GEMTEC
www.gemtec.ca

Hydrogeological Investigation Report
Commercial Storage and Truck and Trailer Parking
13291 Airport Road
Caledon, Ontario

GEMTEC Project: 103140.008

GEMTEC
www.gemtec.ca

Submitted to:

Giampaolo Developments Limited
1 Kenview Blvd., Suite 301
Brampton, Ontario
L6T 5E6

Hydrogeological Investigation Report
Commercial Storage and Truck and Trailer Parking
13291 Airport Road
Caledon, Ontario

April 3, 2025
GEMTEC Project: 103140.008

GEMTEC Consulting Engineers and Scientists Limited
6695 Millcreek Drive, Unit 7,
Mississauga, ON, Canada
L5N 5M4

April 3, 2025

File: 103140.008 – Rev0

Giampaolo Developments Limited
1 Kenview Blvd., Suite 301
Brampton, Ontario
L6T 5E6

Attention: Todd Kerr, President

Re: Hydrogeological Investigation Report
Commercial Storage and Truck and Trailer Parking
13291 Airport Road, Caledon, Ontario

Please find enclosed the Hydrogeological Investigation Report for the Proposed Commercial Storage and Truck and Trailer Parking development to be located at 13291 Airport Road in Caledon Ontario. The report presented herein is based on the scope of work summarized in our Proposal dated October 1, 2024. This report was prepared by Hakyung Choi, M.Sc., and reviewed by Kimberly Gilder, P.Geo.

Hakyung Choi

Hakyung Choi, M.Sc.
Geoscientist-in-Training

Kim Gilder

Kimberly Gilder, P.Geo.
Senior Hydrogeologist

CC/KG/SJ/sv

N:\Projects\103100\103140.008\03_Submittals\Reports\HydroG\103140.008_RPT_HG Investigation_13291 Airport Road_2025'04'03_Rev0.docx

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) has been retained by Giampaolo Developments Limited (Client), to carry out geotechnical, hydrogeological, and environmental investigation for the Commercial Storage and Truck and Trailer Parking Lot proposed to be constructed on a portion of the property located at 13291 Airport Road in Caledon, Ontario, herein referred to as the site.

The purpose of the hydrogeological investigation is to characterize the general subsurface soils and groundwater conditions at the site by means of a limited number of boreholes and monitoring wells and based on the information obtained, to determine local groundwater flow direction and conduct a water balance study.

This report is subject to the Conditions and Limitations of This Report, which are provided in Appendix A, and which are considered an integral part of the report.

2.0 PROJECT DESCRIPTION AND SETTING

2.1 Project Location and Description

The site is located east of Airport Road and north of Healey Road in Caledon, Ontario and consists of a rectangular shaped parcel of land approximately 19.4 hectare (ha) (47.98 acres) in size. The land use at the site is agricultural with a residential house, farm shed, and driveway leading to Airport Road (Figure B.1, *Site Plan*, Appendix B).

Based on the temporary use site plan provided by the client (Figure B.2, *Temporary Use Site Plan*, Appendix B; Appendix C), it is understood that the proposed development will consist of a gravel-paved transport truck and trailer parking lot with no concrete curbs or asphalt pavement. Further, we understand that the storm water run-off will be directed to the edges of the new construction and that no storm water management system (i.e. storm water collection or storm water management pond) is proposed.

2.2 Topography and Drainage

Based on the available topographic mapping, the site gently slopes towards the south with the ground surface Elevation (El.) ranging from approximately 260 m amsl to 255 m amsl (Ministry of Natural Resources, 2024). Topography is presented on Figure B.3, *Topography and Natural Heritage*, Appendix B. The proposed truck/trailer parking area is gently undulating with very little topographic relief.

Note that most of the site falls within the jurisdictional boundaries of the Toronto and Region Conservation Authority.

There is an onsite surface water feature, the TRCA-regulated tributary and branches of the Salt Creek, which covers approximately one-third of the site along the west and south. The tributary flows roughly north/northwest to south across the site and crosses the driveway. This tributary ultimately discharges to West Humber River approximately 6 km to the southeast.

As shown in Figure B.3, there are two unevaluated wetlands in the southern portion of the site. Within 500 m of the site, there are two unevaluated wetlands located adjacent north and south of the site.

2.3 Surficial Geology and Physiography

The site is located within the physiographic region known as the South Slope which is characterized by clay till plains (Chapman and Putnam, 1984).

Published surficial geology mapping (Ontario Geological Survey, 2010) indicates that the site is underlain by glaciolacustrine derived silty clay to clayey till (Figure B.4, *Surficial Geology*, Appendix B). Isolated modern alluvial deposits of clay, silt, sand, and gravel are mapped to the south of the site and include a portion of the southern part of the site.

Paleozoic bedrock geology mapping (Armstrong and Dodge, 2007) indicates that the bedrock underlying the overburden consists of Queenston Formation shale. Bedrock was not encountered within the boreholes advanced at the site as part of this investigation; however, based on the review of the Oak Ridges Moraine Groundwater Program (ORMGP, 2024), the depth to bedrock ranges from approximately 20 m to 24 m below ground surface.

2.4 MECP Water Well Records

A review of the Ministry of the Environment, Conservation, and Parks (MECP) water well records (WWR) (MECP, 2024) indicates that there are 22 WWR located within approximately 500 m of the site limits (Figure B.5, *MECP Well Records within 500 metres*, Appendix B), including 8 domestic wells, and 14 wells no longer in use or the use is not indicated. A summary of the information provided on the records is presented in Table 2.1 below and in Table D.1, “MECP Online Well Database Summary (500-m Radius)” in Appendix D.

Table 2.1 - Well Records Review Summary

Well Use	Depth (m)			Overburden Source	Bedrock Source	Unknown
	min	max	avg			
Domestic	12.8	29.26	18.5	6	2	-
Not Used/No information available	22.86	39.30	30.0	-	2	12
Totals	**-**	**-**	**-**	**6**	**4**	**12**

Notes:

- min = minimum
- max = maximum
- avg = geometric mean
- m = meter

According to the WWR, the depth to bedrock within 500 m of the site (where recorded) ranged between about 19.8 m and 25.9 m below ground surface (bgs). The overburden is recorded to consist primarily of loam, underlain by clayey to sandy till which is consistent with the published geological mapping. Bedrock consisting of red and blue shale were reported in the WWR.

Recorded groundwater levels ranged from 0.6 m to 6.1 m bgs, with a geometric mean of 2.6 m bgs (n=10). Typically, shallow dug and bored wells are the most susceptible to water level fluctuations and surficial sources of contamination. Records for six dug/bored wells were identified within 500 m of the site.

2.5 Source Water Protection

The MECP Source Protection Information Atlas (MECP, 2023) was reviewed to assess the presence of source water protection areas including: Wellhead Protection Areas (WHPA) associated with municipal groundwater supplies, Intake Protection Zones (IPZ) associated with municipal surface water supplies, Significant Groundwater Recharge Areas (SGRA), and Highly Vulnerable Aquifers (HVA).

The nearest WHPA is located about 4.0 km northwest of the site in Caledon, Ontario. The nearest IPZ-2 is located about 30 km southeast of the site for surface water intakes in Lake Ontario. The nearest HVA is about 550 m southeast of the site and there is a SGRA adjacent north of the site.

3.0 CURRENT SITE INVESTIGATION METHODOLOGY

3.1 Current Investigation(s)

3.1.1 Geotechnical Investigation

GEMTEC carried out a concurrent geotechnical field investigation along with the hydrogeological investigation between November 5 and 6, 2024. During that time, six boreholes (numbered Boreholes BH24-1 to BH23-6, inclusive) were advanced at the approximate locations shown on

Figure B.1, Appendix B. The boreholes were advanced to approximate depths of about 6 m below ground surface (bgs). The results of the geotechnical investigation is provided under separate cover in the report entitled:

- *Geotechnical Investigation, Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario - DRAFT*, dated December 13, 2024, 103140.008 – (GEMTEC, 2024).

The reader is referred to this report for additional details of the investigation methods and findings. Descriptions of the subsurface conditions observed in the boreholes are provided on the Record of Borehole Sheets in Appendix E.

The borehole locations were selected by GEMTEC and positioned on the site relative to existing features. The borehole coordinates were approximated using a cellular global position system (GPS) and the ground surface elevations were approximated using the available topographic information on Google Earth.

3.1.1.1 Site Instrumentation

Five of the six boreholes advanced as part of the drilling program were completed with monitoring wells (BH24-1, BH24-3, BH24-4, BH24-5 and BH24-6). Monitoring well construction details for each location are presented in Table F.1, Appendix F. The monitoring wells were constructed using nominal 50 mm diameter, Schedule 40 polyvinyl chloride (PVC) pipe with a No. 10 machine slotted screen (0.01-inch slot). The annular space between the monitoring well screen and surrounding soils was backfilled with a silica sand filter to a maximum of 0.6 m above the top of the screen, and the remainder of the annular space was sealed with bentonite. All monitoring wells were completed with aboveground lockable protective steel casings.

Following installation, the monitoring wells were developed. The monitoring wells were purged using dedicated 16 mm inside diameter low density polyethylene (LDPE) tubing and a D-25 Waterra™ foot valve. The monitoring wells were developed by removing three casing volumes or until purged dry, whichever came first.

3.1.1.2 Hydraulic Response Testing

In-situ hydraulic response testing was carried out in three monitoring wells (i.e. Boreholes BH24-1, BH24-3 and BH24-5) to estimate the bulk horizontal hydraulic conductivity (K_b) of the overburden materials adjacent to the screened intervals. The testing consisted of creating a near-instantaneous change through rapid purging of the well by removing a known volume of water, followed by the recording of water level recovery (i.e., rising head test). The data was analyzed with the Aqtesolv® version 4.50 software using the Bouwer and Rice (1976) solution for the unconfined aquifer scenario. A summary of current and previous hydraulic testing of Site monitoring wells is provided in Table F.3, Appendix F. A summary of the test data, analysis interval, input parameters and estimated bulk hydraulic conductivity for each test is provided in Appendix G.

3.1.1.3 Infiltration Testing

Infiltration rate testing was carried out at two locations (GP24-1 to GP24-2) in hand-augered holes using the Guelph Permeameter apparatus on November 18, 2024 (Figure 1, Appendix B). The Soilmoisture Equipment Corp. Model 2800K1 Guelph Permeameter was operated in general accordance with the manufacturer's instructions for the single head method. The test results were used to estimate field saturated hydraulic conductivity (K_{fs}) using the method of Elrick and Reynolds (1992).

The testing depths ranged from approximately 0.4 m to 0.5 m bgs. A soil sample was collected at each testing location. Following completion of the infiltration rate testing, the soil samples were examined by a geotechnical engineer. A sheet summarizing the results for each test is provided in Appendix H.

4.0 HYDROGEOLOGICAL ASSESSMENT

4.1 Subsurface Conditions

As previously indicated, the soil and groundwater conditions identified in the boreholes as part of the current study are presented on the Record of Borehole sheets in Appendix E. The Record of Borehole sheets indicate the subsurface conditions at the specific borehole locations only. Boundaries between zones on the Record of Borehole sheets are often not distinct, but rather are transitional and have been interpreted from discontinuous drilling observations. The precision with which subsurface conditions are indicated depends on the method of drilling, the frequency and recovery of samples, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions at locations other than the boreholes may vary from the conditions encountered in the boreholes, both laterally and with depth.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil and rock involves judgement and GEMTEC does not guarantee descriptions as exact but infers accuracy to the extent that is common in current geotechnical/hydrogeological practice.

Generally, the subsurface conditions encountered over the site consist of the following:

- Surficial topsoil ranging in thickness from about 0.15 m to 0.25 m was encountered at the ground surface in all boreholes. The surficial topsoil was underlain by;
- A till deposit generally comprised of silty clay, trace sand to sandy, and trace gravel was encountered between approximate depths of 0.15 m and 0.25 m bgs and extended to the termination depths at all of the borehole locations. Layers of silty sand and gravelly sand

between 0.1 m and 0.7 m thick were encountered within the glacial till deposit at all the borehole locations except for BH24-3 and BH24-6.

4.2 Water Level Monitoring

Groundwater levels were manually measured in the monitoring wells on November 27, December 2 and December 10, 2024. The groundwater depth and elevation data are provided in Table F.2, Appendix F. The groundwater levels were measured relative to the top of the PVC standpipe at each monitoring well location. The borehole elevations were approximated using the available topographic information on Google Earth. The groundwater conditions described in this report refer only to those measured at the place and time of observation. Seasonal and annual fluctuations should be anticipated.

On November 27 and December 2, the depth to groundwater in monitoring wells ranged from about 1.48 m bgs (Borehole BH24-3) to 3.72 m bgs (Borehole BH24-4) and from El. 252.28 m amsl (Borehole BH24-4) to 255.48 m amsl (Borehole BH24-6). It should be noted that these readings may reflect that the monitoring wells had not yet been developed.

On December 10, the depth to groundwater in monitoring wells across the site ranged from about 1.49 m bgs (Borehole BH24-3) to 3.38 m bgs (Borehole BH24-4), and from El. 252.51 m amsl (Borehole BH24-3) to El. 255.39 m amsl (Borehole BH24-6). The groundwater elevation data and inferred groundwater elevation contours on December 10, 2024, are presented on Figure B.6, Groundwater Flow Contours (December 10, 2024), Appendix B. The figure shows that the shallow groundwater in the silty clay till flows southwest towards the tributaries of the Salt Creek.

