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**A REPORT TO**
**QUEENSGATE HOMES BARRIE INC.**

**HYDROGEOLOGICAL ASSESSMENT PROPOSED**
**RESIDENTIAL DEVELOPMENT**
**681-685 YONGE STREET**

**CITY OF BARRIE**

**REFERENCE NO. 1909-W019**

**NOVEMBER 2019**

## DISTRIBUTION

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## 1.0 EXECUTIVE SUMMARY

We have completed a hydrogeological assessment for the subject site located at 681-685 Yonge Street, in the City of Barrie. The subject site consists of former residential housing lots, where the surrounding land uses includes; residential and commercial properties to the north, Yonge Street and an active development site and commercial properties to the West, Ashford Drive an existing school to the south and an active development site to the southwest.

The investigation revealed that below a veneer of topsoil 22 cm thick and/or a layer of earth fill extending to depths of 1.4 to 2.1 m, the site is underlain by native subsoil strata, comprising silty sand till and sandy silt till, embedded with sand layers. Cobbles and boulders are encountered in the tills, in places, extending to the maximum depths of the investigation at 15.5 mbgs.

The findings show that the average of groundwater levels range from below El. 252.09 to 253.3 masl (3.16 to 4.11 mbgl) as measured over the monitoring period. The shallow groundwater flow pattern is towards the south-west.

Review of the nearby are records indicates that Hewitt's Creek is located approximately 1,170 m east of the subject site and Lover's Creek is located about 718 m west of the subject site, both of which flow north into Lake Simcoe. There are also records of unevaluated wetlands west and east of the site.

The single well response tests yielded an estimated hydraulic conductivity (K) values ranging from between $6.6 \times 10^{-7}$ m/sec and $1.6 \times 10^{-6}$ m/sec for the sandy silt till at the depths of the well screen, suggesting low to moderate anticipated seepage rates into open excavations below the water table during construction.

Since the shallow groundwater level elevation is above the lowest basement floor elevation for the proposed residential building, and temporary construction dewatering will be required to manage any groundwater seepage through use of occasional pumping from sumps for construction of the proposed underground structure and associated services. The temporary construction dewatering flows to build the proposed underground structure will range from 12,510.8 to 181,135.23 L/day with application of a 3x safety factor these flows could reach daily maximums of 37,532.4 up to 543,405.69 L/day. The high end of the anticipated daily flows is above the MECP approval threshold limit of 50,000 L/day whereby the approval for proposed groundwater taking is by means of an EASR with the

EASR filed through the MECP. The construction dewatering estimates represent the high end of the estimated flow where a safety factor has been applied to the flows.

The combined long-term foundation drainage estimates for the completed underground structure is estimated at 4,460.97 L/day for the shore wall, perimeter mira drainage network and is 472.69 L/day for the basement under-slab drainage network. The combined drainage rate for both systems is 4,933.66L/day, with application of a 2 x safety factor the combined drainage rate could reach 9,867.32 L/day. The high end of the drainage flow estimate is below the MECP groundwater taking threshold approval requirement with no MECP water taking approval being anticipated.

The anticipated maximum zone of influence for temporary construction dewatering is 24.4 m away from the dewatering alignments around the excavation footprints. Based on the records review, there are no records for natural heritage features or existing wells within the anticipate zones of influence for temporary construction dewatering. The surrounding area is serviced with municipal water with no nearby private wells still being used. It is recommended that any existing supply wells on site be decommissioned prior to earth works if they are no longer needed.

Results of the groundwater quality assessment indicate that only Total Suspended Solids (TSS) exceeded the Barrie Storm sewer use standards. As such minimal pre-treatment of any dewatering effluent is recommended to lower TSS to meet Barrie’s storm sewer use limits.

# 2.0 INTRODUCTION

## 2.1 Project Description

In accordance with the authorization, dated September 3, 2019, from Mr. Andrew Iacobelli, of Queensgate Homes (Barrie) Inc., Soil Engineers Ltd. (SEL) has performed a hydrogeological assessment for a development property, located at 618-685 Yonge Street, in the City of Barrie. The location of the site is shown on Drawing No. 1.

The subject site consists of former residential housing lots, where surrounding land uses includes; residential and commercial properties to the north, Yonge Street and an active development site and commercial properties to the West, Ashford Drive an existing school to the south and an active development site to the southwest. The total site area is about 1.4 acres. It is our understanding that the existing housing structures have now been demolished.

According to the conceptual site plan prepared by Architecture Unfolded, dated September 17, 2019, a 7-storey condominium with 1.5-level underground parking structure will be developed. The condominium will be provided with full municipal services, driveways and underground parking, meeting urban standards. In addition, it is understood that a water storage tank has been designed.

This report summarizes the findings of the ongoing field study, associated groundwater monitoring and hydraulic testing, and provides a description and characterization of the hydrogeostratigraphy for the site and surrounding area.

## 2.2 Project Objectives

The major objectives of this Hydrogeological Study Report are as follows:

1. Establish the local hydrogeological setting of the site and surrounding area;
2. Interpret shallow groundwater flow patterns;
3. Identify zones of higher groundwater yield as potential sources of ongoing shallow groundwater seepage;
4. Characterize the hydraulic conductivity (K) for groundwater-bearing subsoil strata;
5. Prepare an interpreted hydrostratigraphic cross-section across the subject site;

6. Estimate the anticipated dewatering flows that may be required to lower the shallow groundwater table to facilitate construction, or to facilitate any long-term foundation drainage needs following construction;
7. Estimate the anticipated zone of influence associated with construction dewatering, if required;
8. Evaluate potential impacts to nearby groundwater receptors within the anticipated zone of influence for any construction dewatering, and;
9. Assess the shallow groundwater quality in advance of any temporary dewatering for construction, or for any long-term foundation drainage needs to evaluate disposal management options for dewatering or drainage effluent.

## 2.3 **Scope of Work**

The scope of work for the hydrogeological study is summarized below:

1. Clearance of underground services, drilling of (3) boreholes within the site's development footprint, and installation of three (3) monitoring wells at each of the borehole locations;
2. Monitoring well development and performance of Single Well Response Tests (SWRTs) at the three (3) installed monitoring wells to estimate the hydraulic conductivity (K) for the groundwater-bearing subsoils at the depths of the well screens;
3. Reviewing and plotting of Ministry of Environment Conservation and Parks (MECP) water well records within 500 m of the proposed residential development site;
4. Describing the geological and hydrogeological setting for the site and surrounding area;
5. Review of available engineering development plans and profiles; and completion of calculations to estimate any anticipated dewatering flows necessary to lower the groundwater level to facilitate construction, or for any anticipated long-term foundation drainage and;
6. Groundwater sampling and analysis from one monitoring well to assess shallow groundwater quality for evaluation to the City of Barrie storm and sanitary sewer use standards to determine any disposal management options for any dewatering effluent generated during construction or from any long term foundation drainage effluent following construction.

# 3.0 METHODOLOGY

## 3.1 Borehole Advancement and Monitoring Well Installation

The borehole drilling and monitoring well construction was performed on September 23, 2019. Three (3) boreholes were advanced, with a monitoring well installed in each of the three borehole locations, each to depths of 7.6 m, at the locations shown on Drawing No. 2.

The drilling and monitoring well installation were completed by DBW Drilling, a licensed water well contractor. The boreholes were drilled using solid-stem flight-augers, and the field work was supervised, and the findings recorded by a geotechnical technician who logged the soil strata changes and collected representative soil samples for classification. Detailed descriptions of the encountered subsurface strata and groundwater conditions are presented on the Borehole and Monitoring Well Logs, Figures 1 through 7. Borehole logs from the previous soil investigation are provided in Appendix 'E'.

The monitoring wells were constructed using 50-mm diameter PVC riser pipe and screen sections, which were installed in accordance with Ontario Regulation (O. Reg.) 903. All monitoring wells were provided with steel, monument-type, protective casings at the ground surface. The details of the monitoring well construction are provided on the Borehole Logs.

The UTM coordinates and ground surface elevations at the borehole/monitoring well locations, together with the well construction details, are provided in Table 3-1.

**Table 3-1 -** Monitoring Well Installation Details

| Well ID | Installation Date | UTM Coordinates | | Ground El. (masl) | Borehole Depth (mbgs) | Screen Interval (mbgs) | Casing Dia. (mm) |
|---|---|---|---|---|---|---|---|
| | | East | North | | | | |
| BH/MW 101 | September 23, 2019 | 608233.7 | 4912223.1 | 256.1 | 15.4 | 4.6 - 7.6 | 50 |
| BH/MW 102 | September 23, 2019 | 608262.1 | 4912216.1 | 257.2 | 15.5 | 4.6 - 7.6 | 50 |
| BH/MW 5 | September 23, 2019 | 608220.3 | 4912257.1 | 256.9 | 7.8 | 4.6 - 7.6 | 50 |

Note:
mbgs - metres below ground surface
masl: metres above sea level

It should be noted that the measured ground surface elevations at the borehole and monitoring well locations were adopted from review of the survey plan.

### 3.2 Groundwater Monitoring

The groundwater levels in the monitoring wells were measured, manually on September 25, October 9th and 22nd, 2019.

### 3.3 Mapping of Ontario Water Well Records

SEL reviewed the MECP Water Well Records (WWRs) for the registered wells located on the subject site and within 500 m from the site boundaries (study area). The records indicate that eighty-seven (87) wells are located within the study area. Based on the records, the well locations are shown on Drawing No. 3, and the WWRs reviewed for this study are listed in Appendix 'A'.

### 3.4 Monitoring Well Development and Single Well Response Tests

The monitoring wells underwent development in preparation for single well response tests (SWRT) to estimate hydraulic conductivity (K) for the subsoil strata at the depths of the well screens. Well development involves the purging and removal of several casing volumes of groundwater from each well to remove remnants of clay, silt and other debris introduced into the wells during construction, and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the aquifer formation at the well screen depths.

A SWRT is used to estimate the hydraulic conductivity (K) for the groundwater-bearing subsoil strata at the depth of the well screen. The K estimates provide an indication of the groundwater yield capacity for the water-bearing subsoil strata and can be used to estimate the flow of groundwater through the water-bearing subsoil strata.

The SWRT involves the placement of a slug of known volume into the well, below the water table, to displace the groundwater level upward. The rate at which the groundwater level recovers to static conditions (falling head) is tracked, using either a data logger/pressure transducer, and/or manually, using a water level tape. The rate at which the water table recovers to static conditions is used to estimate the K value for the water-bearing subsoil formation at the well screen depths. BH/MWs 101,102 and 5, underwent a SWRT on October 9, 2019 with the results being provided in Appendix 'B'.

### 3.5 Concurrent Report

The following concurrent report was reviewed in preparation of this hydrogeological study:

A Report to Queensgate Homes Barrie Inc., A Geotechnical Investigation for Proposed, Mixed Use Condominium Development 681 Yonge Street, City of Barrie, Soil Engineers Ltd. Reference No. 1903-S038, dated June 2019.

A Report to Queensgate Homes Barrie Inc., A Geotechnical Investigation for Proposed, Mixed Use Condominium Development 681 Yonge Street, City of Barrie, Soil Engineers Ltd. Reference No. 1909-S019, dated October 2019.

# 4.0 REGIONAL AND LOCAL SETTING

## 4.1 Regional Geology

The subject site lies within the physiographic region of Southern Ontario known as the Peterborough Drumlin Field, within the mapped physiographic feature known as Till Plains (drumlinized). The Peterborough Drumlin Field lies between the Oak Ridges Moraine and an area of shallow overburden overlying limestone of the Gull River Formation. The Peterborough Drumlin Field encompasses an area of about4,500 $km^2$, and constitutes a rolling till plain, extending from Hastings County in the east to Simcoe County in the west, and includes drumlins situated south of the moraine within Northumberland County. This belt contains approximately3,000 drumlins in addition to many other drumlinoid hills and surface flutings of the surficial till sheet. The drumlins throughout are composed of highly calcareous till but there are local differences. The Peterborough Drumlin Field is also notable for its eskers as well as its drumlins. The eskers comprise gravel ridges affording poor soils for agriculture, but they are valuable as sources of road and building aggregate material since other gravels of good quality are rather scarce (Chapman and Putnam, 1984).

Based on a review of a surface geological map of Ontario, the subject site is located on the Newmarket Till deposits, comprised of sandy silt to silt matrix, having moderate to high clast content. Glaciolacustrine (sandy) deposits lie about 1.4 km north of the site and ice contact glacial fluvial sands and gravel are about 1.5 km west of the site. Drawing No. 4, as reproduced from Ontario Geological Survey (OGS) mapping, illustrates the quaternary surface soil geology for the site and surrounding area. The bedrock underlying the site is comprised mainly of Upper Ordovician aged shale, limestone, dolostone and siltstone of the Georgian Bay Formation, the Blue Mountain Formation, the Billings Formation, the Collingwood Member and the Reference Member (Ontario Ministry of Northern Department and Mines, 1991). The approximate elevation for the top of bedrock beneath the site is at about 129.54 masl (BedrockGeology of Ontario, 1993) which is about 130.6 m below the existing surface grade.

## 4.2 Physical Topography

A review of the local topography shows that the subject site exhibits minimal relief of less than 2 m. with a gentle decline in elevation relief towards its western and northern limits. Runoff from the site is expected to drain in westerly and northerly directions. Based on review of the topographic map for the area and from review of the ground surface elevations at the borehole and monitoring well locations, the elevation relief across the subject site is

about 1.5 m. Drawing No. 5 shows the mapped topographical contours for the site and surrounding area.

## 4.3 **Watershed Setting**

The study area lies within the Hewitt's Creek sub watershed of the Lake Simcoe Watershed. The Lake Simcoe watershed comprises a total land and water surface area of 3,324 $km^2$, of which the lake occupies about 20 percent, or 722 km2. The land portion of the watershed is approximately 2,600 $km^2$ and is drained by 35 tributary creeks and rivers, with five major tributaries accounting for more than 60 percent of the total drainage area. The Lake Simcoe watershed has been divided into 18 sub watersheds, or hydrological units (excluding Lake Simcoe Islands) (LSRCA). Drawing No. 6.

## 4.4 **Local Surface Water and Natural Features**

Hewitt's Creek is located approximately 1,170 m east of the subject site. Tributaries of the creek originate southeast and east of the subject site, and join the main branch of Hewitt's Creek northwest of the subject site where it flows northwards into Kemptfeld Bay. Lover's Creek is located about 718 m west of the subject site where it also flows northwards in to Kempfeldt Bay. Wooded areas were observed within the existing housing lot area of the subject site. In general, wooded areas were observed along the banks of the Hewitt's Creek and Lovers Creek, and its associated tributaries. Wetlands, which have not been classified under the Ontario Wetland Evaluation system (OWES) are also located approximately 100 m northeast of the site. Wetlands, classified as 'Other' under the OWES are also located approximately 600 m southeast of the site.

The locations for the above, mentioned natural features, relative to the site are shown on Drawing No. 7.

## 5.0 SOIL LITHOLOGY

The current study has disclosed that beneath a layer of earth fill, the native subsoils soils underlying the subject site consists of silty sand till, sandy silt till and silty clay till. A Key Plan and the interpreted geological cross-sections along the delineated northwest to southeast and east west transects are presented on Drawing Nos. 8-1 and 8-2.

### 5.1 Topsoil (All Boreholes)

Topsoil was contacted at two of the original borehole locations during the initial soil investigation. The revealed topsoil veneer is approximately 22 cm thick. It is dark brown in colour, indicating appreciable amounts of roots and humus.

### 5.2 Earth Fill (All Boreholes)

A layer of earth fill was encountered below the topsoil veneer, or at the ground surface, extending to a depth of 1.4 to 2.1 m below the prevailing ground surface, The earth fill is brown and is 1.4 to 4.3 m thick and was contacted at the ground surface of the site at all of the borehole locations. The earth fill mainly consists of sandy silt and silty clay, although some silty sand was also observed, along with gravel, sand and scattered topsoil inclusions. It consists of a mixture of silty clay and silty sand with traces of gravel and topsoil inclusions. The earth fill moisture ranges from 13% to 33%, indicating that the fill exhibits very moist to wet condition

### 5.3 Silty Sand Till (All Boreholes, except BH 2 and BH 5)

Silty sand till was encountered at most of the boreholes. It was found beneath the sandy silt till at BH 1, BH 3, BH/MWs 101, and BH/MW 102, and beneath the earth fill at BH4. The silty sand till unit is brown to grey and ranges in thickness from 1.3 to over 9.9 m where it extends to the termination depths for some of the boreholes. It contains traces of clay and gravel and occasional sand seams and bounders and has a compact consistency. The moisture content of the retrieved soil samples ranges from 5% to 9%, indicating moist conditions. The estimated permeability for this layer ranges from about $10^{-7}$ to $10^{-6}$ m/sec. Grain size analyses were performed on two (2) samples, with the gradations being plotted on Figure 6.

### 5.4 Sandy Silt Till (All BH and BH/MW locations)

Sandy silt till was encountered at all of the BH and BH/MW locations. It is brown to grey and is generally found beneath the earth fill horizon except at BH 4 where it was contacted beneath the silty sand layer. It was contacted at two depths at BH3. The thickness of the unit ranges from 1.3 m to over 9.7 m where it extends to the termination depth for many of the boreholes advanced beneath the site. The sandy silt is in a compact consistency, and the moisture contents for retrieved soil samples ranged from 5% to 9%, indicating damp to moist conditions.

### 5.5 **Sand** (BH 5)

A stratum of sand was encountered at BH 5 at a depth of 7 m. It is brown and the thickness of the layer is over 0.8 m where it extends to the termination depth of BH 5. The sand contains occasional gravel and has a dense consistency. The moisture content for retrieved soil samples ranges from 7% indicating moist conditions.

# 6.0 GROUNDWATER STUDY

## 6.1 Review of Previous and Concurrent Reports

The previous and concurrent soil investigation reports were reviewed for the preparation of this hydrogeological study:

The results of investigation revealed that below a veneer of topsoil 22 cm thick and/or a layer of earth fill extending to depths of 1.4 to 1.6 m, the site is underlain by strata of silty sand till and sandy silt till, embedded with sand layers. Cobbles and boulders are encountered in the tills, in places. Five boreholes were installed in Spring 2019 disclosing a layer of earth fill overlying native subsoils comprising sandy silt till or silty sand till overlying sandy silt till or sandy silt till and occasionally sand extending to the 11.1 m termination depth of this previous investigation. Two of the boreholes exhibited water in the open boreholes upon completion, at depths of 1.6 and 2.6 m below the prevailing grades.

## 6.2 Review of Ontario Water Well Records

The MECP water well records for the subject site and for properties within a 500 m radius of the boundaries of the subject site (Study Area) were reviewed.

The records indicate that Eight Seven (87) wells are located within the 500 m study area relative to the subject site. The locations of these records, based on the UTM coordinates provided by the records, are shown on Drawing No 3. The details for the MECP well records are provided in Appendix ‘A’.

A review of the first use of the wells within the study area reveals that five (5) are registered as monitoring and test hole wells, sixty-Five (65) are domestic water supply wells, one (1) is a commercial well, three (3) are reported as not being used and no information is available for thirteen (13) records.

A review of the final use of the wells shows that nine (9) are registered as monitoring and test hole or observation wells, sixty six (66) are water supply wells, one (1) is reported as an unfinished well, 1 (one) is reported as an alteration well, and 4 (four) records have no information associated with them.

The data base mapping shows two (2) records (No's. 70 and 76) for wells being within the subject site. Based on the data base, these are identified as former domestic water supply

wells. The former supply wells were not present on the site during the field visits. If any are encountered during earthworks for construction, they should be properly decommissioned in accordance with O. Reg 903.

## 6.3 Groundwater Monitoring

Groundwater levels were measured at all of the monitoring wells to record the fluctuation of the groundwater table beneath the site on September 27 and on October 9, 2019. The water levels and corresponding elevations are summarized in Table 6-1.

**Table 6-1 -** Water Level Measurements

| Well ID | | September 27, 2019 | October 9, 2019 | October 22, 2019 |
|---|---|---|---|---|
| BH/MW 101 | mbgs | 3.93 | 3.16 | 3.07 |
| | masl | 252.17 | 252.94 | 253.03 |
| BH/MW 102 | mbgs | 4.11 | 4.06 | 4.0 |
| | masl | 253.09 | 252,14 | 252.20 |
| BH/MW 5 | mbgs | 3.65 | 3.60 | 3.53 |
| | masl | 253.25 | 253.30 | 253.37 |

mbgs -- metres below ground surface
masl -- metres above sea level

As shown above, groundwater levels generally rose at BH/MWs 101, 102 and 5, during this current, monitoring period. The highest fluctuation was observed at BH/MW 101, which exhibited a 0.86 m increase of the shallow groundwater level. The measurements were also used to interpret the horizontal flow patterns for shallow groundwater across the site, as illustrated on Drawing No. 9.

## 6.4 Single Well Response Test Analysis

BH/MW 101, 102 and 5, and underwent a SWRT to assess the hydraulic conductivity (K) for saturated aquifer subsoils at the depths of the well screens. The results of the SWRT analysis are presented in Appendix 'B', with a summary of the results shown in Table 6-2.

**Table 6-2** - Summary of SWRT Results

| Well ID | Ground El. (masl) | Monitoring Well Depth (mbgs) | Borehole Depth (mbgs) | Screen Interval (mbgl) | Screened Soil Strata) | Hydraulic Conductivity (K) (m/sec) |
|---|---|---|---|---|---|---|
| BH/MW 101 | 256.1 | 7.69 | 15.4 | 4.6 - 7.6 | Sandy silt till, Silty sand till | $6.6 \times 10^{-7}$ |
| BH/MW 102 | 257.2 | 7.65 | 15.5 | 4.6 - 7.6 | Sandy silt till, | $1.6 \times 10^{-6}$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Silty sand till | |
| BH/MW 5 | 256.9 | 7.66 | 7.8 | 4.6 -7.6 | Sandy silt till, Silty sand till | $8.8 \times 10^{-7}$ |

The results of the SWRT suggest the hydraulic conductivity for the groundwater-bearing subsoil layers at the depths of the well screens is moderate, with correspondingly low to moderate anticipated groundwater seepage rates into open excavations completed below the water table.

## 6.5 **Shallow Groundwater Flow Pattern**

The shallow groundwater flow pattern for the site was interpreted from the average of groundwater level elevations measurements recorded at BH/MWs 5, 101 and 102, (Table 6-1). Review of the shallow groundwater level elevations suggests that its flow pattern is towards the west. The interpreted shallow groundwater flow pattern for the subject site where groundwater levels were measured is illustrated on Drawing No. 9.

