasaga Valley Conservation Authority. © NVCA and Queen's Printer for Ontario, 2020.



Notes:

Enter map notes



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.

© Copyright for Ontario Parcel data is held by Queen's Printer for Ontario and its licensors and may not be reproduced without permission. THIS IS NOT A PLAN OF SURVEY.



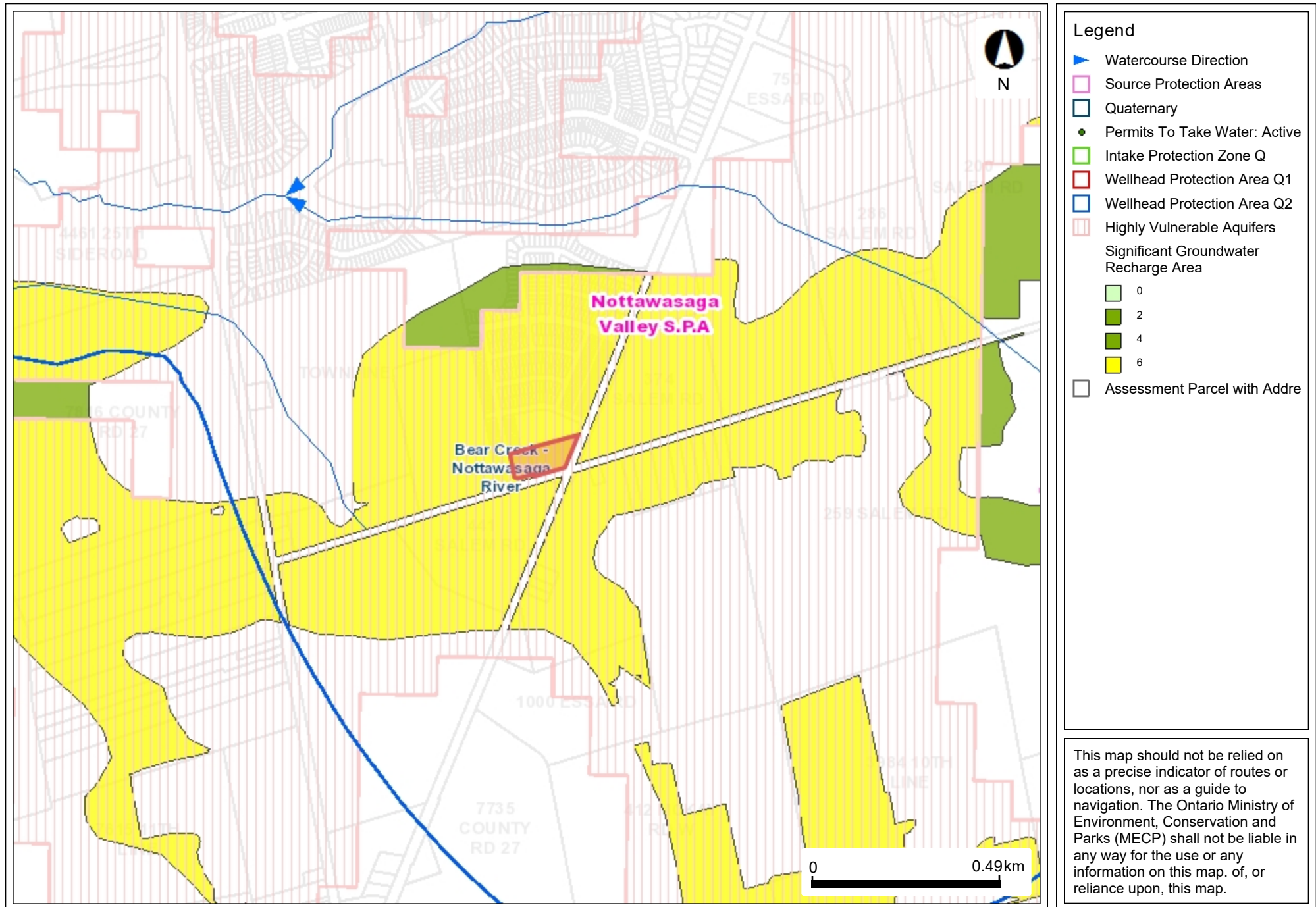
Imagery Copyright Notices: DRAPE © Aéro-Photo (1961) Inc., 2008 - 2009
GTA 2005 / SWOOP 2006 / Simcoe-Muskoka-Dufferin © FirstBase Solutions, 2005 / 2006 / 2008
© Queen's Printer for Ontario, 2022

Legend

- Assessment Parcel
- Ecoregion
- ORM Boundary
- NEP Parks and Open Space System
- NEP Minor Urban Centres
- ANSI
- Earth Science Provincially Significant/sciences de la terre d'importance provinciale
- Earth Science Regionally Significant/sciences de la terre d'importance régionale
- Life Science Provincially Significant/sciences de la vie d'importance provinciale
- Life Science Regionally Significant/sciences de la vie d'importance régionale
- Evaluated Wetland
- Provincially Significant/considérée d'importance provinciale
- Non-Provincially Significant/non considérée d'importance provinciale
- Unevaluated Wetland
- Woodland
- Natural Heritage System



Source Protection Mapping



Features

WHPA Q Policy Area

-  WHPA-Q1
-  WHPA-Q1/Q2
-  WHPA-Q2

WHPA Q Risk Level

-  Significant
-  Moderate
-  Low

Lakes

-  SGBLS Source Protection Boundary

Lower Tier Municipality

-  Assessment Parcel

Roads

-  Hwy 400 Series
-  Highway, Arterials
-  Local Road

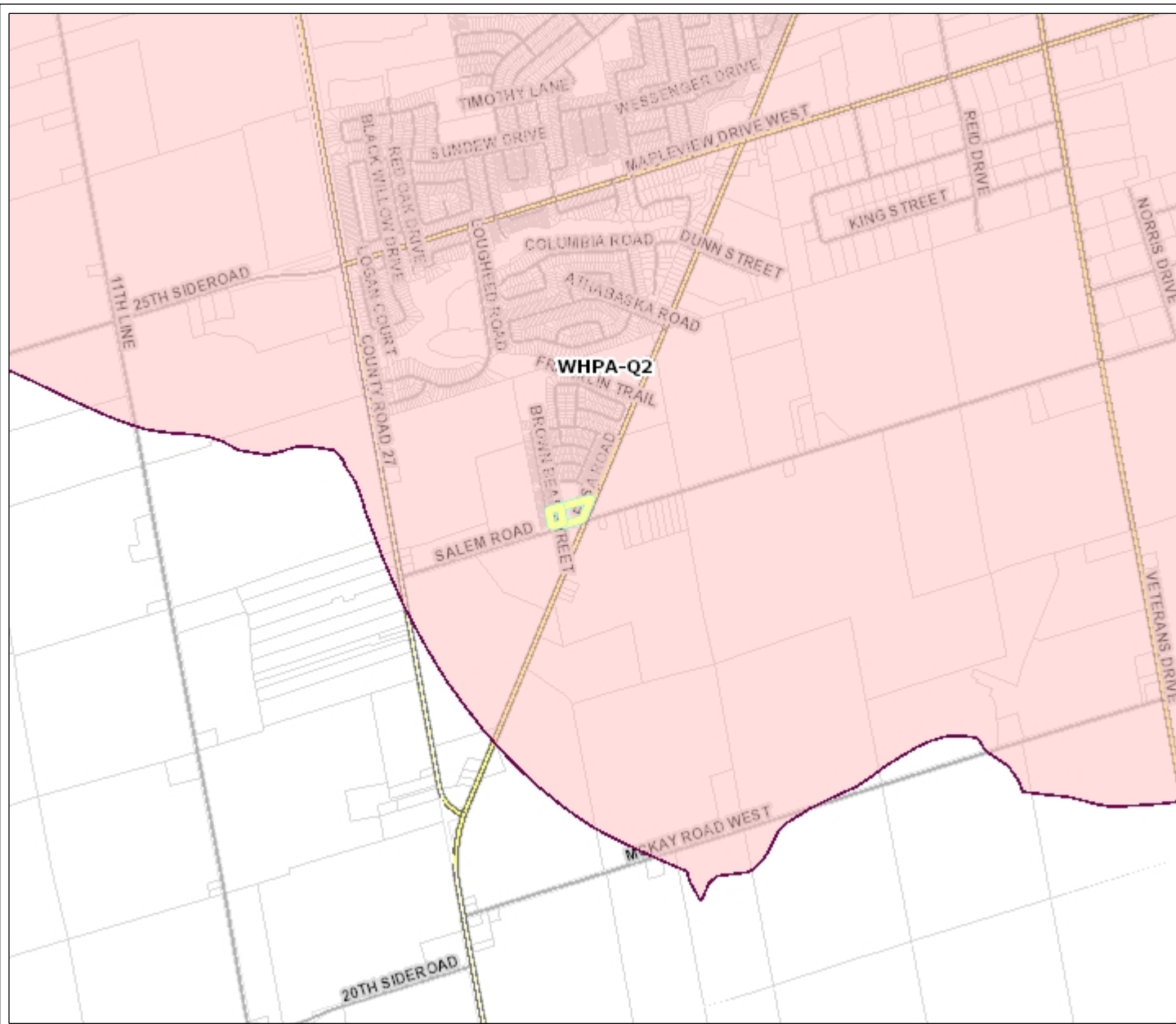
Printed On:
3/23/2022



WGS_1984_Web_Mercator_
Auxiliary_Sphere

Mapped By:

This product was produced for the South Georgian Bay Lake Simcoe Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the information, data/mapping errors may exist. This map has been produced for illustrative purposes from an interactive web mapping site. LSRCA GIS Services DRAFT printed 2022. © South Georgian Bay Lake Simcoe Source Protection Region, 2022. All Rights Reserved. The following data sets of Assessment Parcel, Roads, Upper & Lower Tier Municipalities are © Queens Printer for Ontario. Reproduced with Permission, 2022. Orthophotography 2002, 2005, 2007-2009, 2011-2021. © First Base Solutions Inc.



Scale 1: 25,964





Nottawasaga Valley
Conservation Authority

Highly Vulnerable Aquifers

23-Mar-2022

Information Resources for Regulated Properties

[Do I need a permit?](#)

[Submit a Property Inquiry](#)

[Google Driving Directions](#)

[Info Regarding Covid-19](#)

Email the Regulations Department
permits@nvca.on.ca

NVCA Contact Information

(705) 424-1479

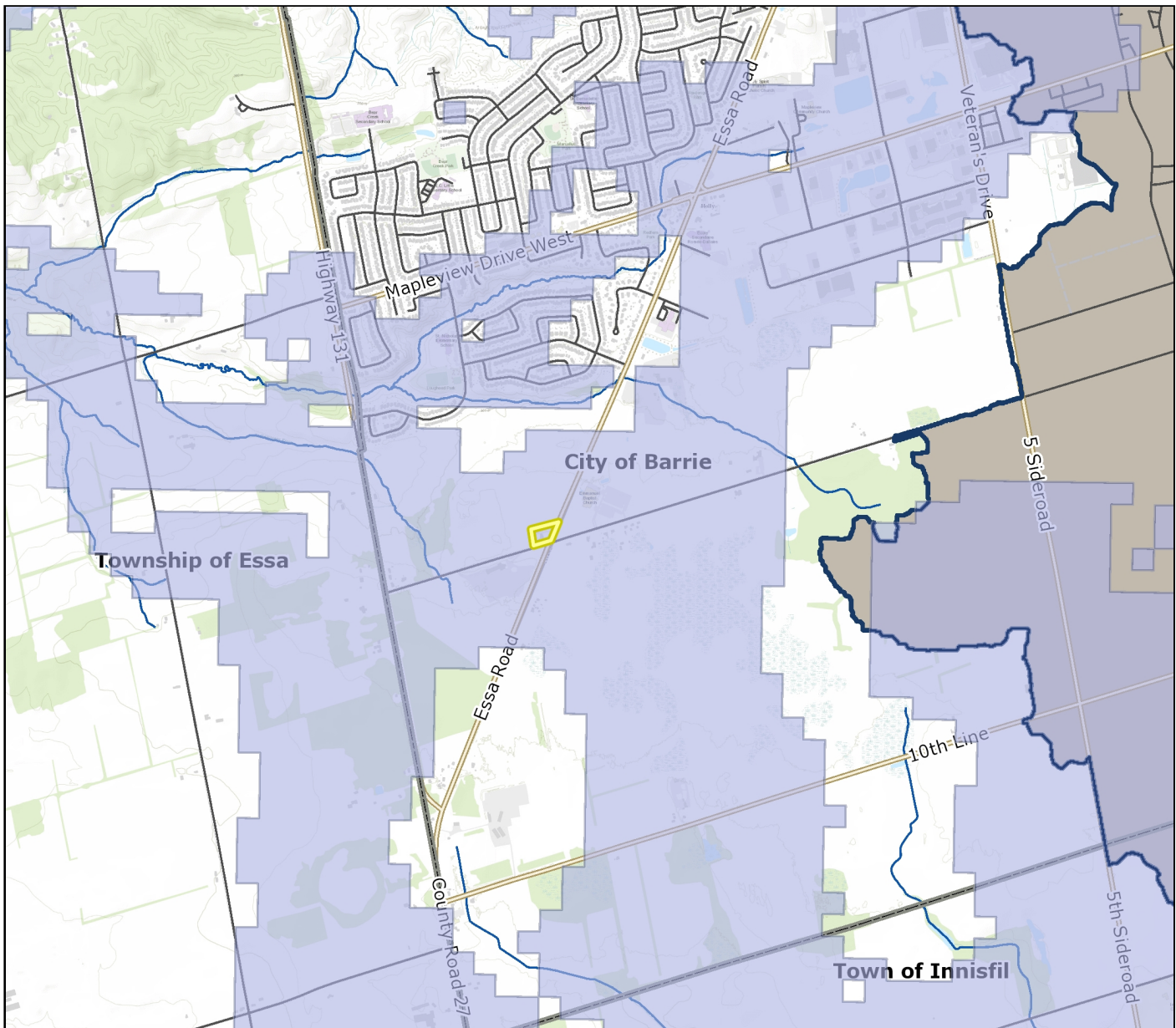
8195 8th Line,
Utopia, ON L0M 1T0

www.nvca.on.ca

Monday to Friday

8:30 a.m. to 4:30 p.m.