4.3 Hydraulic Response Test Results

The results of the hydraulic response testing carried out in the monitoring wells are presented in Appendix G. The hydraulic conductivity values estimated from the rising head tests are presented in Table F.3, Appendix F. The following provides a summary of the test results:

Table 4.1 - Summary Hydraulic Conductivity Estimates

Monitoring Well ID	Predominant Soil Unit	Hydraulic Conductivity [m/s]
BH/MW24-1	Silty Clay Till	3×10^{-7}
BH/MW24-3	Sandy Silty Clay Till	1×10^{-8}
BH/MW24-5	Silty Clay Till	9×10^{-9}

Notes:

1. K_b = bulk hydraulic conductivity; m/s = metres per second
2. Filter pack effects noted in BH24-1 and BH24-5, late-time data estimated for K_h considered to be representative of native soils.

The estimated hydraulic conductivities of the silty clay range from approximately 9 x 10^{-9} m/s to 3 x 10^{-7} m/s, with a geometric mean of 3 x 10^{-8} m/s (n=3). These hydraulic conductivity values are within the expected literature range for clay of 10^{-11} m/s to 10^{-8} m/s (Fetter, 1994), with the exception of BH24-01. The higher hydraulic conductivity value at BH24-01 may be due to the presence of silty sand layer within the till that may contribute to the higher hydraulic conductivity results. Conducting single well response tests within screened intervals consisting of more than one geological unit results in a bulk hydraulic conductivity result. This can mean that the individual layers or seams may exhibit higher or lower hydraulic conductivity than those reported here.

4.4 Infiltration Test Results

The infiltration rates at the hand auger locations were estimated based on in-situ testing completed using a Guelph Permeameter. The measured field saturated hydraulic conductivities (K_{fs}) and corresponding infiltration rates are 4.6 x 10^{-8} m/s and 20 mm/hr at GP24-01 location and 3.1 x 10^{-8} m/s and 16 mm/hr at GP24-02 location, respectively (Appendix H).

Table 4.2 - Guelph Permeameter – Estimated Infiltration Rates

Location	Soil Description	Hand Auger Hole Depth (m bgs)	Saturated Hydraulic Conductivity Field Estimate (m/s)	Field Measured Infiltration[1] (mm/hr)
GP24-01	(CL) Silty Clay	0.40	4.6 x 10^{-8}	20
GP24-02	(CL) Silty Clay	0.50	3.1 x 10^{-8}	16

Notes:
1. Infiltration based on the approximate relationship between infiltration rate and hydraulic conductivity (TRCA, 2012).

For the purpose of designing future subsurface best management practices (BMP), Credit River Conservation Stormwater Management Criteria (CVC, 2022) recommends that infiltration rates be divided by a safety factor in order to compensate for potential reductions in soil permeability due to compaction or smearing during construction. Where similar soil conditions are continuous within 1.5 m of the bottom of the proposed BMP, a safety factor of 2.5 is recommended (CVC, 2022).

It should be noted that LID feature details or locations were not provided to GEMTEC as part of this investigation. As such, once locations and details for the features have been established, additional infiltration testing may be required to confirm the capabilities of the soils at the locations and depths of planned feature installations.

5.0 HYDROLOGIC WATER BALANCE

Water balance assessment for the site was carried out to assess potential changes of on-site groundwater recharge under the post-development conditions without Low Impact Development

(LID) features to enhance recharge. It is GEMTEC's understanding that the mitigation of reductions to infiltration will be addressed as part of detail design in the functional servicing report. The Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a post-development infiltration target of 80% of the pre-development infiltration rates to maintain groundwater recharge. Post-development infiltration can be mitigated using Low Impact Development (LID) techniques, such as buried infiltration chambers, rain gardens, infiltration swales, etc.

5.1 Land Use

5.1.1 Pre-Development Conditions

Land use at the site currently consists of cropped agricultural fields, a farm shed and a residential house. There is a paved driveway from the house leading to Airport Road and a gravel driveway leading to the shed. Moreover, there are two unevaluated wetlands located in the southern portion of the site. The pre-development land use is shown on the satellite imagery of Figure B.1, of Appendix B.

5.1.2 Post-Development Conditions

Post-development land use at the site will be gravel-paved transport truck and trailer parking lot with no concrete curbs or asphalt pavement and include lawns or landscaped areas (see "Temporary Use Site Plan" by Humphries Planning Group Inc. provided by the client in Appendix C). The unevaluated wetlands in vicinity of the watercourse will remain post-development. The grading plan post-development was unavailable at the time of preparation of the report. For the purpose of this water balance, it was assumed that the grade will remain the same as pre-development conditions.

5.2 Methods

A water balance is an accounting of the distribution of components of the hydrologic cycle and can be simplified in the following equation:

$$P = ET + S + R + I$$

where: P = precipitation;

ET = evapotranspiration;

S = change in soil water storage;

R = runoff; and

I = infiltration (groundwater recharge).

Precipitation is the amount of water that falls on land as either rain or snow.

Evapotranspiration refers to water lost to the atmosphere through a combination of evaporation and transpiration by vegetation. Potential evapotranspiration refers to the loss of water to the atmosphere under conditions with an unlimited water supply. Potential evapotranspiration is calculated based on temperature, heat index, and an adjusting factor for latitude. Actual evapotranspiration is typical less than the potential evapotranspiration, and is calculated using the inputted precipitation, calculated potential evapotranspiration, and change in soil water storage.

Water remains in soil after actual evapotranspiration has been removed from the sum precipitation. Change in soil water storage occurs on a seasonal basis (e.g. typically dry conditions in the summer months and wet conditions in the spring and winter); changes on an annual are assumed to be negligible. The maximum soil storage capacity for different combinations of soils and land use is quantified using water holding capacities (WHC).

A water surplus occurs when precipitation exceeds evapotranspiration and available soil water storage. A water surplus represents the amount of water available for either runoff or infiltration. The proportion of the water surplus that infiltrates was calculated using the method presented in the Ontario Ministry of the Environment (MOE) now MECP, *Stormwater Management Planning and Design Manual* (MOE, 2003). There are three infiltration sub-factors that are used to determine the proportion of the water surplus that infiltrates:

- Soil: soils are grouped into five hydrologic soil types;
- Cover: either cultivated land or woodland; and
- Topography: average the slope.

The sum of these three sub-factors is used to estimate the infiltration factor, which is applied to estimate the proportion of water surplus that may infiltrate in an area with sufficient downward gradient. Runoff is calculated as the difference between the water surplus and infiltration.

No infiltration is assumed to occur under impervious areas, and the water surplus is assumed to be equal to 90% of precipitation.

The water balance assessment was calculated on an annual basis, and components of the hydrologic cycle are quantified as depths in millimetres (mm). These depth values are then converted to volumetric estimates, reported in cubic metres per (m^3), for areas with different land uses across the Site. The change in infiltration under pre- and post-development conditions across the whole Site are compared; the objective of the mitigated post-development condition is to maintain the pre-development infiltration rates.

5.2.1 Meteorological Data

The water balance assessment was completed using historical meteorological records (1980 to 2012) obtained from Environment and Climate Change Canada’s (ECCC) datasets for the Georgetown WWTP Meteorological Station (ID 6152695) for soil with different WHC. Georgetown WWTP Meteorological Station is the closest station to the site with expected similar meteorologic conditions where a substantial historical record exists (1980 to 2012). Data regarding precipitation, potential and actual evapotranspiration, and water surplus for the soil with a WHC represented at the site were obtained from ECCC are presented in Tables I.1 of Appendix I.

The average annual precipitation between 1980 and 2012 at the Georgetown WWTP station was 861 mm/yr and the average annual potential evapotranspiration was 609 mm/yr.

5.3 Water Balance Parameters

In addition to meteorological data, the water balance assessment was carried out using information regarding the soil types at the site as identified through subsurface investigations, the current and proposed land uses, and the topography. Based on the observations of the subsurface investigation, the existing surficial soil was observed to be relatively consistent across the site. Soils were observed to be predominantly silty clay, are classified as clay loam for the water balance study. For this assessment, it assumed that surficial soil after grading will be of a similar hydrologic soil grouping to the pre-development condition soil.

Crop residue observed at the surface during site visits indicate that recent crops consist of corn (moderately rooted crops). Post-development, land use cover will include gravel-paved parking areas, lawns or other landscaping, wetland, and asphalt-paved driveway.

Water holding capacities for each soil group and land use combinations were selected from *Table 3.1: Hydrologic Cycle Component Values* in MOE (2003). The soil, land cover and topographic sub-factors applied pre- and post-are summarized in Table 5.1. No infiltration is assumed to occur under impervious areas.

Table 5.1 - Summary of Applied Water Holding Capacities and Infiltration Factors for Soil and Land Cover Combinations

Land Use: Soil Group	WHC (mm)	Infiltration Sub-Factors			
		Soil	Land Cover	Topography Factor	Infiltration Factor
Cultivated: Clay Loam	200	0.2	0.1	0.2	0.5
Lawns or Landscaping: Clay Loam	100	0.2	0.1	0.2	0.5
Impervious	-	-	-	-	-

5.4 Results

The pre-development and post-development water balance results and inputs including the areal estimates of each land use, the WHC applied to the soil group, and infiltrations factors and sub-factors for each land cover combination applied are summarized in Table I.3 to I.4 of Appendix I.

5.4.1 Pre-Development

The average annual pre-development water balance assessment for the commercial site is summarized in Table 5.2

Table 5.2 - Average Annual Pre-Development Water Balance Results

Hydrologic Cycle Components (m^3/year)			
Precipitation (P)	**Evapotranspiration (ET)**	**Infiltration (I)**	**Runoff (R)**
165,616	103,364	27,784	33,190

5.4.2 Post-Development

The average annual post-development water balance assessment for the site is summarized in Table 5.3.

Table 5.3 - Average Annual Post-Development Water Balance Results

Hydrologic Cycle Components (m^3/year)			
Precipitation (P)	**Evapotranspiration (ET)**	**Infiltration (I)**	**Runoff (R)**
165,616	51,156	12,174	102,286

As presented in the water balance assessment summaries (Table 5.2 and Table 5.3.), the proposed development water balance without mitigation is estimated to result in an increase in runoff of 208 % (from 33,190 m^3/year to 102,286 m^3/year) on annual basis and a decrease in infiltration across the entire site of 56 % (from 27,784 m^3/year to 12,174 m^3/year) on annual basis.

It is GEMTEC’s understanding that the mitigation of reductions to infiltration will be addressed as part of detail design. Note that a separation distance of 1 m is required between the bottom of an infiltration BMP and seasonally high groundwater levels, and between the bottom of an infiltration BMP and the top of the bedrock (CVC, 2022).

5.5 LID Design Considerations

In order to facilitate appropriate design of the LID features for the site (not available for review by GEMTEC at this time), in addition to estimating the volume of infiltration to be captured, the feature locations and invert depths should be considered to ensure appropriate separation distances from seasonally high groundwater levels, low permeability soils and/or bedrock. It should be noted that high groundwater conditions were encountered on-site.

To balance the post-development infiltration with the pre-development water balance infiltration values, on-site retention/infiltration measures will be required to mitigate an estimated annual deficit of 15,610 m^3/yr of infiltration. This calculation is based on the difference between post-development and pre-development infiltration scenarios.

Additional testing at detailed design is recommended once the location and depth of any LID facility is known to confirm recommendations and calculations presented here. Long-term monitoring of groundwater levels for a minimum of one year at the site are also recommended to establish the seasonal high groundwater level. This parameter could have an impact on the design and placement of LID features at the site.

6.0 SUMMARY

GEMTEC has carried out a hydrogeological investigation for a proposed commercial development located at 13291 Airport Road, Caledon, Ontario. The site is located east of Airport Road and north of Healey Road in Caledon, Ontario and consists of a rectangular shaped parcel of land approximately 19.4 hectare (ha) (47.98 acres) in size. A gravel-paved transport truck and trailer parking area with storm water run-off directed to the edges of the new construction. Surficial geology mapping indicates that surficial geology at the site consists of glaciolacustrine derived silty clay to clayey till. Isolated deposits modern alluvial deposits of clay, silt, sand, and gravel are mapped to the south of the site and include a portion of the southern part of the site. Bedrock consists of Queenston shale and is expected at depth between 20 m to 24 m bgs at the site.

Six boreholes were advanced at the site as part of the field investigation, five of which were instrumented with shallow monitoring wells. On December 10, 2024, the most recent groundwater measurement, the depth to groundwater in monitoring wells across the site ranged from 1.49 m bgs to 3.38 m bgs, and from El. 252.51 m amsl to El. 255.39 m amsl. The shallow groundwater generally follow topography and drains to the southwest to a drainage feature that discharges to tributaries of Salt Creek.

In-situ hydraulic response testing was conducted at three monitoring wells, the geometric mean of hydraulic conductivity of these three tests completed as part of a previous investigation was 3×10^{-8} m/s, which is consistent with literature values for clay.

A water balance assessment was carried out for the site. Post-development, it is estimated that infiltration will decrease by 56 % and runoff will increase by 208 % over the entire site. According to the Guidance: Water Balance Assessment (CTC Source Protection Region, 2018), the maintenance of pre-development infiltration is general requirement of source protection plans. It is GEMTEC understanding that the mitigation of reductions to infiltration will be addressed as part of detail design. Note that a separation distance of 1 m is required between the bottom of an infiltration BMP and seasonally high groundwater levels, and between the bottom of an infiltration BMP and the top of the bedrock (CVC, 2022).

