Hydrogeological and Geotechnical Assessment

Proposed Residential and Commercial Development; Fallis Line, Millbrook, ON

Vargas P Inc.

24 June 2025

→ **The Power of Commitment**

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1. Introduction

GHD Limited (GHD) was retained by the Vargas P Inc. (Client) to conduct a hydrogeological assessment and geotechnical investigation of a proposed commercial and residential development at the location of Lot 13, Concession 6 within the Township of Cavan-Monaghan, Ontario ("the Site") located between Fallis Line and Larmer Line. The location of the Site is presented on **Figure 1**.

The Site encompasses an area of 33.62 hectares (ha) (83.1 acres) and currently supports agricultural fields. The Site is proposed to be developed into mixed commercial and residential use subdivision with low and medium density residential blocks, commercial blocks, an internal road network, a stormwater management pond (SMWP) block, and a parkland area block. The proposed development will be municipally serviced for water and sewer. New development to the west is also municipally serviced for water and sewer while existing lots along County Road 10 and Larmer Line are privately serviced with well and septic. The Draft Plan of Subdivision[1] showing the proposed development is presented on **Figure 2**.

The purpose of the hydrogeological assessment was to define and characterize the subsurface soil and groundwater conditions of the Site including groundwater depth, flow direction, an assessment of construction dewatering, a preliminary infiltration characterization, and a generic water balance. The purpose of the geotechnical investigation was to obtain subsurface information regarding the soil and groundwater conditions at the test hole locations and provide geotechnical engineering recommendations regarding earthwork construction, backfilling, bearing capacity and foundations design, slab-on-grade design, service installation (bedding and backfill), and pavement structure for the internal road network.

The scope of work included a desktop review of available geological and groundwater mapping; a review of the Source Protection Information Atlas; a review of the Ministry of the Environment, Conservation and Parks (MECP) well records; the drilling of boreholes and excavation of test pits to investigate the subsurface conditions; installation of monitoring wells to facilitate water level measurements; completion of single well response testing to assess the hydraulic conductivity of the saturated zones; and a computed a generic water balance evaluation to establish groundwater infiltration targets (i.e. pre- and post-development runoff / infiltration conditions) in support of Low Impact Development strategies (LIDs). GHD notes that the water balance evaluation does not include tasks associated with a storm water study and / or related design work. As the work at this stage is investigative, this report does not include any applications for Permits to Take Water (PTTW), Environmental Activity and Sector Registry (EASR) permits for construction dewatering, sewer use by-law testing, excess soil etc.

This report is organized into the following sections:

Section 1.0 – Introduction: Outlines the purpose, objectives and scope of work, and presents the report organization.

Section 2.0 – Background: Provides a description of the existing Site conditions, background information and surrounding land uses. The regional environmental setting including the physiography, topography, surface water features, and surficial, Quaternary and bedrock geology is presented. This section of the report also considers a review of the Source Protection Information Atlas. The source protection information for the Site is based upon information current as of April 23, 2025.

Section 3.0 – Methodology: Describes the field activities and methodologies used to assess the hydrogeological and geotechnical conditions and to evaluate potential impacts associated with the undertaking.

Section 4.0 – Field Investigation Results: Provides a detailed description of the Site geology, hydrogeology and hydraulic properties of the underlying stratigraphy.

[1] Biglieri Group "Draft Plan of Subdivision". Drawing No. DP-01, dated 2025.06.18.

Section 5.0 – Discussion and Recommendations: Discusses the hydrostatic units and flow direction; single well response testing, and potential dewatering related to expected construction activities. A generic water balance evaluation was completed providing calculations of the expected pre- and post-development infiltration values to establish an infiltration target for the development. The water balance was based upon the Draft Plan of Subdivision provided to GHD. This section also provides geotechnical recommendations for the proposed development based on the soil and groundwater conditions encountered at the test hole locations.

Section 6.0 – Conclusions and Closure: Provides the overall conclusion of the report based upon the assessment findings and closure of the document. This section is followed by a Statement of Limitations.

2. Background

2.1 Site Description

The Site is located at Lot 13, Concession 6 within the Township of Cavan-Monaghan, Ontario and encompasses a total area of 33.62 ha (83.1 acres). At the time of GHD's field investigation, the Site is being used for agricultural purposes. A creek runs through the middle of the Site from west to east and two residential structures are present on the Site. There are also two (2) seasonal drainage areas that will drain overland flow and shallow water toward the east. It is understood by GHD that the Site will be municipally serviced for water and sanitary services.

The Site is within the Otonabee-Peterborough Source Protection Area and the Site is zoned as Agricultural (A) and Natural Linkage (NL) as per the Township of Cavan Monaghan Zoning By-Law 2018-58. The surrounding land use consists of:

– North – Larmer Line, Agricultural fields
– East – Agricultural fields
– South – Fallis Line, Future mixed-use development
– West – County Rd 10, Commercial, residential, municipal properties.

The planned development will involve the removal of the existing residential structures on Site. The proposed development will include commercial properties along County Road 10, low and medium density residential housing, an internal road network, a stormwater management pond, and a parkland area. Design details, such as a grading plan and building design loads, were not available GHD at the time of writing this report.

2.2 Regional Setting

The regional topography, as presented on **Figure 3,** is of rolling to hilly terrain. Local topography across the Site is undulating with gentle to steep slopes and relatively flat ridges. Low-lying areas and a valley area that bisects the Site contain seasonal and perennial watercourses. In the southern area of the Site, the lands to the east of the Site slope toward the west, and, from County Road 10 the topography slopes to the east creating a low-lying area through the middle of the Site in this area. This area was also noted to be wet during our site visits in the spring of 2025. The middle portion of the Site slopes toward the creek and to the east with another wet area noted. The far northern extent of the Site also has a localized area that slopes toward the west. It is assumed that the creek that bisects the Site flowing from west to east is a perennial stream. No other permanent water courses or bodies were observed on the Site.

The Site is situated within the physiographic region known as the Peterborough Drumlin Field[2], as presented on **Figure 4**. Locally, the Site is within a sand plains.

[2] Chapman and Putnam, 1984. The Physiography of Southern Ontario, 3rd Edition. Ministry of Natural Resources.

According to the Surficial Geology of Southern Ontario[3], as presented on **Figure 5**, the surface soils at the Site consists of stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain overlain by coarse textured glaciolacustrine deposits of sand, gravel, minor silt and clay, and modern alluvial deposits of clay, silt, sand, gravel and organic remains.

Based upon the Quaternary Geology of Ontario[4], as presented on **Figure 6**, most of the Site is defined as organic deposits, consisting of peat, muck and marl. Sections in the north and south ends of the Site are classified as till consisting of undifferentiated, predominantly sandy silt to silt matrix, commonly rich in clasts and often high in total matrix carbonate content.

According to the Bedrock Geology of Ontario[5], as presented on **Figure 7**, the bedrock of the area consists of limestone, dolostone, shale, arkose, and sandstone and belongs to the to the Simcoe Group of the Upper Ordovician Era. Based upon the well records within the vicinity, bedrock in the area ranges in depth from 63 m to 69 m.

2.3 Existing Local Water Supplies

New development to the west is municipally serviced for water and sewer while existing lots along County Road 10 and Larmer Line are privately serviced with well and septic. The locations of water wells and their corresponding data recorded by the MECP within 500 m of the Site are shown in **Appendix A**. Based on the review of the well records, there are nineteen (19) records within 500 m of the Site. The well record information indicates that there are:

- Twelve (12) drilled overburden well records;
- Three (3) bedrock well records;
- One dug / bored well record; and,
- Three (3) abandonment well records.

One (1) of the abandonment well records, an overburden well, was identified to be a flowing artesian well, drilled to a depth of 32.6 m. The depth to where groundwater was encountered was:

– Overburden wells: 7.6 to 65.8 m (average depth of 27.7 m).
– Bedrock wells: 63.7 to 68.6 m (average depth of 66 m).
– Dug / bored well: 8.5 m.

Based upon this data, the groundwater aquifers targeted for domestic usage in this area is typically found at depth from 7.6 m to nearly 70 m.

Other data from the well records reviewed is summarized in **Table 1**.

Table 1 MECP Well Record Data

Well Use	Well Type/Unit	No. of Records	Well Depth Min – Max (Avg) (m)	Static WL Min – Max (m)	Yield Min – Max (L/min)
Water Supply	Overburden – Drilled	12	10.4 – 68.9 (28.6)	1.8 – 22.9 (10.6)	11.3 – 226.8 (51.3)
Water Supply	Dug /Bored	1	15.2	7.9	15.1
Water Supply	Bedrock – Drilled	3	64 – 72.2 (68.8)	20.1 – 25 (22.1)	7.6 – 15.1 (11.3)
Total		**16**			
Abandonment	Unknown	3	5.2 – 16.2 (12.0)	-0.3 – 13.1 (6.4)	NA

[3] Ontario Geological Survey, 2010. Surficial Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release-Data 128 – Revised.
[4] Ontario Geological Survey, 1997. Quaternary Geology, Seamless Coverage of the Province of Ontario: Ontario Geological Survey, Data Set 14.
[5] Ontario Geological Survey, 2011. 1:250 000 scale Bedrock Geology of Ontario; Ontario Geological Survey, Miscellaneous Release–Data 126 - Revision 1.

2.4 Source Water Protection

Where proposed developments are being planned, it is important to assess the Site for areas that are protected under the Clean Water Act (2006). These include the presence of Significant Groundwater Recharge Areas (SGRAs), Highly Vulnerable Aquifers (HVAs) and Wellhead Protection Areas (WHPAs). These features are considered by reviewing the "Source Protection Information Atlas" (SPIA) that is currently available through the MECP website. The published information is dated current as of April 23, 2025. The Site falls withing the Otonabee-Peterborough Source Protection Area.

In general, SGRAs are defined as areas where water seeps into an aquifer from rain and melting snow, supplying water to the underlying aquifer. A HVA aquifer occurs where the subsurface material offers limited protection from contamination resulting from surface activities. A WHPA is defined as the surface and subsurface area surrounding a water well or well field that supplies a municipal residential system through which contaminants are reasonably likely to move so as to eventually reach the water well. WHPA-A is a 100 m radius around the wellhead. WHPA-B is an area where water and any pollution that may be present can reach the well within 2 years. WHPA-C is an area where water and any pollution that may be present can reach the well within 2 to 5 years. WHPA-D is an area where water and any pollution that may be present can reach the well within 5 to 25 years. WHPA-E is an area where the groundwater is under the direct influence of surface water, meaning that there may be direct pathways from the ground surface to the well, making the drinking water source vulnerable to contamination from the ground surface.

Based on the information reviewed from the SPIA, a portion of the Site, mostly around the onsite creek, is within a SGRA (score of 2) as presented on **Figure 8.** The Site is not within a HVA or WHPA.

2.4.1 Other Source Water Protection Considerations

The Site is not within a Wellhead Protection Area Q1 or Q2 (WHPA Q1/Q2). WHPA Q1/Q2 (moderate risk level) means that activities that take water without returning it to the same source may be a threat (Q1) and activities that reduce recharge may be a threat (Q2). Activities that take water would include construction dewatering or other groundwater pumping. Pumping or dewatering activities may require appropriate permitting from the MECP; however, are not a concern from a Source Water Protection perspective.

3. Methodology

To achieve the purpose and objectives of this hydrogeological and geotechnical investigation, the following activities and tasks were undertaken:

- Prepared and implemented a Health and Safety Plan for the field activities and completed underground utility locate clearances including public and private locates.
- Conducted a walkover inspection of the Site.
- Advanced boreholes for obtaining hydrogeological and geotechnical parameters and installation of monitoring wells to facilitate the collection of groundwater levels to evaluate groundwater flow conditions.
- Obtained groundwater levels from the monitoring wells to evaluate depth to groundwater and flow direction.
- Completed test pits for obtaining further hydrogeological and geotechnical information.
- Surveyed ground elevations of the monitoring wells and borehole locations.
- Conducted Single Well Response Tests (SWRTs) to assess the horizontal hydraulic conductivity and groundwater flux of the saturated stratigraphic deposits investigated.
- Completed geotechnical laboratory testing in accordance with the latest editions of the ASTM Standards.
- Prepared this geotechnical and hydrogeological investigation report providing factual data, analysis and recommendations including a generic water balance for assessing pre- and post-construction infiltration values.

3.1 Health and Safety

For projects that incorporate field activities, GHD conducts Health and Safety planning. For this project, a site-specific Health and Safety Plan (HASP) was prepared and implemented during the field activities. The HASP presents the visually observed Site conditions to identify potential physical hazards to field personnel. Required personal protective equipment was also listed in the HASP. It is mandatory for GHD personnel involved in the field program, to read and have a copy of the HASP available at the Site.

3.2 Utility Clearance

GHD completed a pre-drilling Site visit to review the Site conditions and access restrictions. Based on the limits of approach, the test holes were positioned appropriately to avoid potential obstructions and were placed in the field based on the proposed concept plan at that time.

Prior to initiating the subsurface investigation activities, the applicable utility companies (gas, hydro, network cables, water, waste water, etc.) were contacted, to demarcate the location of their respective underground utilities to ensure that service lines would not be damaged during the investigative works.

GHD also retained a specialist private services locator (Utility Marx) to locate any underground private utilities that could potentially be present at the Site within the areas of intrusive work. The test holes were positioned at appropriate locations to avoid existing service lines.

3.3 Subsurface Exploration

A subsurface investigation was conducted by GHD through the advancement of boreholes between March 11 and 13 2024 and test pits were carried out on March 24, 2025. The work associated with the test holes was carried out under the full-time supervision of a GHD technical representative and included the installation of monitoring wells.

A summary of the observations made during the subsurface exploration program are presented below in the following sections.

3.3.1 Test Holes and Monitoring Well Installation

A total of fourteen (14) boreholes and seven (7) test pits were advanced with monitoring wells installed at six (6) of the borehole locations to evaluate the Site subsurface conditions. The boreholes were advanced to depths ranging between 6.2 to 6.7 mbgs and monitoring wells were installed to depths ranging between 3.1 to 6.1 mbgs. The test pits were each excavated to a depth of 3.1 mbgs.

The locations of the boreholes, test pits, and monitoring wells are presented on **Figure 2**. Following their installation, the monitoring wells were documented with the MECP and became the property of the Site's owner. Monitoring wells were installed at boreholes MW1-25, MW3-25, MW4-25, MW6-25, MW9-25, and MW11-25. One (1) nested well was installed at borehole MW6-25 (deep and shallow monitoring wells) for a total of seven (7) monitoring wells installed at the Site.

The boreholes were advanced by a track-mounted conventional drilling rig, supplied and operated by G.E.T. Drilling, a MECP-licensed well driller, under the full-time supervision of a GHD experienced technical representative. The monitoring wells were installed by the well driller consistent with the requirements of Ontario Regulation (O. Reg.) 903 – Wells (R.R.O 1990). The test pits were dug by a CAT 315 tracked excavator supplied and operated by Leahy Excavating, under the full-time supervision of a GHD experienced technical representative. The test hole information is provided in **Table 2** and the monitoring well completion details are presented in **Table 6.** The stratigraphy logs of the test holes and monitoring wells are presented in **Appendix B.**

The boreholes were advanced using continuous solid stem augers and soil samples were collected using a 50-millimetre (mm) outside diameter split spoon sampler in general accordance with the specifications of the Standard

Penetration Test (SPT) procedure described in ASTM D1586[6]. The relative density or consistency of the subsurface soil layers were measured using the Standard Penetration Test (SPT) method, by counting the number of blows ('N') required to drive a conventional split barrel soil sampler 300 mm in depth. Disturbed samples of the strata penetrated by the test pits were collected from the excavator's bucket. Groundwater level observations and measurements were made in the boreholes as drilling proceeded and upon completion of drilling and from the test pits during the excavation operations.

The GHD technical representative logged the material encountered in the test holes and examined the samples as they were obtained. The recovered samples were sealed in clean, airtight containers and transferred to GHD's laboratory, where they were reviewed by a geotechnical engineer.

Monitoring wells were constructed with 50 mm (2-inch) Schedule 40 PVC screen and casing. The well screens are 1.5 m in length and pre-slotted (No. 10 slot) (refer to **Table 6**). Silica sand pack was placed at the bottom of the monitoring well screen and typically extended 0.3 m above the screen. The remaining annular space was sealed with bentonite and the wells were completed with steel protective monument style casings. The installation details for each monitoring well are provided in the respective borehole logs. The installed monitoring wells will need to be abandoned in accordance with O. Reg. 903 once no longer required.

The as-drilled test hole locations were surveyed by GHD staff using an EOS Arrow Gold Plus Global Navigation Satellite System (GNSS) that streams to the Real Time Kinetic (RTK) Network. The test hole locations are shown in UTM Coordinates, Zone 17 with NAD 83 Datum (Original), northing and easting coordinates and ground surface elevations at the test hole locations are referenced to a Geodetic Datum. The ground elevations are provided for engineering analysis purposes only and should be confirmed by a licensed surveyor.

A summary of the test hole and monitoring locations, depths and ground surface elevations of the test holes is provided in **Table 2** below.

Table 2 Summary of Advanced Test Holes

Test Hole ID	Location – UTM Coordinates System		Ground Surface Elevation (m)	Test Hole Depth	
	Northing	Easting		mbgs	m
MW01-25	4894422	703316	241.76	6.4	235.36
BH02-25	4894434	703482	243.44	6.2	237.24
MW03-25	4894308	703528	244.70	6.4	238.30
MW04-25	4894130	703482	243.77	6.2	237.57
BH05-25	4894073	703615	238.75	6.7	232.05
MW06-25S	4893930	703553	238.17	3.1	235.07
MW06-25D	4893929	703551	238.15	6.7	231.45
BH07-25	4893877	703677	243.84	6.3	237.54
BH08-25	4893682	703556	244.99	6.7	238.29
MW09-25	4893733	703752	242.52	6.7	235.82
BH10-25	4893581	703652	244.73	6.4	238.33
MW11-25	4893460	703611	250.28	6.5	243.78
BH12-25	4893489	703852	244.32	6.7	237.62
BH13-25	4893396	703806	243.12	6.7	236.42
BH14-25	4893218	703705	252.28	6.7	245.58
TP01-25	4894441	703346	242.01	3.0	239.01

[6] ASTM D1586-11 - Standard Test Method for Standard Penetration Test and Split-Barrel Samplings of the soil, ASTM International, West Conshohocken, PA 2015

Test Hole ID	Location – UTM Coordinates System		Ground Surface Elevation (m)	Test Hole Depth	
	Northing	Easting		mbgs	m
TP02-25	4894284	703533	245.05	2.5	242.55
TP03-25	4894123	703491	243.06	3.1	239.96
TP04-25	4893893	703589	240.66	3.1	237.56
TP05-25	4893645	703780	242.79	3.1	239.69
TP06-25	4893381	703825	243.44	3.0	240.44
TP07-25	4893268	703903	246.48	3.1	243.38
"S" refers to "shallow" monitoring well; "D" refers to "deep" monitoring well.					

It should be noted that the provided coordinates and elevations are approximate and should not be used for construction purposes.

3.4 Physical Laboratory Testing

The physical laboratory testing was conducted in accordance with the American Society for Testing and Materials (ASTM) and Canadian Council of Independent Laboratories (CCIL) applicable standards. Laboratory testing consisted of moisture content tests on all recovered soil samples and grain size distribution analyses (sieve and hydrometer) on seven (7) selected soil samples and Atterberg limits testing on four (4) cohesive soil samples to assess soil plasticity index properties.

The results of the moisture content and grain size distribution testing results are reported on the boreholes logs presented in **Appendix B**. The grain size distribution curves are provided in **Appendix C**.

The soil testing program and soil classification conformed to the latest edition of the following standards:

- ASTM D2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D6913 Standard Test Method for Particle Size Distribution (Gradation) of Soils using Sieve Analysis
- MTO LS-702 Standard Test Method for Particle Size Analysis of Soils (Hydrometer Analysis)
- ASTM D2487 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

3.5 Single Well Response Testing

Single well response testing (SWRTs) was conducted at seven (7) monitoring wells to estimate the horizontal hydraulic conductivity of the saturated geologic deposits underlying the Site. SWRTs were completed on monitoring wells MW01-25, MW03-25, MW04-25, MW06-25S, MW06-25D, MW09-25 and MW11-24.

SWRTs involve the injection or removal of a known volume of water into / from the well and measuring the water level response in the well until it returns to static or near static conditions (i.e., falling / rising head test). The results of the hydraulic testing were analyzed using the Bouwer-Rice (1976) solution for an unconfined aquifer condition as provided in the software package AQTESOLV™.

These solutions were used to determine the horizontal hydraulic conductivity of the saturated soils within the immediate vicinity of the screened interval of each monitoring well. The SWRTs conducted are summarized in **Table 8**. The results of the testing are presented in **Appendix D**.

3.6 Water Balance

To understand the pre- and post-infiltration components, a water budget analysis was undertaken for the Site to evaluate the amount of water surplus generated for the existing and proposed Site conditions and assess the potential impacts that may occur in the recharge / discharge characteristics related to the proposed development. The Site encompasses an area of 33.62 ha and supports agricultural fields. It is our opinion that groundwater infiltration should be maintained to the greatest extent possible.

The Site was subdivided into two (2) subcatchments for purposes of the water balance. The subcatchments (i.e. “north subcatchment” and “south subcatchment” refer to north and south of the creek) were based upon local topography and the creek that runs through the centre of the Site. It is our opinion that groundwater infiltration should be maintained to support any potential baseflow to the creek as this area is within a SGRA.

This evaluation is based upon the Draft Plan of Subdivision provided to GHD consisting of commercial properties along County Road 10, low and medium density residential housing, an internal road network, a stormwater management pond, and a parkland area. GHD understands that the removal of the existing residential structures on Site is proposed.

The objective of this water balance is to illustrate that post-development infiltration within the developable area can meet or be close to pre-development values. GHD utilized the Thornthwaite Method to complete this water balance. Based upon monthly temperature and precipitation average values, the method calculates the water surplus. Infiltration rate into the subsurface is based upon soil types, land cover and topography and is based upon MOEE Hydrogeological Technical Information Requirements for Land Development Applications, April 1995. The computations have used detailed parameters such as precipitation (Peterborough composite weather station using data from 1991 to 2020 was used), regional evapotranspiration, infiltration and runoff. Weather data from Peterborough (composite station metadata 6166418, 6166420, and 6166415) was selected as it was the closest weather station to the Site (~10 km away) using the most updated weather normalized data. The detailed water balance calculations are provided in **Appendix E**.

3.7 Groundwater Level Monitoring

Manual groundwater levels were collected using a Solinst water level meter. Groundwater levels were collected and are documented in this report from the monitoring wells on March 24, 2025. The water levels are summarized in **Table 5**.

4. Field Investigation Results

The following sections provide a detailed description of the field activities completed including geology and hydrogeology of the Site based on the results of the investigation completed and on the available background information. Detailed stratigraphy is shown on the test hole logs.

It should be noted that the subsurface conditions are only confirmed at the borehole locations and may vary between and beyond the borehole locations. The boundaries between the various strata, as shown on the borehole logs are based on non-continuous sampling and drilling resistance noted and observed at the time of drilling. These boundaries represent an inferred transition between the various strata, rather than precise planes of geological change.

4.1 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the test holes advanced during the investigation and the results of the laboratory tests carried out on selected soil samples are presented on the test hole logs provided in **Appendix B**. The results of the geotechnical laboratory testing are presented in **Appendix C**.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling, observations of drilling process and the results of the SPT. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations.

In summary, the test holes generally encountered surficial topsoil over native sandy silt underlain by cohesive and non-cohesive glacial till deposits. The non-cohesive glacial till was generally comprised of silty sand / sandy silt with varying amounts of clay and gravel. The cohesive glacial till was generally comprised of a clayey silt / silty clay with varying amounts of sand and gravel.

Detailed descriptions of subsurface conditions of the advanced test holes are provided in the following sections of this report.

4.1.1 Topsoil

A surficial layer of topsoil was encountered in all test holes and was observed to range between approximately 200 to 690 mm in thickness. This soil was observed to be in a damp, loose state, with a silty, highly organic content. As such, it is expected to be devoid of any structural engineering properties.

4.1.2 Sandy Silt

A layer of native sandy silt or silt was encountered in boreholes BH01-25 to BH07-25, BH11-25 and BH14-25 as well as within test pits TP01-25 to TP05-25 and TP07-25. The sandy silt / silt was encountered immediately beneath the surficial topsoil and extended to depths ranging from 0.6 mbgs to 3.0 mbgs. The native sandy silt contained varying amounts of gravel and clay. The SPT ‘N’ values recorded within the sandy silt material ranged from 5 blows per 300 mm of penetration to 37 blows per 300 mm of penetration indicating a loose to dense in-situ state of relative density. Samples of this material were visually described as moist. Measured moisture contents ranged between 9% to 22% by weight.

4.1.3 Non-Cohesive Till Deposit

A non-cohesive till deposit generally consisting of light brown to grey sandy silt / silty sand with varying amounts of clay and gravel and occasional cobbles was encountered initially at depths ranging from 0.8 mbgs to 4.6 mbgs. The non-cohesive till deposit extended to depths ranging between 3.1 mbgs to 6.7 mbgs. The non-cohesive till was encountered within all boreholes (except for MW06-25 and BH13-25) and within test pit TP01-25 to TP05-25. The SPT ‘N’ values recorded within the non-cohesive till ranged from 20 blows per 300 mm of penetration to 96 blows per 300 mm of penetration, with several spoons encountering refusal, indicating a compact to very dense relative density. Samples of the non-cohesive till material were visually described to be in a generally moist to wet condition. Measure moisture contents ranged between 3% to 25% by weight.

Grain size distribution testing was conducted on four (4) representative soil samples of the non-cohesive till deposit. Based upon grain size distribution analysis, the non-cohesive till consisted of 5 to 32% gravel, 6 to 38% sand, 24 to 69% silt, and 11 to 20% clay-sized particles by weight. The results are provided in **Appendix C** of this report and are summarized below in **Table 3**.

4.1.4 Cohesive Till Deposit

A cohesive till deposit generally consisting of light brown to grey clayey silt / silty clay with varying amounts of sand and gravel and occasional cobbles was encountered initially at depths ranging from 0.3 mbgs to 6.1 mbgs. The cohesive till deposit extended to depths ranging between 2.5 mbgs to 6.7 mbgs. The cohesive till was encountered within boreholes MW06-25, BH08-25, MW09-25, BH10-25, BH12-25 and BH13-25, as well as within all test pits TP06-25 and TP07-25. The SPT 'N' values recorded within the cohesive till ranged from 5 blows per 300 mm of penetration to 69 blows per 300 mm of penetration indicating a firm to hard consistency. Samples of the cohesive till material were visually described to be in a generally moist to wet condition. Measure moisture contents ranged between 8% to 33% by weight.

Grain size distribution testing was conducted on three (3) representative soil samples of the cohesive till deposit. Based upon grain size distribution analysis, the cohesive till consisted of 9 to 11% gravel, 13 to 32% sand, 33 to 34% silt, and 24 to 44% clay-sized particles by weight. The results are provided in **Appendix C** of this report and are summarized below in **Table 3**.

4.2 Physical Laboratory Testing Results

A total of seven (7) samples collected from the soils encountered at the Site were selected for testing of grain size distribution analyses and four (4) samples of the cohesive soils were also tested for Atterberg limits. The laboratory test results are summarized in the following tables and detailed test results are presented in **Appendix C**.

Table 3 Physical Laboratory Sieve and Hydrometer Testing Results

Borehole ID	Sample ID	Sample Depth (mbgs)	Grain Size (%)				Wn (%)	Soil Description (USCS Symbol)
			Gravel	Sand	Silt	Clay-size[1]		
BH01-25	SS4	2.3 – 2.9	9	35	37	19	7	Sandy Silt Till (ML)
BH05-25	SS7	6.1 – 6.7	5	6	69	20	17	Silt Till (ML[2])
BH06-25	SS6	4.6 – 5.2	9	13	34	44	17	Silty Clay Till (CL[2])
BH07-25	SS3	1.5 – 2.1	32	33	24	11	7	Gravelly Silty Sand Till (SM)
BH10-25	SS4	2.3 – 2.9	11	18	36	35	21	Silty Clay Till (CL[2])
BH13-25	SS6	4.6 – 5.2	11	32	33	24	14	Sandy Clayey Silt Till (CL-ML[2])
BH14-25	SS4	2.3 – 2.9	14	38	30	18	7	Silty Sand Till (SM)

[1] Soil particles <2 µm
Wn - natural water content
[2] USCS symbol based on Atterberg limits result below (**Table 4**)

The Atterberg limit test results from the cohesive deposit are summarized in **Table 4**.

Table 4 Atterberg Limits Results – Cohesive Deposits

Sample Identification	Depth (mbgs)	Atterberg Results (%)			Natural Moisture Content (%)	Soil Description (USCS Classification Symbol)
		Liquid Limit	Plastic Limit	Plasticity Index		
BH05-25 / SS7	6.1 – 6.7	19	16	3	17.1	Silt Till (ML)
BH06-25 / SS6	4.6 – 5.2	29	18	11	17.4	Silty Clay Till (CL)
BH10-25 / SS4	2.3 – 2.9	32	15	17	21.2	Silty Clay Till (CL)
BH13-25 / SS6	4.6 – 5.2	18	11	7	13.6	Sandy Clayey Silt Till (CL-ML)

4.3 Monitoring Wells and Groundwater Monitoring

4.3.1 Depth to Groundwater

During the drilling and the excavating process, the depth where water / wet and / or grey soils were encountered was noted. Upon completion of drilling, groundwater measurements were also collected from the open boreholes. Water / wet soils were encountered within eleven (11) of the twenty-one (21) test holes during the drilling / excavation process. A summary of the depths to water / wet and / or grey soils and the water levels measured upon completion of drilling is summarized in **Table 5**.

Table 5 Summary of Groundwater During Drilling / Excavating

Location	Depth to Water / Wet / Grey Soils Encountered (mbgs / m)	Water Level Upon Completion of Drilling (mbgs / m)
MW01-25	Wet / Grey at 4.6 mbgs (237.2 m)	4.0 mbgs / 237.8 m
BH02-25	Sand seam and wet at 2.4 mbgs (241.0 m)	2.4 mbgs / 241.0 m
MW03-25	Wet at 2.1 mbgs (242.6 m)	0.3 mbgs / 244.4 m
MW04-25	Wet at 4.6 mbgs (239.2 m)	2.9 mbgs / 240.9 m
BH05-25	Wet at 1.5 mbgs (237.3 m) / Grey at 2.3 mbgs (236.5 m)	4.3 mbgs / 234.5 m
MW06-25S	None encountered to 235.1 m	Dry to 235.1 m
MW06-25D	No water. Grey soils at 3.05 mbgs (235.1 m)	Dry to 231.5 m
BH07-25	None encountered to 237.5 m	4.0 mbgs /239.8 m
BH08-25	No water. Grey soils at 3.05 mbgs (241.9 m)	Dry to 238.3 m
MW09-25	No water. Grey soils at 4.6 mbgs (237.9 m)	Dry to 235.8 m
BH10-25	No water. Grey soils at 4.6 mbgs (240.1 m)	1.8 mbgs / 242.9 m
MW11-25	No water. Grey soils at 6.1 mbgs (244.2 m)	4.6 mbgs / 239.7 m
BH12-25	Sand seam and wet at 2.9 mbgs (241.4 m)	2.4 mbgs / 241.9 m
BH13-25	Wet / Grey at 2.3 mbgs (240.8 m)	0.6 mbgs / 242.5 m
BH14-25	None encountered to 245.6 m	Dry to 245.6 m
TP01-25	Water seepage at 1.7 mbgs (240.3 m)	Test pit backfilled. Water level not measured after excavation.
TP02-25	Water seepage at 0.9 mbgs (244.1 m)	
TP03-25	Water seepage at 1.1 mbgs (242.0 m)	
TP04-25	None encountered to 237.6 m	
TP05-25	None encountered to 239.7 m	
TP06-25	None encountered to 240.4 m	
TP07-25	Water seepage at 1.0 mbgs (245.5 m)	
Notes: “S” refers to “shallow” monitoring well; “D” refers to “deep” well.		

Based upon the table above, water and wet soils during drilling and excavation activities were observed from 0.9 to 4.6 mbgs and between elevations 237.2 m to 245.5 m at various locations. Grey soils were observed from 3.1 to 6.1 mbgs (235.1 m to 244.2 m) at various test holes. Grey soils are typically indicative of poorly draining soil where frequent saturation may be found. At six (6) locations (i.e. 27% of the test holes), no water / wet soils / grey soils were observed.

At some locations such as at BH07-25, BH10-25, and MW11-25, wet soils were not observed during the drilling process; however, a water level was measured within the open borehole after drilling was completed. This suggests that groundwater seepage may be occurring from small seams / lenses that were not readily observed during the drilling process. At these locations, groundwater appears to be migrating within the overburden although it is expected to be of low volume.

The following table provides the monitoring well installation details regarding the ground elevation, screened intervals and the soil that was screened. A monitoring well was installed within six (6) borehole locations including MW01-25, MW03-25, MW04-25, MW06-25, MW09-25, and MW11-25 to facilitate groundwater level measurements. A nested well was installed at borehole MW06-25 denoted as MW06-25S and MW06-25D for a total of seven (7) monitoring wells installed at the Site. The material screened was predominantly a glacial till. Four (4) existing monitoring wells, BH-14, MW-1, MW-2 and MW-3, were also observed on Site and were included for groundwater level measurements.

Table 6 Monitoring Well Information

Location	Ground Elevation (m)*	Well Pipe Stick Up (m)	Screened Interval		Sandpack Interval (effective screen)		Screened Material
			Depth (mbgs)	Elevation (m)	Depth (mbgs)	Elevation (m)	
BH-14	--	1.00	Well details are not known. Well depth 6.0 mbgs.				
MW-1	249.9	0.77	Well details are not known. Well depth 4.4 mbgs (245.5 m)				
MW-2	250.3	0.77	Well details are not known. Well depth 5.8 mbgs (244.5 m)				
MW-3	243.3	0.76	Well details are not known. Well depth 3.5 mbgs (239.8 m)				
MW01-25	241.8	0.81	3.1 – 1.5	238.7 – 240.3	3.1 – 1.2	238.7 – 240.6	Sandy Silt / Sandy Silt Till
MW03-25	244.7	0.80	3.1 – 1.5	241.6 – 243.2	3.1 – 1.2	241.6 – 243.2	Sandy Silt / Sandy Silt Till
MW04-25	243.8	0.81	3.1 – 1.5	240.7 – 242.3	3.1 – 1.2	240.7 – 242.6	Gravelly Silty Sand Till
MW06-25S	238.2	0.89	3.1 – 1.5	235.1 – 236.7	3.1 – 1.2	235.1 – 236.7	Silt, some sand
MW06-25D	238.2	0.88	6.1 – 4.6	232.1 – 233.6	6.1 – 3.1	232.1 – 235.1	Silty Clay Till
MW09-25	242.5	0.90	3.1 – 1.5	239.4 – 241.0	3.1 – 1.2	239.4 – 241.3	Clayey Silt / Silty Sand Till
MW11-25	250.3	1.05	3.1 – 1.5	247.2 – 248.8	3.1 – 1.2	247.2 – 249.1	Silty Sand Till

Notes:

m = metres; mbgs = metres below ground surface

(*) Ground elevations were measured using an EOS Arrow Gold Plus GPS system and, are for the purposes of evaluating groundwater elevation and flow direction and should not be relied upon as a legal survey or topographic elevation survey.

“S” refers to “shallow” monitoring well; “D” refers to “deep” well.

GHD collected groundwater levels on March 4, 2025 before the 2025 drilling program at the existing wells and all monitoring wells on March 25, 2025. The water level data from the monitoring event is summarized in **Table 7:**

Table 7 Groundwater Levels and Elevations

Monitoring Well ID	Ground Surface Elevation (m)*	Water Levels			
		March 4, 2025		March 25, 2025	
		mbgs	m	mbgs	m
BH-14	--	4.7	--	1.24	--
MW-1	249.9	2.92	247.0	0.15	249.7
MW-2	250.3	3.21	247.1	2.25	248.0
MW-3	243.3	Dry to 239.8 m		0.08	243.2

Monitoring Well ID	Ground Surface Elevation (m)*	Water Levels			
		March 4, 2025		March 25, 2025	
		mbgs	m	mbgs	m
MW01-25	241.8	Not drilled at this time		0.38	241.4
MW03-25	244.7			0.52	244.2
MW04-25	243.8			0.98	242.8
MW06-25S	238.2			0.42	237.7
MW06-25D	238.2			0.65	237.5
MW09-25	242.5			0.41	242.1
MW11-25	250.3			0.63	249.7

On March 4, 2025 prior to the snow melt, the water levels at BH-14, MW-1, MW-2 and MW-3 ranged from 2.9 to 4.7 mbgs and also included a dry well. On March 25, 2025 after the snow melt, the water levels at BH-14, MW-1, MW-2 and MW-3 ranged from 0.1 to 2.3 mbgs (groundwater elevations ranged from 243.2 to 249.7 m).

Groundwater levels from the monitoring wells installed by GHD as part of this investigation ranged from about 0.4 to 1.0 mbgs on March 25, 2025 after the snow melt (groundwater elevations ranged from 237.5 to 249.7 m) in these wells.

These seasonal groundwater elevations represent potentiometric groundwater levels. Test pits were also excavated at TP01-25, TP02-25, TP03-25, TP05-25 and TP06-25 in close proximity to MW01-25, MW03-25, MW04-25, MW09-25 and MW-3, respectively. At each location, the water level in the monitoring well was higher than the depth to where groundwater was encountered in the test pit. This indicates that the depth of the seasonal groundwater observed seeping into the test pit was deeper than the water levels in **Table 7** suggest.

It should be noted that ground surface elevations are for the purposes of evaluating groundwater elevation and flow direction and should not be relied upon as a legal survey, as a topographic elevation survey or for construction purposes. Also, that the groundwater levels are subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year, after significant storm events or after the snow melts. Perched groundwater conditions could develop in the shallower soils and fill materials after heavy precipitation and/or during spring thaw; however, would be expected to be temporary.

4.4 Single Well Response Testing

Single well response testing (SWRTs) was completed at each monitoring well. The monitoring wells are screened within the overburden. The data from the SWRTs are provided in **Appendix D** and are summarized in the following table:

Table 8 Single Well Response Test Results

Monitoring Well	Unit Tested	Test Type / Number	Analysis Method	Horizontal Hydraulic Conductivity – K_H (each test) (m/sec)	Geometric Mean Horizontal Hydraulic* Conductivity – K_H (m/sec)
MW01-25	Sandy Silt / Sandy Silt Till	Falling Head	Bouwer-Rice	1.2×10^{-8}	1.2×10^{-8}
MW03-25	Sandy Silt / Sandy Silt Till	Falling Head		9.2×10^{-7}	9.5×10^{-7}
		Rising Head		9.8×10^{-7}	
MW04-25		Falling Head 1		2.6×10^{-4}	3.2×10^{-4}

Monitoring Well	Unit Tested	Test Type / Number	Analysis Method	Horizontal Hydraulic Conductivity – K_H (each test) (m/sec)	Geometric Mean Horizontal Hydraulic* Conductivity – K_H (m/sec)
	Gravelly Silty Sand Till	Rising Head 1		3.5×10^{-4}	
		Falling Head 2		3.1×10^{-4}	
		Rising Head 2		3.7×10^{-4}	
		Falling Head 3		2.8×10^{-4}	
		Rising Head 3		3.6×10^{-4}	
		Falling Head 4		2.9×10^{-4}	
		Rising Head 4		3.7×10^{-4}	
MW06-25D	Silty Clay Till	Falling Head		1.6×10^{-9}	1.6×10^{-9}
MW06-25S	Silt, some sand	Falling Head 1		8.1×10^{-6}	7.6×10^{-6}
		Rising Head 1		6.9×10^{-6}	
		Falling Head 2		7.9×10^{-6}	
		Rising Head 2		7.3×10^{-6}	
MW09-25	Clayey Silt / Silty Sand Till	Falling Head		1.8×10^{-9}	1.8×10^{-9}
MW11-25	Silty Sand Till	Falling Head		1.6×10^{-10}	1.6×10^{-10}
GEOMETRIC MEAN (all tests)				**4.8×10^{-6}**	

The SWRT results range from 3.7×10^{-4} m/s at MW4-25 to 1.6×10^{-10} m/s at MW11-25. The geometric mean of all tests is 4.6×10^{-6} m/s and falls within the range of the expected hydraulic conductivity of a glacial till.

