Hydrogeological Assessment Report - Shore Lane Development, Wasaga Beach, Ontario

2020-09-11

Prepared for:
Beachwood Development Inc.

 Reference No.: 10131-002

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Beachwood Development Inc., to complete a hydrogeological assessment in support of a proposed residential development located at Part Lot 34 and 35, Concession 3 Town of Wasaga Beach, Ontario (Site).

The property is irregularly shaped and is approximately 5.88 hectares in size. At the time of investigation the Site predominately consisted of forested lands, with adjacent residential buildings bordering the northeast perimeter of the lot. A Site plan is outlined on Figure 1. A proposed development plan is included in Appendix A.

At the time this document was prepared the proposed development consisted of a mix of residential densities (and other land use) which included the following:

- two 6 storey residential buildings with a private amenity area at the southeast corner of the property,
- seven blocks of townhomes in the southwest area of the lot and one additional block of townhomes north of the 6 storey residential buildings,
- thirty one single residential lots,
- two parking lots immediately north of the respective 6 storey residential buildings, parkland in the western area of the Site and open space in the northern area of the Site,
- a storm water management area in the northern corner of the Site.

The hydrogeological assessment was required to characterize the hydrogeological setting of the Site and assess impact (if any) to sensitive receptors upon development. A geotechnical investigation was completed concurrently with the hydrogeological assessment and was titled *as Geotechnical Investigation – PART Lot 34 & 35 Concession 3, Wasaga Beach, Ontario, Revision 2* (Cambium Inc., 2020).

2.0 Methodology

This section describes the methodology undertaken to complete the hydrogeological assessment.

2.1 Drilling Program

A borehole investigation was completed as part of the geotechnical investigation between December 2 and 5, 2019 to assess subsurface conditions at the Site. A total of seven (7) boreholes were advanced within the site, designated as BH101-19 through BH107-19. The boreholes were terminated at depths ranging from 2.7 m to 9.6 m below ground surface (mbgs).

Drilling and sampling was completed using a track-mounted drill rig, under the supervision of a Cambium Geotechnical Analyst. The boreholes were advanced to the pre-determined depths by means of continuous flight hollow stem augers with 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) N values were recorded for the sampled intervals as the number of blows required to drive a split spoon (SS) sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. Soil samples were collected at 0.75 m intervals from 0 to 3 m and 1.5 m intervals after 3 m.

Four (4) boreholes; BH103-19, BH104-19, BH105-19, and BH107-19 were installed with monitoring wells to allow for measurement of the static groundwater elevation at the site.

The borehole and monitoring well elevations were surveyed using a Sokkia RTK GNSS system. The elevations were adjusted based on a geodetic benchmark provided by the Jones Consulting Group Ltd., which was the top bolt of a fire hydrant located on the northwest corner of 74 Street N. and Beachwood Road behind the Canada Post mailboxes, which was assigned an estimated relative elevation of 182.32 meters above sea level (mASL). The borehole UTM locations and elevations are provided on the borehole logs in Appendix B. Borehole locations are shown on Figure 1.

2.2 Physical Laboratory Testing

Physical laboratory testing, including four (4) sieve and hydrometer analyses (LS-702, 705), was completed on selected soil samples to confirm textural classification and to assess geotechnical parameters. Natural moisture content testing (LS-701) was completed on all retrieved soil samples. Results are presented in Appendix C.

2.3 Hydrogeological Field Tasks

On February 4th, 2020, Cambium staff visited the Site to complete Single Well Hydraulic Tests (SWHTs) on four monitoring wells: MW103-19, MW104-19, MW105-19 and MW107-19. The SWHTs (or bail tests) involved inducing an instantaneous change in groundwater head (level) in the well and monitoring the water level response as it recovered to static conditions. Water level recovery was monitored using an automated water level logging device (pressure transducer) which were validated with manual measurements. All equipment used in the wells was decontaminated prior to inserting into the wells. The saturated hydraulic conductivity of water bearing units screened in each well was estimated using AquiferTest Pro™ software, the results of which are attached in Appendix D.

On May 28, 2020 Cambium staff visited the Site to completed surficial, in-situ infiltration testing. Infiltration testing was performed with a Guelph Permeameter. To complete the infiltration testing, test holes were augered to approximately 0.3 mbgs from the existing grade and the soils encountered at that depth were tested. The results provide the hydraulic conductivity of the soil. Established relationships of hydraulic conductivity and infiltration rate were referenced to determine the infiltration rate of tested soils (Ministry of Municipal Affairs and Housing, Housing Development and Buildings Branch., 1997). Cambium completed in-situ infiltration testing at four locations (labelled as IT101-20 through IT104-20) at the Site. Other locations were assessed, however there were several areas on-site that were flooded, therefore additional testing was not possible. The locations of the infiltration tests are outlined on Figure 2.

At the time this document was prepared water levels were measured monthly from the monitoring wells since their installation in December of 2019, to July 2020.

3.0 Geological and Hydrogeological Setting

The Site is located within the physiographic region known as the Simcoe Lowlands, which is characterized as till plains which have scoured southern portions of the watershed resulting in flat-floored valley features that generally correspond to current river systems. As a result, soils in the region generally consist of organic material, sands, gravels and some silts and clays are found in the lowland valleys, where they were deposited by glacial and fluvial processes (Chapman, L.J. and D.F. Putnam, 1984).

According to the Ontario Geological Survey (OGS, 2019), the Site is within an area where the following surficial deposits are present:

- Coarse-textured lacustrine deposits consisting of sand, gravel, minor silt and clay
- Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain
- Coarse-textured glaciolacustrine deposits consisting of sand, gravel, minor silt and clay

According to the Bedrock Geology of Ontario, southern sheet; Ontario Geological Survey, Map 2544, scale 1:250 000 (OGS, 2019) the bedrock in the area of the Site is characterized as limestone, dolostone, shale, arkose and sandstone.

Based on available quaternary geological mapping, the site consists of till deposits generally grading from sandy silt to silt matrix, commonly rich in clasts, often high in total matrix carbonate content (OGS, 2020).

3.1 Subsurface Investigation

As reported in the geotechnical investigation, the subsurface conditions are fairly consistent across the Site. There was approximately 150 mm to 750 mm of topsoil, with an average thickness of approximately 450 mm. Beneath the topsoil, the native soils predominately consists of interbedded sand, silty sand, silt and sand and silty clay extending to borehole termination. Bedrock was not encountered within the investigation depths however the majority of the boreholes were terminated due to both split spoon and practical auger refusal indicating

likely cobbles or boulders. The boreholes were terminated at depths ranging from 2.7 mbgs to 9.6 mbgs. Overburden extended to a depth greater than 9.6 mbgs.

3.1.1 Grain Sieve Analysis

Laboratory grain size distribution analyses were completed on samples collected from four 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	2.3 - 2.7	Brown silty clay, some sand, trace gravel	6	13	29	52
BH102-19	2.3 – 2.7	Grey silt and sand, some clay, some gravel	16	32	34	18
BH104-19	2.3 – 2.7	Grey silty sand, some clay, some gravel	11	45	33	11
BH107-19	2.3 – 2.7	Brown silty clay, some sand, trace organics	2	16	40	42

3.2 Water Well Records

The MECP's Water Well Information System (WWIS) was accessed to review water well records located within 300 m of the Site. Water well records located within 500 m of the Site boundaries are outlined on Figure 3.

There are 38 water well records located within 300 m of the Site boundaries. Of these records 27 detailed the installation of overburden wells, 8 detailed the installation of bedrock wells, 2 detailed the installation of monitoring wells and 2 detailed well abandonments.

The well records indicate that the soil stratigraphy varied between fine grained (clay material) and coarse grained (sand and gravel) sediments. In many cases a coarse grained water bearing aquifer unit was encountered at depth beneath an aquitard comprised of finer grained sediments. A small portion of the surrounding wells were installed in the bedrock.

Information pertaining to the overburden and bedrock wells is summarized below in Table 2.

Table 2 Water Well Info Summary

		Depth (mbgs)	Water Encountered (mbgs)	Static Water Level	Flow Rate (gpm)
Overburden Wells Count: 27	Max	25.30	24.70	12.20	20.00
	Min	12.80	4.88	0.61	2.00
	Avg	19.76	17.71	3.24	6.74
Bedrock Wells Count: 8	Max	45.70	36.28	20.00	20.00
	Min	18.60	1.52	5.00	1.00
	Avg	26.18	19.09	10.25	6.38

3.2.1 Water Servicing

A water servicing map was acquired from the Town of Wasaga Beach which outlines those properties provided water servicing by the Town. The map indicates that most properties surrounding the Site to the north, east and west are provided potable water by the Town. A copy of the water servicing map is attached in Appendix A.

To confirm water servicing in the area a water well survey should be completed of adjacent properties.

3.3 Hydrogeological Conditions

Overburden at the Site consists predominately of interbedded sand, silty sand, silt and sand and silty clay. There were no confining layers identified in the overburden, as such all of the saturated sediments encountered as part of the drilling investigation are considered hydraulically connected.

Groundwater levels measured at the monitoring wells ranged in depth from 3.71 mbgs to 0.65 mbgs. Groundwater elevations ranged from 177.54 metres above sea level (masl) and 180.86 masl. The direction of groundwater flow was north, towards Georgian Bay (see Figure 1).

The water level/elevation information collected to date is outlined below in Table 3.

Table 3 Water Well and Groundwater Information

Well		MW103-19	MW104-19	MW105-19	MW107-19
Easting [1]		569967	570105	570086	569899
Northing [1]		4924336	4924317	4924257	4924243
Top of Pipe (TOP) Elevation (masl) [2]		180.31	179.65	181.58	183.27
Ground Surface Elevation (masl) [2]		179.41	178.68	180.49	182.20
Depth (mtop) [3]		10.10	5.57	3.79	5.67
Depth (mbgs) [4]		9.20	4.60	2.70	4.60
Stick-up (m)		0.90	0.97	1.09	1.07
Dec 9, 2019	Water Level (mtop) [3]	2.38	2.11	1.95	dry
	Water Level (mbgs) [4]	1.48	1.15	0.86	dry
	Groundwater Elevation (masl) [2]	177.93	177.54	179.63	dry
Jan 17, 2020	Water Level (mtop) [3]	2.67	1.73	1.91	4.78
	Water Level (mbgs) [4]	1.77	0.77	0.82	3.71
	Groundwater Elevation (masl) [2]	177.64	177.92	179.67	178.49
Feb 4, 2020	Water Level (mtop) [3]	2.66	1.78	1.9	4.4
	Water Level (mbgs) [4]	1.76	0.82	0.81	3.33
	Groundwater Elevation (masl) [2]	177.65	177.87	179.68	178.87
Mar 9, 2020	Water Level (mtop) [3]	2.69	1.76	2.08	3.9
	Water Level (mbgs) [4]	1.79	0.80	0.99	2.83
	Groundwater Elevation (masl) [2]	177.62	177.89	179.50	179.37
Apr 13, 2020	Water Level (mtop) [3]	2.58	1.61	1.77	3.4
	Water Level (mbgs) [4]	1.68	0.65	0.68	2.33
	Groundwater Elevation (masl) [2]	177.73	178.04	179.81	179.87
May 11, 2020	Water Level (mtop) [3]	2.68	1.80	2.03	3.13
	Water Level (mbgs) [4]	1.78	0.84	0.94	2.06
	Groundwater Elevation (masl) [2]	177.63	177.85	179.55	180.14
Jun 12, 2020	Water Level (mtop) [3]	2.61	1.78	2.07	2.74
	Water Level (mbgs) [4]	1.71	0.82	0.98	1.67
	Groundwater Elevation (masl) [2]	177.70	177.87	179.51	180.53
May 11, 2020	Water Level (mtop) [3]	2.69	1.87	2.08	2.41
	Water Level (mbgs) [4]	1.79	0.91	0.99	1.34
	Groundwater Elevation (masl) [2]	177.62	177.78	179.50	180.86

1. *Universal Transverse Mercator (Zone 17T)*
2. *Metres Above Sea Level*
3. *Metres Below Top Of Pipe*
4. *Metres Below Ground Surface*

4.0 Results

This section discusses the results of the field program.

4.1 Single Well Hydraulic Testing

On February 4, 2020, SWHTs were completed at wells MW103-19, MW104-19 and MW105-19 and MW107-19. The data generated from the SWHTs was processed by AquiferTest Pro™ software, the results of which are summarized in Table 4.

The SWHTs were completed by instantaneously bailing a volume of water from each monitoring well and monitoring water level recovery. The results of the rising head tests are included below.

Note: The water levels at well MW105-19 did not recover during the testing, as such the data could not be assessed for hydraulic conductivity.

The hydraulic conductivity of the water bearing sediments varied from 1.00x 10^{-6} m/s to 3.71 x 10^{-6} m/s and were considered typical of silty sand/silty clay soils. The hydraulic conductivity results were similar to results outlined in literature (Fetter, 2001; Powers, 2007).

Table 4 SWHT Hydraulic Conductivity Results

Test #	BH103-19	BH104-19	BH107-19
Bail Test 1	3.71 x 10^{-6} m/s	1.34 x 10^{-6} m/s	1.00 x 10^{-6} m/s
Bail Test 2	3.11 x 10^{-6} m/s	1.56 x 10^{-6} m/s	2.46 x 10^{-6} m/s
Bail Test 3	3.05 x 10^{-6} m/s	2.00 x 10^{-6} m/s	-

4.2 Infiltration Testing

Cambium had planned to test the infiltration rate at six locations across the Site. Standing water/high water conditions were encountered in the northern and western areas of the Site. The infiltration tests require unsaturated conditions and as a results, only four locations were selected for infiltration testing.

The results of the infiltration testing have been outlined in Table 5. The hydraulic conductivities determined from the Guelph Permeameter testing were assigned corresponding infiltration rates and percolation times as per the Supplementary Guidelines to the Ontario Building Code

1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario (Ministry of Municipal Affairs and Housing, Housing Development and Buildings Branch., 1997).

The infiltration rates varied from a geometric mean of 20 mm/hr to 118mm/hr. The range of infiltration rates reflects the variability of the soils found near surface. Additional infiltration testing should be completed in the future at the detailed design stage of any re-infiltration features included in proposed development.

Table 5 Infiltration Rates

Infiltration Location	IT101		IT102		IT103	
Material Tested	Silty clay		Brown sand		Silty clay	
Testing Head Depth (m)	0.05	0.10	0.05	0.10	0.05	0.10
Hydraulic Conductivity (m/s)	5.34×10^{-8}	1.27×10^{-7}	3.20×10^{-5}	3.82×10^{-7}	5.12×10^{-8}	3.08×10^{-8}
Infiltration Rate (mm/hr)	21	27	116	121	21	18
Geometric Mean Rate (mm/hr)	24		118		20	

5.0 Dewatering

The Geotechnical Investigation indicates that the minimum founding level for the footings of the detached homes/townhomes was 1.4 mbgs. The minimum founding level for the six storey condominium was 3.0 mbgs.