7.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Regards,

GEMTEC Consulting Engineers and Scientists Limited

Hakyung Choi

Hakyung Choi, M.Sc.
Geoscientist-in-Training

PROFESSIONAL GEOSCIENTISTS ONTARIO
KIMBERLY GILDER (K.G.)
PRACTISING MEMBER
2417
Apr. 3, 2025

Kim Gilder

Kimberly Gilder, P.Geo.
Senior Hydrogeologist

8.0 REFERENCES

Armstrong, D.K. and Dodge, J.E.P., 2007. Paleozoic Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219.

Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Chapman, L.J. and Putnam D.F., 1984. The Physiography of Southern Ontario, 3rd Edition. Ontario Geological Survey, Special Volume 2.

Conservation Ontario. 2013. Hydrogeological Assessment Submissions – Conservation Ontario Guidelines to Support Development Applications. June.

Credit River Conservation Authority (CVC). 2022. Storm Water Management Guideline. (July)

CTC Source Protection Region. 2018. Guidance : Water Balance Assessment. Version 1.0. (April 19)

Fetter, C.W., 1994. Applied Hydrogeology, Third Edition. Prentice-Hall, New Jersey.

GEMTEC Consulting Engineers and Scientist Ltd (GEMTEC). 2024. Geotechnical Investigation, Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario - DRAFT. Prepared for Giampaolo Developments Limited. (December 13, 2024).

Ministry of the Environment. 2003. Stormwater Management Planning and Design Manual. Retrieved May 2024, from https://dr6j45jk9xcmk.cloudfront.net/documents/1757/195-stormwater-planning-and-design-en.pdf

Ministry of the Environment, Conservation and Parks (MECP). 2024. Well records [data files]. Retrieved January 2024, from https://data.ontario.ca/dataset/well-records

Ministry of the Environment, Conservation and Parks (MECP). 2023. Source Protection Information Atlas. Retrieved on June 12, 2023 from www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/Index.html?site=SourceWaterProtection&viewer=SWPViewer&locale=en-US

Ministry of Natural Resources. 2024. Make A Topographic Map. Retrieved on December 13, 2024 from https://www.lioapplications.lrc.gov.on.ca/MakeATopographicMap/index.html?viewer=Make_A_Topographic_Map.MATM&locale=en-CA

Oakridges Moraine Groundwater Program. 2024. Public Mapping. Retrieved May 20, 2024, from https://maps.oakridgeswater.ca/Html5Viewer/index.html?viewer=ORMGPP

Ontario Geological Survey (OGS). 2010. Surficial geology of Southern Ontario [data file]. Ontario Geological Survey, Miscellaneous Release-Data 128-Revised. Retrieved June 2023, from http://www.geologyontario.mndm.gov.on.ca/mndmaccess/mndm_dir.asp?type=pub&id=MRD128-REV

APPENDIX A

Report Conditions and Limitations

CONDITIONS AND LIMITATIONS OF THIS REPORT

1. **Standard of Care:** GEMTEC has prepared this report in a manner consistent with generally accepted engineering or environmental consulting practice in the jurisdiction in which the services are provided at the time of the report. No other warranty, expressed or implied is made.
2. **Copyright:** The contents of this report are subject to copyright owned by GEMTEC, save to the extent that copyright has been legally assigned by us to another party or is used by GEMTEC under license. To the extent that GEMTEC owns the copyright in this report, it may not be copied without our prior written agreement for any purpose other than the purpose indicated in this report. The methodology (if any) contained in this report is provided to the Client in confidence and must not be disclosed or copied to third parties without the prior written agreement of GEMTEC. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests.
3. **Complete Report:** This report is of a summary nature and is not intended to stand alone without reference to the instructions given to GEMTEC by the Client, communications between GEMTEC and the Client and to any other reports prepared by GEMTEC for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. GEMTEC cannot be responsible for use of portions of the report without reference to the entire report.
4. **Basis of Report:** This Report has been prepared for the specific site, development, design objectives and purposes that were described to GEMTEC by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this report expressly addresses the proposed development, design objectives and purposes. Any change of site conditions, purpose or development plans may alter the validity of the report and GEMTEC cannot be responsible for use of this report, or portions thereof, unless GEMTEC is requested to review any changes and, if necessary, revise the report.
5. **Time Dependence:** If the proposed project is not undertaken by the Client within 18 months following the issuance of this report, or within the timeframe understood by GEMTEC to be contemplated by the Client, the guidance and recommendations within the report should not be considered valid unless reviewed and amended or validated by GEMTEC in writing.
6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.
7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.
8. **Decrease in Property Value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
9. **Reliance on Provided Information:** The evaluation and conclusions contained in this report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions,

misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fill materials or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Figures

KEY PLAN

1:30,000

Legend

BH #	BOREHOLE ID
⊕	BOREHOLE LOCATION
⊕	MONITORING WELL
⊕	INFILTRATION TEST LOCATION
—	WATERCOURSE
■	WATERBODY
☐	SITE BOUNDARY
▨	TRCA REGULATED AREA (2023)

NOTES:

1. All locations approximate.
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario
5. TRCA Regulation 2023 WFL1 (Mar 26, 2024), https://gemtecsauga.maps.arcgis.com/home/item.html?id=27cdee5076254d42a80466b6a2945a6a
6. Service Layer Credits: World Imagery: Peel Region, Maxar
World Street Map Background (Community Map of Canada): Province of Ontario, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

Scale:

1:3,000

0 25 50 100 150 200 250 Meters

Drawing: SITE PLAN

Client: GIAMPAOLO DEVELOPMENTS

Project: HYDROGEOLOGICAL INVESTIGATION
13291 AIRPORT ROAD,
CALEDON, ONTARIO

Drwn By:	S.J.	Chkd By:	K.G.
Project No.	103140.008	Revision No.	0
Date	DECEMBER 2024		**FIGURE B.1**

GEMTEC
Consulting Engineers and Scientists

6695 Millcreek DR #7,
Mississauga, ON L5N 5M4
T: (416) 347-7427
www.gemtec.ca

Folder: N:\Projects\103100\103140.008\06_Civil Drafting\Design\WaterBalance\103140_008_WaterBalance_AirPortRd_R0_2024_12_10\

Legend

BH # BOREHOLE ID

⊕ BOREHOLE LOCATION

⊕ MONITORING WELL

⊕ INFILTRATION TEST LOCATION

— WATERCOURSE

■ WATERBODY

□ SITE BOUNDARY

NOTES:

1. All locations approximate.
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario
5. Proposed Site Plan Provided by Humphries Planning Group Inc., (October 29, 2024).
6. Service Layer Credits: World Imagery: Peel Region, Maxar

Scale:
1:3,000

0 25 50 100 150 200 250 Meters

Drawing
PROPOSED SITE PLAN

Client:
GIAMPAOLO DEVELOPMENTS

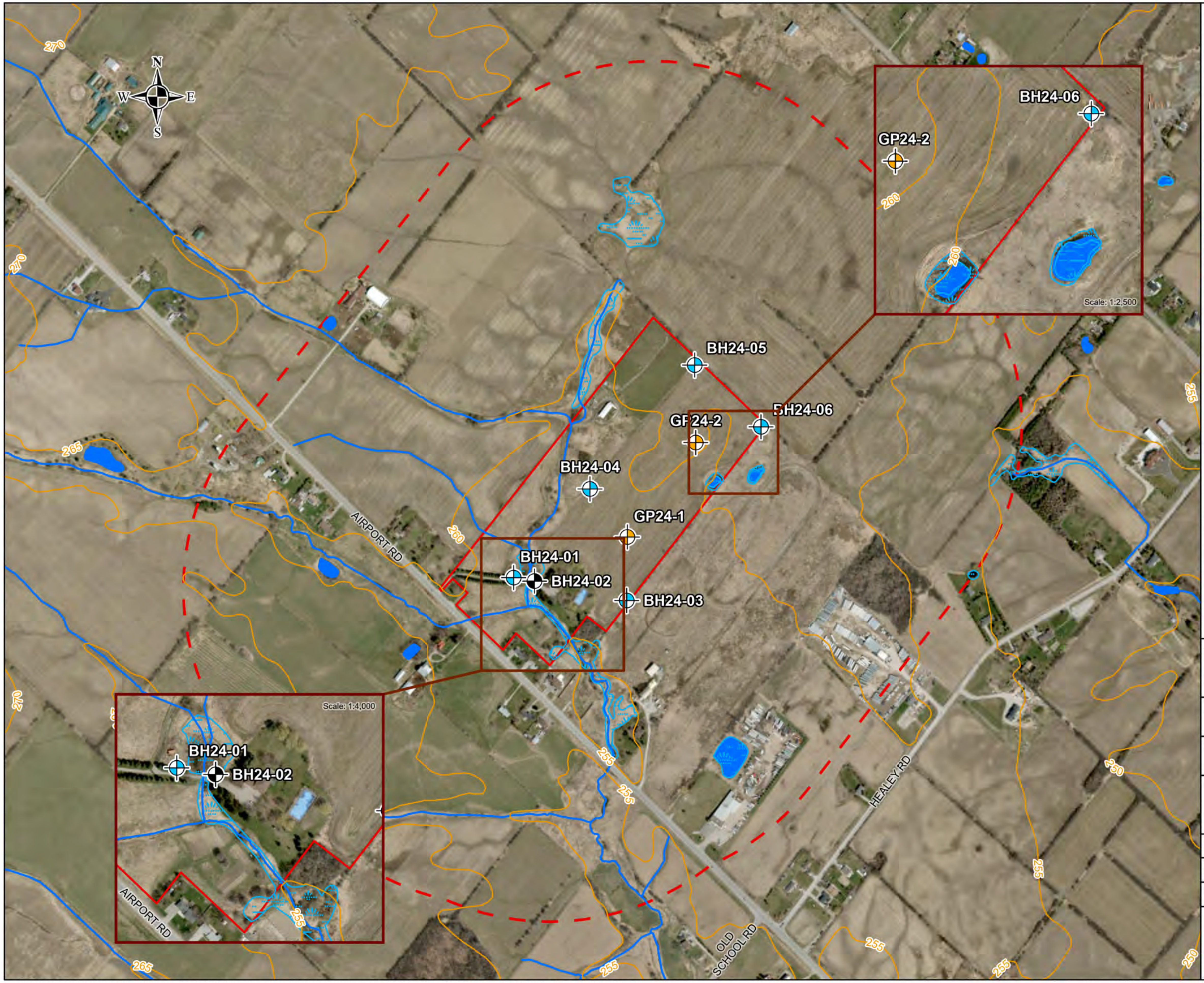
Project
HYDROGEOLOGICAL INVESTIGATION
13291 AIRPORT ROAD,
CALEDON, ONTARIO

Drwn By: S.J.
Chkd By: K.G.
Project No. 103140.008
Revision No. 0
Date DECEMBER 2024
FIGURE B.2

GEMTEC
Consulting Engineers and Scientists

6695 Millcreek DR #7,
Mississauga, ON L5N 5M4
T: (416) 347-7427
www.gemtec.ca

Folder: N:\Projects\103100\103140.008\06_Civil Drafting\Design\WaterBalance\103140_008_WaterBalance_AirPortRd_R0_2024_12_10\



Legend

BH # BOREHOLE ID

⊕ BOREHOLE LOCATION

⊕ MONITORING WELL

⊕ INFILTRATION TEST LOCATION

― ELEVATION CONTOUR (m amsl)

― WATERCOURSE

▬ WATERBODY

▭ UNEVALUATED WETLAND

▭ SITE BOUNDARY

⌐ ┘ 500 m RADIUS FROM SITE

NOTES:

1. All locations approximate.
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario

5 m amsl = metres above mean sea level.