## 6.6 **Assessment of Hydraulic Conductivity Based on the Hazen Equation**

The Hazen Equation method was also adopted to estimate the hydraulic conductivity (K) for different subsoil layers which may contain groundwater during the seasonal high, water table spring period, or if encountered within the deeper excavations. These layers are primarily above the well screen depths.

The Hazen Equation method relies on the interrelationship between hydraulic conductivity and effective grain size, $d_{10}$, in the soil media. This empirical relation predicts a power-law relation with $K$, as follow:

$$K = Ad_{10}^2$$

where;

$d_{10}$: Value of the soil's grain size gradation curve as determined by sieve analysis, whereby 10% by weight of the soil particles are finer and 90% by weight are coarser.

$A$: Coefficient; it is equal to 1 when $K$ in cm/sec and $d_{10}$ in mm

The Hazen Equation estimation provides an indication of the groundwater yield capacity for water-bearing substrata at the depths where the soil samples obtained for grain size analyses were retrieved. The calculated results indicate that the K estimate for the sandy silt till, retrieved from depths of 6.1 and 10.1m from BH 2 is about $2.25 \times 10^{-6}$ cm/sec respectively.

The results of the Hazen method estimation are provided in Table 6-3 below. The K estimate, determined from the Hazen method suggests a low hydraulic conductivity for the groundwater bearing subsoil layers beneath the subject site.

**Table 6-3** - Summary of Hazen Equation Results

| Well ID | Sample Depth (mbgs) | Sample El. (masl) | Description of Subsoil Strata | Soil Grain Size $D_{10\ (mm)}$ | Hydraulic Conductivity (K) (cm/sec) |
|---|---|---|---|---|---|
| BH 2 | 6.1 | 251.3 | Silty Sand Till | 0.0015 | $2.25 \times 10^{-6}$ |
| BH 2 | 10.9 | 246.5 | Silty Sand Till | 0.0015 | $2.25 \times 10^{-6}$ |

Notes
mbgs -- metres below ground surface
masl -- metres above sea level

## 7.0 GROUNDWATER CONTROL DURING CONSTRUCTION

The estimated hydraulic conductivity (K) values suggest that moderate groundwater seepage rates could be encountered within open excavations below the groundwater table. As such, dewatering through occasional pumping from sumps may be required to provide safe, dry and stable conditions for excavations or for underground servicing and for construction of the proposed foundation for the 1.5 level underground parking structure. The estimates for the construction dewatering flows based on the K test results are discussed in the following sections.

### 7.1 Groundwater Construction Dewatering Rates

The Site Plan, prepared by Jablonsky Ast. and Partners Consulting Engineers Drawing No. S100, P2 Level Foundation Plan, dated September 17, 2019, was reviewed for the construction dewatering needs estimation. Based on a review of the plans, the proposed development will involve the construction of a sever (7) -story mixed-use condominium development having a 1.5-level underground parking level structure. Based on review of the shallow groundwater level elevations, construction dewatering is anticipated for installation of the underground services and for the proposed1.5 level underground structure. The construction dewatering flow rate estimates are discussed below:

Construction Dewatering Estimation for Proposed 1.5-Level Underground Parking Structure – Inner Underground Structure

A review of the site plan indicates that the proposed finished basement foundation level elevations range from 247.97 to 252.70 masl. The excavation depths for the proposed foundation construction were considered as ranging from 4.35 m below the proposed grading level elevation of 257.35 masl for the 1 level underground parking structure to 7.17 m below the proposed grading elevation for the 1.5-level underground parking structure. Assuming an addition 30 cm depth to account for the building footings and floor slab thicknesses, the lowest proposed base elevations of 252.70 masl, 249.72 masl and 247.97 masl were considered for current construction dewatering needs assessment for the P1- and 1.5-level underground parking structures and proposed elevator shaft respectively. Given these considerations, the inner 1.5-level underground parking structure floor slab was considered at an elevation of 249.72 masl and the outer P1 underground parking structure was considered at an elevation of 252.70 masl.

The conceptual excavation perimeter is approximately 175.81 m in length. The subsoil

comprises topsoil and earth fill overlying silty sand and sandy silt till extending to the proposed maximum depth for the building footprint excavation. Comparison of the high groundwater elevation of 253.30 masl with the lowest proposed excavation depth of 249.72, indicates that the stabilized groundwater table is 3.58 m above the lowest considered excavation depth. With the water table lowered by an additional 1 m to a depth elevation of 248.72 masl, construction dewatering for groundwater control is anticipated to provide dry stable subsoil conditions for the proposed excavation earthworks program. Using a hydraulic conductivity (K) of 1.6 x $10^{-6}$ m/sec for the sandy silt till subsoil, the estimated temporary dewatering flow rate to lower the shallow groundwater table could reach a daily rate of 99,768.95 L/day. By considering a 3x safety factor, the anticipated maximum dewatering flow rate could reach a maximum of 299,306.84 L/day. It is anticipated that occasional pumping from sumps is anticipated to provide dry subsoil conditions for the proposed excavation earthworks program.

Construction Dewatering Estimation for Proposed 1 Level Underground Parking Structure – Outer Underground Structure

A review of the site plan indicates that the proposed finished basement foundation level elevations range from 247.97 to 252.70 masl. The excavation depths for the proposed 1 level parking structure foundation construction was considered at a depth of 4.35 m below the grading elevation of 257.35 masl. The lowest proposed 1 level parking level base elevation of 252.70 masl was considered for current construction dewatering needs estimation which includes an additional 30 cm depth to account for the basement floor slab thickness an under-slab footings.

The conceptual excavation perimeter is approximately 300.3 m in length. The subsoil comprises topsoil and earth fill overlying silty sand and sandy silt till extending to the proposed maximum depth for the building footprint excavation. Comparison of the high groundwater elevation of 253.3 masl with the lowest proposed excavation depth of 252.70 indicates that the stabilized groundwater table is 0.6 m above the lowest considered excavation depth. With the water table lowered by an additional 1 m to a depth elevation of 251.7 masl, a 1.6 m water level drawdown was considered for the assessment for groundwater control to provide dry stable subsoil conditions for the proposed excavation earthworks program. Using a hydraulic conductivity (K) of 1.6 x $10^{-8}$ m/sec for the sandy silt till subsoil, the estimated construction dewatering flow rate for the 1 level underground parking structure is 181,135.23 L/day. By considering a 3x safety factor, the anticipated maximum dewatering flow rate could reach a maximum of 543,405.69 L/day. It is anticipated that occasional pumping from sumps is anticipated to provide dry subsoil

conditions for the proposed excavation earthworks program.

Elevator Pit Structure an Elevation of 247.4 masl

A review of the site plan indicates that the proposed finished basement foundation level elevations range from 247.40 to 252.20 masl. The subsoil comprises topsoil and earth fill overlying silty sand and sandy silt till extending to the proposed maximum depth for the building footprint excavation. The excavation depths for the proposed foundation construction was considered as ranging from about 4.35 and 7.15 m below the average existing site grade. The lowest proposed base elevations of 248.17 was considered for the elevator shaft current construction dewatering needs estimation. The proposed elevator pit structure will be placed with the south corner of the site. The base of the elevator pit structure was considered at an elevation of 248.17 masl. By considering a 30 cm thick elevator pit floor thickness and to accommodate the footings beneath the pit slab, the under slab of the pit floor would be at an elevation of 247.87 masl.

Using the approximate perimeter of 23.38 m for the elevator pit structure, and the consideration for lowering the groundwater table by an additional 1m to an elevation of 246.8. masl, the anticipated total groundwater level drawdown of 6.43 m was considered for the assessment. By using a hydraulic conductivity (K) of 1.6 x $10^{-8}$ m/sec for the sandy silt till subsoil, the anticipated dewatering flow could reach a daily limit of 12,510.80 L/day. By considering a 3x safety factor, the anticipated maximum dewatering flow rate could reach a maximum of 37,532.41 L/day. It is anticipated that occasional pumping from sumps is anticipated to provide safe subsoil conditions for the proposed excavation earthworks program.

In addition, there may be a need to remove any accumulated rain fall runoff within the excavation footprint following heavy rain storms. Using the proposed dimensions for the excavation of 2.48 m length by 5.86 m in width, the area for the proposed overall excavation was considered at about 14.54 $m^2$. Using the intensity duration frequency data available for the area from the Ministry of Transportation (MTO website, the maximum 24-hour rainfall rate was considered at a depth of 123.9 mm/day. Multiplying the estimated area for the excavation footprint by the maximum expected rainfall rate gives estimate accumulated runoff volume of 1.788 $m^3$/day (1,788.14 L/day) which may have to be removed from the excavation following an intense rainfall event. It is anticipated that occasional pumping from sumps is anticipated to provide dry subsoil conditions for the proposed excavation earthworks program.

The above estimates are considered conservative as safety factors have been applied so the high end of the flow estimates are unlikely to be achieved. It is anticipated that occasional pumping from sumps is anticipated to provide dry subsoil conditions for the proposed excavation earthworks program

Underground Water Storage Tank at an Elevation of 250 masl

An underground water storage tank will also be installed beneath the southwest corner of the site. The approximate perimeter of the structure is 34.7 m and its base will be set at an elevation of 250 masl. The subsoil comprises topsoil and earth fill overlying silty sand till and sandy silt till extending to the 15.5 m termination depth for the boreholes installed on site. Using an average grade elevation of 256.7 masl, the highest groundwater elevation was measured at an elevation of 253.30 masl. Based on its comparison to the proposed depth elevation for the tank, a groundwater table drawdown of 3.30 is anticipated to complete this structure. With the water table lowered by an additional 1 m to and elevation of 249.00 a groundwater table drawdown of 4.30 m is anticipated to provide safe stable subsoil conditions for excavation and construction for the proposed underground water storage tank. Using a hydraulic conductivity of (K) of $1.6 \times 10^{-6}$ and the perimeter of the proposed structure, the anticipated daily flows to lower the water table to facilitate the services installation were estimated at 19,832.02 L/day with application of a 3 x safety factor the maximum anticipated dewatering flows could reach 59,496.06 L/day

In addition, there may be a need to remove any accumulated rain fall runoff within the excavation footprint following heavy rain storms. Using the proposed dimensions for the excavation of 8.11 m length by 11.12 m in width, the area for the proposed overall excavation was considered at about 90.18 $m^2$. Using the intensity duration frequency data available for the area from the Ministry of Transportation (MTO website, the maximum 24-hour rainfall rate was considered at a depth of 123.9 mm/day. Multiplying the estimated area for the excavation footprint by the maximum expected rainfall rate gives and estimate accumulated runoff volume of 11.173 $m^3$/day (11,173.7 L/day) which may have to be removed from the excavation following an intense rainfall event.

Construction Dewatering Estimation for Underground Services Installation:

The proposed invert elevations for installation of underground services were not available at the time of this current report preparation. By considering a 5 m invert depth for the underground services and a length of 30 m, the dewatering needs assessment for installation of the services is discussed as follows.

The subsoil comprises topsoil and earth fill overlying silty sand till and sandy silt till extending to the 15.5 m termination depth for the boreholes installed on site. Using an average grade elevation of 256.7 masl, the highest groundwater elevation was measured at an elevation of 253.30 masl, and using a 5 m depth for underground services installation the anticipated invert depth elevation would be at 251.7 masl. Comparison of this depth with the high measured groundwater table indicates that it is about 1.60 m above the lowest considered servicing invert elevation. With the water table lowered by an additional 1 m, to provide dry stable subsoil conditions for earthworks, limited temporary construction is anticipate for the installation of underground services. The anticipated daily flows to lower the groundwater table to facilitate the underground services installation was estimated at 17,797.23 L/day with application of a 3 x safety factor, the maximum anticipated dewatering flows could reach 53,391.7 L/day.

In addition, there may be a need to remove any accumulated rain fall runoff within the servicing trenches following heavy rain storms. Using the proposed dimensions for the excavation of 30 m length by 5 m in width, the area of the proposed servicing trench excavation was considered at about 150 $m^2$. Using the intensity duration frequency data available for the area, from the Ministry of Transportation (MTO website, the maximum 24-hour rainfall rate was considered at a depth of 123.9 mm/day. Multiplying the estimated area for the conceptual servicing trench excavation by the maximum expected rainfall rate gives an accumulated runoff volume of 18.45 $m^3$/day (18,450 L/day) which may have to be removed from the servicing trench excavation following an intense rainfall event. It is anticipated that occasional pumping from sumps is anticipated to provide stable subsoil conditions for the proposed excavation earthworks program for the underground services installation.

In accordance with the current policy of the Ministry of Environment Conservation and Parks , where the dewatering flow exceeds 50,000 L/day, but are below the Permit to take Water (PTTW) threshold of 400,000 L/day, the approval for groundwater taking to implement construction dewatering program for groundwater control is by means of an Environmental Activity and Sector Registry EASR which is filed on line through the MECP. As such, it is recommended to apply for and acquire an EASR through the MECP in advance of the proposed earthworks program.

## 7.2 **Groundwater Control Methodology**

Low groundwater seepage rates that are anticipated in open excavations below the water

table, can likely be controlled by occasional pumping from sumps when and where required during construction. It is recommended that perspective contractors conduct test pits to satisfy themselves of subsoil and groundwater conditions prior to earthworks commencing. The final design for any dewatering system will be the responsibility of the construction contractors

## 7.3 Mitigation of Potential Impacts Associated with Dewatering

The zone of influences for construction dewatering alignments around the excavation footprints could reach a range of 17.4 to 24.4 m away from the conceptual dewatering arrays being considered around the construction footprints for the proposed new development. The maximum estimates ZOI is associated with the elevator pit structure which is unlikely to extend beyond the excavation footprint.

Based on the records review, there are no records for natural heritage features or water supply wells within the estimated zone of influence of dewatering for the proposed development. However, Yonge Street, and Ashford Drive are within the conceptual zone of influence for any temporary construction dewatering which could potentially be impacted by ground settlement associated with the zone of influence for any temporary construction dewatering. It has been confirmed in the soil investigation report that there are no concerns pertaining to potential ground settlement within the zone of influence for any construction dewatering., if encountered on site be decommissioned in accordance with O. Reg 903 if they are no longer needed in the future.

## 7.4 Groundwater Function for the Subject Site

The subject site is located within an existing, partially developed industrial, commercial, residential and institutional land usage neighbourhood. The proposed new structures will be constructed below the shallow groundwater level, along with the associated underground services. As such, the shallow groundwater flow pattern may be temporarily impacted from proposed development. There are no records for any nearby natural heritage features within or in close proximity of the subject site. The local are is provide with full municipal services. As such no impacts are anticipated to any supply wells in the area.

## 7.5 Groundwater Quality

The monitoring well at the BH/MW 1 location was sampled for groundwater quality analysis and evaluation against the City of Barrie Storm and Sanitary sewer use standards on

October 22, 2019. The monitoring well was purged of a minimum of 3 well casings of groundwater prior to sample collection. As per the protocols of the City of Barrie, the groundwater was sample was collected unfiltered. A second set of selected sample bottles that were also collected, underwent field filtration prior to analysis for metals and phosphorus. Upon sampling, all of the sample bottles were packed in an ice cooler for shipment to the laboratory. The groundwater quality analysis for the submitted samples was performed by SGS of Lakefield, Ontario which is a CAEL certified laboratory.

The analytical results for the unfiltered groundwater show one exceedance of the City of Barrie Storm Sewer Use By-Law parameters. The exceedances, together with the storm and sanitary criteria, are presented in Table 7-1.

**Table 7-1 -** Groundwater Quality Exceedences Results (Unfiltered-Groundwater)

| **Parameter** | **Groundwater Quality Results (Unfiltered Groundwater) (mg/L)** | **City of Barrie Storm Sewer Use Limits (mg/L)** | **City of Barrie Sanitary Sewer Use Limits (mg/L)** | **Comments** |
|---|---|---|---|---|
| | **BH/MW 101** | | | |
| Total Suspended Solids (TSS) | 17 | 15 | 350 | Exceeds Storm Sewer use limits; meets Sanitary Sewer use limits |

As shown above, the results of analysis for unfiltered groundwater obtained from BH/MW 101 indicate that the concentrations for, TSS, exceed the City of Barrie Storm Sewer Use limits, but meets the City of Barrie Sanitary Sewer Use limits.

The results suggest that short-term construction dewatering effluent and any long-term foundation drainage effluent should be acceptable for disposal to the City of Barrie's Sanitary Sewer use limits without any pre-treatment.

The results suggest that short-term construction dewatering effluent and any long-term foundation drainage effluent should be acceptable for disposal to the City of Barrie Sanitary Sewer use limits without any pre-treatment.

The results suggest that if there is any short-term construction dewatering effluent and/or any long-term foundation drainage effluent, the effluent should be acceptable for disposal to the City of Barrie sanitary sewer. Minimal pretreatment being implemented to lower TSS to meet City of Barrie Storm Sewer Use limits should permit disposal of the effluent to the City's Storm Sewer system.

A long-term foundation drainage network designated to minimize or eliminate TSS from the disposal discharge would likely minimize any further effluent treatment requirements for the effluent to meet the City of Toronto Barrie Storm Sewer standards.

For temporary construction dewatering a settlement tank can likely be user to minimize TSS from the dewatering effluent prior to its disposal to the city sewer system.

For the long-term foundation drainage effluent management, the final design for drainage system to minimize the generation of the TSS will be the responsibility of the mechanical engineer responsible for the design of a long-term foundation drainage system.

## 7.6 Ground Settlement

The maximum zone of influence could extend to 24.4 m from the development footprint. It is recommended that a geotechnical engineer confirm if there are any potential ground settlement concerns to existing structures within the zone of influence for any construction dewatering prior to proposed earthworks.

## 7.7 Long-Term Foundation Drainage Assessment

The proposed development plans indicate that a 7-storey high residential mixed-use, residential building which will be constructed at the site, having a common, 1.5-level underground parking structure having a variable basement floor elevation including an underground water storage tank and elevator pits. An average grading elevation of 257.35 masl was considered to accommodate the proposed 1.5-level underground parking structure. The proposed elevator shaft under-slab structure will be built at the lowest considered elevation of 247.87 masl, while the basement under-slab for inner underground structure was considered at elevation of 249.72 masl, and the basement slab for the outer underground structure was considered at a base elevation 252.72 masl. The highest shallow groundwater level elevation of 253.30 masl, which is about 5.43 m above the base for the proposed elevator pit structure, 0.6 m above the outer basement slab structure and 3.58 m above the inner under-slab basement structure. The proposed elevator shaft structure will be waterproofed.

Given the lot to moderate anticipated groundwater seepage rate estimates for long-term foundation drainage, a conventionally shored excavation, using pile and lagging methods can be designed and completed for the construction of the proposed underground parking level structure. A standard Mira Drainage network can be included with the design of a conventionally shored excavation along with a simple basement under-slab drainage

network to address any long-term seepage into the excavation and completed underground structure. These systems can be drained to separate sump pits. The drainage network should be designed by a qualified mechanical engineer, having experience with the designs for under-slab and Mira drainage networks.

The drainage networks should have separate connections to the proposed sump pits, with one pit connected to the Mira drainage network for the shore walls and a second pit connected to the under-slab floor drainage network.

In order to estimate the long-term foundation drainage needs for the Mira perimeter foundation drainage network and to the under-slab floor basement drainage systems at the constructed site, Darcy's Equation was used, as described below:

$$Q = KiA$$

Where:

- Q = Estimated foundation drainage rate ($m^3$/day)
- K = $1.6 \times 10^{-6}$ m/sec (highest hydraulic conductivity (K) assessed for the screened subsoil and shale units encountered beneath the site)
- A = 180.2 $m^2$ for the saturated Mira Drain foundation walls area around the outer underground structure, 492.3 $m^2$ around the inner underground structure. A total area of 295.04 $m^2$ was considered for the under-slab floor drainage network which is the approximate total surface areas for weeper tiles used to estimate groundwater seepage to the basement under-slab drainage network, below the water table (cross-sectional area of flow) ($m^2$)
- iv = the vertical groundwater hydraulic gradient varies between 0.052 to 0.09 [unitless], considered for the under-slab basement drainage system
- ih = 0.048 [unitless], Horizontal Hydraulic Gradient for groundwater considered for the perimeter, shore wall, mira drainage system.

For the proposed inner and outer underground parking structure, the total long-term foundation seepage drainage rate to the Mira perimeter drainage network for a conventionally shored excavation is 4,460.97 L/day. The long-term, average seepage drainage rate to the under-slab basement floor drainage networks for these structures is 472.69 L/day. The combined, long-term seepage drainage rate to both the Mira drain, perimeter system for the shore walls, and from the under-slab drainage networks is estimated at 4,933.67 L/day. By applying a safety factor of two (2), the combined seepage

flow drainage rate is estimated at 9,867.32 L/day. It should be noted that these estimates are all be below the MECP threshold of 50,000 L/day for a groundwater taking approval for long-term foundation drainage which is not anticipated following construction.

The pumping facility and sump systems should be designed for the maximum expected drainage seepage rate. The drainage piping should be properly constructed using weeper tiles surrounded by filter cloth, in turn surrounded by bedding stone or concrete sand to minimize potential losses of fines and to prevent silt from clogging of weeper tiles. Over time, the foundation drainage flows to the underground basement structure may diminish to a lower, or possibly negligible steady state rate, but more likely to a steady state rate that will remain relatively constant over time.

