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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

MARCH 2022

DISTRIBUTION

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TABLE OF CONTENTS

TABLES

ENCLOSURES

APPENDICES

1.0 EXECUTIVE SUMMARY

Soil Engineers Ltd. (SEL) has completed a Hydrogeological Assessment for a proposed residential development site, located at 730 Granite Court, in the City of Pickering.

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 content.

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 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 1.4×10^{-8} to 1.9×10^{-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.

Based on a review of the measured groundwater levels and the assumed elevation for the proposed underground parking structure, the shallow groundwater levels are below the considered elevation for the proposed underground parking structure. As such, there will be

no need for construction dewatering for groundwater control, other than the management for any accumulated runoff within the excavation footprint following heavy rainfall events.

The estimated construction dewatering flow rate for installation of the associated underground services is anticipated to reach a daily rate of 2,165.0 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 6,494.9 L/day.

Since the estimated maximum dewatering flow rate is lower than 50,000 L/day where it could reach a maximum daily rate of 6,494.9 L/day, the registering or applying for an EASR, or a PTTW with the MECP as approvals to facilitate any proposed groundwater-taking for construction is not anticipated.

The conceptual zone of influence for any dewatering well or dewatering array used during services installation is approximately 1.5 m away from the conceptual dewatering wells or array around the servicing trenches. 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.

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 use 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.

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 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. Characterize 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 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 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) as groundwater taking approvals to facilitate any temporary construction dewatering or any long-term foundation drainage.

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 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 profile. The Borehole and Monitoring Well Logs are enclosed as Figures 1 to 4, inclusive.

The monitoring wells, consisting of 50 mm diameter PVC riser pipes and screen sections, were installed in the boreholes in accordance with Ontario Regulation (O. Reg.) 903. All 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. 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 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 wells during construction, and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the groundwater bearing formation at the 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 SEL 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, 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 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 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 Duffins 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 content for the retrieved subsoil samples ranged from 5% to 11%, indicating damp to moist conditions. The estimated permeability for the sandy silt till ranges from about 10^{-7} 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 a depth of 8.1 to 10.4 m below the prevailing ground surface at BHs 1 and 2, while BHs 3 and 4 remained dry.

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 in 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	1.9×10^{-7}
BH/MW 2	104.40	9.0	12.3	6.0-9.0	Sandy Silt Till	1.4×10^{-8}
BH/MW 4	103.99	9.0	12.3	6.0-9.0	Sandy Silt Till	6.1×10^{-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 anticipated 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 the subject site. Review of the groundwater table data indicates that shallow groundwater is interpreted to generally flow in south and west directions. The interpreted groundwater flow pattern for 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 soils will range from low to moderate. To provide safe, dry and stable conditions for excavation and construction of 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

A Site Plan, prepared by KNYMH Inc., Project No 20076, Drawing No. SP 1, dated December 20, 2020, was reviewed for this preliminary dewatering needs assessment. Based on a review of the plans, the proposed development will consist of two, 6-storey midrise buildings, with a shared 1-level underground parking structure.

Dewatering Flow Rate Estimates for Construction of Proposed 1-Level Underground Parking Structure

Proposed development plans, showing the finished floor and underground parking slab elevations were not available for our review at the time of this current report preparation. As such, the average of the existing ground surface elevations, as recorded at the BH and BH/MW locations was considered as the finished ground surface grade elevations for this preliminary construction dewatering needs assessment. By considering a finished floor elevation of 104.4 masl, and a 3.0 m depth for the proposed 1-level underground parking structure, a base elevation of 101.4 masl was considered 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 100.4 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 below the considered elevations for the proposed underground parking structure. As such, there will be no need for construction dewatering for groundwater control, other than for the management for any accumulated runoff within the excavation footprint following heavy rainfall events.

Construction Dewatering Flow Rate Estimates for Installation of Underground Services

The proposed invert elevations for installation of underground services were not available for our review at the time of this current report preparation. As such, the lowest underground servicing invert elevation of 99.4 masl was considered, based on an installation depth of 5.0± m beneath the assumed finished floor elevation of 104.4 masl for this current construction dewatering needs assessment. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the shallow groundwater table be lowered to an elevation of 98.4 masl, which is about 1.0 m below the lowest considered excavation depth. The highest, shallow groundwater level 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. As such, the estimated construction dewatering flow rate is anticipated to reach a daily rate of 2,165.0 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 6,494.9 L/day. It should be noted that an active dewatering array for an open servicing trench length of 25 m was considered for this assessment.

In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), where the dewatering flow rate is lower than 50,000 L/day, there is no need to register for a proposed groundwater-taking approval for construction, by means of the filing an Environmental Activity and Sector Registry (EASR), or through a Permit-To-Take water (PTTW) application with the MECP. Since the estimated maximum dewatering flow rate is lower than 50,000 L/day where it could reach a maximum daily rate of 6,494.9 L/day, the registering or applying for an EASR, or a PTTW with the MECP as approvals to facilitate any proposed temporary groundwater-taking for construction is not anticipated. There may be a need to remove temporary runoff accumulation within construction excavations, and/or servicing trenches follow high rainfall events. It is anticipated that any management for the removal of any accumulated runoff within excavations can be accomplished without the need for an EASR.

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 and updated, once finalized development plans, showing the proposed finished floor and underground structure invert elevations and dimensions become available for review, and/or if there are any significant differences between the above considered

assumptions and the final finished floor and servicing depth elevations for the proposed development.

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. 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 used during services installation is approximately 1.5 m away from the conceptual dewatering wells or array around the servicing trenches. 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 1.5 m away from the conceptual dewatering wells/array considered for installation of the underground services. 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 for construction. As such no long-term impacts to groundwater function of the subject site are anticipated.

7.5 Ground Settlement

Potential ground settlement to existing structures associated with temporary construction dewatering should be assessed by a geotechnical engineer prior to earthworks and construction.

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 1.4×10^{-8} to 1.9×10^{-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 a review of the measured groundwater levels, and the considered elevation for the proposed underground parking structure, the shallow groundwater levels are below the considered elevations for the proposed underground parking structure. As such, there will be no need for construction dewatering for groundwater control, other than the management for any accumulated runoff within the excavation footprint areas following heavy rainfall events.
8. The estimated construction dewatering flow rate for installation of the underground services is anticipated to reach a daily rate of 2,165.0 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 6,494.9 L/day.
9. Since the estimated maximum dewatering flow rate is lower than 50,000 L/day, where it could reach a maximum daily rate of 6,494.9 L/day, the registering or applying for an EASR, or a PTTW with the MECP as approvals to facilitate any proposed groundwater-taking for construction is not anticipated.