6. Service Layer Credits: World Imagery: Peel Region, Maxar
World Imagery: Peel Region, Maxar, Microsoft

Scale:
1:7,500
0 75 150 300 450 600 Meters

Drawing
TOPOGRAPHY AND NATURAL HERITAGE

Client:
GIAMPAOLO DEVELOPMENTS

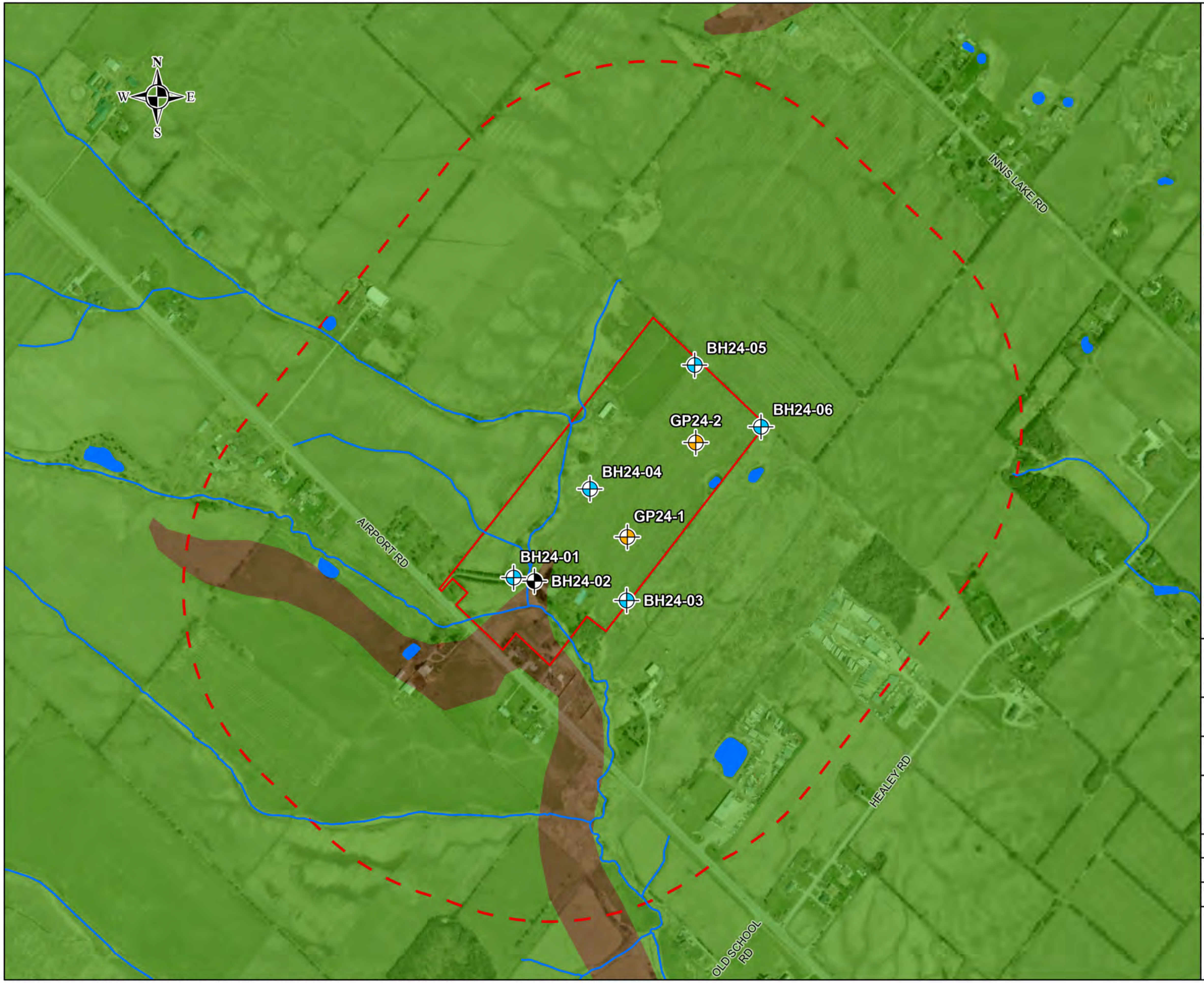
Project
HYDROGEOLOGICAL INVESTIGATION
13291 AIRPORT ROAD,
CALEDON, ONTARIO

Drwn By:	S.J.	Chkd By:	K.G.
Project No.	103140.008	Revision No.	0
Date	DECEMBER 2024		**FIGURE B.3**

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

6695 Millcreek DR #7,
Mississauga, ON L5N 5M4
T: (416) 347-7427
www.gemtec.ca

Folder: N:\Projects\103100\103140.008\06_Civil Drafting\Design\WaterBalance\103140_008_WaterBalance_AirPortRd_R0_2024_12_10\



Legend

BH # BOREHOLE ID

⊕ BOREHOLE LOCATION

⊕ MONITORING WELL

⊕ INFILTRATION TEST LOCATION

— WATERCOURSE

▬ WATERBODY

☐ SITE BOUNDARY

⌐ ┘ 500 m RADIUS FROM SITE

SURFICIAL GEOLOGY

🟫 MODERN ALLUVIAL DEPOSITS (CLAY, SILT, SAND, GRAVEL, MAY CONTAIN ORGANIC REMAINS)

🟩 HALTON TILL (CLAY TO SILT-TEXTURED TILL (DERIVED FROM GLACIOLACUSTRINE DEPOSITS OR SHALE))

NOTES:

1. All locations approximate.
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario.
5. Service Layer Credits: World Imagery: Peel Region, Maxar

Scale:
1:7,500

0 75 150 300 450 600 Meters

Drawing
SURFICIAL GEOLOGY

Client:
GIAMPAOLO DEVELOPMENTS

Project
HYDROGEOLOGICAL INVESTIGATION
13291 AIRPORT ROAD,
CALEDON, ONTARIO

Drwn By:	S.J.	Chkd By:	K.G.
Project No.	103140.008	Revision No.	0
Date	DECEMBER 2024		**FIGURE B.4**

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

6695 Millcreek DR #7,
Mississauga, ON L5N 5M4
T: (416) 347-7427
www.gemtec.ca

Folder: N:\Projects\103100\103140.008\06_Civil Drafting\Design\WaterBalance\103140_008_WaterBalance_AirPortRd_R0_2024_12_10\

Legend

4909502 WELL ID

▭ SITE BOUNDARY

⌐ ┘ 500 m RADIUS FROM SITE

WELL TYPE

● OVERBURDEN-DEEP

⊜ BEDROCK

○ NO INFORMATION

WELL USE

🟦 DOMESTIC, STOCK WATERING, A/C, WATER SUPPLY

⬜ ABANDONED

⬛ UNKNOWN

NOTES:

1. All locations approximate.
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario.
5. Service Layer Credits: World Imagery; Peel Region, Earthstar Geographics

Scale:
1:7,500
0 75 150 300 450 600 Meters

Drawing
WELL RECORDS WITHIN 500 M

Client:
GIAMPAOLO DEVELOPMENTS

Project
HYDROGEOLOGICAL INVESTIGATION
13291 AIRPORT ROAD,
CALEDON, ONTARIO

Drwn By:	S.J.	Chkd By:	K.G.
Project No.	103140.008	Revision No.	0
Date	DECEMBER 2024	**FIGURE B.5**	

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

6695 Millcreek DR #7,
Mississauga, ON L5N 5M4
T: (416) 347-7427
www.gemtec.ca

Folder: N:\Projects\103100\103140.008\06_Civil Drafting\Design\WaterBalance\103140_008_WaterBalance_AirPortRd_R0_2024_12_10\

Legend

BH # BOREHOLE ID
XX.XX GROUNDWATER ELEVATIONS, (m amsl) (DECEMBER 10, 2024)

⊕ BOREHOLE LOCATION

⊕ MONITORING WELL

⊕ INFILTRATION TEST LOCATION

— GROUNDWATER CONTOUR (m amsl)

— WATERCOURSE

▬ WATERBODY

▭ SITE BOUNDARY

NOTES:

1. All locations approximate.
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario.
5. m amsl = metres above mean sea level.
6. Service Layer Credits: World Imagery: Peel Region, Maxar, Microsoft

Scale:
1:3,000
0 25 50 100 150 200 250 Meters

Drawing GROUNDWATER FLOW CONTOURS
(DECEMBER 10, 2024)

Client: GIAMPAOLO DEVELOPMENTS

Project HYDROGEOLOGICAL INVESTIGATION
13291 AIRPORT ROAD,
CALEDON, ONTARIO

Drwn By: S.J.
Chkd By: K.G.
Project No. 103140.008
Revision No. 0
Date DECEMBER 2024
FIGURE B.6

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

6695 Millcreek DR #7,
Mississauga, ON L5N 5M4
T: (416) 347-7427
www.gemtec.ca

Folder: N:\Projects\103100\103140.008\06_Civil Drafting\Design\WaterBalance\103140_008_WaterBalance_AirPortRd_R0_2024_12_10\

APPENDIX C

Supporting Documentation

KEY PLAN

Scale N.T.S.

HUMPHRIES PLANNING GROUP INC.
190 PIPPIN ROAD, SUITE A, VAUGHAN, ONTARIO, L4K 4X9
TEL (905)264-7678, FAX (905)264-8073
www.humphriesplanning.com

TRUCK AND TRAILER PARKING

DEVELOPMENT STATISTICS

TOTAL SITE AREA	19.4 ha
TEMPORARY TRUCK & TRAILER PARKING AREAS 'A' THROUGH 'F'	11.6 ha
TOTAL TEMPORARY TRUCK & TRAILER PARKING SPACES	729

TYPICAL PARKING SPACE (3.66m X 18.3m)

🟦 FLOOD HAZARD LANDS

TEMPORARY USE SITE PLAN
AIRPORT ROAD SITE

TOWN OF CALEDON
REGIONAL MUNICIPALITY OF PEEL

SCALE:
20 0 20 50 100m

HUMPHRIES PLANNING GROUP INC.
190 PIPPIN ROAD, SUITE A, VAUGHAN, ONTARIO, L4K 4X9
TEL (905)264-7678, FAX (905)264-8073
www.humphriesplanning.com

File Number:
Date Drawn: 14 AUG 24
Drawn By: BT
Checked By: R.H.
Date Revised: 29 OCT 24
CAD File No.:

Drawing Number:
A

APPENDIX D

Water Well Records

MECP Online Well Database Summary (500-m Radius)

(1 of 2)

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
4900010	CALEDON TOWN (ALBION CON 01 007	8/11/1964	DO	15.2		14.0	2.4	FR 0045	LOAM 0001 YLLW CLAY 0012 BLUE CLAY 0045 GRVL MSND 0050
4901545	CALEDON TOWN (CHINGU HS E 06 024	7/19/1949	NU	22.9	22.3		4.3	FR 0056	LOAM CLAY 0003 CLAY GRVL 0009 CLAY 0056 GRVL MSND 0057 CLAY MSND 0060 CLAY 0065 CLAY HPAN 0073 BLUE SHLE 0075
4903469	CALEDON TOWN (ALBION CON 01 006	3/23/1970	DO	26.8	19.8	20.4	3.0	SA 0084	LOAM 0001 BRWN CLAY 0003 BLUE CLAY 0065 BLUE SHLE 0088
4903640	CALEDON TOWN (ALBION CON 01 006	7/15/1971	DO	12.8		12.8	2.1	FR 0042	BRWN LOAM 0001 GREY CLAY 0025 GREY STNS 0026 GREY CLAY 0042
4905040	CALEDON TOWN (CHINGU HS E 06 023	12/4/1976	DO	14.3		8.2	6.1	UK 0021 UK 0040	BRWN LOAM HARD 0001 BRWN CLAY HARD 0020 GREY CLAY STNS HARD 0040 GREY GRVL CLAY LOOS 0047
4905886	CALEDON TOWN (CHINGU HS E 06 025	6/19/1981	DO	22.9		10.7	3.0	UK 0040 UK 0060	BRWN LOAM HARD 0001 BRWN CLAY HARD 0020 GREY CLAY HARD 0060 GREY SAND LYRD PCKD 0075
4905893	CALEDON TOWN (ALBION CON 01 007	10/19/1981	DO	16.2		10.1	0.6	UK 0050	BRWN LOAM HARD 0001 BRWN CLAY HARD 0020 GREY CLAY HARD 0050 GREY GRVL SAND 0053
4905948	CALEDON TOWN (ALBION CON 01 007	7/16/1982	DO	29.3	21.0	22.9	2.1	FR 0085	LOAM 0002 BRWN CLAY GVLY 0014 BLUE CLAY 0067 GRVL DRTY 0069 BLUE CLAY SHLE 0075 RED SHLE 0077 BLUE SHLE 0096
4907131	CALEDON TOWN (CHINGU HS E 06 023	4/20/1989	DO	16.8		9.1	2.4	UK 0050	BRWN LOAM HARD 0001 BRWN CLAY HARD 0020 GREY CLAY HARD 0050 GREY SAND LOOS 0055
4909502	CALEDON TOWN (ALBION CON 01 007	7/29/2004		39.3	25.9				BRWN CLAY GRVL 0014 GREY CLAY GRVL 0030 GREY GRVL SAND CLAY 0043 BLUE CLAY GRVL SAND 0085 GREY SHLE CLAY LYRD 0093 GREY SHLE 0129
4909882	CALEDON TOWN (CHINGU	8/6/2005	OT						
7145562	CALEDON TOWN (ALBION CON 01 007	4/29/2010					4.0		
7248953	CALEDON TOWN (ALBION CON 01 007	8/31/2015				9.7		FR 0008	

AC = Cooling and A/C
CO = Commercial
DE = Dewatering
DO = Domestic
IN = Industrial
IR = Irrigation
MN = Municipal
MO = Monitoring
MT = Monitoring and Test Hole
NU = Not Used
OT = Other
PS = Public
ST = Livestock
TH = Test Hole

GEMTEC
Consulting Engineers and Scientists

MECP Online Well Database Summary (500-m Radius)

(2 of 2)

ID	Township	Completion Date (yyyy-mm-dd)	Water Use	Well Depth (m)	Bedrock Depth (m)	Minimum Casing Depth (m)	Static Water Levels (m)	Water Types and Bearing Zone Depths (ft)	Stratigraphic Layers (ft)
7261704	CALEDON TOWN (ALBION CON 01 007	3/30/2016				5.5		UT 0003	
7261706	CALEDON TOWN (ALBION CON 01 007	3/15/2016							
7311366	CALEDON TOWN (ALBION CON 01 007	4/20/2018				10.4		UT	
7311367	CALEDON TOWN (ALBION	4/20/2018				8.8		UT 0004	
7336381	CALEDON TOWN (ALBION CON 01 006								
7338301	CALEDON TOWN (ALBION CON 01 006	7/12/2019				13.1		UT 0005	
7338302	CALEDON TOWN (ALBION CON 01 006	7/12/2019				24.4		UT 0010	
7388463	CALEDON TOWN (ALBION CON 01 007	5/13/2021				13.1		UT 0008	
7409260	CALEDON TOWN (ALBION CON 01 006	11/1/2021							

AC = Cooling and A/C
CO = Commercial
DE = Dewatering
DO = Domestic
IN = Industrial
IR = Irrigation
MN = Municipal
MO = Monitoring
MT = Monitoring and Test Hole
NU = Not Used
OT = Other
PS = Public
ST = Livestock
TH = Test Hole

APPENDIX E

Record of Borehole Logs

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

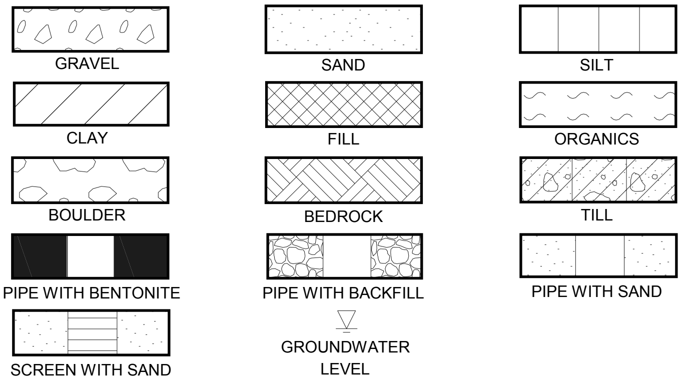
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

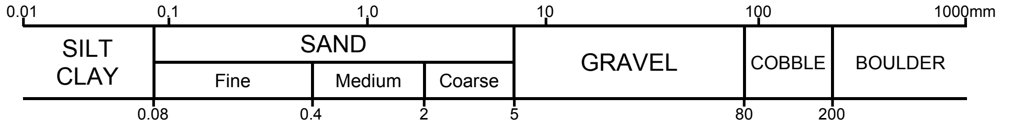
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to ‘A’ size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	Description	Cu, kPa	Description
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)

0 10 20 35

TRACE	SOME	ADJECTIVE	noun > 35% and main fraction
trace clay, etc	some gravel, etc.	silty, etc.	sand and gravel, etc.

