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**A REPORT TO**
**1334281 ONTARIO LIMITED**

# HYDROGEOLOGICAL ASSESSMENT FOR PROPOSED RESIDENTIAL DEVELOPMENT

**720 GRANITE COURT**

**CITY OF PICKERING**

**REFERENCE NO. 2111-W043**

**SEPTEMBER 2024**
**(REVISION OF REPORT DATED MARCH 2022)**

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## 1.0 EXECUTIVE SUMMARY

Soil Engineers Ltd. (SEL) has completed a Hydrogeological Assessment for a proposed residential development site, located at 720 Granite Court, in the City of Pickering.

Based on the updated architectural plans, dated February 14, 2023, project number 22035, prepared by Onespace Unlimited Inc., the proposed development is anticipated to be completed with 12-storey building over 2-levels of underground parking structure.

The subject site is located within the Physiographic Region of Southern Ontario known as the Iroquois plain, where the clay plain is the predominant physiographic feature for the area. The mapped surface geological unit consists of a Till Unit, consisting, predominantly of undifferentiated sandy silt to silt matrix, commonly rich in clasts and often high in total matrix calcium carbonate.

A review of the topography shows that the subject site is relatively flat, with the surrounding area exhibiting a gentle decline in elevation relief towards the west and southwest.

The proposed development site is located within the Petticoat Creek Watershed. Review of available mapping indicates that Petticoat Creek and its associated wooded areas and wetlands are located, approximately 550 m south of the subject site. In addition, the Rouge River and its associated wooded areas, Provincially Significant wetlands, water courses, water bodies and Areas of Natural and Scientific Interest (ANSI) are located, approximately 1,500 m southeast of the subject site.

This study has revealed that beneath a layer of topsoil, the native subsoils underlying the subject site consists of sandy silt till extending to the maximum investigated depth.

The groundwater monitoring program indicates that the measured groundwater levels ranged from 3.61 to 8.24 m below the prevailing ground surface, or at the elevations, ranging from 96.16 to 100.38 masl. The interpreted shallow groundwater flow pattern beneath the stie suggests that it flows in southerly and westerly directions.

The Single Well Response Tests (SWRT) estimates for hydraulic conductivity (K) for the underlying sandy silt till unit ranged from $1.4 \times 10^{-8}$ to $1.9 \times 10^{-7}$ m/sec. These results suggest that the hydraulic conductivity (K) estimates for the groundwater bearing sandy silt till unit are low, with correspondingly low to moderate anticipated groundwater seepage rates being anticipated into open excavations, below the groundwater table.

Based on the provided development plans, the estimated construction dewatering flow rate is anticipated to reach a daily rate of 80,340.2 L/day; by considering a 3 x safety factor, it could reach an approximate daily maximum of 241,020.6 L/day. The conceptual zone of influence may reach approximately 4.2 m away from construction dewatering array or well used or around for the excavation footprint for the construction of 2-levels underground parking structure. In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is above the groundwater taking threshold limit of 50,000 L/day, but is below Permit-To-Take-Water limit of 400,000 L/day, whereby a Environmental Activity and Sector Registry (EASR) would be required as an approval to facilitate the groundwater takings for a temporary construction dewatering program for groundwater control.

The conceptual zone of influence for any dewatering well or dewatering array used during installation of underground services is approximately 4.3 m away from the conceptual dewatering wells or array for the construction of the considered underground services. There are no natural features, such as; watercourses, bodies of water, wetlands or any groundwater receptors, including water supply wells on site, or within anticipated zones of influence for any temporary construction dewatering.

The long-term foundation drainage rates for the complete P2 underground structure from a mira drain for a conventionally shored exaction is 508.17 L/day and to the under-slab drainage network it is 241.77 L/day with the combined drainage rate being749.94 L/day by applying a safety factor of 3 it could reach a maximum rate of 2,249.82 L/day.

# 2.0 INTRODUCTION

## 2.1 Project Description

In accordance with authorization from Mr. Steve Margie of 1334281 Ontario Limited, we have carried out a hydrogeological study for a proposed development property, located at 720 Granite Court, which is located northwest of the intersection of Granite Court and Whites Road South in the City of Pickering. The location of the subject site is shown on Drawing No. 1.

The subject site currently comprises of vacant land that is covered in grass and weeds. The surrounding land uses consists of a highway the north, Whites Road South and existing residential and commercial properties to the east, Granite Court and residential properties to the south, along with a railway line and commercial/industrial properties to the west. Based on the updated architectural plan, dated February 14, 2023, project number 22035, prepared by Onespace Unlimited Inc., the proposed development is anticipated to be completed with 12-storey high building over 2-levels of underground parking structure. Based on the topographic plan, provided by the client, the finished floor elevation has been considered at an elevation of 105.20 masl.

This Hydrogeological Study summarizes findings of a field study and the associated groundwater monitoring and testing programs, and provides a description and characterization for the site's hydrogeological setting. The current study provides preliminary recommendations for any construction dewatering needs, and for any need to acquire an Environmental Activity and Sector Registry (EASR), or a Permit-To-Take Water (PTTW) as an approval to facilitate a temporary construction dewatering program in support of proposed earthworks.

## 2.2 Project Objectives

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

1. Establish the local and regional hydrogeological setting for the subject site and the local surrounding areas;
2. Interpret the site's shallow groundwater flow patterns;
3. Identify zones of higher groundwater yield as potential sources for on-going shallow groundwater seepage from the site's subsoil strata;
4. Characterizing the hydraulic conductivity (K) for groundwater-bearing subsoil strata;
5. Preparing an interpreted hydrogeostratigraphic cross-sections across the subject site;

6. Estimate the temporary dewatering flows that may be required to lower the groundwater table to facilitate earthworks and construction;
7. Estimate the anticipated zones of influence associated with any construction dewatering, if required, and to provide mitigation recommendations to safeguard nearby groundwater receptors from potential impacts, and;
8. Provide comments regarding any need to file an Environmental Activity and Sector Registry (EASR), or to acquire a Permit-To-Take Water (PTTW) as an approval to facilitate a construction dewatering program.

## 2.3 **Scope of Work**

The scope of work for the Hydrogeological Study is summarized below:

1. Clearance of underground services, drilling of four (4) boreholes, and installation of monitoring wells, one in each of three (3) selected boreholes, at the time of borehole drilling.
2. Monitoring well development, groundwater level monitoring and measurements at the three installed monitoring wells;
3. Monitoring well development and performance of Single Well Response Tests (SWRTs) at the monitoring wells to estimate the hydraulic conductivity (K) for shallow groundwater-bearing subsoil strata at the depths of the monitoring well screens;
4. Reviewing plotting and mapping of Ministry of the Environment, Conservation and Parks (MECP) water well records within 500 m of the subject site;
5. Describing the geological and hydrogeological setting for the subject site and the nearby surrounding areas;
6. Assessing the preliminary dewatering needs and estimating any anticipated temporary dewatering flows necessary to lower groundwater levels to facilitate earthworks and construction;
7. Review of groundwater receptors in the vicinity of the development site, and providing of preliminary recommendations for any monitoring, mitigation and discharge management plans to safeguard nearby groundwater receptors from potential adverse impacts associated with any construction dewatering, and;
8. Providing comments regarding any need to register an Environmental Activity and Sector Registry (EASR) approval, or to apply for and obtain a Permit-To-Take Water (PTTW) to facilitate a groundwater taking approval for any temporary construction dewatering or any long-term foundation drainage following construction.

# 3.0 METHODOLOGY

## 3.1 Borehole Advancement and Monitoring Well Installation

The field work for borehole drilling and monitoring well construction were performed on December 14, 16 and 17, 2021. It consisted of four (4) drilled boreholes (BH) and the installation of three (3) monitoring wells (MW), one (1) within each of three (3) selected boreholes drilled at the locations shown on Drawing No. 2. The boreholes were drilled using solid stem flight-augers. The drilling and monitoring well construction were completed by a licensed well contractor, DBW Drilling Limited, under the full-time supervision of a geotechnical technician from SEL, who also logged the subsoil strata encountered during borehole advancement and collected representative soil samples to confirm the subsoil textures. The Borehole and Monitoring Well Logs are enclosed as Figures 1 to 4.

The monitoring wells, consisting of 50 mm diameter PVC riser pipes and screen sections, which were installed in the boreholes in accordance with Ontario Regulation (O. Reg.) 903. All of the monitoring wells were equipped with above-ground, monument-type, steel protective casings. The monitoring well construction details are shown on the Borehole/Monitoring Well Logs and the details are summarized in Table 3-1.

The UTM coordinates and ground surface elevations at the borehole and 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 | East (m) | North (m) | Ground El. (masl) | Borehole Depth (mbgs) | Screen Interval (mbgs) | Casing Dia. (mm) |
|---|---|---|---|---|---|---|---|
| BH/MW 1 | December 16, 2021 | 651771.5 | 4852735.8 | 104.50 | 12.3 | 6.0-9.0 | 50 |
| BH/MW 2 | December 16, 2021 | 651723.7 | 4852753.2 | 104.40 | 12.3 | 6.0-9.0 | 50 |
| BH/MW 4 | December 14, 2021 | 651735.7 | 4852844.0 | 103.99 | 12.3 | 6.0-9.0 | 50 |

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

## 3.2 Groundwater Monitoring

The groundwater levels in the monitoring wells were measured, manually by our representative on January 7, January 19, and February 1, 2022.

### 3.3 Mapping of Ontario Water Well Records

SEL reviewed the MECP Water Well Records (WWRs) for registered monitoring wells on the subject site, and within 500 m of the site boundaries (study area). The records indicate that fifteen (15) wells are located within the 500 m study area relative to the subject site boundaries. A summary of the Ontario WWRs reviewed for this study is provided in Appendix 'A' with the locations of the well records shown on Drawing No. 3.

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

All of the monitoring wells underwent development to prepare them for SWRTs to estimate the hydraulic conductivity (K) for the saturated aquifer subsoils at the monitoring well screen depths. The well development involved purging and removing several casing volumes of groundwater from each monitoring well to remove remnants of clay, silt and other debris introduced into the monitoring wells during construction, and to induce the flow of formation groundwater through the monitoring well screens, thereby improving the transmissivity of the groundwater bearing formation at the monitoring well screen depth intervals.

The K estimates provide an indication of the seepage yield capacity for the groundwater-bearing subsoil strata and can be used to estimate the flow of groundwater through the groundwater-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 a data logger/ pressure transducer and/or manually using a water level tape, with this rate being used to estimate the K value for the groundwater-bearing subsoil formation at the well screen depths. All of the BH/MWs underwent a SWRT (Falling Head Tests) on February 1, 2022. The results for the tests are provided in Appendix 'B'.

### 3.5 Review of Previous or Concurrent Reports

The following report was reviewed for the preparation of this hydrogeological study:
A Report to 1334281 Ontario Limited, A Geotechnical Investigation for Proposed Mid-Rise Residential Development, 720 Granite Court, City of Pickering, SEL Reference No. 2111-S043 dated January 2022.

# 4.0 REGIONAL AND LOCAL SETTING

## 4.1 Regional Geology

The subject site lies within the Physiographic Region of Southern Ontario, known as the Iroquois Plain, on the clay plains physiographic feature. The Iroquois Plain occupies the north shore of Lake Ontario, where it extends from Scarborough to Trenton and is considered an area of considerable complexity, not easily divisible into well-marked geological units. The Highland Creek and the Rouge River deposited sand into a former glacial lake to build the present-day sand plain in the southeast corner of the City of Scarborough and within the adjacent portions of the Cities of Pickering, Ajax and Whitby. Across the Regional Municipality of Durham, the Iroquois plain has a fairly consistent pattern (Chapman and Putnam, 1984).

Based on a review of a surface Geological Map of Ontario, the subject site is located on the Till deposits, consisting predominantly of undifferentiated sandy silt to silt matrix, commonly rich in clasts and often high in total matrix calcium carbonate content. Drawing No. 4, reproduced from Ontario Geological Survey mapping, illustrates the Quaternary surface soil geology for the subject site and the surrounding local areas.

The top of bedrock beneath the subject site lies at an elevation of approximately 76 to 78 masl (Bedrock Topography of the Markham Area, Southern Ontario, 1992) and consists 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 Eastview Member (Ontario Ministry of Northern Department and Mines, 1991).

## 4.2 Physical Topography

A review of the topographic map for the subject site and surrounding area shows that it is relatively flat, with the surrounding area exhibiting a gentle decline in elevation relief towards the west and southwest. Drawing No. 5 shows the mapped topographic contours for the subject site and the local surrounding areas.

## 4.3 Watershed Setting

The subject site is located within the Petticoat Creek Watershed, as shown, mapped, on Drawing No. 6. The Petticoat Creek river systems have a total length of about 49 km and drains an area of approximately 27 square km, with portions of the associated watershed being within the Cities of Pickering, Markham, and Toronto. In contrast with many of the

watersheds in the Greater Toronto Area (GTA), Petticoat Creek does not originate on the Oak Ridges Moraine. Its headwaters, or upper reaches, are located south of the Oak Ridges Moraine, between the larger Rouge River and Duffin's Creek watersheds. Petticoat Creek flows south and empties into Lake Ontario at the Petticoat Creek Conservation Area (Toronto and Region Conservation Authority, 2012).

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

Records review shows that Petticoat Creek and its associated wooded areas and wetland are located, approximately 550 m south of the subject site. In addition, the Rouge River and its associated wooded areas, Provincially Significant wetlands, water courses, water bodies and Areas of Natural and Scientific Interest (ANSI) are located, approximately 1,500 m southeast of the subject site.

Drawing No. 7 shows the locations of the natural features around the subject site.

## 5.0 SOIL LITHOLOGY

This study has revealed that beneath a layer of topsoil, the native soils underlying the subject site consists of sandy silt till. A Key Plan and the interpreted geological cross-sections along north-to-south and west-to-east transects are presented on Drawing Nos. 8-1 and 8-2.

### 5.1 Topsoil (All BH and BH/MW locations)

Topsoil was found at the ground surface at all of the BH/MW locations. The thickness for the topsoil horizon ranges from 20 to 25 cm.

### 5.2 Sandy Silt Till (All BH/MW locations)

Sandy silt till was encountered beneath the topsoil horizon at all of the BH and BH/MW locations, where it extended to the maximum investigated depth of 12.3 m below grade. The sandy silt till unit is brown to grey in colour, is dense to very dense in consistency, and contains a trace of gravel with occasional silty clay layers and cobbles and boulders. The moisture contents for the retrieved subsoil samples ranged from to 11%, indicating damp to moist conditions. The estimated permeability for the sandy silt till ranges from about $10^{-7}$ cm/sec to $10^{-6}$ cm/sec. Grain size analyses were performed on three (3) subsoil samples, and the gradations are plotted on Figure 5.

# 6.0 GROUNDWATER STUDY

## 6.1 Review Summary of Previous Report

A review of the findings from the geotechnical soil investigation, prepared by SEL (Reference No. 2111-S043) has indicated that beneath the topsoil horizon, the underlying subsoils consist of sandy silt till. Upon completion of the boreholes, groundwater was recorded at depths of 8.1 to 10.4 m below the prevailing ground surface at BHs 1 and 2, while BHs 3 and 4 remained dry upon completion of the drilling.

## 6.2 Review of Ontario Water Well Records

The Ministry of the Environment, Conservation and Parks (MECP) water well records (WWRs) for the subject site and for the properties within a 500 m radius of the boundaries of the site were reviewed.

The records indicate that fifteen (15) wells are located within the 500 m study area relative to the site boundaries. The locations of these wells, based on the UTM coordinates provided by the records, are shown on Drawing No. 3. A detailed summary of the MECP WWRs is provided in Appendix 'A'.

A review of the final status of the well records within the study area reveals that one (1) well is registered as an abandoned-supply well, four (4) are observation wells, four (4) are test hole wells, and six (6) are monitoring and test hole wells.

A review of the first status of the monitoring wells shows that eight (8) are registered as monitoring wells, five (5) are monitoring and test hole wells, one (1) well is not used and one (1) well has an unidentified status.

## 6.3 Groundwater Monitoring

Groundwater levels were measured within the monitoring wells to record the fluctuation of the groundwater table beneath the site over the monitoring period, covering the dates between January 7 and February 1, 2022. The groundwater level measurements and their corresponding elevations are summarized in Table 6-1.

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

| Well ID | | January 7, 2022 | January 19, 2022 | February 1, 2022 | Average | Fluctuation |
|---|---|---|---|---|---|---|
| BH/MW 1 | mbgs | 6.48 | 6.68 | 6.81 | 6.66 | 0.33 |
| | masl | 98.02 | 97.82 | 97.69 | 97.85 | |
| BH/MW 2 | mbgs | 6.79 | 8.24 | 8.04 | 7.69 | 1.25 |
| | masl | 97.61 | 96.16 | 96.36 | 96.71 | |
| BH/MW 4 | mbgs | 5.50 | 4.78 | 3.61 | 4.63 | 1.89 |
| | masl | 98.49 | 99.21 | 100.38 | 99.36 | |

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

As shown above, the groundwater levels generally decreased at BH/MWs 1 and 2, and increased at BH/MW 4 over the monitoring period, exhibiting small fluctuations in between. The highest shallow groundwater level fluctuation was recorded at BH/MW 2, which exhibited a 1.89 m difference in groundwater level over the monitoring period.

## 6.4 Single Well Response Test Analysis

All of the BH/MWs underwent Falling Head Tests (SWRT's) to assess the hydraulic conductivity (K) for saturated aquifer subsoils at the monitoring well screen depths. The results for the SWRT analysis are presented in Appendix 'B', with a summary of the findings 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 (mbgs) | Screened Soil Strata | Hydraulic Conductivity (K) (m/sec) |
|---|---|---|---|---|---|---|
| BH/MW 1 | 104.50 | 9.0 | 12.3 | 6.0-9.0 | Sandy silt till | $1.9 \times 10^{-7}$ |
| BH/MW 2 | 104.40 | 9.0 | 12.3 | 6.0-9.0 | Sandy silt till | $1.4 \times 10^{-8}$ |
| BH/MW 4 | 103.99 | 9.0 | 12.3 | 6.0-9.0 | Sandy silt till | $6.1 \times 10^{-8}$ |

The SWRT results provide an indication of the yield capacity for the groundwater-bearing subsoil strata at the depths for the monitoring well screens. The results of the field investigation indicate low to moderate anticipated groundwater seepage rates are associated with the subsoils at the depths for the monitoring well screens.

## 6.5 **Shallow Groundwater Flow Pattern**

The average of groundwater levels, measured within the monitoring wells were used to interpret the shallow groundwater flow pattern across and beneath the subject site. Review of the groundwater table data indicates that shallow groundwater is interpreted to generally flow in south and westerly directions. The interpreted groundwater flow pattern beneath the subject site is illustrated on Drawing No. 9.

## 7.0 GROUNDWATER CONTROL DURING CONSTRUCTION

The hydraulic conductivity (K) estimates suggest that groundwater seepage rates into open excavations below the groundwater table, within the till subsoils will range from low to moderate. To provide safe, dry and stable conditions for excavation and construction for the proposed underground parking structure, and for the installation of the associated underground services, the shallow groundwater table may need to be lowered in advance of or during construction. The preliminary estimates for the temporary construction dewatering flows required to locally lower the groundwater table, based on the K test results are discussed in the following sections.

### 7.1 Groundwater Construction Dewatering Rates

Based on the updated architectural plan, dated February 14, 2023, project number 22035, prepared by Onespace Unlimited Inc., the proposed development is anticipated to be completed with 12-storeys high building over 2-levels of underground parking. Based on the topographic grading plan provided by the client, the finished floor elevation will be considered at an elevation of 105.20 masl, where the elevation for the P2 underground structure slab has been considered at elevation 98.2 masl which is about 7.0 m below the proposed finished grade level floor.

**Dewatering Flow Rate Estimates for Construction of Proposed 2-Levels Underground Parking Structure**

Based on the provided plans, the P2-slab elevation is considered at an elevation of 98.2 masl for this construction dewatering needs assessment. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 97.20 masl, which is about 1.0 m below the lowest proposed excavation depth. The highest, shallow groundwater level within the monitoring wells was measured at an elevation of. 100.38 masl. The subsoil profile consists of topsoil and sandy silt till, extending to the maximum anticipated excavation depth. Based on a review of the measured groundwater levels, the shallow groundwater levels are about 2.18 m above the considered elevations for the proposed underground parking structure. As such some limited construction dewatering is anticipated for the proposed development of the P2 underground structure. As a conservative approach, the highest estimated hydraulic conductivity values of $1.9 \times 10^{-7}$ m/sec obtained from the installed monitoring wells on site was used for current dewatering needs assessments. The estimated construction dewatering flow rate is - anticipated to reach a daily rate of 80,340.2 L/day; by considering a 3=x safety factor, it could reach an approximate daily maximum of 241,020.6 L/day. It should be noted that the

excavation footprints assumed for the dewatering needs flow rates are considered to be 140.0 m in length and 110.0 m in width, where the estimated perimeter for the construction footprints being considered at a length of 500.0 m. The conceptual zone of influence may reach approximately 4.2 m away from construction dewatering array or well used for dewatering purposed for the construction of 2-levels underground parking structure.

In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is above the groundwater taking threshold limit of 50,000 L/day, but is below Permit-To-Take-Water limit of 400,000 L/day, whereby a Environmental Activity and Sector Registry (EASR) would be required as an approval to facilitate the groundwater takings for a temporary construction dewatering program for groundwater control. This higher dewatering flow estimates may only occur at the beginning of the dewatering process, which includes; any rapid removal of collected runoff within the excavation area after a high intensity storm. It is anticipated that, following the lowering of the localized water table, groundwater seepage removed via dewatering from the open excavation will be a fraction of the above estimate, since much of the groundwater in the proposed excavation areas will have been removed from local storage. Furthermore, upon excavation for, any encountered, perched groundwater within the shallow fill horizons is expected to dissipate relatively quickly following commencement of earthworks.

It should be noted that shallow groundwater levels were monitored over the winter season and it is anticipated that they will increase over the high, precipitation, spring season. As such, it is recommended that shallow groundwater levels be monitored again, over the spring season, and that the dewatering estimates be updated if excavation and construction are planned for this season. It is also recommended that the construction dewatering needs assessment be revised if significant changes in the excavation depth and construction footprints are anticipated.

## 7.2 **Groundwater Control Methodology**

Low to moderate groundwater seepage rates which may be encountered in open excavations below the groundwater table can likely be controlled by occasional pumping from sumps. When and where needed during construction. Well points can be employed to lower water table if wet subsoil is unstable and seepage cannot be controlled via sump pumping. The final designs for the dewatering system will be the responsibility of the construction contractors.

## 7.3 **Mitigation of Potential Impacts Associated with Dewatering**

The conceptual zone of influence for any dewatering well or dewatering array is

approximately 4.3 m away from the conceptual dewatering wells or array for the construction of 2-levels underground parking structure. There are no natural features, such as; watercourses, bodies of water, wetlands or any groundwater receptors, including water supply wells on site, or within anticipated zones of influence for any temporary construction dewatering.

## 7.4 Groundwater Function for the Subject Site

The zone of influence for any temporary construction dewatering array or wells could reach a maximum of 4.3 m away from the conceptual dewatering wells/array considered for the construction of 2-levels of underground parking structure. No private wells, bodies of water, watercourses, wetlands or any natural features are present within the conceptual zone of influence for any temporary construction dewatering array being considered for construction. In addition, the subject site is underlain by lower permeable subsoil, resulting in limited estimated zones of influence for temporary construction dewatering, resulting in minimal to negligible anticipated impacts to any nearby features from any temporary dewatering needs for construction. As such no long-term impacts to groundwater function of the subject site are anticipated.

## 7.5 Long-Term Permanent Foundation Drainage

Based on the updated architectural plan, dated February 14, 2023, project number 22035, prepared by Onespace Unlimited Inc., the proposed development is anticipated to be completed with 12-storey high building over 2-levels of underground parking. Based on the topographic grading plan provided by the client, the finished floor elevation is considered at an elevation of 105.20 masl, where the elevation of P2 slab is considered at 98.2 masl which is about 7.0 m below the finished floor.

Given the low seepage rate estimates for any long-term foundation drainage needs, a conventionally shored excavation, using pile and lagging methods can be designed and completed for the construction of the proposed 2-levels underground parking structures. A conventional, Mira drainage network can be included with the design for a conventionally shored excavation, along with a simple basement under-slab drainage network to address any long-term seepage needs to the excavation and the completed underground structure. These systems can be drained to separate sump pits, one for the shore wall, Mira drainage network, and the other for the under-basement floor slab drainage network. The drainage network should be designed by a qualified mechanical engineer, having experience with the designs for under-slab and Mira drainage networks.

In order to estimate the long-term foundation drainage needs for the shored excavations, the associated mira foundation drainage networks, and for the under-slab floor basement drainage networks at the subject site, Darcy's expression and equation was used. The base elevation for the 2-levels underground parking structure was considered to be at elevation of approximately 98.2 masl, which was used for the long-term foundation drainage needs estimation. Review of the measured groundwater levels indicates that the shallow groundwater levels are above the base elevations for the proposed P-2 underground parking structure. As such, it is anticipated that that some long-term foundation drainage needs may be required for the proposed underground parking structure. Darcy's Expression below, was used to assess the long-term foundation seepage flow estimates:

$$Q = KiA$$

Where:

- Q = Estimated seepage drainage rate ($m^3$/day)
- K = $1.90 \times 10^{-7}$ m/sec (highest hydraulic conductivity (K) assessed for the silty clay till subsoil and shale bedrock aquifer encountered during the study)
- A = 1,090.0 $m^2$ for the saturated Mira drain foundation walls and 967.61 $m^2$ for the under-slab floor drainage network which is the approximate area for weeper tiles comprising the under-basement floor slab drainage network (cross-sectional area of flow).
- iv = 0.0152205 [unitless], Vertical Hydraulic Gradient for groundwater considered for the under-slab basement floor drainage system
- ih = 0.0284 [unitless], Horizontal Hydraulic Gradient for groundwater considered for the perimeter, shore wall Mira drainage network system.

Based on review of the plans for the proposed 2-levels underground parking structure, the estimated long-term seepage drainage rate to the Mira drainage network is 508.17 L/day. The long-term drainage seepage drainage rate to the under-slab basement floor drainage networks 241.77 L/day. The combined long-term seepage rate from both the Mira shore wall foundation drainage network and from the under-slab basement floor drainage networks are estimated at 749.94 L/day. After applying a safety factor of three (3), the combined drainage flow rate is estimated at 2,249.82 L/day for the proposed 2-levels underground parking structure. As the estimated drainage flow rates are below the EASR limit of 50,000 L/day, the approval to facilitate the groundwater takings for a permanent foundation drainage program for the completed underground structure is not required to register with MECP with an EASR application.

Given that estimated drainage rates are low, the conventional pumping facility and sump system can be designed for the maximum expected seepage, drainage rates. 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 loss of fines and to prevent silt from clogging the weeper tiles. Over time, the foundation seepage drainage rates to the underground parking structures may diminish to a lower, or possibly negligible steady state rate. It is recommended that the long-term drainage system be design by a mechanical engineer with experience designing foundation drainage networks. It is recommended that the mira drain perimeter system be drained to a separate sump than the basement under-slab drainage network. Potential storm runoff could overwhelm the perimeter system if the shore wall gap between the building foundation and shore wall is not properly sealed against potential runoff accumulation.

The groundwater monitoring program was completed during the winter season when the shallow groundwater levels are typically lower than during the spring seasons.

## 7.6 **Ground Settlement**

The following report was reviewed in preparation for this hydrogeological assessment, "A Geotechnical Review for Potential Ground Settlement, Proposed Mid-Rise Residential Development, 720 Granite Court, City of Pickering, dated September 11, 2024". The report is presented in Appendix 'C'. The report indicates that:

- In order to provide a dry and stable subgrade for construction, the groundwater should be lowered to at least 1.0 m below the bottom of the excavation. Considering that the conceptual zone of influence is primarily within the property boundary and in areas extends to the existing sidewalk and boulevard, no structure will be affected from the construction dewatering. Furthermore, the ground settlement due to construction dewatering is estimated to be less than 1.0 mm for the sidewalk and is considered geotechnically acceptable. Once the dewatering system ceases operation, additional ground settlement due to construction dewatering is not anticipated.

- With the very dense sandy silt till in the subgrade below the lowest parkade level, long-term foundation drainage discharge will likely be water seepage captured in the perimeter foundation subdrains and underfloor subdrains, which can be considered minimal and would not significantly change the groundwater condition from the proposed development; thus, potential settlement due to long-term foundation drainage discharge is not anticipated.

## 8.0 CONCLUSIONS

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

1. The subject site is located within the Physiographic Region of Southern Ontario known as the Iroquois plain, where the clay plain is the predominant Physiographic feature for the area
2. A review of the topography information shows that the subject site is relatively flat, with the surrounding area exhibiting a gentle decline in elevation relief towards the west and southwest.
3. The proposed development site is located within the Petticoat Creek Watershed. Review of available mapping indicates that Petticoat Creek and its associated wooded areas and wetlands are located, approximately 550 m south of the subject site.
4. This study has revealed that beneath a layer of topsoil, the native subsoils underlying the subject site consists of sandy silt till, extending to the maximum investigated depth of 12.3 m below grade.
5. The groundwater monitoring program indicates that the measured groundwater levels ranged from the depths of 3.61 to 8.24 m below the prevailing ground surface, or at the elevations, ranging from 96.16 to 100.38 masl. The interpreted shallow groundwater flow pattern suggests that it flows in southerly and westerly directions.
6. The Single Well Response Tests (SWRT) estimates for hydraulic conductivity (K) for the underlying sandy silt till unit ranged from $1.4 \times 10^{-8}$ to $1.9 \times 10^{-7}$ m/sec. These results suggest that the hydraulic conductivity (K) estimates for the groundwater bearing sandy silt till unit is low, with correspondingly low anticipated groundwater seepage rates being anticipated into open excavations, below the groundwater table.
7. Based on the provided updated architectural plans, the estimated construction dewatering flow rate is anticipated to reach a daily rate of 80,340.2 L/day; by considering a 3 x safety factor, it could reach an approximate daily maximum of 241,020.6 L/day. The conceptual zone of influence may reach approximately 4.2 m away from construction dewatering array or well used for dewatering purposed for the construction of 2-levels underground parking structure. In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is above the groundwater taking threshold limit of 50,000 L/day, but is below Permit-To-Take-Water limit of 400,000 L/day, whereby a Environmental Activity and Sector Registry (EASR) would be required as an approval to facilitate the groundwater takings for a temporary construction dewatering program for groundwater control.
8. The conceptual zone of influence for any dewatering well or dewatering array used

during services installation is approximately 4.3 m away from the conceptual dewatering wells or array for the construction of 2-levels of underground parking. There are no natural features, such as; watercourses, bodies of water, wetlands or any groundwater receptors, including water supply wells on site, or within anticipated zones of influence for any temporary construction dewatering.

9. The long term foundation drainage rates for the complete P2 underground structure from a mira drain for a conventionally shored exaction is 508.17 L/day and to the under-slab drainage network it is 241.77 L/day with the combined drainage rate being749.94 L/day by applying a safety factor of 3 it could reach a maximum rate of 2249.82 L/day.

Yours Truly,
**SOIL ENGINEERS LTD.**

Harpreet Singh

Harpreet Singh, EIT, PMP, C.Tech.

Nar

Narjes Alijani, M.Sc., P.Geo.
HS/NA

## 9.0 REFERENCES

1. The Physiography of Southern Ontario (Third Edition), L. J. Chapman and D. F. Putnam, 1984

2. Petticoat Creek Watershed Action Plan, 2012, Toronto and Region Conservation Authority

3. Bedrock Topography of the Markham Area, Southern Ontario, 1992, Open File Map 196, Mines and Minerals Division, Ontario Geological Survey

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|---|---|---|---|---|---|
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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) 542-2769 |


**FIGURES 1 TO 5**

**BOREHOLE LOGS AND GRAIN SIZE DISTRIBUTION GRAPHS**

**REFERNCE NO. 2111-W043**

# LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

## SAMPLE TYPES

AS Auger sample
CS Chunk sample
DO Drive open (split spoon)
DS Denison type sample
FS Foil sample
RC Rock core (with size and percentage recovery)
ST Slotted tube
TO Thin-walled, open
TP Thin-walled, piston
WS Wash sample

## PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH Sampler advanced by static weight
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
NP No penetration

## SOIL DESCRIPTION

Cohesionless Soils:

| 'N' (blows/ft) | Relative Density |
|---|---|
| 0 to 4 | very loose |
| 4 to 10 | loose |
| 10 to 30 | compact |
| 30 to 50 | dense |
| over 50 | very dense |

Cohesive Soils:

| Undrained Shear Strength (ksf) | 'N' (blows/ft) | Consistency |
|---|---|---|
| less than 0.25 | 0 to 2 | very soft |
| 0.25 to 0.50 | 2 to 4 | soft |
| 0.50 to 1.0 | 4 to 8 | firm |
| 1.0 to 2.0 | 8 to 16 | stiff |
| 2.0 to 4.0 | 16 to 32 | very stiff |
| over 4.0 | over 32 | hard |

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 Field vane test in borehole; the number denotes the sensitivity to remoulding

△ Laboratory vane test

□ Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

## METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

JOB NO.: 2111-W043

# LOG OF BOREHOLE: BH/MW 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 16, 2021

| 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 |
|---|---|---|---|---|---|---|---|---|
| 104.5 | Ground Surface | | | | | | | |
| 0.2 | 23 cm TOPSOIL | 1 | DO | 2 | 0 | | 17 | |
| | Very dense weathered SANDY SILT TILL a trace of gravel occ. silty clay layers, cobbles and boulders | 2 | DO | 56 | 1 | | 11 | |
| | | 3 | DO | 50/4 | | | 7 | |
| | | 4 | DO | 50/4 | 2 | | 6 | |
| | | 5 | DO | 50/4 | 3 | | 7 | |
| | brown grey | 6 | DO | 50/5 | 4 | | 5 | |
| | | 7 | DO | 50/6 | 5 | | 7 | |
| | | 8 | DO | 50/3 | 6 | | 7 | |
| | | 9 | DO | 50/1 | 7 | | 6 | |
| | | 10 | DO | 50/3 | 8 | | 7 | |
| 92.2 | | 11 | DO | 50/3 | 9 | | 7 | |
| 12.3 | END OF BOREHOLE | | | | 10 | | | |
| | Installed 50 mm Ø monitoring well to 9.0 m<br>3.1 m slotted screen from 5.9 m to 9.0 m<br>Sand backfill from 5.5 to 9.0 m<br>Bentonite seal from 0.0 m to 5.5 m<br>Provided with a monument steel casing | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |

W.L. @ El. 98.02 m on January 7, 2022
W.L. @ El. 97.82 m on January 19, 2022
W.L. @ El. 97.69 m on February 1, 2022

Soil Engineers Ltd.

JOB NO.: 2111-W043

# LOG OF BOREHOLE: BH/MW 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 16, 2021

| 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 |
|---|---|---|---|---|---|---|---|---|
| 104.4 | Ground Surface | | | | | | | |
| 0.2 | 23 cm TOPOSIL | 1 | DO | 2 | 0 | | 27 | |
| | Dense to very dense weathered SANDY SILT TILL a trace of gravel occ. silty clay layers, cobbles and boulders | 2 | DO | 41 | 1 | | 16.5 | |
| | | 3 | DO | 50/3 | | | 7 | |
| | | 4 | DO | 50/5 | 2 | | 7 | |
| | | 5 | DO | 50/6 | 3 | | 7 | |
| | brown grey | 6 | DO | 50/5 | 4 | | 11 | |
| | | 7 | DO | 50/5 | 5 | | 6 | |
| | | 8 | DO | 50/4 | 6 | | 7 | |
| | | 9 | DO | 90/11 | 7 | | 6 | |
| | | 10 | DO | 50/4 | 8 | | 8 | |
| 92.1 | | 11 | DO | 50/2 | 9 | | 10 | |
| 12.3 | END OF BOREHOLE | | | | 10 | | | |
| | Installed 50 mm Ø monitoring well to 9.0 m<br>3.1 m slotted screen from 5.9 m to 9.0 m<br>Sand backfill from 5.5 to 9.0 m<br>Bentonite seal from 0.0 m to 5.5 m<br>Provided with a monument steel casing | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |

W.L. @ El. 97.61 m on January 7, 2022
W.L. @ El. 96.16 m on January 19, 2022
W.L. @ El. 96.36 m on February 1, 2022

Soil Engineers Ltd.

JOB NO.: 2111-W043

# LOG OF BOREHOLE: BH 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 17, 2021

| 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 |
|---|---|---|---|---|---|---|---|---|
| 104.9 | Ground Surface | | | | | | | |
| 0.2 | 20 cm TOPSOIL | 1 | DO | 1 | 0 | | 30 | |
| | Dense to very dense weathered SANDY SILT TILL a trace of gravel occ. silty clay layers, cobbles and boulders | 2 | DO | 37 | 1 | | 8 | |
| | | 3 | DO | 50/5 | | | 7 | |
| | | 4 | DO | 50/5 | 2 | | 7 | |
| | | 5 | DO | 50/3 | 3 | | 7 | |
| | brown grey | 6 | DO | 50/5 | 4 | | 7 | |
| | | 7 | DO | 50/6 | 5 | | 7 | |
| | | 8 | DO | 50/3 | 6 | | 9 | |
| | | 9 | DO | 50/4 | 7 | | 9 | |
| | | 10 | DO | 50/3 | 8 | | 5 | |
| 92.6 12.3 | END OF BOREHOLE | 11 | DO | 50/3 | 9 | | 6 | Dry upon completion |
| | | | | | 10 | | | |
| | | | | | 11 | | | |
| | | | | | 12 | | | |
| | | | | | 13 | | | |
| | | | | | 14 | | | |
| | | | | | 15 | | | |

Soil Engineers Ltd.

JOB NO.: 2111-W043

# LOG OF BOREHOLE: BH/MW 4

FIGURE NO.: 4

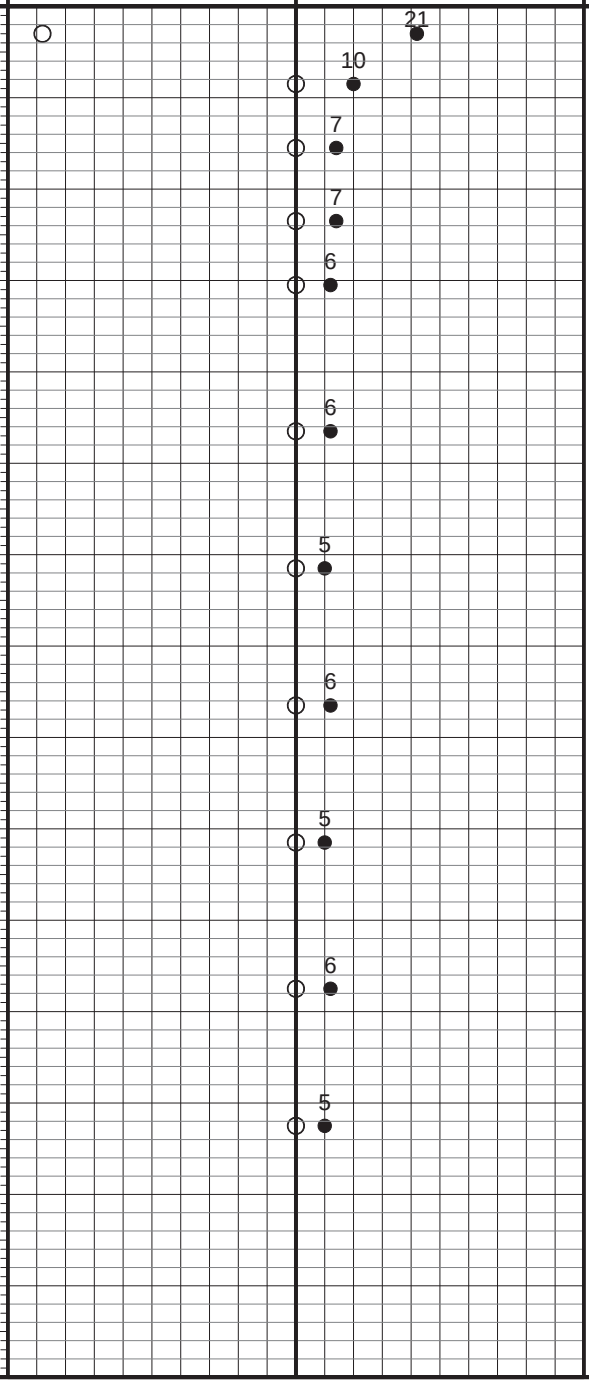
PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 14, 2021

| El. (m) / Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Depth Scale (m) |
|---|---|---|---|---|---|
| 104.0 | Ground Surface | | | | |
| 0.3 | 25 cm TOPSOIL | 1 | DO | 12 | 0 |
| | Very dense — weathered<br>SANDY SILT TILL<br>a trace of gravel<br>occ. silty clay layers, cobbles and boulders | 2 | DO | 79/8 | 1 |
| | | 3 | DO | 50/4 | |
| | | 4 | DO | 50/4 | 2 |
| | | 5 | DO | 50/4 | 3 |
| | — brown<br>grey | | | | 4 |
| | | 6 | DO | 50/3 | |
| | | 7 | DO | 50/3 | 5 |
| | | 8 | DO | 50/2 | 6 |
| | | 9 | DO | 50/2 | 7 |
| | | 10 | DO | 50/4 | 8 |
| | | | | | 9 |
| 91.7 | | 11 | DO | 50/4 | 10 |
| 12.3 | END OF BOREHOEL<br>Installed 50 mm Ø monitoring well to 9.0 m<br>3.1 m slotted screen from 5.9 m to 9.0 m<br>Sand backfill from 5.5 to 9.0 m<br>Bentonite seal from 0.0 m to 5.5 m<br>Provided with a momument steel casing | | | | 11 |
| | | | | | 12 |
| | | | | | 13 |
| | | | | | 14 |
| | | | | | 15 |




W.L. @ El. 98.49 m on January 7, 2022
W.L. @ El. 99.21 m on January 19, 2022
W.L. @ El. 100.38 m on February 1, 2022

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# Soil Engineers Ltd.

# GRAIN SIZE DISTRIBUTION

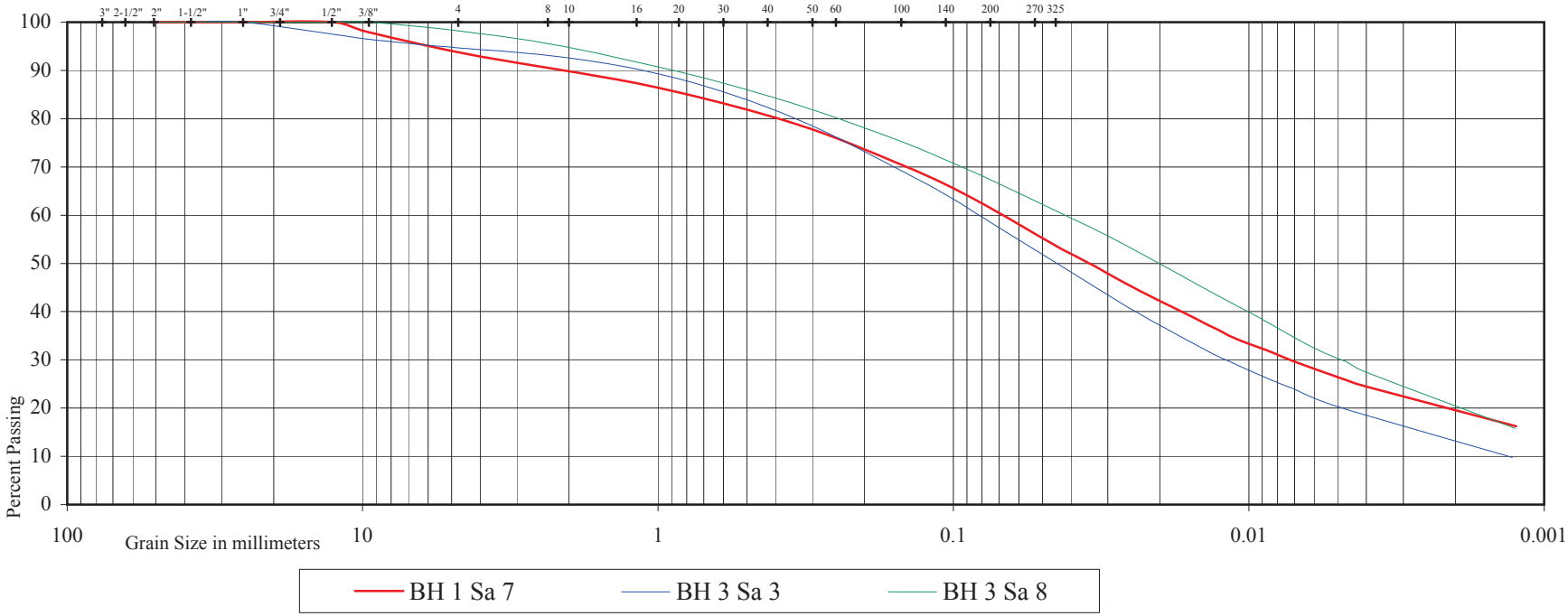
Reference No: 2111-W043

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 Residential Development

Location: 720 Granite Court, City of Pickering

| | | | |
|---|---|---|---|
| Borehole No: | 1 | 3 | 3 |
| Sample No: | 7 | 3 | 8 |
| Depth (m): | 6.1 | 1.5 | 7.6 |
| Elevation (m): | 98.4 | 103.4 | 97.3 |

BH 1 Sa. 7 Estimated Permeability (cm./sec.) = $10^{-7}$

BH 3 Sa. 3 Estimated Permeability (cm./sec.) = $10^{-6}$

BH 3 Sa. 8 Estimated Permeability (cm./sec.) = $10^{-7}$

Classification of Sample [& Group Symbol]: SANDY SILT TILL

some clay, a trace of gravel

Figure: 5

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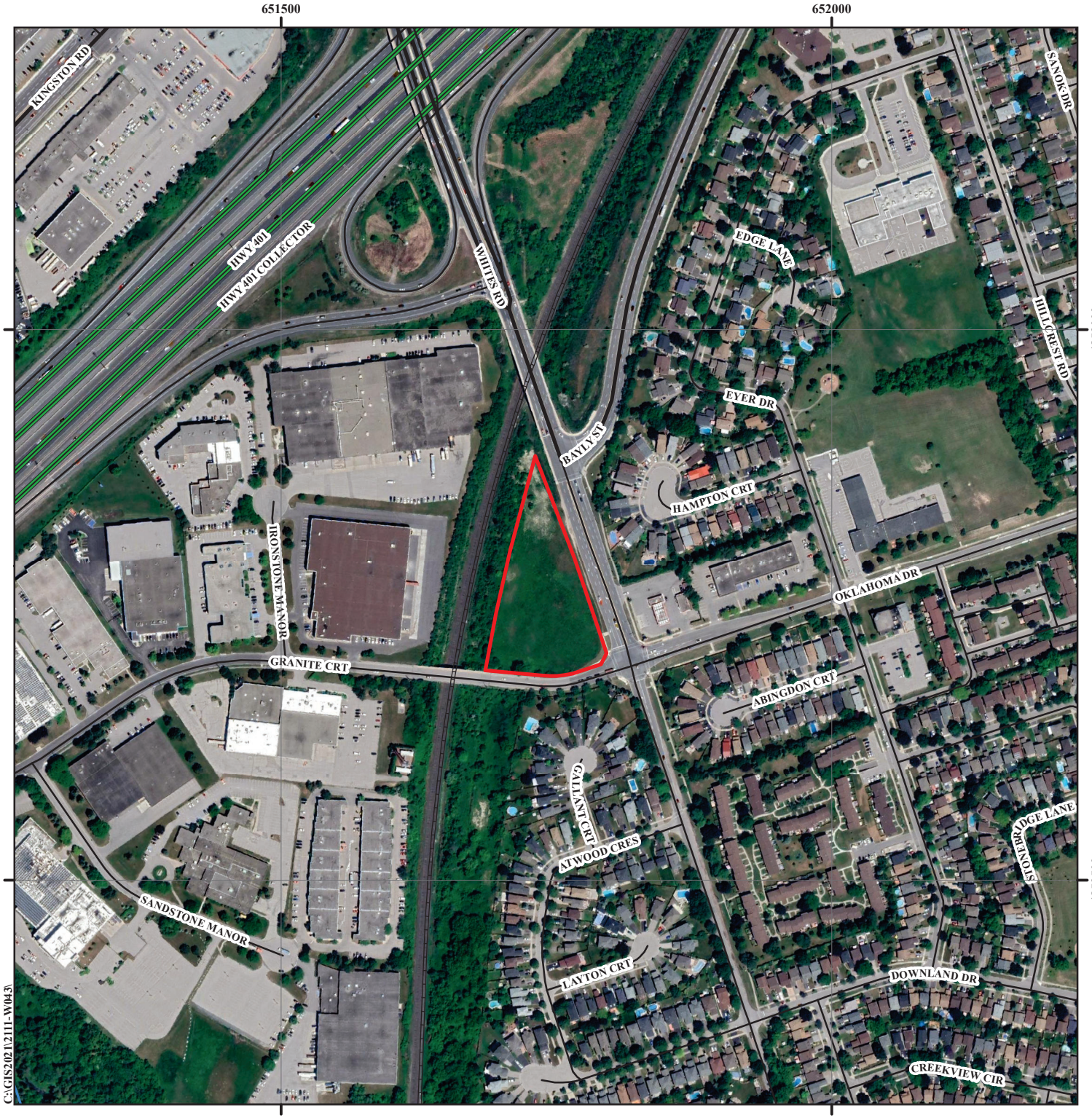
| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (905) 881-8335 | FAX: (705) 684-8522 | FAX: (905) 542-2769 |


**DRAWINGS 1 TO 9**

**REFERNCE NO. 2111-W043**




N

Approximate Boundary of Subject Site

Watercourse

Expressway/Freeway

Major Road

Local Road

Railway

*Soil Engineers Ltd.*

Title: Site Location Plan

Project:

Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

Date: January 19, 2022

Scale:

0 25 50 100 150 200 250

Metres

Drawing No. 1


N

Approximate Boundary of Subject Site

Borehole

Borehole with Monitoring Well

Major Road

Local Road

Railway

*Soil Engineers Ltd.*

Title: Borehole and Monitoring Well Location Plan

Project:

Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

Date: January 19, 2022

Scale:

0 5 10 20 30 40 50

Metres

Drawing No. 2


N

Approximate Boundary of Subject Site

500 metres from Subject Site Boundary

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

Watercourse

Expressway/Freeway

Major Road

Local Road

Railway

**Soil Engineers Ltd.**

Title: MECP Well Location Plan

Project:

Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

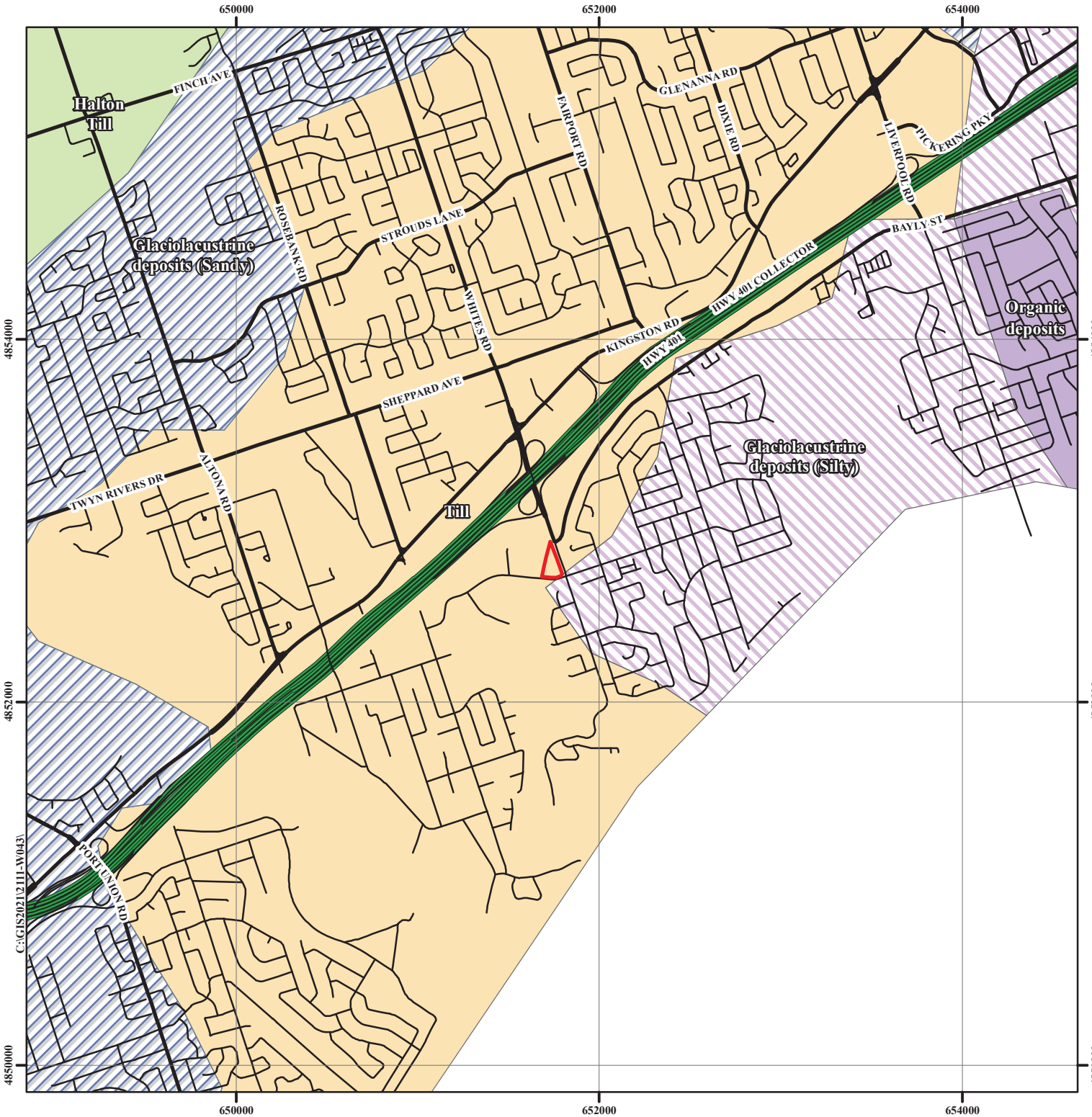
Date: January 19, 2022

Scale:

0 25 50 100 150 200 250
Metres

Drawing No. 3

Source: Ontario Ministry of Natural Resources and Forestry




N

- Approximate Boundary of Subject Site
- Glaciolacustrine deposits (Sandy)
  Material: sand, gravelly sand and gravel, nearshore and beach deposits
- Glaciolacustrine deposits (Silty)
  Material: silt and clay, minor sand, basin and quiet water deposits
- Halton Till
  Material: predominantly silt to silty clay matrix, high in matrix carbonate content and clast poor
- Organic deposits
  material: peat, muck and marl
- Till
  Material: undifferentiated, predominantly sandy silt to silt matrix, commonly rich in clasts, often high in total matrix carbonate content
- Expressway/Freeway
- Major Road
- Local Road

*Soil Engineers Ltd.*

Title: Quarternary and Surface Geology Map

Project:

Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

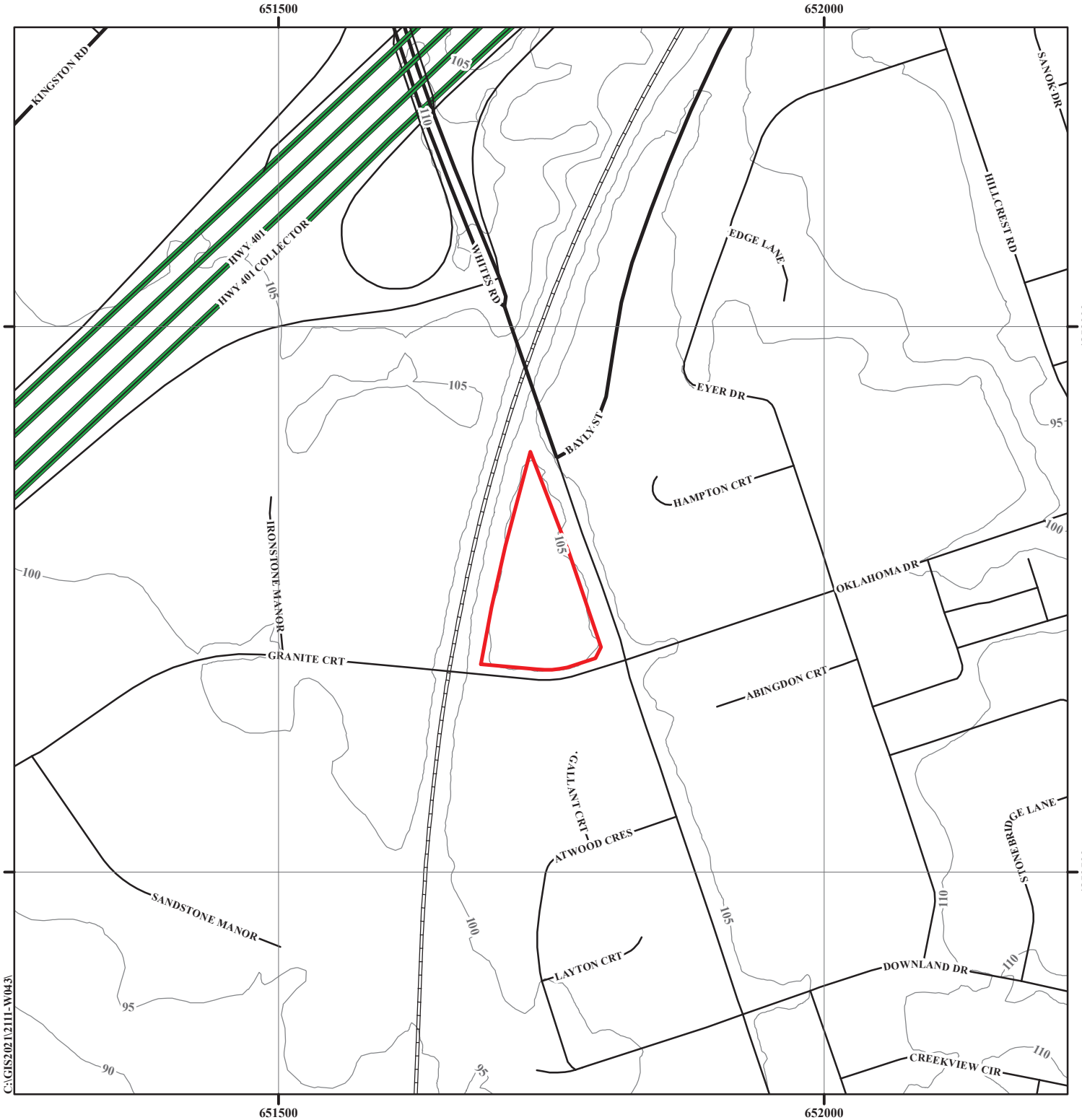
Date: January 19, 2022

Scale:

0 200 400 600 800 1,000
Metres

Drawing No. 4

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




N

Approximate Boundary of Subject Site

Expressway/Freeway

Major Road

Local Road

Railway

100 Topographic Contour (masl)

*Soil Engineers Ltd.*

Title: Topographic Map

Project:
Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

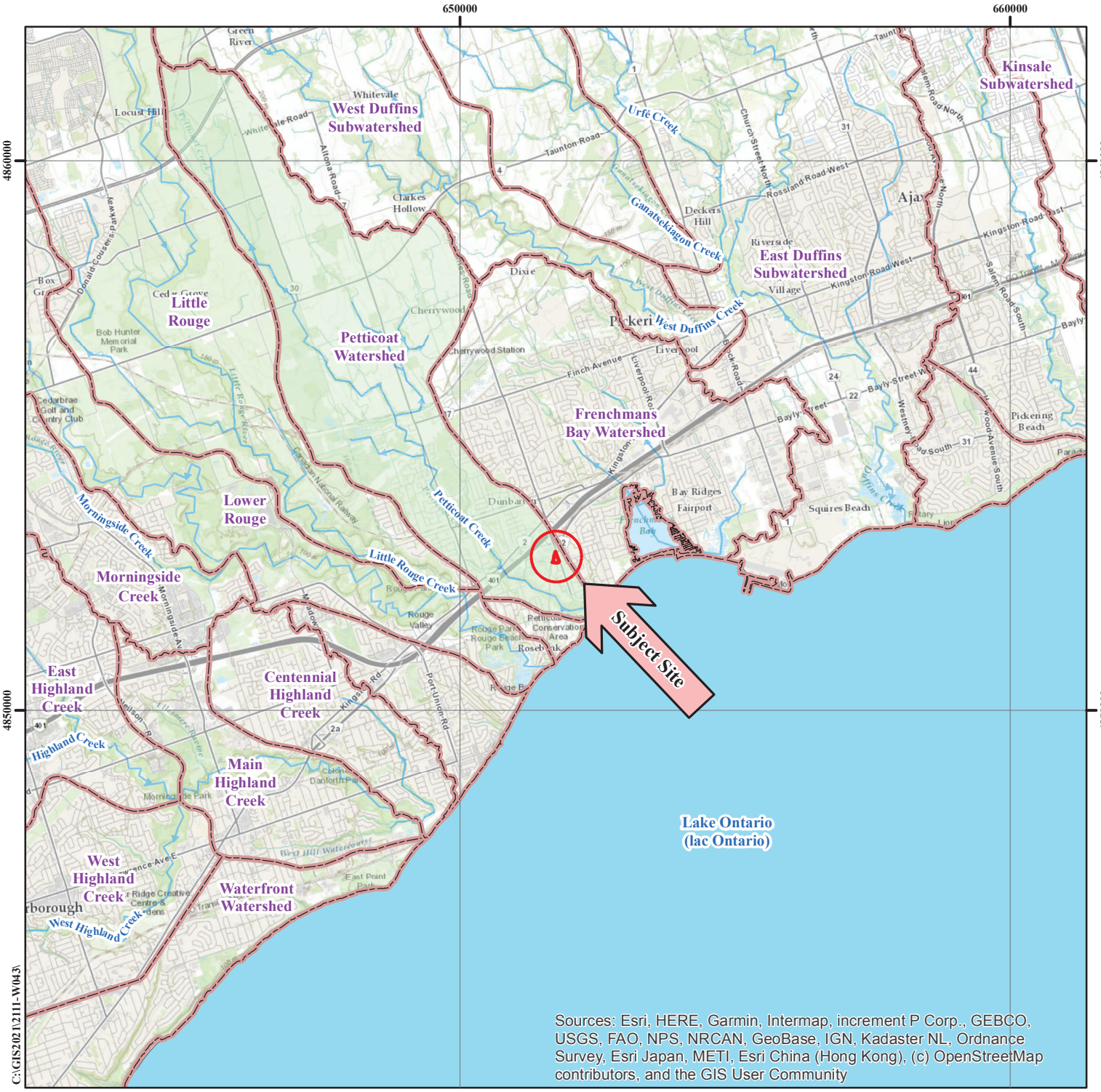
Date: January 19, 2022

Scale:
0 25 50 100 150 200 250
Metres

Drawing No. 5

C:\GIS\2021\2111-W043\

Source: Ontario Ministry of Natural Resources and Forestry

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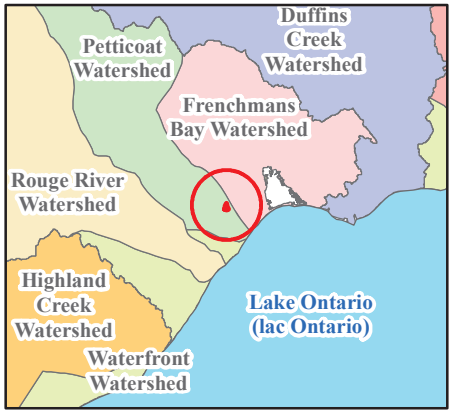
N

**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 Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

Date: January 19, 2022

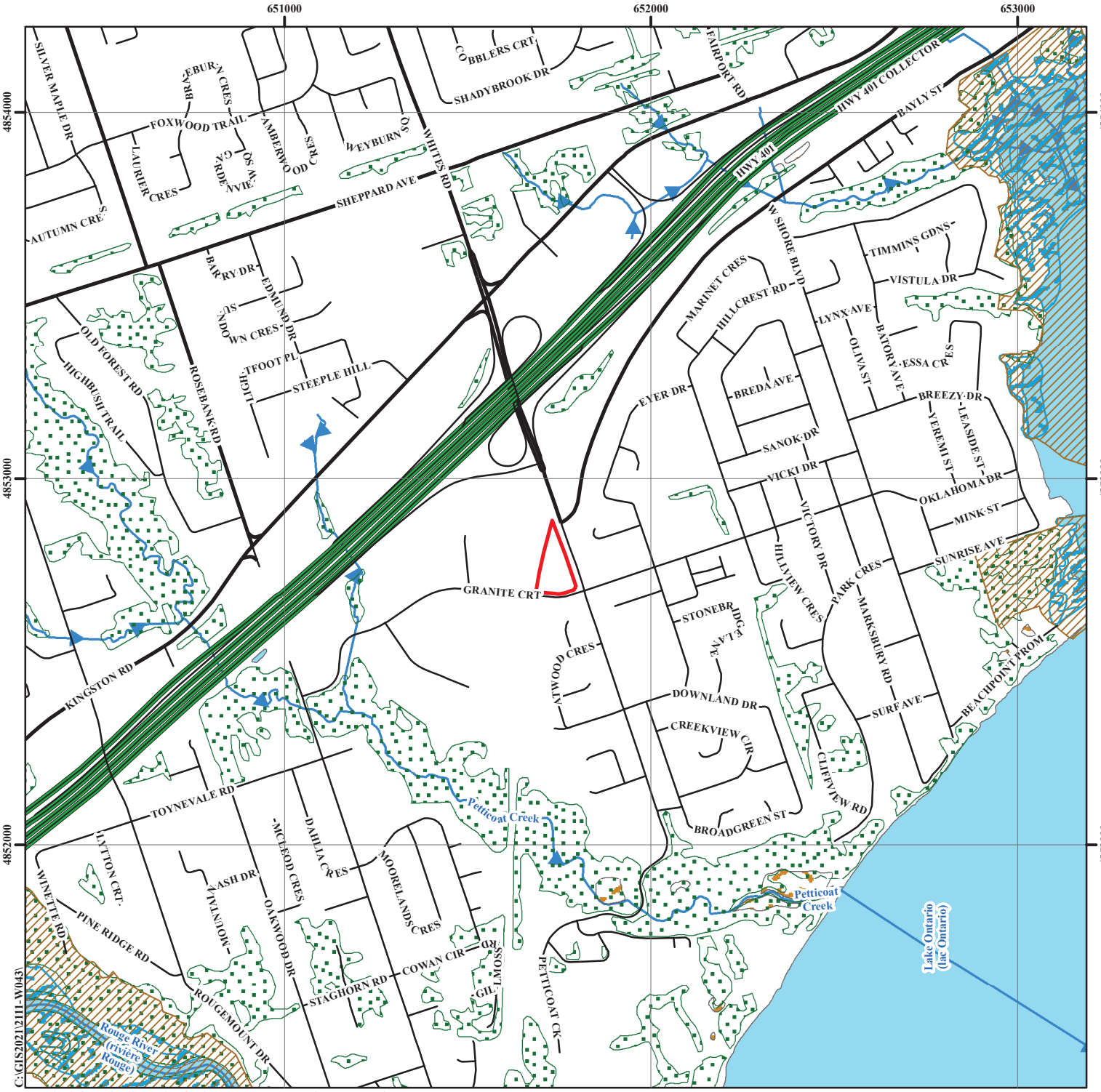
Scale:

0 1,000 2,000 3,000 4,000 5,000

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.




C:\GIS\2021\2111-W043)



Source: Ontario Ministry of Natural Resources and Forestry

OWES: Ontario Wetland Evaluation System


N

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

Soil Engineers Ltd.

Title: Cross-Section Key Plan

Project:
Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

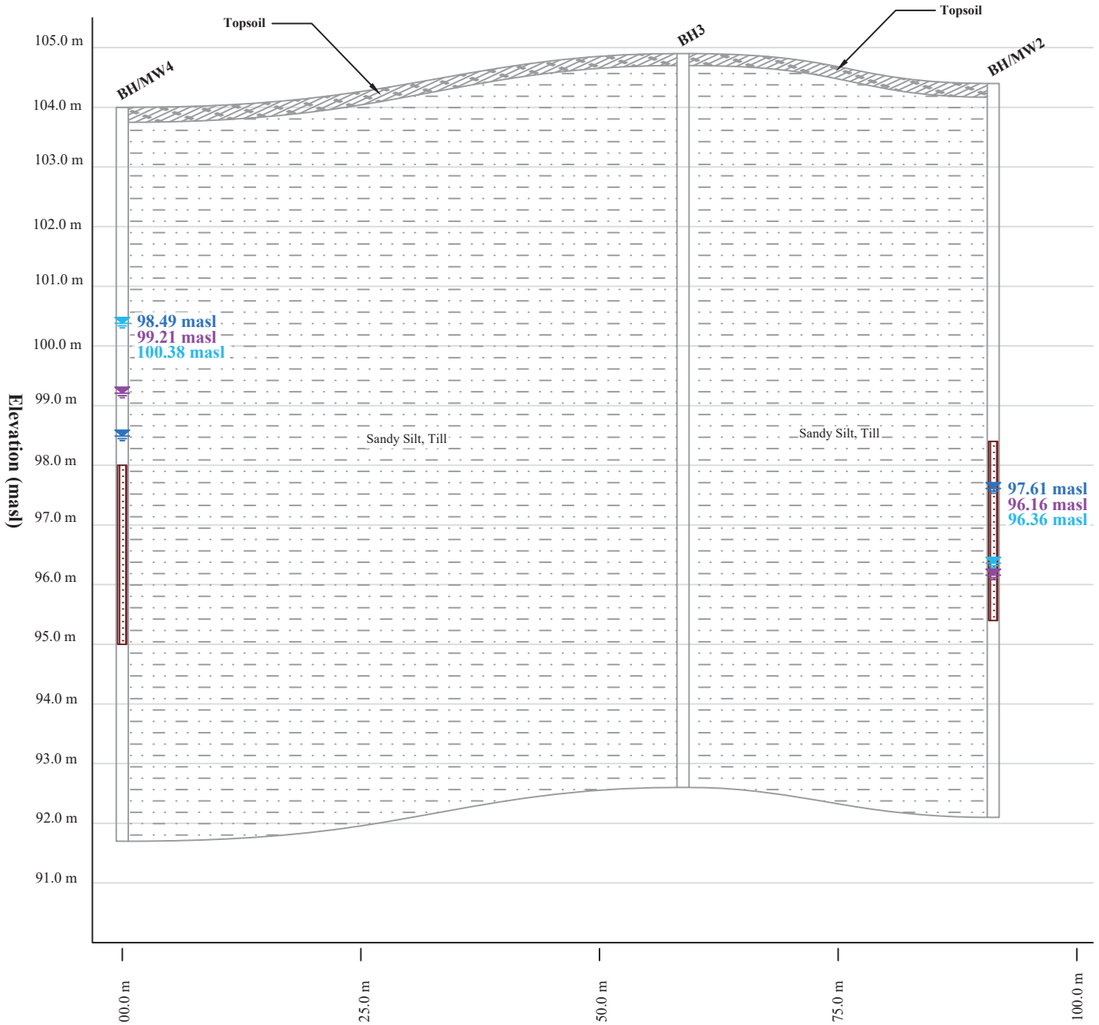
Date: March 1, 2022

Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 8-1

North
A

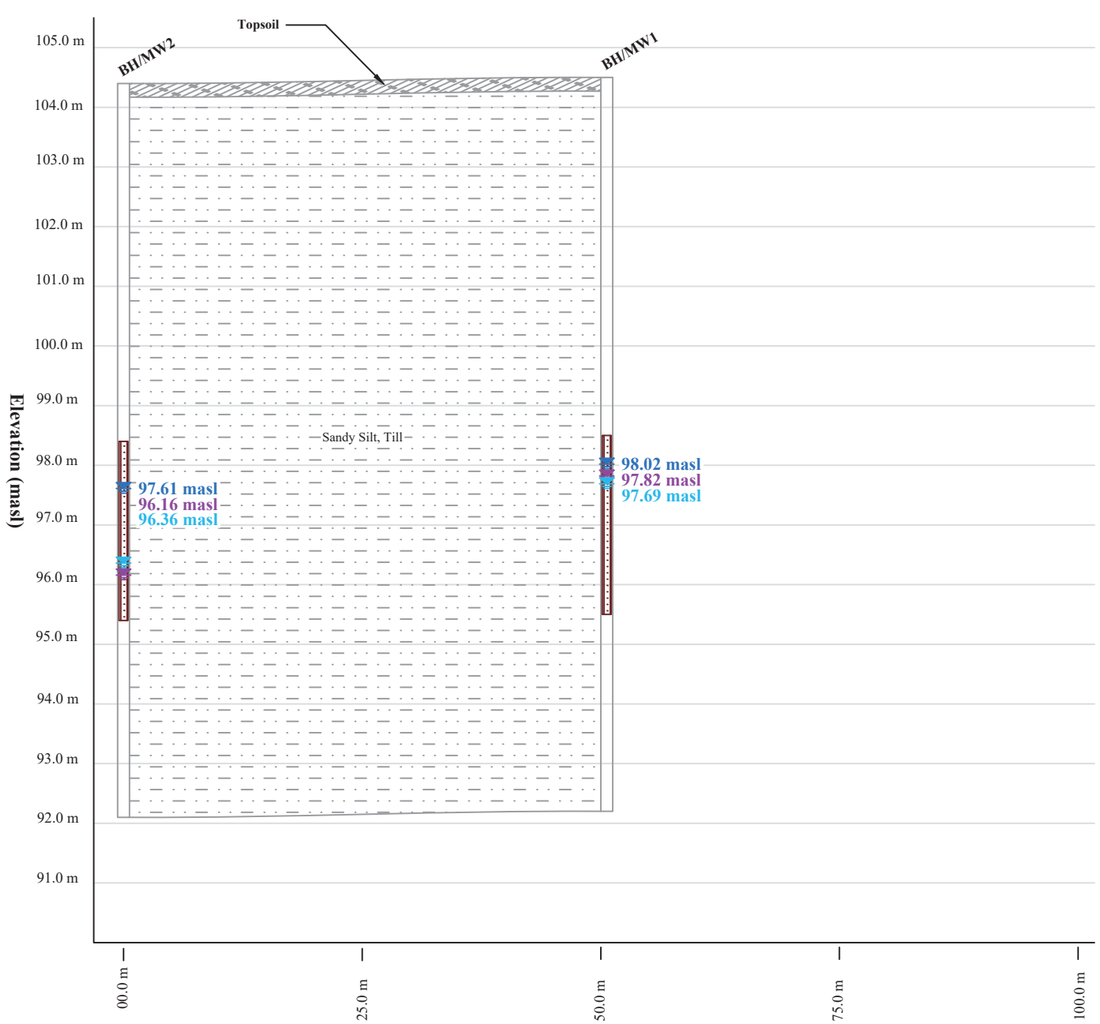
South
A'




Section A-A'

West
B

East
B'




Section B-B'

Topsoil

Sandy Silt, Till

3.0 m Screen

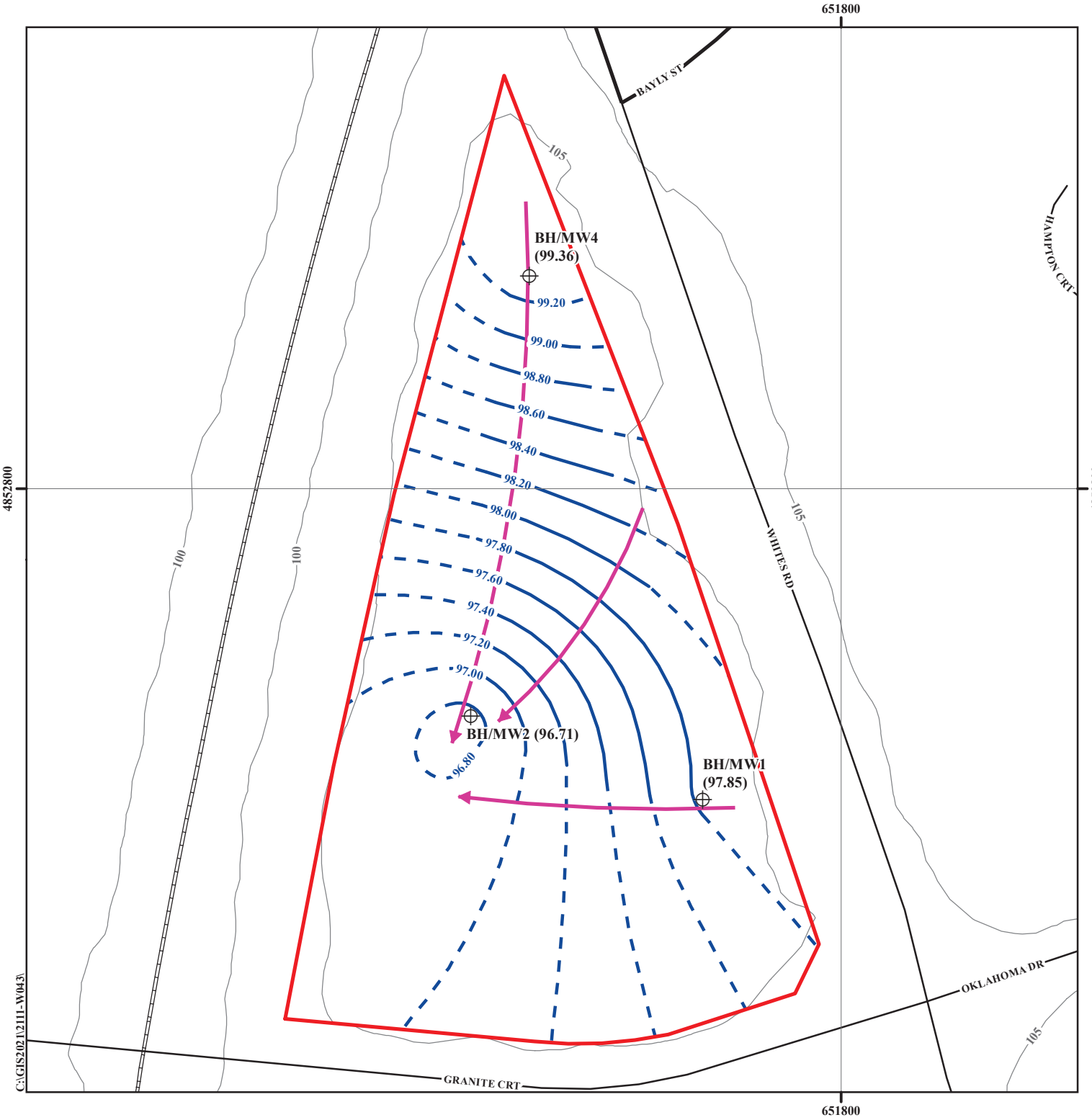
Water Table on January 7, 2022
Water Table on January 19, 2022
Water Table on February 1, 2022

Soil Engineers Ltd.
CONSULTING SOIL, FOUNDATION & ENVIRONMENTAL ENGINEERS

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

Project: Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court, City of Pickering

| Reference No: | Date: | Scale: V | Scale: H | Drawing No. |
|---|---|---|---|---|
| 2111-W043 | March, 2022 | 1:100 | 1:2500 | 8-2 |




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

Railway

100 Topographic Contour (masl)

(97.85) Average Shallow Groundwater Level Elevation (masl)

*Soil Engineers Ltd.*

Title: Shallow Groundwater Flow Pattern Plan

Project:
Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

Date: March 1, 2022

Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 9

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| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | MUSKOKA | 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) 542-2769 |


# APPENDIX 'A'

## MECP WATER WELL RECORDS SURVEY

## REFERNCE NO. 2111-W043

**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 | 4601906 | Rotary (Convent.) | 37.49 | Abandoned-Supply | - | 28.35 | 19.20 | - | - |
| 2 | 7041862 | Boring | 6.00 | Observation Wells | Not Used | - | - | 1.50 | 6.00 |
| 3 | 7125150 | Boring | 3.90 | Test Hole | Monitoring | - | - | 0.90 | 3.90 |
| 4 | 7125150 | Boring | 3.90 | Test Hole | Monitoring | - | - | 0.90 | 3.90 |
| 5 | 7125150 | Boring | 3.90 | Test Hole | Monitoring | - | - | 0.90 | 3.90 |
| 6 | 7125150 | Boring | 3.90 | Test Hole | Monitoring | - | - | 0.90 | 3.90 |
| 7 | 7183708 | Direct Push | 6.10 | Monitoring and Test Hole | Monitoring and Test Hole | - | - | 3.10 | 6.10 |
| 8 | 7183709 | Direct Push | 6.10 | Monitoring and Test Hole | Monitoring and Test Hole | - | - | 3.10 | 6.10 |
| 9 | 7253328 | Auger | 4.57 | Monitoring and Test Hole | Monitoring and Test Hole | - | - | 1.52 | 4.57 |
| 10 | 7253330 | Auger | 4.57 | Monitoring and Test Hole | Monitoring and Test Hole | - | - | 1.52 | 4.57 |
| 11 | 7253329 | Auger | 6.10 | Monitoring and Test Hole | Monitoring and Test Hole | - | - | 3.10 | 6.10 |
| 12 | 7335757 | Auger | 9.14 | Observation Wells | Monitoring | - | - | 6.10 | 9.14 |
| 13 | 7335758 | Auger | 19.81 | Observation Wells | Monitoring | 15.24 | - | 16.76 | 19.81 |
| 14 | 7335759 | Auger | 9.14 | Monitoring and Test Hole | Monitoring | 7.32 | - | 6.10 | 9.14 |
| 15 | 7335763 | Auger | 4.27 | Observation Wells | Monitoring | - | - | 2.74 | 4.27 |

*MECP WWID: Ministry of Environment, Conservation, and Parks Water Well Records Identification

**metres below ground surface

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# APPENDIX 'B'

## SINGLE WELL RESPONSE TEST RESULTS

## REFERNCE NO. 2111-W043

## Falling Head Test (Slug Test)

| | | | |
|---|---|---|---|
| Test Date: | | 1-Feb-22 | |
| Piezometer/Well No.: | | BH/MW 1 | |
| Ground level: | | 104.50 | m |
| Screen top level: | | 98.40 | m |
| Screen bottom level: | | 95.40 | m |
| Test El. (at midpoint of screen): | | 96.90 | m |
| Test depth (at midpoint of screen): | | 7.6 | m |
| Screen length | L= | 3.0 | m |
| Diameter of undisturbed portion of aquifer | 2R= | 0.22 | m |
| Standpipe diameter | 2r= | 0.05 | m |
| Initial unbalanced head | Ho= | -0.2057 | m |
| Initial water depth | | 6.81 | m |
| Aquifer material: | | **Sandy Silt Till** | |

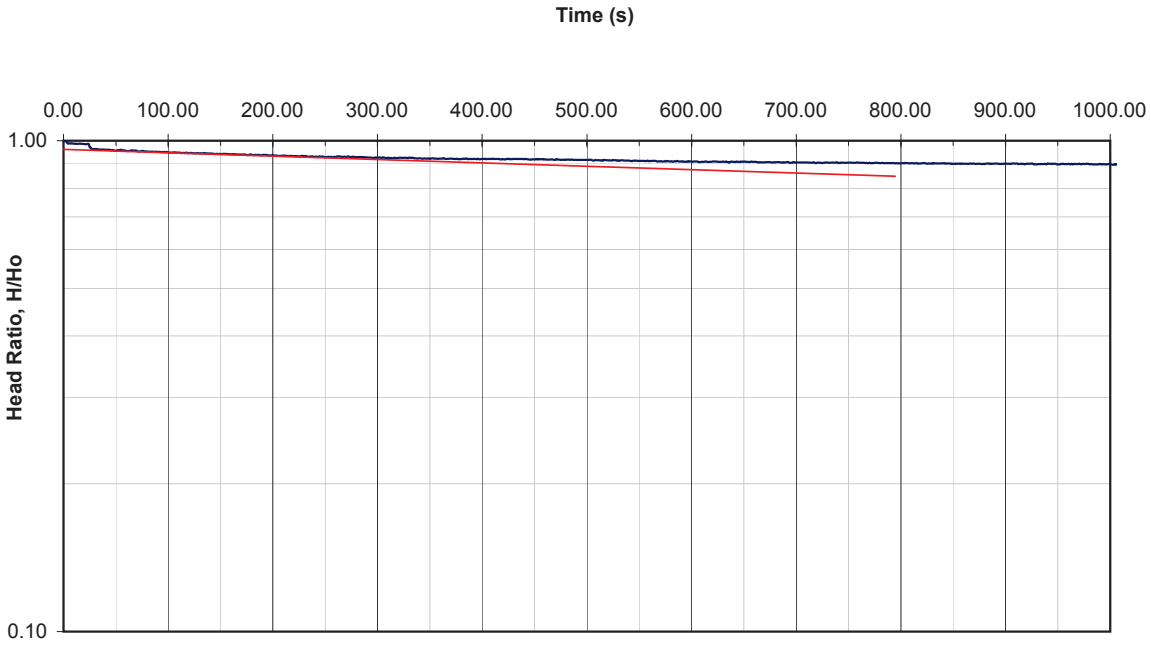
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

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

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000549589$

K= **1.9E-05** cm/s

**1.9E-07** m/s



## Falling Head Test (Slug Test)

| | | | |
|---|---|---|---|
| Test Date: | | 1-Feb-22 | |
| Piezometer/Well No.: | | BH/MW 2 | |
| Ground level: | | 104.40 | m |
| Screen top level: | | 98.10 | m |
| Screen bottom level: | | 95.10 | m |
| Test El. (at midpoint of screen): | | 96.60 | m |
| Test depth (at midpoint of screen): | | 7.8 | m |
| Screen length | L= | 3.0 | m |
| Diameter of undisturbed portion of aquifer | 2R= | 0.22 | m |
| Standpipe diameter | 2r= | 0.05 | m |
| Initial unbalanced head | Ho= | -0.5609 | m |
| Initial water depth | | 8.04 | m |
| Aquifer material: | | **Sandy Silt Till** | |

