Hydrogeological Assessment Report – 505, 511, 515, and 533 Yonge Street, Barrie, Ontario

October 4, 2023

Prepared for:
Renaissance Barrie Retirement Trust

Cambium Reference: 9574-004

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1.0 Introduction

Renaissance Barrie Retirement Trust (the Client) retained Cambium Inc. (Cambium) to complete a hydrogeological assessment in support of redevelopment of 505, 511, 515, and 533 Yonge St., Barrie, Ontario (referred to hereafter as the Site).

This assessment characterizes the hydrogeological setting of the Site with information generated from previous assessments and additional field investigations. Included herein are long term water level measurements, hydraulic testing of monitoring wells, construction dewatering calculations, and a conceptual water balance to account for the development plan.

A revised geotechnical investigation (Cambium Inc., 2023) was completed concurrently with this hydrogeological assessment and is referenced herein when appropriate.

1.1 Site Description

The Site is approximately 27,000 m² and fronts onto the east side of Yonge Street. The southwestern area of the Site is currently developed. Existing development includes a parking area, a two storey brick commercial building, one single storey frame dwelling, one single storey brick dwelling and a two storey stucco dwelling. The remaining areas of the Site are undeveloped. The Site descends in grade from approximately 248 m above sea level (masl) in the northwestern area of the Site to approximately 233 masl in the eastern portion of the property (approximately +/- 15 m grade differential). Lovers Creek is located directly east of the eastern property limits and has an edge of water elevation of approximately 231.55 masl.

The updated development plan includes three multi-story apartment buildings with above and below ground parking areas. The proposed buildings are 8, 10 and 12 storeys tall. The proposed 10 storey building will also include commercial space at the ground level. The underground parking structure will span to the extents of the proposed footprint of all buildings and will consist of two underground levels. There also associated green spaces and amenity areas. The proposed development plan is attached in Appendix A.

2.0 Methodology

The methodologies of the field investigation program are outlined in this section.

2.1 Drilling Program

Cambium completed a geotechnical investigation at the Site on August 15, 16, 26, 27 and October 16, 2019. A total of eight boreholes, designated as BH101-19 through BH108-19 were advanced at predetermined locations throughout the Site to depths between 5.0 metres below ground surface (mbgs) and 15.7 mbgs. Cambium returned to Site on September 15 and 22, 2021 to advance three additional boreholes, designated as BH109-21 through BH111-21. The additional boreholes were advanced to depths ranging from 3.5 to 14.0 mbgs.

On November 4, 2021 Cambium staff returned to the Site and installed a piezometer in the northeastern area of the property to confirm shallow groundwater conditions. The piezometer was labelled as MW112-21 and was installed with 0.019 m diameter stainless steel pipe and a 0.15 m long screen. The piezometer was installed with hand tools to a depth of 1.5 mbgs.

Boreholes and monitoring wells were surveyed with a TOPCON Hiper II Survey Unit relative to benchmarks provided by the Client. A Site Plan, including borehole locations is attached as Figure 1. Borehole logs are attached as Appendix B.

2.2 Physical Laboratory Testing

Physical laboratory testing, including seven (7) particle size distribution analyses (LS-702,705), were completed on selected soil samples from boreholes advanced in 2019 and 2021 to confirm textural classification and to assess geotechnical parameters. Moisture content testing was completed on all soil samples. The testing results are presented in Appendix C and are discussed in Section 3.1.1.

2.3 Hydrogeological Field Tasks

Single Well Hydraulic Tests (SWHTs) were completed at wells MW102-19, MW106-19 and MW108-19 between October 24 and 28, 2019. The hydraulic conductivity of water bearing

units screened in each well were estimated using AquiferTest Pro™ software, the results of which are attached in Appendix D and are discussed further in Section 4.1.

On October 24, 2019, one groundwater sample was collected from well BH106-19 and analyzed for those parameters outlined in the City of Barrie Sewer Use-Bylaw 2012-172. The groundwater analyses results are attached in Appendix E.

On October 25, 2019, Cambium staff visited the Site to complete infiltration testing of the shallow surficial soils at six locations. Infiltration testing was completed using a Guelph Permeameter. The results of the infiltration testing are discussed in Section 4.2.

On October 5, 2021, Cambium staff visited the Site to complete SWHTs on monitoring wells BH109-21, BH110-21 and BH111-21. Testing results are attached in Appendix D.

Groundwater levels were measured manually at the Site between August 2019 and December 2022. During the monitoring period water levels were measured monthly between January 2022 and June 2022. Water levels were measured monthly between October and December 2022. Prior to January 2022 the water level monitoring frequency was variable. Water levels of some monitoring wells could not be measured since they were inaccessible located on a seasonal basis and/or were destroyed from Site operations. Water levels were converted to groundwater elevations by referencing surveyed top of well pipe elevations. Groundwater levels and elevations are attached in Appendix F.

3.0 Geological and Hydrogeological Setting

Lovers Creek is located directly east of the eastern property boundary and has an edge of water elevation of approximately 231.55 masl. Drainage across the Site is generally directed eastwards, towards the creek. Information outlined in the Barrie Creeks, Lovers Creek, and Hewitt\s Creek Subwatershed Plan (Lake Simcoe Region Conservation Authority, 2012) indicates that baseflow to Lovers Creek in the area of the Site is -0.01 to -5 L/s/km. The negative baseflow value indicates that Lovers Creek is a “losing stream” in the area of the Site.

The Site is located in the physiographic region known as Peterborough Drumlin Field. The Peterborough Drumlin Field is approximately 4,530 km² and extends from Hastings County in the east to Simcoe County in the west. This physiographic region contains approximately 3,000 drumlins in addition to many other drumlinoid hills and surface flutings of the till sheet. In general, the drumlins are composed of sand, gravel and boulder till and are separated by low-lying wetlands areas composed of fine grained soils (Chapman, L.J. and D.F. Putnam, 1984).

According to Map 2556 of the Ontario Geological Survey (Barnett, P.J.,Cowan, W.R. and Henry, A.P., 1991), the following soils are located in the area of the Site:

- Till consisting of gravel/cobbles, sandy silt to silty sand-textured till on Palezoic Terrain.
- Modern alluvial deposits consisting of clay, silt, sand, gravel and possibly organics.

According to the *Bedrock Geology of Ontario, southern sheet*; Ontario Geological Survey, Map 2544, scale 1:1 000 000 (Ontario Geological Survey, 1991), the bedrock in the area of the Site consists of limestone, dolostone, shale, arkose and sandstone of the Ottawa Group, Simcoe Group and the Shadow Lake Formation.

3.1 Subsurface Investigation

Based on the results of the geotechnical investigation, subsurface conditions at the Site generally consists of silty sand sediments (some of which was interpreted as fill) overlying silty sand to sandy silt glacial till soils (Cambium Inc., 2023). Bedrock was not encountered as part of the drilling program.

3.1.1 Grain Size Analyses

Laboratory grain size distribution analyses were completed on samples collected from seven boreholes. A summary of the grain size analyses results is outlined below in Table 1.

Table 1 Grain Size Analysis Results

Borehole	Depth (mbgs)	Material	%Gravel	%Sand	%Silt	%Clay
BH101-19-SS12	13.7 – 14.2	Silty Sand some clay trace gravel	2	51	30	17
BH103-19-SS4	2.3 – 2.7	Silty Gravelly Sand, trace clay	23	42	25	10
BH104-19-SS7	6.1 – 6.6	Silty Sand some clay trace gravel	3	55	32	10
BH106-19-SS6	4.6 – 5.0	Silty Sand some gravel trace clay	11	58	23	8
BH107-19-SS2	0.8 – 1.2	Silty Sand trace gravel trace clay	6	60	26	8
BH109-21-SS6	4.5 – 5.0	Sandy Silt some Clay trace Gravel	5	29	55	11
BH111-21-SS3	1.5 – 1.9	Gravelly Sand some Silt	32	53	15	

3.1.2 Regulated and Vulnerable Areas

As per the Lake Simcoe Region Conservation Authority (LSRCA) mapping, the eastern and southern portions of the Site are located within regulated areas (because of the presence of Lovers Creek). As Cambium understands appropriate set-back distances from the Lovers Creek have already been established to and are included in the proposed development plan (see Appendix A).

As per the Ministry of Environment, Conservation and Parks (MECP) Source Water Protection Information Atlas (SPIA) the Site is located within the following areas:

- WHPA Q2. - The WHPA Q2 is where a reduction to ground groundwater recharge may influence nearby municipal supply wells. In these areas, groundwater recharge must be

maintained (as reasonably possible) to the pre-development recharge rate by Low Impact Development (LID) measures and other best management practices. Further discussion of the water balance is outlined in Section 6.0.

- Intake Protection Zone – 2 (IPZ-2) of Barrie Drinking Water System 220001192. The "Intake Protection Zone" is the area around a surface water intake that is defined to protect the source water for a municipal residential drinking water system. It is the vulnerable area where potential contaminants could pose a significant risk or threat to the source water. In most cases, the protection zone includes the water and the land that surrounds the intake and takes into account the influence of land use and water activities.
    - IPZ -1 is the zone closest to the intake with the highest concern for vulnerability to the source water. In this zone, there would be little or no dilution before the potential contaminant reached the intake. IPZ-1 is usually a 1-kilometre radius around the intake. The influence of land use activities is taken into consideration with setback on land of 120 metres from the shoreline.
    - IPZ-2 is the next zone of protection and is determined in three parts: in-water and along shore, upland, and up-tributary. In addition, consideration is given to a time of travel calculation to the intake. A two-hour time of travel is considered appropriate to allow a water plant operator time to shut down the intake to deal with a potential spill or threat to the source water supply.

As per the SPIA mapping, the Site is not located within a Highly Vulnerable Aquifer (HVA) or a Significant Groundwater Recharge Area (SGRA). Mapping provided from the LSRCA and the SPIA is included in Appendix A.

Pre-consultation comments from the City of Barrie dated March 2, 2021 confirm that the Site is located within an IPZ-2, however no policies within the South Georgian Bay Lake Simcoe Protection Plan apply to the Site. Re-infiltration of runoff from paved areas will and rooftops is acceptable.

The comments indicate that the City of Barrie Official Plan includes policies relating to snow storage that apply to the Site. The snow storage policies were developed in response to rising sodium and chloride concentrations within local groundwater resources.

The pre-consultation comments indicate that the Site is located within an HVA. The public mapping available through the SPIA contradicts the City's conclusion since the Site does not appear to be located within an HVA.

Ecologically significant groundwater recharge areas (ESGRAs) are areas of land that are responsible for supporting groundwater systems that sustain sensitive features like coldwater streams and wetlands (Lake Simcoe Region Conservation Authority, 2012). The eastern portion of the Site is located within an ecologically significant groundwater recharge area (ESGRA) (Lake Simcoe Region Conservation Authority, 2022). ESGRA mapping is included in Appendix A.

As outlined in Section 6.0, re-infiltration on-site is not possible due to high water level conditions. Therefore, LSRCA Water Balance Recharge Offsetting Policy 6.10 off-site recharge compensation process should be invoked (Lake Simcoe Region Conservation Authority, 2023).

3.2 Water Well Records

The MECP's Water Well Information System (WWIS) was accessed to review water well records located within 500 m of the Site. Water well records located within 500 m of the Site boundaries are outlined on Figure 2.

There are 59 water well records located within approximately 500 m of the Site boundaries. Of these records 41 detailed the installation of drilled wells, 8 detailed the installation of dug wells, 2 detailed the installation of monitoring wells and 8 detailed well abandonments.

The well records indicate that the soil stratigraphy varied between fine grained (clay material) and coarse grained (sand and gravel). In many cases a coarse grained water aquifer unit was encountered at depth beneath an aquitard comprised of finer grained sediments. The depths of the aquitards and aquifers varied, indicating that a complex subsurface environment exists in

the area of the Site. Bedrock was not recorded on any of the water well records. Information pertaining to the dug and drilled wells in summarized below in Table 2.

Table 2 Water Well Info Summary

		Depth (mbgs)	Water Encountered (mbgs)	Static Water Level	Flow Rate (gpm)
Dug Wells Count: 8	Max	17.07	9.15	7.32	4.0
	Min	5.18	3.05	1.52	2.0
	Avg	9.07	4.95	3.77	2.7
Drilled Wells Count: 41	Max	85.06	81.40	25.91	10.0
	Min	14.02	11.89	1.52	6.0
	Avg	33.88	28.43	8.08	1.5

3.2.1 Records Within Site Boundaries

As per the MECP WWIS there were nine water well records plotted within the property boundaries. The well records plotted within the property boundaries are listed below in Table 3, along with their location. Eight of the water well records are interpreted to be represent wells installed off-site and/or well abandonments. One additional well record (No. 7400741) outlines a well installed in 2021, however no specific information is provided. It is possible that this record is for monitoring well installations completed by Cambium.

Available water well records do not suggest any supply well installations within the property boundaries. If a historical private supply well is found on-site (and is no longer used) it should be decommissioned according to O.Reg. 903.

Table 3 Water Well Records Plotted Within Site Boundary

Record No.	Location (as per description in well record)	Conclusion
5715834	Located on Concession 12	Not located on-site
5725624	Located on Cox Mill Rd.	Not located on-site
5732538	Located 47 m south of Concession 14	Not located on-site
5735739	Abandonment at 440 Big Bay Point Rd.	Not located on-site
5735740	Abandonment at 440 Big Bay Point Rd.	Not located on-site
5735741	Abandonment at 458 Big Bay Point Rd.	Not located on-site
5735742	Abandonment at 440 Big Bay Point Rd.	Not located on-site
5737080	New well installed at 47 Big Bay Point Rd.	Not located on-site
7400741	No information in log – likely well installed on-site.	Possibly Located on-site

3.2.2 Water Servicing

A water servicing map was acquired from the City of Barrie which outlines those properties that are provided water servicing by the City. The map indicates that all properties surrounding the Site are provided potable water by the City of Barrie (and none are provided potable water servicing by a private supply well, according to the map). A cropped version of the water servicing map is attached in Appendix A.

3.3 Hydrogeological Conditions

The overburden generally consists of silty sand sediments (some of which was interpreted as fill) overlying silty sand to sandy silt glacial till soils. A shallow, unconfined overburden aquifer was identified on-site. The depth of the silty sand material was variable and extended up to approximately 6 mbgs in depth in some areas.

There are ten monitoring wells on-site. The wells were installed between August 2019 and November 2021. In November of 2021 three wells installed as part of a previous assessment were found on-site (being BH3, BH6 and BH7). There is limited information pertaining to these wells other than a rough map of their location and identification label. A well record from BH7 was also available to review and is attached in Appendix B.

The water levels measured at the Site in 2022 ranged between 0.35 mbgs (at BH7 on April 28, 2022) and 4.56 mbgs (at 110-21 on October 31, 2022).

Groundwater elevations in 2022 ranged between 246.15 masl (at BH3 on April 28, 2022) and 236.81 masl (at 111-21 on October 31, 2022).

The highest groundwater elevations at the Site were regularly reported from wells BH109-21 and BH3 (both located in the western corner of the property). Groundwater flow was directed eastwards across the Site from wells BH109-21 and BH3 towards Lovers Creek for the duration of the water level monitoring program. Groundwater level and elevation information is attached in Appendix F.

Information outlined in the Barrie Creeks, Lovers Creek and Hewitt's Creek Subwatershed Plan (Lake Simcoe Region Conservation Authority, 2012) indicates that Lovers creek is a losing stream. As such, groundwater may not discharge to Lovers creek as baseflow.

3.3.1 City of Barrie Risk Management Official Comments

Comments from the City of Barrie Risk Management Official dated February 16, 2021 indicate that the depth to the local confined aquifer ranges in depth between 55 mbgs and 67 mbgs. Shallower aquifer/confining layer systems (labelled A1/C1 and A2/C2) were identified above the confined municipal aquifer (Lake Simcoe Region Conservation Authority, 2012). Specifically, the information provided by the City of Barrie indicates that aquifer/confining layer A1/C1 extend to depths ranging between 7 mbgs and 17 mbgs overlies aquifer system A2. Aquifer system A2 extends to depths ranging between 39 mbgs and 46 mbgs and overlies confining layer C2. Confining layer C2 extends to depths ranging between 55 mbgs and 67 mbgs and overlies the municipal aquifer (as outlined above).

The lowest finished floor elevation of the proposed development is 237.05 masl, which equate to a depth of approximately 11 mbgs of existing grade at its deepest extent (i.e., in the western corner of the Site). A depth of 11 mbgs indicates that the elevation of the lowest finished floor may partially extend in the A2 aquifer system. The lowest finished floor elevation will not intercept the confined municipal aquifer (i.e., encountered at depths ranging between 55 mbgs and 67 mbgs).

The foundation of the proposed structure will be water tight, as such it will not require perpetual dewatering. However, dewatering will be required during construction of the proposed development. Construction dewatering estimates are provided in Section 5.0.

4.0 Results

This section outlines the results of the hydrogeological field-testing tasks.

4.1 Single Well Hydraulic Testing

SWHTs were completed on wells MW102-19, MW106-19 and MW108-19 through MW111-21. The data generated from the bail tests was processed by AquiferTest Pro ™ software, the results of which are summarized in Table 4 and Table 5 below.

The hydraulic conductivity results of the SWHTs ranged between 3.80 x 10^{-8} m/s and 1.30 x 10^{-5} m/s. The geometric mean of all hydraulic conductivity results was 5.9 x 10^{-7} m/s. The monitoring wells were screened in sandy silt to silt sand soils. The hydraulic conductivity results are similar to those outlined in literature (J.P.Powers, 2007) (Fetter, 2001). The hydraulic testing results are attached in Appendix D.

Table 4 Slug Testing Results - Wells MW102-19, MW106-19 and MW108-19 (Hydraulic Conductivity Expresses in m/s)

		Test 1	Test 2
MW102-19	Slug In	3.98 x 10^{-8}	3.80 x 10^{-8}
	Slug Out	4.41 x 10^{-8}	4.60 x 10^{-8}
MW106-19	Slug In	8.38 x 10^{-7}	1.30 x 10^{-6}
	Slug Out	1.23 x 10^{-6}	1.20 x 10^{-6}
MW108-19	Slug Out	4.40 x 10^{-8}	5.05 x 10^{-8}

Table 5 Slug Testing Results - Wells MW109-21, MW110-21 and MW111-21 (Hydraulic Conductivity Expressed in m/s)

	Test 1	Test 2	Test 3	Test 4	Test 5
MW109-21	1.08 x 10^{-5}	1.08 x 10^{-5}	1.20 x 10^{-5}	1.30 x 10^{-5}	1.20 x 10^{-5}
MW110-21	2.99 x 10^{-6}	2.12 x 10^{-6}	1.60 x 10^{-6}	1.08 x 10^{-6}	-
MW111-21	1.46 x 10^{-7}	1.24 x 10^{-7}	1.13 x 10^{-7}	1.05 10^{-7}	-

4.2 Infiltration Testing

On October 25, 2019 in-situ infiltration testing was completed at six locations across the Site. The infiltration tests were completed at depths ranging between 0.43 mbgs and 0.69 mbgs. The soils encountered ranged between sand to silty sand (as corroborated by the shallow

surficial grain size analysis of sample 2 from borehole BH107-19, see Table 1. The average shallow surficial infiltration rates range between 40 mm/hr and 92 mm/hr (as outlined below in Table 6). A safety correction factor was not incorporated into the infiltration rates outlined below (a safety correction should be applied as required by the designer of any proposed re-infiltration facilities to be built at the Site). The locations of the infiltration tests are outlined on Figure 1.

Table 6 Average Infiltration Testing Rates

Test #	IT1	IT2	IT3	IT4	IT5	IT6
Depth of test (mbgs)	0.56	0.61	0.61	0.43	0.69	0.43
Avg. Infiltration Rate (mm/hr)	73	40	92	38	64	70

4.3 Groundwater Quality

On October 24, 2019 a groundwater sample was collected from well MW106-19. The sample was analyzed for those parameters outlined in the City of Barrie Sewer Use-Bylaw 2012-172. The certificate of analysis of the testing is attached in Appendix E.

At the time this document was prepared the receiver of construction dewatering discharge water was not known. As such the groundwater quality was compared against the City of Barrie Sewer Use-Bylaw criteria and the Provincial Water Quality Objectives (PWQO) (Ministry of the Environment, 1994). Parameters reported at concentrations greater than associated guideline criteria are summarized below in Table 7.

The concentration of included Total Suspended Solids (TSS) was reported in greater than both the sanitary and storm sewer use criteria. The total concentration of several metals were reported greater than sanitary and storm sewer use criteria. The dissolved concentrations of those same metals were less than corresponding sanitary and storm sewer use criteria.

The total concentration of several metals, and phosphorus were reported at concentrations greater than PWQO criteria. In most cases the dissolved fraction of those same metals was less than the corresponding PWQO criteria.

All other parameters were reported at concentrations less than detectable limits and/or less than corresponding guideline criteria.

The water discharged from construction excavations should be treated to the appropriate quality of the receiver (once the location of discharge water disposal has been confirmed). A discharge water sampling/monitoring program should be implemented, as required.

Table 7 Water Quality Results

Parameter	Concentration in Sample (mg/L)	Sanitary Sewer Use Criteria (mg/L)
Total Suspended Solids	**8,400**	350
Total Iron	**102 (0.035)**	50
Parameter	**Concentration in Sample (mg/L)**	**Storm Sewer Use Criteria (mg/L)**
Total Suspended Solids	**8,400**	15
Total Chromium	**0.225 (<0.002)**	0.08
Total Copper	**0.129 (<0.002)**	0.01
Total Nickel	**0.08 (<0.01)**	0.05
Total Zinc	**0.407 (0.023)**	0.04
Parameter	**Concentration in Sample (mg/L)**	**PWQO Criteria (mg/L)**
Total Phosphorus	**7.5**	0.03
Total Aluminum	**46.9 (0.06)**	0.075
Total Cadmium	**0.000347 (0.000015)**	0.0001
Total Chromium	**0.225 (<0.002)**	0.001
Total Cobalt	**0.041 (<0.005)**	0.0009
Total Copper	**0.129 (<0.002)**	0.005
Total Iron	**102 (0.035)**	0.3
Total Lead	**0.04 (<0.02)**	0.005
Total Nickel	**0.08 (<0.01)**	0.025
Total Vanadium	**0.117 (<0.005)**	0.006
Total Zinc	**0.407 (0.023)**	0.02
Total Zirconium	**0.029 (<0.003)**	0.004

1. *The dissolved fraction of metals are included in parentheses.*

5.0 Dewatering Estimates

Construction dewatering is intended to lower the groundwater levels in an excavation area in order to ensure a dry and safe working condition.

The requirements for construction dewatering generally depend on the Site's soil and groundwater conditions including soil type, soil permeability or hydraulic conductivity, local groundwater levels, and the design of the proposed development (such as the foundation and/or basement elevation as well as the footprint of the proposed structure).

5.1 Proposed Development, Excavation and Dewatering

The proposed development will have three multi-story apartment buildings with above and below ground parking areas. The underground parking structure will span to the extents of the proposed footprint of all buildings and will consist of two underground levels. The underground parking structure has an approximate area of 11,264 m^2. The underground parking structure will have two levels and is anticipated to have a lower finished floor elevation 237.05 masl. The maximum elevation of the developable area of the Site, under existing conditions, is approximately 248 masl; therefore, the excavation for the underground parking structure will extend to a maximum depth of approximately 11 mbgs (in some areas, particularly in the western/northwestern area of the property).

The total depth of the excavation (or excavations) advanced during construction of the proposed development was not known at this time this document was prepared. Presumably groundwater would need to be lowered 2 m below the bottom of the finished floor elevation (i.e., to an elevation of 235.05 masl) to facilitate safe working conditions. The highest groundwater elevation was recorded to be 246.15 masl (at BH3 on April 28, 2022). As such, during high groundwater conditions, the shallow overburden water table will need to be lowered 11.1 m (i.e., 246.15 masl – 235.05 masl).

The geometric mean of all hydraulic conductivity results in the shallow overburden soils was 5.91 x 10^{-7} m/s. The highest hydraulic conductivity derived from the SWHTs was 1.30 x 10^{-5} m/s. These two hydraulic conductivity rates were used to provide a range of construction dewatering estimates.

The excavation will cut through native soils for which, the dominant deposit is silty sand material (some of which was interpreted as fill) overlying silty sand to sandy silt glacial till. The surficial aquifer in the vicinity of the Site is interpreted to be unconfined. Groundwater levels should be measured on-site on a regular basis to confirm high water conditions prior to construction activities commence.

5.2 Construction Dewatering Rate Estimation for General Excavation

To calculate the estimated dewatering rate required for the open-cut excavation for each building unit, a modified Dupuit-Forchheimer equation for an unconfined flow into a rectangular excavation was used (J.P.Powers, 2007):

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

$Where$:

$Q = dewatering\ rate\ (m^3/s)$

$K = hydraulic\ conductivity\ (m/s)$

$H = initial\ hydraulic\ head\ in\ aquifer\ (m)$

$h = target\ hydraulic\ head\ (initial\ hydraulic\ head - target\ drawdown)\ (m)$

$R_0 = radius\ of\ influence\ (from\ edge\ of\ excavation) = 3000(H - h)\sqrt{K}\ (m)$

$r_s = equivalent\ single\ well\ radius$

For rectangular excavations, the equivalent radius (r_s)can be determined as the radius of a circle with the same area as the excavation, or with the same perimeter as the excavation.

Here, the equivalent perimeter method was used such that:

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

The length and width (a and b) included in the equation above were assumed to be 150 m and 75 m, respectively. The resultant r_s value was 60 m.

A summary of calculated dewatering rates for the structure, given a target depth to water of 11.1 mbgs, is provided in Table 8. Detailed calculations are provided in Appendix G.

Table 8 Calculated Construction Dewatering Rates

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)		Factor of Safety Rate (x 1.5)	
	(m/s)	(m)	L/day	m^3/day	L/day	m^3/day
Maximum	1.30×10^{-5}	120	1,461,766	1,462	2,192,649	2,193
Geom. Mean	5.91×10^{-7}	26	22,313	22	33,469	33

Given the maximum estimated hydraulic conductivity for worst case soils of 1.30×10^{-5} m/s, the estimated zone of influence is 120 m from the edge of the excavation. The maximum estimated construction dewatering rate is 1,462 m^3/day (1,461,766 L/day). Applying a safety factor of 1.5, the estimated dewatering rate is 2,193 m^3/day (2,192,649 L/day).

The geometric mean hydraulic conductivity resulted in a zone of influence of 26 m, and a daily dewatering rate of 22 m^3/day (33 m^3/day including a factor of safety).

5.2.1 Construction Dewatering Rate Estimation Considerations

The calculation methodology for the construction dewatering rate assumes that groundwater will flow into the excavation from all sides. The proposed development will be constructed into the side of a slope. As such, most of the groundwater inflow is expected to occur through the northern and western walls of the construction excavation, once dewatering activities have reached equilibrium with the shallow overburden aquifer system. The excavation walls along the southern and eastern footprint of the development will be much shorter (or non-existent, depending on site grading at the time of dewatering). Therefore, groundwater inflow from the southern and eastern walls of the excavation is anticipated to be relatively minimal (once equilibrium is achieved). Due to the nature of these types of construction dewatering estimates, the rates outlined herein are considered conservative but are referenced for an abundance of safety.

