Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

HYDROGEOLOGICAL ASSESSMENT
65 WARD STREET
PORT HOPE, ONTARIO

Prepared For:

CVH (No. 6) LP
766 Hespeler Road
Cambridge, Ontario
N3H 5L8

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Terraprobe Inc.

Greater Toronto
11 Indell Lane
Brampton, Ontario L6T 3Y3
(905) 796-2650 Fax: 796-2250

Hamilton – Niagara
903 Barton Street, Unit 22
Stoney Creek, Ontario L8E
(905) 643-7560 Fax: 643-7559

Central Ontario
220 Bayview Drive, Unit 25
Barrie, Ontario L4N 4Y8
(705) 739-8355 Fax: 739-8369

Northern Ontario
1012 Kelly Lake Rd., Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax: 670-0558

www.terraprobe.ca

EXECUTIVE SUMMARY

Terraprobe Inc. (Terraprobe) was retained CVH (No. 6) LP to conduct a hydrogeological assessment for the proposed development located at 65 Ward Street in the Municipality of Port Hope, Ontario (the "Site"). This report was prepared to estimate the potential short-term construction dewatering requirements associated with the proposed development. Furthermore, groundwater quality was assessed in comparison to the Municipality of Port Hope Sanitary and Storm Sewer Discharge By-Law to provide comments on discharge options.

The Site is bounded by Ward Street to the north, Hope Street South to the east, residential properties to the south and Princess Street to the west. The Site is currently consisting of three (3) properties with the municipal addresses of 18 and 20 Hope Street and 65 Ward Street. A 3-storey residential building and one (1) detached family residential house are located at 20 and 18 Hope Street South, respectively. A 2-storey building is also located at 65 Ward Street. The current conditions of the Site are presented in **Table I**.

Table I: Existing Buildings Conditions

Municipal Address	Above Grade Levels	Below Grade Levels
18 Hope Street	1	1
20 Hope Street	3	Slab-on-grade
65 Ward Street	2	1

Terraprobe previously submitted the hydrogeological assessment report dated January 29, 2020 and the findings of that report form the basis of this report. This report is an updated version of the previous report due to change in Site Plan and number of storeys of the proposed building.

The proposed development will include construction of a 7- storey residential slab-on-grade building based on the e-mail dated May 19, 2021. The proposed Site Plan prepared by Lawrence Architect Inc., dated May 6, 2021 (drawing no. A1.0) was reviewed for the current study. The plan shows the proposed residential building footprint. However, proposed development details are not available for review at the time of preparation of the current report. As such, base of the excavation for constructing the footing walls, proposed by geotechnical engineer, was considered at El. 98.27 metres above sea level (masl) (2.6 metres below ground surface (mbgs)). A summary of the proposed development is presented in **Table II**.

Table II: Proposed Development

Proposed Development	Above Grade Levels	Underground Levels	Approximate Base of Excavation (masl) for Constructing the Footings	The Highest Groundwater Level (masl)
Proposed building	7	Slab-On-Grade	98.27	99.26

The Subsoil profile and groundwater conditions and requirements for the Site are summarized in **Table III and Table IV**:

Table III: Summary of Subsoil Profile

Stratum/Formation	Aquifer or Aquitard	Depth Range (mbgs)	Elevation Range (masl)	Hydraulic Conductivity (m/s)
Fill	Aquifer/Perched	Ground surface to between 0.8 and 2.3	100.7 to 97.6	1.00×10^{-6} *
Clayey Silt Till	Aquitard	0.8 to 3.4	96.5 to 99.7	2.92×10^{-9}**
Silty Sand Till	Aquifer	3.1to 8.2mostly end of the borehole	92.1 to 98.1mostly end of the borehole	3.12×10^{-7}***
Sand	Aquifer	4.6 to 7.6	96.3 to 93.3	1.17×10^{-4}***

*Indicates conductivity was estimated using typical published values from Freeze and Cherry (1979)

**Indicates conductivity was estimated using grain size analysis

***Indicates conductivity was estimated using in-situ hydraulic conductivity test

Table IV: Summary of Groundwater Conditions

Groundwater Conditions	
The Stabilized Shallow Groundwater Elevation Considered for the Dewatering Flow Rate Estimation	99.26 masl (1.57 mbgs)

Short-term construction dewatering flow rates and the estimated conceptual zone of influence (ZOI) for dewatering are summarized in **Table V**. An excavation trench with 0.8 m width and 323.4 m length was considered to estimate the short-term dewatering flow rate. These calculations assume that the sand encountered outside the proposed building footprint at BH10 is localized. It is recommended that this be investigated prior to construction. Since the building is slab on grade no long-term dewatering is required.

Table V: Summary of Shot-Term Dewatering Calculations

Conceptual Zone of Influence (ZOI)			**9.3 m**			
Groundwater Quantity – Short-Term (Construction)						
Underground Structure	**Groundwater Seepage (Safety Factor – 1.5)**		**2-Year Rainfall Event**		**Total Discharge Volume (Seepage + Rainfall)**	
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**
Spread Footing*	300	0.21	60	0.04	360	0.25
Strip Footing**	41,400	28.75	6,500	4.51	47,900	33.26

*Considering 1.5 m for each side of the footing. Additionally, the flow rate is estimated for one (1) spread footing.
**Considering 323.4 m and 0.8 m as the length and width of the trench.

Groundwater quality was assessed in comparison with the Municipality of Port Hope Sewer By-Law with the results summarized in **Table VI**.

Table VI: Summary of Groundwater Quality Assessment

	Municipality of Port Hope Storm Sewer Limits	Municipality of Port Hope Sanitary Sewer Limits
Untreated Groundwater (Sample ID – BH10)	Exceeds for TSS and Iron	Exceeds for TSS
Treatment Required Prior to Discharge	Yes	Yes

Permits potentially required to be obtained for short-term dewatering are summarized in **Table VII**.

Table VII: Summary of Permits Required for Shot-Term Dewatering

Permit Requirements	
Environmental Activity and Sector Registry (EASR) Posting	Not Required
Short-Term Permit to Take Water (PTTW)	Not Required
Municipality Requirements, if connected to municipal sewer	
Short-Term Discharge Agreement	Required

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1.0 INTRODUCTION

1.1 Site Location and Project Description

Terraprobe Inc. was retained by CVH (No. 6) LP, to conduct a Hydrogeological Assessment at the property located at 65 Ward Street, Port Hope, Ontario (the Site). The Site is located at the southwest corner of the intersection of Ward Street and Hope Street, where it is bounded by Ward Street to the north, Hope Street South to the east, residential properties to the south and Princess Street to the west. Location of the Site is shown on **Figure 1**.

The Site currently consists of three (3) properties with municipal addresses of 18 and 20 Hope Street and 65 Ward Street. A review of a survey plan prepared by Eliott and Parr (Peterborough) LTD., August 23, 2019 indicates that a 3-storey residential building, and one (1) detached family residential house are located at 20 and 18 Hope Street South, respectively. A 2-storey building is also located at 65 Ward Street. One (1) level of underground structure is present at the properties with the municipal addresses 18 Hope Street and 65 Ward Street.

Terraprobe previously submitted the hydrogeological assessment report dated January 29, 2020 and the findings of that report form the basis of this report. This report is an updated version of the previous report due to change in Site Plan and number of storeys of the proposed building.

Terraprobe understands that the future development of the Site will include construction of a 7-storey residential slab-on-grade building. As such, underground structures are not proposed as a part of the future development.

Currently, municipal water and sewer services are provided to the Site. It is understood that future residential development will be municipally serviced.

The study was undertaken to assess hydrogeological conditions of the Site and to provide general information regarding the hydrogeological impact of the proposed development on the local groundwater function. The report addresses the following areas:

- Identifying the geological and hydrogeological setting of the Site;
- Confirming groundwater level and groundwater flow direction beneath the Site;
- Assessing groundwater quality in comparison with Municipality of Port Hope Sanitary and Storm Sewer By-Law;
- Evaluate potential short-term construction dewatering needs for proposed development;
- Identifying potential impacts to the nearby groundwater receptors including water supply wells and natural heritage features pertaining the proposed development;

- Providing mitigation plan on the potential impacts to the groundwater receptors associated to the proposed development; and,
- Providing recommendation on any needs for applying for Permit to Take Water (PTTW), or posting Environmental Activity and Sector Registry (EASR) with the Ministry of the Environment, Conservation and Parks (MECP).

1.2 Scope of Work

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

- Review of available background information: A review of available background geological and hydrogeological information for the Site including topographic mapping, surface geological and bedrock geological mapping, natural heritage features databases, and MECP water well records.
- Review of the Municipality of Port Hope Official Plans and Ganaraska Region Conservation Authority (GRCA) Policy Areas: The Municipality of Port Hope official plans and GRCA maps was reviewed to understand the location of the Site and the proposed development within the policy areas.
- Site inspection: A visual inspection of the Site and surrounding areas to determine local topography and drainage, and an assessment of significant features.
- Groundwater Monitoring and Hydraulic Conductivity Testing: Groundwater level within the installed monitoring wells was monitored over three (3) monitoring events. In-situ hydraulic conductivity testing was completed within the installed monitoring wells to estimate the hydraulic conductivity of the strata within the well screen interval.
- Groundwater Quality Assessment: Groundwater quality was assessed in comparison with the Municipality of Port Hope Sanitary and Storm Sewer By-Law to assess available options to discharge the potential short-term dewatering effluent.
- Review of Proposed Site Development Concept: A review of the currently proposed site development concept with respect to measures being implemented at the Site in order to estimate the potential construction dewatering needs.
- Construction Dewatering Flow Rate Estimate: Considering the proposed development plans, construction dewatering flow rate (short-term dewatering) was estimated using the stable groundwater table and estimated hydraulic conductivity measured in the Site.

- Mitigation Plans for Dewatering: A mitigation plan is 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.
- Potential Short-Term Dewatering Permits: Considering the estimated short-term construction dewatering flow rates, recommendations are provided on any need for applying for a PTTW or posting on the EASR with the MECP, if required.

2.0 APPLICABLE REGULATIONS AND AGENCIES

The environmental regulations and policies relevant to this hydrogeological study are briefly discussed below.

2.1 Ganaraska 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 Ontario Regulation (O. Reg.) 168/06, Development, Interference with Wetlands and Alterations to Shorelines and Watercourses for development proposal 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 Municipality of Port Hope Official Plan

The Municipality of Port Hope's 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 Plans were reviewed for the current study with the results summarized as below:

- Schedule B-1 (Development Constructions and Urban Detail) - A review of the map, dated November 22, 2019, indicates that the Site is not located within the areas designated as Natural Heritage or Natural Hazards.
- Schedule B-3 (Drinking Water Source Protection Vulnerable Areas) - A review of the map, dated November 22 2016, indicates that the Site is located within an area designated as Intake Protection Zone 2.
- Schedule C-1 (Land Use Urban Area Detail) - A review of the map, dated November 22, 2016, shows that the Site is located with the Low Density Residential Area.

2.3 Permit to Take Water (PTTW)

According to Part III of O. Reg. 63/16, for construction dewatering, water takings of more than 50,000 L/day but less than 400,000 L/day is to be registered on the Environmental Activity and Sector

Registry (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 Site, a hydrogeological report will need to be submitted in support of the application. Construction dewatering estimation was completed as a part of scope of work for the current assessment.

2.4 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 regional-scale source water protection mapping (Source Water Protection Information atlas) provided by the MECP, the Site is not located within a WHPA area, and SGRA. However, it is located within an area designated as HVA having score of 6. Additionally, the Site is located within Intake Protection Zone 2.

3.0 METHODOLOGY

3.1 Borehole Advancement and Monitoring Well Installation

Drilling boreholes and construction of monitoring wells were conducted in conjunction with geotechnical investigation and Phase Two Environmental Site Assessment (ESA) between October 29 and November 1, 2019. The program consisted of the drilling of twelve (12) boreholes (BH). Seven (7) monitoring wells, including four (4) monitoring wells for hydrogeological assessment purposes and three (3) monitoring wells for Phase Two ESA purposes, one in each of the selected boreholes, were advanced and istalled at the Site. The locations of the boreholes and monitoring wells are shown on **Figure 2**.

Borehole drilling and monitoring well construction were completed by a licensed water well contractor, Strong Soil Search Inc., under the full-time supervision of a geotechnical technician from Terraprobe, who also logged the soil strata encountered during borehole advancement and collected representative soil samples for textural classification. The boreholes were drilled using continuous flight, solid-stem augers. Detailed descriptions of the encountered subsoil and groundwater conditions are presented on the borehole and monitoring well logs, on the enclosed **Appendix A**, inclusive.

The monitoring wells were constructed using 50-mm diameter PVC riser pipes and screens, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. All of the monitoring wells were equipped with steel flush mount or monument protective casings 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**. It should be noted that the ground surface elevations at the monitoring wells locations were confirmed through the previously mentioned survey plan.

Table 3-1- Monitoring Well Installation Details

Monitoring Well ID	Installation Date	UTM Coordinates (m)		Ground El. (masl)	Monitoring Well Depth (mbgs)	Screen Interval (mbgs)	Casing Dia. (mm)	Protective Casing Type
		Easting	Northing					
BH3	November 1, 2019	717558.7	4870462.1	100.83	7.6	4.6 – 7.6	50	Monument
BH4	October 31, 2019	717545.7	4870460.9	100.88	7.6	4.6 – 7.6	50	Flush Mount
BH5	October 29, 2019	717549.2	4870435.9	101.19	7.6	4.6 – 7.6	50	Flush Mount
BH6	October 31, 2019	717590.3	4870358.2	102.21	7.6	4.6 – 7.6	50	Monument
BH8	October 30, 2019	717534.5	4870415.3	100.74	7.6	4.6 – 7.6	50	Monument
BH10	October 29, 2019	717516.6	4870386.9	100.86	7.6	4.6 – 7.6	50	Monument
BH12	October 29, 2019	717503.0	4870444.3	99.89	7.6	4.6 – 7.6	50	Monument

Notes:
mbgs metres below ground surface

masl metres above sea level

3.2 Groundwater Monitoring

All seven (7) installed monitoring wells were utilized to measure and monitor groundwater levels. Monitoring wells were developed, and the groundwater monitoring program confirmed the stabilized groundwater level beneath the Site. The stabilized groundwater levels were monitored over three (3) monitoring events.

3.3 MECP Water Well Records Review

MECP Water Well Records (WWRs) were reviewed for the registered wells located at the Site and within 500 m radius of the Site boundaries (study area). The findings of the MECP well records are presented in the **Section 4.6** of the current report.

3.4 In-Situ Hydraulic Conductivity Test

Three (3) of four (4) installed monitoring wells for hydrogeological assessment including BH3, BH6 and BH10 were utilized to conduct hydraulic conductivity testing. The in-situ test 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 rate at which the water level recovers to static conditions (falling head) is tracked using a data logger/pressure transducer, and/or manually, using a water level tape. The rate at which the water table recovers to static conditions is used to estimate the K value for the water-bearing strata formation at the well screen depth. The findings for the hydraulic conductivity testing are presented in **Section 6.3.1** of the current report.

3.5 Hydraulic Conductivity based on Grain Size Distribution Graphs

The Hazen equation estimation method was also used to estimate the hydraulic conductivity (K) for saturated subsoils at selected depths beneath the water table below the subject Site. The method provides alternative hydraulic conductivity (K) estimates which are derived from the grain size diameter, whereby 10% by weight of the soil particles are finer and 90% are coarser (Freeze and Cherry, 1979). The soils

chosen for Hazen method to estimate were selected primarily from above the well screen depths. Findings are presented in **Section 6.3.2**.

3.6 Groundwater Quality Assessment

One (1) set of groundwater samples wascollected from one (1) selected monitoring well (BH10) to characterize its quality for evaluation against the Municipality of Port Hope Storm and Sanitary Sewer Use By-Law (30/94) parameters. This is performed to assess whether any anticipated dewatering effluent can be disposed of into the Municipality of Port Hope sewer system during construction, or following site development for any long-term foundation drainage. Based on the results, recommendations for any pre-treatment for any dewatering/drainage effluent can be developed, if required.

One (1) selected monitoring well was developed and purged of three (3) well casings volumes of groundwater prior to sample collection. One complete set of groundwater samples was not filtered during collection, prior to placement in the laboratory sample bottles. Upon sampling, all of the bottles were placed in ice and packed in a cooler at about 4 ± C^{o} for shipment to the analytical laboratory. Sample analysis was performed by ALS Environmental, a laboratory accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). The results of the analysis are discussed in **Section 6.4** of the current report.

3.7 Review of Regional Data and Available Reports for the Site

The maps, data, and documents provided by the MECP, Ontario Geological Survey (OGS), Ministry of Natural Resource and Forestry (MNRF), and GRCA were reviewed. Additionally, available previously issued and concurrent geotechnical reports were be reviewed at the time of preparation of the current hydrogeological report, with the findings summarized in S**ection 4.**

4.0 REGIONAL AND LOCAL SITE SETTING

4.1 Regional Geology

The current understanding of the surface geological setting of the Site is based on scientific work conducted by the OGS (OGS, 2003). The Site is located within an area mapped as fine-textured glaciolacustrine deposits (8a), comprising silt and clay, minor sand and gravel. **Figure 3** illustrates the mapped surficial geology for the Site and the surrounding area.

Oak Ridges Moraine Group (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:

- Halton Till (equivalent)
- Oak Ridges Moraine
- Newmarket Till
- Thorncliffe Formation
- Sunnybrook Drift
- Scarborough Formation

Halton Till (Upper Till): The Halton Till is mainly comprised of sandy silt to clayey silt till interbedded with silt, clay, and a number of discontinuous sand and gravel lenses. It was deposited approximately 12,500 years ago. Based on cross-sectional geology, the Halton Till or equivalent is present in ground surface, with an approximate thickness of up to 0.3 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 reach to 8.3 m beneath the Site. ORAC can be contacted approximately 100.0 masl extending to 91.8 masl.

