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

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	MUSKOKA	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

A REPORT TO
13750701 CANADA INC.

A HYDROGEOLOGICAL ASSESSMENT FOR PROPOSED RESIDENTIAL SUBDIVISION

4646 COUNTY ROAD 2
MUNICIPALITY OF PORT HOPE, ON
L1A 3V5

REFERENCE NO. 2402-W021

JULY 23, 2024

DISTRIBUTION

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EXECUTIVE SUMMARY

Soil Engineers Ltd. (SEL) was retained by 13750701 Canada Inc. to conduct a hydrogeological assessment for proposed residential subdivision at 4646 County Road 2, in the Municipality of Port Hope (the Subject Site).

The Subject Site is located at the southeast corner of the intersection of Dale Road and County Road 2, approximately 900 m north of Highway 401. It is currently occupied by a farm field with one dwelling and associated driveway at the northwest corner of the Subject Site.

Based on the review of the Preliminary Development Plan, prepared by Candevcon Limited, dated July 14, 2023, and per the oral communication (phone call) with the Mr. Ramesh Konda on May 24, 2024, it is understood that the existing dwelling will be retained, and the remaining of the Subject Site will be developed into a residential subdivision with 11 lots with one (1) level of basement, an access roadway and municipal services.

The current investigation revealed that:

- The Subject Site is underlain by a native stratum of silty sand till the termination depth of the investigation at 6.6 metres below ground surface (mbgs).
- Groundwater was monitored within the silty sand till unit. The highest and lowest shallow groundwater level was measured at El. 137.1 masl and 140.4 mals at BH/MW 1 and BH/MW 2, respectively.
- Estimated hydraulic conductivity using single well response test (SWRT) ranges from 5.32×10^{-7} m/sec at BH/MW 5 to 4.93×10^{-6} m/sec at BH/MW 1 for the screened silty sand till unit.
- Groundwater quality for one (1) collected sample from BH/MW 1 meets the Municipality of Port Hope Sanitary and Storm Sewer Use By-Law limits.
- Based on the preliminary estimates, the anticipated dewatering flow rate for short-term construction activities including groundwater seepage with a safety factor of 1.5 and stormwater associated with the proposed houses range from a minimum rate of 51,200.0 L/day to a maximum rate of 94,100.0 L/day for excavation and construction of the basements.
- Findings of the preliminary estimated long-term foundation drainage flow rates show that the anticipated groundwater seepage considering a safety factor of 1.5 ranges between 16,000.0 L/day and 35,900.0 L/day. The total anticipated long-term foundation drainage flow rate considering infiltration due to storm events and groundwater seepage with a safety factor of 1.5 ranges between 34,979.0 L/day and 60,811.6.0 L/day.

- Considering the findings of the preliminary short-term dewatering assessment and anticipated dewatering flow calculated for each proposed lots that well be excavated and constructed below the shallow groundwater table, filing EASR with MECP is required if the proposed excavation and construction is completed over phases. Additionally, obtaining a discharge permit from the Municipality of Port Hope may be required, if the potential collected discharge water during construction is proposed to be discharged to the municipal's sewer system.
- A review of the preliminary estimated long-term foundation drainage flow rates indicates that anticipated groundwater flow does not exceed 50,000 L/day for post-construction houses with 1-level basement that will be constructed below shallow groundwater table. As such, filing PTTW with MECP is not required. However, obtaining discharge agreement from the Municipality of Port Hope is required if long-term foundation drainage effluent is proposed to be conveyed to the municipal's sewer system.
- Groundwater quality result indicates that groundwater quality sample collected from a selected monitoring well (BH/MW 1) meets the Municipality of Port Hope Storm and Sanitary Sewer Use By-Law standards. As such, significant pre-treatment is not required prior to discharge to the region's sewer system.
- The conceptual ZOI for dewatering may reach a maximum of 49.4 m away from the dewatering area in the area of the proposed houses. As per the conceptual ZOI, nearby building structures and public roads are partially located within the conceptual ZOI for dewatering. As a such, potential risk for ground settlement is expected due to dewatering. It is recommended a professional geotechnical engineer is consulted in advance of excavation and construction. However, considering the early stage of the project, the potential risk for ground settlement should be assessed when further details become available for review.
- A record review indicates that natural heritage features including wooded areas, wetland, watercourses and ANSI were not identified within the conceptual ZOI for dewatering at the Subject Site. As such, impacts to surface water, wetlands, and areas of natural significance are not anticipated pertaining to the proposed construction.
- A review of the MECP well records confirmed that there are fifty-nine (59) records for water supply well that is registered within 500 m of the Subject Site Study Area. There are three (3) records of domestic water supply well located within the Subject Site. It is recommended that the three (3) wells located within the Subject Site to be decommissioned in advance of construction should it still exist. Additionally, seven (7) of the records are in the adjacent properties of the Subject Site. As such, impacts to water supply wells within the ZOI are anticipated and a door-to-door well survey will be required in advance of, during and after construction. However, considering the early

stage of the project, the potential risk for local groundwater users should be assessed when further details become available for review.

1.0 INTRODUCTION

1.1 Site Location and Project Description

Soil Engineers Ltd. (SEL) was retained by 13750701 Canada Inc. to conduct a hydrogeological assessment for the proposed residential development at 4646 County Road 2, Municipality of Port Hope (the Subject Site). The location of the Subject Site is shown on **Drawing 1**.

The Subject Site is located at the southeast corner of the intersection of Dale Road and County Road 2, approximately 900 m north of Highway 401. It is currently occupied by a farm field with one dwelling and associated driveway at the northwest corner of the Subject Site. The Subject Site is surrounded by residential properties to the north and west, and a farm field to the east and south.

Based on the review of the Preliminary Development Plan, dated July 14, 2023, prepared by Candevcon Limited, it is understood that the existing dwelling will be retained, and the remaining of the Subject Site will be developed into a residential subdivision with 11 lots with one (1) level of basement, an access roadway and municipal services.

1.2 Project Objectives

The current hydrogeological assessment report presents the regional and local setting of the Subject Site. The findings of the fieldwork, including subsoil investigation, groundwater level monitoring, groundwater quality assessment, and hydraulic conductivity testing are presented in the report. Potential needs for short-term dewatering and long-term foundation drainage control are assessed, and hydrogeological impacts of the proposed development to the nearby groundwater receptors including water supply wells, natural heritage features, and structures are assessed (if applicable). This report provides comments on the potential impacts of the proposed development to the groundwater receptors, and structures. Comments and recommendations are provided on any needs for applying for a Permit to Take Water (PTTW), or posting Environmental Activity and Sector Registry (EASR) with the Ministry of the Environment, Conservation and Parks (MECP).

The current report is prepared in consideration of the Ontario Water Resource Act, Ontario Regulation (O. Reg.) 387/04.

1.3 Scope of Work

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

- *Background Review:* Available background geological and hydrogeological information for the Subject Site including topographic mapping, surface geological, natural heritage features databases,

Municipality of Port Hope official plans, Ganaraska Region Conservation Authority (GRCA) regulated area plans, and MECP water well records were reviewed.

- *Fieldwork:* Fieldwork includes inspecting the Subject Site and surrounding properties with respect to the natural features, groundwater receptors, and structures, as well as installing and developing the monitoring wells. Additionally, groundwater levels within the installed monitoring wells were monitored over three (3) monitoring events, in-situ hydraulic conductivity testing was completed within the installed monitoring wells. One (1) set of groundwater samples was collected and submitted to a CALA laboratory to characterize groundwater quality in comparison with the Municipality of Port Hope Sanitary and Storm Sewer Use By-Law (By-Law No. 30/94) parameters.
- *Short-Term Dewatering and Long-Term Drainage Flow Rate:* Based on a review of the available conceptual site plan, findings of the current subsurface investigation, and recommendations provided in the geotechnical investigation report (if available), preliminary short-term dewatering and long-term drainage flow rates including groundwater seepage, and anticipated water that should be collected over potential storm events were calculated. A preliminary mitigation plan was recommended to mitigate potential short-term dewatering impacts to the nearby groundwater receptors (including natural heritage features and water supply wells), and structures, if applicable.
- *Permit Requirements:* Considering the estimated preliminary short-term construction dewatering and long-term drainage flow rates, recommendations were provided on any need for applying for a PTTW or posting on the EASR with the MECP, if required.

2.0 APPLICABLE REGULATIONS AND OFFICIAL PLANS

The regulations and policies are relevant to this hydrogeological assessment and the location of the Subject Site within the official plans are summarized below.

2.1 Ganaraska Region Conservation Authority (GRCA) Policies and Regulation (O. Reg. 168/06)

Under Section 28 of the Conservation Authorities Act, local conservation authorities are mandated to protect the health and integrity of the regional greenspace system, and to maintain or improve the hydrological and ecological functions performed by valley and stream corridors. The GRCA, through its regulatory mandate, is responsible for issuing permits under O. Reg. 168/06, Development, Interference with Wetlands and Alterations to Shorelines and Watercourses for development proposals or Site alteration work to shorelines and watercourses within the regulated areas. There was no open to public data on the GRCA regulated areas to review.

2.2 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 of 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.

Based on a regional-scale source water protection mapping (Source Water Protection Information Atlas) provided by the MECP updated on April 19, 2024, the Subject Site is not located within a WHPA area, an issue contributing area, intake protection zone, event based area, HVA or SGRA.

2.3 Municipality of Port Hope Official Plan

The Municipality of Port Hope Official Plan sets up policies that deal with legislative and administrative concerns, guides physical growth, and addresses social, economic, and environmental concerns. The Official Plan provides land use planning designations and identifies areas of environmental significance where more stringent policies may apply for development applications.

Municipality of Port Hope Official Plan maps were reviewed for the current study with the results summarized below:

- Schedule B (Development Constraints) – A review of the map, dated November 2016, indicates that the Subject Site is not located within the area designated as Natural Heritage System.
- Schedule B-2 (Development Constraints - Hazards) – A review of the map, dated November 2016, indicates that the Subject Site is not located within the area designated as Natural Hazrds.
- Schedule B-3 (Drinking Water Protection Vulnerable Areas) – A review of the map, dated November 2016, indicates that the Subject Site is partially located within the area designated as Highly Vulnerable Aquifer.
- Schedule C (Land Use) – A review of the map, dated November 2016, indicates that the Subject Site is located within the area designated as Hamlet.
- Schedule E (Community Character) – A review of the map, dated November 2016, indicates that the Subject Site is located within the area designated as Rural Settlement.

3.0 METHODOLOGY

3.1 Borehole Advancement and Monitoring Well Installation

An initial field work of drilling boreholes and construction of monitoring wells were conducted for geotechnical and hydrogeological investigations by SEL on February 28, 2024. The program consisted of the drilling of five (5) boreholes (BH) and the installation of five (5) monitoring wells (BH/MW) for hydrogeological assessment purposes. The locations of the boreholes and monitoring wells are shown on **Drawing 2**.

Borehole drilling and monitoring well construction were completed by a licensed water well contractor, under the full-time supervision of SEL's geotechnical supervisor who logged the soil strata encountered during borehole advancement and collected representative soil samples for textural classification. The boreholes were drilled using a track-mounted drill rig equipped with continuous flight, solid-stem augers. Detailed descriptions of the encountered subsoil and groundwater conditions as well as a grain size distribution graph are provided by SEL and presented on the borehole and monitoring well logs, in the enclosed **Appendix A**.

The monitoring wells were constructed using 50-mm diameter Trilock pipes and a 1.5 m long 10-slot well screen, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. All monitoring wells were equipped with monument protective casing at the ground surface.

The UTM coordinates and ground surface elevations at the monitoring wells' locations, as well as the monitoring well construction details, are presented in **Table 3-1**. The ground surface elevations and horizontal coordinates at the monitoring well locations were determined at the time of the investigation, using a Trimble TSC3 handheld Global Navigation Satellite System.

Table 3-1 – Monitoring Well Installation Details

Monitoring Well ID	Installation Date	UTM Coordinates (m)		Ground El. (masl)	Screen Interval (mbgs)	Soil in the Screen Interval	Casing Dia. (mm)	Protective Casing Type
		Easting	Northing					
BH/MW 1	February 28, 2024	713286.3	4872379.7	138.1	4.7-6.2	Silty Sand Till	50	Monument
BH/MW 2	February 28, 2024	713523.1	4872449.9	140.7	4.6-6.1	Silty Sand Till	50	Monument
BH/MW 3	February 28, 2024	713409.7	4872418.1	140.0	4.6-6.1	Silty Sand Till	50	Monument
BH/MW 4	February 28, 2024	713453.3	4872316.1	140.1	4.6-6.1	Silty Sand Till	50	Monument
BH/MW 5	February 28, 2024	713542.9	4872326.6	140.3	4.7-6.2	Silty Sand Till	50	Monument

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

3.2 MECP Water Well Records Review

MECP Water Well Records (WWRs) were reviewed for the registered wells located within 500 m radius of the Subject Site (Study Area). The water well records indicate that one hundred ninety-nine (99) wells are located within the 500 m zone of influence Study Area relative to the Subject Site. The findings of the MECP well records are summarized in the **Section 4.6** of the current report.

3.3 Groundwater Monitoring

Five (5) monitoring wells installed in February 2024 were utilized to measure and monitor groundwater levels. Monitoring wells were developed, and the groundwater monitoring program confirmed the stabilized groundwater level beneath the Subject Site. The stabilized groundwater levels were manually measured over three (3) monitoring events on March 7 and 28, 2024 and April 17, 2024 with the results presented in **Section 6.1**.

3.4 In-Situ Hydraulic Conductivity Test

SEL has conducted in-situ hydraulic conductivity tests (falling head or rising head) at all previously installed five (5) BH/MWs on March 28, 2024. The in-situ hydraulic conductivity test (falling head and rising head) provides estimated hydraulic conductivity (K) for subsoil strata at the depths of the well screens. The monitoring wells were developed in advance of the tests. Well development involves the purging and removal of groundwater from each monitoring well to remove remnants of clay, silt and other debris introduced into the monitoring well during construction, and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata formation at the well screen depths.

The in-situ falling head hydraulic conductivity test involves the placement of a slug of known volume into the monitoring well, below the water table, to displace the groundwater level upward. The in-situ rising head hydraulic conductivity test involves removing a volume of water from the monitoring well to displace the groundwater level downward. The rate at which the water level recovers to static conditions (rising head/falling head) is tracked manually using a water level tape and a data logger. Slug tests in the monitoring wells with partially submerged screens may exhibit a double straight-line effect due to the filter pack drainage. Therefore, the data that represents the filter pack around the screen is eliminated during the interpretation of the slug test. The rate at which the water table recovers to static conditions is used to estimate the K value for the water-bearing strata formation at the well screen depth using the Bouwer and Rice method (1976). The findings for the hydraulic conductivity testing are presented in **Section 6.3** of the current report.

3.5 Groundwater Quality Assessment

Groundwater quality assessment was completed by SEL on April 17, 2024. One (1) set of groundwater samples was collected from one (1) selected monitoring well (BH/MW 1) to characterize its quality for evaluation against the Municipality of Port Hope Sanitary and Storm Sewer Use By-Law (By-Law No. 30/49) parameters. This is performed to assess whether any anticipated dewatering effluent can be disposed of into the Municipality of Port Hope sanitary and/or storm sewer system during construction. Based on the results, recommendations for any pre-treatment for any dewatering effluent can be developed, if required.

The sample analysis was performed by SGS Canada Inc. and the results of the analysis are discussed in **Section 6.4** of the current report.

3.6 Review of Regional Data and Available Reports for the Subject Site

The maps, data, and documents provided by the MECP, Ontario Geological Survey (OGS), Ministry of Natural Resource and Forestry (MNRF), Oak Ridges Moraine Groundwater Program (ORMGP), and GRCA were reviewed. Additionally, the geotechnical investigation report, dated April 2024 was reviewed at the time of preparation of the current hydrogeological assessment report, with the findings summarized in **Sections 4, 5 and 7.2**.