Further, the construction dewatering rates assume that the water level will be lowered 2 m below the finished floor elevation of 237.05 masl. This assumption should be reviewed with actual planned construction conditions at a later date. Construction dewatering estimates should be revised as required.

Construction dewatering rates should be monitored daily once dewatering activities commence.

5.3 Precipitation Inputs

Once the excavation is advanced into the subsurface it will require dewatering to maintain dry working conditions (as discussed in the previous section). The excavation will also collect precipitation/stormwater runoff flows. Stormwater runoff that mixes with groundwater will contribute towards the allowable permitted rate when pumped out of the excavation. The footprint of the excavation was assumed to be 11,264 m². According to the Ministry of Transportation Intensity-Duration-Frequency rainfall curves, the 24 hour storm, with a return period of 2 years, will produce 56.2 mm of rain.

A single 56.2 mm rainfall event will result in approximately 633 m³ of stormwater runoff (assuming there is no infiltration, evaporation or additional runoff flows that discharge into or out of the excavation). The stormwater flows will mix with groundwater inflows, therefore the combined daily dewatering rate could be up to 2,826 m³/day. The Client should review available stormwater management strategies that can be included during construction and determine what type of water taking permitting is most appropriate.

5.3.1 Recommended Water Taking Permitting

The maximum estimated dewatering rate (2,193 m³/day) is considered conservative, however this figure accounts for potentially unknown conditions that may develop on-site. Precipitation inputs will be variable, however the 24 hour storm with the 2 year return period will increase dewatering rates by 633 m³. The total estimated daily dewatering rate could be up to 2,826 m³/day.

The range of potential dewatering rate estimations is greater than 400 m³/day. As such, the Client should procure a Category 3 Permit To Take Water for construction dewatering activities.

The initial dewatering rate during groundwater inflow stabilization period (prior to equilibrium) is not included in the dewatering estimates. The factor of safety was included to account for potentially elevated flow rates during the initial phases of construction dewatering.

Further, the method of disposal of water removed from the construction excavation should be determined prior to the commencement of water withdrawal.

Appropriate excavation stabilization and ground settlement monitoring should be completed (as needed) during construction dewatering activities.

5.4 Operational Dewatering

As Cambium understands the foundation will be built with a water tight membrane. As a result, there will be no operational dewatering of the proposed structure once it is constructed.

5.4.1 Zone of Influence

The dewatering calculations include estimates of the horizontal distance away from the walls of each excavation where the influence of water withdrawal will be negligible (i.e., the length to zero drawdown (Kyrieleis, W., Sichardt, W, 1930). The area included within the length of zero drawdown from the excavation is the zone of influence (ZOI). The maximum lengths to zero drawdown of the construction excavation at the Site is 120 m. See Figure 3. The ZOI was mapped extending away from the Site towards the northwest and southwest. Lovers Creek will act as a hydraulic barrier to water withdrawal influences extending east from the Site, as such the ZOI was not mapped extending east past the creek.

Available information indicates that there are eleven private supply wells located within the ZOI. Nine of the records have been mapped within the property boundaries (as outlined in Table 3), however eight of these well records are likely for wells installed off-site to the east or are abandonments. One of the well records plotted on-site is likely for a monitoring well (or wells) installed by Cambium. The exact location of the wells outlined in Table 3 could not be

confirmed, however these wells are not considered to be at risk from construction dewatering activities because they are either located outside of the ZOI, or they have been abandoned (since the area is provided water servicing by the City of Barrie).

The ZOI also captures well records plotted northwest of the Site (not included in Table 3). These are well records 5701557 and 5701558. These records outline dug wells installed with 0.76 m diameter concrete tile casing. The wells were installed to depths of 5.15 mbgs and 6.10 mbgs (respectively), in overburden sediments. Both wells reported fresh water and were used for either domestic use and/or a “body shop” (presumably an automotive repair facility). Seeing as the City of Barrie provides water servicing to the local area, it is considered unlikely that these two wells are still in service.

There are no anticipated private groundwater users in the area as all properties are presumably provided water servicing by the City of Barrie.

The ZOI intercepts adjacent roadways and structures. Land settlement should be monitored regularly during construction to determine if there are any influences that extend off-site.

6.0 Water Balance

Based on the Thornthwaite and Mather methodology (1957), the water balance is an accounting of water in the hydrologic cycle. Precipitation (P) falls as rain and snow. It can run off towards lakes and streams (R), infiltrate to the groundwater table (I), or evaporate from ground or evapotranspiration by vegetation (ET). When long-term average values of P, R, I, and ET are used, there is minimal or no net change to groundwater storage (ΔS).

The annual water budget can be expressed as:

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

Where:

P = Precipitation (mm/year)

ET = Evapotranspiration (mm/year)

R = Run-off (mm/year)

I = Infiltration (mm/year)

ΔS = Change in groundwater storage (taken as zero) (mm/year)

It is noted that the water balance described herein does not account for catchment areas that extend off-site. The calculations compare the pre- and post-development water balance changes within the Site boundaries.

The Site is 26,815 m² and has a developable area of 16,457 m². The Site is currently developed with several structures, paved areas and gravel areas. It is understood that there will be three multi-story apartment buildings with above and below ground parking areas. The proposed buildings are 8, 10, and 12 storeys tall. The proposed 10 storey building will also include commercial space at the ground level. The underground parking structure will span to the extents of the proposed footprint of all buildings and will consist of two underground levels. There also associated green spaces and amenity areas (Appendix A).

Based on the available design information, the development area at the Site can be generally categorized into three (3) types as paved area, roof area, and landscape areas.

It is noted that some of the landscaped areas will be developed atop the underground parking structure. These landscaped areas will allow for evapotranspiration but will have an assumed infiltration factor of 0. Post-development areas are approximate and based on Site Plan drawing A101 (Appendix A). A summary of the surface areas of the pre- and post-development is listed in Table 9:

Table 9 Pre- and Post Development Statistics

Type of Land Coverage	Pre-Developments Areas (m^2)	Post Development Areas (m^2)
Paved Area	2,255	5,390
Building Roof Area	790	4,802
Gravel Area	1,032	-
Landscape/Vegetated Area (Above underground parking)	-	1,072
Vegetated Slope to Lovers Creek	10,914	10,914
Landscape/Vegetated Area	11,824	4,638
Total (m^2)	**26,815**	**26,815**

Supporting information referenced herein (including detailed water balance calculations) is attached in Appendix H.

6.1 Surplus Water

Water surplus is calculated by determining the difference between precipitation and evapotranspiration (changes in soil water storage was assumed to be negligible over the course of a year). The volume of water surplus is further sub-divided into portions that infiltrate the on-site soils and that are directed off-site as runoff.

The climatic data including monthly average temperature and precipitation were obtained from Environment Canada, for Barrie WPCC station (Climate ID: 6110557) located about 3.13 km distance from the Site. Accordingly, the average annual evapotranspiration was estimated to be about 539 mm/annum using the USGS Thornthwaite Monthly Water Balance methodology (Appendix H), and the average annual precipitation was recorded to be 933 mm/annum. The

water surplus of the Site was calculated to be 394 mm/yr. Evapotranspiration does not occur from structures, paved areas, or gravel surfaces. It was assumed that 10% of precipitation falling on these surfaces is lost directly to evaporation. The remaining depth (i.e., 90% of precipitation) was considered surplus and converted to infiltration and/or runoff.

6.2 Infiltration Factor

The volume of surplus water that infiltrates through pervious surfaces on-site was determined by applying an infiltration factor to the surplus depth. The surplus water that does not infiltrate into pervious surfaces will leave the Site as surface water runoff. The infiltration factor varies from 0 to 1 and is estimated based on topography, soils, and vegetation cover as per the *Stormwater Management Planning and Design Manual* (Ministry of the Environment, 2003).

The portion of the Site that will be developed exhibits a slight grade downwards to the south and east. The topography of the Site slopes down significantly downwards to Lovers Creek along the southern and eastern boundaries (no development will occur on this slope). These two areas of the Site were modelled separately, as described below. The rate of infiltration at a site is expected to vary, based on a number of factors to be considered in any infiltration model. To partition the available water surpluses into infiltration and surface run-off, the Ministry of Environment, Conservation and Parks (MECP) infiltration factor was used. The MECP Storm Water Management Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding run-off component was calculated for the soil moisture storage conditions.

The structures and paved areas associated with the existing and proposed land-use are considered impervious surfaces. Gravel areas were assumed to have an infiltration rate of 0.1. The slope to Lovers Creek was assumed to have an infiltration factor of 0.5. The landscaped and vegetated areas of the existing and proposed development were assumed to have an infiltration factor of 0.6. Impervious surfaces were assumed to an infiltration factor of 0.

It is noted that the landscaped areas included in the proposed development that will be built atop the footprint of the underground parking structure will not contribute infiltration to the water balance. These areas will exhibit evapotranspiration, but the surplus water will be

assumed to be 100% runoff. The calculations for the infiltration factor of the pre- and post-development conditions of the Site have been outlined in Table 10.

Table 10 Infiltration Factor

	Slope to Lovers Creek (1)	Pre-Development			Post-Development	
		Landscaped/ Vegetated Areas	Gravel Areas	Impervious Surfaces	Landscaped Areas	Impervious Surfaces
Topography	0.10	0.25	-	-	0.25	-
Soil	0.20	0.20	-	-	0.20	-
Cover	0.20	0.15	-	-	0.15	-
Infiltration Factor (I)	**0.50**	**0.60**	**0.10**	**0**	**0.60**	**0**

1. *This area will not be developed*

6.3 Pre- Development Water Balance

The pre-development water balance is summarized in Table 11. The pre-development water balance conditions result in approximately 4,950 m³/year of infiltration and 7,473 m³/year of runoff.

Table 11 Pre- Development Water Balance

Land Use		Area (m²)	Precipitation (m³)	Evapotranspiration (m³)	Infiltration (m³)	Run-off (m³)
Impervious Areas	Paved Area	2,255	2,104	210	-	1,894
	Gravel Area	1,032	963	96	41	867
	Roof Area	790	737	74	-	663
Pervious Areas	Slope to Lovers Creek	10,914	10,182	5,882	2,580	1,720
	Vegetated Areas	11,824	11,032	6,373	2,329	2,329
	Totals	**26,815**	**25,018**	**12,636**	**4,950**	**7,473**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

6.4 Post-Development Water Balance

The post-development water balance is summarized in Table 12. The post-development infiltration rate was calculated to be 3,494 m³/yr and the runoff volume was 12,091 m³/yr.

Table 12 Post- Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	5,390	5,029	503	-	4,526
	Landscaped Area Above Underground Parking	1,072	999	100	-	899
	Roof Area	4,802	4,480	448	-	4,032
Pervious Areas	Slope to Lovers Creek	10,914	10,182	5,883	2,580	1,720
	Landscaped Areas	4,638	4,327	2,500	914	914
	Totals	**26,815**	**25,018**	**9,433**	**3,494**	**12,091**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

6.5 Water Balance Comparison

The water balances of the pre-development and post-development scenarios are summarized below in Table 13.

Table 13 Water Balance Comparison

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	25,018	12,636	4,950	7,473
Post-Development	25,018	9,433	3,494	12,091
Change in Volume	-	**-3,203**	**-1,456**	**4,618**
Change in %	-	**-25**	**-29**	**62**

Based on the above, there is a net infiltration deficit of about 1,456 m^3/year compared to the pre-development infiltration, while the runoff rate upon development of the Site will increase by 4,618 m^3/year.

The water balance indicates there will be an infiltration deficit of 1,456 m^3/year. Based on the water level measurements it is not possible to implement of Low Impact Development (LID) measures to allow for re-infiltration of site runoff. Therefore, LSRCA Water Balance Recharge Offsetting Policy 6.10 off-site recharge compensation process should be invoked due to previously mentioned constraints (Lake Simcoe Region Conservation Authority, 2023).

7.0 Conclusions and Recommendations

Cambium completed a hydrogeological assessment of 505, 511, 515, and 533 Yonge St., Barrie, Ontario. The findings of the assessment are summarized below:

- Subsurface conditions at the Site generally consists of silty sand material (some of which was interpreted as fill) overlying silty sand to sandy silt glacial till soils. Bedrock was not encountered during this geotechnical investigation.
- Pre-consultation comments indicate that City of Barrie Official Plan snow storage policies apply to the Site. However, the Site does not appear to be located within an HVA.
- An unconfined, overburden aquifer was encountered at the Site. Groundwater flow was eastwards, and was interpreted to discharge to Lovers Creek. The depth to groundwater varied between 4.56 mbgs to 0.35 mbgs. Groundwater elevations ranged from 246.15 masl to 236.81 masl.
- The concentration of TSS and the total fraction of several metals exceeded the City of Barrie Sewer Use-Bylaw 2012-172 criteria, and PWQO criteria. Dewatering discharge will require treatment depending on where the water is disposed to. A discharge water sampling/monitoring program should be implemented, as required.
- The projected construction dewatering rates could extend up to 2,826 m^3/day. This rate includes potential precipitation inputs, and conservative groundwater inflow estimates (as an abundance of safety). Due to the size of the project excavation and the variability is soil conditions, Cambium recommends that the Client procure a Category 3 Permit To Take Water for construction dewatering activities. Construction dewatering rates should be monitored daily once dewatering activities commence.
- The assumptions included in the construction dewatering calculations outlined herein should be reviewed against the construction plan at a later date. Construction dewatering estimates should be revised as required.
- There are no anticipated private groundwater users in the area of the Site as all properties are presumably provided water servicing by the City of Barrie. As such, construction

dewatering activities are not expected to interfere with water supplies of adjacent residents. The ZOI intercepts adjacent roadways and structures. Land settlement should be monitored regularly during construction to determine if there are any influences that extend off-site.

- Excavation stabilization monitoring should be completed within the construction excavation during dewatering activities (as required).
- The foundation of the proposed structure will be water tight, as such it will not require perpetual dewatering.
- The water balance indicates there will be an infiltration deficit of 1,456 m^3/year. Based on the water level measurements it is not possible to implement of Low Impact Development (LID) measures to allow for re-infiltration of site runoff. Therefore, LSRCA Water Balance Recharge Offsetting Policy 6.10 off-site recharge compensation process should be invoked due to previously mentioned constraints (Lake Simcoe Region Conservation Authority, 2023).

8.0 Closing

We trust that the information in this submission meets your current requirements. If you have any questions regarding the contents of this report, please contact the undersigned

Respectfully submitted,

Cambium Inc.

PROFESSIONAL GEOSCIENTIST
Oct 4, 2023
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PRACTISING MEMBER
2676
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Cameron MacDougall, P.Geo.
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CM/WY

\\cambiumincstorage.file.core.windows.net\projects\9500 to 9599\9574-004 Renaissance Retirement Barrie Trust - Geo & Hydro G - 505 Yonge Street, Barrie\Deliverables\REPORT - Hydro G\Sep23 Update\2023-10-04 RPT HG Assess - 505, 511, 515 & 533 Young St.docx

9.0 References

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10.0 Standard Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

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When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

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Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

Appended Figures

HYDROGEOLOGICAL ASSESSMENT REPORT

CORE GROUP

505, 511, 515 and 533 Yonge Street, Barrie, Ontario

LEGEND

- Benchmark
- Borehole
- Monitoring Well
- Infiltration Tests
- Groundwater Contours (1m intervals) (March 22, 2022)
- Groundwater Contours (1m intervals) (April 28, 2022)
- Site (approximate)
- (241.50) Groundwater Elevation (masl) (March 22, 2022)
- (240.94) Groundwater Elevation (masl) (April 28, 2022)
- Groundwater Flow Direction

Notes:
- Benchmark is the top nut of a fire hydrant.
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM

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SITE PLAN

Project No.:	9574-004	Date:	March 2023
		Rev.:	
Scale:	1:1,500	Projection:	NAD 1983 UTM Zone 17N
Created by:	MAT	Checked by:	CM
Figure:	1		

O:\GIS\MXDs\9500-9999\9574-004 Renaissance Retirement Barrie Trust - Geo & Hydro G - 505 Yonge Street, Barrie\2023-02-28 FIG 1 - Site Plan.mxd

HYDROGEOLOGICAL ASSESSMENT REPORT

CORE GROUP

505, 511, 515 and 533 Yonge Street,
Barrie, Ontario

LEGEND

- MECP Well Records
- 500m Study Area
- Site (approximate)

Notes:
- Benchmark is the top nut of a fire hydrant.
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
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WATER WELL RECORDS WITHIN 500m OF SITE

Project No.: 9574-004		Date: November 2021 Rev.:	
Scale: 1:7,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: CM	Figure:	**2**

O:\GIS\MXDs\9500-9999\9574-004 Renaissance Retirement Barrie Trust - Geo & Hydro G - 505 Yonge Street, Barrie\2021-11-29 FIG 2 - Water Well Records.mxd

HYDROGEOLOGICAL ASSESSMENT REPORT

CORE GROUP

505, 511, 515 and 533 Yonge Street, Barrie, Ontario

LEGEND

- MECP Well Records
- 120m Zone of Influence
- Site (approximate)

Notes:

- Benchmark is the top nut of a fire hydrant.
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
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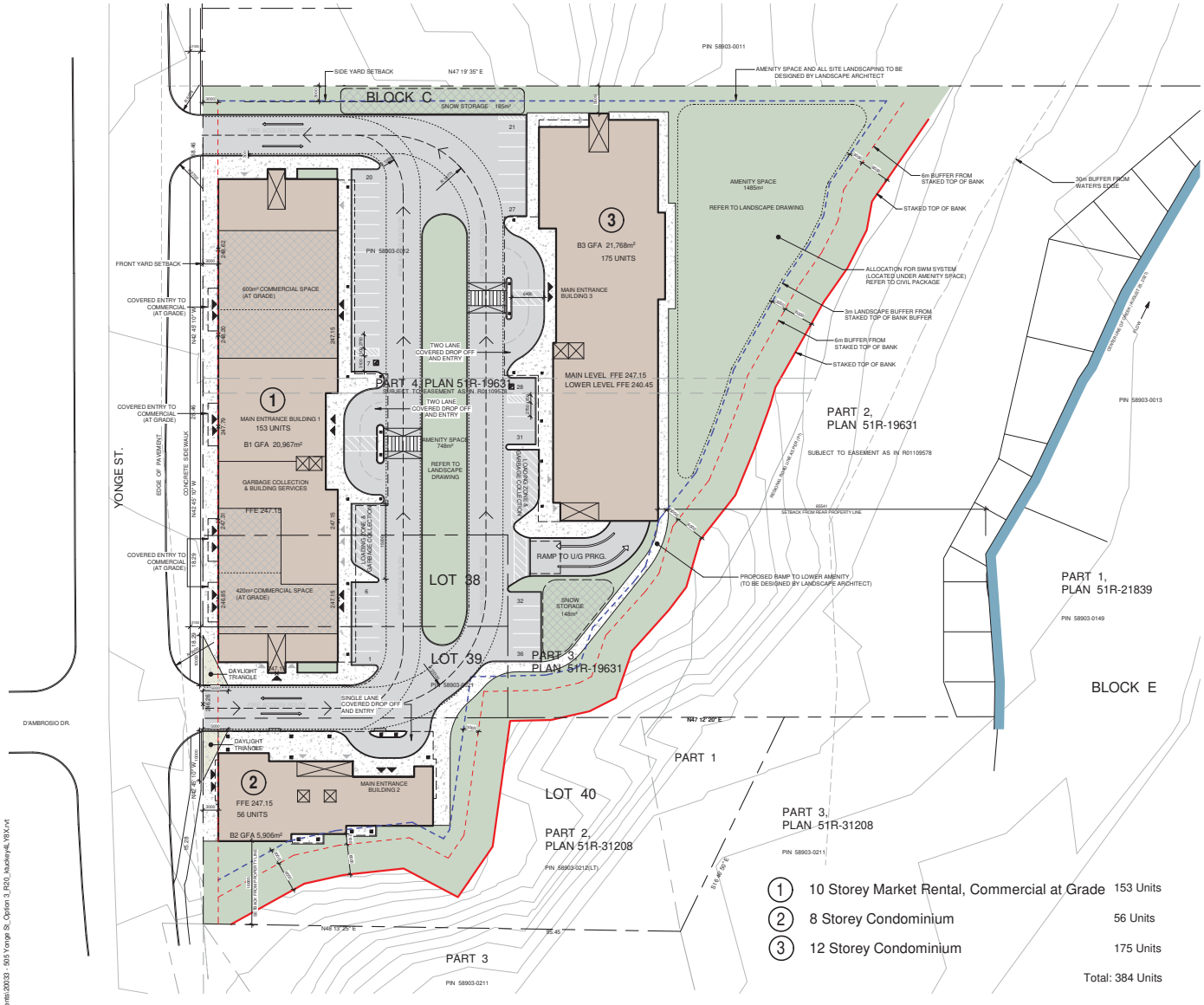
ZONE OF INFLUENCE - CONSTRUCTION EXCAVATIONS

Project No.: 9574-004		Date: November 2021 Rev.:	
Scale: 1:3,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: CM	Figure:	3

O:\GIS\MXDs\9500-9999\9574-004 Renaissance Retirement Barrie Trust - Geo & Hydro G - 505 Yonge Street, Barrie\2021-11-29 FIG 3 - Zone of Influence.mxd

Appendix A

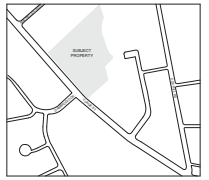
Proposed Development Plan and Land Information



1 / A101 Site Plan
1 : 400

APARTMENT DWELLING SECOND DENSITY - 2 (RA2-2) ZONE		
PROVISIONS	REQUIRED	PROVIDED
LOT AREA	1300m²	26,815.2m²
DEVELOPABLE AREA	-	16,457.7m²
LOT FRONTAGE (min.)	30m²	167.6m
FRONT YARD SETBACK (min.)	7m	3m *
SIDE YARD SETBACK (min.)	5m	5.5m
REAR YARD SETBACK (min.)	7.0m	65m
LANDSCAPED OPEN SPACE (min.)	35%	58%
DWELLING UNIT FLOOR AREA (min.)	35.0m² / dwelling unit + 10.0m² / bedroom	55.0m² / dwelling unit + 12.0m² / bedroom
LOT COVERAGE (max.)	35%	17% - Lot Area 28% Developable Area
GROSS FLOOR AREA (max. % of lot area)	200%	181% Lot Area * 295% Developable Area
HEIGHT OF MAIN BUILDING (max.)	45m	40.8m
COMMERCIAL USES WITHIN APARTMENT DWELLINGS	Max. 25% of the ground floor area	23% - all buildings 47% - Building 1
PARKING: RESIDENTIAL BUILDINGS CONTAINING MORE THAN 3 DWELLING UNITS	1.5 spaces per dwelling unit (384 units x 1.5 = 576 spaces) B.F. Spaces 19 Type 'A' and 'B'	419 spaces * incl. 14 B.F. spaces (8 Type 'A' & 6 Type 'B')
PARKING: COMMERCIAL (PERSONAL SERVICE STORE (5.2.6))	1 space per 30m² of gross floor area (1061m²/30 = 36 spaces) B.F. spaces 1 Type 'A' Space & 1 Type 'B' Space	36 spaces incl. 2 B.F. spaces (1 Type 'A' & 1 Type 'B')
PARKING FOR UNDERGROUND STRUCTURE	The minimum setback from the street line to the nearest part of a parking structure underground shall be 1.8m, except where the minimum yard setback for the applicable zone is less than 1.8m	3m
PARKING FOR APARTMENT DWELLINGS - MAX. LOT COVERAGE (5.4.4.1)	35%	25%
LANDSCAPED BUFFER AREAS (PARKING AREAS)	A parking area which provides for more than 4 parking spaces adjoining a residentially zoned lot requires a continuous landscaped buffer area with a minimum width of 3m shall be provided along the abutting lot line and a continuous light board fence with a minimum height of 2m is to be constructed along the lot line. The landscaped buffer area shall be planted with appropriate vegetation to effectively screen the parking area.	Complies
LANDSCAPED BUFFER AREAS (APARTMENT DWELLINGS)	A continuous landscaped buffer area shall be provided along the side and rear lot lines of any lot which is occupied by an Apartment Dwelling. The landscaped buffer area shall be 3m in width along the side and rear lot lines.	Min. 3m

* Indicates currently non-compliant



KEY PLAN

SITE PLAN LEGEND:

- PROPERTY LINE
- PART LOT / EASEMENT LINE
- STABLE TOP OF SLOPE AS STAKED
- CENTRELINE OF LOVERS CREEK
- LANDSCAPE BUFFER
- COMMERCIAL (1 STOREY @ GRADE)
- SNOW STORAGE
- CONCRETE PAVING / SIDEWALK
- ASPHALT PAVEMENT
- GRASS / DEVELOPABLE LIMIT

No.	Revision	Date
2	Zoning By-Law Ammendment Resubmission	
1	Issued for Zoning By-Law Ammendment	2021.12.17

Orientation

PROJECT NORTH

Seal

All dimensions to be checked and verified on the job by the Contractor. Any discrepancies are to be reported to the Consultant prior to action. Only the latest approved drawings to be used for construction in conformance with all applicable codes, by-laws and regulations. All drawings remain the property of the Consultant.

salterpilon architecture
151 Ferris Lane, Suite 400 Barrie, Ontario L4M 6C1
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Project Information
Renaissance Residences - Barrie
505 to 533 Yonge St., Barrie, ON

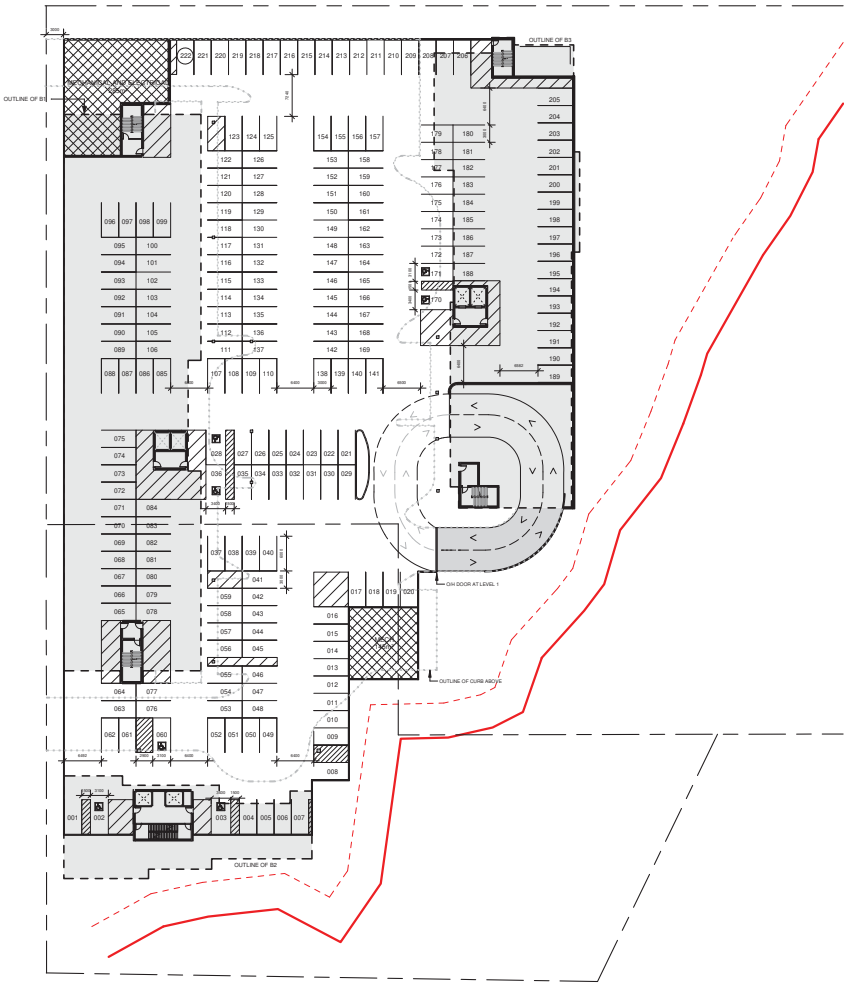
For
Core Advisory Group

Drawing Title
Site Plan

Date	Project No	Drawing No
Drawn by KT	20033	A101
Scale As indicated		

C:\Users\ktuckey\Documents\20033 - 505 Yonge St_Option 3_R20_ktuckeyvk_Y9JX.rvt
2023-04-18 11:01:12 AM