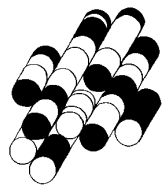
except between 12:00 p.m. - 1:00 p.m.



This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of the information displayed in this map product are strongly cautioned to verify all information before making any decisions. Produced by Nottawasaga Valley Conservation Authority under license with the MNRF. Reproduction of this map is prohibited without written permission from the Nottawasaga Valley Conservation Authority. © NVCA and Queen's Printer for Ontario, 2020.

APPENDIX B

TERRAPROBE INC.



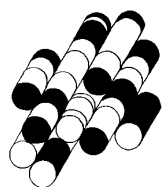
MECP Well Records Summary										
WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Water Found (mbgs)**	Static Water Level (mbgs)**	Top of Screen Depth (mbgs)**	Bottom of Screen Depth (mbgs)**	Date Completed
				Final Status	First Use					
1	7339765			Abandoned-Other						May 28, 2019
2	7176147	Rotary (Convent.)	4.6	Observation Wells	Monitoring	0.6		1.5	4.6	October 18, 2011
3	7176146	Rotary (Convent.)	7.6	Observation Wells	Monitoring	4.0		4.6	7.6	October 19, 2011
4	5710487	Boring	8.5	Water Supply	Domestic	4.6	4.0			October 7, 1973
5	7339768			Abandoned-Other			3.1			June 17, 2019
6	7319538			Abandoned-Other	Not Used					July 30, 2018
7	7339770			Abandoned-Other			4.0			June 17, 2019
8	7048667	Boring	25.6	Observation Wells	Monitoring					August 2, 2007
9	7319539			Abandoned-Other	Not Used					July 30, 2018
10	7353251	Auger	7.3	Other Status	Monitoring					October 17, 2019
11	5715880	Rotary (Convent.)	47.2	Water Supply	Industrial	39.7	33.2	40.0	41.5	January 31, 1979
12	7306468	Auger	4.6	Observation Wells	Monitoring	4.6		3.1	4.6	January 25, 2018
13	7333266			Other Status						April 9, 2019
14	5734437	Cable Tool	13.1	Water Supply	Domestic	12.8	1.2	11.9	12.8	June 23, 1999
15	7354623		6.7	Observation Wells	Other					June 17, 2019
16	7339771			Abandoned-Other			3.4			June 17, 2019
17	7308428									February 7, 2018
18	7319537			Abandoned-Other	Not Used					July 30, 2018
19	7319536			Abandoned-Other	Not Used					July 30, 2018
20	7319523	Rotary (Convent.)	3.1	Observation Wells	Monitoring	2.4	2.4	1.5	3.1	August 20, 2018
21	7319522	Rotary (Convent.)	4.6	Observation Wells	Monitoring	2.4	2.4	3.1	4.6	August 20, 2018
22	7319525	Rotary (Convent.)	4.6	Observation Wells	Monitoring	3.7	3.7	3.1	4.6	August 20, 2018
23	7339773			Abandoned-Other			5.5			June 17, 2019
24	5701248	Boring	12.2	Water Supply	Domestic	8.5	3.7			August 12, 1964
25	7319524	Rotary (Convent.)	3.1	Observation Wells	Monitoring	2.1	2.1	1.5	3.1	August 20, 2018
26	5734726	Cable Tool	48.5	Water Supply	Domestic	48.5	36.3	47.6	48.5	November 16, 1999
27	5709516	Cable Tool	50.9	Water Supply	Domestic	42.7	6.1	50.0	50.9	August 14, 1972
28	7328955	Other Method		Abandoned-Other	Monitoring	0.6		0.5	0.9	December 12, 2018
29	5739780	Cable Tool	6.0	Water Supply	Domestic	44.0	35.2	45.7	48.8	January 4, 2005
30	5739342	Cable Tool	24.1	Water Supply	Domestic	22.0	3.1			July 23, 2004
31	5701249	Boring	6.1	Water Supply	Domestic	2.7	2.7			October 12, 1965
32	5710004	Boring	7.0	Water Supply	Domestic	3.7	0.9			March 4, 1973
33	5710285	Cable Tool		Water Supply	Domestic	9.8	38.4	45.1	46.1	September 11, 1973
34	5723468	Cable Tool	45.4	Water Supply	Domestic	42.7	34.8	44.5	45.4	June 22, 1988
35	5719417	Cable Tool	46.9	Water Supply	Domestic	45.1	35.7	45.4	46.7	September 19, 1984
36	5709995	Boring	10.7	Water Supply	Domestic	6.1	6.1			March 5, 1973
37	5731407	Cable Tool	45.1	Water Supply	Domestic	42.7	36.0	43.6	44.5	March 6, 1995
38	5709996	Boring	9.1	Water Supply	Domestic	4.6	4.6	14.0	17.7	March 6, 1973

*Ministry of Environment, Conservation and Parks

** meters below ground surface

APPENDIX C

TERRAPROBE INC.



Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 8, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

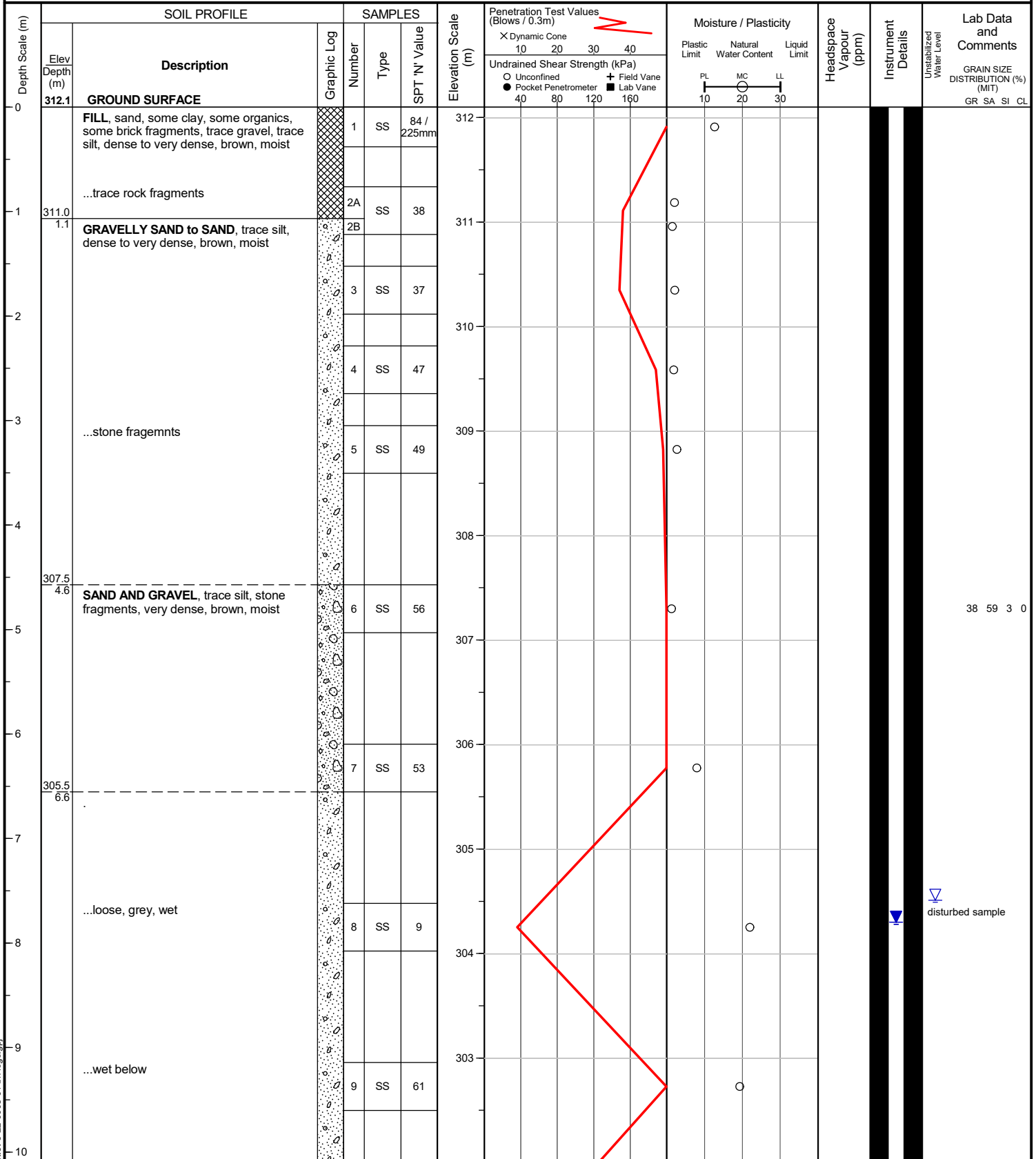
Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

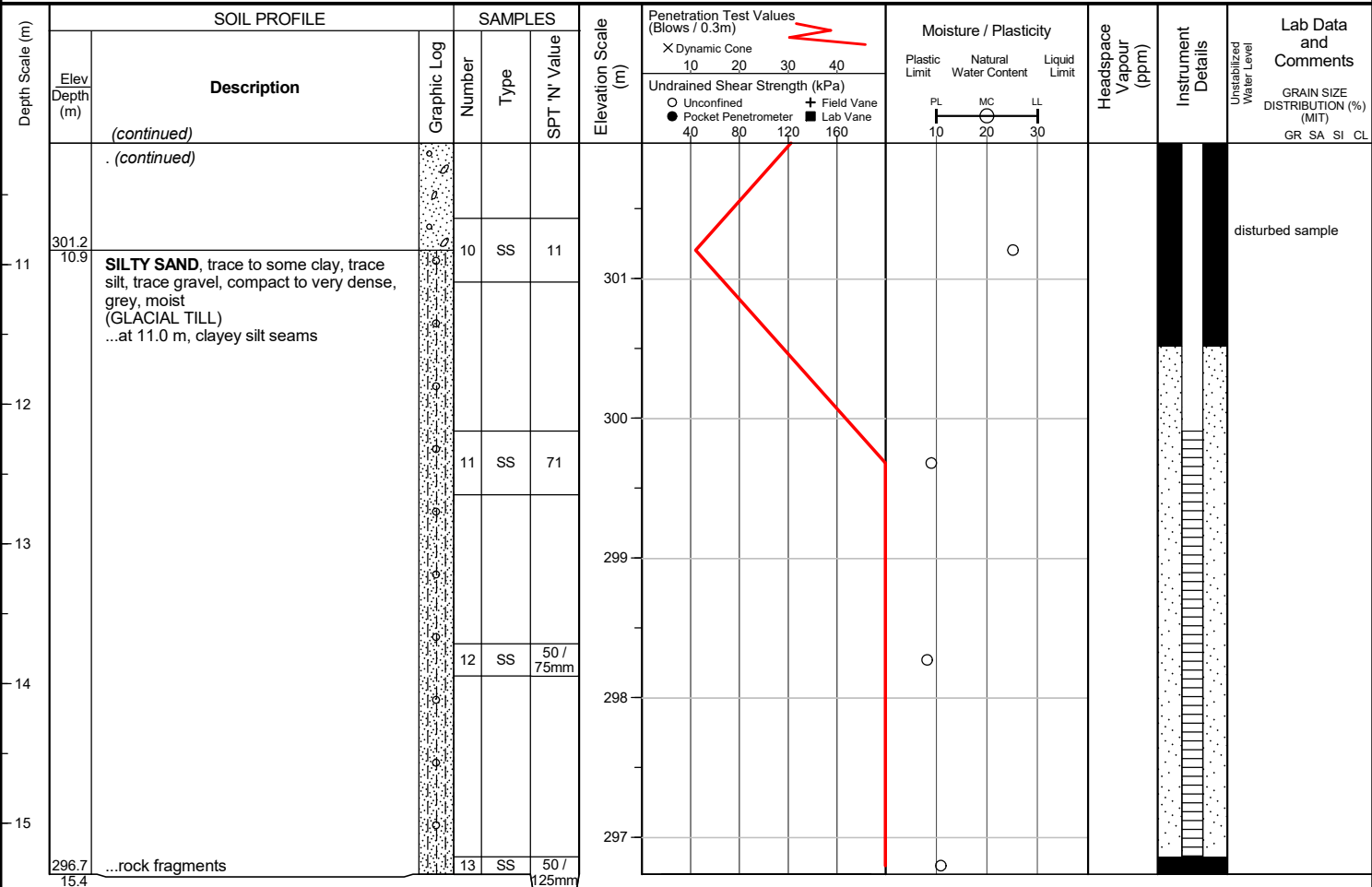


file: 3-22-0008-01 bh logs.gpj

(continued next page)

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 8, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers



END OF BOREHOLE

Unstabilized water level measured at 7.6 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	7.8	304.3



Project No. : 3-22-0008-01

Date started : February 7, 2022

Sheet No. : 1 of 2

Client : Brown Bear Dev. Ltd.