## 8.0 CONCLUSION

1. The subject site is located within the physiographic region of Southern Ontario known as the known as the Peterborough Drumlin Field.
2. Based on review of the surface geological map of Ontario, the subject site is located on the Newmarket Till unit material, consisting of sandy silt to silt matrix, having moderate to high matrix carbonate content with moderate to high clast content.
3. A review of the local topography shows that the site is relatively flat, exhibiting a gentle decline in elevation relief towards the site's west limits.
4. The subject site is located within the Hewitt's Creek sub watershed of the Lake Simcoe Watershed.
5. The findings from the current study have disclosed that beneath a layer of topsoil and earth fill, the native soil underlying the subject site consist of silty sand till, and sandy silt till extending to the termination depth of 15.5 m below the exiting site grades.
6. The findings show that the average of groundwater levels ranges from El. 252.09 to 253.3 masl (3.16 to 4.11 mbgl) as recorded during the monitoring period, with shallow groundwater interpreted as flowing in a westerly direction.
7. The single well response tests yielded an estimated K values in the range of $6.6 \times 10^{-7}$ m/sec and $1.6 \times 10^{-6}$ m/sec for the sandy silt till at the depths of the well screen, suggesting low to moderate anticipated seepage rates into open excavations below the water table during construction.
8. Since the shallow groundwater level elevation is above the lowest basemen floor elevation for the proposed multi storey residential building, temporary construction dewatering is anticipated to facilitate safe stable subsoil conditions for earthworks excavations for construction of the proposed underground structure and associated services. The temporary construction dewatering flows to build the proposed underground structures will range from 12,510.80 to 181,135.23 L/day with application of a 3 x safety factor these flows could reach daily maximums of 37,532.41 L/day up 543,405.69 L/day. The high end of the anticipated daily flows is above the MECP approval threshold limit of 50,000 L/day whereby the approval for proposed groundwater taking is by means of an EASR with the EASR filed through the MECP.
9. The combined long-term foundation drainage estimates for the completed underground structure is 4,460.97 L/day for the shore wall perimeter mira drainage network and is 472.69 L/day for the basement under-slab drainage network. The combined drainage rate for both systems is 4,933.67 L/day, with application of a 2x safety factor the combined drainage rate could reach 9,867.32 L/day. The high end of the drainage flow estimate is below the MECP groundwater taking threshold

approval requirement with no MECP approval being anticipated.

10. The anticipated maximum zone of influence for temporary construction dewatering is 24.4 m away from the dewatering alignments around the excavation footprints. Based on the records review, there are no records for natural heritage features within the anticipate zones of influence for temporary construction dewatering. The surrounding area is serviced with municipal water with no nearby private wells still being used. It is recommended that any existing supply wells on site, if encountered be decommissioned prior to earth works if they are no longer needed. A geotechnical has determined that there are no ground settlement concerns to any existing structures or infrastructure associated with the proposed development.
11. Results of the groundwater quality analysis indicate that the groundwater quality is acceptable for disposal to the Barrie storm sewer system as long as total suspended solids in any dewatering effluent is lowered to meet Barrie's storm sewer use standards.

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Gavin O'Brien, M.Sc., P.Geo.
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## 9.0 REFERENCES

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2. Bedrock Geology of Ontario, 1993, Data set 6, Ministry of Northern Development

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# FIGURES 5-7

## BOREHOLE LOGS AND
## GRAIN SIZE DISTRIBUTION GRAPHS

## REFERENCE NO. 1909-W019

**JOB NO.:** 1909-w019

# LOG OF BOREHOLE NO.: 101

**FIGURE NO.:** 6

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Flight Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** September 23, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 256.1 | Ground Surface | | | | | | | |
| 0.0 | **EARTH FILL** dark brown to brown, silty clay a trace of gravel occ. topsoil pockets | 1A 1B | DO | 6 | 0 | | 26 15 | |
| 255.3 / 0.8 | weathered | 2 | DO | 18 | 1 | | 12 | |
| | Brown, dense to very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles and boulders | 3 | DO | 57 | 2 | | 7 | |
| | | 4 | DO | 39 | | | 10 | |
| | | 5 | DO | 43 | 3 | | 8 | |
| | | 6 | DO | 50/10 | 4 | | 7 | |
| 250.6 / 5.5 | Very dense **SILTY SAND TILL** traces of clay and gravel occ. cobbles and boulders | 7 | DO | 61 | 5 6 | | 7 | |
| | brown / grey | 8 | DO | 58 | 7 8 | | 7 | |
| | | 9 | DO | 50/15 | 9 | | 6 | |
| | | 10 | DO | 50/7 | 10 11 | | 7 | |
| | | 11 | DO | 50/15 | 12 | | 6 | |
| | | 12 | DO | 50/4 | 13 14 | | 6 | |
| 240.7 / 15.4 | **END OF BOREHOLE** | 13 | DO | 50/15 | 15 16 | | 7 | |

W.L @ El. of 251.99 m on September 27, 2019

W.L. @ El. of 248.5 m upon completion of drilling

**Soil Engineers Ltd.**

**JOB NO.:** 1909-w019

# LOG OF BOREHOLE NO.: 102

**FIGURE NO.:** 7

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Flight Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** September 23, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 257.2 | Ground Surface | | | | | | | |
| 0.0 | **EARTH FILL**<br>dark brown to brown, sandy silt to silty clay<br>a trace of gravel<br>occ. topsoil inclusions | 1A<br>1B | DO | 14 | 0 | | 29<br>11 | |
| | | 2 | DO | 12 | 1 | | 11 | |
| 255.1 | | 3 | DO | 10 | 2 | | 12 | |
| 2.1 | Brown, very dense<br>**SANDY SILT TILL**<br>traces of clay and gravel<br>occ. cobbles and boulders | 4 | DO | 50/15 | | | 7 | |
| | | 5 | DO | 50/15 | 3 | | 6 | |
| | | 6 | DO | 52/15 | 4 | | 8 | |
| 251.7 | | | | | 5 | | | |
| 5.5 | Dense to very dense<br>**SILTY SAND TILL**<br>traces of clay and gravel<br>occ. cobbles and boulders<br>brown<br>grey | 7 | DO | 80 | 6 | | 7 | |
| | | 8 | DO | 60/15 | 7 | | 6 | |
| | | 9 | DO | 55/15 | 8 | | 7 | |
| | | 10 | DO | 50/15 | 9 | | 8 | |
| | | 11 | DO | 55/15 | 10 | | 6 | |
| | | 12 | DO | 54 | 11 | | 16 | |
| | | | | | 12 | | | |
| 241.7 | | 13 | DO | 52/15 | 13 | | 7 | |
| 15.5 | **END OF BOREHOLE** | | | | 14 | | | |
| | | | | | 15 | | | |
| | | | | | 16 | | | |

W.L @ El. of 252.61 m on September 27, 2019

W.L. @ El. of 249.0 m upon completion of drilling

**Soil Engineers Ltd.**

**JOB NO.:** 1909-W019

# LOG OF BOREHOLE NO.: 5

**FIGURE NO.:** 5

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Hollow Stem Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** April 18, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 256.9 | Ground Surface | | | | | | | |
| 0.0 | **EARTH FILL**<br>dark brown, silty clay<br>a trace of gravel<br>occ. topsoil inclusions | 1 | DO | 8 | 0 | | 14 | |
| | | 2 | DO | 19 | 1 | | 25 | |
| 255.5 | | | | | | | | |
| 1.4 | Brown, compact to very dense<br>**SANDY SILT TILL**<br>traces of clay and gravel<br>occ. sand seams, cobbles and boulders | 3 | DO | 23 | 2 | | 10 | |
| | | 4 | DO | 44 | | | 8 | |
| | | 5 | DO | 44 | 3 | | 10 | |
| | | 6 | DO | 50/15 | 4 | | 8 | |
| | | 7 | DO | 52 | 5 | | 11 | |
| 249.9 | | | | | 6 | | | |
| 7.0 | Brown, very dense<br>**SAND** | | | | 7 | | | |
| 249.1 | fine to medium grained | 8 | DO | 50/15 | | | 7 | |
| 7.8 | some gravel<br>a trace of silt<br>**END OF BOREHOLE** | | | | 8 | | | |
| | | | | | 9 | | | |
| | | | | | 10 | | | |
| | | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |
| | | | | | 16 | | | |

W.L @ El. of 253.25 m on September 27, 2019

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# GRAIN SIZE DISTRIBUTION

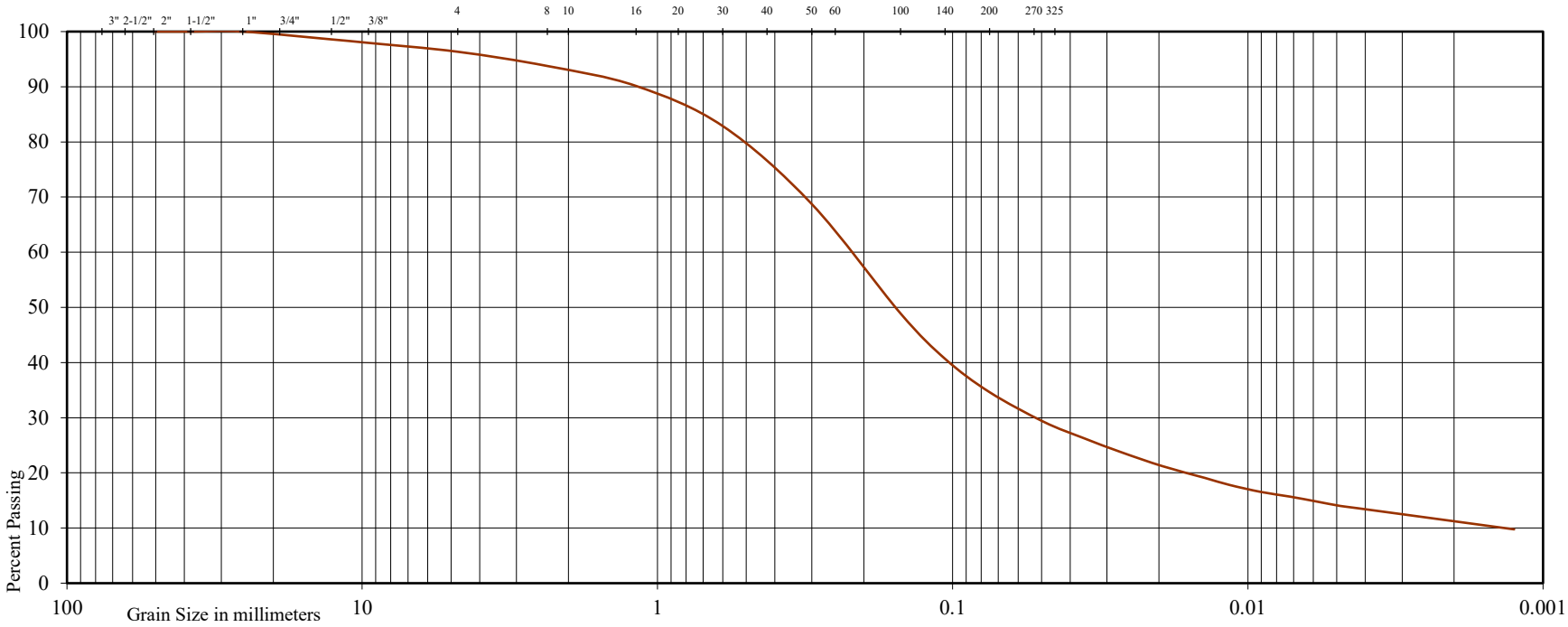
Reference No: 1903-S083

U.S. BUREAU OF SOILS CLASSIFICATION

| GRAVEL | | SAND | | | | SILT | CLAY |
|---|---|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | V. FINE | | |

UNIFIED SOIL CLASSIFICATION

| GRAVEL | | SAND | | | SILT & CLAY |
|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | |




Project: 1909-w019

Location: 681 Yonge Street Barrie

Borehole No: 2

Sample No: 7

Depth (m): 6.3

Elevation (m): 251.1

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = $10^{-6}$

Classification of Sample [& Group Symbol]: SILTY SAND TILL, some clay, a trace of gravel

Figure:8

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# GRAIN SIZE DISTRIBUTION

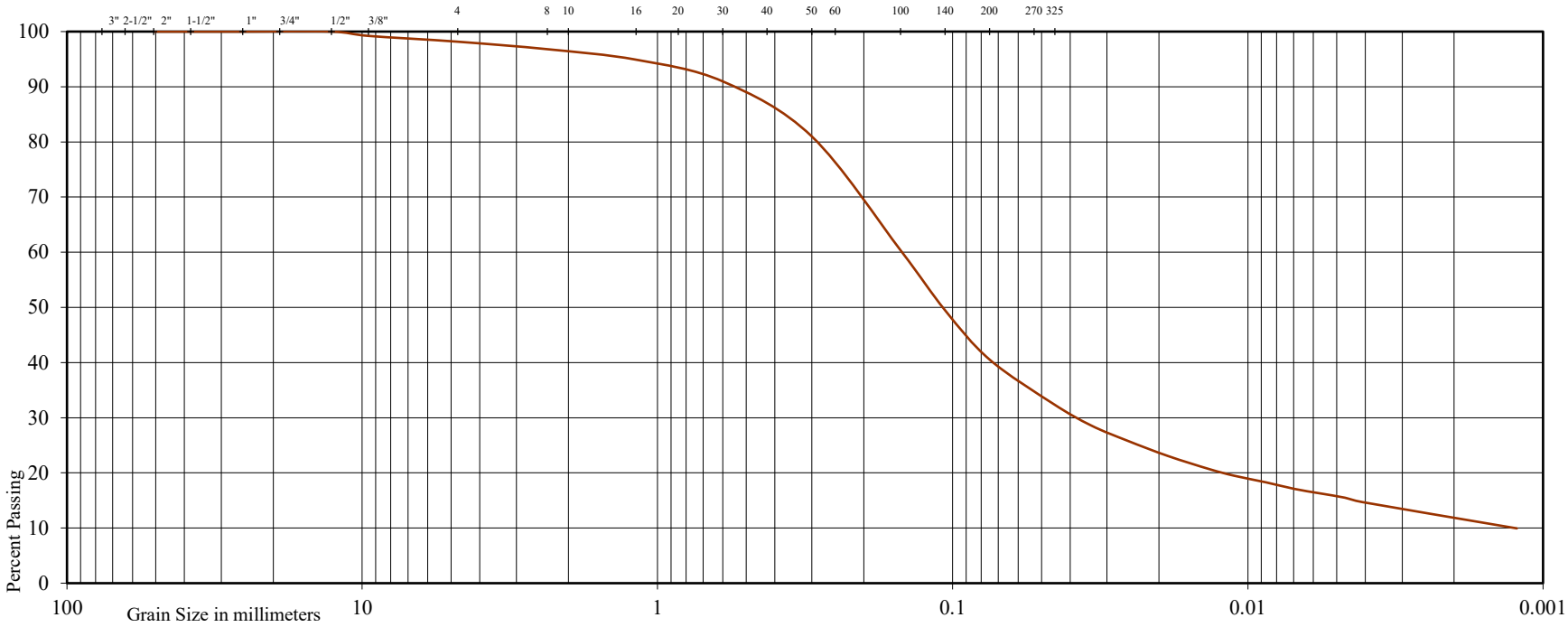
Reference No: 1903-S083

U.S. BUREAU OF SOILS CLASSIFICATION

| GRAVEL | | SAND | | | | SILT | CLAY |
|---|---|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | V. FINE | | |

UNIFIED SOIL CLASSIFICATION

| GRAVEL | | SAND | | | SILT & CLAY |
|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | |




Project: 1909-W019

Location: 681 Yonge Street Barrie

Borehole No: 102

Sample No: 9

Depth (m): 9.3

Elevation (m): 247.9

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = $10^{-6}$

Classification of Sample [& Group Symbol]: SILTY SAND, TILL

some clay, a trace of gravel

Figure 9

**Soil Engineers Ltd.**

# GRAIN SIZE DISTRIBUTION

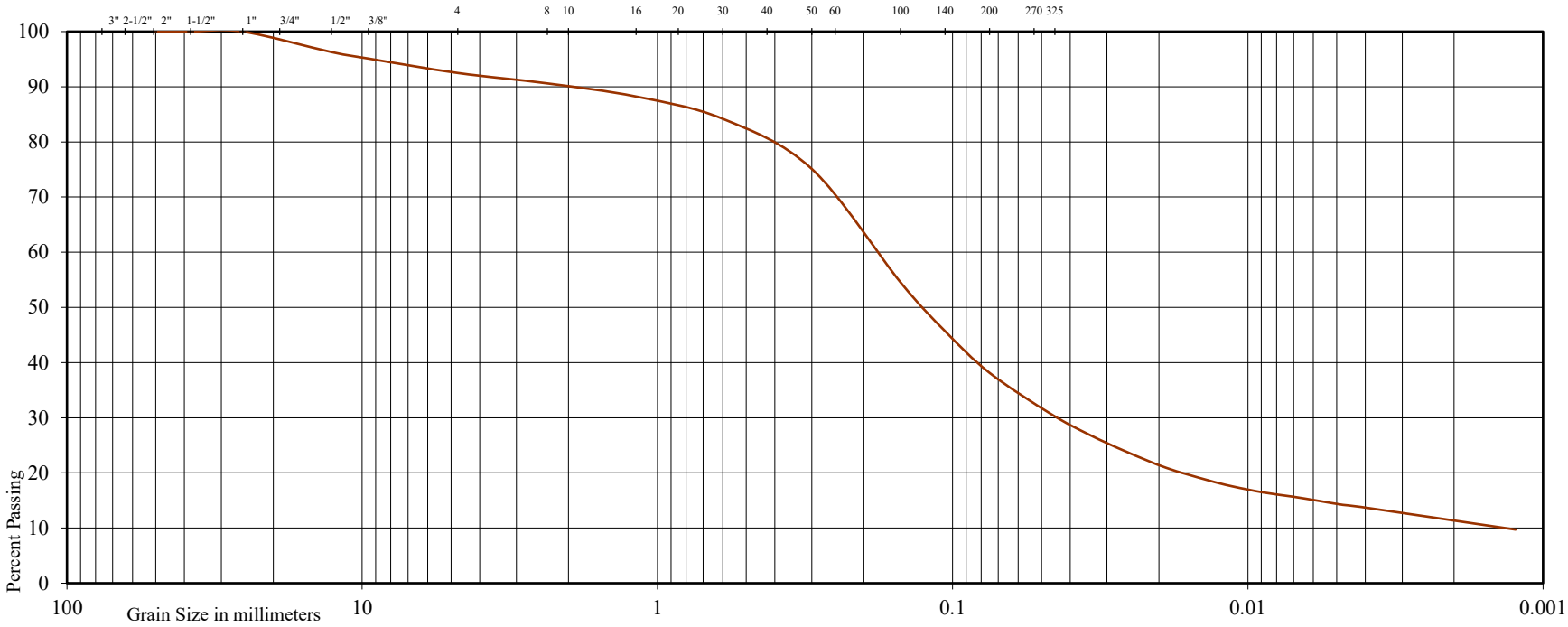
Reference No: 1903-S083

U.S. BUREAU OF SOILS CLASSIFICATION

| GRAVEL | | SAND | | | | SILT | CLAY |
|---|---|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | V. FINE | | |

UNIFIED SOIL CLASSIFICATION

| GRAVEL | | SAND | | | SILT & CLAY |
|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | |




Project: 1909-W019

Location: 681 Yonge Street Barrie

Borehole No: 2

Sample No: 10

Depth (m): 10.8

Elevation (m): 246.6

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = $10^{-6}$

Classification of Sample [& Group Symbol]: SILTY SAND TILL, some clay, a trace of gravel

Figure 10

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90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL (416) 754-8515 · FAX (905) 881-8335

| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | GRAVENHURST | PETERBOROUGH | HAMILTON |
|---|---|---|---|---|---|---|
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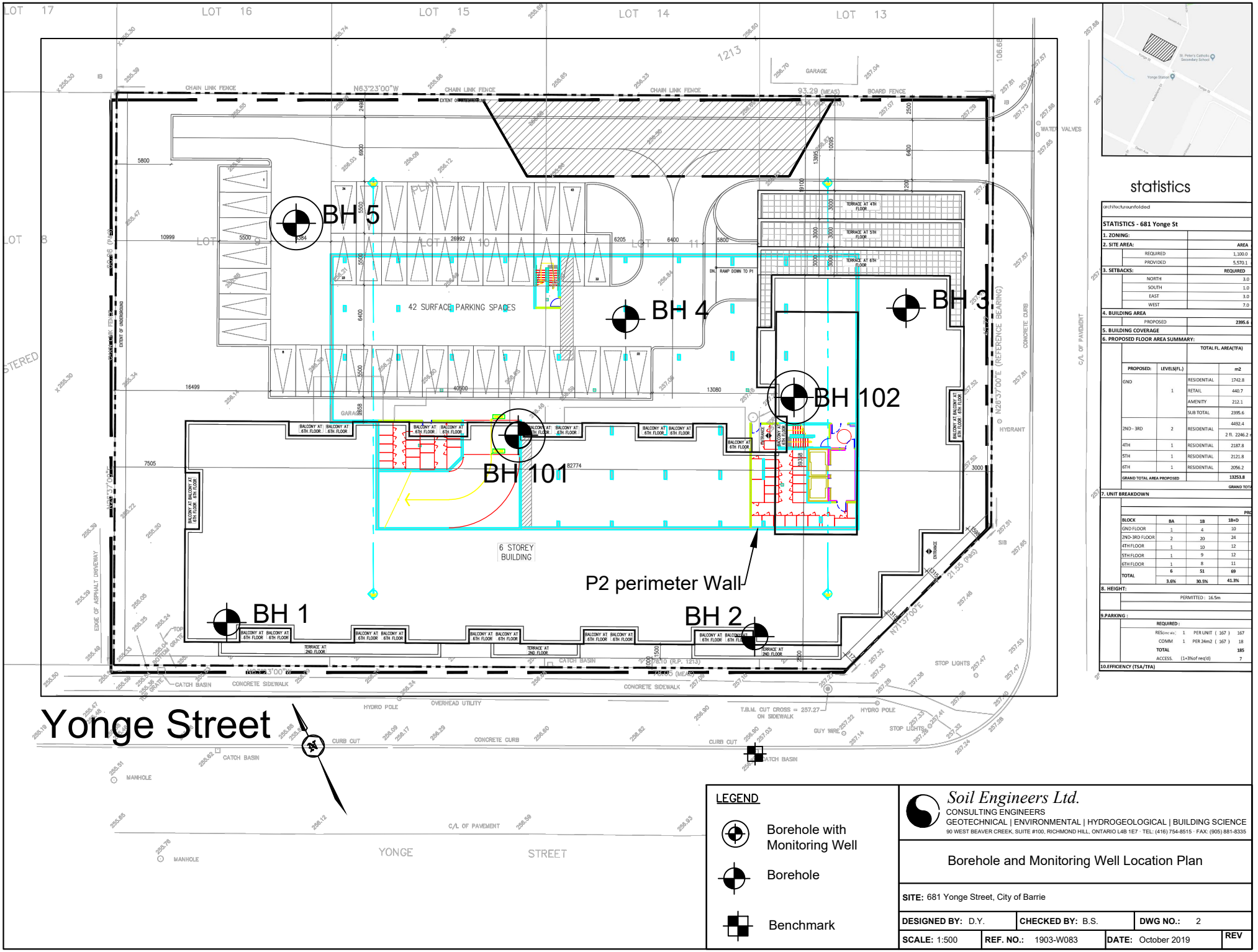
| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (905) 881-8335 | FAX: (705) 684-8522 | FAX: (905) 725-1315 | FAX: (905) 542-2769 |