The highest water level measured at the Site was 0.65 mbgs during the April measurement at well MW104-19. As such, the construction excavations for the proposed development will intercept the groundwater table.

The highest construction dewatering rates will occur during the construction activities for the condominiums. The founding depth for the condominiums was recommended to be 3 mbgs. To facilitate a safe working environment it was assumed that the water level will be lowered to approximately 4 mbgs.

The hydraulic conductivities utilized in the dewatering calculations were the high and low rates outline in Table 4 (i.e., 3.71×10^{-6} m/s and 1.00×10^{-6} m/s, respectively).

To calculate inflow into the excavation, the methods outlined in the Construction Dewatering and Groundwater Control (Powers, 2007) were utilized. The dewatering calculations are attached in Appendix E.

The estimated groundwater inflow rate (into the construction excavation as described above), ranged between 58 m³/day and 16 m³/day.

The zone of influence (ZOI) of the water taking activities is described as the distance from the excavation to a point at which groundwater lowering due to water taking activities becomes negligible (Powers, 2007). It was conservatively estimated that the ZOI generated from one condominium excavations extends approximately 38 m from the walls of the excavation. The ZOI was outlined on Figure 1 and extended from the property boundaries (as a conservative measure).

The dewatering calculations indicate that the daily dewatering rate of the construction excavation per condominium structure will likely be less than 50 m³/day, in which case the construction dewatering activities do not need to be registration on the Environmental Activity

and Sector Registry (EASR). Actual dewatering rates should be monitored during construction activities to confirm that dewatering does not require registration on the EASR.

To register water taking activities on the EASR a Water Taking and Discharge Plan is required, It is recommended that a Water Taking and Discharge Plan be prepared should dewatering activities need to be registered on the EASR. The registration process can be delayed until such time as dewatering rates reach the regulatory limit of 50 m^3/day.

Available information indicates that many of the residences to the north, west and east of the Site are provided potable water servicing by the Town of Wasaga Beach. A water well survey should be completed to confirm water servicing of all adjacent properties. If sensitive wells are identified within (or near) the projected ZOI then a water monitoring program should be established for those wells.

6.0 Water Balance

Cambium completed pre- and post-development water balances to assess the potential impact of the development on local groundwater and surface water resources. To complete the assessment the following equations were utilized:

$$QI = A \times S \times I$$

Where:
- QI - Infiltration Volume (m³/yr)
- A - Area (m²)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

$$QR = A \times S \times (1-I)$$

Where:
- QR - Runoff Volume (m³/yr)
- A - Area (m²)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

It is noted that the water balance described herein does not account for catchment areas that may extend off-site. The calculations compare the pre- and post-development water balance changes within the Site boundaries (and conceptually determine if changes in groundwater infiltration can be mitigated wholly by on-site LID measures).

The total area of the Site is approximately 5.88 ha. The Site existed undeveloped forested land prior to development. The proposed development consists the following of

- two 6 storey residential buildings with a private amenity area at the southeast corner of the property,
- seven blocks of townhomes in the southwest area of the lot, as well as one additional block of townhomes north of the 6 storey residential buildings,
- thirty one single residential lots,
- two parking lots immediately north of the respective 6 storey residential buildings, parkland in the western area of the Site and open space in the northeastern and southern areas of the property, and,
- a storm water management area in the northern corner of the lot.

The approximate footprints of the proposed development areas are outlined below in Table 6.

Table 6 Proposed Development Areas

Area	Footprint (m^2)	Impervious Area (%)	Impervious Area (m^2)	Pervious Area (m^2)
Parkland and Landscaped Areas	9,550	0	0	9,550
Stormwater Management and Drainage Blocks	3,900	0	0	3,900
Roads, Parking Lots and Sidewalks	16,500	100	16,500	0
Single Residential Lots	11,270	60	6,762	4,508
Townhomes	11,200	85	9,520	1,680
Amenity Areas	3,900	50	1,750	1,750
Condominiums	2,880	100	2,880	0
Total	58,800	-	37,412	21,388

6.1 Water Surplus

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.

According to the Environment Canada Climatic Normals (1981-2010) for the Essa Ontario station (Environment Canada, 2020) the average annual precipitation is 912 mm/year.

The Thornthwaite method was used to determine the amount of evapotranspiration that will occur at the Site (S. Lawrence Dingman, 2008). The calculated depth of evapotranspiration was 545 mm/year. The evapotranspiration calculations are included in Appendix F.

The water surplus of the Site was calculated to be 366 mm/yr from pre-development surfaces and landscaped areas.

Evapotranspiration does not occur from structures or paved areas. It was assumed that 10% of precipitation falling on structures or paved areas is lost directly to evaporation. The remaining depth (i.e., 90% of precipitation) was considered surplus and converted to infiltration and/or runoff. The surplus depth from structures and paved areas was estimated to be 821 mm/yr.

6.2 Infiltration of Water Balance

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).

Prior to development, the Site exists as relatively flat, undeveloped forested land. The soils were determined to consist of silt and clay soils. The infiltration factor of the pre-development land was assumed to be 0.55 of available surplus. The infiltration factor of all landscaped, parkland and stormwater management areas included in the proposed development was also assumed to be 0.55. An infiltration factor of 0.55 corresponds to an infiltration rate of 202 mm/yr and a runoff rate of 165 mm/yr.

6.3 Pre-Development Water Balance

The water balance for the existing conditions of the Site was calculated. The pre-development water balance is outlined in Table 6. The pre-development infiltration rate was calculated to be 11,869 m³/yr and the runoff rate was 9,711 m³/yr.

Table 7 Pre-Development Water Balance

	Area (m²)	Infiltration Rate (QI) (m³/yr)	Runoff Rate (QR) (m³/yr)
Undeveloped Land	58,888	11,869	9,711
		Sum of QI and QR (m³/yr)	**21,580**

6.4 Post-Development Water Balance

The post-development water balance is summarized in Table 8. The proposed development includes a significant increase of impervious surfaces, and a reduction of surfaces which allow groundwater infiltration. As a result, groundwater infiltration was calculated to be 4,317 m³/year upon development and runoff was calculated to be 38,557 m³/year upon development.

Table 8 Post-Development Water Balance

	Area (m^2)	Infiltration Rate (QI) (m^3/yr)	Runoff Rate (QR) (m^3/yr)
Parkland and Landscaped Areas	9,550	1,928	1,577
Stormwater Management and Drainage Blocks	3,900	787	644
Roads, Parking Lots and Sidewalks	16,500	0	13,543
Single Residential Lots	11,270	910	6,295
Townhomes	11,200	399	8,091
Amenity Areas	3,900	353	1,725
Condominiums	2,880	0	2,364
Total	**58,800**	**4,317**	**34,240**
		Sum of QI and QR (m^3/yr)	**38,557**

1. *Runoff for impervious was assumed to be 100% of the surplus generated from these surfaces (i.e., 90% of the total precipitation depth).*

6.5 Water Balance Comparison

The water balances of the pre-development and post-development scenarios are summarized below in Table 9.

Table 9 Water Balance Comparison

Scenario	QI (m^3/yr)	QI Difference From Pre-Development Scenario (m^3/yr, % change)	QR (m^3/yr)	QR Difference From Pre-Development Scenario (m^3/yr, % change)
Pre-Development	11,869	-	9,711	-
Post-Development	4,317	(-7,552 m^3/yr, -64%)	34,240	(+24,529 m^3/yr, 253%)

The post-development water balance indicates that the groundwater infiltration deficit is 7,552 m^3/year.

The stormwater management and Low Impact Development features included in the proposed development plan should account for infiltrating at 7,552 m^3/yr of water in order to compensate for the projected infiltration deficit.

A qualified stormwater management engineer should be retained to design re-infiltration features and develop a stormwater management plan to mitigate storm flows. Groundwater infiltration features should target the native soils underlying the fill. Additional infiltration testing and subsurface investigation features should be completed for the detailed design of groundwater infiltration features. From the observations to date, enhanced infiltration would be

best located in the vicinity of MW103-19 and/or MW107-19. Only runoff from roofed or landscaped/parkland areas should be used for re-infiltration.

7.0 Conclusions

Cambium was retained by Beachwood Development Inc., to complete a hydrogeological assessment to support the proposed residential development located at Part Lot 34 and 35, Concession 3 Town of Wasaga Beach, Ontario.

Groundwater levels at the Site ranged between 3.71 mbgs and 0.65 mbgs. The direction of groundwater flow was north, towards Georgian Bay. The hydraulic conductivity of the water bearing sediments was typical of silty sand to silty clay material. Surficial infiltration rates (where measured) ranged between 20 mm/hr and 118 mm/hr.

The dewatering assessment indicated that dewatering rates could range between 58 m³/day and 16 m³/day (per condominium construction excavation), as such registering dewatering activities on the EASR may be required. Actual dewatering rates should be monitored during construction to determine if and when registration is required.

Cambium recommends that a Water Taking and Discharge Management plan be prepared prior to the commencement of excavation activities to avoid delays should construction dewatering need to be registered on the EASR. Further, a water well survey should be completed prior to dewatering to confirm private water servicing in the area of the Site. If sensitive wells are identified within (or near) the projected ZOI then a water monitoring program should established for those wells.

The water balance indicates that the infiltration deficit will be approximately 7,552 m³/year (upon development of the Site). Stormwater management and LID enhanced infiltration features should be designed to re-infiltrate this volume of water per year (at minimum) and sourced from roof drainage or landscaped/parkland areas.

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8.0 References

Cambium Inc. (2020). *Geotechnical Investigation - PART Lot 34 & 35, Concession 3, Wasaga Beach, Ontario, Revision 2.*

Chapman, L.J. and D.F. Putnam. (1984). *The Physiography of Southern Ontario: Ontario Geological Survey, Special Volume 2.*

Environment Canada. (2020). Retrieved 10 1, 2019, from Canadian Climate Normals 1981-2010: https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProx&txtRadius=25&selCity=&selPark=&optProxType=custom&txtCentralLatDeg=43&txtCentralLatMin=52&txtCentralLatSec=44.79&txtCentralLongDeg=78&txtCentralLongMin=58&txtCentral

Fetter, C. (2001). *Applied Hydrogeology.*

Ministry of Municipal Affairs and Housing, Housing Development and Buildings Branch. (1997). *Ontario Building Code 1997, containing the Building Code Act and O. Reg. 403/97.* Toronto, ON.

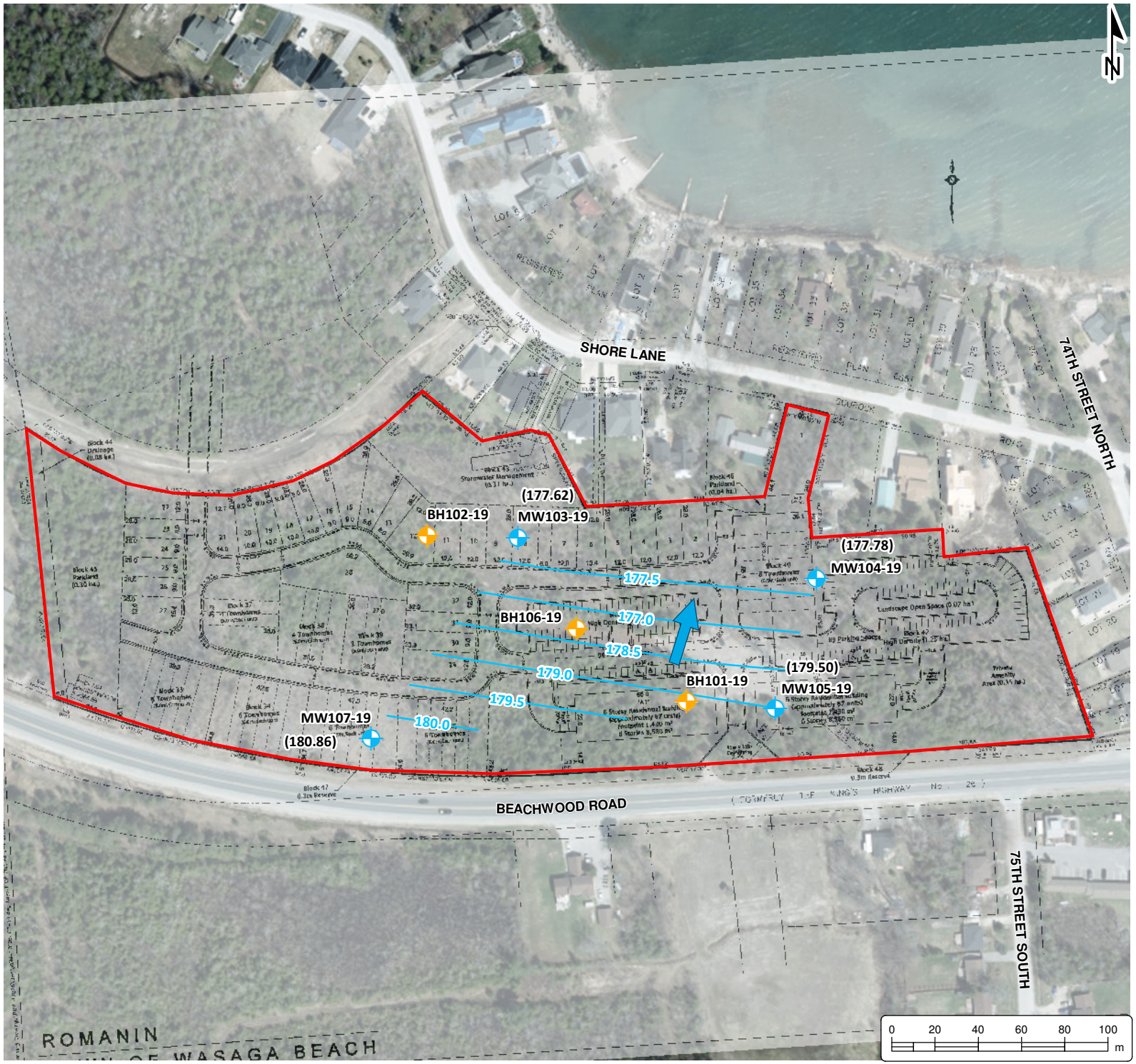
Ministry of the Environment. (2003). *Stormwater Management Planning and Design Manual.*

OGS. (2019). *Bedrock Geology of Ontario, southern sheet; Ontario Geological Survey, scale 1:250 000.*

OGS. (2019). Ontario's Quaternary Geology at a compilation scale of 1:1 000 000.