1 / A202 Level 00 U/G Parking 1
1 : 400



2 / A202 U/G Parking 2
1 : 400

No.	Revision	Date
2	Zoning By-Law Ammendment Resubmission	
1	Issued for Zoning By-Law Ammendment	2021.12.17

Orientation

PROJECT NORTH

Seal

All dimensions to be checked and verified on the job by the Contractor. Any discrepancies are to be reported to the Consultant prior to action. Only the latest approved drawings to be used for construction in conformance with all applicable codes, by-laws and regulations. All drawings remain the property of the Consultant.

salterpilon architecture

151 Ferris Lane, Suite 400 Barrie, Ontario L4M 6C1
salterpilon.com t: 705.737.3530

Project Information

Renaissance Residences - Barrie

505 to 533 Yonge St., Barrie, ON

For

Core Advisory Group

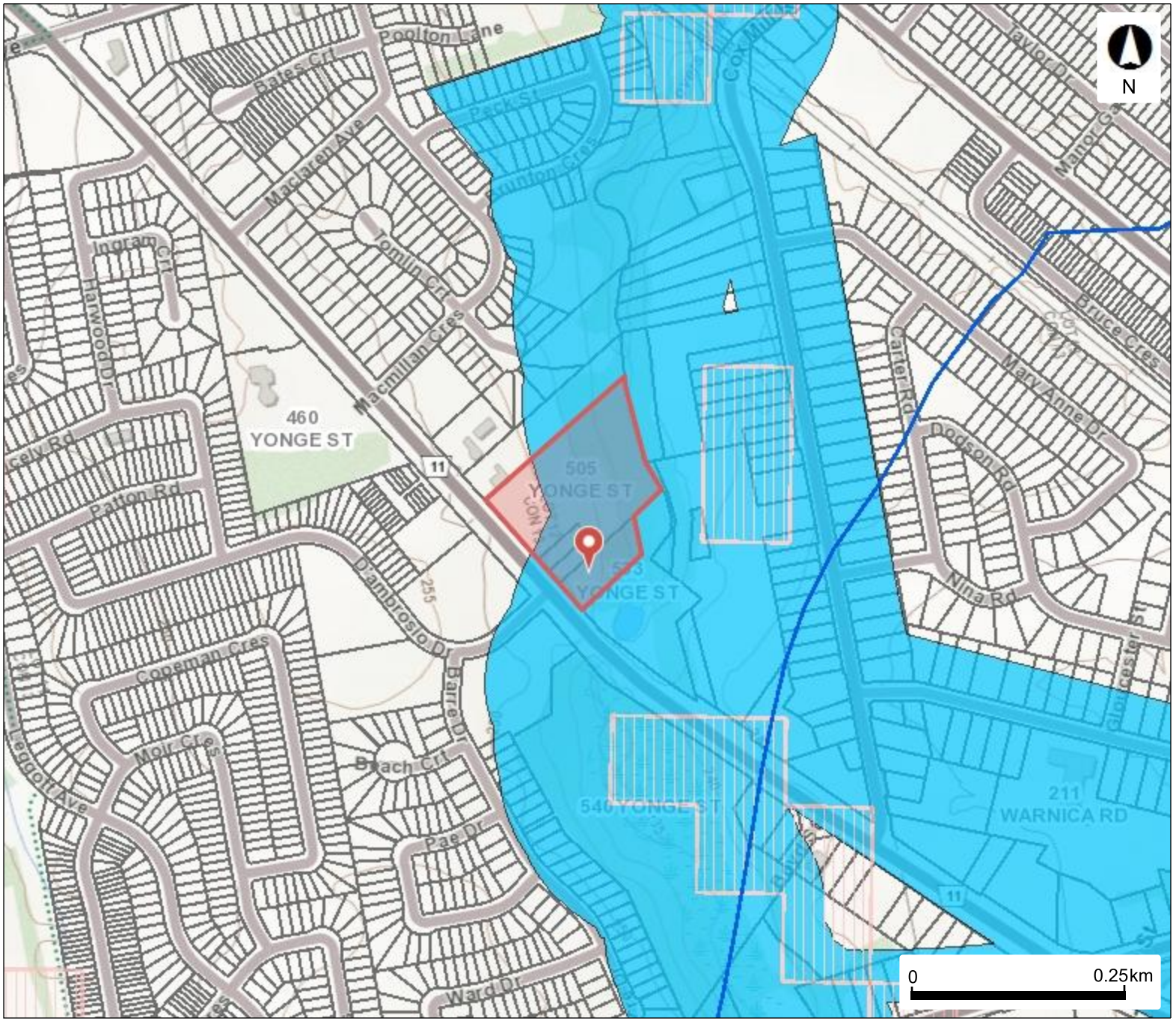
Drawing Title

Parking Plans

Date	Project No	Drawing No
Drawn by KT	20033	A202
Scale 1 : 400		

C:\Users\KKuckey\Documents\20033 - 505 Yonge St_Option 3_R20_kkuckeyvk_Y9X.rvt
2023-04-06 9:37:59 AM

SPIA Mapping



Legend

- Intake Protection Zone Q
- Wellhead Protection Area Q2
- Highly Vulnerable Aquifers
- Intake Protection Zone 1
- Intake Protection Zone 2
- Assessment Parcel

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 6/22/2021
Map Center: 44.36176 N, -79.65511 W

Lake Simcoe Region conservation authority

Regulated Areas

Features

- Regulation Map Index
- LSRCA Watershed Boundary
- Watercourse
- Regulated Area Boundary
- Regulated Area
- Address Labels
- Assessment Parcel
- Lot and Concession
- Roads
  - Hwy 400 Series
  - Highway, Arterials
  - Local Road
- Railway

Printed On:
11/12/2019

WGS_1984_Web_Mercator_Auxiliary_Sphere

Mapped By:

Scale 1: 2,290

Meters

116 0 58 116


ESGRA Mapping
Legend
ESGRA
Red Line = Approximate Property Boundary
Google Earth
200 m
N

Appendix B
Borehole Logs

Peterborough
Barrie
Oshawa
Kingston
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Log of Borehole: BH101-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 15, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607082, 4912922
Elevation: 247.79 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0 / 247		Gravelly Sand: Brown gravelly sand, some silt, trace clay, occasional cobbles, moist, compact, FILL	1	SS	40	19				
1			2	SS	40	23				
246		Sand: Brown sand, some silt, some gravel, trace clay, occasional cobbles, moist, compact, FILL	3	SS	80	22				
2 / 245		Silty Sand: Brown silty sand, trace gravel, trace clay, occasional cobbles, moist, dense	4	SS	90	43				
3			5	SS	90	40				
244										
4 / 243		Wet, very dense	6	SS	50	50/ 205 mm				
5 / 242										

Logged By: CM
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Log of Borehole: BH101-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 15, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607082, 4912922
Elevation: 247.79 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
6										
			7	SS	60	50/ 280 mm				Spoon bouncing at 6.1 mbgs
241 7										
			8	SS	60	50/ 205 mm				
240 8										
239 9		Moist, increased gravel content, less cobbles	9	SS	50	50/ 205 mm				
238 10										
			10	SS	60	50/ 205 mm				Spoon bouncing at 11 mbgs
237 11										
236										

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Log of Borehole: BH101-19

Client:	Park City Inc.	**Project Name:**	Geotech Investigation - 505 Yonge Street	**Project No.:**	9574-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 15, 2019
Location:	505 Yonge Street, Barrie, ON	**UTM:**	17T 607082, 4912922	**Elevation:**	247.79 mASL

Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
	12										
				11	SS	50	50/ 230 mm				GSA SS12: 2% Gravel 51% Sand 30% Silt 17% Clay
235	13										
234			Compact	12	SS	100	26				
	14										
233											Spoon bouncing at 15.4 mbgs
	15		Very dense	13	SS	40	50/ 205 mm				Groundwater observed at 8.2 mbgs and caving measured at 8.5 mbgs upon completion
232											
	16		Borehole terminated at 15.7 mbgs								

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Log of Borehole: BH102-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 16, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607110, 4912895
Elevation: 247.57 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0 / 247		Asphalt: (25 mm)							Cap	Top of Standpipe (TOS) elevation: 247.46 mASL. Groundwater measured at 4.10 mbgs (243.47 mASL) on November 19, 2019.
		Gravelly Sand: Brown gravelly sand, with silt, trace clay, occasional cobbles, moist, compact, FILL	1	GS	-	-				
1			2	SS	30	15			Cuttings	
246			3	SS	50	20				
2			4	SS	90	38				
245		Dense								
3		Silty Sand: Brown silty sand, some gravel, trace clay, occasional cobbles, moist, very dense	5	SS	100	50/ 230 mm			Bentonite Plug	
244										
4										
243		Sandy Silt: Brown sandy silt, with gravel, trace clay, moist, very dense	6	SS	75	50/ 205 mm				
5										
242										

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Log of Borehole: BH102-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 16, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607110, 4912895
Elevation: 247.57 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
6										
241		Grey	7	SS	20	50/ 75 mm			PVC Standpipe	
7										
240			8	SS	70	50/ 255 mm				
8		Wet								
239										
9			9	SS	50	50/ 230 mm			Sand Pack	Spoon bouncing at 9.1 mbgs
238										
10										
237			10	SS	0	50/ 125 mm				Tip of spoon came off when it was being pulled out of hole, thus no sample was acquired
11										
236										

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Log of Borehole: BH102-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 16, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607110, 4912895
Elevation: 247.57 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
12 / 235		Moist, trace gravel, occasional cobbles	11	SS	100	50/ 205 mm				
13 / 234			12	SS	100	50/ 230 mm			PVC Screen	
14 / 233			13	SS	100	50/ 305 mm			Cap	
15 / 232		Borehole terminated at 15.7 mbgs								Groundwater first observed at 8.2 mbgs
16 / 231										

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Log of Borehole: BH103-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 26, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607113, 4912942
Elevation: 246.14 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
246 / 0		Sand: Brown sand, with gravel, some topsoil, trace silt, trace organics, occasional cobbles, moist, compact, FILL	1	SS	40	14				
		Silty Sand: Brown silty sand, trace gravel, trace organics, trace clay, moist, loose, FILL	2	SS	70	9				
245 / 1										
		Sand: Brown sand, some silt, some gravel, trace clay, moist, compact	3	SS	60	23				
244 / 2		Wet								
		Dense	4	SS	5	44				GSA SS4: 23% Gravel 42% Sand 25% Silt 10% Clay
243 / 3										
			5	SS	95	41				
		Moist								
242 / 4										
		Sandy Silt: Brown sandy silt, some gravel, moist, very dense	6	SS	60	50/ 205 mm				
241 / 5										

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Log of Borehole: BH103-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 26, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607113, 4912942
Elevation: 246.14 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
240 — 6		Occasional cobbles	7	SS	70	50/ 230 mm				Groundwater observed at 5.8 mbgs and caving measured at 5.9 mbgs upon completion
239 — 7		Borehole terminated at 6.6 mbgs								

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Log of Borehole: BH104-19

Client:	Park City Inc.	**Project Name:**	Geotech Investigation - 505 Yonge Street	**Project No.:**	9574-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 26, 2019
Location:	505 Yonge Street, Barrie, ON	**UTM:**	17T 607178, 4912908	**Elevation:**	243.60 mASL

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
243	0	Asphalt: (50) mm								
		Sand: Brown sand, trace silt, trace gravel, some asphalt fragments, occasional cobbles, moist, compact, FILL	1	GS	-	-				
	1		2	SS	50	12				
242		Loose	3	SS	60	8				
	2									
		Some silt, trace clay, wet, very loose	4	SS	40	2				
241	3									
		Silty Sand: Grey silty sand, some gravel, trace clay, moist, compact	5	SS	65	14				
240	4									
239		Sandy Silt: Grey sandy silt, some clay, some gravel, moist, dense	6	SS	100	36				
	5									
238	6									

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Log of Borehole: BH104-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 26, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607178, 4912908
Elevation: 243.60 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
237 / 7		Silty Sand: Brown silty sand, some gravel, trace clay, occasional cobbles, moist, very dense	7	SS	100	50/ 230 mm				GSA SS7: 3% Gravel 55% Sand 32% Silt 10% Clay
236 / 8		Dense	8	SS	5	46				
235 / 9			9	SS	80	43				
234 / 10										
233 / 11		Very dense, wet	10	SS	20	50/ 75 mm				Borehole open and groundwater at 11.0 mbgs upon completion
232 / 12		Borehole terminated at 11.4 mbgs due practical refusal								

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Log of Borehole: BH105-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 27, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607143, 4912886
Elevation: 246.64 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0 / 246		Sand: Brown sand with silt, some topsoil, trace gravel, occasional organics, trace cobbles, moist, loose, FILL	1	SS	20	5				
			2	SS	10	6				
1 / 245		Sandy Silt: Brown sandy silt, some gravel, trace clay, occasional cobbles, moist, compact, FILL	3	SS	35	14				
2 / 244		Sand: Brown sand, some gravel, trace silt, trace clay, occasional cobbles, moist, dense	4	SS	50	43				
			5	SS	60	46				
3 / 243										
4 / 242		Sand: Brown sand, some gravel, some silt, trace clay, occasional cobbles, moist, very dense	6	SS	50	50/ 255 mm				
5 / 241		Wet								

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Input By: CM

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Log of Borehole: BH105-19

Client:	Park City Inc.	**Project Name:**	Geotech Investigation - 505 Yonge Street	**Project No.:**	9574-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 27, 2019
Location:	505 Yonge Street, Barrie, ON	**UTM:**	17T 607143, 4912886	**Elevation:**	246.64 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
6										
			7	SS	90	50/ 230 mm				Groundwater observed at 4.0 mbgs and caving measured at 5.2 mbgs upon completion
240		Borehole terminated at 6.6 mbgs								
7										

Logged By: CM **Input By:** CM

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Log of Borehole: BH106-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 27, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607159, 4912841
Elevation: 244.45 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0 / 244		Topsoil: Brown sandy topsoil, moist, compact, FILL	1	SS	50	24			Cap	Top of Standpipe (TOS) elevation: 244.35 mASL. Groundwater measured at 3.60 mbgs (240.85 mASL) on November 19, 2019.
1 / 243		Sand: Brown sand, some silt, trace gravel, trace clay, occasional organics, moist, loose, FILL	2	SS	5	6			Cuttings	
		Dense	3	SS	80	33			Bentonite Plug	
2 / 242		Sand: Brown sand, some silt, trace gravel, trace clay, occasional cobbles, moist, dense	4	SS	60	47			PVC Standpipe	
3 / 241		Silty Sand: Brown silty sand, some gravel, trace clay, occasional cobbles, moist, dense	5	SS	70	45			Cuttings	
4 / 240		Grey, very dense	6	SS	60	50/ 205 mm			Bentonite Plug	GSA SS6: 11% Gravel 58% Sand 23% Silt 8% Clay
5 / 239										

Logged By: CM **Input By:** CM

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Log of Borehole: BH106-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 27, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607159, 4912841
Elevation: 244.45 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
6 / 238										
			7	SS	55	50/ 180 mm			Sand Pack PVC Screen	
7 / 237		Dense, wet	8	SS	60	48			Cap	
8 / 236		Borehole terminated at 8.1 mbgs due to practical refusal								Groundwater first observed at 7.6 mbgs
9										

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Log of Borehole: BH107-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: August 27, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607176, 4912875
Elevation: 241.33 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
241 / 0		Topsoil: Brown sandy topsoil, moist, compact, FILL	1	SS	45	11				
		Sand: Grey sand, with silt, with gravel, trace clay, moist, compact	2	SS	60	22				GSA SS2: 6% Gravel 60% Sand 26% Silt 8% Clay
240 / 1										
			3	SS	75	22				
239 / 2		Dense	4	SS	80	32				
		Compact	5	SS	70	28				
238 / 3										
237 / 4		Dense	6	SS	80	38				
236 / 5		Borehole terminated at 5.0 mbgs								Groundwater observed at 4.1 mbgs and caving measured at 4.3 mbgs upon completion
6										

Logged By: CM
Input By: CM

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Log of Borehole: BH108-19

Client: Park City Inc.
Project Name: Geotech Investigation - 505 Yonge Street
Project No.: 9574-001
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: October 16, 2019
Location: 505 Yonge Street, Barrie, ON
UTM: 17T 607143, 4912886
Elevation: 242.59 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0 / 242		Topsoil: Brown sandy topsoil, moist, loose, FILL	1	SS	20	9			Cap; Grout	Top of Standpipe (TOS) elevation: 243.38 mASL. Groundwater measured at 0.97 mbgs (241.62 mASL) on November 19, 2019.
1 / 241		Sand: Brown sand, some silt, some gravel, trace organics, moist, compact, FILL	2	SS	40	16			Bentonite Plug	
		Less organics, occasional cobbles	3	SS	90	16			Cuttings	
2 / 240		Sand: Brown sand, some gravel, some silt, occasional cobbles, moist, very dense	4	SS	75	50/ 255 mm				
3 / 239			5	SS	60	50/ 230 mm			PVC Standpipe; Bentonite Plug	
4 / 238			6	SS	50	50/ 205 mm				
5 / 237										
6						50/				

Logged By: CM
Input By: CM

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Log of Borehole: BH108-19

Client:	Park City Inc.	**Project Name:**	Geotech Investigation - 505 Yonge Street	**Project No.:**	9574-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	October 16, 2019
Location:	505 Yonge Street, Barrie, ON	**UTM:**	17T 607143, 4912886	**Elevation:**	242.59 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
236 / 7		Silty Sand: Grey silty sand, some gravel, occasional cobbles, moist, very dense	7	SS	50	50/ 230 mm				
235 / 8		Less cobbles	8	SS	60	50/ 180 mm				
234 / 9		Trace clay, wet, dense	9	SS	100	38			Sand Pack; PVC Screen	
233 / 10										
232 / 11		Occasional cobbles, moist, very dense	10	SS	100	50/ 305 mm			Cap	Groundwater first observed at 8.5 mbgs
231 / 12		Borehole terminated at 11.1 mbgs								

Logged By: CM **Input By:** CM

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Log of Borehole: BH/MW109-21

Client: Core Group (2570974 Ontario Inc.) **Project Name:** Geotechnical Investigation **Project No.:** 9574-004

Contractor: Landshark Drilling **Method:** Hollow Stem Auger **Date Completed:** September 16, 2021

Location: 505 Yonge St., Barrie, ON **UTM:** 17T, 4912949 m N, 607084 m E **Elevation:** 247.04 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
247 / 0		TOPSOIL: Black topsoil, some organics, compact, moist	1A						Monument	
			1B	SS	95	12			Cap	Top of Standpipe (TOS) elevation: 248.19 mASL. Groundwater measured at 1.77 mbgs (245.27 mASL.) on September 24, 2021
		SANDY SILT: Brown sandy silt, trace gravel, compact, moist, FILL	2	SS	95	13				
246 / 1										
		SANDY SILT: Brown sandy silt, some clay, trace gravel, compact, moist	3	SS	100	18			Cuttings	
245 / 2										
		-dense	4	SS	70	43				
244 / 3		-wet	5	SS	65	44				Wet soils encountered at 3.0 mbgs during the investigation
									PVC Standpipe	
243 / 4										
		-grey	6	SS	75	48				GSA SS6: 5% Gravel 29% Sand 55% Silt 11% Clay
242 / 5										
									Bentonite Plug	
241 / 6		SILTY SAND: Grey silty sand, trace gravel, very dense, wet	7	SS	40	50/ 175 mm				
240 / 7										
			8	SS	80	50/ 225 mm				
239 / 8										

Logged By: C. Malliaros **Input By:** C. Malliaros

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Log of Borehole: BH/MW109-21

Client: Core Group (2570974 Ontario Inc.) **Project Name:** Geotechnical Investigation **Project No.:** 9574-004

Contractor: Landshark Drilling **Method:** Hollow Stem Auger **Date Completed:** September 16, 2021

Location: 505 Yonge St., Barrie, ON **UTM:** 17T, 4912949 m N, 607084 m E **Elevation:** 247.04 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
238 — 9									Sand Pack	
			9	SS	80	50/ 125 mm			PVC Screen	
237 — 10										
			10	SS	100	50/ 250 mm				
236 — 11										
235 — 12			11	SS	100	50/ 225 mm				
234 — 13										
			12	SS	100	50/ 250 mm			Cap	
233 — 14										
		Borehole terminated in SILTY SAND at 14.0 mbgs due to exploration depth achieved								
232 — 15										

Logged By: C. Malliaros **Input By:** C. Malliaros

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Log of Borehole: BH/MW110-21

Client: Core Group (2570974 Ontario Inc.) **Project Name:** Geotechnical Investigation **Project No.:** 9574-004

Contractor: Landshark Drilling **Method:** Hollow Stem Auger **Date Completed:** September 16, 2021

Location: 505 Yonge St., Barrie, ON **UTM:** 17T, 4912935 m N, 607174 m E **Elevation:** 243.90 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0		ASPHALT: (75 mm)							Flushmount	Top of Standpipe (TOS) elevation: 243.73 mASL. Groundwater measured at 4.33 mbgs (239.58 mASL.) on September 24, 2021
		GRAVELLY SAND: Brown gravelly sand, compact, moist, FILL	1A	GS	-	-			Cap	
			1B							
243 — 1		SAND: Brown sand, some gravel, very loose, moist, FILL	2	SS	80	4			Cuttings	
		-loose								
			3	SS	60	6				
242 — 2										
		-very loose	4	SS	90	2			PVC Standpipe	
									Bentonite Plug	
241 — 3										
		SAND: Grey sand, some silt, very loose, moist	5	SS	80	2				
240 — 4										
		-compact	6	SS	100	22				
239 — 5										
									Sand Pack	
238 — 6									PVC Screen	
		SILTY SAND: Grey silty sand, dense, moist	7	SS	90	35				
237 — 7										
		-compact	8	SS	90	29			Cap	
236 — 8										
		Borehole terminated in SILTY SAND at 8.0 mbgs due to exploration depth achieved								No wet soils encountered during the investigation
235 — 9										

Logged By: C. Malliaros **Input By:** C. Malliaros

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Log of Borehole: BH/MW111-21

Client: Core Group (2570974 Ontario Inc.) **Project Name:** Geotechnical Investigation **Project No.:** 9574-004

Contractor: Walker Drilling **Method:** Tripod **Date Completed:** September 22, 2021

Location: 505 Yonge St., Barrie, ON **UTM:** 17T, 4912971 m N, 607162 m E **Elevation:** 239.61 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
239 / 0		TOPSOIL: Black topsoil, some sand, some silt, some organics, wet, compact	1A / 1B	SS	50	11			Monument; Cap; Bentonite Plug; PVC Standpipe	Top of Standpipe (TOS) elevation: 239.78 mASL. Groundwater measured at 1.83 mbgs (237.93 mASL.) on September 24, 2021
238 / 1		SAND: Brown sand, trace gravel, trace silt, compact, moist -saturated	2	SS	10	29				
237 / 2		GRAVELLY SAND: Grey gravelly sand, some silt, very dense, saturated	3	SS	60	50/ 230 mm			Sand Pack; PVC Screen	Wet soils encountered at 1.5 mbgs during the investigation GSA SS3: 32% Gravel 53% Sand 15% Silt and Clay
			4	SS	20	50/ 75 mm				
236 / 3			5	SS	40	50/ 75 mm			Cap	
235 / 4		Borehole terminated in GRAVELLY SAND at 3.5 mbgs due to exploration depth achieved								
234 / 5										
233 / 6										
232 / 7										
231 / 8										
9										

Logged By: B. White **Input By:** C. Malliaros

Terraprobe

LOG OF BOREHOLE ..7..

