GEI Consultants

Hydrogeological Investigation

Proposed Residential Building - 60 Dean Avenue

Barrie, Ontario

Submitted to:
Nestwise Inc.
35 Worsley Street
Barrie, Ontario

Submitted by:
GEI Consultants Canada Ltd.
411 Huronia Road, Unit 5
Barrie, ON L4N 9B3
1.800.810.3281

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Tanvi Patel

Tanvi Patel, G.I.T.
Hydrogeologist-In-Training

Kim Pickett, M. Ed, C.E.T, LET, QPESA
Project GeoScientist

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Record of Revisions

Identification	Date	Description of Issued and/or Revision
First Submission	March 4, 2025	Hydrogeological Investigation

Acronyms and Abbreviations

%	Percent (per 100 units)
<	Less than …
>	Greater than …
Δ	Change in …
µm	micrometer
ANSI	Area of Natural and Scientific Interest
APEC	Areas of Potential Environmental Concern
BESR	Brownfields Environmental Site Registry
bgs	Below Ground Surface
BH	Borehole
BH/MW	Borehole / Monitoring Well
cm	centimeters
CVC	Credit Valley Conservation
EASR	Environmental Activity and Sector Registry
EBA	Event Based Area
ECA	Environmental Compliance Approval
Elev.	Elevation
EPA	Environmental Protection Act
ERIS	EcoLog Environmental Risk Information Services Ltd.
ESA	Environmental Site Assessment
ET	Evapotranspiration/Evaporation
FOS	Factor of Safety
FSR	Functional Servicing Report
GEI	GEI Consultants Canada Ltd.
GP	Guelph Permeameter
ha	hectares
hr	hours
HVA	Highly Vulnerable Aquifer
I	Infiltration
ICA	Issue Contributing Area
ID	Identification
IPZ	Intake Protection Zone
K	Hydraulic Conductivity
kg	kilogram
km	Kilometres
kPa	Kilopascal
L	Litres
LID	Low Impact Development
LSRCA	Lake Simcoe and Region Conservation Authority
m	Metres
m^3	Cubic Meters
MECP / MOEE / MOECC / MOE	Ministry of Environment, Conservation and Parks / Ministry of Environment and Energy / Ministry of the Environment and Climate Change / Ministry of the Environment
min	minute
mm	Millimetres
MMAH	Ministry of Municipal Affairs and Housing
MNRF	Ministry of Natural Resources and Forestry
MW	Monitoring Well

N values	“N” Values
NRC	Natural Resources Canada
NRCC	National Research Council of Canada
NVCA	Nottawasaga Valley Conservation Authority
O.Reg.	Ontario Regulation
OBC	Ontario Building Code
ODWO	Ontario Drinking Water Objectives
OGS	Ontario Geological Survey
OWES	Ontario Wetland Evaluation System
OWRA	Ontario Water Resources Act
P	Precipitation
PHC	Petroleum Hydrocarbon
PTTW	Permit to Take Water
PWQO	Provincial Water Quality Objective
R	Runoff
ROI/ROIs	Radius/Radii of Influence
ROW	Right-of-Way
RQD	Rock Quality Designation
RSC	Record of Site Condition
s	Seconds
S	Storage
SCS	Site Condition Standards
SGRA	Significant Groundwater Recharge Area
SPT	Standard Penetration Test
SS	Split Spoon
SWM	Stormwater Management
TRCA	Toronto and Region Conservation Authority
TSS	Total Suspended Solids
U/G	Underground
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
WHPA	Wellhead Protection Area
WTRS	Water Taking and Reporting System
WWIS	Water Well Information System

It is noted that all elevations in this report are metric/geodetic and expressed in m. All measurements are also in metric and expressed in mm, m, or km.

Executive Summary

GEI was retained by Nestwise Inc. (the Client) to conduct a hydrogeological investigation at the proposed residential development located at 60 Dean Avenue, Barrie, Ontario. The investigation aimed to determine subsurface and groundwater conditions and provide preliminary recommendations on permitting requirements, preliminary infiltration capacity, construction dewatering, and precipitation run-off and infiltration conditions in order to aid discussion of future development planning.

E.S.1. Site Description

- Location: 60 Dean Avenue, Barrie, ON
- Topography: Rolling land with stockpiles of material in the central and northern portion.
- Geology: Overburden of topsoil, fill, with silty sand glacial till that is compact to very dense, this glacial till layer was overlying a gravelly sand unit in one borehole location.

E.S.2. Groundwater Conditions

- Groundwater Levels Reported: January and February 2025.
  - A long-term groundwater level monitoring program is recommended to determine the seasonally high groundwater level at the site.
- Groundwater Depths: 1.73 to 3.01 m bgs (Elev. 248.59 to 247.35 m asl).
- Local Groundwater Flow: is expected to follow local topography towards the west.
- Regional Groundwater Flow: Towards the north to Lake Simcoe.
- Preliminary Groundwater Quality Chemical Results
  - Regulatory Standards for Construction Dewatering (unfiltered samples):
    - City of Barrie Sewer Use Bylaw Criteria: Met except for TSS.
    - PWQO and Interim PWQO: Met except for total iron, total zinc, total cobalt, total copper, total lead and total vanadium.
    - O.Reg. 153/04 SCS: Met for parameters analyzed.
  - Field filtered samples were also collected TSS, PWQO metals, and Interim PWQO metals. These samples were found to have no exceedances for parameters assessed, thus supporting that the treatment and disposal of the dewatering discharge should follow best management practices, including removal of suspended solids by a decanting tank and/or filter bag.

E.S.3. Preliminary In-Situ Infiltration Rates

- Near Surface Soil Types: SC (unified soil classifications).
- Preliminary Design Factored Infiltration Rate: 12 mm/hr.
- Applicable SWM Practices: May be limited to sand filters, grassed swales, vegetated filter strips, and oil/grit separators.

E.S.4. Preliminary Construction Dewatering Conditions

- Temporary Construction Dewatering Plan
    - Installation of site servicing.
    - Installation of one (1) level of U/G parking garage.
- Predicted Water Taking Rates: As much as 377,542 L/day.
    - PTTW Application: May be required if dewatering is conducted during high groundwater level conditions.
    - EASR Registration: Currently required. May not be required if dewatering is conducted outside of high groundwater level conditions.
        - Always required in the event of dewatering over 50,000 L/day.

E.S.5. Preliminary Water Balance

Impact Assessment: Proposed development decreases average infiltration by approximately 659 m^3/year (58% decrease) and increases runoff by approximately 2,269 m^3/year (164% increase).

E.S.6. Disclaimer

This executive summary provides a high-level overview of the Hydrogeological Investigation's findings and recommendations. It does not encompass all the details and considerations covered in the full report. For comprehensive information and context, it is essential to read the entire report in full.

1. Introduction

GEI was retained by Nestwise Inc. (the Client) to complete a preliminary hydrogeological investigation in support of the proposed residential building for the property located at 60 Dean Avenue in Barrie, Ontario (the Site). A site location plan is enclosed as Figure 1.

This preliminary hydrogeological investigation was aimed to assess subsurface and groundwater conditions at the site and provide a report with initial recommendations on permitting requirements, preliminary infiltration capacity, construction dewatering, and precipitation runoff and infiltration. Site & Project Description

The site is rectangular in shape and is approximately 60 m east/west and 120 m north/south. The site is situated in a residential neighborhood, and is bordered by housing to the south, a library with a parking lot that borders to the west and commercial properties to the north and east. The site is currently vacant and recent field visits indicate stockpiles of materials scattered in the central and northern portion of the property. An aerial image with the conceptual site plan is provided in Figure 2A.

GEI was provided with the following documents for review:

- “Conceptual Site Plan - 60 Dean Avenue”, Drawing Name: PRA-24067-CP-9J.dwg, Project PRA-24067, by Jones Consulting Group Ltd., dated February 11, 2025.
- “General Servicing Plan - Hansen Group Inc., 60 Dean Ave., City of Barrie”, Dwg. No. GS-1, Project PRA-24067, by Jones Consulting Group Ltd., dated February 2025.
- “General Grading Plan - Hansen Group Inc., 60 Dean Ave., City of Barrie”, Dwg. No. SG-1, Project PRA-24067, by Jones Consulting Group Ltd., dated January 2025.

Based on the information provided from the above documents, the preliminary concept will consist of a six (6) storey building with associated parking along with one (1) level of U/G parking. One shared access point with the public library from Dean Avenue is proposed. It is understood that the development would be connected to municipal servicing. Review of the documents provided is further discussed in Section 2.1 and the current proposed concept plan is included as Figure 2B.

As part of the scope of work a geotechnical investigation was also carried out by GEI for the project. The results of the geotechnical investigation are provided under separate cover.

1.1. Scope of Work

The Hydrogeological Investigation included the following scope of work:

a) Conduct a background desktop review of pertinent geological and hydrogeological resources, MECP Water Well Records, surficial and bedrock geology mapping, Source Water Protection mapping, previous reports, and proposed site plan drawings.

b) Visit the site and note existing site conditions, site setting, topography, drainage, water features, and potential water wells within 500 m of the site, if any.

c) As part of the concurrent geotechnical investigation, GEI advanced five (5) BHs across the site and installed three (3) MWs within selected BHs. MWs were developed following installation.

d) Measure groundwater levels in all MWs to assess groundwater table and groundwater flow direction.

e) Conduct single well response testing (SWRT) in select MWs to determine the hydraulic conductivity of overburden soils.

f) Collect and submit one (1) representative unfiltered groundwater samples for laboratory testing to compare against the City of Barrie Sewer Use Bylaw Criteria, Provincial Water Quality Objectives (PWQO) standards for metals and TSS, and O.Reg. 153/04 SCS, as amended, for PHCs and VOCs, subject to sufficient available monitoring well groundwater quantity.

g) Collect and submit one (1) representative filtered groundwater samples for laboratory testing to compare against the PWQO standards for metals and TSS, subject to sufficient available monitoring well groundwater quantity.

h) Carry out a dewatering assessment for construction and permitting requirements.

i) Complete a preliminary pre-to-post construction water balance.

j) Prepare a preliminary hydrogeological investigation to support design and permitting.

1.2. Applicable Regulations

1.2.1. Source Water Protection

The site is within the jurisdictional boundary of the LSRCA, and within the Lakes Simcoe and Couchiching/Black River Protection Area, in the South Georgian Bay Lake Simcoe Source Protection Region. The following documents should be used in determination of the regulatory requirements when it comes to maintaining hydrogeological function at this site:

- "Approved South Georgian Bay Lake Simcoe Source Protection Plan", as amended, by the South Georgian Bay Lake Simcoe Source Protection Region.
    - As the proposed development at the site is assumed to include the construction of a building or buildings on a lot with a cumulative ground floor area equal to or greater than 500 m^2, and any other impervious surfaces, it will likely be considered a major development.

Based on Source Water Protection, Natural Heritage Areas, LSRCA, and Simcoe County online mappings, the following are noted:

- WHPA: The site is not located within a WHPA (Figure 3).
- IPZ: The site is not located within an IPZ (Figure 4).
- HVA: The site is not located within an HVA (Figure 5).
- SGRA: The site is not located within a SGRA (Figure 6)
- The site is not located within the Oak Ridges Moraine nor Niagara Escarpment planning areas.
- The site is not located in nor within 500 m of an ANSI.
- The site is located within the Lovers Creek subwatershed plan.
- The site is located 500 m of the following surficial water features including:
    - Lover’s Creek (350 m west of the site)
    - Lover’s Creek Swamp (350 m west of the site)

1.2.2. Water Taking / Discharge - Temporary

The volume of water entering the excavation during construction will be based on both groundwater infiltration and precipitation events. Based on O.Reg. 63/16, the following dewatering limits and requirements are as follows:

- Construction dewatering less than 50,000 L/day: The takings of both groundwater and stormwater does not require a hydrogeological report, does not require registration on the EASR, and does not require a PTTW from the MECP.
- Construction dewatering greater than 50,000 L/day and less than 400,000 L/day: The taking of groundwater and/or stormwater requires a hydrogeological report and registration on the EASR but does not require a PTTW from the MECP.
- Construction dewatering greater than 400,000 L/day: The taking of groundwater and/or stormwater requires a hydrogeological report and requires a PTTW from the MECP.
- City of Barrie Discharge Agreement: All discharges to the municipal sewer system are regulated by City of Barrie’s Sewer Use Bylaw 2021-002. Discharge of water originating from a source other than the City’s Municipal Drinking Water System and leachate to the municipal sanitary sewer is prohibited unless authorized by a Discharge Agreement. Long term discharge to the municipal sanitary sewer is not permitted.

2. Background Review & Site Setting

2.1. Relevant Investigations and Supporting Documents

2.1.1. Jones Consulting Group Ltd (July 12, 2024) Conceptual Site Plan

This drawing, prepared by a consultant retained by the client (Jones Consulting Group Ltd.), was provided to GEI as part of the conceptual plan for the proposed development of a 1710 m^2 6-storey apartment building with associated parking and one (1) level U/G car park. The concept plan identifies the site as having a total development area of approximately 0.71 ha. Access to the site is proposed as a shared entrance with the library from Dean Avenue to the south.

2.1.2. Jones Consulting Group Ltd (February 2025) Site Servicing Plan

This drawing, prepared by a consultant retained by the client (Jones Consulting Group Ltd.), was provided to GEI as part of the site servicing plan for the proposed development. The plan identifies that the site:

- will be municipally serviced with servicing inverts extending to approximately Elev. 249.18 in the north and Elev. 246.39 in the south,
- will have U/G parking beneath the residential structure extending to Elev. 249.70 with a footprint of 86 m by 20 m, and
- will have an U/G storage tank north of the residential structure extending to Elev. 249.65 with a footprint of 15 m by 8 m.

Installation details during construction have not been provided to GEI. Assumptions of the excavations dimensions and staging are further discussed in Section 5.0, including the expectations for construction dewatering.

2.1.3. Jones Consulting Group Ltd (January 2025) Site Grading Plan

This drawing, prepared by a consultant retained by the client (Jones Consulting Group Ltd.), was provided to GEI as part of the site grading plan for the proposed development. The plan identifies that the site will overall slope down from northeast corner of the site at Elev. 251.51, down towards the southwest corner of the site at Elev. 248.81, at the property boundaries. The site will also be graded to meet the surrounding properties with proposed grades of Elev. 250.16 and 249.95 at the northwest and southeast corners of the site.

Assumptions for the grade cutting dimensions and staging are further discussed in Section 5.0, including the expectations for construction dewatering.

2.1.4. GEI Geotechnical Investigation

GEI was retained by the Client to complete a subsurface investigation and geotechnical report for the proposed residential development located at the site.

The purpose of the geotechnical investigation was to assess the subsurface soil conditions at the site, and based on this information, provide geotechnical engineering recommendations in support of the proposed residential building. The geotechnical report summarized the BH findings. The BH findings are also provided in Section 4.1 of this hydrogeological report. The geotechnical report provided geotechnical engineering recommendations regarding earthworks/engineered fill, available bearing capacities for foundations, slabs-on-grade, site servicing installation, and pavement design. Considerations for constructability such as soil excavation, compaction, on-site backfill suitability and temporary groundwater control were also provided.

The following geotechnical recommendations and considerations that are relevant to this hydrogeological report are summarized below.

- Subsurface Conditions:
    - BHs revealed compact to very dense glacial till overlying a gravelly sand unit encountered in BH5.
    - Unsuitable materials, including topsoil, fill, organics, and weak/disturbed soils, need removal to a depth of 0.8–1.5 m before engineered fill placement.
- Grading and Foundations:
    - Prior to receiving the site grading plans, cut-and-fill activities were anticipated. Engineered fill will be required in fill areas to support structures. It is recommended that the topsoil and stockpiles of material be stripped separately.
    - Conventional shallow foundations (spread and strip footings) are recommended on undisturbed native soils or engineered fill, with all foundations set on consistent soil subgrades to minimize differential settlement risks.
- Floor Slabs and Pavement:
    - Engineered fill or compact native soils can support lightly loaded floor slabs. Unsuitable materials (e.g., organics, excessive moisture) are not appropriate for slab support.
- Excavation and Site Servicing:
    - Prior to receiving the site serving plan, the original excavations to 1.5–3.0 m were expected to remove fill, silty sand, and glacial till. Harder digging is likely in glacial till, with cobbles and boulders present.
    - Water, sanitary, and storm sewers are expected with inverts as deep as 3 m bgs.

2.2. Review of MECP Water Well Records

MECP water well records within 500 m of the site area were obtained from the MECP's online interactive well records map to assess the general nature of the groundwater resource in the near vicinity of the site, and historical/current uses of wells in the area, as shown in Figure 7 and summarized in Appendix A.

No water well records were identified on-site, and one-hundred-thirteen (13) records were identified with 500 m of the site. A summary of these water well records is provided below.

Table 2-1. Summary of MECP Water Well Records

Well Use	Number of Records	Year(s) Installed	Water Encountered (Type & Depth)	Well Screen / Open Hole (Media & Depth)	Closest Well Record to Site (ID)
Public	0	N/A			
Domestic and/or Livestock	64	1956 to 2021	Fresh: 10 m to 53 m	Overburden: 1 m to 180 m	5701463, 5710480, 5737207
Industrial	1	1981	Fresh: 79 m	Overburden: 3 m to 79 m	5717741
Commercial	1	1963	Fresh: 12 m	Overburden: 7 m to 12 m	5701469
Dewatering	0	N/A			
Monitoring, Observation, and/or Test Hole	13	2009 to 2020	Untested: 3 m to 13 m	Overburden: 1 m to 22 m	7143472,
Other, Not Used, and/or Not Listed	38	1968 to 2021	Fresh: 15 m Untested: 12 m to 15 m	Overburden: 1 m to 30 m Assumed Bedrock: 5 m to 87 m	5701461, 7039252, 5739673

The stratigraphic descriptions within the MECP monitoring well records are often inaccurate due to the methodology in which they are determined (observations of cuttings without depositional context and possibly some mixture between layers, plus no consistency between descriptions of soils between drillers). While this may be the case, an overall sense of the regional stratigraphy can be determined by looking at commonalities between most stratigraphic descriptions and where the wells were terminated in an aquifer. The well records typically indicate overburden of predominantly clay or loam over variable silt, sand, and gravel. Bedrock was not encountered in the well records within 500 m of site.

It is expected that all existing private water supply wells (used for domestic, livestock, industrial, or commercial purposes) on and/or within 500 m are not in use considering there is full municipal servicing in the City of Barrie.

Of the sixty-four (64) water well records labelled as domestic use, 62 wells were installed in the late 1960s to mid-1970s. It is likely that the wells have been removed or abandoned since that time. The remaining two (2) water well records labelled as domestic use installed in 2008 and 2020 are labelled as abandoned on the MECP Water Well record.

2.3. Review of MECP Permits to Take Water

Records of PTTW were obtained within 500 m of the site area from the Access Environment and MECP's online interactive permits to take water map to assess the general nature of the groundwater resources in the vicinity of the site, and the scale of historical/current groundwater takings required in the area. It should be noted that while these records indicate approved daily water taking volumes, it does not provide details on target depths for the water takings nor does it provide the actual volumes extracted, which could be less.

No active water taking records were found on-site nor surrounding the site within the search radius.

2.4. Visual Inspection of the Site

A visual site inspection was conducted by GEI staff on December 18, 2025, to evaluate site drainage, topography, surface water features, ground cover, and existing structures.

At the time of the inspection, the temperature was approximately 2°C, and the weather was sunny. The site's topography slopes downward from the north edge of the property down south toward the entrance at Dean Avenue.

During the site inspection, fill stockpiles were observed on site, mainly piled at the northern portion of the property. Additionally, the small structures identified in the aerial photos to be in the northern portion of the site (Figures 2A/2B), were not observed and are assumed to be demolished and/or removed during the stockpiling activities on site. No major structures nor private or monitoring wells were observed on the site.

During the site inspection, the site and surrounding area was snow covered, therefore obscuring potential surficial features such surface water features, or any groundwater discharge features (seeps). Surface runoff is anticipated to follow topography and drain into municipal catch basins. There were no signs of recent ponding water on the site observed nor areas with phreatophytic vegetation, such as cattails and bull rushes, which could indicate either groundwater at the surface or low permeability soils. While these features are not anticipated for this site , conditions may become more apparent in the growing seasons.

Given the site's topography, surface runoff is expected to flow predominantly to the south and southwest. No additional surface water features or groundwater discharge points (e.g., seeps) were observed on or near the property.

2.5. Site Physiographic and Geological Setting

The site is located within the physiographic region denoted as the Peterborough Drumlin Field. The local terrain is characterized predominantly by rolling glacial till plain of stone free silt, fine sand, minor gravel ridges and limestone. (Chapman, L.J. and Putnam, D.F., 2007). The predominant surficial geology of the site is described as stone-poor sandy silt to silty sand-textured till on Paleozoic terrain (OGS, 2010).

The bedrock underlying the general area corresponds to the Lindsay formation, consisting predominantly of nodular to black laminated limestone. Bedrock was not encountered in the MECP Water Well Records within 500 m of site. According to the Oak Ridges Moraine Groundwater Program Website, bedrock can be expected approximately 130 m below ground surface.

2.6. Site Condition Standard

The MECP has developed a set of Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the EPA (April 15, 2011) and O.Reg. 153/04, as amended. The standards consist of nine tables (Table 1 through Table 9) that provide criteria for maximum concentrations of various contaminants. In general, the applicable O.Reg. 153/04, as amended, SCS depends on the site location, land use, soil texture, bedrock depth and the applicable potable or non-potable ground water condition at the investigation site.

In order to determine the Site Sensitivity, Sections 41 and 43.1 of O.Reg. 153/04, as amended, were evaluated by GEI as shown in the following table.

Table 2-3. Determination of Site Applicable O.Reg. 153/04 SCS

Criteria	Result
Current Land Use	Vacant
Proposed Land Use	Residential
Potable vs. Non-Potable Ground Water	Potable
Proximity of Areas of Natural Significance	> 30 m
Proximity to a Water Body	> 30 m
Shallow Soil Condition	No
Applicable SCS for Proposed Use	Table 2:Full Depth Generic SCS in a Potable Ground Water Condition

3. Procedures and Methodology

3.1. BH Drilling & MW Installation

As referenced in Section 2.1.2, a drilling program associated with the concurrent geotechnical investigation at the site was carried out on December 18, 2024.

- Five (5) BHs were advances across the site to provide sufficient coverage for preliminary investigation of the soil properties on site.
  - BHs 1 to 5were drilled to 6.6 m bgs (Elev. 242.6 to 244.3).
  - Three (3) BHs were instrumented with MWs.
    - BH/MWs 2, 3, and 5.

The BH locations were laid out in the field by GEI staff prior to commencement of drilling operations. The locations of U/G utilities were coordinated with locating companies. Ground surface elevations of the BHs and coordinates (referencing NAD 83 geodetic datum) were surveyed by GEI with a Topcon FC – 5000 GPS Survey unit. The elevations are provided on the BH logs in Appendix B. BH and MW locations are shown on Figures 2A/B.

Drilling and sampling of the BHs was completed using track mounted drilling equipment operated by a specialty drilling subcontractor retained and supervised by GEI. The BHs were advanced to predetermined depths using solid stem augers and sampling was conducted using a 51 mm O.D. SS sampler. SPT N values were recorded for the sampled intervals as the number of blows required to drive an SS sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, in accordance with ASTM D1586. Soil sampling was conducted at 0.75 m intervals for the upper 3.0 m and at 1.5 m intervals thereafter.

A total of three (3) MWs were installed by GEI within five (5) selected BHs on site to facilitate long-term groundwater monitoring, sampling, and in-situ testing. The MWs consisted of 50 mm diameter PVC pipe and protective casing. The MWs were installed with a 1.5 m or 3.0 m long screens where sufficient overburden was available. BHs without MWs were backfilled in accordance with industry best practices. MWs construction is shown on the BH logs in Appendix B, listed in Appendix C, and summarized below.

Table 3-1. Summary of Monitoring Well Installation Details

BH ID	Well Screen Depth (m / Elev.)	Soil Unit Screened	Rational	Location
BH/MW 2	3.0 to 4.5 / 247.8 to 246.3	Silty Sand Glacial Till (very dense)	General – Horizontal Gradient	North-East
BH/MW 3	3.0 to 6.0 / 247.8 to 244.8	Silty Sand Glacial Till (very dense)	General – Horizontal Gradient	Central
BH/MW 5	4.5 to 6.0 / 245.3 to 243.8	Gravelly Sand (very dense)	General – Horizontal Gradient	South-East

The GEI field staff examined and classified characteristics of the soils encountered in the BHs, including the presence of fill materials, groundwater observations during and upon completion of the drilling, recorded observations of BH advancement, and processed the recovered samples. All recovered soil samples were logged in the field, carefully packaged, and transported to the laboratory for more detailed examination and classification.

In GEI's laboratory, the soil samples were classified as to their visual and textural characteristics. All samples were submitted for moisture content determination in accordance with ASTM D2216. Four (4) representative soil samples were selected and submitted to our laboratory for grain size analysis. Grain size analysis results are provided in Appendix D.

3.2. Hydraulic Conductivity Testing

Rising head hydraulic conductivity tests were conducted to estimate the horizontal hydraulic conductivity (K) of the soils at the depths of the well screens. These tests were carried out in monitoring wells at the site with an adequate water volume available (>0.5 m column of water) on February 7, 2025, after drilling, development, and stabilization of groundwater levels. Hydraulic conductivity (K) values were then estimated using the displacement-time data.

In a rising head test, water is manually purged rapidly from the monitoring well using LDPE tubing and a foot valve to create a near-instantaneous displacement of approximately 1 m of the water column within the well. The water level is then measured as it returns to an equilibrium.

The static water level was measured prior to the start of testing, and the initial change in water level was monitored both manually and by using an electronic level logger set to measure water levels every second. The level loggers were left in the monitoring wells to measure recovery of the groundwater to equilibrium or after 90% recovery was achieved. Specialty software (AQTESOLV Pro V4.50.002 by HydroSOLVE Inc.) was then used to analyze the data. The semi-log plots from this analysis for drawdown versus time for the tests are provided in Appendix E.

3.3. Groundwater Sampling

To establish baseline conditions and assess the most suitable discharge options for pumped groundwater during potential dewatering activities, the following groundwater samples were collected from two (2) MWs on the site on February 7. 2025:

- One (1) unfiltered groundwater sample for laboratory testing to compare against the City of Barrie Sewer Use Bylaw Criteria, PWQO standards for metals and TSS, and O.Reg. 153/04 SCS for PHCs and VOCs.
- One (1) filtered groundwater sample for laboratory testing to compare against the PWQO standards for total metals and TSS.

The purpose of sampling for the municipal sewer use bylaw criteria is to aid in the planning for and application of a future municipal sewer use agreement, should groundwater be discharged to the local municipal sewer system(s).

The purpose of sampling for PWQO total metals and TSS, and O.Reg. 153/04 PHCs and VOCs are for the evaluation of the groundwater to discharge into the natural environment and/or into sewer systems in which municipal discharge water quality standards do not currently exist.

Although PWQO and interim PWQO are not legally binding standards, they serve as the foundation for establishing acceptable wastewater loading limits on a site-specific basis (the natural environment and/or to sewer systems in which municipal discharge water quality standards do not currently exist).

The MECP has acknowledged that applying PWQOs can pose challenges, especially in regard to the limits of PHCs and VOCs. These challenges include instances where PWQOs may fall below the laboratory limits of detection, or PWQOs may be more stringent than background concentrations, even in water bodies with apparently thriving aquatic ecosystems.

As such, the applicable O.Reg. 153/04 SCS for the proposed site use is used to evaluate the groundwater on site for future discharge to the natural environment and/or to sewer systems in which municipal discharge water quality standards do not currently exist, specifically for assessing the concentrations of PHCs and VOCs found in the groundwater.

Should the quality of groundwater found on site exceed the PWQO and/or O.Reg. 153/04 SCS, additional treatment measures from the dewatering contractor may be required before discharging to the natural environment is advisable and/or approved, and as such discharge to local sewers may be a more efficient option for groundwater discharge during dewatering operations.

Prior to collection of the samples, a minimum of three (3) standing well volumes of groundwater were purged from each well. The samples are then collected via a “low-flow” peristaltic pump (Geotech Geopump Series I), to reduce sediment collected during sampling) and placed into sterile laboratory-supplied vials and/or bottles already pre-charged with analytical test group specific preservatives, as required. New single-use nitrile gloves were used during sample handling. The field-filtered samples are processed through a sterile 45 µm filter prior to collection in the required vials/bottles. The samples were submitted to CALA-accredited Caduceon for analysis.