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 mapped beneath the ORAC. It can be contacted approximately 91.7 masl extending to 85.0 masl. The thickness of the Newmarket Till could reach 6.7 m beneath the 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 could reach 0.8 m beneath the Site. It could be contacted approximately 85.0 masl extending to 84.2 masl.

Sunnybrook Drift: The Sunnybrook Drift consists of silt to silty clay materials deposited 45,000 years ago and acts as a regional aquitard. The thickness of the Sunnybrook Drift is generally less than 10 m to 20 m. Based on the ORMGP cross-section it can be encountered approximately 84.6 masl, extending to 79.1 masl, with the estimated thickness that could reach 5.5 m beneath the Site.

Scarborough Formation: 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 could reach 0.5 m beneath the Site. It is anticipated the Scarborough Formation can be contacted approximately 79.7 masl.

The underlying bedrock at the 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 depth of 20 mbgs (El. 80.4 masl) beneath the Site.

4.2 Regional Physiography

The Site is located within a regional physiography of Southern Ontario known as Iroquois Plain. The Iroquois plain within the vicinity of the Site comprises clay plains. The Iroquois Plain occupies the lowlands around the western part of Lake Ontario, where it covers about a distance of 300.0 km, from the Niagara River to the Trent River. It has a width varying from about 100.0 m to over 10.0 km. When the last glacier (Wisconsin) was receding from Southern Ontario, the area was inundated by a body of water known as Lake Iroquois, which emptied eastward at Rome, New York State (Chapman and Putnam, 1984). **Figure 4** shows the location of the Site within the regional physiography map.

4.3 Regional Topography and Drainage

A review of a survey plan prepared by Elliot and Parr (Peterborough) LTD., dated August 23, 2019 indicates that the topography of the Site is relatively flat. The ground surface elevation ranges approximately between 100 and102 masl. Considering the topography map, ground surface elevation for the Site slopes northwesterly direction. As such, it is anticipated that generated runoff (if it is not managed) will flow northwesterly direction.

4.4 Watershed Setting

Southern Ontario interactive watershed map was reviewed on December 25, 2019. The Site is located within the Ganaraska River watershed. 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 on December 10, 2019 for any natural heritage features including, watercourses, bodies of water, wetland features, Area of Natural and Scientific Interest (ANSI) and wooded areas. **Figure 5** shows the location of the Site within the surrounding Natural Heritage Features. The Lake Ontario is located approximately 900 m to the south of the Site, and Ganaraska River is located approximately 500 m to the west of the Site.

Record review indicates that there are no records for natural heritage features including wetland, water bodies, watercourses and ANSI within or in close proximity to the Site.

4.6 Groundwater Resources (MECP Well Records)

MECP well record database was reviewed for records located within a radius of 500 m from the approximate Site boundary (Study Area). The location of the well records is presented on **Figure 6** with the details for each well summarized in **Appendix B.** A total of 12 wells were located within the study area. A summary of data obtained from record review is presented in **Table 4-1.**

Table 4-1- MECP Well Record Summary

Number of the Well Records	**12**
Unknown Status	1 (8%)
Well Type	
Drilled Well	10 (83%)
Dug Well	0 (0 %)
Unknown	2 (17%)
Depth Ranges	
Less or 3.0 m (10 ft)	2 (17%)
3.0 m to 6.0 m (10 ft to 20 ft	1 (8%)
Greater than 6.0 m (20 ft)	6 (50%)
Unknown	3 (25%)

Water Use (Final Status)	
Observation Well	2 (17%)
abandoned/Other	2 (17%)
Test Hole	5 (42%)
Monitoring/test hole	1 (8%)
Water Supply	1 (8%)
Unknown	1 (8%)
Reported Static Level	
0 to 4 m (0 to 13 ft)	2 (17%)
Unknown	10 (83%)

The above summary indicates that most of the local wells are registered as test hole or observation wells. Approximately 50% of the registered wells are completed deeper than 6.0 mbgs. Static groundwater level was unknown for majority of the wells. It was recorded shallower than 4.0 mbgs within approximately 17% of the wells.

Record review indicates that one (1) water supply well, which was previously registered as industrial well is located approximately 400 m to the southwest of the Site (record no.7 on Figure 6, and appendix D).

The Site is situated in a serviced area within the Municipality of Port Hope. Additionally, as there is no water supply well within or in close proximity to the Site, a door to door well survey is not required in advance of, during and after construction.

4.7 Active Permit to Take Water Application Records Review

MECP website was reviewed for any active PTTW application records within 1.0 km radius of the Site on December 10, 2019. Record review indicates there are no records for active PTTW within the Study Area.

5.0 LOCAL GEOLOGY AND SUBSURFACE INVESTIGATION

Terraprobe completed a geotechnical investigation report on December 11, 2019. The fieldwork consisted of drilling a total of twelve (12) boreholes extending to the maximum depth of 8.2 mbgs. Information regarding borehole logs and grain size distribution graphs is presented in Appendix A. The approximate locations of boreholes are shown on **Figure 2**. A review of the geotechnical investigation report indicates that the stratigraphy beneath the investigated areas of the Site generally consists of the followings:

5.1 Surficial Pavement and Topsoil

An asphalt pavement structure, 380 mm to 800 mm thick, was contacted at BH2, BH4 and BH9 locations. The pavement structure comprises asphaltic concrete and underlying aggregate layer.

A topsoil layer was encountered in all borehole locations except BH2, BH4 and BH9. It varies in thickness from about 150 to 300 mm. The topsoil was brown to dark brown in color and consisted of a silt matrix.

5.2 Earth Fill

A layer of earth fill materials consisting of clayey silt, a trace to some sand, trace amounts of organics and rootlets/sand and gravel with trace amounts of silt was encountered beneath the topsoil layer or surficial pavement structure extending to the depths ranging between 0.8 m to 2.3 m below grade. The earth fill is brown in color and moist to wet (1 to 37%) in moisture content.

5.3 Native Soil (Undisturbed Soils)

5.3.1 Glacial Till

Glacial till beneath the Site comprises moist clayey silt and silty sand layers. It was encountered underlying the earth fill zone in each borehole extending to the full depth of investigation up to about 8.2 mbgs, except at BH10 location, where a layer of sand was contacted beneath the silty sand till layer extending to a depth of 7.6 mbgs.

Clay silt is stiff to hard in consistency and brown in color. The silty sand layer is compact to very dense. It is brown in color except for BH12, where a grey layer of silty sand was contacted.

5.3.2 Sand

Stratum of brown sand with trace to some gravel and trace amounts of silt was locally encountered at BH10. It was contacted between silty sand till layers from 4.6 to 7.6 mbgs and may be a sub-unit within the silty sand till. It is very dense in consistency and wet in moisture content.

5.4 Bedrock

No bedrock was observed within 8.2 m of grade (maximum depth of investigation).

6.0 LOCAL HYDROGEOLOGICAL STUDY

6.1 Monitoring Well Development and Groundwater Level Monitoring

A groundwater monitoring program was completed between November 14 and December 9, 2019 as a part of the hydrogeological assessment. Four (4) monitoring wells installed for the hydrogeological assessment (BH3, BH6, BH10 and BH12), and three (3) monitoring wells installed for the Phase Two ESA (BH4, BH5 and BH8) were considered for groundwater monitoring program.

Groundwater levels were monitored over three (3) monitoring events. The measured groundwater levels, along with other monitoring wells details and findings, are presented in **Appendix C**. A summary of the groundwater observations is provided in **Table 6-1**:

Table 6-1- A Summary of Groundwater Monitoring

Monitoring Well ID	Unit	Screen Interval	Groundwater Level			Average	Fluctuation
			Nov. 14, 2019	Nov. 19, 2019	Dec. 09, 2019		
BH3	masl	96.2 – 93.2	1.54	2.68	1.57	1.93	1.14
	mbgs	4.6 – 7.6	99.29	98.15	99.26	98.90	
BH4	masl	96.3 – 93.3	2.07	2.25	2.11	2.14	0.18
	mbgs	4.6 – 7.6	98.81	98.63	98.77	98.73	
BH5	masl	96.6 – 93.6	2.00	2.29	2.26	2.18	0.29
	mbgs	4.6 – 7.6	99.20	98.91	98.94	99.01	
BH6	masl	97.6 – 94.6	3.05	3.46	3.03	3.18	0.41
	mbgs	4.6 – 7.6	99.17	98.76	99.19	99.04	
BH8	masl	96.1 – 93.1	2.83	3.08	2.88	2.93	0.25
	mbgs	4.6 – 7.6	97.91	97.66	97.86	97.81	
BH10	masl	96.3 – 93.3	3.55	3.60	3.59	3.58	0.05
	mbgs	4.6 – 7.6	97.31	97.26	97.27	97.28	
BH12	masl	95.3 – 92.3	1.78	1.83	1.86	1.82	0.05
	mbgs	4.6 – 7.6	98.11	98.06	98.03	98.06	

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

As shown in **Table 6-2**, average groundwater levels ranged from 99.04 masl (3.18 mbgs) to 97.28 masl (3.58 mbgs). The highest and lowest shallow groundwater levels were measured at El. 99.29 masl and 97.26 masl at BH3 and BH10, respectively.

In addition, the highest groundwater fluctuation of 1.14 m was measured at monitoring well BH3. The lowest fluctuation of 0.05 m was also recorded at monitoring wells BH10 and BH12 locations over the monitoring period.

6.2 Shallow Groundwater Flow Pattern

Groundwater level elevations measured on December 9, 2019 was considered to interpret the shallow groundwater flow pattern beneath the Site. **Figure 7** presents the interpreted shallow groundwater elevation contours. A review of the plan indicates that the shallow groundwater is interpreted flowing the westerly direction, in general, towards the Ganaraska River.

6.3 Hydraulic Conductivity Testing

6.3.1 In-Situ Hydraulic Conductivity Testing

Monitoring wells BH3, BH6, and BH10 underwent single well response tests (SWRTs) to assess the hydraulic conductivity (K) for saturated shallow aquifer subsoils 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 D**, with a summary of the findings provided in **Table 6-2**.

Table 6-2- A Summary of Rising Head Hydraulic Conductivity Testing

Well ID	Ground El. (masl)	Monitoring Well Depth (mbgs)	Screen Interval (mbgs)	Screened Soil Strata	Hydraulic Conductivity (K) (m/sec)	Test Method
BH3	100.83	7.6	4.6 – 7.6	Silty sand till	1.35×10^{-7}	Falling Head Test
BH6	102.21	7.6	4.6 – 7.6	Silty sand till	3.12×10^{-7}	Falling Head Test
BH10	100.86	7.6	4.6 – 7.6	Sand	1.17×10^{-4}	Falling Head Test

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

A review of the findings indicates a low to moderate hydraulic conductivity for the silty sand till unit and a high hydraulic conductivity for the sand unit.

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 which 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:

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

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 soils 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 (mbgs)	Soil Sample Elevation (masl)	Soil Strata	Hydraulic Conductivity (m/sec.)
BH1	1.8 (SS3)	98.6	Clayey Silt till	2.92×10^{-9}

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

The K estimates determined using the Hazen method suggests very low hydraulic conductivity for the native clayey silt (till).

6.4 Groundwater Quality

One (1) representative groundwater sample was collected for analysis from within monitoring well BH10 on November 15, 2019. The sample was submitted for analysis and evaluation against the Municipality of Port hope storm and sanitary sewer use By-Law (30/94) standards.

The submitted samples consisted of unfiltered groundwater, with results presented as totals for various parameters analyzed. Upon sampling, all bottles were placed in ice and packed in a cooler at about 4° C for shipment to the analytical laboratory. Sample analysis was performed by ALS Environmental, which is accredited by CALA. The results of the analysis are provided in **Appendix E**, with a discussion of the findings provided below.

The analytical results for the unfiltered groundwater samples obtained from monitoring well BH10 indicate that the concentrations for all the analyzed parameters meet the Municipality of Port Hope's sanitary and storm sewer use limits with the exception of the exceedance for Total Suspended Solids (TSS) in comparison with the sanitary sewer By-Law limits; and TSS and Iron in comparison with the storm sewer By-Law limits. The exceedances, together with the storm and sanitary sewer use criteria, are presented in **Table 6-4.**

Table 6-4- Groundwater Quality Analysis Results Exceeded

Exceeded Parameter	Groundwater Quality Results (mg/L)	Municipality of Port Hope Sanitary Limits (mg/L)	Municipality of Port Hope Storm Limits (mg/L)
TSS	**1,880**	350	15
Iron	**37.3**	50	17

The results suggest that any construction dewatering or foundation drainage effluents should be acceptable for discharge to the Municipality of Port Hope sanitary sewer by using pre-treatment (filtration) to reduce the elevated TSS. The anticipated effluent would not be acceptable for discharge to the Municipality of Port Hope storm sewer system. However, implementing pre-treatment to lower TSS and Total Iron to meet Municipality of Port Hope storm sewer By-Law limits could permit its discharge to the Municipality's storm sewer system.

7.0 CONSTRUCTION DEWATERING

7.1 Proposed Development Plan Review

The proposed Site Plan prepared by Lawrence Architect Inc., dated May 6, 2021 (drawing no. A1.0) was reviewed for the current study. The plan shows the proposed residential building footprint. However, proposed development details are not available for review at the time of preparation of the current report. **Figure 8** shows the site plan.

7.2 A review of Geotechnical Investigation Report

- A slab-on-grade building is proposed for the development. Based on the geotechnical Investigation report prepared by Terraprobe dated December 11, 2019, all exterior foundations and foundations in unheated areas must be provided with a minimum soil cover of 1.2 m or equivalent insulation for frost protection. All footings must be designed to bear at least 0.3 m into the undisturbed native soil stratum.
- BHs 1, 3 to 8, 10 and 12 are located within or in close proximity of the footprints of the proposed development. These boreholes encountered a layer of earth fill materials (beneath the surficial topsoil layer or pavement structure), which extended to a depth of about 1.5 m to 2.3 m below existing grade, generally underlain by undisturbed clayey silt till. Beneath the clayey silt till a silty sand till unit extended to the full depth of investigation up to about 8.2 m below grade. Approximately 3 m of sand was also present within the silty sand at BH10 located outside of the proposed building footprint.
- The relatively deep earth zone was encountered at Boreholes 4, 8 and 12 locations, extending up to 2.3 m depth below grade. In this area, the footings will be extended to be founded on the silty sand till deposit. Alternatively, consideration may be given to backfill this over-excavation zone (from design foundation level to the underlying competent undisturbed native soils) with lean mix concrete (strength to be determined by the structural engineer) and the building foundations may be supported on this lean mix concrete pad/pedestal. The lean mix concrete pad must extend a minimum of 300 mm beyond the edge of the foundations in every direction.
- The minimum width of the continuous strip footings must be 450 mm and the minimum footing area for column must be 0.9×0.9 m^2 regardless of loading considerations, in conjunction with the recommended geotechnical resistance.
- The earth fill materials and native soils encountered in the boreholes are classified as Type 3 Soil above and Type 4 Soil below the prevailing groundwater level under these regulations. Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably

sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The steepest slope of excavation for Type 3 Soil should be 1 horizontal and 1 vertical, and for Type 4 Soil should be 3 horizontal and 1 vertical.

7.3 Summary of Hydrogeological Conditions of Site Development

The results of the investigation completed by Terraprobe indicate the following hydrogeological features for the Site:

- Underlying the fill, native deposits mainly comprise glacial till (clayey silt and silty sand). In addition, a layer of sand was encountered within the southwest portion of the Site.
- The shallow groundwater table for design purposes should be considered to be at El. 99.26 ± masl (1.57 mbgs) measured at BH3 located within the proposed building footprint.
- Based on a review of the estimated hydraulic conductivity for the silty sand till (glacial till), in which the excavation and construction will be completed, the hydraulic conductivity 3.12×10^{-7} m/sec is considered for dewatering calculation. Additionally, an estimate hydraulic conductivity of 2.92×10^{-9} /sec was considered for clayey silt (glacial till) and 1.0×10^{-6} m/sec for fill material underlaying the proposed building foot print.

7.4 Short-Term Groundwater Control Requirements (Construction Dewatering)

Detailed development plans showing the grading elevation proposed for developing the slab on grade building are not available to review at the time of preparation of the current report. As such, average of existing ground surface elevation at monitoring wells' locations, which are located within the proposed building footprint, is considered as a grading elevation for dewatering flow rate estimation. A review of the proposed Site Plan prepared by Lawrence Architect Inc., dated May 6, 2021 (drawing no. A1.0) indicates that the proposed development includes a total perimeter of 323.4 m.

Based on the recommendation provided in the geotechnical investigation report, a strip footing and spread footings were considered for the construction dewatering flow rate estimation. The length of the trench for construction of the strip footing will be equal to the perimeter of the proposed building. 0.8 m was also considered as width of the trench. The base of the strip footing is considered 2.6 mbgs, as recommended by the geotechnical engineering team. Spread footings should be constructed within the proposed building footprint. The structural drawings are not available to review at the time of preparation of the current report. However, 1.5 m is considered for each side of the footing that is assumed will be constructed at a depth of 2.6 mbgs.

The highest shallow groundwater was measured at El. 99.26 masl over the monitoring period. The dewatering requirements are summarized in **Table 7-1**.

Table 7-1- Proposed Construction details

Proposed Footing	Assumed Invert El.	Ground Elevation (masl)	Excavation Dimensions (m)	Maximum Required Drawdown to 1 m below the Proposed Invert El. (m)
Strip Footing	98.27	100.87	323.4 x 0.8 x 2.6	97.27
Spread Footing*	98.27	100.87	1.5 x 1.5 x 2.6	97.27

*One (1) spread footing is considered.