PROJECT NAME: 505 Yonge Street
PROJECT No.: 3-09-5016
CLIENT: Melchior Management Corp
BORING DATE: March 30, 2009
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D50 Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE	PENETRATION RESISTANCE PLOT (20 40 60 80) / SHEAR STRENGTH kPa (20 40 60 80)	WATER CONTENT (%) (10 20 30)	INSTALLATION INFORMATION
0	GROUND SURFACE		242.9						
	75mm – TOPSOIL Brown Loose Moist to Wet		0.0	1	SS	17	x	o	
1	SAND & SILT, trace gravel, trace organics, FILL			2	SS	8	x	o	▽ 0.9m Bentonite Seal
2				3	SS	8	x	o	
			240.8						
	Brown Dense to Very Dense Moist		2.1	4	SS	36	x	o	
3	SAND & SILT, trace gravel, trace clay, TILL			5	SS	50/150mm		o	
4									
5				6	SS	46	x	o	▼ 4.6m
6									
7				7	SS	50/150mm		o	
8			234.8	8	SS	50/75mm		o	
	End of Borehole		8.1						
9									

1. Borehole caved and water level noted at 0.9m upon completion of drilling.

2. Water level on April 1, 2009 measured at 4.6m (elev. 238.3m).

Appendix C
Grain Size Analyses

Grain Size Distribution Chart

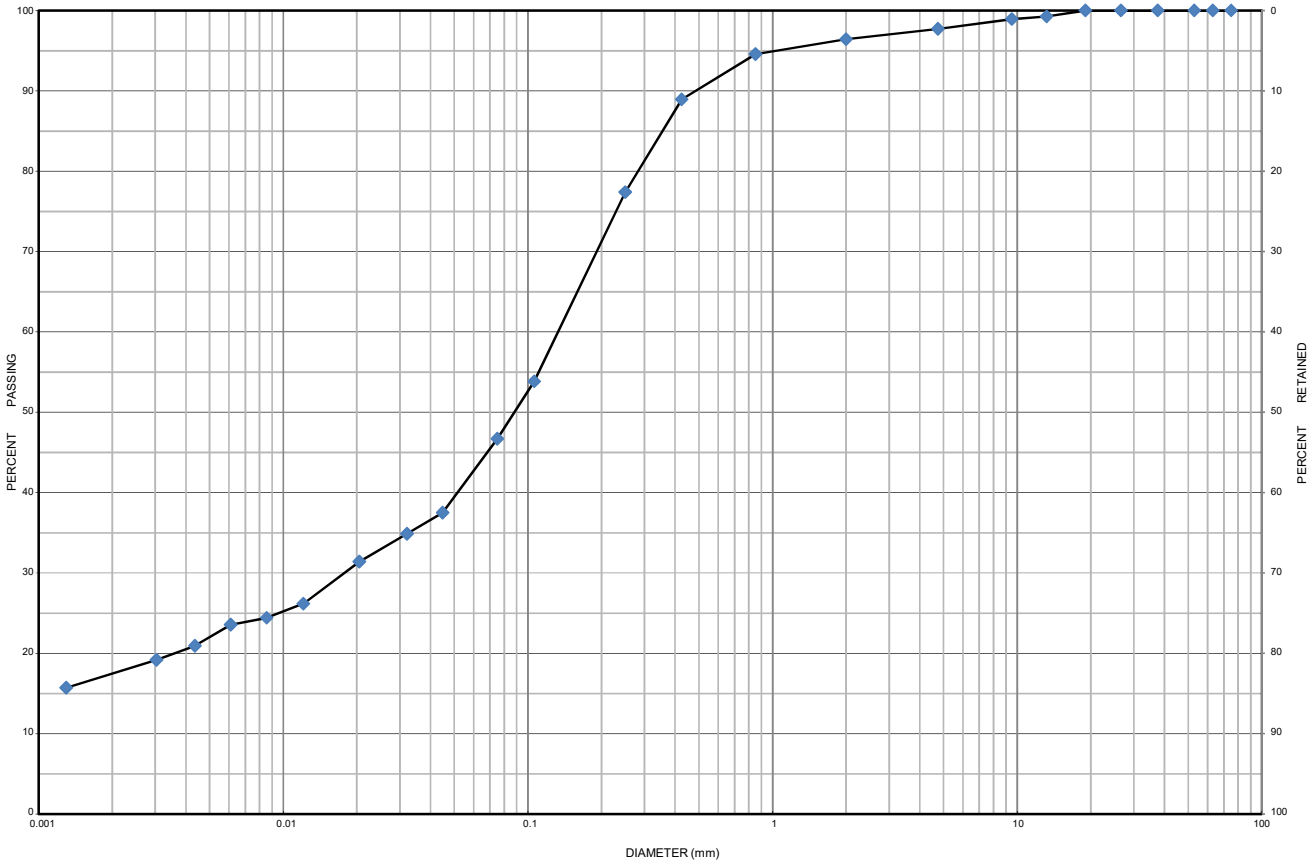
Project Number: *9574-001* **Client:** *iViva Homes*

Project Name: *Geotechnical - 505 Yonge St, Barrie, ON*

Sample Date: *Aug 14, 15, 26, 27, Oct 15, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 101-19 SS 12* **Depth:** *13.7 m to 14.2 m* **Lab Sample No:** *S-19-0886*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-19	SS 12	13.7 m to 14.2 m	2	51	47		8.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Clay trace Gravel		0.140	0.0180	0.0		

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Grain Size Distribution Chart

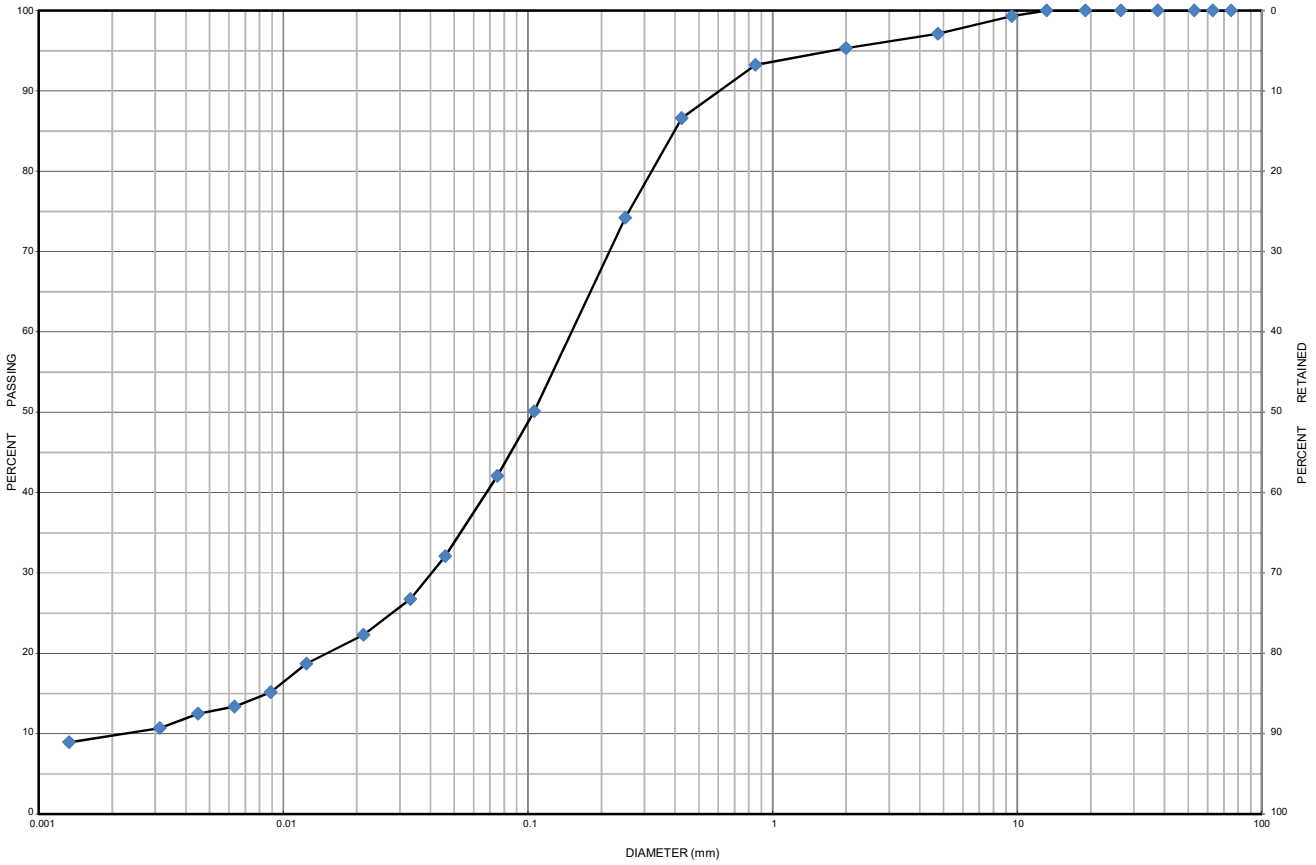
Project Number: *9574-001* **Client:** *iViva Homes*

Project Name: *Geotechnical - 505 Yonge St, Barrie, ON*

Sample Date: *Aug 14, 15, 26, 27, Oct 15, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 104-19 SS 7* **Depth:** *6.1 m to 6.6 m* **Lab Sample No:** *S-19-0887*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 104-19	SS 7	6.1 m to 6.6 m	3	55	42		7.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Clay trace Gravel		0.160	0.0400	0.0	80.00	5.00

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Grain Size Distribution Chart

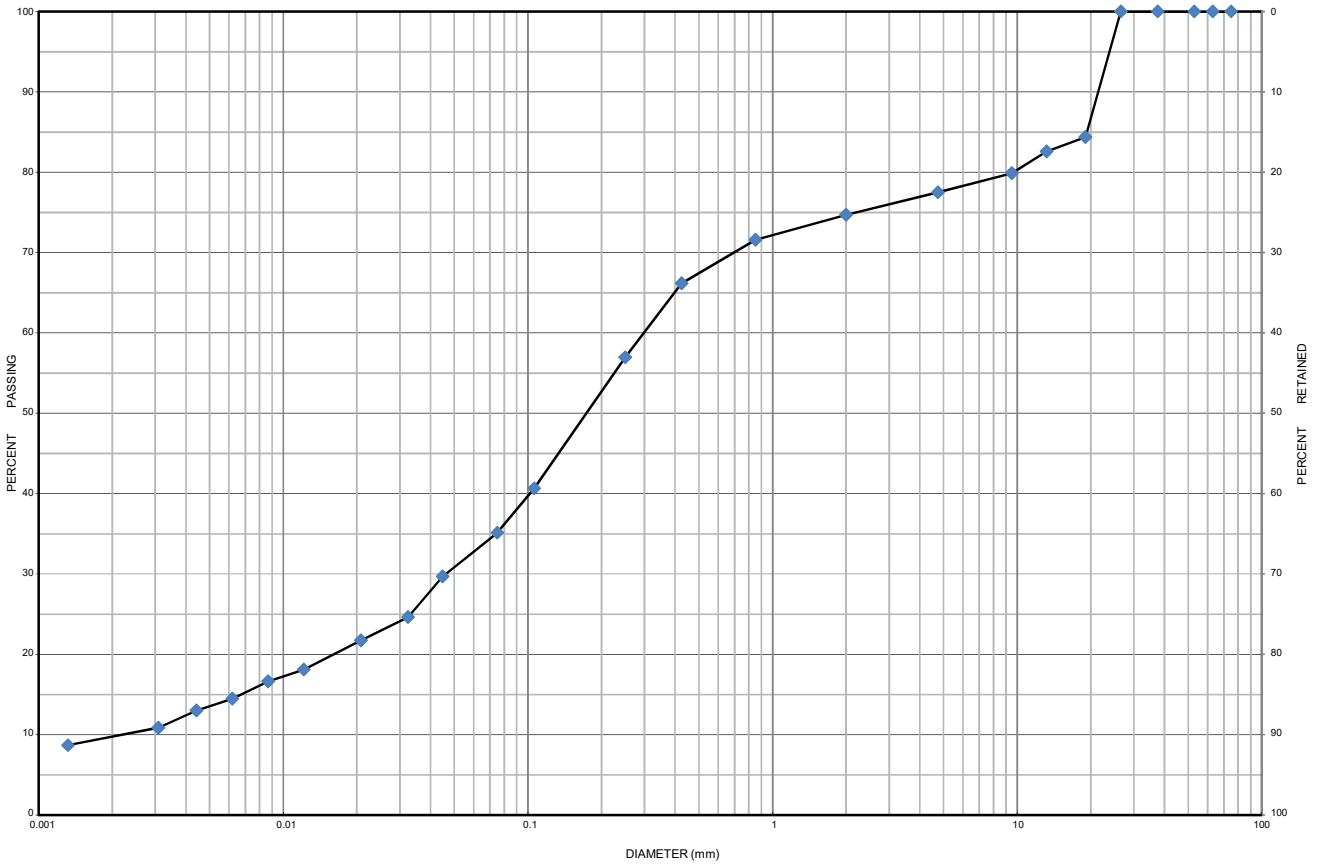
Project Number: *9574-001* **Client:** *iViva Homes*

Project Name: *Geotechnical - 505 Yonge St, Barrie, ON*

Sample Date: *Aug 14, 15, 26, 27, Oct 15, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 103-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-0888*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-19	SS 4	2.3 m to 2.7 m	23	42	35		11.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravelly Silty Sand trace Clay		0.300	0.0450	0.002	150.00	3.38

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Grain Size Distribution Chart

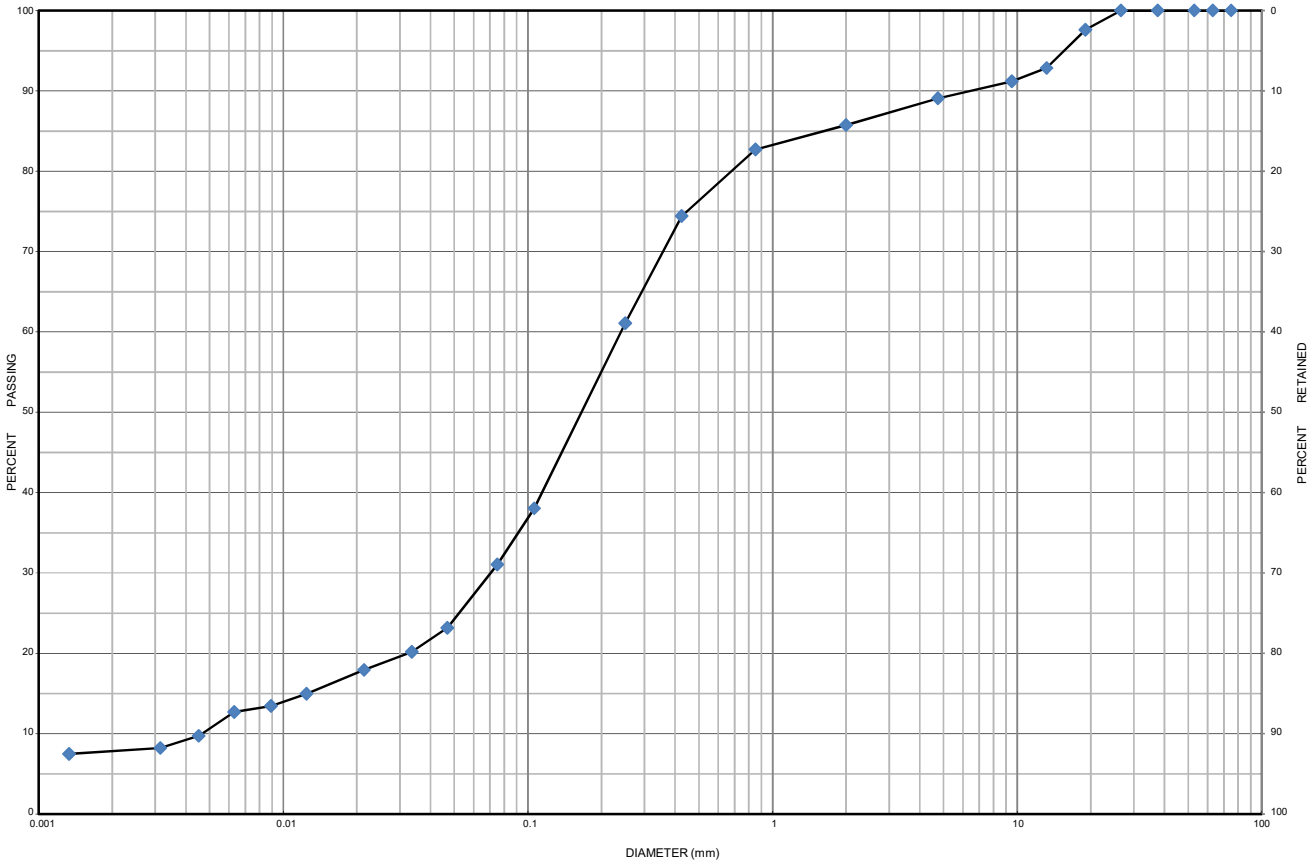
Project Number: *9574-001* **Client:** *iViva Homes*

Project Name: *Geotechnical - 505 Yonge St, Barrie, ON*

Sample Date: *Aug 14, 15, 26, 27, Oct 15, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 106-19 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-19-0889*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 106-19	SS 6	4.6 m to 5 m	11	58	31		8.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Gravel trace Clay		0.240	0.0700	0.0045	53.33	4.54

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Grain Size Distribution Chart

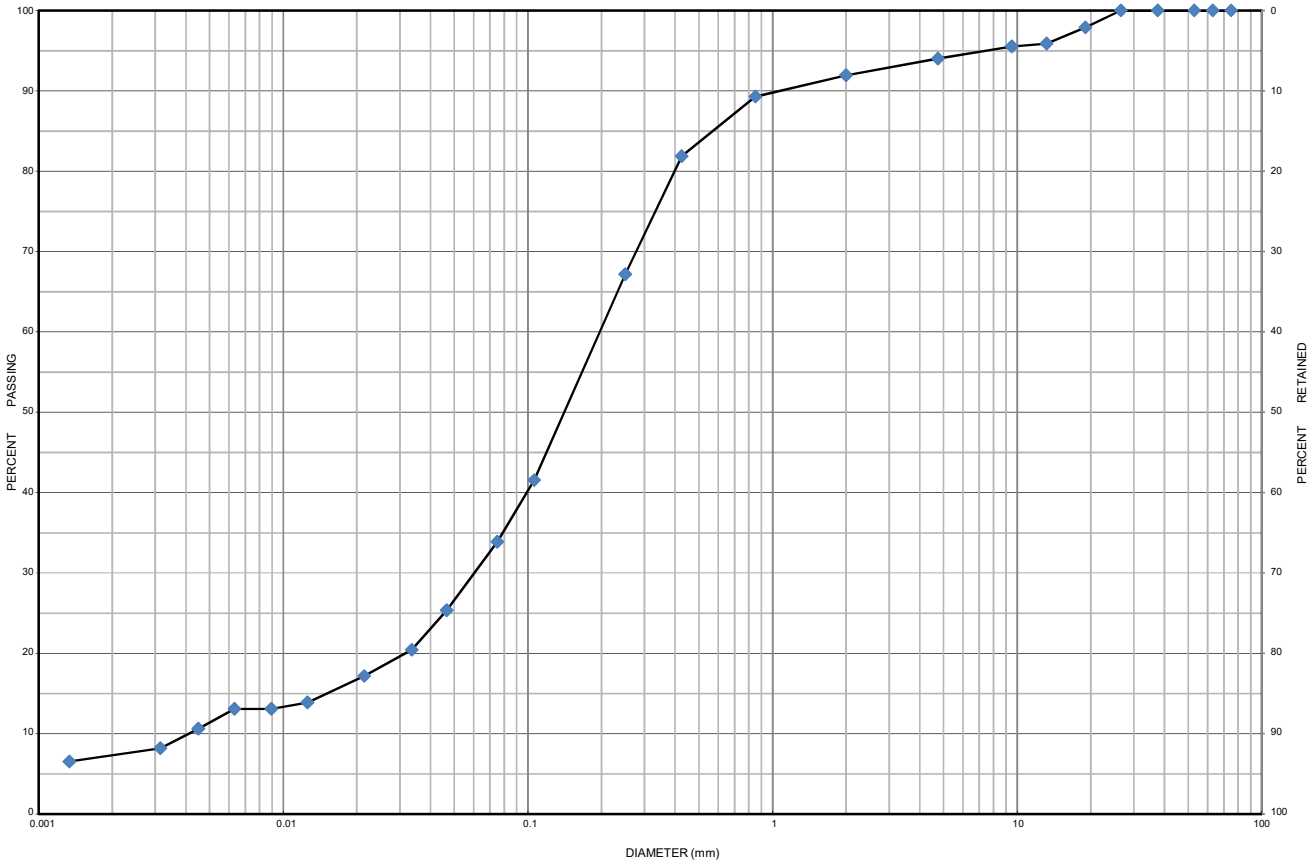
Project Number: *9574-001* **Client:** *iViva Homes*

Project Name: *Geotechnical - 505 Yonge St, Barrie, ON*

Sample Date: *Aug 14, 15, 26, 27, Oct 15, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 107-19 SS 2* **Depth:** *0.8 m to 1.2 m* **Lab Sample No:** *S-19-0890*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 107-19	SS 2	0.8 m to 1.2 m	6	60	34		9.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Gravel trace Clay		0.190	0.0500	0.003	63.33	4.39

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Grain Size Distribution Chart

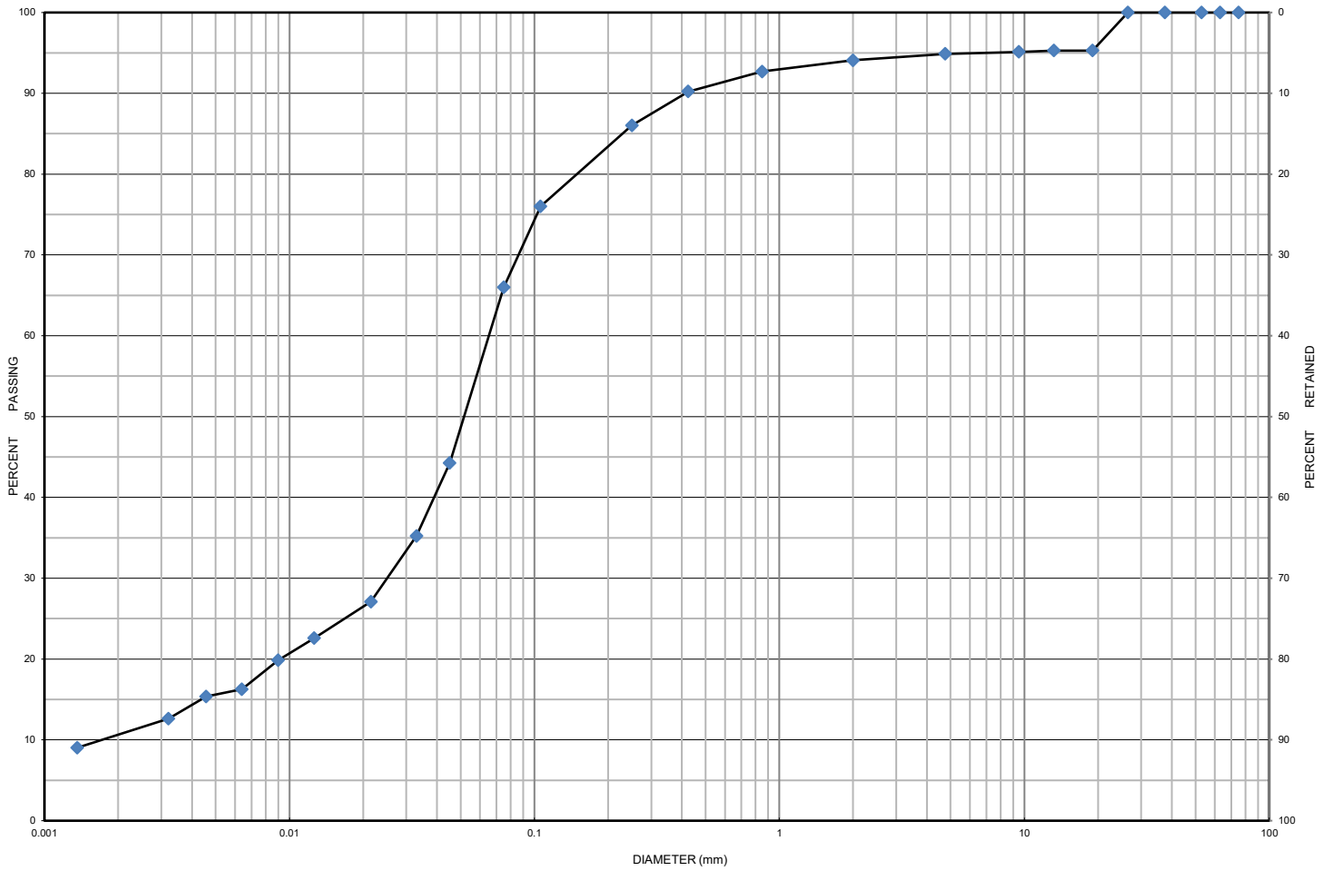
Project Number: *9574-004* **Client:** *Renaissance Retirment Barrie Trust*

Project Name: *505 Yonge Street, Barrie*

Sample Date: *September 16, 2021* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 109-21 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-21-1181*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 109-21	SS 6	4.6 m to 5 m	5	29	55	11	14.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt some Clay trace Gravel	ML	0.0660	0.0150	0.0017	38.82	2.01

Additional information available upon request

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Grain Size Distribution Chart

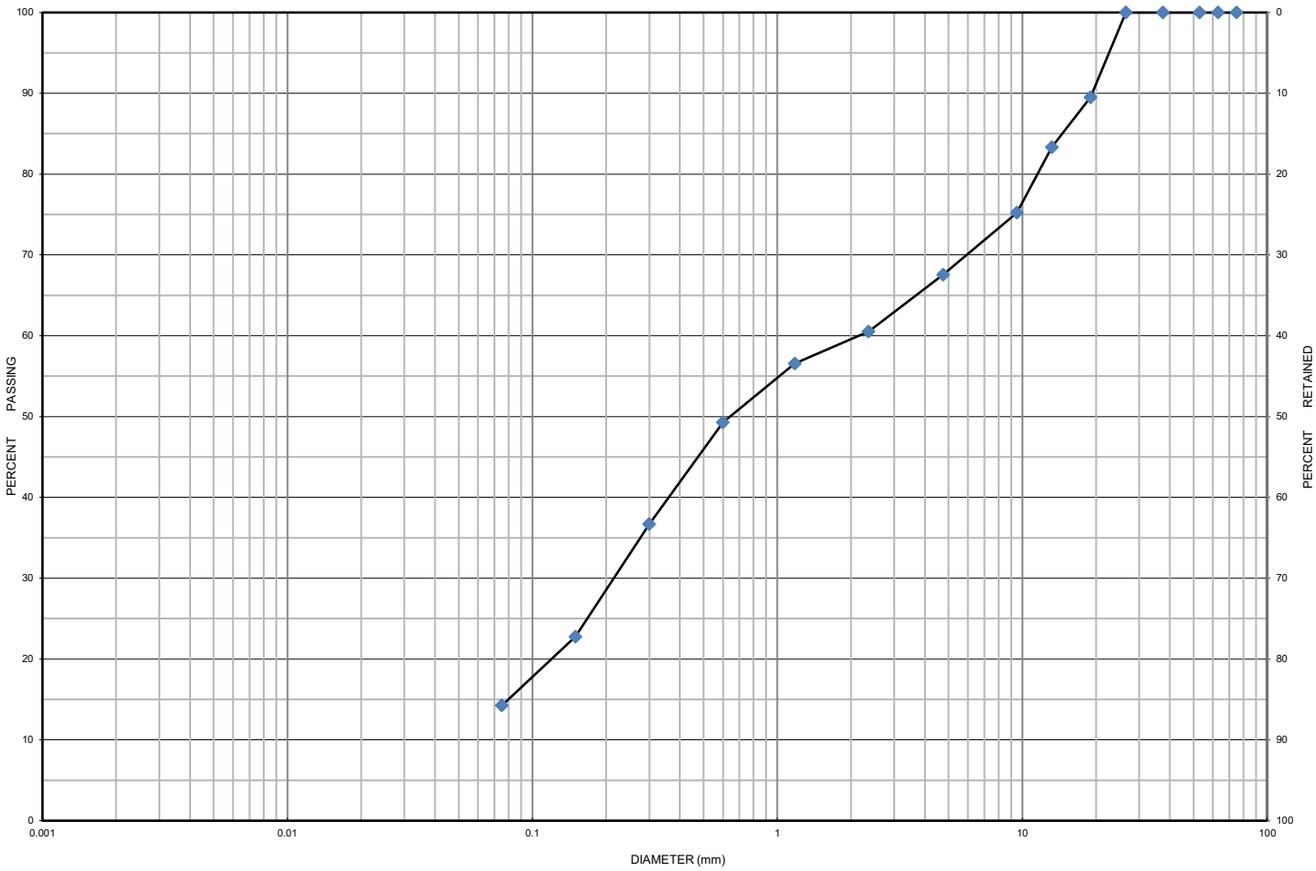
Project Number: *9574-004* **Client:** *Renaissance Retirment Barrie Trust*

Project Name: *505 Yonge Street, Barrie*

Sample Date: *September 22, 2021* **Sampled By:** *Ben White - Cambium Inc.*

Location: *BH 111-21 SS 3* **Depth:** *1.5 m to 1.9 m* **Lab Sample No:** *S-21-1182*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 111-21	SS 3	1.5 m to 1.9 m	32	53	15		9.7

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravelly Sand some Silt	SM	2.115	0.220	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *October 1, 2021*