4. Subsurface Conditions

4.1. Stratigraphy

The detailed soil profiles encountered in the BHs are indicated on the attached BH logs in Appendix C, and the geotechnical laboratory results are included in Appendix D. The BH locations are shown on Figures 2A/B and the subsurface profiles (conceptual geological cross section) interpreted from those logs are included as Figures 8 and 9.

It should be noted that the conditions indicated on the BH logs are for specific locations only and can vary between and beyond the locations. Additionally, the soil boundaries indicated on the BH logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the BH logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.). The passage of time also may result in changes in conditions interpreted to exist at locations where sampling was conducted.

4.1.1. Topsoil

A surficial topsoil layer was at the ground surface in Boreholes 1, 2, 4, and 5. The topsoil ranged in thickness from 75 to 760 mm. Topsoil thickness may vary between boreholes and in other areas of the site.

4.1.2. Fill

A fill layer was encountered beneath the topsoil in Boreholes 1, 2, 4, and 5 and was penetrated at 0.8 and 1.5 m depth (Elev. 248.4 to 249.0). A surficial fill layer was encountered in Borehole 3 and extended to1.5 m below ground surface (Elev. 249.3). The fill material consisted of silty sand with trace to some gravel. Trace organics were also observed in some samples. The fill was moist with moisture contents of 10 to 19%. The fill had N values ranging from 6 to 30 blows, showing loose to compact conditions.

4.1.3. Glacial Till

Underlying the topsoil and fill layer, a glacial till deposit was encountered in all boreholes and extended to the 6.6 m depth of exploration (Elev. 242.6 to 244.3), locally penetrated at 4.6 m depth (Elev. 245.2) in Borehole 5. The till matrix consisted of silty sand with trace to some clay and trace gravel. Cobbles and boulders should be expected based on augers grinding during advancement of the boreholes. Three (3) samples of the material were submitted for grain size analysis and the results are provided in Appendix D. The soil was moist, with moisture contents of 5 to 12%, local wet seams were noted. N values ranged from 13 to greater than 100 blows, indicating compact to very dense conditions, but typically dense to very dense, being compact near the top of the unit.

4.1.4. Gravelly Sand

Underlying the silty sand glacial till in Borehole 5, a gravelly sand unit with some silt and trace clay was encountered from 4.6 to 6.6 m depth of exploration (Elev.245.2 to 243.2). One (1) sample of the material was submitted for grain size analysis and the results are provided in Appendix D. The gravelly sand was wet, with moisture contents of 7 to 11%. N values were greater than 100 blows, indicating very dense conditions.

4.2. Groundwater Conditions

Unstabilized groundwater level measurements were taken upon the completion of drilling of each BH, as shown on the BH logs in Appendix B and in Appendix C. These measurements were taken to provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations that may arise. Additional groundwater level measurements taken during the remainder of the field investigation are considered more representative of static groundwater conditions as the wells had been developed and had time to recover and stabilize following initial construction.

The current groundwater observations are noted on the BH logs in Appendix B and in Appendix C, and a summary of groundwater measurements recorded to date are provided below.

Table 4-1. Summary of Unstabilized and Stabilized Groundwater Encountered

Well ID	**Unstabilized Groundwater Level[1]**		**Stabilized Groundwater Level**				**Range by BH/MW (Δm / ΔElev.)**	
			2025					
			January 8		**February 4**			
	m	Elev.	m	Elev.	m	Elev.	Δm	ΔElev.
BH/MW 2	2.3	248.5	2.29	248.50	2.82	247.97	0.53	0.53
BH/MW 3	2.2	248.6	2.22	248.59	3.01	247.81	0.79	0.78
BH/MW 5	5.2	244.6	1.73	248.04	2.42	247.35	0.69	0.69
Range by Month (Δm / ΔElev.)			0.56	0.55	0.59	0.62	---	

Notes:

1. Measured immediately after monitoring well is installed for preliminary results and comparison to first stabilized groundwater measurement in the following 1-2 weeks after well installation.

As discussed in Section 2.1.1, the MWs installed at the site were installed in December 2024 (as described further in Section 3.1) and groundwater levels to date have been measured in January and February 2025, it is unlikely that the annual high groundwater levels of the site have been measured during this investigation (which are typically found in the Spring).

For preliminary planning purposes the highest and lowest groundwater levels measured on site to date are summarized below.

Table 4-2. Summary of Extreme Groundwater Levels.

Shallowest Groundwater Level (m)	**Highest Groundwater Elevation (Elev.)**
1.73 (January 2025 - BH/MW 5)	248.59 (January 2025 - BH/MW 3)
Deepest Groundwater Level (m)	**Lowest Groundwater Elevation (Elev.)**
3.01 (February 2025 – BH/MW 2)	247.35 (February 2025 - BH/MW 5)

Groundwater levels have been measured within the MWs in January and February 2025, at depths ranging from 1.73 to 3.01 m bgs, and elevations ranging from Elev. 248.59 to 247.35 m asl. It is noted that due to the site's significantly varying surface topography the location of the shallowest or deepest groundwater levels measured do not necessarily coincide with the highest or lowest groundwater elevations measured, respectively.

Groundwater levels, especially near the surface, are expected to show seasonal fluctuations and vary in response to prevailing climate conditions. It is anticipated that the local groundwater flow will generally be west following the site's surficial topography towards a small tributary of Lover's Creek, as shown in Figure 10. Regionally, groundwater flow is anticipated to be northward toward Lake Simcoe.

GEI has been retained to conduct a long-term groundwater level monitoring program comprising of monthly groundwater level measurements at all MWs on site for one (1) year (January to December 2025). Upon completion, the results of this monitoring program will be provided under a separate cover. It is recommended that detailed designs of LIDs and/or other subsurface developments affected by the presence of the high groundwater table be deferred until the high groundwater levels have been determined.

4.3. Preliminary Infiltration Conditions

Percolation rates (also known as infiltration rates) are useful in the design of LIDs, such that they can be designed to best infiltrate surface water into the ground, that would otherwise runoff the site. As LIDs are typically not recommended to infiltrate into topsoil nor fill, LIDs should be designed to infiltrate into existing in-situ native materials and/or imported fill engineered to meet or exceed the infiltration capacity of the native near-surface soils on site.

Determination of percolation rates are based on the "MMAH Supplementary Standard SB-6, Percolation Time and Soil Descriptions, September 14, 2012". The BHs and grain size analyses (Appendices B and D) indicate that the site is predominantly underlain by cohesionless native soils and glacial tills.

In general, it is recommended that the base of the infiltration facilities penetrate at least into the native soils on site, but still maintain a clearance of 1 m from the groundwater table and as such it is recommended that detailed designs of LIDs be deferred until the high groundwater levels have been determined.

Based on this soil type alone, the infiltration properties of the near surface soils are estimated in the table below.

Table 4-3. Estimates of Soil Infiltration Properties

Soil Type[1] (unified soil classification)	Saturated Hydraulic Conductivity[2]		Unfactored Percolation Time[1]		General Comments on Permeability
	cm/s	m/s	min/cm	mm/hr	
SC: Clayey sands, sand-clay mixtures	10^{-4} to 10^{-6}	10^{-5} to 10^{-7}	8 to 20	75 to 30	Medium to Low (depending on amount of clay)

Notes:
1. It is noted that the MMAH 2012 – Supplemental Standard SB-6, does not provide information on glacial till soils and as such the most similar soil type has been selected.
2. Values from MMAH 2012 – Supplemental Standard SB-6: Percolation Time and Soil Descriptions.

The infiltration rate is not applicable below the groundwater table, and infiltration into earth fill or weathered / disturbed soil is not recommended. As per industry best practices in Southern Ontario, Appendix C of “LID SWM and Planning Design Guide” (Version 1.0, 2010, by CVC and TRCA) suggests safety factors to be applied to infiltration rates. The safety factor applicable to the site is expected to be 2.5 but must be confirmed once the final location and elevation of LID measures are known.

As per industry best practices for LID designs, using a factor of safety of 2.5 results an overall design factored infiltration rate of 50 min/cm (equivalent to approximately 12 mm/hr). These values are preliminary and can be used to facilitate initial assessment of the type, size and location of infiltration features that may be incorporated on this site.

It is noted that the MECP’s SWM plan and SWM practice design guide provides guidance on physical constraints for various SWM Practice types, which is briefly summarized below.

Table 4-4. Select Physical Constraints for SWM Practice Types[1]

SWM Feature	Property Size Requirement (Area)	Soil Requirement	Applicable to Site?
Wet Pond / Dry Pond / Wetland	>5 ha	None	No, site is <5 ha.
Infiltration Basin	<5 ha	Minimum Infiltration Rate ≥60 mm/hr	No, site infiltration rate is expected to be ≤15 mm/hr.
Sand Filters	<5 ha	None	Possible, depending on other factors, to be determined by a SWM Engineer.
Infiltration Trench	<2 ha	Minimum Infiltration Rate ≥15 mm/hr	No, site infiltration rate is expected to be ≤15 mm/hr.
Grassed Swales / Vegetated Filter Strips / Oil/Grit Separators	<2 ha	None	Possible, depending on other factors, to be determined by a SWM Engineer.
Soakaway Pit / Rear Yard Ponding	<0.5 ha	Minimum Infiltration Rate ≥15 mm/hr	No, site is >0.5 ha and site infiltration rate is expected to be ≤15 mm/hr.
Reduced Lot Grading / Pervious Pipes	None	Minimum Infiltration Rate ≥15 mm/hr	No, site infiltration rate is expected to be ≤15 mm/hr.

Notes:

1. Modified from the MECP SWM Plan and SWM Practice Design guide Table 4.1.

Based on the above it is understood that SWM practice may be limited to sand filters, grassed swales, vegetated filter strips, and oil/grit separators, at the site due to its size and the expected design infiltration rate for the near surface soils on site. As such, SWM through infiltration may be impractical at the site since the expected design infiltration rate for the near surface soils on site, has a percolation rate less than 15 mm/hr. Should the client be requested and/or required by approval authorities to incorporate infiltration features onsite a SWM engineer should be retained to assess the SWMP for the site and provide LID design options to client, including commentary on any offset costs that may be required if development negatively impacts the water balance of the site (further discussed in Section 6).

4.4. Hydraulic Conductivity

In-situ hydraulic conductivity tests were conducted in three (3) monitoring wells containing a sufficient water volume (> 0.5 m column of water in well) on February 7, 2025. The data from these tests was input into AQTESOLV Pro V4.50.002 (HydroSOLVE, Inc.) and by applying:

a. Hvorslev’s solution (1979) where the well screen was fully saturated.

Hydraulic conductivity values were calculated from each test. The semi-log plots for the results are provided in Appendix E and are summarized in the table below. It should be noted that the hydraulic conductivity values obtained from the manual level measurements were very similar to the results obtained from the test where the logger data was analyzed.

Table 4-5. Summary of Hydraulic Conductivity Testing Results

ID	Well Screen Depth / Elevation (m)	Soil Unit Screened	Static Water Level[1] Depth / Elevation (m)	In-Situ Bulk Hydraulic Conductivity (K) (m/s)
BH/MW 2	3.0 to 4.5 / 247.8 to 246.3	Silty Sand Glacial Till (very dense)	2.87 / 247.92	2.3×10^{-6}
BH/MW 3	3.0 to 6.0 / 247.8 to 244.8	Silty Sand Glacial Till (very dense)	3.07 / 247.74	2.9×10^{-7}
BH/MW 5	4.5 to 6.0 / 245.3 to 243.8	Gravelly Sand (very dense)	2.49 / 247.29	3.0×10^{-6}

Notes:

1. Variation in the static water levels measured 1-2 weeks after well installation, compared to those measured before hydraulic conductivity testing, can be expected due to the effects of well purging prior to and during the testing.

According to Freeze and Cherry (1979), the typical range in hydraulic conductivity for the soils encountered are as follows:

- Gravel:	10^{-0} to 10^{-3} m/s
- Sand:	10^{-2} to 10^{-6} m/s
- Silty Sand:	10^{-3} to 10^{-7} m/s
- Silt:	10^{-5} to 10^{-9} m/s
- Glacial Till:	10^{-6} to 10^{-12} m/s

From the hydraulic conductivity test results for the well screened within the glacial till units encountered on site, the results on the order of 10^{-6} and 10^{-7} m/s fell within the higher range of the expected values for glacial till (10^{-6} to 10^{-12} m/s).

From the hydraulic conductivity test result for the well screened within the gravelly sand unit encountered on site, the result on the order of 10^{-6} m/s fell within the lower of the range of the expected values for sand (10^{-2} to 10^{-6} m/s). This may be due to the variety of grain sizes being present (sand, gravel, and silt) such that each grain size comprises 20 – 53 % of the soil, not solely clean gravel, clean sand, and/or silty sand as referred to by Freeze and Cherry (1979).

As such, the hydraulic conductivity test results measured on site, at the discrete locations of the monitoring wells are considered to be representative of the overall horizontal hydraulic conductivity of the wide variety of soils encountered on site, the maximum hydraulic conductivities calculated for the overburden on site (3.0×10^{-6} m/s, respectively) are appropriate conservative values to be used for the preliminary construction dewatering calculations in Section 5.

It is noted that soil samples collected during BH drilling were collected at discrete depths such that unidentified lenses or layers between these samples and within the depth of the monitoring wells' screens may exist causing any deviations from the typical ranges in hydraulic conductivities as expected from Freeze and Cherry (1979).

4.5. Hydrostratigraphy

Based on the regional and site stratigraphy, the current stabilized groundwater levels, and subsurface conditions, the sandy silts/silts (described in Section 4.1.2) were observed below the topsoil in BHs 2, 3, and 6, extending to depths of 0.8 m (Elev. 222.8 to 222.2), and is expected to produce minor groundwater inflow from perched water during excavations.

The loose to very dense upper glacial till encountered in all BHs extending to 6.6 m depth of exploration are expected to produce groundwater inflow from the water table during excavations, particularly if seams of courses materials are encountered during excavations within the glacial till and if any excavations extend into the deeper very dense gravelly sand.

4.6. Groundwater Chemistry

4.6.1. Dewatering Discharge

To assess the suitability for discharge of pumped groundwater to the land surface or to the local sewer options during construction dewatering activities, three (3) groundwater samples total were collected. One (1) field filtered sample and one (1) unfiltered sample were collected on February 7, 2025 from BH/MW2. One (1) unfiltered sample was collected on February 7, 2025, from BH/MW5.

For assessment purposes, the analytical results were compared to the City of Barrie’s Sewer Use Bylaw Criteria, PWQO, and O.Reg. 153/04, as amended.

The results of the groundwater chemistry analysis are presented in the laboratory Certificates of Analysis provided in Appendix F. A summary of the results is presented in the table below for samples relative to the sewer use bylaw criteria, PWQO and Interim PWQO, and O.Reg. 153/04, as amended.

Table 4-6. Summary of Groundwater Quality with Identified Exceedances (Dewatering Discharge)

Sample ID	**Exceedances**				
	City of Barrie		**Interim PWQO**	**PWQO**	**O.Reg. 153/04 Table 1 SCS**
	Storm Sewer	**Sanitary Sewer**			
BH/MW 2 (Unfiltered)	Parameters not analyzed or assessed		Zinc (total) 36 vs 20 µg/L Cobalt (total) 5.4 vs 0.9 µg/L Copper (total) 14.3 vs 5 µg/L Lead (total) 3.87 vs 1 µg/L Vanadium (total) 15.2 vs 6 µg/L	Iron (total) 9260 vs 300 µg/L Zinc (total) 36 vs 30 µg/L	No exceedances found for parameters assessed
BH/MW 2F (Field Filtered)			No exceedances found for parameters assessed	No exceedances found for parameters assessed	
BH/MW 5 (Unfiltered)	Total Suspended Solids (TSS) 132 vs 15 mg/L	No exceedances found for parameters assessed	Parameters not analyzed or assessed		Parameters not analyzed or assessed

Notes:

1. Groundwater samples that have met O.Reg. 153/04 Table 1 SCS have met the applicable SCS for the proposed site use (Table 8).

The unfiltered groundwater sample from BH/MW 5 was evaluated against the City of Barrie Storm and Sanitary Sewer Use Bylaw Criteria. All parameters assessed met the bylaw criteria except for TSS.

The unfiltered and filtered groundwater sample from BH/MW 2 was assessed against the PWQO and interim PWQO. All parameters assessed met the objectives, except for total iron and total zinc which exceeded PWQO. All parameters assessed met the objectives, except for total zinc, total cobalt, total lead, total copper, and total vanadium which exceeded interim PWQO. Notably, the field-filtered sample from the same well demonstrated a reduction in all metal exceedances compared to the unfiltered sample such that both the PWQO and interim PWQO were met.

The unfiltered and filtered groundwater sample from BH/MW 2 was assessed against the O.Reg.153/04 Table 1 SCS. All parameters assessed met Table 1 SCS (the most stringent of the O.Reg.153/04 SCS) and the applicable SCS for the site and its proposed use (Table 2).

If pumped groundwater will be released to the ground surface and/or local sewer systems, it must be suitably treated to remove the parameter exceedances prior to discharge (treatment methods to be determined by the dewatering contractor or civil engineer).

It is expected that during construction dewatering, the pumped water is to be first discharged to a sedimentation tank and/or a silt/sediment bag, at a minimum, before being discharged to the surface or a local sewer.

5. Site Dewatering

5.1. Preliminary Construction Dewatering

As previously discussed in Section 2.1, it is understood that the site: will be municipally serviced with servicing inverts extending to approximately Elev. 249.18 in the north and Elev. 246.39 in the south; will have U/G parking beneath the residential structure extending to Elev. 249.70 with a footprint of 86 m by 20 m; and will have an U/G storage tank north of the residential structure extending to Elev. 249.65 with a footprint of 15 m by 8 m.

Additionally, it is understood that the site will be graded such that there is a relatively smooth transition between the local elevation high in the northeast and low in the southeast sloping down from Elev. 251.51 to 248.81. The site will also be graded to meet the surrounding properties with proposed grades of Elev. 250.16 and 249.95 at the northwest and southeast corners of the site.

The approximate excavation depths and dimensions have been plotted onto the geological cross sections in Figures 8 and 9 with the following assumptions:

- Excavations for the site servicing will extend 0.5 m below the servicing inverts and the target groundwater level will be 0.5 m below the excavation,
- Excavations for the U/G parking will extend 1.0 m below the basement floor and the target groundwater level will be 1.0 m below the excavation,
- Excavations for the U/G storage tank will extend 0.3 m below the base and the target groundwater level will be 0.3 m below the excavation, and
- The transitions between the proposed grades at the corners of the site will slope downwards consistently.

In review of Figures 8 and 9, it is assumed that the site will be cut to grade such that the proposed grade will come within 1.2 m of the groundwater levels measured in January 2025 near the centre of the site. As previously discussed, it is unlikely that the annual high groundwater levels of the site have been measured during this investigation (which are typically found in the Spring), and as such grading plans and/or foundational plans may need to be altered following the completion the long-term groundwater level monitoring program.

The following calculations for the excavations are based on the assumed groundwater conditions for temporary dewatering rates anticipated to occur during construction. As previously discussed in Section 4.2, it is unlikely that the annual high groundwater levels of the site have been measured during this investigation (which are typically found in the Spring), and as such the following analysis assumes that the future construction will occur during similar groundwater conditions (late Winter). As such, it is recommended that any further detailed construction dewatering analysis be deferred until the high groundwater levels have been determined.

The current recommendations are based on our understanding of the project and the results of the field investigation. The interpretation and recommendations are intended for the use of the design consultant and Client and shall not be relied upon by any other parties including the construction contractor or used for any purposes other than development of the project design.

Comments on construction methodology and equipment, where presented, are provided only to highlight those aspects that could affect the design of the project. Contractors must make their own assessment of the factual information presented in previous sections of the report, and the implications on equipment selection, construction methodology, and scheduling.

5.1.1. Construction Description & Dewatering Assumptions

The annual high groundwater elevation has not yet been identified. Therefore, the current highest groundwater level measured to date (as measured on January 8, 2025) have been assumed to be encountered during the setting of engineered fill materials beneath installations of site servicing and/or beneath future building(s).

The dewatering assessment in the following sections assumes open-cut excavations or permeable shoring. A mitigated "worst-case-scenario" approach has been applied to these preliminary dewatering calculations. This approach assesses the reasonable potential impact and suggests methods to consider during construction dewatering.

It is GEI's understanding that future work may take place in on or multiple of the following zones.

Table 5-1. Construction Dewatering Zones

Dewatering Zone		Description
1	Site Servicing (North to South)	Linear excavation for the installation of water and sewer services across the site. 50 m long by 5 m wide
2	U/G Parking	Linear excavation for the installation of U/G parking in the eastern portion of the site. 86 m long by 20 m wide
3	U/G Storage Tank	Linear excavation for the installation of U/G parking in the northern portion of the site. 15 m long by 8 m wide

GEI's understanding of the proposed work, the excavation, dewatering, and site condition assumptions are summarized below, and explanations are provided in the tables below.

Table 5-2. Summary of Assumed Excavation Geometry

Dewatering Zone		Assumed Excavation Dimensions			Target Pumping Groundwater^4 Elev. (m)
		Length (m)	Width (m)	Lowest Excavation^3 Elev. (m)	
1	Site Servicing (North to South)	50^1	5^1	248.68 to 245.89	248.2 to 245.4
2	U/G Parking	86^2	20^2	248.70	247.7
3	U/G Storage Tank	15^2	8^2	249.35	249.1

Notes:
1. Assumed based on similar construction scenarios.

2. Based on site plans provided.
3. As discussed in Section 5.1, 0.3 to 1.0 m below lowest inverts.
4. As discussed in Section 5.1, 0.3 to 1.0 m below lowest excavation.

Table 5-3. Summary of Assumed Groundwater Conditions

Dewatering Zone		**Local Groundwater Elev. (m)**	**Target Pumping Groundwater[3] Elev. (m)**	**Assumed Aquifer Bottom Depth / Elev.[4] (m)**	**Construction Dewatering Expected?[5]**
1	Site Servicing (North to South)	248.6[1] to 248.5[2]	248.2 to 245.4	242.9	Yes
2	U/G Parking	248.6[1]	247.7		Yes
3	U/G Storage Tank	248.6[1]	249.1		No, dewatering not anticipated

Notes:
1. Highest groundwater elevation measured to date at BH/MW 3.
2. Highest groundwater elevation measured to date at BH/MW 2.
3. As discussed in Section 5.1, 0.3 to 1.0 m below lowest excavation.
4. Assumed 3.0 m below the deepest excavation.
5. Is the Local Groundwater higher than the Target Pumping Groundwater for at least a portion of the excavation?

Based on the conditions above, the following points/assumptions were noted:

- A bulk hydraulic conductivity of the materials on site were assumed to be 4.2×10^{-6} m/s based on the maximum hydraulic conductivity test results measured on site (as presented in Section 4.4) as a part of the hypothetical scenario approach.

Considering the geometries above, excavations for site servicing and the U/G parking are currently planned to extend as much as 2.6 m below the prevailing groundwater table. Therefore, where dewatering is necessary, groundwater drawdowns ranging from 0.4 to 3.1 m are assumed during construction, during which, below the surficial topsoil, excavations will encounter the glacial till deposit. Harder digging will be experienced in the dense to very dense soil. Cobbles and boulders should be expected in the glacial till.

5.1.2. *Radius/Radii of Influence*

The ROI for the construction dewatering is based on the empirical Sichardt Equation. This equation is used to predict the distance at which the drawdown resulting from pumping becomes negligible. This equation is simplistic and is based on steady state conditions, as well as homogeneous hydrogeological conditions (i.e., uniform infinite aquifer). As such, steady state dewatering may not be achieved during the relatively short-term construction dewatering work, plus homogeneous hydrogeological conditions are not typically encountered outside of a laboratory, so the ROI presented here may be an overestimation of the actual ROI encountered. The Sichardt equation is described as follows and the results are summarized in the table below (and presented in Appendix G).

$$R_0 = C(H-h)\sqrt{K}$$

Where:

R_0 = ROI (m)
C = Sichardt’s Constant (1750 $s^{0.5}/m^{0.5}$)
H = Static Saturated Head (m)
h = Dynamic Saturated Head (m)
K = Hydraulic Conductivity (m/s)

Based on the Sichardt equation, the hydraulic conductivity of 4.2 x 10^{-6} m/s and the total groundwater drawdowns required at this site, the ROIs can be assumed to be up to 11.2 m from the centre of the excavations. Calculation details are provided in Appendix G, and zone-specific ROIs are summarized below.

Table 5-4. Summary of Dewatering Drawdown Conditions for ROI

Dewatering Zone		Static Saturated Head	Dynamic Saturated Head	Hydraulic Conductivity	ROI
		Above Aquifer Bottom			
		H (m)	h (m)	K (m/s)	R_0 (m)
1	Site Servicing (North to South)	5.7 to 5.6	5.3 to 2.5	4.2 x 10^{-6}	1.5 to 11.2
2	U/G Parking	5.7	4.8		3.2
3	U/G Storage Tank	5.7	6.2		Dewatering Not Anticipated

The ROI calculation is a conservative methodology and is calculated based on the assumption of active (steady state) pumping during the construction dewatering. It should be noted that a higher volume of water will be pumped during the first stage of the construction period or when a rain event occurs. It is uncertain whether dewatering efforts would reach steady state prior to the completion of construction of each dewatered segment.

5.1.3. Temporary Dewatering Flow Rates

The Dupuit-Forcheimer method for radial flow from an unconfined aquifer for a fully penetrating excavation was used to calculate steady-state flow rate estimates for non-linear excavations and is expressed as follows:

$$Q = \frac{\pi K(H^2 - h^2)}{In\, {}^{R_a}/_{r_s}}$$

Where:

Q = Rate of pumping (m^3/s)
K = Hydraulic conductivity (m/s)
H = Head beyond the influence of pumping (static groundwater elevation) (m)
h = Head above base of aquifer at the excavation (m)
R_a = Radius of influence from the center of the excavation R_0+r_s (m)
r_s = Equivalent well radius (m, radius of a circle with an area equal to the excavation footprint)

*Where the ROI is less than equivalent well radius, the value of R_0 is assumed to be the sum of the ROI as calculated by the Sichardt equation and equivalent well radius.

A combination of groundwater flux and Dupuit-Forcheimer equation was used to calculate steady-state flow rates for linear excavations (Dewatering Zones 1 to 3) from both sides of a trench and at both ends of the trench through an unconfined aquifer resting on a horizontal impervious surface. This equation was used to obtain a flow rate estimate while dewatering is expressed as follows for an unconfined aquifer:

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

Where:

Q = Rate of pumping (m^3/s)
K = Hydraulic conductivity (m/s)
H = Head beyond influence of pumping (static groundwater elevation) (m)
h = Head above base of aquifer at excavation (m)
R_0 = Radius of influence (m)
r_s = Distance to wellpoints from the centre (assumed half of trench width)
R_a = Radius of influence from the centre of the excavation (R_0+r_s)
x = Length of excavation (m)
L = Length of excavation (m)

It is expected that the initial dewatering rates will be higher in order to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water levels are achieved in the excavation footprints as groundwater will have been removed locally from storage resulting in lower seepage rates into the excavations.

Please note that the anticipated dewatering rate may increase if larger excavations are undertaken beyond the assumptions detailed in the preceding section. The calculated dewatering rates below are based on the current assumptions; however, larger excavations would likely elevate the overall dewatering requirements beyond these calculations.

Based on the assumptions provided in this report, the results of the dewatering rate estimates are summarized below, and calculation details are provided in Appendix G.

Table 5-5. Summary of Construction Dewatering Flow Rate Calculations

Dewatering Zone		Construction Dewatering Flow Rate	
		As Calculated including FOS[1]	Combined and including Rainfall Event[2,3]
		L/day	
1	Site Servicing (North to South)	63,391 to 100,906	377,502
2	U/G Parking	121,245	
3	U/G Storage Tank	Dewatering Not Anticipated	

Notes:
1. A FOS of 2.0 is included to account for seasonal fluctuations in the groundwater table, initial removal of groundwater from storage and variation in hydrogeological properties beyond those encountered during this study.
2. A 44 mm rainfall event was included in the water-taking calculation to account for the maximum projected single-day precipitation in the local area in the immediate future (2021 to 2050) under high carbon emissions (RCP8.5), according to the Climate Atlas of Canada. The Climate Atlas uses data from the Pacific Climate Impacts Consortium, which provides downscaled projections of daily temperature and precipitation from 24 climate models using two carbon emission scenarios.
3. It is noted that under specific conditions, if the water taking is 100% storm water registration on the EASR may not be required, however if water taking consists of any mixture of storm water and groundwater typical registry or permitting is likely required.