Powers, J. C. (2007). *Construction Dewatering and Groundwater Control, New Methods and Applications.*

S. Lawrence Dingman. (2008). *Physical Hydrology, Second Edition.*



HYDROGEOLOGICAL ASSESSMENT

BEACHWOOD DEVELOPMENT INC.
PART Lot 34 & 35, Concession 3
Wasaga Beach, Ontario

LEGEND

- Borehole Location
- Monitoring Well Location
- Groundwater Contours (0.5m intervals)
- Site (approximate)
- (177.85) Groundwater Elevation July 14, 2020
- Groundwater Flow Direction

Notes:
- Overlay image: Beachwood Development Inc. - Concept Plan 14, Town of Wasaga Beach, County of Simcoe by Jones Consulting Group LTD, dated January 27, 2020.
- Imagery was obtained from Simcoe County online GIS database, accessed December 2019.
- 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.

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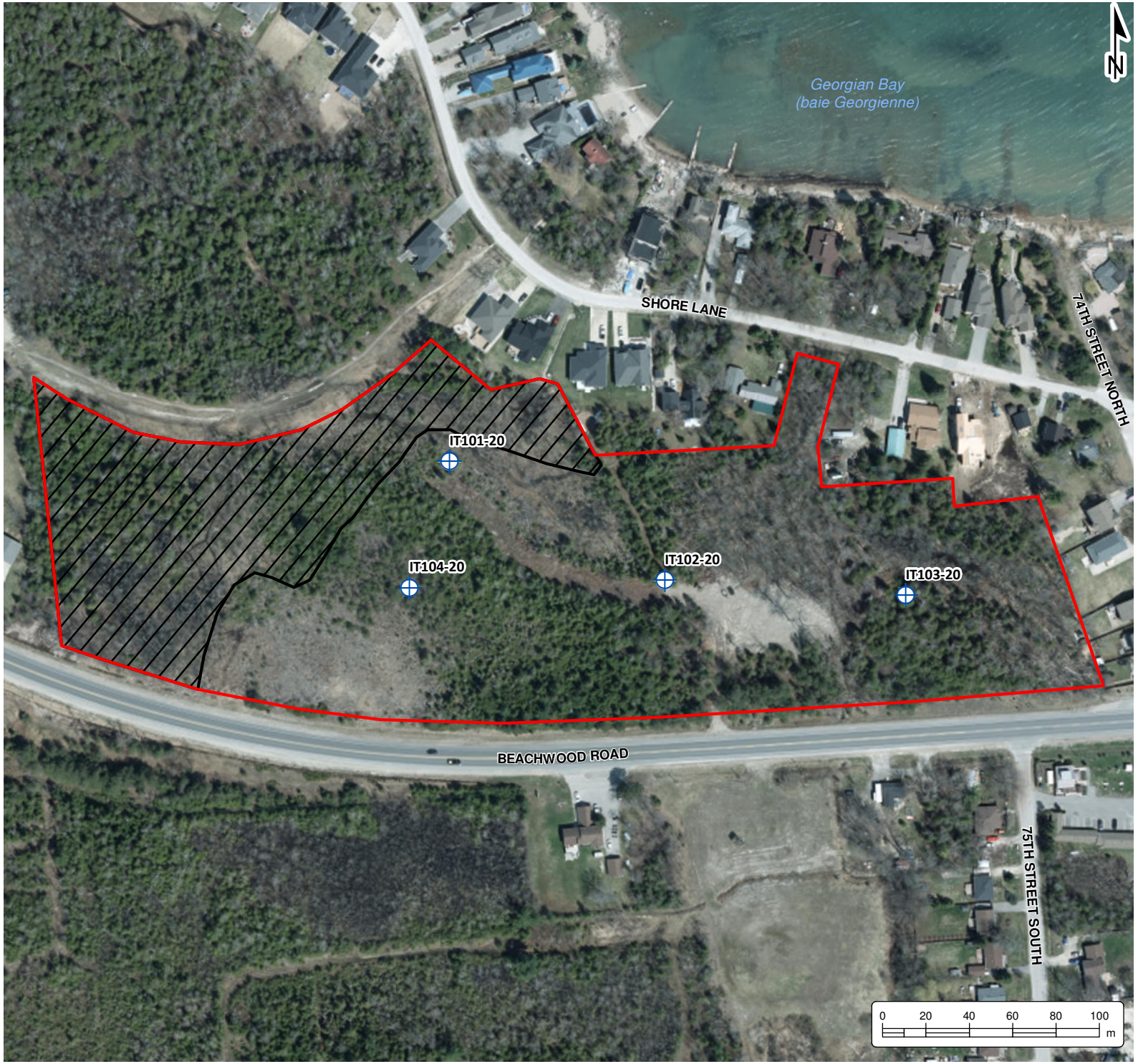
SITE PLAN

Project No.: 10131-002		Date: June 2020	Rev.:
Scale: 1:2,500		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: CM	Figure: 1	

O:\GIS\project_MXDs\10100-10199\10131-002 Tony Romanin - Hydrogeological Assessment - Shore Lane Wasaga Beach\2020-06-12 FIG 1 - Site Plan.mxd



HYDROGEOLOGICAL ASSESSMENT

BEACHWOOD DEVELOPMENT INC.
PART Lot 34 & 35, Concession 3
Wasaga Beach, Ontario

LEGEND

- Infiltration Test Location
- Area of Saturation at or near surface
- Site (approximate)

Notes:
- Imagery was obtained from Simcoe County online GIS database, accessed December 2019.
- 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).
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INFILTRATION TEST LOCATIONS

Project No.: 10131-002		Date: June 2020	Rev.:
Scale: 1:2,500		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: CM	Figure: 2	

O:\GIS\project_MXDs\10100-10199\10131-002 Tony Romanin - Hydrogeological Assessment - Shore Lane Wasaga Beach\2020-06-12 FIG 2 - Infiltration Test Locations.mxd

HYDROGEOLOGICAL ASSESSMENT

BEACHWOOD DEVELOPMENT INC.
PART Lot 34 & 35, Concession 3
Wasaga Beach, Ontario

LEGEND

- Water Well Record
- 38m Zone of Influence
- 300m Buffer
- Site (approximate)

Notes:
- Imagery was obtained from Simcoe County online GIS database, accessed December 2019.
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- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
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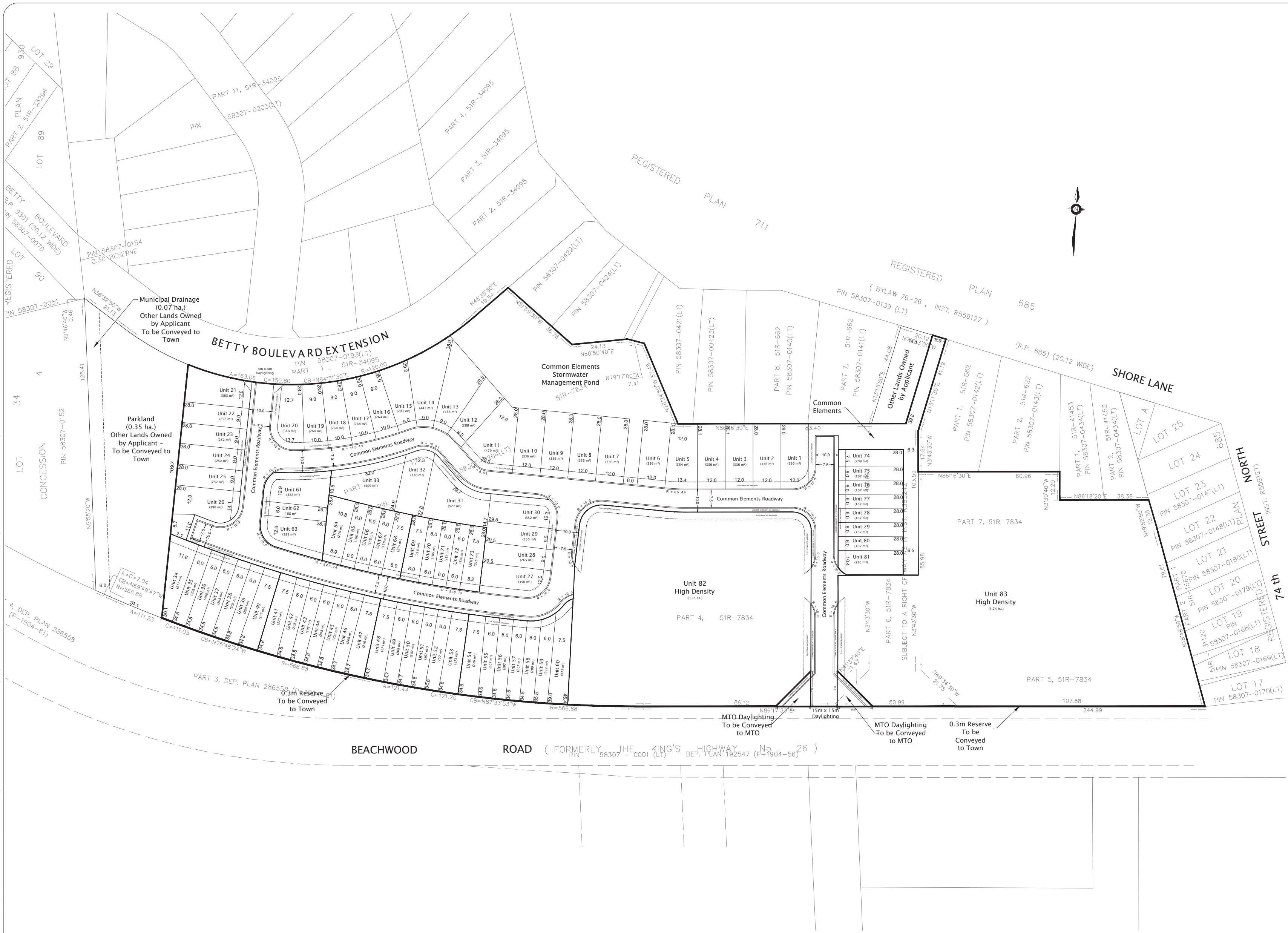
WATER WELL RECORDS WITHIN 300m OF SITE AND ZONE OF INFLUENCE

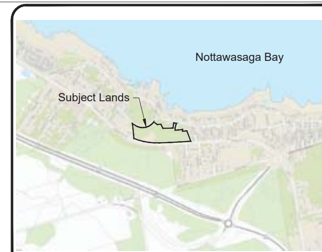
Project No.: 10131-002		Date: June 2020 Rev.:	
Scale: 1:6,000		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: CM	Figure:	3

O:\GIS\project_MXDs\10100-10199\10131-002 Tony Romanin - Hydrogeological Assessment - Shore Lane Wasaga Beach\2020-06-12 FIG 3 - WW Records Within 300m.mxd

Appendix A

Proposed Development Plan and Land Information





KEY PLAN SCALE: 20,000

Proposed Draft Plan of Vacant Land Condominium
Part of Lot 34, Concession 3
Town of Wasaga Beach
County of Simcoe
2020

OWNERS' CERTIFICATE

WE, THE UNDERSIGNED, BEING THE REGISTERED OWNERS OF THE SUBJECT LANDS, HEREBY AUTHORIZE THE JONES CONSULTING GROUP LTD., TO PREPARE THIS DRAFT PLAN OF SUBDIVISION AND TO SUBMIT SAME TO THE TOWN OF WASAGA BEACH FOR APPROVAL.

DATE M.ROMANIN CONTRACTING LIMITED

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE SASA KRCMAR OLS, KRCMAR SURVERYORS

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

a) SHOWN ON DRAFT PLAN
b) SHOWN ON DRAFT PLAN
c) SHOWN ON KEY PLAN
d) RESIDENTIAL, SWM & DRAINAGE
e) SHOWN ON DRAFT PLAN
f) SHOWN ON DRAFT PLAN
g) SHOWN ON DRAFT PLAN
h) MUNICIPAL PIPED WATER TO BE PROVIDED
i) SAND
j) SHOWN ON DRAFT PLAN
k) ALL MUNICIPAL SERVICES TO BE PROVIDED
l) NONE

SUBDIVISION STATISTICS	AREA (ha.)	UNITS
Residential - Singles (Units 1 - 33)	1.10 ha.	33 units
Residential - Townhomes (Units 34 - 81)	1.07 ha.	48 units
Residential - High Density (Units 82 & 83)	2.09 ha.	134 units
Stormwater Management	0.31 ha.	
Roadway	0.68 ha.	
Common Elements	0.12 ha.	
County Daylighting	0.02 ha.	
0.3m Reserves	0.01 ha.	
SUBDIVISION TOTAL	5.40 ha.	
Parkland to be Conveyed	0.35 ha.	
Municipal Drain to be Conveyed	0.07 ha.	
Other Lands Owned by Applicant	0.06 ha.	
Other Lands Total	0.48 ha.	
Total Land Holdings	5.88 ha.	215 units

0 5 10 50m
SCALE 1 : 750 (A1)

BEACHWOOD DEVELOPMENTS INC.
WASAGA BEACH

Proposed Draft Plan of Vacant Land Condominium

Brandi L. Clement
REGISTERED PROFESSIONAL PLANNER
R.P.P.
ONTARIO PROFESSIONAL PLANNERS INSTITUTE
INSTITUT DES PLANIFICATEURS PROFESSIONNELS DE L'ONTARIO

Date Issued:	AUG 27, 2020
Checked By:	BC
Project No.:	ROM-17026
Drawn By:	m.c.r.
Drawing Name:	ROM-17026-DP-VLC-20-09-02.dwg