Pumping rate calculations for constructing the proposed trenches were based on equations of radial flow provided by Powers et al. (2007). For the purposes of this analysis, steady state flow 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 strip and spread footings, which are based on unconfined aquifer conditions:

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

Trench Excavation (Strip footing)

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)}$$

Single Well (Spread Footing)

Dewatering Equations

where,

Q = Anticipated pumping rate (m^3/day)

K = Hydraulic conductivity (m/day)

H = Distance from initial static water level to bottom of the saturated aquifer (m)

h = Depth of water in the well while pumping (m)

X = Trench Length (m)

L = Distance from a line source to the trench (m)

R_0 = Distance from a point of greatest drawdown to a point where there is no drawdown (radius of influence) (m)

r_s = Equivalent radius of the excavation (m). The equivalent radius was estimated as an imaginary dewatering well with a radius that will produce an equivalent area of the excavation; calculated as follow:

$$r_s = \sqrt{\frac{ab}{\pi}}$$

where,

a = Length of the excavation

b = Width of the excavation

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

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

where,

R_0 = Zone of Influence (m), beyond which there is negligible drawdown

H = Distance from initial static water level to bottom of saturated aquifer (m)

S_y = 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)

A summary of the dewatering flow rate calculations is presented in **Table 7-2** below and in **Appendix F**.

Table 7-2- Dewatering Flow Rate Summary

Proposed Footing	H (m)	h (m)	K (m/s)	r_s (m)	Drawdown (m)	Zone of Influence R_0 (m)	Pumping Rate (m^3/day)(1.5 S.F.)*
Strip Footing	2.3	0.3	3.12×10^{-7}	0.8	2.0	9.3	41.4
Spread Footing	2.3	0.3	3.12×10^{-7}	0.8	2.0	9.3	0.3**

*S.F.-Safety Factor
**The estimated flow rates for one spread footing.

From practical construction point of view, the entire strip footing will not be excavated and constructed at one time. As such, the anticipated seepage was calculated for a trench with 20 m length. The estimated groundwater seepage considering a safety factor of 1.5 is anticipated to reach up to 2,600 L/day. Furthermore, since the structural drawings are not available for review, short-term dewatering flow rate was estimated for one (1) spread footing. As such, the estimated groundwater flow rate will change considering the number of the proposed spread footings and the proposed dimensions.

Potential flow generated from rainfall event should be considered for construction of the footings. A dewatering system should be designed to take into account removal of rainfall from the excavation. Volumes for a 25 mm design storm have been provided in the quantity estimates and also are presented in **Appendix F**. The estimated construction dewatering flow rates for construction of the proposed footings are summarized below:

Table 7-3 Dewatering Flow Rate Considering Precipitation

Proposed Footing	Groundwater Seepage Rounding (L/day) S.F. *1.5	2-Year Precipitation (L/day)	Total (L/day)
Strip Footing (Entire Perimeter)	41,400	6,500	47,900
Strip Footing (a trench with 20 Length)	2,600	400	3,000
Spread Footing**	300**	60	360

*S.F.: Safety Factor
***The estimated flow rates for one spread footing.

As required by Ontario Regulation 63/16, a plan for discharge must consider the conveyance of storm water from a 100-year storm. The volume that will be generated in the occurrence of a 100-year storm event is approximately 24,400 L/day and 215 L/day for construction of Strip footing and a spread footing.

The detail drawings are not available to review at the time of preparation of the current report. If the proposed construction details are significantly different compared to the above assumption the estimated dewatering flow rates should be revised. Additionally, details for potential elevator pit were not available for review. As such, potential dewatering flow rate was not calculated for construction of the elevator pit.

Any storm water entering the excavation to be pumped and discharged to the Port Hope sewers will require verification of quality and potentially treatment (filtration and/or settling tanks) prior to discharge to the Port Hope storm or sanitary sewer system as a part of the water collection system.

7.5 Permit Requirements

In accordance with the current policy of the MECP where the dewatering flow rate is lower than 50,000 L/day, approval for the proposed groundwater-taking for construction from the MECP is not required. As the estimated dewatering flow rate does not exceed 50,000 L/day and is expected to reach a maximum daily rate of 48,260 L/day MECP approval is not required for the proposed groundwater-taking.

The Site is located within an area designated as Intake Protection Zone 2. As such, taking permit from the Municipality of Port Hope may be required.

7.6 Long-Term Foundation drainage Flow Rate

A slab-on-grade building is proposed for the future development. Additionally, the proposed building will be constructed above shallow groundwater level. As such, discharge plan for long-term foundation drainage is not required for the post development structure.

Any localized protrusions extending below the base of the excavation, including elevator or sump pits should be waterproofed in the long-term.

7.7 Potential Dewatering Impacts and Mitigation Plan

7.7.1 Ground Settlement

The estimated ZOI could reach to 9.3 m away from the proposed excavated area. There are no structures within the anticipated ZOI. However, the sidewalk along the Ward Street and Princess Street are partially located within the conceptual ZOI. It is recommended a professional geotechnical engineer is consulted in advance of dewatering.

7.7.2 Surface Water, Wetlands and Areas of Natural Significance

Record review indicates that no natural heritage features including wetland, water bodies, watercourses and ANSI were identified on the Site or within the conceptual ZOI. As such, no impacts to natural heritage features are anticipated pertaining the proposed development. However, it is understood that the Site is located within an area designated as Intake Protection Zone 2. As such, obtaining a permit from the Municipality of Port Hope may be required.

7.7.3 Water Supply Wells and Zone of Influence

The Site is located in a serviced area of the Municipality of Port Hope. A review of the MECP well records confirmed that there are no records for any active water supply wells at or within 500 m of the Site. There is a record for an industrial water supply well located approximately 400 m to the southwest of the Site. This well is not located within the conceptual ZOI. As such, no concerns are anticipated regarding local groundwater users.

7.7.4 Contamination Sources

Terraprobe is currently completing a phase Two ESA report with the findings provided under a separate cover page.

8.0 CONCLUSIONS AND RECOMMENDATIONS

- The Site is located within the Physiographic Region of Southern Ontario known as the Iroquois Plain.
- The Site is located within an area mapped as fine-textured glaciolacustrine deposits (8a), comprising silt and clay, minor sand and gravel.
- The 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 Site. Lake Ontario is located approximately 900 m to the south of the Site, and the Ganaraska River is located approximately 500 m to the west of the Site. It is also located with the area designated as Intake Protection Zone 2.
- The subsoil profile beneath the pavement structure and partially topsoil consists mainly of earth fill glacial till (silty sand and clayey silt) and sand to termination depth of investigation at 8.2 mbgs.
- Groundwater was monitored within the silty sand till and sand units. The average groundwater level ranges from 99.04 (3.18 mbgs) to 97.28 masl (3.58 mbgs). The highest and lowest shallow groundwater level was measured at El. 99.29 masl and 97.26 masl at BH3 and BH10 location, respectively.
- Estimated hydraulic conductivity using single well response test (SWRT) ranges from 1.35×10^{-7} to 3.12×10^{-7} m/s for silty sand till, and it is 1.17×10^{-4} m/s for the sand unit. Hydraulic conductivity for clay silt till unit using Hazen Equation was estimated at 2.92×10^{-9} m/s.
- Groundwater quality for one (1) sample from monitoring well BH10 meets the Municipality of Port Hope's sanitary and storm sewer use limits, with an exception for the exceedance for Total Suspended Solid (TSS), in comparison with the sanitary sewer By-Law limits; and TSS and Iron in comparison with the storm sewer By-Law limits.
- Short-term construction dewatering flow rate considering a safety factor of 1.5 and a 2-year storm events could reach 48,260 L/day.
- The estimated ZOI could extend up to 9.3 m from the proposed excavation(s). There are no records for wetlands, water bodies, watercourses, ANSI and water supply wells on the Site or within the conceptual ZOI. Additionally, there are no structures within the anticipated ZOI.

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,

Terraprobe Inc.

Amar Neku

Amar Neku, Ph.D., P.Eng., P.Geo
Project Manager

Nar

PROFESSIONAL GEOSCIENTIST
NARJES ALIJANI
PRACTISING MEMBER
2386
June 16, 2021
ONTARIO

Narjes Alijani, M.Sc., P.Geo
Senior Hydrogeologist

Dr. Giorgio Garofalo, P.Geo., QP_{ESA}
Sr. Hydrogeologist/Sr. Project Manager

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11.0 LIMITATIONS OF LIABILITY

This report was prepared at the request of, and for the exclusive use of CVH (No. 6) LP and its affiliates ("the Intended User") is intended to provide an assessment of the hydrogeological conditions of the Property located at 65 Ward Street, in the Municipality of Port Hope, Ontario (the Site). No one other than the Intended User has the right to use and rely on the work without first obtaining the written authorization of Terraprobe Inc. and CVH (No. 6) LP.

Terraprobe Inc. expressly excludes liability to any party except the Intended User for any use of, and/or reliance upon, the work. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Terraprobe Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, including consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

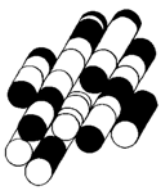
The assessment should not be considered a comprehensive audit that eliminates all risks of encountering hydrogeological problems. The information presented in this report is based on information collected during the completion of the hydrogeological study by Terraprobe Inc. It was based on the conditions on the Site at the time of the hydrogeological study by a review of historical information and field investigation to assess the hydrogeological conditions of the Site, as reported herein.

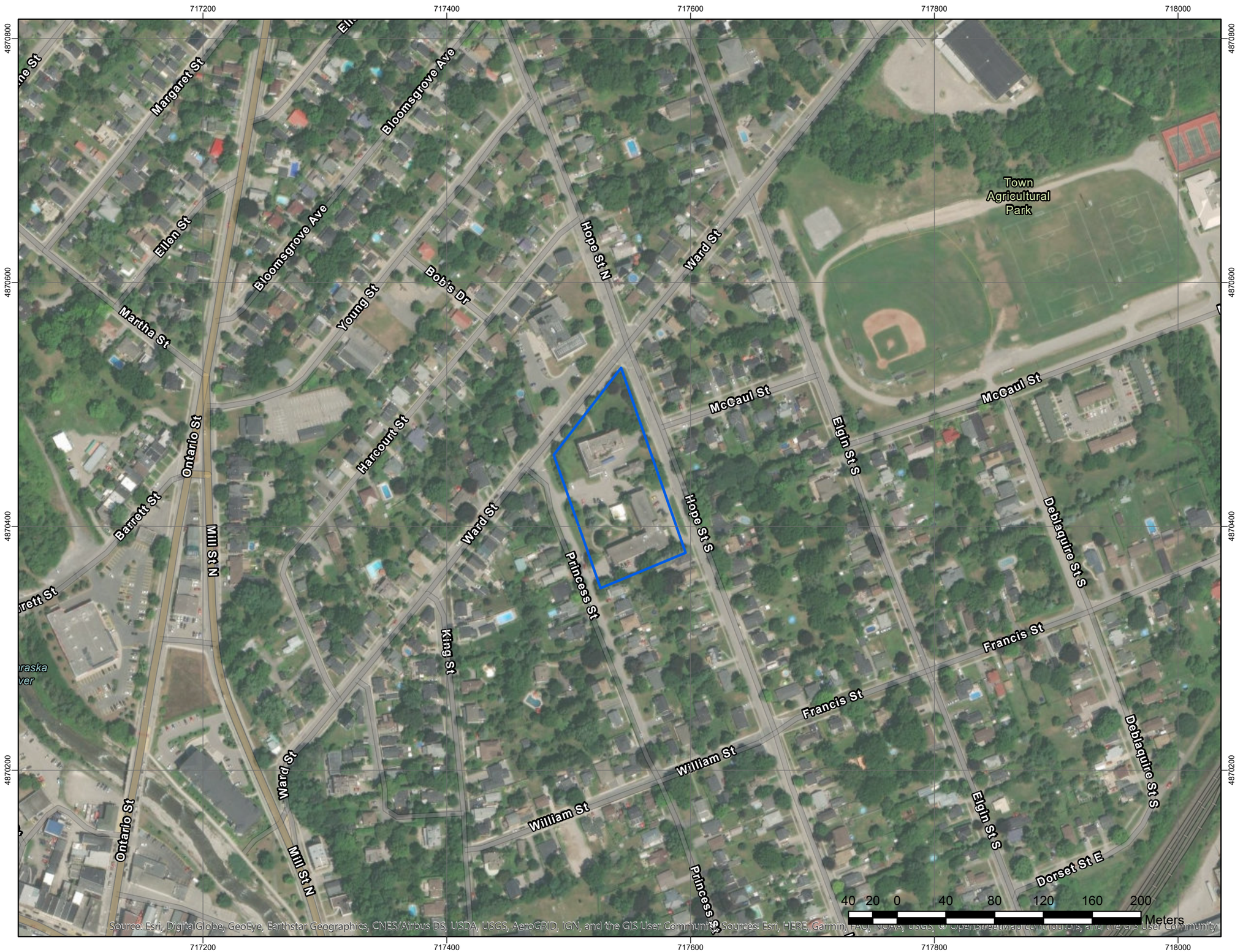
There is no warranty expressed or implied by this report regarding the hydrogeological conditions for the Site. Professional judgement was exercised in gathering and analyzing information collected by reviewing previous reports, data provided by government and are open to public and field work investigation. The conclusions presented are the product of professional care and competence, and cannot be construed as an absolute guarantee.

In the event that during future work new information regarding the hydrogeological conditions of the Site is encountered, or in the event that the outstanding responses from the regulatory agencies indicate outstanding issues on file with respect to the Site, Terraprobe Inc. should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.

FIGURES

TERRAPROBE INC.





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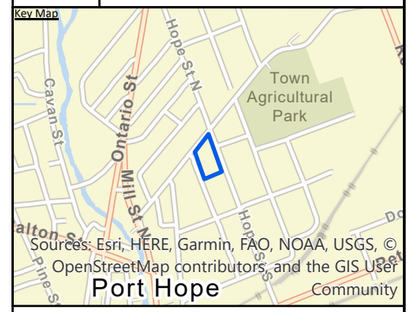
N W E S

References:

GIS Basemaps

Key Map



Notes:

Legend:

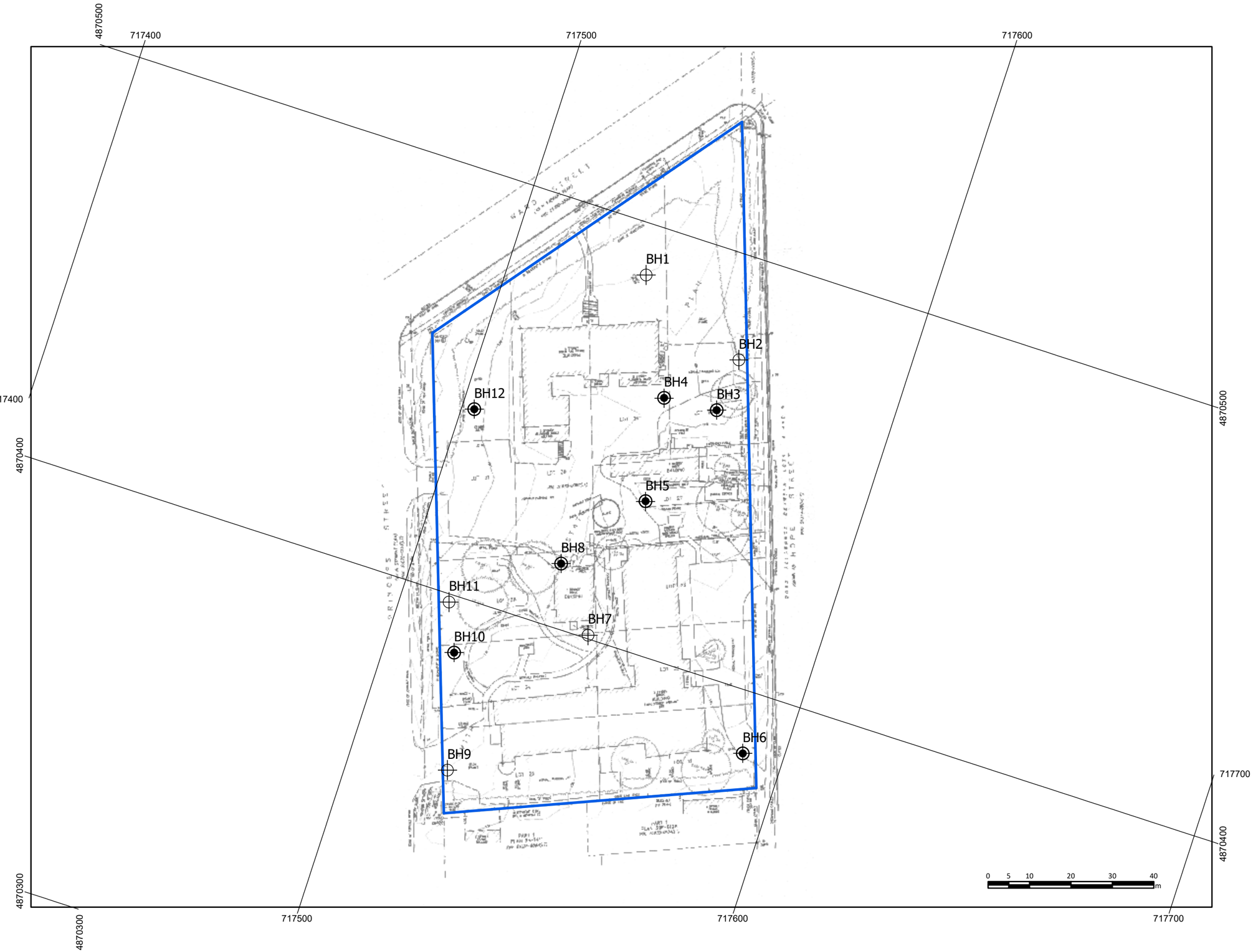
Approximate SIte Boundary

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
Site Location Plan

Designed By: NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 1
Date: December 2019	