4.0 REGIONAL AND LOCAL SITE SETTING

4.1 Regional Geology

The current understanding of the surface geological setting of the Subject Site is based on scientific work conducted by the OGS (OGS, 2003). The northwest portion of the Subject Site is located within an area mapped as glacial deposits (8a) comprising silt and clay minor sand and gravel. The remaining portions of the Subject Site is mapped on Till (5b) (Newmarket/Northern/Bowmanville Till), comprising stone-poor, sandy silt to silty sand-textured till. **Drawing 3** illustrates the mapped surficial geology for the Subject Site and the surrounding area.

The Oak Ridges Moraine Groundwater Program (ORMGP) produced a cross-sectional geological map to aid in the characterization of the general area. Considering the regional cross-section, it is understood that the overburden units prevalent in this area are as follows, with the youngest unit at the top:

- *Undifferentiated Sediments:* Undifferentiated sediments present at the ground surface, with an approximate thickness between 0 m and 0.4 m.
- *Oak Ridges Moraine:* The Oak Ridges Moraine Aquifer Complex (ORAC) is a regionally significant aquifer in southern Ontario. A majority of the aquifer's recharge occurs at the crest of the moraine north of the Site. It is primarily composed of interbedded fine sand and silt deposits with localized coarse sand and gravel deposits. The ORAC is approximately 90 m thick beneath the crest of the moraine, but thins out rapidly towards the margins. Approximate thickness of the ORAC could range from 0.6 m to 1.7 m beneath the Subject Site.
- *Newmarket Till:* The Newmarket Till is a regionally extensive till formation that acts as an aquitard separating the Oak Ridges Aquifer Complex (ORAC) from the underlying Thorncliffe Formation. Based on the ORMGP cross-section, Newmarket Till is mapped beneath the ORAC. The Newmarket Till can be contacted beneath the ORAC. The Newmarket Till (Lower Newmarket Till) has an approximate thickness ranges from 21.5 to 34.0 m beneath the Subject Site.
- *Thorncliffe Formation:* The Thorncliffe Formation consists of glaciofluvial and glaciolacustrine sand and silt deposited approximately 30,000 to 50,000 years ago. The Thorncliffe Formation shows a considerable variation in grain size and thickness, both locally and regionally. It acts as a regional aquifer. Based on the ORMGP cross-section, the thickness of the Thorncliffe range from 3.0 m to 17.5 m beneath the Subject Site.
- *Sunnybrook Drift:* The Scarborough Formation is composed of clay, silt, and sand sediments in a deltaic sequence. It acts as an aquifer of regional extent. This unit is mostly found within bedrock valleys and thins laterally away from the valleys. Based on the ORMGP cross-section, the thickness to the Scarborough Formation ranges from 3.0 m to 4.5 m beneath the Site.

The underlying bedrock at the Subject Site is the Lindsay Formation, which consists of limestone along with shale (OGS, 2007). A review of the ORMGP cross-section indicates that the bedrock could be contacted at an approximate elevation between 94.5 metres above sea level (masl) and 96.0 masl beneath the Subject Site.

4.2 Regional Physiography

The Subject Site is located within a regional physiography of southern Ontario known as Iroquois Plain. The Iroquois Plan within the vicinity of the Subject Site consists of clay plains. The Iroquois Plain occupies the lowland bordering Lake Ontario, when the last glacier was receding but still occupied the St. Lawrence Valley, was inundated by a body of water known as Lake Iroquois which emptied eastward at Rome, New York State. Its old shorelines, including cliffs, bars, beaches, and boulder pavements are easily identifiable features, while the undulating till plains above stand in strong contrast to the lake bottom which has been smoothed by wave action or lacustrine deposits. The latter area is the Iroquois plain which is discussed in this section, excluding the areas to the east which were flooded by Lake Iroquois but which, because of shallow soils, are treated elsewhere. The Iroquois plain extends around the western part of Lake Ontario, from the Niagara River to the Trent River, a distance of 306 kilometres its width varying from a few hundred metres to about 13 kilometers. Then it extends inland to include a large area in the Trent River valley. Conditions in the old lake plain vary greatly and it is convenient to divide it into a number of sub-sections for purposes of discussion (Chapman and Putnam, 1984). **Drawing 4** shows the location of the Subject Site within the regional physiography map.

4.3 Regional Topography and Drainage

A review of a regional topography map presented on **Drawing 5** indicates that the topography of the Subject Site exhibits a gradual decline towards the west/southwest direction.

The ground surface elevation ranges approximately between 138.1 and 140.7 masl, based on ground surface elevations measured at the borehole and monitoring wells' locations.

4.4 Watershed Setting

The Subject Site is located within the Ganaraska River Watershed that falls in the Ganaraska Region Conservation Authority (GRCA) jurisdiction. The Ganaraska River Watershed is recognized for its fisheries, aquatic habitat, terrestrial natural heritage and recreational opportunities. The Ganaraska River Watershed within the Ganaraska Region Conservation Authority (GRCA) drains to Lake Ontario as it passes through the City of Kawartha Lakes, the Township of Cavan Monaghan, and the Municipality of Clarington within the Regional Municipality of Durham, the Municipality of Port Hope and the Township of Hamilton, which are both in Northumberland County. The watershed is a dynamic and unique place with complex webs of

natural features, functions, and interactions among the soil, water, air, plants and animals. These features and functions in a watershed need to be conserved for the benefit of the local environment, watershed and community (GRCA, 2010).

4.5 Local Surface Water and Natural Heritage Features

MNRF database was reviewed for any natural heritage features including, watercourses, bodies of water, wetland features, Area of Natural and Scientific Interest (ANSI) and wooded areas. Details are presented below. **Drawing 6** shows the location of the Subject Site within the surrounding Natural Heritage Features.

Record review indicates that the closest wooded areas are located approximately 253 m to the northwest of the Subject Site. Record review indicates that the watercourse, a tributary of Ganaraska River, is located approximately 99 m to the west of the Subject Site.

4.6 Ground Water Resources (MECP Well Records)

MECP well record database was reviewed for records located within a radius of 500 m from the approximate Subject Site (Study Area). The records indicate that one hundred ninety-nine (99) well records are located within the Study Area relative to the Subject Site boundaries. A summary of the first and final status of the records, obtained from the records review is presented in **Table 4-1**.

The locations of the well records, based on the UTM coordinates provided by the records, are shown on **Drawing 7**. Details of the MECP water well records that were reviewed are provided in **Appendix B**.

Table 4-1 – MECP Well Record Summary

Water Use- Final Status		Water Use- First Status	
Status	**Number of Records**	**Status**	**Number of Records**
Water Supply	59	Domestic	50
Abandoned-Other	26	Unknown	33
Unknown	5	Commercial	5
Test Hole	3	Public	4
Monitoring and Test Hole	3	Test Hole	3
Abandoned-Supply	2	Livestock	3
Abandoned-Quality	1	Not Used	1
Total	**99**	**Total**	**99**

The above summary indicates that there are fifty-nine (59) records of wells with the final status of water supply wells in the Study Area.

4.7 Active Permit to Take Water Application Record Review

MECP website was reviewed for any active PTTW application records within 1.0 km radius of the Subject Site on June 13, 2024. Record review indicates there is no record for active PTTW within 1 km radius of the Subject Site.

5.0 SOIL LITHOLOGY AND SUBSURFACE INVESTIGATION

The subsoil investigation has revealed that beneath the topsoil, the Subject Site is underlain by a native stratum of silty sand till. Information regarding borehole logs and grain size distributions is presented in **Appendix A** on **Figure 1 to 6**. The approximate locations of boreholes are shown on **Drawing 2**. Additionally, a key plan and subsoil profiles are presented on **Drawing 8-1, 8-2A** and **8-2B**, respectively. Based on a review of the borehole logs, the stratigraphy beneath the investigated areas of the Subject Site generally consists of the followings:

5.1 Topsoil

The ground surface is covered by a topsoil veneer, approximately 25 to 36 cm in thickness. Thicker topsoil may occur in low lying areas beyond the borehole locations.

5.2 Silty Sand Till

The silty sand till was encountered beneath the topsoil veneer and extended to the termination depth in all boreholes. It consists of a random mixture of soil particle sizes ranging from clay to gravel, with the sand and silt being the predominant fraction. Grain size analyses were performed on three selected samples of the silty sand till; the results are plotted on **Appendix A (Figure 6)**.

5.3 Bedrock

No bedrock was observed within the maximum depth of investigation, which is 6.6 metre below ground surface (mbgs).

6.0 LOCAL HYDROGEOLOGICAL STUDY

6.1 Monitoring Well Development and Groundwater Level Monitoring

The groundwater levels in the monitoring wells were measured, manually on March 7, March 28 and April 17, 2024 to record the fluctuation of the shallow groundwater table beneath three sections of the Subject Site.

Monitoring wells were developed and groundwater levels were monitored over three (3) monitoring events. SEL measured the groundwater levels using an interface probe (Solinst Interface Metre). A summary of the groundwater level observations and their corresponding elevations are provided in **Table 6-1**.

Table 6-1 – A Summary of Groundwater Monitoring

MW ID	Unit	Groundwater Level		
		March 7, 2024	March 28, 2024	April 17, 2024
BH/MW 1	mbgs	0.97	0.66	0.62
	masl	**137.13**	137.44	137.48
BH/MW 2	mbgs	0.39	0.3	0.36
	masl	140.31	**140.40**	140.34
BH/MW 3	mbgs	0.29	0.19	0.16
	masl	139.71	139.81	139.84
BH/MW 4	mbgs	0.69	0.59	0.51
	masl	139.41	139.51	139.59
BH/MW 5	mbgs	0.75	0.56	0.60
	masl	139.55	139.74	139.70

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

As shown in **Table 6-1**, the groundwater levels range from the highest at 140.40 masl to the lowest at 137.13 masl at BH/MW 2 and BH/MW 1, respectively.

6.2 Shallow Groundwater Flow Pattern

The shallow groundwater flow pattern at the Subject Site is shown on **Drawing 9**. The recorded groundwater level measured on April 17, 2024 was considered for interpretation of the shallow groundwater direction beneath the Subject Site. A review of the interpreted shallow groundwater flow pattern indicates that shallow groundwater flows southwest/southerly direction.

6.3 Hydraulic Conductivity Testing

6.3.1 Single Well Response Test

All five (5) BH/MWs underwent a single well response testing (SWRTs) on March 28, 2024, to assess the hydraulic conductivity (K) for saturated shallow aquifer or water bearing unit at the depths of the well screens. Each monitoring well was equipped with a digital transducer to record the fluctuation made to complete the SWRT. The results of the SWRT tests are presented in **Appendix C**, with a summary of the findings provided in **Table 6-2**.

Table 6-2 – A Summary of In-Situ Hydraulic Conductivity Testing

Well ID	Ground El.	Monitoring Well Depth	Screen Interval	Screened Soil Strata	Hydraulic Conductivity (K)	Test Method
	(masl)	(mbgs)	(mbgs)		(m/sec)	
BH/MW 1	138.1	6.2	4.7-6.2	Silty Sand Till	4.93×10^{-6}	Falling Head Test
BH/MW 2	140.7	6.1	4.6-6.1	Silty Sand Till	4.80×10^{-6}	Falling Head Test
BH/MW 3	140.0	6.1	4.6-6.1	Silty Sand Till	2.38×10^{-6}	Falling Head Test
BH/MW 4	140.1	6.1	4.6-6.1	Silty Sand Till	1.67×10^{-6}	Falling Head Test
BH/MW 5	140.3	6.2	4.7-6.2	Silty Sand Till	5.32×10^{-7}	Falling Head Test

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

The findings of SWRTs reveal that the hydraulic conductivity (K) for the water bearing units underneath the Subject Site ranges from 5.32×10^{-7} m/sec at BH/MW 5 to 4.93×10^{-6} m/sec at BH/MW 1.

6.3.2 Hydraulic Conductivity Test Using Grain Size Distribution Graphs

The Hazen Equation method was adopted to estimate the hydraulic conductivity (K) for different soil layers that may contain groundwater during the seasonal high-water table (spring) period, or if they are not encountered within the screen intervals.

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

$$\boldsymbol{K = A d_{10}^{\,2}}$$

where;

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

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

The Hazen Equation estimation provides an indication of the groundwater yield capacity for saturated soil

strata at the depths where soil samples were selected for grain size analysis. The grain size distribution graphs prepared for the geotechnical investigation were used to estimate the hydraulic conductivity, with the details presented in **Appendix A**. The results of the Hazen equation are provided in **Table 6-3**, below.

Table 6-3 – A Summary of Hydraulic Conductivity Using Hazen Equation

Monitoring Well ID	Soil Sample Depth and (ID)	Soil Sample Elevation	Soil Strata	Hydraulic Conductivity
	(mbgs)	(masl)		(m/s)
BH/MW 1	4.8 (6)	133.3	Silty Sand Till	1.56×10^{-8}
BH/MW 5	3.3 (5)	137.0	Silty Sand Till	1.56×10^{-8}

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

The K estimates determined using the Hazen method suggests a hydraulic conductivity of 1.56×10^{-8} m/sec for the silty clay till.

6.4 Groundwater Quality

Groundwater quality assessment was completed by SEL on April 17, 2024. One (1) set of groundwater samples was collected from one (1) selected monitoring well (BH/MW 1) to characterize its quality for evaluation against The Municipality of Port Hope Sewer Use By-Law (By-Law No. 30/94) parameters. Upon sampling, all of the bottles were placed in a cooler for shipment to the analytical laboratory. Sample analysis was performed by SGS Canada Inc., which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Results of the analysis are provided in **Appendix D**, with a discussion of the findings provided below. The chain of custody number for the submitted samples that underwent analysis is 035831.

As per the protocols for Municipality of Port Hope Sewer Use analysis, a complete set of unfiltered groundwater samples were submitted to the laboratory with the results being presented as totals for various analyzed parameters.

The results of analysis for the unfiltered groundwater indicate all parameters pass the Municipality of Port Hope Sanitary and Storm Sewer Use By-Law. As such, significant pre-treatment will not be required prior to groundwater discharge.

7.0 DISCHARGE WATER CONTROL

7.1 A review of Proposed Development Plans

Based on a review of the Preliminary Development Plan prepared by Candevcon Limited, dated July 14, 2023, it is understood that the existing dwelling at the Subject Site will be retained (Lot 1), and the remaining of the Subject Site will be developed into a residential subdivision with 11 lots with one (1) level of basement, an access roadway and municipal services. The reviewed plan is presented as **Appendix E**. At the time of preparation of this report, detailed design drawings, grading plans, and sections presenting the lowest Finished Floor Elevation (FFE) are not available for review.

7.2 A review of Geotechnical Report

A review of the Geotechnical Investigation report, Reference No. 2402-S021, dated April 2024, prepared by SEL indicates that:

- Prior to site grading, the vegetation and topsoil must be removed and can only be reused in landscaped areas of the subdivision. Any surplus must be removed off site.
- The badly weathered soils should be subexcavated, inspected, sorted free of organics and other deleterious material before reusing for structural backfill or engineered fill applications.
- Where site grading with additional fill is required, the imported fill can be constructed in accordance with the engineered fill specifications for supporting the house footings, underground services and pavement construction. The final site grading plan needs to be reviewed by a geotechnical engineer to confirm the soil bearings.
- The proposed structures can be supported on conventional footing founded on engineered fill or sound native soil below the frost penetration depth. The footing subgrade must be inspected by the geotechnical engineer or a senior geotechnical technician to ensure that the revealed conditions are compatible with the foundation design requirements.

7.3 Construction Dewatering Requirements

Based on the available design drawing with the details discussed in Section 7.1, the following sections present the estimated dewatering flow rates for each portion separately.

7.3.1 Methodology

Short-Term Dewatering Flow Rate Estimate: The pumping rate calculation for the construction for the proposed development was performed based on the assumption with each excavation acting as trench considering the dimensions of the proposed excavation boxes. The calculation was based on the equations provided by Powers et al. (2007). For the purposes of this analysis, steady sate follow into an open excavation is assumed. Additionally, the equations of radial flow have the following assumptions:

- Ideal aquifer conditions (homogeneous, isotropic, uniform thickness and infinite areal extent);
- Fully penetrating pumping well;
- Only uniform lateral flow to the pumping well; and
- Constant pumping rate with the flow to the pumping well reaching steady state.