SCHEDULE OF REVISIONS

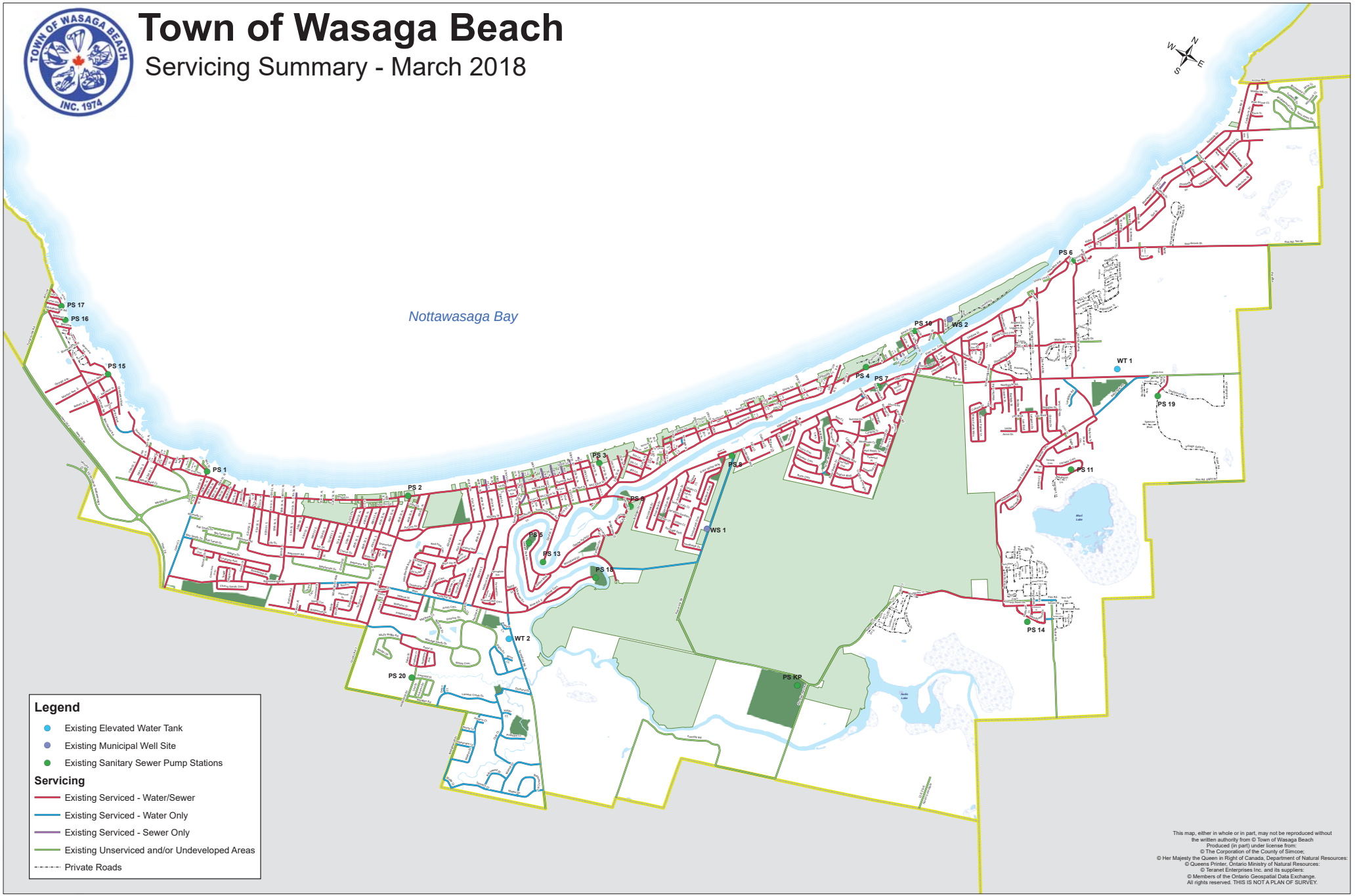
DATE	DESCRIPTION	DRAWN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Drive East, Unit 1, Barrie, Ontario, L4N 0W5
Phone: 705-734-2538 Fax: 705-734-1056
www.jonesconsulting.com

BEACHWOOD DEVELOPMENTS INC.
TOWN OF WASAGA BEACH

Town of Wasaga Beach

Servicing Summary - March 2018



Appendix B
Borehole Logs

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
www.cambium-inc.com

Log of Borehole: BH101-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 2, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 570045, 4924260 **Elevation:** 181.52 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
181 / 0		Topsoil: Brown sandy topsoil, trace gravel, trace silt, loose, moist	1	SS	5	5				
1		Sand: Brown sand, trace gravel, trace silt, compact, moist	2	SS	50	15				
180 / 2		Silty Clay: Brown silty clay, some sand, trace gravel, firm, wet	3	SS	100	8				
179 / 3			4	SS	100	5				GSA SS4: 6% Gravel 13% Sand 29% Silt 52% Clay
178 / 4		Sand: Brown sand, trace gravel, trace silt, trace clay, occasional cobbles, compact, wet	5	SS	5	18				
177 / 5		Very dense	6	SS	0	50/ 50 mm				Spoon bouncing at 4.6 mbgs
176 / 6		Borehole terminated at 5.0 mbgs due to SPT and practical auger refusal.				49*				Dynamic Cone Penetration Test (DCPT) began at 5.2 mbgs, terminated at 6.7 mbgs. DCPT was advanced in a separate borehole adjacent to BH101-19.
						62*				
						59*				
175 / 7						55*				
174						60*				Wet soils encountered at 1.5 mbgs, borehole open upon completion.

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

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Oshawa
Kingston
T: 866-217-7900
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Log of Borehole: BH102-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 2, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 569925, 4924337 **Elevation:** 180.01 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
180 / 0		Topsoil: Black topsoil, trace sand, trace gravel, occasional cobbles, loose, moist	1A							
		Sand: Brown sand, some clay, some silt, trace gravel, loose, moist	1B	SS	10	7				
		Compact	2	SS	50	24				
179 / 1										
		Silty Clay: Brown silty clay, trace gravel, trace sand, very stiff, wet	3	SS	50	17				
178 / 2										
		Silt and Sand: Grey silt and sand, some clay, some gravel, compact, wet	4	SS	100	19				GSA SS4: 16% Gravel 32% Sand 34% Silt 18% Clay
177 / 3		Very Dense	5	SS	0	50/ 75 mm				Wet soils encountered at 1.5 mbgs and caving at 3.0 mbgs upon completion.
		Borehole terminated at 3.5 mbgs due to SPT and practical auger refusal.								
176 / 4										

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

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Log of Borehole: BH103-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 4, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 569967, 4924336 **Elevation:** 179.41 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
179 / 0		Topsoil: Black sandy topsoil, trace sand, loose, moist	1A						Cap	Top of Standpipe (TOS) elevation: 180.31 mASL. Groundwater measured at 1.76 mbgs (177.65 mASL) on February 4, 2020.
			1B	SS	40	6			Sand Pack	
		Silty Clay: Brown silty clay, trace sand, trace gravel, firm, moist								
178 / 1			2	SS	100	5				
		Wet	3	SS	100	6				
177 / 2		Grey, some sand, very stiff	4	SS	40	22				
176 / 3		Silty Sand: Grey silty sand, trace clay, trace gravel, very dense, wet	5	SS	55	50/ 255 mm			PVC Standpipe	
									Bentonite Plug	
175 / 4			6	SS	50	50				
174 / 5										
173 / 6			7	SS	90	50/ 255 mm				
172 / 7									Sand Pack	
			8	SS	80	50/ 75 mm			PVC Screen	
8										

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

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Kingston
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Log of Borehole: BH103-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 4, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 569967, 4924336 **Elevation:** 179.41 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
171 / 9										
170			9	SS	80	50/ 255 mm			Cap	
10		Borehole terminated at 9.6 mbgs.								Wet soils encountered at 1.5 mbgs.
169										

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

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Log of Borehole: BH104-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 4, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 570105, 4924317 **Elevation:** 178.68 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
178 / 0		Silty Sand: Brown silty sand, trace gravel, trace clay, compact, moist	1	SS	30	29			Cap; Bentonite Plug; PVC Standpipe	Top of Standpipe (TOS) elevation: 179.65 mASL. Groundwater measured at 0.82 mbgs (177.87 mASL) on February 4, 2020.
177 / 1		Silty Clay: Brown silty clay, some sand, trace gravel, occasional cobbles, firm, wet	2	SS	40	6				
			3	SS	90	4				
176 / 2		Silty Sand: Grey silty sand, some clay, some gravel, dense, wet	4	SS	50	43			Sand Pack; PVC Screen	GSA SS4: 11% Gravel 45% Sand 33% Silt 11% Clay
175 / 3			5	SS	60	42				
174 / 4		Sand: Grey sand, some gravel, trace silt, compact, wet	6	SS	50	25			Cap	
173 / 5		Borehole terminated at 5.0 mbgs.								Wet soils encountered at 0.8 mbgs.
6										

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

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Kingston
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Log of Borehole: BH105-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 4, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 570086, 4924257 **Elevation:** 180.49 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
180 / 0		Topsoil: Black sandy topsoil, trace clay, very loose, moist	1	SS	30	2			Cap	Top of Standpipe (TOS) elevation: 181.58 mASL. Groundwater measured at 0.81 mbgs (179.68 mASL) on February 4, 2020.
									Bentonite Plug	
									PVC Standpipe	
179 / 1		Silty Clay: Grey silty clay, trace sand, soft, wet	2	SS	95	3				
		Firm	3	SS	95	4			Sand Pack	
									PVC Screen	
178 / 2		Silty Sand: Grey silty sand, trace clay, trace gravel, occasional cobbles, very dense, wet	4	SS	10	50/ 280 mm			Cap	
177 / 3		Borehole terminated at 2.7 mbgs due to SPT and practical auger refusal.				35*				Dynamic Cone Penetration Test (DCPT) began at 3.0 mbgs, terminated at 5.8 mbgs. DCPT was advanced in a separate borehole adjacent 10 BH105-19.
						25*				
						23*				
176 / 4						24*				
						31*				
						59*				
175 / 5						72*				
						82*				
6						80*				Wet soils encountered at 0.8 mbgs.

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Log of Borehole: BH106-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 4, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 569994, 4924294 **Elevation:** 180.59 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
180 / 0		Sand: Brown sand, some organics, trace gravel, trace silt, loose, moist	1	SS	20	7				
179 / 1		Grey, some silt, no organics, compact	2	SS	80	14				
		Silty Clay: Brown silty clay, some sand, trace gravel, occasional cobbles, firm, wet	3	SS	60	8				
178 / 2										
177 / 3		Grey, wet	4	SS	60	7				
176 / 4										
		Sand: Grey sand, some silt, trace gravel, occasional cobbles, very dense, wet	5	SS	20	50/ 205 mm				
175 / 5		Borehole terminated at 5.0 mbgs due to SPT and practical auger refusal.								Wet soils encountered at 1.5 mbgs.
6										

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

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Log of Borehole: BH107-19

Client: Beachwood Development Inc. **Project Name:** Geotech Investigation - Romanin Development **Project No.:** 10131-001

Contractor: Walker Drilling Ltd. **Method:** Hollow Stem Augers **Date Completed:** December 5, 2019

Location: PART Lot 34 &35, Concession 3, Wasaga Beach **UTM:** 17T, 569899, 4924243 **Elevation:** 182.20 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
182 / 0		Silty Clay: Brown silty clay, some sand, trace organics, stiff, moist	1	SS	20	11			Cap	Top of Standpipe (TOS) elevation: 183.27 mASL. Groundwater measured at 3.3 mbgs (179.94 mASL) on February 4, 2020.
									Bentonite Plug	
		Very stiff	2	SS	40	17			PVC Standpipe	
181 / 1										
		Grey, less organics, stiff, wet	3	SS	50	11				
180 / 2										
		Trace gravel, firm	4	SS	85	7			Sand Pack	GSA SS4: 2% Gravel 16% Sand 40% Silt 42% Clay
									PVC Screen	
179 / 3			5	SS	100	6				
178 / 4										
		Sand: Grey sand, some silt, trace gravel, trace clay, occasional cobbles, very dense, wet	6	SS	50	50/ 230 mm			Cap	
177 / 5		Borehole terminated at 5.0 mbgs.								Wet soils encountered at 1.5 mbgs.
176 / 6										

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

Appendix C
Grain Size Analysis Results

Grain Size Distribution Chart

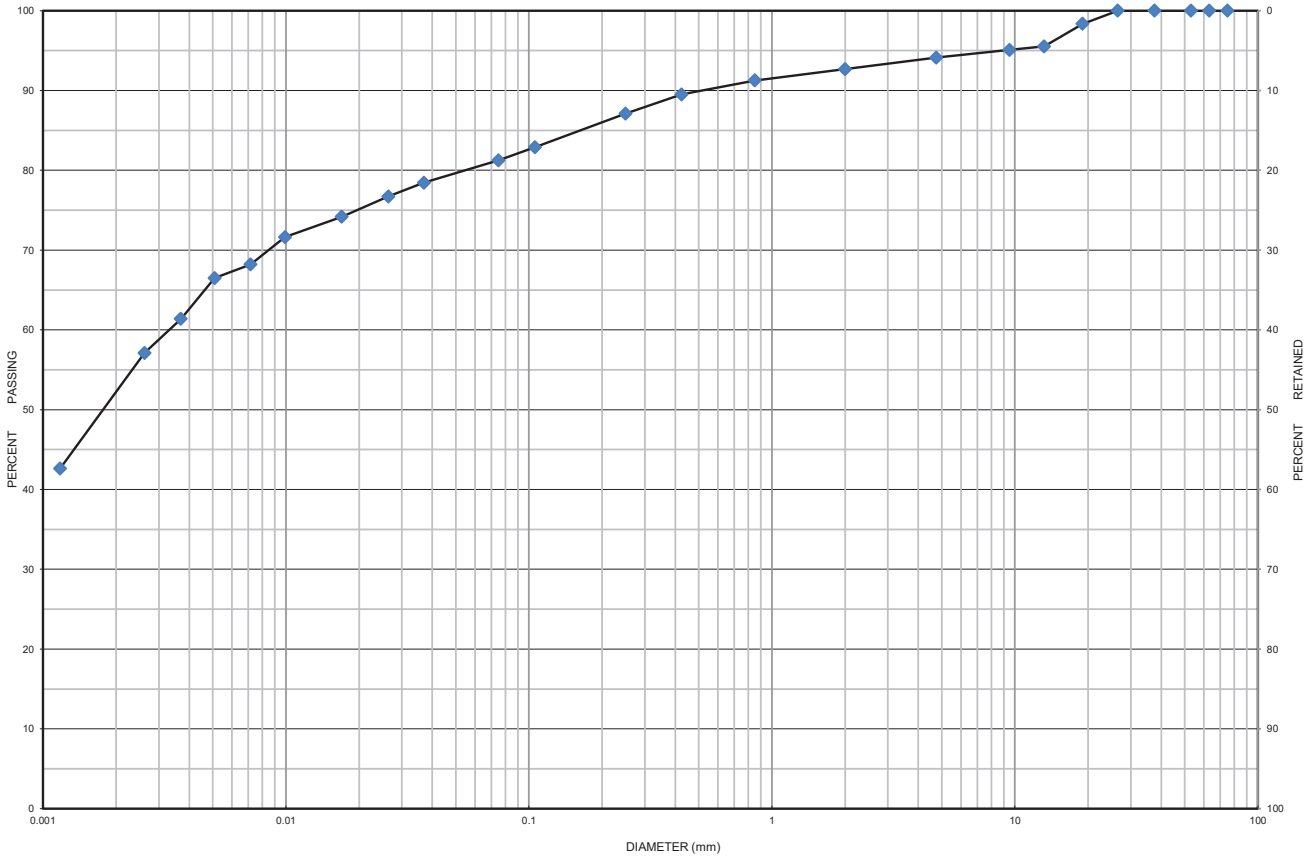
Project Number: *10131-001* **Client:** *Beachwood Development Inc.*