5. Discussion and Recommendations

5.1 Hydrogeology

5.1.1 Hydrostratigraphic Units

The primary hydrostratigraphic units (i.e. aquifer / aquitard units) underlying the Site include the following:

- **Topsoil** – unsaturated
- **Sandy Silt** – unsaturated to minor groundwater seepage (anticipated to be seasonal)
- **Till** – unsaturated with some water within sand seams expected within the till (aquitard)

Based on the subsurface investigation, the shallow sandy silt is generally expected to be unsaturated with seepage expected to be encountered periodically across the Site, particularly in the southern low-lying area of the Site. Seasonally or during significant storm events, surface water may infiltrate the topsoil and into the shallow sandy silt material and may also become perched upon the underlying till deposit. Particularly in the southern low-lying central area, which was observed to be very wet due to poor drainage in this area. The till deposit is generally expected to act as an aquitard underlying the Site with minimal vertical groundwater flow. The horizontal gradient in the southern

area appears to be toward the middle low-lying area and is relatively flat to the east from this area. Thus shallow, seasonal groundwater in the southern area does not drain well and collects in this area before draining / flowing to the east. Fill material to raise the grades or improved drainage should be considered in this area.

The underlying till is considered to be an aquitard; however, there were sand seams with water encountered throughout the till unit. The volume of groundwater from these seams is generally expected to be of relatively low volume; however, there could be zones / layers with higher permeabilities that could potentially yield higher groundwater flows.

Based upon the data collected, it is our opinion there does not appear to be a continuous, permanent groundwater table across the Site. The shallow groundwater above the till will be seasonally perched or present periodically due to significant storm events, particularly in the southern area of the Site. It is recommended that long-term groundwater monitoring be conducted to confirm the seasonal water levels / trends for future Low Impact Development strategies and for assessment of residential basements and other subsurface structures related to water levels.

5.1.2 Flow Direction and Gradients

Based upon the water levels measured by GHD, the groundwater elevations indicate that, in close proximity of the creek, there is localized groundwater flow towards this feature. Further away from the creek, the flow direction is generally expected to be in an easterly direction. In the southern area of the Site, shallow water is expected to collect in the low-lying area before flowing to the east / northeast. The groundwater elevations and flow direction are presented on **Figure 9.** Based upon the nested well, there is a small vertical gradient indicating that the groundwater is moving down through the soil profile. It should be noted that groundwater levels are transient and tend to fluctuate with the seasons, periods of precipitation and temperature.

Based upon the groundwater elevations at MW09-25 and MW11-25, the average horizontal groundwater gradient in the direction of flow is estimated to be on the order of 0.02 metres per metre (m/m).

The results of the SWRTs indicate that the horizontal hydraulic conductivity of the screened intervals of the monitoring wells tested range from 3.7×10^{-4} m/s at MW04-25 to 1.6×10^{-10} m/s at MW11-25 depending upon the subsurface material screened. The average geometric mean hydraulic conductivity (K_h) based upon the testing completed is 4.8×10^{-6} m/s. The average groundwater flux (per square metre) in the deposit can be estimated using the following relationship:

$q = Ki$

where:

q = groundwater flux (per square metre)
K = average hydraulic conductivity (4.8×10^{-6} m/s)
i = hydraulic gradient (0.02 m/m)

Therefore, the estimated average groundwater flux in the native till deposit where groundwater was encountered is estimated to be 1.8×10^{-9} m/s, per square metre (4.8×10^{-6} m/s x 0.02 m/m = 9.6×10^{-8} m/s). The flow rate per square metre is approximately 5.8×10^{-3} L/min (9.6×10^{-8} m/s x 60 sec/minute x 1,000 L/m^3 = 5.8×10^{-3} L/min). Based upon the SWRT completed, the flow rate per square meter ranges from 0.44 L/min at MW4-25 to 1.9×10^{-7} L/min at MW11-25.

Overall, the till exhibits a low flow rate and low hydraulic conductivity characteristics which are supported by the SWRT results. Note that slight variations in the soil stratigraphy may cause variations in the permeability / transmissivity of the soil in both vertical and horizontal orientations, that could result in K-values outside the stated range if pockets or seams of soils with different grain size and permeabilities (e.g. coarse sand / gravel seams / layers) are encountered.

5.1.3 Preliminary Infiltration Rates

The plotted gradation curves for the soil samples tested were compared to the gradation curves and descriptions in the Supplementary Guidelines to the Ontario Building Code[7] to determine the infiltration rates for the soils. The estimated coefficient of permeability and corresponding estimated infiltration rate ranges for the soils encountered in the Site are provided in the table below:

Table 9 Preliminary Infiltration Rate Ranges based on Site Soils

Soil Description (USCS Symbol)*	Coefficient of Permeability, K (cm/sec)	Percolation Time, T (mins/cm) **	Range of Estimated Infiltration Rates 1/T (mm/hr)
Non-Cohesive Sand Till (SM)	10^{-3} to 10^{-5}	8 to 20	30 to 75
Non-Cohesive Silt Till (ML)	10^{-5} to 10^{-6}	20 to 50	12 to 30
Cohesive Clay Till (CL)	Less than 10^{-6}	Over 50	Less than 12
*Soils encountered at the Site **Provided in the Supplementary Guidelines (Ontario Ministry of Municipal Affairs and Housing, August 15, 2006)			

The infiltration rates provided above are suitable for preliminary design; however, in-situ infiltration testing is recommended once design details for the Low Impact Development (LID) infiltration facilities are available.

It is noted that slight variations in the soil stratigraphy may cause variations in the permeability of the soil in both vertical and horizontal orientations.

A safety correction factor from Appendix C of the Low Impact Storm Water Management Planning and Design Guide must be applied to the measured in-situ infiltration rates.

LIDs can be applied to any soil type; however, it is recommended that more permeable zones are targeted and that sub-grade infiltration locations be kept away from private lands. LIDs require maintenance and long-term care. If possible, naturally occurring infiltration strategies such as roof water discharged via downspouts to sodded lawns with adequate topsoil depths and maximized flow path distances are recommended.

5.1.4 Construction Dewatering

Excavations are expected to extend into the underlying glacial till deposit for this development. Based upon our subsurface investigation, groundwater seepage will be encountered at depth. Dewatering to remove groundwater seepage as well as surface water runoff and precipitation to ensure safe and dry working conditions may be required depending on the depth of the excavation and the time of the year. Pumping from collection sumps to an acceptable outlet will control this expected groundwater infiltration.

It is recommended that prior to commencing the construction of the site servicing, consideration be given to the excavation of a series of trial excavations along the alignment of the proposed sewers / watermains to determine more accurately the soil behaviour and if any dewatering works are required.

Should any excavations require more intensive dewatering or groundwater control, the use of filtered sumps, or other suitable method of dewatering is recommended. If short-term pumping of groundwater at volumes greater than 50,000 L/day and less than 400,000 L/day is required during the construction stage, the Environmental Activity and Sector Registry (EASR) must be completed. If the projected construction dewatering volumes exceed 400,000 L/day, then a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

It is not the purpose of this report to assess the planned water taking related to any required dewatering work. Once the detailed design drawings have been prepared, a water taking assessment can be completed to determine

[7] Ontario Ministry of Municipal Affairs and Housing – Building and Development Branch. Supplementary Standard SB-6. Percolation Time and Soil Descriptions. August 15, 2006.

requirements of dewatering and recommendations for an EASR or PTTW application, should they be needed. At the construction stage of the development, any monitoring wells at the Site are to be decommissioned in accordance with O. Reg. 903 by a licensed and experienced contractor.

5.1.5 Water Balance

The following subsections describe the water balance and establish a post-development infiltration target for the proposed development based upon the referenced Draft Plan of Subdivision. For purposes of the water balance, the Site has been divided into "North Subcatchment" and "South Subcatchment" for completion of the water balance calculations. The subcatchment areas are based upon the environmental protection area and creek which runs through the Site.

The Thornthwaite Method calculations are provided in **Appendix E.1** and are summarized in **Table 10**.

Table 10 Summary of Thornthwaite Method Calculations

Station	Precipitation (mm/yr)	Adjusted ET (mm/yr)	Surplus (mm/yr)
Peterborough (1991 – 2020)	839.8	562.6	277.2

The calculations indicate that 277.2 mm/year of water is available as either runoff or infiltration.

5.1.5.1 Pre-Development Water Balance

The pre-development water balance incorporated the existing soils, slope and agricultural areas. The infiltration factor for the area was calculated from the table of values presented in the "Land Development Guidelines"[8]. It is based on three sub-factors which are:

- Topography sub-factor;
- Soil sub-factor; and
- Cover sub-factor.

The slope of the Site was considered to be an intermediate value (0.15) between "rolling" (slope of 2.8 to 3.8 m per km) to "hilly" (average slope of 28 to 47 m per km). The soil factor was assigned a value of 0.25 based upon the soils encountered at the Site. The land cover factor considered agricultural, naturalized, gravel driveway and rooftop areas. The existing vegetation factor for the pre-development site ranged from agriculture (0.1) to naturalized areas (0.175). The existing residential structures were also considered in the pre-development calculations (see **Appendix E.2** for a breakdown of the areas). The Site subcatchment areas included "North Subcatchment" comprising about 8.8 ha north of the creek and "South Subcatchment" comprising nearly 25 ha south of the creek. **Table 11** summarizes the expected pre-development water balance values for the Site. Based upon the values presented below, 99.7% of the Site is pervious and 0.3% is impervious.

Table 11 Pre-Development Land Use Summary

Land Use	Area (m^2)
North Subcatchment	
Agricultural	78,023
Treed / Naturalized	9,600
Sub-Total – North Subcatchment	**87,623**
South Subcatchment	
Agricultural	238,003

[8] MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

Land Use	Area (m^2)
Treed / Naturalized	9,600
Existing Residential -Rooftops -Driveway	 -575 -400
Sub-Total – South Subcatchment	**248,578**
TOTAL AREA	**336,200**

Table 12 summarizes the pre-development water balance calculations:

Table 12 Pre-Development Water Balance Results

ID	Area (m^2)	Area for Recharge (m^2)	Precipitation (m^3/yr)	ET (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)
NSC	87,623	87,623	73,585	49,297	11,878	12,410
% of Precipitation in this Subcatchment				67.0%	16.1%	16.9%
SSC	248,578	247,603	208,755	139,466	34,508	34,782
% Precipitation in this Subcatchment				66.8%	16.5%	16.7%
Site	336,200	335,225	282,341	188,763	46,386	47,192
% of Total Precipitation				66.9%	16.4%	16.7%

Note: NSC refers to North Subcatchment. SSC refers to South Subcatchment.

It was assumed that the stormwater runoff from existing rooftops will have an infiltration factor of 37.5% (i.e. 37.5% of the rooftop runoff will be infiltrated). Based upon these values, the Site infiltrates on the order of 47,192 m^3/year (~140 mm/year) or about 16.7% of the precipitation that falls on the Site each year. Further, the pre-development catchments north and south infiltrate an estimated 12,410 m^3 per year and 34,782 m^3 per year, respectively. In our opinion, the infiltration volume of these pre-development catchments is to be maintained to support downgradient receptors such as the creek that bisects the Site.

5.1.5.2 Post-Development Water Balance (No Infiltration Enhancements)

The computation of the water budget was repeated for the proposed development assuming no infiltration enhancements, that is, runoff from impervious surfaces is unrecoverable and not infiltrated into the ground. The anticipated impact of the development is related to increased runoff from imperious surfaces such as building rooftops and asphalt surfaces. These are assumed to be impervious surfaces with zero infiltration capacity in this model.

The post-development water balance was based upon the Draft Plan of Subdivision provided to GHD and indicated single detached residential lots, street townhouses, medium density residential buildings, commercial lots, a stormwater management pond, asphalt roads, a park area, and an environmental protection area. The purpose of these post-development calculations with no infiltration enhancements is to illustrate that based upon these calculations that the post-development conditions will require LIDs to mitigation the expected additional stormwater runoff and anticipated reduction of pre-development infiltration.

Several assumptions were made to develop the post-development water balance. These assumptions include:

– Asphalt has 0% infiltration capacity
– Evaporation from impervious surfaces assumed to be 20% of precipitation
– Residential single lots
    - Assumed rooftops cover 55% of the lot
    - Assumed driveways cover 10% of the lot

- Assumed lawns cover 35% of the lot

– Townhouse lots
  - Assumed rooftops cover 65% of the lot
  - Assumed driveways cover 10% of the lot
  - Assumed lawns cover 25% of the lot
– Commercial
  - Assumed rooftops cover 20% of the lot
  - Assumed asphalt covers 65% of the lot
  - Assumed landscaping covers 15% of the lot

The areas of the north and south catchments were maintained within the post-development calculations. The detailed calculations are provided in **Appendix E.3**. A summary of the computations is provided in **Table 13**.

Table 13 Post-Development Summary (No Enhancements)

Description / Parameter	Value
Site Area	336,200 m^2
Pervious Areas -Lawn / Grass -Park -Environmental Protection area (EP)	127,695 m^2 (38.0% of the Site area) -88,895 m^2 -19,300 m^2 -19,500 m^2
Impervious Areas -Rooftops -Asphalt roadways and driveways -Stormwater pond	208,505 m^2 (62.0% of the Site area) -102,035 m^2 -106,470 m^2 -8,150 m^2
Total Water Surplus -Percent of Precipitation – 62.2%	175,479 m^3/yr
Evapotranspiration -Percent of Precipitation – 37.8%	106,862 m^3/yr
Total Estimated Infiltration -Percent of Precipitation – 7.0% Infiltration % Difference (pre- vs post-)	19,899 m^3/yr (-58%) (decrease)
North Catchment Estimated Infiltration Infiltration % Difference (pre- vs post-)	7,741 m^3/yr (-38%) (decrease)
South Catchment Estimated Infiltration Infiltration % Difference (pre- vs post-)	12,159 m^3/yr (-65%) (decrease)
Total Estimated Runoff -Percent of Precipitation – 55.1% Runoff % Difference (pre- vs post-)	155,579 m^3/yr (235%) (increase)

Under this scenario, impervious surfaces increased by 62%; the total infiltration volume decreased by about 58% and runoff volume increased by 235%. Based upon this scenario, mitigative strategies are required to minimize infiltration losses and reduce storm water runoff.

5.1.5.3 Post-Development Water Balance (With Downspout Disconnection)

Based on the calculations presented above, infiltration and recharge to the shallow groundwater regime will be reduced by about 27,293 m^3/year from the pre-development site compared to post-development site and based upon the Draft Plan of Subdivision provided. The reduction does not consider the incorporation of LID strategies. The post-construction water budget computations were repeated considering enhanced infiltration options which are also known as LID technologies. The water balance provides generic infiltration and runoff values that was completed solely for demonstration purposes to illustrate that pre-development conditions can be maintained. Specific LID design criteria and selection of actual LID technologies will be the responsibility of the stormwater engineer for the development. These technologies include and are not restricted to rainwater harvesting, downspout disconnection, infiltration trenches, vegetated filter strips, bioretention, permeable pavement, enhanced grass swales, dry swales and perforated pipe systems in order to balance the water budget.

The post-development water balance was modelled to show that stormwater from building roof tops can be directed via downspouts (disconnected from storm sewers) to sodded areas or undeveloped areas (e.g. open spaces) for infiltration. Downspout disconnection, for example, can reduce runoff by 25% to 50% based on LID documentation developed by the Credit Valley Conservation and Toronto and Region Conservation Authority. For this Site, based upon the shallow underlying soils, the reduction of 37.5% of the stormwater via downspout disconnection was assumed.

A summary of the post-construction water budget with downspout disconnection mitigation from each rooftop was modelled. The data summary is presented in **Table 14**.

Table 14 Post-Development Summary with Enhanced Infiltration – Downspout Disconnection

Description / Parameter	Value
Site Area	336,200 m^2
Rooftop Infiltration Target	27,293 m^3/yr
Rooftop Stormwater Surplus Available -Single Detached Lot rooftops -Medium Density rooftops -Townhouse rooftops -Commercial rooftops	63,076 m^3/yr 26,272 m^3/yr 7,555 m^3/yr 17,075 m^3/yr 12,174 m^3/yr
Infiltration via Pervious Surfaces (grass, EP area etc.)	19,899 m^3/yr
Downspout Disconnection Infiltration	23,653 m^3/yr
Total Estimated Infiltration using Downspout Disconnection (based upon 37.5% rooftop runoff reduction)	43,553 m^3/yr (3,640 m^3/yr LESS than pre-development)
North Catchment Estimated Infiltration using LIDs Infiltration % Difference (pre- vs post-)	13,763 m^3/yr (10.9%) (increase)
South Catchment Estimated Infiltration using LIDs Infiltration % Difference (pre- vs post-)	29,788 m^3/yr (-14.4%) (decrease)

Assuming that rooftop runoff can be reduced by 37.5% using downspout disconnection, the water balance calculations (using downspout disconnection only) show that there can be an infiltration surplus in the north area and an infiltration deficit in the southern area. Overall, infiltration reduction will be on the order of about 7.7% when compared with pre-development values.

Based upon the water balance calculations with downspout disconnection only, additional infiltration measures would be required to maintain post-development infiltration values at pre-development levels from a quantity perspective.

5.1.5.4 Post-Development Water Balance (With Enhanced Infiltration – Downspout Disconnection and Soakaway Pits)

The post-construction water budget computations were repeated considering additional infiltration measures. Downspout disconnection can reduce runoff by 25% to 50% and soakaway pits can reduce runoff by 85%, as outlined within LID documentation developed by the Credit Valley Conservation and Toronto and Region Conservation Authority.

In our model, GHD assumed the following LIDs for this enhanced example:

– Rooftop runoff for single detached lots within the north and south catchments was directed to sodded areas / lawn via downspout disconnection assuming an infiltration factor of 37.5%
– Rooftop runoff for medium density residential lots and townhouses within the north and south catchments was directed to soakaway pits assuming an infiltration factor of 85%
– Rooftop runoff for the commercial areas within the south catchment was directed to soakaway pits assuming an infiltration factor of 85%

Stormwater runoff from road surfaces and driveways is assumed to be lost and not infiltrated. As noted previously, this is a generic water balance to illustrate that there is sufficient surplus water to be infiltrated to match pre-development values. The actual LIDs selected will be at the discretion of the stormwater design team.

A summary of the post-construction water budget with mitigation measures for infiltration is presented in the following table:

Table 15 Post-Development Summary with Enhanced Infiltration – Downspout Disconnection and Soakaway Pits

Description / Parameter	Value
Site Area	336,200 m^2
Rooftop Stormwater Surplus Available -Single Detached Lot rooftops -Medium Density rooftops -Townhouse rooftops -Commercial rooftops	63,076 m^3/yr 26,272 m^3/yr 7,555 m^3/yr 17,075 m^3/yr 12,174 m^3/yr
Infiltration via Pervious Surfaces (grass, EP etc.)	19,899 m^3/yr
Downspout Disconnection Infiltration	9,852 m^3/yr
Soakaway Pit Infiltration	31,283 m^3/yr
Total Estimated Infiltration using LIDs -Percent of Precipitation – 21.6% Infiltration % Difference (pre- vs post-)	61,034 m^3/yr (29.3%) (increase)
North Catchment Estimated Infiltration using LIDs Infiltration % Difference (pre- vs post-)	15,901 m^3/yr (28.1%) (increase)
South Catchment Estimated Infiltration using LIDs Infiltration % Difference (pre- vs post-)	45,133 m^3/yr (29.8%) (increase)
Total Estimated Runoff -Percent of Precipitation – 40.5% Runoff % Difference (pre- vs post-)	114,444 m^3/yr (147%) (increase)

Based upon the data modelled, the overall infiltration values are shown to **exceed** the pre-development values for the north and south catchments. The calculations illustrate that there is sufficient stormwater available that, if it can be infiltrated, will meet the pre-development values. At the detailed design stage, the use of downspouts and infiltration chambers can be finalized to ensure the water balance is maintained.

The following bullets are provided as potential options that could be further evaluated for feasibility at the Site and are for consideration only to improve infiltration (this were not considered in this water balance):

- Reduction of grading to 0.5 – 1.0% slopes and swales to allow for additional evapotranspiration and infiltration.
- Scarification, or tilling of the soil to a depth of approximately 300 mm, would enhance evapotranspiration and infiltration within landscaped areas to overcome soil compaction that occurs during construction. Also, adding topsoil to a minimum depth of 300 mm to promote increased infiltration.

For further reducing stormwater runoff, landscaped areas could include the plantings of trees (for example), resulting in greater evapotranspiration and further decreasing runoff.

5.2 Geotechnical

The Site encompasses an area of 33.62 ha (83.1 acres) and supports agricultural fields and is proposed to be re-developed into mixed commercial and residential use with an internal road network, a stormwater management pond (SMWP), and a parkland area. The proposed development will be municipally serviced for water and sewer. The Draft Plan of Subdivision[9] showing the proposed development is presented on **Figure 2** and includes low and medium density residential blocks, commercial blocks, the SMWP block, and the parkland area block.

It should be noted that the recommendations provided herein are intended for use by designers only. Contractors bidding on or undertaking any work at the site should examine the factual results of the assessment, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data given above as it affects their proposed construction techniques, equipment capabilities, costs, sequencing, and other related issues. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project. Comments, techniques, or recommendations pertaining to construction should not be considered as instructions to the contractor. On-going liaison with GHD during the final design and construction phase of the project is recommended to ensure that the recommendations in this report are applicable and / or correctly interpreted and implemented.

Based upon the above comments and the test hole information, and assuming them to be representative of the subsoil conditions across the Site, the following comments and recommendations are offered.

5.2.1 Site Preparation, Grading and Backfill

Based on the subsurface conditions encountered in the test holes, the Site is generally consisted surficial topsoil over native sandy silt underlain by cohesive and non-cohesive glacial till deposits. The non-cohesive glacial till was generally comprised of silty sand / sandy silt with varying amounts of clay and gravel. The cohesive glacial till was generally comprised of a clayey silt / silty clay with varying amounts of sand and gravel.

Any topsoil, vegetation, disturbed earth, fill, organic and organic-bearing material should be removed from the footprint of the proposed building areas and from within pavement areas prior to site grading activities. If native materials are encountered and contains topsoil / organics or rootlets, the material should not be used as backfill.

Prior to removing any excess soils from the Site, it is recommended that such materials be subjected to chemical testing to characterize the excess soils for handling and disposal purposes.

Prior to Site grading activity, the subgrade soils exposed after the removal of the surficial topsoil and loose native material within the proposed building footprints and pavement areas should be visually inspected, compacted if required, and proof rolled using large axially loaded equipment. Any loose, soft, organic, or unacceptable areas should be subexcavated and removed as directed by the Geotechnical Engineer and replaced with suitable fill materials compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD). Clean earth fill used to raise grades should be placed in thin layers (200 mm thick or less) and compacted by a heavy appropriate

[9] [9] Biglieri Group “Draft Plan of Subdivision”. Drawing No. DP-01, dated 25.06.18.

roller to 98 percent SPMDD. Installation of engineered fill must be continuously monitored on a full-time basis by qualified geotechnical personnel.

The native soils encountered at the Site are generally suitable for reuse as backfill to raise site grades where required, to be used as trench backfill during installation of buried services, or as pavement subgrade, provided they are free of organic material, compactable with the subgrade soils and are within the optimum moisture content. Control of moisture content during placement and compaction will be essential for maintaining adequate compaction. Based on moisture content measurements of the recovered soi samples, the native soils are generally found to be moist to wet. They may be left aside to dry, or mixed with drier material that is to be used as backfill within settlement sensitive areas. It should be noted that during compaction of the cohesive soil additional effort will be required to adjust the moisture content. A final review and approval to reuse any soils should be made at the time of construction. If site soils cannot be reused as backfill, then an OPSS Granular B Type 1 material is recommended for general backfilling.

Backfill for basement foundation walls, should be accomplished using well graded Granular “B” Type I material complying with Ontario Provincial Standard Specifications (OPSS) 1010.

Installation of engineered fill, where required, must be continuously monitored on a full-time basis by qualified geotechnical personnel.

5.2.2 Depth of Frost Penetration

It is recommended that the building perimeter foundations and those foundations within unheated areas should be protected from frost effects by at least 1.2 m of earth cover or equivalent insulation. All exterior footings, footings beneath unheated areas, and foundations exposed to freezing temperatures should have at least such earth cover or equivalent synthetic insulation for frost protection. During winter construction exposed surfaces to support foundations must be protected against freezing by means of loose straw and tarpaulins, heating, etc.

5.2.3 Seismic Site Classification

The latest Ontario Building Code (OBC) requires the assignment of a Seismic Site Class for calculations of earthquake design forces and the structural design based on a two percent probability of exceedance in 50 years. According to the latest OBC, the Seismic Site Class is a function of soil profile and is based on the average properties of the subsoil strata to a depth of 30 m below the ground surface. The OBC provides the following three methods to obtain the average properties for the top 30 m of the subsoil strata:

– Average shear wave velocity.
– Average Standard Penetration Test (SPT) values (uncorrected for overburden).
– Average undrained shear strength.

For design purposes, based on the criteria listed in Table 4.1.8.4.A. of the OBC and the results obtained from standard penetration resistance of the underlying subsurface conditions and our knowledge of the regional geology, a Seismic **Site Class ‘D’** can be used for the design of the proposed residential and commercial buildings.

The values of seismic hazard parameters shown in **Table 16** were derived from the 2020 National Building Code of Canada Seismic Hazard Tool, sourced from the Earthquakes Canada website.

Table 16 Peak Ground Acceleration (PGA), Peak Ground Speed (PGV), and Design Spectral Acceleration (S) Values

Seismic Hazard Values	10% Exceedance in 50 years (475-year return period) Site Class D	5% Exceedance in 50 years (975-year return period) Site Class D	2% Exceedance in 50 years (2,475-year return period) Site Class D
PGA (g)	0.0729	0.113	0.181
PGV (m/s)	0.0713	0.117	0.2
S (0.2) (g)	0.129	0.199	0.315
S (0.5) (g)	0.127	0.195	0.311
S (1.0) (g)	0.0719	0.114	0.188
S (2.0) (g)	0.0322	0.0528	0.0903
S (5.0) (g)	0.00748	0.0132	0.0241
S (10.0) (g)	0.00237	0.00414	0.00757

5.2.4 Foundation Design

The common practice for the Serviceability Limit States (SLS) design of most structures and building foundations is to limit the total and differential foundation settlements to 25 mm and 19 mm, respectively. However, other serviceability criteria for the proposed buildings may be determined by the structural engineer considering tolerable settlement that would not restrict the use of operation of the facility.

It is understood that the proposed development includes three (3) to four (4) storey residential buildings, 157 residential lots, and a commercial development comprising of multiple single-storey buildings.

Based on the available geotechnical data, it is expected that structural loading for the proposed residential and commercial structures may be supported on spread and continuous strip footings founded on the approved compact / very stiff native soils, dense / hard native soils or on engineered fill constructed on the approved native soils. The Minimum depths and maximum elevation at which the compact / stiff and dense / hard native soils were encountered at each borehole is summarized in **Table 17** below.

Table 17 Minimum Depth (mbgs) / Elevation to Compact / Very Stiff and Very Dense / Hard Native Soils

Borehole ID	Minimum Depth (mbgs) / Maximum Elevation to Compact / Very Stiff Native Soils	Minimum Depth (mbgs) / Maximum Elevation to Dense / Hard Native Soils
MW01-25	0.8 / 241.0	1.8 / 239.9
BH02-25	0.8 / 242.4	2.1 / 241.3
MW03-25	2.1 / 242.6	4.6 / 240.1
MW04-25	0.8 / 243.0	1.5 / 242.3
BH05-25	0.8 / 237.9	1.5 / 237.3
MW06-25	2.3 / 235.9	Not Encountered
BH07-25	0.8 / 243.0	2.3 / 241.5
BH08-25	0.8 / 244.2	3.0 / 241.9
MW09-25	0.8 / 241.7	2.3 / 240.2
BH10-25	1.5 / 243.2	4.6 / 240.2
MW11-25	0.8 / 249.5	1.5 / 248.8
BH12-25	0.8 / 243.5	2.3 / 242.0

Borehole ID	Minimum Depth (mbgs) / Maximum Elevation to Compact / Very Stiff Native Soils	Minimum Depth (mbgs) / Maximum Elevation to Dense / Hard Native Soils
BH13-25	1.5 / 241.6	Not Encountered
BH14-25	1.5 / 250.8	2.3 / 250.0

For design purposes, it is recommended that footings constructed on approved compact / very stiff native soils, dense / hard native soils (as per minimum depths / maximum elevation provided in the table above) or engineered fill be proportioned using the following bearing capacities:

Table 18 Preliminary Bearing Pressure for Foundation Design

Parameter	Bearing Pressure	
	Compact / Very Stiff Undisturbed Native Soils or Engineered Fill(2)	Dense / Hard Undisturbed Native Soils
Factored Bearing Capacity at ULS (1)	225 kPa	300 kPa
Bearing Capacity at SLS	150 kPa	200 kPa

Notes:
(1) Resistance factor Φ =0.5 applied to the ULS bearing pressure for design purposes.
(2) At least 0.3 m of Granular or Earth Borrow fill. Quality of material is to be approved prior to use as engineered fill.

These capacities assume a minimum footing width of 0.5 m, maximum footing width of 3.0 m and vertical and concentric loadings only. The perimeter foundations and those foundations within unheated areas should be protected from frost effects by at least 1.2 m of earth cover or equivalent insulation.

Under no circumstances should the foundations be placed above organic materials, loose, frozen subgrade, construction debris, or within ponded water. Prior to forming, all foundation excavations must be inspected and approved by a member of GHD's geotechnical group. This will ensure that the foundation bearing material has been prepared properly at the foundation subgrade level and that the soils exposed are similar to those encountered during this investigation.

Should basement or otherwise subgrade areas be incorporated into any of the buildings' designs, it is recommended that for drainage purposes, perimeter drains be installed about the structure in accordance with the Ontario Building Code (OBC). The subdrains would serve to drain seepage water that infiltrates the backfill, intersect any groundwater that may be present, and help relieve hydrostatic pressures due to any seasonally high groundwater levels. The drains should consist of a perforated pipe, at least 100 mm in diameter, surrounded by clear, crushed stone and suitable filter protection. The drain should discharge to a positive sump or other permanent frost-free outlet. It is also strongly recommended that the building's foundation walls be sealed and waterproofed.

Backfill to basement foundation walls, should be accomplished using well graded Granular "B" Type I material complying with Ontario Provincial Standard Specifications (OPSS) 1010.

5.2.4.1 Engineering Fill Construction for Footings

Any engineered fill upon which footings are placed must be a minimum thickness corresponding to the notes that accompany the above table. Footings (and foundation walls) placed on engineered fill must be suitably reinforced; as a minimum, and where not already specified in the design drawings, this reinforcing should use 2 continuous runs of 15M rebar throughout the footings, and 2 runs of 15M rebar throughout near the top and bottom of the foundation walls.

The following is recommended for the construction of any engineered fill for the footings:

1. Remove any and all existing vegetation, topsoil, fill, organics, and organic-bearing soils to the competent, undisturbed native soil from within the area of the proposed engineered fill.
2. The area of the engineered fill should extend horizontally 1m beyond the outside edge of the building foundations and then extend downward at a 1:1 slope to the competent native soil.
3. The base of the engineered fill area must be approved by a member of GHD prior to placement of any fill, to ensure that all unsuitable materials have been removed, that the materials encountered are similar to those observed, and that the subgrade is suitable for the engineered fill.
4. All engineered fill material is to be approved by GHD at the time of construction.
5. Place approved engineered fill, in maximum 200 mm lifts, compacted to 100 percent of its SPMDD. Any fill material placed under wet conditions should consist of an approved, rock-based fill, with the inclusion of appropriate geotextile fabric around the rock-based fill should the rock fill contain enough voids to warrant. Rock-based fill material should be compacted by a plate tamper and visually inspected by a geotechnical engineer to confirm appropriate compaction.
6. Full time testing and inspection of the engineered fill will be required, to ensure compliance with material and compaction specifications.

The engineered fill should not be placed during winter months when freezing ambient temperatures occur persistently or intermittently.

5.2.5 Slab-On-Grade Construction

Floors may generally be constructed as normal slabs-on-grade, on granular or 19 mm clear stone over native, inorganic subsoils. The floor slab should be formed over a base course consisting of at least 150 mm of Granular “A” backfill as per OPSS compacted to a minimum of 100 percent of its SPMDD or 150 mm of 19 mm angular clear stone material underneath basement areas, compacted by a plate tamper as per OBC requirements. All grade increases or infilling below the granular “A” or clearstone should be constructed in accordance with the engineered fill steps provided in **Section 5.2.4.1** of this report.

If the groundwater table is intersected by any basement excavations, the floor slabs should incorporate under slab drains, and a vapour barrier should be installed beneath the slab to prevent migration of moisture vapour. The drain should discharge to a positive sump or other permanent frost-free outlet.

All fill placed as engineered fill must be inspected, approved and compaction verified by personnel from GHD.

5.2.6 Basement and Retaining Walls

It is recommended that free draining backfill consisting of Granular “B” Type I material complying with Ontario Provincial Standard Specifications (OPSS) 1010, to basement and retaining walls be provided. Walls may be designed for lateral earth pressures using the following equation:

$$P = K [\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w.h_w$$

where:

P = the horizontal pressure at depth, h (m)
K = the earth pressure coefficient,
γ = the bulk unit weight of soil, (kN/m^3)
γ' = the submerged unit weight of soil, (kN/m^3)
γ_w = the unit weight of water, (kN/m^3)
h_w = the depth below the groundwater level (m)
q = the surcharge loading (kPa)

Where elevated groundwater level is not anticipated to be present or that a perimeter drainage system is used to eliminate hydrostatic pressures on the soil retaining structure, the above noted expression will be simplified as follows:

$P = K (\gamma h + q)$

If required and depending on the type of shoring used during construction, the temporary shoring system for excavation support can be designed for the lateral earth pressures provided in the Canadian Foundation Engineering Manual (CFEM 2023). Surcharge loads and hydrostatic pressures should be considered as appropriate.

The following table summarizes the recommended soil parameters to be used for lateral earth pressure calculations.

Table 19 Summary of Soil Parameters for Lateral Earth Pressure Calculations

Soil Type	Bulk Unit Weight	Effective Friction Angle	Coefficient of Lateral Earth Pressure		
	γ (kN/m^3)	ϕ' (°)	K_a	K_o	K_p
Imported Granular Fill (Granular A or B Type II)	21	34	0.28	0.44	3.54
Compact Native Sandy Silt and Non-Cohesive Till	20	30	0.33	0.50	3.00
Dense to Very Dense Non-Cohesive Till	21	32	0.31	0.47	3.25
Fim to Stiff Cohesive Till	18	26	0.42	0.59	2.37
Very Stiff to Hard Cohesive Till	20	30	0.33	0.50	3.00

Surcharge and hydrostatic pressures should be considered as appropriate. The above-noted earth pressure coefficients apply only to horizontal surfaces behind the walls/supports as well as vertical back face of the wall and smooth wall-backfill interface.

It is noted that large deformation will be required prior to the full mobilization of passive earth pressure and mobilization of full active or passive resistance requires a measurable and significant wall movement or rotation. Therefore, unless the structural element can tolerate these deflections, the at-rest earth pressure should be used in design. Where movement sensitive services exist close to the shoring, the lateral pressure should also be computed using the coefficient of earth pressure at rest, K_0.

Free draining material should be placed behind the foundation wall and a minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the walls. Care must be taken during the compaction operation not to overstress the wall. Heavy construction equipment should be maintained at a distance of at least 1 m away from the walls while the backfill soils are being placed. Hand operated compaction equipment should be used to compact the backfill soils immediately behind the walls as per OPSS.MUNI 501 (Compacting).

The recommended value for the coefficient for sliding friction between the soil and the concrete is 0.4.

5.2.7 Site Servicing

Underground municipal watermains and sewers can be founded on either undisturbed native soils or a prepared fill subgrade. The suitability of the native soils to provide adequate support for buried services must be verified on site by qualified geotechnical personnel experienced in such works. Buried services will be ultimately supported on conventional well-graded granular bedding. Where disturbance of the trench base has occurred, due to the presence of soft cohesive soils or groundwater seepage, the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill.

Based on the installed monitoring wells and our monitoring data, levels ranged from about 0.1 to 2.3 mbgs with corresponding elevations ranged from about 249.72 m at MW-1 to 237.50 at MW6-25D.

Groundwater seepage should be expected during excavation for installation of proposed site servicing. Provided the groundwater control measures are undertaken in conjunction with the excavation works, the base of all excavations are expected to be relatively stable, although some disturbed conditions could develop within the base of the

excavations if the dewatering is not totally effective at lowering perched groundwater or saturated cohesive materials are encountered.

It is recommended that prior to commencing the construction of the site servicing, consideration be given to the excavation of a series of trial excavations along the alignment of the proposed sewers / watermains to determine more accurately the soil behaviour and if any dewatering works are required.

The bedding for the trenched services should consist of material meeting the Township's specifications. The bedding and sand cover materials should be adequately compacted to provide support and protection to the service pipes. Provided the base area of the sewer pipes and watermains are free of all loose and deleterious materials, the pipe bedding should comply with a Class B bedding configuration as per the requirements of OPSD 802.030 (rigid pipe) and / or OPSD 802.010 (flexible pipe).

Backfilling of trenches can be accomplished by reusing the excavated soils or similar fill material provided the moisture content is maintained within 2 percent of optimum and the fill is free of topsoil, organics and any deleterious material. The fill placed in excavated trenches should be in loose lifts not exceeding 200 mm thick and compacted to not less than 95 percent of its SPMDD.

Alternatively, if the excavated soils are not suitable for backfilling, the bedding and pipe zone backfill material may consist of OPSS Granular "A" material compacted to at least 95% of its SPMDD. However, if some limited depths of standing water are present, High Performance Bedding (HPB) and/or HL6 clear stone wrapped in geo-textile may be adopted as bedding material below the pipe to provide stabilization. All backfill materials should be placed and compacted in thin lifts not exceeding 200 mm in thickness to achieve at least 95% of its SPMDD throughout.

It is recommended that trench plugs be installed at appropriate locations along the trench alignment (in particular, the main north/south alignments of the storm and sanitary sewers) to minimize and control any flow of groundwater along the trench bedding and backfill materials. It should be noted that concrete trench plugs for shallower watermain trench are susceptible to differential movement and heaving in relation to surrounding soils, particularly where plugs are located within the frost penetration depth. Clay plugs should be used in such instances, utilizing frost tapers to minimize movement within the frost zones.

5.2.8 Excavation and Temporary Shoring

The Occupational Health and Safety Act (OHSA) regulations require that if workers must enter an excavation deeper than 1.2 m, the excavation must be suitably sloped and / or braced in accordance with the OHSA requirements. OHSA specifies maximum slope of the excavations for four (4) broad soil types as summarized in the following table:

Table 20 Soil Types and Slope Information

Soil Type	Base of Slope	Maximum Slope Inclination
1	Within 1.2 metres of bottom	1 horizontal to 1 vertical
2	Within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	From bottom of excavation	1 horizontal to 1 vertical
4	From bottom of excavation	3 horizontal to 1 vertical

The native soils underlying the Site are considered Type 3 soils above the groundwater level, and Type 4 if affected by surface water or groundwater seepage. If the above recommended excavation side slopes cannot be maintained due to lack of space or any other reason, the excavation side slopes must be supported by an engineered shoring system.

The excavation for the underground parking structure will likely need to be supported with an engineered shoring system. The shoring system should be designed in accordance with CFEM 2023 and the OHSA Regulations for Construction Projects. Required soil parameters for the design of the engineered shoring system is provide in **Section 5.2.6** of this report. Shoring systems must be designed by a Professional Engineer taking into consideration not only the lateral earth pressures but also loads from adjacent structures, and any possible surcharge loadings through construction (i.e., trucks, equipment, stockpiles, etc.), and vibrations caused by construction methods.

Based on the groundwater level observations during the investigation, groundwater is expected in the excavated areas for the underground parking and building foundations. Water quantities will depend on seasonal conditions, depth of excavations, and the duration that excavations are left open. Watertight shoring systems are recommended to reduce the groundwater seepage. Pumping from collection sumps to an acceptable outlet is expected to control this estimated groundwater infiltration.

An examination of the slopes should be carried out by qualified soils personnel before any worker enters the excavation. The exposed fill material and native soil should be protected against erosion from water run-off or rain.

5.2.9 Pavement Structures

Based on the results of this investigation, we would recommend the following procedures be implemented to prepare the proposed asphalt pavement areas for its construction:

1. Remove any saturated or frozen earth, and boulders larger than 150 mm in diameter encountered at subgrade elevation for the full width of construction. It is expected that some of the excavated soils may be suitable for reuse as trench backfill, conditional upon suitable moisture content (within 2 % of optimum) and final review and approval by an experienced geotechnical engineer or representative at the time of construction.
2. Proof roll the subgrade for the purpose of detecting possible zones of overly wet or soft subgrade. Any unstable areas thus delineated should be reinforced with woven geotextile approximately equivalent to Terrafix 200W, or replaced with acceptable granular material compacted to a minimum of 98 percent of its SPMDD.
3. Contour the subgrade surface to prevent ponding of water during the construction and to promote rapid drainage of the sub-base and base course materials.
4. To maximize drainage potential, and ensure satisfactory pavement performance, 150 mm diameter perforated pipe subdrains should be installed along any curb lines. The pipe should be encased in filter fabric and surrounded by clear stone aggregate or another suitable free-draining material. It is recommended that the subdrains outlet to the storm sewer system.
5. Construct transitions between varying depths of granular base materials at a rate of 1:10 minimum.

Depending on the final proposed grades, the subgrade soils for the proposed new roadways are expected to consist of native sandy silt or glacial till. For overall pavement design purposes, the frost susceptibility of the native soils is assessed as being generally moderate to high. The Township's pavement structures standard (for both asphalt depths and granular depths) are considered sufficient. In this regard, the following minimum flexible pavement structure is recommended for the construction of the new roadways.

Table 21 Recommended Pavement Structure for New Roadways

Profile	Material	Minimum Thickness (mm)		In Conformance with Form
		Local Residential	Collectors & Arterial	
Asphalt Surface	H.L.4	40	40	OPSS 1150
Asphalt Base	H.L.8	40	50	
Granular Base	Granular "A"	150		OPSS 1010
Granular Subbase	Granular "B"	450		

It is expected that the proposed asphalt paved parking lot and access driveway areas for the proposed commercial and multi-storey building will experience relatively low traffic volumes consisting of passenger vehicles and occasional heavy service trucks. In this regard, based on the subgrade soils encountered in our test holes the following minimum flexible pavement structure is recommended for these areas.

Table 22 Recommended Pavement Structure for Private Access Driveways and Parking Lot Areas

Profile	Material	Minimum Thickness (mm)		In Conformance with Form
		Light Duty	Heavy Duty	
Asphalt Surface	H.L.4	40	40	OPSS 1150
Asphalt Base	H.L.8	50	50	
Granular Base	Granular "A"	150	150	OPSS 1010
Granular Subbase	Granular "B"	300	450	

The following steps are recommended for optimum construction of paved areas:

1. The Granular "A" and "B" courses should be compacted to a minimum 100 percent of their respective SPMDD's.
2. All asphaltic concrete courses should be placed, spread and compacted conforming to OPSS 310 or equivalent. All asphaltic concrete should be compacted to a minimum 92.0 percent of their respective laboratory Maximum Relative Density (MRD).
3. Adequate drainage should be provided to ensure satisfactory pavement performance.

It is recommended that all fill material be placed in uniform lifts not exceeding 200 mm in thickness before compaction. It is suggested that all granular material used as fill should have an in-situ moisture content within 2 percent of their optimum moisture content. All granular materials should be compacted to 100 percent SPMDD. Granular materials should consist of Granular "A" and Granular "B" conforming to the requirements of OPSS.MUNI 1010 or equivalent.

The performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible. It is noted that the above recommended pavement structures are for the end use of the project. The most severe loading conditions on pavement areas and the subgrade may occur during construction. As such, during construction of the project, the recommended granular depths may not be sufficient to support loadings encountered. Consequently, special provisions such as restricted lanes, half-loads during paving, etc. may be required, especially if construction is carried out during unfavourable weather.

5.2.10 Storm Water Management Pond

It is GHD's understanding that a Storm Water Management Pond (SWMP) is proposed in the central area of the Site (south of the creek) and is to be located within the area of boreholes MW6D-25 and MW6S-25 as shown on the Test Hole Plan. The proposed base elevation of the SWMP is not known at the time of writing this report; however, it is expected that the bottom of the SWMP will consist of stiff silty clay glacial till native soils. The hydraulic conductivity of the silty clay till is expected to be on the order of about 1 $x10^{-9}$ m/sec based on the SWRT completed at MW06-25D. It is noted, however, that slight variations in the soil stratigraphy may cause variations in the permeability of the soil in both vertical and horizontal orientations.

Based on the soils observed, and the assumed base elevations, it appears that construction of the SWMP in this area is feasible. In general, excavation of the soils for the SWMP is expected to be straightforward, provided that appropriate measures are taken during construction to minimize any overland or near-surficial flow of water into the area. Groundwater and surficial water inflow into the open SWMP excavation may be encountered depending on the time of the year in which construction is conducted, however this is expected to be controlled by pumping from within the excavation, along with further measures if required including up-gradient cutoff trenching with appropriate drainage outletting.

It is recommended that the SWMP subgrade surfaces be proof rolled, and a representative of GHD approve the subgrade prior to construction of the berms. Construction of the berms may utilize excavated soils, such as the sand and silt till native soils. Such operations should place soils in lifts no thicker than 150 mm prior to compaction and compacted to at least 95 percent SPMDD.

The native, undisturbed stiff silty clay till soils are expected to have a sufficiently low permeability where they could substitute for a liner. An inspection of the excavated and exposed SWMP surface should be performed at the time of construction, to assess whether any discrete or localized areas of increased hydraulic conductivity (such as sand and/or gravelly seams typically encountered within till soils) are present within the exposed soils, in which case such areas may be lined with a more suitable (i.e. less hydraulically conductive) material.

For the purpose of the proposed SWMP, the soils observed should be stable from slip circle failure if sloped at 3 horizontal to 1 vertical (3H:1V) or flatter in the long term both above and below the water table. Between the stable water level and the expected high-water level, it is recommended that the slopes be lessened to 4H:1V (or flatter) to guard against erosion by wavelet action. The native material will require vegetative root mass (or otherwise suitable erosion protection) to minimize erosional forces on exposed slopes.

Slopes and berms of the SWMP should be constructed to reduce or eliminate the effects of surficial erosion. Features to do so may include slope vegetation, installation of erosion or gabion mats, rip rap, and/or other acceptable stabilizing features.

5.2.11 Construction Monitoring

The foundation installations and any Engineered Fill placement must be closely monitored and inspected by qualified personnel to ensure consistency with the design bearing. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 6.2.2 of the OBC.

Qualified Geotechnical personnel should inspect and test all stages of the proposed development. Specifically, they should ensure that the materials and conditions comply with this geotechnical assessment report. In addition, qualified geotechnical personnel should provide material testing services prior to and during backfilling and/or grade raising operation. Should soil conditions be encountered that vary from those described in this report, our office should be informed immediately such that the proper measures are undertaken.

In addition to the typical quality control and construction reviews, it is also recommended to establish project specific monitoring, including monitoring of the existing shoring systems during construction, grade raise settlement monitoring and ground movement monitoring in the vicinity of new excavations.

6. Conclusions and Closure

Supporting data upon which our recommendations are based have been presented in the foregoing sections of this report and are governed by the physical properties of the subsurface materials that were encountered at the Site and assume that they are representative of the overall site conditions.

It is our opinion that the results of this hydrogeological and geotechnical investigation support the proposed development at the location of Lot 13, Concession 6, Township of Cavan-Monaghan, Ontario.

We trust this report meets your immediate needs. Should any questions arise regarding any aspect of our report, please contact our office.

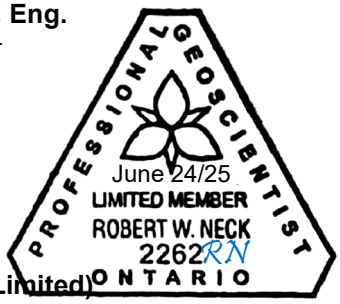
All of Which is Respectfully Submitted,

GHD

Michael Nieukirk, P. Eng.
Geotechnical Engineer

Kathleen Goodman, P. Eng.
Environmental Engineer

Leandro Ramos, P.Eng.
Senior Geotechnical Engineer



Robert Neck, P.Geo. (Limited)
Senior Geoscientist, Project Director

Statement of Limitations

This report is intended solely for Vargas P Inc and their designers and is prohibited for use by others without GHD's prior written consent. This report is considered GHD's professional work product and shall remain the sole property of GHD. Any unauthorized reuse, redistribution of or reliance on the report shall be at the Client and recipient's sole risk, without liability to GHD. No portion of this report may be used as a separate entity; it is to be read in its entirety and shall include all supporting drawings and appendices.

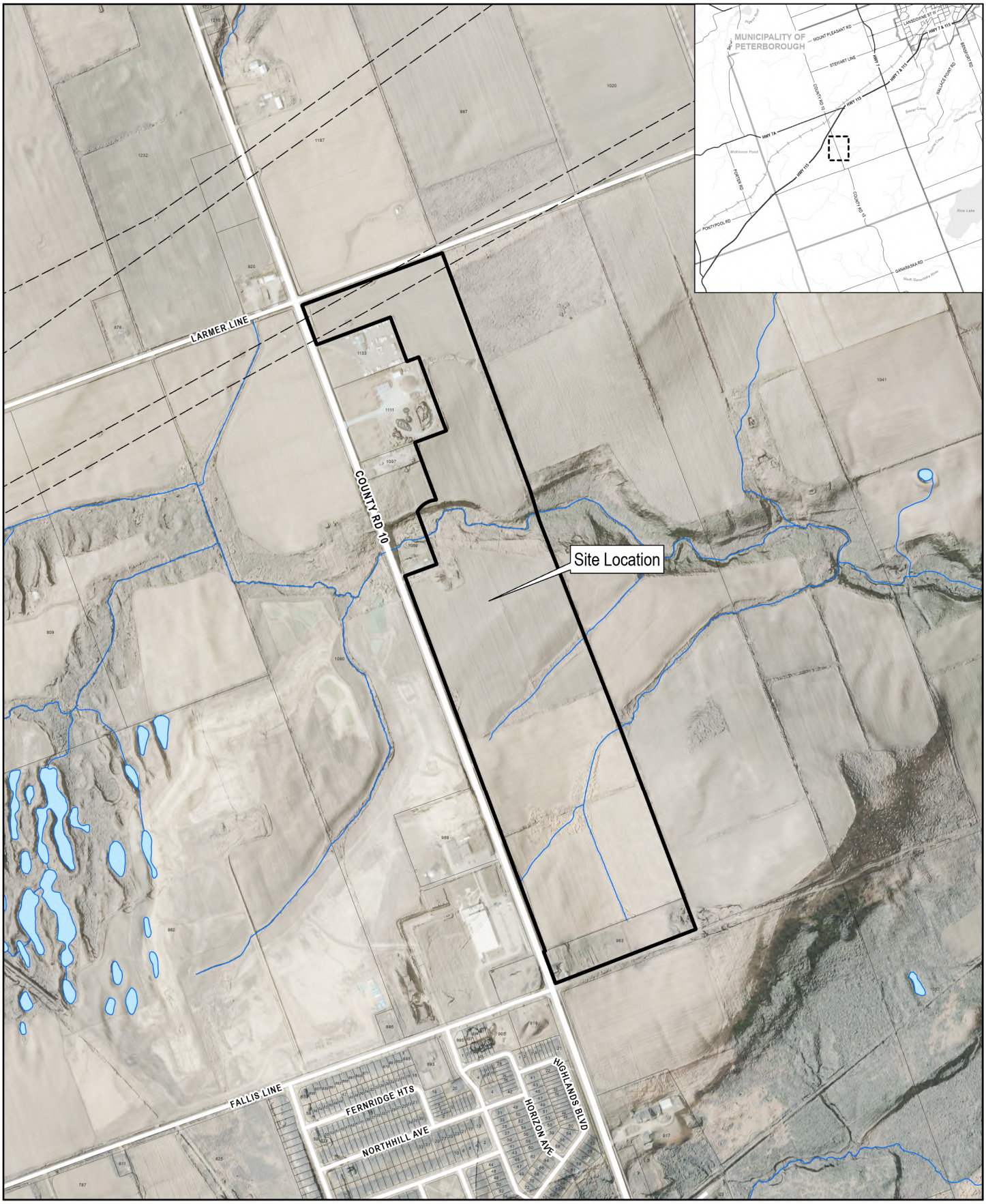
The recommendations made in this report are in accordance with our present understanding of the project, the current site use, ground surface elevation and conditions, and are based on the work scope approved by the Client and described in the report. The services were performed in a manner consistent with that level of care and skill ordinarily exercised by members of geotechnical engineering professions currently practicing under similar conditions in the same locality. No other representations, and no warranties or representations of any kind, either expressed or implied, are made. 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.

All details of design and construction are rarely known at the time of completion of a geotechnical or hydrogeological assessment. The recommendations and comments made in the study report are based on our subsurface investigation and resulting understanding of the project, as defined at the time of the study. We should be retained to review our recommendations when the drawings and specifications are complete. Without this review, GHD will not be liable for any misunderstanding of our recommendations or their application and adaptation into the final design.

By issuing this report, GHD is the geotechnical engineer of record. It is recommended that GHD be retained during construction of all foundations and during earthwork operations to confirm the conditions of the subsoil are actually similar to those observed during our study. The intent of this requirement is to verify that conditions encountered during construction are consistent with the findings in the report and that inherent knowledge developed as part of our study is correctly carried forward to the construction phases.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments included in this report are based on the results obtained at the test locations only. The subsurface conditions confirmed at the test locations may vary at other locations. The subsurface conditions can also be significantly modified by the construction activities on site (e.g., excavation, dewatering and drainage, blasting, pile driving, etc.). These conditions can also be modified by exposure of soils or bedrock to humidity, dry periods or frost. Soil and groundwater conditions between and beyond the test locations may differ both horizontally and vertically from those encountered at the test locations and conditions may become apparent during construction which could not be detected or anticipated at the time of our investigation. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by GHD is completed.

Figures



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Metres

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Grid: NAD 1983 UTM Zone 17N

N

GHD

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Site Location Plan

Project No. 12662348
Revision No.
Date Apr 29, 2025

Figure 1

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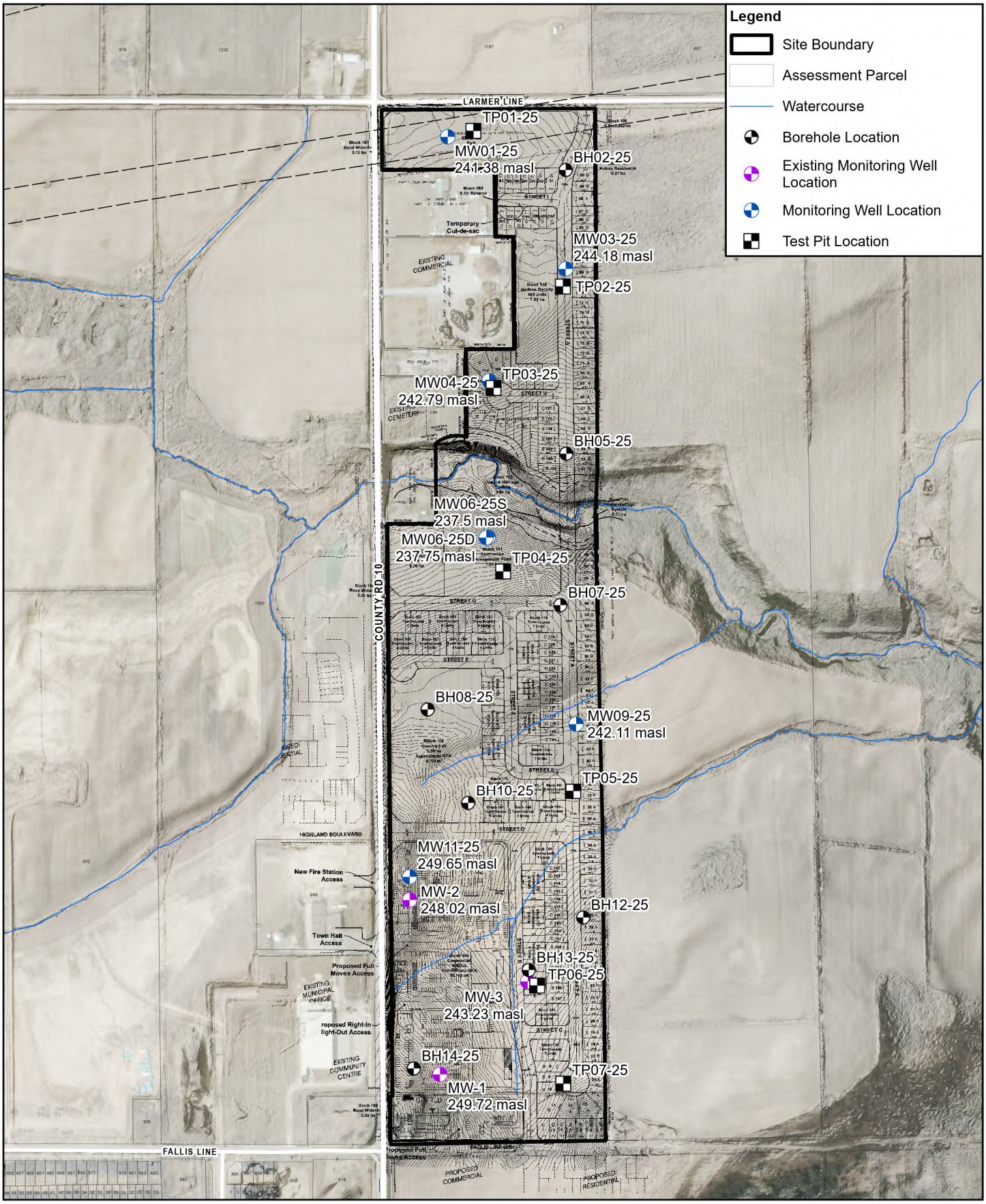

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Grid: NAD 1983 UTM Zone 17N

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Test Hole Plan

Project No. 12662438
Revision No.
Date Jun 24, 2025

Figure 2

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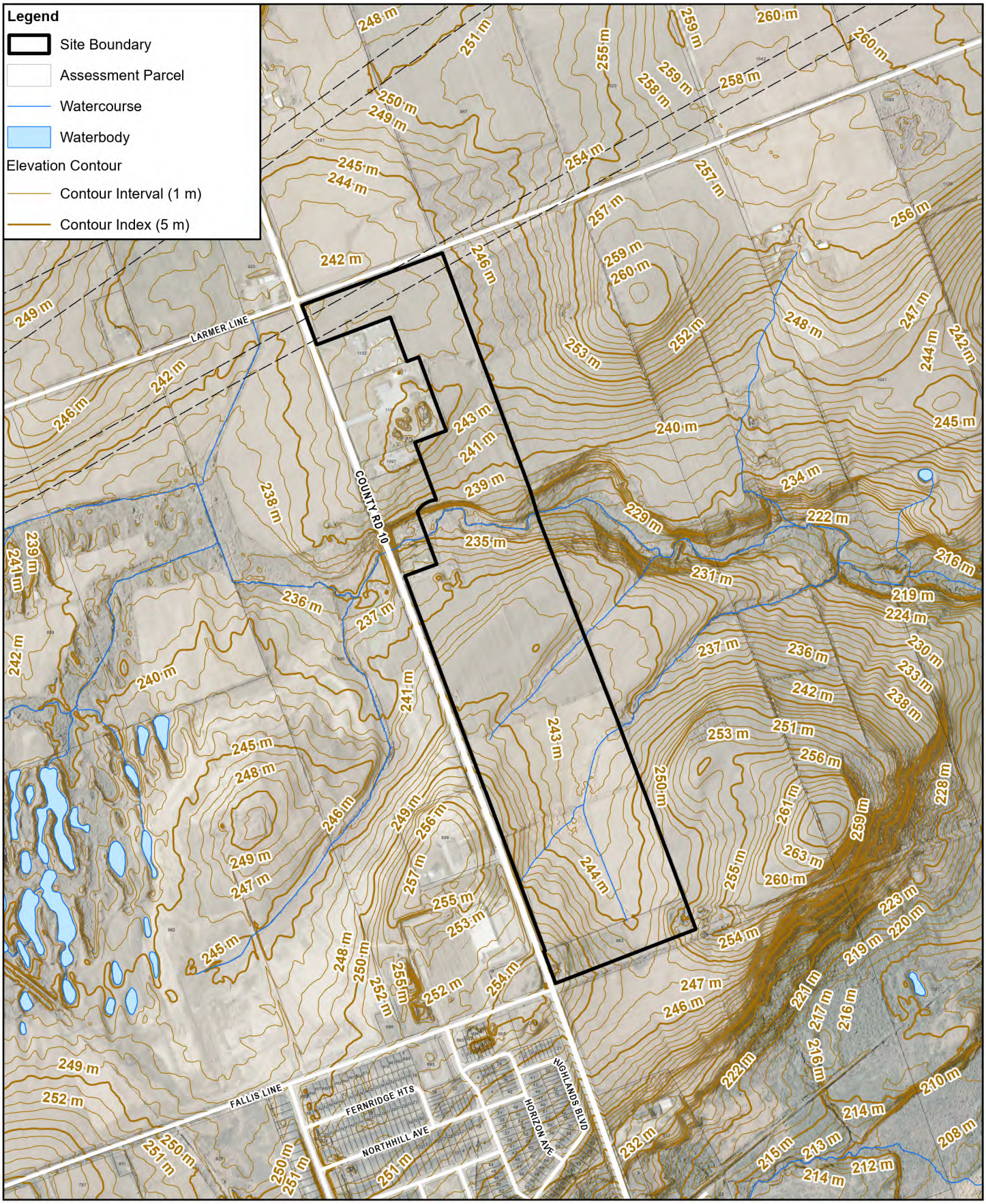

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Metres

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Grid: NAD 1983 UTM Zone 17N

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GHD

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Project No. 12662348
Revision No.
Date Apr 29, 2025

Hydrogeological and Geotechnical Investigation Report

Regional Topography

Figure 3

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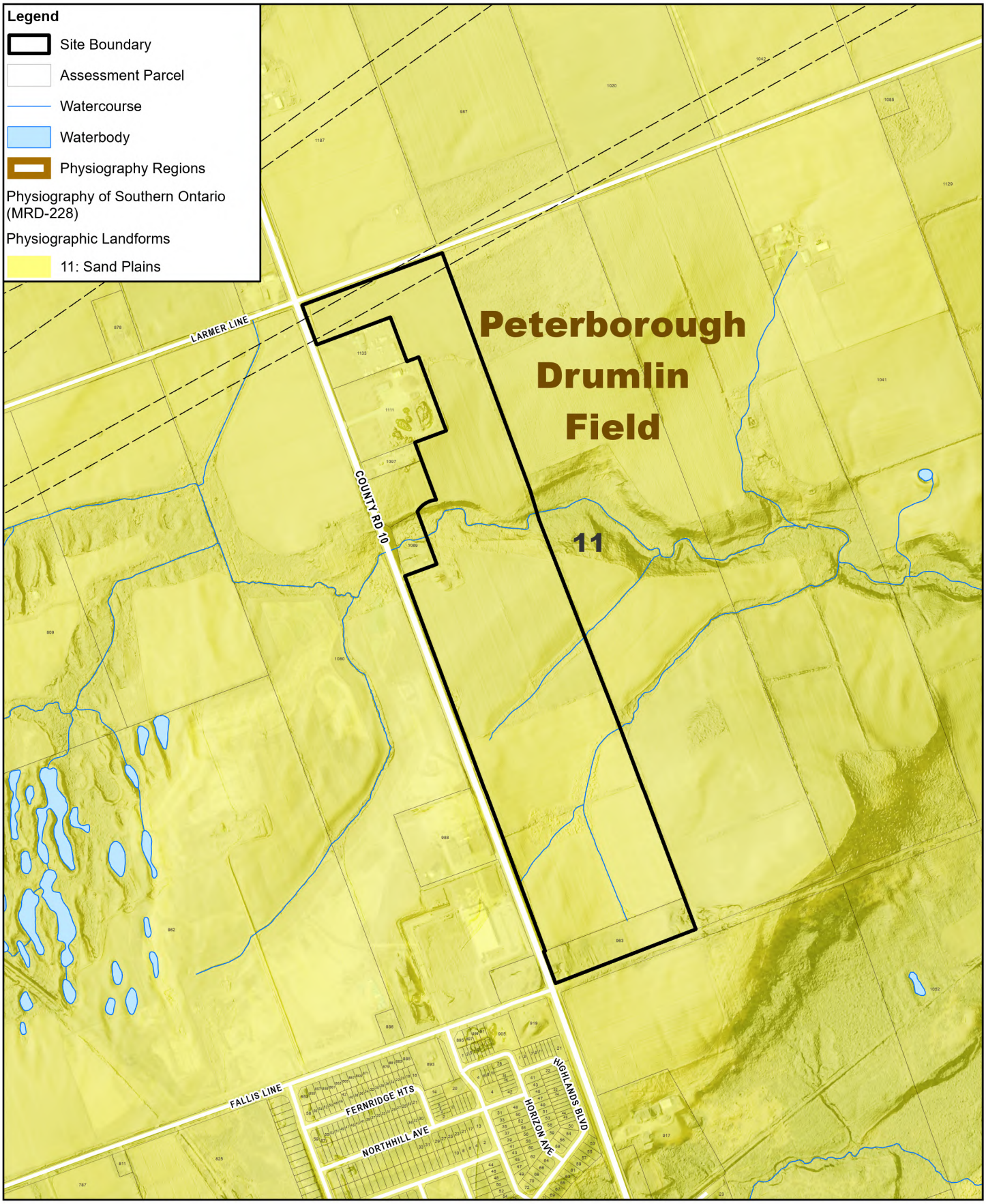

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Grid: NAD 1983 UTM Zone 17N

N

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Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Physiography

Project No. 12662348
Revision No.
Date Apr 29, 2025

Figure 4

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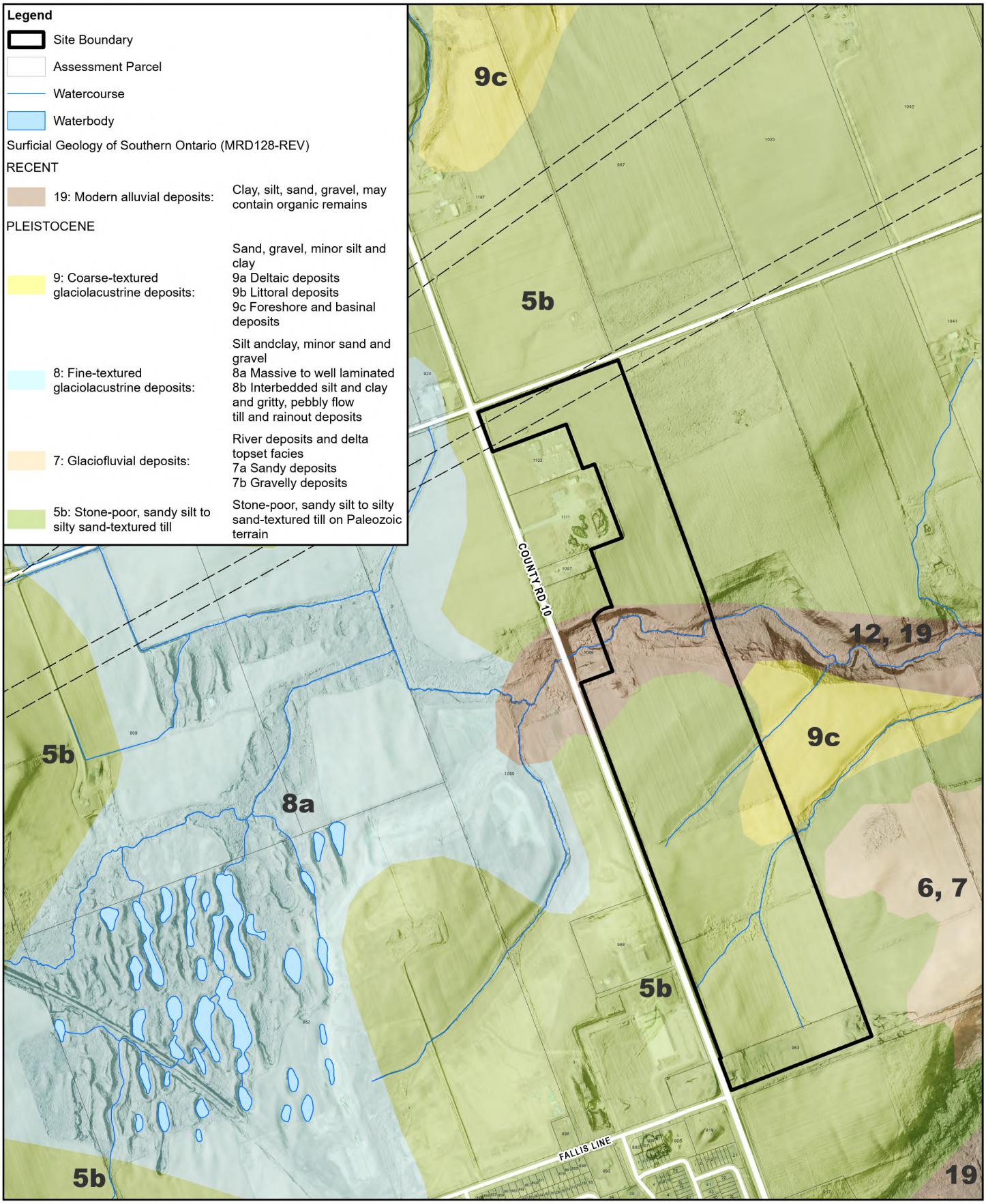

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GHD

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Surficial Geology

Project No. 12662348
Revision No.
Date Apr 29, 2025

Figure 5

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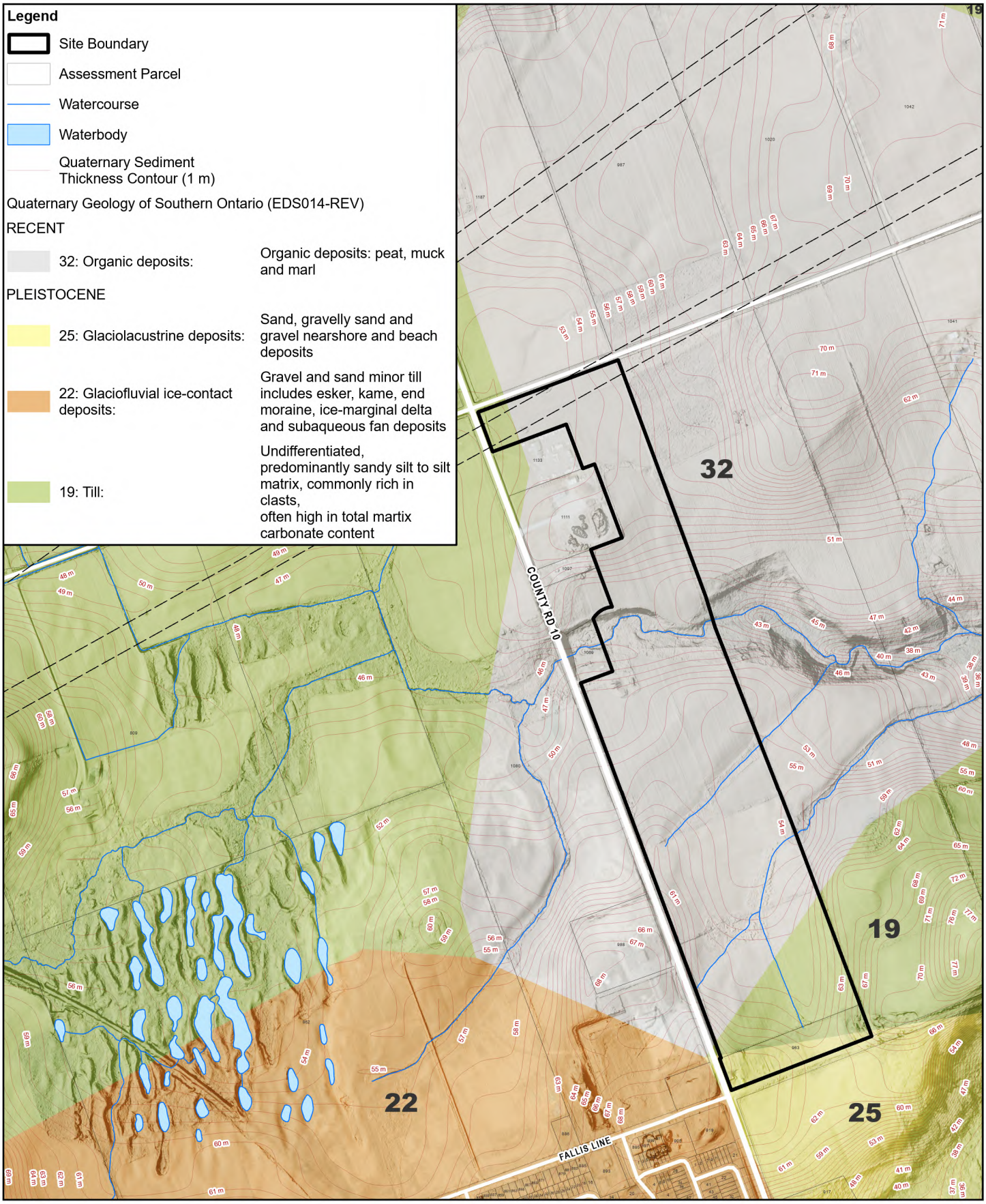

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Grid: NAD 1983 UTM Zone 17N

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Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Quaternary Geology

Project No. 12662348
Revision No.
Date Apr 29, 2025

Figure 6

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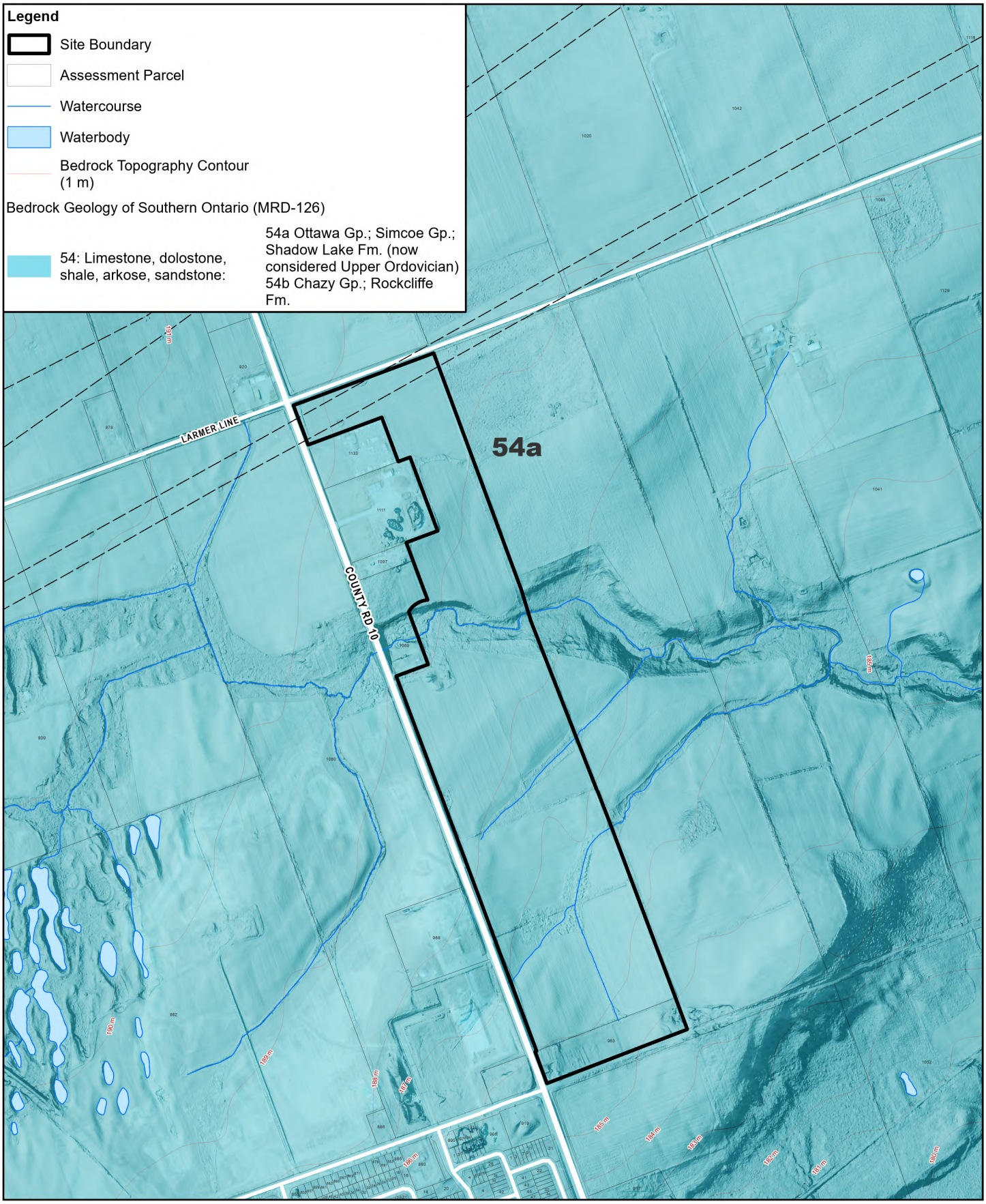

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Metres

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Grid: NAD 1983 UTM Zone 17N

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GHD

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Bedrock Geology

Project No. 12662348
Revision No.
Date Apr 29, 2025

Figure 7

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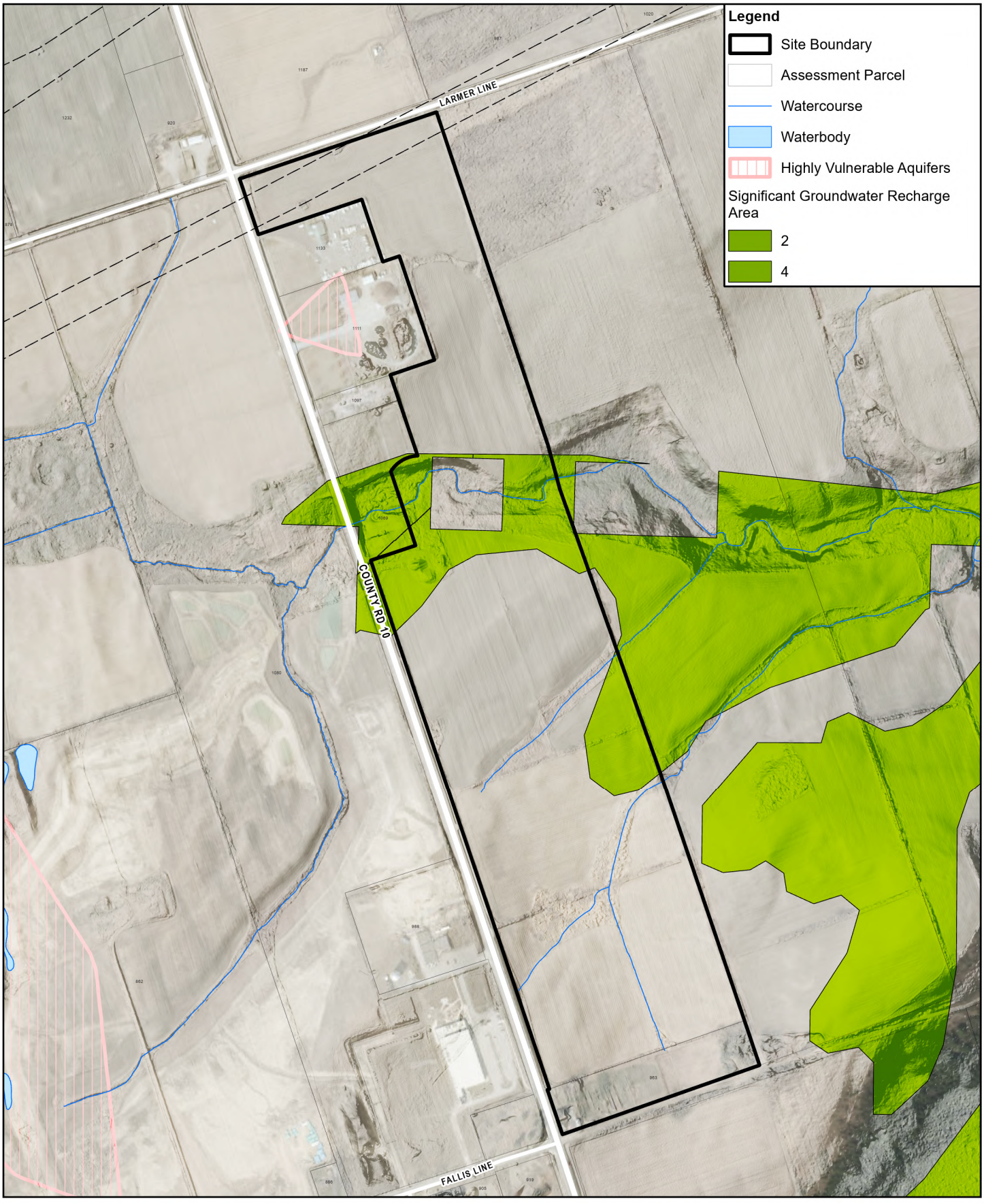

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Grid: WGS 1984 Web Mercator Auxiliary Sphere

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GHD

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Source Water Protection

Project No. 12662438
Revision No.
Date Apr 29, 2025

Figure 8

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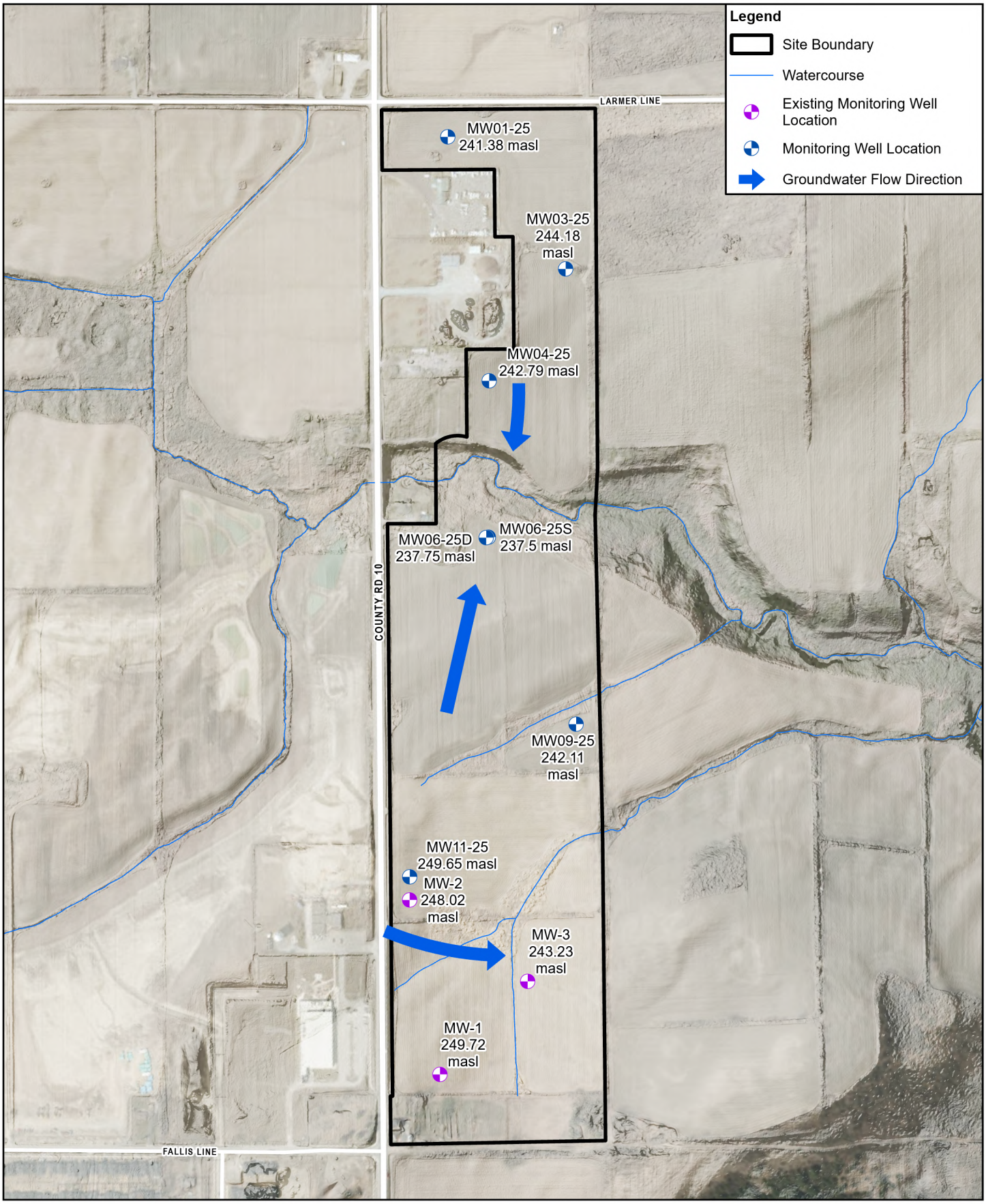

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Grid: NAD 1983 UTM Zone 17N

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

Groundwater Flow Direction

Project No. 12662438
Revision No.
Date Apr 29, 2025

Figure 9

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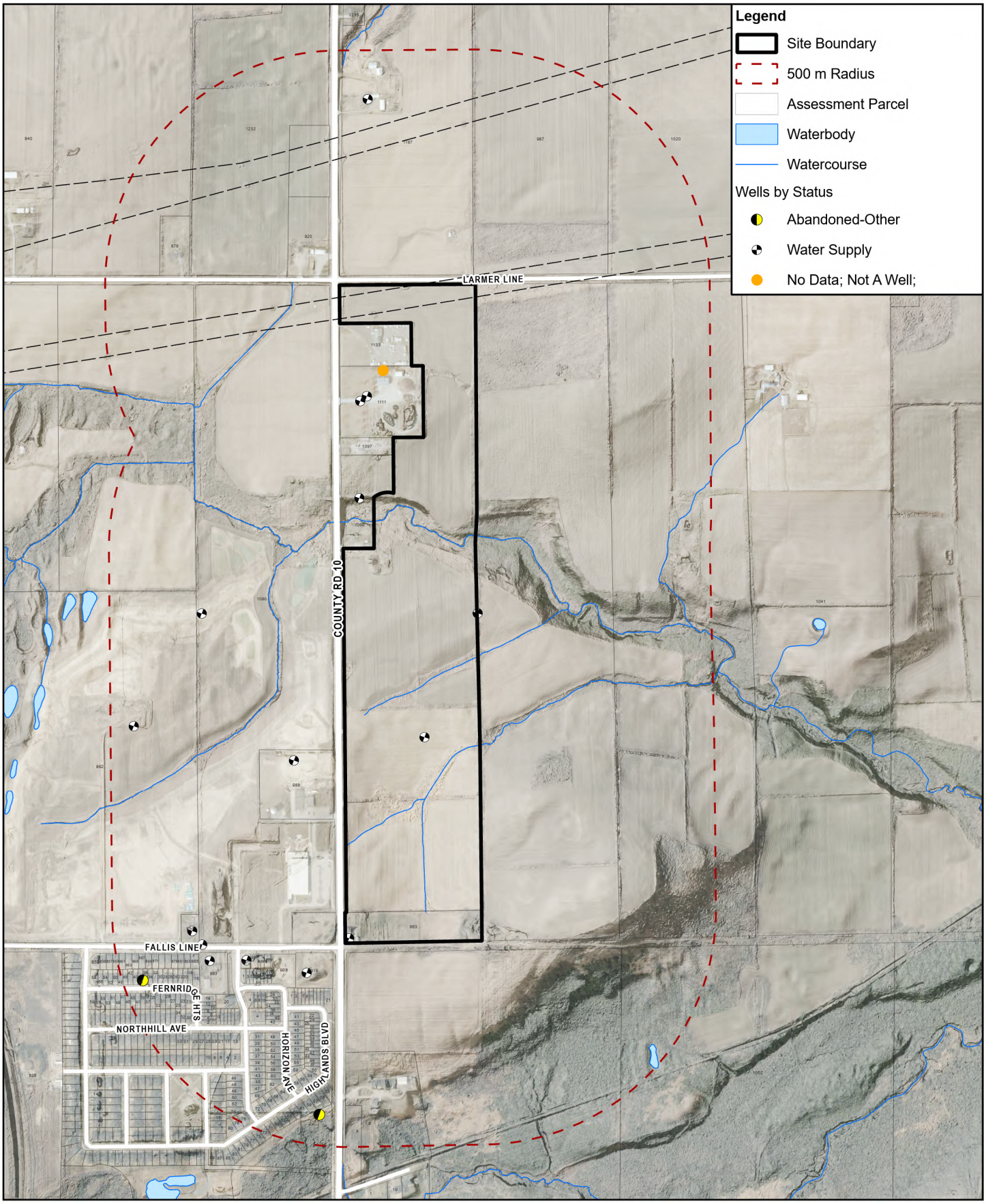
Appendices

Appendix A

MECP Well Records



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Metres

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Grid: NAD 1983 UTM Zone 17N

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GHD

Vargas P Inc.
North of Fallis Line, Lot 13, Concession 6
Township of Cavan-Monaghan, Ontario

Hydrogeological and Geotechnical Investigation Report

MECP Well Location Plan

Project No. 12662438
Revision No.
Date Apr 29, 2025

Appendix A

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MECP WELL RECORD LISTINGS

Ministry of the Environment, Conservation & Parks (MECP)

17

Easting:	703525.20
Northing:	4893004.00
Elev (masl):	253.44

Latitude: 44.161885
Longitude: -78.454554

Well ID: 1900380

LOCATION

Lot:	012	**Tag:**	
Con:	05	**Audit No:**	
Municipality:	PETERBOROUGH	**Contractor License:**	4713
Township:	CAVAN TOWNSHIP	**Well Completion Date:**	12-09-1953
Street:		**Received Date:**	02-22-1954
City:	n/a		

WELL

Well Status:	Water Supply	**Well Depth (m):**	16.4592
Prim. Use:	n/a	**Depth to Bedrock (m):**	n/a
Sec. Use:	n/a	**Depth to Water:**	ft
Boring Method:	Cable Tool	**Water Kind:**	FRESH

PUMP TEST

Test Method:	CLEAR	**Pipe ID:**	10618018
Pump Set (m):	n/a	**Pump Test ID**	991900380
SWL (ft)	40	**Flowing:**	N
Final Level:	44 ft	**Pump Duration (hr):**	2
Pump Rate:	12 GPM	**Pump Duration (m):**	0
Recom. Rate:	n/a GPM		

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930126682	6	inch	STEEL	n/a	54 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	n/a	n/a	n/a	0	2 ft
2	CLAY	MEDIUM SAND	STONES	BROWN	2	20 ft
3	CLAY	STONES	n/a	BLUE	20	53 ft
4	GRAVEL	n/a	n/a	n/a	53	54 ft

End of Record

17

Easting:	703474.20
Northing:	4893440.00
Elev (masl):	254.24

Latitude: 44.16582
Longitude: -78.455023

Well ID: 1900416

LOCATION

Lot:	012	**Tag:**	
Con:	06	**Audit No:**	
Municipality:	PETERBOROUGH	**Contractor License:**	2113
Township:	CAVAN TOWNSHIP	**Well Completion Date:**	01-24-1964
Street:		**Received Date:**	05-04-1964
City:	n/a		

WELL

Well Status:	Water Supply	**Well Depth (m):**	70.7136
Prim. Use:	n/a	**Depth to Bedrock (m):**	n/a
Sec. Use:	n/a	**Depth to Water:**	ft
Boring Method:	Cable Tool	**Water Kind:**	FRESH

PUMP TEST

Test Method:	CLEAR	**Pipe ID:**	10618054
Pump Set (m):	n/a	**Pump Test ID**	991900416
SWL (ft)	65	**Flowing:**	N
Final Level:	202 ft	**Pump Duration (hr):**	24
Pump Rate:	40 GPM	**Pump Duration (m):**	0
Recom. Rate:	30 GPM		

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930126721	6	inch	STEEL	n/a	217 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	n/a	n/a	n/a	0	1 ft
2	CLAY	MEDIUM SAND	STONES	BROWN	1	45 ft
3	CLAY	MEDIUM SAND	STONES	GREY	45	207 ft
4	GRAVEL	COARSE SAND	CLAY	n/a	207	216 ft
5	GRAVEL	n/a	n/a	BROWN	216	220 ft
6	CLAY	STONES	n/a	GREY	220	227 ft
7	GRAVEL	n/a	n/a	BROWN	227	232 ft

End of Record

17

Easting:	703719.20
Northing:	4893582.00
Elev (masl):	242.62

Latitude: 44.167029
Longitude: -78.451906

Well ID: 1900417

LOCATION

Lot: 013
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 2501
Well Completion Date: 11-22-1952
Received Date: 01-19-1953

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: Domestic
Boring Method: Cable Tool

Well Depth (m): 32.6136
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) n/a
Final Level: n/a ft
Pump Rate: 60 GPM
Recom. Rate: n/a GPM

Pipe ID: 10618055
Pump Test ID 991900417
Flowing: Y
Pump Duration (hr): n/a
Pump Duration (m): n/a

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930126722	5	inch	STEEL	n/a	107 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	PREVIOUSLY DUG	n/a	n/a	n/a	0	30 ft
2	CLAY	BOULDERS	n/a	GREY	30	107 ft

End of Record

17

Easting:	703414.20
Northing:	4894013.00
Elev (masl):	237.58

Latitude: 44.170991
Longitude: -78.455551

Well ID: 1900418

LOCATION

Lot: 013
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 1904
Well Completion Date: 01-11-1967
Received Date: 05-16-1967

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: Domestic
Boring Method: Cable Tool

Well Depth (m): 10.3632
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method:	CLOUDY	**Pipe ID:**	10618056
Pump Set (m):	n/a	**Pump Test ID**	991900418
SWL (ft)	18	**Flowing:**	N
Final Level:	25 ft	**Pump Duration (hr):**	4
Pump Rate:	20 GPM	**Pump Duration (m):**	0
Recom. Rate:	5 GPM		

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930126723	6	inch	STEEL	n/a	24 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	PREVIOUSLY DUG	n/a	n/a	n/a	0	24 ft
2	CLAY	n/a	n/a	n/a	24	26 ft
3	GRAVEL	BOULDERS	n/a	n/a	26	34 ft

End of Record

17

Easting:	703140.20
Northing:	4894818.00
Elev (masl):	245.25

Latitude: 44.178307
Longitude: -78.458664

Well ID: 1900450

LOCATION

Lot:	013	**Tag:**	
Con:	07	**Audit No:**	
Municipality:	PETERBOROUGH	**Contractor License:**	2113
Township:	CAVAN TOWNSHIP	**Well Completion Date:**	07-31-1963
Street:		**Received Date:**	10-07-1963
City:	n/a		

WELL

Well Status:	Water Supply	**Well Depth (m):**	22.2504
Prim. Use:	n/a	**Depth to Bedrock (m):**	n/a
Sec. Use:	Domestic	**Depth to Water:**	ft
Boring Method:	Cable Tool	**Water Kind:**	FRESH

PUMP TEST

Test Method:	CLEAR	**Pipe ID:**	10618088
Pump Set (m):	n/a	**Pump Test ID**	991900450
SWL (ft)	37	**Flowing:**	N
Final Level:	65 ft	**Pump Duration (hr):**	3
Pump Rate:	3 GPM	**Pump Duration (m):**	0
Recom. Rate:	3 GPM		

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930126761	6	inch	STEEL	n/a	73 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	n/a	n/a	n/a	0	1 ft
2	CLAY	n/a	n/a	BROWN	1	10 ft
3	CLAY	BOULDERS	n/a	GREY	10	50 ft
4	CLAY	MEDIUM SAND	STONES	GREY	50	67 ft
5	MEDIUM SAND	STONES	CLAY	n/a	67	73 ft

End of Record

17

Easting:	703425.20
Northing:	4893003.00
Elev (masl):	252.56

Latitude: 44.161903
Longitude: -78.455804

Well ID: 1903021

LOCATION

Lot:	012	**Tag:**	
Con:	05	**Audit No:**	
Municipality:	PETERBOROUGH	**Contractor License:**	4713
Township:	CAVAN TOWNSHIP	**Well Completion Date:**	09-17-1970
Street:		**Received Date:**	02-04-1971
City:	n/a		

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 72.2376
Depth to Bedrock (m): 215
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) 66
Final Level: 230 ft
Pump Rate: 3 GPM
Recom. Rate: 3 GPM

Pipe ID: 10620643
Pump Test ID 991903021
Flowing: N
Pump Duration (hr): 1
Pump Duration (m): 0

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930129615	6	inch	STEEL	n/a	216 ft
2	930129616	n/a	inch	OPEN HOLE	n/a	237 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	CLAY	STONES	n/a	BROWN	0	27 ft
2	CLAY	STONES	n/a	BLUE	27	130 ft
3	CLAY	MEDIUM SAND	n/a	BLUE	130	135 ft
4	CLAY	STONES	n/a	BLUE	135	215 ft
5	LIMESTONE	n/a	n/a	GREY	215	237 ft

End of Record

17

Easting:	703715.20
Northing:	4893123.00
Elev (masl):	254.12

Latitude: 44.162902
Longitude: -78.452134

Well ID: 1903540

LOCATION

Lot: 013
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 4814
Well Completion Date: 11-13-1972
Received Date: 04-09-1973

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 70.104
Depth to Bedrock (m): 225
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) 70
Final Level: 225 ft
Pump Rate: 2 GPM
Recom. Rate: 2 GPM

Pipe ID: 10621152
Pump Test ID 991903540
Flowing: N
Pump Duration (hr): 8
Pump Duration (m): 0

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930130162	6	inch	STEEL	n/a	225 ft
2	930130163	6	inch	OPEN HOLE	n/a	230 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	n/a	n/a	n/a	0	1 ft
2	CLAY	STONES	n/a	BROWN	1	45 ft
3	CLAY	STONES	n/a	GREY	45	135 ft
4	FINE SAND	CLAY	n/a	n/a	135	144 ft
5	FINE SAND	GRAVEL	CLAY	n/a	144	155 ft
6	GRAVEL	FINE SAND	CLAY	n/a	155	170 ft
7	FINE SAND	CLAY	GRAVEL	n/a	170	225 ft
8	LIMESTONE	n/a	n/a	GREY	225	230 ft

End of Record

17		
	Easting:	703345.20
	Northing:	4894208.00
	Elev (masl):	244.17

Latitude: 44.172764
Longitude: -78.456338

Well ID: **1904211**

LOCATION

Lot: 013
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 4713
Well Completion Date: 12-26-1974
Received Date: 03-13-1975

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 15.24
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: n/a
Pump Set (m): n/a
SWL (ft) 8
Final Level: 40 ft
Pump Rate: 12 GPM
Recom. Rate: 10 GPM

Pipe ID: 10621775
Pump Test ID 991904211
Flowing: N
Pump Duration (hr): 2
Pump Duration (m): 30

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930130855	6	inch	STEEL	n/a	47 ft
2	930130856	6	inch	OPEN HOLE	n/a	50 ft
3	930130857	n/a	inch	<null>	n/a	500 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	CLAY	BOULDERS	n/a	BROWN	0	40 ft
2	CLAY	GRAVEL	n/a	BLUE	40	48 ft
3	GRAVEL	SAND	n/a	BROWN	48	50 ft

End of Record

17		
	Easting:	703128.20
	Northing:	4893392.00
	Elev (masl):	250.37

Latitude: 44.165485
Longitude: -78.459365

Well ID: **1904212**

LOCATION

Lot: 012
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 2104
Well Completion Date: 03-13-1975
Received Date: 04-08-1975

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 10.9728
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) 15
Final Level: 21 ft
Pump Rate: 10 GPM
Recom. Rate: 10 GPM

Pipe ID: 10621776
Pump Test ID 991904212
Flowing: N
Pump Duration (hr): 3
Pump Duration (m): 0

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930130858	6	inch	STEEL	n/a	36 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth

1	TOPSOIL	n/a	n/a	n/a	0	1	ft
2	SAND	GRAVEL	n/a	BROWN	1	12	ft
3	CLAY	STONES	n/a	WHITE	12	34	ft
4	GRAVEL	n/a	n/a	BROWN	34	36	ft

End of Record

17

Easting:	726565.10
Northing:	4924523.00
Elev (masl):	244.29

Latitude: 44.172896
Longitude: -78.456207

Well ID: 5110032

LOCATION

Lot: 013
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 2104
Well Completion Date: 11-20-1980
Received Date: 12-16-1980

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 23.1648
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) 6
Final Level: 38 ft
Pump Rate: 10 GPM
Recom. Rate: 10 GPM

Pipe ID: 10886685
Pump Test ID 995110032
Flowing: N
Pump Duration (hr): 9
Pump Duration (m): 10

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930558442	6	inch	STEEL	n/a	73 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	SOFT	n/a	BROWN	0	1 ft
2	CLAY	STONES	PACKED	BROWN	1	12 ft
3	SAND	GRAVEL	STONES	BROWN	12	26 ft
4	GRAVEL	CLAY	STONES	BROWN	26	69 ft
5	COARSE SAND	GRAVEL	LOOSE	BROWN	69	76 ft
6	CLAY	GRAVEL	DENSE	BROWN	76	76 ft

End of Record

17

Easting:	733805.10
Northing:	4914084.00
Elev (masl):	251.75

Latitude: 44.162092
Longitude: -78.456171

Well ID: 5110451

LOCATION

Lot: 012
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 2104
Well Completion Date: 04-16-1982
Received Date: 05-11-1982

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 64.008
Depth to Bedrock (m): 208
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) 82
Final Level: 199 ft
Pump Rate: 5 GPM
Recom. Rate: 4 GPM

Pipe ID: 10887098
Pump Test ID 995110451
Flowing: N
Pump Duration (hr): 2
Pump Duration (m): 40

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930558950	6	inch	STEEL	n/a	210 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	CLAY	STONES	PACKED	BROWN	0	16 ft
2	SAND	GRAVEL	LOOSE	GREY	16	37 ft
3	MEDIUM SAND	CLAY	MEDIUM GRAVEL	GREY	37	98 ft
4	SAND	SOFT	n/a	BLACK	98	123 ft
5	CLAY	GRAVEL	PACKED	GREY	123	129 ft
6	SAND	SOFT	n/a	GREY	129	146 ft
7	MEDIUM SAND	MEDIUM GRAVEL	CLAY	GREY	146	208 ft
8	SHALE	GRAVEL	LOOSE	BLACK	208	209 ft
9	UNKNOWN TYPE	n/a	n/a	n/a	209	210 ft

End of Record

17

Easting:	730265.10
Northing:	4935273.00
Elev (masl):	252.88

Latitude: 44.162019
Longitude: -78.452923

Well ID: **5110516**

LOCATION

Lot: 012
Con: 05
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 4635
Well Completion Date: 06-03-1981
Received Date: 07-09-1982

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 36.2712
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: n/a
Pump Set (m): n/a
SWL (ft) 49
Final Level: 113 ft
Pump Rate: 6 GPM
Recom. Rate: n/a GPM

Pipe ID: 10887163
Pump Test ID 995110516
Flowing: N
Pump Duration (hr): 4
Pump Duration (m): 0

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930559015	6	inch	STEEL	n/a	119 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	n/a	n/a	n/a	0	1 ft
2	CLAY	STONES	n/a	WHITE	1	37 ft
3	COARSE GRAVEL	n/a	n/a	BROWN	37	44 ft
4	CLAY	n/a	n/a	WHITE	44	102 ft
5	FINE GRAVEL	FINE SAND	n/a	BROWN	102	119 ft

End of Record

17

Easting:	698065.10
Northing:	4903323.00
Elev (masl):	241.23

Latitude: 44.167943
Longitude: -78.458584

Well ID: **5111244**

LOCATION

Lot: 012
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street:
City: n/a

Tag:
Audit No:
Contractor License: 1413
Well Completion Date: 11-09-1984
Received Date: 12-14-1984

VELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use:

Well Depth (m): 20.4216
Depth to Bedrock (m): n/a
Depth to Water: ft

Boring Method: Rotary (Convent.) **Water Kind:** FRESH

PUMP TEST

Test Method:	CLEAR	**Pipe ID:**	10887870
Pump Set (m):	n/a	**Pump Test ID**	995111244
SWL (ft)	60	**Flowing:**	N
Final Level:	62 ft	**Pump Duration (hr):**	2
Pump Rate:	4 GPM	**Pump Duration (m):**	0
Recom. Rate:	4 GPM		

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930559797	6	inch	STEEL	n/a	67 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	CLAY	STONES	HARD	BROWN	0	30 ft
2	GRAVEL	DRY	n/a	BROWN	30	58 ft
3	SAND	GRAVEL	LOOSE	BROWN	58	67 ft

End of Record

17

Easting:	715347.20
Northing:	4910436.00
Elev (masl):	241.91

Latitude: 44.169606
Longitude: -78.451595

Well ID: 5114057

LOCATION

Lot:	013	**Tag:**	
Con:	06	**Audit No:**	54924
Municipality:	PETERBOROUGH	**Contractor License:**	3129
Township:	CAVAN TOWNSHIP	**Well Completion Date:**	08-24-1989
Street:		**Received Date:**	09-14-1989
City:	n/a		

WELL

Well Status:	Water Supply	**Well Depth (m):**	15.24
Prim. Use:	n/a	**Depth to Bedrock (m):**	28
Sec. Use:	n/a	**Depth to Water:**	ft
Boring Method:	Boring	**Water Kind:**	FRESH

PUMP TEST

Test Method:	CLEAR	**Pipe ID:**	10890672
Pump Set (m):	n/a	**Pump Test ID**	995114057
SWL (ft)	26	**Flowing:**	N
Final Level:	34 ft	**Pump Duration (hr):**	1
Pump Rate:	8 GPM	**Pump Duration (m):**	0
Recom. Rate:	4 GPM		

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930562935	30	inch	CONCRETE	n/a	50 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	n/a	n/a	n/a	0	1 ft
2	CLAY	STONES	HARD	BROWN	1	20 ft
3	SAND	GRAVEL	ROCK	n/a	20	28 ft
4	CLAY	ROCK	HARD	GREY	28	50 ft

End of Record

17

Easting:	713824.00
Northing:	4926480.00
Elev (masl):	241.91

Latitude: 44.169606
Longitude: -78.451595

Well ID: 5117311

LOCATION

Lot:	013	**Tag:**	
Con:	06	**Audit No:**	166446
Municipality:	PETERBOROUGH	**Contractor License:**	3367
Township:	CAVAN TOWNSHIP	**Well Completion Date:**	09-16-1996
Street:		**Received Date:**	10-18-1996
City:	n/a		

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Cable Tool

Well Depth (m): 23.7744
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: Not stated

PUMP TEST

Test Method: CLEAR
Pump Set (m): n/a
SWL (ft) 8
Final Level: 60 ft
Pump Rate: 7 GPM
Recom. Rate: 5 GPM

Pipe ID: 10893910
Pump Test ID 995117311
Flowing: N
Pump Duration (hr): 6
Pump Duration (m): 0

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	930566876	6	inch	STEEL	n/a	78 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	TOPSOIL	SOFT	n/a	BROWN	0	2 ft
2	CLAY	DENSE	n/a	BROWN	2	18 ft
3	CLAY	GRAVEL	PACKED	GREY	18	77 ft
4	COARSE GRAVEL	SAND	WATER-BEARING	BROWN	77	78 ft

End of Record

17

Easting:	737301.20
Northing:	4910737.00
Elev (masl):	243.85

Latitude: 44.173459
Longitude: -78.45601

Well ID: **5120398**

LOCATION

Lot: 013
Con: 06
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street: COUNTY RD #10
City: MILLBROOK

Tag:
Audit No: Z29375
Contractor License: 3367
Well Completion Date: 07-14-2005
Received Date: 09-20-2005

WELL

Well Status: <null>
Prim. Use: n/a
Sec. Use: n/a
Boring Method: n/a

Well Depth (m): 0
Depth to Bedrock (m): n/a
Depth to Water:
Water Kind:

PUMP TEST

Test Method:
Pump Set (m):
SWL (ft)
Final Level:
Pump Rate:
Recom. Rate:

Pipe ID:
Pump Test ID
Flowing:
Pump Duration (hr):
Pump Duration (m):

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth

End of Record

---

n/a

Easting:	<null>
Northing:	<null>
Elev (masl):	252.59

Latitude: 44.161653
Longitude: -78.45548

Well ID: **7170060**

TION

Lot: 012
Con: 05
Municipality:

Tag: A108386
Audit No: Z128143
Contractor License: 1413

LOCA

Township: PETERBOROUGH CAVAN TOWNSHIP
Street: 893 FALLIS LINE
City: MILLBROOK

Well Completion Date: 07-12-2011
Received Date: 10-14-2011

WELL

Well Status: Water Supply
Prim. Use: n/a
Sec. Use: n/a
Boring Method: Rotary (Convent.)

Well Depth (m): 63.3984
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind: FRESH

PUMP TEST

Test Method: CLEAR
Pump Set (m): 175
SWL (ft) 75
Final Level: 175 ft
Pump Rate: 10 GPM
Recom. Rate: 8 GPM

Pipe ID: 1004007579
Pump Test ID 1004007580
Flowing: n/a
Pump Duration (hr): 1
Pump Duration (m): n/a

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	1004007590	6.25	inch	STEEL	0	203 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
1	CLAY	STONES	HARD	BROWN	0	15 ft
2	SAND	GRAVEL	LOOSE	BROWN	15	38 ft
3	CLAY	HARD	DENSE	GREY	38	110 ft
4	SILT	CLAY	SOFT	GREY	110	168 ft
5	CLAY	n/a	HARD	GREY	168	195 ft
6	FINE SAND	SILT	n/a	GREY	195	203 ft
7	SAND	n/a	FINE-GRAINED	GREY	203	208 ft

End of Record

---

n/a

Easting:	<null>
Northing:	<null>
Elev (masl):	

Latitude: 44.160895
Longitude: -78.457013

Well ID: **7311533**

LOCATION

Lot: 012
Con: 05
Municipality: PETERBOROUGH
Township: CAVAN TOWNSHIP
Street: 879 FALLIS LINE
City: MILLBROOK

Tag:
Audit No: Z277113
Contractor License: 7067
Well Completion Date: 03-26-2018
Received Date: 05-25-2018

WELL

Well Status: Abandoned-Other
Prim. Use: n/a
Sec. Use: Livestock
Boring Method: n/a

Well Depth (m): 0
Depth to Bedrock (m): n/a
Depth to Water: ft
Water Kind:

PUMP TEST

Test Method: n/a
Pump Set (m): n/a
SWL (ft) 43
Final Level: n/a ft
Pump Rate: n/a GPM
Recom. Rate: n/a GPM

Pipe ID: 1007277962
Pump Test ID 1007277963
Flowing: n/a
Pump Duration (hr): n/a
Pump Duration (m): n/a

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth
1	1007277967	6.25	inch	STEEL	0	53 ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth
0	n/a	n/a	n/a	n/a	n/a	n/a ft

End of Record

n/a		
	Easting:	<null>
	Northing:	<null>
	Elev (masl):	

Latitude: 44.15951
Longitude: -78.45142

Well ID: 7311534

LOCATION

Lot:	012
Con:	05
Municipality:	PETERBOROUGH
Township:	CAVAN TOWNSHIP
Street:	919 FALLIS LINE
City:	MILLBROOK

Tag:	
Audit No:	Z277114
Contractor License:	7067
Well Completion Date:	03-26-2018
Received Date:	05-25-2018

WELL

Well Status:	Abandoned-Other
Prim. Use:	n/a
Sec. Use:	Livestock
Boring Method:	n/a

Well Depth (m):	0
Depth to Bedrock (m):	n/a
Depth to Water:	ft
Water Kind:	

PUMP TEST

Test Method:	n/a
Pump Set (m):	n/a
SWL (ft)	-1
Final Level:	n/a ft
Pump Rate:	n/a GPM
Recom. Rate:	n/a GPM

Pipe ID:	1007277977
Pump Test ID	1007277978
Flowing:	n/a
Pump Duration (hr):	n/a
Pump Duration (m):	n/a

CASING DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Case ID	Casing Diamter	Diamter Units	Material	Top Depth	Bottom Depth	
1	1007277982	36	inch	CONCRETE	-2.5	17	ft

FORMATION DETAILS

Layer Value of "0" denotes a Null value and cannot be stratified and ordered.

Layer	Material	Material 2	Material 3	Colour	Top Depth	Bottom Depth	
0	n/a	n/a	n/a	n/a	n/a	n/a	ft

End of Record

Appendix B

Test Hole Logs

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW01-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 11/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4894422 m

Easting: 703316 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 241.76 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.38 m

Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)
0.00 / 241.76														
0.36 / 241.40		TOPSOIL (360 mm)	SS1A	62	1-2-5-6	7						35		
		SANDY SILT, trace clay, loose to dense, brown, moist	SS1B									29		
			SS2	42	6-7-30-13	37						10		
1.83 / 239.93			SS3A	67	9-20-38-44	58						15		
		SANDY SILT (Till), some clay, trace gravel, very dense, brown, moist	SS3B									5		
			SS4	~~100~~	25-43-49-46	92	9	35	37	19		7		
			SS5	100	19-50/50 mm	R						9		
		- grey, wet at 4.57m BGS	SS6	96	38-46-50/125 mm	96						12		
6.38 / 235.38			SS7	100	28-50/125 mm	R						9		
		End of Hole at 6.38 m BGS												

Plasticity Index (%): 20

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL — w — LL
40 60 80

Water Level(s)

Monitoring Well

Cuttings 0.15 / 241.61
Bentonite
1.22 / 240.54 T.O.S.
1.52 / 240.24
#3 Sand
3.05 / 238.71 B.O.S.
3.05 / 238.71

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 3.96 m **on** 11/03/2025

▽ **Last Water Level Taken:** 25/03/2025

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)
MW01-25	242.76

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.38	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH02-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 11/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4894434 m

Easting: 703482 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 243.44 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.23 m

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)	● SPT N-Value ▼ DCPT Value (blows 100mm) Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak □ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual ○ Moisture Content (%) PL w LL	Water Level(s)	Backfill Details
	0.00 / 243.44										20	40 60 80		
	0.30		TOPSOIL (300 mm)	SS1A					32					
	243.14		SANDY SILT, trace clay, trace gravel, loose to compact, brown, moist	SS1B	21	2-4-5-5	9		24					
1				SS2	75	15-11-16-16	27		11					
2	2.13			SS3	100	8-15-13-17	28		9					
	241.31		SANDY SILT (Till), trace clay, trace gravel, very dense, brown, wet - sand seam at 2.44m BGS	SS4	92	27-34-32-28	66		10					
3				SS5	85	41-38-46-34	84		9					
4														
				SS6	100	50/125 mm	R		9					
5														
6	6.23			SS7	100	50/125 mm	R		10					
	237.21		End of Hole at 6.23 m BGS											
7														
8														
9														

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 2.40 m **on** 11/03/2025

▽ **Last Water Level Taken:**

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW03-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 11/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4894308 m

Easting: 703528 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 244.70 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.37 m

Depth (m) / Elev. (m)	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Moisture Content %	PL% - LL%	Plasticity Index (%)
0.00 / 244.70								
0.36 / 244.34	TOPSOIL (360 mm)							
	SANDY SILT, trace gravel, trace clay, occasional cobbles, loose to compact, brown, moist	SS1	38	2-2-5-3	7	32		
		SS2	29	5-5-5-8	10	39		
		SS3	67	5-5-4-12	9	9		
2.13 / 242.57	SANDY SILT (Till), trace gravel, trace clay, very dense, brown, wet	SS4	100	21-18-23-50 /75 mm	41	17		
	- compact at 3.00m BGS	SS5	100	17-12-13-17	25	10		
		SS6	100	50/125 mm	R	14		
6.37 / 238.33	End of Hole at 6.37 m BGS	SS7	100	16-50/125 mm	R	15		

Grain Size Analysis: Gravel %, Sand %, Silt %, Clay %, Fines %

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Water Level(s)

Monitoring Well

Cuttings 0.15 / 244.55
Bentonite
1.22 / 243.48 T.O.S.
1.52 / 243.18
#3 Sand
3.05 / 241.65 B.O.S.
3.05 / 241.65

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

At Time of Drilling:

Upon Completion of Drilling: 0.30 m **on** 11/03/2025

Last Water Level Taken: 25/03/2025

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)
MW03-25	245.70

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.52	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW04-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 11/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4894130 m

Easting: 703482 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 243.77 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.15 m

Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel % / Sand % / Silt % / Clay % / Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)
0.00 / 243.77										
0.53		TOPSOIL (530 mm)	SS1	67	1-2-2-2	4		29		
243.24		SANDY SILT, some clay, trace gravel, occasional cobbles, compact to very dense, light brown, moist	SS2	100	4-6-9-12	15		14		
1.50										
242.27		SANDY SILT (Till), with gravel, with clay, occasional cobbles and boulder, light brown, very dense	SS3	100	18-50/25 mm	R		10		
		- very dense, spoon refusal (inferred boulder) at 1.52m BGS								
		- auger grinding at 2.13m BGS	SS4	100	50/75 mm	R		3		
		- cobble crushed by spoon at 2.29m BGS								
		- auger grinding at 3.05m BGS	SS5	100	38-50/75 mm	R		5		
		- wet at 4.57m BGS	SS6	75	8-20-32	52		14		
6.15			SS7	100	50/50 mm	R		8		
237.62		End of Hole at 6.15 m BGS								

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Water Level(s)

Monitoring Well

Cuttings 0.15 243.62
Bentonite
1.22 242.55
T.O.S. 1.52 242.25
#3 Sand
3.05 240.72
B.O.S. 3.05 240.72

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 2.90 m **on** 11/03/2025

▼ **Last Water Level Taken:** 25/03/2025

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)
MW04-25	244.77

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.98	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH05-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 11/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4894073 m

Easting: 703615 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 238.75 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.71 m

Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Backfill Details
0.00 / 238.75																
0.41 / 238.34		TOPSOIL (410 mm)	SS1	54	1-1-4-4	5						28				
		SANDY SILT, some clay, compact, brown, moist														
1.52 / 237.23		SANDY SILT (Till), with clay, trace gravel, dense to compact, brown, wet	SS2	100	2-4-8-14	12						17				
		- grey at 2.29m BGS	SS3	100	1-25-17-14	42						13				
			SS4	96	6-8-12-20	20						10				
			SS5	92	14-14-19-22	33						7				
			SS6	100	5-9-11-7	20						11				
6.10 / 232.65		SILT (Till), with clay, trace sand, trace gravel, grey, wet, very stiff	SS7	83	5-8-15-13	23	5	6	69	20		17	16-19	3		
6.71 / 232.04		End of Hole at 6.71 m BGS														

Plasticity Index (%): 20

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

40 60 80

LL=19
PL=16

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 4.27 m **on** 11/03/2025

▼ **Last Water Level Taken:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW06D-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893929 m

Easting: 703551 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 238.15 m

Elevation Datum: MAMSL

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

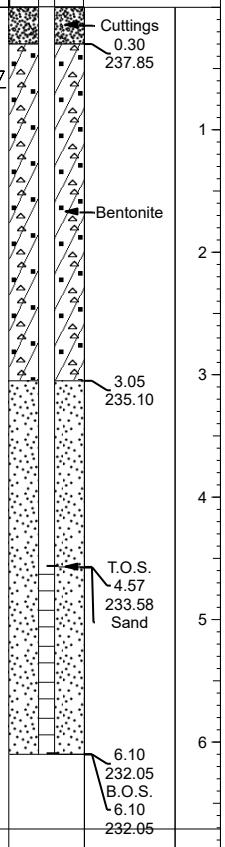
Final Depth: 6.71 m

Coordinates and Elevation Values are Approximate

Depth (m) / Elev. (m)	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel % / Sand % / Silt % / Clay % / Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)
0.00 / 238.15									20	
0.28 / 237.87	TOPSOIL (280 mm)									
	SANDY SILT, trace clay, trace gravel, loose to compact, brown, moist	SS1	42	3-2-4-4	6		32			
		SS2	100	3-2-3-4	5		22			
	- sand seam at 1.22m BGS	SS3	52	4-5-6-11	11		11			
		SS4	100	5-6-12-14	18		11			
3.05 / 235.10	SILTY CLAY (Till), with sand, trace gravel, stiff, grey, moist	SS5	100	6-11-15-17	26		13			
		SS6	96	3-6-8-6	14	9 / 13 / 34 / 44	17	18-29	11	
	- very stiff at 6.10m BGS	SS7	100	11-12-17-17	29		10			
6.71 / 231.44	End of Hole at 6.71 m BGS									

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL — w — LL
40 60 80

LL=29
PL=18



Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** Dry

▼ **Last Water Level Taken:** 25/03/2025

Well - Reference Elevation(s)	
Location	Elevation (m)
MW06D-25	239.15

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.65	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW06S-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893930 m

Easting: 703553 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 238.17 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 3.05 m

Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Monitoring Well
0.00 / 238.17												
0.28 / 237.89		TOPSOIL (280 mm)	SS1									
		SANDY SILT, trace clay, trace gravel, loose, brown, moist										
		- sand seam at 1.22m BGS	SS2									
			SS3									
			SS4									
3.05 / 235.12		End of Hole at 3.05 m BGS										

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

20 40 60 80

Cuttings 0.30 / 237.87
Bentonite
1.22 / 236.95
T.O.S. 1.52 / 236.65
#3 Sand
B.O.S. 3.05 / 235.12

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

At Time of Drilling:

Upon Completion of Drilling: Dry

Last Water Level Taken: 25/03/2025

Well - Reference Elevation(s)	
Location	Elevation (m)
MW06S-25	239.17

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.42	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH07-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893877 m

Easting: 703677 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 243.84 m

Elevation Datum: MAMSL

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.30 m

Coordinates and Elevation Values are Approximate

Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Backfill Details
0.00 / 243.84														20		
0.28 / 243.56		TOPSOIL (280 mm)														
		SANDY SILT, trace clay, trace gravel, compact, brown, moist	SS1	38	1-2-3-4	5						30				
			SS2	54	7-6-8-9	14						18				
1.37 / 242.47		GRAVELLY SILTY SAND (Till), with clay, compact, brown, moist														
			SS3	75	11-11-17-22	28	32	33	24	11		7				
		- very dense at 2.30m BGS	SS4	100	22-30-42-42	72						7				
			SS5	67	10-28-50/75 mm	78						7				
			~~SS6~~	~~100~~	~~50/25 mm~~	R						~~7~~				
6.30 / 237.54		End of Hole at 6.30 m BGS	SS7	100	11-50/50 mm	R						11				

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

40 60 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 3.96 m **on** 12/03/2025

▽ **Last Water Level Taken:**

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH08-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893682 m

Easting: 703556 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 244.99 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.71 m

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Backfill Details
	0.00 / 244.99																
	0.33		TOPSOIL (330 mm)														
	244.66		SILTY CLAY (Till), with sand, trace gravel, stiff to very stiff, brown, moist	SS1	54	7-1-2-2	3						44				
1				SS2	100	2-5-6-8	11						25				
2				SS3	100	6-8-15-12	23						22				
				SS4	92	1-5-10-15	15						21				
3	3.05		- sand seam at 2.87m BGS														
	241.94		SILTY SAND (Till), trace clay, trace gravel, compact, grey, moist - dense at 3.10m BGS	SS5	100	6-14-18-26	32						8				
4																	
5				SS6	100	9-10-15-15	25						8				
6			- dense at 6.10m BGS														
	6.71			SS7	100	13-20-22-21	42						10				
	238.28		End of Hole at 6.71 m BGS														
7																	
8																	
9																	

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Plasticity Index (%): 20

Moisture Content %: 40 60 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** Dry

▽ **Last Water Level Taken:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW09-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893733 m

Easting: 703752 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 242.52 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

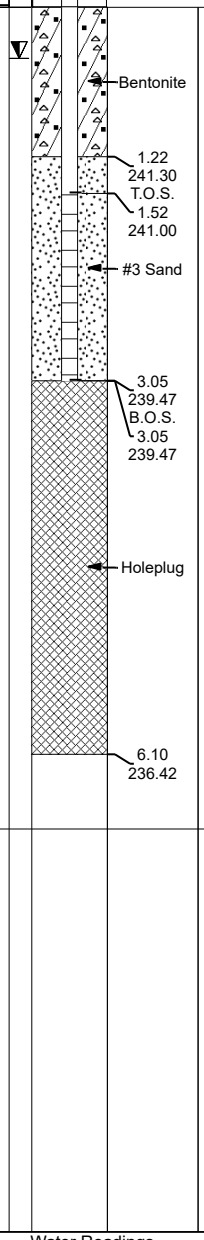
Final Depth: 6.71 m

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel % / Sand % / Silt % / Clay % / Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)
	0.00 / 242.52										20
	0.21 / 242.31		TOPSOIL (210 mm)	SS1A					26		
1			SILTY CLAY (Till), with sand, trace gravel, stiff to very stiff, brown, moist	SS1B	29	2-2-3-3	5		15		
				SS2	71	5-5-6-9	11		12		
2				SS3	100	4-6-15-10	21		10		
	2.29 / 240.23		SILTY SAND (Till), trace clay, dense, brown, moist	SS4	100	10-15-18-20	33		9		
3				SS5	100	7-35-15-19	50		9		
4											
5			- compact, grey at 4.57m BGS	SS6	100	4-9-18-19	27		6		
6			- very dense at 6.10m BGS	SS7	100	12-32-30-45	62		12		
	6.71 / 235.81		End of Hole at 6.71 m BGS								
7											
8											
9											

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL
20 40 60 80

Water Level(s)

Monitoring Well



Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** Dry

▼ **Last Water Level Taken:** 25/03/2025

Well - Reference Elevation(s)	
Location	Elevation (m)
MW09-25	243.52

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.41	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH10-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025 **Northing:** 4893581 m **Logged By:** C. Ayrheart

Drilling Company: GET **Easting:** 703652 m **Reviewed By:** M. Nieukirk

Horizontal Datum: NAD83 / UTM zone 17N

Drilling Method(s): Solid Stem Auger **Elevation:** 244.73 m **Final Depth:** 6.38 m

Hole Diameter(s): 152 mm **Elevation Datum:** MAMSL

Coordinates and Elevation Values are Approximate

Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Backfill Details
0.00 / 244.73		TOPSOIL (690 mm)	SS1	42	1-1-1-2	2						35				
0.69 / 244.04		SILTY CLAY (Till), with sand, trace gravel, stiff to very stiff, brown, moist	SS2	100	2-3-5-5	8						25				
			SS3	100	6-8-10-12	18						16			▼	
			SS4	25	6-7-7-9	14	11	18	36	35		21	15-32	17		
			SS5	100	4-6-12-12	18						15				
4.57 / 240.16		SILTY SAND (Till), trace clay, trace gravel, dense, grey, moist	SS6	83	13-13-19-17	32						11				
6.38 / 238.35		- very dense at 6.10m BGS End of Hole at 6.38 m BGS	SS7	100	12-50/125 mm	R						12				

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

20 40 60 80

LL=32
PL=15

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 1.83 m **on** 12/03/2025

▽ **Last Water Level Taken:**

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

MW11-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 13/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893460 m

Easting: 703611 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 250.28 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.51 m

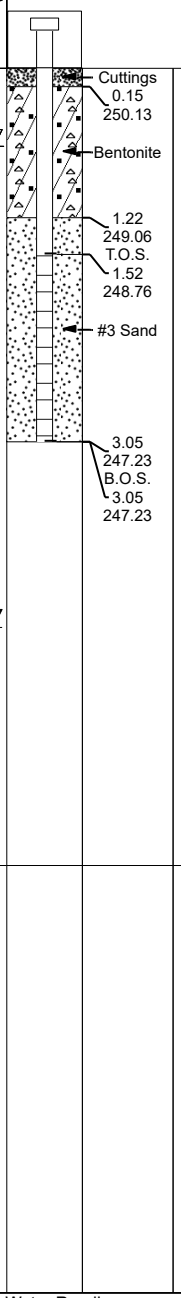
Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)
0	0.00 / 250.28										
	0.46 / 249.82		TOPSOIL (460 mm)	SS1	33	0-1-1-1	2		30		
1			SANDY SILT, trace clay, trace gravel, dense, brown, moist	SS2	100	4-11-20-33	31		10		
	1.52 / 248.76		SILTY SAND (Till), with clay, trace gravel, dense to very dense, brown, moist	SS3	100	27-29-32-30	61		8		
2				SS4	33	9-17-15-23	32		12		
3				SS5	100	27-29-32-30	61		9		
4				SS6	100	50/125 mm	R		12		
5											
6			- grey at 6.10m BGS	SS7	99	44-49-50/10 0 mm	99		20		
	6.51 / 243.77		End of Hole at 6.51 m BGS								
7											
8											
9											

20 40 60 80

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Water Level(s)

Monitoring Well



Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 4.57 m **on** 13/03/2025

▼ **Last Water Level Taken:** 25/03/2025

N Value: R - Refusal

Well - Reference Elevation(s)	
Location	Elevation (m)
MW11-25	251.28

T.O.S.: Top of Screen
B.O.S.: Bottom of Screen
Screen Diameter: 51 mm
Screen Slot Size:
Material: PVC

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit
25/03/2025	0.63	

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH12-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 13/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893489 m

Easting: 703852 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 244.32 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.66 m

Depth (m) / Elev. (m)	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis (Gravel % / Sand % / Silt % / Clay % / Fines %)	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Backfill Details
0.00 / 244.32	TOPSOIL (360 mm)	SS1A	100	1-2-2-4	4		27				
0.36 / 243.96	SILTY CLAY (Till), with sand, trace gravel, soft to very stiff, brown, moist	SS1B					28				
		SS2	100	5-6-6-8	12		21				
		SS3	100	6-7-11-13	18		22				
2.30 / 242.02	SILTY SAND (Till), with clay, trace gravel, dense to very dense, grey, moist to wet	SS4	100	7-10-33-29	43		25				
	- sand seam, black at 2.87m BGS	SS5	100	18-33-42-34	75		8				
		SS6	100	14-32-18-19	50		9				
		SS7	100	5-26-46-50/ 100 mm	72		7				
6.66 / 237.66	End of Hole at 6.66 m BGS										

Plasticity Index (%): 20

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Moisture Content % axis: 40 60 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

At Time of Drilling:

Upon Completion of Drilling: 2.44 m **on** 13/03/2025

Last Water Level Taken:

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH13-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 13/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893396 m

Easting: 703806 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 243.12 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.71 m

Depth (m) / Elev. (m)	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)
0.00 / 243.12													
0.36 / 242.76	TOPSOIL (360 mm)												
	SILTY CLAY (Till), with sand, trace gravel, firm, brown, moist	SS1	67	2-1-1-2	2						34		
		SS2	100	0-2-3-6	5						19		
	- very stiff at 1.52m BGS	SS3	100	7-7-9-11	16						23		
2.30 / 240.82	SANDY CLAYEY SILT (Till), some gravel, very stiff, grey, wet	SS4	100	7-11-15-16	26						8		
	- hard at 3.10m BGS	SS5	79	16-19-50/100 mm	69						15		
	- very stiff at 4.57m BGS	SS6	58	7-8-13-13	21	11	32	33	24		14	11-18	7
		SS7	67	4-8-9-10	17						33		
6.71 / 236.41	End of Hole at 6.71 m BGS												

20 40 60 80

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

LL=18
PL=11

Water Level(s)

Backfill Details

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Drilling:**

▼ **Upon Completion of Drilling:** 0.61 m **on** 13/03/2025

▽ **Last Water Level Taken:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

STRATIGRAPHIC AND INSTRUMENTATION RECORD

(Overburden)

BH14-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 12/03/2025

Drilling Company: GET

Drilling Method(s): Solid Stem Auger

Hole Diameter(s): 152 mm

Northing: 4893218 m

Easting: 703705 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 252.28 m

Elevation Datum: MAMSL

Coordinates and Elevation Values are Approximate

Logged By: C. Ayrheart

Reviewed By: M. Nieukirk

Final Depth: 6.68 m

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Sample Number	Recovery %	Blows per 0.15m or Partial Increment	'N'/RQD Value	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Fines %	Moisture Content %	PL% - LL%	Plasticity Index (%)	Water Level(s)	Backfill Details
0	0.00 / 252.28																
	0.23 / 252.05		TOPSOIL (230 mm)	SS1A	62	1-2-3-4	5						24				
			SANDY SILT, trace clay, trace gravel, loose to compact, brown, moist	SS1B									18				
1				SS2	100	4-4-3-6	7						13				
2	2.29 / 249.99			SS3	52	3-4-6-6	10						14				
			SILTY SAND (Till), with clay, with gravel, very dense, brown, moist	SS4	70	17-27-27-24	54	14	38	30	18		7				
3			- dense at 3.10m BGS	SS5	100	15-16-18-19	34						8				
4																	
5				SS6	100	9-17-19-19	36						9				
6			- very dense at 6.10m BGS	SS7	100	19-30-48-50 /125 mm	78						8				
	6.68 / 245.60		End of Hole at 6.68 m BGS														
7																	
8																	
9																	

Plasticity Index (%): 20

Moisture Content %: ● SPT N-Value; ▼ DCPT Value (blows 100mm); Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak; □ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual; ○ Moisture Content (%); PL — w — LL; 40 60 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

At Time of Drilling:

Upon Completion of Drilling: Dry

Last Water Level Taken:

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP01-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4894441 m

Easting: 703346 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 242.01 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 3.02 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	Water Level(s)	Backfill Details
	0.00 / 242.01								
	0.23 / 241.78		TOPSOIL (230 mm)						
	0.67 / 241.34		SANDY SILT, trace gravel, brown, reddish, moist		GS1		32		
1			SANDY SILT (Till), some clay, trace gravel, occasional cobble, light brown, moist		GS2		29		
2			- groundwater seepage at 1.74m BGS - trace clay at 2.13m BGS						
	3.02 / 238.99				GS3		11		
3			End of Test Pit at 3.02 m BGS						
4									
5									
6									
7									
8									
9									

Moisture Content %: ● SPT N-Value; ▼ DCPT Value (blows 100mm); Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak; □ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual; ○ Moisture Content (%); PL w LL

Moisture Content % scale: 20, 40, 60, 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP02-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4894282 m

Easting: 703533 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 245.05 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 2.53 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	Water Level(s)	Backfill Details
	0.00 / 245.05								
	0.30 / 244.75		TOPSOIL (300 mm)						
			SANDY SILT, trace gravel, trace organics, reddish brown, moist		GS1		26		
1	1.01 / 244.04		- water seepage at 0.91m BGS SANDY SILT (Till), some clay, trace gravel, occasional cobble, light brown, moist		GS2		22		
2			- trace clay at 2.23m BGS						
	2.53 / 242.52		End of Test Pit at 2.53 m BGS		GS3		4		
3									
4									
5									
6									
7									
8									
9									

Moisture Content %: 20

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL
40 60 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP03-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4894123 m

Easting: 703491 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 243.06 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 3.05 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	Water Level(s)	Backfill Details
	0.00 / 243.06								
	0.46 / 242.60		TOPSOIL (460 mm)						
	0.76 / 242.30		SANDY SILT, trace organics, trace gravel, reddish brown		GS1		23		
1			SILTY SAND (Till), with clay, trace gravel, light brown, moist - groundwater seepage at 1.07m BGS		GS2		12		
2			- trace clay at 1.83m BGS		GS3		21		
3	3.05 / 240.01		End of Test Pit at 3.05 m BGS						

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Moisture Content % scale: 20, 40, 60, 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP04-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4893893 m

Easting: 703589 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 240.66 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 3.05 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	Water Level(s)	Backfill Details
	0.00 / 240.66								
	0.27 / 240.39		TOPSOIL (230 mm)						
	0.55 / 240.11		SANDY SILT, trace gravel, trace clay, trace organics, reddish brown, moist		GS1		36		
1			SANDY SILT (Till), with clay, trace gravel, occasional cobbles, light brown, moist		GS2		33		
2									
3	3.05 / 237.61		End of Test Pit at 3.05 m BGS		GS3		30		
4									
5									
6									
7									
8									
9									

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Moisture Content % scale: 20, 40, 60, 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP05-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4893645 m

Easting: 703780 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 242.79 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 3.05 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	Water Level(s)	Backfill Details
	0.00 / 242.79								
	0.30		TOPSOIL (300 mm)						
	242.49		SANDY SILT, trace gravel, trace clay, trace organics, reddish brown, moist		GS1		37		
	0.73 / 242.06		SANDY SILT (Till), with clay, trace gravel, occasional cobbles, light brown, moist		GS2		19		
3	3.05 / 239.74		End of Test Pit at 3.05 m BGS		GS3		13		

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL

Moisture Content % scale: 20, 40, 60, 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP06-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4893381 m

Easting: 703825 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 243.44 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 3.02 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	● SPT N-Value ▼ DCPT Value (blows 100mm) Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak □ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual ○ Moisture Content (%) PL w LL	Water Level(s)	Backfill Details
	0.00 / 243.44						20	40 60 80		
	0.23		TOPSOIL (200 mm)							
	243.21		SANDY CLAYEY SILT (Till), trace gravel, reddish brown, moist		GS1		28	○		
1			- light brown at 0.84m BGS							
					GS2		28	○		
2										
			- trace clay at 2.44m BGS		GS3		9	○		
3	3.02 / 240.42		End of Test Pit at 3.02 m BGS							
4										
5										
6										
7										
8										
9										

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

TEST PIT STRATIGRAPHIC RECORD

TP07-25

Project Number: 12662438

Client: Vargas P Inc.

Project: Geotechnical and Hydrogeological, Fallis Line

Location: Lot 13, Concession 6, Township of Cavan-Monaghan

Date Range (dd/mm/yyyy): 24/03/2025

Drilling Company: Leahy Excavation

Drilling Method(s): Backhoe

Northing: 4893268 m

Easting: 703903 m

Horizontal Datum: NAD83 / UTM zone 17N

Elevation: 246.48 m

Elevation Datum: MAMSL

Logged By: C. Baggesen

Reviewed By: M. Nieukirk

Final Depth: 3.05 m

Dimension:

Coordinates and Elevation Values are Approximate

Depth Scale (m)	Depth (m) / Elev. (m)	Strata	Description	Remarks	Sample Number	Grain Size Analysis (Gravel %, Sand %, Silt %, Clay %, Fines %)	Moisture Content %	Water Level(s)	Backfill Details
	0.00 / 246.48								
	0.30		TOPSOIL (300 mm)						
	246.18		SANDY SILT, with clay, trace organics, trace gravel, reddish brown, moist		GS1		35		
	0.88								
1	245.60		SANDY CLAYEY SILT (Till), trace gravel, light brown, moist - groundwater seepage at 1.01m BGS		GS2		14		
2									
3	3.05				GS3		19		
	243.43		End of Test Pit at 3.05 m BGS						
4									
5									
6									
7									
8									
9									

Grain Size Analysis: Gravel %, Sand %, Silt %, Clay %, Fines %

Moisture Content %: 20

● SPT N-Value
▼ DCPT Value (blows 100mm)
Δ Peak Undrained Shear Strength (vane), C_u (kPa)-Peak
□ Remoulded Undrained Shear Strength (Vane), C_u (kPa)-Residual
○ Moisture Content (%)
PL w LL
40 60 80

Legend:

Measuring Point Elevation may change; Refer to Current Elevation Table

▽ **At Time of Excavation:**

▼ **Upon Completion of Excavation:**

Well - Reference Elevation(s)	
Location	Elevation (m)

Water Readings		
Date (dd/mm/yyyy)	Depth	Unit

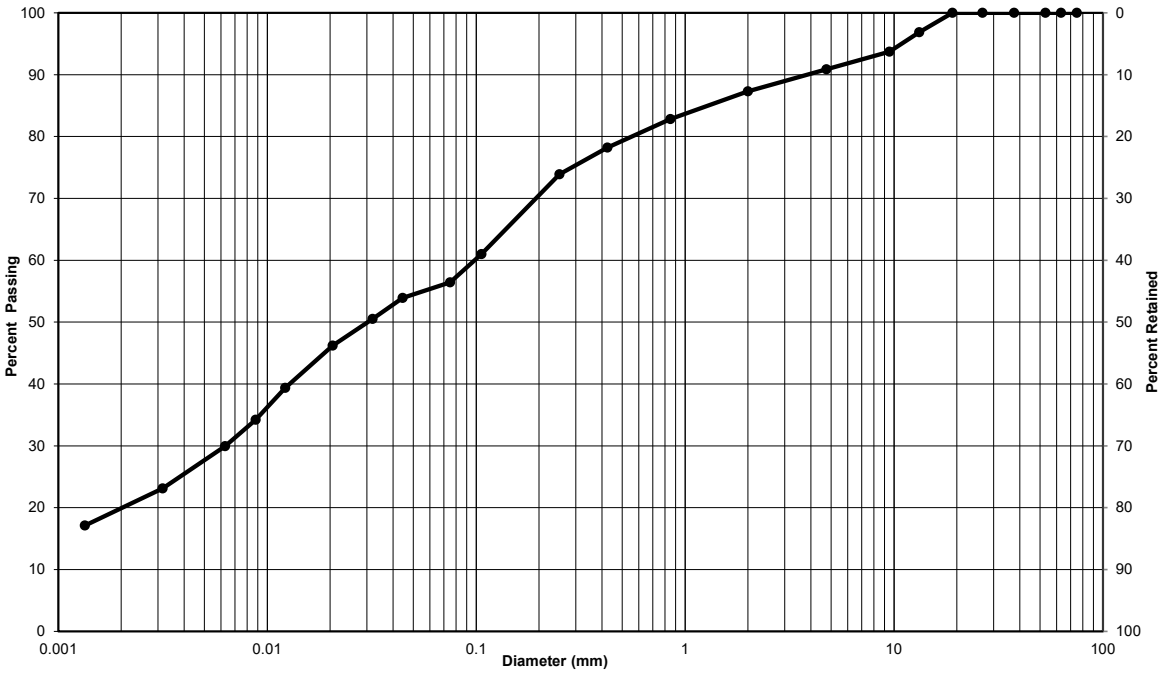
Appendix C

Geotechnical Laboratory Testing Results

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH1-25	Sample No.:	SS4
Depth:	2.3-2.9m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy silt, some clay, trace gravel	9	35	56
Silt-size particles (%) :	37		
Clay-size particles (%) (<0.002 mm):	19		

Additional laboratory reporting information available upon request.

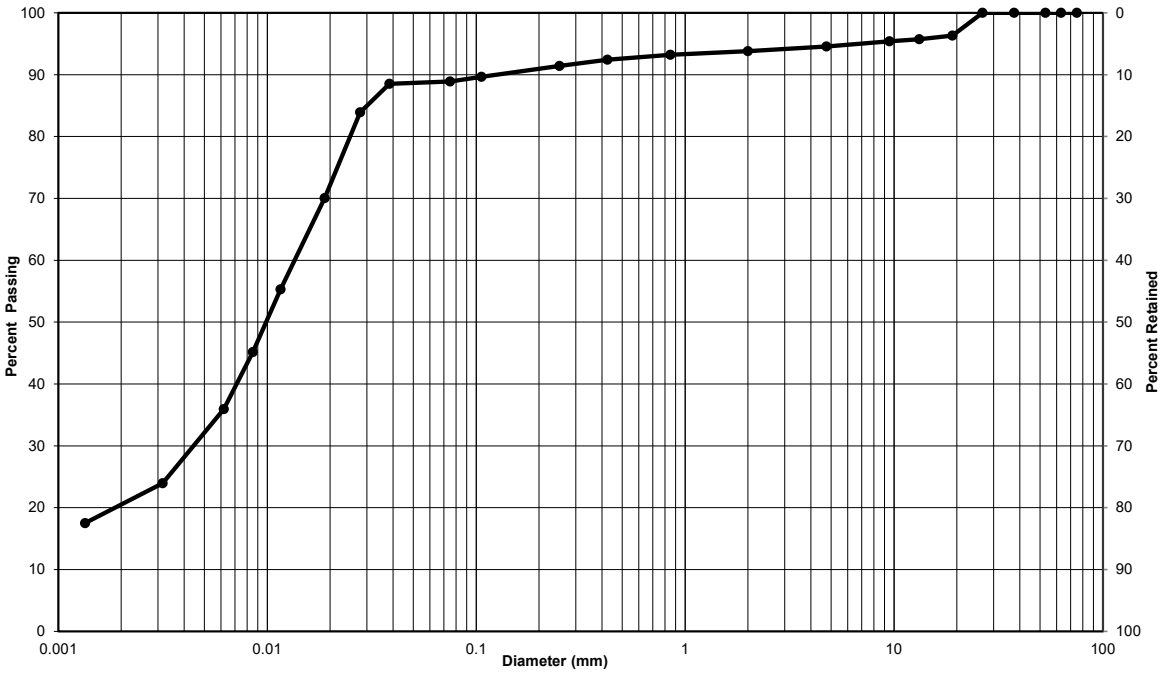
Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH5-25	Sample No.:	SS7
Depth:	6.1-6.7m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt, some clay, trace sand and gravel	5	6	89
Silt-size particles (%) :	69		
Clay-size particles (%) (<0.002 mm):	20		

Additional laboratory reporting information available upon request.

Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Liquid Limit, Plastic Limit and Plasticity Index of Soils

(ASTM D4318, MTO LS-703/704)

Client:	Vargas P. Inc.	**Lab no.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project no.:**	12662438-01

Borehole no.:	BH5-25	Sample no.:	SS7	Sample Depth:	6.1-6.7m
Soil Description:				Date sampled:	-

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B23-002667	Spatula no.:	1
Sieve no.:	0.425	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	15	22	32
Water Content:			
Tare no.	17	737	132
Wet soil+tare, g	34.34	29.75	33.44
Dry soil+tare, g	32.22	28.35	31.64
Mass of water, g	2.12	1.40	1.80
Tare, g	21.67	21.19	22.06
Mass of soil, g	10.55	7.16	9.58
Water content %	20.1%	19.6%	18.8%

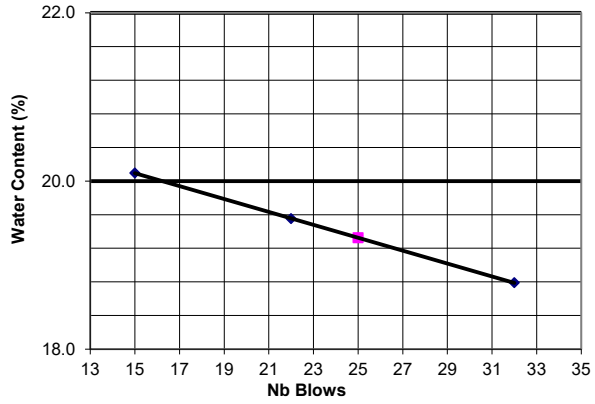
Plastic Limit (PL) - Water Content:		
Tare no.	24	142
Wet soil+tare, g	29.39	28.98
Dry soil+tare, g	28.33	27.97
Mass of water, g	1.06	1.01
Tare, g	21.59	21.51
Mass of soil, g	6.74	6.46
Water content %	15.7%	15.6%
Average water content %	15.7%	

Natural Water Content (W^n):		
Tare no.	BOWL	
Wet soil+tare, g	1083.43	
Dry soil+tare, g	954.20	
Mass of water, g	129.23	
Tare, g	197.50	
Mass of soil, g	756.70	
Water content %	17.1%	

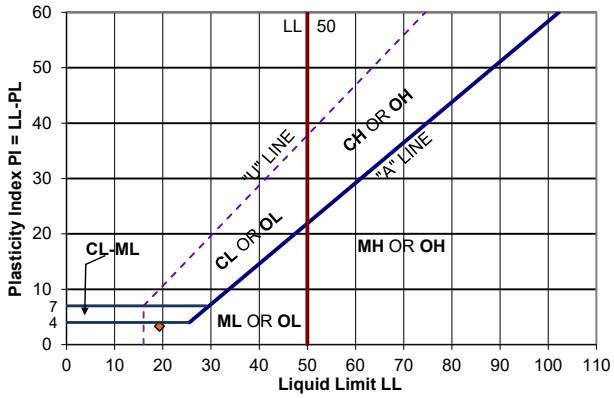
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation (oven dried))
- ☐ Dry preparation (air dried)
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content Wn
19	16	3	17.1

Plasticity Chart based on ASTM D2487. Additional laboratory reporting information available upon request.

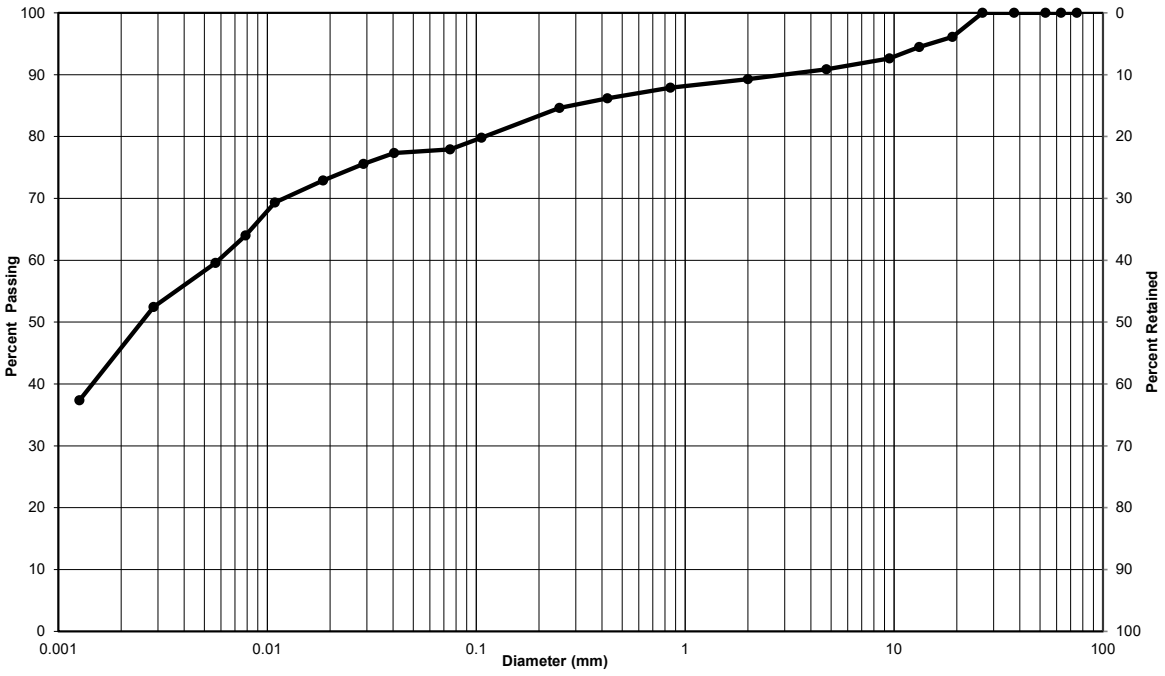
Remarks:

Performed by:	Josh Sullvan	**Date:**	April 9, 2025
Reviewed by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH6-25	Sample No.:	SS6
Depth:	4.6-5.2m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty clay, some sand, trace gravel	9	13	78
Silt-size particles (%) :	34		
Clay-size particles (%) (<0.002 mm):	44		

Additional laboratory reporting information available upon request.

Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Liquid Limit, Plastic Limit and Plasticity Index of Soils

(ASTM D4318, MTO LS-703/704)

Client:	Vargas P. Inc.	**Lab no.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project no.:**	12662438-01

Borehole no.:	BH6-25	Sample no.:	SS6	Sample Depth:	4.6-5.2m
Soil Description:				Date sampled:	-

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B23-002667	Spatula no.:	1
Sieve no.:	0.425	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	35	29	19
Water Content:			
Tare no.	1	71	401
Wet soil+tare, g	31.55	28.33	30.46
Dry soil+tare, g	29.41	26.70	28.30
Mass of water, g	2.14	1.63	2.16
Tare, g	21.68	21.05	21.21
Mass of soil, g	7.73	5.65	7.09
Water content %	27.7%	28.8%	30.5%

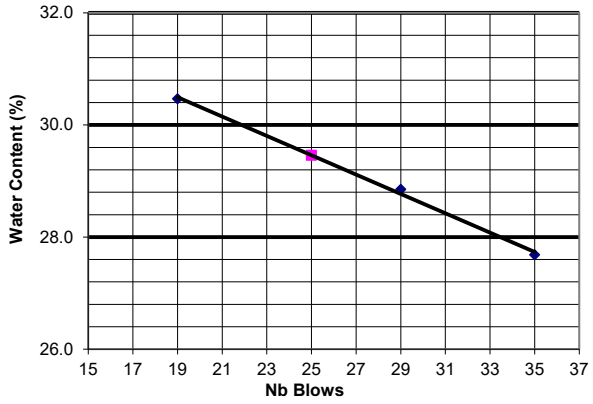
Plastic Limit (PL) - Water Content:		
Tare no.	326	330
Wet soil+tare, g	30.13	29.87
Dry soil+tare, g	28.77	28.57
Mass of water, g	1.36	1.30
Tare, g	21.11	21.07
Mass of soil, g	7.66	7.50
Water content %	17.8%	17.3%
Average water content %	17.5%	

Natural Water Content (W^n):		
Tare no.	BOWL	
Wet soil+tare, g	1252.80	
Dry soil+tare, g	1095.82	
Mass of water, g	156.98	
Tare, g	193.48	
Mass of soil, g	902.34	
Water content %	17.4%	

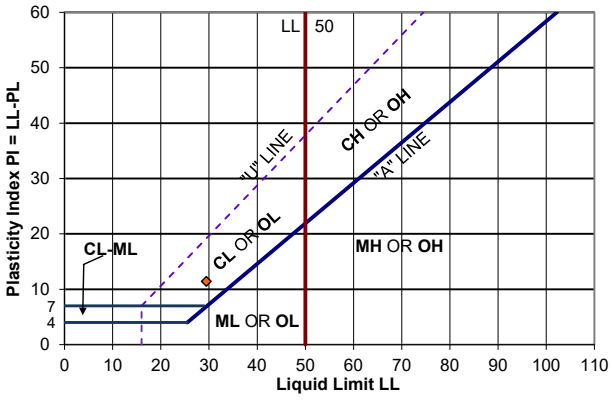
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation (oven dried))
- ☐ Dry preparation (air dried)
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content Wn
29	18	11	17.4

Plasticity Chart based on ASTM D2487. Additional laboratory reporting information available upon request.

Remarks:

Performed by: Josh Sullvan **Date:** April 9, 2025

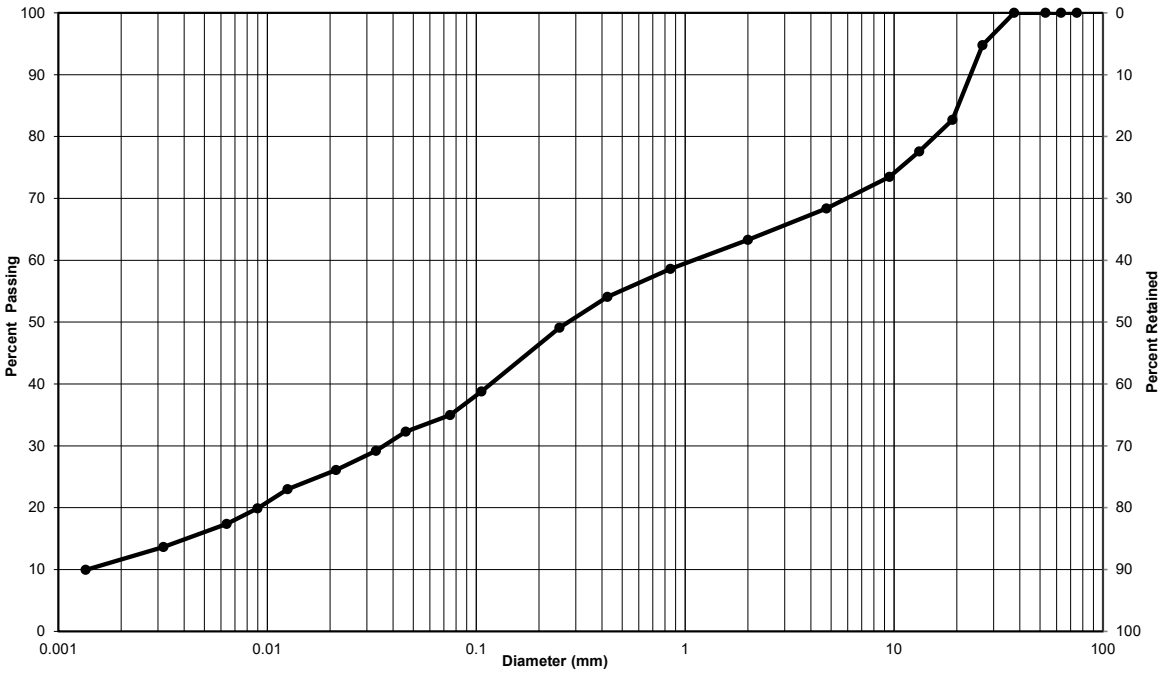
Reviewed by: Joe Sullivan **Date:** April 9, 2025

Laboratory Location: GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH7-25	Sample No.:	SS3
Depth:	1.5-2.1m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Gravelly, silty sand, some clay	32	33	35
Silt-size particles (%) :	24		
Clay-size particles (%) (<0.002 mm):	11		

Additional laboratory reporting information available upon request.

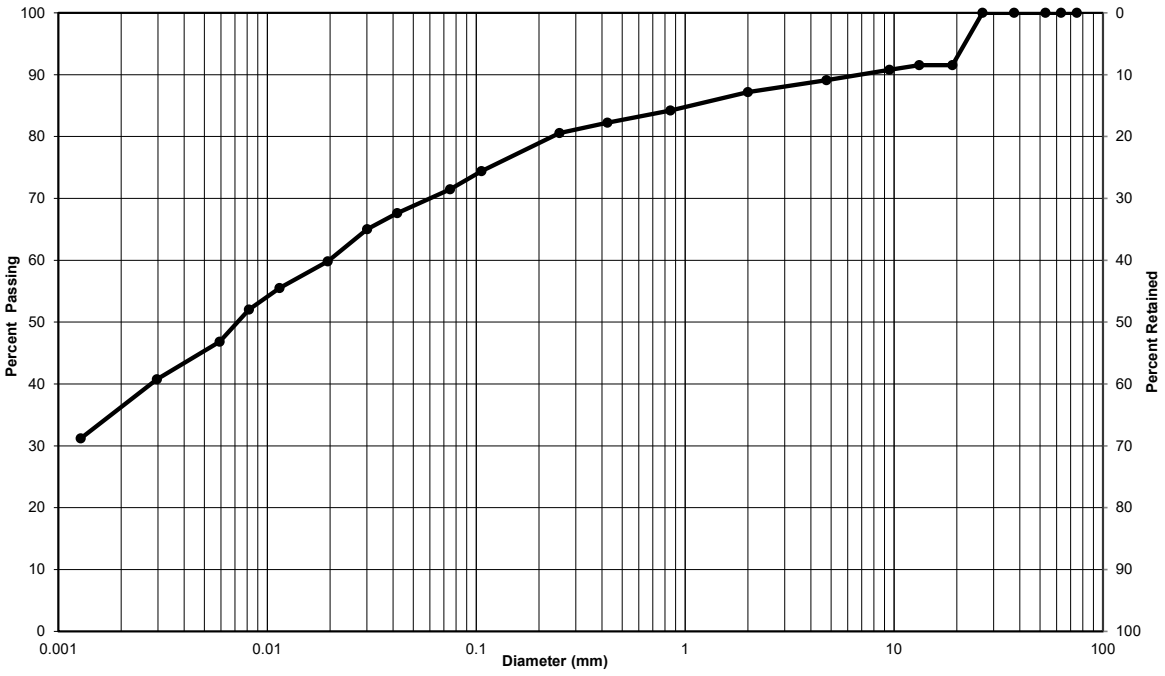
Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH10-25	Sample No.:	SS4
Depth:	2.3-2.9m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt and clay, some sand and gravel	11	18	71
Silt-size particles (%) :	36		
Clay-size particles (%) (<0.002 mm):	35		

Additional laboratory reporting information available upon request.

Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Liquid Limit, Plastic Limit and Plasticity Index of Soils

(ASTM D4318, MTO LS-703/704)

Client:	Vargas P. Inc.	**Lab no.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project no.:**	12662438-01

Borehole no.:	BH10-25	Sample no.:	SS4	Sample Depth:	2.3-2.9m
Soil Description:				Date sampled:	-

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B23-002667	Spatula no.:	1
Sieve no.:	0.425	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	35	21	15
Water Content:			
Tare no.	317	320	325
Wet soil+tare, g	29.83	28.87	29.42
Dry soil+tare, g	27.79	26.97	27.31
Mass of water, g	2.04	1.90	2.11
Tare, g	21.20	21.15	21.06
Mass of soil, g	6.59	5.82	6.25
Water content %	31.0%	32.6%	33.8%

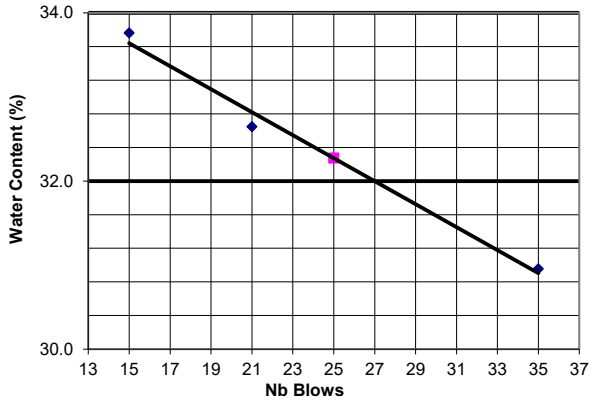
Plastic Limit (PL) - Water Content:		
Tare no.	10	17
Wet soil+tare, g	30.17	31.37
Dry soil+tare, g	29.07	30.12
Mass of water, g	1.10	1.25
Tare, g	21.59	21.79
Mass of soil, g	7.48	8.33
Water content %	14.7%	15.0%
Average water content %	14.9%	

Natural Water Content (W^n):		
Tare no.	BOWL	
Wet soil+tare, g	490.85	
Dry soil+tare, g	432.76	
Mass of water, g	58.09	
Tare, g	158.96	
Mass of soil, g	273.80	
Water content %	21.2%	

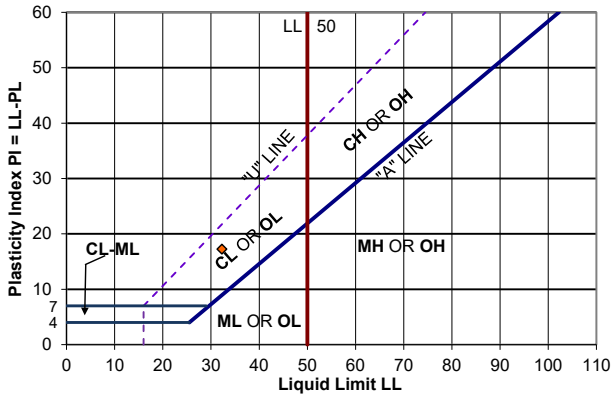
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation (oven dried))
- ☐ Dry preparation (air dried)
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content Wn
32	15	17	21.2

Plasticity Chart based on ASTM D2487. Additional laboratory reporting information available upon request.

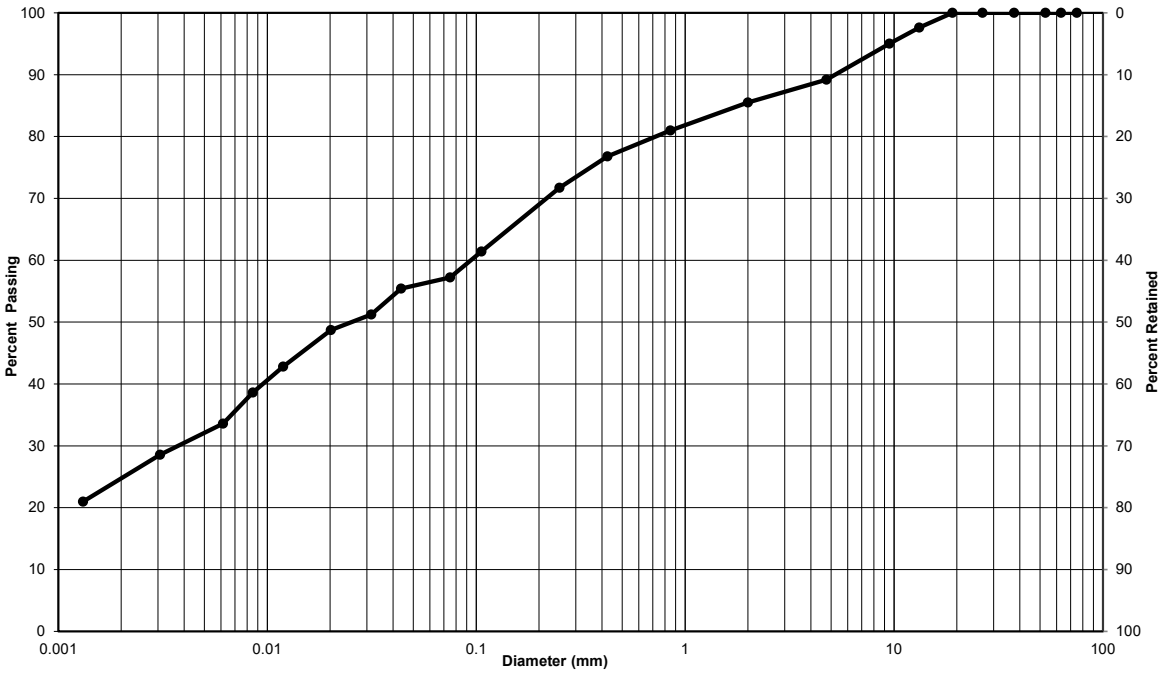
Remarks:

Performed by:	Josh Sullvan	**Date:**	April 9, 2025
Reviewed by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH13-25	Sample No.:	SS6
Depth:	4.6-5.2m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy, clayey silt, some gravel	11	32	57
Silt-size particles (%) :	33		
Clay-size particles (%) (<0.002 mm):	24		

Additional laboratory reporting information available upon request.

Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Liquid Limit, Plastic Limit and Plasticity Index of Soils

(ASTM D4318, MTO LS-703/704)

Client:	Vargas P. Inc.	**Lab no.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project no.:**	12662438-01

Borehole no.:	BH13-25	Sample no.:	SS6	Sample Depth:	4.6-5.2m
Soil Description:				Date sampled:	-

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B23-002667	Spatula no.:	1
Sieve no.:	0.425	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	15	24	29
Water Content:			
Tare no.	118	303	324
Wet soil+tare, g	30.76	31.74	29.82
Dry soil+tare, g	29.27	30.16	28.53
Mass of water, g	1.49	1.58	1.29
Tare, g	21.78	21.49	21.20
Mass of soil, g	7.49	8.67	7.33
Water content %	19.9%	18.2%	17.6%

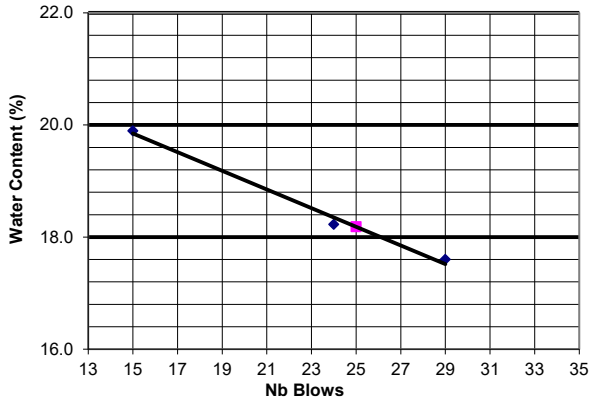
Plastic Limit (PL) - Water Content:		
Tare no.	321	322
Wet soil+tare, g	30.33	30.15
Dry soil+tare, g	29.39	29.23
Mass of water, g	0.94	0.92
Tare, g	21.14	21.16
Mass of soil, g	8.25	8.07
Water content %	11.4%	11.4%
Average water content %	11.4%	

Natural Water Content (W^n):		
Tare no.	BOWL	
Wet soil+tare, g	783.23	
Dry soil+tare, g	714.83	
Mass of water, g	68.40	
Tare, g	210.91	
Mass of soil, g	503.92	
Water content %	13.6%	

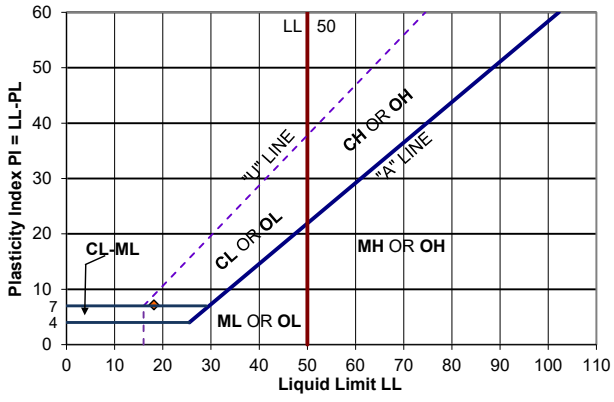
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation (oven dried))
- ☐ Dry preparation (air dried)
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content Wn
18	11	7	13.6

Plasticity Chart based on ASTM D2487. Additional laboratory reporting information available upon request.

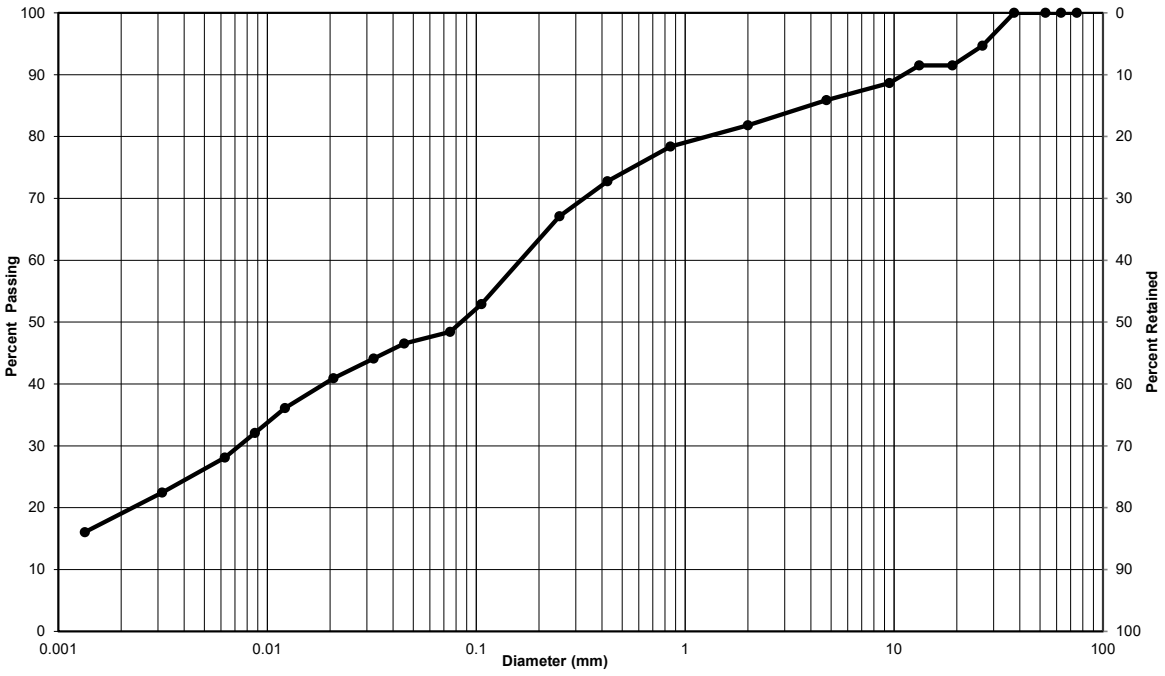
Remarks:

Performed by:	Josh Sullvan	**Date:**	April 9, 2025
Reviewed by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Particle-Size Analysis of Soils

MTO LS-702/ASTM D422 (Geotechnical)

Client:	Vargas P Inc.	**Lab No.:**	SS-25-26
Project/Site:	Fallis Line, Millbrook, ON	**Project No.:**	12662438-01
Borehole No.:	BH14-25	Sample No.:	SS4
Depth:	2.3-2.9m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand, some clay and gravel	14	38	48
Silt-size particles (%) :	30		
Clay-size particles (%) (<0.002 mm):	18		

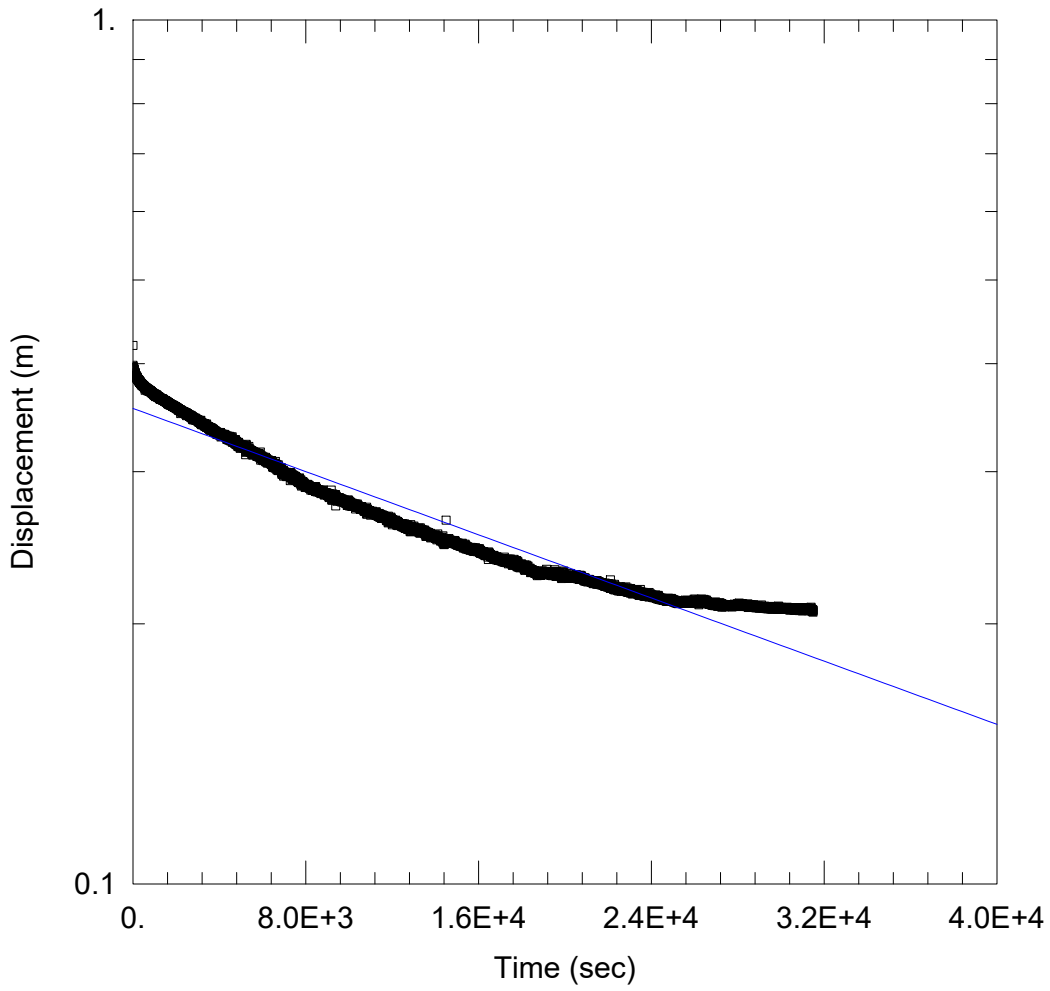
Additional laboratory reporting information available upon request.

Remarks:

Performed by:	Alex Fawcett	**Date:**	April 9, 2025
Verified by:	Joe Sullivan	**Date:**	April 9, 2025
Laboratory Location:	GHD Limited - 347 Pido Road, Unit 29, Peterborough, ON		

Appendix D

Single Well Response Testing Results



MW1-25: FALLING HEAD TEST

Data Set: N:\...\12662438-SWRT-MW1-25-FH.aqt
Date: 04/29/25 Time: 10:08:23

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW1-25
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 2.43 m Anisotropy Ratio (Kz/Kr): 1.

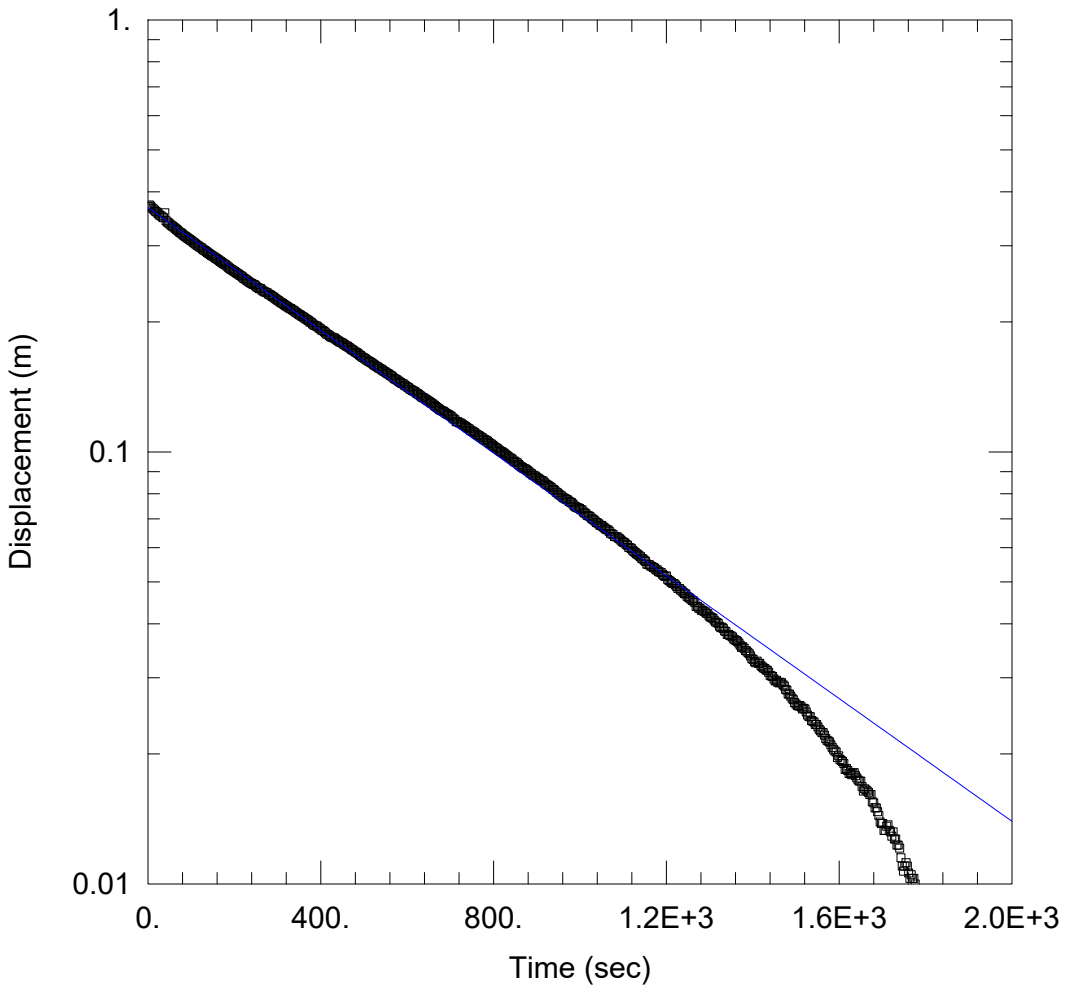
WELL DATA (MW1-25)

Initial Displacement: 0.42 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.43 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.178E-8 m/sec y0 = 0.3551 m



MW3-25: FALLING HEAD TEST

Data Set: N:\...\12662438-SWRT-MW3-25-FH.aqt
Date: 04/29/25 Time: 10:11:11

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW3-25
Test Date: 25/03/24

AQUIFER DATA

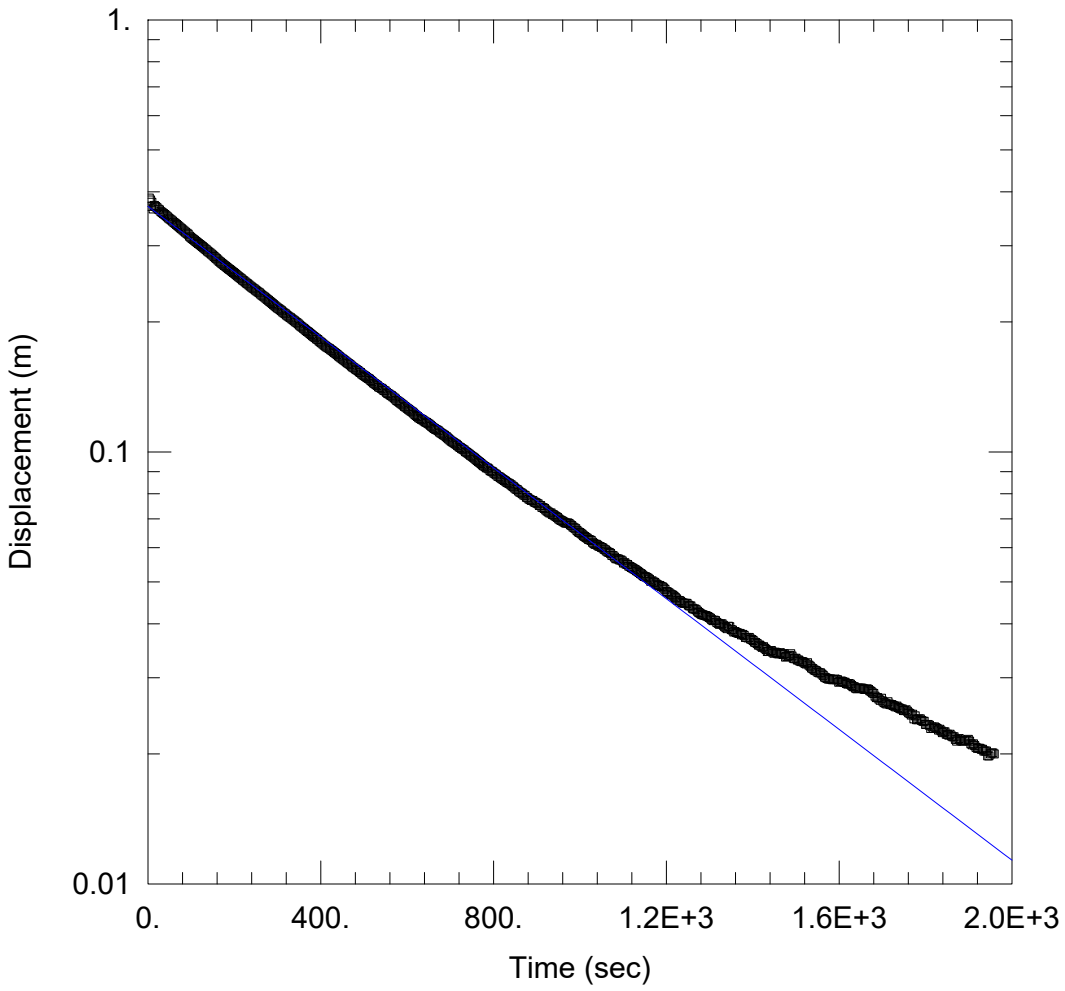
Saturated Thickness: 2.57 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW3-25)

Initial Displacement: 0.37 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.57 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 9.156E-7 m/sec
y0 = 0.3678 m



MW3-25: RISING HEAD TEST

Data Set: N:\...\12662438-SWRT-MW3-25-RH.aqt
Date: 04/29/25 Time: 10:12:08

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW3-25
Test Date: 25/03/24

AQUIFER DATA

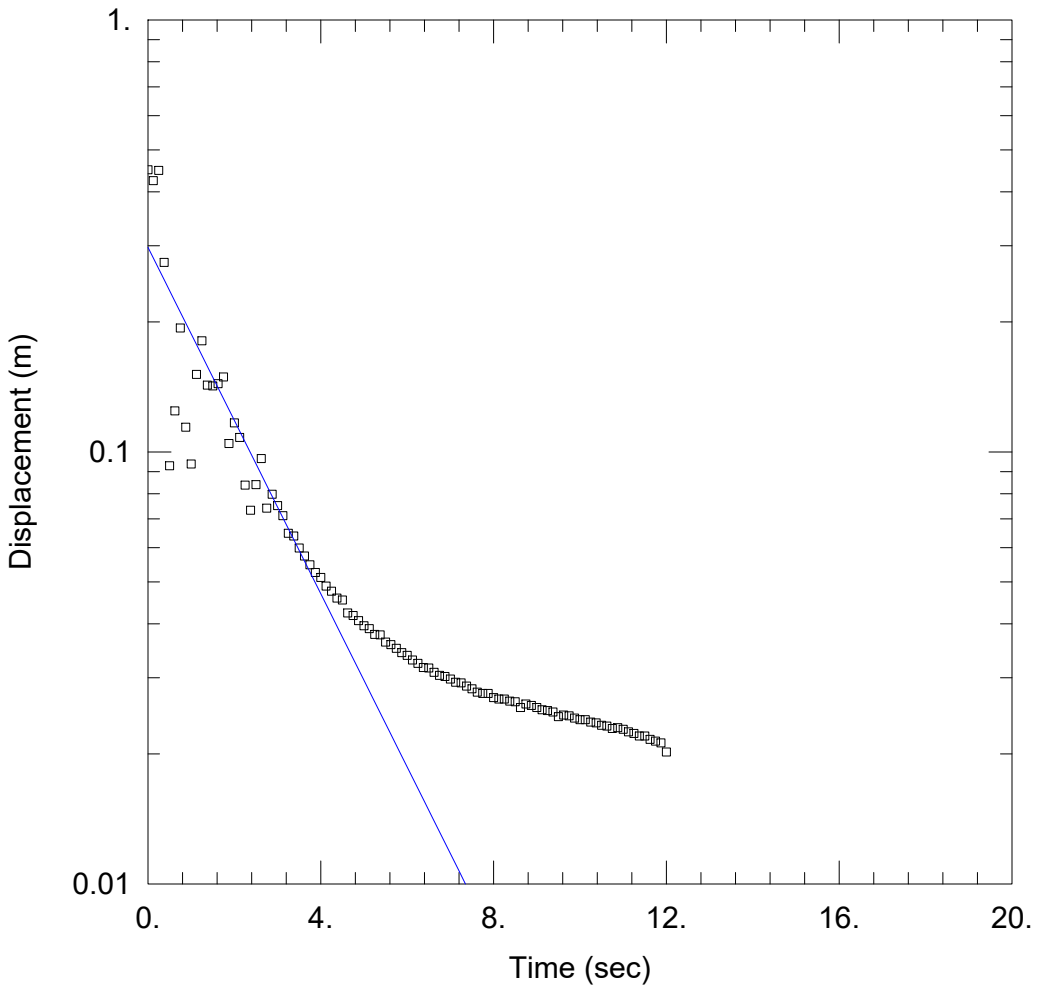
Saturated Thickness: 2.57 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW3-25)

Initial Displacement: 0.37 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.57 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 9.754E-7 m/sec
y0 = 0.3701 m



MW4-25: FALLING HEAD TEST 1

Data Set: N:\...\12662438-SWRT-MW4-25-FH1.aqt
Date: 04/29/25 Time: 10:13:19

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 2.15 m Anisotropy Ratio (Kz/Kr): 1.

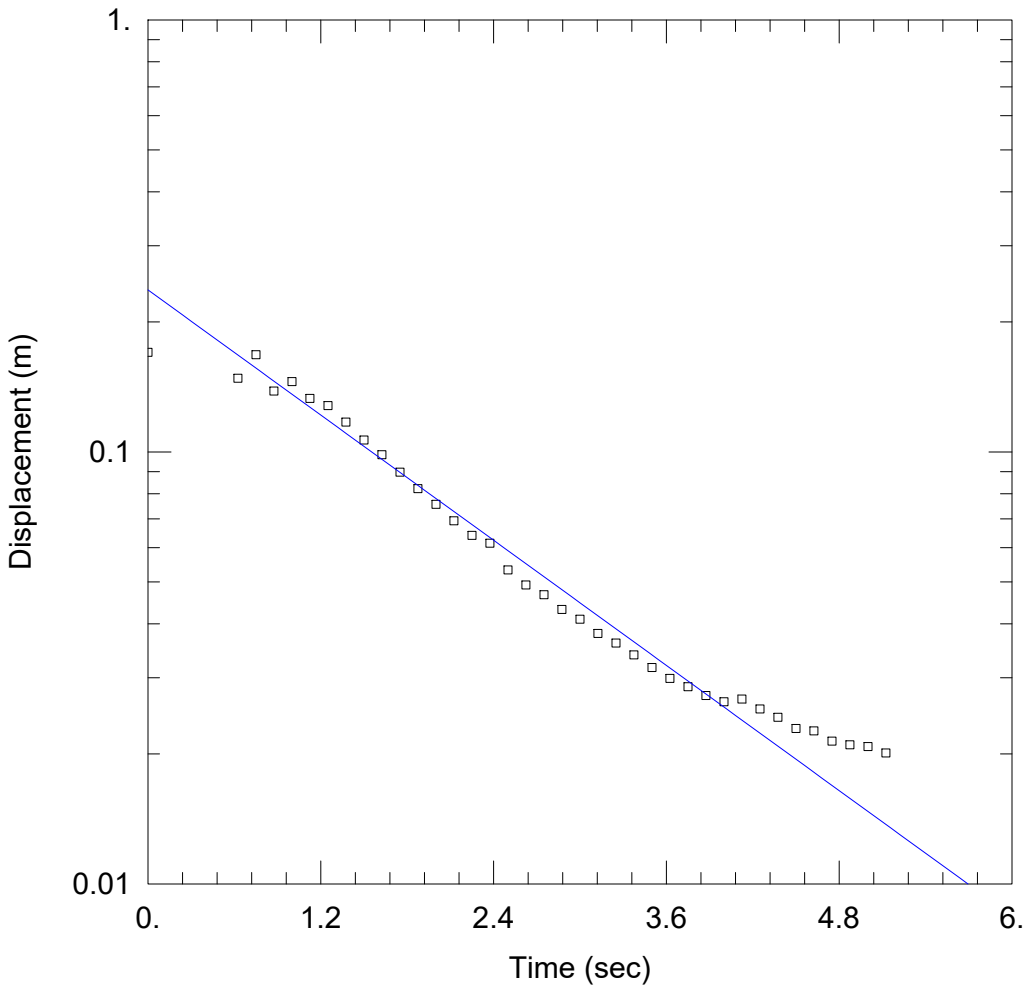
WELL DATA (MW4-25)

Initial Displacement: 0.45 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0002584 m/sec
y0 = 0.2976 m



MW4-25: FALLING HEAD TEST 2

Data Set: N:\...\12662438-SWRT-MW4-25-FH2.aqt
Date: 04/29/25 Time: 10:14:20

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 2.15 m Anisotropy Ratio (Kz/Kr): 1.

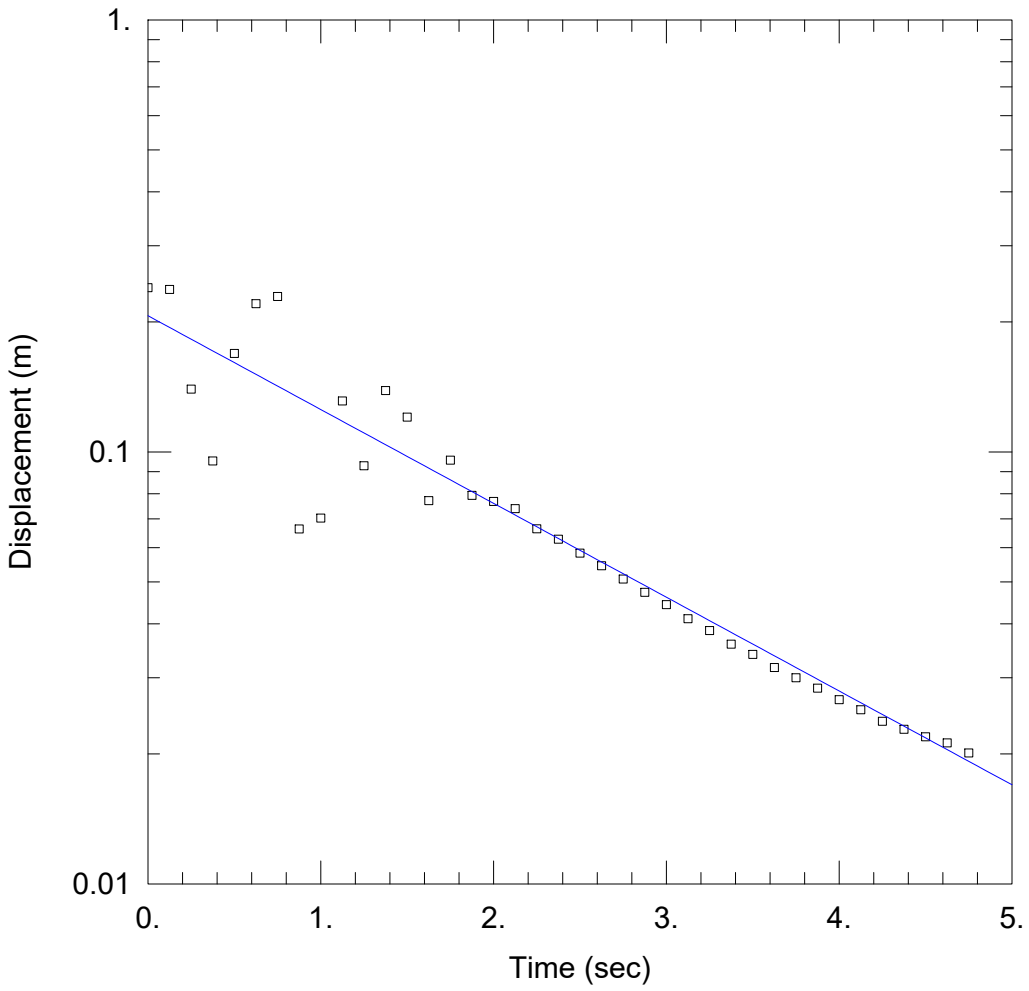
WELL DATA (MW4-25)

Initial Displacement: 0.17 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0003112 m/sec
y0 = 0.2371 m



MW4-25: FALLING HEAD TEST 3

Data Set: N:\...\12662438-SWRT-MW4-25-FH3.aqt
Date: 04/29/25 Time: 10:15:28

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 2.15 m Anisotropy Ratio (Kz/Kr): 1.

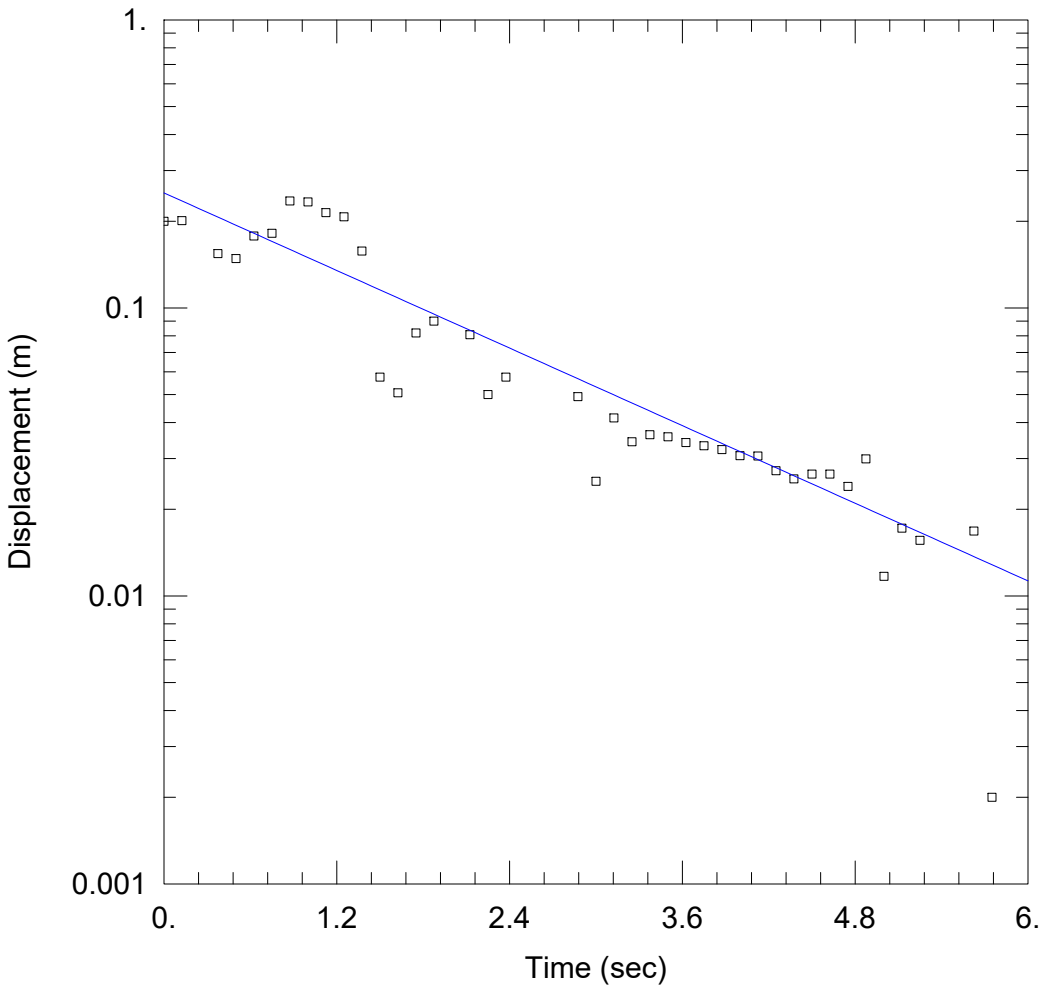
WELL DATA (MW4-25)

Initial Displacement: 0.24 m Static Water Column Height: 2.15 m
Total Well Penetration Depth: 3.05 m Screen Length: 1.51 m
Casing Radius: 0.0254 m Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0002798 m/sec y0 = 0.2066 m



MW4-25: FALLING HEAD TEST 4

Data Set: N:\...\12662438-SWRT-MW4-25-FH4.aqt
Date: 04/29/25 Time: 10:16:19

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

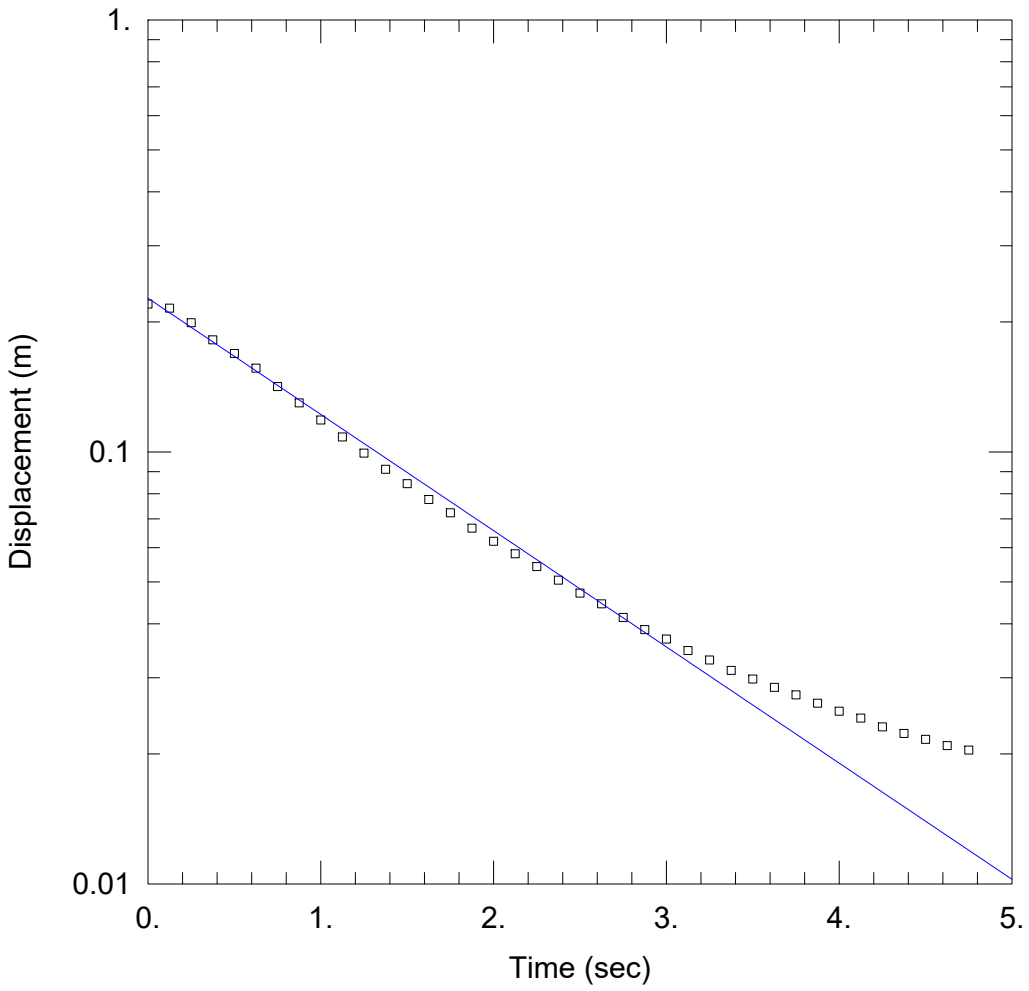
Saturated Thickness: 2.15 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4-25)

Initial Displacement: 0.2 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0002893 m/sec
y0 = 0.2508 m



MW4-25: RISING HEAD TEST 1

Data Set: N:\...\12662438-SWRT-MW4-25-RH1.aqt
Date: 04/29/25 Time: 10:17:17

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

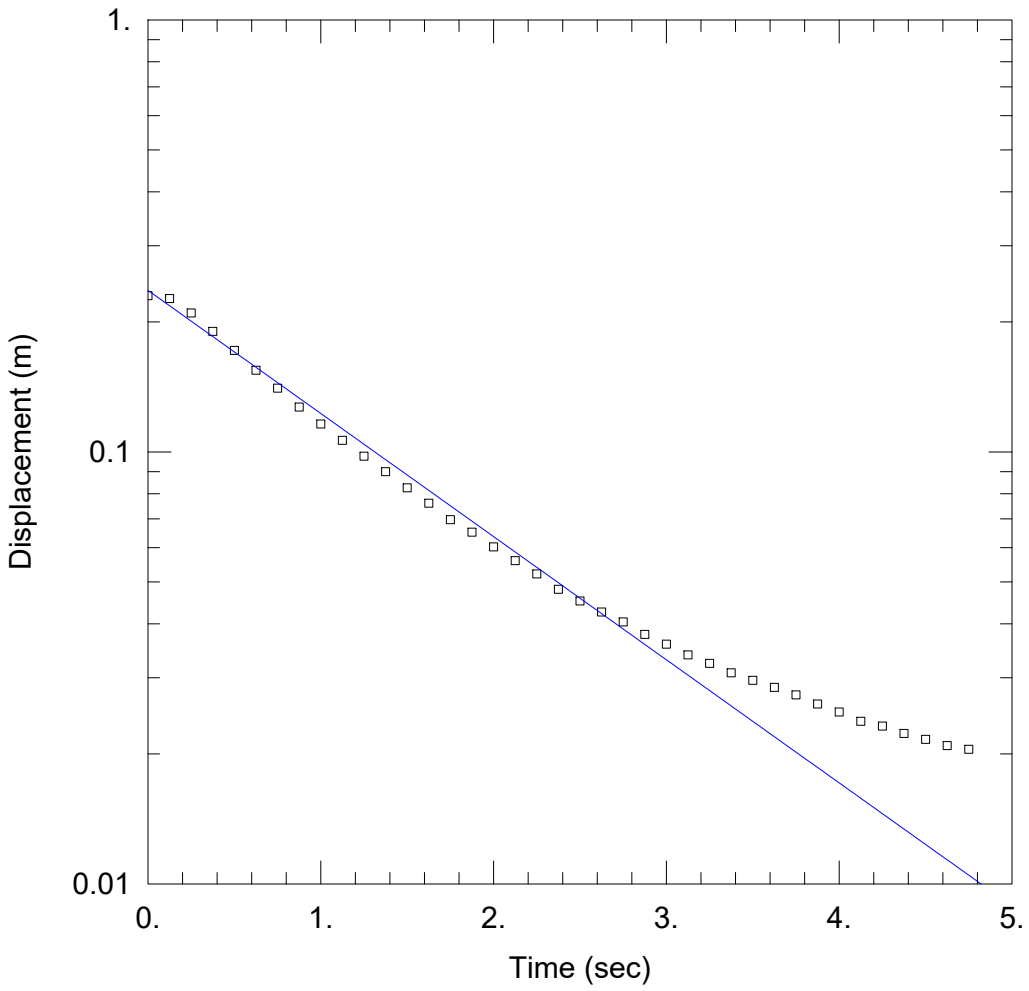
Saturated Thickness: 2.15 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4-25)

Initial Displacement: 0.22 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003467 m/sec
y0 = 0.2268 m



MW4-25: RISING HEAD TEST 2

Data Set: N:\...\12662438-SWRT-MW4-25-RH2.aqt
Date: 04/29/25 Time: 10:18:12

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

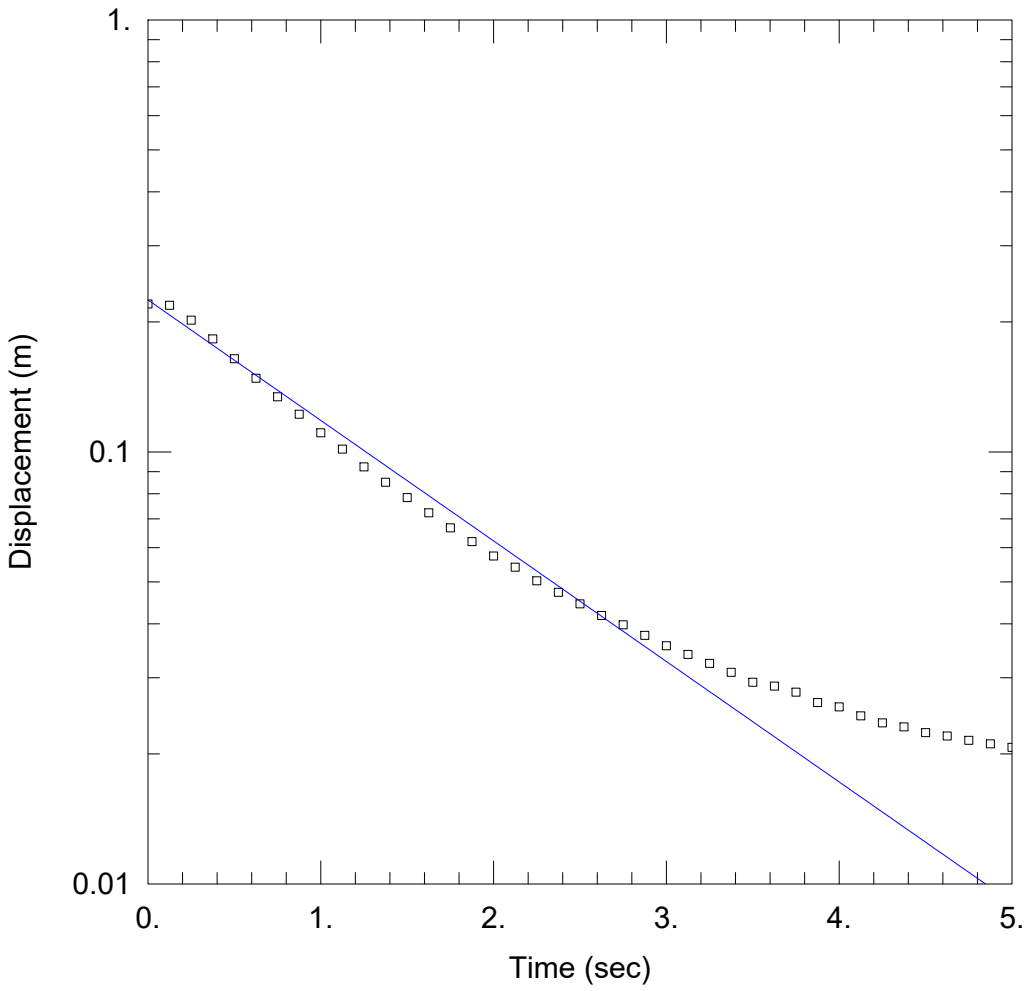
Saturated Thickness: 2.15 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4-25)

Initial Displacement: 0.23 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003673 m/sec
y0 = 0.2366 m



MW4-25: RISING HEAD TEST 3

Data Set: N:\...\12662438-SWRT-MW4-25-RH3.aqt
Date: 04/29/25 Time: 10:19:03

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

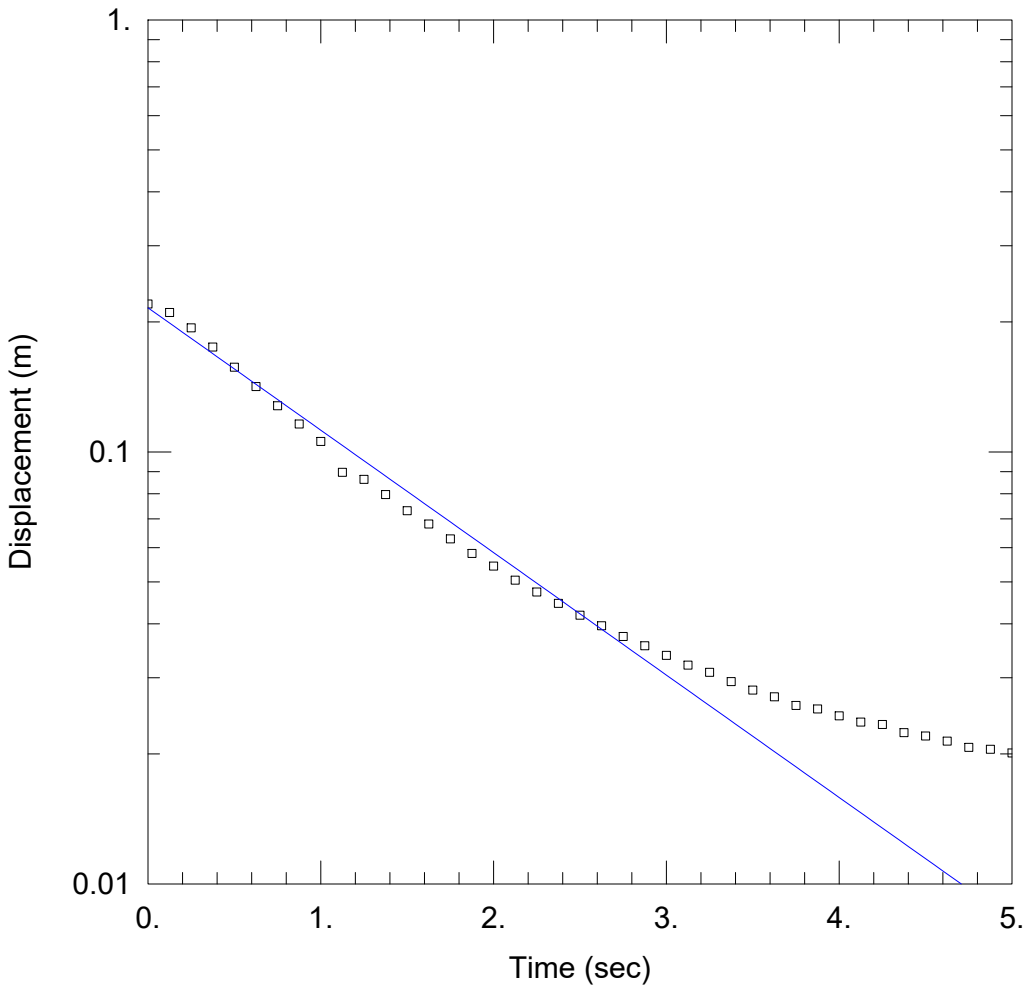
Saturated Thickness: 2.15 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4-25)

Initial Displacement: 0.22 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003594 m/sec
y0 = 0.2248 m



MW4-25: RISING HEAD TEST 4

Data Set: N:\...\12662438-SWRT-MW4-25-RH4.aqt
Date: 04/29/25 Time: 10:19:58

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW4-25
Test Date: 25/03/24

AQUIFER DATA

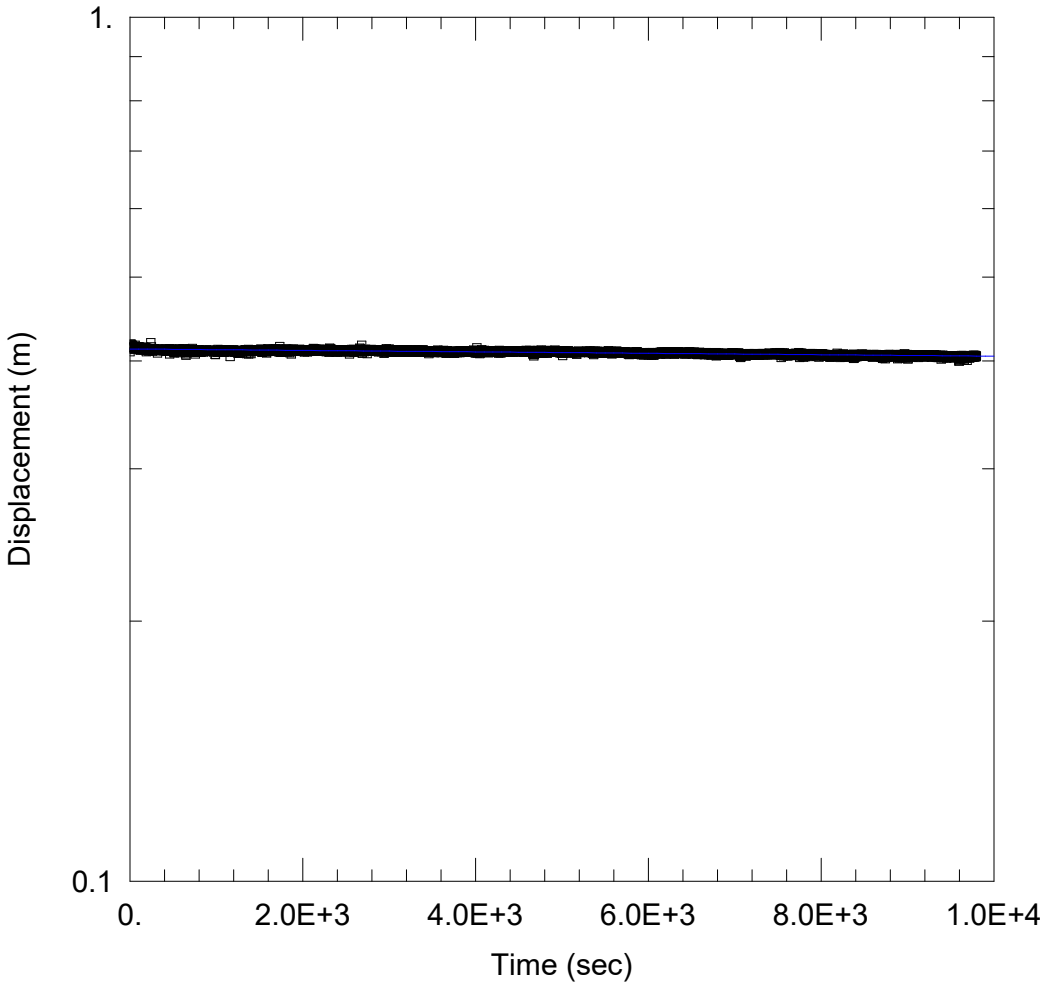
Saturated Thickness: 2.15 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4-25)

Initial Displacement: 0.22 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.15 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003652 m/sec
y0 = 0.2156 m



MW6-25D: FALLING HEAD TEST

Data Set: N:\...\12662438-SP-19-MW6-25D.aqt
Date: 03/25/25 Time: 13:40:12

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW6-25D
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 5.31 m Anisotropy Ratio (Kz/Kr): 1.

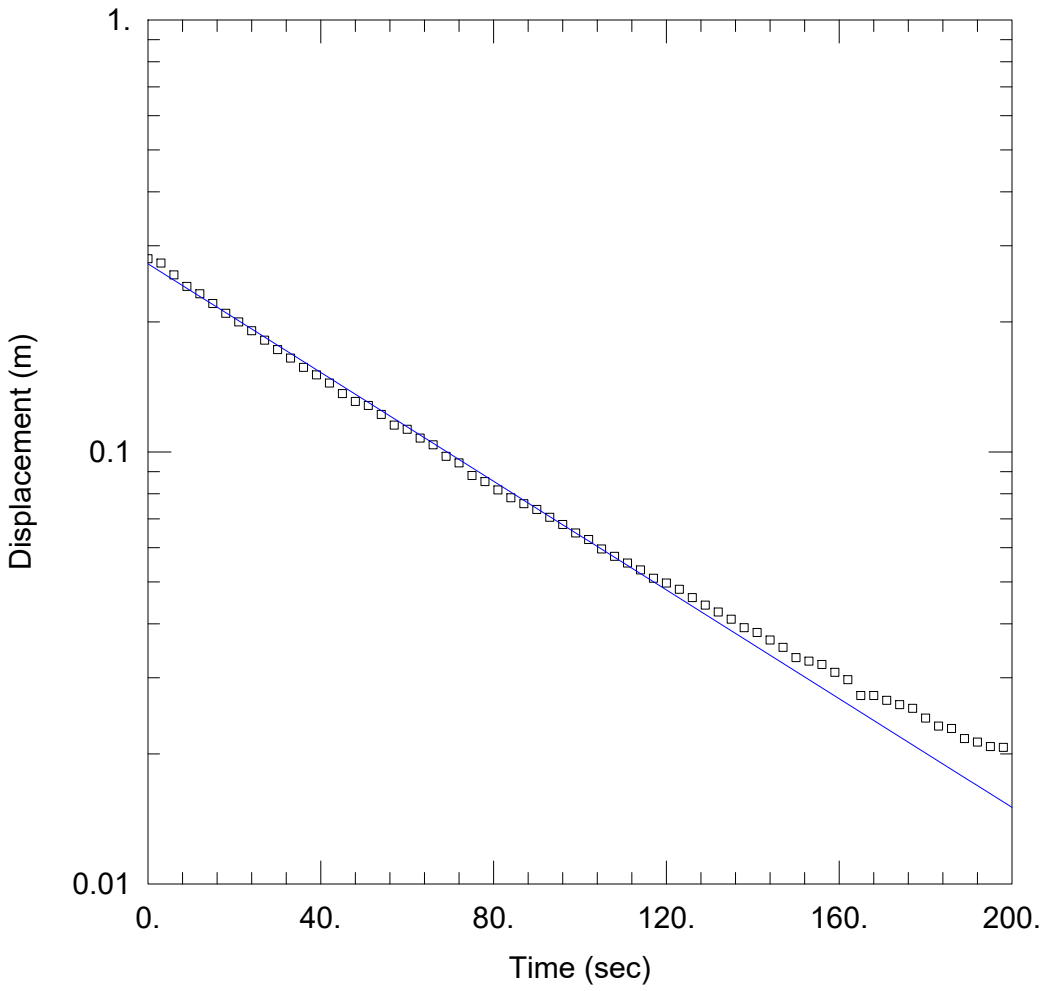
WELL DATA (MW6-25D)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 5.31 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.31 m
Screen Length: 1.51 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.603E-9 m/sec y0 = 0.413 m



MW6-25S: FALLING HEAD TEST 1

Data Set: N:\...\12662438-SWRT-MW6-25S FH1.aqt
Date: 04/29/25 Time: 10:21:24

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW6-25S
Test Date: 25/03/24

AQUIFER DATA

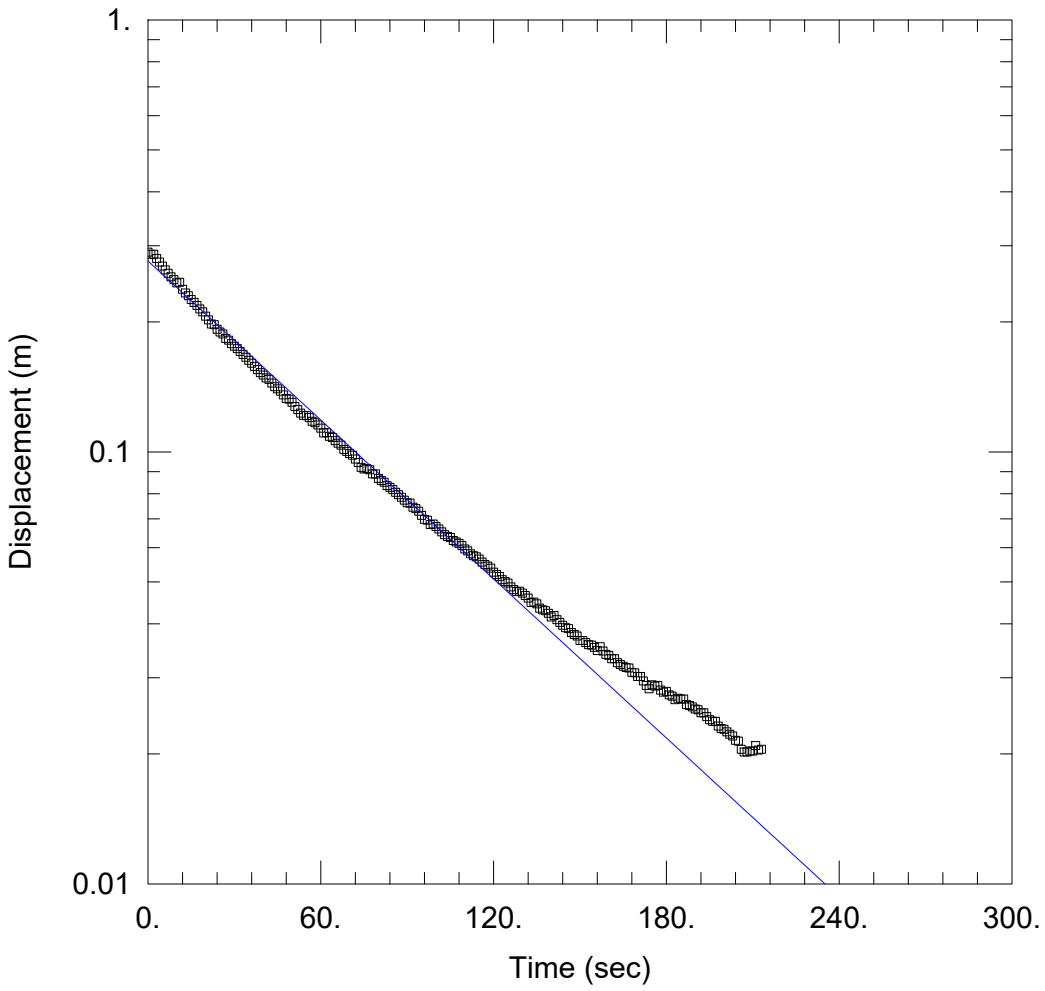
Saturated Thickness: 2.5 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6-25S)

Initial Displacement: 0.28 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.5 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 8.11E-6 m/sec
y0 = 0.2726 m



MW6-25S: FALLING HEAD TEST 2

Data Set: N:\...\12662438-SWRT-MW6-25S FH2.aqt
Date: 04/29/25 Time: 10:22:46

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW6-25S
Test Date: 25/03/24

AQUIFER DATA

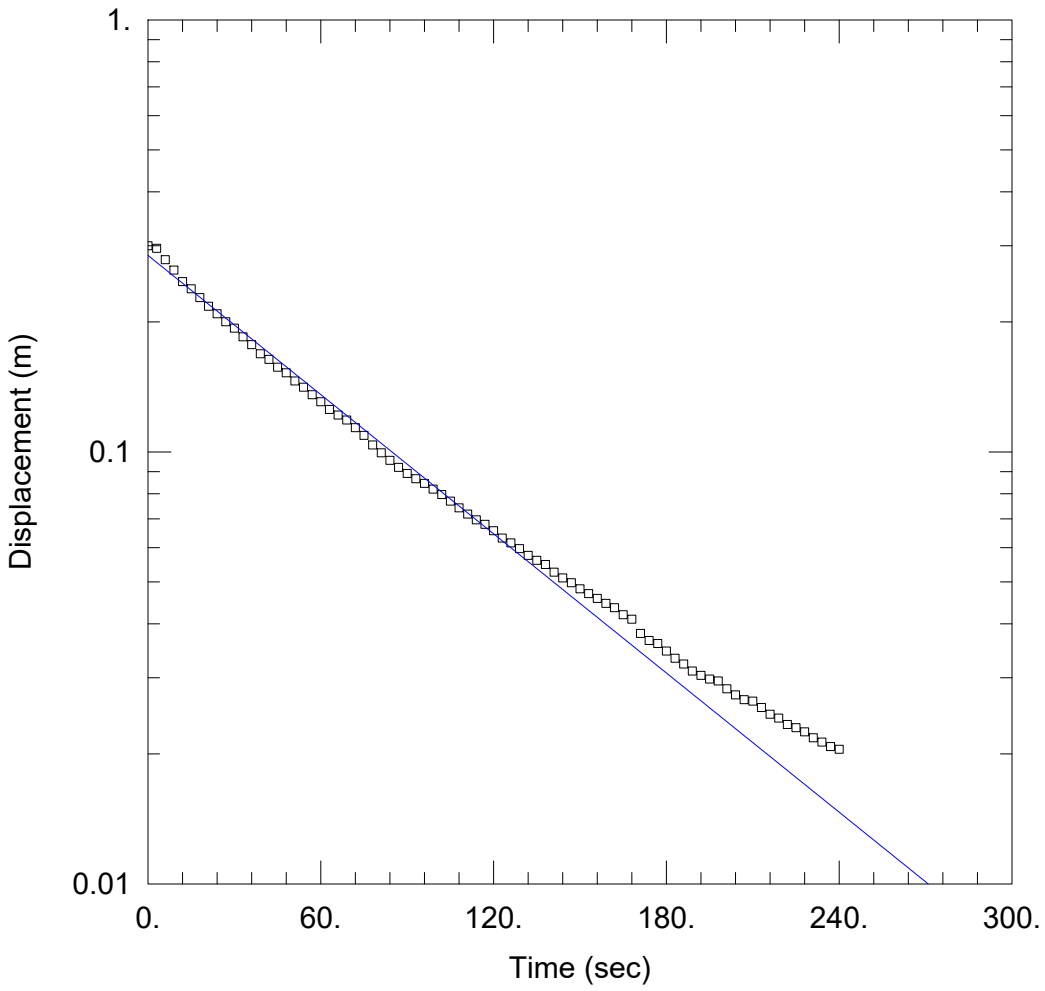
Saturated Thickness: 2.5 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6-25S)

Initial Displacement: 0.29 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.5 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 7.906E-6 m/sec
y0 = 0.2766 m



MW6-25S: RISING HEAD TEST 1

Data Set: N:\...\12662438-SWRT-MW6-25S RH1.aqt
Date: 04/29/25 Time: 10:24:09

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW6-25S
Test Date: 25/03/24

AQUIFER DATA

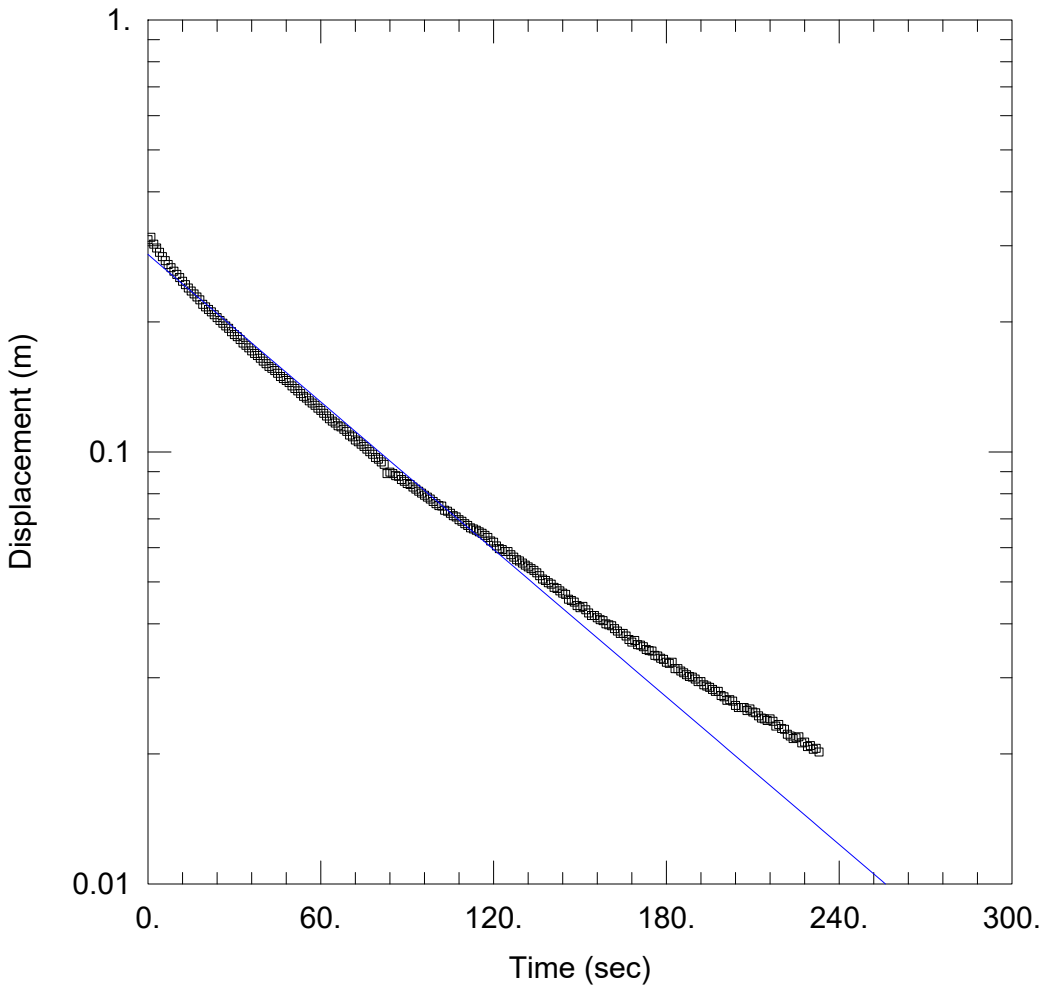
Saturated Thickness: 2.5 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6-25S)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.5 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 6.922E-6 m/sec
y0 = 0.2851 m



MW6-25S: RISING HEAD TEST 2

Data Set: N:\...\12662438-SWRT-MW6-25S RH2.aqt
Date: 04/29/25 Time: 10:25:20

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW6-25S
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 2.5 m Anisotropy Ratio (Kz/Kr): 1.

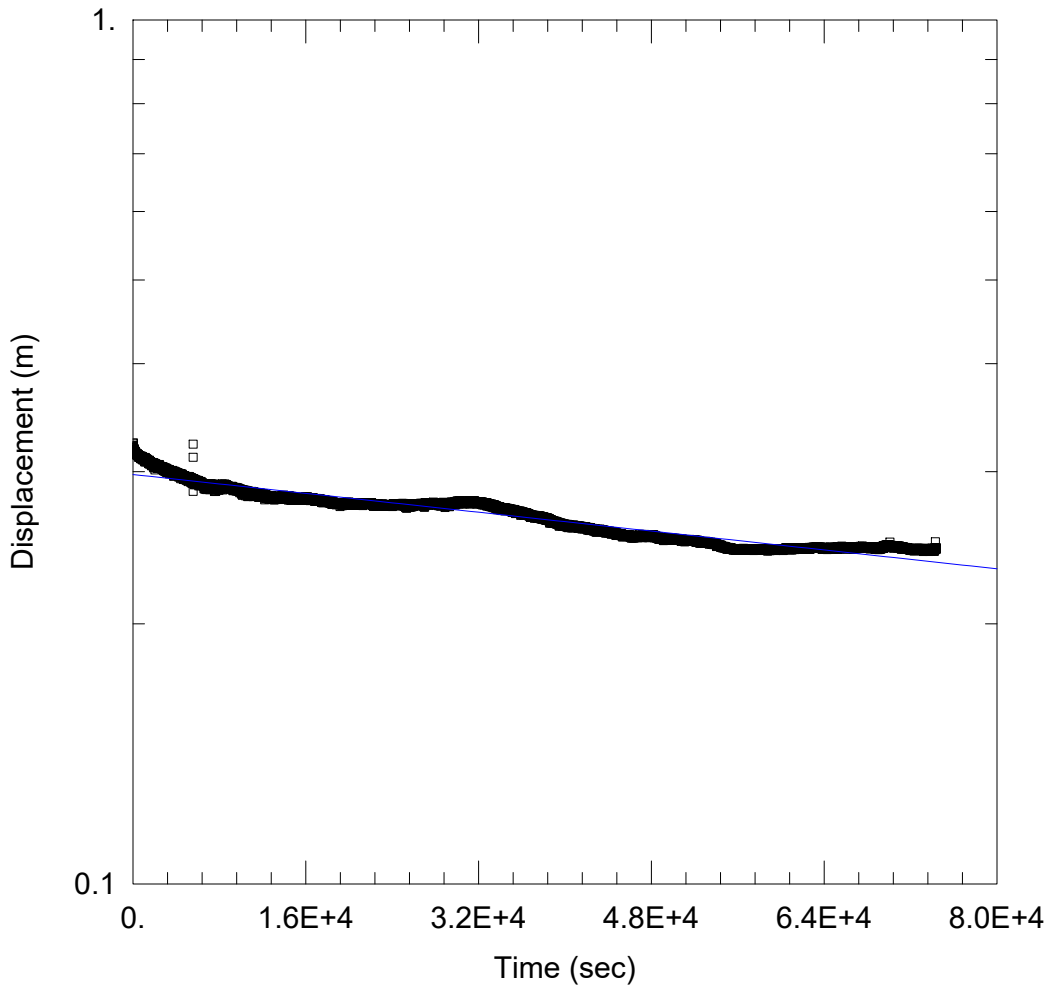
WELL DATA (MW6-25S)

Initial Displacement: 0.31 m Static Water Column Height: 2.5 m
Total Well Penetration Depth: 3.05 m Screen Length: 1.51 m
Casing Radius: 0.0254 m Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 7.334E-6 m/sec y0 = 0.2864 m



MW9-25: FALLING HEAD TEST

Data Set: N:\...\12662438-SWRT-MW9-25 FH.aqt
Date: 04/29/25 Time: 10:27:30

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW9-25
Test Date: 25/03/24

AQUIFER DATA

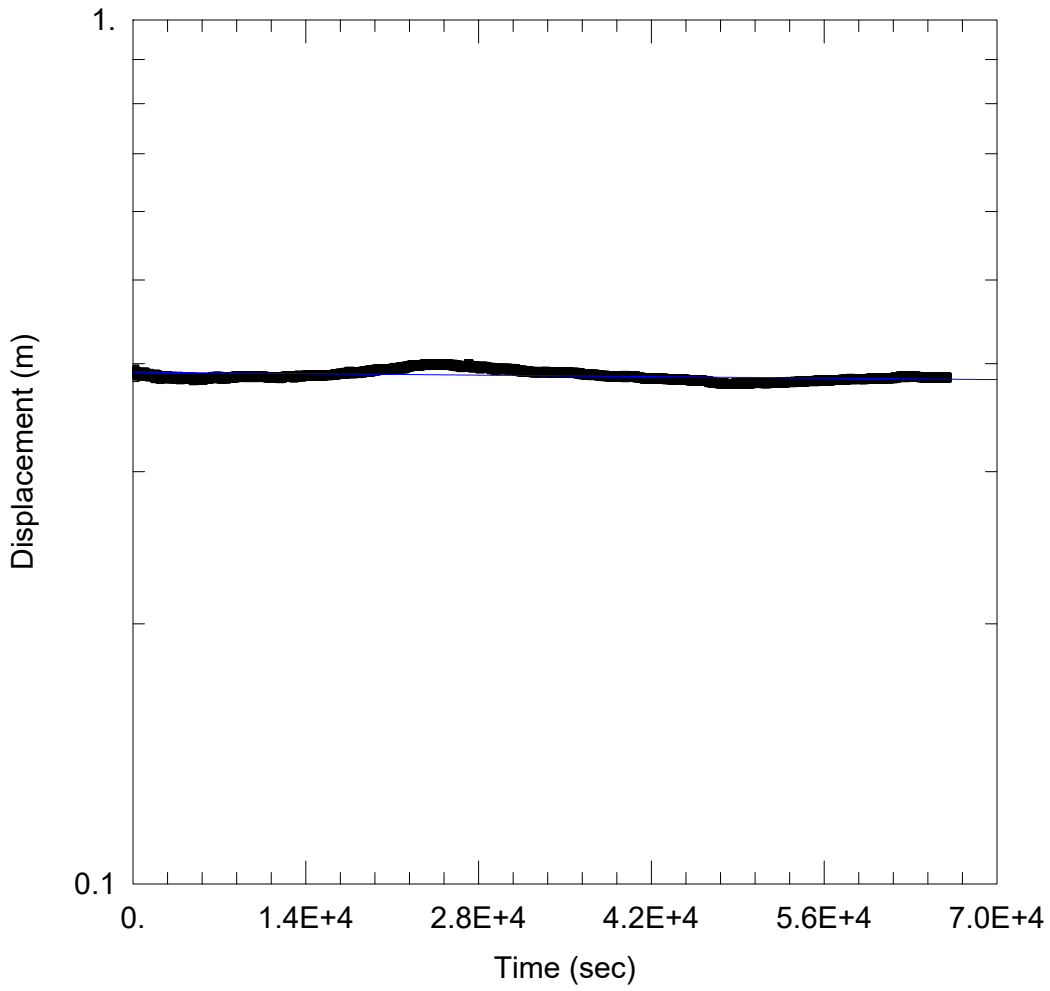
Saturated Thickness: 2.63 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW9-25)

Initial Displacement: 0.32 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.63 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.759E-9 m/sec
y0 = 0.2978 m



MW11-25: FALLING HEAD TEST

Data Set: N:\...\12662438-SWRT-MW11-25 FH.aqt
Date: 04/29/25 Time: 10:29:05

PROJECT INFORMATION

Company: GHD Ltd
Client: Bromont Group
Project: 12662438
Location: Fallis Line, Millbrook
Test Well: MW11-25
Test Date: 25/03/24

AQUIFER DATA

Saturated Thickness: 2.2 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW11-25)

Initial Displacement: 0.39 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.2 m
Screen Length: 1.51 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.584E-10 m/sec
y0 = 0.3911 m

Appendix E

Water Balance Calculations

Appendix E.1

Water Budget (Thornthwaite Method) - Average Values 1991-2020*

Composite Weather Station Name: Peterborough

Composite Station Metadata #: 6166418, 6166420, 6166415 **Elevation:** 191.4 masl **Distance Away:** ~9.9 km

Month	Mean Temperature (°C)	Heat Index	Unadjusted Potential ET (mm)	Daylight Correction Factor	Adjusted ET (mm)	Total Precipitation (mm)	Surplus (mm)	Deficit (mm)
January	-7.6	0	0	0.78	0	66.5	66.50	
February	-7.3	0	0	0.88	0	42.3	42.30	
March	-1.5	0	0	0.99	0	53.6	53.60	
April	5.7	1.22	27.1	1.12	30.4	72.7	42.33	
May	12.5	4.00	61.4	1.22	74.9	79.4	4.49	
June	17.4	6.61	86.6	1.28	110.9	87.8	0.00	23.09
July	19.7	7.97	98.6	1.25	123.2	69.1	0.00	54.13
August	18.6	7.31	92.9	1.15	106.8	77.6	0.00	29.19
September	14.4	4.96	71.1	1.04	74.0	75.7	1.71	
October	8	2.04	38.6	0.92	35.5	74.7	39.20	
November	1.9	0.23	8.6	0.8	6.9	76.3	69.39	
December	-3.9	0	0	0.76	0	64.1	64.10	
TOTAL	6.5	34.3	485.0		562.6	839.8	383.6	106.4

TOTAL WATER SURPLUS: 277.2 mm

Notes:

*Average values of precipitation were used. Average values of temperature were also used.