# DRAWINGS

## REFERENCE NO. 1909-W019


607700
608050
608400
608750
4912800
4912450
4912100
4911750
GLOUCESTER ST
DODSON RD
GOLDEN MEADOW RD
WARNICA RD
BIG BAY POINT RD
CHERRY CRT
PANE DR
MONTGOMERY DR
ASHFORD DR
BERTHA AVE
KENNETH AVE
GO TRANSIT
YONGE ST
RUSSELL HILL DR
DEAN AVE
MADELAINE DR
RAYMOND CRES
SERENA LANE
ESTHER DR
JOSEPH CRES
SHANA CRT
RAQUEL ST
HONEY CRES
C:\GIS\2019\1909-W019\
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Source: Ministry of Natural Resources and Forestry
©Queen's Printer for Ontario, 2019
N
Approximate Boundary of Subject Site
Major Road
Local Road
Railway
Soil Engineers Ltd.
Title: Site Location Plan
Project:
Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie
Reference No. 1909-W019
Date: September 25, 2019
Scale:
0 30 60 120 180 240 300
Metres
Drawing No. 1




## statistics

architectureunfolded

**STATISTICS - 681 Yonge St**

| | | |
|---|---|---|
| **1. ZONING:** | | |
| **2. SITE AREA:** | | AREA |
| | REQUIRED | 1,100.0 |
| | PROVIDED | 5,570.1 |
| **3. SETBACKS:** | | REQUIRED |
| | NORTH | 3.0 |
| | SOUTH | 1.0 |
| | EAST | 3.0 |
| | WEST | 7.0 |
| **4. BUILDING AREA** | | |
| | PROPOSED | 2395.6 |
| **5. BUILDING COVERAGE** | | |
| **6. PROPOSED FLOOR AREA SUMMARY:** | | |

| PROPOSED: | LEVELS(FL) | | TOTAL FL. AREA(TFA) m2 |
|---|---|---|---|
| GND | 1 | RESIDENTIAL | 1742.8 |
| | | RETAIL | 440.7 |
| | | AMENITY | 212.1 |
| | | SUB TOTAL | 2395.6 |
| 2ND - 3RD | 2 | RESIDENTIAL | 4492.4 |
| | | | 2 fl. 2246.2 e |
| 4TH | 1 | RESIDENTIAL | 2187.8 |
| 5TH | 1 | RESIDENTIAL | 2121.8 |
| 6TH | 1 | RESIDENTIAL | 2056.2 |
| GRAND TOTAL AREA PROPOSED | | | 13253.8 |
| | | | GRAND TOTA |

**7. UNIT BREAKDOWN**

| BLOCK | BA | 1B | 1B+D |
|---|---|---|---|
| GND FLOOR | 1 | 4 | 10 |
| 2ND-3RD FLOOR | 2 | 20 | 24 |
| 4TH FLOOR | 1 | 10 | 12 |
| 5TH FLOOR | 1 | 9 | 12 |
| 6TH FLOOR | 1 | 8 | 11 |
| TOTAL | 6 | 51 | 69 |
| | 3.6% | 30.5% | 41.3% |

**8. HEIGHT:** PERMITTED : 16.5m

**9.PARKING :**

| | | | |
|---|---|---|---|
| REQUIRED : | | | |
| RES(inc vis) | 1 | PER UNIT ( 167 ) | 167 |
| COMM | 1 | PER 24m2 ( 167 ) | 18 |
| TOTAL | | | 185 |
| ACCESS. | (1+3%of req'd) | | 7 |

**10.EFFICIENCY (TSA/TFA)**

**LEGEND**

- Borehole with Monitoring Well
- Borehole
- Benchmark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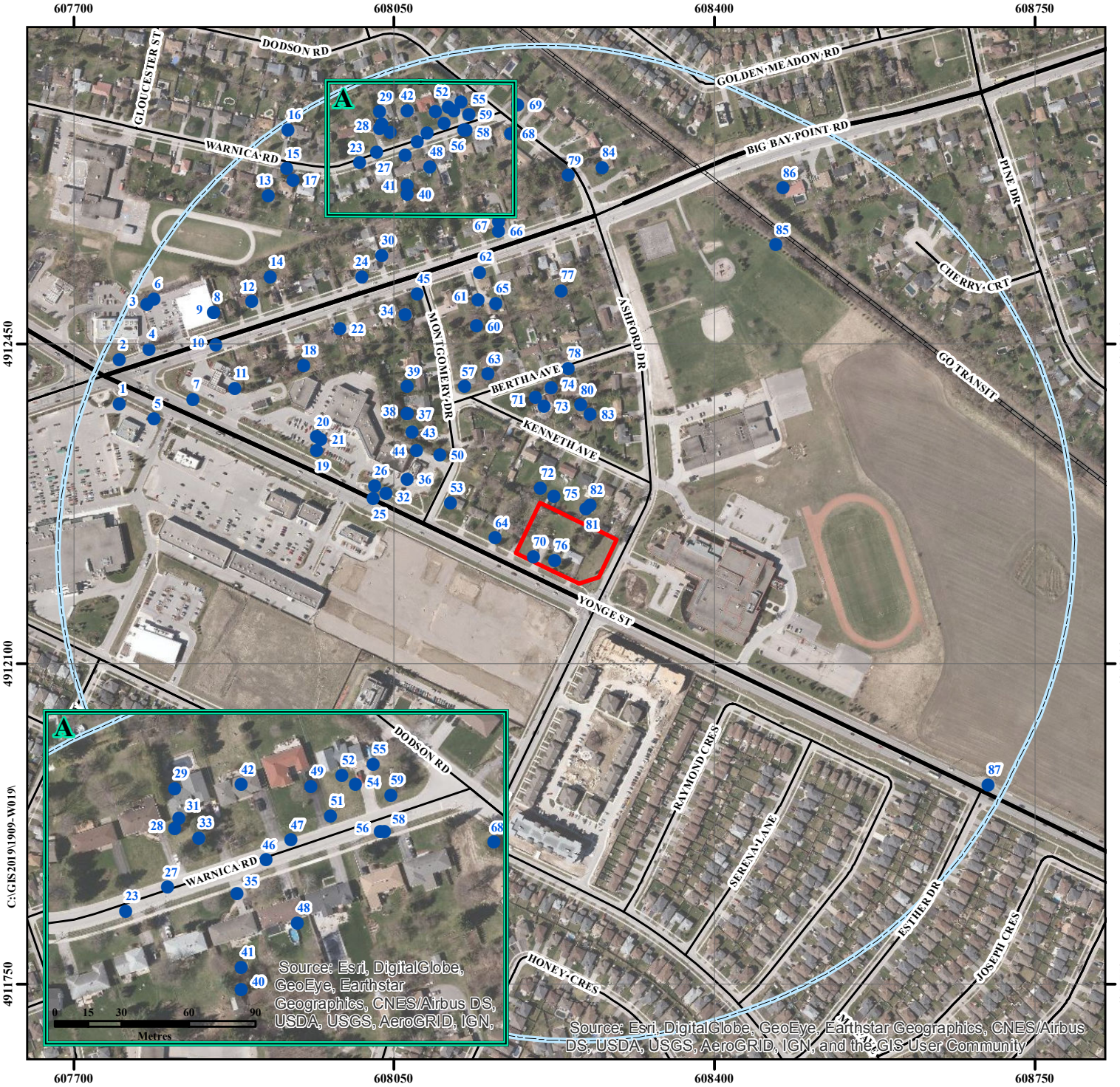
# Borehole and Monitoring Well Location Plan

**SITE:** 681 Yonge Street, City of Barrie

| | | | |
|---|---|---|---|
| **DESIGNED BY:** D.Y. | **CHECKED BY:** B.S. | **DWG NO.:** 2 | |
| **SCALE:** 1:500 | **REF. NO.:** 1903-W083 | **DATE:** October 2019 | **REV** |




N

Approximate Boundary of Subject Site

500 metres from Subject Site Boundary

1 Well Location from MECP Well Records (see Appendix 'A')

Major Road

Local Road

Railway

Soil Engineers Ltd.

Title: MECP Well Location Plan

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

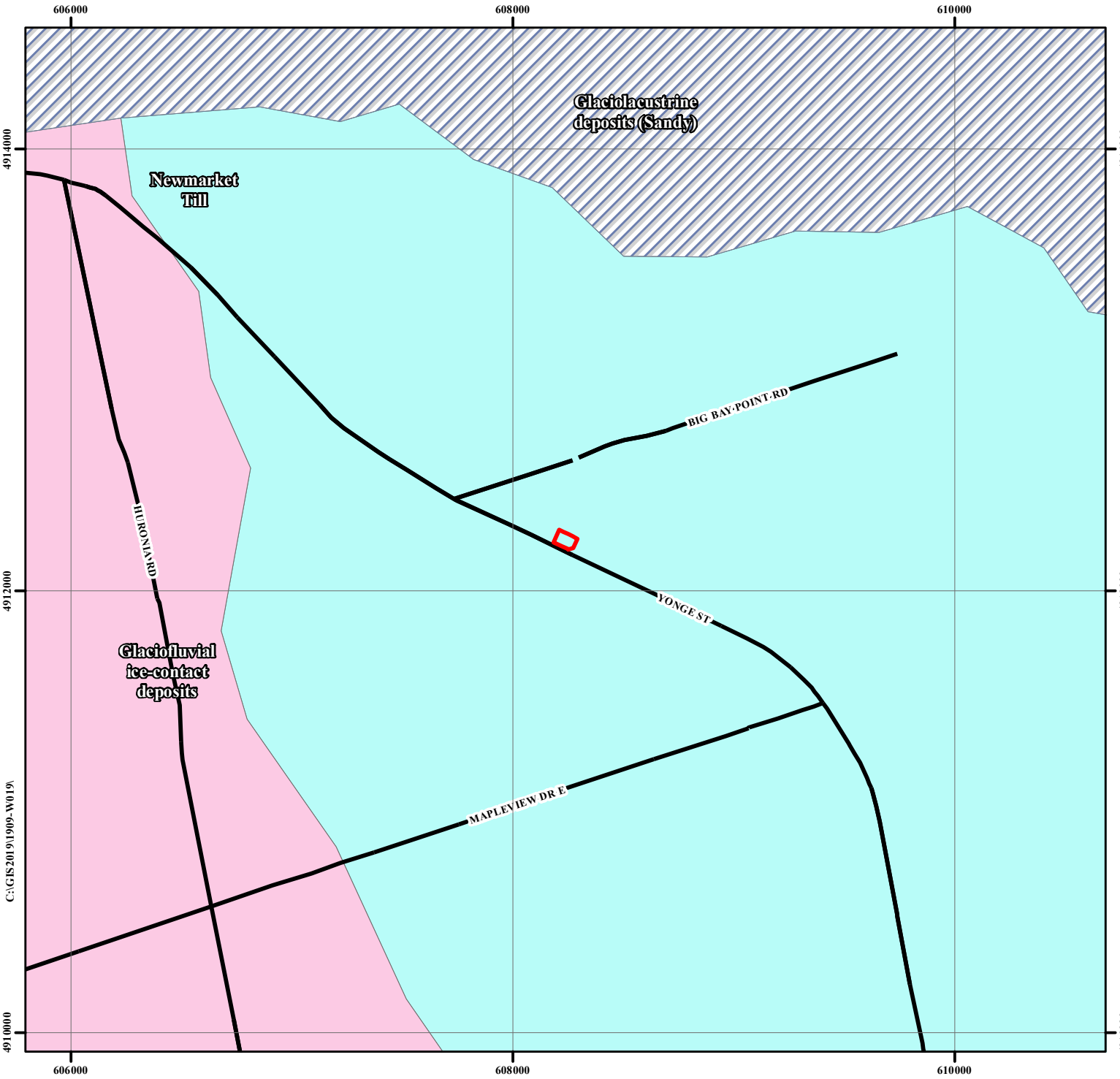
Reference No. 1909-W019

Date: September 25, 2019

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 3

Source: Water Course, Ontario Ministry of Natural Resources and Forestry
©Queen's Printer for Ontario
Source: Water Body, Ontario Ministry of Natural Resources and Forestry
©Queen's Printer for Ontario




Source:Ontario Geological Survey, 1997, Surface Geology of Ontario; Ontario Geological Survey, Miscellaneous Released-Data 0014

N

Approximate Boundary of Subject Site

Glaciofluvial ice-contact deposits
Material: gravel and sand, minor till, includes esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits

Glaciolacustrine deposits (Sandy)
Material: sand, gravelly sand and gravel, nearshore and beach deposits

Newmarket Till
Material: sandy silt to silt matrix, moderate to high matrix carbonate content, clast content moderate to high

Major Road

*Soil Engineers Ltd.*

Title: Quarternary and Surface Geology Map

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

Reference No. 1909-W019

Date: September 25, 2019

Scale:

0 125 250 500 750 1,000 1,250

Metres

Drawing No. 4


Source: Contour, Ontario Ministry of Natural Resources and Forestry, 2015
©Queen's Printer for Ontario, 2015

Source: Water Body, Ontario Ministry of Natural Resources and Forestry, 2015
©Queen's Printer for Ontario, 2015

Source: Water Course, Ontario Ministry of Natural Resources and Forestry, 2015
©Queen's Printer for Ontario, 2015

N

Approximate Boundary of Subject Site

Major Road

Local Road

Railway

260 Topographic Contour (masl)

*Soil Engineers Ltd.*

Title: Topographic Map

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

Reference No. 1909-W019

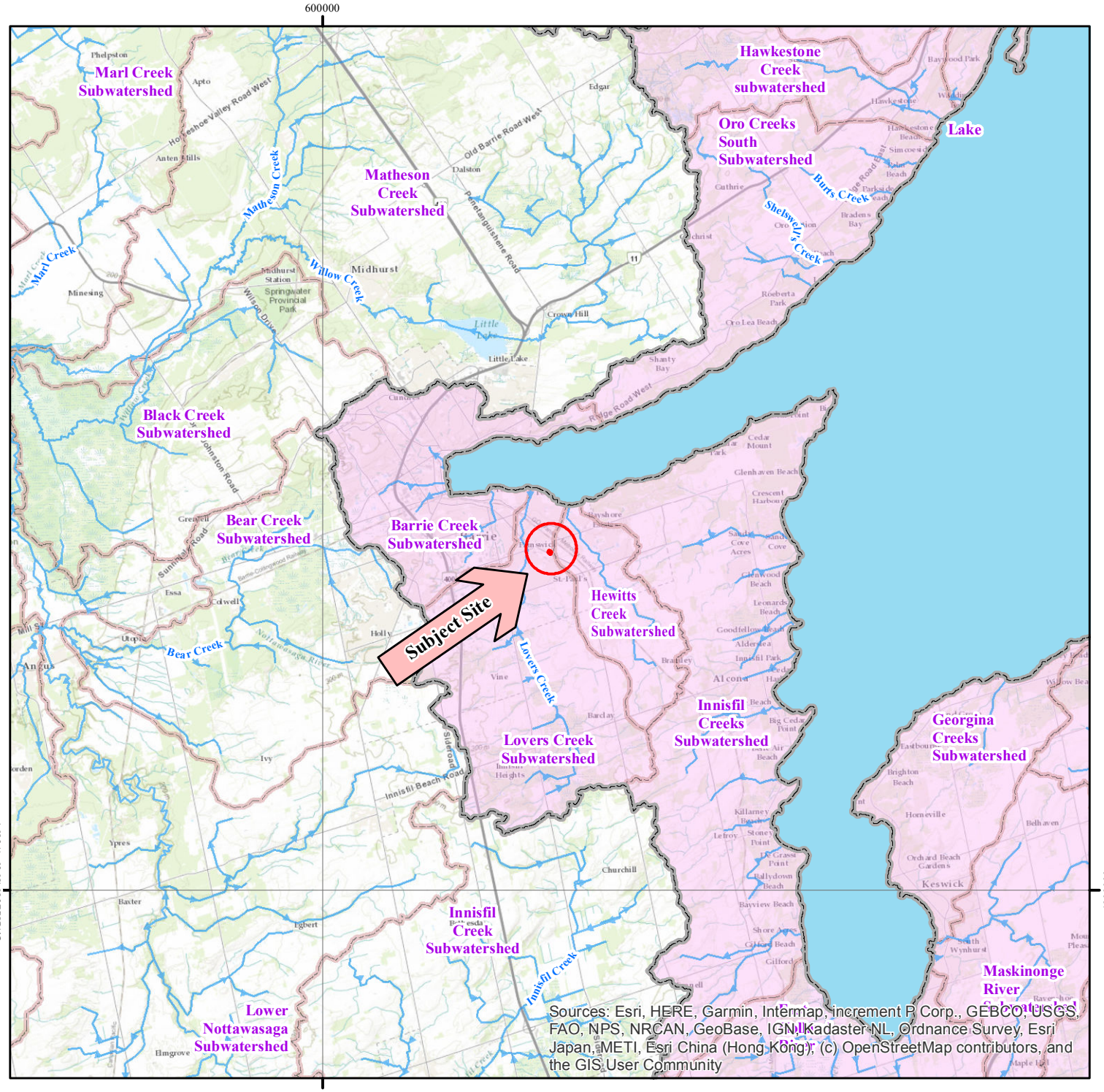
Date: September 25, 2019

Scale:

0 30 60 120 180 240 300

Metres

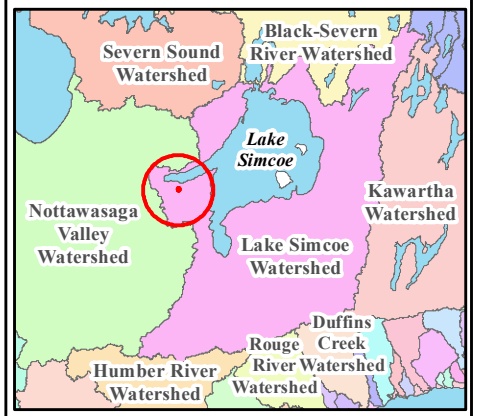
Drawing No. 5




C:\GIS\2019\1909-W019\

N

**Watershed:**




Approximate Boundary of the Subject Site

Watershed Boundaries

Waterbody

Watercourse

Expressway/Major Road

*Soil Engineers Ltd.*

Title: Watershed and Subwatershed Map

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

Reference No. 1909-W019

Date: September 25, 2019

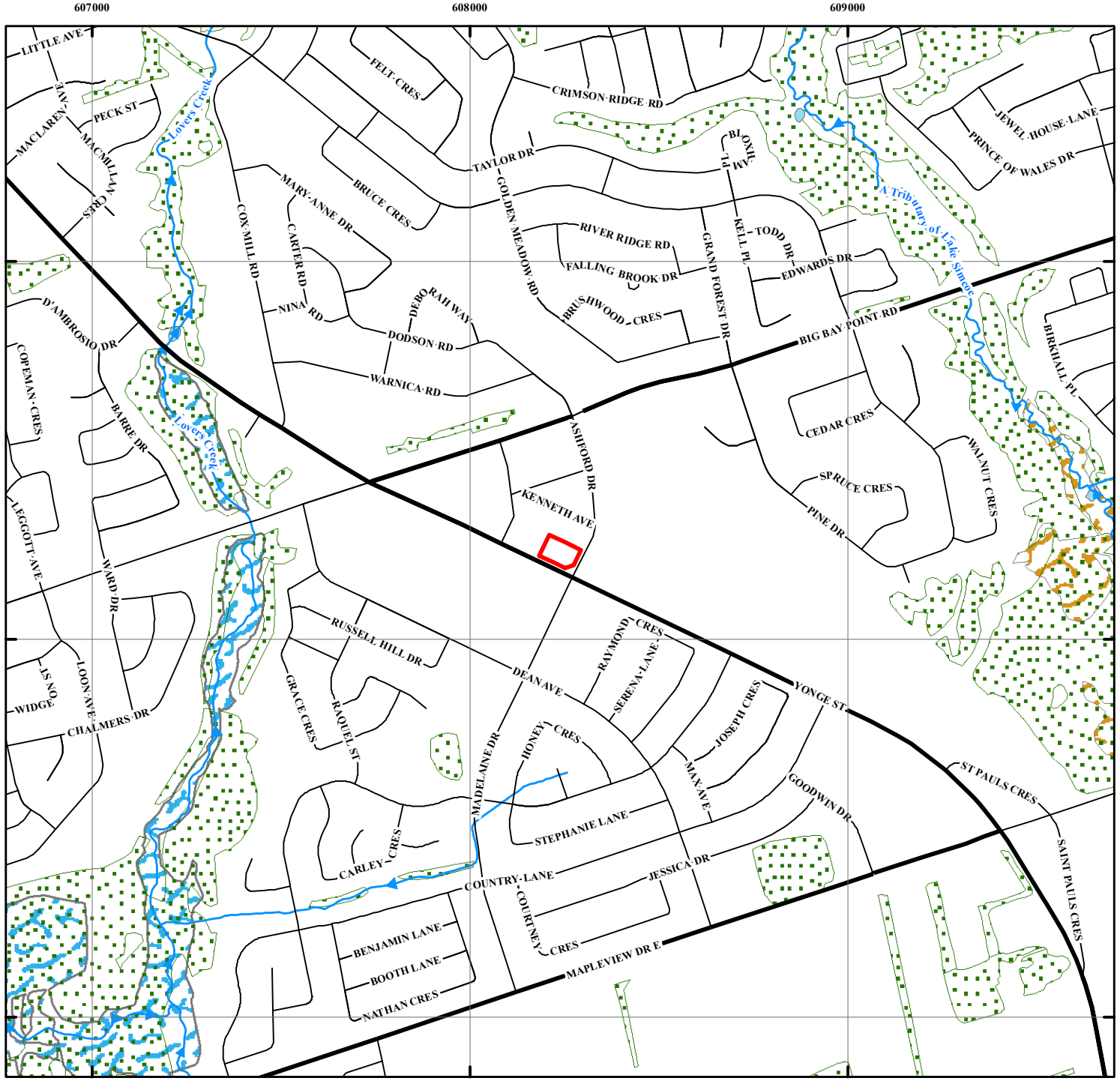
Scale:

0 10,000 20,000 40,000 60,000 80,000 100,000

Metres

Drawing No. 6

this mapping was produced by SEL and should be used for information purposes only.
Data sources used in its production are of varying quality and accuracy and all boundaries should be considered approximate.