Project Name: *PART Lot 34 & 35, Concession 3, Town of Wasaga Beach*

Sample Date: *December 2, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 101-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-1131*

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 4	2.3 m to 2.7 m	6	13	81		23.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Clay some Sand trace Gravel	CL	0.0035	-	-	-	-

Issued By: _____ *Date Issued:* *August 7, 2020*

(Senior Project Manager)

Cambium Inc. (Laboratory)

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701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Grain Size Distribution Chart

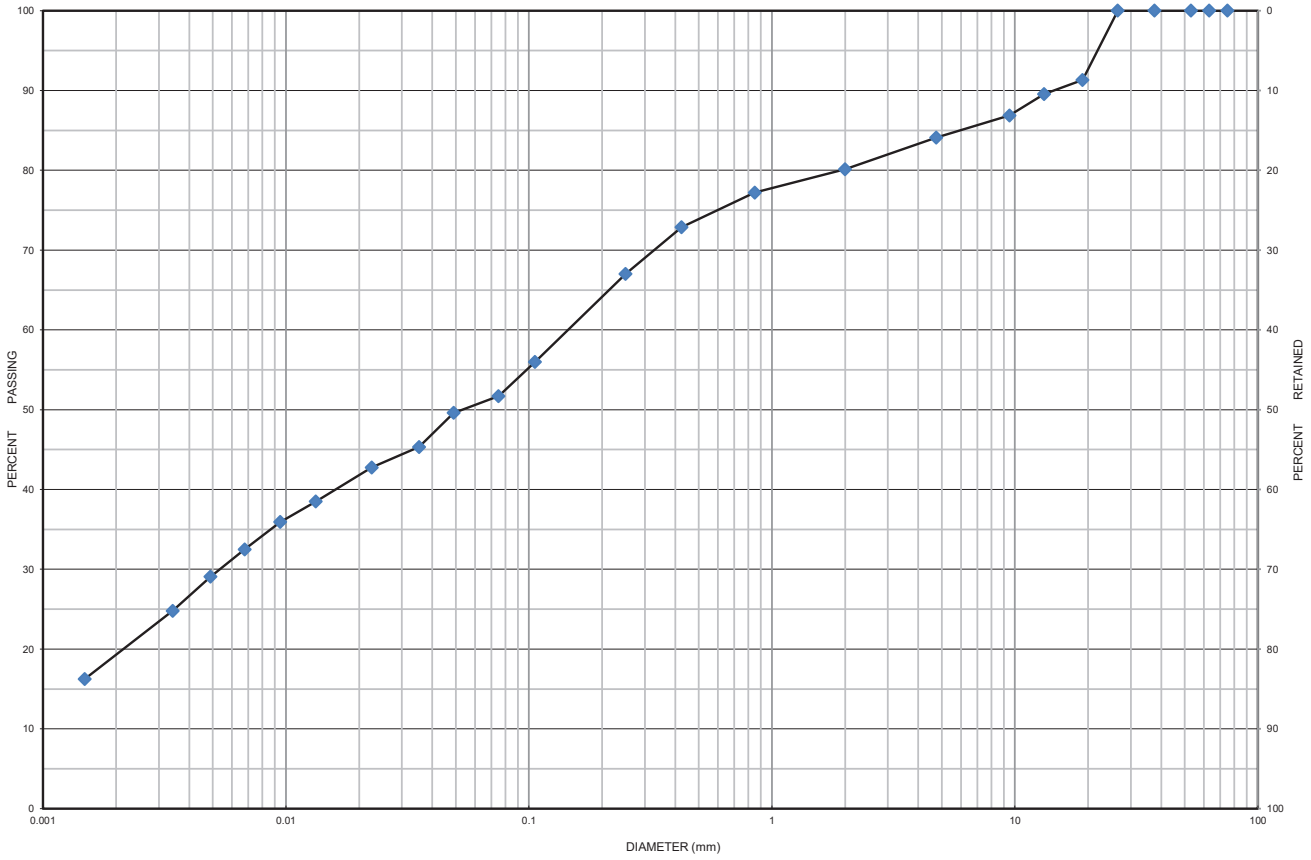
Project Number: *10131-001* **Client:** *Beachwood Development Inc.*

Project Name: *PART Lot 34 & 35, Concession 3, Town of Wasaga Beach*

Sample Date: *December 2, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 102-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-1132*

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 102-19	SS 4	2.3 m to 2.7 m	16	32	52		9.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt and Sand some Clay some Gravel	ML	0.1500	0.0065	-	-	-

Issued By: _____ *Date Issued:* *August 7, 2020*

(Senior Project Manager)

Cambium Inc. (Laboratory)

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Grain Size Distribution Chart

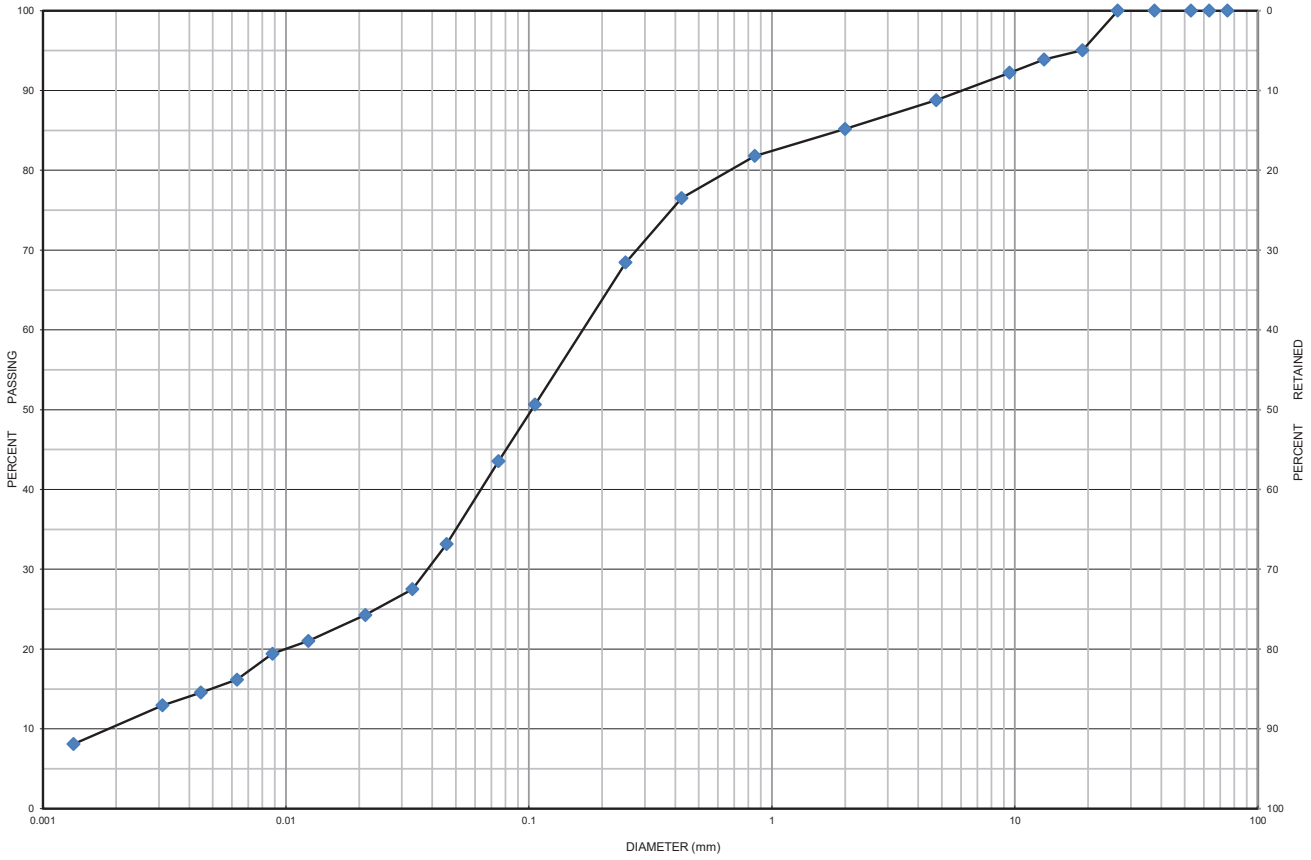
Project Number: *10131-001* **Client:** *Beachwood Development Inc.*

Project Name: *PART Lot 34 & 35, Concession 3, Town of Wasaga Beach*

Sample Date: *December 4, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 104-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-1133*

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 4	2.3 m to 2.7 m	11	45	44		7.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Clay some Gravel	SM	0.1800	0.0390	0.0019	94.74	4.45

Issued By: _____ *Date Issued:* *August 7, 2020*

(Senior Project Manager)

Cambium Inc. (Laboratory)

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701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Grain Size Distribution Chart

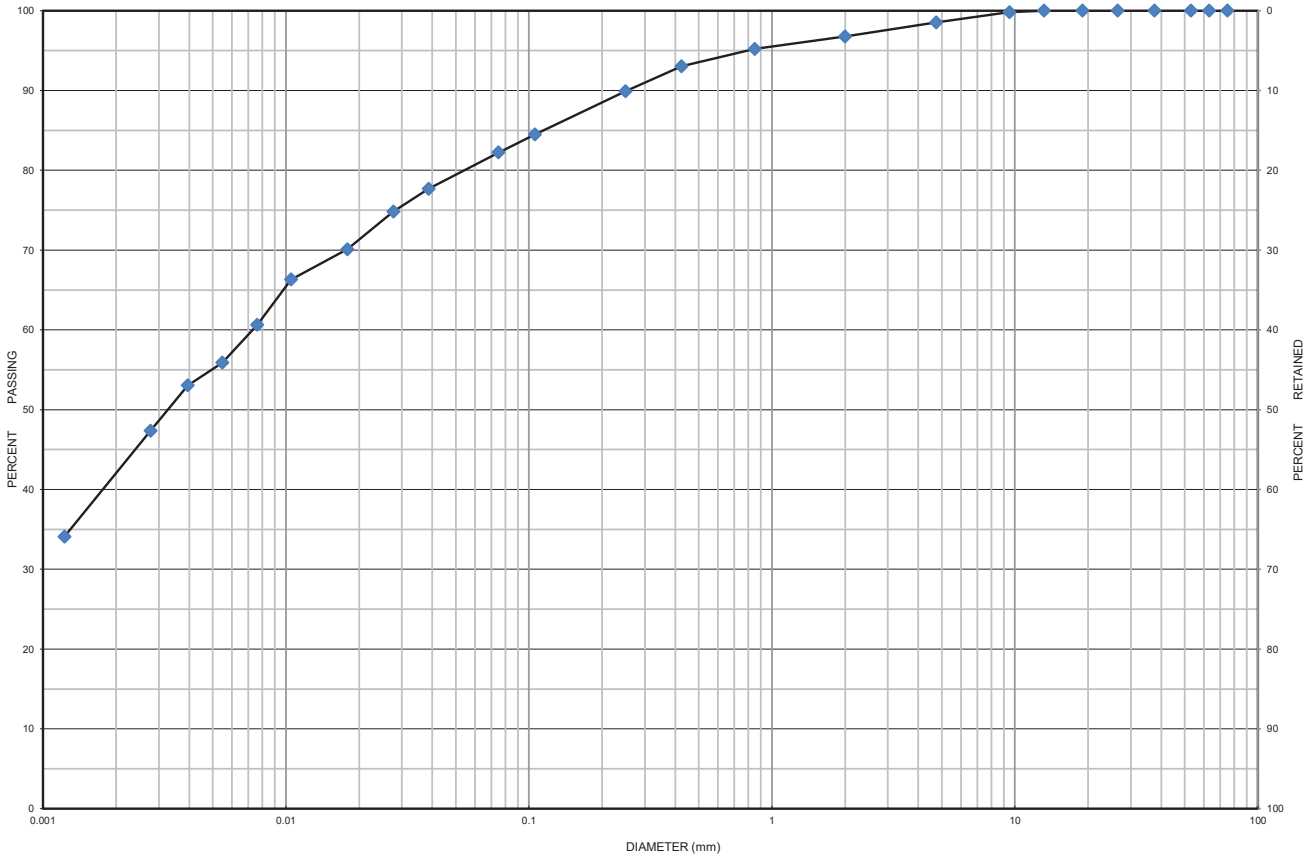
Project Number: *10131-001* **Client:** *Beachwood Development Inc.*

Project Name: *PART Lot 34 & 35, Concession 3, Town of Wasaga Beach*

Sample Date: *Decemeber 5, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 107-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-1134*

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 4	2.3 m to 2.7 m	2	16	82		20.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Clay and Silt some Sand trace Gravel	CL	0.0075	-	-	-	-

Issued By: _____ *Date Issued:* *August 7, 2020*

(Senior Project Manager)

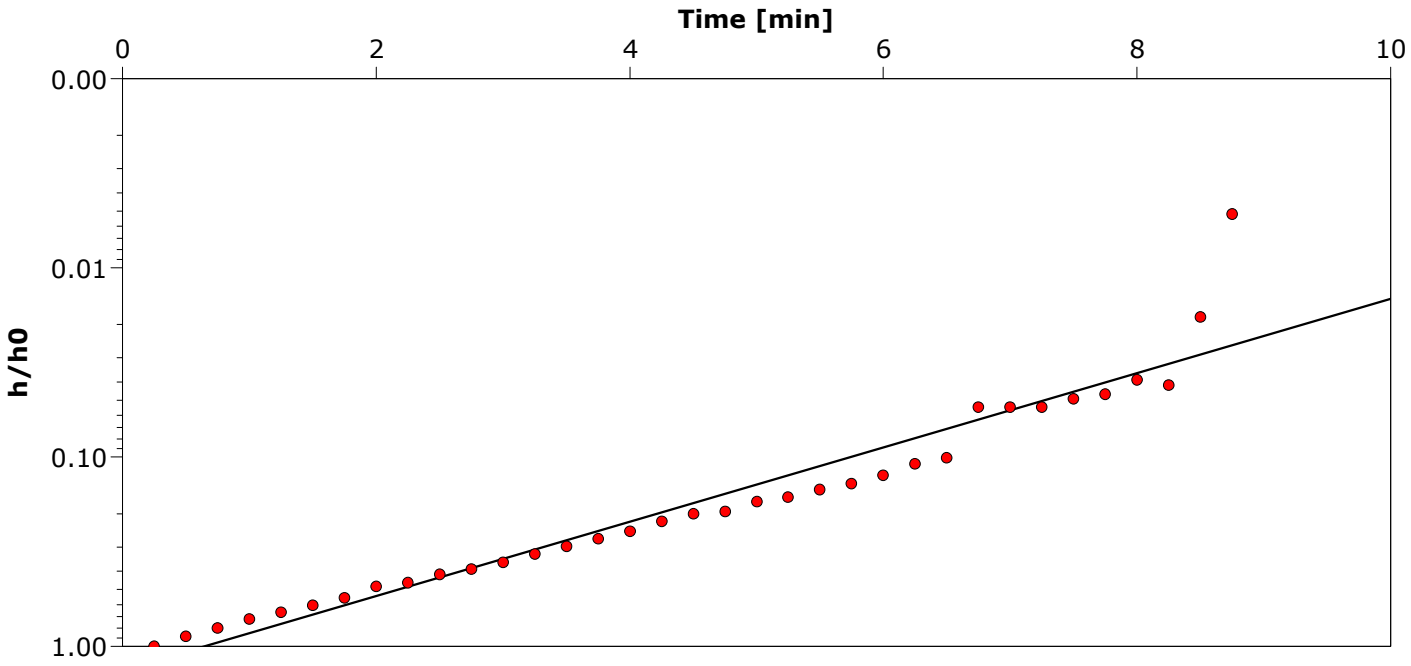
Cambium Inc. (Laboratory)