5.1.4. Permit Recommendations

Given that the predicted preliminary temporary water taking rates for construction dewatering on site (installation of engineered fill) is calculated to exceed 50,000 L/day, but not 400,000 L/day, a PTTW application is not expected be required, but a registration on the EASR is anticipated for dewatering works on site. It should be noted that groundwater levels collected to date are not reflective of the seasonal variation and water levels will likely be higher during and immediately following freshet. Temporary dewatering discharge rates will likely be higher due to higher groundwater table elevations.

Dewatering more than 50,000 L/day shall not take place until the proposed water taking is registered with the MECP.

It is the responsibility of the contractor to ensure dry conditions are maintained within the excavations at all times. Based on the calculated water taking rate, it is expected that sump pumping and/or keg wells will be required to achieve the recommended drawdowns during earthworks for the building and/or site servicing. However, the dewatering contractor is responsible for selecting the dewatering method based on their preferred means and methods after reviewing the information provided in this report. Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events.

The maximum flow calculation is intended to provide a conservative estimate to account for unforeseeable conditions that may arise during construction. It should be noted that the dewatering estimates provided in this report are based on assumptions and details available at the time of this report. If changes to the design are implemented (e.g., increase to planned excavation depths, widening of excavations, increased length of trenching etc.), the dewatering estimates must be revised to include and reflect future changes and to ensure that any conclusions or recommendations made by GEI remain valid.

5.1.5. Remedial Dewatering Activities

The dewatering contractor will be responsible for finalizing and implementing the discharge plan, including information such as the exact discharge location, erosion control methods, method of conveyance, treatment systems, temperature of the discharged groundwater, etc. It is the contractor’s responsibility to implement a treatment system to ensure that discharged groundwater meets the applicable standards. This may be done by examining the hydrogeologic conditions in a test pit (and/or a full-range pumping test by the dewatering subcontractor).

Treatment and disposal of the dewatering discharge should follow best management practices, including sediment and erosion control measures, removal of suspended solids by a decanting tank and/or filter bag, as well as water quality and quantity control monitoring programs, as mentioned earlier. The contractor should be aware that the purpose of the dewatering system is to maintain stable excavation slopes and dry working conditions during excavation.

The extent and details of the dewatering scheme (trench or well dimensions, spacing, pump levels, screen size and wick gradation, etc.) are left solely to the contractor’s discretion to achieve the performance objectives for maintaining stable slopes and dry working conditions and will be based on their own interpretation and analysis of site conditions, equipment, experience, and efficiency. The contractor should also appreciate that additional dewatering means and modifications may be required as variations in site conditions are encountered. The recommended groundwater taking, and discharge plans are provided in Appendices H and I, respectively.

5.1.6. Impact Assessment for Groundwater Dewatering

The impact assessment for taking groundwater during construction is provided in the Groundwater Taking Plan in Appendix H and includes a review of settlement, impacts to nearby groundwater users or to surface water / environmental features.

6. Preliminary Water Balance

6.1. Water Balance Components

A water balance is an accounting of the water resources within a given area. The water balance equates the precipitation (P) over a given area to the summation of the change in groundwater storage (S), evapotranspiration/evaporation (ET), surface water runoff (R) and infiltration (I) using the following equation:

$$\mathrm{P} = S + I + ET + R$$

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). For example, runoff occurs at a higher percentage during periods of snowmelt when the ground is frozen or during intense rainfall events.

Precise measurement of the water balance components is difficult, and as such, approximations and simplifications are made to characterize the water balance of a property. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important inputs to the water balance calculations.

- Precipitation (P): For the purposes of approximating the annual precipitation at this site, the mean annual precipitation value for the applicable subwatershed, land cover, and hydrologic soil group from the Lake Simcoe Climate Data (LSRCA, 2017) was used (914 mm).
- Storage (S): Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero.
- Evapotranspiration/Evaporation (PET): For the purposes of approximating the annual evapotranspiration and evaporation at this site, the actual evapotranspiration value for the applicable subwatershed, land cover, and hydrologic soil group from the Lake Simcoe Climate Data (LSRCA, 2017) was used (571 mm).
- Water Surplus (R + I): For the purposes of approximating the annual water surplus at this site, the precipitation surplus value for the applicable subwatershed, land cover, and hydrologic soil group from the Lake Simcoe Climate Data (LSRCA, 217) was used (343 mm).

6.2. Water Balance Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre- and post- development infiltration volumes. The detailed water balance calculation is provided in Appendix J, which is summarized in this and subsequent sections of the report. The following assumptions were used as part of the soil-moisture balance calculations:

- A soil moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists.
- During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Considering the nature of the current near surface soils and vegetation cover, a soil moisture storage capacity of 75 mm was assumed for pre- and post- development scenarios.
- Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

The Thornthwaite and Mather analytical approach (1957) was used to calculate the water balance and involves monthly potential evapotranspiration calculations accounting for latitude, climate and the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions were calculated. The MECP SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding infiltration factor was calculated for pre- and post-development conditions. The water surplus was multiplied by the infiltration factor to determine both the pre-existing and post-condition annual volumes for run-off and infiltration for the property.

The pre-development scenario was estimated from the site inspection and aerial images. As the site is vacant and predominantly covered by meadow the condition of the site pre-development is estimated to be 100% permeable. The post-development water balance scenario was estimated based on the "Concept Plan” by Jones Consulting Group Ltd. (July 12, 2024). The post-construction scenario assumes 42% of the site remains permeable land. The remaining 58% of the land is assumed to be impermeable and consists of the proposed residential lots, SWM area, internal roadways green/park space and watercourses. The current site plans are preliminary and subject to change. The water balance must be updated following final site configuration to reflect the actual plans.

It is noted that the infiltration and runoff values presented in Appendix J are estimates only. Single values are used for water balance calculations, but it is important to understand that infiltration rates are dependent upon the hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration and runoff component values are potentially quite large. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post-development conditions.

6.3. Existing Conditions

Detailed water balance calculations are included in Appendix J. The pre- and post- development calculations summarized in this section are preliminary only and must be updated once site plans are finalized.

The table below summarizes the pre-construction water balance as per the proposed site development plans.

Table 6-1. Summary of Pre- and Post-Development Water Balance Conditions

<table>
<tr><th>Condition</th><th>Total Area (ha)</th><th>Relative Permeable Areas</th><th>Relative Impermeable Areas</th><th>Average Annual Infiltration Volume (m³/year)</th><th>Average Annual Runoff Volume (m³/year)</th></tr>
<tr><td>Pre-/Existing Development Land Use</td><td rowspan="2">0.67</td><td>100%</td><td>0%</td><td>1,030</td><td>1,258</td></tr>
<tr><td>Post-/Proposed Development Land Use</td><td>42%</td><td>58%</td><td>431</td><td>3,538</td></tr>
<tr><td colspan="6">Pre- to Post-Development Change</td></tr>
<tr><td colspan="4">Annual Volume Change (m³/year)</td><td>-598</td><td>+ 2,280</td></tr>
<tr><td colspan="4">Relative Change (%)</td><td>-58</td><td>+ 181</td></tr>
</table>

These calculations suggest that, without mitigation such as LID measures, the proposed development will decrease average infiltration by approximately 598 m^3/year (58% decrease). The proposed development will increase runoff by approximately 2,280 m^3/year (181% increase). The potential impacts of these changes and recommended mitigation measures are discussed below.

6.4. Recommended Mitigation Measures

The three broad categories which typically need to be mitigated and accounted for are:

- Reducing the volume and speed in which additional surface water runoff occurs;
- Increasing the amount of infiltration to match pre-development conditions; and
- Ensuring that the quality of existing surface water features and groundwater will not be adversely impacted.

It is understood that the client will be implementing LID features on this site. Details have not been yet provided to GEI. In general, it is recommended that the base of the infiltration facilities penetrate at least into the native soils on site and may be limited by soil type. LID features are required to maintain a clearance of 1 m from the groundwater table.

6.4.1. Runoff Quantity

Urban development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (e.g., roads, parking lots, driveways, rooftops). Impervious surfaces prevent infiltration of water into the underlying soils and the removal of the vegetation reduces the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 15% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (up to two thirds of precipitation). So, the net effect of the urbanization of the site is that most of the precipitation that falls onto impervious surfaces increases the surplus water resulting in more direct runoff from developed areas and reduced natural infiltration.

In conjunction with increased runoff, there is a reduction in infiltration to the shallow groundwater system. A reduction in infiltration can potentially lead to a lowering of the local water table and reduce the potential for this seasonal water table intersection and discharge.

Methods which do not necessarily increase infiltration rate, but decrease the volume and concentration of surface water runoff can be considered at this site include (but are not limited to):

- Increasing the topsoil thickness by about two times the normal thickness (up to 30 cm) to retain more water in storage; and
- Implementation of rainwater harvesting which intercepts, diverts and stores roof runoff (i.e., cisterns) for future use.

6.4.2. Mitigation Measures for Maintaining Infiltration

The increases in surface water runoff that will occur with urban development and mitigation of the potential impacts to the local water table due to reduction of infiltration may be minimized by using appropriate SWM and using LID measures to promote infiltration. These measures can be implemented on-site.

The basic premise for LID is to try to minimize changes to runoff and infiltration. As outlined in the MECP SWM Practice Design Manual (2003), Technical Guidelines for SWM Submissions published by the LSRCA (2022), and LID SWM Planning and Design Guide published by the CVC and TRCA (2010), and industry standard for best practices in Southern Ontario, there are a suite of techniques that may be considered to promote infiltration and reduce runoff.

However, as previously discussed (in Section 4.3), it is understood that SWM practices may be limited to infiltration basin, sand filters, infiltration trenches, grassed swales/vegetated filter strips/oil/grit separators and, reduced lot grading/precious pipes at the site due to its size and the expected design infiltration rate for the near surface soils on site.

It is understood that wet ponds, dry ponds, and/or wetlands may not be a possible SWM practices suitable for the site.

Should LID measures such as the SWM pond and/or others be implemented for the site, the details and designs should demonstrate through plans and sections (including all dimensions, materials used and including the seasonal high groundwater level) how this infiltration deficit will be mitigated.

As it is typically a requirement of maintaining the same levels of infiltration post construction, no appreciable change in the groundwater table elevation should occur over the long-term condition.

If LID infiltration measures will be designed and constructed on site, it is recommended to measure the in-situ infiltration rates by excavating test pits and conducting GP tests in the exact footprints and elevations of the LID measures.

6.4.3. Groundwater Quality

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, phosphorous, bacteria and viruses. For groundwater, generally except for the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater flow through the soils.

LID measures or end treatments such as oil/grit separators or wet ponds also help to remove suspended solids and other contaminants in runoff prior to infiltration or conveying the flows off the site, especially when a treatment train approach is taken for SWM. Any SWM facilities must be designed such that the water quality is maintained or improved prior to discharging water from the site or infiltrating water into the ground.

Runoff from rooftops and landscaped areas are typically considered “clean” and can be collected and infiltrated where possible. Infiltration-based practices for runoff from paved areas may be restricted for the proposed commercial development or may require pre-treatment prior to any infiltration.

Provided only clean or pre-treated runoff will be infiltrated, the groundwater quality will not be degraded and will not impact nearby domestic wells or other nearby environmental features.

7. Limitations

The recommendations and comments provided are necessarily on-going as new information of U/G conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the BH information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

GEI should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, GEI will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of BHs required to determine the localized U/G conditions between BHs affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual BH results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was authorized by and prepared by GEI for the Nestwise Inc. (as provided in the signed Standard Professional Services Agreement). 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. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

8. Closure

We trust that this information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact our office.

Yours truly,

GEI Consultants Canada Ltd.

Prepared By:

PROFESSIONAL GEOSCIENTIST
SARAH E. GRIFFITH
PRACTISING MEMBER
3988
ONTARIO

Tanvi Patel

SGriffith

Tanvi Patel, G.I.T.
Hydrogeologist-In-Training

Sarah Griffith, P.Geo.
Project Hydrogeologist

Reviewed By:

Professional Engineers Ontario
Licensed Engineering Technologist
Name: K. L. PICKETT
Number: 100501338
Limitations: Environmental investigations of soil, groundwater, air and sediment products including Record of Site Conditions, soil management plans and completion of Phase I and Phase II Environmental Site Assessments, excluding design, construction and verification of site remediation
Association of Professional Engineers of Ontario

LICENSED PROFESSIONAL ENGINEER
G.R. WHITE
Mar. 4, 25
PROVINCE OF ONTARIO

KPickett

Kim Pickett M. Ed, C.E.T, LET, QP_{ESA}
Project GeoScientist

Geoffery R. White, P.Eng.
Barrie Office Branch Manager and
Senior Geotechnical Engineer

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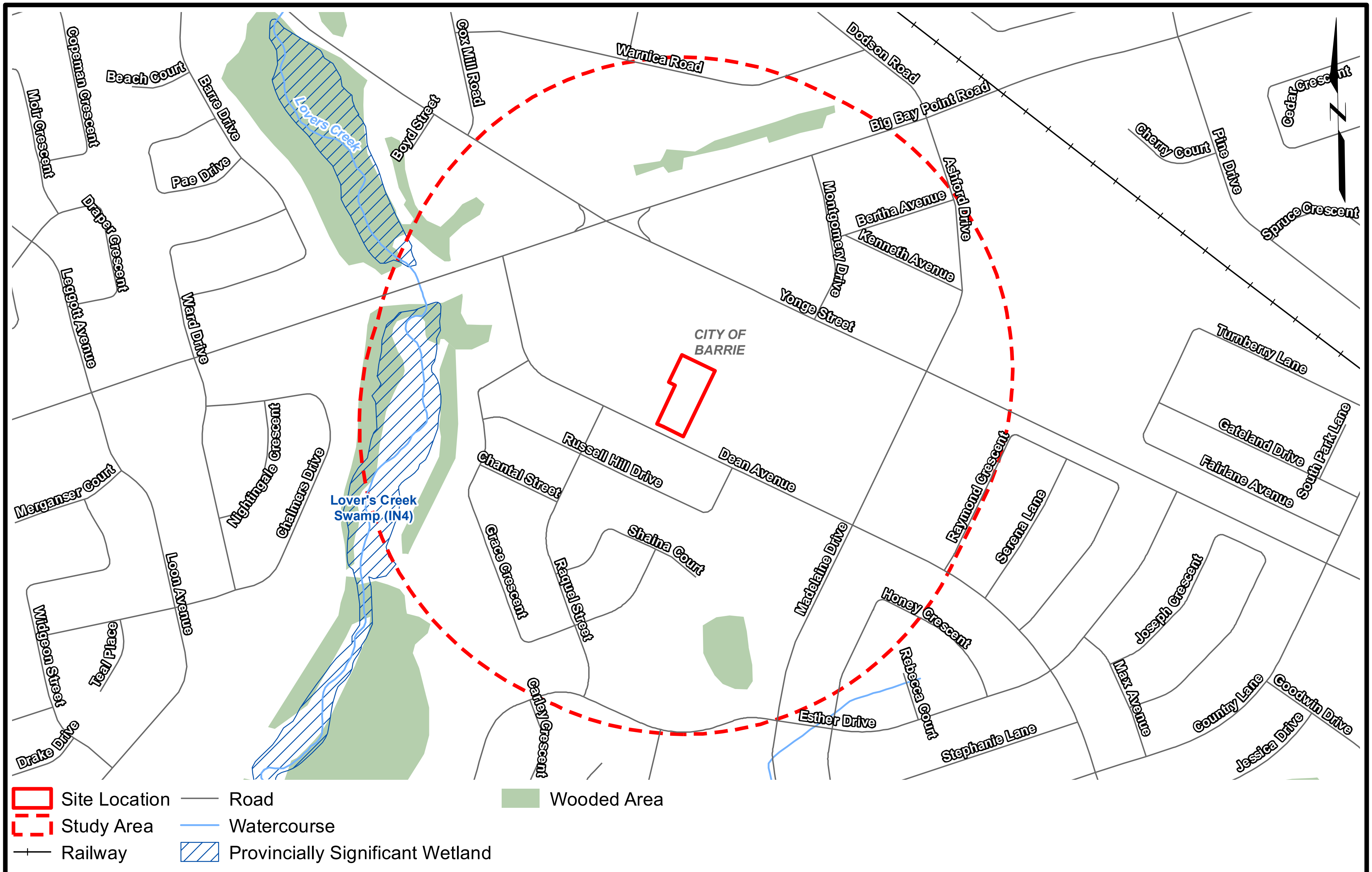
Figures



Reference(s):
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Metres

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

Nestwise Inc.

GEI Consultants

SITE LOCATION PLAN

Project 2408904

March 2025

Fig. 1

🟥 Site Location

— Road

● Approximate Borehole Location

⌖ Approximate Borehole/Monitoring Well location

↔ Geological Cross Sections (see Figures 9 and 10)

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Metres

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BOREHOLE LOCATION PLAN (AERIAL)

Project 2408904

March 2025

Fig. 2A

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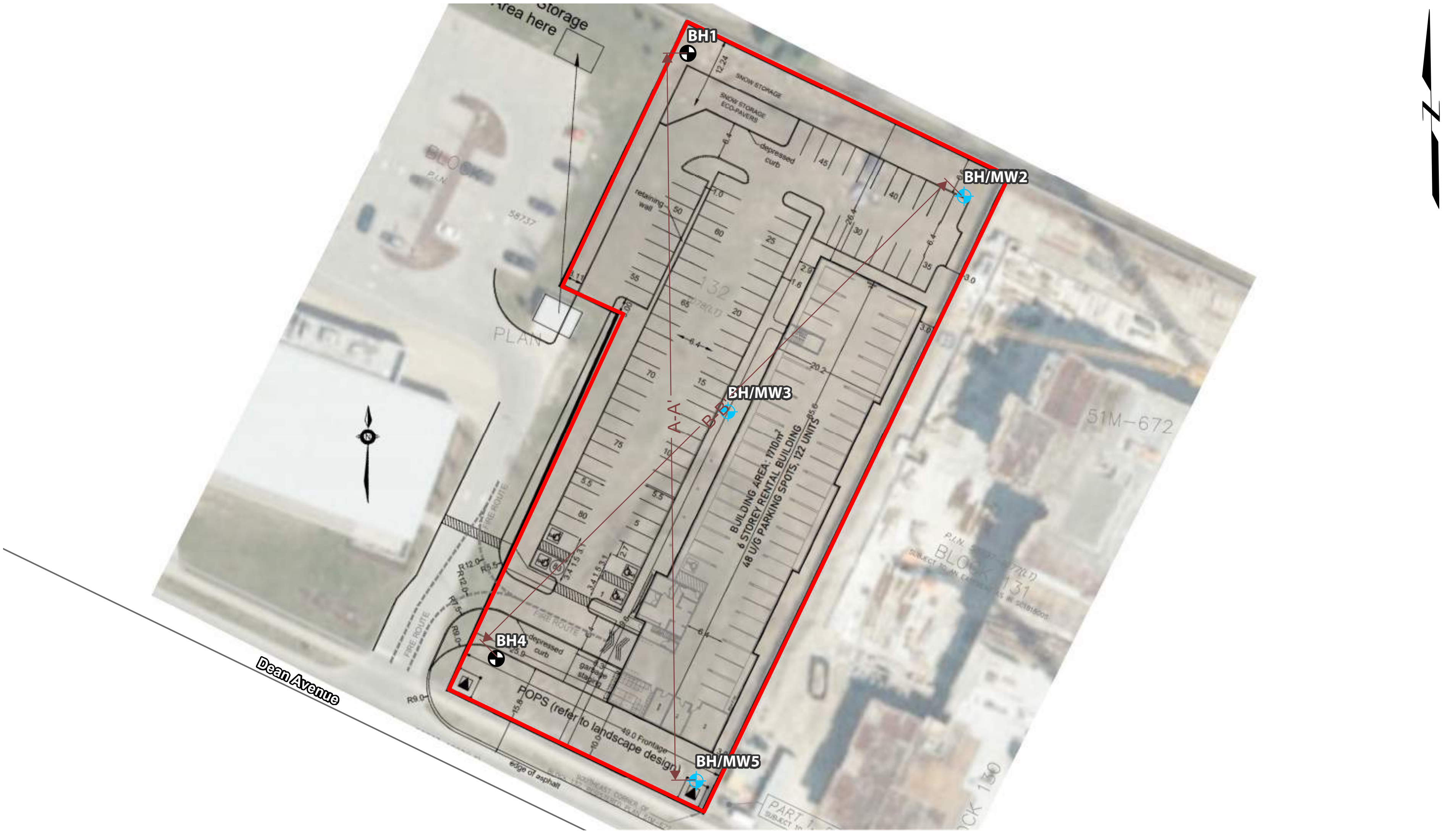

□ Site Location

— Road

⊕ Approximate Borehole Location

⊕ Approximate Borehole/Monitoring Well location

↔ Geological Cross Sections (see Figures 9 and 10)

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Metres

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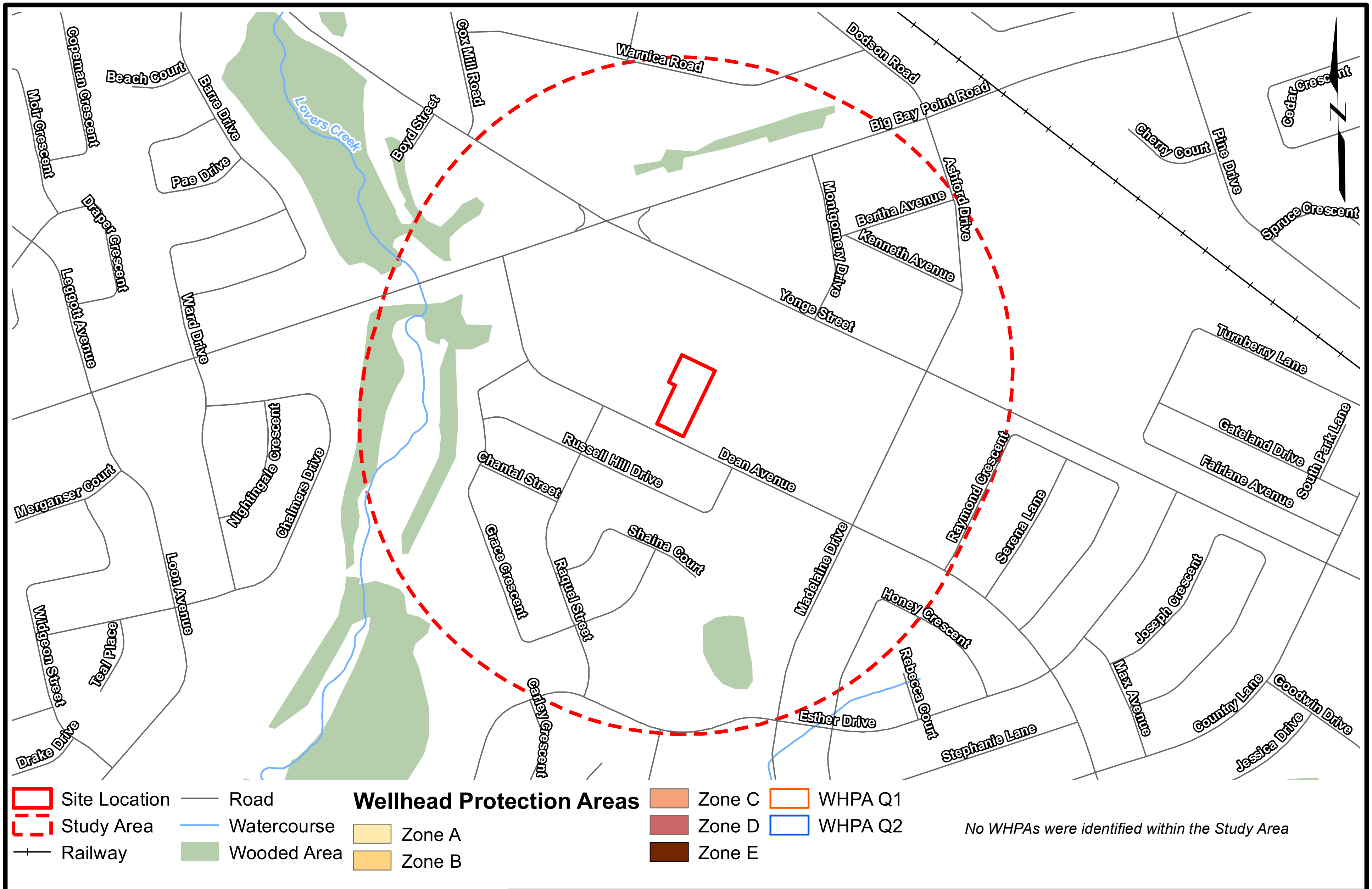
Project 2408904

BOREHOLE LOCATION PLAN (SITE PLAN)

March 2025

Fig. 2B



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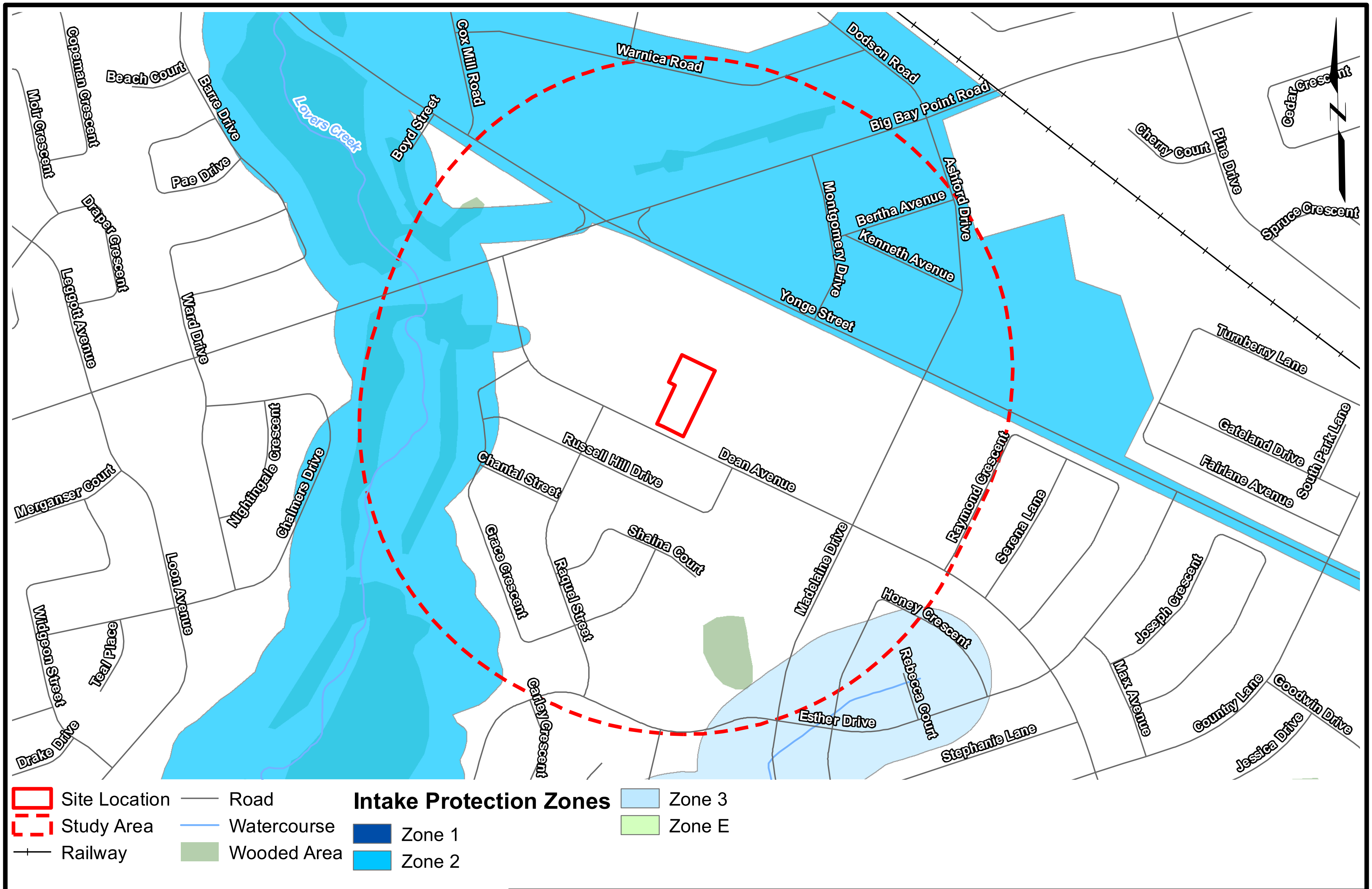
WELLHEAD PROTECTION AREAS