Project : 901 Essa Road and Brown Bear Street

Location : Barrie, Ontario

Originated by : CB

Compiled by : GO

Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
0	312.6	GROUND SURFACE													
		FILL, sand, some gravel, some rock fragments, trace silt, very dense, brown, moist		1	SS	50/180mm									
		...rock fragments		2	SS	85									
1															
	311.1	...compact to dense		3	SS	29									
	1.5	GRAVELLY SAND to SAND, trace silt, compact to very dense, brown, moist		4	SS	39									
2															
				5	SS	79									
3															
				6	SS	80									
4															
				7	SS	43									
5															
		...wet		8	SS	46									
6															
		...some silt, wet													
7															
8															
9	303.5	SILTY SAND to SAND, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL)		9	SS	50									
	9.1														
10															

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 7, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Undrained Shear Strength (kPa)				Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10	20	30	40						
		SILTY SAND to SAND, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL) (continued)															
11		...wet		10	SS	100 / 200mm	302										8 76 11 5
12		...some clay, some gravel, wet		11	SS	50 / 150mm	301										
13							300										
14		...rock fragments		12	SS	50 / 125mm	299										
15							298										
	297.1			13	SS	50 / 75mm											
	15.5																

END OF BOREHOLE

Unstabilized water level measured at 8.0 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS
 Date Water Depth (m) Elevation (m)
 Feb 17, 2022 8.0 304.6



Project No. : 3-22-0008-01

Date started : February 8, 2022

Sheet No. : 1 of 2

Client : Brown Bear Dev. Ltd.

Project : 901 Essa Road and Brown Bear Street

Location : Barrie, Ontario

Originated by : CB

Compiled by : GO

Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

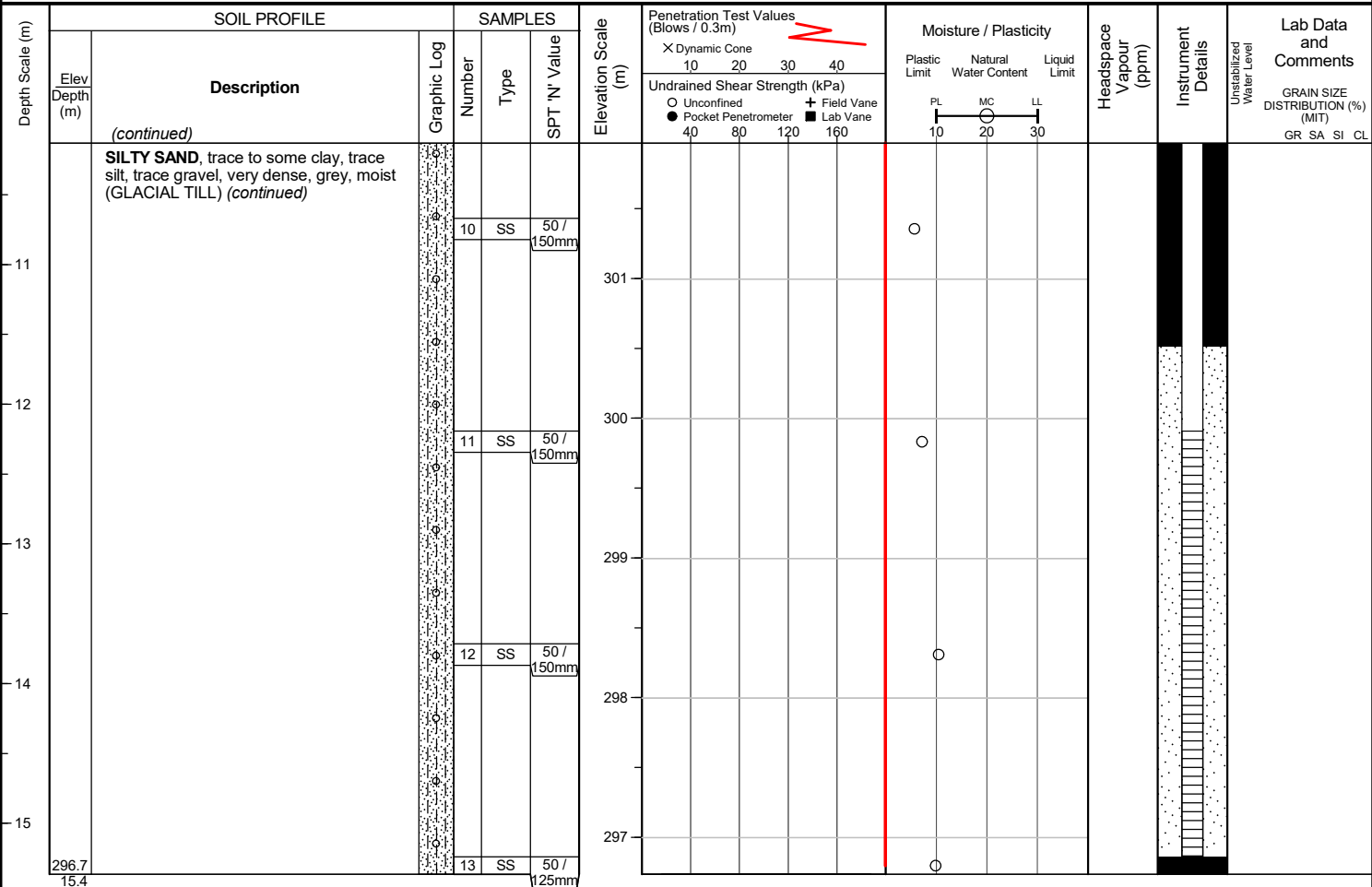
Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
0	312.1	GROUND SURFACE					312								
		600mm TOPSOIL		1	SS	0									
1	311.5	GRAVELLY SAND to SAND, trace silt, compact to very dense, brown, moist		2	SS	24	311								
	0.6			3	SS	32									
2				4	SS	60									
3				5	SS	37									
4				6	SS	34									
5		...wet		7	SS	38									
6															
7		SILTY SAND, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL)		8	SS	61									
8	304.5														
	7.6			9	SS	50 / 125mm									
9															
10															

file: 3-22-0008-01 bh logs.gpj

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 8, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers



END OF BOREHOLE

Unstabilized water level measured at 8.3 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	8.3	303.8



Project No. : 3-22-0008-01

Date started : February 9, 2022

Sheet No. : 1 of 2

Client : Brown Bear Dev. Ltd.

Project : 901 Essa Road and Brown Bear Street

Location : Barrie, Ontario

Originated by : CB

Compiled by : GO

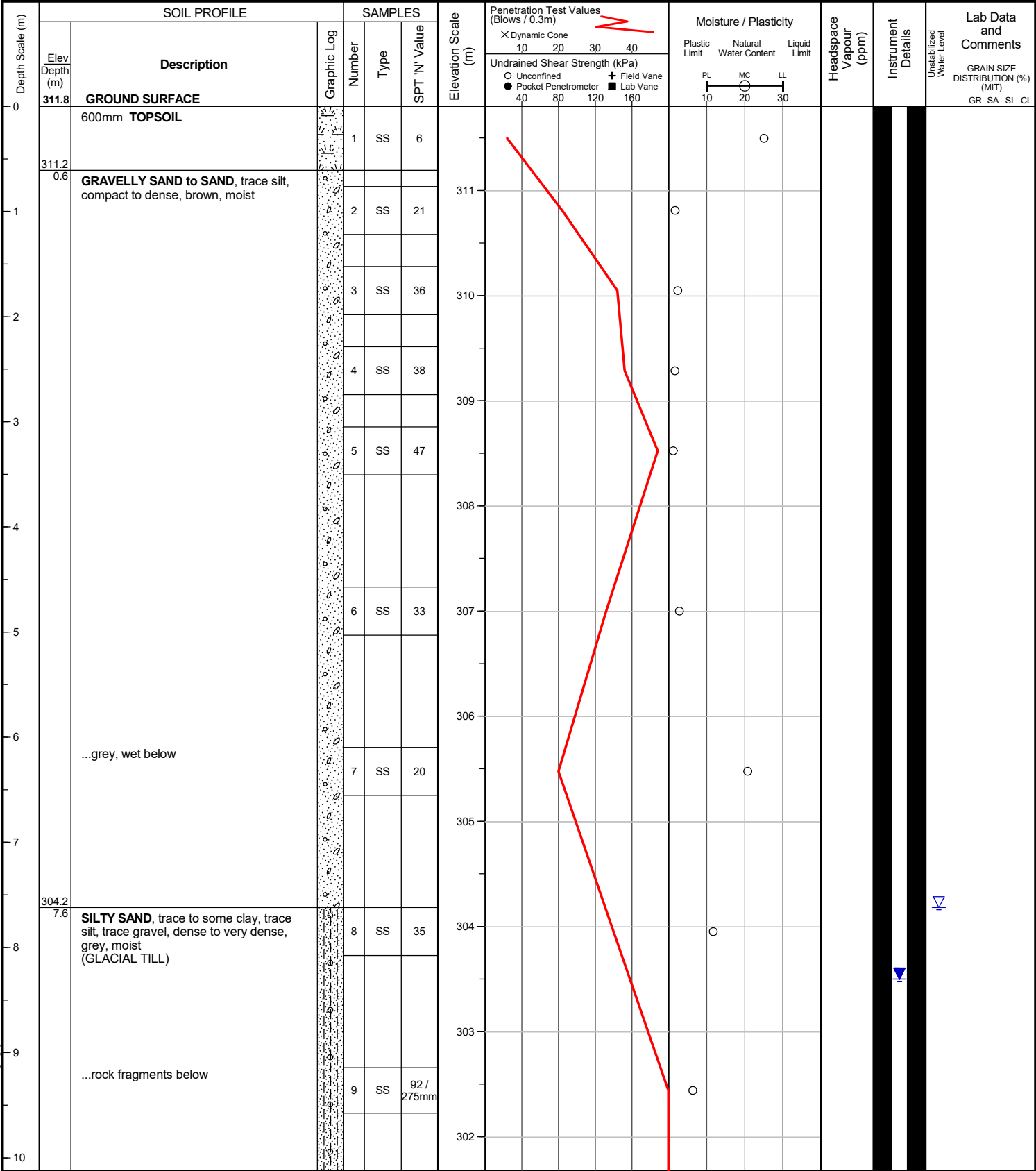
Checked by : OB

Position : E: 601826, N: 4907647 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers



Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 9, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601826, N: 4907647 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments	
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone				Plastic Limit	Natural Water Content	Liquid Limit				
								10	20	30	40							
								Undrained Shear Strength (kPa)										
		(continued)																
11		SILTY SAND, trace to some clay, trace silt, trace gravel, dense to very dense, grey, moist (GLACIAL TILL) (continued)		10	SS	50 / 75mm	301											
12									300									
13									299									
14						12	SS	50 / 75mm	298									
15									297									
						</												

END OF BOREHOLE

Unstabilized water level measured at 7.5 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	8.3	303.5

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 14, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments		
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone		Plastic Limit	Natural Water Content	Liquid Limit					
								10	20							30	40
								Undrained Shear Strength (kPa)									
								○ Unconfined ● Pocket Penetrometer	✚ Field Vane ■ Lab Vane	PL	MC	LL					
								40	80	120	160	10	20	30			
0	312.4	GROUND SURFACE		1	SS	0	312										
	311.8	GRAVELLY SAND to SAND, trace silt, compact to very dense, brown, moist to wet		2	SS	27											
	0.6																
				3	SS	33											
				4	SS	43											
				5	SS	25											
				6	SS	64											
		...very moist		7	SS	37											
		...wet		8	SS	51											

(continued next page)

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 14, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

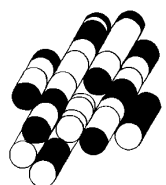
Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone				Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10	20	30	40						
								Undrained Shear Strength (kPa)				MC					
								○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane				PL					
								40	80	120	160	10	20	30			
11	301.7 10.7	SILTY SAND , trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL) (continued)					302										
	301.3 11.1	GRAVELLY SAND , very dense, brown, wet		10	SS	69 / 250mm											
12							301										
							300										
				11	SS	50 / 100mm											
13							299										
							298										
14				12	SS	100 / 225mm											
							297										
15																	
	296.9 15.5			13	SS	50 / 150mm											

END OF BOREHOLE

Water level and cave not measured upon completion of drilling.

APPENDIX D

TERRAPROBE INC.