866.217.7900 | cambium-inc.com

701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Appendix D
Aquifer Test Pro™ Results

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontario** **K9L1S1**	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment: Shore Lane Wasaga Beach	
	Number: 10131-002	
	Client: Beachwood Development Inc.	
Location: Shore Lane Wasaga Beach	Slug Test: MW103-19 Bail Test 1	Test Well: MW103-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW103-19 Bail Test 1	Analysis Date: 2/20/2020
Aquifer Thickness: 6.50 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW103-19	3.71×10^{-6}	

Cambium Inc.
52 Hunter St. East
Peterborough, Ontario
K9L1S1

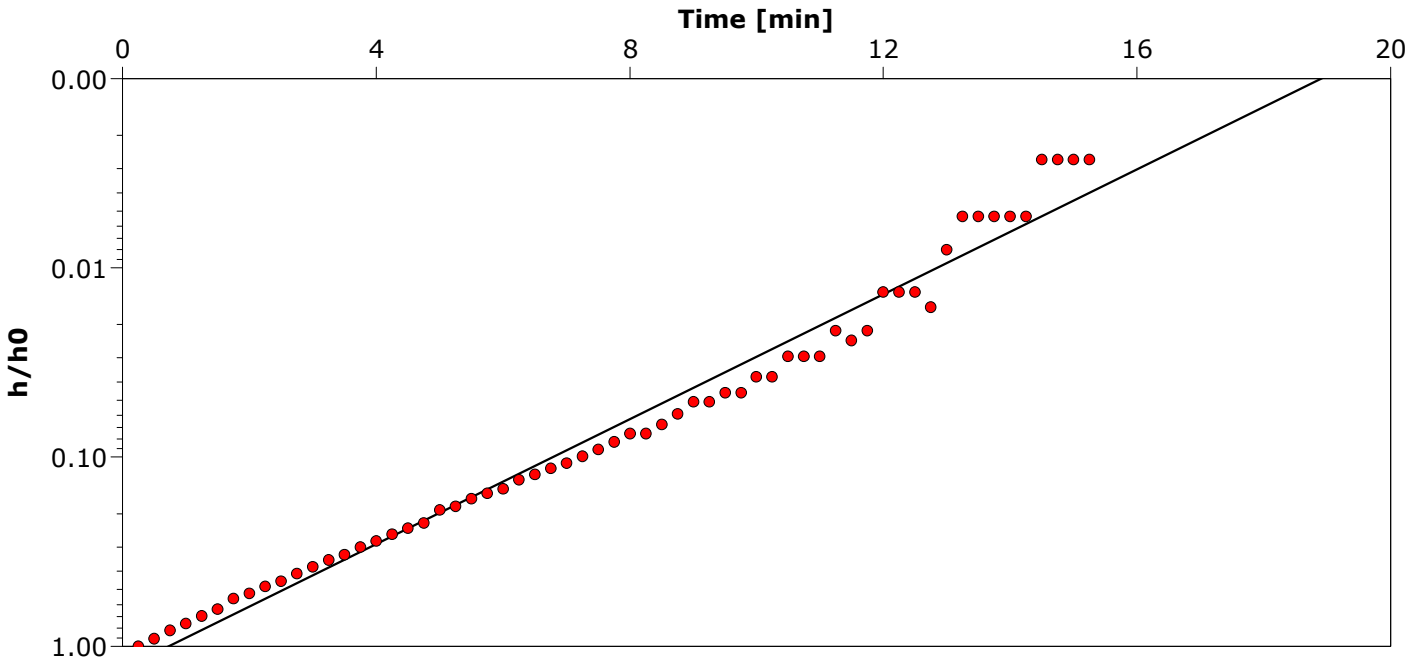
Slug Test Analysis Report

Project: Hydrogeological Assessment: Shore Lane Wasaga Beach

Number: 10131-002

Client: Beachwood Development Inc.

Location: Shore Lane Wasaga Beach	Slug Test: MW103-19 Bail Test 2	Test Well: MW103-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW103-19 Bail Test 2	Analysis Date: 2/20/2020
Aquifer Thickness: 6.50 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW103-19	3.11×10^{-6}	

Cambium Inc.
52 Hunter St. East
Peterborough, Ontario
K9L1S1

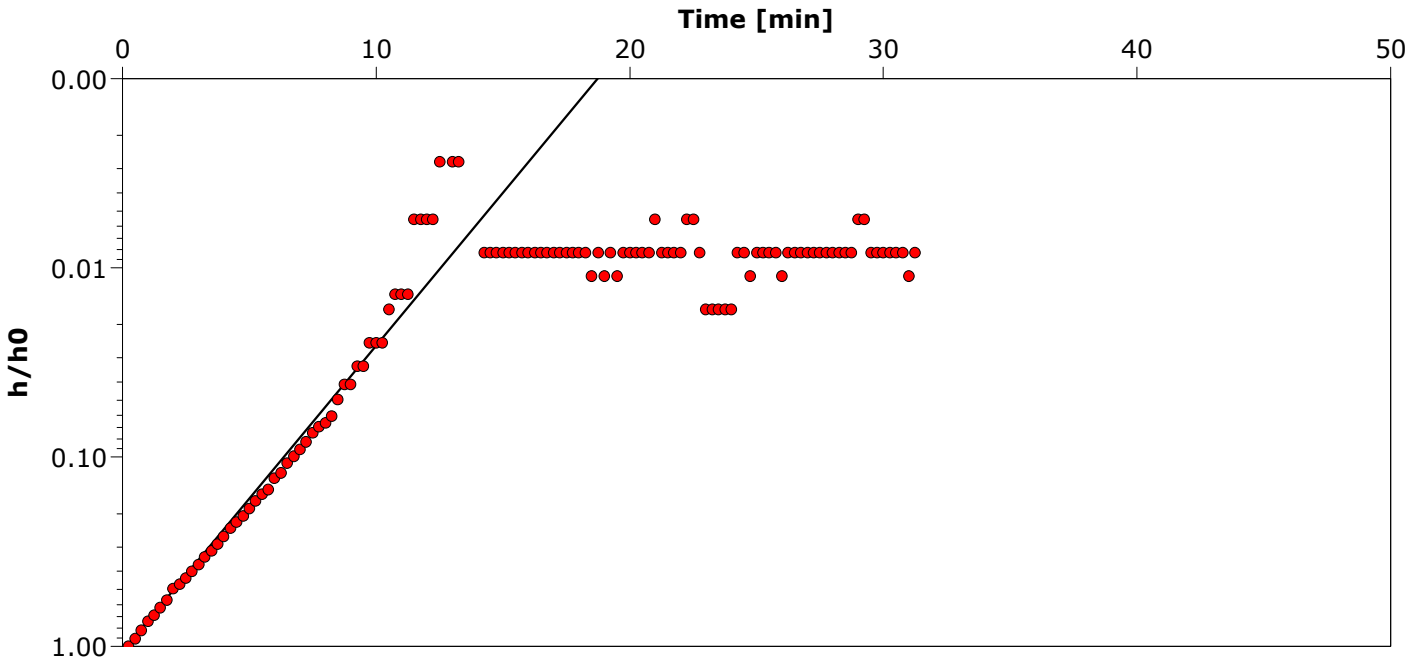
Slug Test Analysis Report

Project: Hydrogeological Assessment: Shore Lane Wasaga Beach

Number: 10131-002

Client: Beachwood Development Inc.

Location: Shore Lane Wasaga Beach	Slug Test: MW103-19 Bail Test 3	Test Well: MW103-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW103-19 Bail Test 3	Analysis Date: 2/20/2020
Aquifer Thickness: 6.50 m		

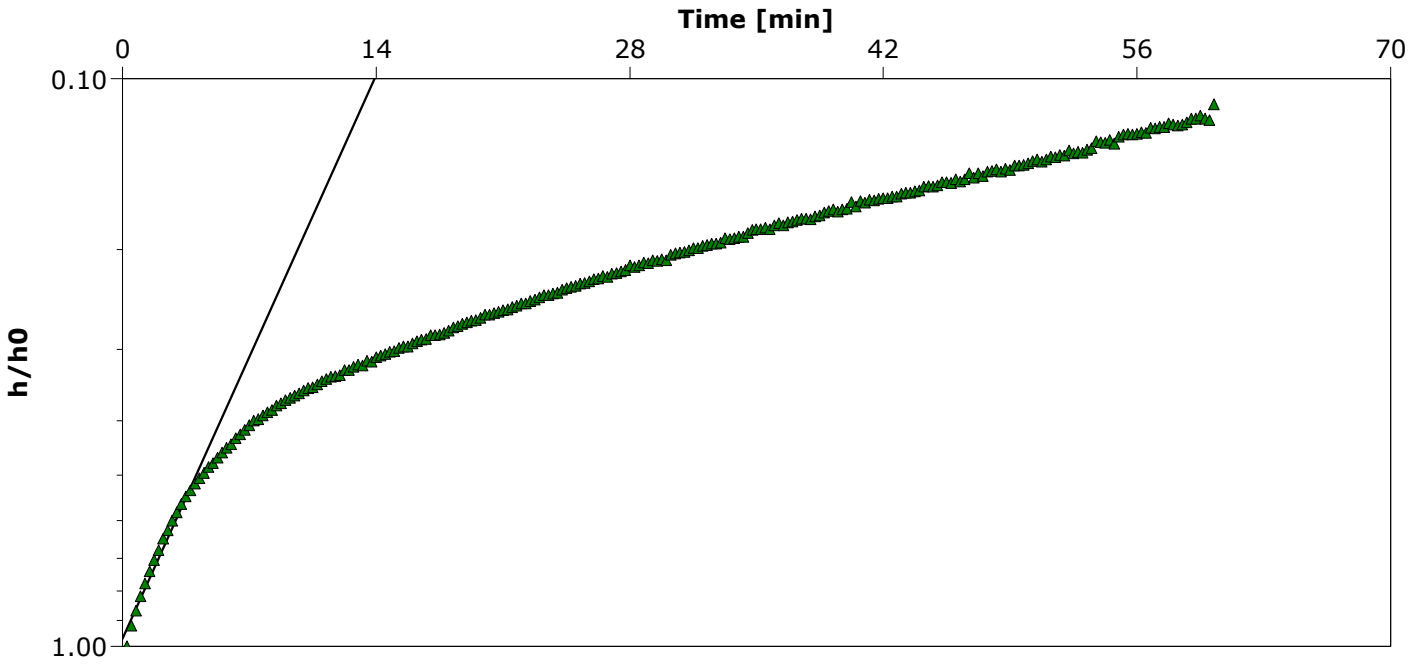


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW103-19	3.05×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontario** **K9L1S1**	**Slug Test Analysis Report** Project: Hydrogeological Assessment: Shore Lane Wasaga Beach Number: 10131-002 Client: Beachwood Development Inc.

Location: Shore Lane Wasaga Beach	Slug Test: MW104-19 Bail Test 1	Test Well: MW104-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW104-19 Bail Test 1	Analysis Date: 6/12/2020
Aquifer Thickness: 2.00 m		

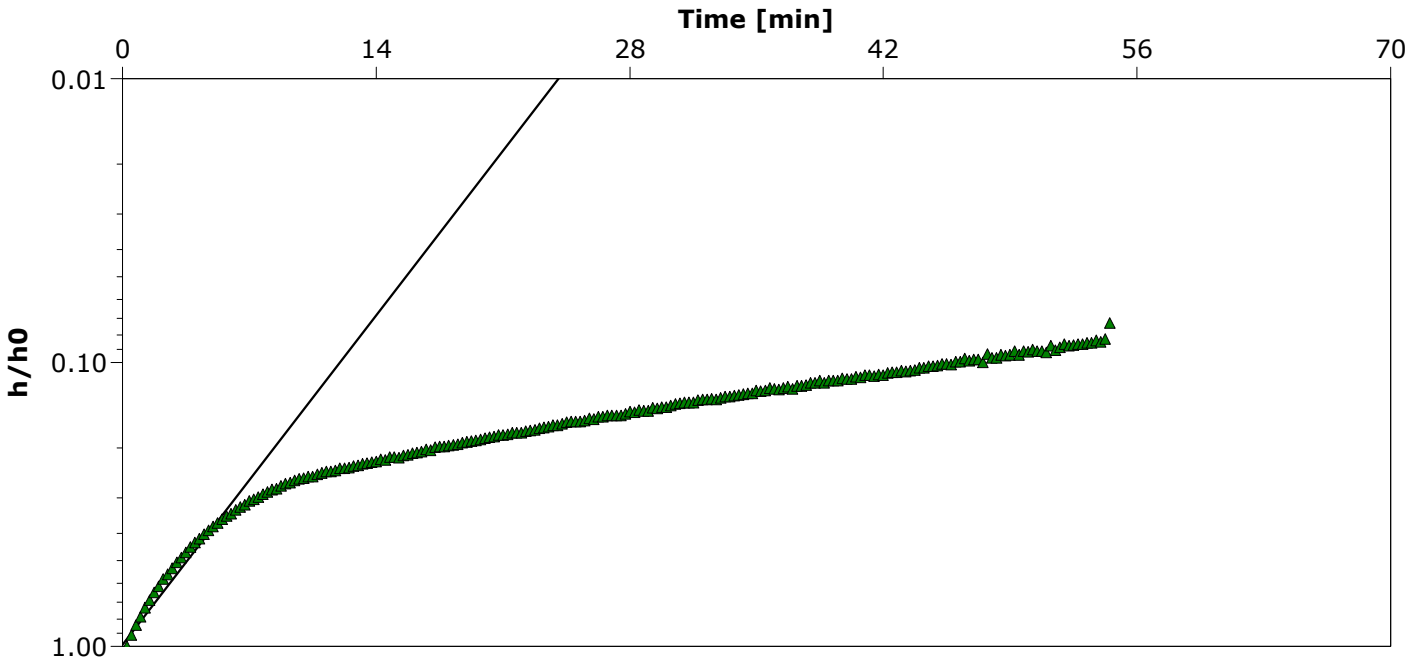


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW104-19	1.34×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontario** **K9L1S1**	**Slug Test Analysis Report** Project: Hydrogeological Assessment: Shore Lane Wasaga Beach Number: 10131-002 Client: Beachwood Development Inc.