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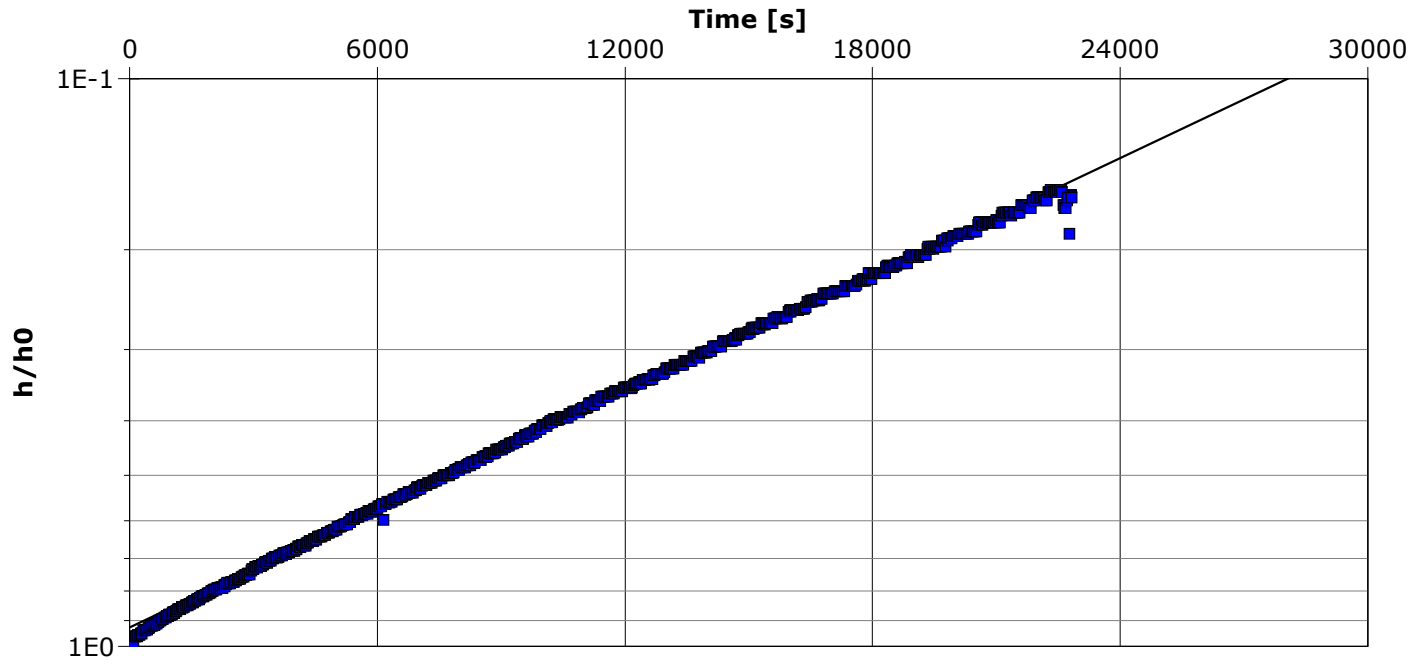
Appendix D
Aquifer Test Analyses

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW102-19	Test Well: MW102-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW102-19 Slug 1 In	Analysis Date: 11/13/19
Aquifer Thickness: 10.73 m		

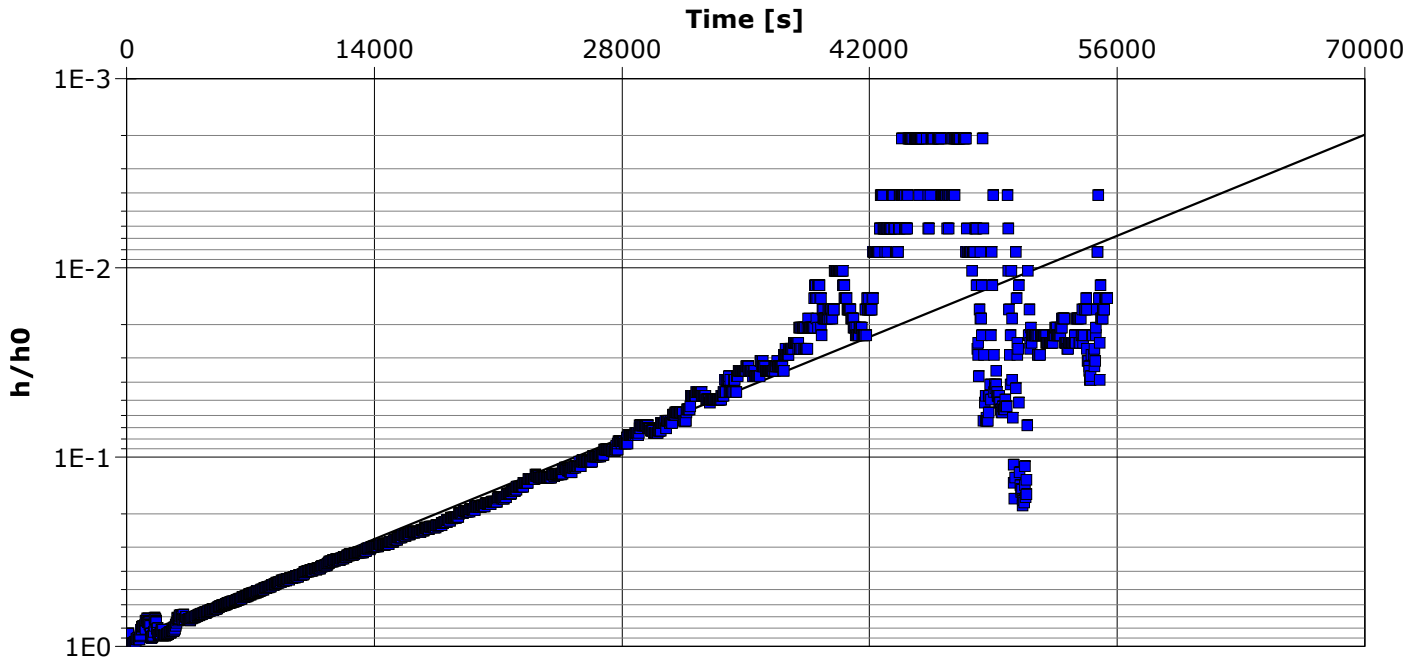


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW102-19	3.98×10^{-8}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW102-19 Slug 1 Out	Test Well: MW102-19
Test Conducted by: Benden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW 102-19 Slug 1 Out	Analysis Date: 11/13/19
Aquifer Thickness: 10.73 m		

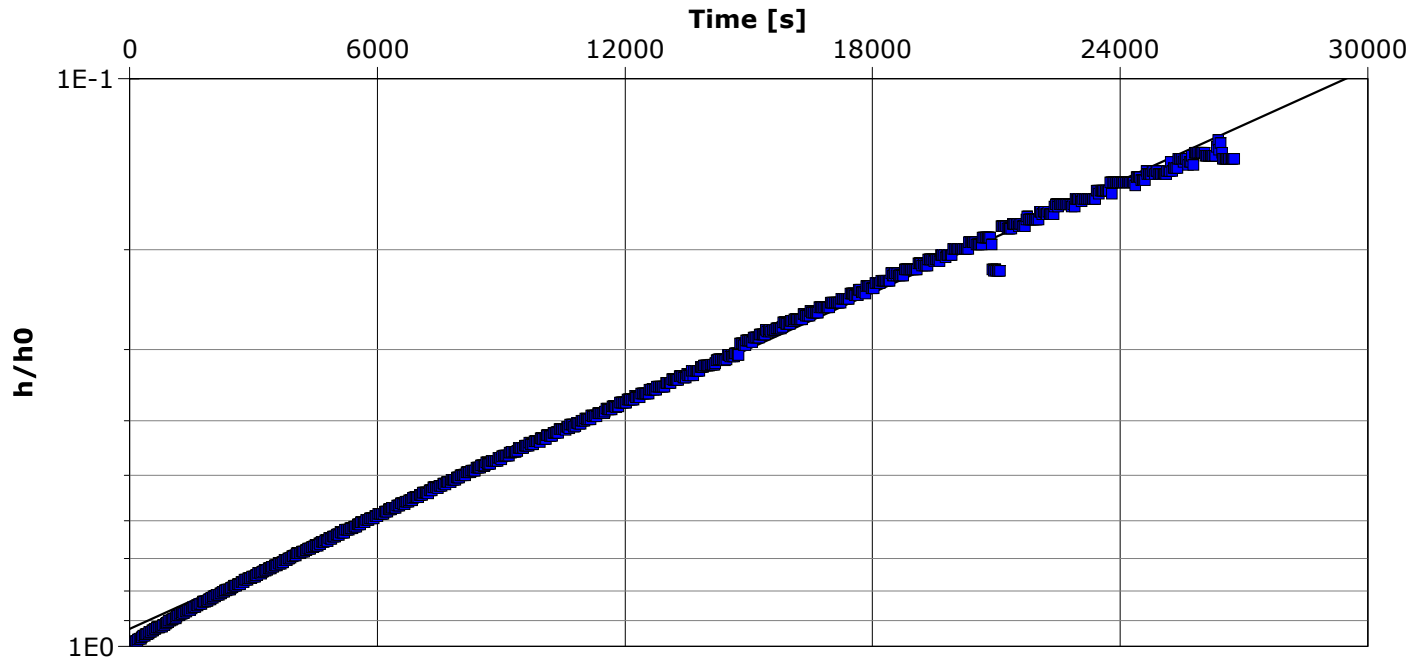


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW102-19	4.41×10^{-8}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW102-19 Slug 2 In	Test Well: MW102-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW102-19 Slug 2 In	Analysis Date: 11/13/19
Aquifer Thickness: 10.73 m		

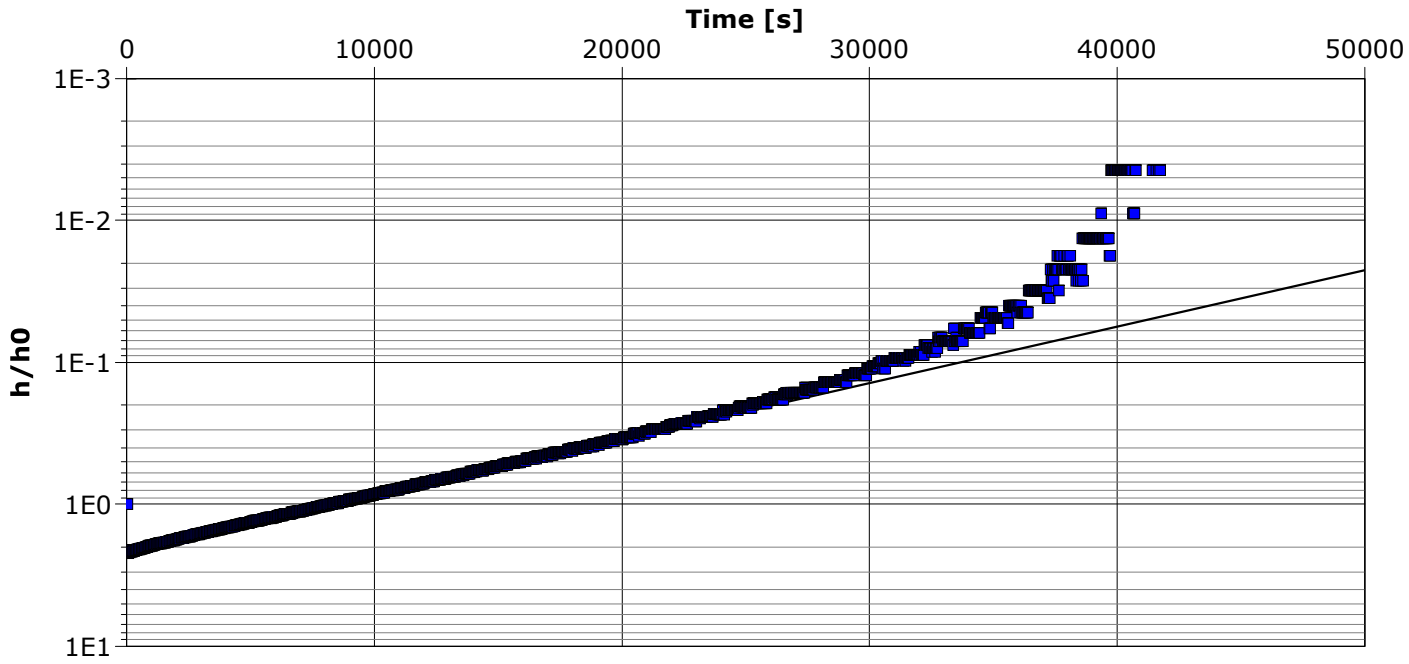


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW102-19	3.80×10^{-8}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report**
	Project: Hydro G Assess.
	Number: 9574-001
	Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW102-19 Slug 2 Out	Test Well: MW102-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW102-19 Slug 2 Out	Analysis Date: 11/13/19
Aquifer Thickness: 10.73 m		

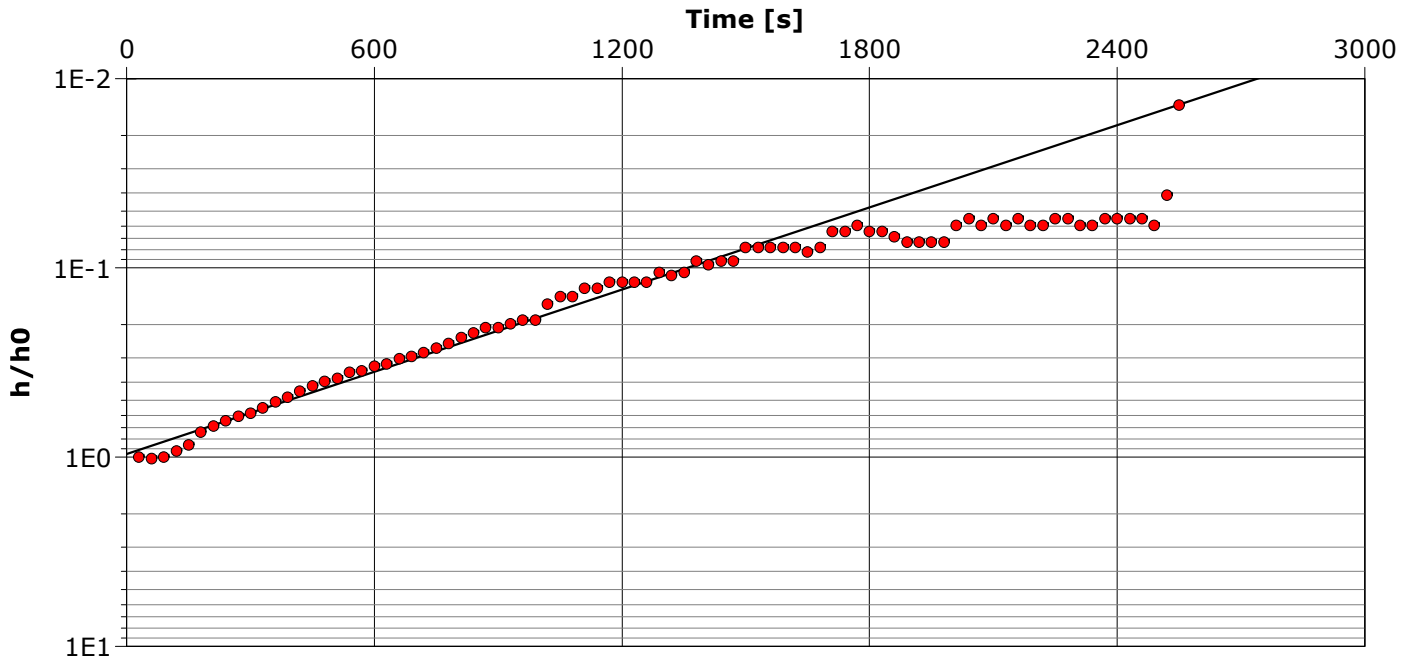


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW102-19	4.60×10^{-8}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW106-19 Slug 1 In	Test Well: MW106-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW106-19 Slug 1 In	Analysis Date: 11/13/19
Aquifer Thickness: 3.84 m		

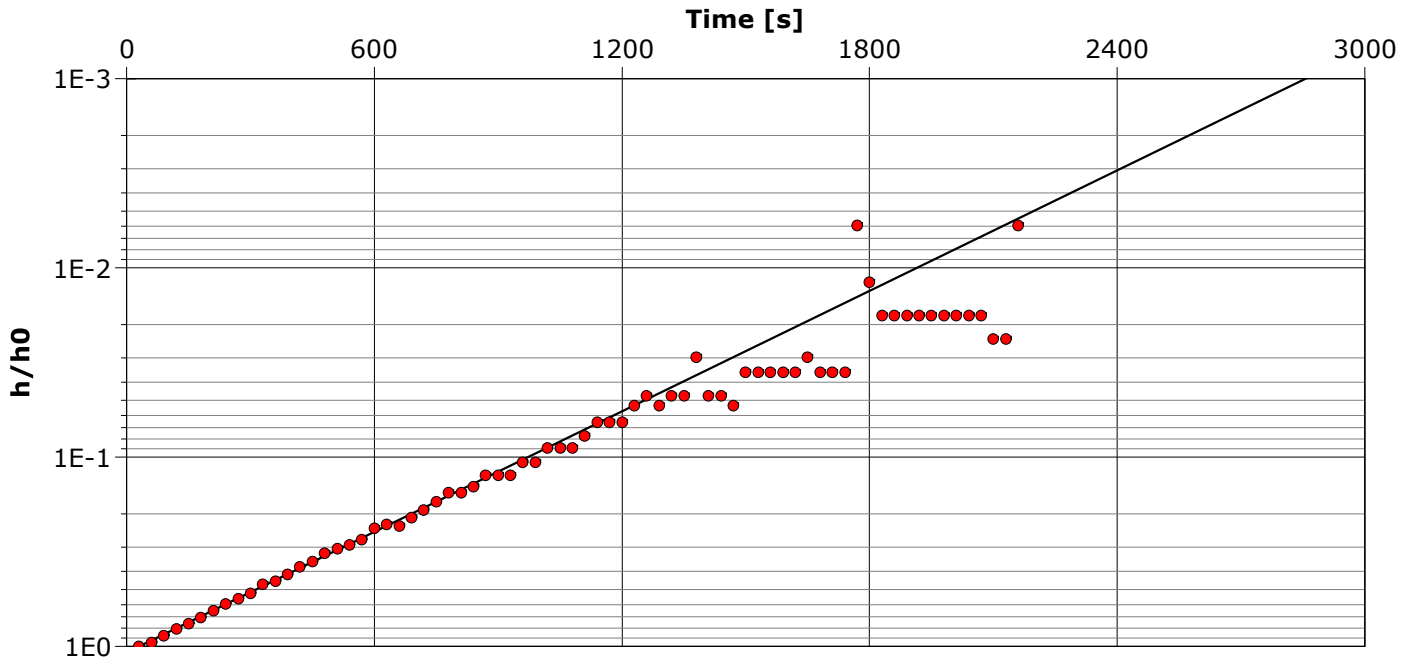


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW106-19	8.38×10^{-7}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW106-19 Slug 1 Out	Test Well: MW106-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW106-16 Slug 1 Out	Analysis Date: 11/13/19
Aquifer Thickness: 3.84 m		

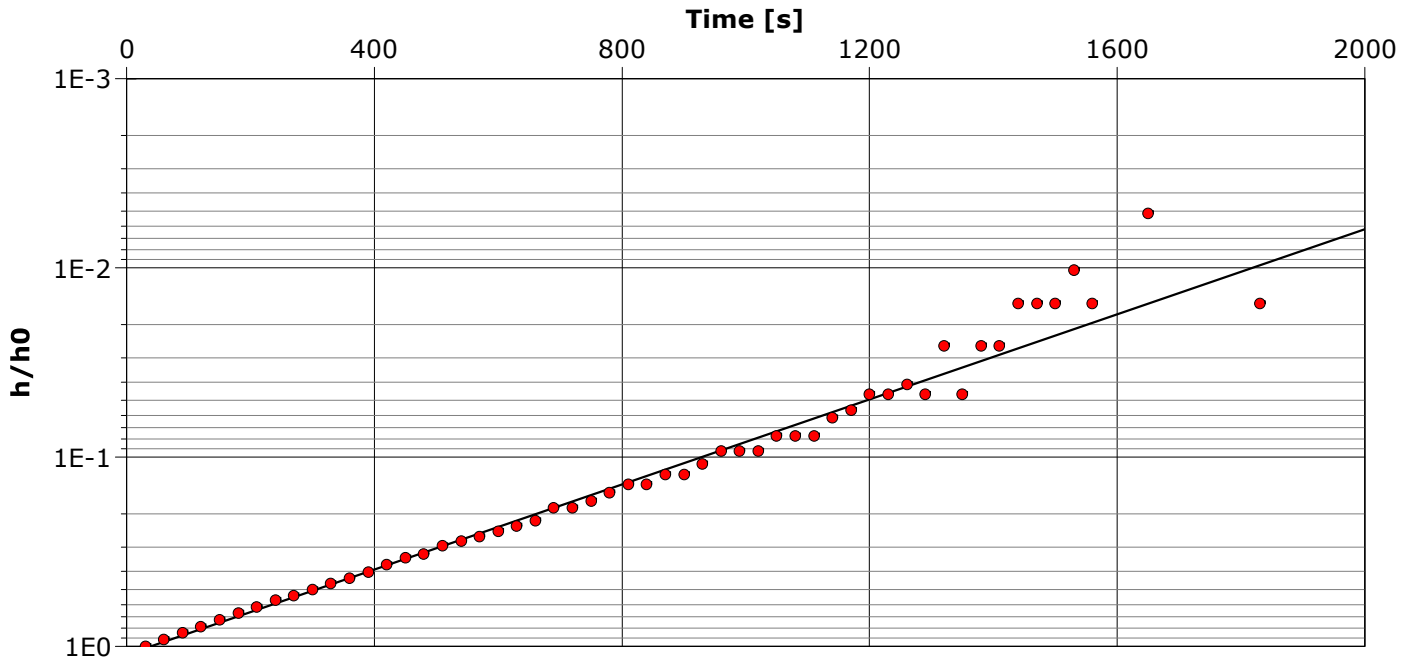


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW106-19	1.23×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW106-19 Slug 2 In	Test Well: MW106-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW106-19 Slug 2 In	Analysis Date: 11/13/19
Aquifer Thickness: 3.84 m		

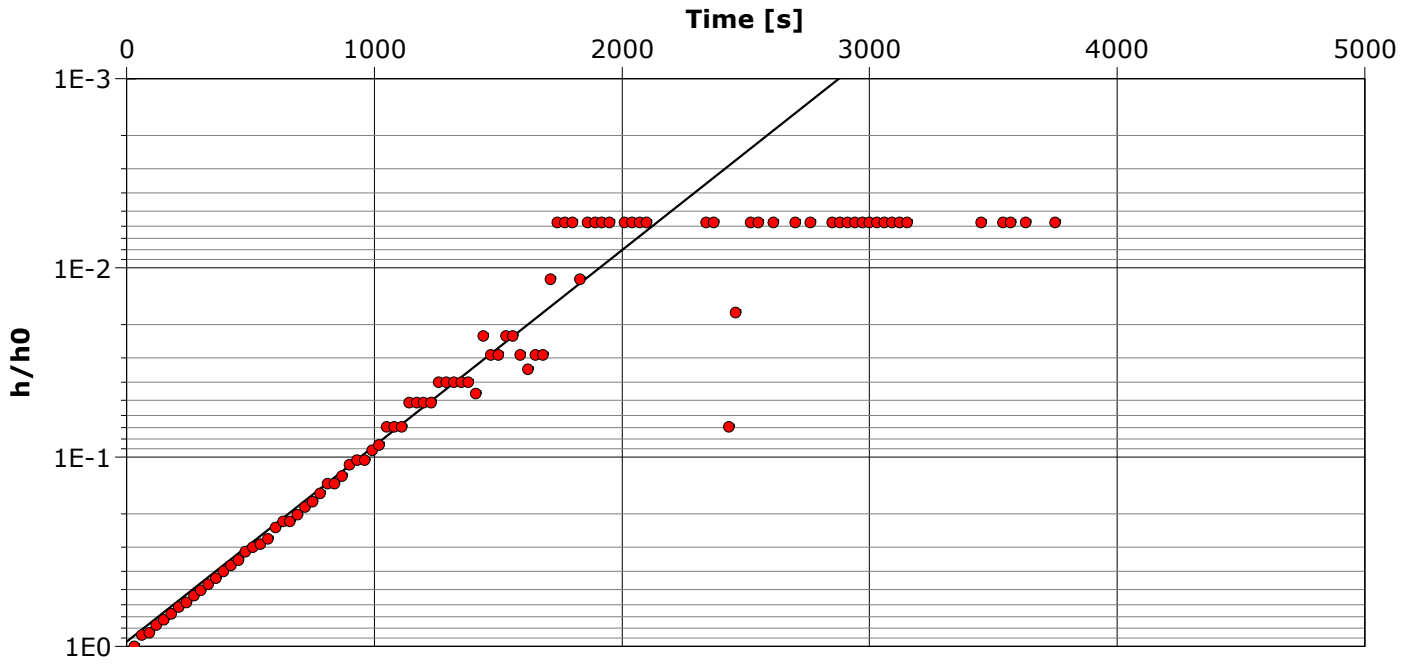


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW106-19	1.30×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydro G Assess. Number: 9574-001 Client: iViva Homes

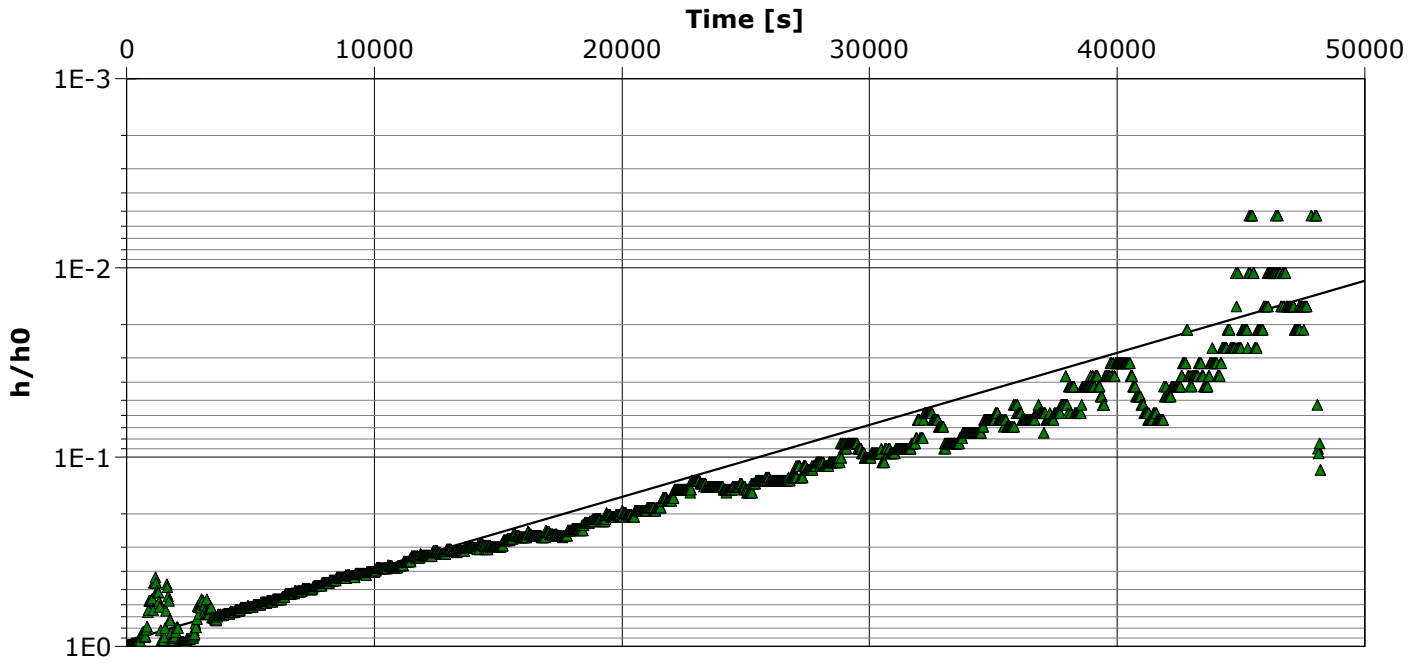
Location: 505 Yonge St. Barrie, ON	Slug Test: MW106-19 Slug 2 Out	Test Well: MW106-19
Test Conducted by: Cameron M		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW106-19 Slug 2 Out	Analysis Date: 11/13/19
Aquifer Thickness: 3.84 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW106-19	1.20×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report**	
	Project: Hydro G Assess.	
	Number: 9574-001	
	Client: iViva Homes	
Location: 505 Yonge St. Barrie, ON	Slug Test: MW108-19 Slug 1 Out	Test Well: MW108-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW108-19 Slug 1 Out	Analysis Date: 11/13/19
Aquifer Thickness: 8.99 m		

