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A REPORT TO
RHEMM PROPERTIES LTD.

HYDROGEOLOGICAL STUDY FOR PROPOSED RESIDENTIAL DEVELOPMENT

372 GREY ROAD 21 WEST

TOWN OF BLUE MOUNTAIN

REFERENCE NO. 2201-W051B

JULY 23, 2025

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1.0 EXECUTIVE SUMMARY

Soil Engineers Ltd. has conducted a hydrogeological assessment for the proposed residential development, located at 372 Grey Road 21 West in the Town of Blue Mountain.

According to the Conceptual Site Plan (Project: 372 Grey Road 21-West) drawing no. SP-2, job number ET12105-1, prepared by Envision Tatham, dated August 18, 2021, the proposed development will consist of residential dwellings, with accessible driveways and municipal services.

The subject site lies within the Physiographic Region of Southern Ontario, known as the Simcoe Lowlands, on the former beaches and sand plains physiographic feature.

The underlying bedrock is comprised mainly of shale, limestone, dolostone, and siltstone of the Georgian Bay Formation, Blue Mountain Formation, Billings Formation, Collingwood Member and Eastview Member, which were deposited during the Upper Ordovician Epoch (Bedrock Geology of Ontario, 1993). Based on the filed investigation the bedrock was inferred at depths, ranging between 0.6 mbgs and 3.4 mbgs or at elevations, ranging between 180.8 masl and 184.4 masl.

A review of the elevations recorded at borehole locations shows that the site exhibits an undulating topography where the subject site generally declines in elevation relief, towards west, the total elevation relief across the site is approximately 2.0 m. A review of the topographic map for the site and surrounding area indicates that the surrounding area shows decline in elevation relief towards the north. Suggesting that the surface runoff flows, resulting from precipitation will be towards north, draining into Georgian Bay.

The subject site is located within the South Georgian Bay Shoreline Watershed.

The review of the records reveals that the subject site is located within Niagara Escarpment area classified as recreation area. The subject site is surrounded by wooded areas, where the majority of the subject site is covered by wooded areas as well. Two (2) watercourses which appear to be traversing through the subject site, where one watercourse traverses through northwest corner of the subject site and the other appears to be located along the northern boundary of the site, where both the watercourses appear to be flowing northly, before merging together, within northern limits the site. A closest water body, Georgian Bay, is located, approximately 330 m north of the subject site. This wetland feature, which has not been evaluated as being Provincial Significant can be found scattered within the northern portions of the subject site. This wetland feature, which has not been evaluated as being

Provincial Significant as per OWES appears to be emerging from within the northern portions of the site where it extends, approximately 1,300 m to the east.

This study has disclosed that beneath a veneer of topsoil, the subject site is underlain by native sand and gravel subsoils stratum bedding onto bedrock.

The recorded groundwater levels beneath site range, from between from the depths of 0.44 m and 3.01 m below ground surface, or at elevations, ranging between 181.20 masl and 184.60 masl. The K estimates for the saturated subsoil is1.8×10^{-6} m/sec for the native overburden subsoils at the screened depth intervals for the monitoring wells constructed beneath the site. The K estimates for the sand and gravel subsoil sample using Hazen's Equation estimation method, retrieved from the depth of 2.3 m at BH/MW 12 location is 1.21×10^{-4} m/sec.

The estimated construction dewatering flow rates to facilitate excavation for the proposed underground housing basement structures could reach a daily maximum rate of 23,298.25 L/day (with 3x safety factor). In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is below the EASR threshold limit of 50,000 L/day, whereby an Environmental Activity and Sector Registry (EASR) would not be required as an approval to facilitate groundwater takings for a temporary construction dewatering program to facilitate groundwater control during construction.

The estimated construction dewatering flow rates to facilitate excavation for the proposed underground servicing could reach a daily maximum rate of 20,335.9 L/day (with a 3x safety factor). In accordance with the current policy from the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is below the EASR threshold limit of 50,000 L/day, whereby an Environmental Activity and Sector Registry (EASR) would not be required as an approval to facilitate groundwater takings for a temporary construction dewatering program for groundwater control.

The zone of influence for any conceptual temporary dewatering wells or dewatering array used during construction for the proposed housing basement structure construction and or underground services installation could reach a maximum of 22.3 m away from the dewatering array or sump pit wells. Based on the records review, there are two (2) records (MECP Well Id: 2507059 and 2507060) for private water supply wells, wooded areas, watercourses or wetlands which are present within the conceptual zone of influence for any temporary construction dewatering. Also, the subject site is located in partially developed area, which is bordered by existing residential buildings and the Georgian Trail which could

potentially be affected by ground settlement associated with the conceptual zone of influence for any temporary construction dewatering.

Due to the presence underlying saturated sand and gravel deposits, some long-term permanent foundation drainage system is anticipated for the proposed housing basement structures that are being proposed below the groundwater table. The permanent dewatering flow rates will be calculated once the final design drawings become available for our review.

The native surficial subsoil beneath the subject consists mainly of moderate to high (sand and gravel) and low (porous bedrock) permeable material. Opportunities may exist to infiltrate collected runoff at the developed site to the subsurface, using appropriate Low Impact Development Infrastructure (LID), such as infiltration galleries, or underground storage/exfiltration tanks. The groundwater levels lie at depths, ranging between 0.44 and 3.01 m below ground surface. Potential LID infrastructure could be implemented in areas where the shallow groundwater is deeper than 1 m below the ground surface, and where it is possible to maintain a minimum of a 1 m separation between the base for any proposed LID stormwater management infiltration infrastructure and the high groundwater table. Any proposed LID infrastructure should be designed by the storm water engineer for the project.

2.0 INTRODUCTION

2.1 Project Description

In accordance with the authorization from Mr. John Rodgers of Rhemm Properties Ltd., Soil Engineers Ltd. (SEL) has conducted a hydrogeological study for a proposed residential development, located at 372 Grey Road 21 West in the Town of Blue Mountain. The location of the subject site is shown on Drawing No. 1.

According to the Conceptual Site Plan (Project: 372 Grey Road 21-West) drawing no. SP-2, job number ET12105-1, prepared by Envision Tatham, dated August 18, 2021, the proposed development will consist of residential dwellings, with accessible driveways and municipal services.

The subject site is located within a partially developed area, where the surrounding land uses includes; a wooded areas to the east, south, and west and residential dwellings and the Georgian Trail to the north. At the time of investigation, the subject site was primarily covered with woods.

This report summarizes the findings of the field study and the associated groundwater monitoring and hydraulic testing, and provides a description and characterization of the interpreted hydro-geo-stratigraphy for the subject site, and the local surrounding area. The current study provides recommendations, addressing any construction dewatering needs, prior to detailed design. Furthermore, the report provides a recommendation for any need to acquire an Environmental Activity and Sector Registry (EASR), or a Permit-To-Take Water (PTTW) as an approval to facilitate temporary groundwater takings for a construction dewatering program.

2.2 Project Objectives

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

1. Establishing the local hydrogeological setting for the site and the local surrounding areas;
2. Interpretation of the shallow groundwater flow and runoff patterns;
3. Identify zones of higher groundwater yield as potential sources for any ongoing shallow groundwater seepage;
4. Characterizing the hydraulic conductivity (K) for the groundwater-bearing sub soil strata;

5. Preparing an interpreted hydrogeostratigraphic cross-section across the subject site;
6. Estimating any anticipated temporary dewatering flows that may be required to lower the shallow water table to facilitate construction, or for any required long-term foundation drainage needs, following construction;
7. Estimating the anticipated zone of influence associated with any temporary construction dewatering, if required;
8. Evaluating potential impacts from any construction dewatering to any nearby groundwater receptors within the anticipated zone of influence associated with temporary construction dewatering, and to develop preliminary estimates for any dewatering flow rates that may be required to facilitate excavation and construction;
9. Preparation of hydrographs, incorporating the shallow groundwater fluctuation levels and precipitation data from nearby weather station, to assist with any correlation of shallow groundwater levels and local precipitation.
10. Providing comments regarding any need to file for an Environmental Activity and Sector Registry (EASR) approval, or to acquire a Permit-To-Take Water (PTTW) approval to facilitate a construction dewatering program.
11. Commenting on the feasibility of the site to accommodate Low Impact Development Infrastructure at the completed development in support of future stormwater management planning and design.

2.3 **Scope of Work**

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

1. Clearance of underground services, drilling of seven (7) boreholes and installation of five (5) monitoring wells, each within selected boreholes within the site's development footprint;
2. Monitoring well development and groundwater level measurements within the three (3) installed monitoring wells to record the prevailing groundwater levels beneath the subject site;
3. Installation of automated pressure transduce, data logger, for continuous groundwater level monitoring;
4. Performance of Single Well Response Tests (SWRTs) at the monitoring wells to estimate the hydraulic conductivity (K) for the groundwater-bearing subsoil strata at the depths of the monitoring well screens;
5. Reviewing and plotting of Ministry of Environment, Conservation and Parks (MECP) water well records within 500 m of the proposed residential development site;
6. Describing the geological and hydrogeological setting for the subject site, and for the subject site and the local surrounding area;

7. Review of the findings of the previous geotechnical soil investigation; review of any available engineering development plans and profiles for proposed underground services and for the proposed housing basement structures; assessing the preliminary dewatering needs, and estimation of any anticipated dewatering flows to lower the groundwater levels to facilitate construction and earth works, or for any anticipated long-term foundation drainage needs, following construction for the completed development;
8. Review of groundwater receptors in the vicinity of the proposed development site, and providing preliminary recommendations for any monitoring, mitigations and discharge management to safeguard the nearby groundwater receptors from any potential adverse impacts associated with any temporary construction dewatering, and;
9. Preparation of hydrographs to assist with any correlation of shallow groundwater levels and local received precipitation.
10. Providing comments regarding any need to file for an Environmental Activity and Sector Registry (EASR) approval, or to acquire a Permit-To-Take Water (PTTW) to facilitate a temporary construction dewatering program.

3.0 METHODOLOGY

3.1 Borehole Advancement and Monitoring Well Installation

Borehole drilling and monitoring well construction were conducted on April 18, 2022. The field program consisted of the drilling of seven (7) boreholes (BH) and the installation of five (5) monitoring wells (MW), one within each of five (5) selected boreholes at the time of the borehole drilling. The locations of the boreholes/monitoring wells are shown on Drawing No. 2.

Borehole drilling and monitoring well installations were completed by DBW Drilling, a licensed water well contractor, under the full-time supervision of a geotechnical technician from SEL, who also logged the subsoil strata, encountered during borehole advancement and collected representative subsoil samples for textural classification. The boreholes were drilled using continuous flight power augers. Detailed descriptions of the encountered subsurface soil, bedrock and groundwater conditions are presented on the borehole and monitoring well logs, on the enclosed Figures 1 to 8, inclusive.

The monitoring wells were constructed, using 50-mm diameter PVC riser pipes and screens, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. All of the monitoring wells were provided with steel, flush mount protective casings at the ground surface. The details for the monitoring well construction are provided on the enclosed Borehole Logs (Figures 1 to 8, inclusive).

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

Table 3-1 - Monitoring Well Installation Details

Well ID	Installation Date	UTM Coordinates		Ground El. (masl)	Monitoring Well Depth (mbgs)	Screen Interval (mbgs)	Casing Diameter (mm)
		East (m)	North (m)				
BH/MW 5	April 18, 2022	555032.6	4929756.6	183.69	1.4	0.8-1.4	50
BH/MW 7	April 18, 2022	555131.9	4929715.5	184.17	1.6	1.0-1.6	50
BH/MW 9	April 18, 2022	555227.4	4929651.9	185.26	1.5	0.9-1.5	50
BH/MW 10	April 18, 2022	555052.3	4929693.6	185.57	1.2	0.6-1.2	50

BH/MW 12	April 18, 2022	555131.9	4929715.5	184.21	3.4	1.9-3.4	50

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

3.2 Groundwater Monitoring

The groundwater levels within the monitoring wells were manually measured on three (3) occasions on April 27, May 27 and on June 28, 2023 to record the stabilized groundwater levels beneath the subject site. Also, BH/MW 7 was instrumented with a data logger for continuous groundwater level monitoring over the above-mentioned monitoring period.

3.3 Mapping of Ontario Water Well Records

SEL reviewed the MECP Water Well Records (WWRs) for registered wells located on the subject site, and within 500 m of the subject site boundaries (study area). The records indicate that ninety-five (95) registered wells are located within the study area relative to the subject site boundaries. The well record locations are shown on Drawing No. 7, and the WWRs reviewed for this study are listed in Appendix 'A'.