Location: Shore Lane Wasaga Beach	Slug Test: MW104-19 Bail Test 2	Test Well: MW104-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW104-19 Bail Test 2	Analysis Date: 6/12/2020
Aquifer Thickness: 2.00 m		

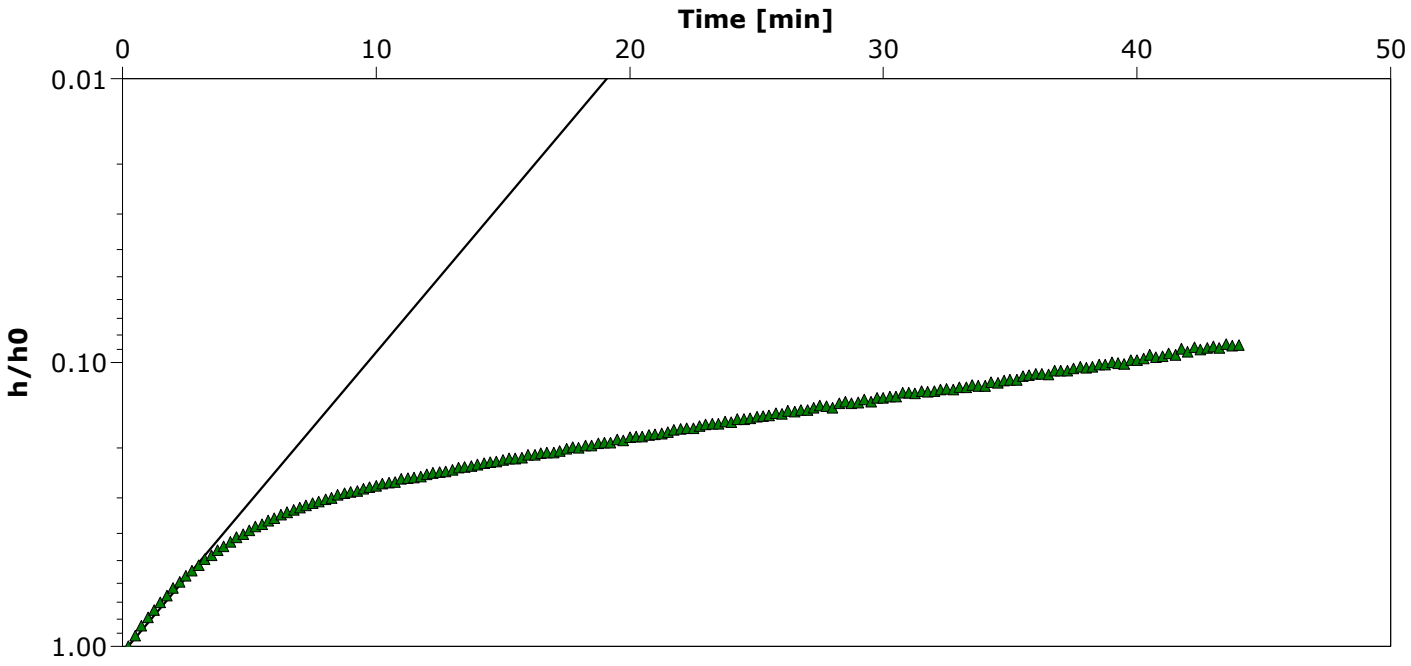


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW104-19	1.56×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontario** **K9L1S1**	**Slug Test Analysis Report** Project: Hydrogeological Assessment: Shore Lane Wasaga Beach Number: 10131-002 Client: Beachwood Development Inc.

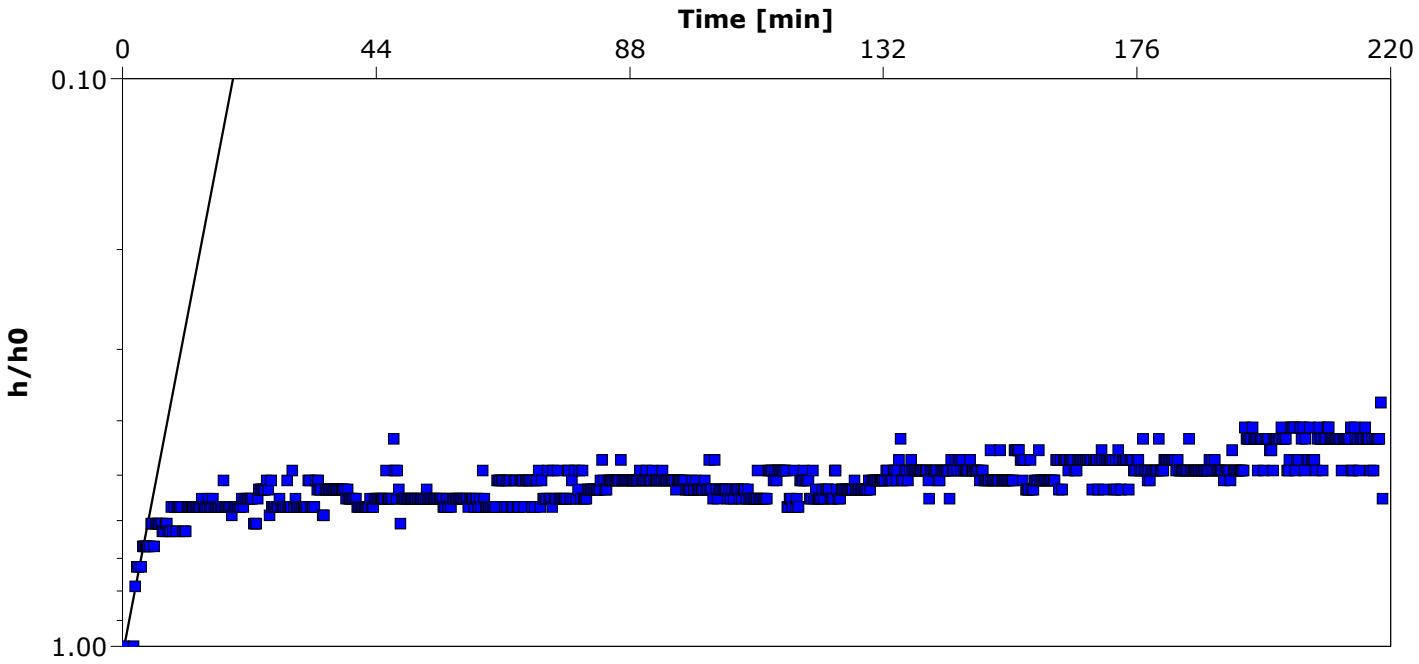
Location: Shore Lane Wasaga Beach	Slug Test: MW104-19 Bail Test 3	Test Well: MW104-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW104-19 Bail Test 3	Analysis Date: 6/12/2020
Aquifer Thickness: 2.00 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW104-19	2.00×10^{-6}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontario** **K9L1S1**	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment: Shore Lane Wasaga Beach	
	Number: 10131-002	
	Client: Beachwood Development Inc.	
Location: Shore Lane Wasaga Beach	Slug Test: MW107-19 Bail Test 1	Test Well: MW107-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW107-19 Bail Test 1	Analysis Date: 6/12/2020
Aquifer Thickness: 0.50 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW107-19	1.00×10^{-6}	

Cambium Inc.
52 Hunter St. East
Peterborough, Ontario
K9L1S1

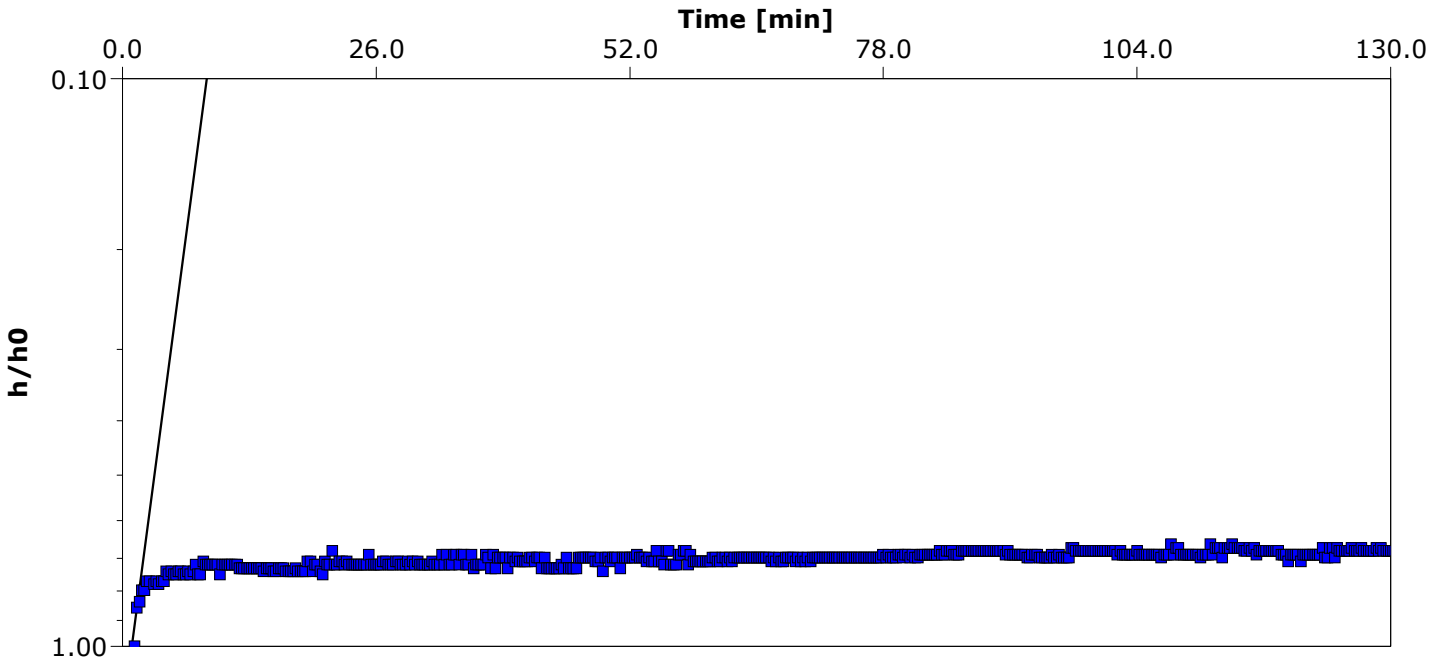
Slug Test Analysis Report

Project: Hydrogeological Assessment: Shore Lane Wasaga Beach

Number: 10131-002

Client: Beachwood Development Inc.

Location: Shore Lane Wasaga Beach	Slug Test: MW107-19 Bail Test 2	Test Well: MW107-19
Test Conducted by: Chris Malliaros		Test Date: 2/4/2020
Analysis Performed by: Elysha Pecena	MW107-19 Bail Test 2	Analysis Date: 6/12/2020
Aquifer Thickness: 0.50 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW107-19	2.46×10^{-6}	

Appendix E
Dewatering Calculations

Construction Excavation Dewatering

Scenario	Depth (mbgs)	Equivalent Radius (rw) (m)	Static Level (m)	Dewatered level (m)	Aquifer Thickness (m)	Drawdown (m)	Conductivity (m/s)	Length to Zero Drawdown (m)	Estimated Inflow L/min	Inflow per day (m3/day)
High K	3	28	0.65	4	6	3.35	3.71E-06	38	40	58
Low K	3	28	0.65	4	6	3.35	1.00E-06	20	11	16

static level (H)	0.65	
ln(Ro/rw) (high)	0.30	
ln(Ro/rw) (low)	0.30	(assumed)
Hydraulic Conductivity (m/s) (high)	3.71E-06	
Hydraulic Conductivity (m/s) (low)	1.00E-06	

Length to Zero Drawdown	3000*((DRAWDOWN))*(HYDRAULIC CONDUCTIVITY^0.5)
(H^2-h^2)	((AQUIFER THICKNESS-STATIC LEVEL)^2)-((AQUIFER THICKNESS-DEWATERED LEVEL)^2)
Estimated Inflow	((HYDRAULIC CONDUCTIVITY)*(H^2-h^2))/((0.00000531)*(ln(R_o/r_w)))

Appendix F
Water Balance Information

Climate Normals 1981-2010 Station Data

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

STATION_NAME	PROVINCE	LATITUDE	LONGITUDE	ELEVATION	CLIMATE_I	WMO_ID	TC_ID
ESSA ONT HYDRO	ON	44°21'00.0	79°49'00.0	216.4 m	6112340		