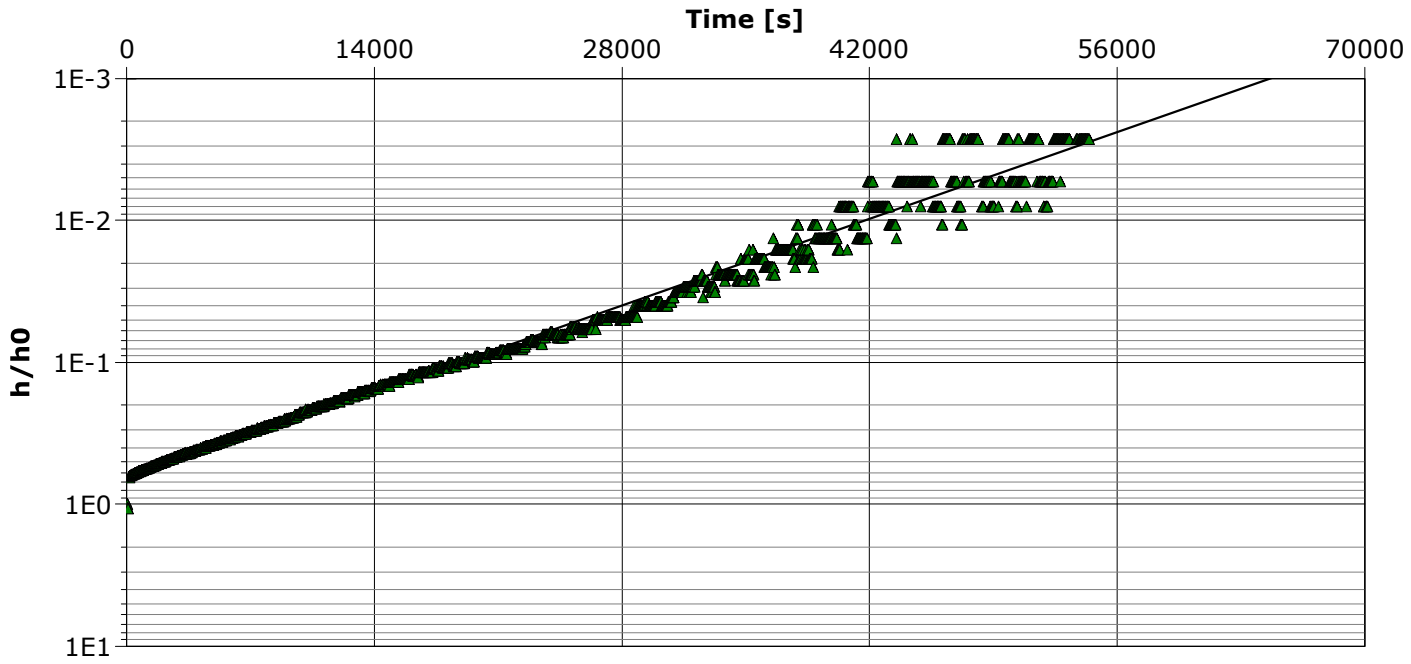


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW108-19	4.40×10^{-8}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report**
	Project: Hydro G Assess.
	Number: 9574-001
	Client: iViva Homes

Location: 505 Yonge St. Barrie, ON	Slug Test: MW108-19 Slug 2 Out	Test Well: MW108-19
Test Conducted by: Brenden H		Test Date: 10/24/19
Analysis Performed by: Cameron M	MW108-19 Slug 2 Out	Analysis Date: 11/13/19
Aquifer Thickness: 8.99 m		

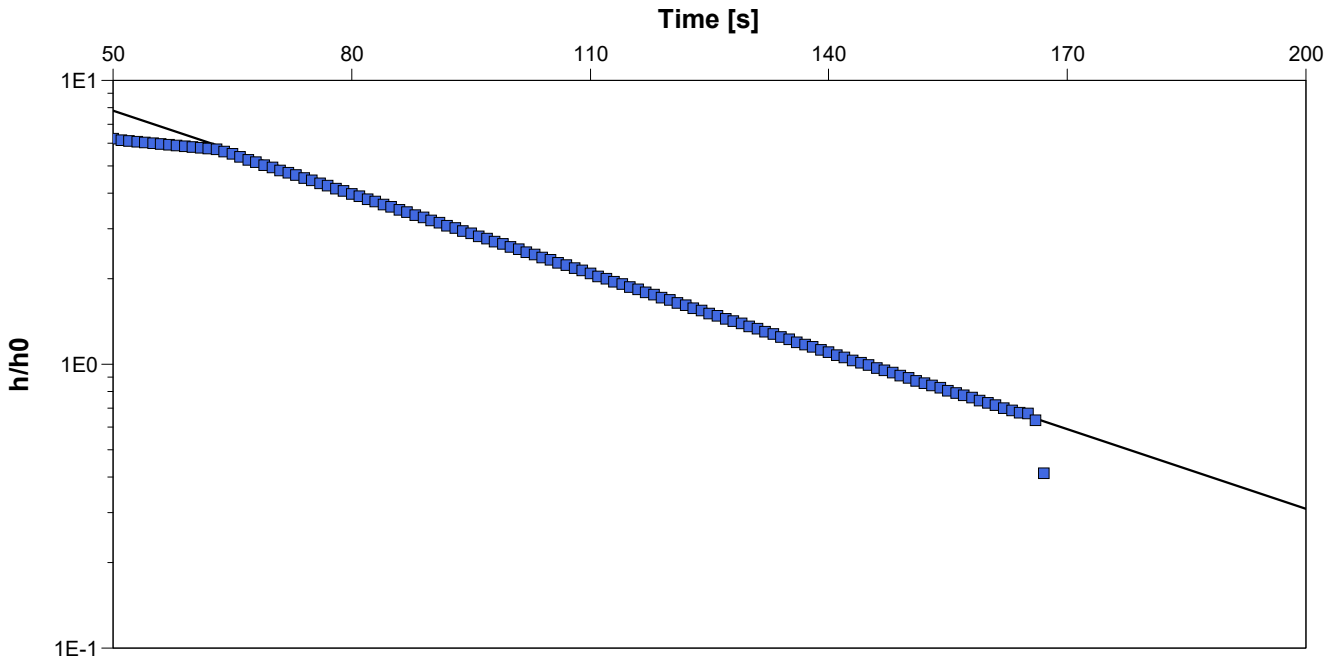


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW108-19	5.05×10^{-8}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH109-21 Slug Test 1	Test Well: BH109-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH109-21 Test 1	Analysis Date: 10/20/2021
Aquifer Thickness: 8.49 m		

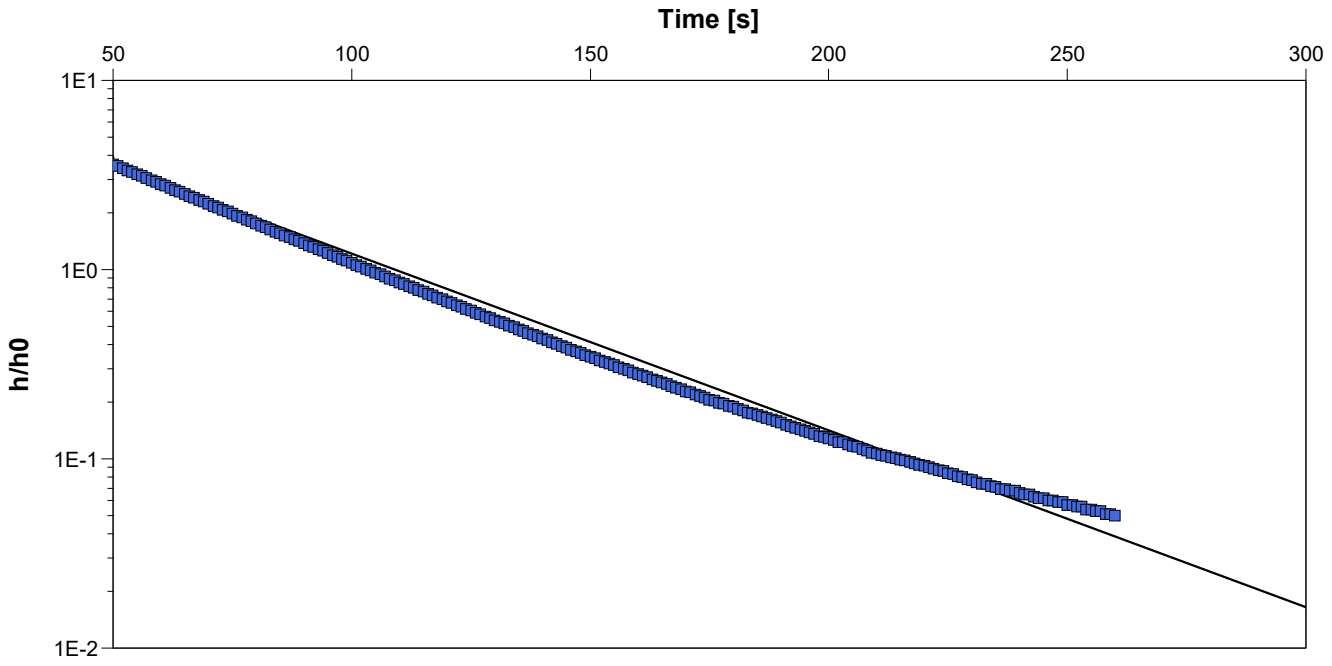


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH109-21	1.08×10^{-5}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH109-21 Slug Test 2	Test Well: BH109-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH109-21 Test 2	Analysis Date: 10/20/2021
Aquifer Thickness: 8.49 m		

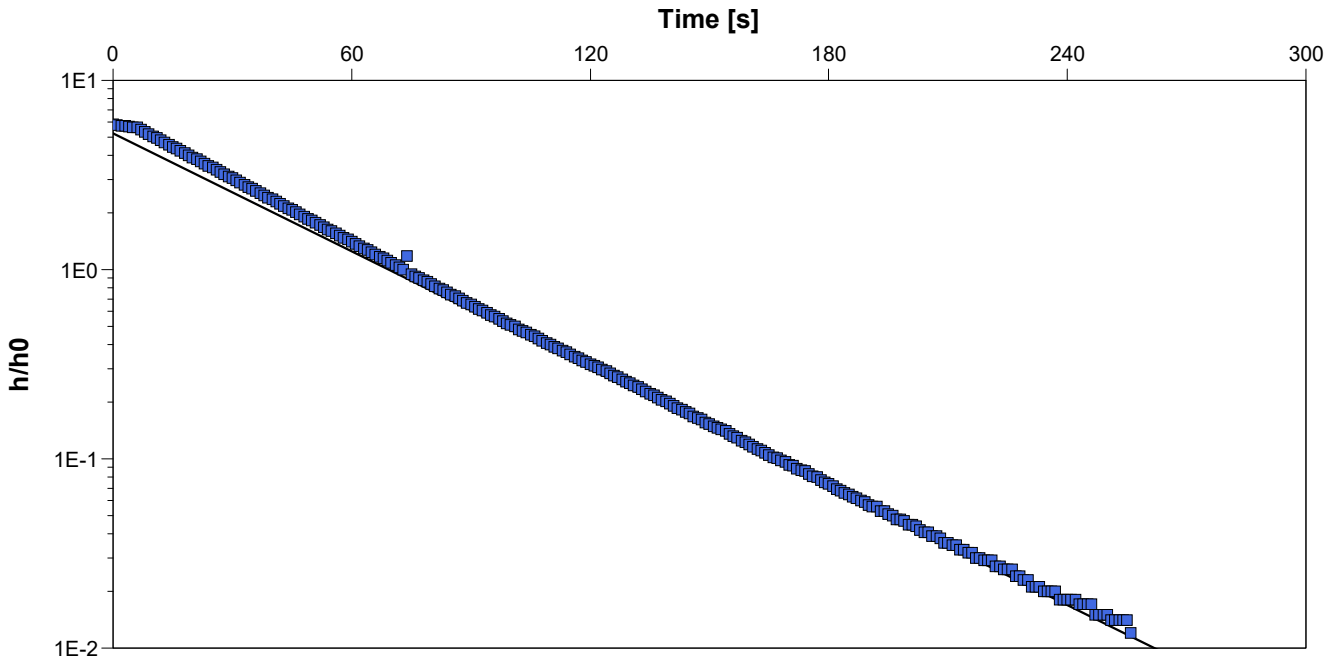


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH109-21	1.08×10^{-5}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH109-21 Slug Test 3	Test Well: BH109-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH109-21 Test 3	Analysis Date: 10/20/2021
Aquifer Thickness: 8.49 m		

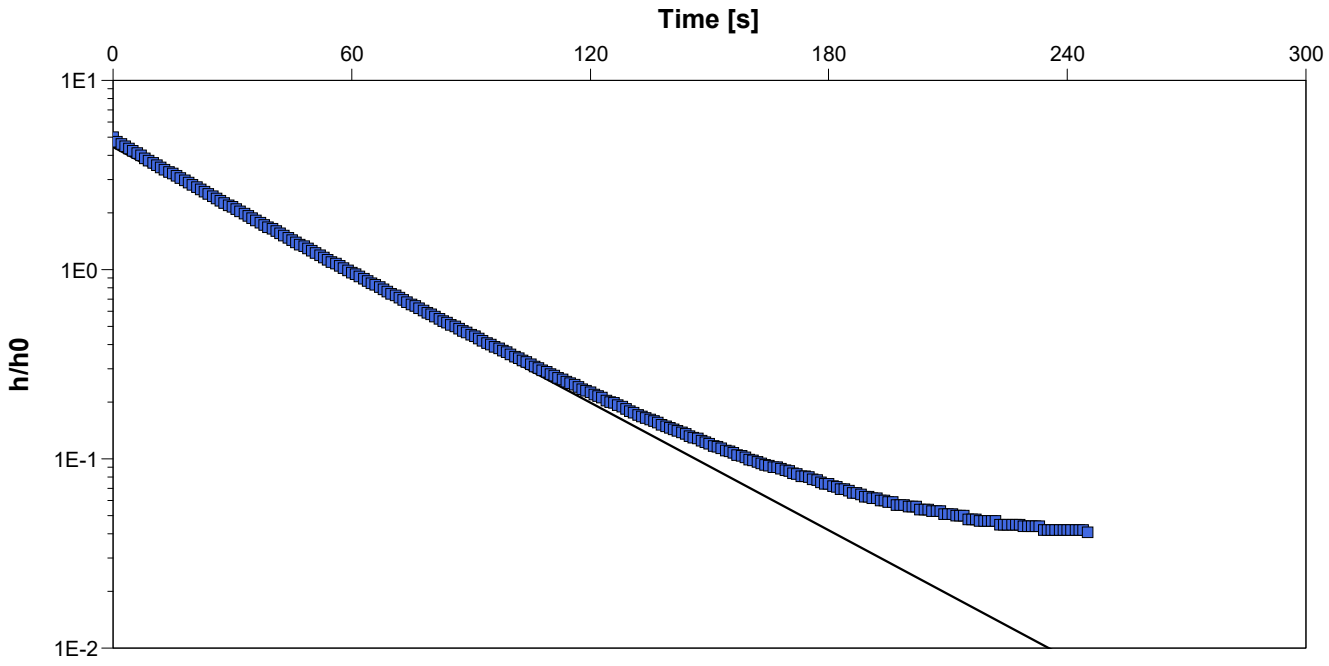


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH109-21	1.20×10^{-5}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH109-21 Slug Test 4	Test Well: BH109-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH109-21 Test 4	Analysis Date: 10/20/2021
Aquifer Thickness: 8.49 m		

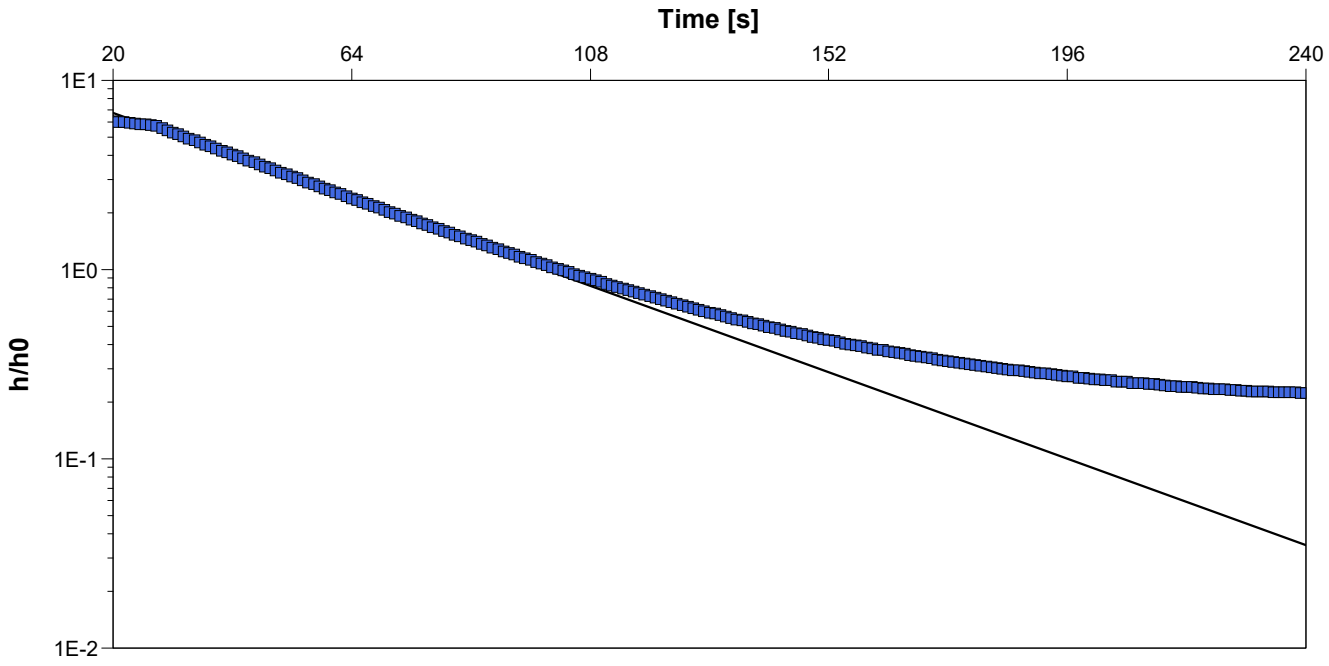


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH109-21	1.30×10^{-5}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

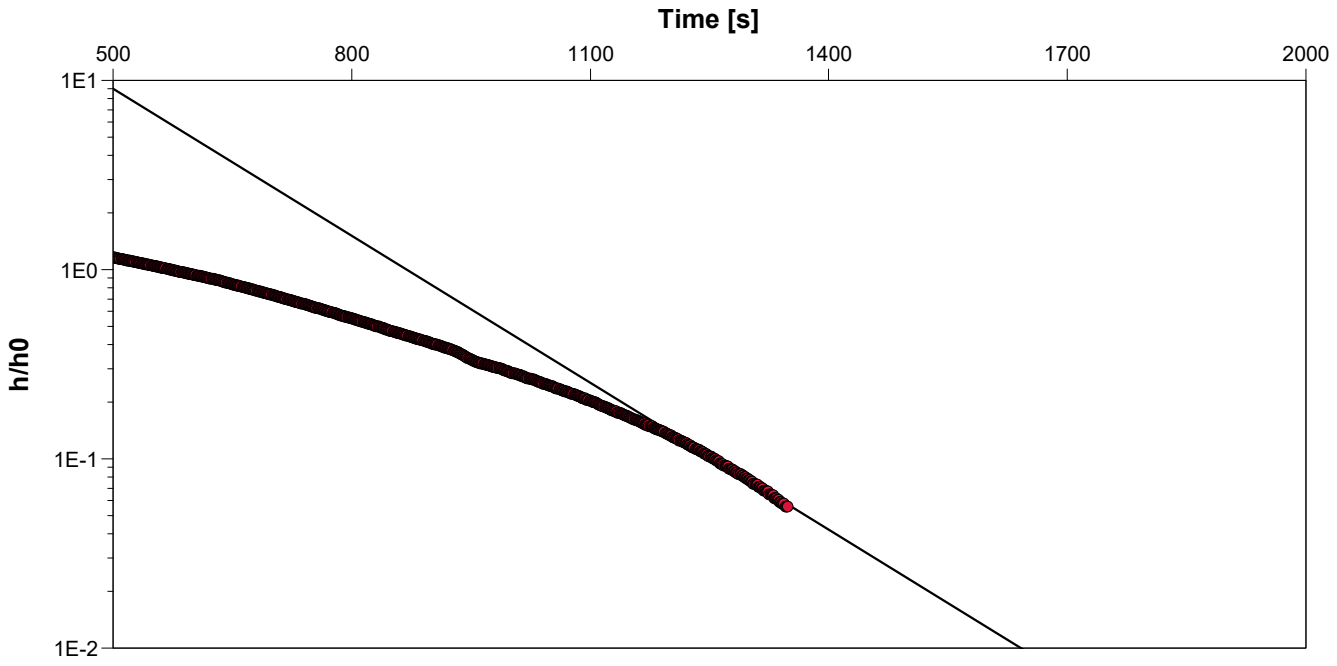
Location: 505 Yonge St., Barrie, ON	Slug Test: BH109-21 Slug Test 5	Test Well: BH109-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH109-21 Test 5	Analysis Date: 10/20/2021
Aquifer Thickness: 8.49 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH109-21	1.20×10^{-5}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	
Location: 505 Yonge St., Barrie, ON	Slug Test: BH110-21 Slug Test 1	Test Well: BH110-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH110-21 Test 1	Analysis Date: 10/20/2021
Aquifer Thickness: 3.38 m		

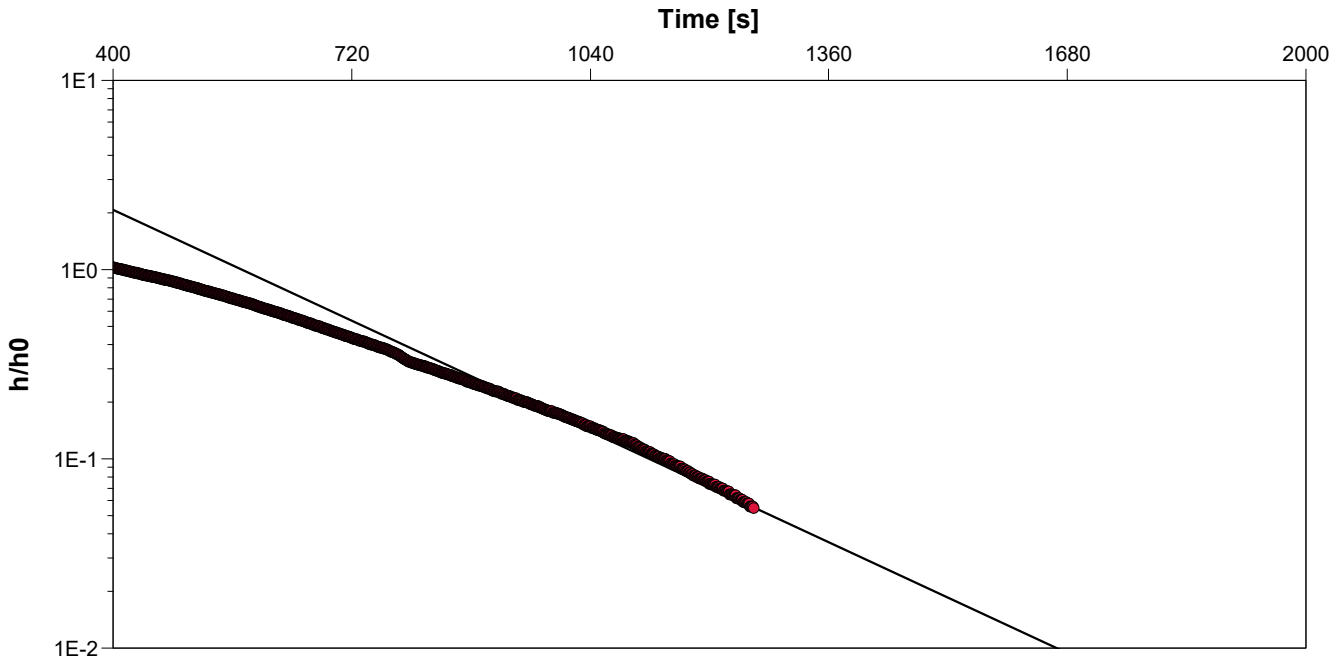


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH110-21	2.99×10^{-6}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH110-21 Slug Test 2	Test Well: BH110-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH110-21 Test 2	Analysis Date: 10/20/2021
Aquifer Thickness: 3.38 m		

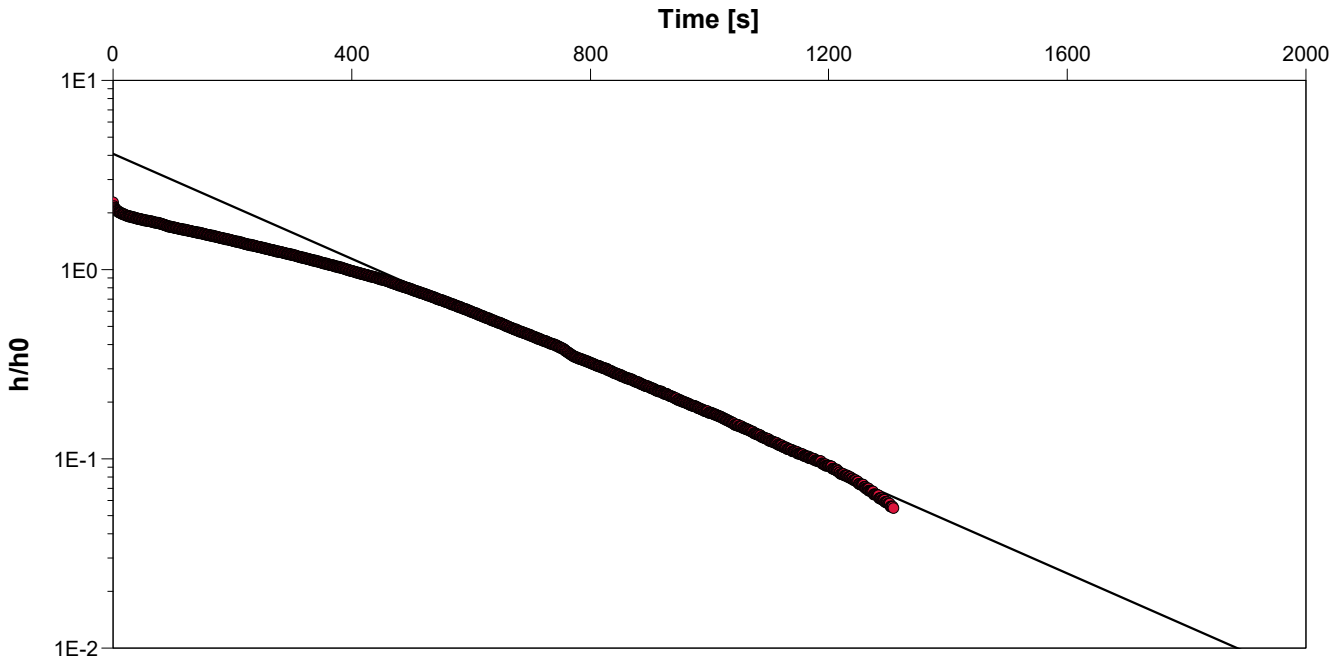


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH110-21	2.12×10^{-6}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH110-21 Slug Test 3	Test Well: BH110-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH110-21 Test 3	Analysis Date: 10/20/2021
Aquifer Thickness: 3.38 m		