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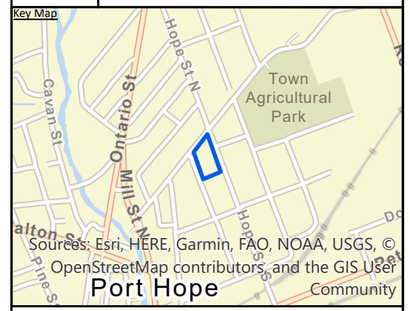
References:
services.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer

Key Map



Notes:

Legend:

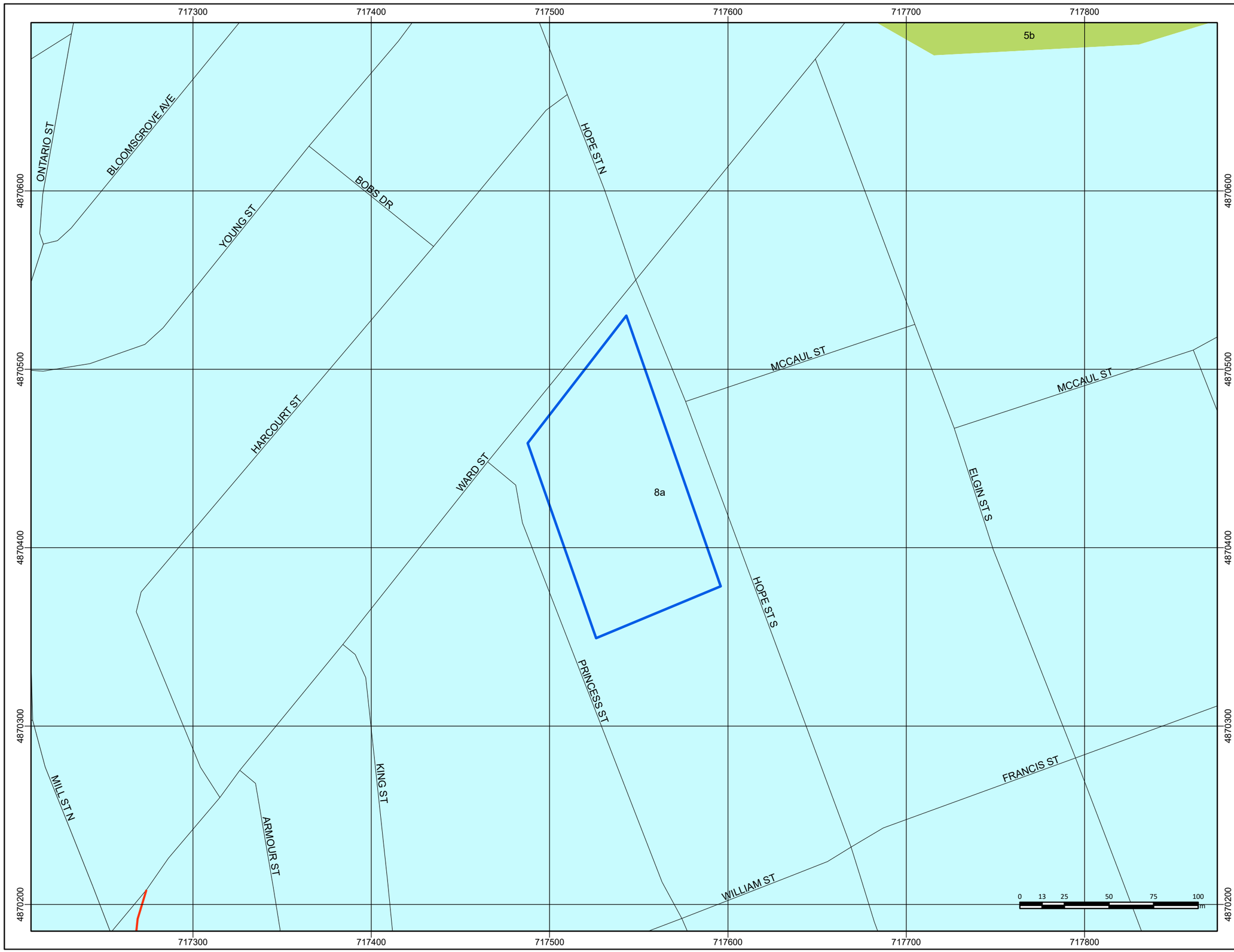
- Approximate SIte Boundary
- Approximate Borehole Location
- Approximate Monitoring Well Location
- base

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
Borehole and Monitoring Well Plan

Designed By: NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 2
Date: January 2020	



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N W E S

References:

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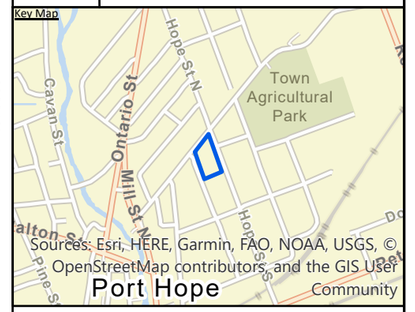
Key Map



Notes:

Legend:

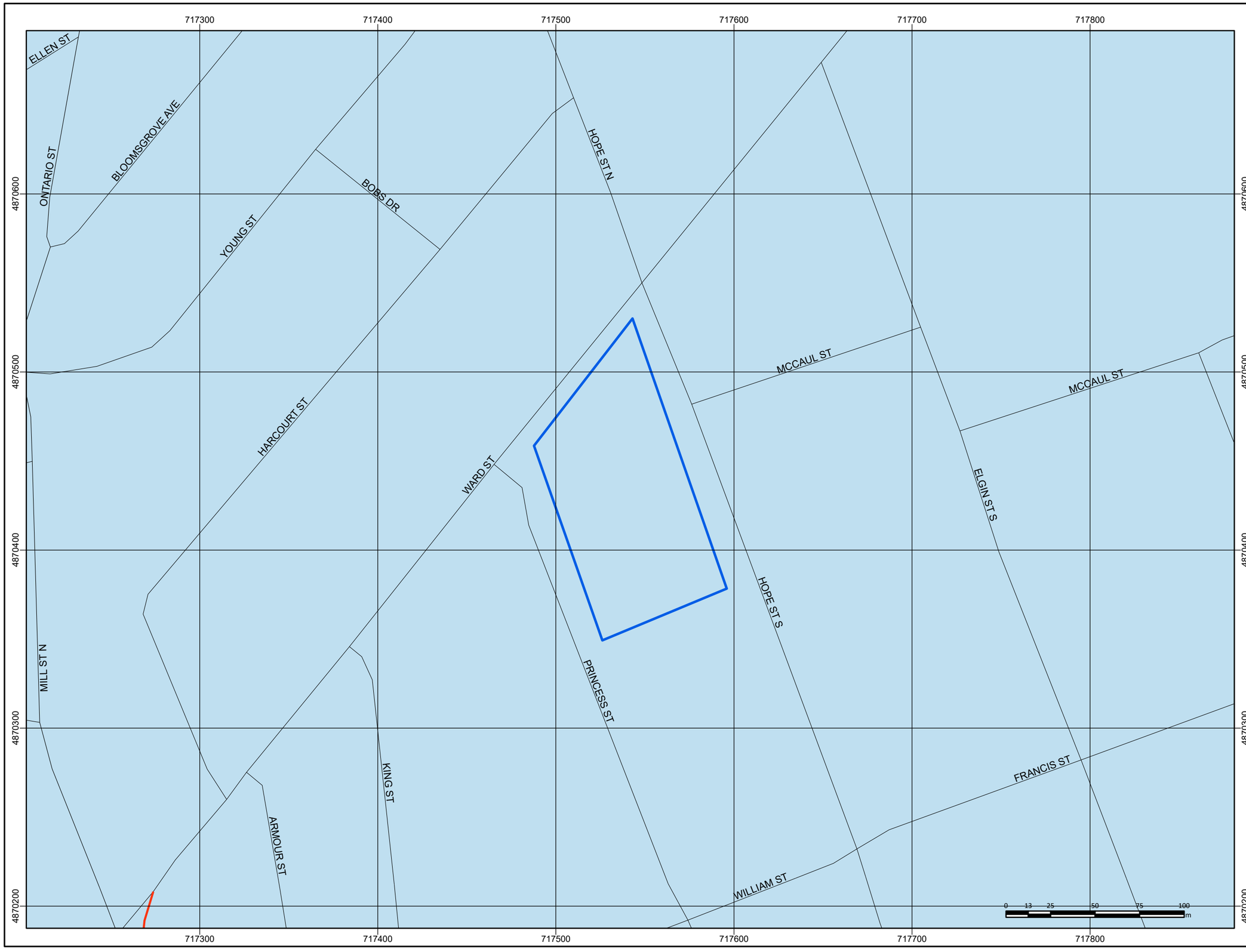
- Approximate SIte Boundary
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 8a: Massive-well laminated
- Collector
- Local / Street
- Ramp

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
Surficial Geology Map

Designed By: NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 3
Date: January 2020	



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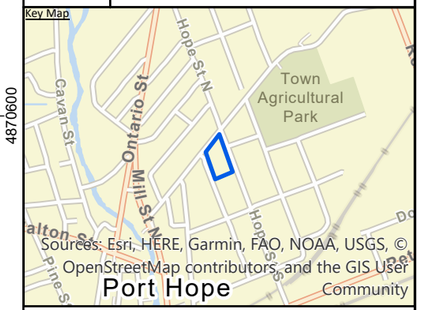
Key Map



Notes:

Legend:

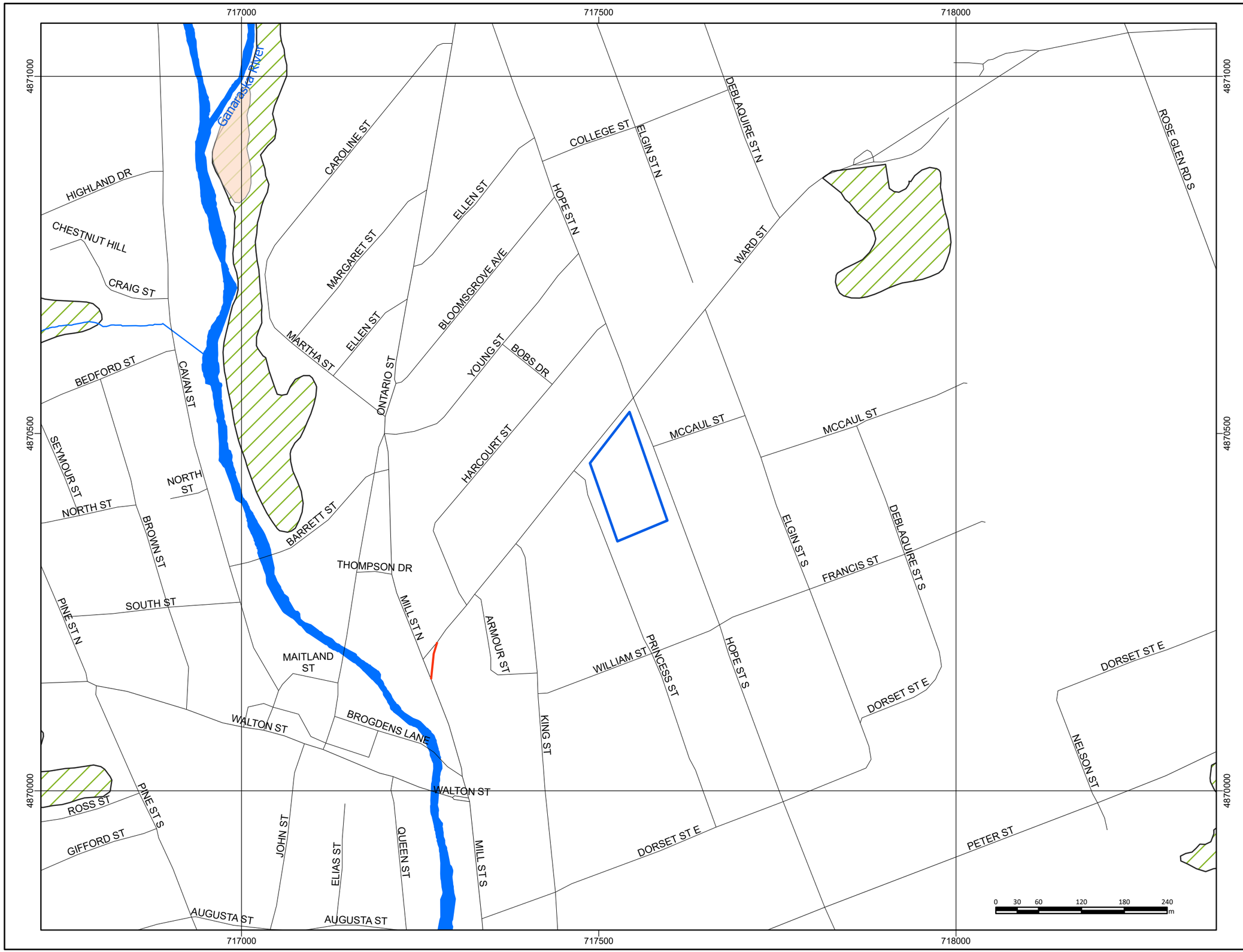
- Approximate SIte Boundary
- Collector
- Local / Street
- Ramp
- 41, Iroquois Plain

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
Regional Physiography Map

Designed By: MK	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 4
Date: January 2020	



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Construction Materials, Inspection & Testing

N W E S

References:

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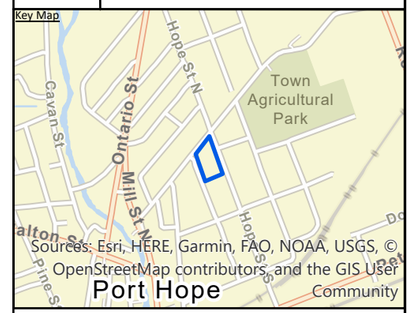
Key Map



Notes:

Legend:

- Approximate SIte Boundary
- Collector
- Local / Street
- Ramp
- Water Body
- Water Course
- Not evaluated per OWES
- Wooded Area

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
Natural Heritage Feature Map

Designed By: NA NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 5
Date: December 2019	

716700 716900 717100 717300 717500 717700 717900 718100 718300

4870900 4870700 4870500 4870300 4870100 4869900

HIGHLAND DR
CHESTNUT HILL
CRAIG ST
BEDFORD ST
SEYMOUR ST
NORTH ST
BROWN ST
PINE ST N
SOUTH ST
HAGERMAN ST
ROSS ST
GIFFORD ST
THOMAS ST
PINE ST S
CAVAN ST
CAROLINE ST
MARGARET ST
MARTHA ST
ELLEN ST
ONTARIO ST
BLOOMSGROVE AVE
YOUNG ST
BOBS DR
HARCOURT ST
BARRETT ST
THOMPSON DR
MILL ST N
MAITLAND ST
Ganaraska River
BROGDENS LANE
WALTON ST
JOHN ST
ELIAS ST
QUEEN ST
MILL ST S
AUGUSTA ST
COLLEGE ST
ELGIN ST N
DEBLAQUIRE ST N
HOPE ST N
WARD ST
ROSE GLEN RD N
ROSE GLEN RD S
MCCAUL ST
ARMOUR ST
KING ST
PRINCESS ST
WILLIAM ST
FRANCIS ST
ELGIN ST S
DEBLAQUIRE ST S
HOPE ST S
DORSET ST E
NELSON ST
PETER ST
LAKE ST

9 10 1 2 3 4 5 6 7 8 11 12

0 25 50 100 150 200 250 m

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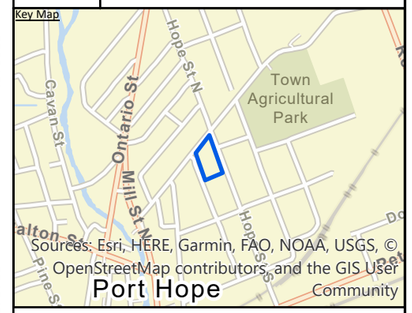
Key Map



Notes:

Legend:

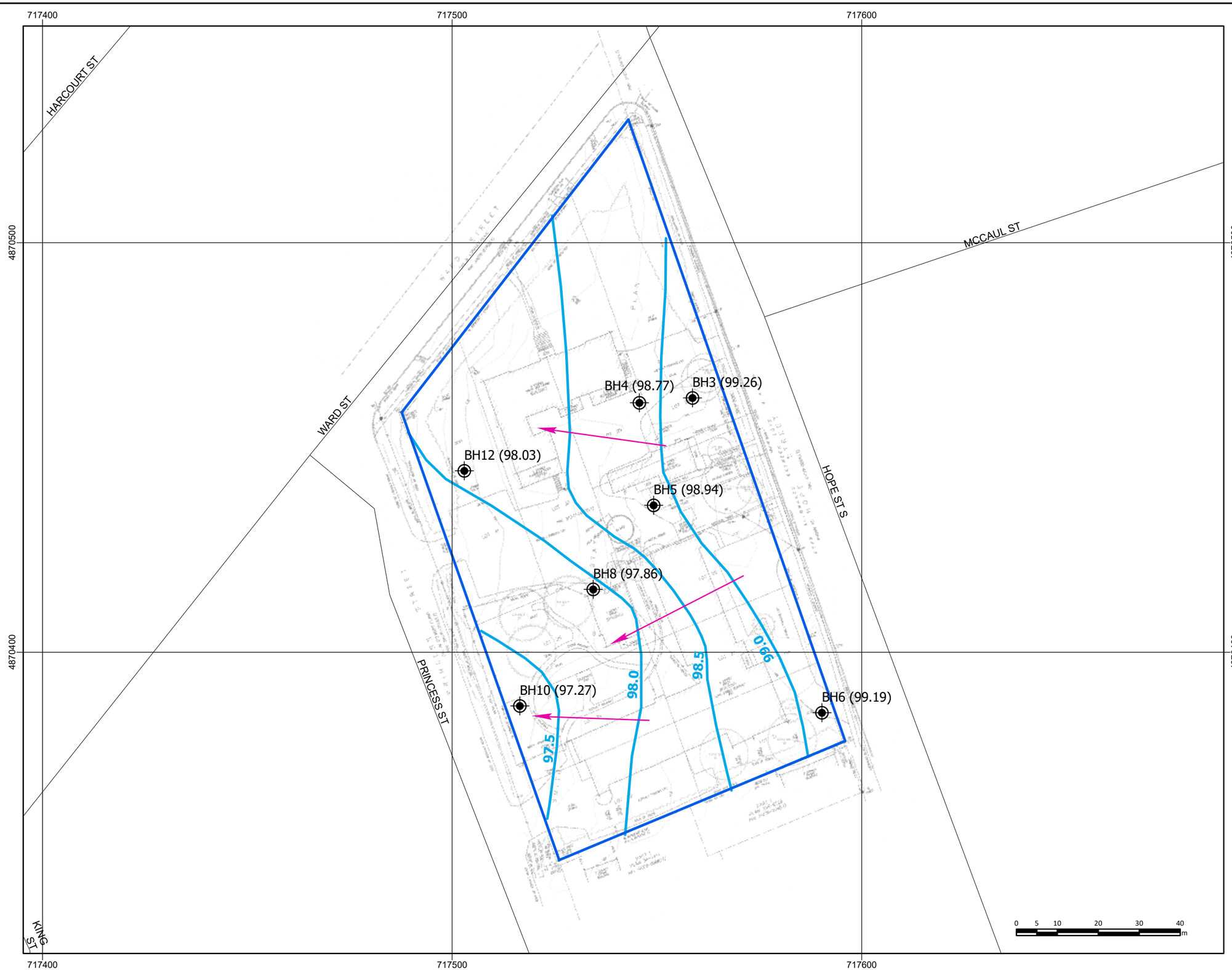
- Approximate SIte Boundary
- Approximate Study Area; 500m
- MECP Water Well Record
- Water Body
- Collector
- Local / Street
- Ramp

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
MECP Water Well Records Map

Designed By: NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 6
Date: December 2019	



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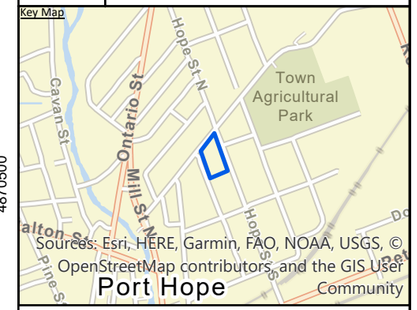
Key Map



Notes:

Legend:

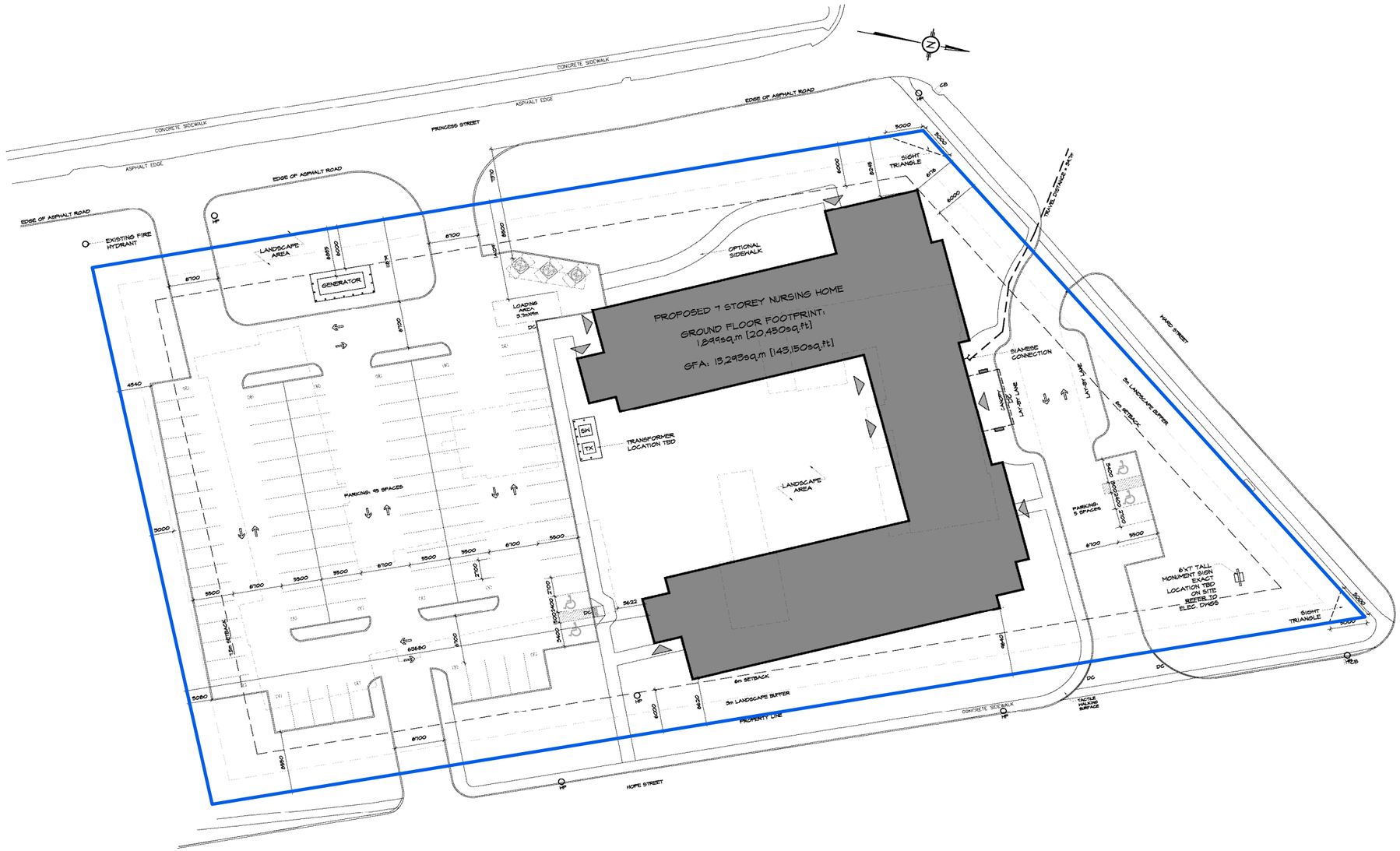
- Approximate SIte Boundary
- Approximate Monitoring Well
- Local / Street
- Interpreted Shallow Ground Water Contours
- Interpreted Shallow Ground Water Flow Direction

Project Title:
Hydrogeological Investigation

Site Location:
65 Ward Street, Port Hope, Ontario

Figure Title:
Shallow Ground Water Flow Pattern

Designed By: NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 7
Date: December 2019	



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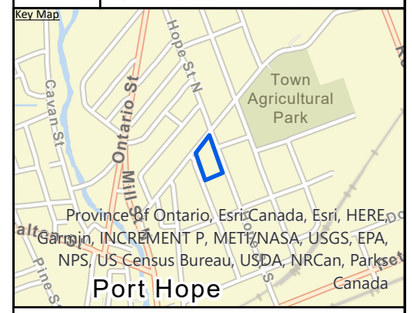
Construction Materials, Inspection & Testing

References:

Concept Site Plan
Port Hope Nursing Home
Dwg No: A1.0
Dated: 2020-10-31
By: S.J Lawrence Architects

Key Map



Notes:

Legend:

Approximate SIte Boundary

Project Title:
Hydrogeological Assessment

Site Location:
65 Ward Street, Port Hope, Ontario

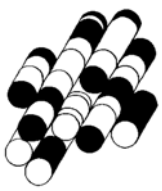
Figure Title:
Proposed Development Plan

Designed By: NA	*File No.:* 1-19-0660-46
Drawn By: SSK	*Scale:* As Shown
Reviewed By: BW	*Figure No.:* 8
Date: December 2019	

APPENDIX A

Boreholes and Monitoring Well Logs
and Grain Size Distribution Graphs

TERRAPROBE INC.



LOG OF BOREHOLE 1

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717532, N: 4870488 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments / GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	100.4	**GROUND SURFACE**					100						
	100.2 / 0.2	150mm **TOPSOIL**											
1		**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm to stiff, blackish brown to brown, moist		1	SS	4				PID: 0			
				2	SS	12	99			PID: 0			
2	98.9 / 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	32				PID: 0			0 18 44 38
				4	SS	15	98			PID: 0			
3	97.4 / 3.0	**SILTY SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)		5	SS	50/ 150mm				PID: 0			
4							97						
		...grey below		6	SS	50/ 100mm	96			PID: 0			
5													
6				7	SS	50/ 50mm	95			PID: 0			wet sampler
							94						
7												▽	
	92.6 / 7.8			8	SS	50 / 75mm	93			PID: 0			

END OF BOREHOLE

Unstabilized water level measured at 7.2 m below ground surface; borehole was open upon completion of drilling.

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 2

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 31, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717560, N: 4870475 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	101.2	**GROUND SURFACE**				
		85mm **ASPHALT**				
	100.8	295mm **AGGREGATE**		1	SS	24
	0.4	**FILL**, sand and gravel, trace silt, compact, brown, damp				
	100.4					
1	0.8	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		2	SS	22
	99.7					
	1.5	**SILTY SAND**, trace to some clay, trace gravel, dense to very dense, brown, moist (GLACIAL TILL)		3	SS	34
2				4	SS	76 / 250mm
3	98.1			5	SS	50 / 100mm
	3.1	**END OF BOREHOLE**				

Elevation Scale (m): 101, 100, 99

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

Headspace Vapour (ppm): PID: 0.2, PID: 0.3, PID: 0.2, PID: 0.3, PID: 0.2

Instrument Details

Unstabilized Water Level

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 3

Terraprobe

Project No. : 1-19-0660-01 | Client : CVH (NO. 6) LP | Originated by : SM

Date started : November 1, 2019 | Project : 65 Ward Street | Compiled by : AR

Sheet No. : 1 of 1 | Location : Port Hope, Ontario | Checked by :

Position : E: 717559, N: 4870462 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Track-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	100.8	**GROUND SURFACE**				
	100.5	300mm **TOPSOIL**				
	0.3	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, soft to firm, blackish brown to brown, wet		1	SS	5
1				2	SS	4
	99.3					
	1.5	**SILTY SAND**, trace to some clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL)		3	SS	20
				4	SS	100 / 150mm
2						
3		...grey below		5	SS	69
4						
				6	SS	100 / 125mm
5						
6				7	SS	100 / 125mm
7						
	93.0			8	SS	100 / 150mm
	7.8	**END OF BOREHOLE**				

Elevation Scale (m): 100, 99, 98, 97, 96, 95, 94

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm): PID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Unstabilized water level measured at 7.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	1.5	99.3
Nov 19, 2019	2.7	98.1
Dec 9, 2019	1.6	99.2

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 4

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 31, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717546, N: 4870461 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	100.9	**GROUND SURFACE**				
		70mm **ASPHALT**		1	SS	22
		730mm **AGGREGATE**				
	100.1 / 0.8	**FILL**, sand, trace silt, loose, brown, wet		2	SS	8
1	99.4 / 1.5	**FILL**, clayey silt, trace to some sand, trace gravel, trace organics, firm, brown, wet		3	SS	5
2	98.6 / 2.3	**SILTY SAND**, trace clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL)		4A	SS	23
				4B		
3		...grey below		5	SS	100 / 150mm
4				6	SS	100 / 150mm
5						
6				7	SS	100 / 150mm
7	93.1 / 7.8	**END OF BOREHOLE**		8	SS	100 / 150mm

Elevation Scale (m): 100, 99, 98, 97, 96, 95, 94

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm): PID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

...at 3.0m, auger grinding

Unstabilized water level measured at 7.3 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	2.1	98.8
Nov 19, 2019	2.3	98.7
Dec 9, 2019	2.1	98.8

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 5

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717549, N: 4870436 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	101.2	**GROUND SURFACE**				
	101.0	150mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm, blackish brown to brown, moist		1	SS	4
1				2	SS	7
	99.7					
	1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	20
2				4	SS	40
	98.2					
3	3.0	**SILTY SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)		5	SS	50 / 150mm
4		...grey below		6	SS	50 / 75mm
5						
6				7	SS	50 / 125mm
7						
	93.5			8	SS	50/ 125mm
	7.7	**END OF BOREHOLE**				

Elevation Scale (m): 101, 100, 99, 98, 97, 96, 95, 94

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm): PID: 0.6; PID: 0.9; PID: 0.7; PID: 0.9; PID: 1.2; PID: 0.7; PID: 2.2; PID: 0.3

Instrument Details: Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

...at 4.6m, sampler wet

Unstabilized water level measured at 7.6 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	2.0	99.2
Nov 19, 2019	2.3	98.9
Dec 9, 2019	2.3	98.9

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 6

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 31, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717590, N: 4870358 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	102.2	**GROUND SURFACE**				
	102.0	200mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm to stiff, blackish brown to brown, moist		1	SS	7
1				2	SS	13
	100.7					
	1.5	**SILTY SAND**, trace to some clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL)		3	SS	19
2				4	SS	85 / 275mm
3				5	SS	50 / 125mm
4		...grey below		6	SS	50 / 125mm
5						
6				7	SS	100 / 125mm
7						
8	94.1			8	SS	100/ 275mm
	8.1	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Elevation Scale (m): 102, 101, 100, 99, 98, 97, 96, 95

Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit; PL, MC, LL: 10, 20, 30

Headspace Vapour (ppm): PID: 2.5; PID: 1.2; PID: 1.3; PID: 1.6; PID: 1.5; PID: 1.3; PID: 1.9; PID: 0.3

Instrument Details — Unstabilized Water Level

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	3.1	99.2
Nov 19, 2019	3.5	98.7
Dec 9, 2019	3.0	99.2

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 7

Terraprobe

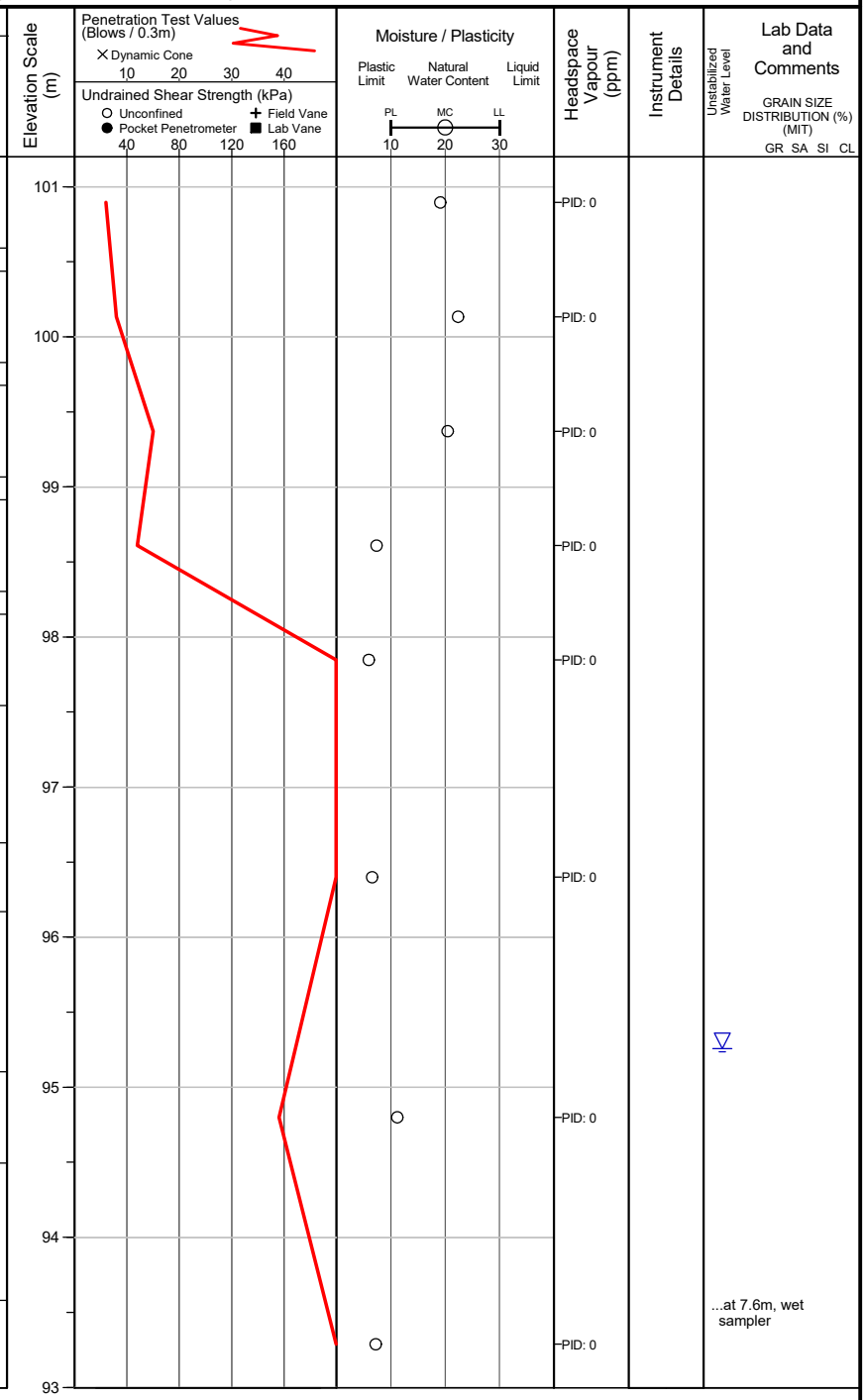
Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717546, N: 4870401 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	101.2	**GROUND SURFACE**				
	101.0	150mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm, blackish brown to brown, moist		1	SS	6
1				2	SS	8
	99.7					
	1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		3	SS	15
2	98.9					
	2.3	**SILTY SAND**, trace to some clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL)		4	SS	12
3				5	SS	62
4						
		...grey below		6	SS	99
5						
6				7	SS	39
7						
				8	SS	68
8	93.0					
	8.2	**END OF BOREHOLE**				

Unstabilized water level measured at 5.9 m below ground surface; borehole was open upon completion of drilling.



file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 8

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 30, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717535, N: 4870415 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	100.7	**GROUND SURFACE**				
	100.5 / 0.2	150mm **TOPSOIL**				
		FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm to very stiff, blackish brown to brown, moist		1	SS	4
1				2	SS	16
2				3	SS	9
	98.4 / 2.3					
		SILTY SAND, trace to some clay, trace gravel, dense to very dense, brown, moist (GLACIAL TILL)		4	SS	40
3				5	SS	100
4						
		...grey below		6	SS	160
5						
6		...wet		7	SS	100 / 150mm
7						
	92.8 / 7.9			8	SS	100 / 150mm
		END OF BOREHOLE				

Elevation Scale (m): 100, 99, 98, 97, 96, 95, 94, 93

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm): PID: 3; PID: 4.2; PID: 1.4; PID: 0.9; PID: 1.1; PID: 0.9; PID: 0.8; PID: 0.6

Instrument Details: Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

7 48 31 14

...at 6.1m, sampler wet

Unstabilized water level measured at 5.5 m below ground surface; borehole caved to 7.3 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	2.8	97.9
Nov 19, 2019	3.1	97.6
Dec 9, 2019	2.9	97.8

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 9

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717524, N: 4870359 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments / GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	101.2	**GROUND SURFACE**					101						
		50mm **ASPHALT**											
	100.8	350mm **AGGREGATE**		1	SS	7				PID: 0.4			0 18 51 31
	0.4	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm, blackish brown to brown, moist		2	SS	8				PID: 0.8			
1	99.7						100						
	1.5	**CLAYEY SILT**, trace to some sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)		3	SS	22				PID: 0.6			
2		...wet		4	SS	22	99			PID: 0.5			
	98.2												
3	3.0	**SILTY SAND**, trace to some clay, trace gravel, compact, brown, moist (GLACIAL TILL)		5	SS	24	98			PID: 0.1			sampler wet
	97.5												
	3.7	**END OF BOREHOLE**											

Penetration Test Values (Blows / 0.3m): Dynamic Cone; scale 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; scale 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL); scale 10 20 30

Borehole was dry and open upon completion of drilling.

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 10

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717517, N: 4870387 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	100.9	**GROUND SURFACE**				
	100.7 / 0.2	150mm **TOPSOIL**				
		FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm to stiff, blackish brown to brown, moist		1	SS	5
1				2	SS	10
	99.4 / 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	31
2				4	SS	18
	97.9 / 3.0	**SILTY SAND**, trace to some clay, trace gravel, dense to very dense, brown, moist (GLACIAL TILL)		5	SS	40
3	96.3 / 4.6	**SAND**, trace to some gravel, trace silt, very dense, brown, wet		6	SS	50
4				7	SS	53
5	93.3 / 7.6					
	93.1 / 7.8	**SILTY SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)		8	SS	50 / 75mm
6		**END OF BOREHOLE**				
7						

Elevation Scale (m): 100, 99, 98, 97, 96, 95, 94

Penetration Test Values (Blows / 0.3m): Dynamic Cone (×) 10 20 30 40

Undrained Shear Strength (kPa): Unconfined (○) Pocket Penetrometer (●) Field Vane (+) Lab Vane (■) 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm): PID: 0 / PID: 0.2 / PID: 0 / PID: 0.2 / PID: 0.2 / PID: 0.2 / PID: 0.6

Instrument Details: Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

...at 3.0m, auger grinding

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	3.6	97.4
Nov 19, 2019	3.6	97.3
Dec 9, 2019	3.6	97.3

Unstabilized water level measured at 3.7 m below ground surface; borehole caved to 4.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 11

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717512, N: 4870398 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	100.6	**GROUND SURFACE**				
	100.4	150mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, soft to firm, blackish brown to brown, moist		1	SS	3
1				2	SS	6
	98.9			3A		
	1.7	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		3B	SS	15
2				4	SS	21
	97.6					
3	3.0	**SILTY SAND**, trace to some clay, trace gravel, dense, brown, moist (GLACIAL TILL)		5	SS	42
	96.9					
	3.7	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 100, 99, 98, 97

Penetration Test Values (Blows / 0.3m)
Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa)
Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity
Plastic Limit, Natural Water Content, Liquid Limit
PL MC LL: 10 20 30

Headspace Vapour (ppm): PID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 12

Terraprobe

Project No. : 1-19-0660-01	Client : CVH (NO. 6) LP	Originated by : SM
Date started : October 29, 2019	Project : 65 Ward Street	Compiled by : AR
Sheet No. : 1 of 1	Location : Port Hope, Ontario	Checked by :

Position : E: 717503, N: 4870444 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	99.9	**GROUND SURFACE**				
	99.7	150mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, soft to firm, blackish brown to brown, moist		1	SS	2
1				2	SS	3
2				3	SS	6
	97.6					
	2.3	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		4	SS	17
3				5A	SS	71/ 250mm
	96.5					
	3.4	**SILTY SAND**, trace to some clay, trace gravel, very dense, grey, moist (GLACIAL TILL)		5B		
4				6	SS	50/ 100mm
5						
6				7	SS	50/ 50mm
7						
	92.1			8	SS	50 / 75mm
	7.8	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Elevation Scale (m): 99 98 97 96 95 94 93

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0

Instrument Details: sampler wet

Unstabilized Water Level

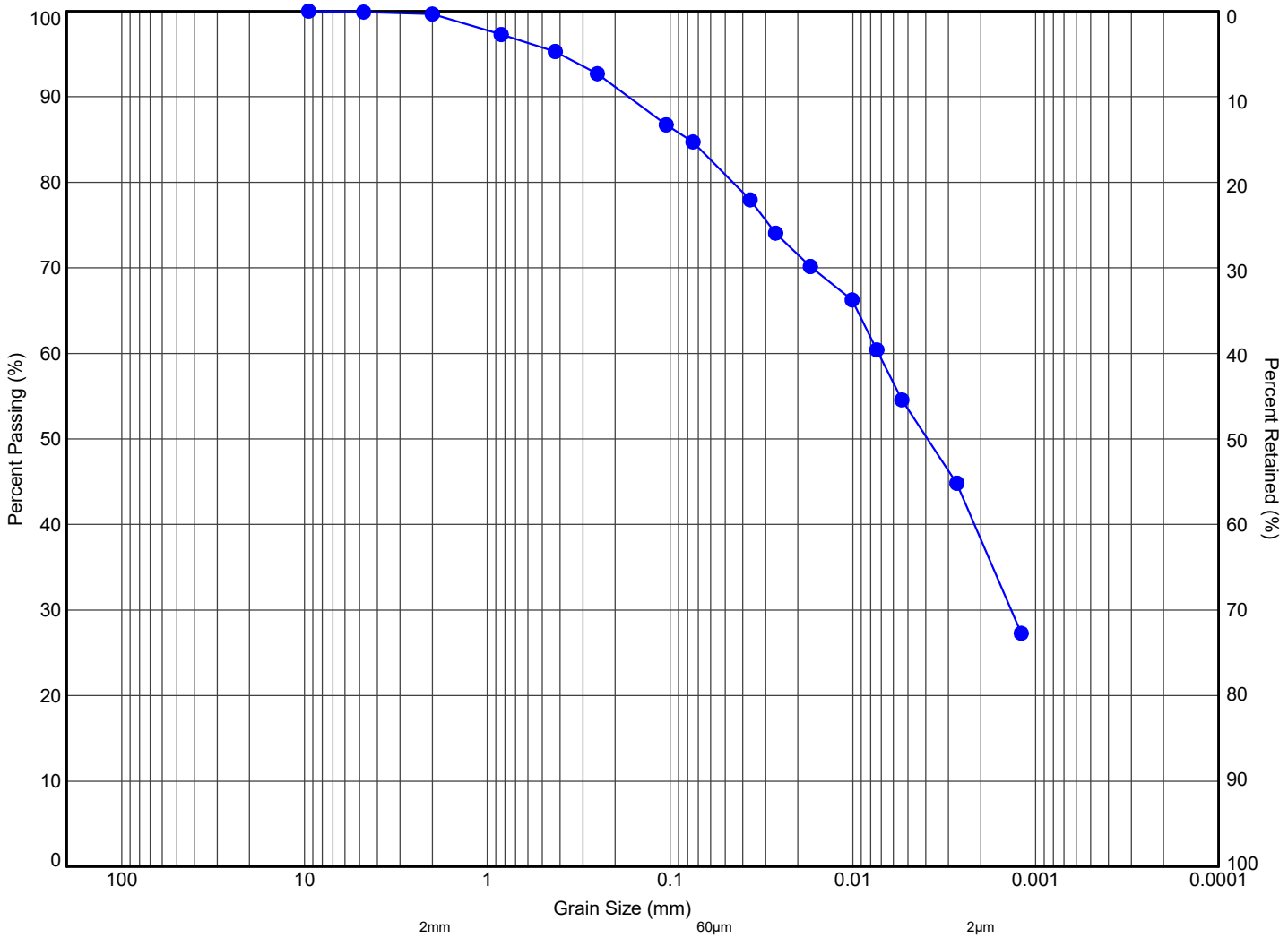
Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 1.8 m below ground surface; borehole caved to 7.3 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	1.8	98.1
Nov 19, 2019	1.8	98.1
Dec 9, 2019	1.9	98.0

file: 1-19-0660-01 bh logs.gpj



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		
		2mm			60µm			2µm	

MIT SYSTEM

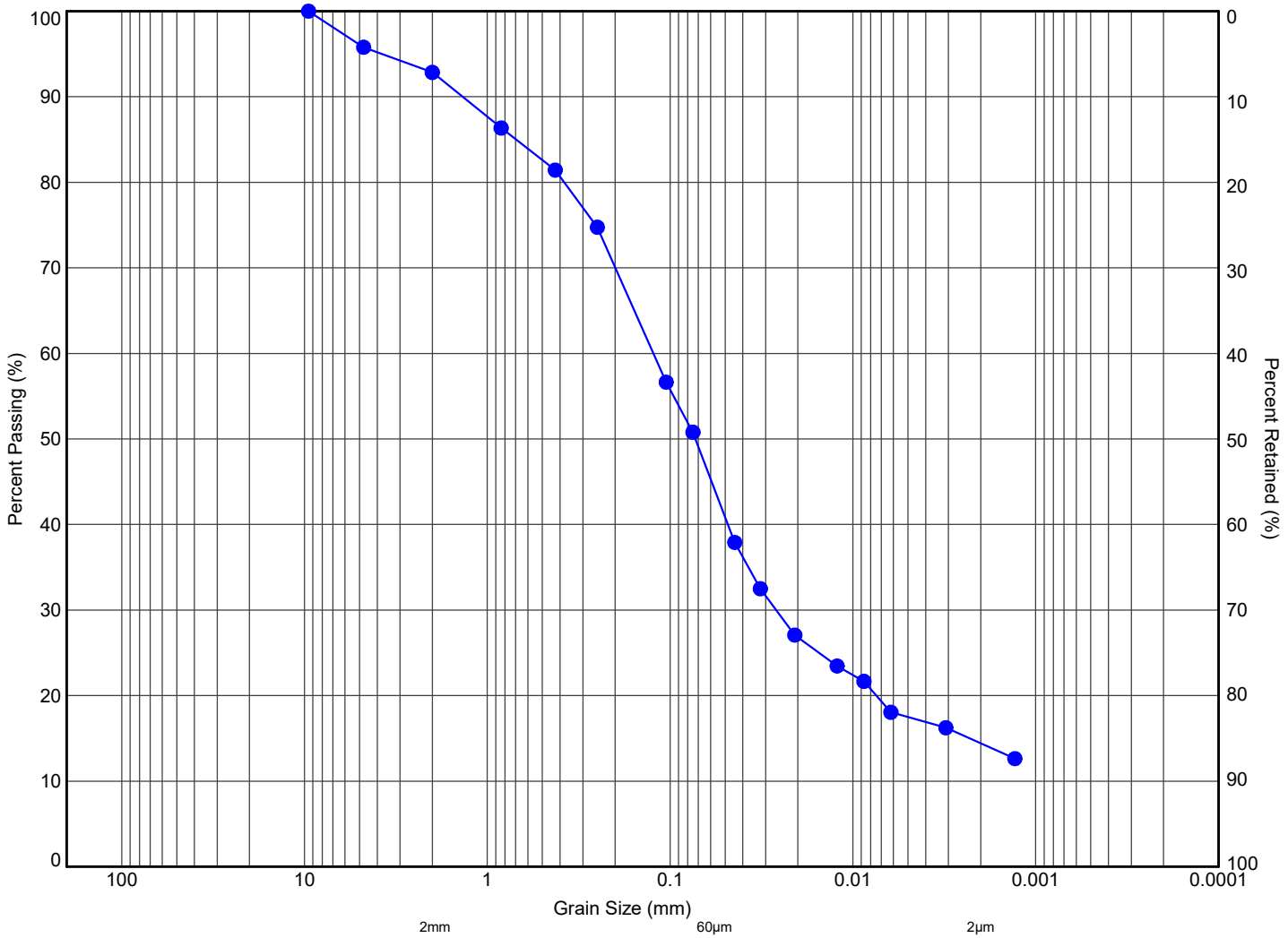
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS3	1.8	98.6	0	18	44	38	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT AND CLAY, SOME SAND

File No.: **1-19-0660-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

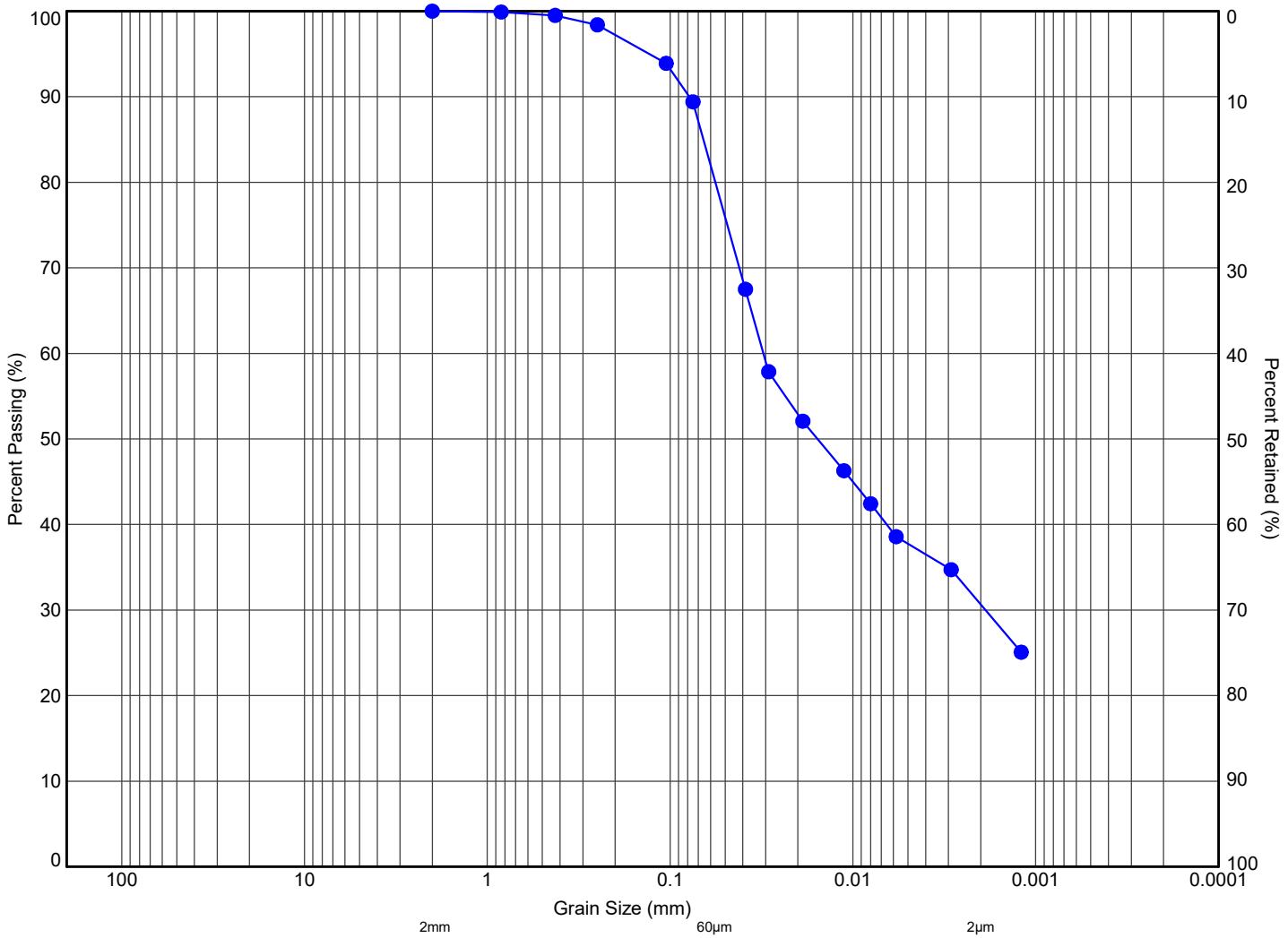
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**8**	SS5	3.4	97.3	7	48	31	14	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME CLAY, TRACE GRAVEL

File No.: **1-19-0660-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**9**	SS1	0.3	100.9	0	18	51	31	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

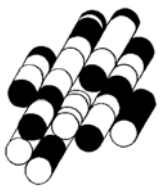
Title: **GRAIN SIZE DISTRIBUTION**
CLAYEY SILT, SOME SAND

File No.: **1-19-0660-01**

APPENDIX B

MECP Well Records

TERRAPROBE INC.



MECP Well Records Summary

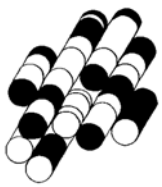
WELL ID	MECP* WWR ID	Coordinates (m)		Construction Method	Well Depth (m)**	Well Usage		Water Found (m)**	Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
		Easting	Northing			Final Status	First Use					
1	7195275	717168	4870258	Direct Push	2.13	Observation Wells	Monitoring and Test Hole	-	-	1.22	2.13	2012-12-20
2	7195272	717183	4870291	Direct Push	2.44	Observation Wells	Test Hole	-	-	0.91	2.44	2012-12-19
3	7195273	717207	4870254	Direct Push	6.10	Test Hole	Monitoring and Test Hole	-	-	3.10	6.10	2012-12-19
4	7195274	717228	4870139	Direct Push	6.10	Test Hole	Monitoring and Test Hole	-	-	3.10	6.10	2012-12-19
5	7195276	717247	4870164	Diamond	6.40	Test Hole	Monitoring and Test Hole	-	-	3.96	6.40	2012-12-21
6	7122074	717278	4869962	-	5.20	-	-	-	-	3.70	5.20	2008-08-04
7	1902520	717315.1	4870098	Cable Tool	-	Water Supply	Industrial	15.25	2.44	-	-	1964-10-30
8	7254267	717392	4870021	Digging	-	Abandoned-Other	Domestic	3.66	3.36	-	-	2015-08-29
9	7218408	717550	4870453	Rotary (Convent.)	6.10	Monitoring and Test Hole	Monitoring and Test Hole	4.58	-	3.05	6.10	2014-01-08
10	7238162	717568	4870428	-	-	Abandoned-Other	-	3.66	-	-	-	2015-01-27
11	7156055	717950	4870026	Rotary (Convent.)	7.63	Test Hole	Test Hole	-	-	9.15	7.63	2010-11-04
12	7146146	718037	4870148	Rotary (Convent.)	6.10	Test Hole	Test Hole	-	-	3.05	6.10	2010-05-17

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

APPENDIX C

Groundwater Monitoring Details

TERRAPROBE INC.



65 Ward Street, Port Hope

Groundwater Depths (metres below ground surface)

Well	Ground Surface Elevation (m asl)	Stick up (m)	Bottom of the Well Screen Depth (mbgs)	Top of the Well Screen Depth (mbgs)	1st GW Monitoring Event	2nd GW Monitoring Event	3rd GW Monitoring Event
					Depth to water November 14, 2019 (mbgs)	Depth to water November 19, 2019 (mbgs)	Depth to water December 9, 2019 (mbgs)
BH3	100.83	0.94	7.60	4.60	1.54	2.68	1.57
BH4	100.88	0.00	7.60	4.60	2.07	2.25	2.11
BH5	101.20	0.00	7.60	4.60	2.00	2.29	2.26
BH6	102.22	0.84	7.60	4.60	3.05	3.46	3.03
BH8	100.74	0.77	7.60	4.60	2.83	3.08	2.88
BH10	100.86	0.91	7.60	4.60	3.55	3.60	3.59
BH12	99.89	0.90	7.60	4.60	1.78	1.83	1.86

Groundwater Elevations (metres above sea level)

Well	Ground Surface Elevation (m asl)	Top of the Riser Elevation (masl)	Bottom of the Well Screen Elevation (mbgs)	Top the Well Screen Elevation (masl)	1st GW Monitoring Event	2nd GW Monitoring Event	3rd GW Monitoring Event
					Groundwater Elevation November 14, 2019 (masl)	Groundwater Elevation November 19, 2019 (masl)	Groundwater Elevation December 9, 2019 (masl)
BH3	100.83	101.77	93.23	96.23	99.29	98.15	99.26
BH4	100.88	100.88	93.28	96.28	98.81	98.63	98.77
BH5	101.20	101.20	93.60	96.60	99.20	98.91	98.94
BH6	102.22	103.06	94.62	97.62	99.17	98.76	99.19
BH8	100.74	101.51	93.14	96.14	97.91	97.66	97.86
BH10	100.86	101.77	93.26	96.26	97.31	97.26	97.27
BH12	99.89	100.79	92.29	95.29	98.11	98.06	98.03

Note: mbgs - metres below ground surface

masl - metrers above sea level

NA - not available

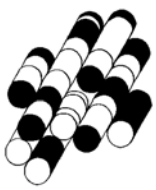
NM - not measured

WNI - well not installed

APPENDIX D

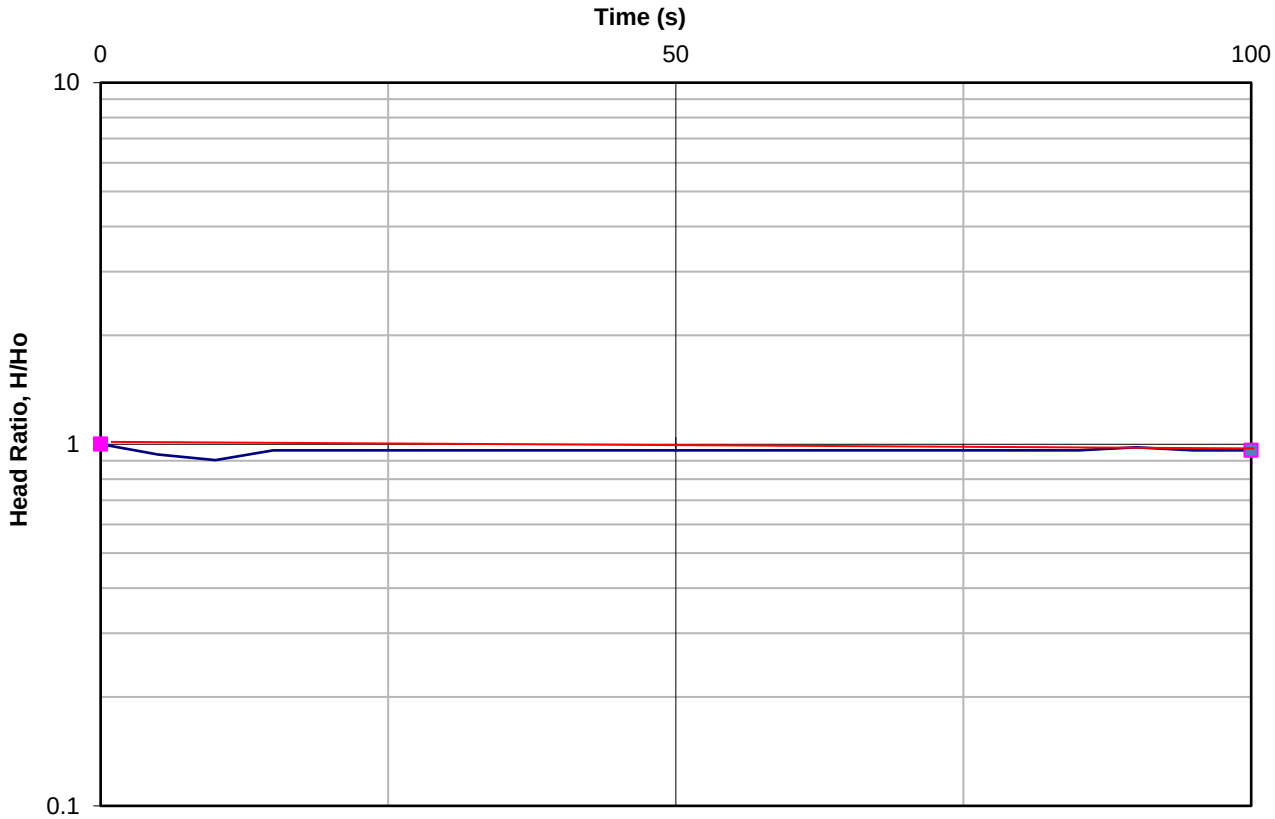
In-situ Hydraulic Conductivity Test Results

TERRAPROBE INC.



Terraprobe Inc.	**Hydraulic Conductivity Test Analysis Report**
	Project Reference No. 1-19-0660-46
	Client: CVH (No.6) LP

Location: 65 Ward Street, Port Hope	Monitoring Well: BH3
Test Conducted by: J.N.	Test Date: November 19, 2019
Analysis Performed by: NA	FHT
Aquifer Thickness: 7.6 m	



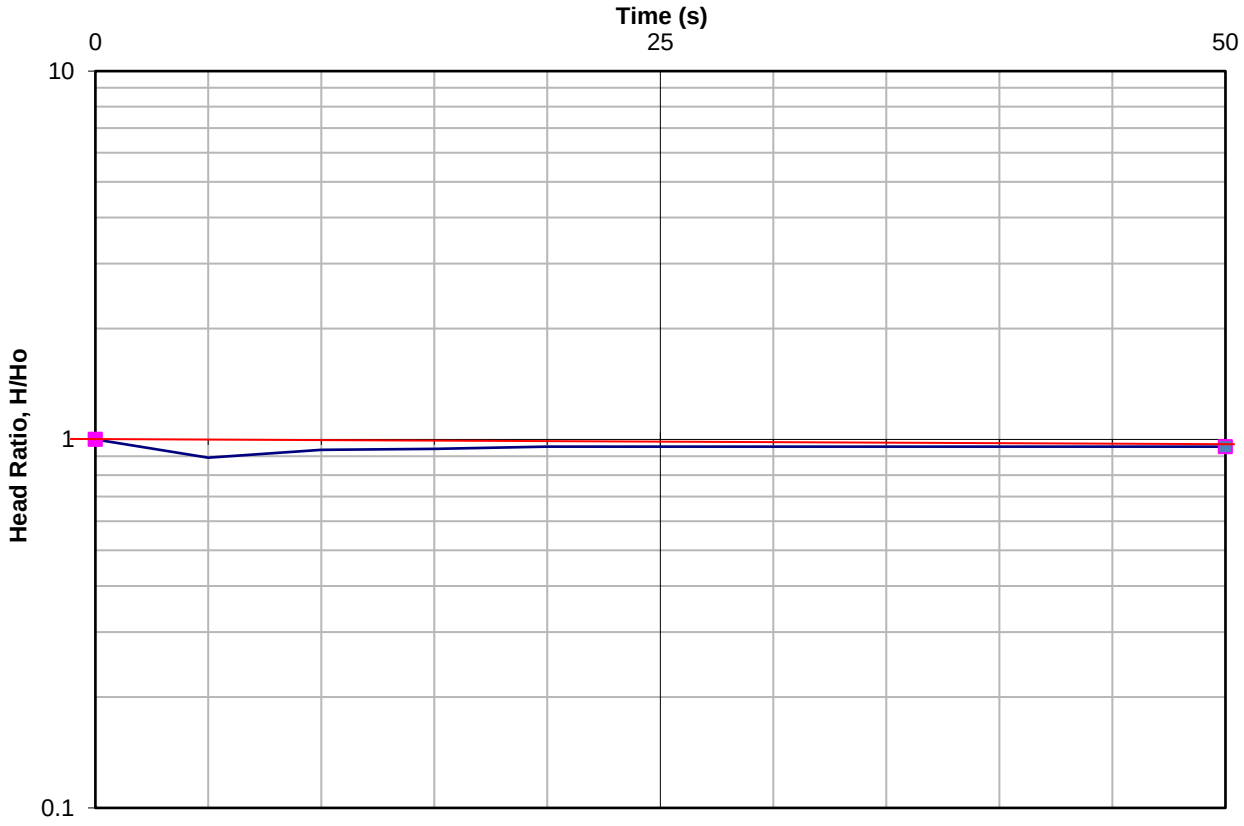
Calculation using Bouwer and Rice, 1976

Observation Well	Hydraulic Conductivity (m/s)	
BH3	1.35E-07	

FHT: Falling Head Test

Terraprobe Inc.	**Hydraulic Conductivity Test Analysis Report**
	Project Reference No. 1-19-0660-46
	Client: CVH (No.6) LP

Location: 65 Ward Street, Port Hope	Monitoring Well: BH6
Test Conducted by: J.N.	Test Date: November 19, 2019
Analysis Performed by: NA	FHT
Aquifer Thickness: 7.6 m	



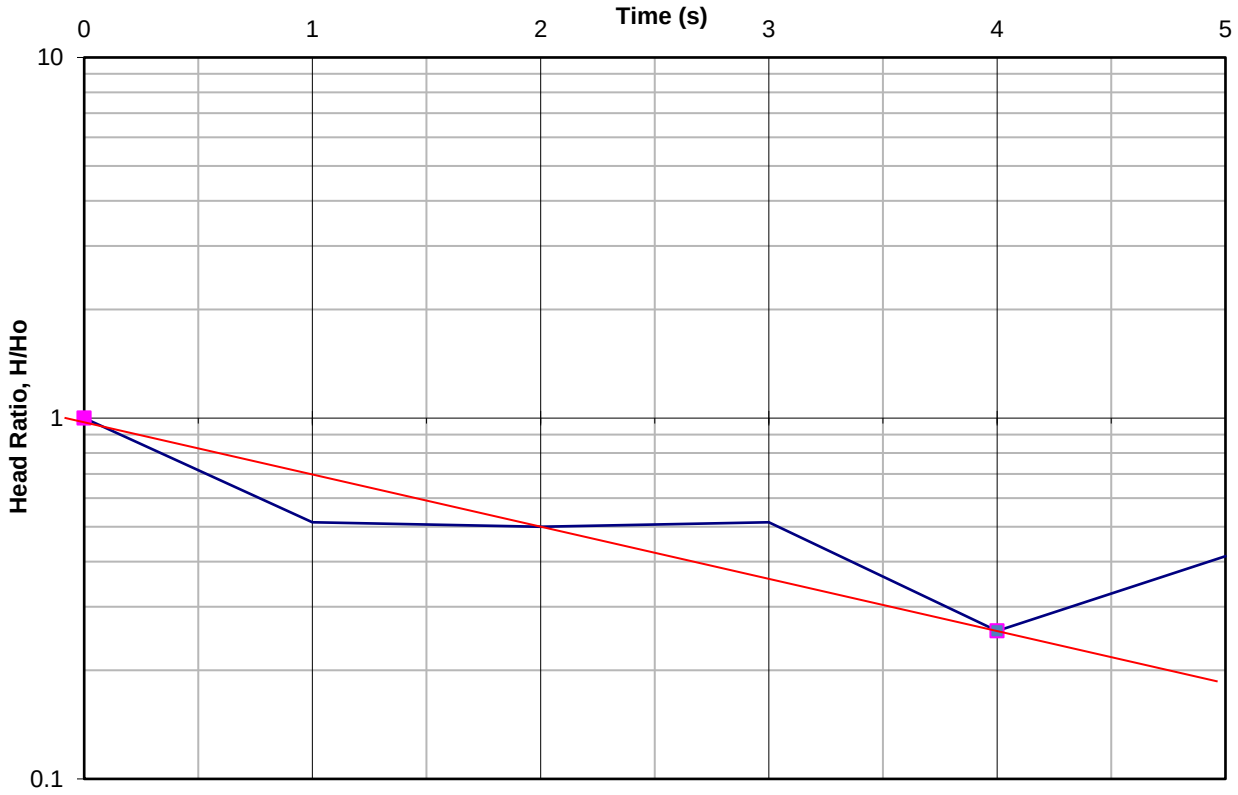
Calculation using Bouwer and Rice, 1976

Observation Well	Hydraulic Conductivity (m/s)	
BH6	3.12E-07	

FHT: Falling Head Test

Terraprobe Inc.	Hydraulic Conductivity Test Analysis Report
	Project Reference No. 1-19-0660-46
	Client: CVH (No.6) LP

Location: 65 Ward Street, Port Hope	Monitoring Well: BH10
Test Conducted by: J.N.	Test Date: November 19, 2019
Analysis Performed by: NA	FHT
Aquifer Thickness: 7.6 m	



Calculation using Bouwer and Rice, 1976

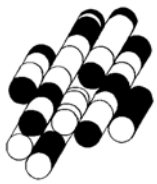
Observation Well	Hydraulic Conductivity (m/s)	
BH10	1.17E-04	

FHT: Falling Head Test

APPENDIX E

Groundwater Quality Test Results

TERRAPROBE INC.



TERRAPROBE - BRAMPTON
ATTN: NARJES ALIJANI
11 Indell Lane
Brampton ON L6T 3Y3

Date Received: 15-NOV-19
Report Date: 22-NOV-19 07:42 (MT)
Version: FINAL

Client Phone: 905-796-2650

Certificate of Analysis

Lab Work Order #: L2383286

Project P.O. #: NOT SUBMITTED
Job Reference: 1-19-0660-46
C of C Numbers:
Legal Site Desc:

Emily Smith
Account Manager

ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Sewer Use Bylaws - Port Hope Sanitary Sewer By-Law (30/94)						
L2383286-1	BH10	Physical Tests	Total Suspended Solids	1880	350	mg/L
Ontario Sewer Use Bylaws - Port Hope Storm Sewer By-Law (30/94)						
L2383286-1	BH10	Physical Tests	Total Suspended Solids	1880	15	mg/L
		Total Metals	Iron (Fe)-Total	37.3	17	mg/L

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2383286-1 Sample Date: 15-NOV-19 Sample ID: BH10
pH	pH units	6.0-9.5	6.0-9.5	7.39
Total Suspended Solids	mg/L	350	15	1880 DLHC

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Anions and Nutrients - WATER

		Guide Limits		Lab ID	Sample Date	Sample ID
Analyte	Unit	#1	#2			
Chloride (Cl)	mg/L	1500	1500	L2383286-1	15-NOV-19	BH10
				59.2		
Sulfate (SO4)	mg/L	1500	1500	32.2		

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Cyanides - WATER

		Guide Limits		Lab ID	Sample Date	Sample ID
Analyte	Unit	#1	#2	L2383286-1	15-NOV-19	BH10
Cyanide, Total	mg/L	2	0.1	<0.0020		

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Bacteriological Tests - WATER

			Lab ID	L2383286-1
			Sample Date	15-NOV-19
			Sample ID	BH10
		Guide Limits		
Analyte	Unit	#1	#2	
Total Coliforms	CFU/100mL	-	2400	2000 DLM

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Total Metals - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2383286-1 Sample Date: 15-NOV-19 Sample ID: BH10
Cadmium (Cd)-Total	mg/L	3	1	0.000296 DLHC
Chromium (Cr)-Total	mg/L	3	1	0.0371 DLHC
Copper (Cu)-Total	mg/L	3	1	0.042 DLHC
Iron (Fe)-Total	mg/L	50	17	37.3 DLHC
Mercury (Hg)-Total	mg/L	-	0.1	0.0000185
Nickel (Ni)-Total	mg/L	3	1	0.0323 DLHC

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Dissolved Metals - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2383286-1 Sample Date: 15-NOV-19 Sample ID: BH10
Dissolved Metals Filtration Location		-	-	LAB
Cadmium (Cd)-Dissolved	mg/L	3	1	<0.0000050
Chromium (Cr)-Dissolved	mg/L	3	1	<0.00050
Copper (Cu)-Dissolved	mg/L	3	1	0.00069
Lead (Pb)-Dissolved	mg/L	3	-	<0.000050
Nickel (Ni)-Dissolved	mg/L	3	1	0.00051
Zinc (Zn)-Dissolved	mg/L	3	1	<0.0010

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Aggregate Organics - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2383286-1 Sample Date: 15-NOV-19 Sample ID: BH10
BOD	mg/L	300	15	<3.0 BODL
Oil and Grease, Total	mg/L	-	-	<5.0
Mineral Oil and Grease	mg/L	15	10	<2.5
Phenols (4AAP)	mg/L	0.1	0.02	0.0090

Guide Limit #1: Port Hope Sanitary Sewer By-Law (30/94)
Guide Limit #2: Port Hope Storm Sewer By-Law (30/94)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
BOD-WT	Water	BOD	APHA 5210 B

This analysis is carried out using procedures adapted from APHA Method 5210B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CN-TOT-WT	Water	Cyanide, Total	ISO 14403-2

Total cyanide is determined by the combination of UV digestion and distillation. Cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

When using this method, high levels of thiocyanate in samples can cause false positives at ~1-2% of the thiocyanate concentration. For samples with detectable cyanide analyzed by this method, ALS recommends analysis for thiocyanate to check for this potential interference

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HG-T-CVAA-WT	Water	Total Mercury in Water by CVAAS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

OGG-SPEC-WT	Water	Speciated Oil and Grease-Gravimetric	APHA 5520 B

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
		The procedure involves an extraction of the entire water sample with hexane. Sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.	
PH-WT	Water	pH	APHA 4500 H-Electrode
		Water samples are analyzed directly by a calibrated pH meter.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days	
PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066
		An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.	
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric
		A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.	
TC-MF-WT	Water	Total Coliforms	SM 9222B
		A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35–0.5°C for 24–2h. Method ID: WT-TM-1200	

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2383286 Report Date: 22-NOV-19

Client: TERRAPROBE-BRAMPTON
11 Indell Lane
Brampton ON L6T 3Y3
Contact: NARJES ALIJANI

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BOD-WT	**Water**							
Batch R4919688								
WG3220673-2 DUP		**L2383202-1**						
BOD		<3.0	<3.0	RPD-NA	mg/L	N/A	20	21-NOV-19
WG3220673-3 LCS								
BOD			103.0		%		85-115	21-NOV-19
WG3220673-1 MB								
BOD			<2.0		mg/L		2	21-NOV-19
CL-IC-N-WT	**Water**							
Batch R4915704								
WG3221423-10 DUP		**WG3221423-8**						
Chloride (Cl)		20.5	20.4		mg/L	0.2	20	18-NOV-19
WG3221423-7 LCS								
Chloride (Cl)			102.5		%		90-110	18-NOV-19
WG3221423-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	18-NOV-19
WG3221423-9 MS		**WG3221423-8**						
Chloride (Cl)			102.1		%		75-125	18-NOV-19
CN-TOT-WT	**Water**							
Batch R4915626								
WG3221493-3 DUP		**L2383148-1**						
Cyanide, Total		<0.020	<0.020	RPD-NA	mg/L	N/A	20	18-NOV-19
WG3221493-2 LCS								
Cyanide, Total			93.5		%		80-120	18-NOV-19
WG3221493-1 MB								
Cyanide, Total			<0.0020		mg/L		0.002	18-NOV-19
WG3221493-4 MS		**L2383148-1**						
Cyanide, Total			82.3		%		70-130	18-NOV-19
HG-T-CVAA-WT	**Water**							
Batch R4914785								
WG3221149-4 DUP		**WG3221149-3**						
Mercury (Hg)-Total		<0.0000050	<0.000005(	RPD-NA	mg/L	N/A	20	18-NOV-19
WG3221149-2 LCS								
Mercury (Hg)-Total			96.6		%		80-120	18-NOV-19
WG3221149-1 MB								
Mercury (Hg)-Total			<0.000005(		mg/L		0.000005	18-NOV-19
WG3221149-6 MS		**WG3221149-5**						
Mercury (Hg)-Total			86.9		%		70-130	18-NOV-19
MET-D-CCMS-WT	**Water**							

Quality Control Report

Client: TERRAPROBE-BRAMPTON
11 Indell Lane
Brampton ON L6T 3Y3
Contact: NARJES ALIJANI

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R4915299								
WG3221394-4 DUP		**WG3221394-3**						
Cadmium (Cd)-Dissolved		<0.0000050	<0.000005(	RPD-NA	mg/L	N/A	20	19-NOV-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	19-NOV-19
Copper (Cu)-Dissolved		0.00069	0.00068		mg/L	0.4	20	19-NOV-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	19-NOV-19
Nickel (Ni)-Dissolved		0.00051	0.00054		mg/L	4.2	20	19-NOV-19
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	19-NOV-19
WG3221394-2 LCS								
Cadmium (Cd)-Dissolved			98.1		%		80-120	18-NOV-19
Chromium (Cr)-Dissolved			102.0		%		80-120	18-NOV-19
Copper (Cu)-Dissolved			100.1		%		80-120	18-NOV-19
Lead (Pb)-Dissolved			103.6		%		80-120	18-NOV-19
Nickel (Ni)-Dissolved			101.0		%		80-120	18-NOV-19
Zinc (Zn)-Dissolved			98.6		%		80-120	18-NOV-19
WG3221394-1 MB								
Cadmium (Cd)-Dissolved			<0.000005(		mg/L		0.000005	18-NOV-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	18-NOV-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	18-NOV-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	18-NOV-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	18-NOV-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	18-NOV-19
WG3221394-5 MS		**WG3221394-6**						
Cadmium (Cd)-Dissolved			94.0		%		70-130	18-NOV-19
Chromium (Cr)-Dissolved			76.3		%		70-130	18-NOV-19
Copper (Cu)-Dissolved			92.8		%		70-130	18-NOV-19
Lead (Pb)-Dissolved			97.2		%		70-130	18-NOV-19
Nickel (Ni)-Dissolved			88.3		%		70-130	18-NOV-19
Zinc (Zn)-Dissolved			94.6		%		70-130	18-NOV-19
MET-T-CCMS-WT	**Water**							
Batch R4914087								
WG3220934-4 DUP		**WG3220934-3**						
Cadmium (Cd)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	18-NOV-19
Chromium (Cr)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	18-NOV-19
Copper (Cu)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	18-NOV-19
Iron (Fe)-Total		0.36	0.37		mg/L	2.4	20	18-NOV-19

Quality Control Report

Client: TERRAPROBE-BRAMPTON
11 Indell Lane
Brampton ON L6T 3Y3
Contact: NARJES ALIJANI

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4914087								
WG3220934-4 DUP		**WG3220934-3**						
Nickel (Ni)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	18-NOV-19
WG3220934-2 LCS								
Cadmium (Cd)-Total			94.4		%		80-120	18-NOV-19
Chromium (Cr)-Total			97.3		%		80-120	18-NOV-19
Copper (Cu)-Total			96.1		%		80-120	18-NOV-19
Iron (Fe)-Total			104.6		%		80-120	18-NOV-19
Nickel (Ni)-Total			96.2		%		80-120	18-NOV-19
WG3220934-1 MB								
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	18-NOV-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	18-NOV-19
Copper (Cu)-Total			<0.0010		mg/L		0.001	18-NOV-19
Iron (Fe)-Total			<0.010		mg/L		0.01	18-NOV-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	18-NOV-19
WG3220934-5 MS		**WG3220934-3**						
Cadmium (Cd)-Total			99.0		%		70-130	18-NOV-19
Chromium (Cr)-Total			100.3		%		70-130	18-NOV-19
Copper (Cu)-Total			95.2		%		70-130	18-NOV-19
Iron (Fe)-Total			N/A	MS-B	%		-	18-NOV-19
Nickel (Ni)-Total			97.1		%		70-130	18-NOV-19
OGG-SPEC-WT	**Water**							
Batch R4917846								
WG3223016-2 LCS								
Oil and Grease, Total			82.1		%		70-130	19-NOV-19
Mineral Oil and Grease			77.3		%		70-130	19-NOV-19
WG3223016-1 MB								
Oil and Grease, Total			<5.0		mg/L		5	19-NOV-19
Mineral Oil and Grease			<2.5		mg/L		2.5	19-NOV-19
PH-WT	**Water**							
Batch R4916040								
WG3222386-4 DUP		**WG3222386-3**						
pH		7.25	7.19	J	pH units	0.06	0.2	19-NOV-19
WG3222386-2 LCS								
pH			7.00		pH units		6.9-7.1	19-NOV-19
PHENOLS-4AAP-WT	**Water**							

Quality Control Report

Client: TERRAPROBE-BRAMPTON
11 Indell Lane
Brampton ON L6T 3Y3
Contact: NARJES ALIJANI

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PHENOLS-4AAP-WT	**Water**							
Batch R4915159								
WG3221241-11 DUP		**L2383160-1**						
Phenols (4AAP)		0.0049	0.0050		mg/L	1.6	20	18-NOV-19
WG3221241-10 LCS								
Phenols (4AAP)			97.5		%		85-115	18-NOV-19
WG3221241-9 MB								
Phenols (4AAP)			<0.0010		mg/L		0.001	18-NOV-19
WG3221241-12 MS		**L2383160-1**						
Phenols (4AAP)			93.3		%		75-125	18-NOV-19
SO4-IC-N-WT	**Water**							
Batch R4915704								
WG3221423-10 DUP		**WG3221423-8**						
Sulfate (SO4)		47.3	47.4		mg/L	0.1	20	18-NOV-19
WG3221423-7 LCS								
Sulfate (SO4)			101.0		%		90-110	18-NOV-19
WG3221423-6 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	18-NOV-19
WG3221423-9 MS		**WG3221423-8**						
Sulfate (SO4)			99.9		%		75-125	18-NOV-19
SOLIDS-TSS-WT	**Water**							
Batch R4917726								
WG3222534-3 DUP		**L2383286-1**						
Total Suspended Solids		1880	1870		mg/L	0.8	20	20-NOV-19
WG3222534-2 LCS								
Total Suspended Solids			99.2		%		85-115	20-NOV-19
WG3222534-1 MB								
Total Suspended Solids			<2.0		mg/L		2	20-NOV-19
TC-MF-WT	**Water**							
Batch R4912936								
WG3220380-3 DUP		**L2383189-1**						
Total Coliforms		0	<10	RPD-NA	CFU/100mL	N/A	65	16-NOV-19
WG3220380-1 MB								
Total Coliforms			0		CFU/100mL		1	16-NOV-19

Quality Control Report

Workorder: L2383286 Report Date: 22-NOV-19

Client: TERRAPROBE-BRAMPTON
11 Indell Lane
Brampton ON L6T 3Y3
Contact: NARJES ALIJANI

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2383286-COFC

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Terraprobe Inc
Contact:	Narjes Alijani
Phone:	905-796-2650
	Company address below will appear on the final report
Street:	11 Indell Lane
City/Province:	Brampton, Ontario
Postal Code:	L6T 3Y3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	Terraprobe Inc
Contact:	Lorena Rossi

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	nalijani@terraprobe.ca
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	lrossi@terraprobe.ca
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q62481	AFE/Cost Center:	PO#
Job #:	1-19-0660-46	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2383286 Nov 15/19	ALS Contact:	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Port Hope Sanitary and Storm Sewer Bylaw	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
1	BH10	15-11-19	13:00	GW	10	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Compare to Port Hope Sanitary and Storm Sewer Bylaw

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☒ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
3.6				1.5			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Amir Karim	Date: November 15, 2019	Time:	Received by: FM	Date: Nov 15/19	Time: 16:41	Received by:	Date: Nov 15/19	Time: 18:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

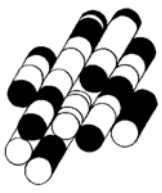
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

APPENDIX F

FEM Modeling

TERRAPROBE INC.



Dewatering Calculations

Dewatering at 65 Ward Street, Port Hope

Proposed slab on-grade Building Buildings (Strip Footing)

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	Strip Footing
Q s.f. 1.5 *	**m^3/day**	41.41
Q	**m^3/day**	27.6
K	**m/day**	0.03
H	**m**	2.3
h	**m**	0.3
R_0	**m**	9.3
Trench width (b)	**m**	0.8
r_s	**m**	9.1
x (a)	**m**	323.4
L	**m**	4.6
	a/b	404.3

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	Value
R_0	**m**	9.3
H	**m**	2.3
K	**m/s**	3.1E-07
S_y (Johnson,1967)		0.06
t	**s**	1209600

*** The estimated flow rate includes total flow rate for a trench with a length and width of 323.4 m (proposed building parameter) and 0.8 m, respectively. The esimated flow rate for a trench with a length and width of 20 m and 0.8 m is 2.56 m^3/day.**

Dewatering Calculations

Construction Dewatering @ 65 Ward Street, Port Hope

Proposed slab on-grade Building Buildings (Spread Footing)

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

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)}$$

Where:

Q = Anticipated pumping rate (m^3/day)
K = Hydraulic conductivity (m/day)
H = Distance from initial static water 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 = Equivalent radius of excavation (m), calculated as follows:

$$r_s = \sqrt{\frac{ab}{\pi}}$$

Where:

a = excavation length (m)
b = excavation width (m)

Parameter	Units	Spread Footing
Q s.f. 1.5*	**m^3/day**	0.27
Q	**m^3/day**	0.2
K	**m/day**	0.03
H	**m**	2.3
h	**m**	0.3
R_0	**m**	9.3
r_s	**m**	0.8
a	**m**	1.5
b	**m**	1.5
a/b		1.0

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

Radius of Influence Formula (Bear, 1979):

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

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	Value
R_0	**m**	9.3
H	**m**	2.3
K	**m/s**	3.1E-07
S_y		0.06
t	**s**	1209600

*** The estimated flow rate considers construction of one proposed spread footing with a side lenghth of 1.5 m**

Short-Term (Strip Footing-Length of 20 m)

Anticipated Groundwater Seepage

Excavation Dimensions (m)	
NS	0.8
EW	20
Area (m2)	16
Perimeter (m)	41.6

Q (L/day)		
Flow	**Length of Base**	**Safety Factor 1.5**
1,707	20	2,560
		~2,600

Anticipated Rainfall

Rainfall Event		
Year	2	100
Hour	3	12
Depth (mm)	25	94
Depth (m)	0.025	0.094

2 Year Event (L/day)	**400**	
100 Year Event (L/Day)	**1,504**	**~1,500**

Total Anticipated Short-Term Dewatering Flow Rates (considering groundwater seepage and 2 years Storm Event) 3,000 L/day

Short-Term (Strip footing-Entire Building Perimeter)

Anticipated Groundwater Seepage

Excavation Dimensions (m)	
NS	0.8
EW	323.4
Area (m2)	258.72
Perimeter (m)	648.4

Q (L/day)		
Flow	**Length of Base**	**Safety Factor 1.5**
27,600	323.4	41,400

Anticipated Rainfall

Rainfall Event		
Year	2	100
Hour	3	12
Depth (mm)	25	94
Depth (m)	0.025	0.094

2 Year Event (L/day)	**6,468**	**~6,500**
100 Year Event (L/Day)	**24,320**	**~24,400**

Total Anticipated Short-Term Dewatering Flow Rates (considering groundwater seepage and 2 years Storm Event) 47,900 L/day

Short-Term (Spread footing-Each Footing)

Anticipated Groundwater Seepage

Excavation Dimensions (m)	
NS	1.5
EW	1.5
Area (m2)	2.25
Perimeter (m)	6

Q (L/day)		
Flow	**Length of Base**	**Safety Factor 1.5**
200	1.5	300

Anticipated Rainfall

Rainfall Event		
Year	2	100
Hour	3	12
Depth (mm)	25	94
Depth (m)	0.025	0.094

2 Year Event (L/day)	**56**	**~60**
100 Year Event (L/Day)	**212**	**~215**

Total Anticipated Short-Term Dewatering Flow Rates (considering groundwater seepage and 2 years Storm Event) 360 L/day