Contains information licensed under the Open Government Licence – Ontario, 2019
Includes information: Provincial Park, Conservation Reserve, Area of Natural and Scientific Interest, Wetland, Niagara Escarpment Protection Area, Oak Ridges Moraine Conservation and Wilderness Areas

Source: Ministry of Natural Resources and Forestry
©Queen's Printer for Ontario, 2019

N

- Approximate Boundary of Subject Site
- Wetland (classified as Provincial)
- Wetland (Not evaluated per OWES)
- Wooded Area
- Water Body
- Watercourse
- Major Road
- Local Road

Soil Engineers Ltd.

Title: Natural Features and Protection Area Plan

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

Reference No. 1909-W019

Date: September 25, 2019

Scale:
0 75 150 300 450 600 750
Metres

Drawing No. 7


Source: Ministry of Natural Resources and Forestry
©Queen's Printer for Ontario, 2019

N

Approximate Boundary of Subject Site
Borehole
Borehole with Monitoring Well
Major Road
Local Road
A A' Cross-Section Direction
260 Topographic Contour (masl)

*Soil Engineers Ltd.*

Title: Cross-Section Key Plan

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

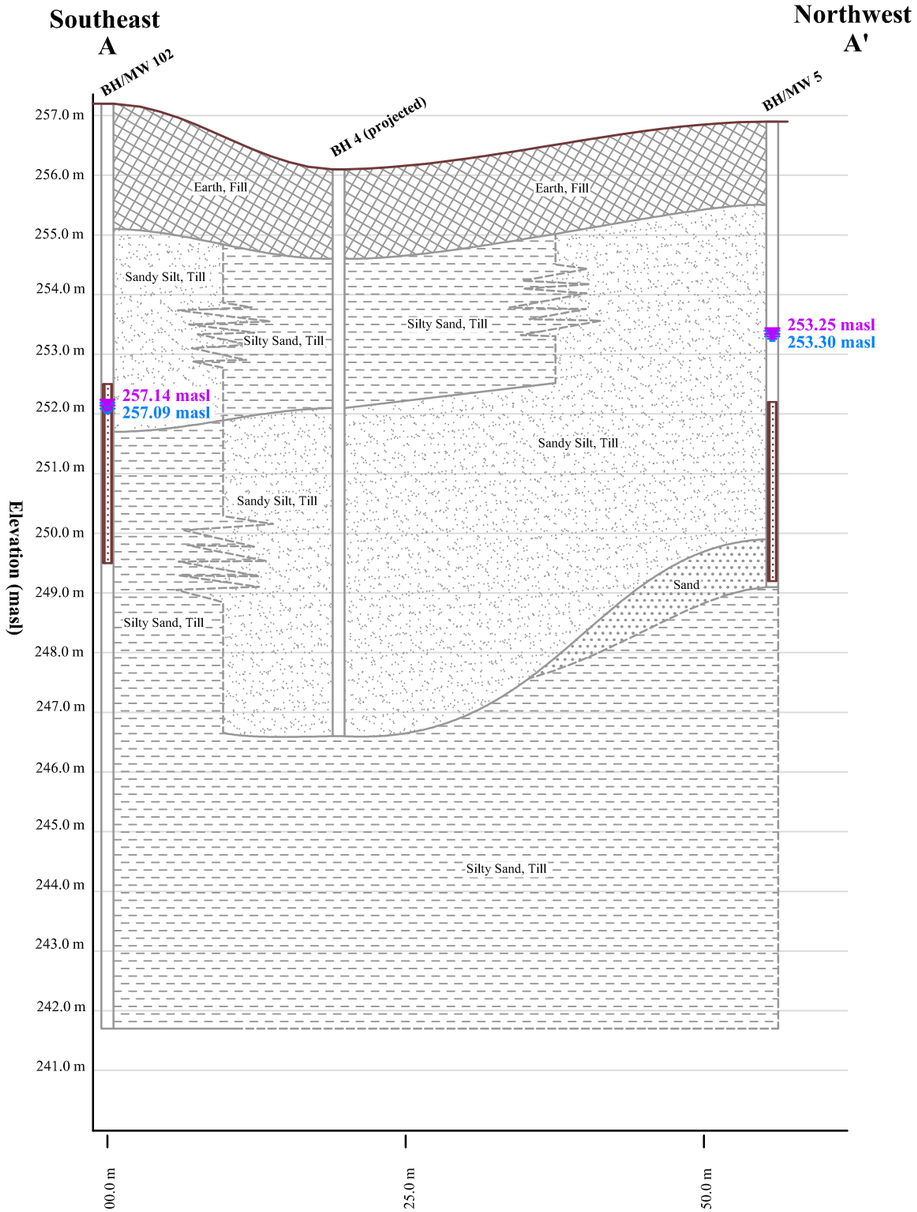
Reference No. 1909-W019

Date: October 10, 2019

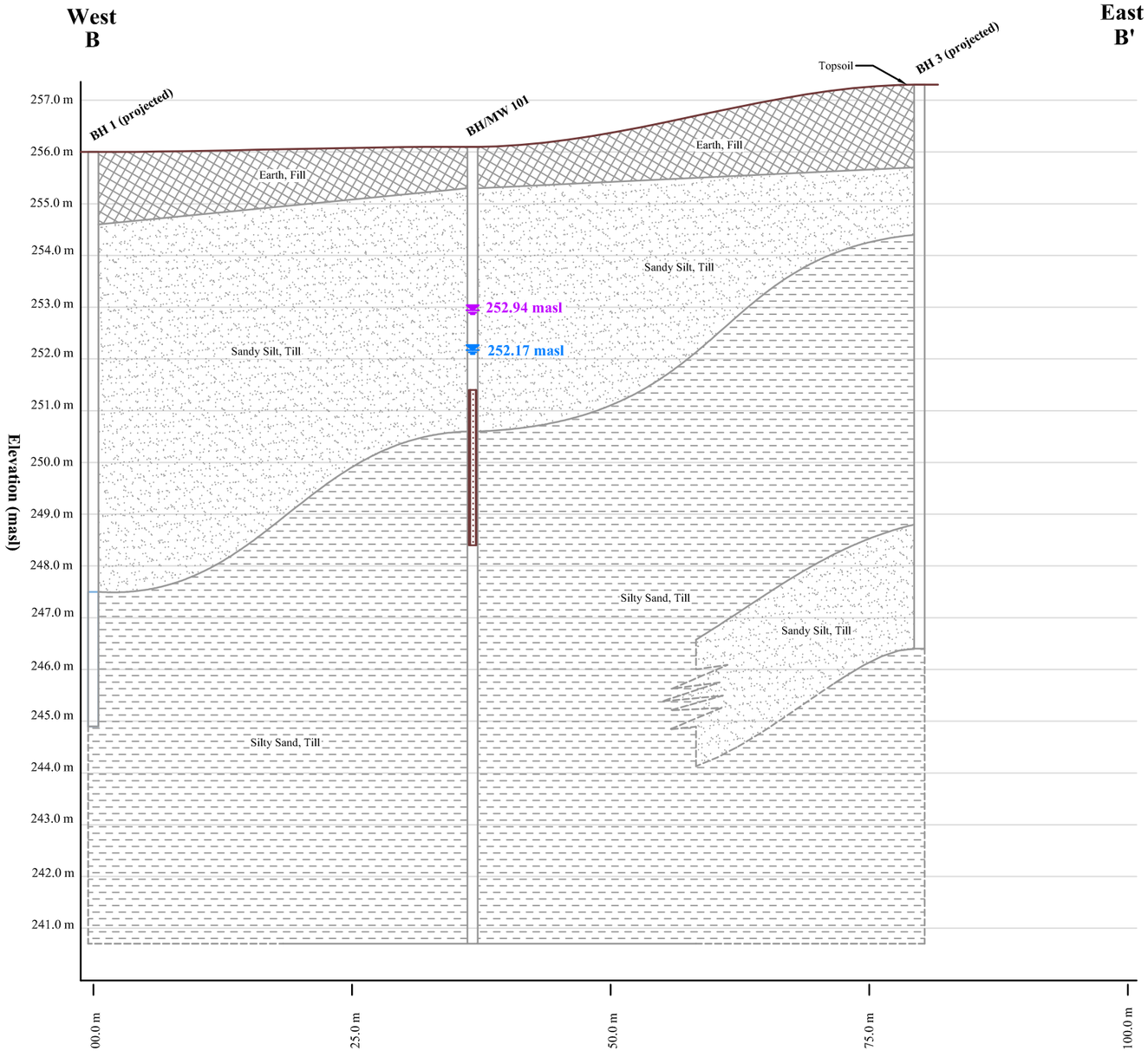
Scale:
0 3 6 12 18 24 30
Metres

Drawing No. 8-1

C:\GIS2019\1909-W019\




## Section A-A'




## Section B-B'

Earth, Fill

Fine to Medium Sand

Silty Sand, Till

Sandy Silt, Till

3.0 m Screen

Water Table on September 27, 2019

Water Table on October 9, 2019

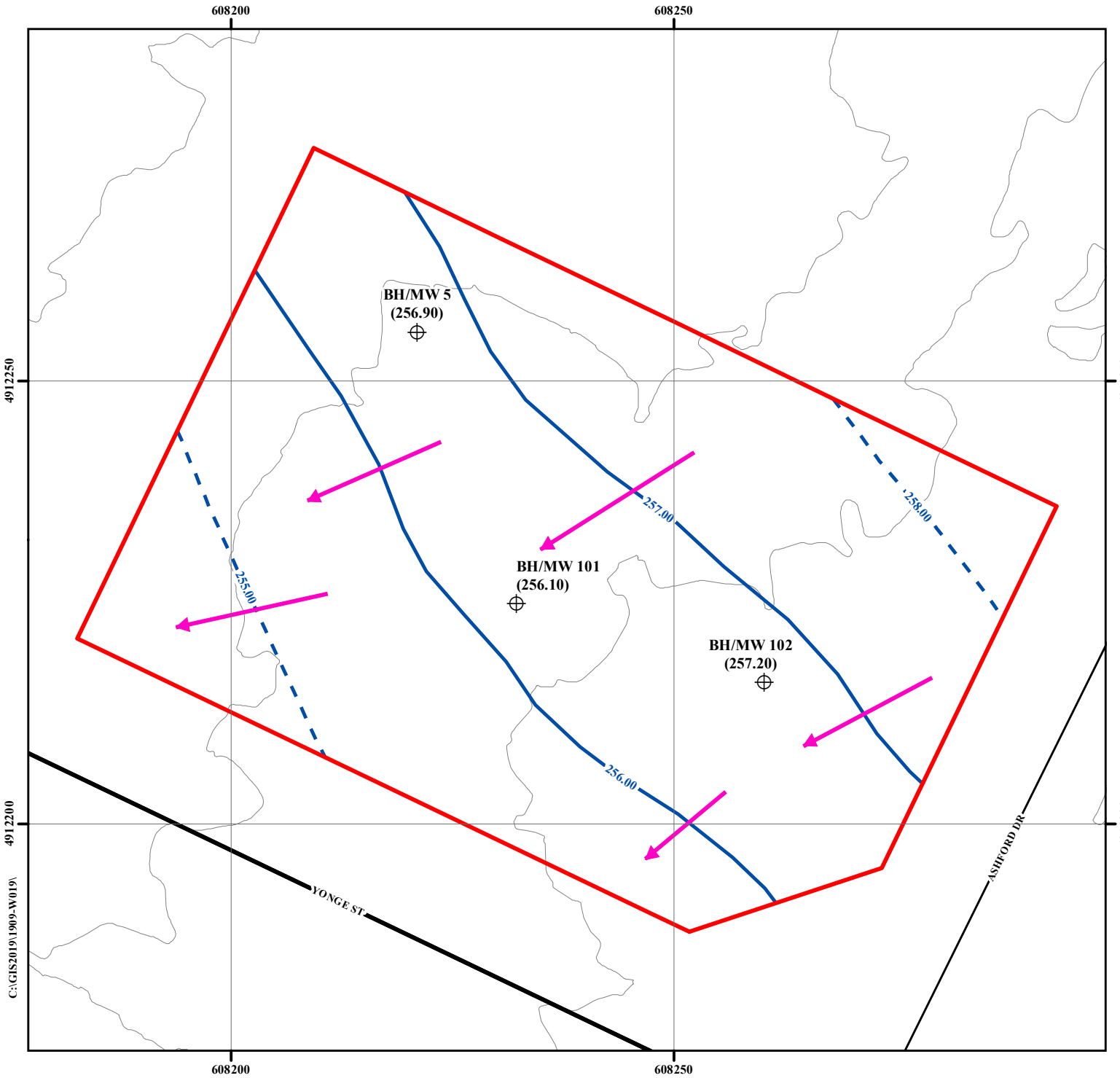
C:Projects/2019 Jobs/1909-W019

Soil Engineers Ltd.
CONSULTING SOIL, FOUNDATION & ENVIRONMENTAL ENGINEERS

Title: Geological Cross-Section (A-A' and B-B')

Project: Hydrogeological Assessment
Proposed Condominium Development with 2-Level Underground Parking
681 Yonge Street, City of Barrie

| Reference No: | Date: | Scale: V | Scale: H | Drawing No. |
|---|---|---|---|---|
| 1909-W019 | October, 2019 | 1:200 | 1:500 | 8-2 |




Source: Ministry of Natural Resources and Forestry
©Queen's Printer for Ontario, 2019

N

- Approximate Boundary of Subject Site
- Borehole with Monitoring Well
- Interpreted Shallow Groundwater Flow Direction
- Interpreted Shallow Groundwater Level Elevation (masl)
- Inferred Shallow Groundwater Level Elevation (masl)
- Major Road
- Local Road
- 260 Topographic Contour (masl)
- 257.20 Average Shallow Groundwater Level Elevation (masl)

*Soil Engineers Ltd.*

Title: Shallow Groundwater Flow Pattern Plan

Project:

Hydrogeological Assessment
Proposed Condominium Development
with 2-Level Underground Parking
681 Yonge Street
City of Barrie

Reference No. 1909-W019

Date: October 10, 2019

Scale:
0 3 6 12 18 24 30
Metres

Drawing No. 9

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| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (905) 881-8335 | FAX: (705) 684-8522 | FAX: (905) 725-1315 | FAX: (905) 542-2769 |


# APPENDIX 'A'

## MECP WATER WELL RECORDS SUMMARY

## REFERENCE NO. 1909-W019

**Ontario Water Well Records**

| WELL ID | MECP WWR ID | Construction Method | Well Depth (m)** | Well Usage | | Water Found (m)** | Static Water Level (m)** | Top of Screen Depth (m)** | Bottom of Screen Depth (m)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Final Status | First Use | | | | |
| 1 | 7228530 | Direct Push | 6.1 | Observation Wells | Monitoring and Test Hole | 0 | 0 | 3.05 | 6.10 |
| 2 | 7187964 | Direct Push | 6.1 | Test Hole | Monitoring and Test Hole | 0 | 0 | 3.05 | 6.10 |
| 3 | 7206078 | | | Observation Wells | | 0 | 0 | 0.00 | 0.00 |
| 4 | 7187965 | Direct Push | 6.71 | Test Hole | Monitoring and Test Hole | 0 | 0 | 3.66 | 6.71 |
| 5 | 7228528 | Direct Push | 6.1 | Observation Wells | Monitoring and Test Hole | 0 | 0 | 3.05 | 6.10 |
| 6 | 7206077 | | | Observation Wells | | 0 | 0 | 0.00 | 0.00 |
| 7 | 5701460 | Cable Tool | | Water Supply | Domestic | 14.03 | 3.66 | 0.00 | 0.00 |
| 8 | 7206079 | | | Observation Wells | | 0 | 0 | 0.00 | 0.00 |
| 9 | 7206074 | | | Abandoned-Other | | 0 | 0 | 0.00 | 0.00 |
| 10 | 7206076 | | | Abandoned-Other | | 0 | 0 | 0.00 | 0.00 |
| 11 | 5701472 | Cable Tool | | Water Supply | Domestic | 17.995 | 4.575 | 18.00 | 18.91 |
| 12 | 5701566 | Cable Tool | | Water Supply | Domestic | 20.74 | 6.1 | 0.00 | 0.00 |
| 13 | 5701586 | Cable Tool | | Water Supply | Domestic | 23.18 | 11.59 | 0.00 | 0.00 |
| 14 | 5705813 | Boring | | Water Supply | | 4.575 | 4.575 | 0.00 | 0.00 |
| 15 | 5701593 | Cable Tool | | Water Supply | Domestic | 27.45 | 10.675 | 0.00 | 0.00 |
| 16 | 5706394 | Cable Tool | | Water Supply | Domestic | 23.18 | 14.335 | 0.00 | 0.00 |
| 17 | 5701576 | Cable Tool | | Water Supply | Domestic | 23.485 | 13.725 | 0.00 | 0.00 |
| 18 | 5701471 | Cable Tool | | Water Supply | Domestic | 15.86 | 8.235 | 0.00 | 0.00 |
| 19 | 5739673 | Rotary (Convent.) | 6 | Observation Wells | | 0 | 0 | 3.00 | 6.00 |
| 20 | 7143472 | Boring | 6.1 | | Monitoring | 3.5075 | 3.5075 | 3.05 | 6.10 |
| 21 | 5739886 | Boring | 8.23 | Observation Wells | Not Used | 0 | 0 | 3.05 | 7.62 |
| 22 | 7114458 | | | Abandoned-Other | | 0 | 0 | 0.00 | 0.00 |
| 23 | 5701579 | Cable Tool | | Water Supply | Domestic | 25.925 | 11.285 | 0.00 | 0.00 |
| 24 | 5710471 | Boring | | Water Supply | Domestic | 4.575 | 6.1 | 0.00 | 0.00 |
| 25 | 5701461 | Jetting | | Unfinished | | 0 | 0 | 0.00 | 0.00 |
| 26 | 5701468 | Cable Tool | | Water Supply | Domestic | 15.86 | 2.44 | 0.00 | 0.00 |
| 27 | 5701581 | Cable Tool | | Water Supply | Domestic | 9.15 | 7.93 | 0.00 | 0.00 |
| 28 | 5701568 | Cable Tool | | Water Supply | Domestic | 20.13 | 11.59 | 17.39 | 20.74 |
| 29 | 5705896 | Cable Tool | | Water Supply | Domestic | 18.605 | 11.285 | 0.00 | 0.00 |
| 30 | 5701559 | Cable Tool | | Water Supply | Domestic | 17.385 | 5.185 | 0.00 | 0.00 |
| 31 | 5701562 | Boring | | Water Supply | Domestic | 10.675 | 9.15 | 0.00 | 0.00 |
| 32 | 5701464 | Boring | | Water Supply | Domestic | 4.575 | 1.525 | 0.00 | 0.00 |
| 33 | 5701606 | Cable Tool | | Water Supply | Domestic | 20.435 | 12.81 | 0.00 | 0.00 |
| 34 | 7114476 | | | Abandoned-Other | | 0 | 0 | 0.00 | 0.00 |
| 35 | 5701569 | Cable Tool | | Water Supply | Domestic | 20.74 | 13.115 | 0.00 | 0.00 |
| 36 | 5701473 | Cable Tool | | Water Supply | Domestic | 12.505 | 0.305 | 12.51 | 13.42 |
| 37 | 5717858 | Cable Tool | | Water Supply | Domestic | 15.555 | 3.355 | 0.00 | 0.00 |
| 38 | 5711645 | Cable Tool | | Water Supply | Domestic | 12.2 | 1.525 | 0.00 | 0.00 |
| 39 | 5705586 | Cable Tool | | Water Supply | Domestic | 52.46 | 7.93 | 52.46 | 53.38 |
| 40 | 5708985 | Cable Tool | | Water Supply | Domestic | 16.165 | 6.1 | 14.03 | 14.95 |
| 41 | 5719010 | Cable Tool | | Water Supply | Domestic | 21.35 | 6.71 | 0.00 | 0.00 |
| 42 | 5701604 | Cable Tool | | Water Supply | Domestic | 27.755 | 14.03 | 0.00 | 0.00 |
| 43 | 5701474 | Cable Tool | | Water Supply | Domestic | 13.42 | 2.135 | 0.00 | 0.00 |
| 44 | 5705576 | Cable Tool | | Water Supply | Domestic | 11.59 | 0.915 | 0.00 | 0.00 |
| 45 | 5701601 | Cable Tool | | Water Supply | Domestic | 9.15 | 7.625 | 0.00 | 0.00 |
| 46 | 5701572 | Cable Tool | | Water Supply | Domestic | 21.35 | 13.115 | 0.00 | 0.00 |
| 47 | 5701575 | Cable Tool | | Water Supply | Domestic | 21.045 | 9.455 | 0.00 | 0.00 |
| 48 | 5701599 | Cable Tool | | Water Supply | Domestic | 25.315 | 10.675 | 0.00 | 0.00 |
| 49 | 5701563 | Boring | | Water Supply | Domestic | 9.15 | 6.1 | 0.00 | 0.00 |
| 50 | 5737208 | Not Known | | Abandoned-Other | Not Used | 0 | 0 | 0.00 | 0.00 |
| 51 | 5701570 | Cable Tool | | Water Supply | Domestic | 20.13 | 10.675 | 0.00 | 0.00 |
| 52 | 5701571 | Cable Tool | | Water Supply | Domestic | 15.86 | 7.625 | 0.00 | 0.00 |
| 53 | 5701462 | Boring | | Water Supply | Domestic | 6.1 | 3.05 | 0.00 | 0.00 |
| 54 | 5701605 | Cable Tool | | Water Supply | Domestic | 24.4 | 11.59 | 24.70 | 30.20 |
| 55 | 5701591 | Cable Tool | | Water Supply | Domestic | 28.67 | 12.81 | 0.00 | 0.00 |
| 56 | 5701588 | Cable Tool | | Water Supply | Domestic | 21.35 | 12.2 | 0.00 | 0.00 |
| 57 | 5701573 | Cable Tool | | Water Supply | Domestic | 13.42 | 9.455 | 13.42 | 14.34 |
| 58 | 5701585 | Cable Tool | | Water Supply | Domestic | 16.47 | 10.675 | 16.77 | 17.69 |
| 59 | 5701578 | Cable Tool | | Water Supply | Domestic | 25.925 | 8.235 | 0.00 | 0.00 |
| 60 | 7125113 | | | Alteration | Domestic | 0 | 0 | 0.00 | 0.00 |
| 61 | 7113591 | | | | | 0 | 0 | 0.00 | 0.00 |
| 62 | 7113595 | | | | | 0 | 0 | 0.00 | 0.00 |
| 63 | 5701465 | Boring | | Water Supply | Domestic | 10.065 | 3.05 | 0.00 | 0.00 |
| 64 | 5701480 | Cable Tool | | Water Supply | Domestic | 15.86 | 3.05 | 0.00 | 0.00 |
| 65 | 5701475 | Boring | | Water Supply | Domestic | 9.15 | 3.05 | 0.00 | 0.00 |
| 66 | 5706172 | Cable Tool | | Water Supply | Domestic | 11.285 | 6.1 | 0.00 | 0.00 |
| 67 | 5710484 | Boring | | Water Supply | Domestic | 3.05 | 3.05 | 0.00 | 0.00 |
| 68 | 5701561 | Cable Tool | | Water Supply | Domestic | 29.585 | 19.215 | 0.00 | 0.00 |
| 69 | 5701618 | Cable Tool | | Water Supply | Domestic | 18.91 | 12.2 | 0.00 | 0.00 |
| 70 | 5701463 | Boring | | Water Supply | Domestic | 4.575 | 1.525 | 0.00 | 0.00 |
| 71 | 5701467 | Boring | | Water Supply | Domestic | 3.05 | 3.05 | 0.00 | 0.00 |
| 72 | 5701469 | Boring | | Water Supply | Commerical | 12.505 | 1.525 | 0.00 | 0.00 |
| 73 | 5741371 | | | Abandoned-Other | Not Used | 0 | 0 | 0.00 | 0.00 |
| 74 | 5701466 | Boring | | Water Supply | Domestic | 8.54 | 4.575 | 0.00 | 0.00 |
| 75 | 5710493 | Boring | | Water Supply | Domestic | 4.575 | 3.66 | 0.00 | 0.00 |
| 76 | 5701454 | Cable Tool | | Water Supply | Domestic | 14.03 | 3.66 | 0.00 | 0.00 |
| 77 | 5701478 | Cable Tool | | Water Supply | Domestic | 15.86 | 8.235 | 0.00 | 0.00 |
| 78 | 5701470 | Cable Tool | | Water Supply | Domestic | 11.285 | 4.575 | 0.00 | 0.00 |
| 79 | 5701617 | Cable Tool | | Water Supply | Domestic | 32.025 | 18.3 | 0.00 | 0.00 |
| 80 | 5710504 | Boring | | Water Supply | Domestic | 4.88 | 1.525 | 0.00 | 0.00 |
| 81 | 5701479 | Cable Tool | | Water Supply | Domestic | 14.335 | 0 | 14.34 | 15.25 |
| 82 | 5717013 | Cable Tool | | Water Supply | Domestic | 19.825 | 0.61 | 19.82 | 20.74 |
| 83 | 5711401 | Boring | | Water Supply | Domestic | 6.1 | 3.05 | 0.00 | 0.00 |
| 84 | 5701619 | Cable Tool | | Water Supply | Domestic | 17.69 | 7.32 | 0.00 | 0.00 |
| 85 | 5701481 | Cable Tool | | Water Supply | Domestic | 18.91 | 12.2 | 19.22 | 20.13 |
| 86 | 5701476 | Cable Tool | | Water Supply | Domestic | 18.91 | 15.25 | 0.00 | 0.00 |
| 87 | 5740666 | | | | | 0 | 0 | 0.00 | 0.00 |