3.4 Monitoring Well Development and Single Well Response Tests

Only BH/MW 7, underwent well development in preparation for single well response testing (SWRT) to estimate the hydraulic conductivity (K) for the saturated subsoil strata, encountered at the depths of the monitoring well screens. Attempts were made to preform SWRT within the remaining monitoring wells. However due to low water columns within the monitoring wells, attempts to complete the SWRT were unsuccessful. Monitoring well development involved the purging and removal of 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 for the subsoil strata formation at the monitoring well screen depths.

An SWRT is used to estimate the hydraulic conductivity (K) for the groundwater-bearing subsoil strata at the depths of the monitoring well screens. The K estimates provide an indication of the 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 monitoring well, below the water table, to displace the groundwater level upward. The rate at which the

groundwater level recovers to static conditions (falling head) is tracked using either a data logger/pressure transducer, and/or manually, using a water level tape. The rate at which the groundwater table recovers to static conditions is used to estimate the K values for the groundwater-bearing subsoil strata formation at the monitoring well screen depths. BH/MW 7 underwent SWRT on May 27, 2022, with the results being provided in Appendix 'B', and a summary of the findings being provided in Table 6-2.

Also, the Hazen Equation method was adopted to estimate the hydraulic conductivity (K) for the selected subsoil samples. The details are provided in Section 6.6.

3.6 **Review Summary of Previous Report**

The following report, prepared by SEL was reviewed for the preparation of this hydrogeological study:

"A Report to RHEMM Properties Ltd., A Geotechnical Investigation for Proposed Residential Development'', Reference No. 2201-S051B, June 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 Simcoe Lowlands, on the beaches and sand plains physiographic feature. The Simcoe Lowlands covers an area of approximately 2,850 square kilometers, which lies at elevations, ranging between El. 177 masl and El. 259 masl. The area was flooded by a former glacial Lake Algonquin and is bordered by shore cliffs, beaches, and boulder terraces. As such, the area is floored by sand, silt, and clay (Chapman and Putnam, 1984). Drawing No. 4, as reproduced from Ontario Geological Survey (OGS) mapping, illustrates the physiography for the subject site and the local surrounding areas.

Based on a review of a surface geological mapping for Southern Ontario, the subject site is underlain by Paleozoic Bedrock, being coarse textured glaciolacustrine littoral foreshore and foreshore-basin deposits. Drawing No. 3, reproduced from Ontario Geological Survey (OGS) mapping, illustrates the Quaternary surface soil geology for the subject site and surrounding areas.

The underlying bedrock is comprised mainly of shale, limestone, dolostone, and siltstone of the Georgian Bay Formation, Blue Mountain Formation, Billings Formation, Collingwood Member and Eastview Member, which were deposited during the Upper Ordovician Epoch (Bedrock Geology of Ontario, 1993). Based on the filed investigation the bedrock was inferred at depths ranging between 0.6 mbgs and 3.4 mbgs or at elevations, ranging between 180.8 masl and 184.4 masl.

4.2 Physical Topography

A review of the elevations recorded at borehole locations shows that the subject site exhibits an undulating topography where it generally declining towards west. The total elevation relief across the site is approximately 2.0 m. A review of the topographic map for the site and the local surrounding area indicates that the surrounding area shows decline in elevation relief towards the north. Suggesting that the surface runoff flows, resulting from precipitation will be towards north, draining into Georgian Bay. Drawing No. 5 shows the mapped topographical contours for the subject site, and the local surrounding area.

4.3 Watershed Setting

The subject site is located within the South Georgian Bay Shoreline Watershed. The shoreline watershed drains an approximate area of 150 km^2. The Southwest Georgian Bay Watershed drains into Georgian Bay, via various local creeks and tributaries along with two major creeks, identified as Indian Brook, Black Ash Creek and Silver Creek. The eastern boundary of the sub-watershed is situated near the boundary of the Blue Mountain Sub-watershed; the aforementioned watershed is located within the shoreline watershed which drains into the Georgian Bay.

4.4 Local Surface Water and Natural Features

The review of the local records reveals that the subject site is located within Niagara Escarpment area classified as recreation area. The subject site is surrounded by wooded areas, where the majority of the site is covered with wooded natural areas as well. Two (2) watercourses appear to be traversing through the subject site, where one watercourse traverses through northwest corner of the subject site, and the other appears to be located along the northern boundary of the site, where both the watercourses appear to be flowing northly before merging together, within northern limits the site. The closest water body, Georgian Bay, is located, approximately 330 m north of the subject site. The wetland features, which have not been evaluated as being Provincial Significant can also be found scattered within the northern portion of the subject site. These wetland features, which have been evaluated as being Provincial Significant as per OWES appears to be emerging from within the northern portion of the site where they extending approximately 1300 m east and south of the site.

The locations of the site and the noted natural features are shown on Drawing No. 6.

4.5 Clean Water Act

The MECP mandates the protection of existing and future sources of drinking water under the Clean Water Act, 2006 (CWA). Initiatives under the CWA include the delineation of Wellhead Protection Areas (WHPAs), significant groundwater recharge areas (SGRAs) and Highly Vulnerable Aquifers (HVAs) as well as the assessment for drinking water quality and quantity threats within Source Protection Regions. Source Protection Plans are developed under the CWA, and include the restriction and prohibition of certain types of activities and land uses within WHPAs.

Source Water Protection Information Atlas provided by MECP was reviewed on September

25, 2023. Record review indicates that the Site is partially located within an area designated as HVA having a vulnerability score of 6.0, and also within an area, designated as SGRA having a score of 6.0.

5.0 SOIL LITHOLOGY

This study has disclosed that beneath a veneer of topsoil and earth fill, the subject site is underlain by a sand stratum, bedding onto bedrock. A Key Plan and the interpreted geological cross-sections along the delineated northwest-southeast transects are presented on Drawing No's. 9-1 and 9-2.

5.1 **Topsoil** (All BH/MWs)

A surficial layer of topsoil, having a thickness between 20 cm to 36 cm, was observed at all of the BH/MW locations. Thicker topsoil might be anticipated within places, beyond the borehole locations, especially within the low-lying areas.

5.2 **Sand** (All BH/MWs)

Sand and gravel deposit was contacted within the upper stratigraphy at all the BH/MW locations beneath the topsoil veneer. Sand and Gravel deposit were encountered at depths of between 0.6 and 3.4 m below ground surface. Sand gravel were noted as having trace to some silt with occasional cobbles and boulders, being brown in colour, exhibiting a saturated condition, and a having very loose to very dense in consistency. The natural water contents for the sand and gravel samples range from 4% to 25%, indicating that the sand unit is in a dry to saturated condition.

The grain size analysis performed on the retrieved subsoil samples of sand and gravel at depths of 0.8 and 2.3 m, below ground surface at BH/MWs 5 and 12 locations, respectively, suggest the estimated permeability of the sand sample ranges from 10^{-3} and 10^{-3} cm/sec, respectively. The grain size analysis plots of two (2) subsoil sample of sand and gravel are shown on Figure No. 5.

5.3 **Bedrock** (All BH/MWs)

Rock fragments and refusal to auguring were encountered at all of the borehole locations, at depths of between 0.6 and 3.4 m (or El. 180.8 to 184.4 m). This may infer that limestone bedrock occurs at this level. However, this has not proven by rock coring, which is beyond the scope of this investigation.

6.0 GROUNDWATER STUDY

6.1 Review Summary of Previous Report

A review of the findings from the previous geotechnical soil investigation report (SEL Reference No. 2201-S051B) indicates that beneath a layer of topsoil veneer, the subject site is underlain by a sand and gravel deposits, overlying the bedrock at depths ranging between 0.6 and 3.4 mbgs. Upon completion of borehole drilling, the groundwater was encountered at depths ranging between 0.4 mbgs and 2.4 mbgs.

6.2 Review of Ontario Water Well Records

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

The records indicate that ninety-five (95) wells are located within the study area relative to the subject site. The records review indicates that two (2) water supply wells (MECP Well Id: 2507059 and 2507060) are located within the subject site. The locations for the well records, based on the UTM coordinates provided by the records, are shown on Drawing No. 3. A detailed summary of the MECP WWR's that were reviewed is provided in Appendix 'A'.

A review of the final status of the well records within the study area reveals that eighty-seven (87) are registered as water supply wells, six (6) are registered as Observation Wells, and two (2) are abandoned-supply wells.

A review of the first status of the well records shows that eighty-one (81) are registered as domestic wells, four (4) are registered as monitoring wells, four (4) are registered as commercial wells, three (3) wells are registered as having no status, one is registered as an irrigation well, one (1) is registered as livestock well and one (1) is registered as an other well.

6.3 Groundwater Monitoring

The groundwater levels within the monitoring wells were manually measured, on three (3) occasions, on April 27, May 27 and on June 28, 2023 to record the depths to the static groundwater table beneath the site. The groundwater levels and their corresponding elevations are summarized in Table 6-1.

Table 6-1 - Water Level Measurements

Well ID		April 27, 2022	May 27, 2022	June 28, 2022	Average	Fluctuation (m)*
BH/MW 5	mbgs	0.47	1.10	1.16	0.91	0.69
	masl	183.22	182.59	182.53	182.78	
BH/MW 7	mbgs	0.44	0.71	0.84	0.66	0.40
	masl	183.73	183.46	183.33	183.51	
BH/MW 9	mbgs	0.67	0.95	1.15	0.92	0.48
	masl	184.59	184.31	184.11	184.34	
BH/MW 10	mbgs	0.97	1.14	1.13	1.08	0.17
	masl	184.60	184.43	184.44	184.49	
BH/MW 12	mbgs	2.16	2.97	3.01	2.71	0.85
	masl	182.05	181.24	181.20	181.50	

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

As shown above, the groundwater levels decreased at all the BH/MW locations as recorded during the monitoring period. The greatest fluctuation was observed at BH/MW 12 where the groundwater levels decrease by 0.85 m over the monitoring period. The recorded groundwater levels beneath site range from the depths of between 0.44 m and 3.01 m below ground surface, or at elevations, ranging between 181.20 masl and 184.60 masl.

BH/MW 7 was instrumented with a pressure transducer data logger to record continues groundwater levels beneath the site, with the resultant hydrograph being presented on Figure 1 in Appendix 'C'. The daily precipitation data was also obtained from Collingwood station (Climate 6111792) to show any correlation between shallow groundwater level fluctuations and local precipitation received at the site.

6.4 Shallow Groundwater Flow Pattern

The groundwater flow pattern beneath the site was interpreted from the highest groundwater levels, measured at all BH/MWs, suggesting that in generally, it flows in westerly, northwesterly and southeasterly directions. The interpreted groundwater flow pattern beneath the subject site is illustrated on Drawing No. 8.

6.5 Single Well Response Test Analysis

The BH/MW 7 underwent single well response tests (SWRTs) to estimate the hydraulic conductivity (K) for saturated aquifer subsoils at the depths of the monitoring well screens. The results for the SWRTs 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 7	184.17	1.6	1.6	1.0-1.6	Sand and Gravel	1.8×10^{-6}

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

As shown above, the K estimates is 1.8 x 10^{-6} m/sec for the overburden sand and gravel subsoils. The results of the SWRT provide an indication of the seepage yield capacity for the shallow groundwater-bearing bedrock strata at the depths of the monitoring well screens. The above results suggest that the hydraulic conductivity for the groundwater-bearing subsoils strata at the depths of the well screens is moderate, with correspondingly moderate anticipated groundwater seepage rates in open excavations below the prevailing groundwater table.

6.6 Assessment Hydraulic Conductivity Based on Hazen Equation

The Hazen Equation method was adopted to estimate the hydraulic conductivity (K) for the selected subsoil samples.

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

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

where;

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

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

The Hazen equation estimation method provides an indication of the yield capacity for the groundwater-bearing substrata at the depths where the subsoil samples obtained for grain size analyses were retrieved. The calculation results indicate that the K estimate for the sand and gravel, retrieved from the depth of 2.3 m at BH/MW 12 location is 1.21 x 10^{-4} m/sec. The results for the Hazen equation method, K estimates are provided in Table 6-3 below. The K estimates, determined from the Hazen method suggests a high hydraulic conductivity for the groundwater bearing subsoil layers beneath the subject site.