Project 2408904

March 2025

Fig. 3

\\bos-pzcc-1\data_storage\Working\HANSEN GROUP\2408904 Proposed Residential Building, 48 Dean Ave, Barrie ON\05_GIS\MXD\2025-02_HydroG\2408904_rpt_fig03_WHPA.mxd



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Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

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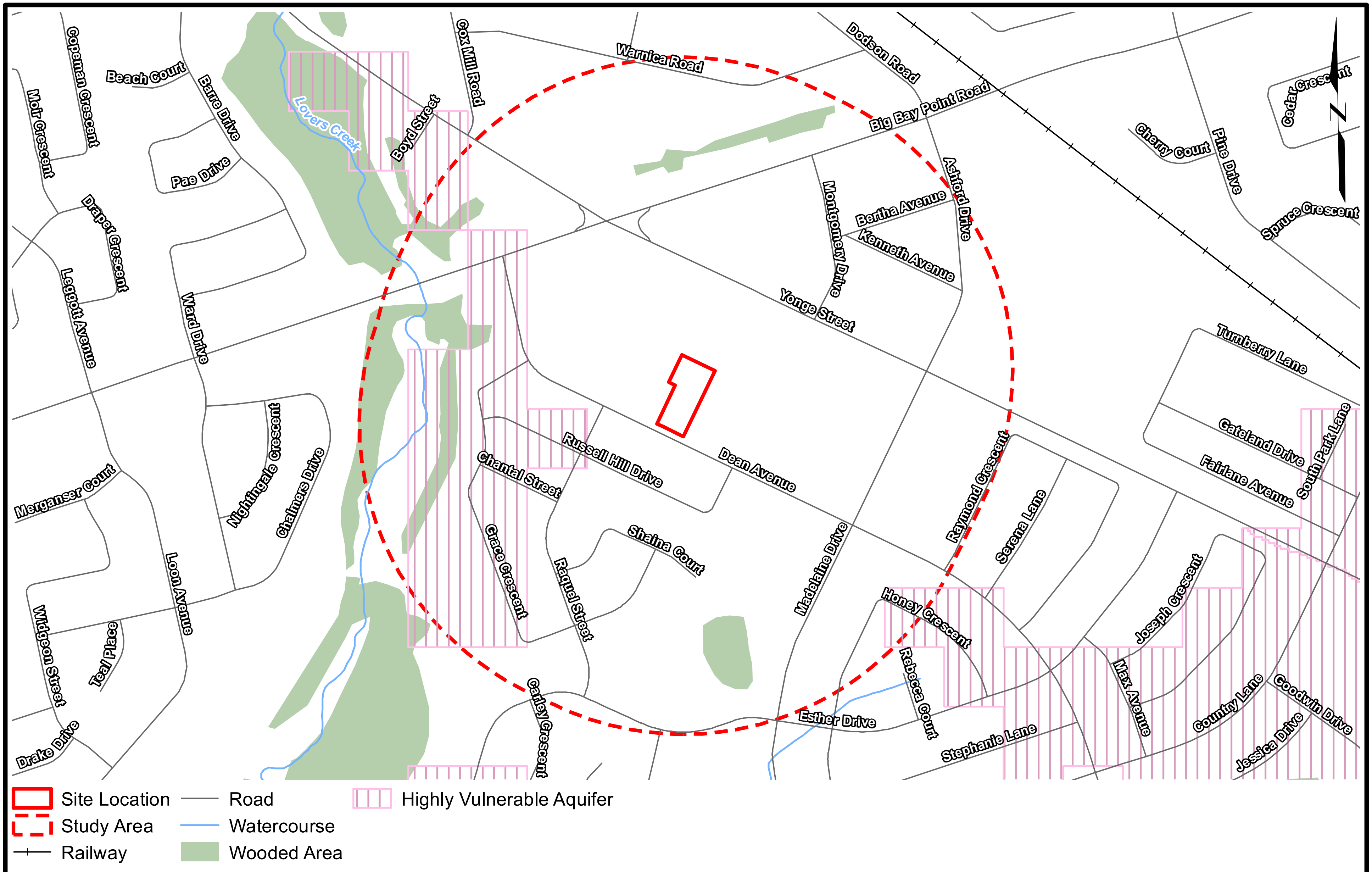
INTAKE PROTECTION ZONES

Project 2408904

March 2025

Fig. 4



Reference(s):
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2025.

0 100 200
Metres

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

Nestwise Inc.

GEI Consultants

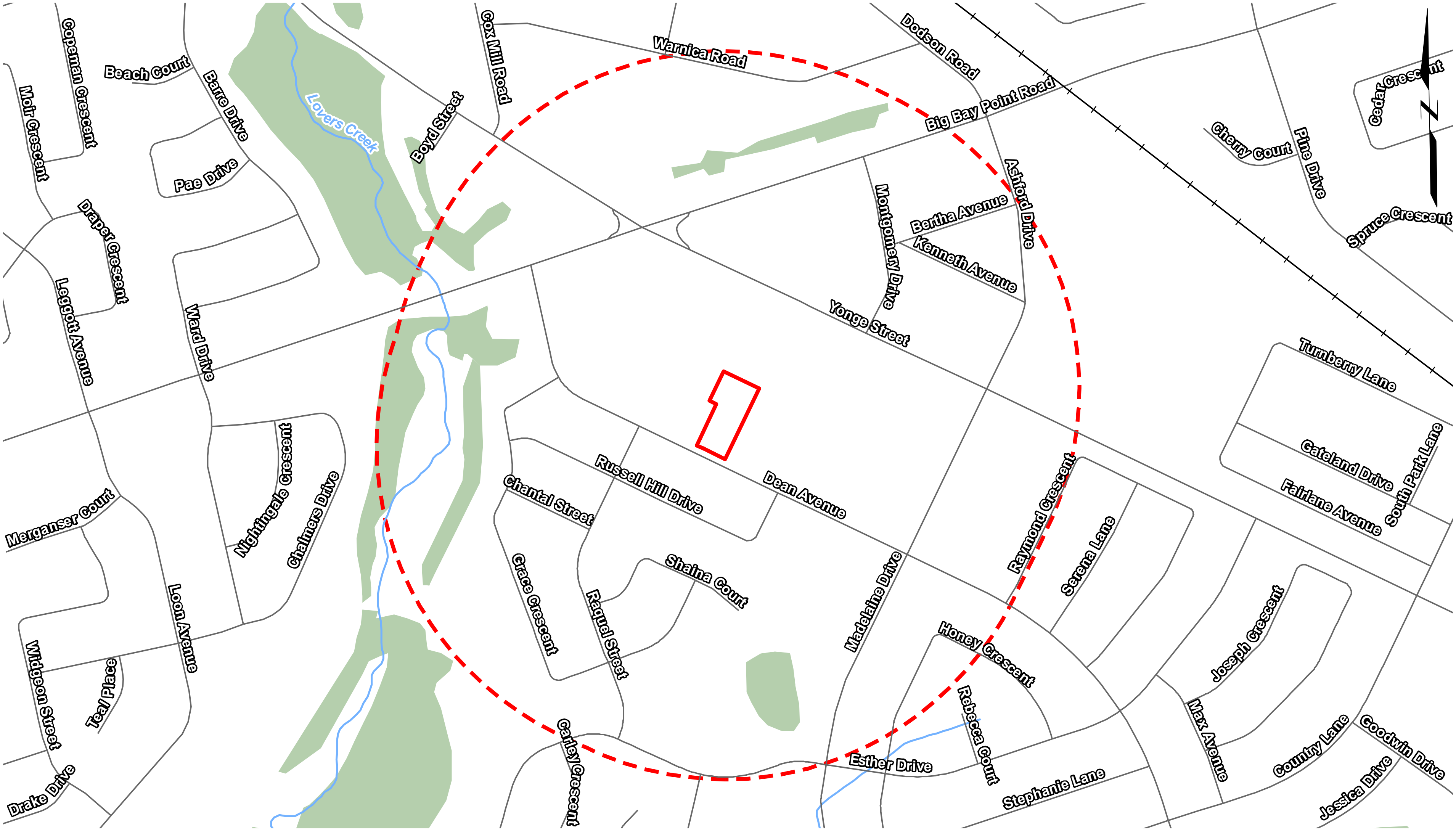
HIGHLY VULNERABLE AQUIFERS

Project 2408904

March 2025

Fig. 5

\\bos-pzcc-1\data_storage\Working\HANSEN GROUP\2408904 Proposed Residential Building, 48 Dean Ave, Barrie ON\05_GIS\MXD\2025-02_HydroG\2408904_rpt_fig05_HVA.mxd



🟥 Site Location
▭ Study Area
┼ Railway
— Road
— Watercourse
🟩 Wooded Area
🟫 Significant Groundwater Recharge Areas

No SGRAs were identified within the Study Area

Reference(s):
1. Coordinate System: NAD 1983 UTM Zone 17N.
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0 100 200
Metres

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

Nestwise Inc.

GEI Consultants

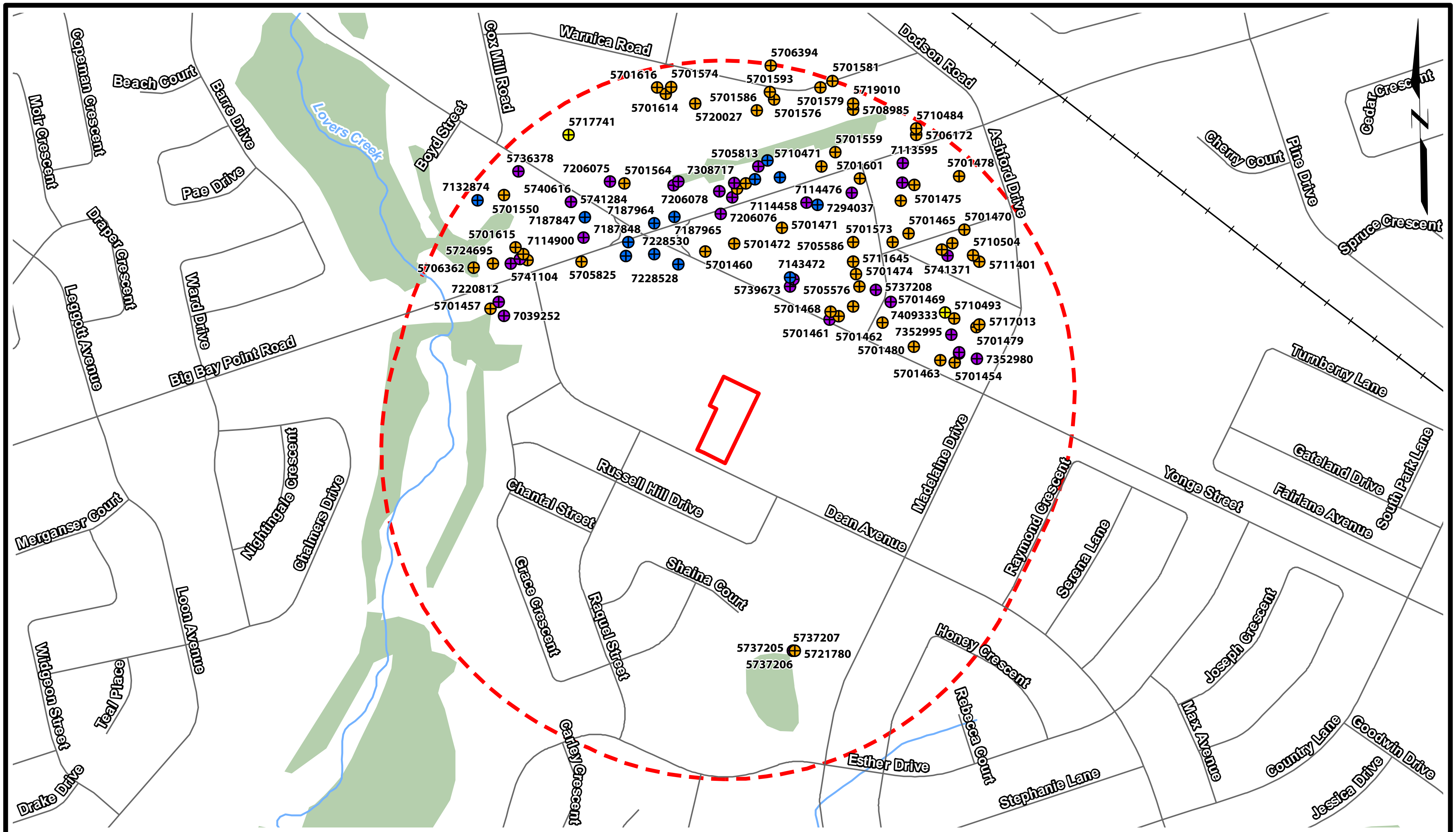
SIGNIFICANT
GROUNDWATER
RECHARGE AREAS

Project 2408904

March 2025

Fig. 6

\\bos-pzcc-1\data_storage\Working\HANSEN GROUP\2408904 Proposed Residential Building, 48 Dean Ave, Barrie ON\05_GIS\MXD\2025-02_HydroG\2408904_rpt_fig06_sgra.mxd



🟥 Site Location	— Road
Study Area	Watercourse
Railway	🟩 Wooded Area

MECP Water Well Use

- ⊕ Domestic
- ⊕ Industrial/Commercial
- ⊕ Monitoring/Testhole
- ⊕ Not Used/No Use Listed

Reference(s):
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2025.

0 100 200
Metres

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

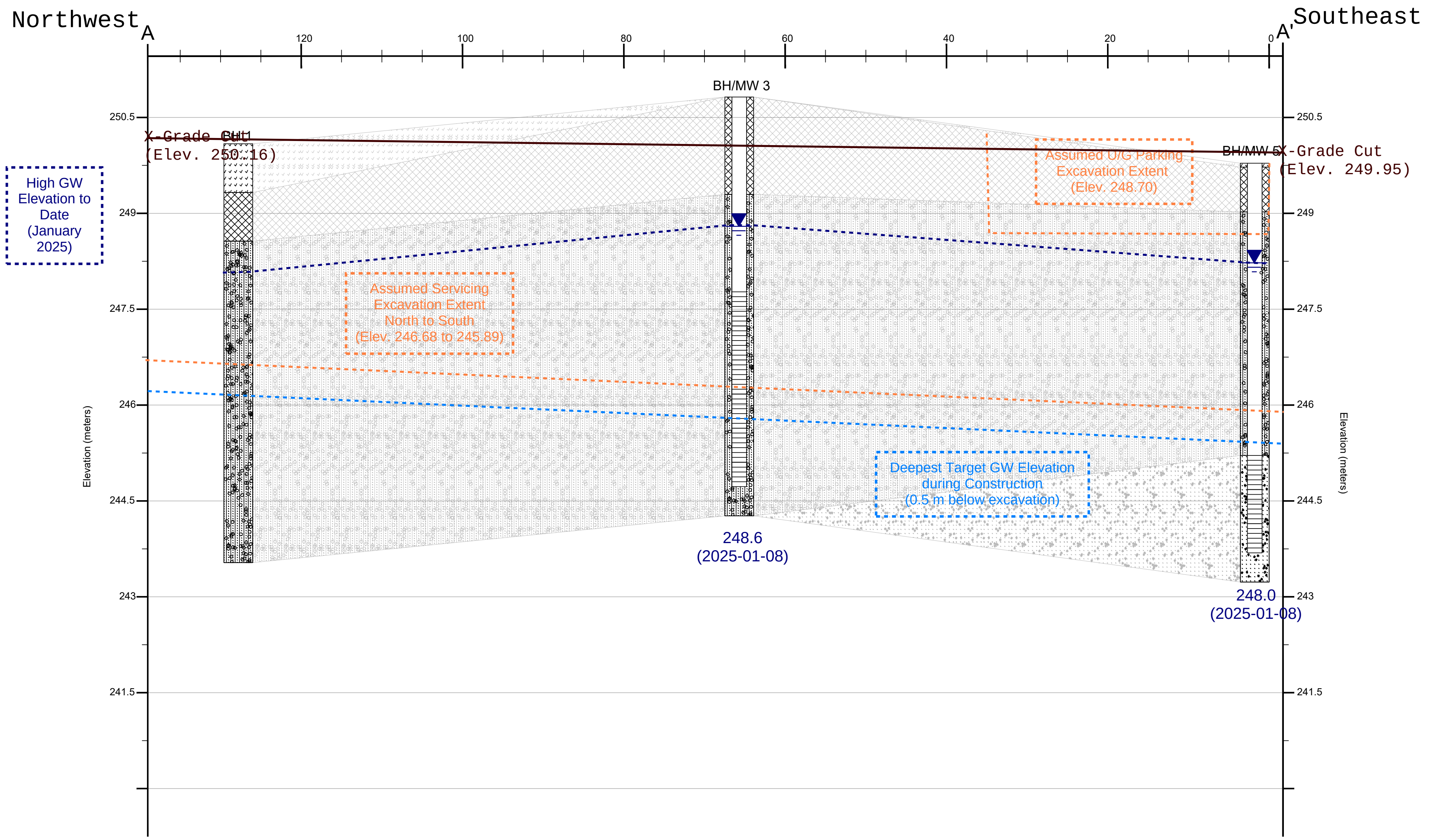
Nestwise Inc.

GEI Consultants

MECP WATER WELL RECORDS

Project 2408904
March 2025
Fig. 7

\\bos-pzcc-1\data_storage\Working\HANSEN GROUP\2408904 Proposed Residential Building, 48 Dean Ave, Barrie ON\05_GIS\MXD\2025-02_HydroG\2408904_rpt_fig07_mecp_water_records.mxd



LEGEND:

- ▨ TOPSOIL
- ▨ FILL
- ▨ SILTY SAND GLACIAL TILL
- ▨ GRAVELLY SAND
- ▼ Highest GW Level (GEI Date Measured)

NOTES:

HORIZONTAL SCALE
0 5 10 15 20 METERS

VERTICAL SCALE
0 0.75 1.5 METERS

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

Nestwise Inc.

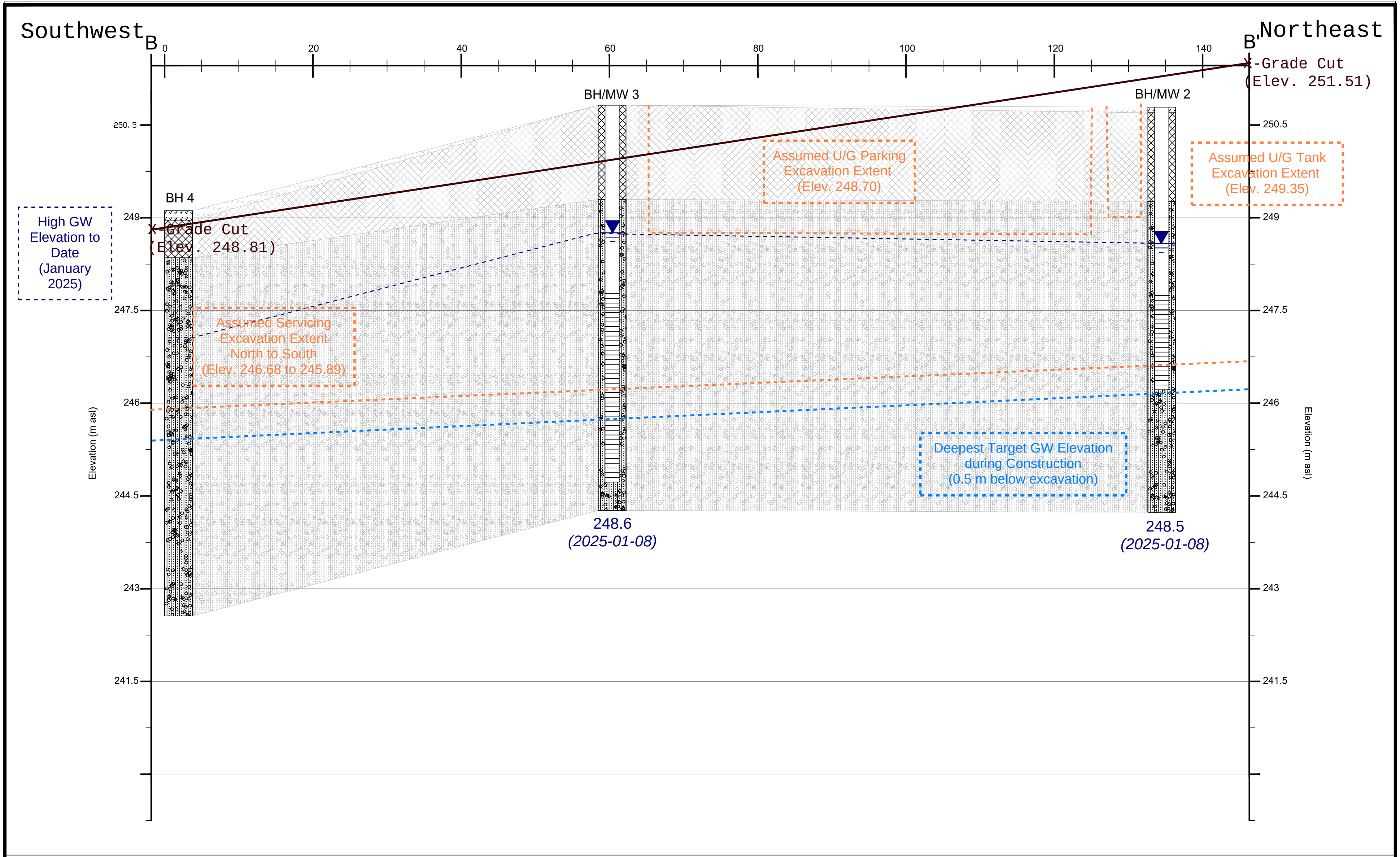
GEI Consultants

GEOLOGICAL CROSS SECTION A-A'

2408904

MARCH 2025

Fig. 8



LEGEND:

▨ TOPSOIL

▨ FILL

▨ SILTY SAND GLACIAL TILL

Highest GW Level
(GEI Date Measured)

NOTES:

HORIZONTAL SCALE
0 5 10 15 20
METERS

VERTICAL SCALE
0 0.75 1.5
METERS

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

Nestwise Inc.

GEI Consultants

GEOLOGICAL CROSS SECTION B-B'

2408904

MARCH 2025

Fig. 9

🟥 Site Location

Road

● Approximate Borehole Location

Approximate Borehole/Monitoring Well location

Highest GW Level
(GEI Date Measured)

Reference(s):
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2025.
3. Orthoimagery © First Base Solutions, 2025. Imagery taken in 2023.

0 10 20
Metres

Hydrogeological Investigation
Proposed Residential Building, 60 Dean Ave

Nestwise Inc.

GEI Consultants

Project 2408904

High Groundwater Level
Measured to Date
(Jan. to Feb. 2025)

March 2025

Fig. 10

\\bos-pzcc-1\data_storage\Working\HANSEN GROUP\2408904 Proposed Residential Building, 48 Dean Ave, Barrie ON\05_GIS\MXD\2025-02_HydroG\2408904_rpt_fig02a_BH_location_plan.mxd

Appendix A MECP Water Well Records

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
INNISFIL TOWNSHIP CON 12 014	17 608225 4912213 W	1964/10 1614	4	FR 0046	12/40/4/2:0	DO		5701454	5701454 ()	CLAY 0007 HPAN STNS 0045 STNS GRVL 0047
INNISFIL TOWNSHIP CON 12 012	17 607312 4912237 W	1958/04 2514	6	FR 0172	25/100/20/7:0	DO		5701456	5701456 ()	LOAM 0001 BRWN CLAY 0037 BLUE CLAY MSND 0170 MSND GRVL 0172
INNISFIL TOWNSHIP CON 12 012	17 607490 4912298 W	1962/10 4102	30	FR 0030	15//2/:	DO		5701457	5701457 ()	BLUE CLAY 0030 MSND 0035
INNISFIL TOWNSHIP CON 12 013	17 607830 4912389 W	1956/08 1637	4	FR 0046	12/30/5/5:0	DO		5701460	5701460 ()	CLAY 0012 HPAN 0046 GRVL 0048
INNISFIL TOWNSHIP CON 12 013	17 608027 4912281 W	1958/10 1510	2					5701461	5701461 ()	BRWN CLAY STNS 0015
INNISFIL TOWNSHIP CON 12 013	17 608111 4912276 W	1960/12 4102	30	FR 0020	10//3/:	DO		5701462	5701462 ()	CLAY MSND 0020 GRVL 0028
INNISFIL TOWNSHIP CON 12 013	17 608202 4912217 W	1961/06 4102	30	FR 0015	5//2/:	DO		5701463	5701463 ()	BLUE CLAY 0015 GREY MSND 0020
INNISFIL TOWNSHIP CON 12 013	17 608041 4912286 W	1961/06 4102	30	FR 0015	5//2/:	DO		5701464	5701464 ()	BLUE CLAY 0015 GREY CSND 0020
INNISFIL TOWNSHIP CON 12 013	17 608152 4912417 W	1961/11 4102	30	FR 0033	10//3/:	DO		5701465	5701465 ()	BRWN CLAY 0008 BLUE CLAY STNS 0032 GRVL MSND 0035
INNISFIL TOWNSHIP CON 12 014	17 608221 4912402 W	1962/06 4102	30	FR 0028	15//2/:	DO		5701466	5701466 ()	BRWN CLAY 0015 BLUE CLAY 0028 GRVL 0030
INNISFIL TOWNSHIP CON 12 014	17 608204 4912392 W	1962/06 4102	30	FR 0010	10//2/:	DO		5701467	5701467 ()	BRWN CLAY 0010 GRVL 0014
INNISFIL TOWNSHIP CON 12 013	17 608028 4912294 W	1962/09 2514	6	FR 0052	8/48/7/2:0	DO		5701468	5701468 ()	LOAM 0001 BRWN CLAY BLDR 0021 BLUE CLAY BLDR 0051 CSND GRVL 0052
INNISFIL TOWNSHIP CON 12 014	17 608210 4912292 W	1963/11 4102	30	FR 0041	5//10/:	CO		5701469	5701469 ()	BRWN CLAY 0007 BLUE CLAY 0040 GRVL 0041
INNISFIL TOWNSHIP CON 12 014	17 608240 4912423 W	1964/12 2514	6	FR 0037	15/30/7/2:0	DO		5701470	5701470 ()	PRDG 0015 MSND CLAY 0036 GRVL 0037
INNISFIL TOWNSHIP CON 12 013	17 607951 4912426 W	1964/12 1614	4	FR 0052	27/46/3/2:0	DO		5701471	5701471 ()	BRWN CLAY 0012 GRVL CLAY 0048 MSND 0051 GRVL 0052
INNISFIL TOWNSHIP CON 12 013	17 607876 4912401 W	1967/06 2514	6	FR 0059	15/58/8/1:30	DO	0059 3	5701472	5701472 ()	LOAM 0001 BRWN CLAY MSND BLDR 0059 GRVL 0062
INNISFIL TOWNSHIP CON 12 013	17 608064 4912302 W	1967/11 2514	6	FR 0041	1/32/9/2:0	DO	0041 3	5701473	5701473 ()	LOAM 0002 YLLW MSND 0003 CLAY MSND GRVL 0041 YLLW CSND 0044 CLAY 0045
INNISFIL TOWNSHIP CON 12 013	17 608069 4912353 W	1967/12 4715	4	FR 0044	7/35/5/1:0	DO		5701474	5701474 ()	FILL 0004 CLAY MSND GRVL 0044 MSND GRVL 0045
INNISFIL TOWNSHIP CON 12 014	17 608161 4912494 W	1959/08 4102	30	FR 0030	10//2/:	DO		5701475	5701475 ()	BLUE CLAY STNS 0030
INNISFIL TOWNSHIP CON 12 014	17 608232 4912508 W	1964/10 1614	4	FR 0052	27/50/4/3:0	DO		5701478	5701478 ()	CLAY LOAM 0006 HPAN STNS 0050 GRVL 0052
INNISFIL TOWNSHIP CON 12 014	17 608259 4912269 W	1967/07 4715	4	FR 0047	0/35/5/2:0	DO	0047 3	5701479	5701479 ()	CLAY GRVL BLDR 0047 FSND MSND 0050 CLAY 0051
INNISFIL TOWNSHIP CON 12 014	17 608160 4912238 W	1964/10 1614	4	FR 0052	10/50/4/1:0	DO		5701480	5701480 ()	CLAY 0007 HPAN STNS 0050 STNS GRVL 0052
INNISFIL TOWNSHIP CON 13 012	17 607448 4912534 W	1958/08 2514	6	FR 0144	11/132/7/3:0	DO		5701547	5701547 ()	PRDG 0035 BLUE CLAY 0141 MSND 0144
INNISFIL TOWNSHIP CON 13 012	17 607512 4912478 W	1964/09 4608	30	FR 0022	9//2/:	DO		5701550	5701550 ()	CLAY MSND 0030
INNISFIL TOWNSHIP CON 13 012	17 607542 4912384 W	1966/09 4608	30	FR 0018	18//2/:	DO		5701556	5701556 ()	BRWN CLAY 0018 GREY CLAY 0035
INNISFIL TOWNSHIP CON 13 013	17 608036 4912546 W	1957/08 2514	6	FR 0057	17/43/6/4:0	DO		5701559	5701559 ()	LOAM 0001 BRWN CLAY GRVL 0054 MSND GRVL 0057
INNISFIL TOWNSHIP CON 13 014	17 607702 4912496 W	1961/08 4102	30	FR 0028	20//2/:	DO		5701564	5701564 ()	BRWN CLAY STNS 0028 MSND 0030
INNISFIL TOWNSHIP CON 13 013	17 607894 4912496 W	1962/05 2514	6	FR 0068	20/55/12/2:0	DO		5701566	5701566 ()	LOAM 0001 BRWN CLAY STNS 0023 MSND GRVL CLAY 0060 CSND 0067 GRVL 0068
INNISFIL TOWNSHIP CON 13 013	17 608062 4912656 W	1962/06 2514	6	FR 0068	43/60/8/1:0	DO		5701569	5701569 ()	PRDG 0046 BRWN CLAY MSND GRVL 0067 CSND GRVL 0068
INNISFIL TOWNSHIP CON 12 013	17 608127 4912403 W	1962/10 2514	6	FR 0044	31/45/7/1:0	DO	0044 3	5701573	5701573 ()	LOAM 0002 BRWN CLAY MSND 0040 CSND 0047
INNISFIL TOWNSHIP CON 13 013	17 607776 4912649 W	1962/11 1614	4	FR 0073	31/64/8/2:0	DO		5701574	5701574 ()	BRWN CLAY 0008 GREY CLAY MSND BLDR 0069 CSND 0073
INNISFIL TOWNSHIP CON 13 013	17 607939 4912629 W	1963/01 1510	4	FR 0077	45/50/5/3:0	DO		5701576	5701576 ()	PRDG 0035 STNS HPAN 0077 GRVL 0078
INNISFIL TOWNSHIP CON 13 013	17 608012 4912648 W	1963/05 2514	6	FR 0085	37/85/4/2:30	DO		5701579	5701579 ()	BLUE CLAY STNS 0015 YLLW CSND 0032 BLUE CLAY BLDR 0085 GRVL MSND 0090
INNISFIL TOWNSHIP CON 13 013	17 608031 4912659 W	1963/07 1510	4	FR 0030	26/30/4/3:0	DO		5701581	5701581 ()	BRWN CLAY 0010 HPAN STNS 0030 GRVL 0036
INNISFIL TOWNSHIP CON 13 013	17 607931 4912696 W	1963/09 2514	6	FR 0080	42/75/5/2:0	DO		5701582	5701582 ()	PRDG 0005 BRWN CLAY 0009 MSND GRVL CLAY 0078 GRVL 0080