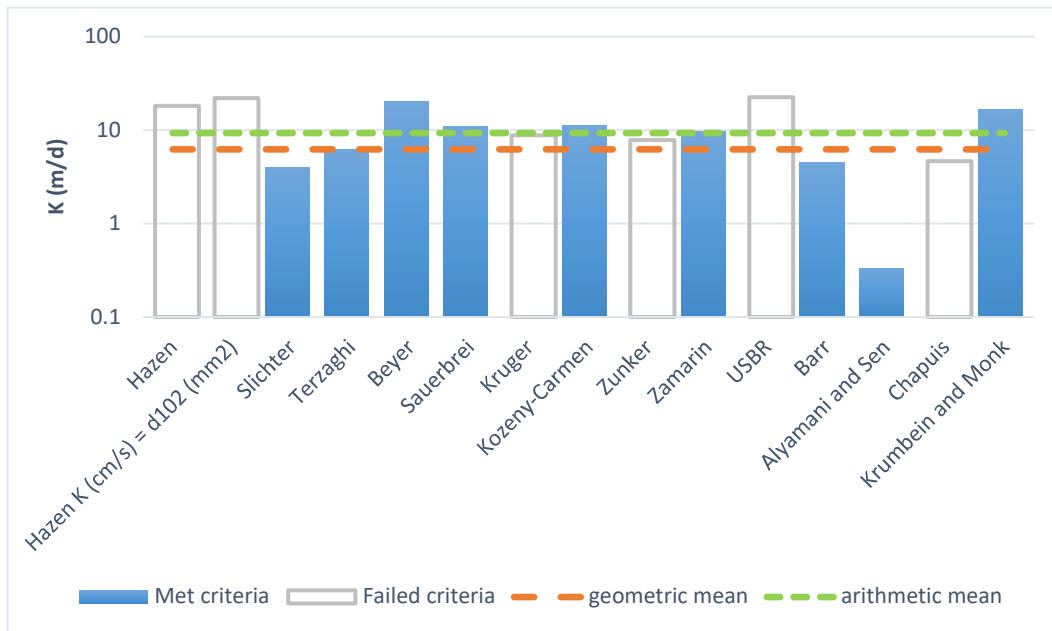


K from Grain Size Analysis Report

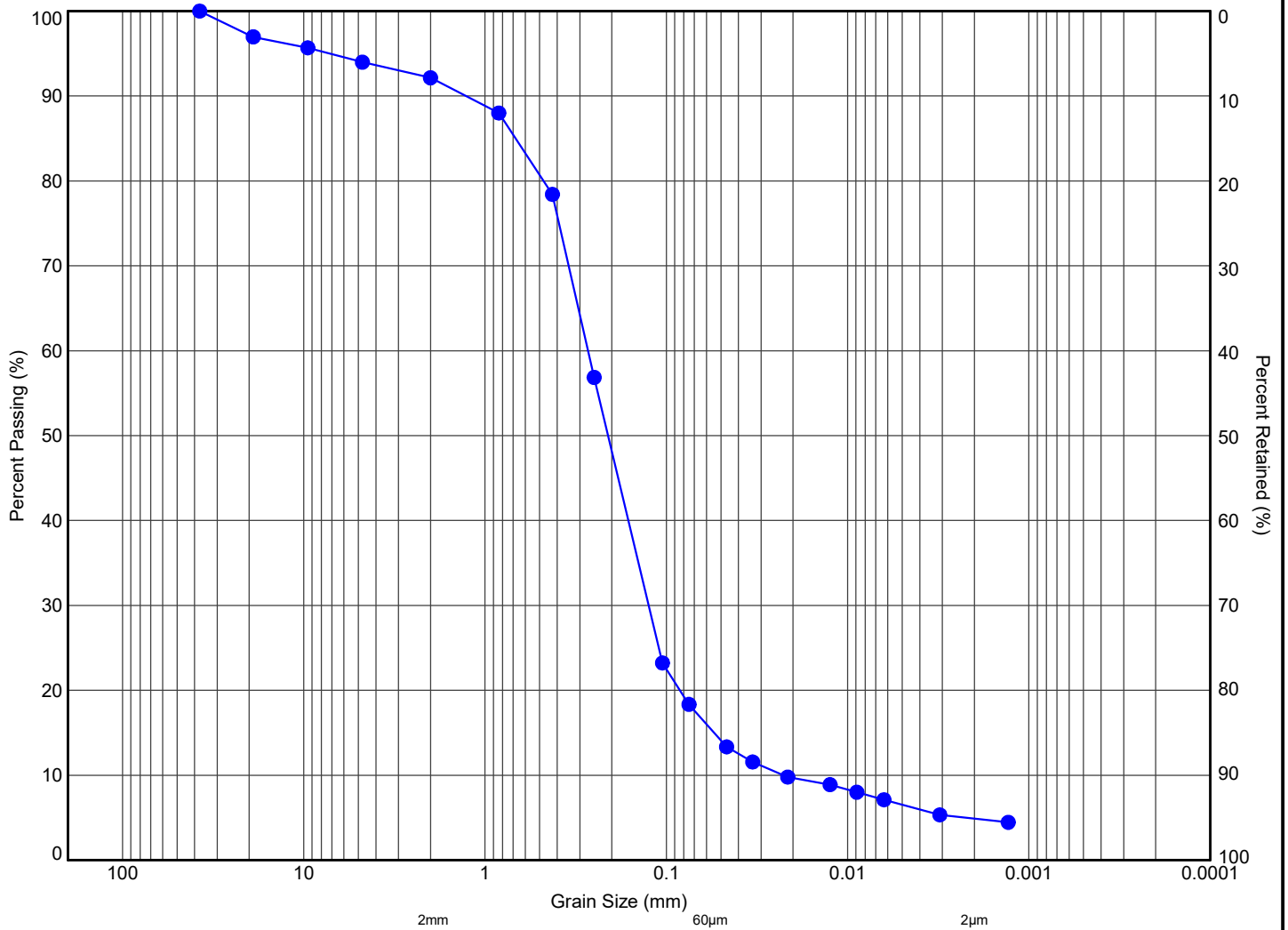
Sample Name: Borehole 1 Sample 6 Elevation (m) 307.3

Mass Sample (g): 384.3 T (°C) 23

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.1E-02	2.1E-04	18.19	
Hazen K (cm/s) = d ₁₀ (mm)	2.5E-02	2.5E-04	22.02	
Slichter	4.6E-03	4.6E-05	3.97	
Terzaghi	7.2E-03	7.2E-05	6.25	
Beyer	2.4E-02	2.4E-04	20.37	
Sauerbrei	1.3E-02	1.3E-04	10.80	
Kruger	1.0E-02	1.0E-04	8.79	
Kozeny-Carmen	1.3E-02	1.3E-04	11.23	
Zunker	9.0E-03	9.0E-05	7.81	
Zamarin	1.1E-02	1.1E-04	9.62	
USBR	2.6E-02	2.6E-04	22.41	
Barr	5.2E-03	5.2E-05	4.50	
Alyamani and Sen	3.8E-04	3.8E-06	0.33	
Chapuis	5.4E-03	5.4E-05	4.64	
Krumbein and Monk	1.9E-02	1.9E-04	16.68	
geometric mean	7.2E-03	7.2E-05	6.25	
arithmetic mean	1.1E-02	1.1E-04	9.31	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 2	SS10	10.8	301.8	8	76	11	5		



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY**

File No.:

3-22-0008-01

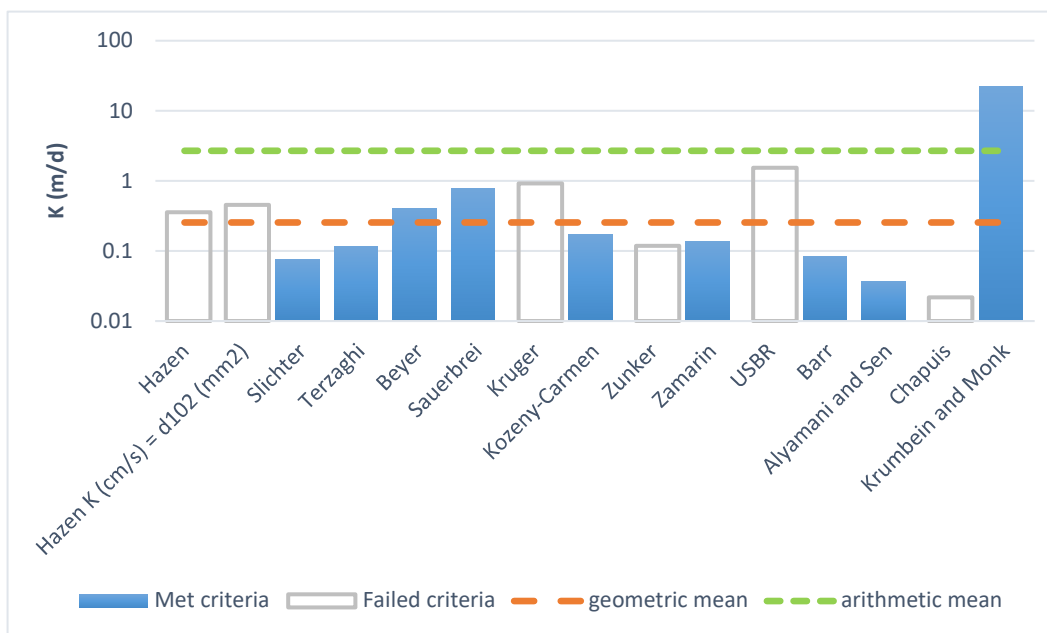


K from Grain Size Analysis Report

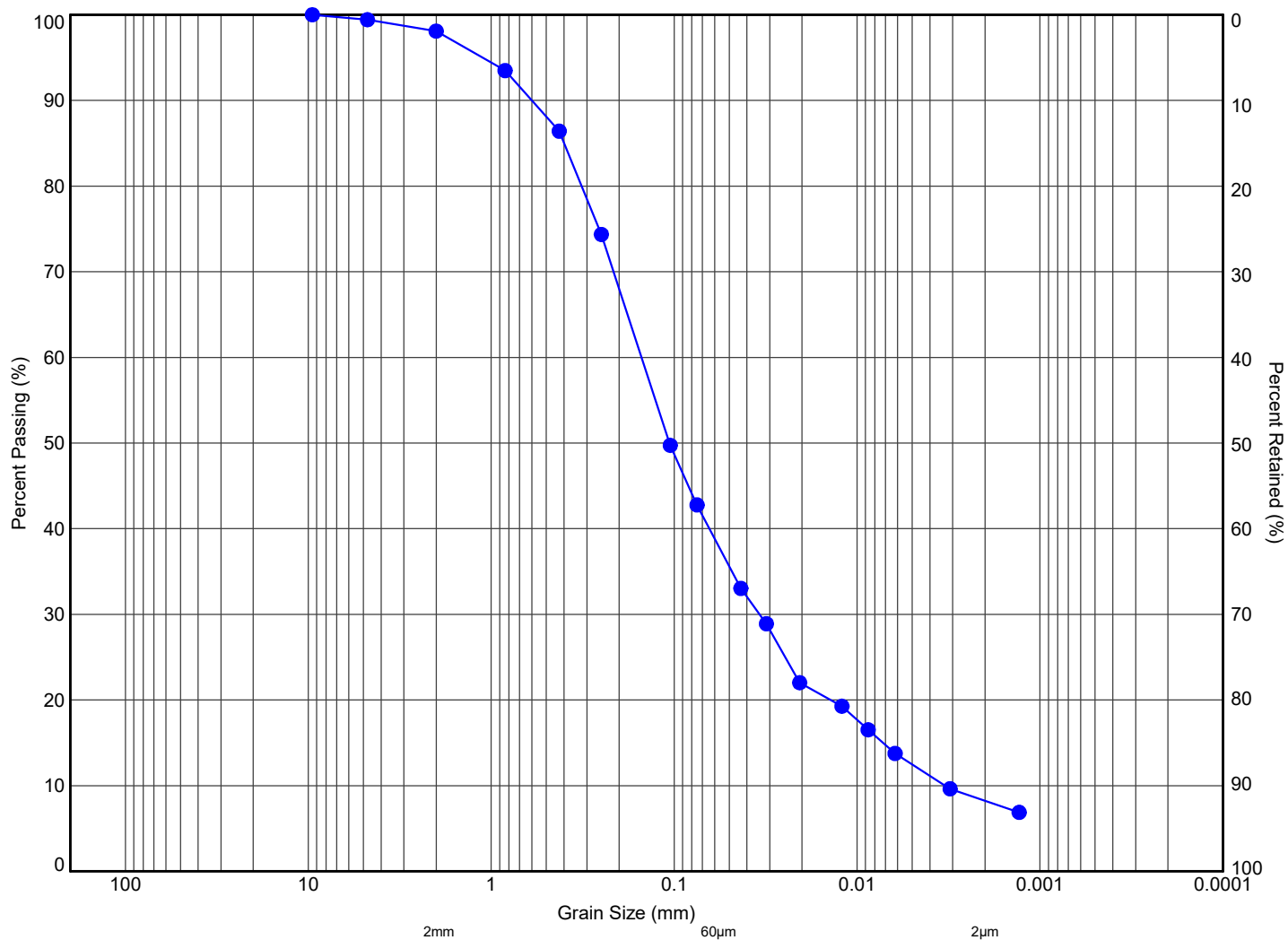
Sample Name: Borehole 2 Sample 10 Elevation (m) 301.8

Mass Sample (g): 406.4 T (°C) 23

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.1E-04	4.1E-06	0.35	
Hazen K (cm/s) = d ₁₀ (mm)	5.2E-04	5.2E-06	0.45	
Slichter	8.7E-05	8.7E-07	0.08	
Terzaghi	1.4E-04	1.4E-06	0.12	
Beyer	4.7E-04	4.7E-06	0.41	
Sauerbrei	9.0E-04	9.0E-06	0.77	
Kruger	1.1E-03	1.1E-05	0.92	
Kozeny-Carmen	2.0E-04	2.0E-06	0.17	
Zunker	1.4E-04	1.4E-06	0.12	
Zamarin	1.6E-04	1.6E-06	0.14	
USBR	1.8E-03	1.8E-05	1.54	
Barr	9.8E-05	9.8E-07	0.08	
Alyamani and Sen	4.3E-05	4.3E-07	0.04	
Chapuis	2.5E-05	2.5E-07	0.02	
Krumbein and Monk	2.6E-02	2.6E-04	22.49	
geometric mean	3.0E-04	3.0E-06	0.26	
arithmetic mean	3.1E-03	3.1E-05	2.70	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 4	SS12	13.8	298.0	2	59	31	8		



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE CLAY, TRACE GRAVEL**

File No.:

3-22-0008-01

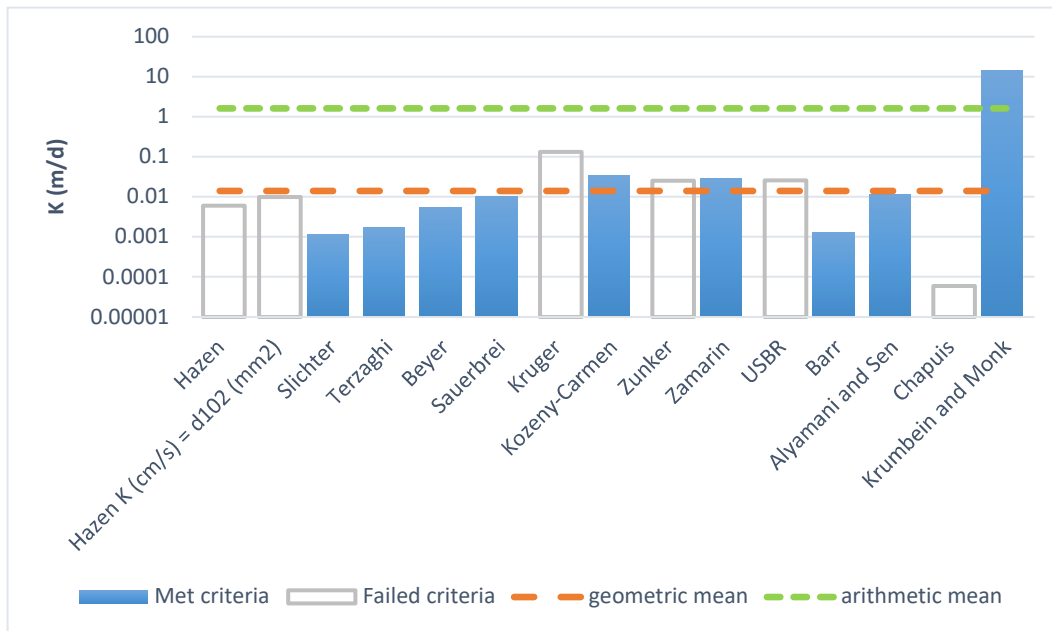


K from Grain Size Analysis Report

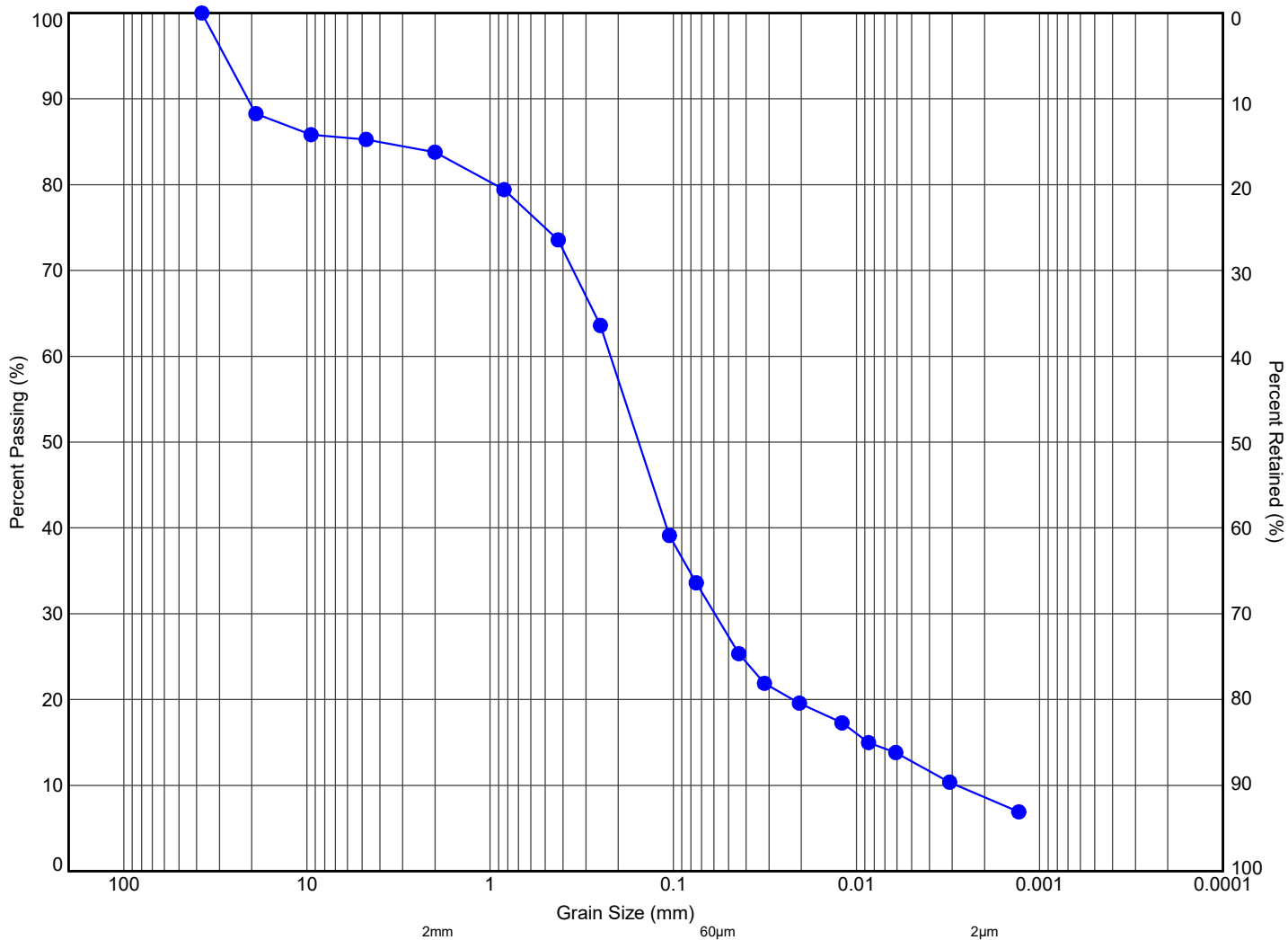
Sample Name: Borehole 4 Sample 12 Elevation (m) 298

Mass Sample (g): 384.6 T (oC) 23

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.0E-06	7.0E-08	0.01	
Hazen K (cm/s) = d ₁₀ (mm)	1.1E-05	1.1E-07	0.01	
Slichter	1.4E-06	1.4E-08	0.00	
Terzaghi	2.0E-06	2.0E-08	0.00	
Beyer	6.4E-06	6.4E-08	0.01	
Sauerbrei	1.2E-05	1.2E-07	0.01	
Kruger	1.5E-04	1.5E-06	0.13	
Kozeny-Carmen	3.8E-05	3.8E-07	0.03	
Zunker	2.9E-05	2.9E-07	0.03	
Zamarin	3.4E-05	3.4E-07	0.03	
USBR	3.0E-05	3.0E-07	0.03	
Barr	1.5E-06	1.5E-08	0.00	
Alyamani and Sen	1.4E-05	1.4E-07	0.01	
Chapuis	6.9E-08	6.9E-10	0.00	
Krumbein and Monk	1.7E-02	1.7E-04	14.45	
geometric mean	1.6E-05	1.6E-07	0.01	
arithmetic mean	1.9E-03	1.9E-05	1.62	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 5	SS9	9.3	303.1	16	53	22	9		



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME GRAVEL, TRACE CLAY**

File No.:

3-22-0008-01

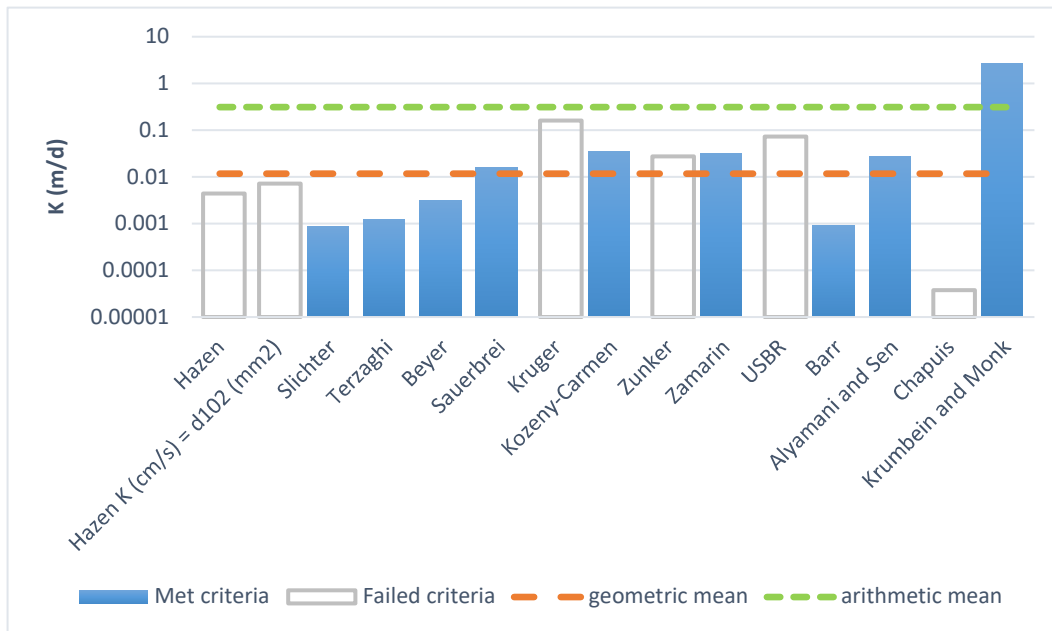


K from Grain Size Analysis Report

Sample Name: Borehole 5 Sample 9 Elevation (m) 303.1

Mass Sample (g): 345.9 T (oC) 23

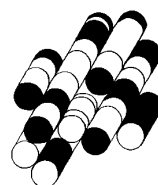
Poorly sorted sand low in fines

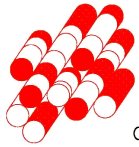


Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.0E-06	5.0E-08	0.00	
Hazen K (cm/s) = d ₁₀ (mm)	8.3E-06	8.3E-08	0.01	
Slichter	9.9E-07	9.9E-09	0.00	
Terzaghi	1.4E-06	1.4E-08	0.00	
Beyer	3.7E-06	3.7E-08	0.00	
Sauerbrei	1.8E-05	1.8E-07	0.02	
Kruger	1.8E-04	1.8E-06	0.16	
Kozeny-Carmen	4.1E-05	4.1E-07	0.04	
Zunker	3.1E-05	3.1E-07	0.03	
Zamarin	3.7E-05	3.7E-07	0.03	
USBR	8.3E-05	8.3E-07	0.07	
Barr	1.1E-06	1.1E-08	0.00	
Alyamani and Sen	3.2E-05	3.2E-07	0.03	
Chapuis	4.4E-08	4.4E-10	0.00	
Krumbein and Monk	3.1E-03	3.1E-05	2.70	
geometric mean	1.4E-05	1.4E-07	0.01	
arithmetic mean	3.6E-04	3.6E-06	0.31	

APPENDIX E

TERRAPROBE INC.





Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

Bail Test Analysis Report

Project: 901 Essa Road and Brown Bear Street

Number: 3-22-0008-46

Client: Brown Bear Dev. Ltd.

Location: Barrie, Ontario

Bail Test: BH 1

Test Well: BH 1

Test Conducted by: CB

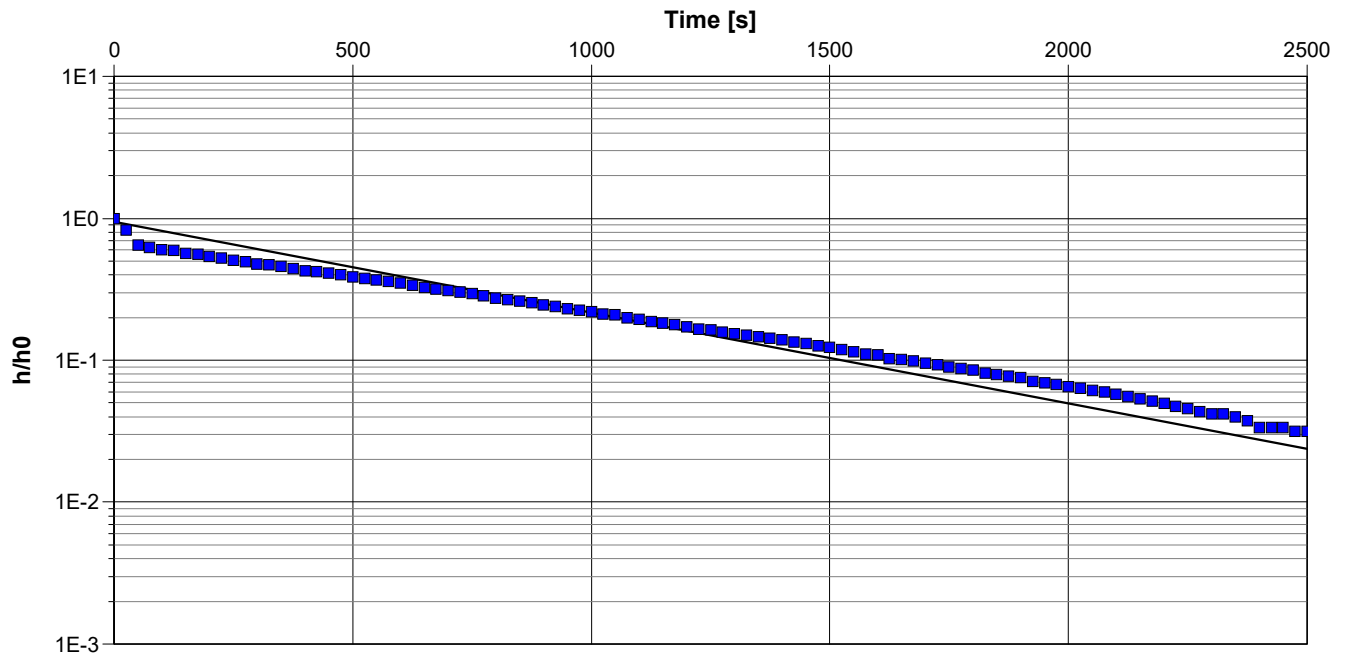
Test Date: 2022-03-18

Analysis Performed by: UA

BH 1

Analysis Date: 2022-03-28

Aquifer Thickness: 7.00 m



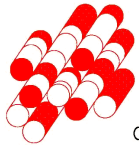
Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH 1

5.91×10^{-7}



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

Bail Test Analysis Report

Project: 901 Essa Road and Brown Bear Street

Number: 3-22-0008-46

Client: Brown Bear Dev. Ltd.

Location: Barrie, Ontario

Bail Test: BH 2

Test Well: BH 2

Test Conducted by: CB

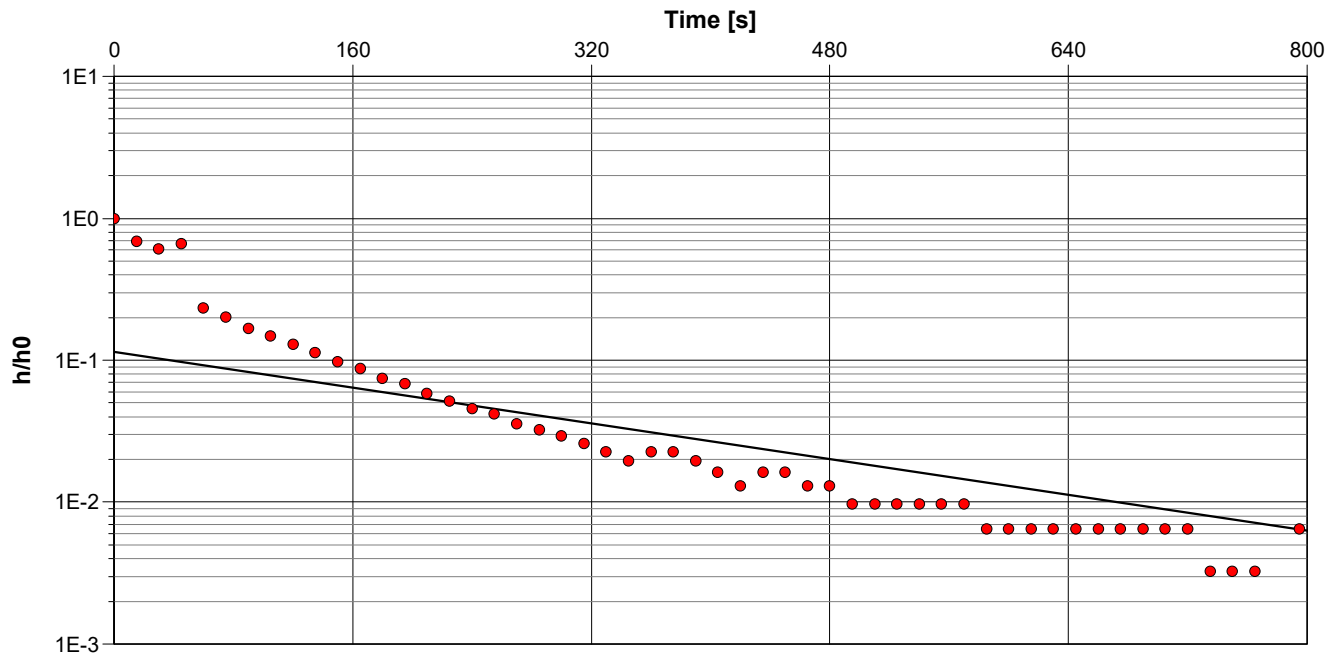
Test Date: 2022-03-18

Analysis Performed by: UA

BH 2

Analysis Date: 2022-03-28

Aquifer Thickness: 7.00 m



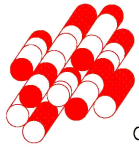
Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH 2

1.44×10^{-6}



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

Bail Test Analysis Report

Project: 901 Essa Road and Brown Bear Street

Number: 3-22-0008-46

Client: Brown Bear Dev. Ltd.

Location: Barrie, Ontario

Bail Test: BH 3

Test Well: BH 3

Test Conducted by: CB

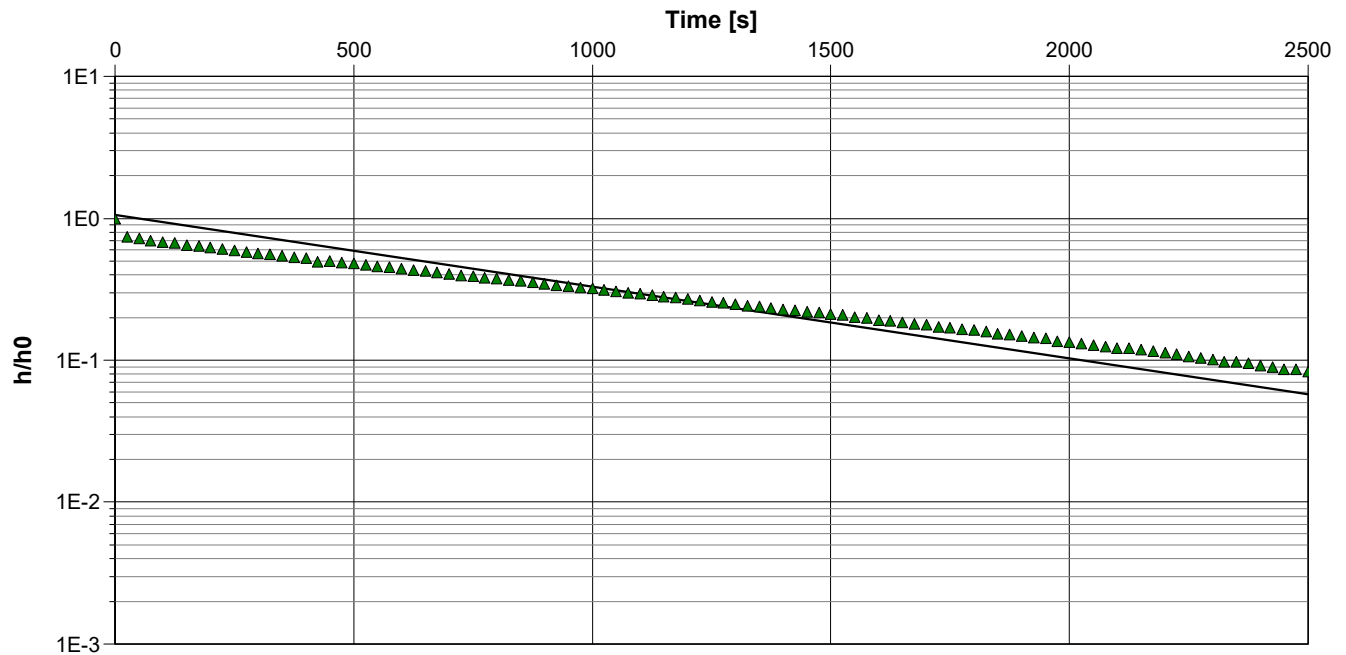
Test Date: 2022-03-14

Analysis Performed by: UA

BH 3

Analysis Date: 2022-03-28

Aquifer Thickness: 7.00 m



Calculation using Bouwer & Rice

Observation Well

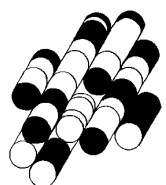
Hydraulic Conductivity
[m/s]

BH 3

4.58×10^{-7}

APPENDIX F

TERRAPROBE INC.



CLIENT NAME: TERRAPROBE INC.
220 BAYVIEW DRIVE, UNIT 25
BARRIE, ON L4N4Y8
(705) 739-8355

ATTENTION TO: Justin Rumney

PROJECT: 3-22-0008-46

AGAT WORK ORDER: 22T867040

TRACE ORGANICS REVIEWED BY: Pinkal Patel, Report Reviewer

WATER ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Mar 03, 2022

PAGES (INCLUDING COVER): 15

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

VERSION 1: March 03, 2022 excluding precious metals

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary - Organics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

		SAMPLE DESCRIPTION:		BH4
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2022-02-24 10:30
Parameter	Unit	G / S	RDL	3551749
Oil and Grease (animal/vegetable) in water	mg/L	150	0.5	0.70
Oil and Grease (mineral) in water	mg/L	15	0.5	<0.5
Dichloromethane	mg/L	0.09	0.0006	<0.0006
Benzene	mg/L	0.01	0.0004	<0.0004
Trichloroethylene	mg/L	0.05	0.0004	<0.0004
Toluene	mg/L	0.02	0.0004	0.0012
Tetrachloroethene	mg/L	0.06	0.0004	<0.0004
Ethylbenzene	mg/L	0.06	0.0002	<0.0002
1,1,2,2-Tetrachloroethane	mg/L	0.06	0.0002	<0.0002
1,4-Dichlorobenzene	mg/L	0.08	0.0002	<0.0002
1,2-Dichlorobenzene	mg/L	0.05	0.0002	<0.0002
Xylenes (Total)	mg/L	0.3	0.0002	<0.0002
Hexachlorobenzene	mg/L	0.0001	0.00001	<0.00001
Naphthalene	mg/L		0.0003	<0.0003
Acenaphthylene	mg/L		0.00011	<0.00011
Acenaphthene	mg/L		0.00010	<0.00010
Fluorene	mg/L		0.0002	<0.0002
Phenanthrene	mg/L		0.00011	<0.00011
Anthracene	mg/L		0.00007	<0.00007
Fluoranthene	mg/L		0.00012	<0.00012
Pyrene	mg/L		0.00012	<0.00012
Benzo(a)anthracene	mg/L		0.00008	<0.00008
Chrysene	mg/L		0.00005	<0.00005
Benzo(b)fluoranthene	mg/L		0.00003	<0.00003
Benzo(k)fluoranthene	mg/L		0.00006	<0.00006
Benzo(a)pyrene	mg/L		0.001	<0.001
Indeno(1,2,3-cd)pyrene	mg/L		0.00003	<0.00003
Dibenzo(a,h)anthracene	mg/L		0.00009	<0.00009
Benzo(ghi)perylene	mg/L		0.00006	<0.00006

Certified By:

Prakash Patel



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary - Organics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

		SAMPLE DESCRIPTION:		BH4
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2022-02-24 10:30
Parameter	Unit	G / S	RDL	3551749
Total PAHs	mg/L	0.005	0.0003	<0.0003
Surrogate	Unit	Acceptable Limits		
Toluene-d8	% Recovery	50-140	107	
4-Bromofluorobenzene	% Recovery	50-140	98	
TCMX	%	50-140	93	
Acridine-d9	%	50-140	85	
Naphthalene-d8	%	50-140	79	
Terphenyl-d14	%	50-140	88	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Limits for Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3551749 Dilution factor=2
The voc sample was diluted because it was foamy. The reporting detection limit has been corrected for the dilution factor used.
Oil and Grease animal/vegetable is a calculated parameter. The calculated value is the difference between Total O&G and Mineral O&G.
Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

BOD5

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

SAMPLE DESCRIPTION: BH4
SAMPLE TYPE: Water
DATE SAMPLED: 2022-02-24
10:30

Parameter	Unit	G / S: A	G / S: B	RDL	3551749
Biochemical Oxygen Demand, Total	mg/L	15	300	2.00	4.00[<A]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Limits for Storm Sewer Discharge - The City of Barrie - By-Law No. 2012-172, B Refers to Limits for Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:



Nivine Basily



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary Sewer Use By-law - Inorganics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

SAMPLE DESCRIPTION: BH4					
SAMPLE TYPE: Water					
DATE SAMPLED: 2022-02-24 10:30					
Parameter	Unit	G / S: A	G / S: B	RDL	3551749
pH	pH Units	6.0-9.5	6.0-9.5	NA	7.81
Chemical Oxygen Demand	mg/L	600		5	16[<A]
Total Suspended Solids	mg/L	350	15	10	<10[<B]
Total Phosphorus	mg/L	10		0.02	<0.02[<A]
Total Kjeldahl Nitrogen	mg/L	100		0.10	0.62[<A]
Fluoride	mg/L	10		0.13	<0.13[<A]
Chloride	mg/L	1500		1.2	1550[>A]
Sulphate	mg/L	1500		0.95	55.8[<A]
Sulphide	mg/L	1.0		0.01	<0.01[<A]
Phenols	mg/L	0.1		0.002	0.033[<A]
Total Cyanide	mg/L	1.2		0.002	0.005[<A]
Total Aluminum	mg/L	50		0.010	0.310[<A]
Total Antimony	mg/L	5.0		0.020	<0.020[<A]
Total Arsenic	mg/L	1.0		0.015	<0.015[<A]
Total Barium	mg/L	5.0		0.020	0.214[<A]
Total Bismuth	mg/L	5.0		0.010	<0.010[<A]
Total Cadmium	mg/L	0.7	0.001	0.001	<0.001[<B]
Total Chromium	mg/L	2.0	0.08	0.015	<0.015[<B]
Total Cobalt	mg/L	5.0		0.020	<0.020[<A]
Total Copper	mg/L	2.0	0.01	0.010	<0.010[<B]
Total Iron	mg/L	50		0.050	0.370[<A]
Total Lead	mg/L	0.7	0.05	0.010	<0.010[<B]
Total Manganese	mg/L	5.0		0.020	0.289[<A]
Total Mercury	mg/L	0.01		0.0002	<0.0002[<A]
Total Molybdenum	mg/L	5.0		0.020	0.030[<A]
Total Nickel	mg/L	2.0	0.05	0.020	<0.020[<B]
Total Selenium	mg/L	1.0		0.002	0.002[<A]
Total Silver	mg/L	0.4		0.020	<0.020[<A]
Total Tin	mg/L	5.0		0.025	<0.025[<A]

Certified By:



Justin Rumney



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary Sewer Use By-law - Inorganics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

SAMPLE DESCRIPTION: BH4
SAMPLE TYPE: Water
DATE SAMPLED: 2022-02-24
10:30
3551749

Parameter	Unit	G / S: A	G / S: B	RDL	
Total Vanadium	mg/L	5.0		0.020	<0.020[<A]
Total Zinc	mg/L	2.0	0.04	0.020	<0.020[<B]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Limits for Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172, B Refers to Limits for Storm Sewer Discharge - The City of Barrie - By-Law No. 2012-172

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3551749 Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Nivine Basly



AGAT Laboratories

Exceedance Summary

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Justin Rumney

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3551749	BH4	ON Barrie SN	Barrie Sanitary Sewer Use By-law - Inorganics	Chloride	mg/L	1500	1550