Table 6-3 - Summary of K Value Estimation

Well ID	Sample ID	Sample Depth (mbgs)	Sample El. (masl)	Soil Strata	Soil Particle Diameter at 10% Passing (mm)	Hydraulic Conductivity (K) (m/sec)
BH/MW 12	BH.12/Sa.4	2.3	181.9	Sand & Gravel	0.11	1.21 x 10^{-04}

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

7.0 GROUNDWATER CONTROL DURING CONSTRUCTION

The estimated hydraulic conductivity (K) values suggest that groundwater seepage rates into open excavation below the groundwater table will range from moderate to high. To provide safe, dry and stable conditions for earthworks excavations for the construction of the proposed housing basements and underground servicing, the groundwater table should be lowered in advance of, or during construction. Preliminary estimates for 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

According to the Conceptual Site Plan (Project: 372 Grey Road 21-West) drawing no. SP-2, job number ET12105-1, prepared by Envision Tatham, dated August 18, 2021, the proposed development will consist of residential dwellings, with accessible driveways and municipal services.

During the preparation of this report, lot area and basement structure dimensions for the proposed housing dwelling were not available. As such dimensions for single detached housing basement structure were considered at 10 x 20 m for current dewatering needs assessment. For the current dewatering needs assessment, detailed drawings, showing Finished Floor Elevation (FFE) were not available, hence the elevations recorded at BH/MW locations were considered as the FFE. Also, as confirmed by the client the proposed housing basement structures will not extend into the bedrock. The construction dewatering flows were estimated and completed for the proposed underground, housing basement structures, with the details presented as follows:

Construction Dewatering Needs Estimation for Construction of the Underground Basement Structure at a base elevation of 182.09 masl (Lot 1):

The base elevation of 182.09 (inferred bedrock depth) was considered for the construction dewatering needs assessment for the underground basement structure. To maintain a dry and safe excavation it is recommended that the groundwater table be lowered for underground basement structure to an elevation of 182.09 masl, where the bedrock was inferred during soil investigation. The highest shallow groundwater levels, recorded at the installed BH/MW in the vicinity of Lot 1, and the highest calculated estimated hydraulic conductivity was used for the current dewatering needs assessment. The highest shallow groundwater level of 183.22 masl (recorded at BH/MW 5) and highest calculated hydraulic conductivity estimate of 1.8×10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering needs

estimations. The highest shallow groundwater level is 1.13 m above the proposed slab elevation for the proposed underground housing basement structure. The subsoil profile consists of topsoil, sand and gravel and the underlying bedrock, extending to the maximum anticipated excavation depths. For the dewatering flow assessment for a rectangular excavation, having the dimensions of approximately 10 m in width and 20 m in length, having an estimated perimeter of 60 m were considered for this preliminary construction dewatering needs assessment. Considering the above-mentioned parameters, the estimated construction dewatering flow rate to facilitate excavation for the proposed underground basement structure could reach a daily rate of 4,938.1 L/day; by applying a safety factor of 3x, it could reach a maximum rate of 14,814.3 L/day. The estimated zone of influence could extend to a maximum of 8.6 m away from the conceptual dewatering alignment, being considered around the excavation footprint area.

Apart from the above estimated dewatering flow rates, the dewatering system should also account for a typical storm event. A typical 2-year 3-hour storm event was considered to calculate the surface flow runoff accumulation resulting from such event. The dewatering rate for above mentioned storm event could generate 5,708.0 L/day following a heavy rainfall event. Hence, total dewatering flow rates of 20,522.29 L/day are anticipated for the construction of underground basement structure.

Construction Dewatering Needs Estimation for Construction of the Underground Basement Structure at a base elevation of 182.57 masl (Lot 37):

The base elevation of 182.57 masl (inferred bedrock depth) was considered for the construction dewatering needs assessment for the underground basement structure. To maintain a dry and safe excavation it is recommended that the groundwater table be lowered to underground structure base elevation of 182.57 masl, where the top of bedrock was inferred during soil investigation. The highest shallow groundwater levels, recorded at the installed BH/MW in the vicinity of lot 37, and the highest calculated estimated hydraulic conductivity were used for the current dewatering need assessment. The highest shallow groundwater level of 183.73 masl (recorded at BH/MW 7) and highest calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering estimations. The highest shallow groundwater level is 1.16 m above the proposed slab elevation for the proposed underground housing basement structure. The subsoil profile consists of topsoil, sand and gravel and underlying bedrock, extending to the maximum anticipated excavation depths. For the dewatering needs assessment for a rectangular excavation, having the dimensions of approximately 10 m in width and 20 m in length, and having an estimated perimeter of 60 m were considered for this preliminary construction dewatering needs assessment. Considering the above-mentioned parameters,

the estimated construction dewatering flow rate to facilitate excavation for the proposed underground housing basement structure could reach a daily rate of 5,007.6 L/day; by applying 3x safety factor, it could reach a maximum rate of 15,022.9 L/day. The estimated zone of influence could extend to a maximum of 8.7 m away from the conceptual dewatering alignment, being considered around the excavation footprint area.

Apart from the above estimated dewatering flow rates, the dewatering system should also account for a typical storm event. A typical 2-year 3-hour storm event was considered to calculate the surface flow runoff accumulation rate, resulting from such event. The dewatering rate for above mentioned storm event could generate 5,708.0 L/day following an intense storm. Hence, total dewatering flow rates of 20,730.94 L/day are anticipated for the construction of underground basement structure.

Construction Dewatering Needs Estimation for Construction of the Underground Basement Structure at a base elevation of 183.16 masl (Lot 27):

The base elevation of 183.16 (inferred bedrock depth) was considered for the construction dewatering needs assessment for the underground basement structure. To maintain a dry and safe excavation it is recommended that the groundwater table be lowered to underground structure base elevation of 183.16 masl, where the top of bedrock was inferred during soil investigation. The highest shallow groundwater levels, recorded at the installed BH/MW's in the vicinity of lot 27, and the highest calculated estimated hydraulic conductivity were used for the current dewatering need assessment. The highest shallow groundwater level of 184.59 masl (recorded at BH/MW 9) and highest calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering needs estimations. The highest shallow groundwater level is 1.40 m above the proposed slab elevation for the proposed underground basement structure. The subsoil profile consists of topsoil, sand and gravel and underlying bedrock, extending to the maximum anticipated excavation depths. For the dewatering flow assessment for a rectangular excavation, having the dimensions of approximately 10 m in width and 20 m in length, having an estimated perimeter of 60 m was considered for this preliminary construction dewatering needs assessment. Considering the above-mentioned parameters, the estimated construction dewatering flow rate to facilitate excavation for the proposed underground housing basement structure could reach a daily rate of 5,633.6 L/day; by applying 3x safety factor, it could reach a maximum rate of 16,900.8 L/day. The estimated zone of influence could extend to a maximum of 9.8 m away from the conceptual dewatering alignment, being considered around the excavation footprint area.

Apart from the above estimated dewatering flow rates, the dewatering system should also account for a typical storm event. A typical 2-year 3-hour storm event was considered to

calculate the surface flow runoff accumulation rate resulting from an intense storm event. The dewatering rate for above mentioned storm event may generate 5,708.0 L/day. Hence, total dewatering flow rates of 22,608.81 L/day are anticipated for the construction of underground basement structure.

Construction Dewatering Needs Estimation for Construction of the Underground Basement Structure at a base elevation of 184.37 masl (Lot 6):

The base elevation of 184.37 (inferred bedrock depth) was considered for the construction dewatering needs assessment for the underground housing basement structure. To maintain a dry and safe excavation it is recommended that the groundwater table be lowered to underground structure base elevation of 184.37 masl, where the top of bedrock was inferred during soil investigation. The highest shallow groundwater levels, recorded at the installed BH/MW's in the vicinity of lot 6, and the highest, hydraulic conductivity estimate were used for the current dewatering need assessment. The highest shallow groundwater level of 184.60 masl (recorded at BH/MW 10) and highest calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering estimations. The highest shallow groundwater level is 0.23 m above the proposed slab elevation for the proposed underground housing basement structure. The subsoil profile consists of topsoil, sand and gravel and underlying bedrock, extending to the maximum anticipated excavation depths. For the dewatering flow assessment for a rectangular excavation, having the dimensions of approximately 10 m in width and 20 m in length, having an estimated perimeter of 60 m were considered for this preliminary construction dewatering needs assessment. Considering the above-mentioned parameters, the estimated construction dewatering flow rate to facilitate excavation for the proposed underground basement structure could reach a daily rate of 2,851.6 L/day; by applying 3x safety factor, it could reach a maximum rate of 8554.7 L/day. The estimated zone of influence could extend to a maximum of 5.0 m away from the conceptual dewatering alignment, being considered around the excavation footprint area.

Apart from the above estimated dewatering flow rates, the dewatering system should also account for a typical storm event. A typical 2-year 3-hour storm event was considered to calculate the surface flow runoff accumulation rate resulting from an intense storm event. The dewatering rate for above mentioned storm event could generate 5,708.0 L/day. Hence, total dewatering flow rates of 14,262.73 L/day are anticipated for the construction of underground basement structure.

Construction Dewatering Needs Estimation for Construction of the Underground Basement Structure at a base elevation of 181.21 masl (Lot 18):

The base elevation of 181.21 was considered for the construction dewatering needs assessment for the underground basement structure. To maintain a dry and safe excavation it is recommended that the groundwater table be lowered to underground structure base elevation of 180.8 masl, where the bedrock was inferred during soil investigation. The highest shallow groundwater levels, recorded at the installed BH/MW in the vicinity of lot 18, and the highest calculated estimated hydraulic conductivity were used for the current dewatering need assessment. The highest shallow groundwater level of 182.05 masl (recorded at BH/MW 12) and highest calculated hydraulic conductivity of 1.8×10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering needs estimations. The highest shallow groundwater level is 0.84 m above the proposed slab elevation for the proposed underground housing basement structure. The subsoil profile consists of topsoil, sand and gravel and underlying bedrock, extending to the maximum anticipated excavation depths. For the dewatering needs assessment for a rectangular excavation, having the dimensions of approximately 10 m in width and 20 m in length, having an estimated perimeter of 60 m were considered for this preliminary construction dewatering needs assessment. Considering the above-mentioned parameters, the estimated construction dewatering flow rate to facilitate excavation for the proposed underground basement structure could reach a daily rate of 5,863.4 L/day; by applying 3x safety factor, it could reach a maximum rate of 17,590.3 L/day. The estimated zone of influence could extend to a maximum of 7.4 m away from the conceptual dewatering alignment, being considered around the excavation footprint area.

Apart from the above estimated dewatering flow rates, the dewatering system should also account for a typical storm event. A typical 2-year 3-hour storm event is considered to calculate the surface flow runoff accumulation rate resulting from an intense storm evant. The dewatering rate for above mentioned storm event may generate 5,708.0 L/day. Hence, total dewatering flow rates of 23,298.25 L/day are anticipated for the construction of underground basement structure.

In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), these dewatering flow rate for excavation, are below the groundwater taking threshold limit of Environmental Activity and Sector Registry (EASR) which is 50,000 L/day, whereby an Environmental Activity and Sector Registry (EASR) would not 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.

It should be noted that the groundwater levels may rise during the seasonal high periods, i.e., spring high season, typically between March to June months, in response to snow melt and excess precipitation, received during the spring period. As such if earthworks commence during the spring high season, the dewatering volumes may go higher than what are being estimated in this report.

It should be noted that the above estimated dewatering rates should be revised when detailed design drawings are available.

Construction Dewatering Needs Estimation for Underground Services

Underground servicing plan showing the proposed invert elevation was not available during the preparation of this report, as such the anticipated depth to facilitate the construction of underground servicing was considered as 5 m below existing grades. The ground surface elevations recorded at BH/MW locations were considered as the existing grades.