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
INNISFIL TOWNSHIP CON 13 013	17 607912 4912612 W	1964/03 4816	6	FR 0076	38/70/10/5:0	DO		5701586	5701586 ()	BRWN CLAY 0008 RED MSND 0028 MSND GRVL BLDR 0065 GRVL 0076
INNISFIL TOWNSHIP CON 13 013	17 607932 4912641 W	1964/09 2514	6	FR 0090	35/80/7/2:30	DO		5701593	5701593 ()	BRWN CLAY 0015 MSND STNS 0040 BRWN CLAY GRVL 0088 GRVL 0090
INNISFIL TOWNSHIP CON 13 013	17 607855 4912697 W	1964/12 2514	6	FR 0065	30/65/4/3:0	DO		5701598	5701598 ()	PRDG 0029 MSND GRVL CLAY 0071
INNISFIL TOWNSHIP CON 13 013	17 608089 4912643 W	1964/12 2514	6	UK 0050 FR 0083	35/80/3/3:0	DO		5701599	5701599 ()	LOAM 0001 BRWN CLAY GRVL BLDR 0030 BLUE CLAY GRVL BLDR 0090
INNISFIL TOWNSHIP CON 12 013	17 608075 4912504 W	1965/02 2514	6	FR 0030	25/35/8/2:0	DO		5701601	5701601 ()	PRDG 0030 MSND GRVL 0048 MSND GRVL CLAY 0055
INNISFIL TOWNSHIP CON 13 013	17 607549 4912375 W	1966/02 3203	5	FR 0176	120/140/3/5:0	DO		5701611	5701611 ()	LOAM 0001 YLLW CLAY 0018 BLUE CLAY 0033 MSND 0034 MSND GRVL CLAY 0065 CLAY STNS 0109 GRVL 0154 SILT CLAY GRVL 0176 FSND 0177 BLUE CLAY 0179
INNISFIL TOWNSHIP CON 13 013	17 607768 4912638 W	1967/03 3203	5	FR 0072	45/70/5/3:0	DO		5701614	5701614 ()	YLLW CLAY STNS 0019 YLLW MSND 0056 GREY MSND CLAY 0059 GREY MSND STNS 0069 GRVL CLAY 0072 GRVL 0074 CLAY GRVL 0077
INNISFIL TOWNSHIP CON 13 013	17 607530 4912395 W	1967/08 4608	30	FR 0025	10//2/:	DO		5701615	5701615 ()	BRWN CLAY STNS 0012 GREY CLAY STNS 0025
INNISFIL TOWNSHIP CON 13 013	17 607754 4912648 W	1967/09 4715	4	FR 0082	26/69/3/2:0	DO		5701616	5701616 ()	CLAY MSND 0082 CLAY MSND GRVL 0087
INNISFIL TOWNSHIP CON 12 013	17 608074 4912333 W	1968/11 2514	6	FR 0038	3/30/7/2:0	DO		5705576	5705576 ()	CLAY MSND BLDR 0037 GRVL 0038
INNISFIL TOWNSHIP CON 12 013	17 608064 4912403 W	1968/11 4715	4	FR 0172	26/55/7/6:0	DO	0172 3	5705586	5705586 ()	PRDG 0045 CLAY MSND GRVL 0172 FSND 0175
INNISFIL TOWNSHIP CON 13 013	17 607914 4912523 W	1968/09 4608	30	FR 0015	15///:			5705813	5705813 ()	GREY CLAY STNS 0025 GREY CLAY 0030
INNISFIL TOWNSHIP CON 12 012	17 607634 4912373 W	1968/09 4608	30	FR 0015	15///:	DO		5705825	5705825 ()	BRWN CLAY STNS 0015 GREY CLAY STNS 0030
INNISFIL TOWNSHIP CON 12 014	17 608164 4912573 W	1969/01 3203	5	FR 0037	20/24/2/1:0	DO		5706172	5706172 ()	FILL 0002 CLAY STNS 0018 MSND 0024 CLAY MSND STNS 0037 GRVL STNS 0038
INNISFIL TOWNSHIP CON 13 012	17 607464 4912363 W	1969/06 4608	30	FR 0032 FR 0033	21/30/4/1:0	DO		5706362	5706362 ()	BLCK LOAM 0001 BRWN CLAY STNS 0015 GREY CLAY 0033
INNISFIL TOWNSHIP CON 13 013	17 607934 4912683 W	1969/05 3203	5	FR 0076	47/63/4/2:0	DO		5706394	5706394 ()	YLLW CLAY 0002 CLAY MSND STNS 0023 MSND CLAY STNS 0058 CLAY STNS 0076 GRVL 0077
INNISFIL TOWNSHIP CON 13 013	17 608064 4912613 W	1972/07 3645	5	FR 0053	20/43/18/6:0	DO	0046 3	5708985	5708985 ()	CLAY 0008 CLAY SAND 0014 CLAY SAND STNS 0040 HPAN 0051 SAND GRVL 0053
INNISFIL TOWNSHIP CON 13 013	17 608014 4912523 W	1973/11 4608	30	FR 0015	20//3/0:30	DO		5710471	5710471 ()	BRWN CLAY 0012 GREY CLAY 0035
INNISFIL TOWNSHIP CON 13 014	17 608164 4912583 W	1973/09 4608	30	FR 0010	10//3/0:30	DO		5710484	5710484 ()	SAND 0020
INNISFIL TOWNSHIP CON 12 014	17 608224 4912283 W	1973/08 4608	30	FR 0015	12/14/3/0:30	DO		5710493	5710493 ()	BRWN CLAY STNS 0027
INNISFIL TOWNSHIP CON 12 014	17 608254 4912383 W	1973/09 4608	30	FR 0016	5/12/5/1:0	DO		5710504	5710504 ()	GREY SAND 0023
INNISFIL TOWNSHIP CON 12 014	17 608264 4912373 W	1974/08 4102	30	FR 0020	10///:	DO		5711401	5711401 ()	LOAM 0002 BRWN CLAY PORS 0012 BLUE CLAY BLDR 0015 BLUE CLAY STNS LYRD 0032
INNISFIL TOWNSHIP CON 12 013	17 608064 4912373 W	1974/07 2514	6 6	FR 0040	5/58/7/1:0	DO		5711645	5711645 ()	BRWN CLAY FILL 0001 BRWN LOAM 0002 BRWN CLAY SAND BLDR 0018 GREY SAND SILT GRVL 0068
INNISFIL TOWNSHIP CON 12 014	17 608264 4912273 W	1980/10 3660	5	FR 0065	2/56/4/1:0	DO	0065 3	5717013	5717013 ()	GREY CLAY 0045 GREY CLAY GRVL 0063 GREY SAND CMTD 0065 BRWN CSND 0068 GREY CLAY 0068
INNISFIL TOWNSHIP CON 13 013	17 607664 4912673 W	1980/10 3203	5	FR 0082	/65/6/1:30	DO	0083 3	5717365	5717365 ()	PRDG 0010 BRWN SAND 0035 BRWN SAND CLAY STNS 0082 BRWN SAND 0086
INNISFIL TOWNSHIP CON 13 013	17 607614 4912573 W	1981/11 1467	5	FR 0256	57/170/7/1:0	IN	0256 3	5717741	5717741 ()	BRWN FILL 0003 BRWN SAND CLAY STNS 0034 GREY SAND CLAY STNS 0126 BRWN CSND 0131 GREY CLAY GRVL 0235 GREY SAND CMTD 0256 GREY FSND 0259 GREY CLAY GRVL 0259
INNISFIL TOWNSHIP CON 12 013	17 608064 4912373 W	1981/07 2514	6	FR 0051	11/40/10/24:0	DO		5717858	5717858 ()	BLCK LOAM 0001 BRWN CLAY SAND BLDR 0022 GREY SILT CLAY SAND 0040 GREN CSND SILT 0043 SILT SNDY 0060
INNISFIL TOWNSHIP CON 13 013	17 608064 4912623 W	1983/01 3135	5	FR 0070	22/40/6/1:30	DO		5719010	5719010 ()	PRDG 0005 CLAY SAND GRVL 0067 SAND GRVL 0070 GRVL 0070
INNISFIL TOWNSHIP CON 13 013	17 607814 4912623 W	1985/07 4816	6 5		35//4/4:0	DO	0132 3	5720027	5720027 ()	LOAM 0001 BRWN CLAY 0012 BRWN SAND 0038 GREY CLAY STNS 0040 SAND SLTY 0050 GREY CLAY 0080 GREY CLAY HARD 0120 GREY CLAY STNS SNDY 0131 SAND GRVL 0138 GREY
BARRIE CITY (INNISFI 12 013	17 607972 4911757 L	1987/07 3413	30 30 24	FR 0047	6/12/25/24:0	DO		5721780	5721780 (06329)	BRWN SAND 0032 BRWN CLAY 0036 GREY CLAY 0047 GREY SAND GRVL 0050 GREY CLAY 0056
INNISFIL TOWNSHIP CON 13 012	17 607494 4912370 W	1989/03 2513	6	FR 0176	22/130/15/1:0	DO	0176 4	5724695	5724695 (44481)	GREY SILT CLAY SAND 0176 GREY MSND CSND SILT 0180
ESSA TOWNSHIP CON 13 012	17 607535 4912515 W	2001/10 3413						5736378	5736378 (235530) A	
INNISFIL TOWNSHIP CON 12 013	17 607969 4911757 L	2002/07 2513				NU		5737205	5737205 (246405) A	
INNISFIL TOWNSHIP CON 12 013	17 607969 4911757 L	2002/07 2513				NU		5737206	5737206 (246404) A	
INNISFIL TOWNSHIP CON 12 013	17 607969 4911757 L	2002/07 2513				NU		5737207	5737207 (246406) A	

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
INNISFIL TOWNSHIP CON 13 013	17 608100 4912328 W	2002/07 2513				NU		5737208	5737208 (246407) A	
INNISFIL TOWNSHIP	17 607965 4912333 W	2005/04 7075	0.79				0010 10	5739673	5739673 (Z22699) A025455	BRWN LOAM 0001 BRWN FILL 0002 BRWN SILT SAND 0010 GREY SILT SAND 0020
INNISFIL TOWNSHIP	17 607970 4912345 W	2005/03 6032	0.2			NU	0010 15	5739886	5739886 (Z05337) A005126	BRWN SILT SAND 0027
INNISFIL TOWNSHIP	17 607618 4912467 W	2006/02 6032	0.2			NU		5740616	5740616 (Z05187) A005207	BRWN SILT SAND 0020
INNISFIL TOWNSHIP 004	17 607523 4912370 W	2006/09 2513				NU		5741104	5741104 (Z51134) A045613	
INNISFIL TOWNSHIP	17 607618 4912467 W	2006/05 6032						5741284	5741284 (Z05160) A005207 A	
INNISFIL TOWNSHIP	17 608214 4912382 W	2006/11 1663	0.3			NU		5741371	5741371 (Z51569) A	
INNISFIL TOWNSHIP CON 12 012	17 607512 4912287 W	2006/09 2513				NU		7039252	7039252 (Z51141) A045620 A	
BARRIE CITY 12 030	17 608142 4912498 W	2008/01 1467						7113591	7113591 (Z75589) A047504 A	
INNISFIL TOWNSHIP CON 13 031	17 608143 4912528 W	2008/07 1467						7113595	7113595 (Z75210) A047512 A	
INNISFIL TOWNSHIP	17 607991 4912466 W	7144						7114458	7114458 (Z34436) A	
BARRIE CITY	17 608062 4912482 W	7144						7114476	7114476 (Z34434) A	
INNISFIL TOWNSHIP	17 607638 4912411 W	2007/10 2514	14.1					7114900	7114900 (Z54584) A048121 A	49
BARRIE CITY	17 608140 4912469 W	2008/12 7144	6			DO		7125113	7125113 (Z94903) A082608	
INNISFIL TOWNSHIP CON 13 012	17 607470 4912470 W	2009/09 7190	2	UT 0009		MO	0010 10	7132874	7132874 (Z91136) A080226	BRWN LOAM 0003 BRWN SAND CLAY PCKD 0004 BRWN SAND CLAY GRVL 0008 GREY SILT SAND WBRG 0010 BRWN SILT GRVL DNSE 0012 GREY SAND SILT GRVL 0020
BARRIE CITY	17 607965 4912348 W	2009/11 7391	2	UT 0012	12///:	MO	0010 10	7143472	7143472 (Z117461) A025455	BLUE SILT SAND 0005 0007 0016 0020
INNISFIL TOWNSHIP CON 13 013	17 607640 4912443 W	2012/08 7241	2			MT	0010 10	7187847	7187847 (Z148585) A120933	BRWN LOAM LOOS 0001 BRWN SILT SAND LOOS 0012 GREY SILT SAND LOOS 0020
INNISFIL TOWNSHIP	17 607709 4912403 W	2012/08 7241	2			MT	0010 10	7187848	7187848 (Z148582) A120932	BRWN LOAM LOOS 0001 BRWN SILT SAND LOOS 0012 GREY SILT SAND LOOS 0020
INNISFIL TOWNSHIP	17 607750 4912433 W	2012/08 7241	2			MT	0010 10	7187964	7187964 (Z148584) A109854	BRWN LOAM LOOS 0001 BRWN SILT SAND LOOS 0012 GREY SILT SAND LOOS 0020
INNISFIL TOWNSHIP	17 607782 4912444 W	2012/08 7241	2			MT	0012 10	7187965	7187965 (Z148583) A120931	BRWN LOAM LOOS 0001 BRWN SILT SAND LOOS 0012 GREY SILT SAND LOOS 0022
INNISFIL TOWNSHIP	17 607853 4912484 W	2013/07 4645	36					7206074	7206074 (Z170320) A	
INNISFIL TOWNSHIP CON 13 013	17 607680 4912499 W	2013/07 4645	5					7206075	7206075 (Z170318) A	
INNISFIL TOWNSHIP	17 607855 4912448 W	2013/07 4645	42					7206076	7206076 (Z170315) A	
INNISFIL TOWNSHIP CON 13 013	17 607788 4912499 W	2013/07 4645	2					7206077	7206077 (Z170314) A	
INNISFIL TOWNSHIP CON 13 013	17 607780 4912493 W	2013/07 4645	2					7206078	7206078 (Z170313) A	
INNISFIL TOWNSHIP CON 13 013	17 607853 4912484 W	2013/07 4645	2					7206079	7206079 (Z170317) A	
INNISFIL TOWNSHIP	17 607504 4912309 W	2013/05 7190	4 2				0010 5	7220812	7220812 (Z159200) A132121	BLCK DNSE 0002 BRWN GRVL DNSE 0006 BRWN SAND DNSE 0010 GREY SILT DNSE 0015
INNISFIL TOWNSHIP	17 607788 4912368 W	2014/08 7241	2			MT	0010 10	7228528	7228528 (Z195668) A163146	BLCK ---- 0005 BRWN SAND GRVL 0005 BRWN SILT CLAY SAND 0015 BRWN SILT SAND CLAY 0020
INNISFIL TOWNSHIP	17 607705 4912381 W	2014/08 7241	2			MT	0010 10	7228529	7228529 (Z195669) A170485	BLCK ---- 0005 BRWN SAND GRVL 0005 BRWN SILT CLAY SAND 0015 BRWN SILT SAND CLAY 0020
INNISFIL TOWNSHIP	17 607750 4912384 W	2014/08 7241	2			MT	0010 10	7228530	7228530 (Z195689) A167825	BLCK ---- 0005 BRWN SAND GRVL 0005 BRWN SILT CLAY SAND 0015 BRWN SILT SAND CLAY 0020
INNISFIL TOWNSHIP CON 13 012	17 607537 4912377 W	2017/06 6409						7291853	7291853 (Z232605) A204284 A	
BARRIE CITY (INNISFI	17 608008 4912463 W	2017/08 7215	2	UT		TH	0010 8	7294037	7294037 (Z264201) A232254	BRWN CLAY FILL LOOS 0004 BRWN SAND LOOS 0015 GREY SAND SILT DNSE 0018
BARRIE CITY (INNISFI	17 607873 4912474 W	2017/07 7230						7303532	7303532 (C38485) A229357 P	
BARRIE CITY (INNISFI	17 607876 4912497 W	2017/10 6988						7308717	7308717 (C37762) A225579 P	
INNISFIL TOWNSHIP CON 13 013	17 607881 4912488 W	2018/03 4645	30			DO		7309892	7309892 (Z271034) A	

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
INNISFIL TOWNSHIP CON 12 014	17 608232 4912229 W	2019/09 7230						7347047	7347047 (C45692) A277436 P	
INNISFIL TOWNSHIP CON 12 014	17 608232 4912227 W	2020/01 7147	1.97	UT 0013			0021 4	7352979	7352979 (9WB5IPS8) _NO_TAG A	
INNISFIL TOWNSHIP CON 12 014	17 608260 4912219 W	2020/01 7147	1.97	UT 0015			0021 4	7352980	7352980 (HKQGXWB3) _NO_TAG A	
INNISFIL TOWNSHIP CON 12 014	17 608220 4912257 W	2020/01 7147	1.97	UT 0012			0021 5	7352995	7352995 (8AHHTYOX) _NO_TAG A	
INNISFIL TOWNSHIP CON 13 013	17 607929 4912533 W	2020/11 7190	2 6		0///:	MO	0015 5	7377329	7377329 (WPREE7L7) A305943	BRWN SILT CLAY LOAM 0002 BRWN SAND SILT GVLY 0009 BRWN SILT SAND 0020
INNISFIL TOWNSHIP CON 13 013	17 607909 4912503 W	2020/11 7190	2 6		0///:	MO	0015 5	7377330	7377330 (DLFLV5OK) A305944	BRWN SILT CLAY LOAM 0002 BRWN SAND SILT GVLY 0009 BRWN SILT SAND 0020
INNISFIL TOWNSHIP CON 13 013	17 607949 4912506 W	2020/11 7190	2 6		0///:	MO	0015 5	7377331	7377331 (4LJYIDCW) A305945	BRWN SILT CLAY LOAM 0002 BRWN SAND SILT GVLY 0009 BRWN SILT SAND 0020
INNISFIL TOWNSHIP CON 12 013	17 608124 4912309 W	2021/12 7725						7409333	7409333 (C49783) A297072 P	

Appendix B Borehole Logs

RECORD OF BOREHOLE No. 01

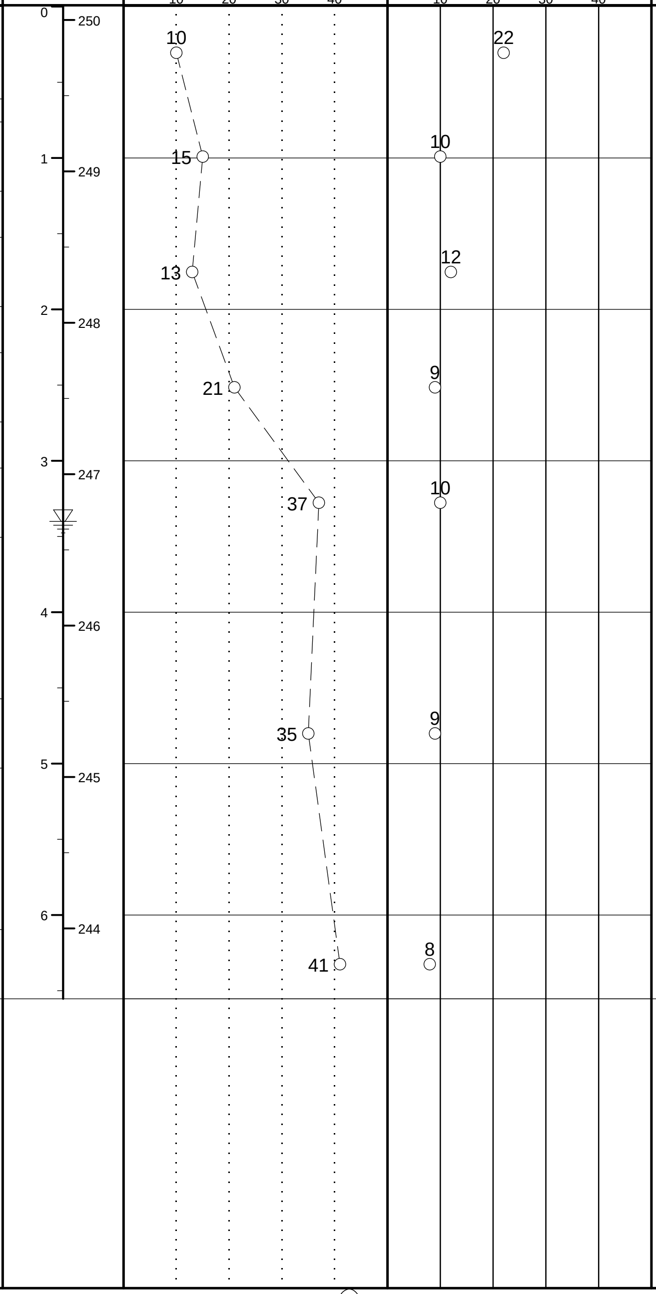
Project Number: **2408904**
Project Client: **Hansen Group Inc.**
Project Name: **60 Dean Ave.**
Project Location: **Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Rubber Tire**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4912185**
Easting: **607859**
Date Started: **Dec 18/24**
Date Completed: **Dec 18/24**

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
Penetration Testing: ○ SPT ● DCPT

LAB TESTING
△ Combustible Organic Vapour - Hex
▲ Combustible Organic Vapour - IBL
◇ Total Organic Vapour (ppm)
Atterberg Limits: PL ├──┤ LL
○ Water Content (%)

Depth (m) / Elevation (m)	LITHOLOGY PROFILE: DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
0.0 / 250.1	TOPSOIL: 760 mm	SS	1	100	10	22				
0.8 / 249.3	FILL: Silty sand, trace gravel, compact, brown, moist	SS	2	100	15	10				
1.5 / 248.6	SILTY SAND GLACIAL TILL: Some clay trace gravel, inferred cobbles and boulders, compact to dense, brown, moist	SS	3	100	13	12				
		SS	4	100	21	9	6	53	31	10
	- - - Wet seams - - -	SS	5	100	37	10				
		SS	6	100	35	9				
		SS	7	100	41	8				
6.6 / 243.5	Borehole Terminated at 6.6 m									



Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Groundwater depth encountered on completion of drilling: 3.4 m.
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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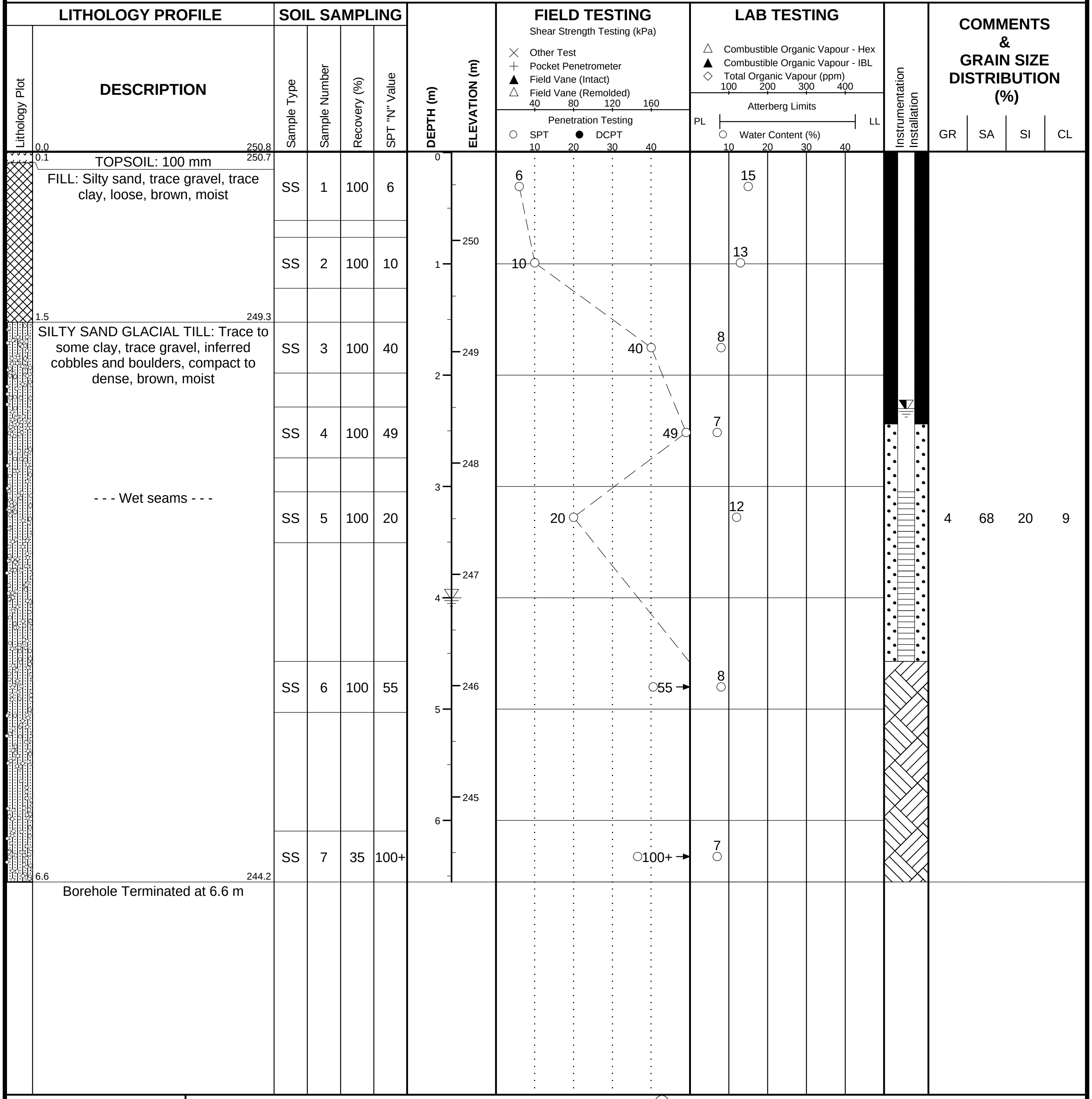
Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :50**
Page: **1 of 1**

RECORD OF BOREHOLE No. 02

Project Number: **2408904**
Project Client: **Hansen Group Inc.**
Project Name: **60 Dean Ave.**
Project Location: **Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Rubber Tire**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4912185**
Easting: **607907**
Date Started: **Dec 18/24**
Date Completed: **Dec 18/24**



DESCRIPTION	Top depth (m)	Top elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
TOPSOIL: 100 mm	0.0	250.8									
FILL: Silty sand, trace gravel, trace clay, loose, brown, moist	0.1	250.7	SS	1	100	6	15				
			SS	2	100	10	13				
SILTY SAND GLACIAL TILL: Trace to some clay, trace gravel, inferred cobbles and boulders, compact to dense, brown, moist	1.5	249.3	SS	3	100	40	8				
			SS	4	100	49	7				
- - - Wet seams - - -			SS	5	100	20	12	4	68	20	9
			SS	6	100	55	8				
			SS	7	35	100+	7				
Borehole Terminated at 6.6 m	6.6	244.2									

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Groundwater depth encountered on completion of drilling: 4.0 m.
Cave depth after auger removal: Open
Groundwater depth observed on: Jan 08/25 at depth of: 2.3 m.
Groundwater Elevation: 248.5 m

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Scale: **1 :50**

Page: **1 of 1**

RECORD OF BOREHOLE No. 03

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Project Number: **2408904**
Project Client: **Hansen Group Inc.**
Project Name: **60 Dean Ave.**
Project Location: **Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Rubber Tire**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4912123**
Easting: **607866**
Date Started: **Dec 18/24**
Date Completed: **Dec 18/24**

LITHOLOGY PROFILE / SOIL SAMPLING

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value
	0.0 250.8				
	FILL: Silty sand, trace to some organics, trace gravel, compact, brown, moist	SS	1	100	11
	- - - Topsoil seam - - -	SS	2	100	12
	1.5 249.3				
	SILTY SAND GLACIAL TILL: Trace gravel, trace clay, inferred cobbles and boulders, dense to very dense, brown, moist	SS	3	100	38
		SS	4	100	42
		SS	5	100	61
		SS	6	35	100+
		SS	7	35	100+
	6.6 244.3				
	Borehole Terminated at 6.6 m				

FIELD TESTING

Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160

Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING

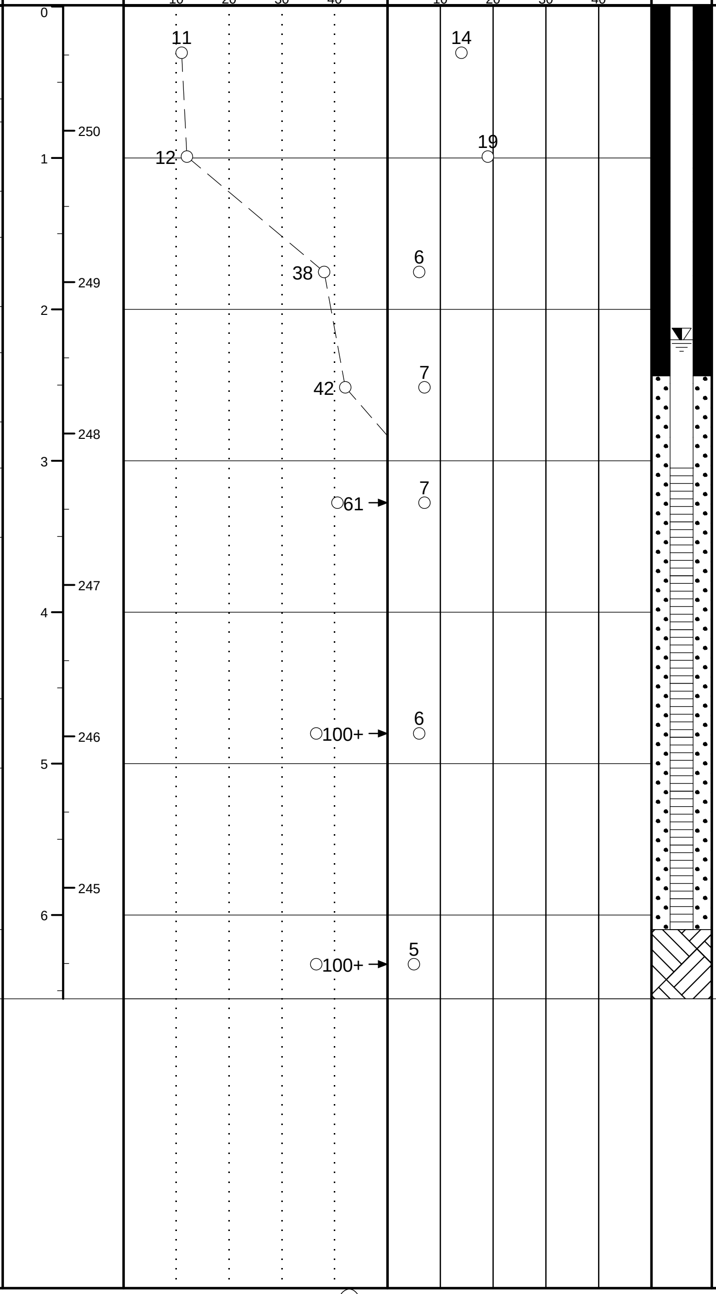
△ Combustible Organic Vapour - Hex
▲ Combustible Organic Vapour - IBL
◇ Total Organic Vapour (ppm)
100 200 300 400

Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL



Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on: Jan 08/25 at depth of: 2.2 m.
Cave depth after auger removal: Open
Groundwater Elevation: 248.6 m

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Scale: **1 :50**

Page: **1 of 1**

RECORD OF BOREHOLE No. 04

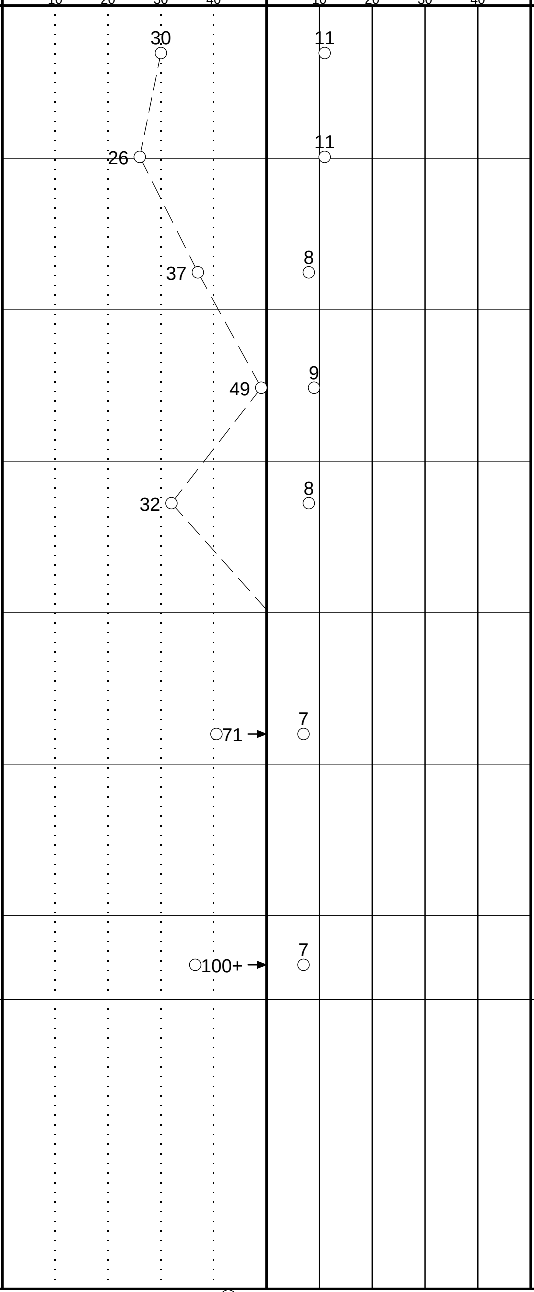
Project Number: **2408904**
Project Client: **Hansen Group Inc.**
Project Name: **60 Dean Ave.**
Project Location: **Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Rubber Tire**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4912080**
Easting: **607826**
Date Started: **Dec 18/24**
Date Completed: **Dec 18/24**

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour - Hex
▲ Combustible Organic Vapour - IBL
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ├──┤ LL
○ Water Content (%)
10 20 30 40

Depth (m) / Elevation (m)	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	SPT (field testing)	Water Content (%)	Instrumentation Installation	GR	SA	SI	CL
0.0 / 249.1 0.2 / 249.0	TOPSOIL: 150 mm											
0.2 / 249.0	FILL: Silty sand, trace gravel, compact, brown, moist	SS	1	100	30	30	11					
0.8 / 248.4	SILTY SAND GLACIAL TILL: Trace clay, trace gravel, inferred cobbles and boulders, compact to very dense, brown, moist	SS	2	100	26	26	11					
		SS	3	100	37	37	8		8	55	29	8
		SS	4	100	49	49	9					
	- - - Wet seams - - -	SS	5	100	32	32	8					
		SS	6	100	71	71 →	7					
6.6 / 242.6		SS	7	35	100+	100+ →	7					
	Borehole Terminated at 6.6 m											



Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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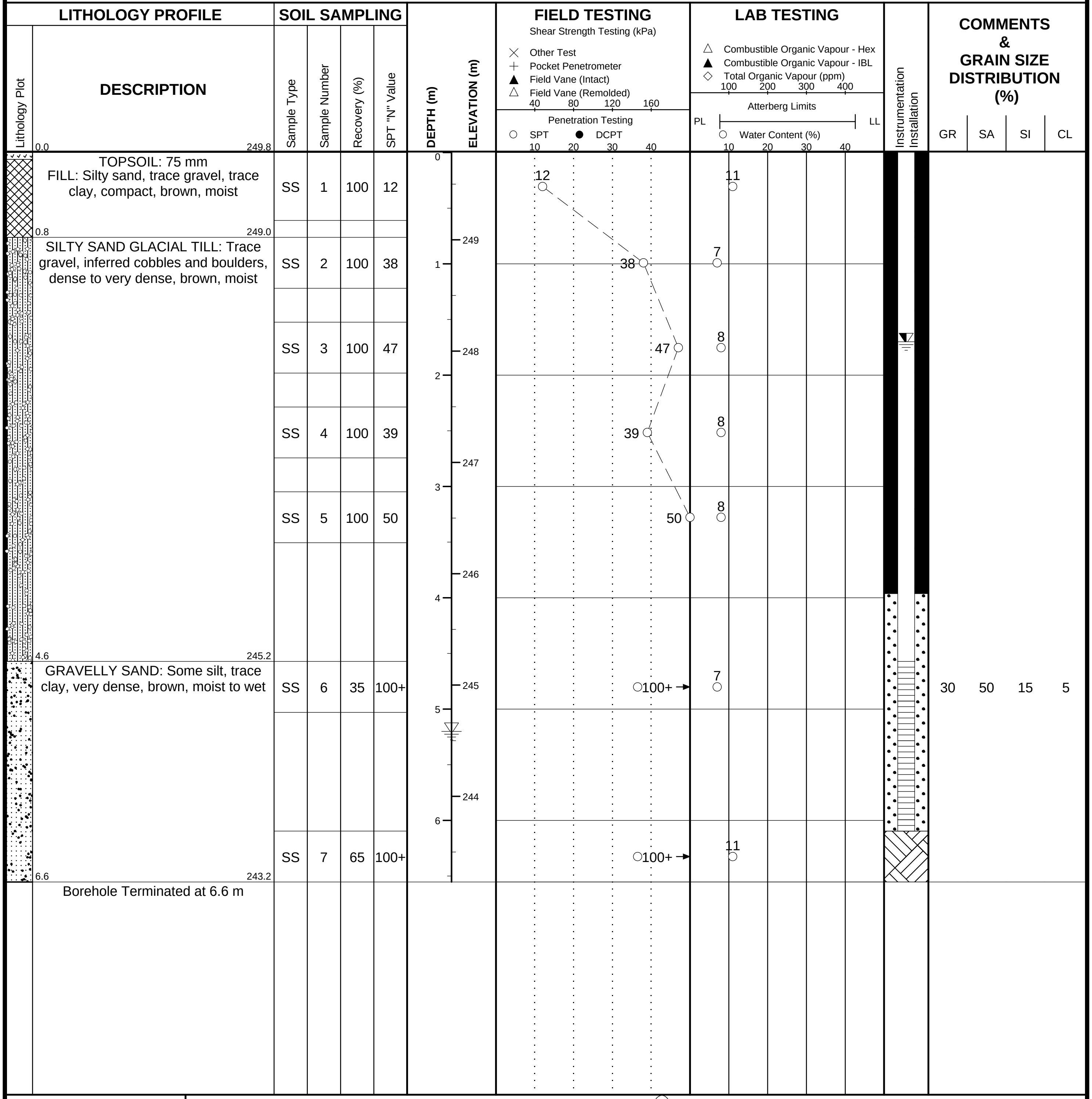
Scale: **1 :50**

RECORD OF BOREHOLE No. 05

Project Number: **2408904**
Project Client: **Hansen Group Inc.**
Project Name: **60 Dean Ave.**
Project Location: **Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Rubber Tire**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4912059**
Easting: **607861**
Date Started: **Dec 18/24**
Date Completed: **Dec 18/24**



DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
0.0 249.8									
TOPSOIL: 75 mm FILL: Silty sand, trace gravel, trace clay, compact, brown, moist	SS	1	100	12	11				
0.8 249.0									
SILTY SAND GLACIAL TILL: Trace gravel, inferred cobbles and boulders, dense to very dense, brown, moist	SS	2	100	38	7				
	SS	3	100	47	8				
	SS	4	100	39	8				
	SS	5	100	50	8				
4.6 245.2									
GRAVELLY SAND: Some silt, trace clay, very dense, brown, moist to wet	SS	6	35	100+	7	30	50	15	5
	SS	7	65	100+	11				
6.6 243.2									
Borehole Terminated at 6.6 m									

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Groundwater depth encountered on completion of drilling: 5.2 m.
Cave depth after auger removal: Open
Groundwater depth observed on: Jan 08/25 at depth of: 1.7 m.
Groundwater Elevation: 248.1 m

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Scale: **1 :50**

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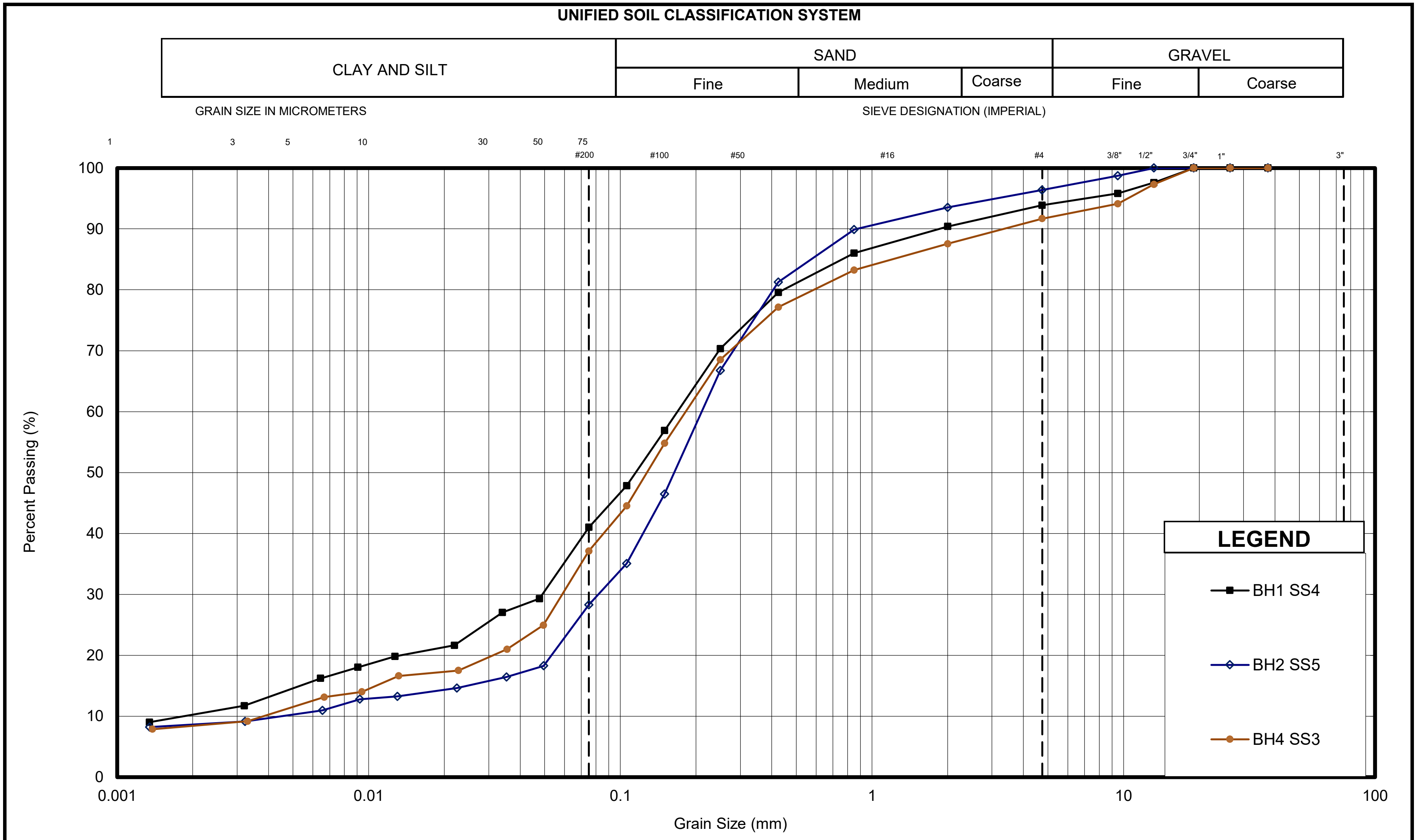
Appendix C Well Details and Groundwater Levels

Hydrogeological Investigation
60 Dean Avenue, Barrie, ON
PN# 2408904
March 2025

Well ID	Well Info				Unstabalized groundwater level post drilling		Groundwater Monitoring								
							8-Jan-25			4-Feb-25			7-Feb-25		
	Stick up	**Ground Elevation**	**Depth mbgs**	**Screened Geology**	**mbgs**	**mbtoc**	mbtoc	mbgs	masl	mbtoc	mbgs	masl	mbtoc	mbgs	masl
BH/MW2	0.71	250.79	4.64	Silty Sand Glacial Till	2.3	248.5	3.00	2.29	248.50	3.53	2.82	247.97	3.58	2.87	247.92
BH/MW3	0.73	250.81	6.00	Silty Sand Glacial Till	2.2	248.6	2.95	2.22	248.59	3.74	3.01	247.81	3.80	3.07	247.74
BH/MW5	0.75	249.77	6.02	Gravelly Sand	5.2	244.6	2.48	1.73	248.04	3.17	2.42	247.35	3.24	2.49	247.29

Appendix D Geotechnical Laboratory Testing



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH1 SS4	SILTY SAND, Some Clay, Trace Gravel	6	53	31	10	0.002	0.049	0.169	91.4	7.7
BH2 SS5	SILTY SAND, Trace Clay, Trace Gravel	4	68	20	9	0.005	0.082	0.211	46.7	7.0
BH4 SS3	SILTY SAND, Trace Clay, Trace Gravel	8	55	29	8	0.004	0.059	0.182	47.7	5.0

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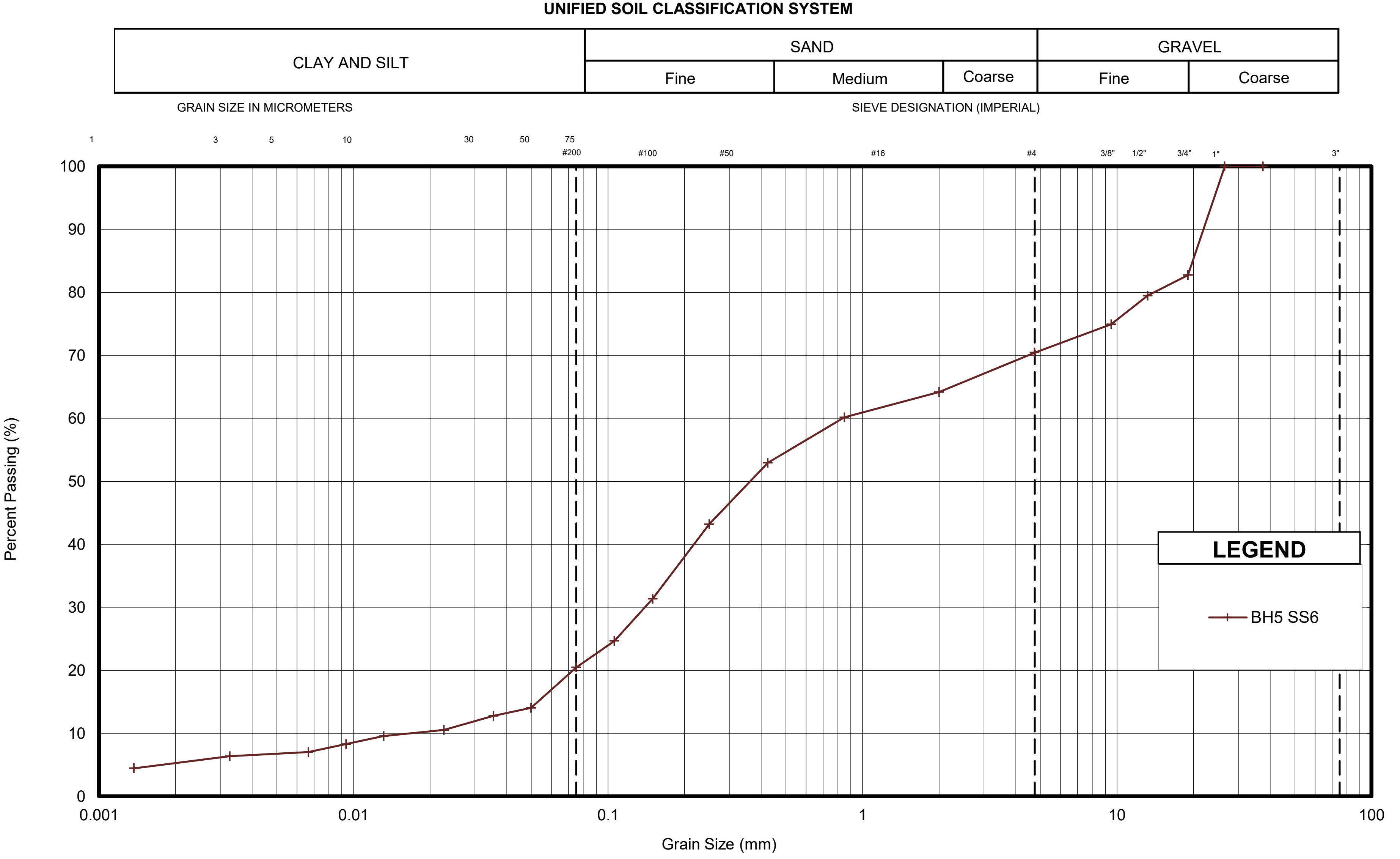
GRAIN SIZE DISTRIBUTION - 48 Dean Ave - Pratt Hansen

GLACIAL TILL

FIGURE No.

REF. No. 2408904

DATE March 2025



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH5 SS6	GRAVELLY SAND, Some Silt, Trace Clay	30	50	15	5	0.017	0.140	0.838	49.8	1.4

GRAIN SIZE DISTRIBUTION - 48 Dean Ave - Pratt Hansen

GRAVELLY SAND

FIGURE No.