Quality Assurance

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Trace Organics Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Barrie Sanitary - Organics															
Oil and Grease (animal/vegetable) in water	3523681		2.11	2.13	NA	< 0.5	95%	70%	130%	108%	70%	130%	106%	70%	130%
Oil and Grease (mineral) in water	3523681		< 0.5	< 0.5	NA	< 0.5	87%	70%	130%	81%	70%	130%	72%	70%	130%
Dichloromethane	3543521		<0.0003	<0.0003	NA	< 0.0003	100%	50%	140%	93%	60%	130%	105%	50%	140%
Benzene	3543521		<0.0002	<0.0002	NA	< 0.0002	79%	50%	140%	75%	60%	130%	75%	50%	140%
Trichloroethylene	3543521		0.0030	0.0026	15.9%	< 0.0002	73%	50%	140%	72%	60%	130%	119%	50%	140%
Toluene	3543521		<0.0002	<0.0002	NA	< 0.0002	73%	50%	140%	89%	60%	130%	74%	50%	140%
Tetrachloroethene	3543521		<0.0002	<0.0002	NA	< 0.0002	76%	50%	140%	99%	60%	130%	75%	50%	140%
Ethylbenzene	3543521		<0.0001	<0.0001	NA	< 0.0001	75%	50%	140%	78%	60%	130%	74%	50%	140%
1,1,2,2-Tetrachloroethane	3543521		<0.0001	<0.0001	NA	< 0.0001	83%	50%	140%	116%	60%	130%	114%	50%	140%
1,4-Dichlorobenzene	3543521		<0.0001	<0.0001	NA	< 0.0001	115%	50%	140%	108%	60%	130%	101%	50%	140%
1,2-Dichlorobenzene	3543521		<0.0001	<0.0001	NA	< 0.0001	116%	50%	140%	103%	60%	130%	96%	50%	140%
Hexachlorobenzene	3525090		< 0.00001	< 0.00001	NA	< 0.00001	94%	50%	140%	102%	50%	140%	91%	50%	140%
Naphthalene	3533006		< 0.0003	< 0.0003	NA	< 0.0003	85%	50%	140%	96%	50%	140%	79%	50%	140%
Acenaphthylene	3533006		< 0.00011	< 0.00011	NA	< 0.00011	76%	50%	140%	84%	50%	140%	82%	50%	140%
Acenaphthene	3533006		< 0.00010	< 0.00010	NA	< 0.00010	82%	50%	140%	72%	50%	140%	84%	50%	140%
Fluorene	3533006		< 0.0002	< 0.0002	NA	< 0.0002	84%	50%	140%	96%	50%	140%	76%	50%	140%
Phenanthrene	3533006		< 0.00011	< 0.00011	NA	< 0.00011	75%	50%	140%	85%	50%	140%	85%	50%	140%
Anthracene	3533006		< 0.00007	< 0.00007	NA	< 0.00007	86%	50%	140%	84%	50%	140%	89%	50%	140%
Fluoranthene	3533006		< 0.00012	< 0.00012	NA	< 0.00012	84%	50%	140%	79%	50%	140%	85%	50%	140%
Pyrene	3533006		< 0.00012	< 0.00012	NA	< 0.00012	79%	50%	140%	85%	50%	140%	84%	50%	140%
Benzo(a)anthracene	3533006		< 0.00008	< 0.00008	NA	< 0.00008	82%	50%	140%	84%	50%	140%	76%	50%	140%
Chrysene	3533006		< 0.00005	< 0.00005	NA	< 0.00005	84%	50%	140%	76%	50%	140%	85%	50%	140%
Benzo(b)fluoranthene	3533006		< 0.00003	< 0.00003	NA	< 0.00003	79%	50%	140%	82%	50%	140%	89%	50%	140%
Benzo(k)fluoranthene	3533006		< 0.00006	< 0.00006	NA	< 0.00006	85%	50%	140%	69%	50%	140%	85%	50%	140%
Benzo(a)pyrene	3533006		< 0.001	< 0.001	NA	< 0.001	84%	50%	140%	85%	50%	140%	84%	50%	140%
Indeno(1,2,3-cd)pyrene	3533006		< 0.00003	< 0.00003	NA	< 0.00003	79%	50%	140%	79%	50%	140%	73%	50%	140%
Dibenzo(a,h)anthracene	3533006		< 0.00009	< 0.00009	NA	< 0.00009	86%	50%	140%	85%	50%	140%	89%	50%	140%
Benzo(ghi)perylene	3533006		< 0.00006	< 0.00006	NA	< 0.00006	85%	50%	140%	84%	50%	140%	85%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Jim Kal Patel

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Water Analysis															
RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Barrie Sanitary Sewer Use By-law - Inorganics

pH	3550559		7.68	7.70	0.3%	NA	102%	90%	110%						
Chemical Oxygen Demand	3551749	3551749	16	16	NA	< 5	97%	90%	110%	100%	90%	110%	94%	70%	130%
Total Suspended Solids	3549578		<10	<10	NA	< 10	98%	80%	120%						
Total Phosphorus	3547318		<0.02	<0.02	NA	< 0.02	96%	70%	130%	101%	80%	120%	98%	70%	130%
Total Kjeldahl Nitrogen	3554776		1.63	1.66	1.8%	< 0.10	99%	70%	130%	104%	80%	120%	90%	70%	130%
Fluoride	3552721		<0.05	<0.05	NA	< 0.05	104%	70%	130%	104%	80%	120%	101%	70%	130%
Chloride	3552721		34.1	33.9	0.6%	< 0.10	93%	70%	130%	105%	80%	120%	106%	70%	130%
Sulphate	3552721		161	160	0.6%	< 0.10	100%	70%	130%	104%	80%	120%	NA	70%	130%
Sulphide	3552639		<0.01	<0.01	NA	< 0.01	101%	90%	110%	100%	90%	110%	100%	80%	120%
Phenols	3552639		<0.002	<0.002	NA	< 0.002	99%	90%	110%	95%	90%	110%	97%	80%	120%
Total Cyanide	3505429		<0.002	<0.002	NA	< 0.002	101%	70%	130%	92%	80%	120%	106%	70%	130%
Total Aluminum	3551749	3551749	0.310	0.311	0.3%	< 0.010	97%	70%	130%	103%	80%	120%	101%	70%	130%
Total Antimony	3551749	3551749	<0.020	<0.020	NA	< 0.020	100%	70%	130%	97%	80%	120%	92%	70%	130%
Total Arsenic	3551749	3551749	<0.015	<0.015	NA	< 0.015	97%	70%	130%	101%	80%	120%	104%	70%	130%
Total Barium	3551749	3551749	0.214	0.220	2.8%	< 0.020	102%	70%	130%	100%	80%	120%	108%	70%	130%
Total Bismuth	3551749	3551749	<0.010	<0.010	NA	< 0.010	91%	70%	130%	101%	80%	120%	80%	70%	130%
Total Cadmium	3551749	3551749	<0.001	<0.001	NA	< 0.001	99%	70%	130%	98%	80%	120%	92%	70%	130%
Total Chromium	3551749	3551749	<0.015	<0.015	NA	< 0.015	100%	70%	130%	101%	80%	120%	101%	70%	130%
Total Cobalt	3551749	3551749	<0.020	<0.020	NA	< 0.020	99%	70%	130%	108%	80%	120%	103%	70%	130%
Total Copper	3551749	3551749	<0.010	<0.010	NA	< 0.010	99%	70%	130%	101%	80%	120%	96%	70%	130%
Total Iron	3551749	3551749	0.370	0.373	0.8%	< 0.050	101%	70%	130%	108%	80%	120%	99%	70%	130%
Total Lead	3551749	3551749	<0.010	<0.010	NA	< 0.010	95%	70%	130%	93%	80%	120%	88%	70%	130%
Total Manganese	3551749	3551749	0.289	0.291	0.7%	< 0.020	101%	70%	130%	107%	80%	120%	103%	70%	130%
Total Mercury	3548601		<0.0002	<0.0002	NA	< 0.0002	98%	70%	130%	101%	80%	120%	93%	70%	130%
Total Molybdenum	3551749	3551749	0.030	0.032	NA	< 0.020	102%	70%	130%	101%	80%	120%	108%	70%	130%
Total Nickel	3551749	3551749	<0.020	<0.020	NA	< 0.020	97%	70%	130%	106%	80%	120%	97%	70%	130%
Total Selenium	3551749	3551749	0.002	0.003	NA	< 0.002	111%	70%	130%	100%	80%	120%	101%	70%	130%
Total Silver	3551749	3551749	<0.020	<0.020	NA	< 0.020	97%	70%	130%	106%	80%	120%	94%	70%	130%
Total Tin	3551749	3551749	<0.025	<0.025	NA	< 0.025	97%	70%	130%	97%	80%	120%	98%	70%	130%
Total Vanadium	3551749	3551749	<0.020	<0.020	NA	< 0.020	97%	70%	130%	104%	80%	120%	107%	70%	130%
Total Zinc	3551749	3551749	<0.020	0.020	NA	< 0.020	97%	70%	130%	99%	80%	120%	88%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

BOD5

Biochemical Oxygen Demand, Total 3548749 <20.0 <20.0 NA < 20.0 102% 70% 130%

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Water Analysis (Continued)

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:


Nivine Basily



Method Summary

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Oil and Grease (animal/vegetable) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	BALANCE
Oil and Grease (mineral) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	BALANCE
Dichloromethane	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Benzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Toluene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Xylenes (Total)	VOL-91-5001	modified from EPA 5030B & EPA 8260D	CALCULATION
Toluene-d8	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Hexachlorobenzene	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
TCMX	ORG-91-5112	EPA SW-846 3510 & 8081	GC/ECD
Naphthalene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Acenaphthylene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Acenaphthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Fluorene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Phenanthrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Anthracene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Fluoranthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Pyrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(a)anthracene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Chrysene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(b)fluoranthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(k)fluoranthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(a)pyrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS

Method Summary

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Indeno(1,2,3-cd)pyrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Dibenzo(a,h)anthracene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(ghi)perylene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Acridine-d9	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Naphthalene-d8	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Terphenyl-d14	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Total PAHs	ORG-91-5105	modified from EPA 3510C and EPA 8270E	CALCULATION



Method Summary

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Biochemical Oxygen Demand, Total	INOR-121-6023	SM 5210 B	INCUBATOR
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Chemical Oxygen Demand	INOR-93-6042	modified from SM 5220 A and SM 5220 D	SPECTROPHOTOMETER
Total Suspended Solids	INOR-93-6028	modified from EPA 1684, ON MOECC E3139, SM 2540C, D	BALANCE
Total Phosphorus	INOR-93-6022	modified from SM 4500-P B and SM 4500-P E	SPECTROPHOTOMETER
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphide	INOR-93-6054	modified from SM 4500 S2- D	SPECTROPHOTOMETER
Phenols	INOR-93-6072	modified from SM 5530 D	LACHAT FIA
Total Cyanide	INOR-93-6051	modified from MOECC E3015; SM 4500-CN- A, B, & C	TECHNICON AUTO ANALYZER
Total Aluminum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Antimony	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Arsenic	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Barium	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Bismuth	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cadmium	MET -93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Chromium	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cobalt	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Copper	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Iron	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Lead	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Manganese	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Mercury	MET-93-6100	modified from EPA 245.2 and SM 3112 B	CVAAS
Total Molybdenum	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Nickel	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Selenium	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Silver	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Tin	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

ATTENTION TO: Justin Rumney

SAMPLING SITE: 901 Essa Rd, Barrie ON

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Vanadium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zinc	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS



Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Terraprobe
Contact: Justin
Address: 220 Bayview Dr. Unit 25, Barrie, O.N.,
L4N 4Y8
Phone: _____ Fax: _____
Reports to be sent to:
1. Email: jrumney@terraprobe.ca
2. Email: cburmeister@terraprobe.ca

Project Information:

Project: 3-22-0008-46
Site Location: 901 Essa Rd. Barrie, ON
Sampled By: Cole Burmeister
AGAT Quote #: _____ PO: _____

Invoice Information:

Company: Terraprobe
Contact: Lorena Rossi
Address: 11 Indell Lane, Brampton, ON L6T 3Y3
Email: lrossi@terraprobe.ca

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04	☐ Excess Soils R406	☒ Sewer Use ☒ Sanitary barrie	☒ Storm
Table _____ <i>Indicate One</i>	Table _____ <i>Indicate One</i>	Region _____	
☐ Ind/Com	☐ Regulation 558	☐ Prov. Water Quality Objectives (PWQO)	
☐ Res/Park	☐ CCME	☐ Other	
☐ Agriculture			
Soil Texture (<i>Check One</i>)			
☐ Coarse			
☐ Fine			
		_____ <i>Indicate One</i>	

Is this submission for a
Record of Site Condition?

☐ Yes ☐ No

Report Guideline on Certificate of Analysis

☒ Yes ☐ No

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

[illegible]

Samples Relinquished By (Print Name and Sign):

Cole Burmeister Cole Burmeister

Date

02/24/22

Time

1

Sample Received By (Print Name and Sign)

Anthony L

Da

Time

Samples Relinquished By (Print Name and Sign):

Date _____

Time	
------	--

Samples Received By (Print Name and Sign):	
--	--

	Da
--	----

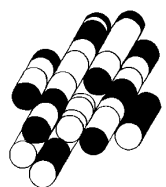
	Time
--	------

Page ____ of ____

Nº: **T 130893**

APPENDIX G

TERRAPROBE INC.



APPENDIX G - Water Balance - 901 Essa Road, Barrie

File No. 3-22-0008-46

1. Climate Information

Precipitation ¹	933 mm/a	0.93 m/a
Actual Evapotranspiration ¹	517 mm/a	0.52 m/a
Precipitation Surplus	416 mm/a	0.42 m/a

2. Infiltration Rates

Table 2 Approach - Infiltration Factors ²		(Pre and Post Development)	
Rolling Land, Fine Sany Loam, Urban Lawns			
Infiltration	270 mm/a	0.270 m/a	
Run-off	146 mm/a	0.146 m/a	

3. Property Statistics

			%
Building Area/Coverage	448 m ²	0.04 ha	5
Hardscape/Impervious	1,919 m ²	0.19 ha	22
Softscape/Landscape (Undeveloped area)	6,494 m ²	0.65 ha	73
TOTAL	8,860.80 m²	0.89 ha	100
Post-Development Coverage			
Building Area/Coverage (Roof Runoff)	3,630 m ²	0.36 ha	41
Hardscape/Impervious (Paved area)	2,725 m ²	0.27 ha	31
Softscape/Landscape	2,507 m ²	0.25 ha	28
TOTAL:	8,860.80 m²	0.89 ha	100

Notes/References:

Water Balance Analysis Method: Thornthwaite and Matther approach

1 Canadian Climate Normals 1981-2010 Station Data for Barrie WPCC Climate Station

2 MOE, June 2003, Stormwater Management Planning and Design Manual

APPENDIX G - Water Balance - 901 Essa Road, Barrie
File No. 3-22-0008-46

4. Annual Water Balance (Pre Development)

Land Use	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Building Area/Coverage	448	418	nil	42	nil	376
Hardscape/Impervious	1,919	1,790	nil	179	nil	1,611
Softscape/Landscape	6,494	6,059	3,357	nil	1,756	946
TOTAL	8,861	8,267	3,357	221	1,756	2,933

6. Annual Water Balance (Post Development)

Land Use	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Building Area/Coverage	3,630	3,386	nil	339	nil	3,048
Hardscape/Impervious	2,725	2,542	nil	254	nil	2,288
Softscape/Landscape	2,507	2,339	1,296	nil	678	365
TOTAL	8,861	8,267	1,296	593	678	5,701

7. Comparison of Pre-Development (before building additions) and Post-Development (after building additions)

	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Pre-Development	8,267	3,357	221	1,756	2,933
Post-Development	8,267	1,296	593	678	5,701
Difference	0	-2,061	372	-1,078	2,768

8. Requirement for Infiltration Maintenance from roof run-off

Volume of roof run-off captured (90%) (roof run-off available in post development) 2,743 m³

Volume of roof run-off required to match pre-development infiltration rates (Infiltration deficit in post development) 1,078 m³

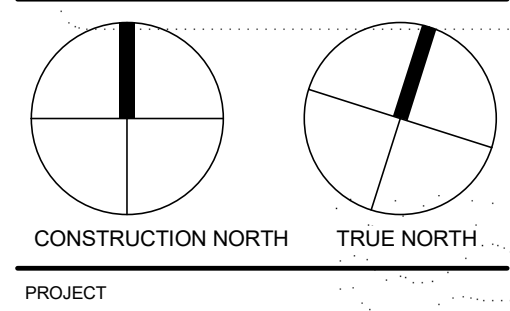
Percentage of roof run-off required to match pre-development infiltration 39%

NO.	ISSUED	DATE
	CLIENT REVIEW	2022-01-12
	CLIENT REVIEW	2022-01-19

DO NOT SCALE DRAWINGS. USE ONLY DIMENSIONS MARKED FOR CONSTRUCTION. VERIFY CONFIGURATIONS AND DIMENSIONS ON SITE BEFORE BEGINNING WORK. NOTIFY ARCHITECT IMMEDIATELY OF ANY ERRORS, OMISSIONS OR DISCREPANCIES. CHAMBERLAIN ARCHITECT SERVICES LIMITED AND CHAMBERLAIN CONSTRUCTION SERVICES LIMITED HAVE SIMILAR OWNERSHIP. CHAMBERLAIN ARCHITECT SERVICES LIMITED HAS COPYRIGHT. CONSTRUCTING A SUBSTANTIALLY SIMILAR BUILDING WITHOUT PERMISSION MAY INFRINGE THE COPYRIGHT OWNERS RIGHTS. MAKING UNLAWFUL CHANGES TO PLANS AND DOES NOT NECESSARILY AVOID COPYRIGHT INFRINGEMENT. INFRINGEMENT IS NOT A DEFENSE TO COPYRIGHT INFRINGEMENT. ©

CLIENT
SEAL

RESIDENTIAL PARKING
Required Barrier Free Parking Over 100 spaces 1 space plus 3% of required parking spaces
Residential building containing more than 3 dwelling units 1.5 spaces per dwelling unit Met
COMMERCIAL PARKING
4.6.2.3 Parking - Multiple Uses
b) Multiple Uses in Commercial Zones: A minimum of 1 parking space per 24m² of gross floor area shall be required except where residential uses are in combination with another use, in which case the residential use components shall be at the rate identified in Table 4.6 and the additional multiple uses shall be at a rate of 1 parking space per 24m².
4.6.2.5.1 Notwithstanding any provisions to the contrary, structural columns in a parking structure may encroach into a parking space provided that the minimum width of the parking space is not less than 2.5m. Encroachment into the standard parking space width of 2.7m is not permitted where a wall, fence or similar full length obstruction is abutting any parking space. (By-law 2016-003)
COMMERCIAL LOADING SPACES
4.7.1 General Provisions
For any industrial or commercial use, permanent loading spaces shall be provided and maintained on the same lot in accordance with the following provisions:
Gross Floor Area Number of Spaces
1,000m² - 2,499m² 1 space
SMALL CAR PARKING
14.4.3 Parking and Driveway Regulations
Notwithstanding the provisions of Section 4.6.2 a maximum of 10% of the minimum parking spaces required for any non-residential parking may be for small vehicle parking spaces. Additional parking spaces provided over and above the minimum requirements may be for small vehicle parking. The dimension of a small vehicle parking space shall have a width of 2.3m and a length of 4.6m.
BICYCLE PARKING
14.4.2 Bicycle parking spaces shall be provided in accordance with the following:
a) A minimum of 0.2 spaces per unit shall be provided in all apartment units including walk-up apartments.
b) Additional spaces shall be provided for all non-residential uses in the NMu at a rate of one bicycle parking space for every 7% of required nonresidential vehicular parking spaces in the Neighbourhood Mixed Use zone.
Required 1.5 / unit x 407 unit = 611 parking
1 / 24m² x 1083 m² = 46 parking
Total 657 parking (21 to be barrier free)
Met
Required 0.2 / unit x 405 unit = 81 bicycle parking
46 Parking x 7% = 4 bicycle parking
Total 85 bicycle parking



BROWN BEAR APARTMENTS

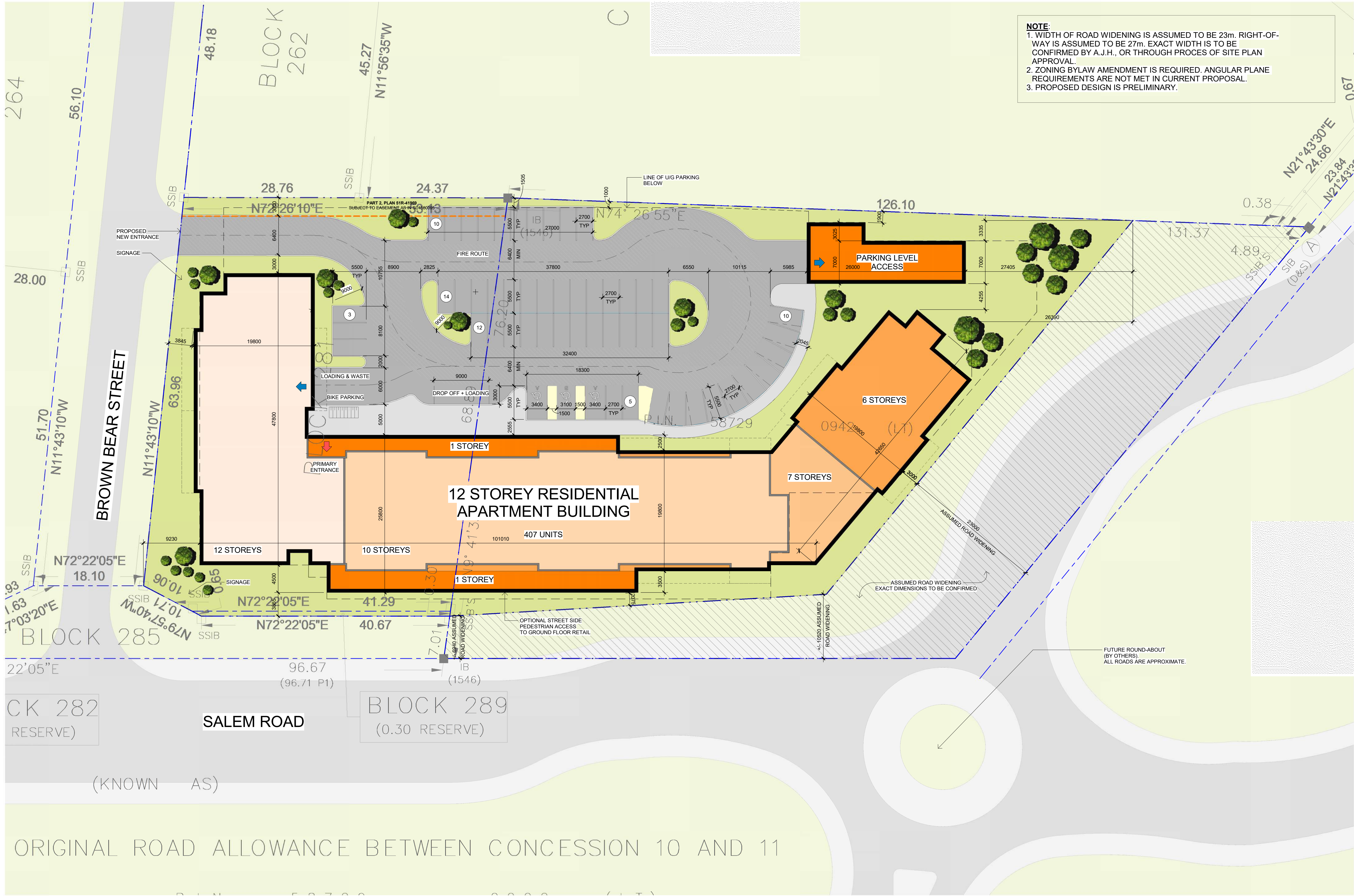
SALEM & ESSA ROAD
BARRIE, ON.

SHEET NAME

SITE PLAN

START DATE JAN. 2022
DRAWN BY MC
CHECKED BY LC
SCALE As indicated
PROJECT NO. 122001
DRAWING

A001



NOTE:
1. WIDTH OF ROAD WIDENING IS ASSUMED TO BE 23m. RIGHT-OF-WAY IS ASSUMED TO BE 27m. EXACT WIDTH IS TO BE CONFIRMED BY A.J.H., OR THROUGH PROCES OF SITE PLAN APPROVAL.
2. ZONING BYLAW AMENDMENT IS REQUIRED. ANGULAR PLANE REQUIREMENTS ARE NOT MET IN CURRENT PROPOSAL.
3. PROPOSED DESIGN IS PRELIMINARY.

1 SITE PLAN A001 1:300

GROSS FLOOR AREA (SUMMARY)			
FLOOR SPACE	AREA (m ²)	AREA (ft ²)	%
COMMERCIAL	1083.3 m ²	11661 ft ²	4%
COMMON	5076.9 m ²	54648 ft ²	17%
RESIDENTIAL - UNITS	24105.1 m ²	259466 ft ²	89%
	30265.4 m ²	325774 ft ²	100%

SUITE MIX (SUMMARY)		
UNIT TYPE	COUNT	%
1 BR	164	40%
1 BR + DEN	179	44%
2 BR	57	14%
3 BR	7	2%
	407	100%

BICYCLE PARKING SCHEDULE		
LEVEL	DESCRIPTION	COUNT
T/O GROUND FLOOR	0.6m x 1.8m	8
T/O PARKING LEVEL 1	0.6m x 1.8m	78
TOTAL PARKING		86

PARKING SCHEDULE		
TYPE	DESCRIPTION	COUNT
T/O GROUND FLOOR		
ACC. PARKING (TYPE A)	3.4m x 5.5m	2
ACC. PARKING (TYPE B)	3.1m x 5.5m	1
LOADING	3.0m x 9.0m	1
TYPICAL PARKING	2.7m x 5.5m	51
		55
T/O PARKING LEVEL 1		
ACC. PARKING (TYPE A)	3.4m x 5.5m	6
ACC. PARKING (TYPE B)	3.1m x 5.5m	3
TYPICAL PARKING	2.7m x 5.5m	200
		209
T/O PARKING LEVEL 2		
ACC. PARKING (TYPE A)	3.4m x 5.5m	6
ACC. PARKING (TYPE B)	3.1m x 5.5m	3
TYPICAL PARKING	2.7m x 5.5m	200
		209
T/O PARKING LEVEL 3		
ACC. PARKING (TYPE A)	3.4m x 5.5m	6
ACC. PARKING (TYPE B)	3.1m x 5.5m	3
TYPICAL PARKING	2.7m x 5.5m	200
		209
TOTAL PARKING		682

SITE STATISTICS			
DESCRIPTION	AREA (m ²)	AREA (ft ²)	%
BUILDING FOOTPRINT			
BUILDING FOOTPRINT	3629.60 m ²	39069 ft ²	41.0%
ACC. PARKING (TYPE B)	3629.60 m ²	39069 ft ²	41.0%
HARD LANDSCAPE			
ASPHALT	2375.64 m ²	25571 ft ²	26.8%
SIDEWALK	348.94 m ²	3756 ft ²	3.9%
	2724.59 m ²	29327 ft ²	30.7%
SOFT LANDSCAPE			
LANDSCAPE	2506.62 m ²	26981 ft ²	28.3%
	2506.62 m ²	26981 ft ²	28.3%
TOTAL SITE AREA	8860.80 m ²	95377 ft ²	100.0%

APPENDIX H

TERRAPROBE INC.