Appendix E.2

Water Budget: Pre-Development

Catchment Designation →	PRE-DEVELOPMENT SITE						TOTAL
	North Catchment		South Catchment				
General Description →	Naturalized	Agricultural	Agricultural	Naturalized	Existing Residential		
Detailed Description →					Rooftops	Gravel Drive	
Area (m^2)	9600	78023	238003	9600	575	400	336200
Pervious Area (m^2)	9600	78023	238003	9600	0	0	335225
% Pervious	2.9%	23.2%	70.8%	2.9%	0%	0%	99.7%
Impervious Area (m^2)	0	0	0	0	575	400	975
% Impervious	0%	0%	0%	0%	0.2%	0.1%	0.3%
INFILTRATION FACTORS							
Topography Infiltration Factor	0.15	0.15	0.15	0.15	0	0.2	
Soil Infiltration Factor	0.25	0.25	0.25	0.25	0	0.25	
Land Cover Infiltration Factor	0.175	0.1	0.1	0.175	0	0	
MECP Infiltration Factor	0.575	0.5	0.5	0.575	0	0.45	
Actual Infiltration Factor	0.6	0.5	0.5	0.6	0.375	0.2	
Runoff Coefficient	0.4	0.5	0.5	0.4	0.625	0.8	
Runoff from Impervious Surfaces*	0	0	0	0	0.8	0.8	
INPUTS (PER UNIT AREA)							
Precipitation (mm/yr)	840	840	840	840	840	840	840
Run On (mm/yr)	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0
Total Inputs (mm/yr)	840	840	840	840	840	840	840
OUTPUTS (PER UNIT AREA)							
Precipitation Surplus (mm/yr)	277	277	277	277	672	672	278
Net Surplus (mm/yr)	277	277	277	277	672	672	278
Evaportranspiration (mm/yr)	563	563	563	563	168	168	561
Infiltration (mm/yr)	166	139	139	166	0	134	140
Rooftop Infiltration (mm/yr)	0	0	0	0	252	0	0.4
Total Infiltration (mm/yr)	166	139	139	166	252	134	140
Runoff Pervious Areas	111	139	139	111	0	0	137
Runoff Impervious Areas	0	0	0	0	420	537	1
Total Runoff (mm/yr)	111	139	139	111	420	537	138
Total Outputs (mm/yr)	840	840	840	840	840	840	840
Difference (Inputs - Outputs)	0	0	0	0	0	0	0
INPUTS (VOLUMES)							
Precipitation (m^3/yr)	8062	65523	199874	8062	483	336	282341
Run On (m^3/yr)	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	8062	65523	199874	8062	483	336	282341
OUTPUTS (VOLUMES)							
Precipitation Surplus (m^3/yr)	2661	21628	65973	2661	386	269	93578
Net Surplus (m^3/yr)	2661	21628	65973	2661	386	269	93578
Evaportranspiration (m^3/yr)	5401	43896	133901	5401	97	67	188763
Infiltration (m^3/yr)	1597	10814	32987	1597	0	54	47048
Rooftop Infiltration (m^3/yr)	0	0	0	0	145	0	145
Total Infiltration (m^3/yr)	1597	10814	32987	1597	145	54	47192
Runoff Pervious Areas (m^3/yr)	1064	10814	32987	1064	0	0	45929
Runoff Impervious Areas (m^3/yr)	0	0	0	0	241	215	456
Total Runoff (m^3/yr)	1064	10814	32987	1064	241	215	46386
Total Outputs (m^3/yr)	8062	65523	199874	8062	483	336	282341
Difference (Inputs - Outputs)	0	0	0	0	0	0	0

Notes:

Catchment areas refer to areas North and South of the environmental protection block / creek

Naturalized areas are open, vacant areas that are not used for agriculture and are not forested areas

Assume 37.5% of rooftop runoff infiltrates the ground in this scenario.

Appendix E.3

Generic Water Budget: Post-Development - No Mitigation Strategies

POST-DEVELOPMENT SITE — North Sub-Catchment

Catchment Designation	Residential - Single Detached			Med. Density			Road ROWs		Parkland	0.3 m Reserve	Road Widening	Future Residential	Env. Protection
Detailed Description	Lawns	Rooftops	Driveways	Lawns	Rooftops	Asphalt/Concrete	Asphalt	Grass	Grass	Grass	Asphalt	Grass	Naturalized
Blocks	Lot/Block 61B-67B, 68A, 69B-82B, 83C-87C, 88A, 89B-90B, 91C-121C, 122B-127B, 200C-201C			Block 186			Streets A-G		Block 190	Block 195 & 196	Block 197	Block 194	Blocks 192 & 193
Area (m^2)	10954	17214	3130	1545	6695	2060	7637	7637	19300	0	1000	700	9750
Pervious Area (m^2)	10954	0	0	1545	0	0	0	7637	19300	0	0	700	9750
% Pervious	3.3%	0%	0%	0%	0%	0%	0%	2.3%	5.7%	0.0%	0%	0.2%	2.9%
Impervious Area (m^2)	0	17214	3130	0	6695	2060	7637	0	0	0	1000	0	0
% Impervious	0%	5.1%	0.9%	0%	2.0%	0.6%	2.3%	0%	0%	0%	0.3%	0%	0%
INFILTRATION FACTORS													
Topography Infiltration Factor	0.15	0	0	0.15	0	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Soil Infiltration Factor	0.25	0	0	0.25	0	0	0	0.25	0.25	0.25	0	0.25	0.25
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0	0.15	0.15	0.15	0	0.15	0.175
MECP Infiltration Factor	0.55	0	0	0.55	0	0.15	0.15	0.55	0.55	0.55	0.15	0.55	0.575
Actual Infiltration Factor	0.55	0	0	0.55	0	0	0	0.55	0.55	0.55	0	0.55	0.6
Runoff Coefficient	0.45	1	1	0.45	1	1	1	0.45	0.45	0.45	1	0.45	0.4
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0.8	0	0	0	0.8	0	0
INPUTS (PER UNIT AREA)													
Precipitation (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840
OUTPUTS (PER UNIT AREA)													
Precipitation Surplus (mm/yr)	277	672	672	277	672	672	672	277	277	277	672	277	277
Net Surplus (mm/yr)	277	672	672	277	672	672	672	277	277	277	672	277	277
Evaportranspiration (mm/yr)	563	168	168	563	168	168	168	563	563	563	168	563	563
Infiltration (mm/yr)	152	0	0	152	0	0	0	152	152	152	0	152	166
Rooftop Infiltration (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/yr)	152	0	0	152	0	0	0	152	152	152	0	152	166
Runoff Pervious Areas	125	0	0	125	0	0	0	125	125	125	0	125	111
Runoff Impervious Areas	0	672	672	0	672	672	672	0	0	0	672	0	0
Total Runoff (mm/yr)	125	672	672	125	672	672	672	125	125	125	672	125	111
Total Outputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0
INPUTS (VOLUMES)													
Precipitation (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188
OUTPUTS (VOLUMES)													
Precipitation Surplus (m^3/yr)	3037	11565	2103	428	4498	1384	5131	2117	5350	0	672	194	2703
Net Surplus (m^3/yr)	3037	11565	2103	428	4498	1384	5131	2117	5350	0	672	194	2703
Evaportranspiration (m^3/yr)	6163	2891	526	869	1124	346	1283	4296	10858	0	168	394	5485
Infiltration (m^3/yr)	1670	0	0	236	0	0	0	1164	2942	0	0	107	1622
Rooftop to Soakaway Pit Infiltration (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/yr)	1670	0	0	236	0	0	0	1164	2942	0	0	107	1622
Runoff Pervious Areas (m^3/yr)	1366	0	0	193	0	0	0	953	2407	0	0	87	1081
Runoff Impervious Areas (m^3/yr)	0	11565	2103	0	4498	1384	5131	0	0	0	672	0	0
Total Runoff (m^3/yr)	1366	11565	2103	193	4498	1384	5131	953	2407	0	672	87	1081
Total Outputs (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0

POST-DEVELOPMENT SITE — South Sub-Catchment

Catchment Designation	Med. Density			Residential - Single Detached			Env. Protection	Road ROWs		Road Widening	SWM Pond		Commercial			Townhouses			TOTAL
Detailed Description	Lawns	Rooftops	Asphalt	Lawns	Rooftops	Driveways	Naturalized	Asphalt	Grass	Asphalt	Pond	Grass	Lawns	Rooftops	Asphalt	Lawns	Rooftops	Driveways	
Blocks	Block 187			Lot/Block 1C-3C, 4B-11B, 12A-50A, 51B-54B, 55A-57A, 58B-60B			Blocks 192 & 193	Streets A, H-I		Blocks 198 & 199	Block 191		Blocks 188 & 189			Blocks 158 - 185			
Area (m^2)	1050	4550	1400	13931	21891	3980	9750	21563	21563	2900	8150	8150	13590	18120	58890	9775	25415	3910	336200
Pervious Area (m^2)	1050	0	0	13931	0	0	9750	0	21563	0	0	8150	13590	0	0	9775	0	0	127695
% Pervious	0%	0%	0%	4.1%	0%	0%	2.9%	0%	6.4%	0%	0%	2.4%	4.0%	0%	0%	2.9%	0%	0%	38.0%
Impervious Area (m^2)	0	4550	1400	0	21891	3980	0	21563	0	2900	8150	0	0	18120	58890	0	25415	3910	208505
% Impervious	0%	1.4%	0.4%	0%	6.5%	1.2%	0%	6.4%	0%	0.9%	2.4%	0%	0%	5.4%	17.5%	0%	7.6%	1.2%	62.0%
INFILTRATION FACTORS																			
Topography Infiltration Factor	0.15	0	0.15	0.15	0	0.15	0.15	0.15	0.15	0.15	0	0.1	0.15	0	0.15	0.15	0	0.15	
Soil Infiltration Factor	0.25	0	0	0.25	0	0	0.25	0	0.25	0	0	0.25	0.25	0	0	0.25	0	0	
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0.175	0	0.15	0	0	0.15	0.15	0	0	0.15	0	0	
MECP Infiltration Factor	0.55	0	0.15	0.55	0	0.15	0.575	0.15	0.55	0.15	0	0.5	0.55	0	0.15	0.55	0	0.15	
Actual Infiltration Factor	0.55	0	0	0.55	0	0	0.6	0	0.55	0	0.05	0.5	0.55	0	0	0.55	0	0	
Runoff Coefficient	0.45	1	1	0.45	1	1	0.4	1	0.45	1	0.95	0.5	0.45	1	1	0.45	1	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0	0.8	0	0.8	0.8	0	0	0.8	0.8	0	0.8	0.8	
INPUTS (PER UNIT AREA)																			
Precipitation (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
OUTPUTS (PER UNIT AREA)																			
Precipitation Surplus (mm/yr)	277	672	672	277	672	672	277	672	277	672	672	277	277	672	672	277	672	672	522
Net Surplus (mm/yr)	277	672	672	277	672	672	277	672	277	672	672	277	277	672	672	277	672	672	522
Evaportranspiration (mm/yr)	563	168	168	563	168	168	563	168	563	168	168	563	563	168	168	563	168	168	318
Infiltration (mm/yr)	152	0	0	152	0	0	166	0	152	0	34	139	152	0	0	152	0	0	59
Rooftop Infiltration (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/yr)	152	0	0	152	0	0	166	0	152	0	34	139	152	0	0	152	0	0	59
Runoff Pervious Areas	125	0	0	125	0	0	111	0	125	0	0	139	125	0	0	125	0	0	47
Runoff Impervious Areas	0	672	672	0	672	672	0	672	0	672	638	0	0	672	672	0	672	672	416
Total Runoff (mm/yr)	125	672	672	125	672	672	111	672	125	672	638	139	125	672	672	125	672	672	463
Total Outputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INPUTS (VOLUMES)																			
Precipitation (m^3/yr)	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341
OUTPUTS (VOLUMES)																			
Precipitation Surplus (m^3/yr)	291	3057	941	3862	14707	2674	2703	14487	5977	1948	5475	2259	3767	12174	39565	2710	17075	2627	175479
Net Surplus (m^3/yr)	291	3057	941	3862	14707	2674	2703	14487	5977	1948	5475	2259	3767	12174	39565	2710	17075	2627	175479
Evaportranspiration (m^3/yr)	591	764	235	7837	3677	669	5485	3622	12132	487	1369	4585	7646	3043	9891	5499	4269	657	106862
Infiltration (m^3/yr)	160	0	0	2124	0	0	1622	0	3287	0	274	1130	2072	0	0	1490	0	0	19899
Rooftop to Soakaway Pit Infiltration (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/yr)	160	0	0	2124	0	0	1622	0	3287	0	274	1130	2072	0	0	1490	0	0	19899
Runoff Pervious Areas (m^3/yr)	131	0	0	1738	0	0	1081	0	2690	0	0	1130	1695	0	0	1219	0	0	15771
Runoff Impervious Areas (m^3/yr)	0	3057	941	0	14707	2674	0	14487	0	1948	5202	0	0	12174	39565	0	17075	2627	139808
Total Runoff (m^3/yr)	131	3057	941	1738	14707	2674	1081	14487	2690	1948	5202	1130	1695	12174	39565	1219	17075	2627	155579
Total Outputs (m^3/yr)	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

Lot / Block Areas based upon "Draft Plan of Subdivision" Drawing No. DP-01 (May 6, 2025) prepared by Biglieri Group

*Evaporation from impervious areas was assumed to be 20% of precipitation. Asphalt has 0% infiltration capability.

Catchment areas refer to areas North and South of the environmental protection block / creek

Env. Protection refers to Natural Heritage areas

Residential Single Lots: Assume rooftops cover about 55% of the lot. Driveways cover about 10% of the lot; Grass (lawns) cover about 35% of the lot.

Medium density / Townhouse Lots: Assume rooftops cover about 65% of the lot. Driveways cover about 10% of the lot; Grass (lawns) cover about 25% of the lot.

Commercial Lots: Assume rooftops covers about 20% of the lot. Asphalt parking covers about 65% of the lot; Landscaping covers about 15% of the lot.

Appendix E.4

Generic Water Budget Post-Development - With Downspout Disconnection Strategy Only

POST-DEVELOPMENT SITE													
Catchment Designation	**North Sub-Catchment**												
General Description →	**Residential - Single Detached**			**Med. Density**			**Road ROWs**		**Parkland**	**0.3 m Reserve**	**Road Widening**	**Future Residential**	**Env. Protection**
Detailed Description →	Lawns	Rooftops	Driveways	Lawns	Rooftops	Asphalt/Concrete	Asphalt	Grass	Grass	Grass	Asphalt	Grass	Naturalized
Blocks →	Lot/Block 61B-67B, 68A, 69B-82B, 83C-87C, 88A, 89B-90B, 91C-121C, 122B-127B, 200C-201C			Block 186			Streets A-G		Block 190	Block 195 & 196	Block 197	Block 194	Blocks 192 & 193
Area (m^2)	10954	17214	3130	1545	6695	2060	7637	7637	19300	0	1000	700	9750
Pervious Area (m^2)	10954	0	0	1545	0	0	0	7637	19300	0	0	700	9750
% Pervious	3.3%	0%	0%	0%	0%	0%	0%	2.3%	5.7%	0.0%	0%	0.2%	2.9%
Impervious Area (m^2)	0	17214	3130	0	6695	2060	7637	0	0	0	1000	0	0
% Impervious	0%	5.1%	0.9%	0%	2.0%	0.6%	2.3%	0%	0%	0%	0.3%	0%	0%
	INFILTRATION FACTORS												
Topography Infiltration Factor	0.15	0	0	0.15	0	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Soil Infiltration Factor	0.25	0	0	0.25	0	0	0	0.25	0.25	0.25	0	0.25	0.25
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0	0.15	0.15	0.15	0	0.15	0.175
MECP Infiltration Factor	0.55	0	0	0.55	0	0.15	0.15	0.55	0.55	0.55	0.15	0.55	0.575
Actual Infiltration Factor	0.55	0	0	0.55	0	0	0	0.55	0.55	0.55	0	0.55	0.6
Runoff Coefficient	0.45	1	1	0.45	1	1	1	0.45	0.45	0.45	1	0.45	0.4
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0.8	0	0	0	0.8	0	0
	INPUTS (PER UNIT AREA)												
Precipitation (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840
	OUTPUTS (PER UNIT AREA)												
Precipitation Surplus (mm/yr)	277	672	672	277	672	672	672	277	277	277	672	277	277
Net Surplus (mm/yr)	277	672	672	277	672	672	672	277	277	277	672	277	277
Evapotranspiration (mm/yr)	563	168	168	563	168	168	168	563	563	563	168	563	563
Infiltration (mm/yr)	152	0	0	152	0	0	0	152	152	152	0	152	166
Downspout Disconnection % Runoff Reduction	--	37.5%	--	--	37.5%	--	--	--	--	--	--	--	--
Rooftop Infiltration (mm/yr)	0	252	0	0	252	0	0	0	0	0	0	0	0
Soakaway Pit % Runoff Reduction	--	--	--	--	--	--	--	--	--	--	--	--	--
Soakaway Pit Infiltration (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/yr)	152	252	0	152	252	0	0	152	152	152	0	152	166
Runoff Pervious Areas	125	0	0	125	0	0	0	125	125	125	0	125	111
Runoff Impervious Areas	0	420	672	0	420	672	672	0	0	0	672	0	0
Total Runoff (mm/yr)	125	420	672	125	420	672	672	125	125	125	672	125	111
Total Outputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0
	INPUTS (VOLUMES)												
Precipitation (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188
	OUTPUTS (VOLUMES)												
Precipitation Surplus (m^3/yr)	3037	11565	2103	428	4498	1384	5131	2117	5350	0	672	194	2703
Net Surplus (m^3/yr)	3037	11565	2103	428	4498	1384	5131	2117	5350	0	672	194	2703
Evapotranspiration (m^3/yr)	6163	2891	526	869	1124	346	1283	4296	10858	0	168	394	5485
Infiltration (m^3/yr)	1670	0	0	236	0	0	0	1164	2942	0	0	107	1622
Rooftop to Downspout Disconnection Infiltration (m^3/yr)	0	4337	0	0	1687	0	0	0	0	0	0	0	0
Rooftop to Soakaway Pit Infiltration (m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/yr)	1670	4337	0	236	1687	0	0	1164	2942	0	0	107	1622
Runoff Pervious Areas (m^3/yr)	1366	0	0	193	0	0	0	953	2407	0	0	87	1081
Runoff Impervious Areas (m^3/yr)	0	7228	2103	0	2811	1384	5131	0	0	0	672	0	0
Total Runoff (m^3/yr)	1366	7228	2103	193	2811	1384	5131	953	2407	0	672	87	1081
Total Outputs (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0

POST-DEVELOPMENT SITE																			
Catchment Designation	**South Sub-Catchment**																		**TOTAL**
General Description →	**Med. Density**			**Residential - Single Detached**			**Env. Protection**	**Road ROWs**		**Road Widening**	**SWM Pond**		**Commercial**			**Townhouses**			
Detailed Description →	Lawns	Rooftops	Asphalt	Lawns	Rooftops	Driveways	Naturalized	Asphalt	Grass	Asphalt	Pond	Grass	Lawns	Rooftops	Asphalt	Lawns	Rooftops	Driveways	
Blocks →	Block 187			Lot/Block 1C-3C, 4B-11B, 12A-50A, 51B-54B, 55A-57A, 58B-60B			Blocks 192 & 193	Streets A, H-I		Blocks 198 & 199	Block 191		Blocks 188 & 189			Blocks 158 - 185			
Area (m^2)	1050	4550	1400	13931	21891	3980	9750	21563	21563	2900	8150	8150	13590	18120	58890	9775	25415	3910	336200
Pervious Area (m^2)	1050	0	0	13931	0	0	9750	0	21563	0	0	8150	13590	0	0	9775	0	0	127695
% Pervious	0%	0%	0%	4.1%	0%	0%	2.9%	0%	6.4%	0%	0%	2.4%	4.0%	0%	0%	2.9%	0%	0%	38.0%
Impervious Area (m^2)	0	4550	1400	0	21891	3980	0	21563	0	2900	8150	0	0	18120	58890	0	25415	3910	208505
% Impervious	0%	1.4%	0.4%	0%	6.5%	1.2%	0%	6.4%	0%	0.9%	2.4%	0%	0%	5.4%	17.5%	0%	7.6%	1.2%	62.0%
	INFILTRATION FACTORS																		
Topography Infiltration Factor	0.15	0	0.15	0.15	0	0.15	0.15	0.15	0.15	0.15	0	0.1	0.15	0	0.15	0.15	0	0.15	
Soil Infiltration Factor	0.25	0	0	0.25	0	0	0.25	0	0.25	0	0	0.25	0.25	0	0	0.25	0	0	
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0.175	0	0.15	0	0	0.15	0.15	0	0	0.15	0	0	
MECP Infiltration Factor	0.55	0	0.15	0.55	0	0.15	0.575	0.15	0.55	0.15	0	0.5	0.55	0	0.15	0.55	0	0.15	
Actual Infiltration Factor	0.55	0	0	0.55	0	0	0.6	0	0.55	0	0.05	0.5	0.55	0	0	0.55	0	0	
Runoff Coefficient	0.45	1	1	0.45	1	1	0.4	1	0.45	1	0.95	0.5	0.45	1	1	0.45	1	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0	0.8	0	0.8	0.8	0	0	0.8	0.8	0	0.8	0.8	
	INPUTS (PER UNIT AREA)																		
Precipitation (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
	OUTPUTS (PER UNIT AREA)																		
Precipitation Surplus (mm/yr)	277	672	672	277	672	672	277	672	277	672	672	277	277	672	672	277	672	672	522
Net Surplus (mm/yr)	277	672	672	277	672	672	277	672	277	672	672	277	277	672	672	277	672	672	522
Evapotranspiration (mm/yr)	563	168	168	563	168	168	563	168	563	168	168	563	563	168	168	563	168	168	318
Infiltration (mm/yr)	152	0	0	152	0	0	166	0	152	0	34	139	152	0	0	152	0	0	59
Downspout Disconnection % Runoff Reduction	--	37.5%	--	--	37.5%	--	--	--	--	--	--	--	--	37.5%	--	--	37.5%	--	--
Rooftop Infiltration (mm/yr)	0	252	0	0	252	0	0	0	0	0	0	0	0	252	0	0	252	0	70
Soakaway Pit % Runoff Reduction	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--	--	--	--
Soakaway Pit Infiltration (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/yr)	152	252	0	152	252	0	166	0	152	0	34	139	152	252	0	152	252	0	130
Runoff Pervious Areas	125	0	0	125	0	0	111	0	125	0	0	139	125	0	0	125	0	0	47
Runoff Impervious Areas	0	420	672	0	420	672	0	672	0	672	638	0	0	420	672	0	420	672	345
Total Runoff (mm/yr)	125	420	672	125	420	672	111	672	125	672	638	139	125	420	672	125	420	672	392
Total Outputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	INPUTS (VOLUMES)																		
Precipitation (m^3/yr)	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341
	OUTPUTS (VOLUMES)																		
Precipitation Surplus (m^3/yr)	291	3057	941	3862	14707	2674	2703	14487	5977	1948	5475	2259	3767	12174	39565	2710	17075	2627	175479
Net Surplus (m^3/yr)	291	3057	941	3862	14707	2674	2703	14487	5977	1948	5475	2259	3767	12174	39565	2710	17075	2627	175479
Evapotranspiration (m^3/yr)	591	764	235	7837	3677	669	5485	3622	12132	487	1369	4585	7646	3043	9891	5499	4269	657	106862
Infiltration (m^3/yr)	160	0	0	2124	0	0	1622	0	3287	0	274	1130	2072	0	0	1490	0	0	19899
Rooftop to Downspout Disconnection Infiltration (m^3/yr)	0	1146	0	0	5515	0	0	0	0	0	0	0	0	4565	0	0	6403	0	23653
Rooftop to Soakaway Pit Infiltration (m^3/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/yr)	160	1146	0	2124	5515	0	1622	0	3287	0	274	1130	2072	4565	0	1490	6403	0	43553
Runoff Pervious Areas (m^3/yr)	131	0	0	1738	0	0	1081	0	2690	0	0	1130	1695	0	0	1219	0	0	15771
Runoff Impervious Areas (m^3/yr)	0	1911	941	0	9192	2674	0	14487	0	1948	5202	0	0	7609	39565	0	10672	2627	116155
Total Runoff (m^3/yr)	131	1911	941	1738	9192	2674	1081	14487	2690	1948	5202	1130	1695	7609	39565	1219	10672	2627	131926
Total Outputs (m^3/yr)	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

Lot / Block Areas based upon "Draft Plan of Subdivision" Drawing No. DP-01 (May 6, 2025) prepared by Biglieri Group

*Evaporation from impervious areas was assumed to be 20% of precipitation. Asphalt has 0% infiltration capability.

Catchment areas refer to areas North and South of the environmental protection block / creek

Env. Protection refers to Natural Heritage areas

Residential Single Lots: Assume rooftops cover about 55% of the lot. Driveways cover about 10% of the lot; Grass (lawns) cover about 35% of the lot.

Medium density / Townhouse Lots: Assume rooftops cover about 65% of the lot. Driveways cover about 10% of the lot; Grass (lawns) cover about 25% of the lot.

Commercial Lots: Assume rooftops covers about 20% of the lot. Asphalt parking covers about 65% of the lot; Landscaping covers about 15% of the lot.

Appendix E.5

Generic Water Budget Post-Development - With Downspout Disconnection and Soakaway Pit Mitigation Strategy

	POST-DEVELOPMENT SITE																																				
Catchment Designation	**North Sub-Catchment**																				**South Sub-Catchment**																	
General Description →	**Residential - Single Detached**			**Med. Density**			**Road ROWs**		**Parkland**	**0.3 m Reserve**	**Road Widening**	**Future Residential**	**Env. Protection**	**Med. Density**			**Residential - Single Detached**			**Env. Protection**	**Road ROWs**		**Road Widening**	**SWM Pond**	**Commercial**			**Townhouses**			**TOTAL**							
Detailed Description →	Lawns	Rooftops	Driveways	Lawns	Rooftops	Asphalt/Concrete	Asphalt	Grass	Grass	Grass	Asphalt	Grass	Naturalized	Lawns	Rooftops	Asphalt	Lawns	Rooftops	Driveways	Naturalized	Asphalt	Grass	Asphalt	Pond	Grass	Lawns	Rooftops	Asphalt	Lawns	Rooftops	Driveways							
Blocks →	Lot/Block 61B-67B, 68A, 69B-82B, 83C-87C, 88A, 89B-90B, 91C-121C, 122B-127B, 200C-201C			Block 186			Streets A-G		Block 190	Block 195 & 196	Block 197	Block 194	Blocks 192 & 193	Block 187			Lot/Block 1C-3C, 4B-11B, 12A-50A, 51B-54B, 55A-57A, 58B-60B			Blocks 192 & 193	Streets A, H-I		Blocks 198 & 199	Block 191	Blocks 188 & 189			Blocks 158 - 185										
Area (m^2)	10954	17214	3130	1545	6695	2060	7637	7637	19300	0	1000	700	9750	1050	4550	1400	13931	21891	3980	9750	21563	21563	2900	8150	8150	13590	18120	58890	9775	25415	3910	336200							
Pervious Area (m^2)	10954	0	0	1545	0	0	0	7637	19300	0	0	700	9750	1050	0	0	13931	0	0	9750	0	21563	0	0	8150	13590	0	0	9775	0	0	127695							
% Pervious	3.3%	0%	0%	0%	0%	0%	0%	2.3%	5.7%	0.0%	0%	0.2%	2.9%	0%	0%	0%	4.1%	0%	0%	2.9%	0%	6.4%	0%	0%	2.4%	4.0%	0%	0%	2.9%	0%	0%	38.0%							
Impervious Area (m^2)	0	17214	3130	0	6695	2060	7637	0	0	0	1000	0	0	0	4550	1400	0	21891	3980	0	21563	0	2900	8150	0	0	18120	58890	0	25415	3910	208505							
% Impervious	0%	5.1%	0.9%	0%	2.0%	0.6%	2.3%	0%	0%	0%	0.3%	0%	0%	0%	1.4%	0.4%	0%	6.5%	1.2%	0%	6.4%	0%	0.9%	2.4%	0%	0%	5.4%	17.5%	0%	7.6%	1.2%	62.0%							
INFILTRATION FACTORS																																					
Topography Infiltration Factor	0.15	0	0	0.15	0	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0	0.15	0.15	0	0.15	0.15	0.15	0.15	0.15	0	0.1	0.15	0	0.15	0.15	0	0.15							
Soil Infiltration Factor	0.25	0	0	0.25	0	0	0	0.25	0.25	0.25	0	0.25	0.25	0.25	0	0	0.25	0	0	0.25	0	0.25	0	0	0.25	0.25	0	0	0.25	0	0							
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0	0.15	0.15	0.15	0	0.15	0.175	0.15	0	0	0.15	0	0	0.175	0	0.15	0	0	0.15	0.15	0	0	0.15	0	0							
MECP Infiltration Factor	0.55	0	0	0.55	0	0.15	0.15	0.55	0.55	0.55	0.15	0.55	0.575	0.55	0	0.15	0.55	0	0.15	0.575	0.15	0.55	0.15	0	0.5	0.55	0	0.15	0.55	0	0.15							
Actual Infiltration Factor	0.55	0	0	0.55	0	0	0	0.55	0.55	0.55	0	0.55	0.6	0.55	0	0	0.55	0	0	0.6	0	0.55	0	0.05	0.5	0.55	0	0	0.55	0	0							
Runoff Coefficient	0.45	1	1	0.45	1	1	1	0.45	0.45	0.45	1	0.45	0.4	0.45	1	1	0.45	1	1	0.4	1	0.45	1	0.95	0.5	0.45	1	1	0.45	1	1							
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0.8	0	0	0	0.8	0	0	0	0.8	0.8	0	0.8	0.8	0	0.8	0	0.8	0.8	0	0	0.8	0.8	0	0.8	0.8							
INPUTS (PER UNIT AREA)																																					
Precipitation (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840							
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
Total Inputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840							
OUTPUTS (PER UNIT AREA)																																					
Precipitation Surplus (mm/yr)	277	672	672	277	672	672	672	277	277	277	672	277	277	277	672	672	277	672	672	277	672	277	672	672	277	277	672	672	277	672	672							
Net Surplus (mm/yr)	277	672	672	277	672	672	672	277	277	277	672	277	277	277	672	672	277	672	672	277	672	277	672	672	277	277	672	672	277	672	672							
Evapotranspiration (mm/yr)	563	168	168	563	168	168	168	563	563	563	168	563	563	563	168	168	563	168	168	563	168	563	168	168	563	563	168	168	563	168	168							
Infiltration (mm/yr)	152	0	0	152	0	0	0	152	152	152	0	152	166	152	0	0	152	0	0	166	0	152	0	34	139	152	0	0	152	0	0							
Downspout Disconnection % Runoff Reduction	--	37.5%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37.5%	--	--	--	--	--	--	--	--	--	--	--	--	--							
Rooftop Infiltration (mm/yr)	0	252	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	252	0	0	0	0	0	0	0	0	0	0	0	0	0							
Soakaway Pit % Runoff Reduction	--	--	--	--	85%	--	--	--	--	--	--	--	--	--	85%	--	--	--	--	--	--	--	--	--	--	--	85%	--	--	85%	--							
Soakaway Pit Infiltration (mm/yr)	0	0	0	0	571	0	0	0	0	0	0	0	0	0	571	0	0	0	0	0	0	0	0	0	0	0	571	0	0	571	0							
Total Infiltration (mm/yr)	152	252	0	152	0	0	0	152	152	152	0	152	166	152	0	0	152	252	0	166	0	152	0	34	139	152	0	0	152	0	0							
Runoff Pervious Areas	125	0	0	125	0	0	0	125	125	125	0	125	111	125	0	0	125	0	0	111	0	125	0	0	139	125	0	0	125	0	0							
Runoff Impervious Areas	0	420	672	0	101	672	672	0	0	0	672	0	0	0	101	672	0	420	672	0	672	0	672	638	0	0	101	672	0	101	672							
Total Runoff (mm/yr)	125	420	672	125	101	672	672	125	125	125	672	125	111	125	101	672	125	420	672	111	672	125	672	638	139	125	101	672	125	101	672							
Total Outputs (mm/yr)	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840							
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
INPUTS (VOLUMES)																																					
Precipitation (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341							
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
Total Inputs (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341							
OUTPUTS (VOLUMES)																																					
Precipitation Surplus (m^3/yr)	3037	11565	2103	428	4498	1384	5131	2117	5350	0	672	194	2703	291	3057	941	3862	14707	2674	2703	14487	5977	1948	5475	2259	3767	12174	39565	2710	17075	2627	175479							
Net Surplus (m^3/yr)	3037	11565	2103	428	4498	1384	5131	2117	5350	0	672	194	2703	291	3057	941	3862	14707	2674	2703	14487	5977	1948	5475	2259	3767	12174	39565	2710	17075	2627	175479							
Evapotranspiration (m^3/yr)	6163	2891	526	869	1124	346	1283	4296	10858	0	168	394	5485	591	764	235	7837	3677	669	5485	3622	12132	487	1369	4585	7646	3043	9891	5499	4269	657	106862							
Infiltration (m^3/yr)	1670	0	0	236	0	0	0	1164	2942	0	0	107	1622	160	0	0	2124	0	0	1622	0	3287	0	274	1130	2072	0	0	1490	0	0	19899							
Rooftop to Downspout Disconnection Infiltration (m^3/yr)	0	4337	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5515	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9852						
Rooftop to Soakaway Pit Infiltration (m^3/year)	0	0	0	0	3823	0	0	0	0	0	0	0	0	0	2598	0	0	0	0	0	0	0	0	0	0	0	10348	0	0	14514	0	31283							
Total Infiltration (m^3/yr)	1670	4337	0	236	3823	0	0	1164	2942	0	0	107	1622	160	2598	0	2124	5515	0	1622	0	3287	0	274	1130	2072	10348	0	1490	14514	0	61034							
Runoff Pervious Areas (m^3/yr)	1366	0	0	193	0	0	0	953	2407	0	0	87	1081	131	0	0	1738	0	0	1081	0	2690	0	0	1130	1695	0	0	1219	0	0	15771							
Runoff Impervious Areas (m^3/yr)	0	7228	2103	0	675	1384	5131	0	0	0	672	0	0	0	459	941	0	9192	2674	0	14487	0	1948	5202	0	0	1826	39565	0	2561	2627	98673							
Total Runoff (m^3/yr)	1366	7228	2103	193	675	1384	5131	953	2407	0	672	87	1081	131	459	941	1738	9192	2674	1081	14487	2690	1948	5202	1130	1695	1826	39565	1219	2561	2627	114444							
Total Outputs (m^3/yr)	9200	14456	2628	1297	5622	1730	6413	6413	16208	0	840	588	8188	882	3821	1176	11699	18384	3343	8188	18109	18109	2435	6844	6844	11413	15217	49456	8209	21344	3284	282341							
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							

Notes:

Lot / Block Areas based upon "Draft Plan of Subdivision" Drawing No. DP-01 (May 6, 2025) prepared by Biglieri Group

*Evaporation from impervious areas was assumed to be 20% of precipitation. Asphalt has 0% infiltration capability.

Catchment areas refer to areas North and South of the environmental protection block / creek

Env. Protection refers to Natural Heritage areas

Residential Single Lots: Assume rooftops cover about 55% of the lot. Driveways cover about 10% of the lot; Grass (lawns) cover about 35% of the lot.

Townhouse Lots: Assume rooftops cover about 65% of the lot. Driveways cover about 10% of the lot; Grass (lawns) cover about 25% of the lot.

Commercial Lots: Assume rooftops covers about 20% of the lot. Asphalt parking covers about 65% of the lot; Landscaping covers about 15% of the lot.

Appendix E.6
Water Budget Summary

PARAMETER	SITE																			
	Pre-Development			Post-Development (no mitigation)						Post-Development (with downspout LID mitigation strategy only)						Post-Development (with downspout AND soakaway pit LID mitigation strategies)					
	TOTAL	*North Sub-Catchment*	*South Sub-Catchment*	*TOTAL*	*Difference Pre- vs. Post-*	*North Sub-Catchment*	*Difference Pre- vs. Post-*	*South Sub-Catchment*	*Difference Pre- vs. Post-*	*Post-Development With Mitigation*	*Difference Pre- vs. Post-*	*North Sub-Catchment*	*Difference Pre- vs. Post-*	*South Sub-Catchment*	*Difference Pre- vs. Post-*	*Post-Development With Mitigation*	*Difference Pre- vs. Post-*	*North Sub-Catchment*	*Difference Pre- vs. Post-*	*South Sub-Catchment*	*Difference Pre- vs. Post-*
INPUTS (VOLUMES)																				
Precipitation (m^3/yr)	282341	73585	208755	282341	0%	73585	0%	208756	0%	282341	0%	73585	0%	208756	0%	282341	0%	73585	0%	208756	0%
Run On (m^3/yr)	0	0	0	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Other Inputs (m^3/yr)	0	0	0	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Total Inputs (m^3/yr)	282341	73585	208755	282341	0%	73585	0%	208756	0%	282341	0%	73585	0%	208756	0%	282341	0%	73585	0%	208756	0%
OUTPUTS (VOLUMES)																				
Precipitation Surplus (m^3/yr)	93578	24289	69290	175479	88%	39181	61%	136298	97%	175479	88%	39181	61%	136298	97%	175479	88%	39181	61%	136298	97%
Net Surplus (m^3/yr)	93578	24289	69290	175479	88%	39181	61%	136298	97%	175479	88%	39181	61%	136298	97%	175479	88%	39181	61%	136298	97%
Evapotranspiration (m^3/yr)	188763	49297	139466	106862	-43%	34404	-30%	72458	-48%	106862	-43%	34404	-30%	72458	-48%	106862	-43%	34404	-30%	72458	-48%
Infiltration (m^3/yr)	47048	12410	34637	19899	-58%	7741	-38%	12159	-65%	19899	-58%	7741	-38%	12159	-65%	19899	-58%	7741	-38%	12159	-65%
%Rooftop Infiltration Factor	37.5%	--	37.5%	--	--	--	--	--	--	37.5%	--	37.5%	--	37.5%	--	37.5%	--	37.5%	--	37.5%	--
Rooftop Infiltration (m3/yr)	145	0	145	--	--	--	--	--	--	23653	16228%	6024	--	17630	12070%	9852	6701%	4337	--	5515	3707%
%Soakaway Pit Infiltration Factor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	85%	--	85%	--	85%	--
Soakaway Pit Infiltration (m^3/yr)	--	--	--	0	--	0	--	0	--	0	--	0	--	0	--	31283	--	3823	--	27460	--
Total Infiltration (m^3/yr)	47192	12410	34782	19899	-58%	7741	-38%	12159	-65%	43553	-7.7%	13764	10.9%	29788	-14.4%	61034	29.3%	15901	28.1%	45133	29.8%
Runoff Pervious Areas (m^3/yr)	45929	11878	34051	15771	-66%	6088	-49%	9684	-72%	15771	-66%	6088	-49%	9684	-72%	15771	-66%	6088	-49%	9684	-72%
Runoff Impervious Areas (m^3/yr)	456	0	456	139808	204%	25352	0%	114456	24976%	116155	25348%	19329	0%	96826	21114%	98673	21518%	17192	0%	81481	17752%
Total Runoff (m^3/yr)	46386	11878	34508	155579	235%	31440	165%	124139	260%	131926	184%	25416	114%	106510	209%	114444	147%	23280	96%	91165	164%
Total Outputs (m^3/yr)	282341	73585	208755	282341	0%	73585	0%	208756	0%	282341	0%	73585	0%	208756	0%	282341	0%	73585	0%	208756	0%

Appendix F

NBC 2020 Seismic Hazard Tool

Government of Canada Gouvernement du Canada

Canada.ca › Natural Resources Canada › Earthquakes Canada

2020 National Building Code of Canada Seismic Hazard Tool

This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_S	X_D
Latitude (°)	44.168
Longitude (°)	-78.453

Please select one of the tabs below.

NBC 2020 | Additional Values | Plots | API | Background Information

The 5%-damped spectral acceleration (S_a(T,X), where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.315	0.311	0.188	0.0903	0.0241	0.00757	0.181	0.2

The log-log interpolated 2%/50 year $S_a(4.0, X_D)$ value is : **0.0332**

▼ Tables for 5% and 10% in 50 year values

NBC 2020 - 5%/50 years (0.001 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.199	0.195	0.114	0.0528	0.0132	0.00414	0.113	0.117

The log-log interpolated 5%/50 year $S_a(4.0, X_D)$ value is : **0.0185**

NBC 2020 - 10%/50 years (0.0021 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.129	0.127	0.0719	0.0322	0.00748	0.00237	0.0729	0.0713

The log-log interpolated 10%/50 year $S_a(4.0, X_D)$ value is : **0.0107**

Download CSV

← Go back to the seismic hazard calculator form

Date modified: 2021-04-06

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