REF. No. 2408904

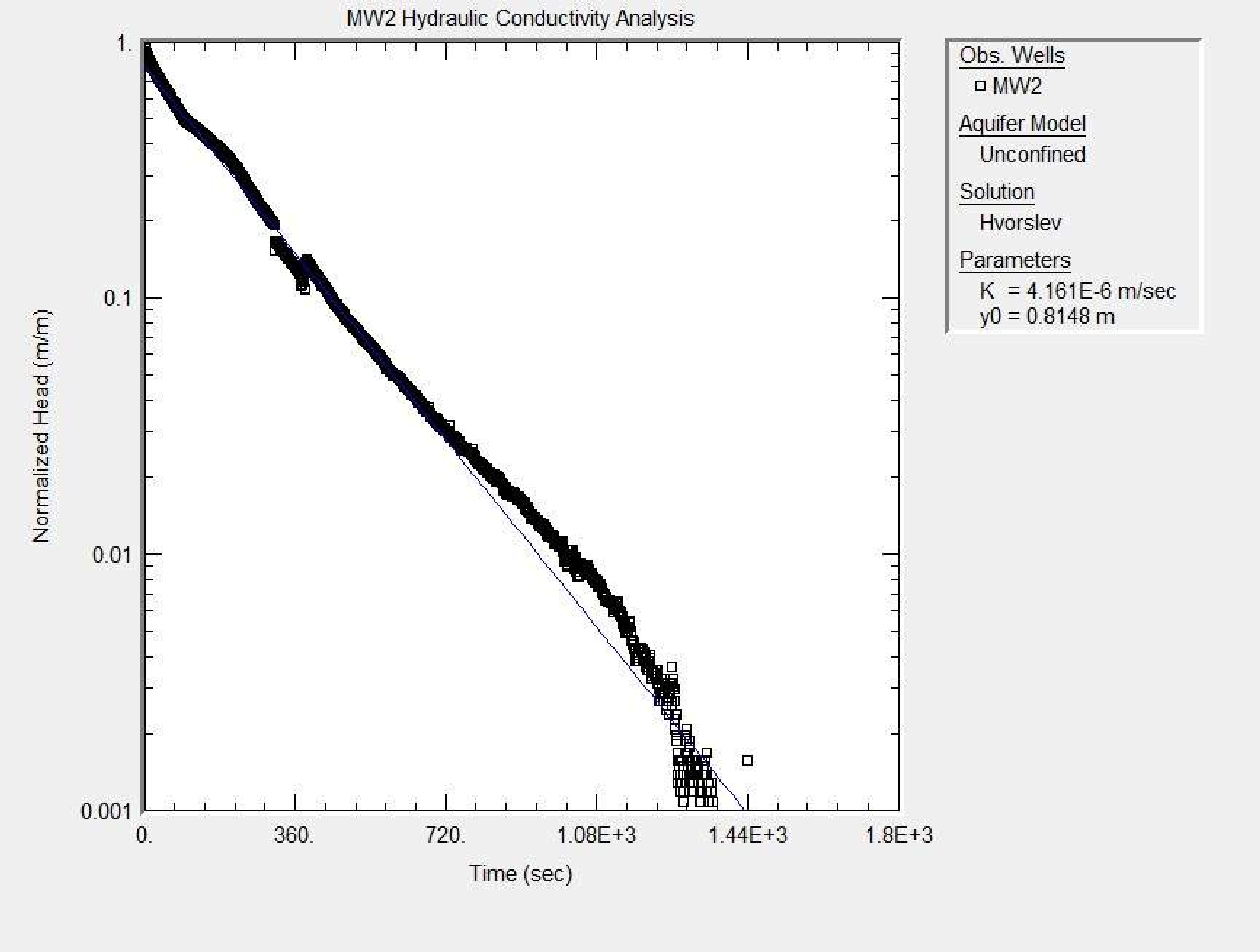
DATE March 2025

Appendix E Hydraulic Conductivity Testing

Estimation of K by Slug Test, based on Horslev equation

Date:	February 21, 2025
Conducted by:	TP

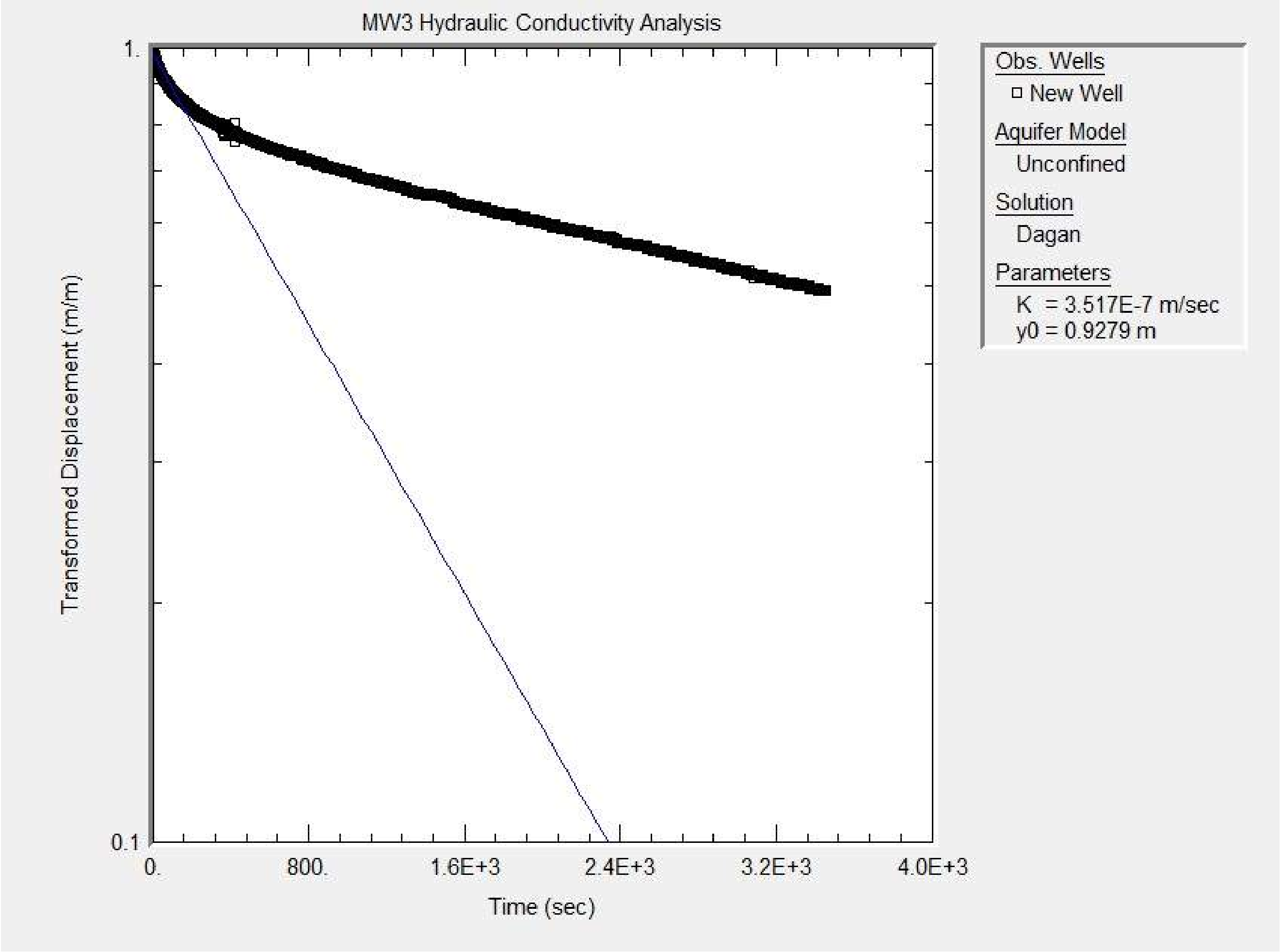
Well Number:	MW2	
Well Screen Bottom:	4.50	mbgs
Top of Pipe:	0.71	mags
Well Casing Diameter:	5.08	cm
Ground Surface:	250.80	masl
Static Water Level:	2.87	mbgs
Estimated Bulk K:	**$4.2x10^{-6}$**	m/s



Estimation of K by Slug Test, based on Dagan equation

Date:	February 21, 2025
Conducted by:	TP

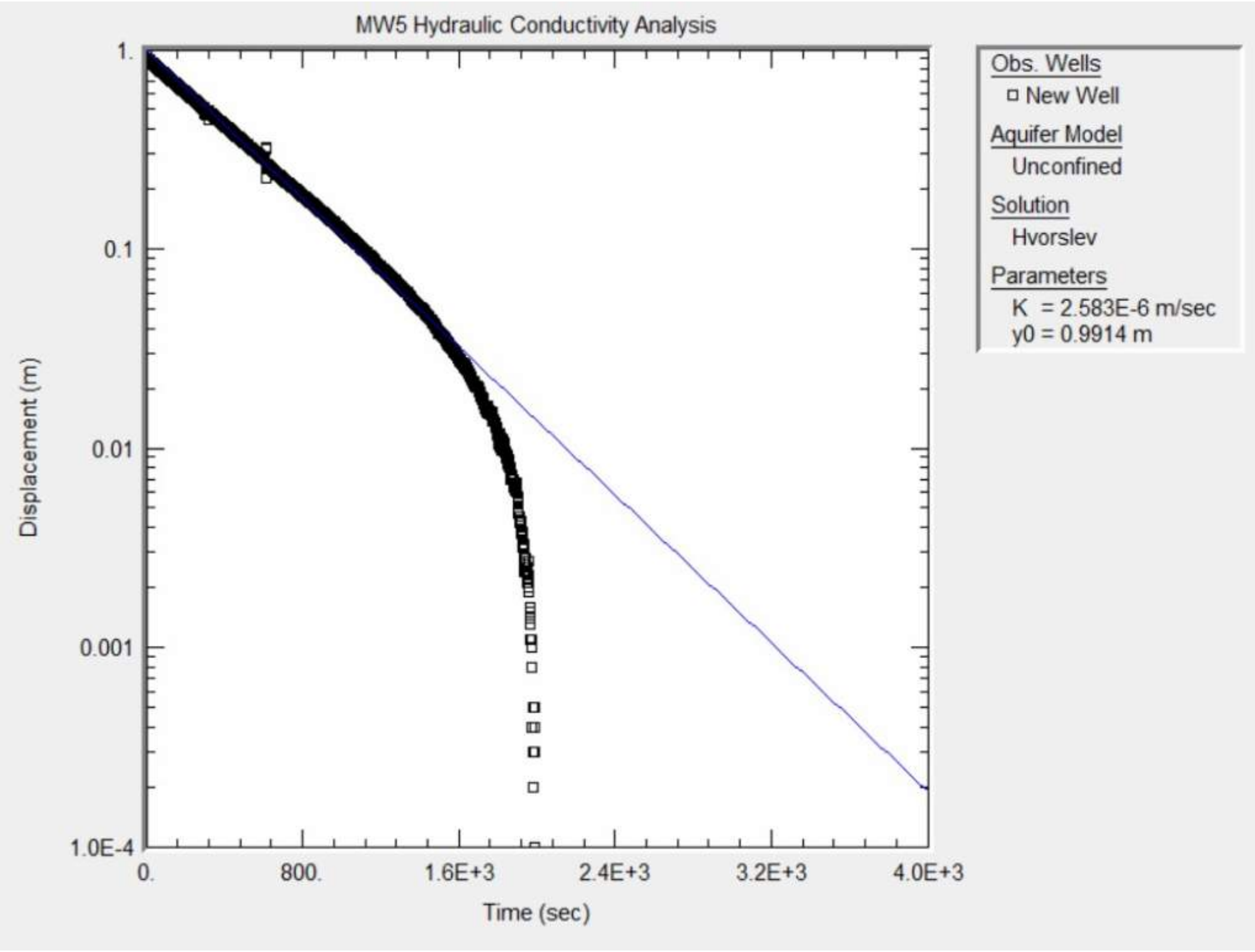
Well Number:	MW3	
Well Screen Bottom:	6.00	mbgs
Top of Pipe:	0.73	mags
Well Casing Diameter:	5.08	cm
Ground Surface:	248.60	masl
Static Water Level:	3.07	mbgs
Estimated Bulk K:	**$3.5\text{x}10^{-7}$**	m/s



Estimation of K by Slug Test, based on Dagan equation

Date:	February 21, 2025
Conducted by:	TP

Well Number:	MW5	
Well Screen Bottom:	6.00	mbgs
Top of Pipe:	0.75	mags
Well Casing Diameter:	5.08	cm
Ground Surface:	248.00	masl
Static Water Level:	2.49	mbgs
Estimated Bulk K:	**2.6x10^{-6}**	m/s



Appendix F Water Quality Laboratory Certificate of Analysis

CADUCEON
ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 25-003455 - Rev. 0

Report To:
GEI Consultants
647 Welham Rd, Unit 14
Barrie, ON L4N 0B7

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Sarah Griffith

DATE RECEIVED: 2025-Feb-07
DATE REPORTED: 2025-Feb-18
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 2408904
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	1	OTTAWA	PCURIEL	2025-Feb-11	A-IC-01	SM 4110B
BOD5 (Liquid)	1	KINGSTON	JWOLFE2	2025-Feb-13	BOD-001	SM 5210B
COD (Liquid)	1	KINGSTON	EHINCH	2025-Feb-13	COD-001	SM 5220D
Cond/pH/Alk Auto (Liquid)	1	OTTAWA	SBOUDREAU	2025-Feb-11	COND-02/PH-02/ALK-02	SM 2510B/4500H/2320B
Cyanide Total (Liquid)	1	KINGSTON	EHINCH	2025-Feb-11	CN-001	SM 4500-CN-E
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2025-Feb-12	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	1	OTTAWA	APRUDYVUS	2025-Feb-12	D-ICP-01	SM 3120B
Mercury (Liquid)	1	OTTAWA	TBENNETT	2025-Feb-12	D-HG-02	SM 3112B
ICPMS Precious Metals (Total)	1	OTTAWA	AOZKAYMAK	2025-Feb-12	D-ICPMS-01	EPA 6020
OC Pesticides (Liquid)	1	KINGSTON	CSUMMERHAYS	2025-Feb-11	PESTCL-001	EPA 8081
Oil & Grease (Liquid)	1	KINGSTON	TMCBRYDE	2025-Feb-11	O&G-001	SM 5520
Phenols (Liquid)	1	KINGSTON	EHINCH	2025-Feb-11	PHEN-01	MECP E3179
Sulphide (Liquid)	1	KINGSTON	MWILSON	2025-Feb-13	H2S-001	SM 4500-S2
SVOC - Semi-Volatiles (Liquid)	1	KINGSTON	KPARKER	2025-Feb-11	NAB-W-001	EPA 8270D
TP & TKN (Liquid)	1	KINGSTON	YLIEN	2025-Feb-12	TPTKN-001	MECP E3516.2
TSS (Liquid)	1	KINGSTON	MCLOSS	2025-Feb-11	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	CBURKE	2025-Feb-14	C-VOC-02	EPA 8260

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 5
				Sample I.D.	25-003455-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-
pH @25°C	pH units	-	9.5, 9.5	SAN, STORM	7.81
Fluoride	mg/L	0.1	10	SAN	<0.1
Chloride	mg/L	0.5	1500	SAN	94.6
Sulphate	mg/L	1	1500	SAN	54
BOD5	mg/L	3	300, 15	SAN, STORM	<3
Total Suspended Solids	mg/L	3	350, 15	SAN, STORM	132
Phosphorus (Total)	mg/L	0.01	10	SAN	0.11
Total Kjeldahl Nitrogen	mg/L	0.1	100	SAN	0.5
Sulphide	mg/L	0.01	1.0	SAN	0.08 (3.)
Cyanide (Total)	mg/L	0.005	1.2	SAN	<0.005
Phenolics	mg/L	0.001	0.1	SAN	<0.001
COD	mg/L	5	600	SAN	17
Hardness (as CaCO3)	mg/L	0.02			513
Aluminum (Total)	mg/L	0.01	50	SAN	1.38
Barium (Total)	mg/L	0.001	5	SAN	0.103
Bismuth (Total)	mg/L	0.02	5	SAN	<0.02
Boron (Total)	mg/L	0.005			0.023
Calcium (Total)	mg/L	0.02			173
Iron (Total)	mg/L	0.005	50	SAN	1.85
Magnesium (Total)	mg/L	0.02			19.4
Manganese (Total)	mg/L	0.001	5	SAN	0.085

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 5
				Sample I.D.	25-003455-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-
Tin (Total)	mg/L	0.05	5	SAN	<0.05
Tungsten (Total)	mg/L	0.01			<0.01
Zinc (Total)	mg/L	0.005	2, 0.04	SAN, STORM	0.008
Zirconium (Total)	mg/L	0.003			<0.003
Antimony (Total)	mg/L	0.0001	5	SAN	0.0004
Arsenic (Total)	mg/L	0.0001	1	SAN	0.0003
Beryllium (Total)	mg/L	0.0001			<0.0001
Cadmium (Total)	mg/L	0.000015	0.7, 0.001	SAN, STORM	<0.000015
Chromium (Total)	mg/L	0.001	2, 0.08	SAN, STORM	0.003
Cobalt (Total)	mg/L	0.0001	5	SAN	0.0010
Copper (Total)	mg/L	0.0001	2, 0.01	SAN, STORM	0.0034
Lead (Total)	mg/L	0.00002	0.7, 0.05	SAN, STORM	0.00080
Molybdenum (Total)	mg/L	0.0001	5	SAN	0.0008
Nickel (Total)	mg/L	0.0002	2, 0.05	SAN, STORM	0.0028
Selenium (Total)	mg/L	0.001	1	SAN	<0.001
Silver (Total)	mg/L	0.0001	0.4	SAN	<0.0001
Thallium (Total)	mg/L	0.00005			<0.00005
Uranium (Total)	mg/L	0.00005			0.00049
Vanadium (Total)	mg/L	0.0001	5	SAN	0.0028
Gold (Total)	mg/L	0.0007	5	SAN	<0.0007
Platinum (Total)	mg/L	0.00004	5	SAN	<0.00004

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 5
				Sample I.D.	25-003455-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-
Rhodium (Total)	mg/L	0.00002	5	SAN	<0.00002
Mercury	mg/L	0.00002	0.01	SAN	<0.00002

				Client I.D.	BH/MW 5
				Sample I.D.	25-003455-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-
Benzene	mg/L	0.0005	0.01	SAN	<0.0005
Dichlorobenzene,1,2-	mg/L	0.0005	0.05	SAN	<0.0005
Dichlorobenzene,1,4-	mg/L	0.0005	0.08	SAN	<0.0005
Ethylbenzene	mg/L	0.0005	0.06	SAN	<0.0005
Dichloromethane (Methylene Chloride)	mg/L	0.005	0.09	SAN	<0.005
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	0.06	SAN	<0.0005
Tetrachloroethylene	mg/L	0.0005	0.06	SAN	<0.0005
Toluene	mg/L	0.0005	0.02	SAN	<0.0005
Trichloroethylene	mg/L	0.0005	0.05	SAN	<0.0005
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	mg/L	0.0011	0.3	SAN	<0.0011
Xylene, o-	µg/L	0.5			<0.5
Oil and Grease (Mineral)	mg/L	1.0	15	SAN	<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0	150	SAN	4.1

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 5
				Sample I.D.	25-003455-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-
Acenaphthene	µg/L	0.05			<0.05
Acenaphthylene	µg/L	0.05			<0.05
Anthracene	µg/L	0.05			<0.05
Benzo[a]anthracene	µg/L	0.05			<0.05
Benzo(a)pyrene	µg/L	0.01			<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1
Benzo(g,h,i)perylene	µg/L	0.05			<0.05
Benzo(k)fluoranthene	µg/L	0.05			<0.05
Chrysene	µg/L	0.05			<0.05
Dibenzo(a,h)anthracene	µg/L	0.05			<0.05
Fluoranthene	µg/L	0.05			<0.05
Fluorene	µg/L	0.05			<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05
Methylnaphthalene,1-	µg/L	0.05			<0.05
Methylnaphthalene,2-(1-)	µg/L	1			<1
Methylnaphthalene,2-	µg/L	0.05			<0.05
Naphthalene	µg/L	0.05			<0.05
Phenanthrene	µg/L	0.05			0.08
Pyrene	µg/L	0.05			<0.05
Total PAH	mg/L	0.0001	0.005	SAN	0.0001

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 5
				Sample I.D.	25-003455-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-
Hexachlorobenzene	mg/L	0.00001	0.0001	SAN	<0.00001

Comments:

3. Elevated RL due to sample matrix interferences/dilution

: City of Barrie Sewer Use By-Law
SAN: Sanitary Sewer By Law
STORM: Storm Sewer By Law

Summary of Exceedances

Storm Sewer By Law

BH/MW 5	**Found Value**	**Limit**
Total Suspended Solids	132	15

Michelle Dubien
Data Specialist

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 25-003456 - Rev. 0

Report To:
GEI Consultants
647 Welham Rd, Unit 14
Barrie, ON L4N 0B7

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Sarah Griffith

DATE RECEIVED:	2025-Feb-08	CUSTOMER PROJECT:	2408904
DATE REPORTED:	2025-Feb-14	P.O. NUMBER:	
SAMPLE MATRIX:	Ground Water		

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
PHC F1 (Liquid)	1	RICHMOND_HILL	CBURKE	2025-Feb-13	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	1	KINGSTON	STHOMPSON	2025-Feb-11	PHC-W-001	MECP E3421
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	CBURKE	2025-Feb-13	C-VOC-02	EPA 8260

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg
F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)
F2 C10-C16 hydrocarbons in µg/g, (F2-napth if requested)
F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)
F4 C34-C50 hydrocarbons in µg/g
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
Any deviations from the method are noted and reported for any particular sample.
nC6 and nC10 response factor is within 30% of response factor for toluene:
nC10,nC16 and nC34 response factors within 10% of each other:
C50 response factors within 70% of nC10+nC16+nC34 average:
Linearity is within 15%:
All results expressed on a dry weight basis.
Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.
If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC
QC will be made available upon request.

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 2
				Sample I.D.	25-003456-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**	**Reg 153 - Liquid**	-
Acetone	µg/L	30	2700	T1GW	<30
Benzene	µg/L	0.5	0.5	T1GW	<0.5
Bromodichloromethane	µg/L	2	2	T1GW	<2
Bromoform	µg/L	5	5	T1GW	<5
Bromomethane	µg/L	0.5	0.89	T1GW	<0.5
Carbon Tetrachloride	µg/L	0.2	0.2	T1GW	<0.2
Chlorobenzene	µg/L	0.5	0.5	T1GW	<0.5
Chloroform	µg/L	1	2	T1GW	<1
Dibromochloromethane	µg/L	2	2	T1GW	<2
Ethylene Dibromide	µg/L	0.2	0.2	T1GW	<0.2
Dichlorobenzene,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	0.5	T1GW	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	0.5	T1GW	<0.5
Dichlorodifluoromethane (Freon 12)	µg/L	2	590	T1GW	<2
Dichloroethane,1,1-	µg/L	0.5	0.5	T1GW	<0.5
Dichloroethane,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Dichloroethylene,1,1-	µg/L	0.5	0.5	T1GW	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	1.6	T1GW	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5	1.6	T1GW	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5			<0.5

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 2
				Sample I.D.	25-003456-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**	**Reg 153 - Liquid**	-
Dichloropropene,1,3-cis+trans- (Calculated)	µg/L	0.5	0.5	T1GW	<0.5
Dichloropropene,1,3-trans-	µg/L	0.5			<0.5
Ethylbenzene	µg/L	0.5	0.5	T1GW	<0.5
Hexane	µg/L	5	5	T1GW	<5
Dichloromethane (Methylene Chloride)	µg/L	5	5	T1GW	<5
Methyl Ethyl Ketone	µg/L	2	400	T1GW	<2
Methyl Isobutyl Ketone	µg/L	20	640	T1GW	<20
Methyl tert-Butyl Ether (MTBE)	µg/L	2	15	T1GW	<2
Styrene	µg/L	0.5	0.5	T1GW	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	1.1	T1GW	<0.5
Tetrachloroethane,1,1,2,2-	µg/L	0.5	0.5	T1GW	<0.5
Tetrachloroethylene	µg/L	0.5	0.5	T1GW	<0.5
Toluene	µg/L	0.5	0.8	T1GW	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	0.5	T1GW	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Trichloroethylene	µg/L	0.5	0.5	T1GW	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5	150	T1GW	<5
Vinyl Chloride	µg/L	0.2	0.5	T1GW	<0.2
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	µg/L	1.1	72	T1GW	<1.1
Xylene, o-	µg/L	0.5			<0.5

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 2
				Sample I.D.	25-003456-1
				Date Collected	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**	**Reg 153 - Liquid**	-
PHC F1 (C6-C10)	µg/L	25	420	T1GW	<25
PHC F2 (>C10-C16)	µg/L	50	150	T1GW	<50
PHC F3 (>C16-C34)	µg/L	400	500	T1GW	<400
PHC F4 (>C34-C50)	µg/L	400	500	T1GW	<400

Reg 153 - Liquid: Reg 153 - Liquid
T1GW: R153 Tbl. 1 - GW

Michelle Dubien
Data Specialist

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 25-003457 - Rev. 0

Report To:
GEI Consultants
647 Welham Rd, Unit 14
Barrie, ON L4N 0B7

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Sarah Griffith

DATE RECEIVED: 2025-Feb-07
DATE REPORTED: 2025-Feb-12
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 2408904
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Chromium VI (Liquid)	2	OTTAWA	STAILLON	2025-Feb-11	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	2	OTTAWA	AOZKAYMAK	2025-Feb-12	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	2	OTTAWA	APRUDYVUS	2025-Feb-12	D-ICP-01	SM 3120B
Mercury (Liquid)	2	OTTAWA	TBENNETT	2025-Feb-12	D-HG-02	SM 3112B
TSS (Liquid)	2	KINGSTON	MCLOSS	2025-Feb-11	TSS-001	SM 2540D

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

M. Dubien

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 2	BH/MW 2F
				Sample I.D.	25-003457-1	25-003457-2
				Date Collected	2025-Feb-07	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-	-
Total Suspended Solids	mg/L	3			680	<3
Hardness (as CaCO3)	mg/L as CaCO3	0.02			720	316
Aluminum (Total)	µg/L	10			6580	38
Boron (Total)	µg/L	5	200	INTERIM	17	9
Calcium (Total)	µg/L	20			262000	112000
Iron (Total)	µg/L	5	300	PWQO	**9260**	29
Magnesium (Total)	µg/L	20			16100	8620
Tungsten (Total)	µg/L	10	30	INTERIM	<10	<10
Zinc (Total)	µg/L	5	20, 30	INTERIM, PWQO	**36**	<5
Zirconium (Total)	µg/L	3	4	INTERIM	4	<3
Antimony (Total)	µg/L	0.1	20	INTERIM	0.6	0.4
Arsenic (Total)	µg/L	0.1	5, 5	INTERIM, PWQO	1.5	0.2
Beryllium (Total)	µg/L	0.1	11	PWQO	0.3	<0.1
Cadmium (Total)	µg/L	0.015	0.1, 0.2	INTERIM, PWQO	0.075	<0.015
Chromium (Total)	µg/L	1			10	<1
Cobalt (Total)	µg/L	0.1	0.9	INTERIM	**5.4**	0.2
Copper (Total)	µg/L	0.1	5	INTERIM	**14.3**	0.9
Lead (Total)	µg/L	0.02	1, 5	INTERIM, PWQO	**3.87**	<0.02
Molybdenum (Total)	µg/L	0.1	40	INTERIM	2.0	1.9
Nickel (Total)	µg/L	0.2	25	PWQO	10.3	0.5
Selenium (Total)	µg/L	1	100	PWQO	<1	<1

Michelle Dubien
Data Specialist

				Client I.D.	BH/MW 2	BH/MW 2F
				Sample I.D.	25-003457-1	25-003457-2
				Date Collected	2025-Feb-07	2025-Feb-07
Parameter	**Units**	**R.L.**	**Limits**		-	-
Silver (Total)	µg/L	0.1	0.1	PWQO	<0.1	<0.1
Thallium (Total)	µg/L	0.05	0.3, 0.3	INTERIM, PWQO	0.11	<0.05
Uranium (Total)	µg/L	0.05	5	INTERIM	2.28	2.00
Vanadium (Total)	µg/L	0.1	6	INTERIM	**15.2**	0.8
Chromium (VI)	µg/L	1	1	PWQO	<1	<1
Mercury	µg/L	0.02	0.2	PWQO	<0.02	<0.02

: PWQO Limits
INTERIM: Interim PWQO
PWQO: PWQO

Summary of Exceedances

Interim PWQO

BH/MW 2	**Found Value**	**Limit**
Zinc (Total)	36	20
Cobalt (Total)	5.4	0.9
Copper (Total)	14.3	5
Lead (Total)	3.87	1
Vanadium (Total)	15.2	6

PWQO

BH/MW 2	**Found Value**	**Limit**
Iron (Total)	9260	300
Zinc (Total)	36	30

Michelle Dubien
Data Specialist

Appendix G Construction Dewatering Calculations

GEI Consultants

Summary of Predicted Temporary Groundwater Flow Rate and Zone of Influence at: Excavations (Dewatering Zones 1 to 3)

Dewatering Zone	Hydraulic Conductivity (m/sec)	Hydraulic Conductivity (m/day)	Material Encountered	Lowest Excavation Depth (masl)	Assumed Base of Aquifer (masl) (3.0 m below lowest excavation)	Length (m)	Width (m)	Length ÷ Width (>1.5)	Inferred Groundater Level (masl)	**Target Pumping Groundwater (masl)	H (m)	h (m)	r_s (m)	R_0 (m)	R_a (m)	Q (m^3/day)	Safety Factor (S.F.)	Construction Flow Rate with S.F. (L/day)
1a - North Servicing	4.2E-06	3.6E-01	Cohessionless Glacial Till	248.68	242.9	50	5	10.0	248.6	248.2	5.7	5.3	2.5	1.5	4.0	31.7	2.0	63,391
1b - South Servicing	4.2E-06	3.6E-01	Cohessionless Glacial Till	245.89					248.5	245.4	5.6	2.5		11.2	13.7	50.5	2.0	100,906
2 - U/G Parking	4.2E-06	3.6E-01	Cohessionless Glacial Till	248.70		86	20	4.3	248.6	247.7	5.7	4.8	10.0	3.2	13.2	60.6	2.0	121,245
3 - U/G Storage Tank	4.2E-06	3.6E-01	Cohessionless Glacial Till	249.35		15	8	1.9	248.6	249.1	5.7	6.2	4.0	Dewatering Not Anticipated	N/A	0.0	2.0	-
																		285,542

Notes:

** Target Groundwater Level Assumed 0.3 to 1.0 m below Lowest Excavation Depth

Precipitaion = Max 1-Day Precipitation (Climate Altas of Canada [climateatlas.ca])

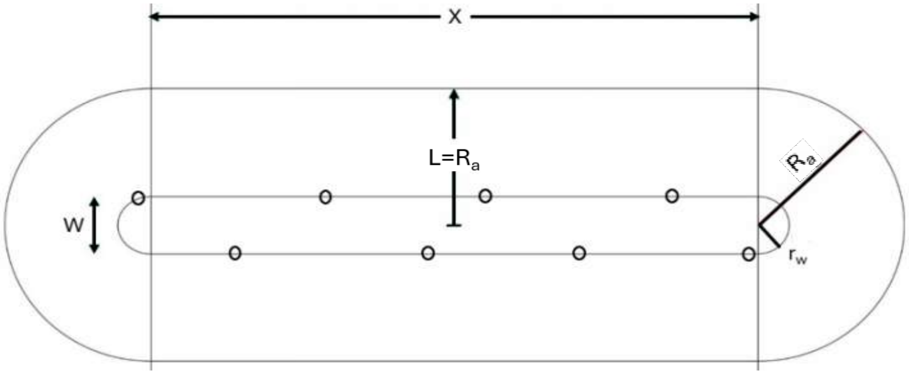
Precipitation Estimate		
Precipitation (mm)	Area (m^2)	Total (L)
44	2090	91,960

Input 🟩 🟦

Sum of Precipitation and Groundwater 377,502

When ratio of X/W is greater than 1.5, Trench Equation is used (below)

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



Where:

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

K = Hydraulic conductivity (m/day)

H = Saturated thickness prior to dewatering (m)

h = Saturated thickness after dewatering (m)

R_0 = Radius of influence from the edge of excavation (m); it is estimated using an empirical relationship developed by Sichart that is a function of drawdown and hydraulic conductivity $R_0 = C\ (H - h)\sqrt{K}$; Where: C is a factor equal to 3000 for radial flow and between 1500 to 2000 for for the trench (Somerville 2005). For the purpose of this estimate a value of 1750 for C is considered.

r_s = Distance to the wellpoints from the centre of the trench, assumed to be half of the trench width (W) in m

R_a = radius of influence from the center of the excavation (R_0+r_s)

x = Trench length (m)

L = Distance from a line source to the trench, assumed to be equivalent to R_a (m)

References:

Driscoll, F.G., 1986: Groundwater and Wells, 2nd edition, Johnson Division, St. Paul, Minnesota

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Appendix H Groundwater Taking Plan

Groundwater Taking Plan

This plan, as required under the OWRA, Section 34 - 34.11 and O.Reg. 387/04 (Water Taking and Transfer) and/or O.Reg. 63/16 – Registration Under Part II.2 of the Act – Water Taking, provides a general outline of the dewatering plan for the site to satisfy the PTTW and/or EASR requirements and that a detailed plan will be generated as needed by the contractor and their dewatering subcontractor that will include detailed treatment and monitoring measures.