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90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL (416) 754-8515 · FAX (905) 881-8335

| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | GRAVENHURST | PETERBOROUGH | HAMILTON |
|---|---|---|---|---|---|---|
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# APPENDIX 'B'

## RESULTS OF
## SINGLE WELL RESPONSE TEST (SWRT)

## REFERENCE NO. 1909-W019

## Falling Head Test (Slug Test)

| | | | |
|---|---|---|---|
| Test Date: | | 09-Oct-19 | |
| Piezometer/Well No.: | | BH/MW 101 | |
| Ground level: | | 256.10 | m |
| Screen top level: | | 250.85 | m |
| Screen bottom level: | | 247.75 | m |
| Test El. (at midpoint of screen): | | 249.30 | m |
| Test depth (at midpoint of screen): | | 6.8 | m |
| Screen length | L= | 3.1 | m |
| Diameter of undisturbed portion c | 2R= | 0.22 | m |
| Standpipe diameter | 2r= | 0.05 | m |
| Initial unbalanced head | Ho= | -0.458 | m |
| Initial water depth | | 3.82 | m |
| Aquifer material: | | **Silty Sand Till** | |

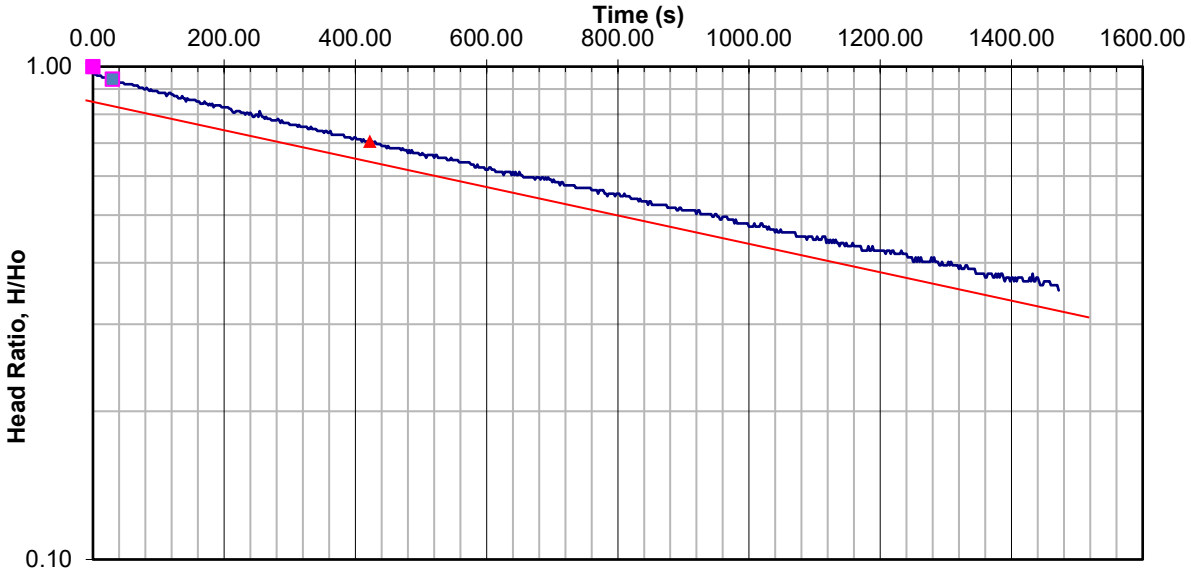
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.83401$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00194812$

K= **6.6E-05** cm/s

**6.6E-07** m/s



## Falling Head Test (Slug Test)

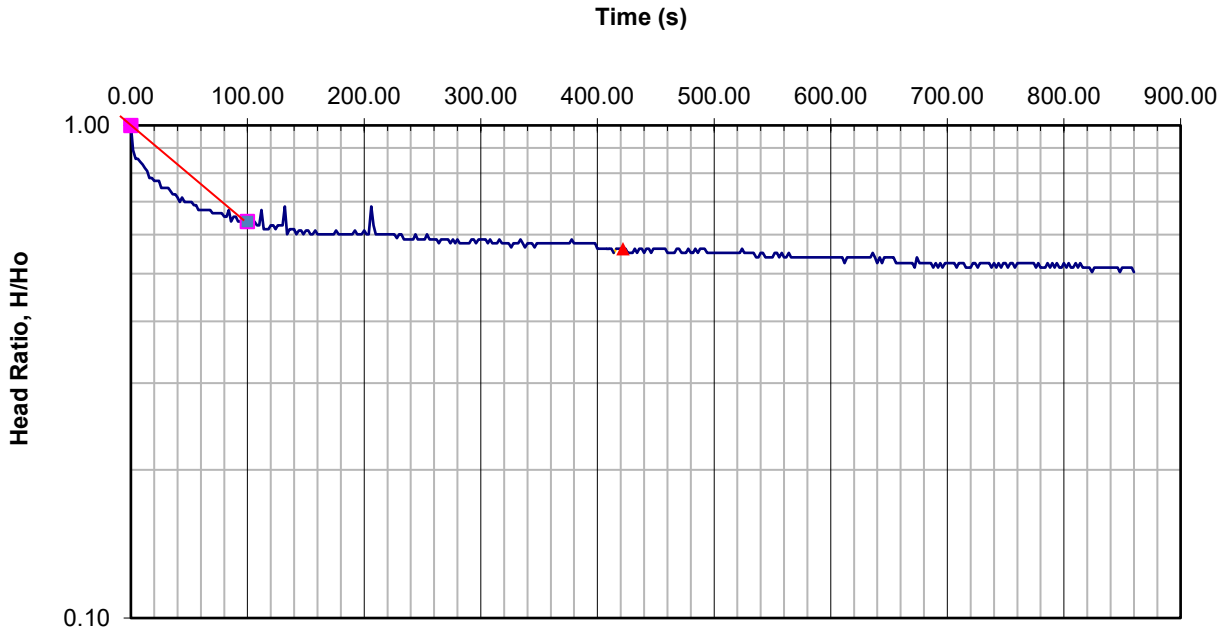
| | | | |
|---|---|---|---|
| Test Date: | | 09-Oct-19 | |
| Piezometer/Well No.: | | BH/MW 102 | |
| Ground level: | | 256.20 | m |
| Screen top level: | | 250.95 | m |
| Screen bottom level: | | 247.85 | m |
| Test El. (at midpoint of screen): | | 249.40 | m |
| Test depth (at midpoint of screen): | | 6.8 | m |
| Screen length | L= | 3.1 | m |
| Diameter of undisturbed portion c | 2R= | 0.22 | m |
| Standpipe diameter | 2r= | 0.05 | m |
| Initial unbalanced head | Ho= | -0.276 | m |
| Initial water depth | | 4.76 | m |
| Aquifer material: | | **Silty Sand Till** | |

Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.83401$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00449917$

K= **1.5E-04** cm/s
**1.5E-06** m/s



## Falling Head Test (Slug Test)

| | | | |
|---|---|---|---|
| Test Date: | | 09-Oct-19 | |
| Piezometer/Well No.: | | BH/MW 5 | |
| Ground level: | | 256.90 | m |
| Screen top level: | | 251.59 | m |
| Screen bottom level: | | 248.49 | m |
| Test El. (at midpoint of screen): | | 250.04 | m |
| Test depth (at midpoint of screen): | | 6.86 | m |
| Screen length | L= | 3.1 | m |
| Diameter of undisturbed portion c | 2R= | 0.22 | m |
| Standpipe diameter | 2r= | 0.05 | m |
| Initial unbalanced head | Ho= | -0.494 | m |
| Initial water depth | | 4.35 | m |
| Aquifer material: | | **Sandy Silt Till &Sand** | |

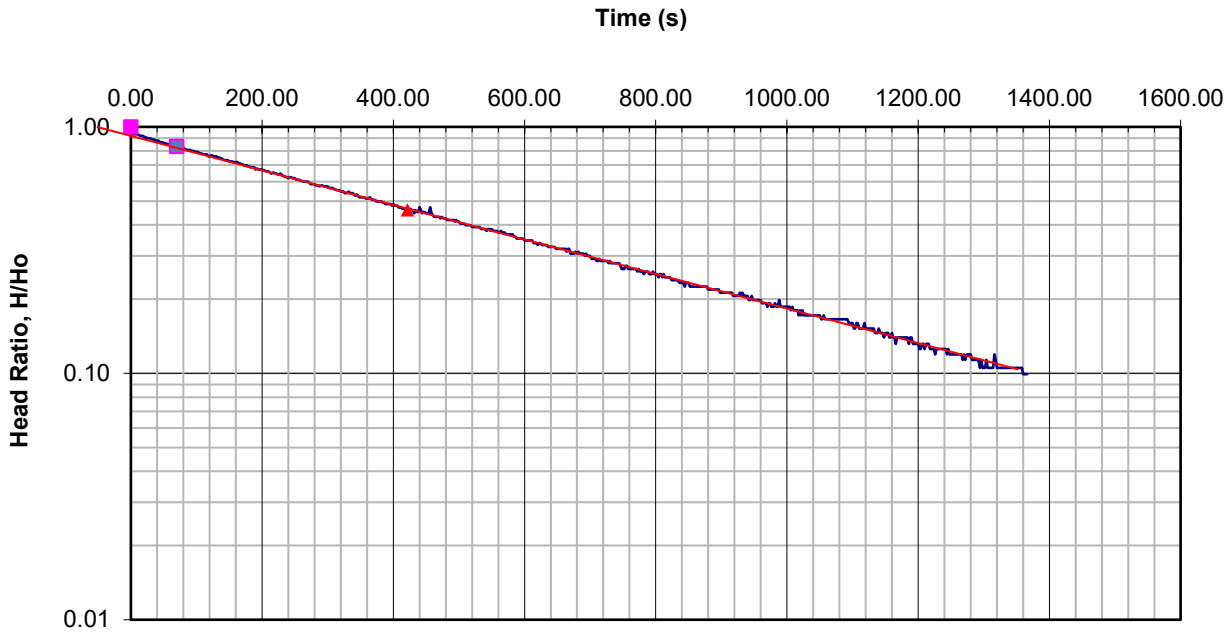
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.83401$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00262775$

K= **8.8E-05** cm/s

**8.8E-07** m/s



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# APPENDIX 'C'

## GROUNDWATER QUALITY TEST RESULTS

**REFERENCE NO. 1909-W019**

# FINAL REPORT

## CA14697-OCT19 R1

**1909-W019 681 Yonge Street, Barrie**

Prepared for

Soil Engineers Ltd.

# FINAL REPORT



## First Page

CLIENT DETAILS

| | |
|---|---|
| Client | Soil Engineers Ltd. |
| Address | 90 West Beaver Creek Rd<br>Richmond Hill, ON<br>M1S 3A7. Canada |
| Contact | Yogiraj Rana |
| Telephone | 705-341-1987 |
| Facsimile | 416-754-8516 |
| Email | yogiraj.rana@soilengineersltd.com |
| Project | 1909-W019 681 Yonge Street, Barrie |
| Order Number | |
| Samples | Ground Water (2) |

LABORATORY DETAILS

| | |
|---|---|
| Project Specialist | Brad Moore Hon. B.Sc |
| Laboratory | SGS Canada Inc. |
| Address | 185 Concession St., Lakefield ON, K0L 2H0 |
| Telephone | 705-652-2143 |
| Facsimile | 705-652-6365 |
| Email | brad.moore@sgs.com |
| SGS Reference | CA14697-OCT19 |
| Received | 10/22/2019 |
| Approved | 10/30/2019 |
| Report Number | CA14697-OCT19 R1 |
| Date Reported | 10/30/2019 |

COMMENTS

RL - SGS Reporting Limit

Total PAH is the sum of anthracene, benzo(a)pyrene, benzo(a)anthracene, benzo(e)pyrene, benzo(b,j)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, dibenzo(a,i)pyrene, dibenzo(a,j)acridine, 7H-dibenzo(c,g)carbazole, fluoranthene, indeno(1,2,3-c,d)pyrene, perylene, phenanthrene and pyrene..

Temperature of Sample upon Receipt: 6 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:008694

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

**Client:** Soil Engineers Ltd.
**Project:** 1909-W019 681 Yonge Street, Barrie
**Project Manager:** Yogiraj Rana
**Samplers:** Yogiraj Rana

PACKAGE: **SANSEW - General Chemistry** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172

L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| Parameter | Units | RL | L1 | L2 | Sample Number: 8 |
|---|---|---|---|---|---|
| | | | | | Sample Name: BH/MW 101 |
| | | | | | Sample Matrix: Ground Water |
| | | | | | Sample Date: 22/10/2019 |
| **General Chemistry** | | | | | |
| Biochemical Oxygen Demand (BOD5) | mg/L | 2 | 300 | 15 | 5 |
| Total Suspended Solids | mg/L | 2 | 350 | 15 | 17 |
| Total Kjeldahl Nitrogen | as N mg/L | 0.5 | 100 | | < 0.5 |
| Chemical Oxygen Demand | mg/L | 8 | 600 | | < 8 |

PACKAGE: **SANSEW - Metals and Inorganics** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172

L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| Parameter | Units | RL | L1 | L2 | Sample Number: 8 | Sample Number: 9 |
|---|---|---|---|---|---|---|
| | | | | | Sample Name: BH/MW 101 | Sample Name: BH/MW 101 Dissolved |
| | | | | | Sample Matrix: Ground Water | Sample Matrix: Ground Water |
| | | | | | Sample Date: 22/10/2019 | Sample Date: 22/10/2019 |
| **Metals and Inorganics** | | | | | | |
| Sulphide | mg/L | 0.02 | 1 | | < 0.02 | |
| Phosphorus (total) | mg/L | 0.03 | | | | < 0.03 |
| Cyanide (total) | mg/L | 0.01 | 1.2 | | < 0.01 | |
| Fluoride | mg/L | 0.06 | 10 | | 0.16 | |
| Sulphate | mg/L | 2 | 1500 | | 23 | |
| Aluminum (total) | mg/L | 0.001 | 50 | | 0.233 | 0.003 |
| Antimony (total) | mg/L | 0.0009 | 5 | | < 0.0009 | < 0.0009 |
| Arsenic (total) | mg/L | 0.0002 | 1 | | 0.0003 | 0.0002 |
| Boron (total) | mg/L | 0.002 | | | 0.043 | 0.051 |
| Bismuth (total) | mg/L | 0.000007 | 5 | | 0.000007 | < 0.000007 |

**Client:** Soil Engineers Ltd.
**Project:** 1909-W019 681 Yonge Street, Barrie
**Project Manager:** Yogiraj Rana
**Samplers:** Yogiraj Rana

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | **Sample Number** | 8 | 9 |
| | | | | | **Sample Name** | BH/MW 101 | BH/MW 101 Dissolved |
| | | | | | **Sample Matrix** | Ground Water | Ground Water |
| | | | | | **Sample Date** | 22/10/2019 | 22/10/2019 |
| **Parameter** | **Units** | **RL** | **L1** | **L2** | **Result** | **Result** |
| **Metals and Inorganics (continued)** | | | | | | |
| Cadmium (total) | mg/L | 0.000003 | 0.7 | 0.001 | 0.000006 | 0.000009 |
| Chromium (total) | mg/L | 0.00008 | 2 | 0.08 | 0.00099 | 0.00075 |
| Cobalt (total) | mg/L | 0.000004 | 5 | | 0.000294 | 0.000111 |
| Copper (total) | mg/L | 0.0002 | 2 | 0.01 | 0.0036 | 0.0011 |
| Iron (total) | mg/L | 0.007 | 50 | | 0.223 | < 0.007 |
| Lead (total) | mg/L | 0.00001 | 0.7 | 0.05 | 0.00016 | 0.00006 |
| Manganese (total) | mg/L | 0.00001 | 5 | | 0.05542 | 0.03805 |
| Molybdenum (total) | mg/L | 0.00004 | 5 | | 0.00348 | 0.00374 |
| Nickel (total) | mg/L | 0.0001 | 2 | 0.05 | 0.0015 | 0.0011 |
| Phosphorus (total) | mg/L | 0.003 | 10 | | 0.025 | 0.008 |
| Selenium (total) | mg/L | 0.00004 | 1 | | 0.00039 | 0.00036 |
| Silver (total) | mg/L | 0.00005 | 0.4 | | < 0.00005 | < 0.00005 |
| Tin (total) | mg/L | 0.00006 | 5 | | 0.00158 | 0.00142 |
| Vanadium (total) | mg/L | 0.00001 | 5 | | 0.00111 | 0.00064 |
| Zinc (total) | mg/L | 0.002 | 2 | 0.04 | 0.003 | 0.004 |
| Gold (total) | mg/L | 0.00001 | 5 | | 0.00002 | < 0.00001 |
| Platinum (total) | mg/L | 0.0001 | 5 | | < 0.0001 | < 0.0001 |
| Rhodium (total) | mg/L | 0.00001 | 5 | | < 0.00001 | < 0.00001 |

**Client:** Soil Engineers Ltd.
**Project:** 1909-W019 681 Yonge Street, Barrie
**Project Manager:** Yogiraj Rana
**Samplers:** Yogiraj Rana

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **Oil and Grease** | | | | | |
| Oil & Grease (total) | mg/L | 2 | | | < 2 |
| Oil & Grease (animal/vegetable) | mg/L | 4 | 150 | | < 4 |
| Oil & Grease (mineral/synthetic) | mg/L | 4 | 15 | | < 4 |

PACKAGE: **SANSEW - Other (ORP)** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **Other (ORP)** | | | | | |
| pH | no unit | 0.05 | 9.5 | 9.5 | 7.76 |
| Chloride | mg/L | 1 | 1500 | | 65 |
| Mercury (total) | mg/L | 0.00001 | 0.01 | | < 0.00001 |

PACKAGE: **SANSEW - PAHs** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **PAHs** | | | | | |
| Benzo(b+j)fluoranthene | mg/L | 0.0001 | | | < 0.0001 |

**Client:** Soil Engineers Ltd.
**Project:** 1909-W019 681 Yonge Street, Barrie
**Project Manager:** Yogiraj Rana
**Samplers:** Yogiraj Rana

PACKAGE: **SANSEW - Phenols** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **Phenols** | | | | | |
| 4AAP-Phenolics | mg/L | 0.002 | 0.1 | | < 0.002 |

PACKAGE: **SANSEW - SVOCs** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **SVOCs** | | | | | |
| PAHs (Total) | mg/L | - | 0.005 | | < 0.001 |
| Perylene | mg/L | 0.0005 | | | < 0.0005 |
| Hexachlorobenzene | mg/L | 0.0001 | 0.001 | | < 0.0001 |

PACKAGE: **SANSEW - SVOCs - PAHs** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172
L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **SVOCs - PAHs** | | | | | |
| 7Hdibenzo(c,g)carbazole | mg/L | 0.0001 | | | < 0.0001 |
| Anthracene | mg/L | 0.0001 | | | < 0.0001 |
| Benzo(a)anthracene | mg/L | 0.0001 | | | < 0.0001 |
| Benzo(a)pyrene | mg/L | 0.0001 | | | < 0.0001 |
| Benzo[e]pyrene | mg/L | 0.0001 | | | < 0.0001 |

**Client:** Soil Engineers Ltd.

**Project:** 1909-W019 681 Yonge Street, Barrie

**Project Manager:** Yogiraj Rana

**Samplers:** Yogiraj Rana

PACKAGE: **SANSEW - SVOCs - PAHs** (WATER)