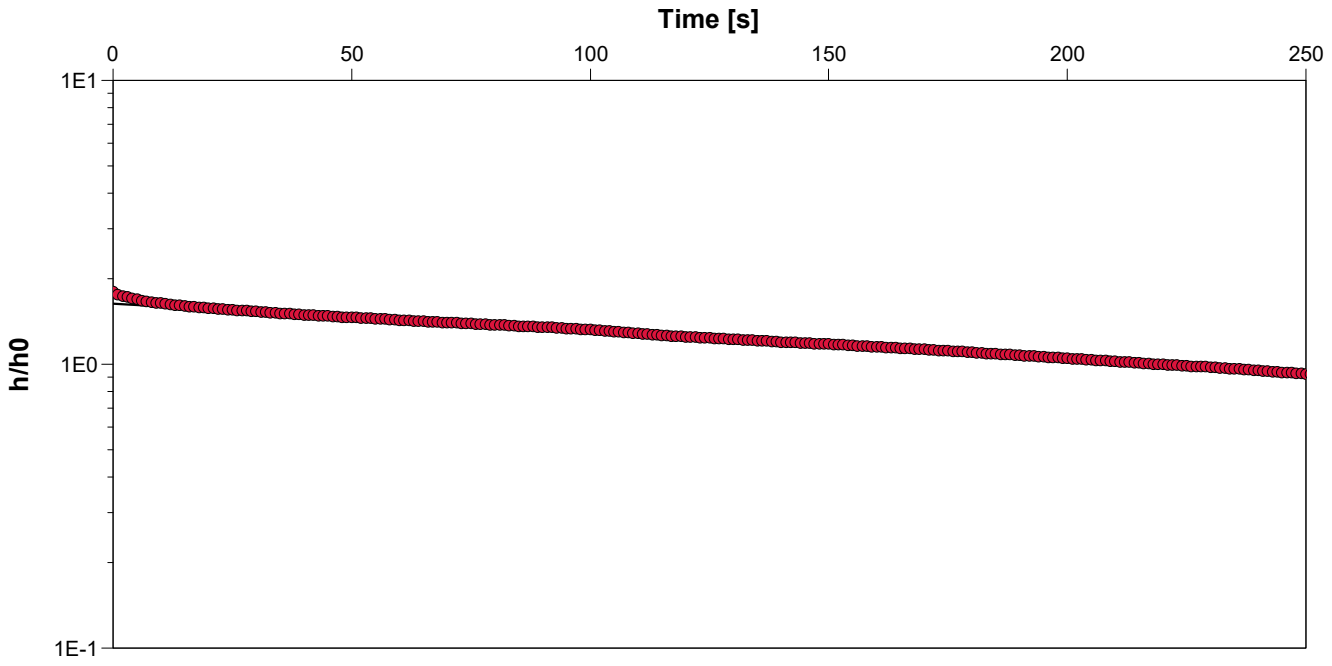


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH110-21	1.60×10^{-6}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH110-21 Slug Test 4	Test Well: BH110-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH110-21 Test 4	Analysis Date: 10/20/2021
Aquifer Thickness: 3.38 m		

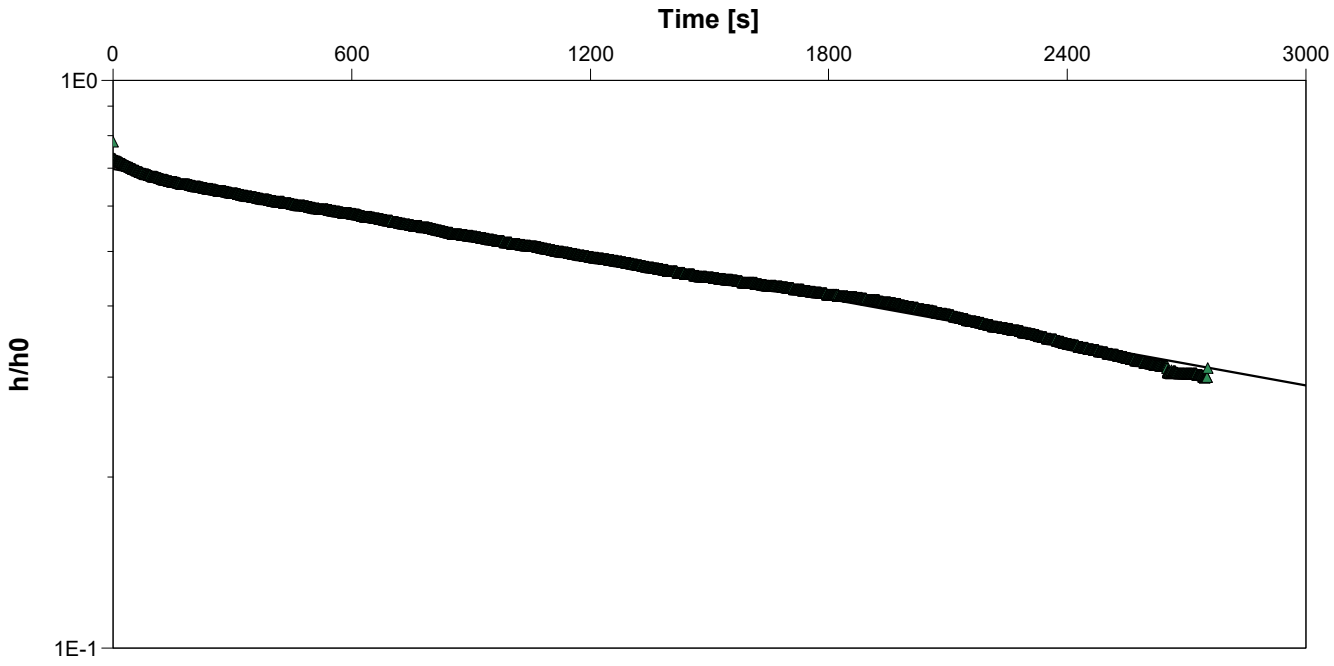


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH110-21	1.08×10^{-6}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH111-21 Slug Test 1	Test Well: BH111-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH111-21 Test 1	Analysis Date: 10/20/2021
Aquifer Thickness: 1.34 m		

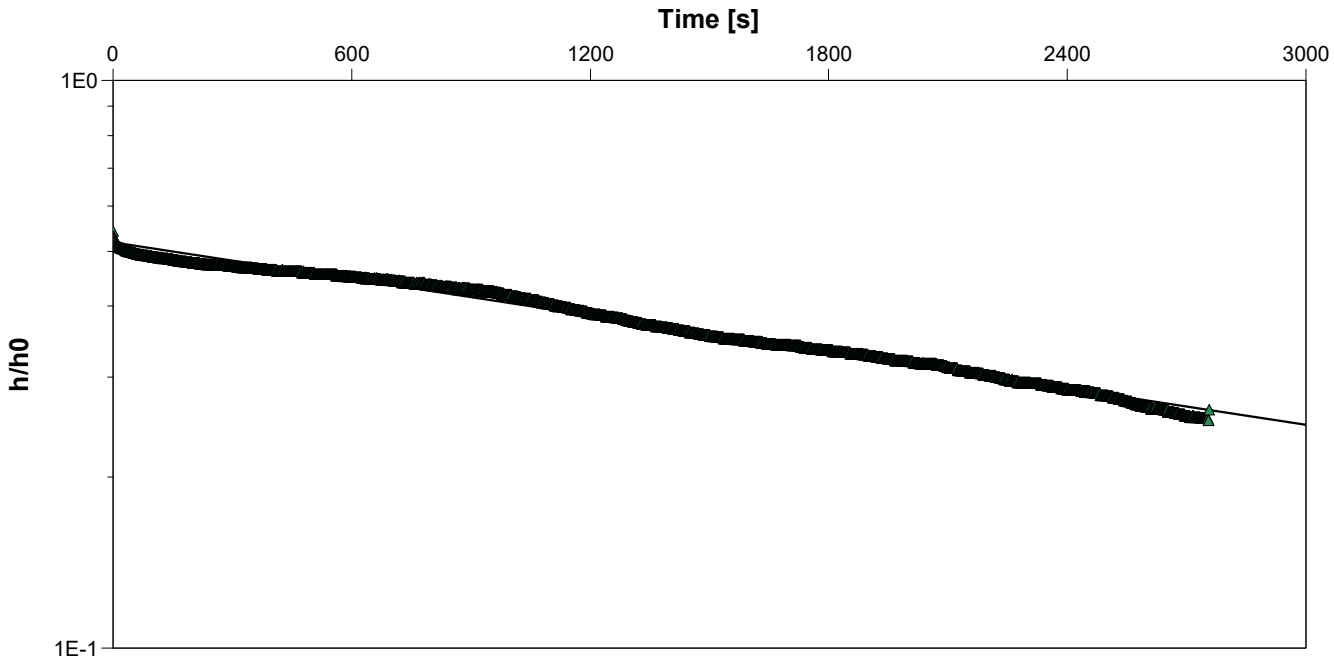


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH111-21	1.46×10^{-7}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH111-21 Slug Test 2	Test Well: BH111-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH111-21 Test 2	Analysis Date: 10/20/2021
Aquifer Thickness: 1.34 m		

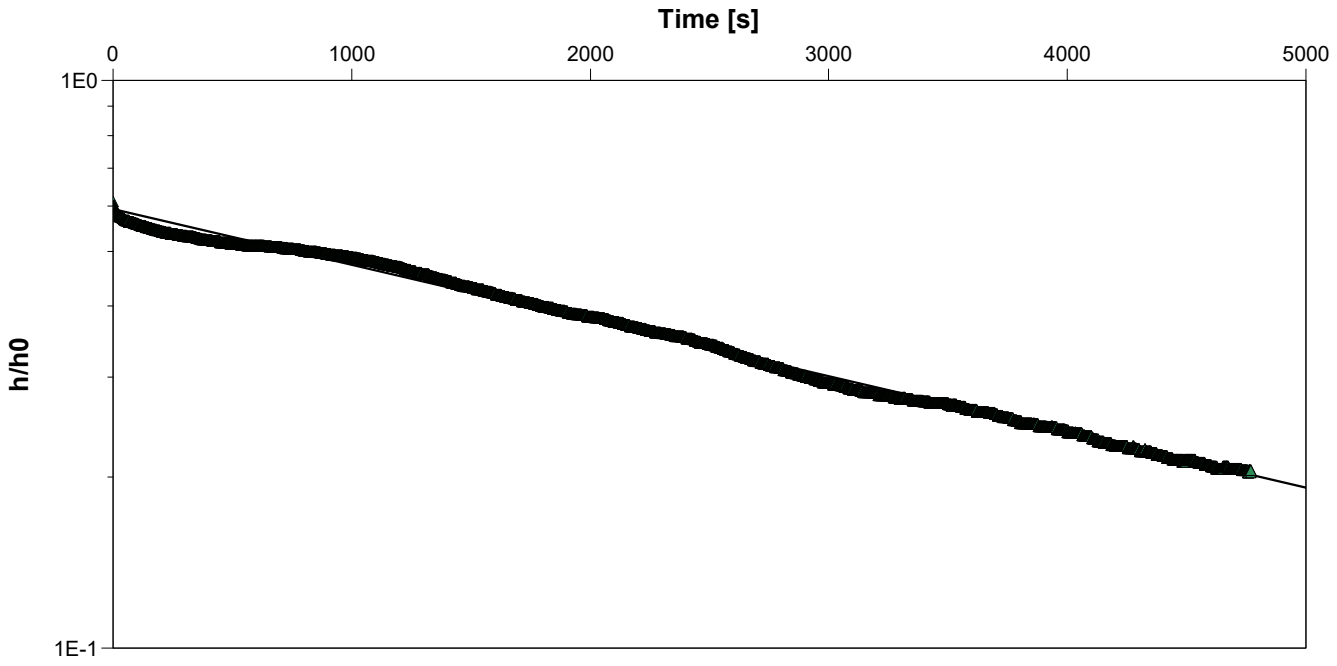


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH111-21	1.24×10^{-7}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH111-21 Slug Test 3	Test Well: BH111-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH111-21 Test 3	Analysis Date: 10/20/2021
Aquifer Thickness: 1.34 m		

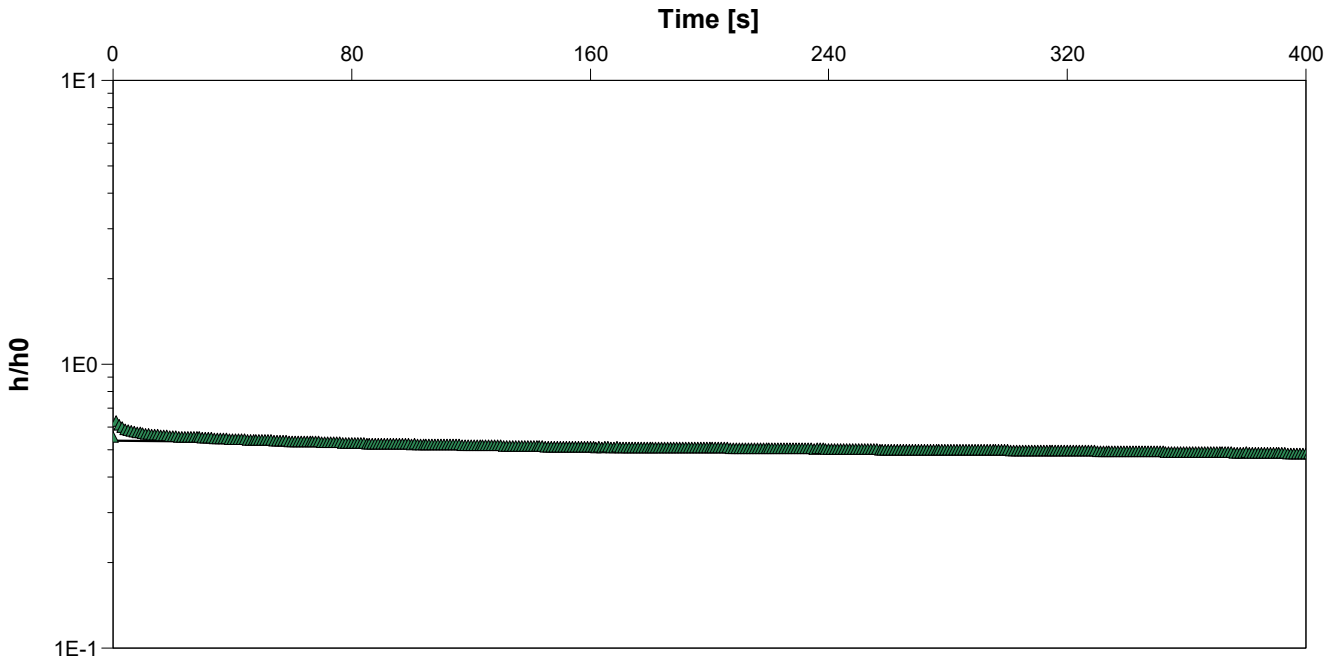


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH111-21	1.13×10^{-7}	

194 Sophia St. Peterborough, ON K9H1E5	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment, 505 Yonge St.	
	Number: 9574-004	
	Client: Renaissance Retirement Barrie Trust	

Location: 505 Yonge St., Barrie, ON	Slug Test: BH111-21 Slug Test 4	Test Well: BH111-21
Test Conducted by: C. Malliaros		Test Date: 10/5/2021
Analysis Performed by: N. Heikoop	BH111-21 Test 4	Analysis Date: 10/20/2021
Aquifer Thickness: 1.34 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH111-21	1.05×10^{-7}	

Appendix E
Certificates of Analysis

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G85505 **REPORT No. B19-34738 (i)**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 25-Oct-19
DATE REPORTED: 07-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
Cyanide	1	Kingston	US	29-Oct-19	A-CN-001 (k)	SM 4500CN
Anions	1	Holly Lane	VK	05-Nov-19	A-IC-01 (o)	SM4110C
pH	1	Holly Lane	SYL	31-Oct-19	A-PH-01 (o)	SM 4500H
Sulphide	1	Kingston	TK	29-Oct-19	A-S2	SM4500-S2
A - Wet Chem	1	Kingston	SHU	31-Oct-19	A-TPTKN-001 (N)(k)	E3199A.1
A - Wet Chem	1	Kingston	SHU	31-Oct-19	A-TPTKN-001 (P)(k)	E3199A.1
Total Suspended Solids	1	Kingston	LSE	29-Oct-19	A-TSS-001 (k)	SM2540D
BOD	1	Kingston	JWF	30-Oct-19	C-BOD-001 (k)	SM 5210B
COD	1	Holly Lane	ST	06-Nov-19	C-COD-01 (o)	SM 5220D
Oil & Grease	1	Kingston	MLY	30-Oct-19	C-O&G-001 (k)	SM 5520
Phenolics (4-aap)	1	Kingston	TK	31-Oct-19	C-PHEN-01 (k)	MOEE 3179
Mercury	1	Holly Lane	PBK	31-Oct-19	D-HG-02 (o)	SM 3112 B
Metals - ICP-OES	2	Holly Lane	AHM	05-Nov-19	D-ICP-01 (o)	SM 3120
Metals-ICP-MS	2	Holly Lane	TPR	05-Nov-19	D-ICPMS Dissolved 7800	EPA 200.8
Metals - ICP-MS	2	Holly Lane	TPR	31-Oct-19	D-ICPMS-01 (o)	EPA 200.8

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Steve Garrett
Director of Laboratory Services

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G85505 **REPORT No. B19-34738 (i)**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 25-Oct-19
DATE REPORTED: 07-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

	Client I.D.		BH 106	BH 106 - Filtered			Barrie Sanitary	
	Sample I.D.		B19-34738-1	B19-34738-2			Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		24-Oct-19	24-Oct-19				
Parameter	**Units**	**R.L.**						
pH @25°C	pH Units		8.02				9.5	9.5
BOD(5 day)	mg/L	3	3				300	15
COD	mg/L	5	122				600	
Total Kjeldahl Nitrogen	mg/L	0.1	1.3				100	
Total Suspended Solids	mg/L	3	**8400**				350	15
Oil and Grease-Mineral	mg/L	1.0	< 1.0				15	
Oil and Grease-Anim/Veg.	mg/L	1.0	< 1.0				150	
Phosphorus-Total	mg/L	0.01	7.50				10	
Cyanide (Total)	mg/L	0.005	< 0.005				1.2	
Chloride	mg/L	0.5	134				1500	
Fluoride	mg/L	0.1	< 0.1				10	
Sulphate	mg/L	1	23				1500	
Aluminum (total)	mg/L	0.01	46.9	0.06			50	
Antimony	mg/L	0.0001	< 0.0005	0.0003			5.0	
Arsenic	mg/L	0.0001	0.0099	0.0008			1.0	
Barium	mg/L	0.001	1.09	0.115			5.0	
Bismuth	mg/L	0.02	< 0.02	< 0.02			5.0	
Cadmium	mg/L	).000015	0.000347	0.000015			0.7	0.001
Chromium	mg/L	0.002	**0.225**	< 0.002			2.0	0.08
Cobalt	mg/L	0.005	0.041	< 0.005			5.0	
Copper	mg/L	0.002	**0.129**	< 0.002			2.0	0.01
Gold	mg/L	0.0007	< 0.0007	< 0.0007			5.0	
Iron	mg/L	0.005	**102**	0.035			50	
Lead	mg/L	0.02	0.04	< 0.02			0.7	0.05
Manganese (Total)	mg/L	0.001	2.36	0.061			5.0	
Mercury	mg/L	0.00002	0.00011 [2]				0.01	
Molybdenum	mg/L	0.01	0.03	< 0.01			5.0	

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Steve Garrett
Director of Laboratory Services

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G85505 **REPORT No. B19-34738 (i)**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 25-Oct-19
DATE REPORTED: 07-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

	Client I.D.		BH 106	BH 106 - Filtered			Barrie Sanitary	
	Sample I.D.		B19-34738-1	B19-34738-2			Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		24-Oct-19	24-Oct-19				
Parameter	**Units**	**R.L.**						
Nickel	mg/L	0.01	**0.08**	< 0.01			2.0	0.05
Phenolics	mg/L	0.002	< 0.002				0.1	
Platinum	mg/L	0.00004	< 0.00004	< 0.00004			5.0	
Rhodium	mg/L	0.00002	< 0.00002	< 0.00002			5.0	
Selenium	mg/L	0.001	< 0.005	< 0.001			1.0	
Silver	mg/L	0.005	< 0.005	< 0.005			0.4	
Sulphide	mg/L	0.01	< 0.5 [1]				1.0	
Tin	mg/L	0.05	< 0.05	< 0.05			5.0	
Vanadium	mg/L	0.005	0.117	< 0.005			5.0	
Zinc	mg/L	0.005	**0.407**	0.023			2.0	0.04
Titanium	mg/L	0.005	3.84	< 0.005				
Zirconium	mg/L	0.003	0.029	< 0.003				

1. Elevated detection limit due to dilution
2. solids present in Hg bottle

Barrie Sanitary - Barrie Sanitary & Combined and Storm
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Barrie-Storm Sewer - Storm Sewer Guidelines

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

Summary of Exceedances

Sanitary/Combined Sewer Guidelines

BH 106	Found Value	Limit
Total Suspended Solids (mg/L)	8400	350
Iron (mg/L)	102	50

Storm Sewer Guidelines

BH 106	Found Value	Limit
Zinc (mg/L)	0.407	0.04
Total Suspended Solids (mg/L)	8400	15
Nickel (mg/L)	0.08	0.05
Copper (mg/L)	0.129	0.01
Chromium (mg/L)	0.225	0.08

Barrie Sanitary - Barrie Sanitary & Combined and Storm
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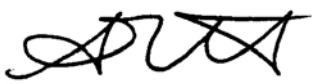
Barrie-Storm Sewer - Storm Sewer Guidelines



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DATE RECEIVED: 25-Oct-19
DATE REPORTED: 07-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
PHC(F2-F4)	1	Kingston	KPR	29-Oct-19	C-PHC-W-001 (k)	MOE E3421
VOC's	1	Richmond Hill	FAL	30-Oct-19	C-VOC-02 (rh)	EPA 8260
PHC(F1)	1	Richmond Hill	FAL	30-Oct-19	C-VPHW-01 (rh)	MOE E3421

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DATE RECEIVED: 25-Oct-19
DATE REPORTED: 07-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

	Client I.D.		BH 106				Barrie Sanitary	
	Sample I.D.		B19-34738-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		24-Oct-19					
Parameter	**Units**	**R.L.**						
Benzene	mg/L	0.0005	< 0.0005				0.01	
Dichlorobenzene,1,2-	mg/L	0.0005	< 0.0005				0.05	
Dichlorobenzene,1,4-	mg/L	0.0005	< 0.0005				0.08	
Ethylbenzene	mg/L	0.0005	< 0.0005				0.06	
Dichloromethane (Methylene Chloride)	mg/L	0.005	< 0.005				0.09	
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	< 0.0005				0.06	
Tetrachloroethylene	mg/L	0.0005	< 0.0005				0.06	
Toluene	mg/L	0.0005	< 0.0005				0.02	
Trichloroethylene	mg/L	0.0005	< 0.0005				0.05	
Xylene, m,p,o-	mg/L	0.0011	< 0.0011				0.3	
PHC F1 (C6-C10)	mg/L	0.05	< 0.05					
PHC F2 (>C10-C16)	mg/L	0.05	< 0.05					
PHC F3 (>C16-C34)	mg/L	0.4	< 0.4					
PHC F4 (>C34-C50)	mg/L	0.4	< 0.4					

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

Summary of Exceedances

Barrie Sanitary - Barrie Sanitary & Combined and Storm
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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
Comment	1	Default Site	CS	31-Oct-19	C-Arochlor Comment	-
PCB's	1	Kingston	CS	31-Oct-19	C-PCB-03 K	EPA 8082
OC Pesticides	1	Kingston	CS	01-Nov-19	C-PESTCL-01 K	EPA 8080

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DATE RECEIVED: 25-Oct-19
DATE REPORTED: 07-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

	Client I.D.	BH 106				Barrie Sanitary	
	Sample I.D.	B19-34738-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected	24-Oct-19					
Parameter	**Units**	**R.L.**					
Aldrin	mg/L	0.00001	< 0.00001				
Chlordane (alpha)	mg/L	0.00005	< 0.00005				
Chlordane (Gamma)	mg/L	0.00005	< 0.00005				
Chlordane Total (alpha+gamma)	mg/L	0.00005	< 0.00005				
DDD, 2,4-	mg/L	0.00005	< 0.00005				
DDD, 4,4-	mg/L	0.00005	< 0.00005				
DDD Total Water	mg/L	0.00005	< 0.00005				
DDE, 2,4-	mg/L	0.00001	< 0.00001				
DDE, 4,4-	mg/L	0.00001	< 0.00001				
DDE Total water	mg/L	0.00001	< 0.00001				
DDT, 2,4-	mg/L	0.00005	< 0.00005				
DDT, 4,4-	mg/L	0.00005	< 0.00005				
DDT Total water	mg/L	0.00005	< 0.00005				
Dieldrin	mg/L	0.00005	< 0.00005				
Lindane (Hexachlorocyclohexane, Gamma)	mg/L	0.00001	< 0.00001				
Endosulfan I	mg/L	0.00005	< 0.00005				
Endosulfan II	mg/L	0.00005	< 0.00005				
Endosulfan I/II	mg/L	0.00005	< 0.00005				
Endrin	mg/L	0.00005	< 0.00005				
Heptachlor	mg/L	0.00001	< 0.00001				
Heptachlor Epoxide	mg/L	0.00001	< 0.00001				
Hexachlorobenzene	mg/L	0.00001	< 0.00001			0.0001	
Hexachlorobutadiene	mg/L	0.00001	< 0.00001				
Hexachloroethane	mg/L	0.00002	< 0.00002				

Barrie Sanitary - Barrie Sanitary & Combined and Storm
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Director of Laboratory Services

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Final Report

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DATE RECEIVED: 25-Oct-19
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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

	Client I.D.		BH 106				Barrie Sanitary	
	Sample I.D.		B19-34738-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		24-Oct-19					
Parameter	**Units**	**R.L.**						
Methoxychlor	mg/L	0.00005	< 0.00005					
Poly-Chlorinated Biphenyls (PCB's)	mg/L	0.00005	< 0.00005					
Aroclor	-		-					

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JOB/PROJECT NO.:
P.O. NUMBER: 9574-001
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
SVOC	1	Kingston	sge	01-Nov-19	C-NAB-W-001 (k)	EPA 8270

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P.O. NUMBER: 9574-001
WATERWORKS NO.