GEMTEC

descriptive terms.pub

Modified May 2018

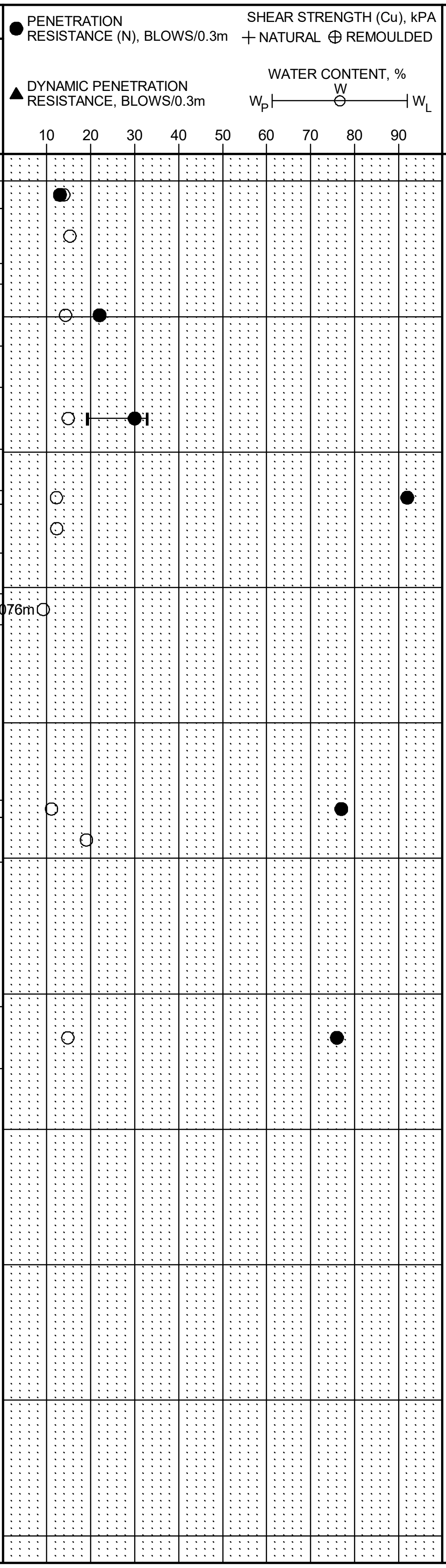
RECORD OF BOREHOLE BH24-1

CLIENT: Giampaolo Developments
PROJECT: Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario
JOB#: 103140.008
LOCATION: See Borehole Location Plan

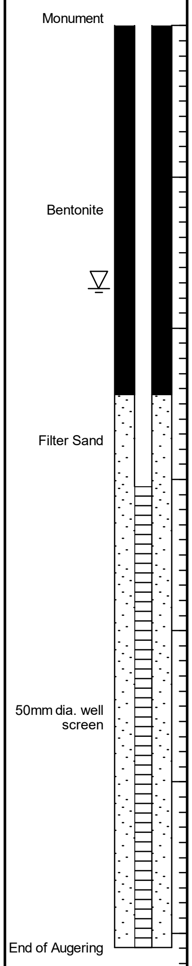
SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Nov 5 2024

BORING METHOD: Power Auger, Solid Stem Auger (152mm OD)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
Ground Surface						
TOPSOIL		1A	SS	406	13	
(CL) Silty Clay, trace to some gravel, some sand; brown (TILL); cohesive, w<PL, very stiff to hard	0.20	1B				
		2	SS	457	22	
		3	SS	457	30	MH
		4A	SS	457	92	
		4B				
- Auger grinding from about 2.9m to 3.0m depth.		5	SS	229	50\0.076m	
- Auger grinding from about 3.2m to 3.7m depth.						
- 2m silty sand layer at about 4.6m depth.		6A	SS	457	77	
		6B				
		7	SS	457	76	
End of Borehole 1. Monitoring well installed as shown upon completion of drilling. 2. Borehole dry upon completion.	6.55					



PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/11/27	1.7 ∇	

GEMTEC
Consulting Engineers and Scientists

LOGGED: E.D
CHECKED: M.W.K

RECORD OF BOREHOLE BH24-2

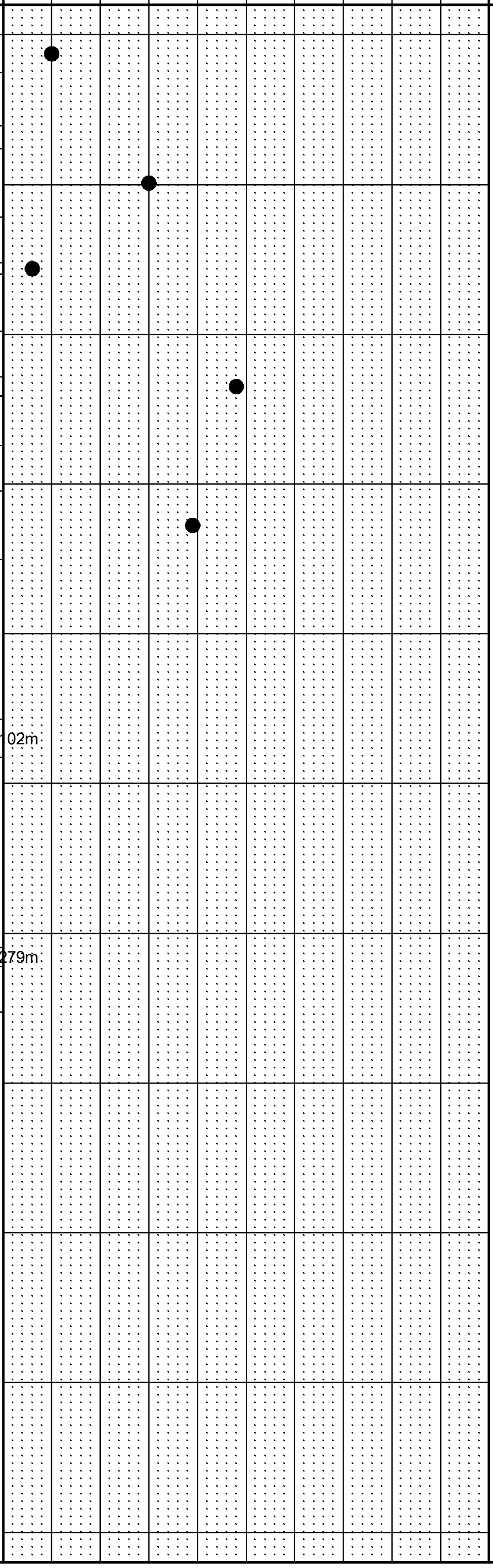
CLIENT: Giampaolo Developments
PROJECT: Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario
JOB#: 103140.008
LOCATION: See Borehole Location Plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Nov 5 2024

BORING METHOD: Power Auger – Solid Stem Auger (152mm OD)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
Ground Surface					
TOPSOIL		1A	SS	406	10
(CL) Silty Clay, trace organics, some sand to sandy; brown (TILL): cohesive, w<PL, hard	0.25	1B			
		2	SS	457	30
		3A	SS	279	6
(SP-SC) Gravelly SAND with CLAY, trace silt; brown to grey; non-cohesive, moist	1.60	3B			
(CL) Silty Clay, some sand, trace gravel; brown (TILL); cohesive, w<PL, hard	2.29	4A	SS	356	48
		4B			
		5	SS	457	39
		6	SS	254	50\0.102m
		7A	SS	432	77\0.279m
- 0.1m thick silty sand layer at about 6.2m depth.		7B			
End of Borehole 1. Borehole dry upon completion.	6.53				

● PENETRATION RESISTANCE (N), BLOWS/0.3m
▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P ⊢ W ⊣ W_L



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: E.D
CHECKED: M.W.K

RECORD OF BOREHOLE BH24-3

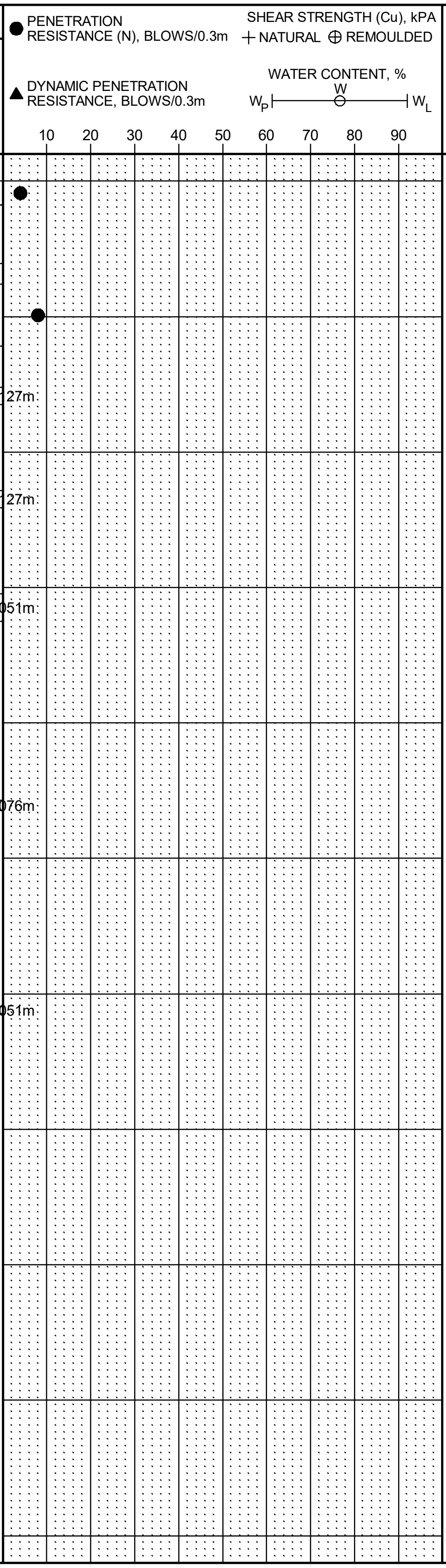
CLIENT: Giampaolo Developments
PROJECT: Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario
JOB#: 103140.008
LOCATION: See Borehole Location Plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Nov 6 2024

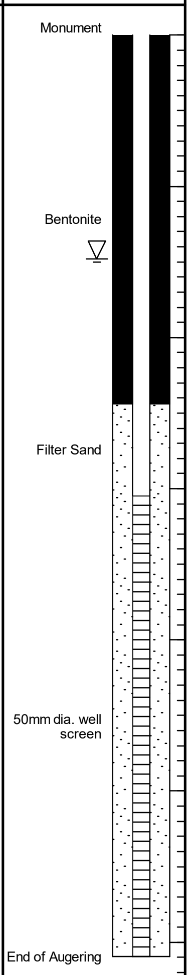
BORING METHOD: Power Auger, Solid Stem Auger (152mm OD)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0	Ground Surface	
	TOPSOIL	
	(CL) Sandy SILTY CLAY, trace gravel; brown/grey mottled (TILL); cohesive, w~PL to w<PL, firm to hard	0.18
3	- Auger grinding between about 3.05m and 4.42m.	
4	- Auger refusal at 3.81m. Moved hole 3m South along fence line.	
6	End of Borehole 1. Monitoring well installed as shown upon completion of drilling. 2. Borehole dry upon completion.	6.15

NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
1A	SS	483	4
1B			
2	SS	381	8
3	SS	127	50\0.127m
4	SS	127	50\0.127m
5	SS	203	50\0.051m
6	SS	76	50\0.076m
7	SS	51	50\0.051m



ADDITIONAL LAB. TESTING



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/11/27	1.5 ▽	

GEMTEC CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: E.D
CHECKED: M.W.K

RECORD OF BOREHOLE BH24-4

CLIENT: Giampaolo Developments
PROJECT: Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario
JOB#: 103140.008
LOCATION: See Borehole Location Plan