Based on the conditions at and around the site, the target receiver for any dewatering discharge will be the surface and/or storm and/or sanitary sewers. Should discharge be planned for either of the sewer systems, the contractor and/or its dewatering subcontractor will need to ensure that all permissions and/or permits are obtained to allow for discharge to that sewer and that all dewatering discharge meets the appropriate chemistry and discharge flow requirements imposed for that system.

Ultimately the method(s) employed to complete the dewatering will be left up to the contractor and/or its dewatering contractor to determine what will work best for them to achieve the dry working conditions that they require.

It is noted that these dewatering estimates are considered preliminary and do not reflect analysis with the information regarding the seasonal or annual high groundwater levels. The following values should be used for discussion and preliminary planning purposes only until site servicing plans and/or building basement or foundation designs are available.

<u>Construction Dewatering Discharge Rates and Zones of Influence</u>

The ROIs were estimated in Section 5.1.2 and the details are summarized below.

Dewatering Zone		Description	R_0 (m)
1	Site Servicing (North to South)	Linear excavation for the installation of water and sewer services across the site. 50 m long by 5 m wide	1.5 to 11.2
2	U/G Parking	Linear excavation for the installation of U/G parking in the eastern portion of the site. 86 m long by 20 m wide	3.2
3	U/G Storage Tank	Linear excavation for the installation of U/G parking in the northern portion of the site. 15 m long by 8 m wide	Dewatering Not Anticipated

The estimated water taking rates are below.

Dewatering Zone		Description	Construction Dewatering Flow Rate	
			As Calculated including FOS[1]	**Combined and including Rainfall Event[2,3]**
			L/day	
1	Site Servicing (North to South)	Linear excavation for the installation of water and sewer services across the site. 50 m long by 5 m wide	63,391 to 100,906	377,502
2	U/G Parking	Linear excavation for the installation of U/G parking in the eastern portion of the site. 86 m long by 20 m wide	121,245	
3	U/G Storage Tank	Linear excavation for the installation of U/G parking in the northern portion of the site. 15 m long by 8 m wide	Dewatering Not Anticipated	

Notes:

1. A FOS of 2.0 is included to account for seasonal fluctuations in the groundwater table, initial removal of groundwater from storage and variation in hydrogeological properties beyond those encountered during this study.
2. A 44 mm rainfall event was included in the water-taking calculation to account for the maximum projected single-day precipitation in the local area in the immediate future (2021 to 2050) under high carbon emissions (RCP8.5), according to the Climate Atlas of Canada. The Climate Atlas uses data from the Pacific Climate Impacts Consortium, which provides downscaled projections of daily temperature and precipitation from 24 climate models using two carbon emission scenarios.
3. It is noted that under specific conditions, if the water taking is 100% storm water registration on the EASR may not be required, however if water taking consists of any mixture of storm water and groundwater typical registry or permitting is likely required.

Impact Assessment

Land Stability and Settlement

Construction dewatering has the potential to result in ground settlement which could damage buried utilities, building foundations, or cause subsidence in adjacent lands. Settlement of the soil within the zone of influence can be calculated based on the increase in effective stress (10 kPa per m of drawdown) from reducing the pore water pressures. The maximum settlement will occur adjacent to the dewatering system where the maximum drawdown occurs and decrease exponentially to zero towards the ROI limit.

At this site, groundwater drawdowns ranging from 0.4 to 3.1 m have been assumed during construction. For a maximum groundwater drawdown of 3.1 m, a corresponding increase in effective stress of 31 kPa is calculated. Based on the predominant soil conditions (typically dense to very dense glacial till), it is estimated that this magnitude of effective stress increase/groundwater drawdown will result in less than 10 mm of ground settlement. Given the magnitude of settlement and the rural nature of the site (limited nearby infrastructure or buildings which are the main consideration for settlement related concerns), the risk of settlement related impacts to nearby buildings from the construction dewatering is considered to be very low.

The estimated settlement does not include potential settlement associated with ground loss due to pumping of fines through the system. It is imperative that any dewatering systems (e.g., well-points, deep wells, sump pumps) shall be installed adequately to ensure no soil is conveyed through the system. Sufficient filtering techniques are incorporated at the entry point to avoid migration fines in the pumping/dewatering system. The turbidity of pumped water should be monitored daily to ensure that only minimal fines are being conveyed through the system.

Potential Impact on Nearby Groundwater Users

No water well records were identified on-site, and one hundred-thirteen (13) records were identified with 500 m of the site. A summary of these water well records is provided below.

Well Use	Number of Records	Year(s) Installed	Water Encountered (Type & Depth)	Well Screen / Open Hole (Media & Depth)	Closest Well Record to Site (ID)
Public	0	N/A			
Domestic and/or Livestock	64	1956 to 2021	Fresh: 10 m to 53 m	Overburden: 1 m to 180 m	5701463, 5710480, 5737207
Industrial	1	1981	Fresh: 79 m	Overburden: 3 m to 79 m	5717741
Commercial	1	1963	Fresh: 12 m	Overburden: 7 m to 12 m	5701469
Dewatering	0	N/A			
Monitoring, Observation, and/or Test Hole	13	2009 to 2020	Untested: 3 m to 13 m	Overburden: 1 m to 22 m	7143472,
Other, Not Used, and/or Not Listed	38	1968 to 2021	Fresh: 15 m Untested: 12 m to 15 m	Overburden: 1 m to 30 m Assumed Bedrock: 5 m to 87 m	5701461, 7039252, 5739673

It is expected that all existing private water supply wells (used for domestic, livestock, industrial, or commercial purposes) on and/or within 500 m are not in use considering there is full municipal servicing in the City of Barrie.

Of the sixty-four (64) water well records labelled as domestic use, 62 wells were installed in the late 1960s to mid-1970s. It is likely that the wells have been removed or abandoned since that time. The remaining two (2) water well records labelled as domestic use installed in 2008 and 2020 are labelled as abandoned on the MECP Water Well record.

As dewatering is expected to be temporary and near the ground surface, it is anticipated that any water supply wells within 500 m of the site will not be affected by the temporary dewatering near the ground surface as the ROI is does not coincide with any public water supply wells.

Potential Impact on Nearby Waterbodies or Other Surface Water Features

The site is otherwise surrounded by the following nearby waterbodies and other surface features:

- Lover’s Creek (350 m west of the site)
- Lover’s Creek Swamp (350 m west of the site)

Minimal impacts to groundwater levels or flow directions, wetlands, tributaries, deeper aquifers, or other environmental features are expected due to the construction dewatering being temporary (short-term), with the ROI for drawdown being relatively small, and only a limited area being dewatered at any given time during construction.

As no ANSIs were identified within 500 m of the site and the water removed will be returned to the Lake Simcoe subwatershed it is not anticipated that the proposed construction dewatering activity will have a negative impact on the overall groundwater flow to the surrounding area.

Water Quantity, Quality and Groundwater Level Monitoring Program

Discharge Options

Based on the groundwater quality analysis conducted to date, the discharge from dewatering operations can either be directed to the surface, provided that the groundwater quality meets the applicable sewer usage bylaw, PWQO, and O.Reg. 153/04 SCS during dewatering activities.

If the groundwater quality of the construction dewatering discharge fails to meet the applicable standards, treatment options should be assessed, and/or the system should be shut down.

Treatment of the dewatering discharge water by filtration (using a decantation tank and/or silt bag at a minimum) to remove sediment and fines is expected to improve water quality by reducing the concentrations of TSS and/or metals. However, additional treatment may be necessary for the groundwater to meet the applicable sewer use bylaw, O.Reg. 153/04 SCS, and/or PWQO.

The purpose of sampling for the municipal sewer use bylaw criteria is to aid in the execution of a future municipal sewer use agreement, should groundwater be discharged to the local municipal sewer system(s).

The purpose of sampling for PWQO metals and TSS and O.Reg. 153/04 SCS for PHCs and VOCs are for the evaluation of the groundwater to discharge into the natural environment and/or into sewer systems in which municipal discharge water quality standards do not currently exist.

The contractor is responsible for designing and operating a treatment system for the collected discharge using their own methods to ensure compliance with the applicable standard. In particular, the contractor should be aware of the following parameters that may require additional treatment, depending on the discharge location selected:

- Iron (Total)
- Zinc (Total)
- Cobalt (Total)
- Lead (Total)
- Vanadium (Total)
- Total Suspended Solids (TSS)

Although PWQO and interim PWQO are not legally binding standards, they serve as the foundation for establishing acceptable wastewater loading limits on a site-specific basis (such as the natural environment and/or sewer systems in which municipal discharge water quality standards do not currently exist). The MECP has acknowledged that applying PWQOs can pose challenges, especially in regard to the limits of PHCs and VOCs. These challenges include instances where PWQOs may fall below the laboratory limits of detection, or PWQOs may be more stringent than background concentrations (even in water bodies with apparently thriving aquatic ecosystems).

As such, the applicable O.Reg. 153/04 SCS for the proposed site use has been used to evaluate the groundwater on site for future discharge to the natural environment and/or to sewer systems in which municipal discharge water quality standards do not currently exist, specifically for assessing the concentrations of PHCs and VOCs found in the groundwater.

Should the quality groundwater discharged during dewatering exceed the PWQO and/or O.Reg. 153/04 SCS, additional treatment measured from the dewatering contractor may be required before discharging to the natural environment is advisable and/or approved, and as such discharge to local sewers may be a more efficient option for groundwater discharge during dewatering operations.

If surface discharge is required, it is imperative to establish the natural background levels of parameters within nearby water bodies or features (such as the local creeks) before dewatering begins. Furthermore, continuous water quality monitoring should be conducted regularly during and after groundwater discharge activities.

Water Quality Monitoring and Potential Treatment Plan

The monitoring plan for discharge to the surface and/or sewers is outlined on Table H-1 below.

Groundwater Level Monitoring Program

The ground water level monitoring program is outlined on Table H-2 below.

Discharge Rate Monitoring

The total groundwater volume pumped must be measured and recorded daily by the dewatering contractor. The water taking rates should be measured using an electronic device, and the daily water volumes must be reported to MECP on the WTRS or through the Regulatory Self Reporting System. The volume of water taken daily for each dewatered work area shall be reported to the ministry on or before March 31 in each year, for each location from which water was taken in the previous calendar year. If no water is taken, then a “no taking” report must be entered.

The contractor will maintain a record of all water takings. This record will include the dates and duration of water takings, and the total measured volume of water pumped per day for each day that water is taken and will be updated and reported to the Client weekly. Daily precipitation must also be recorded by the contractor. The records must be kept up to date and available at or near the site and provided to the MECP upon request.

Summary of Qualifications

Tanvi Patel G.I.T.

Ms. Tanvi Patel is a hydrogeologist-in-training with three years of experience specializing in hydrogeological investigations. She has been trained to complete local scale ground water assessments, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, in-situ BH permeability testing, determination of ground water flow characteristics, surface water sampling, and preparation of hydrogeological reports, PTTW and EASR applications and renewals and compliance monitoring programs in accordance with the applicable MECP requirements.

Kim Pickett, M. Ed, C.E.T, LET

Ms. Pickett is an experienced project manager with over 20 years' experience in both the public and private sectors. Ms. Pickett holds a Master of Education degree from Yorkville University, an undergraduate degree in Geoscience from McMaster University and a diploma in Environmental Engineering Technology from Confederation College. Ms. Pickett has been involved in numerous environmental projects and hydrogeological assessments. Ms. Pickett brings a strong balance of theoretical knowledge combined with practical on-site experience. Along with her technical abilities, Ms. Pickett is well versed in project management, proposal preparation and client liaison. In addition, due to various roles within a municipal setting, Ms. Pickett has significant experience with public consultation, public meetings, and liaising with stakeholders on a number of environmental and hydrogeological projects.

Geoffrey White, P.Eng.

Mr. Geoffrey White, P.Eng., is a senior geotechnical engineer with 29 years of interdisciplinary professional experience Mr. White specializes in geotechnical engineering, with experience in geoenvironmental project, hydrogeological projects and support for materials inspection and testing.

His hydrogeological experience includes long-term/short-term groundwater and surface water monitoring, local scale groundwater assessments, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, and determination of groundwater flow characteristics.

Date of Plan Preparation: This plan was prepared on the date March 4, 2025

Table H-1. Water Quality Monitoring Plan for Dewatering Discharge to Surface or Storm and/or Sanitary Sewers[1]

Time Period	Monitoring Location	Parameters[2]	Monitoring Frequency[3]	Trigger for Mitigation	Mitigation Measures / Comments
Trial Dewatering or at the Start of Construction	Dewatering System Discharge Upstream And Downstream of Any Discharge Directed to Local Water Bodies / Water Courses	Applicable Sewer Use Bylaw Criteria PWQO Metals and TSS O.Reg. 153/04 PHCs and VOC	Once during trial dewatering or on the first day of dewatering (with rushed samples)	Exceeds the Applicable Sewer Use Bylaw Criteria, PWQO, or O.Reg.153/04 SCS: ● No ● Yes – Proceed to Mitigation Measures / Comments	Modify treatment method and/or shut down.
		Turbidity	Daily until stable (minimum 5 samples) then weekly	Exceeds 8 NTU above the baseline levels: ● No ● Yes – Proceed to Mitigation Measures / Comments	Modify treatment method and/or shut down.
During Construction Dewatering	Dewatering System Discharge Upstream And Downstream of Any Discharge Directed to Local Water Bodies / Water Courses	Applicable Sewer Use Bylaw Criteria PWQO Metals and TSS O.Reg. 153/04 PHCs and VOC	Weekly then every four weeks after 3 consecutive weekly compliant samples	Exceeds the Applicable Sewer Use Bylaw Criteria, PWQO, or O.Reg. 153/04 SCS: ● No ● Yes – Proceed to Mitigation Measures / Comments	Modify treatment method and/or shut down.
		Turbidity	Daily until stable (minimum 5 samples) then weekly	Exceeds 8 NTU above the baseline levels: ● No ● Yes – Proceed to Mitigation Measures / Comments	

Time Period	Monitoring Location	Parameters[2]	Monitoring Frequency[3]	Trigger for Mitigation	Mitigation Measures / Comments
		Hydrocarbon sheen in discharge	Daily	Hydrocarbon sheen observed ● No ● Yes – Proceed to Mitigation Measures / Comments	Stop dewatering until the source can be determined and remediate prior to continuing to discharge.
		Total groundwater pumping / discharge rate	Daily with electronic device	Flows exceeds the permitted rate (e.g., due to heavy rainfall event) ● No ● Yes – Proceed to Mitigation Measures / Comments	Temporarily reduce pumping rate or shorten the length of trench being dewatered until rate drops below the permitted rate.
		Record the daily precipitation at the construction site	Daily	N/A	N/A
		Signs of erosion, sediment, or flooding	Daily	Sedimentation, erosion, flooding observed. ● No ● Yes – Proceed to Mitigation Measures / Comments	Reduce pumping and/or improve sediment/erosion control measures.
		Settlement / Subsidence of nearby land	Daily	Visual indication of settlement/subsidence ● No ● Yes – Proceed to Mitigation Measures / Comments	Reduce pumping and consult both dewatering contractor and geotechnical engineer

Time Period	**Monitoring Location**	**Parameters**[2]	**Monitoring Frequency**[3]	**Trigger for Mitigation**	**Mitigation Measures / Comments**
		N/A	N/A	Complaint received with respect to water taking and pertains to natural environment. ● No ● Yes – Proceed to Mitigation Measures / Comments	Document and evaluate if actually related to dewatering, implement mitigation measures. Submit complaint and mitigation measures to local MECP office

Notes: All items and observations during dewatering should be recorded in a log on site, accessible for inspection.

1. It is recommended that discharge be treated by a sediment control facility such as a decantation tank and filtration bags at a minimum. Means and methods determined by the contractor.
2. Parameters may be removed from future testing after three consecutive compliant results and with agreement by QP. If dewatering moves to a different location all initial parameters may need to be retested at the discretion of the QP. Additionally, at the discretion of the QP, parameter sets required to be sampled can be added or removed to reflect the planned/approved discharge location (such as sanitary sewer, storm sewer or to the natural environment, etc.). Additionally, parameters not applicable to the approved discharge location can be removed with the approval of the QP.
3. If dewatering moves to a different location or a non-compliant result is detected, the sampling may need to return to the initial frequency at the QP's discretion

Table H-2. Summarized Groundwater Level Monitoring Plan

Time Period	**Monitoring Location**	**Method**	**Monitoring Frequency**	**Trigger for Mitigation**	**Mitigation Measures / Comments**
Trial Dewatering or at the Start of Construction	On-Site Monitoring Wells Upstream And Downstream of Any Discharge Directed to Local Water Bodies / Water Courses	Water Level Meter	At a minimum, once prior to dewatering	None.	Together with previous measurements establish baseline water levels.
During Construction	On-Site Monitoring Wells Upstream And Downstream of Any Discharge Directed to Local Water Bodies / Water Courses	Water Level Meter	Every two weeks	Water level drops more than 2 m below the target dewatering elevation	Reduce pumping
Post-Construction	On-Site Monitoring Wells Upstream And Downstream of Any Discharge Directed to Local Water Bodies / Water Courses	Water Level Meter	Every two weeks for four weeks, then every four weeks until 90% recovery	Water level recovery less than 90% of baseline level	Continue monitoring

Appendix I Groundwater Discharge Plan

Discharge Plan

This plan, as required under the Ontario Water Resources Act, Section 34 - 34.11 and O.Reg. 387/04 (Water Taking and Transfer) and/or O.Reg. 63/16 – Registration Under Part II.2 of the Act – Water Taking, provides a general outline of the discharge plan for the site to satisfy the PTTW and/or EASR requirements and that a detailed plan will be generated as needed by the contractor and their dewatering subcontractor that will include detailed treatment and monitoring measures.

Based on the conditions at and around the site, the target receiver for any dewatering discharge will be the surface or future sewers. Should discharge be planned for either of the sewer systems, the contractor and/or its dewatering subcontractor will need to ensure that all permissions and/or permits are obtained to allow for discharge to that sewer and that all dewatering discharge meets the appropriate chemistry and discharge flow requirements imposed for that system.

Ultimately the treatment and discharge method(s) employed during dewatering will be left up to the contractor and/or its dewatering contractor to determine.

It is noted that these dewatering estimates are considered preliminary and do not reflect analysis with information regarding the seasonal or annual high groundwater levels. The following values should be used for discussion and preliminary planning purposes only until site servicing plans and/or building basement or foundation designs are available.

Construction Dewatering Discharge Rate

The temporary dewatering discharge rates were estimated in Section 5.1.3 and the details are summarized below.

Dewatering Zone		**Description**	**Construction Dewatering Flow Rate**	
			As Calculated including FOS[1]	**Combined and including Rainfall Event[2,3]**
			L/day	
1	Site Servicing (North to South)	Linear excavation for the installation of water and sewer services across the site. 50 m long by 5 m wide	63,391 to 100,906	377,502
2	U/G Parking	Linear excavation for the installation of U/G parking in the eastern portion of the site. 86 m long by 20 m wide	121,245	
3	U/G Storage Tank	Linear excavation for the installation of U/G parking in the northern portion of the site. 15 m long by 8 m wide	Dewatering Not Anticipated	

Notes:

1. A FOS of 2.0 is included to account for seasonal fluctuations in the groundwater table, initial removal of groundwater from storage and variation in hydrogeological properties beyond those encountered during this study.
2. A 44 mm rainfall event was included in the water-taking calculation to account for the maximum projected single-day precipitation in the local area in the immediate future (2021 to 2050) under high carbon emissions (RCP8.5), according to the Climate Atlas of Canada. The Climate Atlas uses data from the Pacific Climate Impacts Consortium, which provides downscaled projections of daily temperature and precipitation from 24 climate models using two carbon emission scenarios.
3. It is noted that under specific conditions, if the water taking is 100% storm water registration on the EASR may not be required, however if water taking consists of any mixture of storm water and groundwater typical registry or permitting is likely required.

Proposed Discharge Method and Location

It is understood that the preferred discharge location would be the surface or future sewers. Dewatering discharge will be directed by hose or pipe from the dewatering system to any pre-treatment systems (such as a sediment tank and silt bag), and then by hose or pipe to the preferred discharge location.

In the event of a significant rainfall event (100-year storm event), on-site excavation will cease until the dewatering system can be re-evaluated and/or storm water flow subsides.

Erosion and Sediment Control Measures

The construction dewatering setup will include sediment and erosion control measures, and sufficient filtration to ensure removal of suspended solids prior to discharge in accordance with typical Best Management Practices and to be sufficient to meet relevant receptor requirements.

Statements

If discharge is directed to the surface or future sewers with adherence to the water quantity and quality monitoring program outlined in the Water Taking Plan in Appendix H, no adverse effect on the environment is expected.

The discharge water temperature was considered in determining the method of transfer and discharge and is not expected to have an adverse impact.

Summary of Qualifications

Tanvi Patel G.I.T.

Ms. Tanvi Patel is a hydrogeologist-in-training with three years of experience specializing in geoenvironmental and hydrogeological investigations. She has been trained to complete local scale ground water assessments, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, in-situ BH permeability testing, determination of ground water flow characteristics, surface water sampling, and preparation of hydrogeological reports, PTTW and EASR applications and renewals and compliance monitoring programs in accordance with the applicable MECP requirements.

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Ms. Pickett is an experienced project manager with over 20 years' experience in both the public and private sectors. Ms. Pickett holds a Master of Education degree from Yorkville University, an undergraduate degree in Geoscience from McMaster University and a diploma in Environmental Engineering Technology from Confederation College. Ms. Pickett has been involved in numerous environmental projects and hydrogeological assessments. Ms. Pickett brings a strong balance of theoretical knowledge combined with practical on-site experience. Along with her technical abilities, Ms. Pickett is well versed in project management, proposal preparation and client liaison. In addition, due to various roles within a municipal setting, Ms. Pickett has significant experience with public consultation, public meetings, and liaising with stakeholders on a number of environmental and hydrogeological projects.

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His hydrogeological experience includes long-term/short-term groundwater and surface water monitoring, local scale groundwater assessments, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, and determination of groundwater flow characteristics.

Date of Plan Preparation: This plan was prepared on the date March 4, 2025

Appendix J Preliminary Water Balance Calculations

Hydrogeological Investigation
60 Dean Avenue, Barrie, Ontario
Project Number: 2408904
March 2025

Pre-to-Post Development Water Balance

MONTHLY AND YEARLY WATER BALANCE COMPONENTS (POST-DEVELOPMENT CONDITION)														
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Potential Evapotranspiration Calculation	Average Temperature: T (^{o}C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	6.9
	Heat Index: i=(T/5)$^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	36.8
	Unadjusted Daily Potential Evapotranspiration: U (mm)	0.0	0.0	0.0	25.2	59.0	88.5	104.1	98.1	74.7	40.6	11.5	0.0	501.7
	Adjusting Factor for U (Latitude 44 degrees N)	0.81	0.81	1.02	1.13	1.27	1.28	1.30	1.20	1.04	0.94	0.80	0.76	-
	Adjusted Potential Evapotranspiration - PET (mm)	0.0	0.0	0.0	28.5	74.9	113.3	135.3	117.8	77.7	38.1	9.2	0.0	594.8
Pervious Components	Precipitation: P (mm)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	914
	Adjusted Potential Evapotranspiration: PET (mm)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	571
	P - PET	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	343
	Change in Soil Moisture Storage (mm)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
	Water Holding Capacity (max. 75 mm)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
	Water Surplus Available for Infiltration or Runoff	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	343
Impervious Components	Precipitation: P (mm)	-												914.0
	Potential Evaporation: PE (mm), Assume 15%	-												137.1
	Potential Surface Water Runoff: P - PE (mm)	-												776.9

Notes

1. Both potential infiltration and surface water runoff are independent of temperature
2. Assumption is in January maximum soil moisture storage value is present (75 mm)
3. Water Holding Capacity & Infiltration Factors taken from Table 3.1 of MOE SWMPDM, 2003
4. Average Temp. and Precip. taken from Environment Canada station Barrie WPCC (6110557) and Lake Simcoe Climate Data (LSRCA, 2017)
5. Adjusting Factor for U based on Lorente, 1961

Hydrogeological Investigation
60 Dean Avenue, Barrie, Ontario
Project Number: 2408904
March 2025

Pre-to-Post Development Water Balance

PRE- AND POST-DEVELOPMENT WATER BALANCE (WITHOUT MITIGATION)									
		Total Land Area (m^2)	Impervious Factor	Pervious Area (m^2)	Impervious Area (m^2)	Infiltration Factor	Runoff Factor	Infiltration (m^3/year)	Runoff (m^3/year)
Existing Land Use (Pre-Development)	Vacant Land	6670	0%	6670	0	0.45	0.55	1030	1258
	TOTAL	**6,670**	**0%**	**6,670**	**0**	**0.45**	**0.55**	**1,030**	**1,258**
Proposed Land Use (Post-Development No Mitigation)	Proposed 6 storey	1710	100%	0	1710	0.45	0.55	0	1328
	landscaped	2794	0%	2794	0	0.45	0.55	431	527
	Parking + ROW	2166	100%	0	2166	0.45	0.55	0	1683
	TOTAL	**6,670**	**58%**	**2,794**	**3,876**	**0.45**	**0.55**	**431**	**3,538**

	SUMMARY			
	Infiltration		**Runoff**	
	m^3/year	%	m^3/year	%
Pre-to-Post Change Without Mitigation	-598	-58	+ 2280	+ 181
Required to Meet Pre-Development Conditions	+ 598	-	-2,280	-

Notes

1. Both potential infiltration and surface water runoff are independent of temperature
2. Assumption is in January maximum soil moisture storage value is present (75 mm)
3. Water Holding Capacity & Infiltration Factors taken from Table 3.1 of MOE SWMPDM, 2003
4. Average Temp. and Precip. taken from Environment Canada station Barrie WPCC (6110557) and Lake Simcoe Climate Data (LSRCA, 2017)
5. Adjusting Factor for U based on Lorente, 1961