10. The conceptual zone of influence for any dewatering well or dewatering array used during services installation is approximately 1.5 m away from the conceptual dewatering wells or array around the servicing trenches. 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.

Yours Truly,
SOIL ENGINEERS LTD.

Vivian Yu, B.Sc.

Gavin O'Brien, M.Sc., P.Geo.
VY/GO:dd

9.0 REFERENCES

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FIGURES 1 TO 5

BOREHOLE LOGS AND GRAIN SIZE DISTRIBUTION GRAPHS

REFERENCE 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** Installed 50 mm Ø monitoring well to 9.0 m 3.1 m slotted screen from 5.9 m to 9.0 m Sand backfill from 5.5 to 9.0 m Bentonite seal from 0.0 m to 5.5 m Provided with a monument steel casing				10			
					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

JOB NO.: 2111-W043

LOG OF BOREHOLE: BH/MW 2

FIGURE NO.: 2

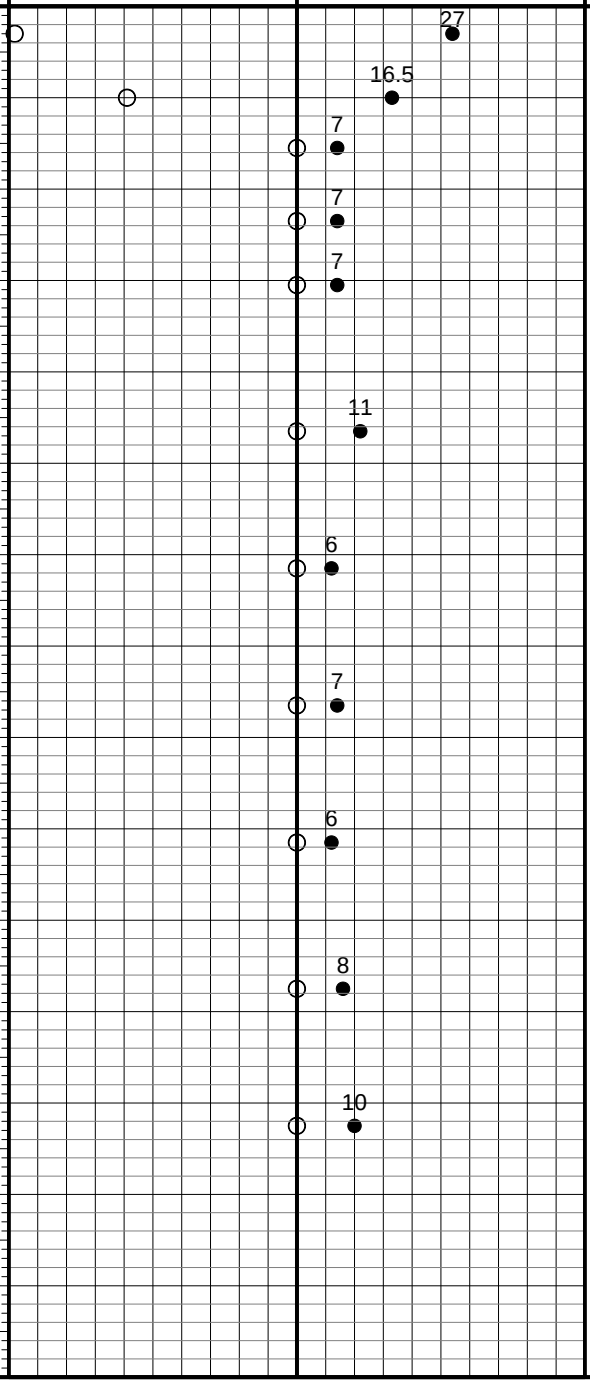
PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

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



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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		11	DO	50/3	9		6	
12.3	**END OF BOREHOLE**				10			
					11			
					12			
					13			
					14			
					15			

Dry upon completion

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)	Dynamic Cone (blows/30 cm) / Shear Strength (kN/m²) / Penetration Resistance (blows/30 cm)	Atterberg Limits PL LL / Moisture Content (%)	WATER LEVEL
104.0	Ground Surface							
0.3	**25 cm TOPSOIL**	1	DO	12	0		21	
	Very dense — weathered **SANDY SILT TILL** a trace of gravel occ. silty clay layers, cobbles and boulders	2	DO	79/8	1		10	
		3	DO	50/4	2		7	
		4	DO	50/4	3		7	
		5	DO	50/4	4		6	
	— — brown grey	6	DO	50/3	5		6	
		7	DO	50/3	6		5	
		8	DO	50/2	7		6	
		9	DO	50/2	8		5	
		10	DO	50/4	9		6	
91.7		11	DO	50/4	10		5	
12.3	**END OF BOREHOEL** Installed 50 mm Ø monitoring well to 9.0 m 3.1 m slotted screen from 5.9 m to 9.0 m Sand backfill from 5.5 to 9.0 m Bentonite seal from 0.0 m to 5.5 m 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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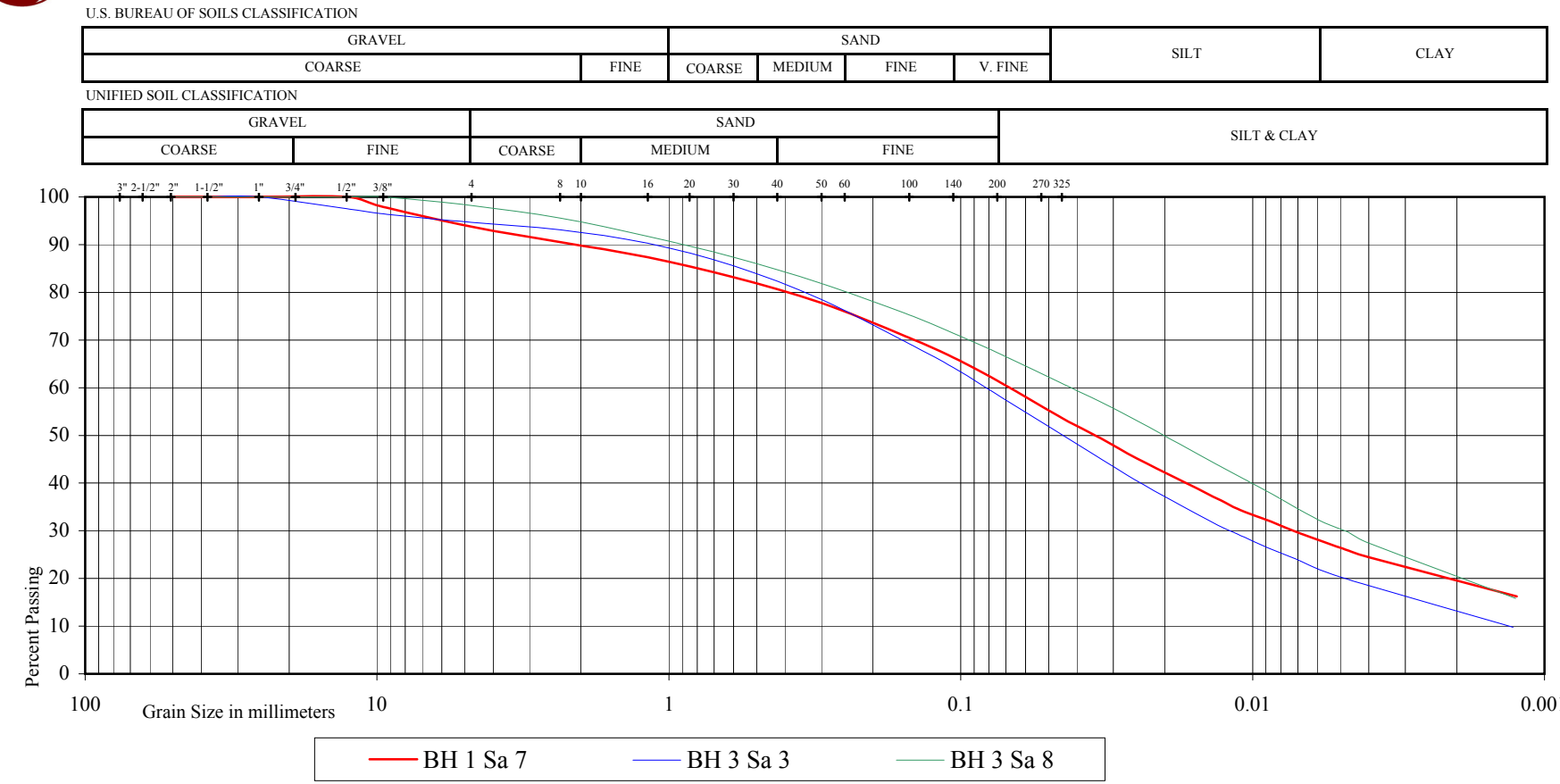
GRAIN SIZE DISTRIBUTION

Reference No: 2111-W043



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

REFERENCE 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

Source: Ontario Ministry of Natural Resources and Forestry

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

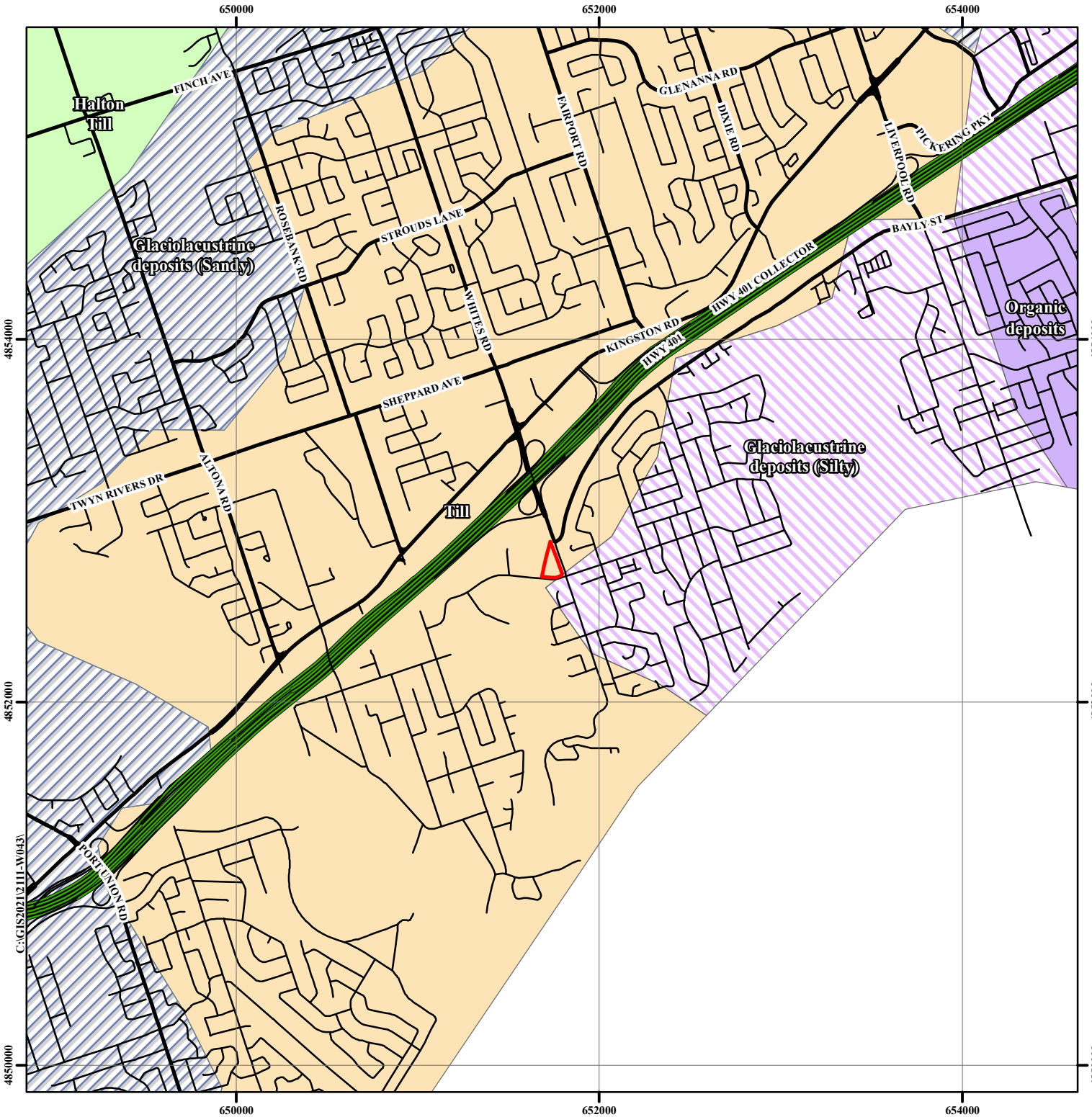
Date: January 19, 2022

Scale:

0 25 50 100 150 200 250

Metres

Drawing No. 3



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

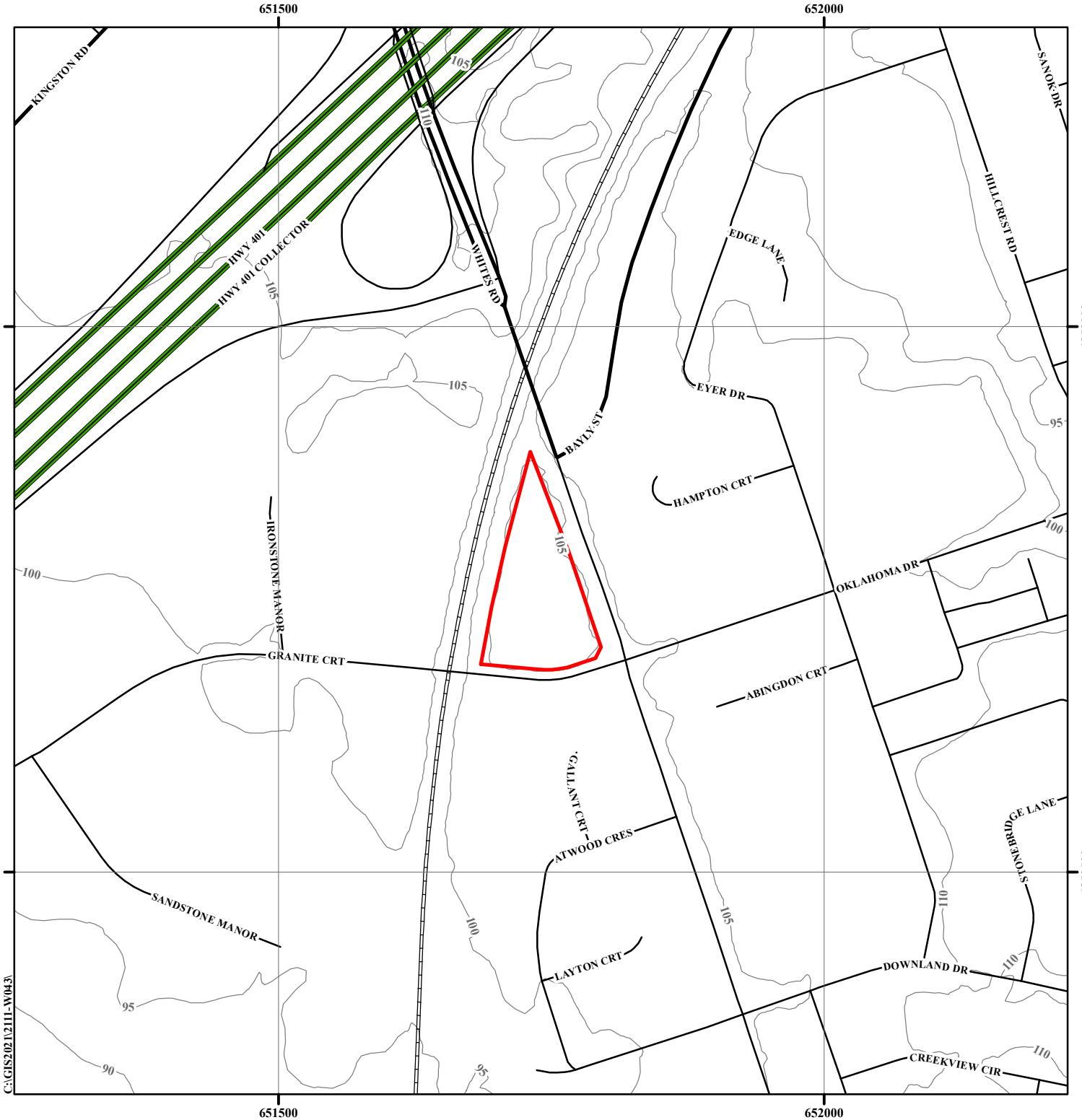
Date: January 19, 2022

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

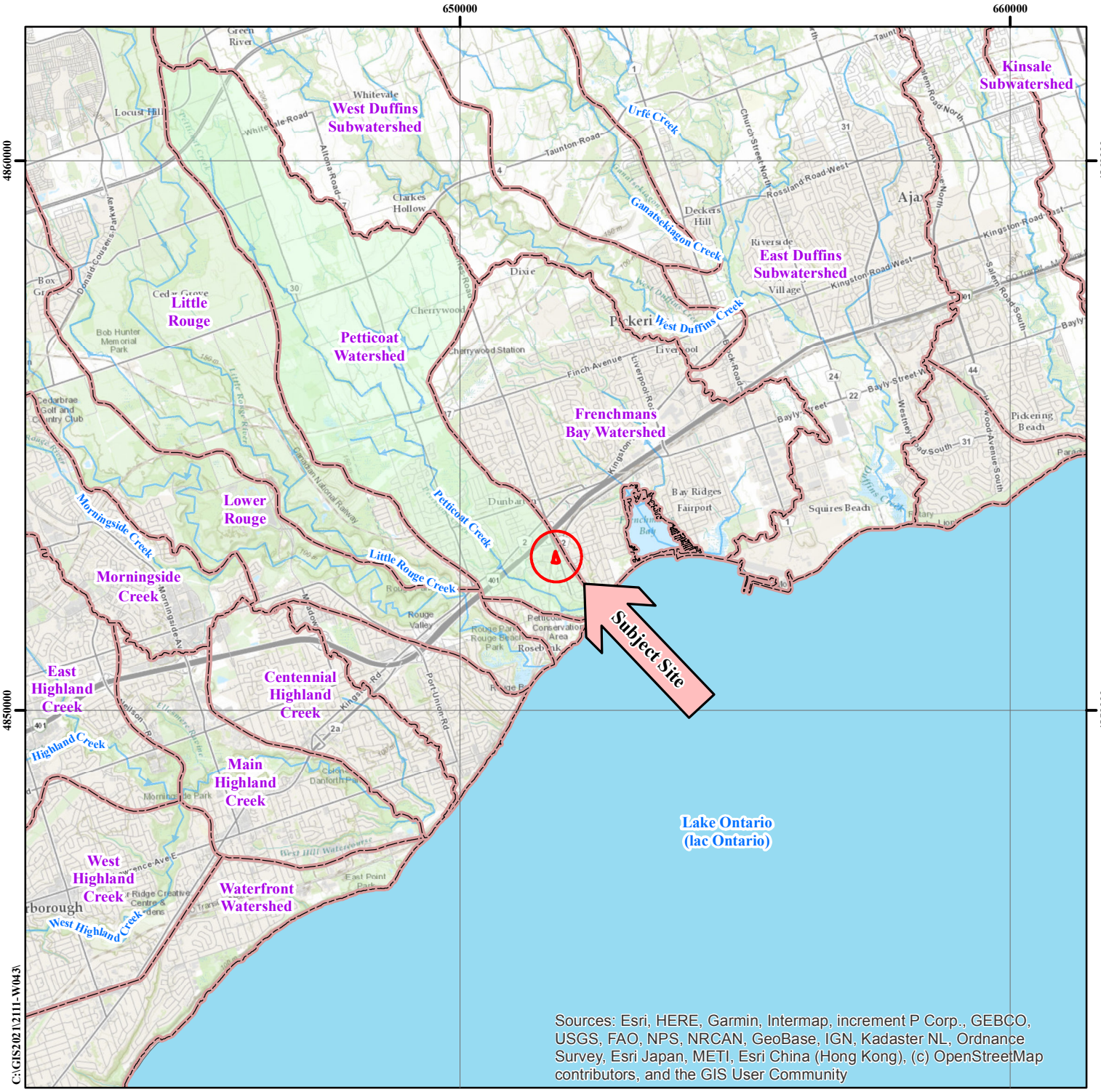
Project:
Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

Date: January 19, 2022

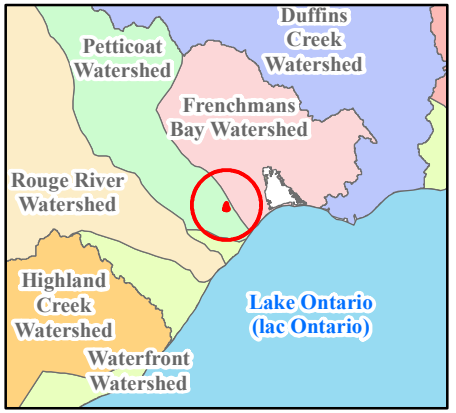
Scale:
0 25 50 100 150 200 250
Metres

Drawing No. 5



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:

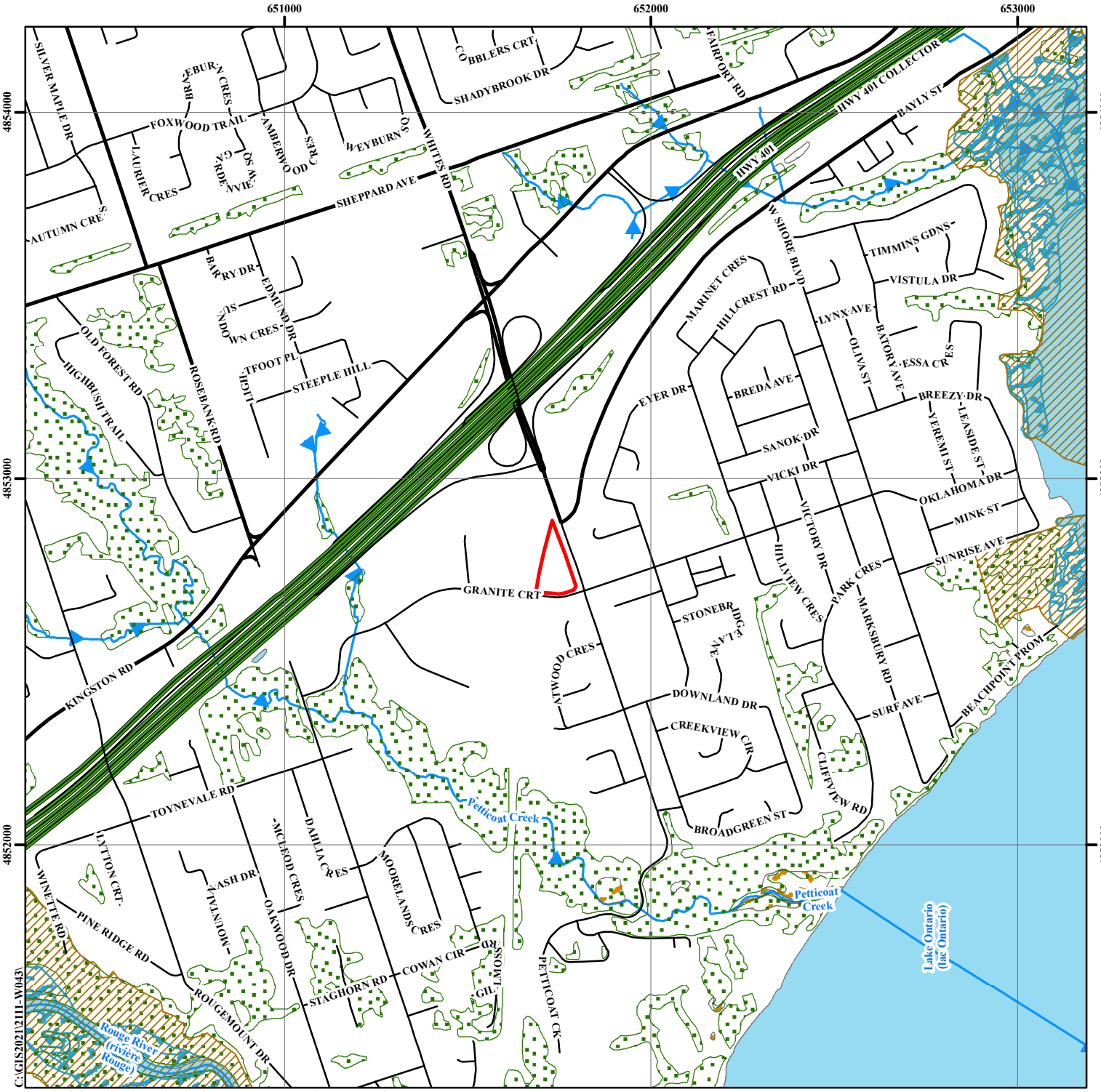
0 1,000 2,000 3,000 4,000 5,000

Metres

Drawing No. 6

C:\GIS2021\2111-W043\

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, 2021.
Includes information: Provincial Park, Conservation Reserve, Area of Natural and Scientific Interest, Wetland, Niagara Escarpment Protection Area, Oak Ridges Moraine Conservation and Wilderness Areas

N

- Approximate Boundary of Subject Site
- Area of Natural and Scientific Interest (ANSI)
- Wetland (classified as Provincial)
- Wetland (Not evaluated per OWES)
- Wooded Area
- Waterbody
- Watercourse
- Expressway/Freeway
- Major Road
- Local Road

Soil Engineers Ltd.

Title: Natural Features and Protection Area Plan

Project:

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

Reference No. 2111-W043

Date: January 19, 2022

Scale:

0 100 200 300 400 500

Metres

Drawing No. 7

Source: Ontario Ministry of Natural Resources and Forestry
© Queen's Printer for Ontario, 2021
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

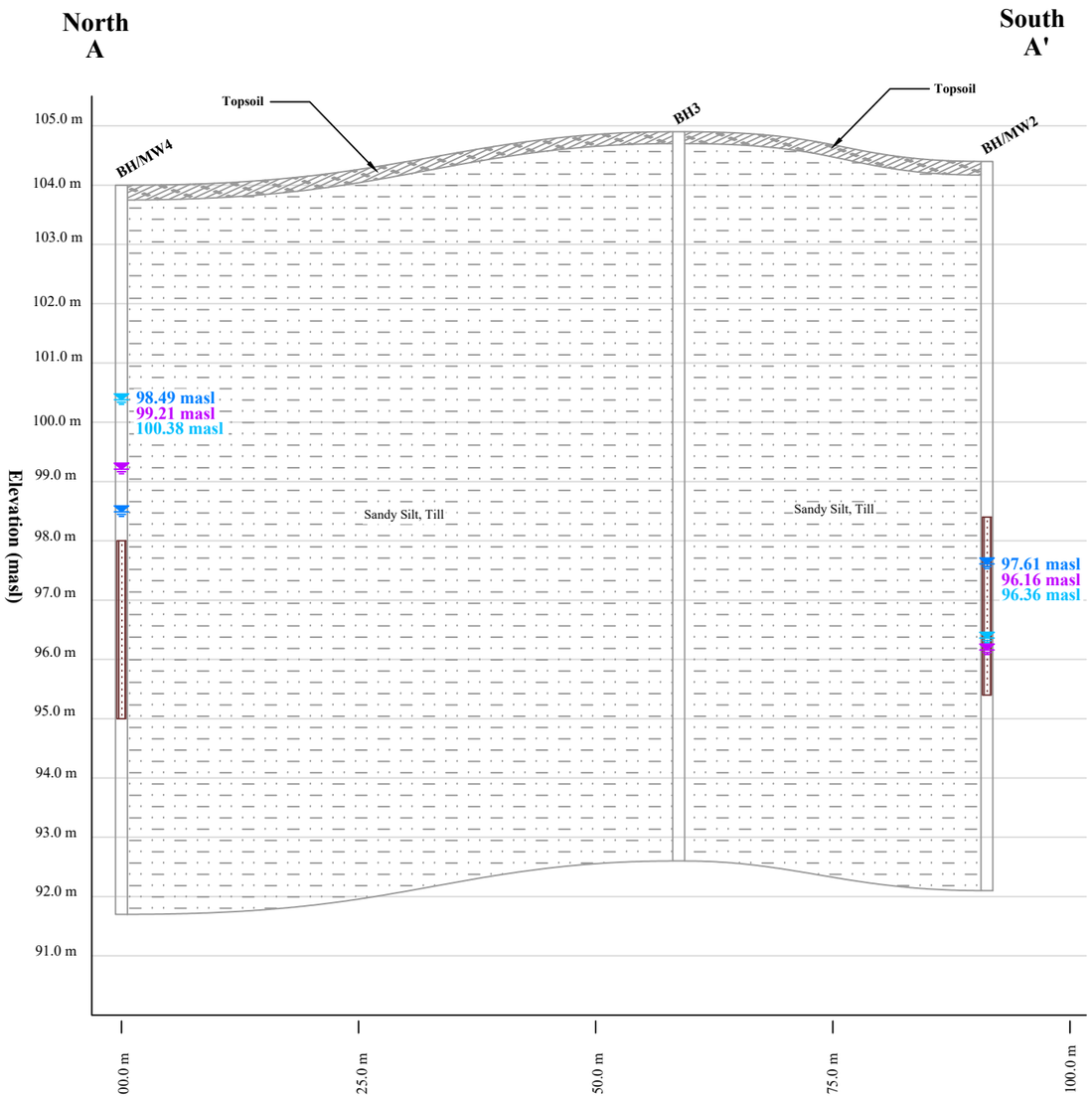
Date: March 1, 2022

Scale:

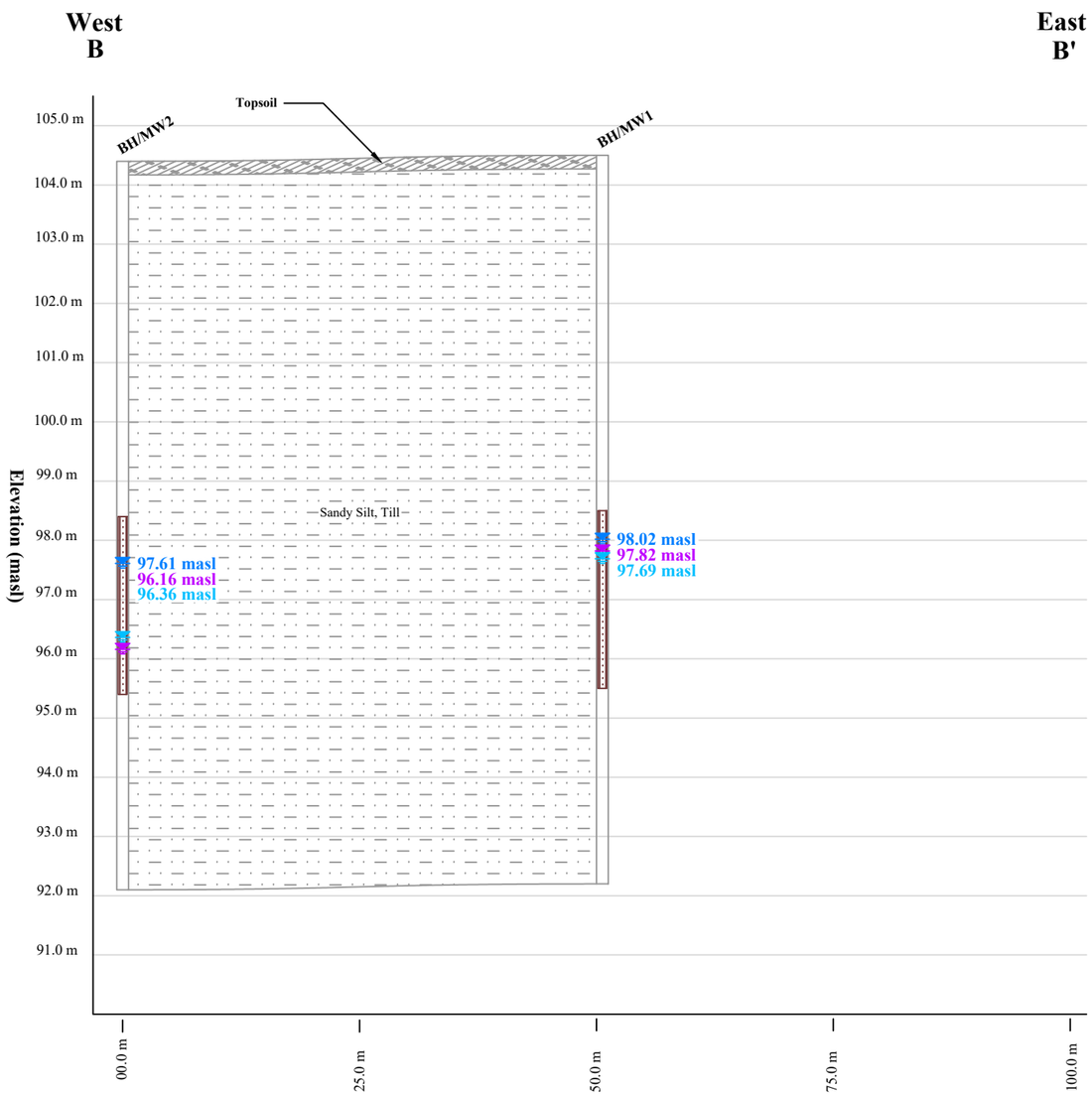
0 5 10 20 30 40 50

Metres

Drawing No. 8-1



Section A-A'



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

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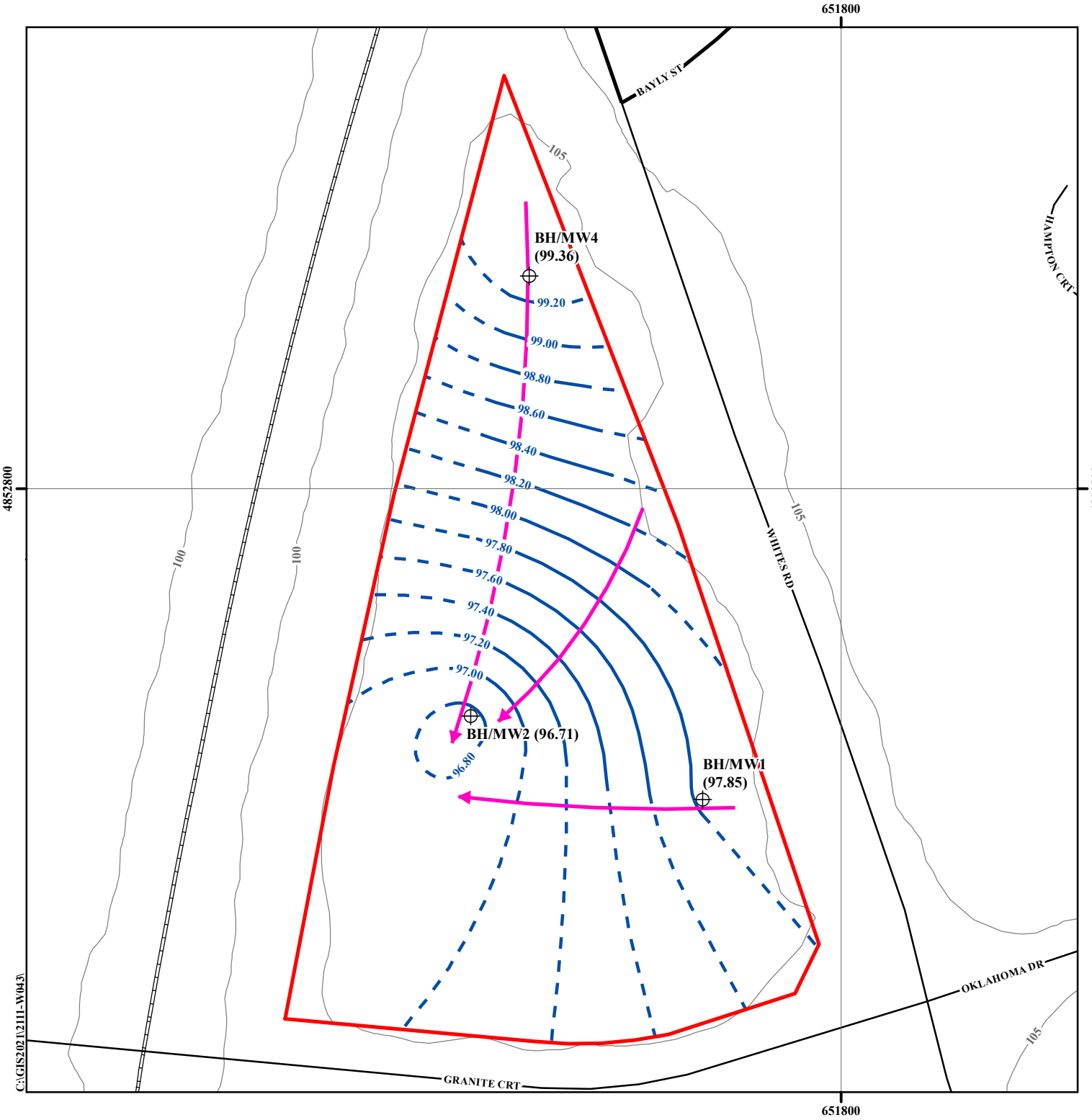
Title:	Geological Cross-Section (A-A' and B-B')
Project:	Hydrogeological Assessment Proposed Mid-Rise Residential Development 720 Granite Court, City of Pickering

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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APPENDIX 'A'

MECP WATER WELL RECORDS SUMMARY

REFERENCE 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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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 'B'

SINGLE WELL RESPONSE TEST RESULTS

REFERENCE 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**	

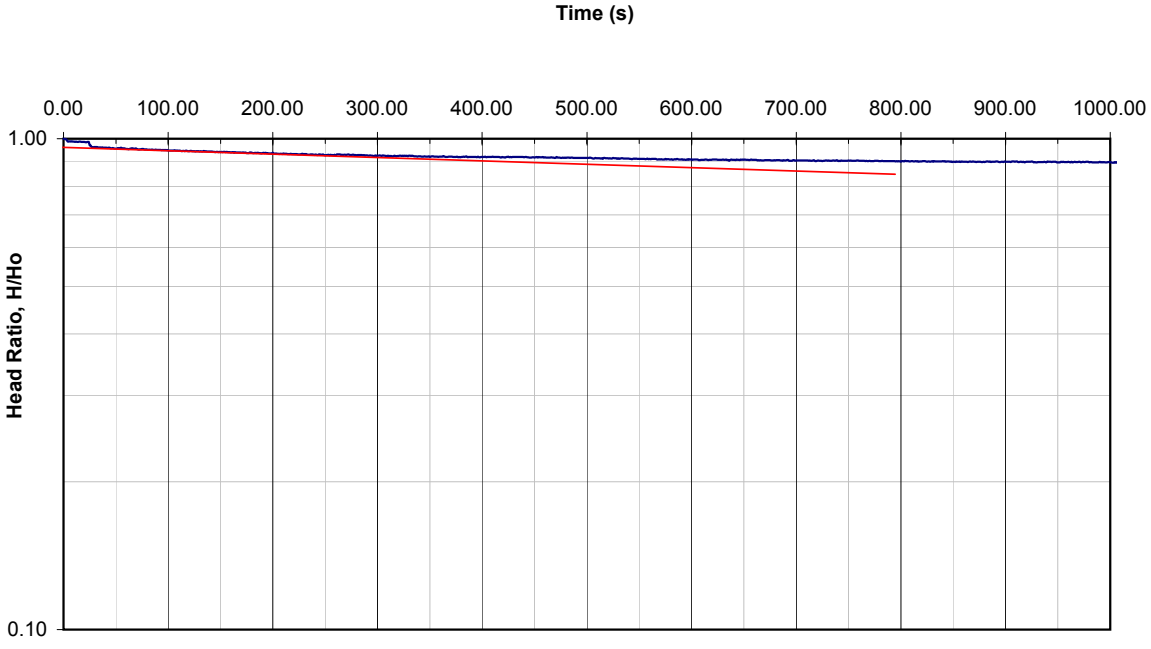
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

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**	

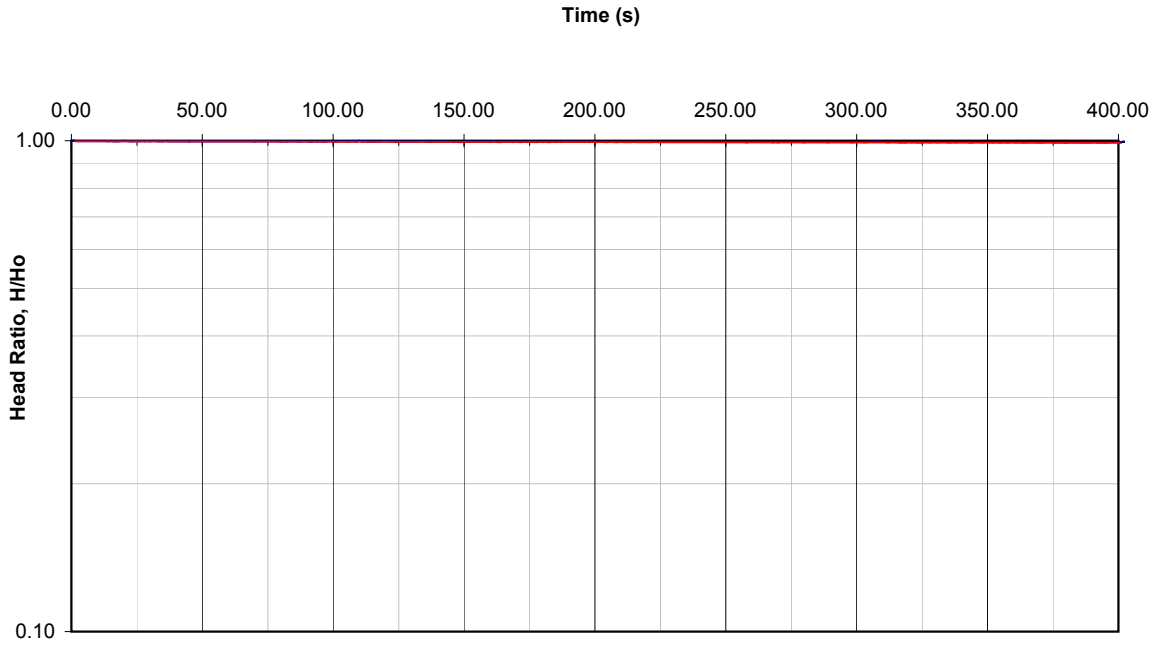
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

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