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 Average (°C)	-7.4	-6.2	-1.8	5.9	12.4	17.6	20.2	19.2	14.9	8.8	2.2	-3.8	6.8	D
Standard Deviation	3	2.6	2.1	1.7	2.1	1.4	1.3	1.4	1.1	1.3	1.5	3	2.1	D
Daily Maximum (°C)	-3	-1.6	3.1	11.3	18.7	23.8	26.3	25.1	20.4	13.6	5.8	0	12	D
Daily Minimum (°C)	-11.8	-10.7	-6.8	0.5	6.1	11.3	13.9	13.3	9.4	3.9	-1.4	-7.5	1.7	D
Extreme Maximum (°C)	13	14	25	31	35	35	36	36	33.9	30.6	23.9	19		
Date (yyyy/dd)	1995/14	1984/23	2000/08	1990/28	1975/22	1969/27	1988/06	1988/04	1960/08	1963/06	1961/03	1982/03		
Extreme Minimum (°C)	-37.5	-37.5	-32.8	-21.7	-6.7	-2	2.8	0	-3.3	-11.1	-22	-36		
Date (yyyy/dd)	1994/16	1979/18	1962/02	1972/07	1966/02	1977/09	1962/03	1965/30	1963/23	1976/27	1989/29	1980/25		
Precipitation														
Rainfall (mm)	18.1	17.2	26.7	55	77	86.4	73.1	95.5	99.7	65.8	61.1	22.3	697.9	D
Snowfall (cm)	58.4	36.9	27.3	6	0.3	0	0	0	0	3.9	27.4	53.6	213.7	D
Precipitation (mm)	76.5	54.1	54	60.9	77.3	86.4	73.1	95.5	99.7	69.7	88.5	75.9	911.6	D
Average Snow Depth (cm)				0	0	0	0	0	0	0	0			
Median Snow Depth (cm)				0	0	0	0	0	0	0	0			
Snow Depth at Month-end (cm)			0	0	0	0	0	0	0	0	1	5		
Extreme Daily Rainfall (mm)	38	32.8	33.8	35.5	47.8	60.4	91.2	72.9	67.4	52.6	35.3	29.5		
Date (yyyy/dd)	1985/01	1997/21	1974/04	1991/08	1994/26	2000/11	1980/20	1961/28	1986/11	1995/05	1968/28	1998/06		
Extreme Daily Snowfall (cm)	30	40.6	23	16	7.6	0	0	0	0	18	36	38.5		
Date (yyyy/dd)	1981/06	1960/19	1987/30	1995/04	1966/02	1959/01	1958/01	1958/01	1958/01	1997/26	1987/25	1978/27		
Extreme Daily Precipitation (mm)	40	40.6	33.8	35.5	47.8	60.4	91.2	72.9	67.4	52.6	36	38.5		
Date (yyyy/dd)	1985/01	1960/19	1974/04	1991/08	1994/26	2000/11	1980/20	1961/28	1986/11	1995/05	1987/25	1978/27		
Extreme Snow Depth (cm)	54	70	30	2	0	0	0	0	0	0	22	48		
Date (yyyy/dd)	1984/27	1985/14	1984/06	1985/05	1983/01	1983/01	1983/01	1983/01	1983/01	1983/01	1987/27	1989/17		
Days with Maximum Temperature														
<= 0 °C	20.9	17	10.3	0.8	0	0	0	0	0	0.05	4.6	14.9	68.5	D
> 0 °C	10.1	11.3	20.7	29.2	31	30	31	31	30	31	25.4	16.2	296.8	D
> 10 °C	0.14	0.38	4.4	15.8	28.9	29.9	31	31	29.4	22.3	6	0.95	200	D
> 20 °C	0	0	0.62	3	11.9	22.4	29.3	26.8	15.4	3.2	0.05	0	112.5	D
> 30 °C	0	0	0	0.05	0.55	2.9	4.6	2.4	0.65	0	0	0	11.1	D
> 35 °C	0	0	0	0	0	0	0.15	0.05	0	0	0	0	0.2	D
Days with Minimum Temperature														
> 0 °C	1.5	1.8	4.1	13.6	26.5	29.9	31	31	29.2	22.4	10.1	3	203.8	D
<= 2 °C	30.6	27.7	29.1	20.2	8	0.8	0	0.05	2.7	13.2	23.5	29.8	185.5	D
<= 0 °C	29.5	26.5	26.9	16.5	4.5	0.15	0	0	0.85	8.7	19.9	28.1	161.4	D
< -2 °C	26.9	23.1	21.4	9	1.1	0	0	0	0.1	2.8	11.3	22.7	118.3	D
< -10 °C	16.2	14.1	8.6	0.25	0	0	0	0	0	0	1.7	10.1	50.9	D
< -20 °C	5.4	3.7	1.5	0	0	0	0	0	0	0	0.11	1.9	12.5	D
< - 30 °C	0.76	0.1	0.05	0	0	0	0	0	0	0	0	0.05	0.96	D
Days with Rainfall														
>= 0.2 mm	3.6	2.9	5.4	10.8	11.9	11.4	10.5	11.9	13.5	14.4	11	5.3	112.3	D
>= 5 mm	1.2	1.1	2	4	5.2	4.5	4.7	5.5	6.2	4.5	4.2	1.5	44.4	D
>= 10 mm	0.67	0.57	0.55	1.5	2.5	3	2.4	3.3	3.3	1.6	1.8	0.7	21.7	D
>= 25 mm	0.05	0.1	0.1	0.24	0.4	0.7	0.7	0.7	0.8	0.2	0.21	0.05	4.3	D
Days With Snowfall														
>= 0.2 cm	13.4	10	6.9	1.7	0.05	0	0	0	0	0.8	4.9	11	48.7	D
>= 5 cm	4.7	2.8	2	0.33	0.05	0	0	0	0	0.25	2	3.9	15.9	D
>= 10 cm	1.2	0.76	0.45	0.14	0	0	0	0	0	0.15	1.1	1.2	4.9	D
>= 25 cm	0.1	0	0	0	0	0	0	0	0	0	0.11	0.1	0.31	D
Days with Precipitation														
>= 0.2 mm	16.5	12.1	11.4	12	11.9	11.4	10.5	11.9	13.5	14.8	14.8	15.3	156	D
>= 5 mm	6	3.9	4	4.4	5.2	4.5	4.7	5.5	6.2	4.8	6.4	5.6	60.9	D
>= 10 mm	2	1.3	1.2	1.8	2.5	3	2.4	3.3	3.3	1.8	3.1	2	27.4	D
>= 25 mm	0.14	0.14	0.15	0.24	0.4	0.7	0.7	0.7	0.8	0.2	0.37	0.15	4.7	D
Days with Snow Depth														
>= 1 cm				0	0	0	0	0	0	0	0			
>= 5 cm				0	0	0	0	0	0	0	0			
>= 10 cm				0	0	0	0	0	0	0	0			
>= 20 cm				0	0	0	0	0	0	0	0			
Degree Days														
Above 24 °C	0	0	0	0	0.1	2.9	7.1	4	0.4	0	0	0	14.5	D
Above 18 °C	0	0	0	1.7	11.7	44.8	83	63.5	20.2	0.9	0	0	225.9	D
Above 15 °C	0	0	0.5	5.6	32	97.4	161.6	135.7	53.7	5.6	0	0	492	D
Above 10 °C	0	0	3.9	22.1	103.4	228.6	314.9	285.7	155.5	40.8	3.3	0.3	1158.6	D
Above 5 °C	0.7	1.1	14.7	73.5	231.1	377	469.9	440.6	297.6	129.4	25.6	3.8	2064.9	D
Above 0 °C	9.2	13.7	52.7	183.1	384.3	527	624.9	595.6	447.4	272	95.6	24.5	3230	D
Below 0 °C	238	187.6	108.8	7.5	0	0	0	0	0	0.2	29.6	141.1	712.8	D
Below 5 °C	384.5	316.2	225.7	47.8	1.8	0	0	0	0.3	12.6	109.6	275.5	1373.9	D
Below 10 °C	538.8	456.3	369.9	146.4	29.2	1.6	0	0.2	8.1	79	237.4	427	2293.8	D
Below 15 °C	693.8	597.5	521.5	279.9	112.7	20.3	1.8	5.1	56.3	198.8	384.1	581.7	3453.4	D
Below 18 °C	786.8	682.2	614.1	366	185.5	57.8	16.1	25.9	112.8	287.1	474	674.6	4282.9	D

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

	Frost-Free: Code						
Average Date of Last Spring Frost	19-May	D					
Average Date of First Fall Frost	30-Sep	D					
Average Length of Frost-Free Per	133 Days	D					
Probability of last temperature in	10%	25%	33%	50%	66%	75%	90%
Date	09-Jun	31-May	28-May	20-May	18-May	14-May	08-May
Probability of first temperature ir	10%	25%	33%	50%	66%	75%	90%
Date	13-Sep	20-Sep	23-Sep	28-Sep	04-Oct	06-Oct	13-Oct
Probability of frost-free period ec	10%	25%	33%	50%	66%	75%	90%
Days	102	116	120	126	135	141	155

THORNTHWAITE-TYPE MONTHLY WATER-BALANCE MODEL													
Location	Wasaga Beach, Ontario												
Latitude	44.5												
Declination (deg)	-21.30	-13.30	-2.00	9.80	18.90	23.30	21.30	13.70	3.00	-9.00	-18.60	-23.30	
Declination (rad)	-0.37	-0.23	-0.03	0.17	0.33	0.41	0.37	0.24	0.05	-0.16	-0.32	-0.41	
DayLength (hr)*	9.10	10.27	11.75	13.26	14.53	15.22	14.90	13.79	12.38	10.85	9.51	8.78	
													Total
Precipitation (mm)	76.5	54.1	54	60.9	77.3	86.4	73.1	95.5	99.7	69.7	88.5	75.9	**912**
Temperature (°C)	-7.4	-6.2	-1.8	5.9	12.4	17.6	20.2	19.2	14.9	8.8	2.2	-3.8	**-**
Potential Evapotranspiration (mm)	0	0	0	40.8	67.8	97.6	111	97.2	67.4	40.3	22.9	0	**545**
Surplus	**366**	mm/yr											
PET Calc													
IF(T>0,924*DayLength*0.611*EXP(17.3*T/(T+237.3))/(T+273.2),0)													

Pre-Development Water Balance

Catchment Designation	Undeveloped Vegetated Areas
Area (m²)	58,800
Pervious Area (m²)	58,800
Impervious Area (m²)	0
Infiltration Factors	
Topography	0.25
Soil	0.10
Land Cover	0.20
Infiltration Factor	0.55
Run-Off Coefficient	0.45
Inputs	
Precipitation (mm/year)	912
Outputs (per Unit Area)	
Evapotranspiration (mm/year)	545
Evaporation (mm/year)(assumed to be 10% of Precipitation if evapotranspiration does not occur)	0
Precipitation Surplus (mm/year)	367
Infiltration (mm/year)	202
Rooftop Infiltration (mm/year)	0
Total Infiltration (mm/year)	202
Runoff Pervious Area (mm/year)	165
Runoff Impervious Areas (mm/year)	0
Total Outputs (mm/year)	912
Difference (Inputs-Outputs)	0
Inputs (Volumes)	
Precipitation (m³/year)	53,626
Total Inputs (m³/year)	53,626
Outputs (Volumes)	
Evapotranspiration (m³/year)	32,046
Evaporation (m³/year)	0
Precipitation Surplus (m³/year)	21,580
Infiltration (m³/year)	11,869
Rooftop Infiltration (m³/year)	0
Total Infiltration (m³/year)	**11,869**
Runoff Pervious Area (m³/year)	9,711
Runoff Impervious Areas (m³/year)	0
Runoff To Storm Sewer (m³/year)	*0*
Total Runoff (m³/year)	**9,711**
Total Outputs (m³/year)	53,626
Difference (Inputs-Outputs)	0

Total Infiltration (QI)	**11,869**
Total Runoff (QR)	**9,711**
Sum of QI and QR	**21,580**

Post-Development Water Balance

Catchment Designation	Parkland and Landscaped Areas	Stormwater Management and Drainage blocks	Roads, Parking Lots and Sidewalks	Single Residential Lots (Per. Areas)	Single Residential Lots (Imp. Areas)	Townhomes (Per. Areas)	Townhomes (Imp. Areas)	Amenity (Per. Areas)	Amenity (Imp. Areas)	Condominiums
Area (m^2)	9,550	3,900	16,500	4,508	6,762	1,680	9,520	1,750	1,750	2,880
Pervious Area (m^2)	9,550	3,900	16,500	4,508	0	1,680	0	1,750	0	0
Impervious Area (m^2)	0	0	16,500	0	6,762	0	9,520	0	1,750	2,880
Infiltration Factors										
Topography	0.25	0.25	0.00	0.25	0.00	0.25	0.00	0.25	0.00	0.00
Soil	0.10	0.10	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.00
Land Cover	0.20	0.20	0.00	0.20	0.00	0.20	0.00	0.20	0.00	0.00
Infiltration Factor	0.55	0.55	0.00	0.55	0.00	0.55	0.00	0.55	0.00	0.00
Run-Off Coefficient	0.45	0.45	1.00	0.45	1.00	0.45	1.00	0.45	1.00	1.00
Inputs										
Precipitation (mm/year)	912	912	912	912	912	912	912	912	912	912
Outputs (per Unit Area)										
Evapotranspiration (mm/year)	545	545	0	545	0	545	0	545	0	0
Evaporation (mm/year)(assumed to be 10% of Precipitation if evapotranspiration does not occur)	0	0	91	0	91	0	91	0	91	91
Precipitation Surplus (mm/year)	367	367	821	367	821	367	821	367	821	821
Infiltration (mm/year)	202	202	0	202	0	202	0	202	0	0
Rooftop Infiltration (mm/year)	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/year)	202	202	0	202	0	202	0	202	0	0
Runoff Pervious Area (mm/year)	165	165	0	165	0	165	0	165	0	0
Runoff Impervious Areas (mm/year)	0	0	821	0	821	0	821	0	821	821
Total Outputs (mm/year)	912	912	912	912	912	912	912	912	912	912
Difference (Inputs-Outputs)	0	0	0	0	0	0	0	0	0	0
Inputs (Volumes)										
Precipitation (m^3/year)	8,710	3,557	15,048	4,111	6,167	1,532	8,682	1,596	1,596	2,627
Total Inputs (m^3/year)	8,710	3,557	15,048	4,111	6,167	1,532	8,682	1,596	1,596	2,627
Outputs (Volumes)										
Evapotranspiration (m^3/year)	5,205	2,126	0	2,457	0	916	0	954	0	0
Evaporation (m^3/year)	0	0	1505	0	617	0	868	0	160	263
Precipitation Surplus (m^3/year)	3,505	1,431	13,543	1,654	5,550	617	7,814	642	1,436	2,364
Infiltration (m^3/year)	1,928	787	0	910	0	339	0	353	0	0
Rooftop Infiltration (m^3/year)	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/year)	**1,928**	**787**	**0**	**910**	**0**	**339**	**0**	**353**	**0**	**0**
Runoff Pervious Area (m^3/year)	1,577	644	0	744	0	277	0	289	0	0
Runoff Impervious Areas (m^3/year)	0	0	13543	0	5550	0	7814	0	1436	2364
Runoff To Storm Sewer (m^3/year)	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total Runoff (m^3/year)	**1,577**	**644**	**13,543**	**744**	**5,550**	**277**	**7,814**	**289**	**1,436**	**2,364**
Total Outputs (m^3/year)	8,710	3,557	15,048	4,111	6,167	1,532	8,682	1,596	1,596	2,627
Differece (Inputs-Outputs)	0	0	0	0	0	0	0	0	0	0

Total Infiltration (QI)	**4,317**
Total Runoff (QR)	**34,240**
Sum of QI and QR	**38,557**