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172

L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

## SVOCs - PAHs (continued)

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| Benzo(ghi)perylene | mg/L | 0.0002 | | | < 0.0002 |
| Benzo(k)fluoranthene | mg/L | 0.0001 | | | < 0.0001 |
| Chrysene | mg/L | 0.0001 | | | < 0.0001 |
| Dibenzo(a,h)anthracene | mg/L | 0.0001 | | | < 0.0001 |
| Dibenzo(a,i)pyrene | mg/L | 0.0001 | | | < 0.0001 |
| Dibenzo(a,j)acridine | mg/L | 0.0001 | | | < 0.0001 |
| Fluoranthene | mg/L | 0.0001 | | | < 0.0001 |
| Indeno(1,2,3-cd)pyrene | mg/L | 0.0002 | | | < 0.0002 |
| Phenanthrene | mg/L | 0.0001 | | | < 0.0001 |
| Pyrene | mg/L | 0.0001 | | | < 0.0001 |

**Client:** Soil Engineers Ltd.
**Project:** 1909-W019 681 Yonge Street, Barrie
**Project Manager:** Yogiraj Rana
**Samplers:** Yogiraj Rana

PACKAGE: **SANSEW - VOCs** (WATER)

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172

L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **VOCs** | | | | | |
| 1,2-Dichlorobenzene | mg/L | 0.0005 | 0.05 | | < 0.0005 |
| 1,4-Dichlorobenzene | mg/L | 0.0005 | 0.08 | | < 0.0005 |
| Methylene Chloride | mg/L | 0.0005 | 0.09 | | < 0.0005 |
| 1,1,2,2-Tetrachloroethane | mg/L | 0.0005 | 0.06 | | < 0.0005 |
| Tetrachloroethylene (perchloroethylene) | mg/L | 0.0005 | 0.06 | | < 0.0005 |
| Trichloroethylene | mg/L | 0.0005 | 0.05 | | < 0.0005 |

PACKAGE: **SANSEW - VOCs - BTEX** (WATER)

| | |
|---|---|
| **Sample Number** | 8 |
| **Sample Name** | BH/MW 101 |
| **Sample Matrix** | Ground Water |
| **Sample Date** | 22/10/2019 |

L1 = SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172

L2 = SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172

| Parameter | Units | RL | L1 | L2 | Result |
|---|---|---|---|---|---|
| **VOCs - BTEX** | | | | | |
| Benzene | mg/L | 0.0005 | 0.01 | | < 0.0005 |
| Ethylbenzene | mg/L | 0.0005 | 0.06 | | < 0.0005 |
| Toluene | mg/L | 0.0005 | 0.02 | | < 0.0005 |
| Xylene (total) | mg/L | 0.0005 | 0.3 | | < 0.0005 |
| m-p-xylene | mg/L | 0.0005 | | | < 0.0005 |
| o-xylene | mg/L | 0.0005 | | | < 0.0005 |

## EXCEEDANCE SUMMARY

| Parameter | Method | Units | Result | SANSEW / WATER / - - City of Barrie - Sanitary Sewers & Combined - BL_2012_172 L1 | SANSEW / WATER / - - City of Barrie - Sanitary Storm - BL_2012_172 L2 |
|---|---|---|---|---|---|
| **BH/MW 101** | | | | | |
| Total Suspended Solids | SM 2540D | mg/L | 17 | | 15 |

## QC SUMMARY

### Anions by discrete analyzer

Method: US EPA 325.2 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-026

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Chloride | DIO0454-OCT19 | mg/L | 1 | <1 | 3 | 20 | 104 | 80 | 120 | 103 | 75 | 125 |
| Sulphate | DIO0454-OCT19 | mg/L | 2 | <2 | ND | 20 | 102 | 80 | 120 | 106 | 75 | 125 |

### Biochemical Oxygen Demand

Method: SM 5210 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-007

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Biochemical Oxygen Demand (BOD5) | BOD0044-OCT19 | mg/L | 2 | < 2 | 8 | 30 | 100 | 70 | 130 | 93 | 70 | 130 |

### Chemical Oxygen Demand

Method: HACH 8000 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-009

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Chemical Oxygen Demand | EWL0405-OCT19 | mg/L | 8 | <8 | 14 | 20 | 110 | 80 | 120 | NV | 75 | 125 |

## QC SUMMARY

### Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-005

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Cyanide (total) | SKA0209-OCT19 | mg/L | 0.01 | <0.01 | ND | 10 | 98 | 90 | 110 | 88 | 75 | 125 |

### Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-014

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Fluoride | EWL0412-OCT19 | mg/L | 0.06 | <0.06 | NV | 10 | 100 | 90 | 110 | NV | 75 | 125 |
| Fluoride | EWL0426-OCT19 | mg/L | 0.06 | <0.06 | ND | 10 | 104 | 90 | 110 | 107 | 75 | 125 |

### Mercury by CVAAS

Method: EPA 7471A/SM 3112B I Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Mercury (total) | EHG0028-OCT19 | mg/L | 0.00001 | < 0.00001 | ND | 20 | 102 | 80 | 120 | 118 | 70 | 130 |

## QC SUMMARY

### Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Silver (total) | EMS0170-OCT19 | mg/L | 0.00005 | <0.00005 | ND | 20 | 100 | 90 | 110 | 93 | 70 | 130 |
| Aluminum (total) | EMS0170-OCT19 | mg/L | 0.001 | <0.001 | 2 | 20 | 108 | 90 | 110 | 111 | 70 | 130 |
| Arsenic (total) | EMS0170-OCT19 | mg/L | 0.0002 | <0.0002 | 3 | 20 | 100 | 90 | 110 | 93 | 70 | 130 |
| Boron (total) | EMS0170-OCT19 | mg/L | 0.002 | <0.002 | 4 | 20 | 104 | 90 | 110 | NV | 70 | 130 |
| Bismuth (total) | EMS0170-OCT19 | mg/L | 0.000007 | <0.000007 | ND | 20 | 97 | 90 | 110 | 84 | 70 | 130 |
| Cadmium (total) | EMS0170-OCT19 | mg/L | 0.000003 | <0.000003 | 2 | 20 | 102 | 90 | 110 | 96 | 70 | 130 |
| Cobalt (total) | EMS0170-OCT19 | mg/L | 0.000004 | <0.000004 | 8 | 20 | 100 | 90 | 110 | 98 | 70 | 130 |
| Chromium (total) | EMS0170-OCT19 | mg/L | 0.00008 | <0.00008 | ND | 20 | 97 | 90 | 110 | 97 | 70 | 130 |
| Copper (total) | EMS0170-OCT19 | mg/L | 0.0002 | <0.0002 | 4 | 20 | 100 | 90 | 110 | 97 | 70 | 130 |
| Iron (total) | EMS0170-OCT19 | mg/L | 0.007 | <0.007 | 3 | 20 | 100 | 90 | 110 | NV | 70 | 130 |
| Manganese (total) | EMS0170-OCT19 | mg/L | 0.00001 | <0.00001 | 4 | 20 | 103 | 90 | 110 | 100 | 70 | 130 |
| Molybdenum (total) | EMS0170-OCT19 | mg/L | 0.00004 | 0.00012058823529412 | 5 | 20 | 110 | 90 | 110 | 100 | 70 | 130 |
| Nickel (total) | EMS0170-OCT19 | mg/L | 0.0001 | <0.0001 | ND | 20 | 100 | 90 | 110 | 97 | 70 | 130 |
| Lead (total) | EMS0170-OCT19 | mg/L | 0.00001 | <0.00001 | 4 | 20 | 99 | 90 | 110 | 96 | 70 | 130 |
| Phosphorus (total) | EMS0170-OCT19 | mg/L | 0.003 | <0.003 | 7 | 20 | 97 | 90 | 110 | NV | 70 | 130 |
| Antimony (total) | EMS0170-OCT19 | mg/L | 0.0009 | <0.0009 | 2 | 20 | 109 | 90 | 110 | 125 | 70 | 130 |
| Selenium (total) | EMS0170-OCT19 | mg/L | 0.00004 | <0.00004 | 2 | 20 | 108 | 90 | 110 | 105 | 70 | 130 |
| Tin (total) | EMS0170-OCT19 | mg/L | 0.00006 | <0.00006 | ND | 20 | 104 | 90 | 110 | NV | 70 | 130 |
| Vanadium (total) | EMS0170-OCT19 | mg/L | 0.00001 | <0.00001 | ND | 20 | 103 | 90 | 110 | 92 | 70 | 130 |
| Zinc (total) | EMS0170-OCT19 | mg/L | 0.002 | <0.002 | 4 | 20 | 106 | 90 | 110 | 113 | 70 | 130 |

## QC SUMMARY

### Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Gold (total) | EMS0196-OCT19 | mg/L | 0.00001 | <0.00001 | ND | 20 | 94 | 90 | 110 | NV | 70 | 130 |
| Platinum (total) | EMS0196-OCT19 | mg/L | 0.0001 | <0.0001 | ND | 20 | 91 | 90 | 110 | NV | 70 | 130 |
| Rhodium (total) | EMS0196-OCT19 | mg/L | 0.00001 | <0.0001 | ND | 20 | 100 | 90 | 110 | NV | 70 | 130 |

### Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-IENVIGC-LAK-AN-019

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Oil & Grease (total) | GCM0411-OCT19 | mg/L | 2 | <2 | NSS | 20 | 102 | 75 | 125 | | | |

## QC SUMMARY

### Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Oil & Grease (animal/vegetable) | GCM0411-OCT19 | mg/L | 4 | < 4 | NSS | 20 | NA | 70 | 130 | | | |
| Oil & Grease (mineral/synthetic) | GCM0411-OCT19 | mg/L | 4 | < 4 | NSS | 20 | NA | 70 | 130 | | | |

### pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| pH | EWL0420-OCT19 | no unit | 0.05 | NA | 0 | | 101 | | | NA | | |

### Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-006

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| 4AAP-Phenolics | SKA0253-OCT19 | mg/L | 0.002 | <0.002 | ND | 10 | 102 | 90 | 110 | 104 | 75 | 125 |

## QC SUMMARY

### Phosphorus by SFA

Method: SM 4500-P J | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-003

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Phosphorus (total) | SKA0236-OCT19 | mg/L | 0.03 | <0.03 | 1 | 10 | 104 | 90 | 110 | 95 | 75 | 125 |

## QC SUMMARY

### Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-[ENV]GC-LAK-AN-005

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| 7Hdibenzo(c,g)carbazole | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 114 | 50 | 140 | NSS | 50 | 140 |
| Anthracene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 103 | 50 | 140 | NSS | 50 | 140 |
| Benzo(a)anthracene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 103 | 50 | 140 | NSS | 50 | 140 |
| Benzo(a)pyrene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 103 | 50 | 140 | NSS | 50 | 140 |
| Benzo(b+j)fluoranthene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 107 | 50 | 140 | NSS | 50 | 140 |
| Benzo[e]pyrene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 91 | 50 | 140 | NSS | 50 | 140 |
| Benzo(ghi)perylene | GCM0385-OCT19 | mg/L | 0.0002 | < 0.0002 | NSS | 30 | 111 | 50 | 140 | NSS | 50 | 140 |
| Benzo(k)fluoranthene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 111 | 50 | 140 | NSS | 50 | 140 |
| Chrysene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 105 | 50 | 140 | NSS | 50 | 140 |
| Dibenzo(a,h)anthracene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 109 | 50 | 140 | NSS | 50 | 140 |
| Dibenzo(a,i)pyrene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 109 | 50 | 140 | NSS | 50 | 140 |
| Dibenzo(a,j)acridine | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 109 | 50 | 140 | NSS | 50 | 140 |
| Fluoranthene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 105 | 50 | 140 | NSS | 50 | 140 |
| Hexachlorobenzene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 104 | 50 | 140 | NSS | 50 | 140 |
| Indeno(1,2,3-cd)pyrene | GCM0385-OCT19 | mg/L | 0.0002 | < 0.0002 | NSS | 30 | 109 | 50 | 140 | NSS | 50 | 140 |
| Perylene | GCM0385-OCT19 | mg/L | 0.0005 | < 0.0005 | NSS | 30 | 104 | 50 | 140 | NSS | 50 | 140 |
| Phenanthrene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 104 | 50 | 140 | NSS | 50 | 140 |
| Pyrene | GCM0385-OCT19 | mg/L | 0.0001 | < 0.0001 | NSS | 30 | 105 | 50 | 140 | NSS | 50 | 140 |

## QC SUMMARY

### Sulphide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-008

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Sulphide | SKA0215-OCT19 | mg/L | 0.02 | <0.02 | 4 | 20 | 98 | 80 | 120 | NA | 75 | 125 |

### Suspended Solids

Method: SM 2540D I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-004

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Total Suspended Solids | EWL0415-OCT19 | mg/L | 2 | < 2 | 0 | 10 | NV | 90 | 110 | NA | | |

### Total Nitrogen

Method: SM 4500-N C/4500-NO3- F I Internal ref.: ME-CA-[ENVISFA-LAK-AN-002

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Total Kjeldahl Nitrogen | SKA0269-OCT19 | as N mg/L | 0.5 | <0.5 | ND | 10 | 94 | 90 | 110 | NV | 75 | 125 |

## QC SUMMARY

### Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| 1,1,2,2-Tetrachloroethane | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 99 | 60 | 130 | 96 | 50 | 140 |
| 1,2-Dichlorobenzene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 100 | 60 | 130 | 97 | 50 | 140 |
| 1,4-Dichlorobenzene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 100 | 60 | 130 | 96 | 50 | 140 |
| Benzene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 99 | 60 | 130 | 93 | 50 | 140 |
| Ethylbenzene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 102 | 60 | 130 | 97 | 50 | 140 |
| m-p-xylene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 103 | 60 | 130 | 98 | 50 | 140 |
| Methylene Chloride | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 109 | 60 | 130 | 105 | 50 | 140 |
| o-xylene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 101 | 60 | 130 | 97 | 50 | 140 |
| Tetrachloroethylene (perchloroethylene) | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 101 | 60 | 130 | 97 | 50 | 140 |
| Toluene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 100 | 60 | 130 | 95 | 50 | 140 |
| Trichloroethylene | GCM0392-OCT19 | mg/L | 0.0005 | <0.0005 | ND | 30 | 98 | 60 | 130 | 92 | 50 | 140 |

## QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier**: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier**: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier**: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

### FOOTNOTES

| | |
|---|---|
| **NSS** | Insufficient sample for analysis. |
| **RL** | Reporting Limit. |
| ↑ | Reporting limit raised. |
| ↓ | Reporting limit lowered. |
| **NA** | The sample was not analysed for this analyte |
| **ND** | Non Detect |

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.



-- End of Analytical Report --

# SGS Request for Laboratory Services and CHAIN OF CUSTODY

No: 008694

Page ____ of ____

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

**Laboratory Information Section - Lab use only**

Received By: Olaq Mozhin
Received Date (mm/dd/yyyy): 10/22/19 (mm\dd\yy)
Received Time: 14:15
Received By (signature):
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑ ice
Temperature Upon Receipt (°C) 0.6 6
LAB LIMS #: CA-14697-OCT19

**REPORT INFORMATION**

Company: Soil Engineers Ltd
Contact: YOGIRAJ RANA
Address: 90 WEST BEVER CREEK ROAD, RICHMOND HILL
Phone: 416-779-2837
Email: yogiraj.rana@soilengineersltd.com

**INVOICE INFORMATION**

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

**PROJECT INFORMATION**

Quotation #:
P.O. #:
Project #: 1909-W019
Site Location/ID: 681 YONGE STREET, BARRIE

**TURNAROUND TIME (TAT) REQUIRED**

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
Rush Confirmation ID:

**REGULATIONS**

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine
Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA
Sewer By-Law: ☑ Sanitary ☑ Storm
Municipality: CITY OF BARRIE

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

**ANALYSIS REQUESTED**

| | SAMPLE IDENTIFICATION | DATE SAMPLED | TIME SAMPLED | # OF BOTTLES | MATRIX | Field Filtered (Y/N) | Metals & Inorganics | PAH ☑ ABN ☐ SVOC(all) ☐ | PCB Total ☐ Aroclor ☐ | PHC F1-F4 ☐ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐ | VOC ☐ BTEX ☐ THM ☐ | Pesticides OC ☐ OP ☐ | TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐ | Water Pkg Gen. ☐ Ext. ☐ | Sewer Use: CITY OF BARRIE STORM & SANITARY | COMMENTS: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BH/MW 101 | 22/10/19 | 10 AM | #19 | GW | | X | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | |

Observations/Comments/Special Instructions

Sampled By (NAME): YOGIRAJ RANA
Signature:
Date: 10/22/19 (mm/dd/yy)
Pink Copy - Client

Relinquished by (NAME):
Signature:
Date: ____/____/____ (mm/dd/yy)
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

**Soil Engineers Ltd.**
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL (416) 754-8515 · FAX (905) 881-8335

| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | GRAVENHURST | PETERBOROUGH | HAMILTON |
|---|---|---|---|---|---|---|
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# APPENDIX 'D'

## CONSTRUCTION DEWATERING NEEDS ASSESSMENT CALCULATIONS PERMANENT DRAINAGE NEEDS CALCULATIONS

**REFERENCE NO. 1909-W019**

681-685 Yonge Street Barrie

**Zone of Influence Calculation**

$R_0$ = 3000 x DD x $K^{0.5}$ (Sichardt's Relationship) 55.85 **m**

$R_0$ = Zone of Influence (m) 90.82 m

DD = Required Drawdown (m) re= 40.18 m

K = Hydraulic Conductivity (m/s)

$$r_e = \sqrt{\frac{axb}{\pi}}$$

Average Grade 256.7 masl

**Table D: Dewatering Flow Estimate and Zone of Influence Calculations**

| Unit | Corresponding borehole/ monitoring well | Proposed invert El. | Highest W.L. | Lowest W.L. | Drawdown DD | K | $R_o$ | re | $r_e+R_o$ | H | $h_0$ | x | Estimated Dewatering Flow Rate (Q) | | | Flow estimate with 3×safety factor | Soil material at invert Depth | Flow Rate L/day | Flow Rate plus Precipitation L/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | masl | | | m | m/s | m | m | m | m | m | m | $m^3/s$ | $m^3/day$ | L/day | L/day | | max | max |
| P1 large underground structure | BH/MW 101 | 252.70 | 253.30 | 251.70 | 1.60 | 1.60E-06 | 6.07 | 40.18 | 46.25 | 11.60 | 10.00 | 300.03 | 2.10E-03 | 181.14 | 181,135.23 | 543,405.69 | Silty Sand Till | | |
| P1 smaller underground structure | BH/MW 102 | 252.70 | 253.30 | 251.70 | 1.60 | 1.60E-06 | 6.07 | 40.18 | 46.25 | 11.60 | 10.00 | 300.03 | 2.10E-03 | 181.14 | 181,135.23 | 543,405.69 | Sandy Silt Till | | |
| | BH/MW 5 | 252.70 | 253.30 | 251.70 | 1.60 | 1.60E-06 | 6.07 | 40.18 | 46.25 | 11.60 | 10.00 | 300.03 | 2.10E-03 | 181.14 | 181,135.23 | 543,405.69 | Sandy Silt Till | | |

**Dewatering Rate Estimate**

silty Sand till

$$Q = \left(0.73 + 0.27\frac{(H - h_0)}{H}\right) \times \frac{Kx}{R_0}\left(H^2 - h^2\right)$$

(modified from "Foundation Engineering", G.A. Leonard)

Q = total discharge from two lines of well points ($m^3/s$)
H = height of static water table above aquifer bottom (m)

$h_w$ = height of water table in well points above aquifer bottom (m)

K = hydraulic conductivity (m/s)

x = length of the trench (m)

Bottom of aquifer = 241.70 masl Aquifer Type: Unconfined

681 Yonge Street Barrie 681-685 Yonge Street Barrie

**Zone of Influence Calculation**

$R_0$ = 3000 x DD x $K^{0.5}$ (Sichardt's Relationship) 30.84 m

$R_0$ = Zone of Influence (m) 56.55 m

DD = Required Drawdown (m) 23.56

K = Hydraulic Conductivity (m/s)

Average Grade 256.7 masl

$$r_e = \sqrt{\frac{a \times b}{\pi}}$$

**Table D: Dewatering Flow Estimate and Zone of Influence Calculations**

| Unit | Corresponding borehole/ monitoring well | Proposed invert El. | Highest W.L. | Lowest W.L. | Drawdown DD | K | $R_o$ | re | $r_e+R_o$ | H | $h_0$ | x | Estimated Dewatering Flow Rate (Q) | | | Flow estimate with 3×safety factor | Soil material at invert Depth | Flow Rate L/day | Flow Rate plus Precipitation L/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | masl | | | m | m/s | m | m | m | m | m | m | $m^3/s$ | $m^3/day$ | L/day | L/day | | max | max |
| Residential Underground Basement Structure Large Perimeter P1 | BH/MW 101 | 249.72 | 253.30 | 248.72 | 4.58 | 1.60E-06 | 17.38 | 23.56 | 40.94 | 11.60 | 7.02 | 175.81 | 1.15E-03 | 99.77 | 99,768.95 | 299,306.84 | Silty Sand Till | | |
| | BH/MW 102 | 249.72 | 253.30 | 248.72 | 4.58 | 1.60E-06 | 17.38 | 23.56 | 40.94 | 11.60 | 7.02 | 175.81 | 1.15E-03 | 99.77 | 99,768.95 | 299,306.84 | Sandy Silt Till | | |
| | BH/MW 5 | 249.72 | 253.30 | 248.72 | 4.58 | 1.60E-06 | 17.38 | 23.56 | 40.94 | 11.60 | 7.02 | 175.81 | 1.15E-03 | 99.77 | 99,768.95 | 299,306.84 | Sandy Silt Till | | |

**Dewatering Rate Estimate**

silty Sand till

$$Q = \left(0.73 + 0.27\frac{(H - h_0)}{H}\right) \times \frac{Kx}{R_0}\left(H^2 - h^2\right)$$

(modified from "Foundation Engineering", G.A. Leonard)

Q = total discharge from two lines of well points ($m^3/s$)
H = height of static water table above aquifer bottom (m)

$h_w$ = height of water table in well points above aquifer bottom (m)

K = hydraulic conductivity (m/s)

x = length of the trench (m)