	Client I.D.		BH 106				Barrie Sanitary	
	Sample I.D.		B19-34738-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		24-Oct-19					
Parameter	**Units**	**R.L.**						
Hexachlorobenzene	mg/L	0.0001	< 0.0001				0.0001	
Total PAH	mg/L	0.0001	< 0.0001				0.005	
Acenaphthene	mg/L	0.00005	< 0.00005					
Acenaphthylene	mg/L	0.00005	< 0.00005					
Anthracene	mg/L	0.00005	< 0.00005					
Benzo(a)anthracene	mg/L	0.00005	< 0.00005					
Benzo(a)pyrene	mg/L	0.00001	< 0.00001					
Benzo(b+k)fluoranthene	mg/L	0.0001	< 0.0001					
Benzo(g,h,i)perylene	mg/L	0.00005	< 0.00005					
Dibenzo(a,h)anthracene	mg/L	0.00005	< 0.00005					
Chrysene	mg/L	0.00005	< 0.00005					
Fluoranthene	mg/L	0.00005	< 0.00005					
Fluorene	mg/L	0.00005	< 0.00005					
Indeno(1,2,3,-cd)pyrene	mg/L	0.00005	< 0.00005					
Methylnaphthalene,1-	mg/L	0.00005	< 0.00005					
Methylnaphthalene,2-	mg/L	0.00008	< 0.00008					
Naphthalene	mg/L	0.00005	< 0.00005					
Phenanthrene	mg/L	0.00005	< 0.00005					
Pyrene	mg/L	0.00005	< 0.00005					

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TESTING REQUIREMENTS

- [ ] O.Reg 153 — Table ____ — [ ] Medium/Fine [ ] Coarse
- [ ] RPI [ ] ICC — [ ] Agricultural (O.Reg 153)
- [ ] Yes [ ] No — Record of Site Condition (O.Reg 153)
- [ ] Provincial Water Quality Objectives
- [x] Sewer Use By-Law: City of Barrie
- [ ] MISA Guidelines
- [ ] O.Reg 558 Leachate Analysis
- Disposal Site: ____
- [ ] Landfill Monitoring
- [ ] Other: ____

REPORT NUMBER (Lab Use): B19-347-38

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? [ ] Yes [x] No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Indicate Laboratory Samples are submitted to: [ ] Kingston [ ] Ottawa [ ] Richmond Hill [ ] Windsor [x] Barrie [ ] London

Organization: Cambium Inc	Address and Invoicing Address (if different): 52 Hunter St E, Peterborough, ON K9H 1G5
Contact: Cameron MacDougall	
Tel: 705-742-7900 x 212	
Fax:	Quote No.: P190206_CM
Email: Cameron.Macdougall@Cambium-inc.com	P.O. No.:
	Project Name: 9574-001
	Additional Info:

ANALYSES REQUESTED (Print Test in Boxes)

P190206_CM

Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page)

- [ ] Platinum 200% Surcharge
- [ ] Gold 100% Surcharge
- [ ] Silver 50% Surcharge
- [ ] Bronze 25% Surcharge
- [x] Standard 5-7 days
- [ ] Specific Date: ____

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Lab No:	Sample Identification	S.P.L.	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	✓	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered(Y/N)
	BH106		GW	24-10-2019	16:05	✓				16	N
	BH106 Metals Filtered		GW	↓	16:05	✓				1	Y
	4x Amber 500mL amber, CN, Sulphides, phenols, nut + gen chem -OK.										
	gen chem, Hg, metals & Nut -TO										
	Vials-Rel										

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	Brenden Hrathw	Brenden Hrathw
Sign:	Brenden Hrathw	Brenden Hrathw
	19-10-24	19-10-25
	Date (yy-mm-dd)/Time:	Date (yy-mm-dd)/Time:

SHIPPING INFORMATION

- [ ] Client's Courier
- [ ] Caduceon's Courier
- [x] Drop Off
- [ ] Caduceon (Pick-up)
- Invoice: [ ]
- # of Pieces: 1

REPORTING / INVOICING

- [ ] Report by Fax
- [x] Report by Email
- [x] Invoice by Email
- [ ] Invoice by Mail

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

- Received By (print): S.Tel — Signature: S
- Date Received (yy-mm-dd): 19/10/25 — Time Received: 16:30
- Laboratory Prepared Bottles: [x] Yes [ ] No
- Sample Temperature °C: 8.3
- Labeled by: SC

Comments: Mercury was not filtered. Dissolved mercury not required.

Page ____ of ____

G 85505

White: Lab Copy / Yellow: Invoicing Copy / Pink: Client Copy

CofC, May 2019, Revision No: 22

Appendix F

Groundwater Level and Elevation Information

Groundwater Elevations (metres above sea level)

Well	Ground Surface (masl)	TOP (masl)	Depth (mbgs)	27-Aug-19	16-Oct-19	24-Oct-19	19-Nov-19	10-Dec-19	10-Jan-20	11-Feb-20	11-Mar-20	02-Apr-20	08-May-20	17-Jun-20	24-Sep-21	05-Oct-21	04-Nov-21	09-Nov-21	16-Nov-21	31-Jan-22	22-Feb-22	22-Mar-22	28-Apr-22	20-May-22	27-Jun-22	31-Oct-22	29-Nov-22	22-Dec-22
BH102-19	247.57	247.46	14.96	243.13	243.02	243.04	243.47	243.67	243.92	243.92	244.10	244.21	243.80	243.67	243.41	243.58	243.58	-	243.53	No Access	No Access	No Access	No Access	243.71	Destroyed	Destroyed	Destroyed	Destroyed
BH106-19	244.45	244.35	11.43	-	240.19	240.32	240.85	-	241.38	241.28	242.08	241.42	241.14	241.10	242.08	241.04	241.01	-	240.93	No Access	No Access	241.50	240.94	240.88	240.73	240.41	240.46	240.48
BH108-19	242.59	243.38	7.14	-	240.84	240.98	241.62	241.99	241.74	241.62	242.05	241.83	241.50	241.40	241.92	241.64	241.73	-	241.60	241.40	241.63	241.93	241.88	241.42	241.29	241.24	241.56	241.46
BH109-21	247.04	248.22	10.67	-	-	-	-	-	-	-	-	-	-	-	245.27	245.10	245.23	-	245.13	245.07	245.13	245.62	245.41	245.13	244.92	244.78	245.05	245.01
BH110-21	243.90	243.75	7.62	-	-	-	-	-	-	-	-	-	-	-	239.59	239.68	239.67	-	239.60	No Access	No Access	239.80	239.43	239.69	239.62	239.34	239.48	239.45
BH111-21	239.61	239.78	3.05	-	-	-	-	-	-	-	-	-	-	-	237.78	237.93	238.23	-	238.06	237.96	238.25	238.67	238.31	238.05	237.80	236.81	237.77	237.68
BH112-21	238.85	239.44	1.40	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry	Dry	237.75	237.74	237.73	237.74	237.74	237.74	Dry	Dry	Dry	Dry
BH3	246.62	247.85	5.75	-	-	-	-	-	-	-	-	-	-	-	-	-	245.18	-	245.14	245.09	245.23	245.55	246.15	245.17	244.99	244.83	245.09	245.05
BH6	245.04	245.76	5.93	-	-	-	-	-	-	-	-	-	-	-	-	-	244.04	-	243.93	243.87	243.99	244.22	244.32	243.98	N/A	N/A	N/A	N/A
BH7	242.85	243.69	5.98	-	-	-	-	-	-	-	-	-	-	-	-	-	242.28	-	242.22	242.14	242.25	242.34	242.50	242.17	242.02	242.12	242.28	242.24

Groundwater Levels (metres below ground surface)

Well	Ground Surface (masl)	TOP (masl)	Depth (mbgs)	27-Aug-19	16-Oct-19	24-Oct-19	19-Nov-19	10-Dec-19	10-Jan-20	11-Feb-20	11-Mar-20	02-Apr-20	08-May-20	17-Jun-20	24-Sep-21	05-Oct-21	04-Nov-21	09-Nov-21	16-Nov-21	31-Jan-22	22-Feb-22	22-Mar-22	28-Apr-22	20-May-22	27-Jun-22	31-Oct-22	29-Nov-22	22-Dec-22
BH102-19	247.57	247.46	14.96	4.45	4.55	4.53	4.10	3.91	3.65	3.65	3.47	3.36	3.78	3.90	4.16	3.99	3.99	-	4.04	No Access	No Access	No Access	No Access	3.86	Destroyed	Destroyed	Destroyed	Destroyed
BH106-19	244.45	244.35	11.43	-	4.26	4.13	3.60	-	3.07	3.17	2.37	3.03	3.31	3.35	2.37	3.41	3.44	-	3.52	No Access	No Access	2.95	3.51	3.57	3.72	4.04	3.99	3.97
BH108-19	242.59	243.38	7.14	-	1.75	1.61	0.97	0.61	0.85	0.97	0.54	0.76	1.10	1.19	0.67	0.95	0.86	-	0.99	1.19	0.96	0.66	0.71	1.17	1.30	1.35	1.03	1.13
BH109-21	247.04	248.22	10.67	-	-	-	-	-	-	-	-	-	-	-	1.77	1.94	1.81	-	1.91	1.97	1.91	1.42	1.63	1.91	2.12	2.26	1.99	2.03
BH110-21	243.90	243.75	7.62	-	-	-	-	-	-	-	-	-	-	-	4.31	4.22	4.23	-	4.30	No Access	No Access	4.10	4.47	4.21	4.28	4.56	4.42	4.45
BH111-21	239.61	239.78	3.05	-	-	-	-	-	-	-	-	-	-	-	1.83	1.68	1.38	-	1.55	1.65	1.36	0.94	1.30	1.56	1.81	2.80	1.84	1.93
BH112-21	238.85	239.44	1.40	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry	Dry	1.69	1.70	1.71	1.70	1.70	1.70	Dry	Dry	Dry	Dry
BH3	246.62	247.85	4.79	-	-	-	-	-	-	-	-	-	-	-	-	-	1.44	-	1.48	1.53	1.39	1.07	0.47	1.45	1.63	1.79	1.53	1.57
BH6	245.04	245.76	5.20	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	-	1.11	1.17	1.05	0.82	0.72	1.06	N/A	N/A	N/A	N/A
BH7	242.85	243.69	5.14	-	-	-	-	-	-	-	-	-	-	-	-	-	0.57	-	0.63	0.71	0.60	0.51	0.35	0.68	0.83	0.73	0.57	0.61

1. N/A = technician could not locate well

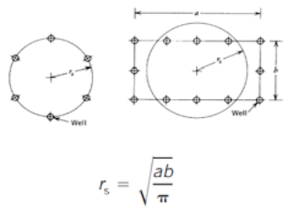
Appendix G
Dewatering Calculations

DEWATERING CALCULATIONS

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Trench Length (a)	Trench Width (b)	Hydraulic Conductivity (K)	s	R_o	$r_s = \sqrt{(ab/\pi)}$	$\ln(R_o/r_s)$ [If $r_s<R_o$] or $\ln((R_o+r_s)/r_s)$ [If $r_s>=R_o$]	H	$h_w = H-s$	r_s	Q_{total}		
		mbgs	mbgs	mbgs	m	m	m/s	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular trench with dimensions axb	Minimum K	1	12.1	14.1	150	75.09	3.80E-08	11.10	6.49	59.88	2.32	13.10	2.00	59.88	**0.000009**	**0.01**	**744**
	Maximum K	1	12.1	14.1	150	75.09	1.30E-05	11.10	120.06	59.88	0.40	13.10	2.00	59.88	**0.016919**	**16.92**	**1,461,766**
	Geometric mean K	1	12.1	14.1	150	75.09	5.91E-07	11.10	25.61	59.88	1.21	13.10	2.00	59.88	**0.000258**	**0.26**	**22,313**

s = target drawdown (initial - target depth to groundwater) (m)
R_o = radius of influence of construction dewatering/pumping (m)
r_s = equivalent single well radius (m)
H = Initial hydraulic head in aquifer (m)
h = hydraulic head at radius of well (m)
Q = construction dewatering rate (m^3/s)



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

Radial flow, water table aquifier

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_O / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

R_o = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

Appendix H
Water Balance Information

Climate Normals 1981-2010 Station Data

Metadata including Station Name, Province, Latitude, Longitude, Elevation, Climate ID, WMO ID, TC ID

STATION_N	PROVINCE	LATITUDE	LONGITUDI	ELEVATION	CLIMATE_I	WMO_ID	TC_ID
BARRIE WP	ON	44°22'33.0	79°41'23.0	221.0 m	6110557		

Legend

A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)
B = At least 25 years
C = At least 20 years
D = At least 15 years

1981 to 2010 Canadian Climate Normals station data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Temperature														
Daily Avera	-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	C
Standard D	3.4	2.6	2.2	1.6	1.9	1.4	1.3	1.5	1.4	1.2	1.6	3	1.4	C
Daily Maxir	-2.9	-1.5	3.2	11	18.1	23.6	26.3	25.1	20.7	13.5	6.5	0.4	12	C
Daily Minin	-12.4	-11.7	-7.4	0.2	6.5	12.3	15.3	14.3	10	3.9	-1	-7.3	1.9	C
Extreme M	14	14	24	30.5	35	35	36	36.5	34.5	30	21.5	19.5		
Date (yyyy/	1995/14	1984/23	1998/30	2002/16	2006/30	1994/17	1988/06	2006/01	2002/09	2005/05	1978/05	1982/03		
Extreme M	-35	-33	-30.5	-15	-4	1	6	0	-1.5	-6.5	-19.5	-33		
Date (yyyy/	1981/04	1979/18	1984/08	2003/07	2006/07	1980/09	1984/08	2004/22	1993/30	1988/31	1989/29	2004/20		
Precipitation														
Rainfall (mı	16.6	16	29.2	56.6	82.3	84.8	77.2	89.9	94	75.2	66	22.2	709.9	C
Snowfall (c	65.9	45.9	29	5.7	0.1	0	0	0	0	2.3	22.8	51.4	223	C
Precipitatic	82.5	61.8	58.1	62.2	82.4	84.8	77.2	89.9	94	77.5	88.9	73.6	932.9	C
Average Sn	16	17	8	1	0	0	0	0	0	0	2	9	4	D
Median Sn	17	17	8	0	0	0	0	0	0	0	1	8	4	D
Snow Dept	17	15	1	0	0	0	0	0	0	0	4	11	4	C
Extreme Da	27	35	43	40	54.4	96	75	79	80	48.8	50	28.6		
Date (yyyy/	1998/05	1997/21	1990/11	1995/21	2004/23	1995/02	1980/20	1995/31	1986/11	1995/05	1999/02	1979/24		
Extreme Da	65	32.4	22	17	2	0	0	0	0	12	27	44		
Date (yyyy/	1978/09	1984/29	1984/10	1979/04	1989/07	1978/01	1978/01	1978/01	1977/01	1997/26	2000/21	1995/10		
Extreme Da	65	35	43	40	54.4	96	75	79	80	48.8	52	44		
Date (yyyy/	1978/09	1997/21	1990/11	1995/21	2004/23	1995/02	1980/20	1995/31	1986/11	1995/05	1999/02	1995/10		
Extreme Sn	57	59	50	21	0	0	0	0	0	8	29	54		
Date (yyyy/	1981/07	2001/09	2003/05	1987/01	1981/01	1981/01	1981/01	1981/01	1981/01	1997/27	1995/28	1995/11		
Days with Maximum Temperature														
<= 0 °C	21	16.6	10	0.92	0	0	0	0	0	0	3.5	14.6	66.6	C
> 0 °C	10	11.6	21	29.1	31	30	31	31	30	31	26.5	16.4	298.6	C
> 10 °C	0.36	0.48	3.8	14.9	28.2	29.9	31	31	29.5	21.8	6.4	1	198.2	C
> 20 °C	0	0	0.54	3.1	10.6	22.6	29.1	27.3	15.6	3.6	0.08	0	112.5	C
> 30 °C	0	0	0	0.04	0.4	2.5	4.4	2.4	0.63	0	0	0	10.4	C
> 35 °C	0	0	0	0	0	0	0.04	0.04	0	0	0	0	0.08	C
Days with Minimum Temperature														
> 0 °C	0.84	1	2.9	13.9	29	30	31	31	29.8	24.8	10.6	3	207.8	C
<= 2 °C	30.9	28.1	30.2	21.7	5.2	0.12	0	0.09	0.96	12.3	23.7	29.9	183	C
<= 0 °C	30.2	27.2	28.1	16.1	2	0	0	0.04	0.21	6.3	19.4	28	157.5	C
< -2 °C	27	24.6	22.9	7.1	0.12	0	0	0	0	0.92	10.6	22.6	115.8	C
< -10 °C	17	15.6	9.1	0.52	0	0	0	0	0	0	0.79	9.6	52.6	C
< -20 °C	6	3.9	0.96	0	0	0	0	0	0	0	0	1.3	12.2	C
< - 30 °C	0.56	0.13	0.04	0	0	0	0	0	0	0	0	0.04	0.77	C
Days with Rainfall														
>= 0.2 mm	2.8	3	5.4	11.3	12.9	11.4	11.1	11.8	13.3	15.5	11.3	4.6	114.4	C
>= 5 mm	1	1.2	2.2	3.9	5.8	4.4	4.7	5.1	5.4	5.5	4.6	1.9	45.5	C
>= 10 mm	0.64	0.58	0.88	1.6	2.7	2.9	2.5	3.4	3	1.9	2.2	0.46	22.8	C
>= 25 mm	0.04	0.08	0.04	0.27	0.36	0.73	0.62	0.81	0.73	0.15	0.28	0.04	4.2	C
Days With Snowfall														
>= 0.2 cm	12.4	10	6.8	1.5	0.04	0	0	0	0	0.54	4.5	9.6	45.5	C
>= 5 cm	5	3.4	2.2	0.35	0	0	0	0	0	0.19	1.6	3.8	16.5	C
>= 10 cm	1.8	1	0.64	0.12	0	0	0	0	0	0.04	0.46	1.6	5.7	C
>= 25 cm	0.08	0.15	0	0.04	0	0	0	0	0	0	0.08	0.08	0.43	C
Days with Precipitation														
>= 0.2 mm	14.9	12.3	11.6	12.2	12.9	11.4	11.1	11.8	13.3	15.6	15.4	13.8	156.1	C
>= 5 mm	6	4.5	4.3	4.2	5.8	4.4	4.7	5.1	5.4	5.7	6.2	5.8	62	C
>= 10 mm	2.4	1.8	1.6	1.7	2.7	2.9	2.5	3.4	3	2	2.7	2.1	28.9	C
>= 25 mm	0.12	0.23	0.04	0.31	0.36	0.73	0.62	0.81	0.73	0.19	0.44	0.13	4.7	C
Degree Days														
Above 24 °(	0	0	0	0	0.1	2.5	8.3	4.2	0.4	0	0	0	15.5	C
Above 18 °(	0	0	0	0.8	8	45.5	95.8	71.4	19.6	1	0	0	242	C
Above 15 °(	0	0	0	3.4	25.6	103.1	180.5	149.2	56.1	5.1	0	0	523	C
Above 10 °(	0	0	1.5	16.8	97.6	239.8	334.6	301.4	165.9	36.1	2.2	0.3	1196.3	C
Above 5 °C	0.4	0.5	10.1	66.1	227.7	389.2	489.6	456.3	310.6	126.9	26.1	3.9	2107.4	C
Above 0 °C	7.7	10.1	44.4	176.1	381.7	539.2	644.6	611.3	460.5	272.9	101.1	25.4	3274.9	C
Below 0 °C	245.7	194.9	110	7.9	0	0	0	0	0	0	21.7	132.5	712.8	C
Below 5 °C	393.4	326.4	230.8	47.9	1.1	0	0	0	0.1	9.1	96.6	266	1371.3	C
Below 10 °(	548	466.9	377.1	148.6	25.9	0.6	0	0.1	5.4	73.2	222.8	417.4	2286.2	C
Below 15 °(	703	608	530.7	285.3	108.9	14	0.9	2.8	45.6	197.2	370.6	572.1	3439.1	C
Below 18 °(	796	692.6	623.7	372.6	184.3	46.3	9.1	18	99	286.2	460.6	665.1	4253.7	C

1981 to 2010 Canadian Climate Normals station data (Frost-Free)

	Frost-Free:	Code
Average Da	07-May	D
Average Da	09-Oct	D
Average Le	153 Days	D

Probability	10%	25%	33%	50%	66%	75%	90%
Date	19-May	16-May	12-May	05-May	03-May	30-Apr	27-Apr
Probability	10%	25%	33%	50%	66%	75%	90%
Date	20-Sep	02-Oct	07-Oct	10-Oct	14-Oct	18-Oct	23-Oct
Probability	10%	25%	33%	50%	66%	75%	90%
Days	126	147	154	156	159	161	169

Water Balance Calculations

505, 511, 515 and 533 Yonge Street, Barrie, Ontario

THORNTHWAITE-TYPE MONTHLY WATER-BALANCE MODEL													
modified from Dingman 2015: Box 6-8 (pg 299) using ET model of Hamon (1963)													
		Input Data				Computed Values							
											Surplus	394	mm/yr
Weather Station Location:	**BARRIE WPCC**					**Latitude:**	**44.2**	**degree**					
Solar Declination (degree)	-20.6	-12.6	-1.5	10.0	19.0	23.1	21.0	13.4	2.6	-9.0	-18.5	-23.0	
DayLength (hr)*	9.1	10.3	11.8	13.3	14.6	15.3	14.9	13.8	12.3	10.8	9.5	8.7	
Available Water Storage Capacity			0.18	m/m	**Root Depth**		1000	mm	**SOILmax**		180.0	mm	

MONTHLY WATER BALANCE DATA													
Temperatures in C, water-balance terms in mm.													
Month:	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Year**
TEMPERATURE (T)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	
PRECIPITATION (P)	82.5	61.8	58.1	62.2	82.4	84.8	77.2	89.9	94.0	77.5	88.9	73.6	933
RAIN	16.6	16.0	29.2	56.6	82.3	84.8	77.2	89.9	94.0	75.2	66.0	22.2	710
SNOW	66	46	29	6	0	0	0	0	0	2	23	51	223
MELT FACTOR (F)	0.00	0.00	0.00	0.93	1.00	1.00	1.00	1.00	1.00	1.00	0.45	0.00	
PACK	130	176	205	14	0	0	0	0	0	0	13	64	
MELT	0	0	0	196	14	0	0	0	0	2	10	0	223
INPUT (W)	17	16	29	253	96	85	77	90	94	78	76	22	933
POTENTIAL ET (PET)	0	0	0	39	68	96	116	100	67	40	23	0	548
NET INPUT (ΔW)	17	16	29	214	29	-12	-38	-10	27	38	54	22	
SOIL MOISTURE (SOIL)	180	180	180	180	180	169	136	129	156	180	180	180	
ΔSOIL	0	0	0	0	0	-11	-32	-7	27	24	0	0	0
ET	0	0	0	39	68	96	110	97	67	40	23	0	539
SURPLUS=W-ET-DSOIL	17	16	29	214	29	0	0	0	0	14	54	22	394

Notes:

Precipitation, Rain, Temperature, and Latitude are inputted parameters

SOILmax = available water storage capacity * root depth

m = month

D = Day length (hrs) $=2*\cos^{-1}(-\tan(\text{Latitude})*\tan(\text{Declination}))/0.2618$ [calculation is in radians]

$SNOW_m = P_m - RAIN_m$

$F_m = 0$ if $T_m <= 0^oC$; $F_m = 0.167*T_m$ if $0^oC<T_m<6^oC$; $F_m = 1$ if $T_m>=6^oC$

$PACK_m = (1-F_m)*(SNOW_m+PACK_{m-1})$

$MELT = F_m*(SNOW_m+PACK_{m-1})$

$W_m = RAIN_m+MELT_m$.

PET = 0 if $T_m<0$; otherwise $PET = 2.98*0.611*\exp(17.3*T_m/(T_m+237))/(T_m+237.2)*$Number of days in month [Hamon ET model (1963)]

$\Delta W_m = W_m - PET_m$

SOIL = $\min\{[\Delta W_m+SOIL_{m-1}], SOILmax\}$, if $\Delta Wm>0$; otherwise $SOIL = SOIL_{m-1}* \exp(\Delta W/SOILmax)$

$\Delta SOIL = SOIL_{m-1} - SOIL_m$

ET = PET if $W_m > PET$; otherwise, $ET=W_m-\Delta SOIL$

Pre- and Post-Development Water Balance Calculations

505 Yonge Street, Barrie, ON

1 Climate Information

Precipitation	933	mm/yr
Actual Evapotranspiration	539	mm/yr
Water Surplus	394	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors	Slope to Tollendale Creek	Vegetated Areas	
Topography: Hilly Land / Flat to Rolling Land	0.1	0.25	
Soil Type: medium combinations of clay and loam	0.2	0.2	
Cover: Woodland / Woodland Cultivated Mix	0.2	0.15	
Total Infiltration Factor	**0.5**	**0.6**	
Infiltration (Water Surplus * Infiltration Factor)	**197**	**236**	mm/yr
Run-off (Water Surplus - Infiltration)	**197**	**158**	mm/yr

Table 3 Approach - Typical Recharge Rates		
Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by silty sand

Based on the above, the recharge rate is typically 150-200 mm/yr

3 Pre-Development Property Statistics

	ha	m^2
Total Paved Area	0.23	2,255
Total Roof Area	0.08	790
Total Gravel Area	0.10	1,032
Slope to Lovers Creek Area	1.09	10,914
Total Vegetated Area	1.18	11,824
4 Total	**2.68**	**26,815**

Post-Development Property Statistics

	ha	m^2
Total Paved Area	0.54	5,390
Total Landscape area above Underground Parking	0.11	1,072
Total Roof Area	0.48	4,802
Slope to Lovers Creek Area	1.09	10,914
Total Landscape Area	0.46	4,638
Total	**2.68**	**26,815**

Pre- and Post-Development Water Balance Calculations

505 Yonge Street, Barrie, ON

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	2,255	2,104	210	-	1,894
	Gravel Area	1,032	963	96	41	867
	Roof Area	790	737	74	-	663
Pervious Areas	Slope to Lovers Creek	10,914	10,182	5,882	2,580	1,720
	Vegetated Areas	11,824	11,032	6,373	2,329	2,329
	Totals	26,815	25,018	12,636	4,950	7,473

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	5,390	5,029	503	-	4,526
	Landscaped Area Above Underground Parking	1,072	999	100	-	899
	Roof Area	4,802	4,480	448	-	4,032
Pervious Areas	Slope to Lovers Creek	10,914	10,182	5,883	2,580	1,720
	Landscaped Areas	4,638	4,327	2,500	914	914
	Totals	26,815	25,018	9,433	3,494	12,091

7 Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	25,018	12,636	4,950	7,473
Post-Development	25,018	9,433	3,494	12,091
Change in Volume	- 0	- 3,203	- 1,456	4,618
8 Change in %	- 0	- 25	- 29	62

Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	4,950
Volume of Post-Development Infiltration (m^3/yr)	3,494
Deficit from Pre to Post Development Infiltration (m^3/yr)	1,456
Percentage of Roof Runoff required to match the pre-development infiltration (%)	36