The following equations were used to compute the dewatering rates required for the proposed constructions within the footprint of the proposed conventional footings, which are based on unconfined aquifer conditions (Powers et. al., 2007):

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where,

Q	=	Anticipated pumping Rate (m3/day)
K	=	Hydraulic Conductivity (m/day)
H	=	Distance from the static water level to the bottom of the saturated aquifer (m)
h	=	Depth of water in the well while pumping (m)
R_0	=	Distance from a point of greatest drawdown to a point where there is zero drawdown (radius of influence) (m)
r_s	=	Distance to the wellpoints from the centre of the trench, assumed to be half of the trench width (m).
X	=	Trench Length (m)
L	=	Distance from a line source to the trench, R_0 (m)/2

The calculated pumping rate was multiplied by a factor of safety of 1.5 to account for uncertainties and natural variability in the range of hydraulic conductivity. Details are presented in **Appendix F** and following sections.

Zone of Influence for Dewatering: An estimate of the Zone of Influence (ZOI) for dewatering in unconfined aquifers can be calculated using the following equation (Bear, 1979):

$$R_0 = 2.45\sqrt{\frac{HK}{S_y}}t$$

Where,

R_o	=	Zone of Influence (m), beyond which there is negligible drawdown
H	=	Distance from initial static water level to bottom of saturated aquifer (m)
Sy	=	Specific yield of the aquifer formation (based on Johnson (1967))
t	=	Time, in seconds, required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)
K	=	Hydraulic Conductivity (m/s)

Anticipated Storm Event: The amount of runoff that could accumulate in the excavation box was also considered for any construction dewatering needs assessment. Additional dewatering may be required to maintain the dry condition of the excavation during and following significant precipitation events. Therefore, the dewatering flow rates at the Subject Site should also include removing stormwater from the excavation.

A review of intensity duration frequency curve (IDF curve) for the year 2010 for the coordinates 43° 58' 15" N, 78° 20' 14" W, the rainfall depth considering 2-year storm event over a 3-hour period per day is approximately 29.83 mm, and a 100-year storm event over a 12-hour period per day is 98.4 mm. The data was taken from the Ministry of Transportation's (MTO) website. The accumulated runoff associated with rainfall events within the anticipated excavations for the proposed basements was calculated using the estimated rainfall depth multiplied by the estimated area of the proposed excavation footprint of the building.

7.3.2 Preliminary Construction Dewatering Flow Rate Calculation

As described in Section 7.1, except for the existing residential building, the Subject Site will be developed into a residential subdivision with 11 lots with one (1) level of basement, an access roadway and municipal services. The reviewed plan is presented as **Appendix E** and **Drawing 2**. Due to the early stage of the project, the dimensions of the proposed dwellings are not available for review. However, the reviewed plan indicates that the area of each lot and the frontage of majority of the lots. Assuming 40% of each lot will be excavated for the construction of basement and the width of the excavation is 25.0 m, the length of each excavation box is estimated as shown in **Table 7-1**.

The summary of proposed construction details, groundwater seepage flow rate estimates, estimated zone of influence, and anticipated maximum drawdown are presented in **Table 7-1** below, and **Appendix F**.

Table 7-1 – Preliminary Groundwater Seepage Flow Rate Estimates for Proposed Houses

Parameters	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 11	Lot 12
	Vicinity of BH/MW 3			Vicinity of BH/MW 4		Vicinity of BH/MW 5			Vicinity of BH/MW 2		
Excavation Box Dimensions (m)	25 x 38.9	25 x 45.8	25 x 45.2	25 x 41.9	25 x 38.6	25 x 42.8	25 x 45.2	25 x 46.6	25 x 41.7	25 x 48.6	25 x 58.5
Excavation Area (m^2)	973.2	1,144.0	1,130.8	1,047.2	965.6	1,068.8	1,130.8	1,164.4	1,042.4	1,215.2	1,462.8
Proposed Ground Floor Elevation (masl)	140	140	140	140.1	140.1	140.3	140.3	140.3	140.7	140.7	140.7
Proposed Basement Floor Elevation (masl)*	137.5	137.5	137.5	137.6	137.6	137.8	137.8	137.8	138.2	138.2	138.2
Assumed Base of Bulk Excavation (masl)*	137.0	137.0	137.0	137.1	137.1	137.3	137.3	137.3	137.7	137.7	137.7
Highest Measured Shallow Groundwater Elevation (masl)	139.9	139.9	139.9	139.6	139.6	139.8	139.8	139.8	140.4	140.4	140.4
Estimated Zone of Influence (m)	35.6	35.6	35.6	28.4	28.4	16.0	16.0	16.0	49.4	49.4	49.4
Anticipated Maximum Drawdown (m)	3.9	3.9	3.9	3.5	3.5	3.5	3.5	3.5	3.7	3.7	3.7
Groundwater Flow Estimate without safety factor (L/day)	20,400.0	21,900.0	21,800.0	15,400.0	14,900.0	13,000.0	13,200.0	13,400.0	28,700.0	30,700.0	33,600.0
Groundwater Flow Estimate with safety factor of 1.5 (L/day)	30,600.0	32,900.0	32,700.0	23,100.0	22,300.0	19,500.0	19,800.0	20,000.0	43,000.0	46,100.0	50,400.0

*Assuming the basement floor elevation extends 2.5 m below ground surface.

**Assuming the excavation for construction the basements will extend 3.0 m below ground surface.

Anticipated water through storm events should also be considered to estimate short-term dewatering flow rates. Considering the location of the Subject Site IDF curve provided by the Ministry of Transportation (MTO) was reviewed to estimate the anticipated flow during the storm event. 29.83 mm storm event (2-year events for a duration of 3 hours) was considered for the current assessment with a summary presented in **Table 7-2**.

Table 7-2 – Preliminary Dewatering Flow Rate Estimates for Proposed Houses (Including Precipitation)

Parameters	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 11	Lot 12
	Vicinity of BH/MW 3			Vicinity of BH/MW 4		Vicinity of BH/MW 5			Vicinity of BH/MW 2		
Excavation Area (m^2)	973.2	1,144.0	1,130.8	1,047.2	965.6	1,068.8	1,130.8	1,164.4	1,042.4	1,215.2	1,462.8
Groundwater Flow Estimate with safety factor of 1.5 (L/day)	30,600.0	32,900.0	32,700.0	23,100.0	22,300.0	19,500.0	19,800.0	20,000.0	43,000.0	46,100.0	50,400.0
Anticipated Storm Flow (2- year storm event with duration of 3 hr/day) (L/day)	29,100.0	34,200.0	33,800.0	31,300.0	28,900.0	31,900.0	33,800.0	34,800.0	31,100.0	36,300.0	43,700.0
Total Anticipated Flow considering 2-year Storm Event (L/day)	59,700.0	67,100.0	66,500.0	54,400.0	51,200.0	51,400.0	53,600.0	54,800.0	74,100.0	82,400.0	94,100.0

Additionally, storm water flow considering 100-year storm event for a duration of 12 hours was considered to estimate the maximum storm water that can be collected during the excavation and construction period. The storm water flow considering 100-year storm event can reach up to 144,000.0 L/day for basement excavation for each excavation box.

7.4 Long-Term Foundation Drainage (Preliminary Estimates)

Groundwater seepage and infiltration flow due to storm event should be collected for the post-construction 1-level basements. As such, a foundation drainage system should be designed to collect the anticipated flow for each basement. The proposed drainage layer elevation for the long-term foundation drainage calculation was considered ranging from 135.1 masl to 137.7 masl for the proposed 1-level basements, which were assumed to be 0.5 m below the proposed basement floor elevation.

Anticipated flow considering 29.83 mm storm event (2-year events for a duration of 3 hours) was considered to estimate the total anticipated long-term foundation drainage flow rate. Summary of the estimated flow rates is presented in **Table 7-3**.

Table 7-3 – Summary of Anticipated Long-term Foundation Drainage Flow Rates – Preliminary

Proposed Development	Groundwater Seepage	Groundwater Seepage S.F.* 1.5	Anticipated Flow through Infiltration	Total Anticipated Foundation Drainage Flow Rates S.F. 1.5
	(L/day)	(L/day)	(L/day)	(L/day)
Lot 2	15,000.0	22,500.0	19,069.7	41,569.7
Lot 3	16,100.0	24,100.0	21,107.7	45,207.7
Lot 4	16,000.0	24,000.0	20,950.2	44,950.2
Lot 5	11,100.0	16,600.0	19,952.7	36,552.7
Lot 6	10,700.0	16,000.0	18,979.0	34,979.0
Lot 7	12,700.0	19,000.0	20,210.4	39,210.4
Lot 8	12,800.0	19,200.0	20,950.2	40,150.2
Lot 9	12,900.0	19,300.0	21,351.1	40,651.1
Lot 10	20,400.0	30,600.0	19,895.4	50,495.4
Lot 11	21,800.0	32,700.0	21,957.3	54,657.3
Lot 12	23,900.0	35,900.0	24,911.6	60,811.6

*S.F. – Safety Factor

The above estimated flow rate does not include potential long-term flow for sump pit or any other localized structures that may extend below the drainage layer, assuming the above noted structures will be waterproofed for post-development structure.

7.5 Permit Requirements

The detailed design for the proposed development as well as the method of construction are not available for review at the time of preparation of the current report. The following permit requirement recommendations are based on preliminary assumptions for short-term construction dewatering and long-term foundation drainage calculations. As such, the permit requirements should be revised when further information become available for review.

Short-Term Construction Dewatering: Water takings of more than 50,000 L/day but less than 400,000 L/day are to be registered on EASR, while water takings of more than 400,000 L/day require a PTTW issued by the MECP. If it is identified that an EASR or PTTW is required for the Subject Site, a hydrogeological assessment report will need to be submitted in support of the application.

A review of the total anticipated dewatering flow rate presented in **Table 7-2** indicates that, the anticipated dewatering flow rate for short-term construction activities including groundwater seepage with a safety factor of 1.5 and stormwater associated with the proposed houses range from a minimum rate of 51,200.0 L/day to a maximum rate of 94,100.0 L/day for excavation and construction of the basements, which are

above the MECP threshold of 50,000 L/day but below 400,000.0 L/day. As such, filing EASR with MECP is required if the proposed construction is completed over phases. However, since the estimated flow rates are preliminary, the permit requirements should be assessed, when the dewatering assessment is updated.

Obtaining a discharge permit from the Municipality of Port Hope may be required, if the potential collected discharge water during construction is proposed to be discharged to the municipal's sewer system.

Long-Term Foundation Drainage: If the estimated long-term foundation drainage flow from the groundwater source exceeds the MECP PTTW threshold limit of 50,000 L/day, applying for PTTW with MECP is required.

The preliminary estimated long-term foundation drainage flow rates from the groundwater source presented in **Table 7-3** indicate that the groundwater flow rate doesn't exceed 50,000 L/day for the proposed post-construction houses with 1-level basements. Therefore, filing PTTW with MECP is not required.

Obtaining a discharge agreement from the Municipality of Port Hope is required if long-term foundation drainage effluent is proposed to be conveyed to the municipal's sewer system.

7.6 Potential Dewatering Impacts and Mitigation Plan

7.6.1 Short-Term Discharge Water Quality

The dewatering system must be appropriately filtered in order to prevent the pumping of fines and loss of ground during the dewatering activities.

One set of groundwater samples were collected for analysis from the monitoring well at BH/MW 1, on April 17, 2024, and the results meet the Municipality of Port Hope Sanitary and Storm Sewer Use By-Law standards. As such, pre-treatment is not required prior to discharge to municipal's sewer system.

The final design for any temporary construction dewatering effluent pre-treatment system is the responsibility of the contractors responsible for construction, or the water treatment system design specialists, if required.

7.6.2 Ground Settlement

The preliminary conceptual ZOI for dewatering may reach a maximum of 49.4 m away from the dewatering area of the proposed houses with 1-level basement, where dewatering is necessary. As per the conceptual ZOI, nearby building structures and public roads are partially located within the conceptual ZOI for dewatering. As a such, potential risk for ground settlement is expected due to dewatering. It is recommended a professional geotechnical engineer is consulted in advance of excavation and construction. However, considering the early stage of the project, the potential risk for ground settlement should be assessed when further details become available for review.

7.6.3 Surface Water, Wetlands and Areas of Natural Significance

A record review indicates that natural heritage features including wooded areas, wetland, watercourses and ANSI were not identified within the conceptual ZOI for dewatering at the Subject Site. As such, impacts to surface water, wetlands, and areas of natural significance are not anticipated pertaining to the proposed construction.

7.6.4 Water Supply Wells and Zone of Influence

A review of the MECP well records confirmed that there are fifty-nine (59) records for water supply wells that are registered within 500 m of the Subject Site Study Area. There are three (3) records of domestic water supply wells located within the Subject Site. These wells are identified as Well ID No. 4, 6 and 27 on MECP Well Location Plan, attached as **Drawing 3** and are listed in **Appendix B**. It is recommended that the three (3) wells located within the Subject Site to be decommissioned in advance of construction should it still exist. Additionally, seven (7) of the records are in the adjacent properties of the Subject Site. As such, impacts to water supply wells located within the ZOI are anticipated and a door-to-door well survey will be required in advance of, during and after construction. However, considering the early stage of the project, the potential risk for local groundwater users should be assessed when further details become available for review.

8.0 CONCLUSIONS AND RECOMMENDATIONS

- The northwest portion of the Subject Site is located within an area mapped as glacial deposits (8a) comprising silt and clay minor sand and gravel. The remaining portions of the Subject Site is mapped on Till (5b) (Newmarket/Northern/Bowmanville Till), comprising stone poor, sandy silt to silty sand-textured till.
- The Subject Site is located within a regional physiography of Southern Ontario known as Iroquois Plain.
- The Subject Site is located within the Ganaraska River Watershed, where there are no records for natural heritage features including wetland, water bodies, watercourses and ANSI within or in close proximity to the Subject Stie. The closest wooded areas are located approximately 253 m to the northwest of the Subject Site, and a tributary of Ganaraska River, is located approximately 99 m to the west of the Subject Site.
- The Subject Site is underlain by a native stratum of silty sand till till the termination depth of the investigation at 6.6 mbgs.
- Groundwater was monitored within the silty sand till unit. The highest and lowest shallow groundwater level was measured at El. 137.13 masl and 140.40 mals at BH/MW 1 and BH/MW 2, respectively.
- Estimated hydraulic conductivity using single well response test (SWRT) ranges from 5.32×10^{-7} m/sec at BH/MW 5 to 4.93×10^{-6} m/sec at BH/MW 1 for the screened silty sand till unit. Hydraulic conductivity for silty sand till unit using Hazen Equation was estimated at 1.56×10^{-8} m/s.
- Groundwater quality for one (1) collected sample from BH/MW 1 meets the Municipality of Port Hope Sanitary and Storm Sewer Use By-Law limits.
- The anticipated dewatering flow rate for short-term construction activities including groundwater seepage with a safety factor of 1.5 and stormwater associated with the proposed houses range from a minimum rate of 51,200.0 L/day to a maximum rate of 94,100.0 L/day for excavation and construction of the basements.
- Findings of the preliminary estimated long-term foundation drainage flow rates show that the anticipated groundwater seepage considering a safety factor of 1.5 ranges between 16,000.0 L/day and 35,900.0 L/day. The total anticipated long-term foundation drainage flow rate considering infiltration due to storm events and groundwater seepage with a safety factor of 1.5 ranges between 34,979.0 L/day and 60,811.6.0 L/day.

- Considering the findings of the preliminary short-term dewatering assessment and anticipated dewatering flow calculated for each proposed lots that well be excavated and constructed below the shallow groundwater table, filing EASR with MECP is required if the proposed excavation and construction is completed over phases. Additionally, obtaining a discharge permit from the Municipality of Port Hope may be required, if the potential collected discharge water during construction is proposed to be discharged to the municipal's sewer system.
- A review of the preliminary estimated long-term foundation drainage flow rates indicates that anticipated groundwater flow does not exceed 50,000 L/day for post-construction houses with 1-level basement that will be constructed below shallow groundwater table. As such, filing PTTW with MECP is not required. Also, obtaining discharge agreement from the Municipality of Port Hope is required if long-term foundation drainage effluent is proposed to be conveyed to the municipal's sewer system.
- Groundwater quality result indicates that groundwater quality sample collected from a selected monitoring well (BH/MW 1) meets the Municipality of Port Hope Storm and Sanitary Sewer Use By-Law standards. As such, significant pre-treatment is not required prior to discharge to the region's sewer system.
- The conceptual ZOI for dewatering may reach a maximum of 49.4 m away from the dewatering area in the area of the proposed houses. As per the conceptual ZOI, nearby building structures and public roads are partially located within the conceptual ZOI for dewatering. As a such, potential risk for ground settlement is expected due to dewatering. It is recommended a professional geotechnical engineer is consulted in advance of excavation and construction. However, considering the early stage of the project, the potential risk for ground settlement should be assessed when further details become available for review.
- A record review indicates that natural heritage features including wooded areas, wetland, watercourses and ANSI were not identified within the conceptual ZOI for dewatering at the Subject Site. As such, impacts to surface water, wetlands, and areas of natural significance are not anticipated pertaining to the proposed construction.
- A review of the MECP well records confirmed that there are fifty-nine (59) records for water supply well that is registered within 500 m of the Subject Site Study Area. There are three (3) records of domestic water supply well located within the Subject Site. It is recommended that the three (3) wells located within the Subject Site to be decommissioned in advance of construction should it still exist. Additionally, seven (7) of the records are in the adjacent properties of the Subject Site. As such, impacts to water supply wells within the ZOI are anticipated and a door-to-door well survey will be required in advance of, during and after construction. However, considering the early

stage of the project, the potential risk for local groundwater users should be assessed when further details become available for review.

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.

Daixi Zhang, B.Sc., GIT
Project Manager-Hydrogeological Services

Narjes Alijani, M.Sc., P.Geo.
Department Manager-Hydrogeological Services

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

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

DRAWINGS

REFERNCE NO. 2402-W021

713000

714000

4873000

4872000

PEARGE ROAD

CHOATE ROAD

DALE ROAD

COUNTY ROAD 10

COUNTY ROAD 2

FOX ROAD

GUIDEBOARD ROAD

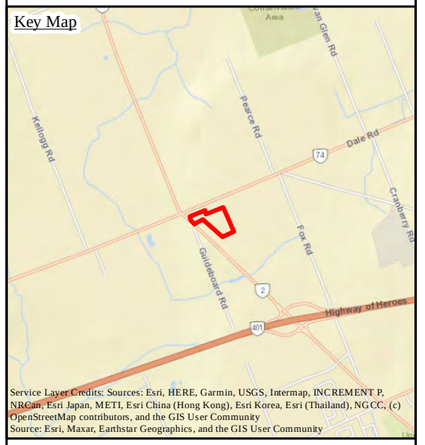
Tributary of Lake Ontario

C:\Users\GIS\Desktop\Hydro\Projects\2402-W021\

N

References: Ontario Ministry of Natural Resources and Forestry

Key Map



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

Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- Waterbody
- Watercourse

Soil Engineers Ltd.

Site Location Plan

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:

0 30 60 120 180 240 300
Metres

Drawing No. 1

713300
713400
713500
713600
4872500
4872400
4872300

DALE ROAD
EXISTING RESIDEN
EXISTING AGRICU
EXISTING RESIDENTIAL
EXISTING
COUNTY ROAD 2
GUIDEBOARD ROAD

LOT 1 (2607m²)
LOT 2 (2433m²)
LOT 3 (2860m²)
LOT 4 (2827m²)
LOT 5 (2618m²)
LOT 6 (2414m²)
LOT 7 (2672m²)
LOT 8 (2827m²)
LOT 9 (2911m²)
LOT 10 (2606m²)
LOT 11 (3038m²)
LOT 12 (3657m²)

BH/MW 1
BH/MW 2
BH/MW 3
BH/MW 4
BH/MW 5

38.5m
40.0m
84.8m
40.0m
73.3m
40.0m
18.0m
40.0m
60.8m
75.3m
40.0m
70.3m
40.0m
64.9m
55.8m
52.5m
52.5m

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N

References: Ontario Ministry of Natural Resources and Forestry
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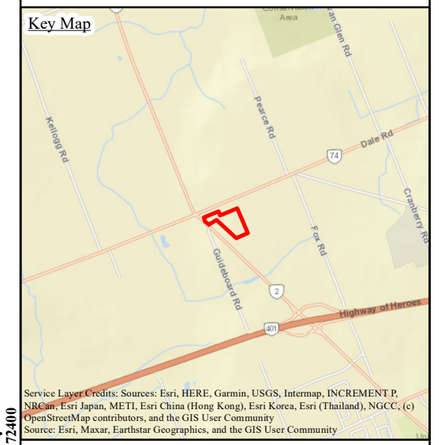
Key Map



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

Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- Watercourse
- Borehole With Monitoring Well (5)

Soil Engineers Ltd.

Borehole and Monitoring Well Location Plan

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 2

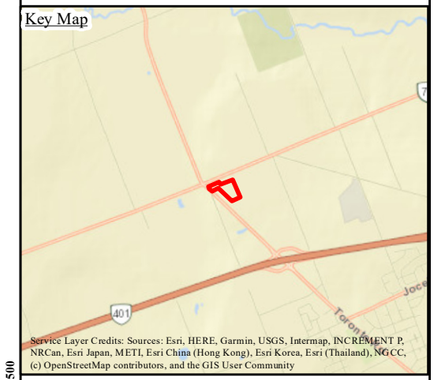
712500
713000
713500
714000
4873000
4872500
4872000

PEARCE ROAD
CHOATE ROAD
DALE ROAD
COUNTY ROAD 10
COUNTY ROAD 2
GUIDEBOARD ROAD
FOX ROAD

5b
8a
9b
9c

N

Key Map



Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- 5b: Glacial deposits (Newmarket/Northern/Bowmanville Till); consisting of diamicton
- 8a: Glacial lake deposits; consisting of clay, silt: foreshore/basinal
- 9b: Glacial lake deposits; consisting of sand, gravel: littoral/foreshore
- 9c: Glacial lake deposits; consisting of sand: foreshore/basinal

Soil Engineers Ltd.

Surface Geology Map

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:
0 60 120 180 240 300
Metres

Drawing No. 3

C:\Users\GIS\Desktop\Hydro\Projects\2402-W021\

712500
713000
713500
714000
4873000
4872500
4872000

Clay Plains

Till Plains
(Drumlinized)

Iroquois
Plain

Sand Plains

COUNTY·ROAD·2

COUNTY·ROAD·10

DALE·ROAD

PEARCE·ROAD

CHOATE·ROAD

FOX·ROAD

GUIDEBOARD·ROAD

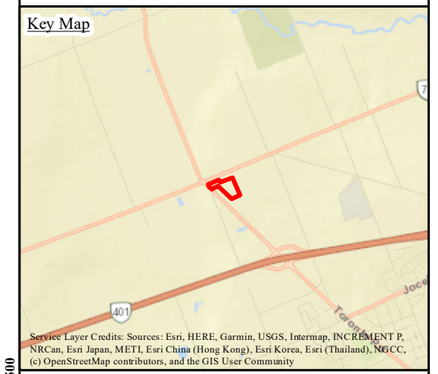
C:\Users\GIS\Desktop\Hydro\Projects\2402-W021\

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

N

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

Key Map



Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- Region Boundary
- Till Plains (Drumlinized)
- Sand Plains
- Clay Plains

Soil Engineers Ltd.

Physiographic Map

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 4

712500
713000
713500
714000
4873000
4872500
4872000

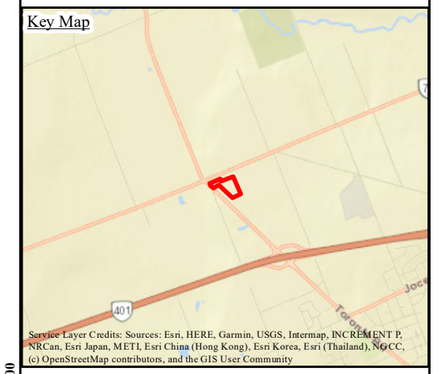
140
145
125
120
135
130

COUNTY·ROAD·10
COUNTY·ROAD·2
DALE·ROAD
PEARCE·ROAD
CHOATE·ROAD
FOX·ROAD
GUIDEBOARD·ROAD
Tributary of Lake Ontario

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

Soil Engineers Ltd.

Topographic Map

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 5

C:\Users\GIS\Desktop\Hydro\Projects\2402-W021\

712500
713000
713500
714000
4873000
4872500
4872000

PEARCE ROAD
CHOATE ROAD
DALE ROAD
COUNTY ROAD 10
COUNTY ROAD 2
GUIDEBOARD ROAD
FOX ROAD
Tributary of Lake Ontario

N

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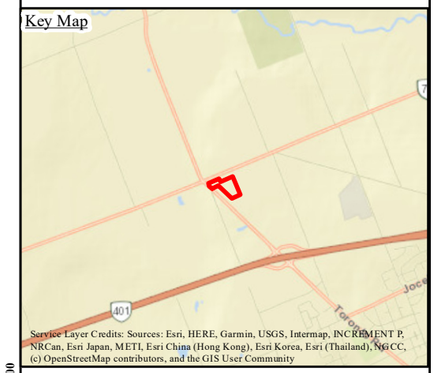
Key Map



Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- Watercourse
- Waterbody
- Wooded Area *Wooded Area*
- Wetland (Not evaluated per OWES)

Soil Engineers Ltd.

Natural Features and Protection Area Plan

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:
0 60 120 180 240 300
Metres

Drawing No. 6

C:\Users\GIS\Desktop\Hydro\Projects\2402-W021\

712500 713000 713500 714000

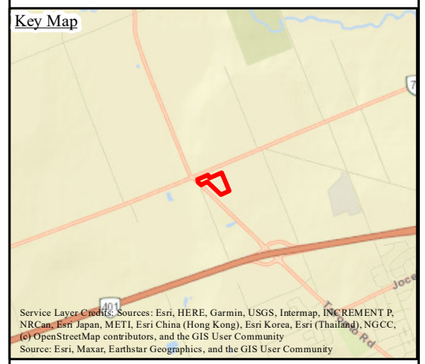
4873000 4872500 4872000

COUNTY ROAD 10
DALE ROAD
PEARCE ROAD
CHOATE ROAD
FOX ROAD
GUIDEBOARD ROAD
COUNTY ROAD 2
KELLOGG ROAD
Tributary of Lake Ontario

N

References: ESRI, DigitalGlobe, GeoEye, Earthstar Geograp -hics, CNES/Airbus Ds, USDA, USGS, AeroGRIS, IGN, and the GIS User Community produced by Soil Engineers 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
- Waterbody
- Watercourse
- Unknown (5)
- Abandoned-Other (26)
- Abandoned-Quality (1)
- Abandoned-Supply (2)
- Monitoring and Test Hole (3)
- Test Hole (3)
- Water Supply (59)

Soil Engineers Ltd.

MECP Well Location Plan

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:

0 30 60 120 180 240 300
Metres

Drawing No. 7

C:\Users\GIS\Desktop\Hydro\Projects\2402-W021\

713250 713400 713550

4872400

DALE ROAD

BH/MW 1
B
A

BH/MW 2
A'

BH/MW 3

BH/MW 4
(Projected)

BH/MW 5
B'

COUNTY ROAD 2

GUIDEBOARD ROAD

4872250

713250 713400 713550

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N

References: Ontario Ministry of Natural Resources and Forestry
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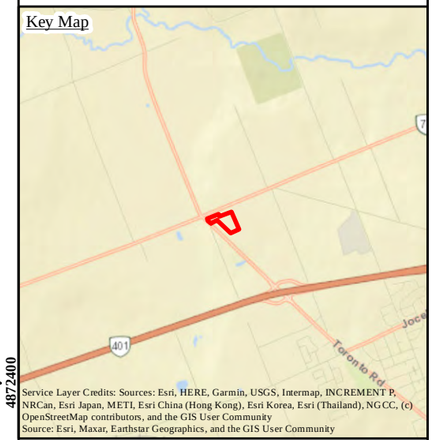
Key Map



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

Legend

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

Soil Engineers Ltd.

Cross-Section Plan

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:
0 5 10 20 30 40 50
Metres

Drawing No. 8-1

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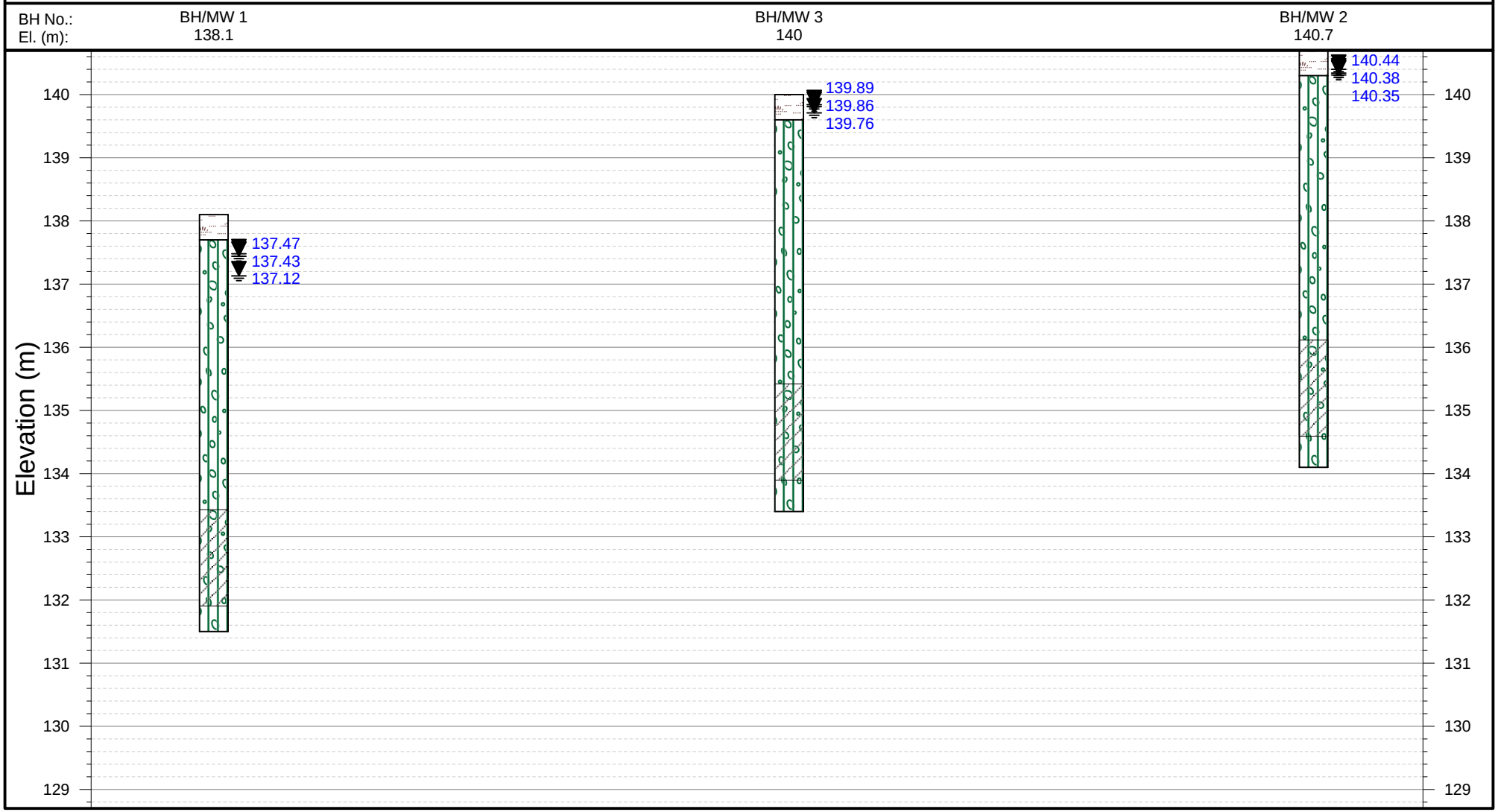
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE

SUBSURFACE PROFILE
CROSS SECTION
DRAWING NO. 8-2A
SCALE: AS SHOWN

JOB NO.: 2402-W021
REPORT DATE: May 2024
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

LEGEND
SILTY SAND TILL | TOPSOIL | SCREEN

WATER LEVEL (STABILIZED)



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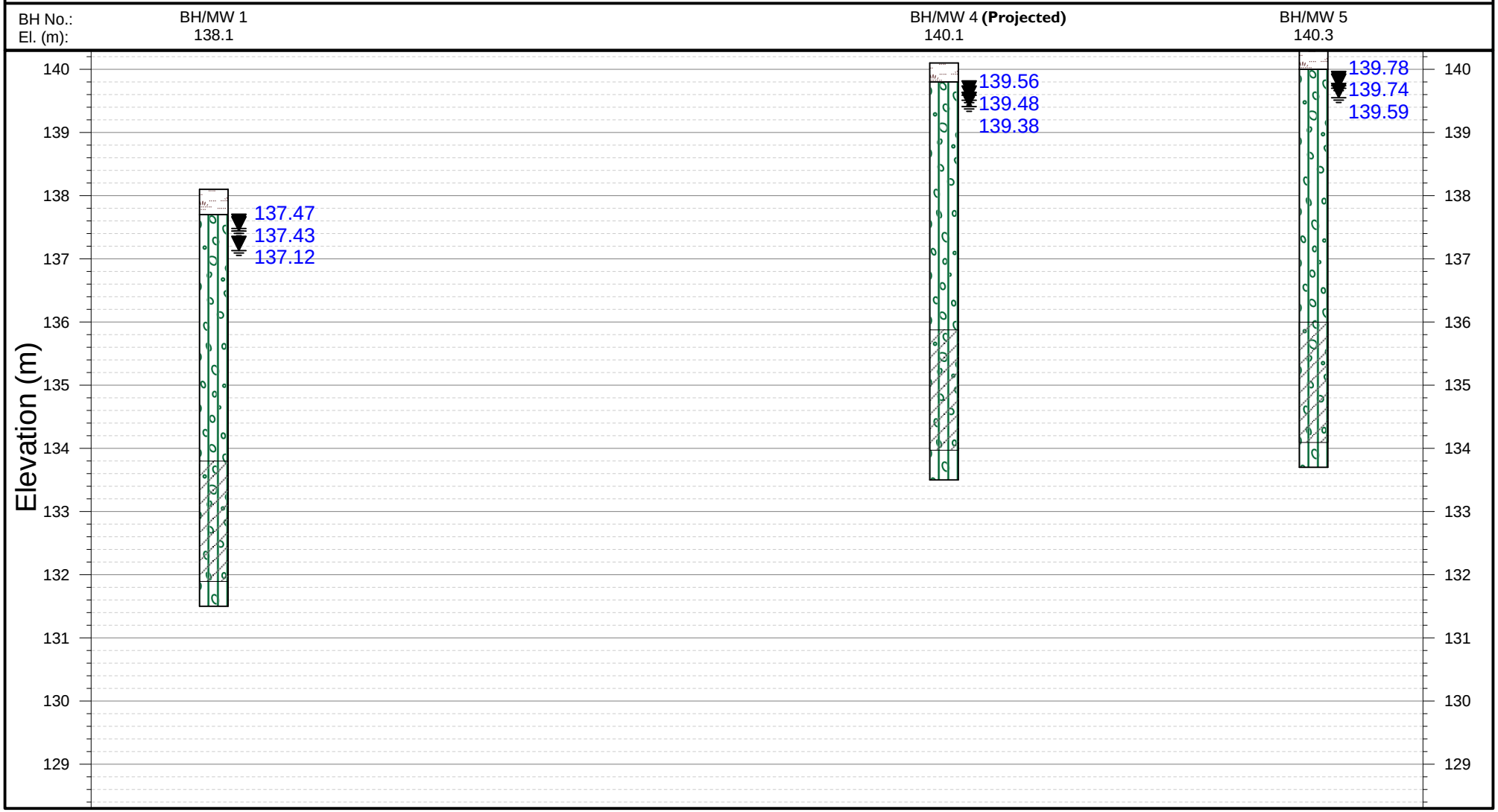
SUBSURFACE PROFILE
CROSS SECTION
DRAWING NO. 8-2B
SCALE: AS SHOWN

JOB NO.: 2402-W021
REPORT DATE: May 2024
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

LEGEND
SILTY SAND TILL | TOPSOIL | SCREEN

WATER LEVEL (STABILIZED)



713250
713400
713550
4872400
4872250

DALE ROAD
COUNTY ROAD 2
GUIDEBOARD ROAD

BH/MW 1
(137.48)
BH/MW 2
(140.34)
BH/MW 3
(139.84)
BH/MW 4
(139.59)
BH/MW 5
(139.70)

140.3
140.2
140.1
140.0
139.9
139.8
139.7
139.6
140
135

N

Refrences: Ontario Ministry of Natural Resources and Forestry
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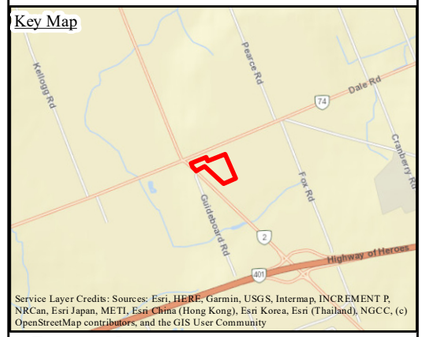
Key Map



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Legend

- Approximate Boundary of Subject Site
- Borehole With Monitoring Well
- Ontario - 5 m
- Major Road
- Local Road
- Highest Interpreted Shallow Groundwater Elevation Contour
- Highest Inferred Shallow Groundwater Elevation Contour
- Interpreted Shallow Groundwater Flow Direction
- (140.34) Highest Shallow Groundwater Level Measured on April 17, 2024

Soil Engineers Ltd.

Shallow Groundwater Flow Pattern Plan

Hydrogeological Assessment
Proposed Residential Development
4646 Country Road 2
Municipality of Port Hope

Reference No. 2402-W021

Date: May 22, 2024

Scale:

0 5 10 20 30 40 50
Metres

Drawing No. 9

D:\Projects\2402-W021

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BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	MUSKOKA	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

APPENDIX A

BOREHOLE AND MONITORING WELLS LOGS
AND
GRAIN SIZE DISTRIBUTION GRAPHS

REFERENCE NO. 2402-W021

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.: 2402-W021

LOG OF BOREHOLE:BH/MW 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Soild Stem Augers

PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

DRILLING DATE: February 28, 2024

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
138.1	Ground Surface							
0.0	**36 cm TOPSOIL**	1	DO	5	0		18	
	Brown, loose to dense — weathered							
	SILTY SAND TILL	2	DO	19	1		10	
	some clay a trace of gravel	3	DO	10	2		10	
		4	DO	22			10	
		5	DO	16	3		11	
		6	DO	20	4		10	
		7	DO	34	5		9	
131.5					6			
6.6	**END OF BOREHOLE**				7			
	Installed 50 mm Ø PVC monitoring well to 6.2 m with 1.5 m screen Sand backfill from 4.4 to 6.2 m Bentonite seal from 0.0 m to 4.4 m Provided with monument casing				8			
					9			
					10			

W.L. @ El. 137.13 masl on Mar 07, 2024
W.L. @ El. 137.44 masl on Mar 28, 2024
W.L. @ El. 137.48 masl on Apr 17, 2024

Soil Engineers Ltd.

JOB NO.: 2402-W021

LOG OF BOREHOLE:BH/MW 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Soild Stem Augers

PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

DRILLING DATE: February 28, 2024

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
140.7	Ground Surface							
0.0	**36 cm TOPSOIL**	1	DO	2	0		23	
	Compact to very dense — weathered							
	SILTY SAND TILL	2	DO	16	1		10	
	some clay a trace of gravel	3	DO	12	2		13	
		4	DO	27			8	
		5	DO	34	3		9	
		6	DO	50	4		7	
		7	DO	62	5		8	
134.1					6			
6.6	**END OF BOREHOLE**				7			
	Installed 50 mm Ø PVC monitoring well to 6.1 m with 1.5 m screen Sand backfill from 4.3 to 6.1 m Bentonite seal from 0.0 m to 4.3 m Provided with monument casing				8			
					9			
					10			

W.L. @ El. 140.31 masl on Mar 07, 2024
W.L. @ El. 140.40 masl on Mar 28, 2024
W.L. @ El. 140.34 masl on Apr 17, 2024

Soil Engineers Ltd.

JOB NO.: 2402-W021

LOG OF BOREHOLE:BH/MW 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Soild Stem Augers

PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

DRILLING DATE: February 28, 2024

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
140.0	Ground Surface							
0.0	**36 cm TOPSOIL**	1	DO	2	0		28	
	Compact to very dense — weathered							
	SILTY SAND TILL	2	DO	20	1		10	
	some clay a trace of gravel	3	DO	17	2		10	
		4	DO	15			12	
		5	DO	26	3		12	
		6	DO	18	4 5		11	
		7	DO	68	6		11	
133.4								
6.6	**END OF BOREHOLE**				7 8 9 10			

Installed 50 mm Ø PVC monitoring well
to 6.1 m with 1.5 m screen
Sand backfill from 4.3 to 6.1 m
Bentonite seal from 0.0 m to 4.3 m
Provided with monument casing

W.L. @ El. 139.71 masl on Mar 07, 2024
W.L. @ El. 139.81 masl on Mar 28, 2024
W.L. @ El. 139.84 masl on Apr 17, 2024

JOB NO.: 2402-W021

LOG OF BOREHOLE:BH/MW 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Soild Stem Augers

PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

DRILLING DATE: February 28, 2024

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
140.1	Ground Surface							
0.0	**30 cm TOPSOIL**	1	DO	0	0		30	
	Brown, compact to dense — weathered							
	SILTY SAND TILL	2	DO	29	1		9	
	some clay a trace of gravel	3	DO	22	2		10	
		4	DO	28	3		11	
		5	DO	26	4		10	
		6	DO	22	5		10	
		7	DO	40	6		10	
133.5								
6.6	**END OF BOREHOLE**				7			
	Installed 50 mm Ø PVC monitoring well to 6.1 m with 1.5 m screen Sand backfill from 4.3 to 6.1 m Bentonite seal from 0.0 m to 4.3 m Provided with monument casing				8			
					9			
					10			

W.L. @ El. 139.41 masl on Mar 07, 2024
W.L. @ El. 139.51 masl on Mar 28, 2024
W.L. @ El. 139.59 masl on Apr 17, 2024

Soil Engineers Ltd.

JOB NO.: 2402-W021

LOG OF BOREHOLE:BH/MW 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Soild Stem Augers

PROJECT LOCATION: 4646 County Road 2, Municipality of Port Hope

DRILLING DATE: February 28, 2024

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
140.3	Ground Surface							
0.0	**25 cm TOPSOIL**				0			
	Brown, loose to dense weathered	1	DO	2			24	
	SILTY SAND TILL							
	some clay a trace of gravel	2	DO	12	1		10	
		3	DO	10	2		11	
		4	DO	44			9	
		5	DO	68	3		10	
		6	DO	50/15	4		9	
		7	DO	58	5		8	
133.7					6			
6.6	**END OF BOREHOLE**				7			
	Installed 50 mm Ø PVC monitoring well to 6.2 m with 1.5 m screen Sand backfill from 4.4 to 6.2 m Bentonite seal from 0.0 m to 4.4 m Provided with monument casing				8			
					9			
					10			

W.L. @ El. 139.55 masl on Mar 07, 2024
W.L. @ El. 139.74 masl on Mar 28, 2024
W.L. @ El. 139.70 masl on Apr 17, 2024

Soil Engineers Ltd.

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

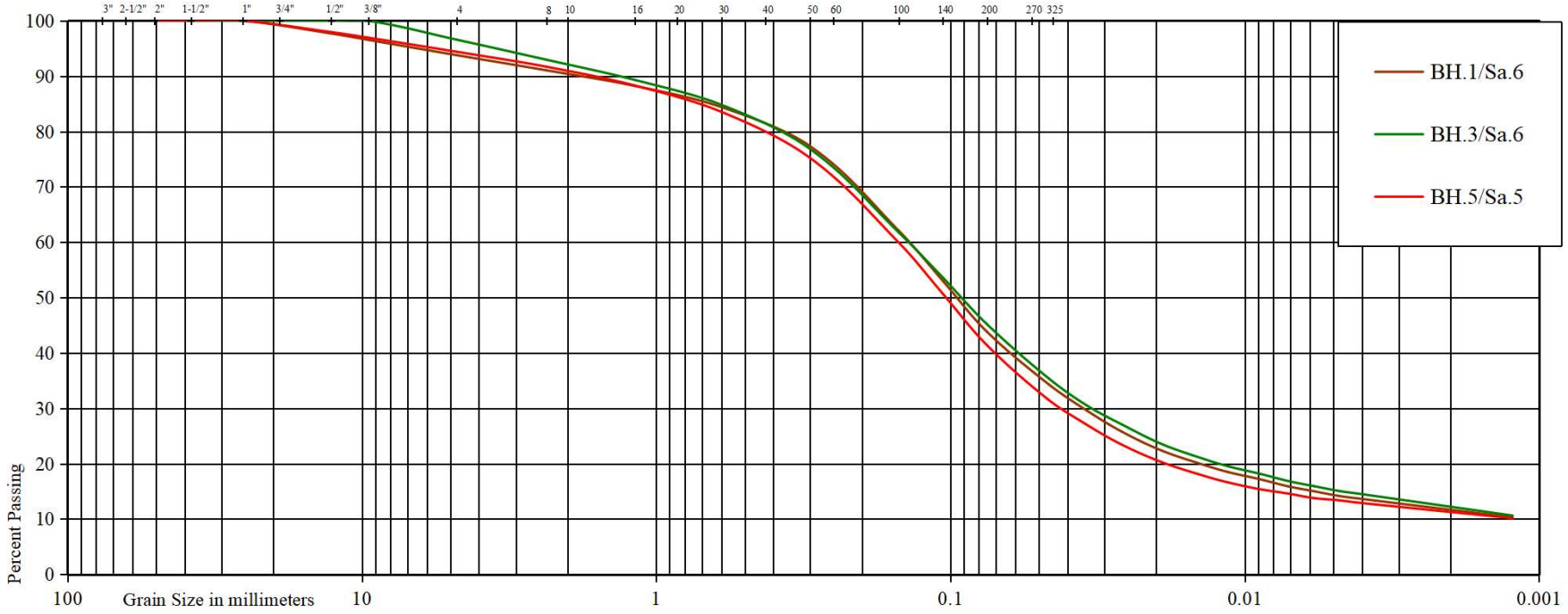
Reference No: 2402-S021

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: 4646 County Road 2, Municipality of Port Hope

Borehole No:	1	3	5
Sample No:	6	6	5
Depth (m):	4.8	4.8	3.3
Elevation (m):	133.3	135.2	137.0

BH./Sa.	1/6	3/6	5/5
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	10	11	10
Estimated Permeability (cm./sec.) =	10^{-6}	10^{-6}	10^{-6}

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

some clay, a trace of gravel

Figure: 6

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

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	MUSKOKA	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

APPENDIX B

MECP WELL RECORDS SUMMARY

REFERENCE NO. 2402-W021

MECP Well Records Summary

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
1	1901907	Cable Tool	40.2	Water Supply	Commercial	14.3	-	-	1962-03-01
2	1901917	Cable Tool	47.5	Water Supply	Domestic	7.6	-	-	1951-01-16
3	1901919	Cable Tool	14.6	Abandoned-Supply	-	-	-	-	1952-11-15
4	1901920	Cable Tool	45.7	Water Supply	Commercial	9.1	-	-	1957-01-24
5	1901922	Boring	9.8	Water Supply	Domestic	6.7	-	-	1963-10-16
6	1901923	Cable Tool	18.3	Water Supply	Domestic	5.5	-	-	1963-12-03
7	1901924	Cable Tool	18.9	Water Supply	Domestic	2.4	-	-	1967-06-10
8	1901925	Boring	8.5	Water Supply	Domestic	4.6	-	-	1967-05-23
9	1901926	Cable Tool	37.2	Water Supply	Domestic	2.4	-	-	1957-10-12
10	1901927	Boring	9.1	Water Supply	Domestic	6.1	-	-	1961-11-24
11	1901929	Boring	5.5	Water Supply	Domestic	1.8	-	-	1966-06-29
12	1901930	Boring	9.1	Water Supply	Domestic	4.0	-	-	1967-12-07
13	1901969	Cable Tool	24.7	Water Supply	Domestic	-	23.2	24.7	1954-03-19
14	1901971	Cable Tool	36.6	Water Supply	Domestic	-	-	-	1961-09-09
15	1901972	Boring	7.9	Water Supply	Domestic	3.0	-	-	1963-10-15
16	1901973	Boring	7.6	Water Supply	Public	4.0	-	-	1963-10-15
17	1901974	Boring	9.1	Water Supply	Domestic	1.8	-	-	1964-08-27
18	1901975	Boring	5.5	Water Supply	Domestic	3.0	-	-	1965-07-27
19	1901977	Boring	13.4	Water Supply	Commercial	10.4	-	-	1955-06-29
20	1901978	Cable Tool	27.4	Water Supply	Commercial	0.3	-	-	1955-08-04
21	1901979	Cable Tool	26.5	Water Supply	Livestock	2.4	-	-	1956-03-05
22	1901980	Cable Tool	36.6	Water Supply	Public	11.3	-	-	1958-10-10
23	1901981	Cable Tool	23.8	Water Supply	Domestic	0.9	-	-	1962-12-17
24	1901982	Boring	7.9	Water Supply	Public	3.0	-	-	1963-07-26
25	1902581	Boring	11.0	Water Supply	Domestic	6.1	-	-	1968-06-11
26	1902582	Boring	10.7	Water Supply	Domestic	6.1	-	-	1968-06-06
27	1902700	Boring	8.2	Water Supply	Domestic	3.7	-	-	1969-06-21
28	1902701	Boring	9.8	Water Supply	Domestic	3.7	-	-	1969-06-20
29	1902891	Boring	9.8	Water Supply	Livestock	4.6	-	-	1969-12-16
30	1903080	Boring	9.4	Water Supply	Domestic	4.6	-	-	1971-01-22
31	1903400	Rotary (Air)	25.3	Water Supply	Domestic	4.6	-	-	1972-08-29
32	1903957	Boring	10.7	Water Supply	Domestic	6.1	-	-	1974-09-26
33	1904452	Boring	18.3	Water Supply	Domestic	4.6	-	-	1976-06-15
34	4504506	Cable Tool	20.1	Water Supply	Domestic	4.6	-	-	1975-09-11
35	4504752	Boring	7.0	Water Supply	Domestic	2.4	-	-	1977-04-30
36	4504753	Boring	7.6	Water Supply	Domestic	2.4	-	-	1977-04-30
37	4504937	Cable Tool	15.5	Water Supply	Domestic	-	-	-	1978-05-02
38	4505003	Boring	12.2	Water Supply	Domestic	5.8	-	-	1978-07-13
39	4505248	Cable Tool	9.8	Water Supply	Domestic	0.6	-	-	1979-05-04

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
40	4506270	Cable Tool	43.6	Water Supply	Domestic	18.3	41.1	42.4	1985-11-11
41	4506661	Cable Tool	47.2	Water Supply	Domestic	12.5	39.9	41.1	1987-04-06
42	4506662	Cable Tool	15.8	Water Supply	Domestic	-	13.1	14.3	1987-04-13
43	4506687	Cable Tool	15.5	Water Supply	Domestic	0.6	12.8	14.0	1987-04-23
44	4506688	-	47.2	-	-	-	-	-	1987-04-23
45	4507064	Boring	9.4	Water Supply	Domestic	1.5	-	-	1988-03-17
46	4507726	Cable Tool	15.2	Test Hole	Domestic	2.7	12.8	15.2	1989-03-22
47	4508228	Rotary (Convent.)	44.2	Test Hole	Domestic	10.7	-	-	1989-09-20
48	4508505	Cable Tool	44.2	Water Supply	Livestock	9.8	-	-	1990-02-22
49	4509116	Rotary (Air)	49.1	Water Supply	Domestic	0.9	-	-	1990-10-26
50	4509117	Cable Tool	43.9	Water Supply	Domestic	16.8	-	-	1990-10-05
51	4509118	Cable Tool	47.5	Water Supply	Domestic	16.8	-	-	1990-10-15
52	4509119	Cable Tool	43.9	Water Supply	Domestic	16.8	-	-	1990-10-20
53	4509120	Cable Tool	49.1	Water Supply	Domestic	16.2	-	-	1990-10-30
54	4509121	Rotary (Air)	73.5	Water Supply	Domestic	18.3	-	-	1990-10-24
55	4509122	Rotary (Air)	55.2	Water Supply	Domestic	16.8	-	-	1990-10-18
56	4509125	Rotary (Air)	53.0	Water Supply	Domestic	16.8	-	-	1990-10-11
57	4509837	Boring	11.3	Water Supply	Domestic	6.1	-	-	1992-09-23
58	4509838	Boring	7.3	Water Supply	Domestic	2.4	-	-	1992-09-23
59	4510020	Cable Tool	63.4	Water Supply	Commercial	16.8	-	-	1993-06-23
60	4510093	-	-	Abandoned-Quality	-	-	-	-	1993-08-16
61	4511356	Cable Tool	27.1	Water Supply	Domestic	5.5	-	-	1997-07-16
62	4512583	Cable Tool	8.2	Water Supply	Domestic	1.5	-	-	2000-07-07
63	4512997	Cable Tool	9.8	Water Supply	Domestic	0.6	-	-	2002-04-19
64	4513106	Cable Tool	35.1	Test Hole	Public	5.8	-	-	2002-08-15
65	7121310	Cable Tool	15.8	Water Supply	Domestic	4.9	-	-	2008-11-05
66	7307108	Boring	-	Monitoring and Test Hole	Test Hole	-	3.0	4.6	2018-02-27
67	7307109	Boring	-	Monitoring and Test Hole	Test Hole	-	-	-	2018-02-27
68	7307111	Boring	-	Monitoring and Test Hole	Test Hole	-	3.0	4.6	2018-02-28
69	7331245	-	-	-	-	-	-	-	2019-03-22
70	7338137	-	-	Abandoned-Supply	Not Used	-	-	-	2019-07-09
71	7341617	-	-	-	-	-	-	-	2019-08-27
72	7341618	-	-	Abandoned-Other	-	-	-	-	2019-08-27
73	7341619	-	-	Abandoned-Other	-	-	-	-	2018-08-27
74	7341620	-	-	Abandoned-Other	-	-	-	-	2019-08-27
75	7341621	-	-	Abandoned-Other	-	-	-	-	2019-08-27
76	7341622	-	-	Abandoned-Other	-	-	-	-	2019-08-27
77	7341623	-	-	Abandoned-Other	-	-	-	-	2019-08-27
78	7341624	-	-	Abandoned-Other	-	-	-	-	2019-08-27

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
79	7341625	-	-	Abandoned-Other	-	-	-	-	2019-08-27
80	7341626	-	-	Abandoned-Other	-	-	-	-	2019-08-27
81	7341627	-	-	Abandoned-Other	-	-	-	-	2019-08-27
82	7341628	-	-	Abandoned-Other	-	-	-	-	2019-08-27
83	7341629	-	-	Abandoned-Other	-	-	-	-	2018-08-27
84	7341630	-	-	Abandoned-Other	-	-	-	-	2019-08-27
85	7341631	-	-	Abandoned-Other	-	-	-	-	2019-08-27
86	7341632	-	-	Abandoned-Other	-	-	-	-	2019-08-27
87	7341633	-	-	Abandoned-Other	-	-	-	-	2019-08-27
88	7341634	-	-	Abandoned-Other	-	-	-	-	2019-08-27
89	7341635	-	-	Abandoned-Other	-	-	-	-	2019-08-27
90	7341636	-	-	Abandoned-Other	-	-	-	-	2019-08-27
91	7341637	-	-	Abandoned-Other	-	-	-	-	2018-08-27
92	7341638	-	-	Abandoned-Other	-	-	-	-	2019-08-27
93	7341639	-	-	Abandoned-Other	-	-	-	-	2019-08-27
94	7341640	-	-	Abandoned-Other	-	-	-	-	2019-08-27
95	7341641	-	-	-	-	-	-	-	2019-08-27
96	7341642	-	-	Abandoned-Other	-	-	-	-	2019-08-27
97	7341643	-	-	-	-	-	-	-	2019-08-27
98	7341644	-	-	Abandoned-Other	-	-	-	-	2019-08-27
99	7341645	-	-	Abandoned-Other	-	-	-	-	2019-08-27

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

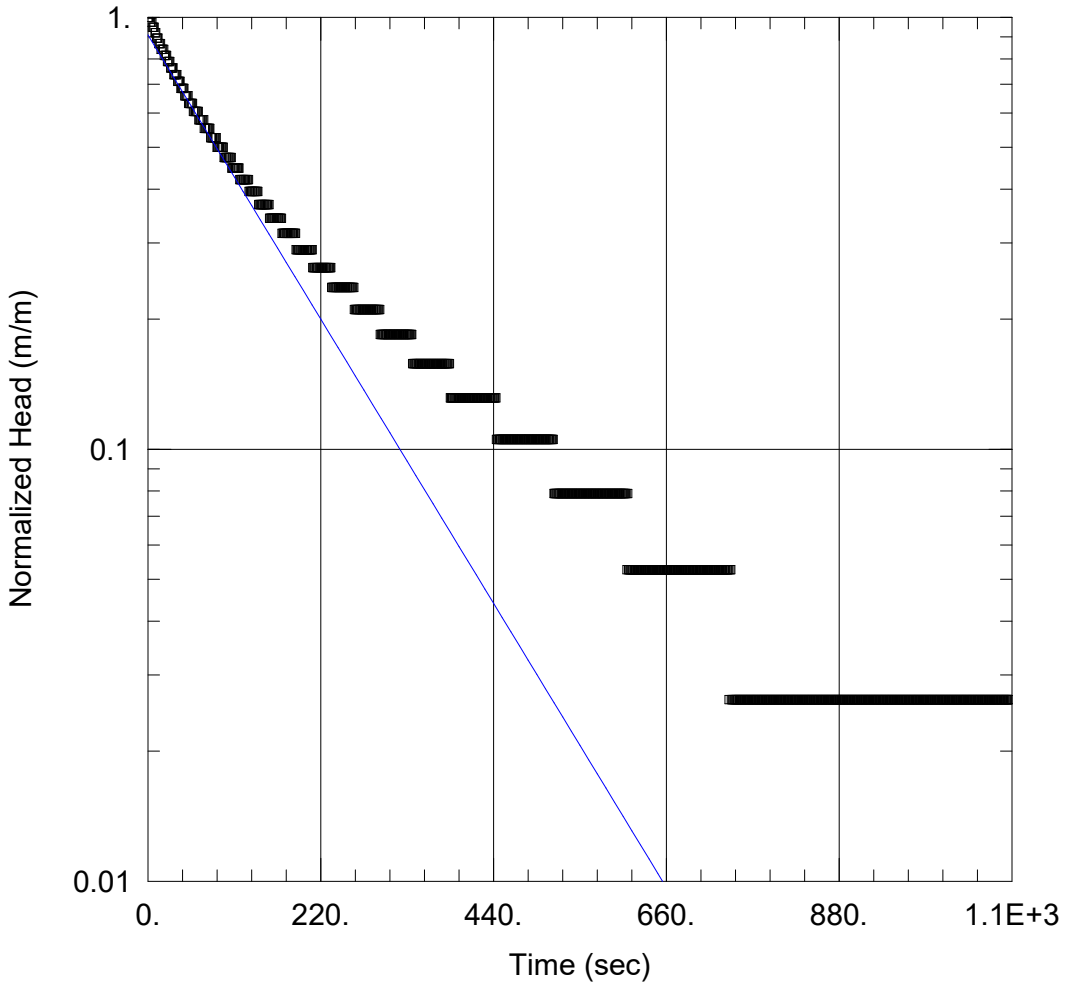
APPENDIX C

IN-SITU HYDRAULIC CONDUCTIVITY TESTING DETAILS

REFERENCE NO. 2402-W021

Falling Head SWRT of BH/MW 1

Prepared By:	Prepared For:
Soil Engineers Ltd.	13750701 Canada Inc.
Project:	**Location:**
2402-W021	4646 County Rd 2, Port Hope



SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 4.926E-6 m/sec y0 = 0.3455 m

AQUIFER DATA

Saturated Thickness: 5.55 m Anisotropy Ratio (Kz/Kr): 1.

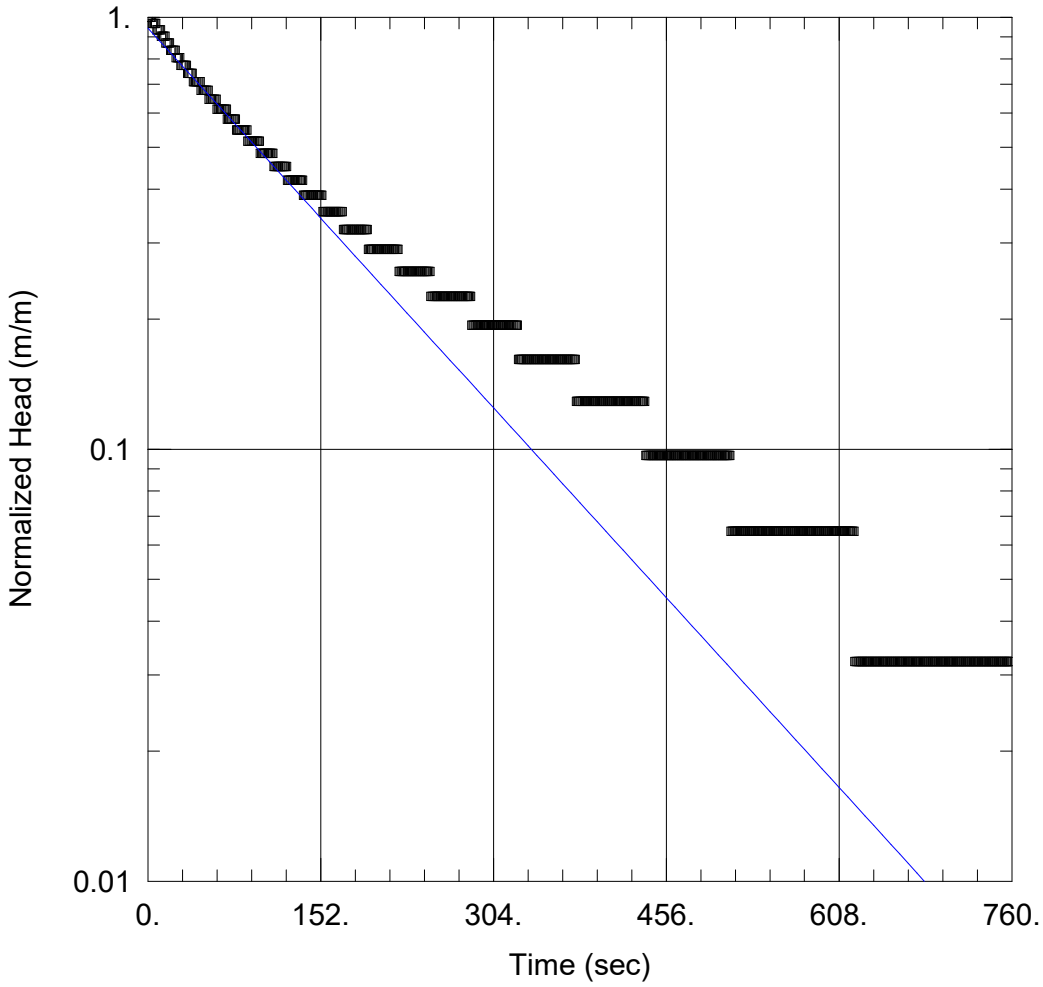
WELL DATA (BH/MW 1)

Initial Displacement: 0.38 m
Static Water Column Height: 5.55 m
Total Well Penetration Depth: 5.55 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0508 m

Soil Engineers Ltd.

Falling Head SWRT of BH/MW 2

Prepared By:	Prepared For:
Soil Engineers Ltd.	13750701 Canada Inc.
Project:	**Location:**
2402-W021	4646 County Rd 2, Port Hope



SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 4.801E-6 m/sec y0 = 0.2923 m

AQUIFER DATA

Saturated Thickness: 5.82 m Anisotropy Ratio (Kz/Kr): 1.

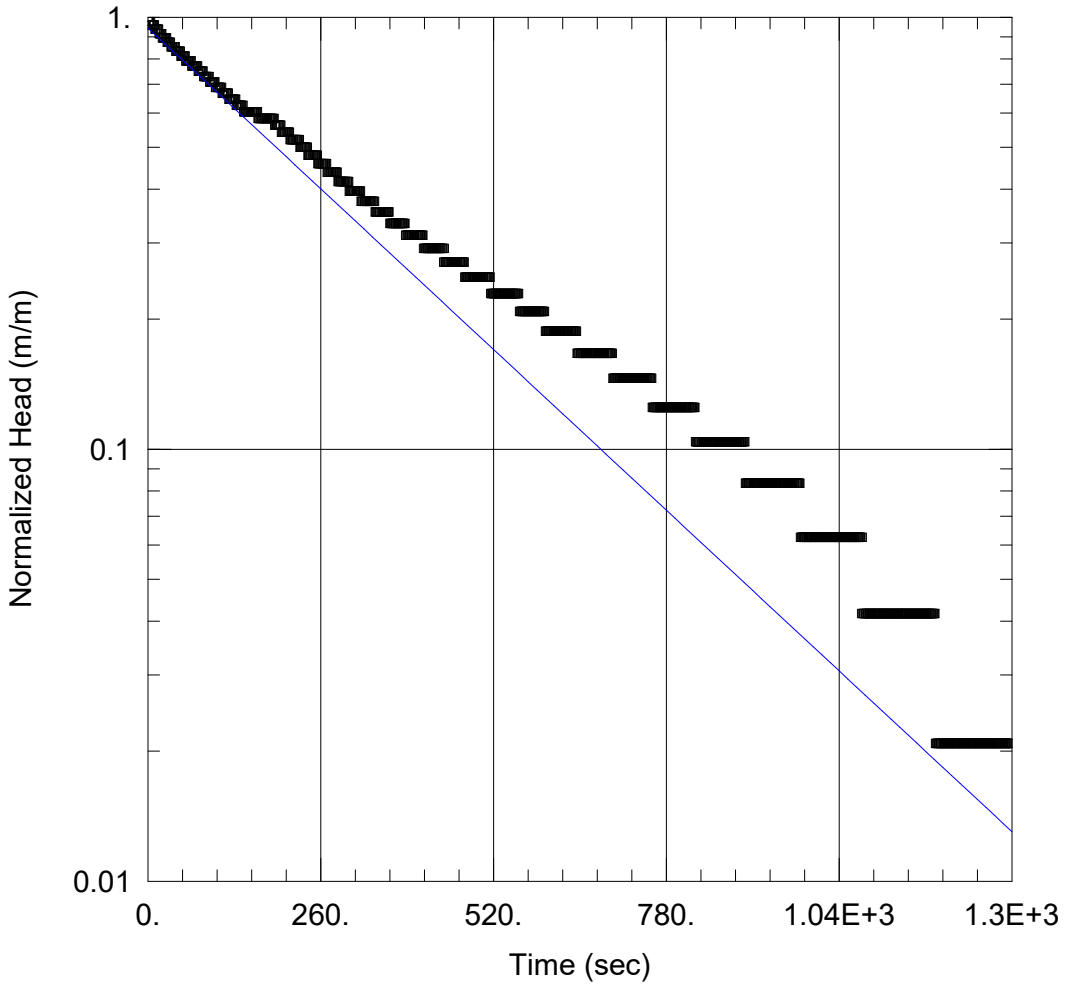
WELL DATA (BH/MW 2)

Initial Displacement: 0.31 m
Static Water Column Height: 5.82 m
Total Well Penetration Depth: 5.82 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0508 m

Soil Engineers Ltd.

Falling Head SWRT of BH/MW 3

Prepared By:	Prepared For:
Soil Engineers Ltd.	13750701 Canada Inc.
Project:	**Location:**
2402-W021	4646 County Rd 2, Port Hope



SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.38E-6 m/sec y0 = 0.4528 m

AQUIFER DATA

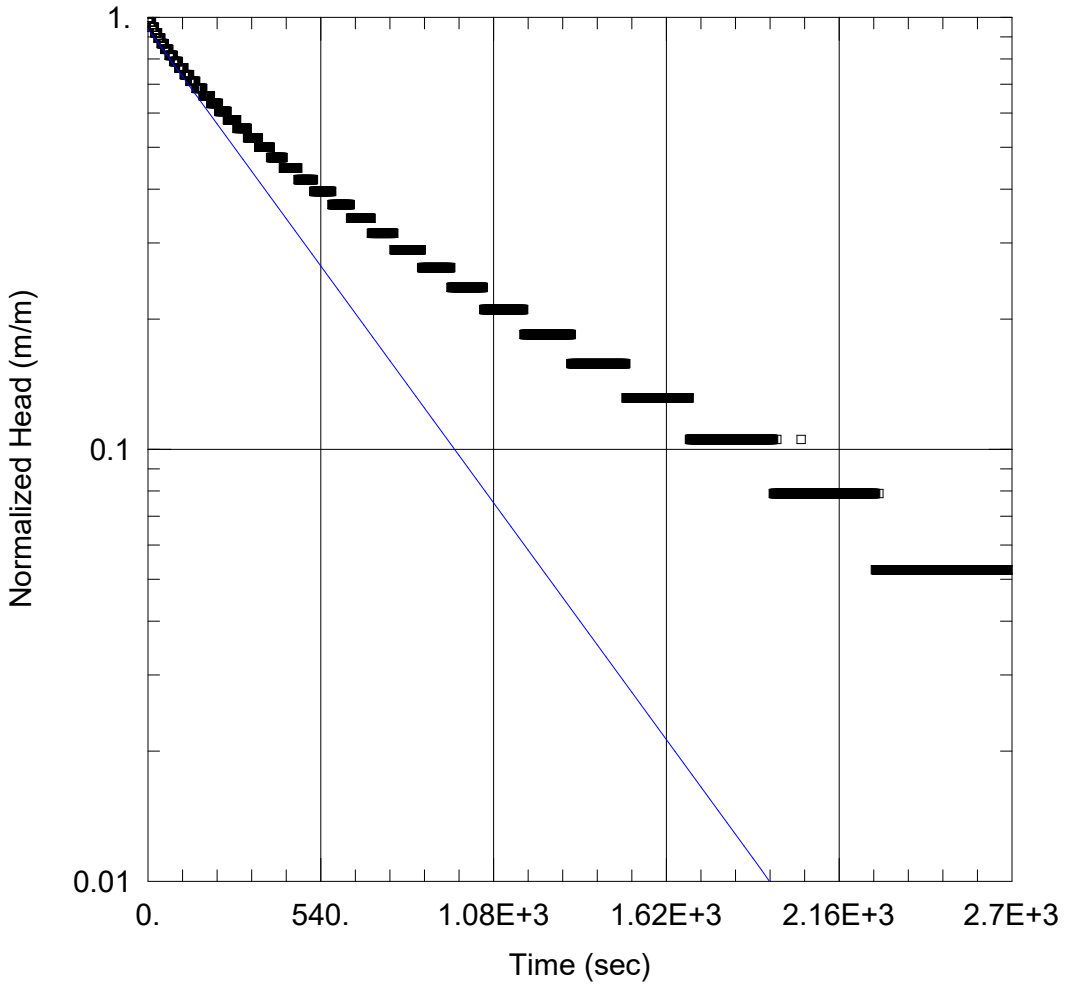
Saturated Thickness: 5.88 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 3)

Initial Displacement: 0.48 m
Static Water Column Height: 5.88 m
Total Well Penetration Depth: 5.88 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0508 m

Falling Head SWRT of BH/MW 4

Prepared By:	Prepared For:
Soil Engineers Ltd.	13750701 Canada Inc.
Project:	**Location:**
2402-W021	4646 County Rd 2, Port Hope



SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.671E-6 m/sec y0 = 0.3567 m

AQUIFER DATA

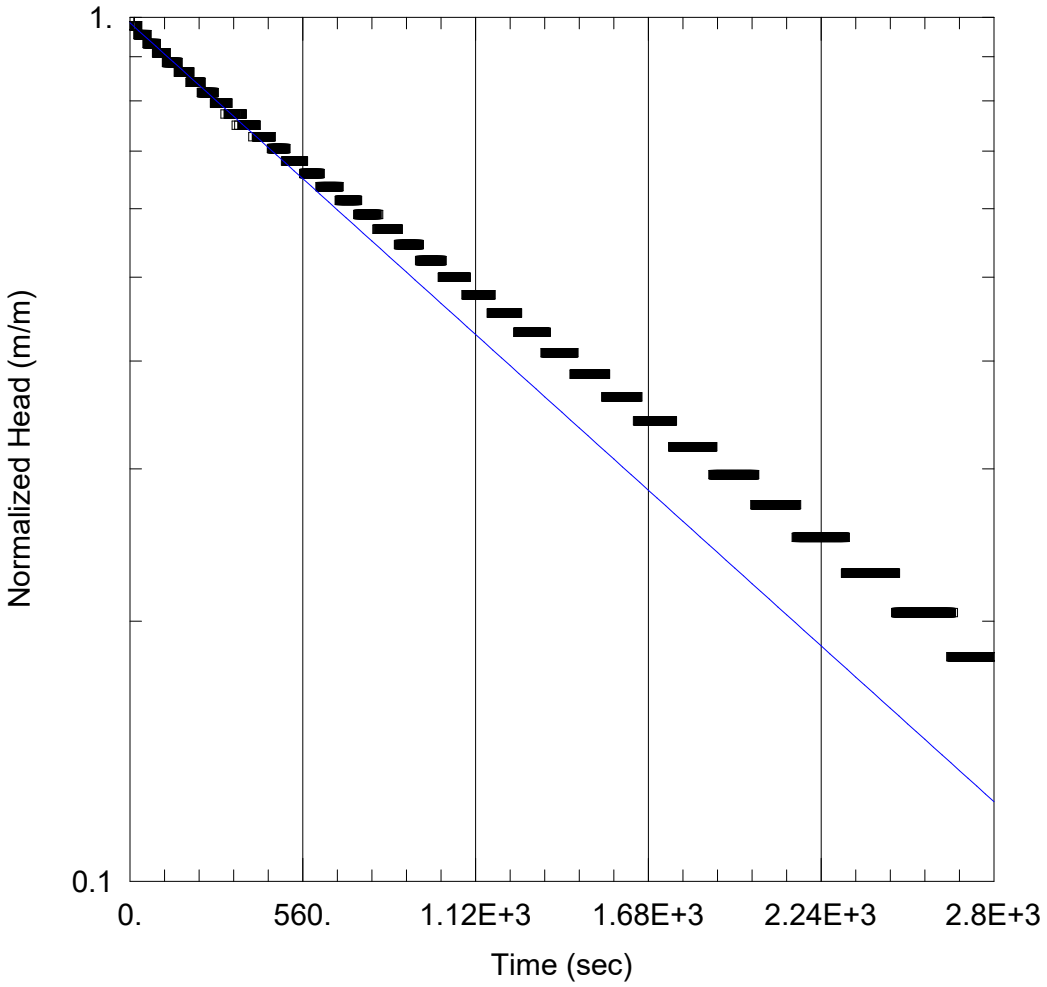
Saturated Thickness: 5.51 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 4)

Initial Displacement: 0.38 m
Static Water Column Height: 5.51 m
Total Well Penetration Depth: 5.51 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0508 m

Falling Head SWRT of BH/MW 5

Prepared By:	Prepared For:
Soil Engineers Ltd.	13750701 Canada Inc.
Project:	Location:
2402-W021	4646 County Rd 2, Port Hope



SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 5.315E-7 m/sec y0 = 0.4333 m

AQUIFER DATA

Saturated Thickness: 5.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 5)

Initial Displacement: 0.44 m
Static Water Column Height: 5.62 m
Total Well Penetration Depth: 5.62 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0508 m

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

APPENDIX D

GROUNDWATER QUALITY TEST RESULTS

REFERENCE NO. 2402-W021

FINAL REPORT

CA14658-APR24 R1

2402-W021, 4646 County Rd 2, Port Hope

Prepared for

Soil Engineers Ltd.

FINAL REPORT

CA14658-APR24 R1

First Page

CLIENT DETAILS

Client	Soil Engineers Ltd.
Address	90 West Beaver Creek Rd Richmond, ON M1S 3A7. Canada
Contact	Gurkaranbir Singh
Telephone	519-731-6442
Facsimile	
Email	gurkaranbir.singh@soilengineersltd.com
Project	2402-W021, 4646 County Rd 2, Port Hope
Order Number	
Samples	Ground Water (1)

LABORATORY DETAILS

Project Specialist	Jill Campbell, B.Sc.,GISAS
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	2165
Facsimile	705-652-6365
Email	jill.campbell@sgs.com
SGS Reference	CA14658-APR24
Received	04/17/2024
Approved	04/19/2024
Report Number	CA14658-APR24 R1
Date Reported	05/22/2024

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: 035831

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

Client: Soil Engineers Ltd.
Project: 2402-W021, 4646 County Rd 2, Port Hope
Project Manager: Gurkaranbir Singh
Samplers: Gurkaranbir Singh

MATRIX: WATER

Sample Number	8
Sample Name	BH/MW1
Sample Matrix	Ground Water
Sample Date	17/04/2024

L1 = SANSEW / WATER / - - Port Hope Sewer Use By Law - Sanitary Sewer Discharge - BL_30_94

L2 = SANSEW / WATER / - - Port Hope Sewer Use By Law - Storm Sewer Discharge - BL_30_94

Parameter	Units	RL	L1	L2	Result
General Chemistry					
Biochemical Oxygen Demand (BOD5)	mg/L	2	300	15	< 4 ↑
Total Suspended Solids	mg/L	2	350	15	2
Hydrogen Sulphide	mg/L	0.02	2		< 0.02
Metals and Inorganics					
Sulphate	mg/L	2	1500	1500	22
Sulphide	mg/L	0.02			< 0.02
Cyanide (total)	mg/L	0.01	2	0.1	< 0.01
Cadmium (total)	mg/L	0.000003	3	1	< 0.000003
Chromium (total)	mg/L	0.00008	3	1	0.00065
Copper (total)	mg/L	0.001	3	1	< 0.001
Iron (total)	mg/L	0.007	50	17	0.039
Lead (total)	mg/L	0.00009	3		< 0.00009
Nickel (total)	mg/L	0.0001	3	1	0.0005
Zinc (total)	mg/L	0.002	3	1	< 0.002

Client: Soil Engineers Ltd.
Project: 2402-W021, 4646 County Rd 2, Port Hope
Project Manager: Gurkaranbir Singh
Samplers: Gurkaranbir Singh

MATRIX: WATER

Sample Number	8
Sample Name	BH/MW1
Sample Matrix	Ground Water
Sample Date	17/04/2024

L1 = SANSEW / WATER / - - Port Hope Sewer Use By Law - Sanitary Sewer Discharge - BL_30_94

L2 = SANSEW / WATER / - - Port Hope Sewer Use By Law - Storm Sewer Discharge - BL_30_94

Parameter	Units	RL	L1	L2	Result
Microbiology					
Total Coliform	cfu/100mL	0		2400	6
Oil and Grease					
Oil & Grease (total)	mg/L	2			< 2
Oil & Grease (mineral/synthetic)	mg/L	4	15	10	< 4
Oil & Grease (animal/vegetable)	mg/L	4	100	10	< 4
Other (ORP)					
pH	No unit	0.05	9.5	9.5	7.29
Chloride	mg/L	1	1500	1500	19
Mercury (total)	mg/L	0.00001		0.1	< 0.00001
Phenols					
4AAP-Phenolics	mg/L	0.002	0.1	0.02	< 0.002

EXCEEDANCE SUMMARY

No exceedances are present above the regulatory limit(s) indicated

QC SUMMARY

Anions by discrete analyzer

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO8056-APR24	mg/L	1	<1	ND	20	96	80	120	103	75	125
Sulphate	DIO8056-APR24	mg/L	2	<2	ND	20	108	80	120	112	75	125

Biochemical Oxygen Demand

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0035-APR24	mg/L	2	< 2	7	30	103	70	130	126	70	130

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0187-APR24	mg/L	0.01	<0.01	ND	10	98	90	110	82	75	125

QC SUMMARY

Mercury by CVAAS

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0040-APR24	mg/L	0.00001	< 0.00001	ND	20	111	80	120	128	70	130

Metals in aqueous samples - ICP-MS

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cadmium (total)	EMS0183-APR24	mg/L	0.000003	<0.000003	8	20	92	90	110	106	70	130
Chromium (total)	EMS0183-APR24	mg/L	0.00008	<0.00008	1	20	96	90	110	111	70	130
Copper (total)	EMS0183-APR24	mg/L	0.001	<0.001	0	20	96	90	110	98	70	130
Iron (total)	EMS0183-APR24	mg/L	0.007	<0.007	2	20	103	90	110	125	70	130
Nickel (total)	EMS0183-APR24	mg/L	0.0001	<0.0001	1	20	95	90	110	91	70	130
Lead (total)	EMS0183-APR24	mg/L	0.00009	<0.00009	0	20	91	90	110	94	70	130
Zinc (total)	EMS0183-APR24	mg/L	0.002	<0.002	1	20	93	90	110	98	70	130

QC SUMMARY

Microbiology

Method: SM 9222 I Internal ref.: ME-CA-IENVIMIC-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Coliform	BAC9299-APR24	cfu/100mL	-	ACCEPTED	ACCEPTED							

Oil & Grease

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0357-APR24	mg/L	2	<2	NSS	20	103	75	125			

QC SUMMARY

Oil & Grease-AV/MS

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (animal/vegetable)	GCM0357-APR24	mg/L	4	< 4	NSS	20	NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0357-APR24	mg/L	4	< 4	NSS	20	NA	70	130			

pH

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0440-APR24	No unit	0.05	NA	0		100			NA		

Phenols by SFA

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0192-APR24	mg/L	0.002	<0.002	ND	10	102	80	120	95	75	125

QC SUMMARY

Sulphide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0215-APR24	mg/L	0.02	<0.02	ND	20	97	80	120	NA	75	125

Suspended Solids

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0505-APR24	mg/L	2	< 2	0	10	96	90	110	NA		

QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

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

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 035831

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

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Cindy Brault
Received Date: 04 / 17 / 24 (mm/dd/yy)
Received Time: 10 : 10 (hr : min)
Received By (signature): Cindy Brault
Custody Seal Present: Yes ☑ No ☐
Custody Seal Intact: Yes ☑ No ☐
Cooling Agent Present: Yes ☑ No ☐ Type: ice
Temperature Upon Receipt (°C) 8.8.5
LAB LIMS #: 9A14658-APR24

REPORT INFORMATION	INVOICE INFORMATION
Company: SOIL ENG LTD	☑ (same as Report Information)
Contact: GURKARANBIR SINGH	Company:
Address: 90 West Beaver Creek Rd, Richmond Hill	Contact:
Phone: 519-731-6442	Address:
Fax:	Phone:
Email: gurkaranbir.singh@soilengineersltd.com	Email:

Quotation #:
P.O. #: 2402W021
Project #:
Site Location/ID: 4646 County Rd 2, Port Hope

TURNAROUND TIME (TAT) REQUIRED

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

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

Specify Due Date:

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

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium/Fine
☐ Table 3 ☐ Agri/Other
☐ Table ____ Appx. ____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ ~~PWQO~~ ☐ MMER
☐ CCME ☐ Other:
☐ MISA
☐ ODWS Not Reportable *See note

Sewer By-Law:
☑ Sanitary
☑ Storm
Municipality: Municipality of Port Hope

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	M&I: Metals & Inorganics (incl CrVI, CN, Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na-water)	M&I: Full Metals Suite (ICP metals plus B(HWS-soil only) Hg, CrVI	M&I: ICP Metals only Sb,As,Ba,Be,B,Cd, Cr,Co,Cu,Pb,Mo,Ni,Se,Ag,Tl,U,V,Zn	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs Total ☐ Aroclor ☐	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other (please specify): Sewer Use: Storm Sanitary Specify pkg Municipality of Port Hope; Water Characterization Pkg General ☐ Extended ☐	SPLP: Specify tests ☐ Metals ☐ VOC ☐ 1,4-Dioxane ☐ OCP ☐ ABN	TCLP: Specify tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	COMMENTS:
1	BH/MW 1	Apr 17, 2024	9:40AM	12	GW	N															
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

Observations/Comments/Special Instructions

Sampled By (NAME): Gurkaranbir Singh Signature: Date: Apr / 17 / 2024 (mm/dd/yy)
Relinquished by (NAME): Gurkaranbir Singh Signature: Date: Apr / 17 / 2024 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

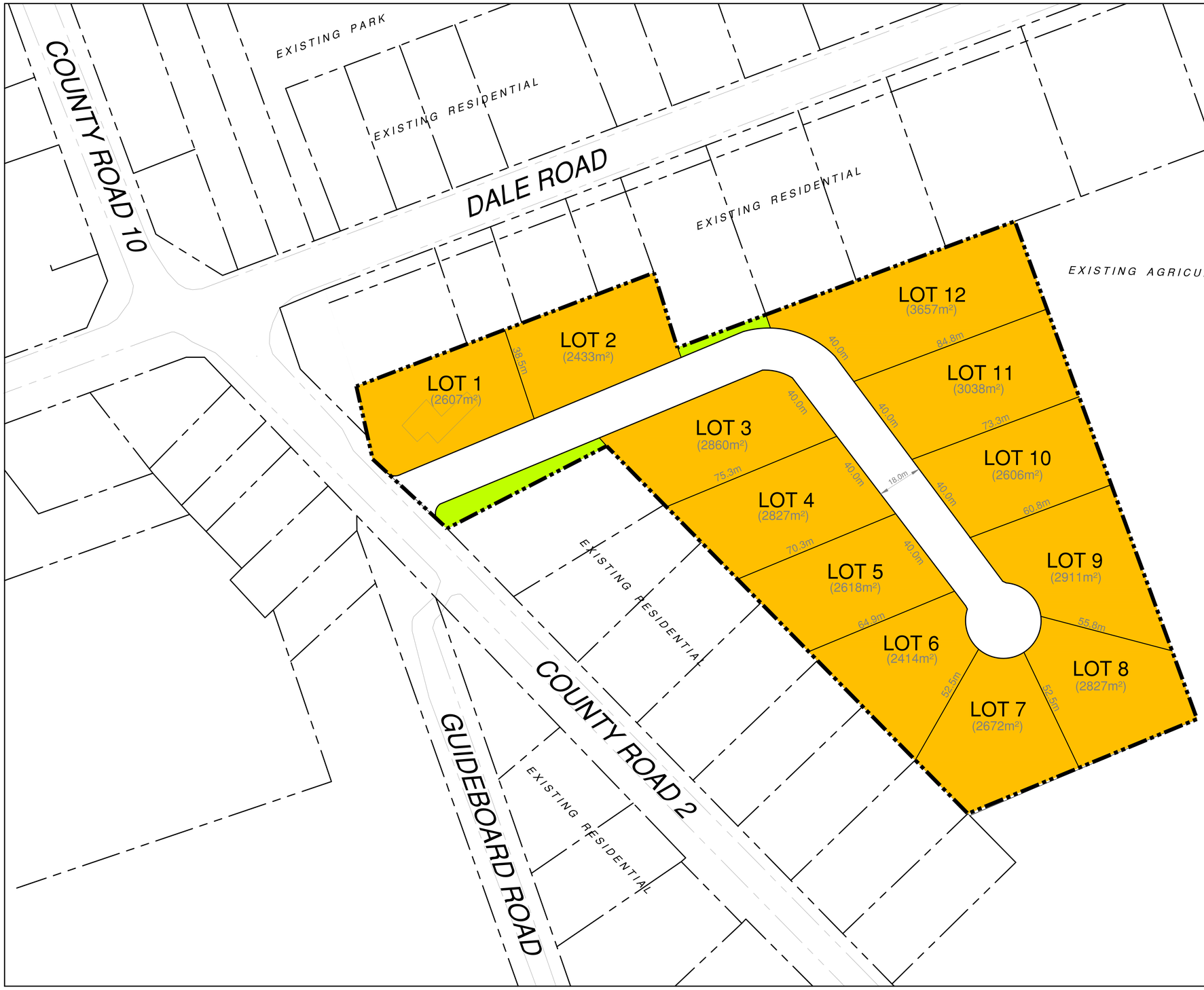
Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	MUSKOKA	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

APPENDIX E

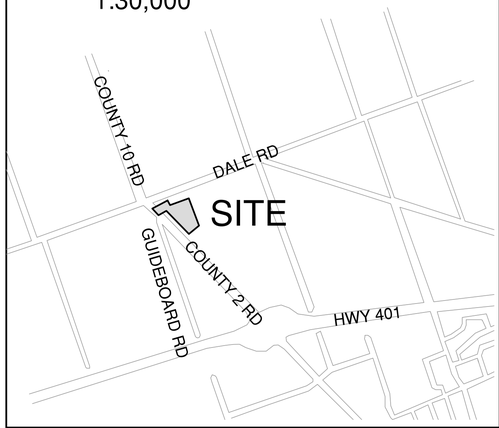
REVIEWED PLANS

REFERENCE NO. 2402-W021



KEY PLAN

1:30,000



4.01ha (9.90Ac) SUBDIVISION AREA

LIMIT OF SUBDIVISION

NOTE:

PRELIMINARY DEVELOPMENT PLAN

4646 COUNTY ROAD 2
MUNICIPALITY OF PORT HOPE

CANDEVCON LIMITED
CONSULTING ENGINEERS AND PLANNERS
TEL. (905) 794-0600 FAX (905) 794-0611

DATE	JULY 14th 2023	JOB No	W23089
DRAWN	S.G.	PLAN No.	PDP-1
SCALE	1:1000		

Soil Engineers Ltd.
CONSULTING ENGINEERS
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90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

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

APPENDIX F

SHORT-TERM DEWATERING AND LONG-TERM DRAINAGE FLOW RATE ESTIMATES

REFERENCE NO. 2402-W021

Short-Term Dewatering Calculation - 4646 County Road 2, Municipality of Port Hope (2402-W021)

Dewatering Rate Formula for an Unconfined Aquifer (Powers et al., 2007):

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where:

- Q = Anticipated pumping rate (m^3/day)
- K = Hydraulic Conductivity (m/day)
- H = Initial Hight of static groundwater level to bottom of the saturated aquifer (m)
- h = Depth of water in the well while pumping (m)
- R_0 = Distance from a point of greatest drawdown to a point where there is no drawdown (Radius of influence) (m)
- r_s = Distance to the wellpoints from the centre of the trench (m), assumed to be half of the trench width
- x = Trench Length (m)
- L = Distance from a line source to the trench, R_o (m)/2

Parameter	Units	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 11	Lot 12
Q s.f. 1.5	**m^3/day**	**30.60**	**32.90**	**32.70**	**23.10**	**22.30**	**19.50**	**19.80**	**20.00**	**43.00**	**46.10**	**50.40**
Q	**m^3/day**	**20.39**	**21.90**	**21.78**	**15.38**	**14.86**	**12.96**	**13.19**	**13.31**	**28.67**	**30.68**	**33.58**
K	**m/day**	0.21	0.21	0.21	0.14	0.14	0.05	0.05	0.05	0.41	0.41	0.41
H	**m**	4.4	4.4	4.4	4.0	4.0	4.0	4.0	4.0	4.2	4.2	4.2
h	**m**	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
R_0	**m**	35.6	35.6	35.6	28.4	28.4	16.0	16.0	16.0	49.4	49.4	49.4
Trench width (b)	**m**	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
r_s	**m**	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
x (a)	**m**	38.9	45.8	45.2	41.9	38.6	42.8	45.2	46.6	41.7	48.6	58.5
L	**m**	17.8	17.8	17.8	14.2	14.2	8.0	8.0	8.0	24.7	24.7	24.7
	a/b	1.6	1.8	1.8	1.7	1.5	1.7	1.8	1.9	1.7	1.9	2.3

Radius of Influence Formula (Bear, 1979):

$$R_0 = 2.45\sqrt{\frac{HK}{S_y}}t$$

a/b>1.5 Trench Dewatering
a/b<1.5 Single Well Dewatering

Where:

- R_0 = Radius of Influence (m), beyond which there is negligible drawdown
- H = Distance from initial static water level to bottom of saturated aquifer (m)
- K = Hydraulic conductivity (m/s)
- S_y = Specific yield of the aquifer formation
- t =Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Units	values	values	values	values	values	values	values	values	values	values	values
R_0	**m**	**35.6**	**35.6**	**35.6**	**28.4**	**28.4**	**16.0**	**16.0**	**16.0**	**49.4**	**49.4**	**49.4**
H	**m**	4.4	4.4	4.4	4.0	4.0	4.0	4.0	4.0	4.2	4.2	4.2
K	**m/s**	2.4E-06	2.4E-06	2.4E-06	1.7E-06	1.7E-06	5.3E-07	5.3E-07	5.3E-07	4.8E-06	4.8E-06	4.8E-06
S_y (Johnson,1967)		0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
t	**s**	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600

Long-Term Foundation Drainage Flow Calculation - 4646 County Road 2, Municipality of Port Hope (2402-W021)

Dewatering Rate Formula for an Unconfined Aquifer (Powers et al., 2007):

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where:

- Q = Anticipated pumping rate (m^3/day)
- K = Hydraulic Conductivity (m/day)
- H = Initial Hight of static groundwater level to bottom of the saturated aquifer (m)
- h = Depth of water in the well while pumping (m)
- R_0 = Distance from a point of greatest drawdown to a point where there is no drawdown (Radius of influence) (m)
- r_s = Distance to the wellpoints from the centre of the trench (m), assumed to be half of the trench width
- x = Trench Length (m)
- L = Distance from a line source to the trench, R_o (m)/2

Parameter	Units	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 11	Lot 12
Q s.f. 1.5	**m^3/day**	**22.50**	**24.10**	**24.00**	**16.60**	**16.00**	**19.00**	**19.20**	**19.30**	**30.60**	**32.70**	**35.90**
Q	**m^3/day**	**14.95**	**16.05**	**15.97**	**11.03**	**10.66**	**12.61**	**12.77**	**12.85**	**20.34**	**21.79**	**23.88**
K	**m/day**	0.21	0.21	0.21	0.14	0.14	0.05	0.05	0.05	0.41	0.41	0.41
H	**m**	3.7	3.7	3.7	3.3	3.3	3.3	3.3	3.3	3.5	3.5	3.5
h	**m**	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
R_0	**m**	32.4	32.4	32.4	25.6	25.6	14.5	14.5	14.5	44.8	44.8	44.8
Trench width (b)	**m**	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
r_s	**m**	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
x (a)	**m**	38.9	45.8	45.2	41.9	38.6	42.8	45.2	46.6	41.7	48.6	58.5
L	**m**	16.2	16.2	16.2	12.8	12.8	7.2	7.2	7.2	22.4	22.4	22.4
	a/b	1.6	1.8	1.8	1.7	1.5	1.7	1.8	1.9	1.7	1.9	2.3

Radius of Influence Formula (Bear, 1979):

$$R_0 = 2.45\sqrt{\frac{HK}{S_y}}t$$

a/b>1.5 Trench Dewatering
a/b<1.5 Single Well Dewatering

Where:

- R_0 = Radius of Influence (m), beyond which there is negligible drawdown
- H = Distance from initial static water level to bottom of saturated aquifer (m)
- K = Hydraulic conductivity (m/s)
- S_y = Specific yield of the aquifer formation
- t =Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Units	values	values	values	values	values	values	values	values	values	values	values
R_0	**m**	**32.4**	**32.4**	**32.4**	**25.6**	**25.6**	**14.5**	**14.5**	**14.5**	**44.8**	**44.8**	**44.8**
H	**m**	3.7	3.7	3.7	3.3	3.3	3.3	3.3	3.3	3.5	3.5	3.5
K	**m/s**	2.4E-06	2.4E-06	2.4E-06	1.7E-06	1.7E-06	5.3E-07	5.3E-07	5.3E-07	4.8E-06	4.8E-06	4.8E-06
S_y (Johnson,1967)		0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
t	**s**	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600