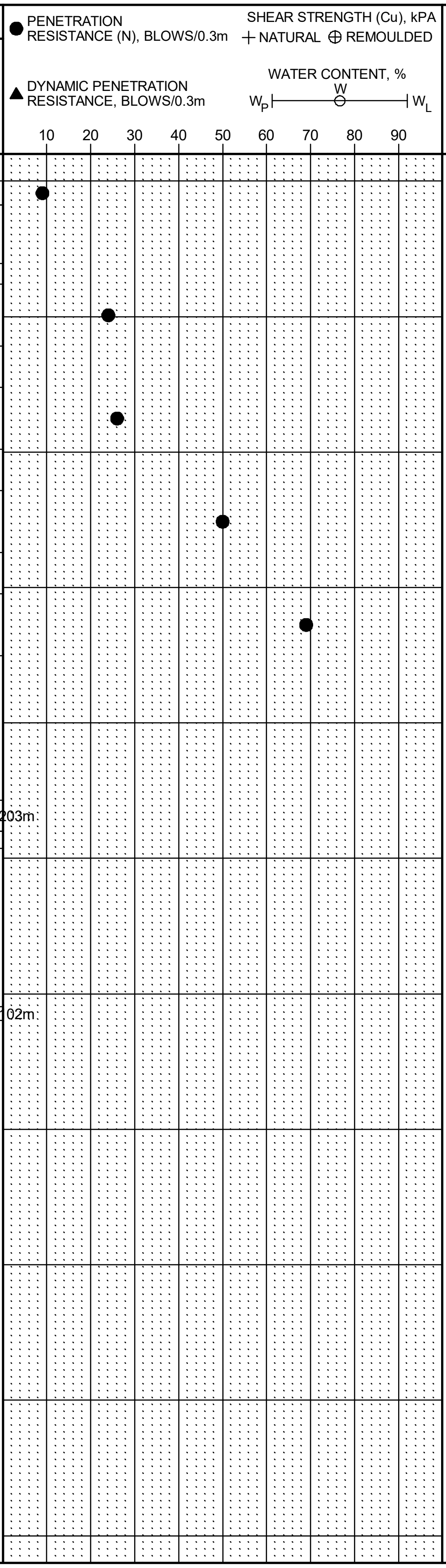
SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Nov 5 2024

BORING METHOD: Power Auger – Solid Stem Auger (152mm OD)

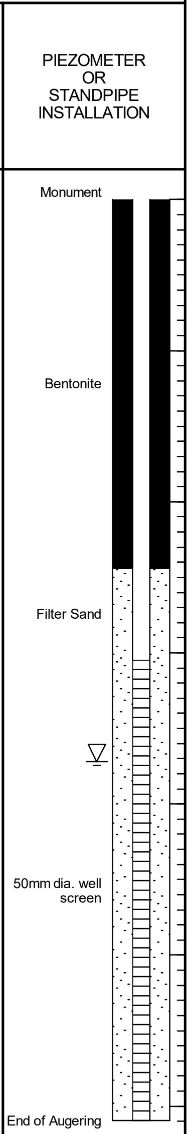
SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
Ground Surface					
TOPSOIL		1A	SS	533	9
(CL) Sandy SILTY CLAY, trace gravel; brown to grey mottled (TILL); cohesive, w<PL, very stiff to hard	0.18	1B			
		2	SS	178	24
		3	SS	457	26
		4	SS	457	50
		5	SS	457	69
- 0.3m thick silty sand layer at about 4.6m depth.		6A	SS	356	89\0.203m
(ML) Sandy SILT, some clay, trace gravel; grey; cohesive, w~PL	4.80	6B			
- Rock fragment blocking spoon tip in sample 7.		7	SS	102	50\0.102m
End of Borehole	6.20				

1. Monitoring well installed as shown upon completion of drilling.

2. Borehole dry upon completion.



ADDITIONAL LAB. TESTING



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/11/27	3.7 ▽	

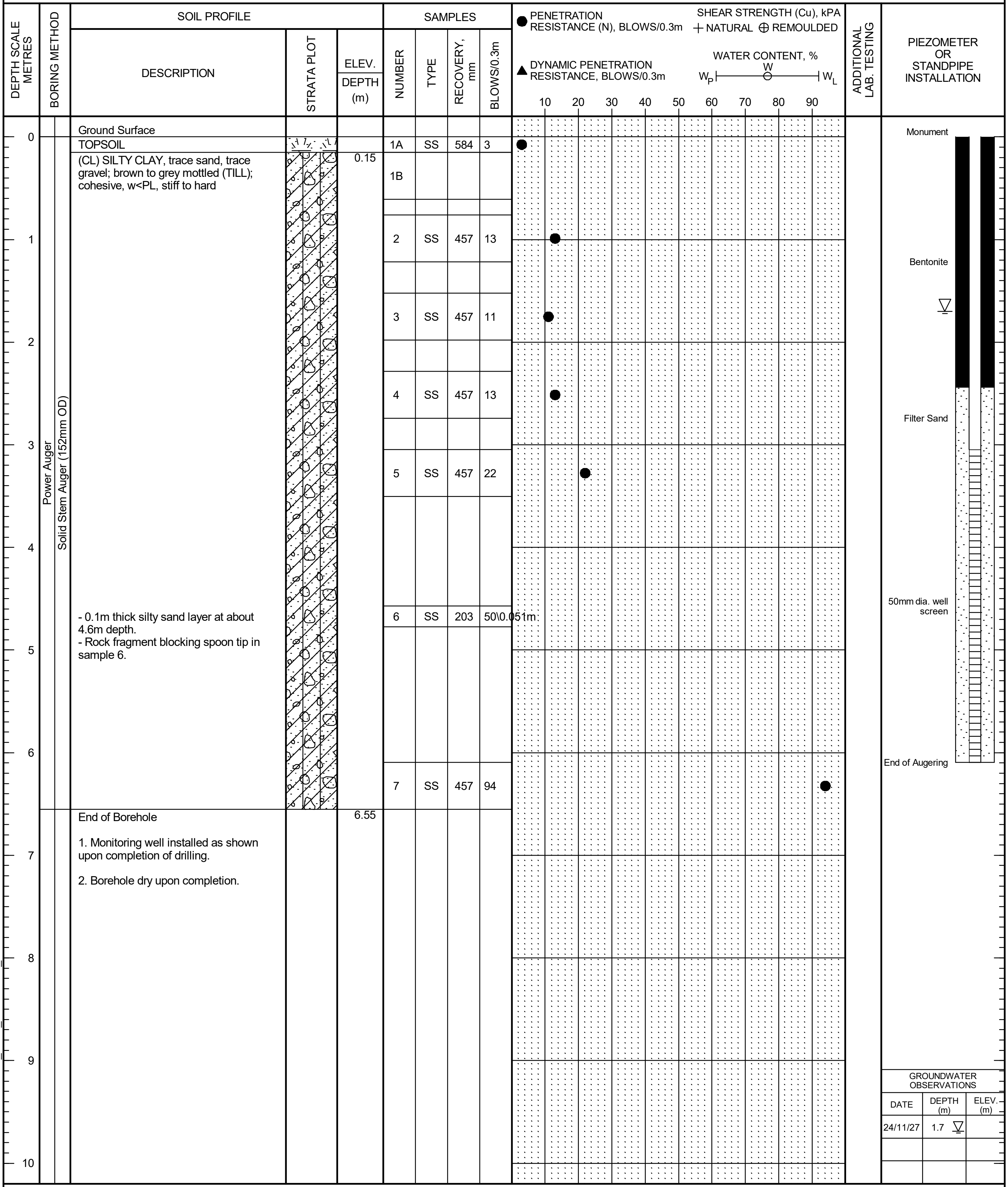
GEMTEC
Consulting Engineers and Scientists

LOGGED: E.D
CHECKED: M.W.K

RECORD OF BOREHOLE BH24-5

CLIENT: Giampaolo Developments
PROJECT: Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario
JOB#: 103140.008
LOCATION: See Borehole Location Plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Nov 5 2024



DESCRIPTION	ELEV. DEPTH (m)
Ground Surface	
TOPSOIL	
(CL) SILTY CLAY, trace sand, trace gravel; brown to grey mottled (TILL); cohesive, w<PL, stiff to hard	0.15
- 0.1m thick silty sand layer at about 4.6m depth. - Rock fragment blocking spoon tip in sample 6.	
End of Borehole	6.55

1. Monitoring well installed as shown upon completion of drilling.

2. Borehole dry upon completion.

NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
1A	SS	584	3
1B			
2	SS	457	13
3	SS	457	11
4	SS	457	13
5	SS	457	22
6	SS	203	50\0.051m
7	SS	457	94

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/11/27	1.7 ▽	

GEMTEC
Consulting Engineers and Scientists

LOGGED: E.D

CHECKED: M.W.K

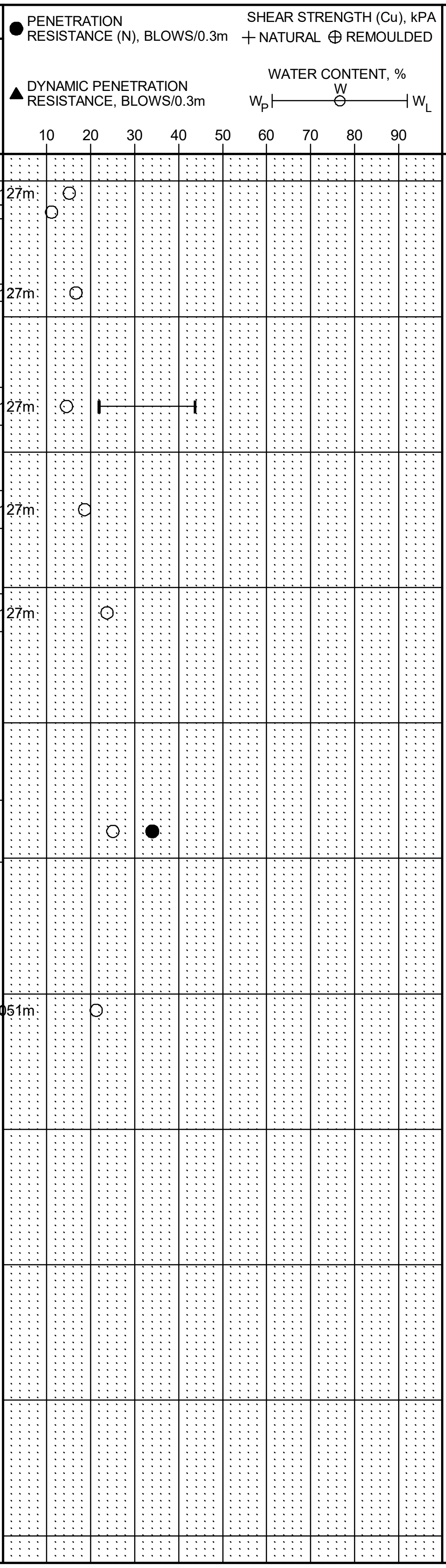
RECORD OF BOREHOLE BH24-6

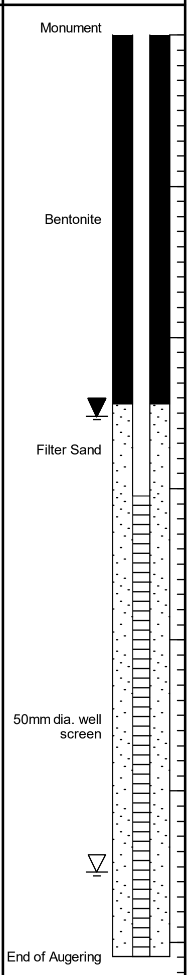
CLIENT: Giampaolo Developments
PROJECT: Commercial Storage and Truck and Trailer Parking, 13291 Airport Road, Caledon, Ontario
JOB#: 103140.008
LOCATION: See Borehole Location Plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Nov 6 2024

BORING METHOD: Power Auger – Solid Stem Auger (152mm OD)

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
Ground Surface						
TOPSOIL		1A	SS	279	50\0.127m	
(SM) SILTY SAND; brown; non-cohesive, moist	0.18	1B				
(CL) SILTY CLAY, some sand, trace gravel; brown to grey (TILL); cohesive, w<PL to w~PL, hard	0.76	2	SS	127	50\0.127m	
		3	SS	279	50\0.127m	MH
		4	SS	279	50\0.127m	
		5	SS	279	50\0.127m	
		6	SS	457	34	
		7	AS	0	50\0.051m	
End of Borehole 1. Monitoring well installed as shown upon completion of drilling.	6.15					





GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/11/06	5.5 ▽	
24/11/27	2.5 ▼	

GEMTEC
Consulting Engineers and Scientists

LOGGED: E.D
CHECKED: M.W.K

APPENDIX F

Tables

Report to: Giampaolo Developments Limited
GEMTEC Project: 103140.008 (April 3, 2025)

Table F.1 : Monitoring Well Construction Information - 13291 Airport Road, Caledon, Ontario

Borehole Location	UTM Coordinates[1]		Installation Date	Ground Surface Elevation[2]	Top of Casing Elevation	Measured Stick-up	Top of Screen Elevation	Bottom of Screen Elevation	Top of Screen	Bottom of Screen	Screened Lithology
	Easting	Northing		(m amsl)	(m amsl)	(m)	(m bgs)	(m bgs)	(m amsl)	(m amsl)	
BH24-1	597077	4852257	2024/11/05	255.00	256.16	1.16	3.05	6.10	251.95	248.90	(CL) SILTY CLAY
BH24-3	597297	4852212	2024/11/06	254.00	255.22	1.22	3.05	6.10	250.95	247.90	(CL) Sandy SILTY CLAY
BH24-4	597225	4852430	2024/11/05	256.00	257.07	1.07	3.05	6.10	252.95	249.90	(CL) Sandy SILTY CLAY
BH24-5	597429	4852671	2024/11/05	257.00	258.04	1.04	3.05	6.10	253.95	250.90	(CL) SILTY CLAY
BH24-6	597559	4852551	2024/11/06	258.00	259.00	1.00	3.05	6.10	254.95	251.90	(CL) SILTY CLAY

Notes:

[1] Approximated using a cellular Global Positioning System (GPS).