Bottom of aquifer = 241.70 masl Aquifer Type: Unconfined

681 Yonge Street Barrie 681-685 Yonge Street Barrie

**Zone of Influence Calculation**

$R_0$ = 3000 x DD x $K^{0.5}$ (Sichardt's Relationship) 2.39

$R_0$ = Zone of Influence (m) 9.253

DD = Required Drawdown (m) 2.65

K = Hydraulic Conductivity (m/s)

$$r_e = \sqrt{\frac{axb}{\pi}}$$

Average Grade 256.7 masl

**Table D: Dewatering Flow Estimate and Zone of Influence Calculations**

| Unit | Corresponding borehole/ monitoring well | Proposed invert El. | Highest W.L. | Lowest W.L. | Drawdown DD | K | $R_o$ | re | $r_e+R_o$ | H | $h_0$ | x | Estimated Dewatering Flow Rate (Q) | | | Flow estimate with 3×safety factor | Soil material at invert Depth | Flow Rate L/day | Flow Rate plus Precipitation L/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | masl | | | m | m/s | m | m | m | m | m | m | $m^3/s$ | $m^3/day$ | L/day | L/day | Depth | max | max |
| Elevator Pit Structure | BH/MW 101 | 247.87 | 253.30 | 246.87 | 6.43 | 1.60E-06 | 24.40 | 2.65 | 27.05 | 11.60 | 5.17 | 23.28 | 1.45E-04 | 12.51 | 12,510.80 | 37,532.41 | Silty Sand Till | | |
| | BH/MW 102 | 247.87 | 253.30 | 246.87 | 6.43 | 1.60E-06 | 24.40 | 2.65 | 27.05 | 11.60 | 5.17 | 23.28 | 1.45E-04 | 12.51 | 12,510.80 | 25,021.61 | Sandy Silt Till | | |
| | BH/MW 5 | 247.87 | 253.30 | 246.87 | 6.43 | 1.60E-06 | 24.40 | 2.65 | 27.05 | 11.60 | 5.17 | 23.28 | 1.45E-04 | 12.51 | 12,510.80 | 25,021.61 | Sandy Silt Till | | |

*invert elevations are not available so average of the BHs and BH/MWs was used as ground sutface

**Dewatering Rate Estimate** silty Sand till

$$Q = \left(0.73 + 0.27\frac{(H - h_0)}{H}\right) \times \frac{Kx}{R_0}\left(H^2 - h^2\right)$$

(modified from "Foundation Engineering", G.A. Leonard)

Q = total discharge from two lines of well points ($m^3/s$)
H = height of static water table above aquifer bottom (m)

$h_w$ = height of water table in well points above aquifer bottom (m)

K = hydraulic conductivity (m/s)

x = length of the trench (m)

Bottom of aquifer = 241.70 masl Aquifer Type: Unconfined

681-685 Yonge Street Barrie

**Zone of Influence Calculation**

$R_0$ = 3000 x DD x $K^{0.5}$ (Sichardt's Relationship) 30

$R_0$ = Zone of Influence (m) 5

DD = Required Drawdown (m) 6.91

K = Hydraulic Conductivity (m/s)

$$r_e = \sqrt{\frac{axb}{\pi}}$$

Average Grade 256.7 masl

**Table D: Dewatering Flow Estimate and Zone of Influence Calculations**

| Unit | Corresponding borehole/ monitoring well | Proposed invert El. | Highest W.L. | Lowest W.L. | Drawdown DD | K | $R_o$ | re | $r_e+R_o$ | H | $h_0$ | x | Estimated Dewatering Flow Rate (Q) | | | Flow estimate with 3×safety factor | Soil material at invert Depth | Flow Rate L/day | Flow Rate plus Precipitation L/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | masl | | | m | m/s | m | m | m | m | m | m | $m^3/s$ | $m^3/day$ | L/day | L/day | Depth | max | max |
| Residential Underground Basement Structure | BH/MW 101 | 251.70 | 253.30 | 250.70 | 2.60 | 6.60E-07 | 6.34 | 5.00 | 11.34 | 11.60 | 9.00 | 30.00 | 1.32E-04 | 11.43 | 11,430.47 | 34,291.42 | Silty Sand Till | | |
| | BH/MW 102 | 251.70 | 253.30 | 250.70 | 2.60 | 1.60E-06 | 9.87 | 5.00 | 14.87 | 11.60 | 9.00 | 30.00 | 2.06E-04 | 17.80 | 17,797.23 | 53,391.68 | Sandy Silt Till | | |
| | BH/MW 5 | 251.70 | 253.30 | 250.70 | 2.60 | 8.80E-07 | 7.32 | 5.00 | 12.32 | 11.60 | 9.00 | 30.00 | 1.53E-04 | 13.20 | 13,198.78 | 39,596.33 | Sandy Silt Till | | |

*invert elevations are not available so average of the BHs and BH/MWs was used as ground sutface

**Dewatering Rate Estimate**

silty Sand till

$$Q = \left(0.73 + 0.27\frac{(H - h_0)}{H}\right) \times \frac{Kx}{R_0}\left(H^2 - h^2\right)$$

(modified from "Foundation Engineering", G.A. Leonard)

Q = total discharge from two lines of well points ($m^3/s$)
H = height of static water table above aquifer bottom (m)

$h_w$ = height of water table in well points above aquifer bottom (m)

K = hydraulic conductivity (m/s)

x = length of the trench (m)

Bottom of aquifer = 241.70 masl Aquifer Type: Unconfined

681-685 Yonge Street Barrie

| | D.D. | Radius of Weeper Interval (m) | D.D./Weeper Interval | Radian | iv |
|---|---|---|---|---|---|
| Q=KiA | 0.60 | 2.5 | 0.24 | 0.0041888 | 0.0041888 |
| **Mira Drain Network** | 3.40 | 2.5 | 1.36 | 0.0237365 | 0.0237409 |
| | 5.43 | 2.5 | 2.172 | 0.0379086 | 0.0379267 |
| | 3.70 | 2.5 | 1.48 | 0.0258309 | 0.0258366 |

| Site | K(m/s) | ih | Grading Elev. | Excavation Depth (m) | Excavation Depth Ele. (m) | Highest W.L. Elev.(m) | D.D. | Excavation Perimetre | A ($m^2$) | Q ($m^3$/s) | Q ($m^3$/day) | Q (L/day) | Q (L/min) | x2 safety factor | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Large P1 perimeter Excavtion wlls | 1.60E-06 | 0.0480 | 257.35 | 252.70 | 252.70 | 253.30 | 0.60 | 300.03 | 180.018 | 1.38E-05 | 1.19 | 1,194.51 | 0.83 | **2,389.03** | |
| Inner perimeter P 1.5 | 1.60E-06 | 0.0480 | 257.35 | 249.90 | 249.90 | 253.30 | 3.40 | 175.81 | 492.268 | 3.78E-05 | 3.27 | 3,266.45 | 2.27 | **6,532.91** | 8,921.93 |
| Elevator Shaft area | 1.60E-06 | 0.0480 | 257.35 | 247.87 | 247.87 | 253.30 | 5.43 | na | na | na | na | na | #VALUE! | **na** | waterproofed/bathtubbed |
| water tank structure | 1.60E-06 | 0.0480 | 256.70 | 6.80 | 249.60 | 253.30 | 3.70 | 34.7 | 128.39 | 9.86E-06 | 0.85 | 851.93 | 0.59 | **1,703.87** | removed from calculations |
| | | | | | | | | | 672.286 | | | 4,460.97 | x3 | **8,921.93** | |

**Under Slab Floor Drainage Network**

| Site | Excavation Width (m) | Weeper Interval (m) | No. of Allognments | Length of the Weeper | Weeper circumfrance (m) | Total Weeper Surface ($m^2$) | K(m/s) | iv | Q ($m^3$/s) | Q ($m^3$/day) | Q (L/day) | Q (L/min) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 perimeter basement north | 10.281 | 5 | 2.0562 | 54.49 | 0.31 | 34.22 | 1.60E-06 | 0.0042 | 2.29344E-07 | 0.0198 | 19.82 | 0.013761 | |
| P1 perimeter basement east 1 | 14.39 | 5 | 2.878 | 29.13 | 0.31 | 27.44 | 1.60E-06 | 0.0042 | 1.84E-07 | 0.0159 | 15.89 | 0.011035 | |
| P1 perimeter basement east 2 | 1.8 | 5 | 0.36 | 34.95 | 0.31 | 10.97 | 1.60E-06 | 0.0042 | 7.36E-08 | 0.0064 | 6.35 | 0.004413 | |
| P1 perimeter basement east 3 | 14.39 | 5 | 2.878 | 19.19 | 0.31 | 18.08 | 1.60E-06 | 0.0042 | 1.21E-07 | 0.0105 | 10.47 | 0.007269 | 32.71 |
| P1 basement south | 12.34 | 5 | 2.468 | 42.84 | 0.31 | 40.36 | 1.60E-06 | 0.0042 | 2.70E-07 | 0.0234 | 23.37 | 0.016228 | |
| P1 Perimeter Excavation west | 12 | 5 | 2.4 | 76.35 | 0.31 | 47.95 | 1.60E-06 | 0.0042 | 3.21E-07 | 0.0278 | 27.76 | 0.019281 | |
| P1.5 perimeter Excavation main | 24.67 | 5 | 4.934 | 24.67 | 0.31 | 38.73 | 1.60E-06 | 0.0237 | 1.47E-06 | 0.1271 | 127.12 | 0.088275 | |
| P1.5 u/g west | 6.16 | 5 | 1.232 | 46.95 | 0.31 | 73.71 | 1.60E-06 | 0.0237 | 2.80E-06 | 0.2419 | 241.92 | 0.167998 | |
| Elevator Pit Underslab 2 waterproofed | 2.5 | 5 | 0.5 | 5.7 | 0.31 | 3.58 | 1.60E-06 | 0.0379 | 2.17E-07 | 0.0188 | 18.77 | 0.013033 | waterproofed considered in total |
| | | Rounded | 3 | | | | | | | | **472.69** | | |
| | | | | | | 295.04 | | | | | **945.39** | total | 4,933.66 x1 |
| | | | | | | | | | | | | | 9,867.32 x2 check |
| | | | | | | | | | total drainage | | with 3 x safety factor | | 9,867.32 L/day |
| | | | | | | | | | both perimeter and underslab | | | | |

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# APPENDIX 'E'

## BOREHOLE LOGS & GRAIN SIZE DISTRIBUTION PLOTS
## PREVIOUS GEOTECHNICAL REPORT Ref. No. 1903-S038

## REFERENCE NO. 1909-W019

**JOB NO.:** 1903-S083

# LOG OF BOREHOLE NO.: 1

**FIGURE NO.:** 1

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Hollow Stem Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** April 18, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 256.0 | Ground Surface | | | | | | | |
| 0.0 | **EARTH FILL**<br>brown, silty sand<br>a trace of gravel<br>occ. topsoil inclusions and organics | 1 | DO | 10 | 0 | | 17 | |
| | | 2 | DO | 13 | 1 | | 19 | |
| 254.6 | | | | | | | | |
| 1.4 | Compact to very dense — — — weathered<br>**SANDY SILT TILL**<br>trace to some gravel<br>a trace of clay<br>occ. sand seams, cobbles and boulders | 3 | DO | 11 | 2 | | 11 | |
| | | 4 | DO | 43 | | | 9 | |
| | | 5 | DO | 58 | 3 | | 7 | |
| | | 6 | DO | 60 | 4 | | 10 | |
| | | 7 | DO | 50/15 | 5 | | 9 | |
| | — — brown grey | 8 | DO | 50/10 | 6 | | 8 | |
| 247.5 | | | | | 7 | | | |
| 8.5 | Grey, very dense<br>**SILTY SAND TILL**<br>a trace of gravel<br>occ. cobbles and boulders | 9 | DO | 50/10 | 8 | | 9 | |
| | | | | | 9 | | | |
| 244.9 | | 10 | DO | N/A | 10 | | | |
| 11.1 | **END OF BOREHOLE** | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |
| | | | | | 16 | | | |

W.L. @ El. of 249.3 m upon completion of drilling

**Soil Engineers Ltd.**

**JOB NO.:** 1903-S083

# LOG OF BOREHOLE NO.: 2

**FIGURE NO.:** 2

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Hollow Stem Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** April 22, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 257.4 | Ground Surface | | | | | | | |
| 0.0 | **22 cm Topsoil** | 1A | DO | 5 | 0 | | 24 | |
| 0.2 | **EARTH FILL**<br>brown, silty clay<br>a trace of sand<br>occ. gravel and topsoil inclusions | 1B | | | | | 19 | |
| | | 2 | DO | 11 | 1 | | 18 | |
| 256.0 | | | | | | | | |
| 1.4 | Loose to very dense<br>**SANDY SILT TILL** — weathered<br>traces of clay and gravel<br>occ. sand seams, cobbles and boulders | 3 | DO | 9 | 2 | | 12<br>14 | |
| | | 4 | DO | 20 | | | 13 | |
| | | 5 | DO | 36 | 3 | | 9 | |
| | | 6 | DO | 50/15 | 4 | | 7 | |
| | | 7 | DO | 50/15 | 5 | | 7 | |
| | | 8 | DO | 50/10 | 6 | | 8 | |
| | | 9 | DO | 78 | 7 | | 9 | |
| | — — brown / grey | | | | 8 | | | |
| 246.3 | | 10 | DO | 49 | 9 | | 11 | |
| 11.1 | **END OF BOREHOLE** | | | | 10 | | | |
| | | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |
| | | | | | 16 | | | |

W.L. @ El. of 254.4 m upon completion of drilling

Cave-in @ El. of 249.8 m upon completion of drilling

**Soil Engineers Ltd.**

**JOB NO.:** 1903-S083

# LOG OF BOREHOLE NO.: 3

**FIGURE NO.:** 3

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Hollow Stem Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** April 22, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 257.3 | Ground Surface | | | | | | | |
| 0.0 | **22 cm Topsoil** | | | | 0 | | | |
| 0.2 | **EARTH FILL**<br>brown, silty clay<br>occ. gravel, sand and topsoil inclusions | 1 | DO | 5 | | | 17 | |
| | | 2 | DO | 9 | 1 | | 33<br>14 | |
| 255.7 | | | | | | | | |
| 1.6 | Brown, compact<br>**SANDY SILT TILL**<br>traces of clay and gravel<br>occ. cobbles and boulders | 3 | DO | 19 | 2 | | 13 | |
| | | 4 | DO | 29 | | | 7 | |
| 254.4 | | | | | | | | |
| 2.9 | Brown, compact to very dense<br>**SILTY SAND TILL**<br>trace to some gravel<br>occ. cobbles and boulders | 5 | DO | 20 | 3 | | 7 | |
| | | 6 | DO | 50/15 | 4 | | 7 | |
| | | 7 | DO | 81 | 5 | | 8 | |
| | | 8 | DO | 50/15 | 6 | | 7 | |
| 248.8 | | | | | 7 | | | |
| 8.5 | Brown, very dense<br>**SANDY SILT TILL**<br>traces of clay and gravel<br>occ. cobbles and boulders | 9 | DO | 50/15 | 8 | | 11 | |
| 246.4 | | 10 | DO | 50/15 | 9 | | 11 | |
| 10.9 | **END OF BOREHOLE** | | | | 10 | | | |
| | | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |
| | | | | | 16 | | | |

Cave-in @ El. of 249.1 m upon completion of drilling

**Soil Engineers Ltd.**

**JOB NO.:** 1903-S083

# LOG OF BOREHOLE NO.: 4

**FIGURE NO.:** 4

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Hollow Stem Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** April 18, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 256.1 | Ground Surface | | | | | | | |
| 0.0 | **EARTH FILL**<br>dark brown to brown, silty clay<br>traces of sand and gravel<br>occ. topsoil inclusions and organics | 1 | DO | 4 | 0 | | 13 | |
| | | 2 | DO | 6 | 1 | | 21 | |
| 254.6 | | | | | | | | |
| 1.5 | Brown, compact to very dense weathered<br>**SILTY SAND TILL**<br>a trace of gravel<br>occ. cobbles and boulders | 3 | DO | 11 | 2 | | 13 | |
| | | 4 | DO | 34 | | | 8 | |
| | | 5 | DO | 52 | 3 | | 8 | |
| 252.1 | | | | | | | | |
| 4.0 | Brown, dense to very dense<br>**SANDY SILT TILL**<br>a trace of clay<br>occ. sand seams, cobbles and boulders | 6 | DO | 42 | 4 5 | | 11 | |
| | | 7 | DO | 70 | 6 | | 9 | |
| | | 8 | DO | 50/15 | 7 8 | | 8 | |
| 246.6 | | 9 | DO | N/A | 9 | | | |
| 9.5 | **END OF BOREHOLE** | | | | 10 11 12 13 14 15 16 | | | |

W.L. @ El. of 254.3 m upon completion of drilling

Cave-in @ El. of 249.7 m upon completion of drilling

**Soil Engineers Ltd.**

**JOB NO.:** 1903-S083

# LOG OF BOREHOLE NO.: 5

**FIGURE NO.:** 5

**PROJECT DESCRIPTION:** Proposed Condominium Development with 2 level of Underground Parking

**METHOD OF BORING:** Hollow Stem Auger

**PROJECT LOCATION:** 681 Yonge Street, City of Barrie

**DRILLING DATE:** April 18, 2019

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) | Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90 | Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40 | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 256.9 | Ground Surface | | | | | | | |
| 0.0 | **EARTH FILL**<br>dark brown, silty clay<br>a trace of gravel<br>occ. topsoil inclusions | 1 | DO | 8 | 0 | | 14 | |
| | | 2 | DO | 19 | 1 | | 25 | |
| 255.5 | | | | | | | | |
| 1.4 | Brown, compact to very dense<br>**SANDY SILT TILL**<br>traces of clay and gravel<br>occ. sand seams, cobbles and boulders | 3 | DO | 23 | 2 | | 10 | |
| | | 4 | DO | 44 | | | 8 | |
| | | 5 | DO | 44 | 3 | | 10 | |
| | | 6 | DO | 50/15 | 4 | | 8 | |
| | | 7 | DO | 52 | 5 | | 11 | |
| 249.9 | | | | | 6 | | | |
| 7.0 | Brown, very dense<br>**SAND** | | | | 7 | | | |
| 249.1 | fine to medium grained | 8 | DO | 50/15 | | | 7 | |
| 7.8 | some gravel<br>a trace of silt<br>**END OF BOREHOLE** | | | | 8 | | | |
| | | | | | 9 | | | |
| | | | | | 10 | | | |
| | | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |
| | | | | | 16 | | | |

W.L @ El. of 253.25 m on September 27, 2019

**Soil Engineers Ltd.**

Soil Engineers Ltd.

# GRAIN SIZE DISTRIBUTION

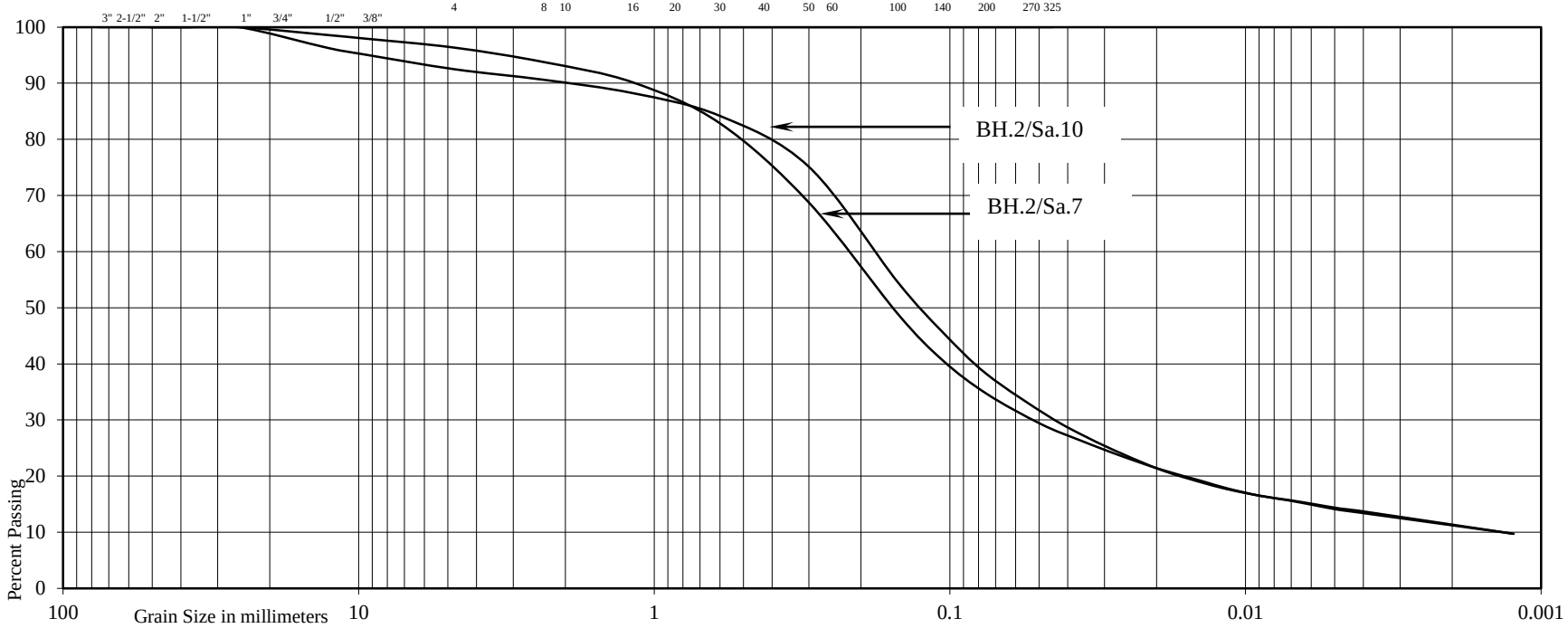
Reference No: 1903-S083

U.S. BUREAU OF SOILS CLASSIFICATION

| GRAVEL | | SAND | | | | SILT | CLAY |
|---|---|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | V. FINE | | |

UNIFIED SOIL CLASSIFICATION

| GRAVEL | | SAND | | | SILT & CLAY |
|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | |




| | | |
|---|---|---|
| Project: | Proposed condominium Development | |
| Location: | 681 Yonge Street, City of Barrie | |
| Borehole No: | 2 | 2 |
| Sample No: | 7 | 10 |
| Depth (m): | 6.1 | 10.9 |
| Elevation (m): | 251.3 | 246.5 |

| BH./Sa. | 2/7 | 2/7 |
|---|---|---|
| Liquid Limit (%) = | - | - |
| Plastic Limit (%) = | - | - |
| Plasticity Index (%) = | - | - |
| Moisture Content (%) = | 7 | 11 |
| Estimated Permeability (cm./sec.) = | $10^{-6}$ | $10^{-6}$ |

Classification of Sample [& Group Symbol]: SILTY SAND TILL, some clay, a trace of gravel

Figure: 6