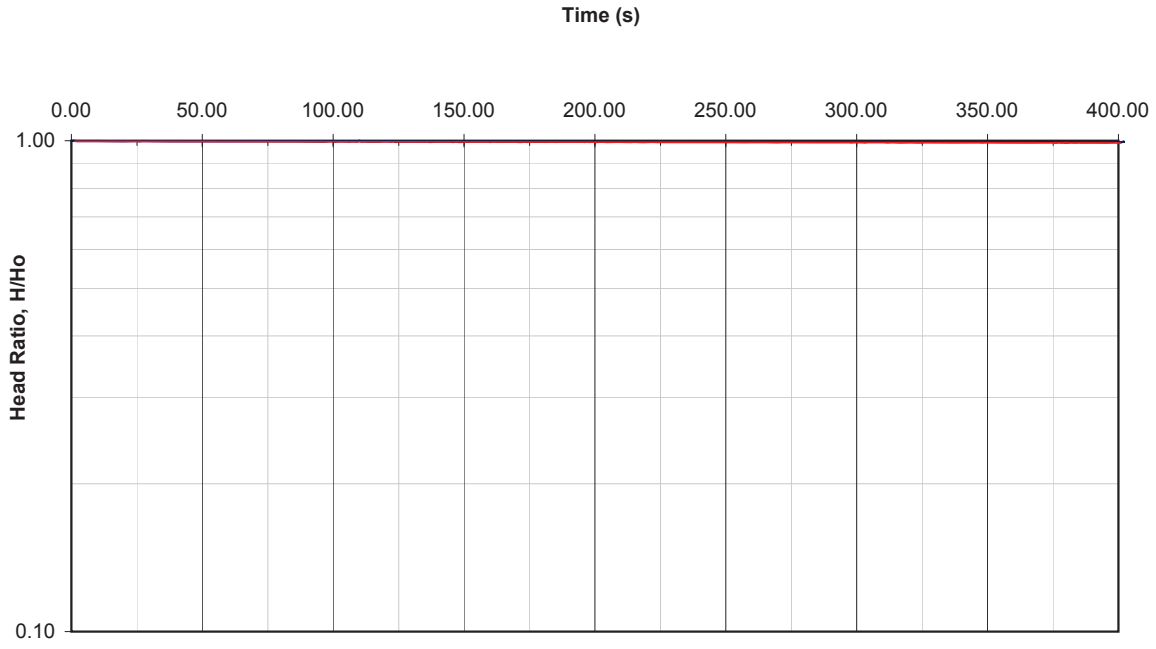
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

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

$\frac{\ln(H1/H2)}{(t2 - t1)} = 4.10898E\text{-}05$

K= **1.4E-06** cm/s

**1.4E-08** m/s



## Falling Head Test (Slug Test)

| | | | |
|---|---|---|---|
| Test Date: | | 1-Feb-22 | |
| Piezometer/Well No.: | | BH/MW 4 | |
| Ground level: | | 103.99 | m |
| Screen top level: | | 97.69 | m |
| Screen bottom level: | | 94.69 | m |
| Test El. (at midpoint of screen): | | 96.19 | m |
| Test depth (at midpoint of screen): | | 7.8 | m |
| Screen length | L= | 3.0 | m |
| Diameter of undisturbed portion of aquifer | 2R= | 0.22 | m |
| Standpipe diameter | 2r= | 0.05 | m |
| Initial unbalanced head | Ho= | -0.4395 | m |
| Initial water depth | | 3.61 | m |
| Aquifer material: | | **Sandy Silt Till** | |

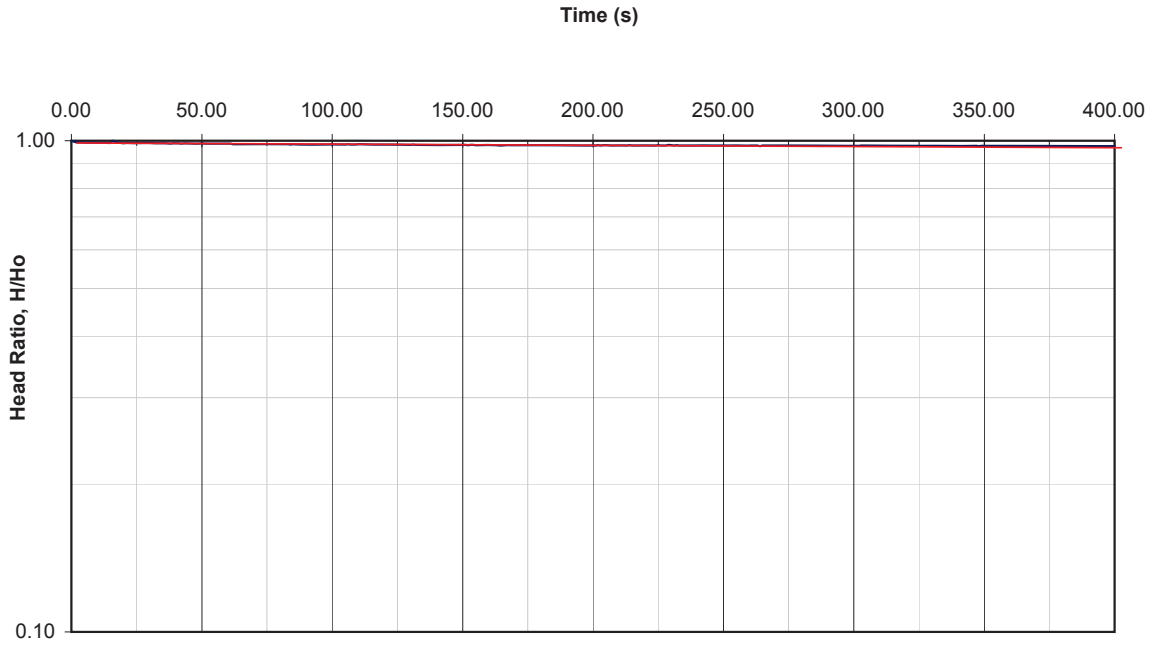
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

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

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000176752$

K= **6.1E-06** cm/s

**6.1E-08** m/s



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# APPENDIX 'C'

## A GEOTECHNICAL REVIEW FOR POTENTIAL GROUND SETTLEMENT

## REFERNCE NO. 2111-W043

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September 11, 2024 Reference No. 2111-S043



1334281 Ontario Limited
720 Granite Court
Pickering, Ontario
L1W 4A3

Attention: Mr. Domenic Grossi

**Re: A Geotechnical Review for Potential Ground Settlement**
**Proposed Mid-Rise Residential Development**
**720 Granite Court**
**City of Pickering**

Dear Sir:

As requested, Soil Engineers Ltd. (SEL) has performed a geotechnical review for potential settlement to the existing structures surrounding the captioned site due to short-term construction dewatering and long-term foundation drainage discharge within the subject site.

The following documents, drawings and reports are reviewed for the assessment:

- *Geotechnical Investigation Report, prepared by SEL, dated March 2023.*
- *Hydrogeological Assessment Report, prepared by SEL, dated September 2024.*
- *Architectural Drawings, prepared by onespace unlimited Inc., dated August 28, 2024*

## Subsurface Conditions

Based on the borehole findings in the geotechnical report, beneath a veneer of topsoil, the site is underlain by a stratum of sandy silt till throughout the site.

The recorded groundwater elevations within the building envelope as reported in the hydrogeological assessment ranges from El. 96.16 to 98.02 m.

**Estimation of Settlement Due to Dewatering**

Based on the architectural drawings, it is estimated that the bottom of excavation for the proposed development is at El. 98.2 m and the base of elevator pit is at El. 97.2 m. Given the bottom of excavation and the base of elevator pit are lower than the recorded groundwater level, construction dewatering is anticipated during construction.

A review of the aerial image and drawings shows that the site is bounded by a municipal street to the south, a regional road to the east and northeast, and a railway line to the west and northwest. According to the hydrogeological report, the Zone of Influence (ZOI) due to construction dewatering is estimated to be 4.2 m. The dewatering array will likely be installed along the extent of underground structure. The extent of the ZOI is estimated and is illustrated on Drawing No. 1, enclosed.

In order to provide a dry and stable subgrade for construction, the groundwater should be lowered to at least 1.0 m below the bottom of the excavation. As such, the maximum drawdown of the groundwater is estimated to be 1.0 m. Considering that the ZOI is primarily within the property boundary and in areas extends to the existing sidewalk and boulevard, no structure will be affected from the construction dewatering. Furthermore, the ground settlement due to construction dewatering is estimated to be less than 1.0 mm for the sidewalk and is considered geotechnically acceptable. Once the dewatering system ceases operation, additional ground settlement due to construction dewatering is not anticipated.

**Long Term Foundation Drainage Discharge**

With the very dense sandy silt till in the subgrade below the lowest parkade level, long-term foundation drainage discharge will likely be water seepage captured in the perimeter foundation subdrains and underfloor subdrains, which can be considered minimal and would not significantly change the groundwater condition from the proposed development; thus, potential settlement due to long-term foundation drainage discharge is not anticipated.

We trust the above satisfies your requirements. Should you have any further queries, please feel free to contact this office.

Yours truly,
**SOIL ENGINEERS LTD.**

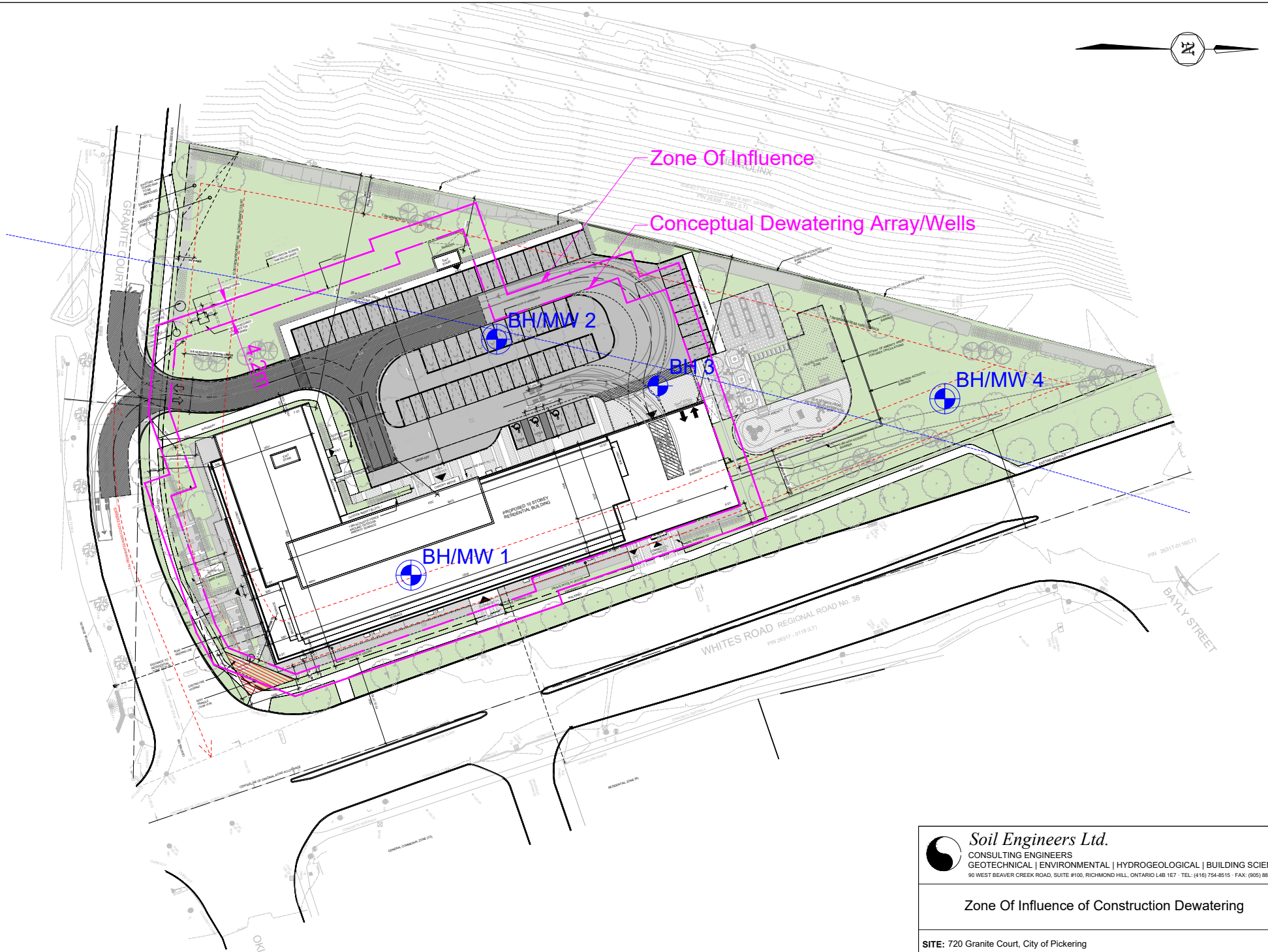
Poh Fung Kwok, M.Sc.

Kin Fung Li, P.Eng.
PK/KL:dd

LICENSED PROFESSIONAL ENGINEER
Sept 11, 2024
K. F. LI
100169280
PROVINCE OF ONTARIO

**ENCLOSURE**

Borehole Location Plan with ZOI of Construction Dewatering.....Drawing No. 1

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# Zone Of Influence of Construction Dewatering

| | | | |
|---|---|---|---|
| **SITE:** 720 Granite Court, City of Pickering | | | |
| **DESIGNED BY:** P.K. | **CHECKED BY:** K.L. | **DWG NO.:** 1 | |
| **SCALE:** 1:1000 | **REF. NO.:** 2111-S043 | **DATE:** September 2024 | **REV** - |