[2] Approximated based on the available topographic information on Google Earth.

m	- metre
m amsl	- metres above mean sea level
m bgs	- metres below ground surface
UTM	- Universal Transverse Mercator, Zone 17T

Table F.2 : Summary of Groundwater Depths and Elevations - 13291 Airport Road, Caledon, Ontario

Borehole Location	UTM Coordinates[1]		Ground Surface Elevation[2]	Top of Casing Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Screened Lithology	27-Nov-24		2-Dec-24		10-Dec-24	
								WL Below Ground	Approximate WL Elev.	WL Below Ground	Approximate WL Elev.	WL Below Ground	Approximate WL Elev.
	Easting	Northing	(m amsl)	(m amsl)	(m amsl)	(m amsl)		(m bgs)	(m amsl)	(m bgs)	(m amsl)	(m bgs)	(m amsl)
BH24-1	597077	4852257	255.00	256.16	251.95	248.90	(CL) SILTY CLAY	1.74	253.26	1.85	253.15	1.74	253.26
BH24-3	597297	4852212	254.00	255.22	250.95	247.90	(CL) Sandy SILTY CLAY	1.48	252.52	1.53	252.47	1.49	252.51
BH24-4	597225	4852430	256.00	257.07	252.95	249.90	(CL) Sandy SILTY CLAY	3.72	252.28	3.37	252.63	3.38	252.62
BH24-5	597429	4852671	257.00	258.04	253.95	250.90	(CL) SILTY CLAY	1.70	255.30	1.75	255.25	1.80	255.20
BH24-6	597559	4852551	258.00	259.00	254.95	251.90	(CL) SILTY CLAY	2.52	255.48	2.60	255.41	2.61	255.39

Notes:

[1] Approximated using a cellular Global Positioning System (GPS).

[2] Approximated based on the available topographic information on Google Earth.

Elev. - Elevation
m - metre
m amsl - metres above mean sea level
m bgs - metres below ground surface
WL - Water Level

Table F.3 : Summary of Hydraulic Conductivity Values - Single Well Response Tests - 13291 Airport Road, Caledon, Ontario

Well Name	Date of Test	Ground Surface Elevation[1]	Top of Screen	Bottom of Screen	Top of Screen Elevation	Bottom of Screen Elevation	Screened / Test Lithology	Type of Test	Hydraulic Conductivity Estimate
		(m amsl)	(m bgs)	(m bgs)	(m amsl)	(m amsl)			(m/s)
BH24-1	2024/12/02	255.00	3.05	6.10	251.95	248.90	(CL) SILTY CLAY	Rising	3.E-07
BH24-3	2024/12/02	254.00	3.05	6.10	250.95	247.90	(CL) Sandy SILTY CLAY	Rising	1.E-08
BH24-5	2024/12/13	257.00	3.05	6.10	253.95	250.90	(CL) SILTY CLAY	Rising	9.E-09

Notes:

All tests were analysed using the Bouwer and Rice (1976) method

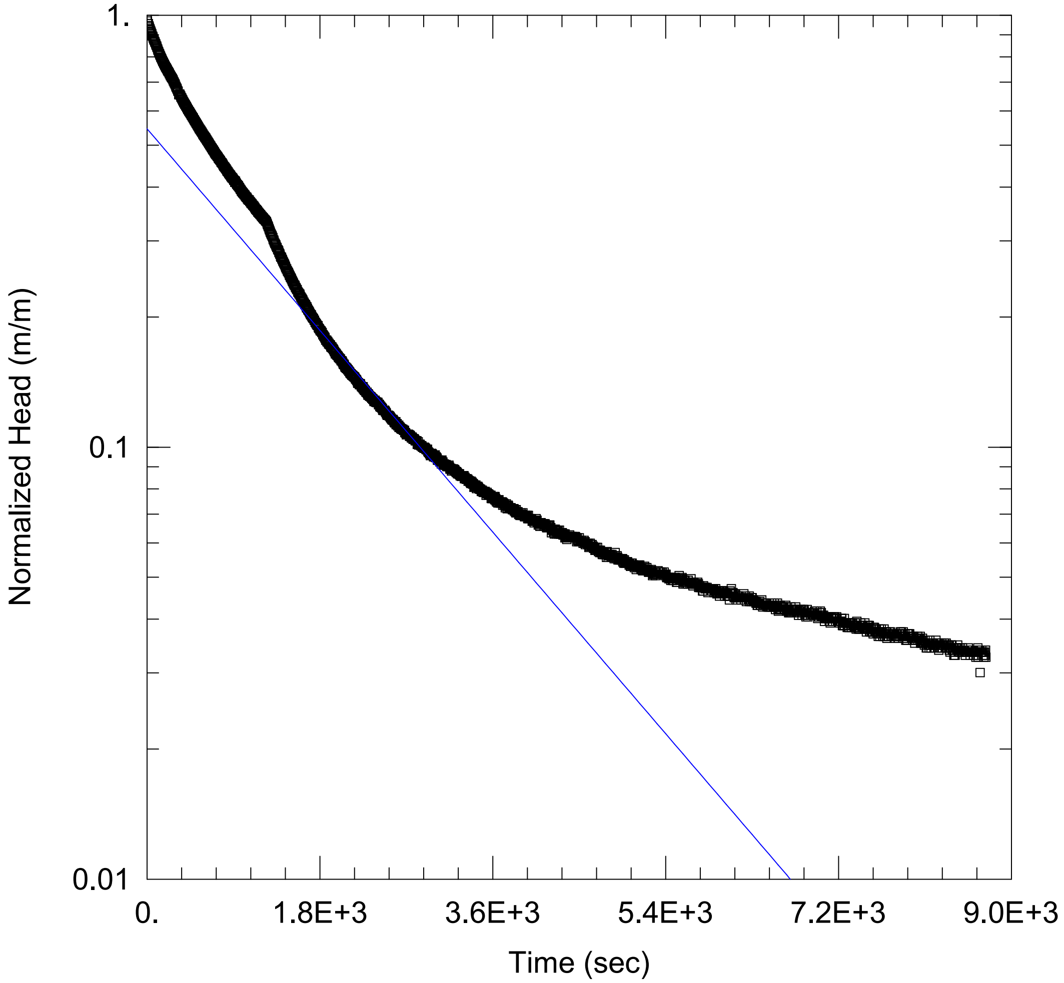
[1] Approximated based on the available topographic information on Google Earth.

m amsl - metres above mean sea level
m bgs - metres below ground surface
m/s - metres per second

Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

APPENDIX G

Hydraulic Conductivity Test Results



MW24-1 RISING HEAD TEST

Data Set: N:\...\103140.008_BH24-1.aqt
Date: 12/16/24 Time: 09:57:02

PROJECT INFORMATION

Company: GEMTEC
Client: Giampaolo Developments Limited
Project: 103140.008
Location: Caledon, ON
Test Well: BH24-1
Test Date: December 2, 2024

AQUIFER DATA

Saturated Thickness: 4.25 m
Anisotropy Ratio (Kz/Kr): 0.1

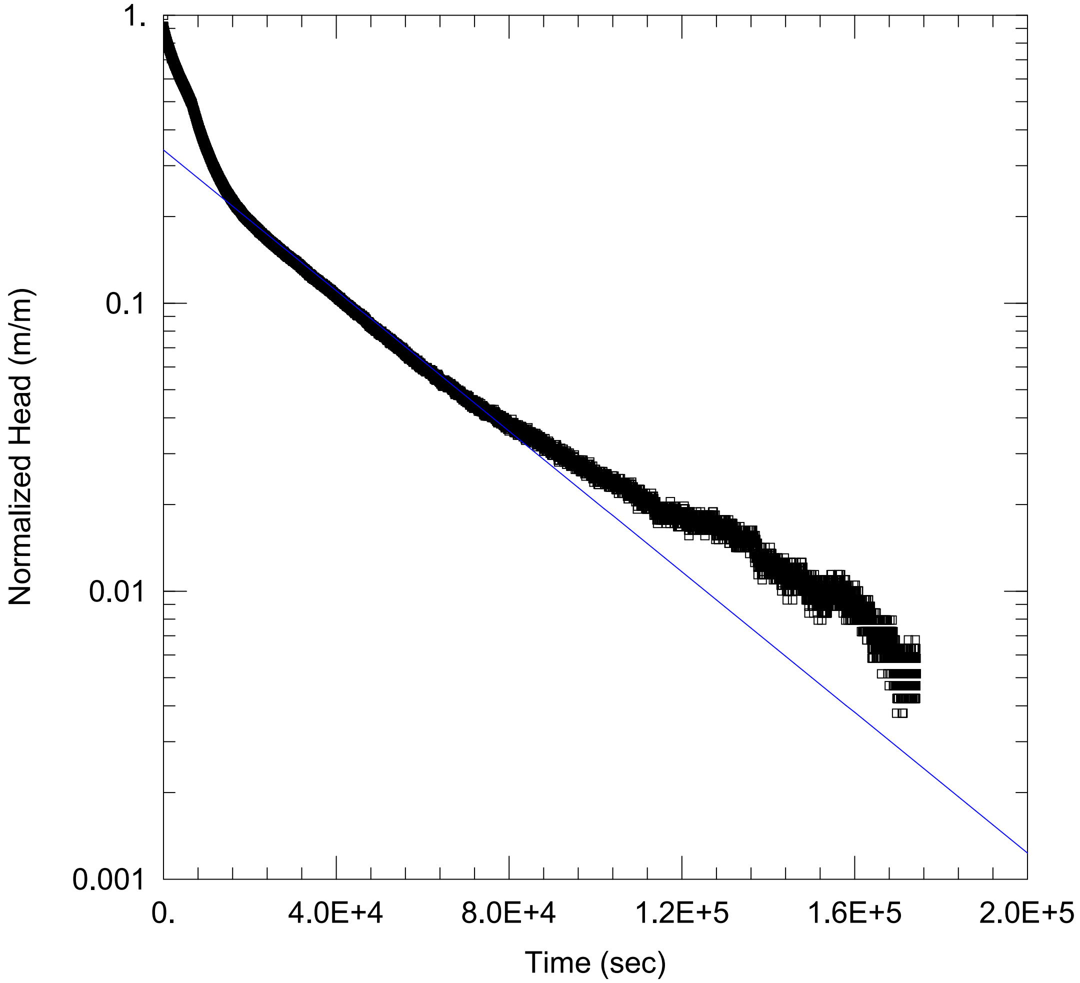
WELL DATA (BH24-1)

Initial Displacement: 3.21 m
Static Water Column Height: 4.25 m
Total Well Penetration Depth: 4.25 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.495E-7 m/sec
y0 = 1.751 m



MW24-3 RISING HEAD TEST

Data Set: N:\...\103140.008_BH24-3.aqt
Date: 12/16/24 Time: 09:57:27

PROJECT INFORMATION

Company: GEMTEC
Client: Giampaolo Developments Limited
Project: 103140.008
Location: Caledon, ON
Test Well: BH24-3
Test Date: December 2, 2024

AQUIFER DATA

Saturated Thickness: 4.57 m
Anisotropy Ratio (Kz/Kr): 0.1

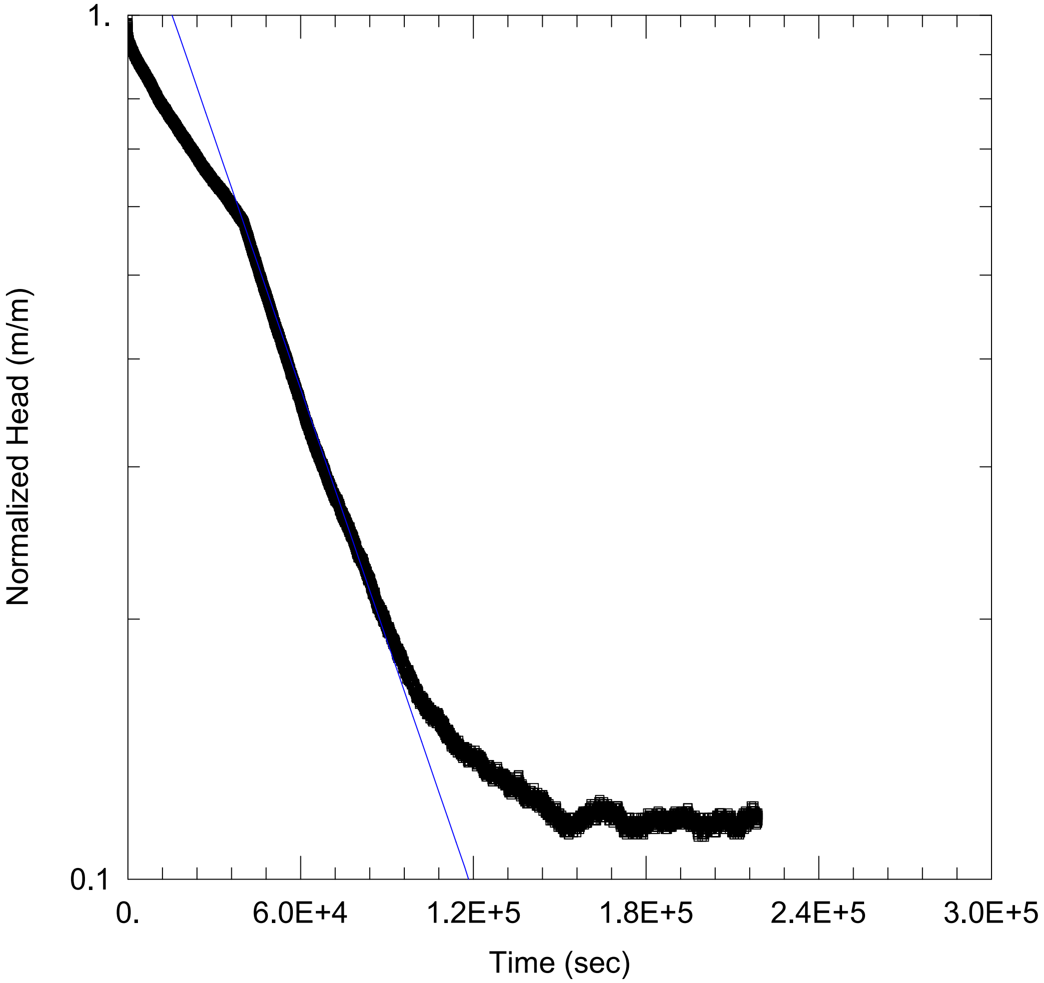
WELL DATA (BH24-3)