Preliminary Construction Dewatering Needs Estimation for Underground Services in the Vicinity of Lot 1 at a grade elevation of 183.69 masl recorded at BH/MW 5:

Based on the ground surface elevation recorded at BH/MW locations within the vicinity of Lot 1 at approximate elevation of 183.69 masl as such the anticipated servicing invert was considered as 178.69, which is 5 m deep from existing grades. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 177.69 masl which is about 1 m below the lowest considered excavation depth. The highest shallow groundwater level was measured at El. 183.22 masl, at the BH/MW 5 location. Comparing the highest groundwater table and anticipated excavation depth for underground servicing construction, groundwater levels are about 4.53 m above the base of the proposed excavation. The subsoil profile consists of sand and gravel and underlying bedrock extending to the maximum anticipated excavation depth. The highest shallow groundwater level of 183.22 masl (recorded at BH/MW 5) and highest calculated hydraulic conductivity of 1.8×10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering needs estimations. As such, the estimated temporary dewatering flow rate anticipated to reach a daily rate of 6,973.1 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 20,919.3 L/day. It should be noted that an active dewatering array for an open underground servicing trench length of 25 m was

considered for the current dewatering needs assessment. The zone of influence is anticipated to extend 22.3 m away from the servicing trench excavation.

Preliminary Construction Dewatering Needs Estimation for Underground Services in the Vicinity of Lot 37 at a grade elevation of 184.17 masl recorded at BH/MW 7:

Based on the ground surface elevation recorded at BH/MW locations within the vicinity of Lot 37 at approximate elevation of 184.17 masl as such the anticipated servicing invert was considered as 179.17, which is 5 m deep from existing grades. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 178.17 masl which is about 1 m below the lowest considered excavation depth. The highest shallow groundwater level was measured at El. 183.73 masl, at the BH/MW 7 location. Comparing the highest groundwater table and anticipated excavation depth for underground servicing construction, groundwater levels are about 4.56 m above the base of the proposed excavation. The subsoil profile consists of sand and gravel and underlying bedrock extending to the maximum anticipated excavation depth. The highest shallow groundwater level of 183.73 masl (recorded at BH/MW 7) and highest calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering estimations. As such, the estimated temporary dewatering flow rate anticipated to reach a daily rate of 7,002.2L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 21,006.7 L/day. It should be noted that an active dewatering array for an open underground servicing trench length of 25 m was considered for the current dewatering needs assessment. The zone of influence is anticipated to be 2.3 m away from the servicing trench excavation.

Preliminary Construction Dewatering Needs Estimation for Underground Services in the Vicinity of Lot 27 at a grade elevation of 185.26 masl recorded at BH/MW 9:

Based on the ground surface elevation recorded at BH/MW locations within the vicinity of Lot 27 at approximate elevation of 185.26 masl as such the anticipated servicing invert was considered as 180.26 masl, which is 5 m deep from existing grades. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 179.26 masl which is about 1 m below the lowest considered excavation depth. The highest shallow groundwater level was measured at El. 184.59 masl, at the BH/MW 9 location. Comparing the highest groundwater table and anticipated excavation depth for underground servicing construction, groundwater levels are about 4.33 m above the base of the proposed excavation. The subsoil profile consists of sand and gravel and underlying bedrock extending to the maximum anticipated excavation depth. The highest shallow groundwater level of 184.59 masl (recorded at BH/MW 9) and highest

calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering estimations. As such, the estimated temporary dewatering flow rate anticipated to reach a daily rate of 6,778.6 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 20,335.9 L/day. It should be noted that an active dewatering array for an open underground servicing trench length of 25 m was considered for the current dewatering needs assessment. The zone of influence is anticipated to be 21.5 m away from the servicing trench excavation.

Preliminary Construction Dewatering Needs Estimation for Underground Services in the Vicinity of Lot 6 at a grade elevation of 185.57 masl recorded at BH/MW 10:

Based on the ground surface elevation recorded at BH/MW locations within the vicinity of Lot 6 at approximate elevation of 185.57 masl as such the anticipated servicing invert was considered as 180.57 masl, which is 5 m deep from existing grades. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 179.57 masl which is about 1 m below the lowest considered excavation depth. The highest shallow groundwater level was measured at El. 184.60 masl, at the BH/MW 10 location. Comparing the highest groundwater table and anticipated excavation depth for underground servicing construction, groundwater levels are about 4.03 m above the base of the proposed excavation. The subsoil profile consists of sand and gravel and underlying bedrock extending to the maximum anticipated excavation depth. The highest shallow groundwater level of 184.60 masl (recorded at BH/MW 10) and highest calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering estimations. As such, the estimated temporary dewatering flow rate anticipated to reach a daily rate of 6,486.8 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 19,460.3 L/day. It should be noted that an active dewatering array for an open underground servicing trench length of 25 m was considered for the current dewatering needs assessment. The zone of influence is anticipated to be 20.2 m away from the servicing trench excavation.

Preliminary Construction Dewatering Needs Estimation for Underground Services in the Vicinity of Lot 18 at a grade elevation of 184.21 masl recorded at BH/MW 12:

Based on the ground surface elevation recorded at BH/MW locations within the vicinity of Lot 6 at approximate elevation of 184.21 masl as such the anticipated servicing invert was considered as 179.21 masl, which is 5 m deep from existing grades. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the groundwater table be lowered to an elevation of 178.21 masl which is about 1 m below the lowest considered excavation depth. The highest shallow groundwater level was measured at El.

182.05 masl, at the BH/MW 12 location. Comparing the highest groundwater table and anticipated excavation depth for underground servicing construction, groundwater levels are about 2.84 m above the base of the proposed excavation. The subsoil profile consists of sand and gravel and underlying bedrock extending to the maximum anticipated excavation depth. The highest shallow groundwater level of 182.05 masl (recorded at BH/MW 12) and highest calculated hydraulic conductivity of 1.8 x 10^{-6} m/sec (BH/MW 7) were considered and used for current dewatering estimations. As such, the estimated temporary dewatering flow rate anticipated to reach a daily rate of 5,326.6 L/day; by considering a 3x safety factor, it could reach an approximate daily maximum of 15,979.9 L/day. It should be noted that an active dewatering array for an open underground servicing trench length of 25 m was considered for the current dewatering needs assessment. The zone of influence is anticipated to be 15.5 m away from the servicing trench excavation.

In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), these dewatering flow rate for excavation, are below the groundwater taking threshold limit of Environmental Activity and Sector Registry (EASR) which is 50,000 L/day, whereby an Environmental Activity and Sector Registry (EASR) would not be required as an approval to facilitate the groundwater takings for a temporary construction dewatering program for groundwater control.

7.2 Groundwater Control Methodology

The seepage rates into an open excavation within sand subsoil, below the groundwater level are expected to be low to moderate. Pumping from sumps would be adequate to control local groundwater seepage, or well points can be considered if seepage and stable subsoil conditions cannot be controlled by localized sump pit dewatering within the excavation footprints or underground servicing trenches. The final design for any temporary dewatering systems will be the responsibility of the contractor retained for construction.

7.3 Mitigation of Potential Impacts Associated with Dewatering

The zone of influence for any conceptual temporary dewatering wells or dewatering array used during construction for the proposed basement structure construction could reach a maximum of 22.3 m away from the dewatering array or sump pit wells.

Based on the records review, there are two (2) records (MECP Well ID. 2507059 and 2507060) for private water supply wells located within the subject site, wooded areas, watercourses or wetlands which are present within the conceptual zone of influence for any temporary construction dewatering. Also, the subject site is located in partially developed

area, which is bordered by existing residential buildings and the Georgian Trail which could potentially be affected by ground settlement associated with the conceptual zone of influence for any temporary construction dewatering. However, if the nearby structures are beyond 22.3 m from the excavation perimeter, no ground settlement impacts are anticipated. A geotechnical engineer should be consulted to review potential ground settlement concerns to nearby structures prior to construction.

7.4 Ground Settlement

The subject site is located in partially developed area, which is bordered by existing residential buildings and roads and infrastructure which could potentially be affected by ground settlement associated with the conceptual zone of influence for any temporary construction dewatering. Potential ground settlements concerns to existing structures associated with construction dewatering should be assessed by a geotechnical engineer prior to earth works and construction.

7.5 Long-Term Permanent Foundation Drainage

Due to the presence underlying saturated sand deposit, some long-term permanent drainage system is anticipated for the completed housing basement structures proposed below the groundwater table. The estimated permanent drainage rates will be calculated once the final design drawings become available. Hence, the current report needs to be revised when the detailed design drawings become available.

However, if the basement structures are completed above groundwater table or if it is waterproofed, below the groundwater table no long-term foundation drainage management is anticipated.

7.6 Groundwater Function of the Subject Site

The proposed development is located within a partially developed, residential neighbourhood. The proposed underground housing basement structures, and associated services will be constructed below the shallow groundwater level. As such, the local shallow groundwater flow pattern for the area may be locally impacted on temporary basis from the proposed development Based on the records review, there are two (2) records (MECP Well ID. 2507059 and 2507060) for private water supply wells, watercourses or wetlands which are present within the conceptual zone of influence for any temporary construction dewatering.

7.7 Low Impact Development Stormwater Management Infrastructure

The native surficial subsoil beneath the site consists mainly of moderate to high (sand and gravel) and generally, low (bedrock) permeable material. Opportunities may exist to infiltrate collected runoff at the developed site to the subsurface, using appropriate Low Impact Development (LID) Infrastructure, such as infiltration galleries, or underground storage/exfiltration tanks. The groundwater levels lie at depths, ranging between 0.44 and 3.01 m below ground surface. Potential LID infrastructure could be implemented in areas where the shallow groundwater is deeper than 1 m below the ground surface, and where it is possible to maintain a minimum of a 1 m separation between the base for any proposed LID stormwater management infiltration infrastructure and the high groundwater table. Any proposed LID infrastructure should be designed by the stormwater engineer for the project.

It is recommended that percolation rates for the surface soil and shallow subsoils be estimated using in-situ infiltration tests in support of any proposed LID infiltration infrastructure designs.

8.0 CONCLUSIONS

1. The subject site lies within the Physiographic Region of Southern Ontario, known as the Simcoe Lowlands, on the former beaches and sand plains physiographic feature.
2. The underlying bedrock is comprised mainly of shale, limestone, dolostone, and siltstone of the Georgian Bay Formation, Blue Mountain Formation, Billings Formation, Collingwood Member and Eastview Member, which were deposited during the Upper Ordovician Epoch (Bedrock Geology of Ontario, 1993). Based on the filed investigation the bedrock was inferred at depth between 0.6 mbgs and 3.4 mbgs or at an elevation between 180.8 masl and 184.4 masl.
3. A review of the elevations recorded at borehole locations shows that the site exhibits an undulating topography where site is generally declining towards west, the total elevation relief across the site is approximately 2.0 m. A review of the topographic map for the site and surrounding area indicates that the surrounding area shows decline in elevation relief towards the north. Suggesting that the surface runoff flows resulting from precipitation will be towards north, draining into Georgian Bay.
4. The subject site is located within the South Georgian Bay Shoreline Watershed.
5. The review of the records reveals that the subject site is located within Niagara Escarpment area classified as recreation area. The subject site is surrounded by wooded areas, where the majority of the site is covered with wooded area as well. Two (2) watercourses appear to be traversing through the subject site, where one watercourse is traversing through northwest corner of the subject site and the other appears to be located along the northern boundary of the subject site, where both the watercourses appear to be flowing northly before merging together, within northern limits the subject site. A closest water body, Georgian Bay, is located, approximately 330 m north of the subject site. The wetland feature, which has not been evaluated as being Provincial Significant can be found scattered within the northern portion of the subject site. The wetland feature, which has been evaluated as being Provincial Significant as per OWES appears to be emerging from within the northern portion of the site and extending approximately 1300 m east of the subject site.
6. This study has disclosed that beneath a veneer of topsoil, the subject site is underlain by a native sand and gravel subsoil stratum bedding on the bedrock.
7. The recorded groundwater levels beneath site range between from the depths of 0.44 m and 3.01 m below ground surface, or at elevations, ranging between 181.20 masl and 184.60 masl. The K estimates for the saturated subsoils is 1.8×10^{-6} m/sec for the overburden soils at the screened depth intervals for the monitoring wells constructed beneath the site. The K estimates for the sand and gravel subsoil sample using Hazen's Equation for the sand and gravel subsoil sample retrieved from the depth of 2.3 m at BH/MW 12 location is 1.21×10^{-4} m/sec.

8. The estimated construction dewatering flow rates to facilitate excavation for the proposed underground housing basement structures could reach a daily maximum rate of 23,298.25 L/day (with 3x safety factor). In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is below the EASR threshold limit of 50,000 L/day, whereby an Environmental Activity and Sector Registry (EASR) would not be required as an approval to facilitate groundwater takings for a temporary construction dewatering program for groundwater control during construction.
9. The estimated construction dewatering flow rates to facilitate excavation for the proposed underground servicing could reach a daily maximum rate of 20,335.9 L/day (with 3x safety factor). In accordance with the current policy of the Ministry of the Environment, Conservation and Parks (MECP), this dewatering flow rate for excavation, is below the EASR threshold limit of 50,000 L/day, whereby an Environmental Activity and Sector Registry (EASR) would not be required as an approval to facilitate the groundwater takings for a temporary construction dewatering program for groundwater control.
10. The zone of influence for any conceptual temporary dewatering wells or dewatering array used during construction for the proposed housing basement structure construction could reach a maximum of 22.3 m away from the dewatering array or sump pit wells. Based on the records review, there are two (2) records (MECP Well Id: 2507059 and 2507060) for private water supply wells, wooded areas, watercourses or wetlands which are present within the conceptual zone of influence for any temporary construction dewatering. Also, the subject site is located in partially developed area, which is bordered by existing residential buildings and Georgian Trail which could potentially be affected by ground settlement associated with the conceptual zone of influence for any temporary construction dewatering.
11. Due to the presence underlying saturated sand and gravel deposit, some long-term permanent foundation drainage is anticipated for the housing basement structures proposed below the groundwater table. The permanent drainage rates will be calculated once the final design drawings are available for our review.
12. The native surficial subsoil beneath the site consists mainly of moderate to high (sand and gravel) and low (bedrock) permeable material. Opportunities may exist to infiltrate collected runoff at the developed site for re-direction to the subsurface, using appropriate Low Impact Development Infrastructure (LID), such as infiltration galleries, or underground storage/exfiltration tanks. The groundwater levels lie at depths, ranging between 0.44 and 3.01 m below ground surface. Potential LID infrastructure could be implemented in areas where the shallow groundwater is deeper than 1 m below the ground surface, and where it is possible to maintain a minimum of a 1 m separation between the base for any proposed LID stormwater management

infiltration infrastructure and the high groundwater table. Any proposed LID infrastructure should be designed by the storm water engineer for the project.

9.0 CLOSURE

We trust that the above-noted information is suitable for your review. If you have any questions regarding this information, please do not hesitate to contact the undersigned.

Yours truly
SOIL ENGINEERS LTD.

Gurkaranbir Singh, M.Eng., EIT
Project Manager

NA

PROFESSIONAL GEOSCIENTIST
NARJES ALIJANI
PRACTISING MEMBER
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July 23, 2025
ONTARIO

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FIGURES 1 to 9

BOREHOLE LOGS AND GRAIN SIZE DISTRIBUTION GRAPH

REFERENCE NO. 2201-W051B

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.: 2201-W051B

LOG OF BOREHOLE: 5

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

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
183.7	Ground Surface							
0.0	30 cm Topsoil				0			
	Brown, loose to very dense SAND AND GRAVEL a trace to some silt occ. cobbles and boulders — weathered	1	DO	5			38	
		2	DO	14	1		20	
182.1		3	DO	50/3				
1.6	END OF BOREHOLE due to auger refusal on probable bedrock Installed 50 mm Ø monitoring well to 1.4 m completed with 0.6 m screen Sand backfill from 0.2 to 1.4 m Bentonite seal from 0.0 m to 0.2 m Provided with a monument steel casing				2 3 4 5 6			W.L. Elevation @ 183.22 masl on April 27, 2022 W.L. Elevation @ 182.59 masl on May 27, 2022 W.L. Elevation @ 182.53 masl on June 28, 2022

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 6

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES 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
183.6	Ground Surface							
0.0	20 cm Topsoil				0		5	
	Brown, very dense SAND AND GRAVEL a trace to some silt — weathered occ. cobbles and boulders	1	DO	15		○	●	
183.0								
0.6	END OF BOREHOLE due to auger refusal on probable bedrock				1			
					2			
					3			
					4			
					5			
					6			

Soil Engineers Ltd.

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 7

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

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
184.2	Ground Surface							
0.0	25 cm Topsoil				0			
	Brown, loose to very dense SAND AND GRAVEL a trace to some silt weathered occ. cobbles and boulders	1	DO	8			14	
		2	DO	50/23	1		16	
182.6		3	DO	50/8			12	
1.6	END OF BOREHOLE due to auger refusal on probable bedrock				2			
	Installed 50 mm Ø monitoring well to 1.6 m completed with 0.6 m screen Sand backfill from 0.4 to 1.6 m Bentonite seal from 0.0 m to 0.4 m Provided with a monument steel casing				3			
					4			
					5			
					6			

W.L. Elevation @ 183.73 masl on April 27, 2022
W.L. Elevation @ 183.46 masl on May 27, 2022
W.L. Elevation @ 183.33 masl on June 28, 2022

Soil Engineers Ltd.

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 8

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

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
184.8	Ground Surface							
0.0	36 cm Topsoil	1	DO	12	0		28	
	Brown, compact to very dense SAND AND GRAVEL weathered a trace to some silt occ. cobbles and boulders	2	AS	50/15	1		4	
183.1		3	DO	50/15			12	
1.7	END OF BOREHOLE due to auger refusal on probable bedrock				2			
					3			
					4			
					5			
					6			

Soil Engineers Ltd.

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 9

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

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
185.3	Ground Surface							
0.0	36 cm Topsoil	1	DO	8	0		37	
	Brown, loose to compact SAND AND GRAVEL a trace to some silt occ. cobbles and boulders — weathered							
	— disturbed	2	DO	7	1		19	
		3	DO	16	2		19	
183.2								
2.1	END OF BOREHOLE due to auger refusal on probable bedrock Installed 50 mm Ø monitoring well to 1.5 m completed with 0.6 m screen Sand backfill from 0.3 to 1.5 m Bentonite seal from 0.0 m to 0.3 m Provided with a monument steel casing				3			
					4			
					5			
					6			

W.L. Elevation @ 184.59 masl on April 27, 2022
W.L. Elevation @ 184.31 masl on May 27, 2022
W.L. Elevation @ 184.11 masl on June 28, 2022

Soil Engineers Ltd.

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 10

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) / Shear Strength (kN/m²) / Penetration Resistance (blows/30 cm)	Atterberg Limits / Moisture Content (%)	WATER LEVEL
185.6	Ground Surface							
0.0	36 cm Topsoil	1	DO	11	0		44	
	Brown, compact to very dense SAND AND GRAVEL — weathered a trace to some silt occ. cobbles and boulders							
		2	DO	50/20	1		25	
184.4								
1.2	END OF BOREHOLE due to auger refusal on probable bedrock Installed 50 mm Ø monitoring well to 1.2 m completed with 0.6 m screen Sand backfill from 0.0 to 1.2 m Provided with a monument steel casing				2 3 4 5 6			W.L. Elevation @ 184.60 masl on April 27, 2022 W.L. Elevation @ 184.43 masl on May 27, 2022 W.L. Elevation @ 184.44 masl on June 28, 2022

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

Soil Engineers Ltd.

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 11

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: N/A

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: N/A

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES: Number	SAMPLES: Type	SAMPLES: 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
100.0	Ground Surface							
0.0	BOREHOLE CANCELLED DUE TO INACCESSIBILITY				0			
					1			
					2			
					3			
					4			
					5			
					6			

Soil Engineers Ltd.

JOB NO.: 2201-W051B

LOG OF BOREHOLE: 12

FIGURE NO.: 8

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 372 Grey Road 21 West, Town of The Blue Mountains

DRILLING DATE: April 18, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
184.2	Ground Surface				
0.0	30 cm Topsoil				0
	Brown, compact to very dense SAND AND GRAVEL a trace to some silt — weathered occ. cobbles and boulders	1	DO	11	
		2	DO	14	1
		3	DO	28	
	— disturbed	4	DO	16	2
		5	DO	50/15	3
180.8					
3.4	END OF BOREHOLE due to auger refusal on probable bedrock Installed 50 mm Ø monitoring well to 3.4 m completed with 1.5 m screen Sand backfill from 1.3 to 3.4 m Bentonite seal from 0.0 m to 1.3 m Provided with a monument steel casing				4 5 6

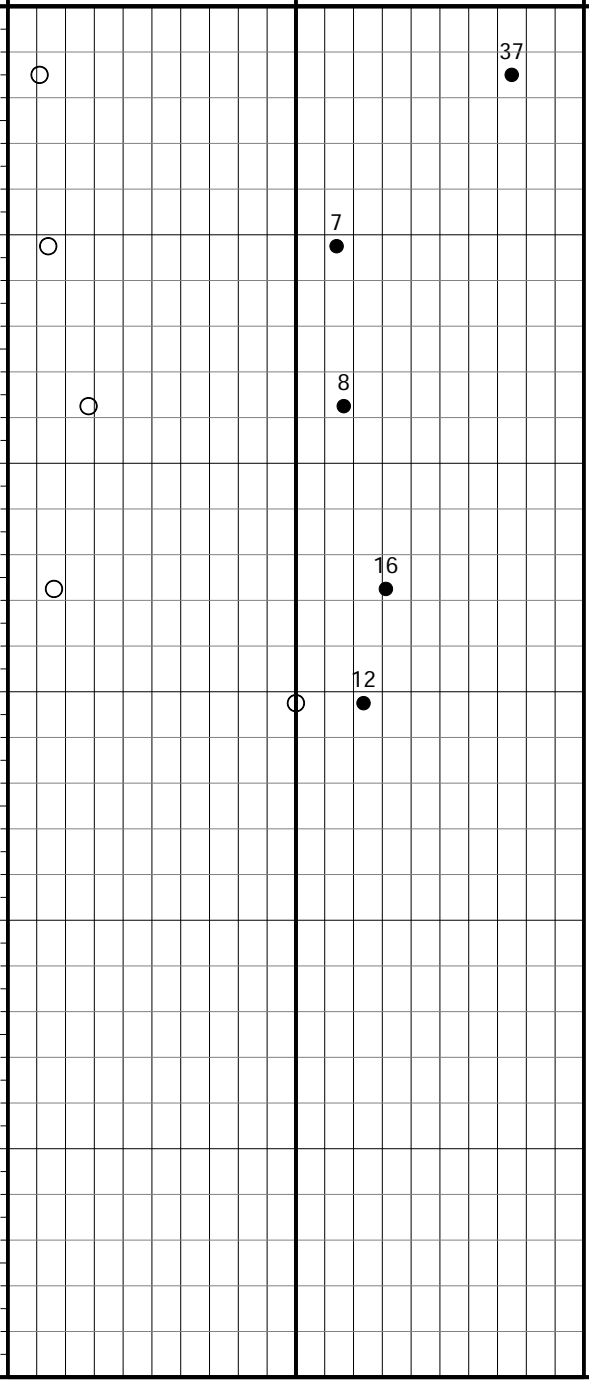
Dynamic Cone (blows/30 cm) 10 30 50 70 90

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

W.L. Elevation @ 182.05 masl on April 27, 2022
W.L. Elevation @ 181.24 masl on May 27, 2022
W.L. Elevation @ 181.20 masl on June 28, 2022

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Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

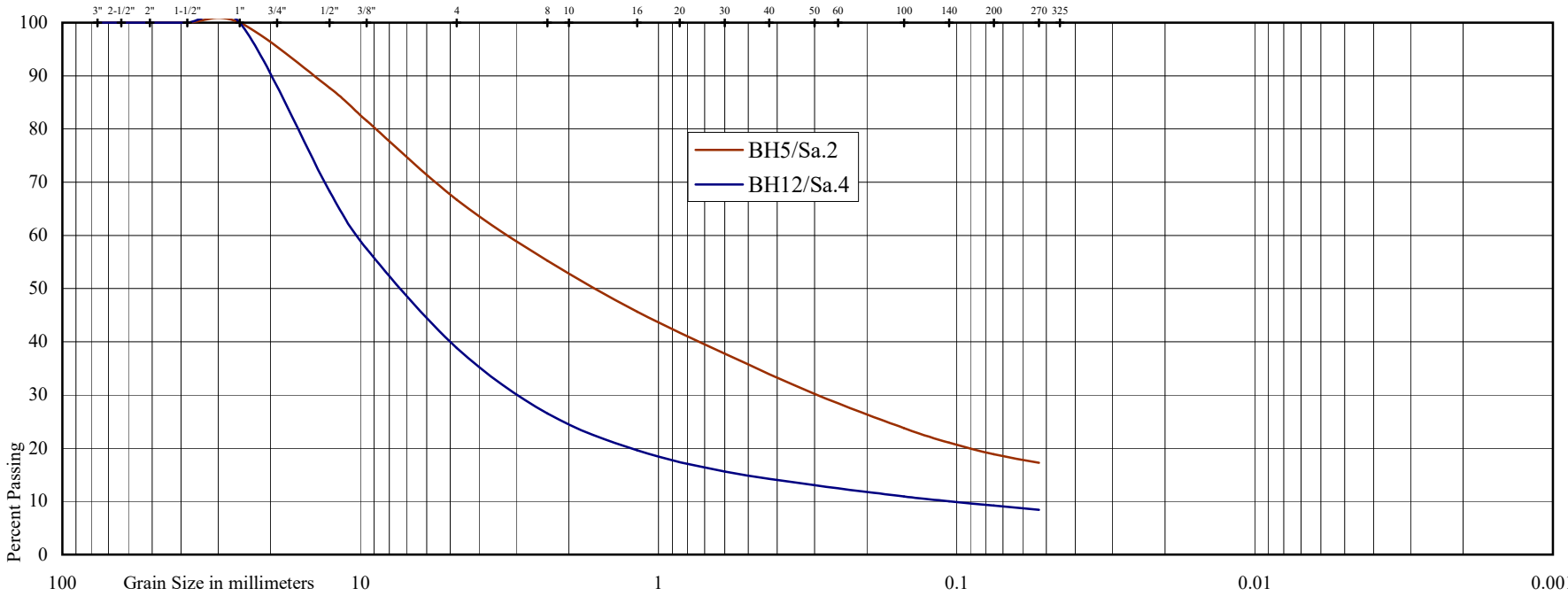
Reference No: 2201-W051B

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: 372 Grey Road 21 West, Town of The Blue Mountains

Borehole No:	5	12
Sample No:	2	4
Depth (m):	0.8	2.3
Elevation (m):	182.9	181.9

BH/Sa.:	5/2	12/4
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	16	20
Estimated Permeability (cm./sec.) =	10^{-3}	10^{-2}

Classification of Sample [& Group Symbol]: SAND AND GRAVEL
a trace to some silt

Figure 9

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
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BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
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. 2201-W051B

554000
555000
556000
4930000
4929000

Water Body
Residential Area
Wooded Area
Residential Area
Wooded Area

LAKESHORE ROAD EAST
FRASER CRESCENT
BLUE MOUNTAIN DRIVE
HIGHWAY 26
HOPE STREET
TIMMONS STREET
BROPHYS LANE
LONG POINT ROAD
SILVER CREEK DRIVE
GREY ROAD 21
FOREST DRIVE
OSLER BLUFF ROAD
BIRCH VIEW TRAIL
TYRO LEAN LANE
LISA'S LANE
CRAIGMORE CRESCENT
ARLBERG CRESCENT
SANDHAR LANE
SETTLERS WAY
KELLIES WAY
FARM GATE ROAD
BROOKER BOULEVARD
RIDGEVIEW DRIVE
MONTERRA ROAD
GREY ROAD 19
AUGUSTA CRESCENT
GRAND CYPRESS LANE

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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Refrences: Ontario Ministry of Natural Resources and Forestry
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Key Map

Legend

- Approximate Boundary of Subject Site
- Expressway/Freeway
- Major Road
- Local Road

Soil Engineers Ltd.

Title: Site Location Plan

Project:
Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:
0 45 90 180 270 360 450
Metres

Drawing No. 1

555000
555200
555400
4929800
4929600

KIMHEATHER COURT
TIMMONS STREET

BH/MW 5
BH 6
BH/MW 7
BH/MW 10
BH 8
BH 11
(Cancelled)
BH/MW 12
BH/MW 9

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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N

References: Ontario Ministry of Natural Resources and Forestry
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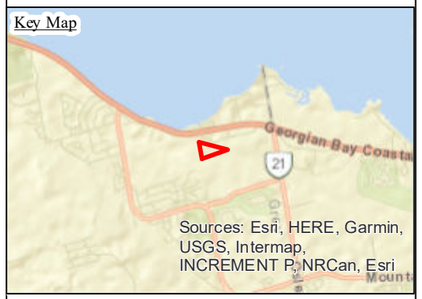
Key Map



Legend

- Approximate Boundary of Subject Site
- Borehole with Monitoring Well
- Borehole
- Major Road
- Local Road

Soil Engineers Ltd.

Title: Borehole and Monitoring Well Location Plan

Project:

Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:

0 10 20 40 60 80 100
Metres

Drawing No. 2

552000 554000 556000 558000

4932000 4930000 4928000

Georgian Bay (baie Georgienne)

HIGHWAY 26

GREY ROAD 21

GREY ROAD 19

OSLER BLUFF ROAD

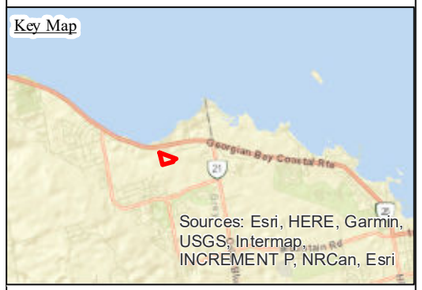
20 14b 9b 5b 6 9c 3 5d

D:\GIS\2201-W051B\

552000 554000 556000 558000

N

Key Map



Legend

- Approximate Boundary of Subject Site
- 3: Paleozoic bedrock
- 5b: Undifferentiated till: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 9b: Coarse-textured glaciolacustrine deposits: Littoral-foreshore deposits
- 9c: Coarse-textured glaciolacustrine deposits: Foreshore-basinal deposits
- 20: Organic deposits
- Waterbody
- Major Road

Soil Engineers Ltd.

Title: Surface Geology Map

Project:

Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:

0 230 460 690 920 1,150
Metres

Drawing No. 3

Source: Ontario Geological Survey, 1997, Miscellaneous Release---Data 0014

552700
555400
558100
4931500
4928800

Beaches
Sand Plains
HIGHWAY 26
Simcoe Lowlands
GREY ROAD 21
GREY ROAD 19
OSLER BLUFF ROAD
Niagara Escarpment
Clay Plains
Escarpments
Horseshoe Moraines
Limestone Plains
SCENIC CAVES ROAD

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Source: Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228 ISBN 978-1-4249-5158-1

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Refrences: © Physiography Map was Produced by Soil Engineering Ltd. under license from the Ministry of North Development and Mines (MNDM). Copyright (c) is hold by the Queen's Printer for Ontatio. Physiography of Southern Ontario Ontatio, 2007, Ontario Geological Survey, Miscellaneous Release — Date 228.

Key Map

Legend

- Approximate Boundary of Subject Site
- Region Boundary
- Sand Plains
- Bevelled Till Plains
- Clay Plains
- Beaches
- Major Road

Soil Engineers Ltd.

Title: Physiographic Map

Project:
Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:
0 145 290 580 870 1,160 1,450
Metres

Drawing No. 4

554000
555000
556000
4930000
4929000
Georgian Bay (baie Georgienne)
LAKESHORE ROAD EAST
FRASER CRESCENT
BLUE MOUNTAIN DRIVE
HOPE STREET
TIMMONS STREET
HIGHWAY 26
BROPHYS LANE
LONG POINT ROAD
SILVER CREEK DRIVE
FOREST DRIVE
GREY ROAD 21
OSLER BLUFF ROAD
BIRCH VIEW TRAIL
TYROLEAN LANE
CRAIGMORE CRESCENT
ARLBERG CRESCENT
KANDAHAR LANE
LIISAS LANE
SETTLERS WAY
FARMGATE ROAD
KELLIES WAY
BROOKER BOULEVARD
RIDGEVIEW DRIVE
MONTERRA ROAD
GREY ROAD 19
AUGUSTA CRESCENT
GRAND CYPRESS LANE
185
180
190
195
205
210
200
215
220
225
230
D:\GIS\2201-W051B\

N

References: Ontario Ministry of Natural Resources and Forestry

Key Map

Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- Waterbody
- Watercourse
- Ontario - 5 m
- 100 Topographic Contour (masl)

Soil Engineers Ltd.

Title: Topographic Map

Project:

Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

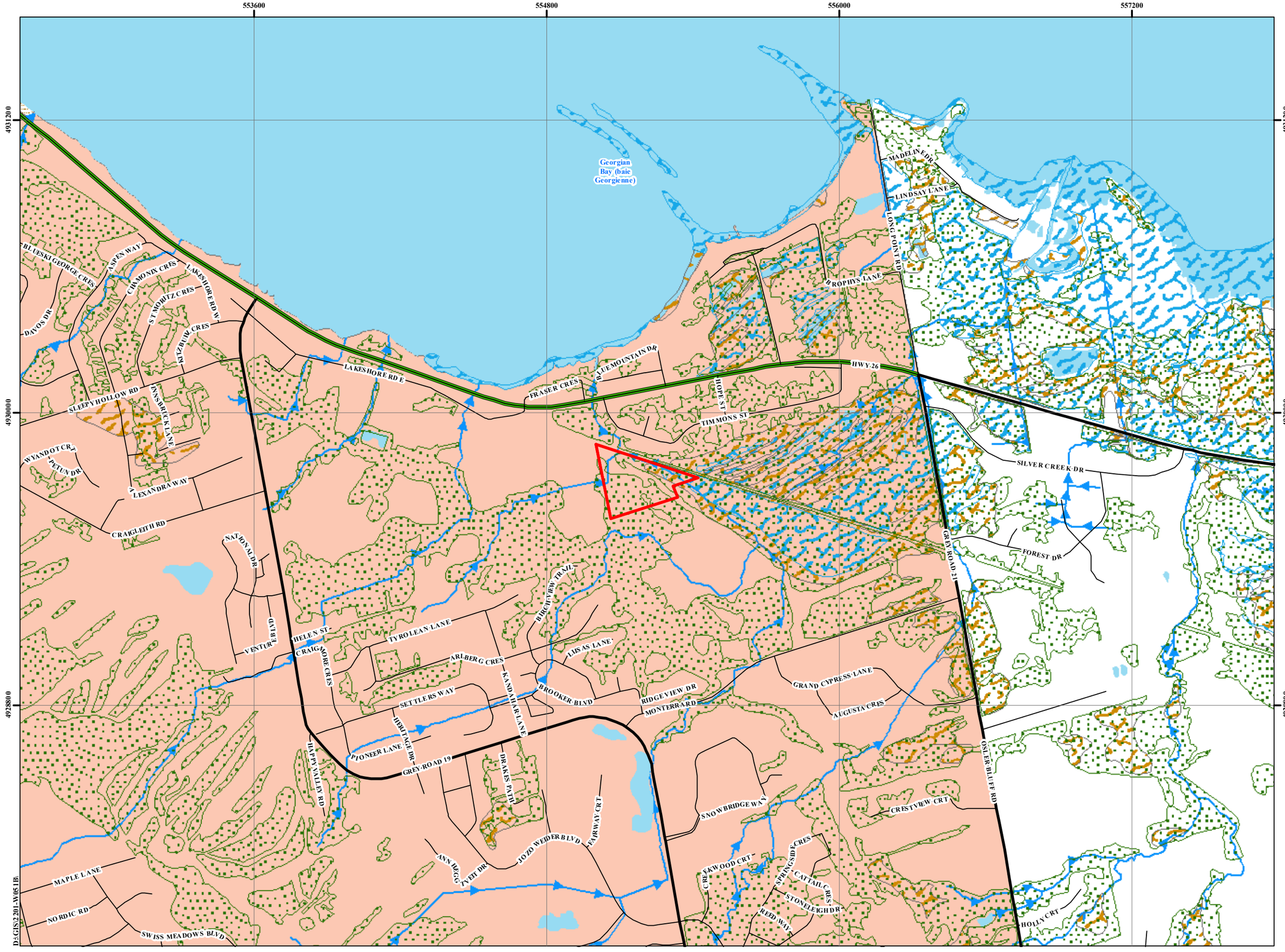
Reference No. 2201-W051B

Date: September 10, 2023

Scale:

0 45 90 180 270 360 450
Metres

Drawing No. 5



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Key Map

Legend

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

Soil Engineers Ltd.

Title: Natural Features and Protection Area Plan

Project:
Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:
0 180 360 540 720 900
Metres

Drawing No. 6

554000 554500 555000 555500 556000 556500

4930500 4930000 4929500 4929000

LAKESHORE ROAD EAST
HIGHWAY 26
FRASER CREEK
BLUE MOUNTAIN DRIVE
HOPE STREET
TIMMONS STREET
HWY 26
BROPHYS LANE
LONG POINT ROAD
SILVER CREEK DRIVE
FOREST DRIVE
GREY ROAD 21
OSLER BLUFF RD
OSLER BLUFF ROAD
BIRCHVIEW TRAIL
LILIAS LANE
TYROLEAN LANE
ARLBERG CRESCENT
KANDAHAR LANE
KELLIES WAY
BROOKER BOULEVARD
RIDGE VIEW DRIVE
MONTERRA ROAD
GREY ROAD 19
SETTLERS WAY
FARM GATE ROAD
AUGUSTA CRESCENT
GRAND CYPRESS LANE

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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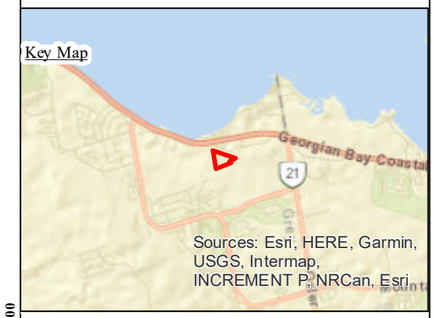
Refrences: ESRI, DigitalGlobe, GeoEye, Earthstar Geograp-hics, CNES/Airbus Ds, USDA, USGS, AeroGRIS, IGN, and the GIS User Community produced by Soil Engineering Ltd. Copyright (c) Queen's Printer 2020. Water Well Information System Ministry of the Environment, Conservation and Parks, 2020

Key Map



Legend

- Approximate Boundary of Subject Site
- 500 metres from Subject Site Boundary
- Major Road
- Local Road

Final Status of Well Record

- Abandoned-Supply
- Observation Wells
- Water Supply

Soil Engineers Ltd.

Title: MECP Well Location Plan

Project:
Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:
0 45 90 180 270 360 450
Metres

Drawing No. 7

555000
555200
555400
4928800
4929600

KIMHEATHER COURT
TIMMONS STREET

180
180
185
190

BH/MW 5
183.22
183.5
BH 6
BH/MW 7
183
184
184.5
BH/MW 10
184.6
BH 8
BH 11
(Cancelled)
BH/MW 12
182.05
BH/MW 9
184.59
184
183.5
183

N

Refrences: Ontario Ministry of Natural Resources and Forestry
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Key Map

Legend

- Approximate Boundary of Subject Site
- Borehole with Monitoring Well
- Borehole
- Road
- Interpreted Shallow Groundwater Contour
- Interpreted Shallow Groundwater Flow Direction
- (265.92) Shallow Groundwater Level Measured on April 27, 2022

Soil Engineers Ltd.

Title: Shallow Groundwater Flow Pattern Plan

Project:
Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:
0 10 20 40 60 80 100
Metres

Drawing No. 8

D:\GIS\2201-W051B\

555000
555150
555300
555450
4929850
4929700
4929550

TIMMONS STREET

A BH/MW 5
BH 6
BH/MW 7
BH/MW 10
BH 8
BH 11 (Cancelled)
BH/MW 12
BH/MW 9
A'

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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References: Ontario Ministry of Natural Resources and Forestry
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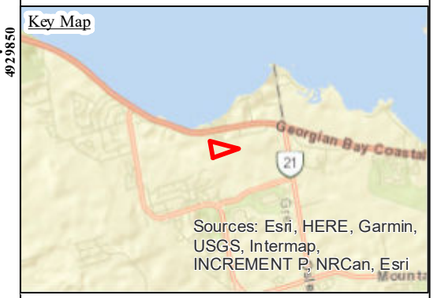
Key Map



Legend

- Approximate Boundary of Subject Site
- Borehole with Monitoring Well
- Borehole
- A A' Cross-Section Direction
- Major Road
- Local Road

Soil Engineers Ltd.

Title: Cross-Section Key Plan

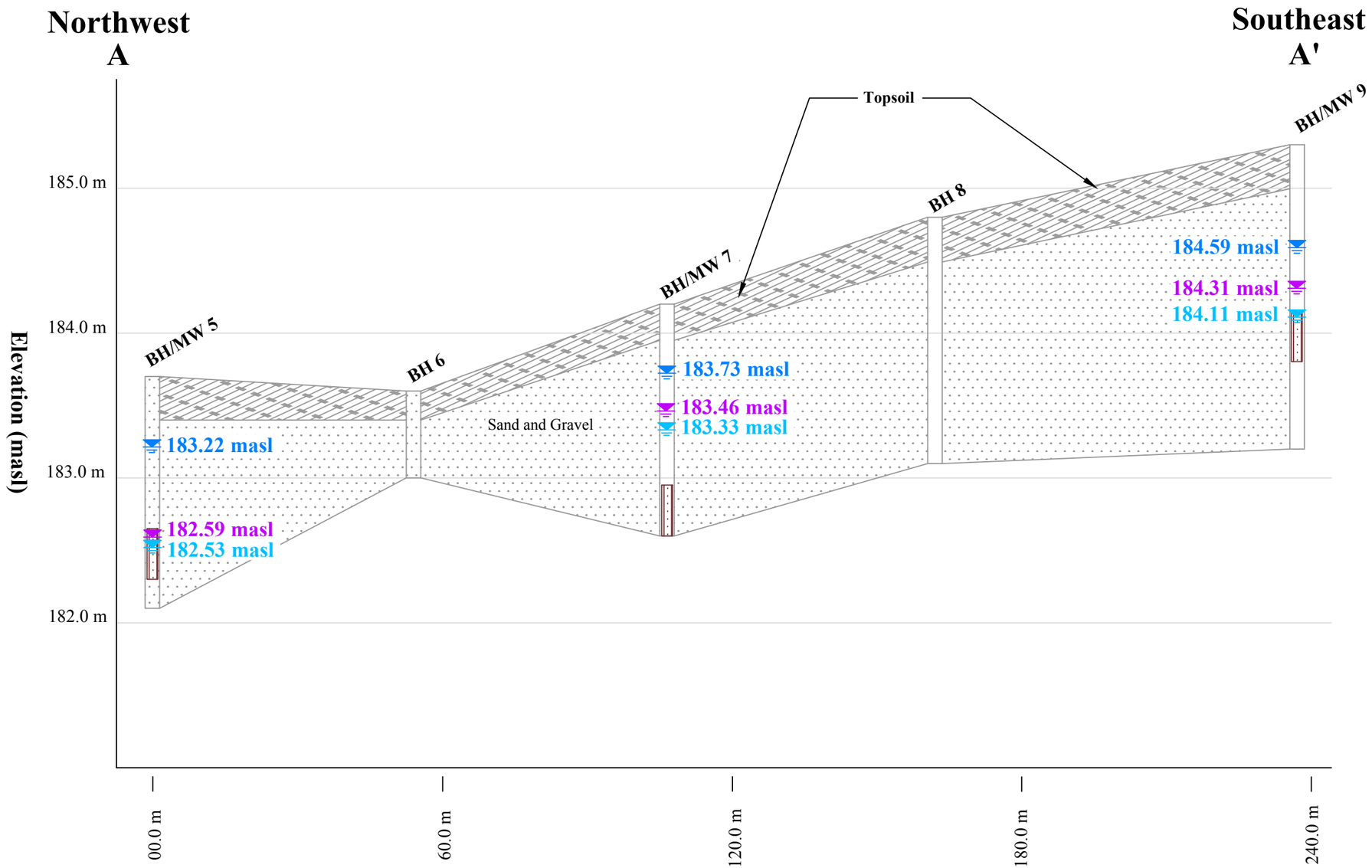
Project:
Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21
Town of The Blue Mountains

Reference No. 2201-W051B

Date: September 10, 2023

Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 9-1



Section A-A'

Topsoil

Sand and Gravel

0.6 m Screen

Water Table on June 07, 2023

Water Table on July 11, 2023

Water Table on July 26, 2023

Soil Engineers Ltd.
CONSULTING SOIL, FOUNDATION & ENVIRONMENTAL ENGINEERS

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

Project: Hydrogeological Assessment
Proposed Residential Development
372 Grey Road 21 Town of The Blue Mountains

Reference No:	Date:	Scale: V	Scale: H	Drawing No.
2201-W051B	September, 2023	1:100	1:2500	9-2

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APPENDIX 'A'

MECP WATER WELL RECORDS SUMMARY

REFERENCE NO. 2201-W051B

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	2500434	Cable Tool	7.30	Water Supply	Domestic	7.32	1.80	-	-
2	2500435	Cable Tool	18.30	Water Supply	Domestic	17.68	0.60	-	-
3	2500366	Cable Tool	12.80	Water Supply	Domestic	12.80	2.40	-	-
4	2500367	Cable Tool	12.20	Water Supply	Domestic	-	2.40	-	-
5	2500368	Cable Tool	10.10	Water Supply	Domestic	9.75	2.40	-	-
6	2500369	Cable Tool	10.40	Water Supply	Commercial	10.06	1.50	-	-
7	2500371	Cable Tool	9.40	Water Supply	Domestic	8.23	4.30	-	-
8	2500372	Cable Tool	12.50	Water Supply	Domestic	11.58	4.30	-	-
9	2500373	Cable Tool	8.20	Water Supply	Domestic	8.23	1.80	3.05	8.23
10	2500374	Cable Tool	10.10	Water Supply	Domestic	10.06	3.70	-	-
11	2500375	Cable Tool	13.10	Water Supply	Commercial	12.19	4.00	-	-
12	2500376	Cable Tool	11.90	Water Supply	Domestic	8.53	1.50	-	-
13	2500377	Cable Tool	11.60	Water Supply	Domestic	11.58	5.50	-	-
14	2500378	Cable Tool	9.80	Water Supply	Domestic	9.14	2.40	-	-
15	2500379	Cable Tool	7.60	Water Supply	Domestic	7.62	0.60	-	-
16	2500380	Cable Tool	8.50	Water Supply	Domestic	6.10	1.20	-	-
17	2500381	Cable Tool	8.50	Water Supply	Domestic	6.10	1.20	-	-
18	2500388	Cable Tool	12.20	Water Supply	Domestic	12.19	2.40	-	-
19	2500394	Cable Tool	12.20	Water Supply	Commercial	10.36	2.40	-	-
20	2500395	Cable Tool	8.50	Water Supply	Domestic	8.53	2.70	-	-
21	2500400	Cable Tool	7.30	Water Supply	Domestic	6.71	2.10	-	-
22	2500401	Cable Tool	7.30	Water Supply	Domestic	3.05	2.10	-	-
23	2500402	Cable Tool	9.40	Water Supply	Domestic	9.45	1.20	-	-
24	2500403	Cable Tool	14.00	Water Supply	Domestic	14.02	0.60	-	-
25	2500404	Cable Tool	9.80	Water Supply	Domestic	9.75	0.60	-	-
26	2500405	Cable Tool	11.30	Water Supply	Domestic	11.28	0.90	-	-
27	2500406	Cable Tool	11.30	Water Supply	Domestic	11.28	1.80	-	-

Notes:

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

**metres below ground surface

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				
28	2500413	Cable Tool	45.70	Abandoned-Supply	-	-	-	-	-
29	2500414	Cable Tool	10.10	Water Supply	Domestic	9.14	4.60	-	-
30	2500419	Cable Tool	5.20	Water Supply	Domestic	5.18	1.20	-	-
31	2500420	Cable Tool	8.20	Water Supply	Domestic	8.23	6.70	-	-
32	2500423	Cable Tool	9.10	Water Supply	Commercial	7.62	1.50	-	-
33	2500424	Cable Tool	7.60	Water Supply	Domestic	5.49	2.40	-	-
34	2500426	Cable Tool	6.10	Water Supply	Domestic	5.18	1.80	-	-
35	2500427	Cable Tool	11.00	Water Supply	Domestic	3.05	0.60	-	-
36	2500429	Cable Tool	8.50	Water Supply	Domestic	4.57	1.80	-	-
37	2500431	Cable Tool	6.40	Water Supply	Irrigation	5.49	1.20	-	-
38	2500433	Cable Tool	11.00	Water Supply	Domestic	9.75	1.20	-	-
39	2502645	Boring	16.80	Water Supply	Domestic	13.72	13.70	-	-
40	2502646	Boring	10.70	Water Supply	Domestic	7.62	7.60	-	-
41	2502647	Boring	19.80	Water Supply	Domestic	16.76	16.80	-	-
42	2502675	Cable Tool	18.30	Water Supply	Domestic	1.83	1.20	-	-
43	2502678	Cable Tool	4.90	Water Supply	Domestic	4.27	1.20	-	-
44	2502679	Cable Tool	8.80	Water Supply	Domestic	7.92	1.50	-	-
45	2503058	Cable Tool	9.40	Water Supply	Domestic	9.45	3.70	-	-
46	2503071	Boring	9.80	Water Supply	Domestic	6.10	6.10	-	-
47	2503072	Boring	10.10	Water Supply	Livestock	6.40	5.20	-	-
48	2503074	Boring	10.10	Water Supply	Domestic	6.40	5.20	-	-
49	2503075	Boring	10.10	Water Supply	Domestic	6.40	5.20	-	-
50	2503081	Not Known	10.70	Water Supply	Domestic	-	2.70	-	-
51	2503083	Not Known	7.60	Water Supply	Domestic	6.40	3.00	-	-
52	2503111	Boring	9.40	Water Supply	Domestic	9.45	4.60	-	-
53	2503255	Boring	6.70	Water Supply	Domestic	3.05	3.00	-	-
54	2503279	Cable Tool	9.80	Water Supply	Domestic	7.32	4.30	-	-

Notes:

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**metres below ground surface

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				
55	2503299	Cable Tool	15.20	Water Supply	Domestic	15.24	4.30	-	-
56	2503300	Cable Tool	10.10	Water Supply	Domestic	10.06	2.70	-	-
57	2503301	Cable Tool	13.40	Water Supply	Domestic	13.41	3.70	-	-
58	2503359	Cable Tool	11.00	Water Supply	Domestic	10.67	1.80	-	-
59	2503373	Boring	12.20	Water Supply	Domestic	7.62	7.60	-	-
60	2503566	Cable Tool	14.00	Water Supply	Domestic	9.14	3.70	-	-
61	2503694	Cable Tool	12.80	Water Supply	Domestic	11.89	4.00	-	-
62	2503697	Cable Tool	35.40	Water Supply	Domestic	30.18	12.20	-	-
63	2503780	Cable Tool	29.90	Water Supply	Domestic	22.86	14.60	-	-
64	2503787	Cable Tool	14.00	Water Supply	Domestic	9.14	2.40	-	-
65	2504023	Cable Tool	7.00	Water Supply	Domestic	2.44	1.80	-	-
66	2504024	Cable Tool	13.10	Water Supply	Domestic	13.11	2.70	-	-
67	2504195	Rotary (Convent.)	20.10	Water Supply	Domestic	13.72	2.40	-	-
68	2504308	Rotary (Convent.)	13.10	Water Supply	Domestic	12.19	4.30	-	-
69	2505395	Cable Tool	8.80	Water Supply	Domestic	7.92	3.00	-	-
70	2505749	Cable Tool	15.20	Water Supply	Domestic	13.41	4.30	-	-
71	2505796	Rotary (Air)	62.80	Water Supply	Domestic	50.29	-	-	-
72	2505882	Cable Tool	17.10	Abandoned-Supply	-	15.24	-	-	-
73	2506122	Rotary (Air)	24.10	Water Supply	Domestic	0.00	-	-	-
74	2506127	Rotary (Air)	13.10	Water Supply	Domestic	12.19	0.90	-	-
75	2506205	Cable Tool	11.30	Water Supply	Domestic	7.32	1.20	-	-
76	2506229	Rotary (Air)	11.00	Water Supply	Domestic	10.67	1.50	-	-
77	2506946	Rotary (Air)	24.70	Water Supply	Domestic	15.24	3.00	-	-
78	2507058	Cable Tool	11.60	Water Supply	Domestic	10.67	3.40	-	-
79	2507059	Cable Tool	16.80	Water Supply	Domestic	8.23	4.00	-	-
80	2507060	Cable Tool	16.80	Water Supply	Domestic	8.23	3.70	-	-
81	2507316	Rotary (Air)	12.50	Water Supply	Domestic	9.14	3.00	-	-

Notes:

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**metres below ground surface

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				
82	2507379	Rotary (Air)	12.50	Water Supply	Domestic	9.14	2.70	-	-
83	2507551	Cable Tool	12.80	Water Supply	Domestic	11.28	3.00	-	-
84	2507554	Rotary (Air)	24.40	Water Supply	Domestic	23.77	13.70	-	-
85	2507592	Rotary (Air)	13.10	Water Supply	Domestic	12.80	1.80	-	-
86	2508384	Cable Tool	11.60	Water Supply	Domestic	11.58	4.30	-	-
87	2508432	Cable Tool	12.50	Water Supply	Domestic	11.89	2.40	-	-
88	2508700	Cable Tool	14.60	Water Supply	Domestic	14.63	4.00	-	-
89	2509519	Cable Tool	45.10	Water Supply	Domestic	44.81	13.40	-	-
90	2516794	Rotary (Convent.)	3.00	Observation Wells	-	-	-	0.90	3.00
91	7128380	Rotary (Convent.)	3.50	Observation Wells	Other	-	-	1.00	3.50
92	7368600	Auger	6.10	Observation Wells	Monitoring	4.57	4.60	4.57	6.10
93	7368602	Auger	13.70	Observation Wells	Monitoring	10.67	10.70	10.67	13.72
94	7380144	Auger	6.10	Observation Wells	Monitoring	-	-	4.57	6.10
95	7380145	Auger	13.70	Observation Wells	Monitoring	-	-	12.19	13.72

Notes:

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**metres below ground surface

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APPENDIX 'B'

SINGLE WELL RESPONSE TEST RESULTS

REFERENCE NO. 2201-W051B

Falling Head Test (Slug Test)

Test Date:		27-May-22	
Piezometer/Well No.:		BH/MW 7	
Ground level:		184.17	m
Screen top level:		183.17	m
Screen bottom level:		182.57	m
Test El. (at midpoint of screen):		182.87	m
Test depth (at midpoint of screen):		1.3	m
Screen length	L=	0.6	m
Diameter of undisturbed portion c	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.6415	m
Initial water depth		0.71	m
Aquifer material:		**SAND & GRAVEL**	

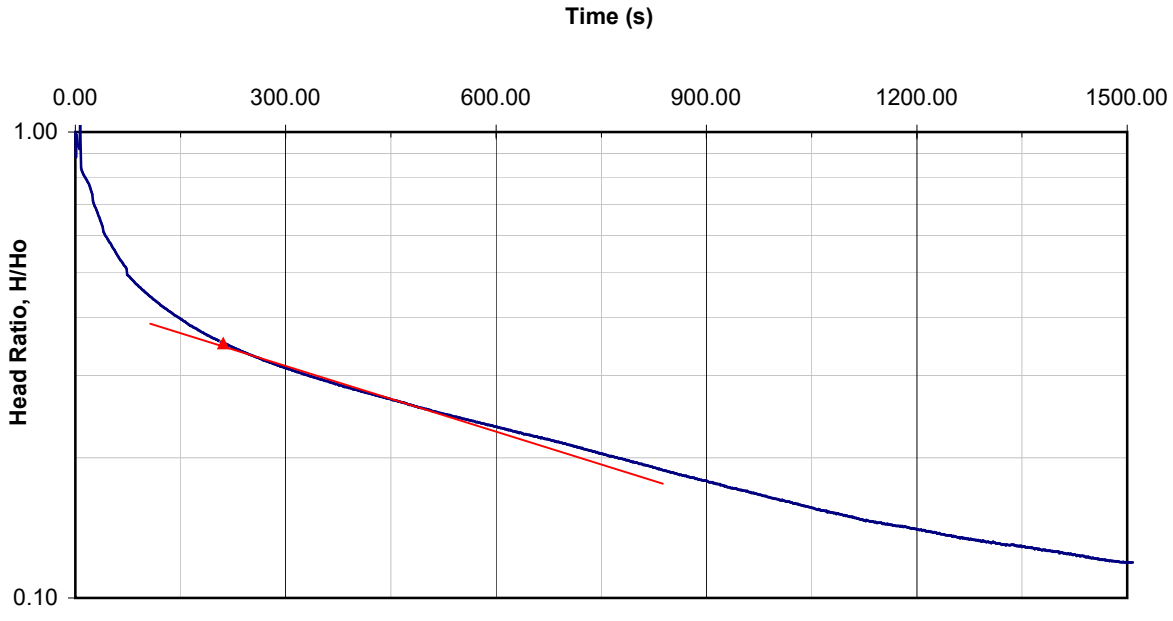
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 2.222236$ m

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

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00199671$

K= **1.8E-04** cm/s

1.8E-06 m/s



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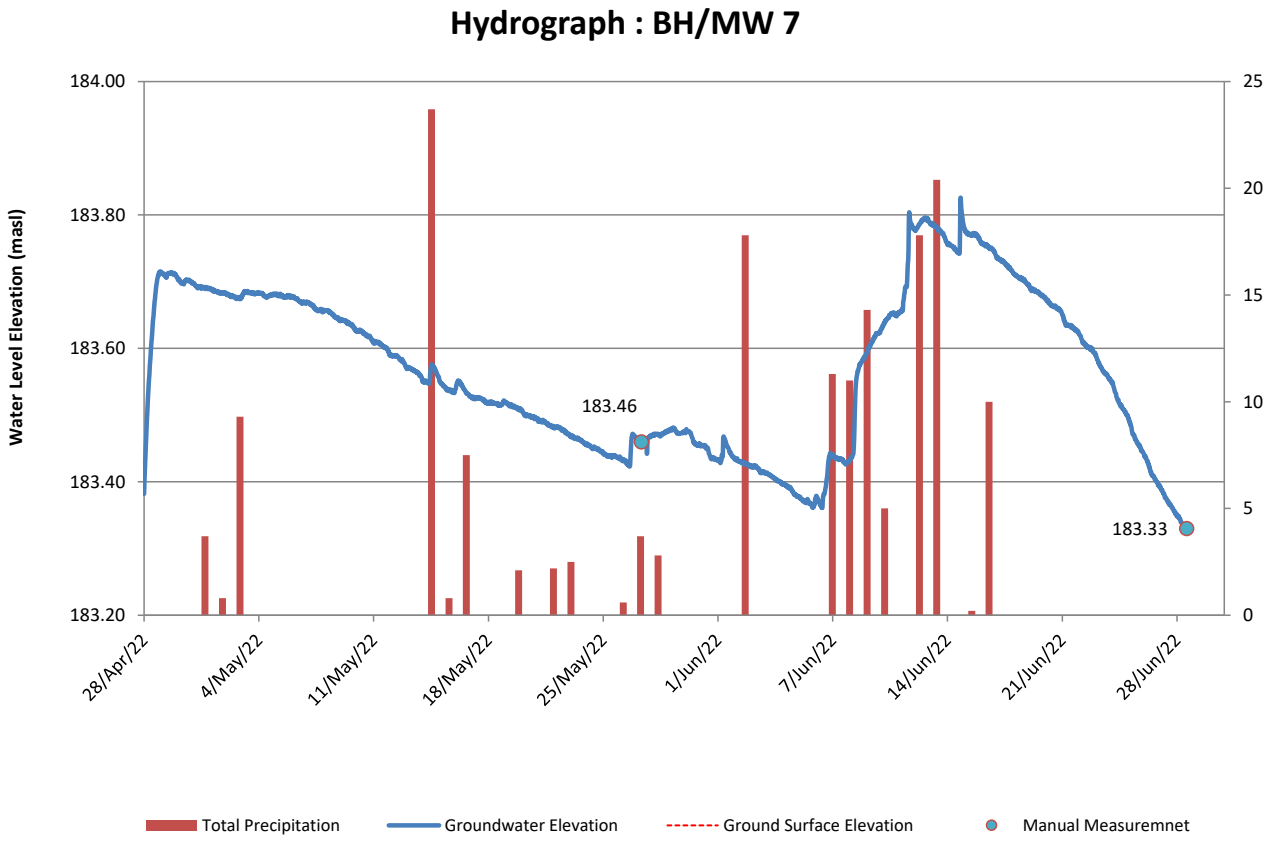
APPENDIX 'C'

HYDROGRAPH

REFERENCE NO. 2201-W051B



Soil Engineers Ltd

Water Level Hydrograph
BH/MW 7

Project:

Proposed Residential Development

Date: September 2023

Ref. No.: 2201-W051B

Scale: NTS

Figure No. 1