Initial Displacement: 2.52 m
Static Water Column Height: 4.57 m
Total Well Penetration Depth: 4.57 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.188E-8 m/sec
y0 = 0.8564 m



MW24-5 RISING HEAD TEST

Data Set: N:\...\103140.008_BH24-5.aqt
Date: 12/16/24 Time: 09:58:02

PROJECT INFORMATION

Company: GEMTEC
Client: Giampaolo Developments Limited
Project: 103140.008
Location: Caledon, ON
Test Well: BH24-5
Test Date: December 13, 2024

AQUIFER DATA

Saturated Thickness: 4.35 m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH24-5)

Initial Displacement: 1.74 m
Total Well Penetration Depth: 4.35 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.35 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 9.375E-9 m/sec
y0 = 2.455 m

APPENDIX H

Infiltration Test Results

Report to: Giampaolo Developments Limited
GEMTEC Project: 103140.008 (April 3, 2025)

GP24-1

SOILMOISTURE Guelph Permeameter

🟩 Input

🟨 Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

Enter water Head Height ("H" in cm): 15

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.3000

Res Type	2.16
H	15
a	3
H/a	5
a*	0.04
C0.01	1.518
C0.04	1.629
C0.12	1.667
C0.36	1.667
C	1.629
R	0.300
Q	0.011
pi	3.142

α*= 0.04 cm^{-1}

C = 1.629144

Q = 0.0108

K_{fs} = 4.61E-06 cm/sec
4.61E-06 cm/sec
2.77E-04 cm/min
4.61E-08 m/sec
1.09E-04 inch/min
1.82E-06 inch/sec

Φ_m = 1.15E-04 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter water Head Height ("H" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

α*= 0 cm^{-1}

C = 0

Q = 0

K_{fs} =
#DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

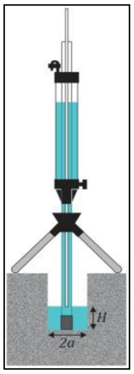
Φ_m = #DIV/0! cm^2/min

Average

]

K_{fs} =
#DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

GP24-2

Guelph Permeameter

🟩 Input

🟨 Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16
Enter water Head Height ("H" in cm): 15
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.2000

Res Type 2.16
H 15
a 3
H/a 5
a* 0.04
C0.01 1.518
C0.04 1.629
C0.12 1.667
C0.36 1.667
C 1.629
R 0.200
Q 0.007
pi 3.142

α*= 0.04 cm^{-1}

C = 1.629144
Q = 0.0072

K_{fs} =	3.07E-06	cm/sec
	1.84E-04	cm/min
	3.07E-08	m/sec
	7.26E-05	inch/min
	1.21E-06	inch/sec

Φ_m = 7.68E-05 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type 0
H 0
a 0
H/a #DIV/0!
a* 0
C0.01 #DIV/0!
C0.04 #DIV/0!
C0.12 #DIV/0!
C0.36 #DIV/0!
C 0
R 0.000
Q 0
pi 3.1415

α*= 0 cm^{-1}

C = 0
Q = 0

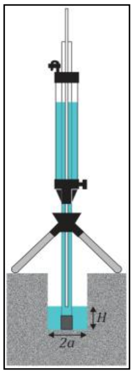
K_{fs} =	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/ses
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

Φ_m = #DIV/0! cm^2/min

Average

K_{fs} =	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

Φ_m = #DIV/0! cm^2/min



Calculation formulas related to shape factor (*C*). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $K_{fs} = G_2 Q_2 - G_1 Q_1$ $G_3 = \frac{(2H_2^2 + a^2 C_2)C_1}{2\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $G_4 = \frac{(2H_1^2 + a^2 C_1)C_2}{2\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $\Phi_m = G_3 Q_1 - G_4 Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

APPENDIX I

Water Balance

Table I.1- Environment Canada Precipitation, Surplus Data Georgetown WWTP, Ontario
Hydrogeological Investigation
Caledon, Ontario

Georgetown WWTP Water Budget Means for the period 1965-2022 6152695

Water Holding Capacity	100	mm
Heat Index	36.28	
Lower Zone	60	mm
A	1.073	
Date Range	1980	2012

Date	Temperature (^oC)	Precipitation (mm)	Rain (mm)	Melt (mm)	Potential Evapo-transpiration (mm)	Actual Evapo·transpiration (mm)	Deficit (mm)	Surplus (mm)	Snow (mm)	Soil (mm)	Accumulated Precipitation (mm)
January	-6.1	61	26	19	1	1	0	40	31	99	279
February	-5.2	56	22	31	2	2	0	50	34	100	336
March	-0.6	58	38	50	9	9	0	78	4	100	393
April	6.3	76	73	7	34	34	0	46	0	100	468
May	12.6	78	78	0	76	76	0	15	0	87	547
June	17.6	77	77	0	110	106	-5	7	0	51	622
July	20.3	77	77	0	130	105	-26	1	0	22	697
August	19.3	79	79	0	115	79	-36	3	0	19	776
September	15.1	84	84	0	77	64	-12	8	0	30	861
October	8.6	70	70	0	39	36	-2	8	0	56	69
November	2.9	81	74	6	13	13	0	35	1	88	152
December	-2.8	66	32	20	3	3	0	39	15	98	218
Average	7.3										
Total		861	730	133	609	528	-81	330			

Entered by: CC
Checked by: KG

Giampaolo Developments Limited
GEMTEC Project: 103140.008
April 2025

Table I.2 - Environment Canada Precipitation, Surplus Data Georgetown WWTP, Ontario
Hydrogeological Investigation
Caledon, Ontario

Georgetown WWTP Water Budget Means for the period 1965-2022 6152695

Water Holding Capacity	200	mm
Heat Index	36.28	
Lower Zone	60	mm
A	1.073	
Date Range	1980	2012

Date	Temperature (°C)	Precipitation (mm)	Rain (mm)	Melt (mm)	Potential Evapo-transpiration (mm)	Actual Evapo-transpiration (mm)	Deficit (mm)	Surplus (mm)	Snow (mm)	Soil (mm)	Accumulated Precipitation (mm)
January	-6.1	61	26	19	1	1	0	28	31	191	279
February	-5.2	56	22	31	2	2	0	46	34	197	336
March	-0.6	58	38	50	9	9	0	74	4	200	393
April	6.3	76	73	7	34	34	0	46	0	200	468
May	12.6	78	78	0	76	76	0	15	0	187	547
June	17.6	77	77	0	110	110	0	7	0	147	622
July	20.3	77	77	0	130	127	-4	1	0	95	697
August	19.3	79	79	0	115	98	-17	3	0	73	776
September	15.1	84	84	0	77	68	-9	8	0	81	861
October	8.6	70	70	0	39	37	-1	7	0	107	69
November	2.9	81	74	6	13	13	0	19	1	156	152
December	-2.8	66	32	20	3	3	0	27	15	177	218
Average	7.3										
Total		861	730	133	609	578	-31	281			

Entered by: CC
Checked by: KG

Giampaolo Developments Limited
GEMTEC Project: 103140.008
April 2025

Table I.3: Pre-Development Water Budget, 13291 Airport Road, Caledon, Ontario

Description	Units	Impervious (House, Shed, and Driveway)	Cultivated	Lawns / Landscaping	Wetland	TOTALS	Notes
Soil Type	**-**	**n/a**	**Clay Loam**	**Clay Loam**	**n/a**		
Topography	**-**	**n/a**	**Flat to Rolling**	**Flat to Rolling**	**n/a**		
WHC (mm)	**-**	**n/a**	**200**	**100**	**n/a**		
Pervious Area	m^2	0	89,466	90,842	0	180,307	
Impervious Area	m^2	6,973	0	0	5,072	12,046	
Total Area	m^2	6,973	89,466	90,842	5,072	192,353	
Infiltration Factor							
Soil Sub-Factor	-	n/a	0.2	0.2	n/a	-	
Land Cover Sub-Factor	-	n/a	0.1	0.1	n/a	-	
Topography Sub-Factor	-	n/a	0.2	0.2	n/a	-	
Infiltration Factor	-	0	0.5	0.5	0	-	
Runoff Factor	-	1	0.5	0.5	1	-	
Average Annual Water Balance (in mm/year)							
Inputs							
Precipitation	mm/yr	861	861	861	861	-	
Total Inputs	**mm/yr**	**861**	**861**	**861**	**861**	**-**	
Outputs							
Actual Evapotranspiration	mm/yr	86	578	528	609	-	
Surplus	mm/yr	775	281	330	252	-	
Infiltration	mm/yr	0	141	165	0	-	
Runoff	mm/yr	775	140	165	252	-	
Total Outputs	**mm/yr**	**861**	**859**	**858**	**861**	**-**	
Average Annual Water Balance (in m^3/year)							
Inputs							
Precipitation	m^3/yr	6,004	77,030	78,215	4,367	165,616	
Total Inputs	**m3/yr**	**6,004**	**77,030**	**78,215**	**4,367**	**165,616**	
Outputs							
Actual Evapotranspiration	m3/yr	600	51,711	47,965	3,089	103,364	
Surplus	m3/yr	5,404	25,319	30,250	1,278	62,252	
Infiltration	m3/yr	0	12659	15125	0	27,784	
Runoff	m3/yr	5,404	12,660	15,125	1,278	33,190	
Total Outputs	**m3/yr**	**6,004**	**77,030**	**78,215**	**4,367**	**161,249**	

Entered by: CC
Checked by: KG

Table I.4: Post-Development Water Budget, 13291 Airport Road, Caledon, Ontario

Description	Units	Asphalt-paved driveway	Roof (Farm shed)	Gravel-paved parking lots	Lawns / Landscaping	Wetland	TOTALS	Notes
Soil Type	-	n/a	n/a	n/a	Clay Loam	n/a		
Topography	-	n/a	n/a	n/a	Flat to Rolling	n/a		
WHC (mm)	-	n/a	n/a	n/a	100	n/a		
Pervious Area	m^2	0	0	0	73,119	0	73,119	
Impervious Area	m^2	7,009	331	107,505	0	4,389	119,234	
Total Area	m^2	7,009	331	107,505	73,119	4,389	192,353	
Infiltration Factor								
Soil Sub-Factor	-	n/a	n/a	n/a	0.2	n/a	-	
Land Cover Sub-Factor	-	n/a	n/a	n/a	0.1	n/a	-	
Topography Sub-Factor	-	n/a	n/a	n/a	0.2	n/a	-	
Infiltration Factor	-	0	0	0	0.5	0	-	
Runoff Factor	-	1	1	1	0.5	1	-	
Average Annual Water Balance (in mm/year)								
Inputs								
Precipitation	mm/yr	861	861	861	861	861	-	
Total Inputs	**mm/yr**	**861**	**861**	**861**	**861**	**861**	**-**	
Outputs								
Actual Evapotranspiration	mm/yr	86	86	86	528	609	-	
Surplus	mm/yr	775	775	775	330	252	-	
Infiltration	mm/yr	0	0	0	165	0	-	
Runoff	mm/yr	775	775	775	165	252	-	
Total Outputs	**mm/yr**	**861**	**861**	**861**	**858**	**861**	**-**	
Average Annual Water Balance (in m^3/year)								
Inputs								
Precipitation	m^3/yr	6,035	285	92,562	62,955	3,779	165,616	
Total Inputs	**m3/yr**	**6,035**	**285**	**92,562**	**62,955**	**3,779**	**165,616**	
Outputs								
Actual Evapotranspiration	m3/yr	603	28	9,245	38,607	2,673	51,156	
Surplus	m3/yr	5,432	257	83,317	24,348	1,106	114,460	
Infiltration	m3/yr	0	0	0	12,174	0	12,174	
Runoff	m3/yr	5,432	257	83,317	12,174	1,106	102,286	
Total Outputs	**m3/yr**	**6,035**	**285**	**92,562**	**62,955**	**3,779**	**165,616**	

experience • knowledge • integrity

civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité