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July 27, 2021 Reference No. 1809-W012
(Revision of Report Dated November 5, 2019)

849413 Ontario Ltd.
13390 Yonge Street
Richmond Hill, Ontario
L4E 2P6

Attention: Mr. Altaf Ahmed

Re: Pre- and Post-Development Water Balance Assessment
Proposed Residential Development
27-31 Blake Street
City of Barrie

Dear Sir:

We have completed a pre- and post-development water balance assessment for a proposed residential development, at the captioned site, in Barrie, and our findings are presented in this Letter Report.

○ Introduction

The proposed development site is located at 27-31 Blake Street, in the City of Barrie. Drawing No. 1, enclosed, shows the location of the subject site for which this water balance applies. The proposed development will consist of a five (5) storey apartment building with 35 units, having a one (1) level underground parking structure basement structures. The proposed development footprint encompasses an area of approximately 2,424 square meters.

○ Background

Soil Engineers Ltd. (SEL) previously completed a hydrogeological assessment for the site in November 2019, and updated in July 2021 (SEL Reference No. 1809-W012). This study reveals that beneath a layer of topsoil, and earth fill, the native soils underlying the subject site consists of silty sand till, sandy silt till, and fine to medium sand, extending to the maximum investigated depth of 6.5 m. The findings of the current study confirm that the groundwater level ranges from El. 228.90 to 232.41 masl (i.e., 0.99 to 2.70 m below ground surface), and that groundwater flows in a southerly direction, towards Lake Simcoe.

Grain size analysis of the silty sand till, sub-soil encountered beneath the site, indicates that the estimated permeability is approximately 10^{-7} m/sec, and it is 10^{-5} m/sec for the sandy silt till, and is 10^{-5} m/sec, for the sand unit beneath the subject site.

The subject site is located within the Barrie Creek sub-watershed of the Lake Simcoe Watershed.

A review of the local topography shows that the subject site is relatively flat, exhibiting a decline in elevation relief towards its southern limits. Runoff from the site is expected to drain in a southerly direction. Based on review of the topographic map for the area, and from review of the ground surface elevations at the borehole and monitoring well locations, the elevation relief across the subject site is about 3.4 m.

- **Water Balance Assessment**

The subject site is located within the Lake Simcoe and Couchiching/Black River Source Water Protection Area, where the general area is designated as being subject to the Well Head Protection WHPA-Q1 and WHPA-Q2 planning policies. As such, a pre- and post-development water balance and an associated mitigation plan to maintain the pre-development water balance is required for the subject site prior to development approval. The water balance assessment for this proposed development is based on the following equation:

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

Where:

P -- Average Annual Precipitation
ET -- Evapotranspiration
R -- Surface Water Runoff
I -- Infiltration
Δs -- Change in Groundwater Storage, taken as 0

- **Precipitation**

The long-term records (30-year average from 1981 to 2010) for monthly and annual precipitation depths received at the site were adopted from the Environment Canada's Barrie WPCC Station (Climate ID. 6110557), located about 2.05 km south of the subject site. The climate data for this station is provided in Appendix 'A'. The 30-year mean annual

precipitation record of 932.90 mm/year was adopted from this station. The 30-year records for average annual, and monthly temperatures were also adopted from this station. The pre- and post-development water balance calculations for the subject site are summarized in the Appendix 'B'.

- **Interception**

Interception is the amount of precipitation lost to grass and leaf foliage prior to it reaching the ground surface. The estimate for leaf and grass foliage related interception of precipitation is typically considered at 4% and is applied to total precipitation received during the months from April through October. The total annual estimate for interception of precipitation is 22.72 mm/year, resulting in a net precipitation of 910.18 mm/year arriving at the site's surface.

- **Groundwater Storage**

Although groundwater storage experiences gains and losses on a short-term basis, the net change in groundwater storage (Δs) over the long-term is generally zero. For this reason, the change in groundwater storage is shown at zero (0) and has not been included in the water balance calculations.

- **Evapotranspiration**

In general, evapotranspiration (ET) refers to the transfer of water from vegetation and from the soil surface to the atmosphere in the form of water vapour. The term considers the evaporation from the soil surface and from man-made infrastructure surfaces (asphaltic and concrete roads, and building roofs), and from transpiration from plants and trees, all together because of the difficulties in separating these processes. Potential evapotranspiration (PET) refers to the transfer/loss of water from vegetated surfaces to the atmosphere under the condition of unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than PET, under dry conditions (i.e., during the summer season when there is a soil moisture deficit). Variation in water holding capacity, which affects ET, depends on the soil type and rooted vegetation. The silty clay fill, silty sand fill, silty sand till, and fine sand, at the site, as revealed from the subsurface drilling program, has been assigned a water holding capacity of -150 mm (Soil and Water Conservation Table 18.2 PP 392 G. Schwab et. al.). Chart 40 from the Climate of the Great Lakes Basin (Environment Canada 1972) suggests that the PET for the Barrie WPCC Weather Station should range from about 558.8 to 609.6 mm/year (22 to 24 in/year). Simulations using Thornthwaite and Mather model developed by US Geological Survey (USGS) indicates that the amount of ET (PET)

for the subject site ranges from 558.8 to 609.6 mm/year, which agrees well with the mapped ET values for the general area; therefore, the average AET value of 560.1 mm/year has been applied to the pre- and post-water balance assessments for the subject site.

- **Infiltration and Runoff**

According to the MECP Guidance Manual (MOEE 1995), a series of infiltration sub-factors can be applied to a site, based on its slope, surface soil and vegetation coverage. The cumulative value of these sub-factors is termed the infiltration factor, with the values ranging from 0 to 1. The difference between the value 1 and the infiltration factor is referred to as the runoff factor.

Slope has an influence on both infiltration and runoff. The topography of the site is considered as flat, based on its elevation relief and from a review of available topographic mapping for the area. The elevation relief across the subject site is about 3.4 m.

Surficial soil and vegetation coverage and/or cropping practices also contribute to the infiltration and runoff factors. The subject site is grass covered, partially wooded and the surficial soil consists of silty clay and silty sand fill, and sand. The selected cumulative infiltration factors and corresponding runoff factors, based on the site's topography and predominant surface soil and vegetation cover are provided in Table 1.

The difference between average annual precipitation and actual evapo-transpiration is referred to as the water surplus. As mentioned, the precipitation value (net precipitation) after removing interception is 910.18 mm/year. Subtracting the averaged Thornthwaite and Mather AET estimate of 560.1 mm/year from the net precipitation gives a water surplus estimate of 350.08 mm/year. The site's average annual infiltration is calculated by multiplying the cumulative infiltration factor by the water surplus estimate, and the site's runoff is calculated by applying its difference from 1, or 1 minus the cumulative infiltration factor multiplied by the water surplus estimate. Table 1 summarizes the average annual depth estimates for the site's infiltration and runoff.

Table 1 - Summary of Infiltration and Runoff Estimation

Land Characteristics	MECP Infiltration Factors	Water Surplus Estimate (mm/yr)	Infiltration Estimate (mm/yr)	Runoff Estimate (mm/yr)
Soil: (Silty Clay and Silty Sand Fill, Sand)	0.25	**350.08**	I = 0.70×350.08	R = (1-0.70) ×350.08
Slope: (Flat Lands)	0.30			
Vegetation Cover: (Grass Covered, Wooded)	0.15			
Cumulative Infiltration Factor	**0.70**		**245.06**	**105.02**

Runoff for impervious surfaces is calculated differently than from pervious soil/vegetated surfaces. As a general rule, the ET for impervious surfaces on an average annualized basis is calculated by taking 10% of the average annual precipitation, after correction for interception, while runoff is calculated by taking 90% of the average annual precipitation, after correction for interception. The existing impervious surfaces at the site, including a paved driveway and the existing buildings, were considered in calculating runoff for the site's pre-developed water balance, and the proposed new condominium building, roads and sidewalks were considered for the post-development water balance. The ET and runoff estimates for the impervious surfaces before development are 91.02 mm/year and 819.16 mm/year, respectively.

- **Pre-Development Water Balance**

The pre-development water balance for the site was calculated by multiplying the site area by the various averaged annualized depth estimates for Precipitation, ET, Infiltration and Runoff. The site currently consists of grass covered land and wooded areas, covering an area of about 1,924 m^2, along with existing buildings and driveway areas, covering an area of about 500 m^2. It should be noted that surface area coverage for the subject site was estimated based on the proposed development plan that was previously provided. The average annualized volumetric water estimates for each water balance component are given in Table 2.

Table 2 - Summary of Pre-Development Volumetric Water Balance Components

Pre-Development Site Areas	Area Coverage (m^2)	Precipitation (m^3/year)	AET (m^3/year)	Infiltration (m^3/year)	Runoff (m^3/year)
Grass Land, Wooded Areas	1,924.00	1,751.19	1,077.63	471.49	202.07
Existing impervious Area	500	455.09	45.51	0.00	409.58
Total Area/Volume	**2,424.00**	**2,206.28**	**1,123.14**	**471.49**	**611.65**

The pre-development water balance for the site is calculated on an annualized depth basis by considering the annualized volumetric estimates for each water balance component from above, divided by the applicable total site area. Based on this approach, the summarized annualized water balance components, presented as depths in mm for the pre-developed site are presented as follows:

$$P\ (910.18) = ET\ (463.34) + I\ (194.51) + R\ (252.33)$$

- **Post-Development Water Balance**

Based on the provided development plan, the entire site will be developed. Approximately 1,800 m^2 will be occupied by the proposed condominium building, driveways, sidewalks, and parking lots, about 624 m^2 will be landscaped open areas.

The post-development water balance was calculated using the same pre-development water balance components, i.e., average annual precipitation and average annual ET, as adopted for the pre-development water balance calculations. For developed impervious site areas, there is no infiltration and the depth estimates for runoff and ET become 90% and 10% of the corrected average annual precipitation, respectively. The estimated post-development water balance volumes are provided in Table 3:

Table 3 - Summary of Post-Development Volumetric Water Balance

Post-Development Site Areas	Area Coverage (m^2)	Precipitation (m^3/year)	AET (Pervious) (m^3/year)	AET (Impervious) (m^3/year)	Infiltration (m^3/year)	Runoff (Pervious) (m^3/year)	Runoff (Impervious) (m^3/year)
Pervious Areas (Landscaped Open Areas)	1,800.00	567.95	349.50	0.00	152.91	65.53	0.00
Impervious Areas (including Road and Sidewalk)	624.00	1,638.32	0.00	163.83	0.00	0.00	1,474.49
Total Area/Volume	**2,424.00**	**2,206.28**	**349.50**	**163.83**	**152.91**	**65.53**	**1,474.49**

Based on the volumetric water balance estimates, shown in Table 3, the depth-based post-development water balance components, presented in mm, are given as follows:

P (910.18) = ET (211.77) + I (63.08) + R (635.32)

Comparison of the pre- and post-development water balances depth components in Table 3 above, show a decrease of 251.57 mm/year, or 54.29%, in annual evapo-transpiration, a decrease of 131.42 mm/year, or 6757%, in annual infiltration, and a gain in runoff of 382.99 mm/year or 151.78%.

Table 4 - Comparison Summary of Pre- and Unmitigated Post-Development Water Balance/Budget Components

	Precipitation (mm/year)	ET (m^3/year)	Infiltration (m^3/year)	Runoff (m^3/year)
Pre-development	2,206.28	1,123.14	471.49	611.65
Post- development	2,206.28	513.33	152.91	1,540.03
Volumetric Change in Pre-and Post-Development Water Balance Parameters	-	**-609.81**	**-318.58**	**+928.38**

Notes:
- -- loss
+ -- gain

The volumetric comparisons in evapotranspiration, infiltration and runoff between the pre-developed and post-developed site are summarized in Table 4. A review of the findings indicates that decreases of 609.81 m^3/year and 318.58 m^3/year are anticipated for ET and infiltration, respectively. An increase of 928.38 m^3/year is expected for runoff for the post-developed site compared with the pre-developed site.

The pre- and post-development water balance calculations for the site are summarized in Appendix 'B'.

- **Water Balance Mitigation Plan**

The differences between the pre- and post-development water balances can be attributed to establishment of impervious surfaces, such as pavements, sidewalks, driveways, and rooftops. For the design of proposed Low Impact Development (LID) infrastructure to maintain the site's predevelopment water balance, the permeability of the native surface soil, comprised of silty sand till, sandy silt till and fine to medium sand, which is considered to range from low to high, exhibiting low to high infiltration rates for precipitation to the subsurface should be considered for proposed LID designs. In this case, opportunities may exist for the infiltration of storm water runoff to the subsurface at the developed site.

The results of the soil geotechnical investigation indicate that groundwater depths range from 0.99 to 2.70 m below the prevailing ground surface. From the hydrogeological assessment investigation, the estimated permeability for the silty sand till is 4.0×10^{-7} m/s. The K estimate for the sandy silt till is 4.40×10^{-6} m/s, the K estimate for the silty sand till is 9.0×10^{-8} m/s, and the K estimate for the fine to medium sand, is 2.5×10^{-5} m/s. This confirms the presence of low to high permeabilities for the shallow native soil that would be considered for the proposed infrastructure design to promote infiltration of precipitation to the subsurface.

The proposed development will consist of driveways, roofs, pavement and landscaped areas. An area of 860 m^2, about 35.48% of the site, is considered as rooftop area, and an area of 940 m^2 or 38.78% of the site, has been considered for driveways, sidewalks and parking spaces, following site development. The anticipated volume of runoff, derived by applying the runoff rate to the rooftop and paved areas (90% of annual precipitation), is provided in Table 5.

Table 5 - Summary of Anticipated Volumetric Runoff from Rooftops and Paved Areas

Proposed Rooftop/ Paved Areas	Approximate Area Coverage (m^2)	Runoff (mm/year)	Runoff (Rooftops and Paved Areas (m^3/year)
Proposed Building Roofs	860.00	819.16	704.47
Proposed Driveways, Parking areas, Curbs and Sidewalks	940.00	819.16	770.01
Total	**1,800.00**	**819.16**	**1,474.49**

Given that about 860 m^2 of the subject site will be developed as rooftop areas and about 940 m^2 will be developed as driveways, sidewalks and curbs, the estimated runoff volumes could reach maximums of 704.47 m^3/year and 704.47 m^3/year for each of the developed areas respectively.

A review of the Functional Servicing and Stormwater Management Report, prepared by Siteplantech Inc. dated July 23, 2021, indicates that the on-site water retention volume of 11.8 m^3 is required to retain a 5 mm storm event. To satisfy this requirement, it is anticipated to redirect runoff flow to grassed at an estimated volume of 4.6 m^3, and to redirect the balance for the volume of 7.2 m^3 to a stormwater management chamber located within the footprint of the P1 underground parking structure. The anticipated 7.2 m^3 is anticipated to be reused as part of the sites, irrigation requirements. The storm sewer system will be used to convey a specific peak rate of runoff rate of 26.2 L/sec. As such, the stormwater management plan will be implemented to satisfy the proposed allowable discharge rate to the existing stormwater management facilities.

A review of the stormwater management report indicates that runoff from rooftop areas for the proposed buildings and from paved areas will be conveyed to the city's stormwater sewer system, ultimately. The system was also designed to control the quality and quantity of the generated runoff using the quality control chamber from the stormwater management chamber in advance of it's discharging to the city's storm sewer system.

Both of these proposed LID measures are being proposed to manage the retention of the unabstracted 5 mm rainfall events volumes of runoff from impervious areas, including proposed rooftop areas.

The stormwater management report provides the site area breakdown for the developed site's pervious and impervious areas, where the 5 mm retention of rainfall events will be implemented. Review of the Pearson Airport long term weather data indicates that 5 mm rainfall events equated to an annual runoff depth of about 394.2 mm/year. By applying this depth estimate over the post development impervious and pervious areas gives the following breakdown for runoff volumes which will be re-directed to proposed stormwater chamber. The proposed stormwater management system has an anticipated volume of 59.9 m^3, with a release flow rate of 26.2 L/s.

Table 6 - Summary of Anticipated Runoff Volumes from 5 mm Retention of Precipitation Over Developed Impervious Areas

Surface	Approximate Area Coverage (m^2)	Precipitation (mm/year)	Generated Runoff (mm/year)	Runoff Re-Directed to LID Infrastructure (m^3/year)
Proposed Roofs, Driveways, Parking areas, Curbs and Sidewalks	1800.00	709.56	638.60	638.60
Total	**1,800.00**	**709.56**	**638.60**	**638.60**

Based on the re-directed run off volumes to proposed LID infrastructure, the mitigated water balance volume estimates for both developed pervious and impervious areas and the associated gains and deficits when compared to the pre-development water balance components are provided in the table 7 as follows.

Table 7 - Comparison Summary of Pre- Mitigated Post-Development Water Balance/Budget Components

	Precipitation (mm/year)	ET (m^3/year)	Infiltration (m^3/year)	Runoff (m^3/year)
Pre-development	2,206.28	1,123.14	471.49	611.65
Mitigated Post-development	2,206.28	513.33	791.52	901.42
Volumetric Change in Pre-and Post-Development Water Balance Parameters	-	**-609.81**	**+320.03**	**+289.77**

Notes:
- -- loss
+ -- gain

The volumetric comparisons in evapotranspiration, infiltration and runoff between the pre-developed and post-developed mitigated site, indicates a decrease in ET of 609.81 m^3/year, an increase of 320.03 m^3/year for infiltration, and an increase in runoff of 289.77 m^3/year.

Proposed LID infrastructure for the developed site will include a stormwater management chamber that will collect, store, treat and redirect water for reuse within the irrigation and municipal storm system.

Based on implementation of the proposed mitigation plan, presentation of the water balance depth estimates for the mitigated post development water balance is provided as follows:

P (910.18 = ET (211.77) + I (326.53) + R (371.87)

It is also recommended that the topsoil be thickened by 30 cm within the proposed landscaped areas to control the generated runoff and to enhance the infiltration rate for the developed landscaped areas.

We trust the above satisfies your present requirements. Should you have any further queries, please feel free to contact this office.

Yours very truly,
SOIL ENGINEERS LTD.

Angella Graham

Angella Graham, M.Sc.

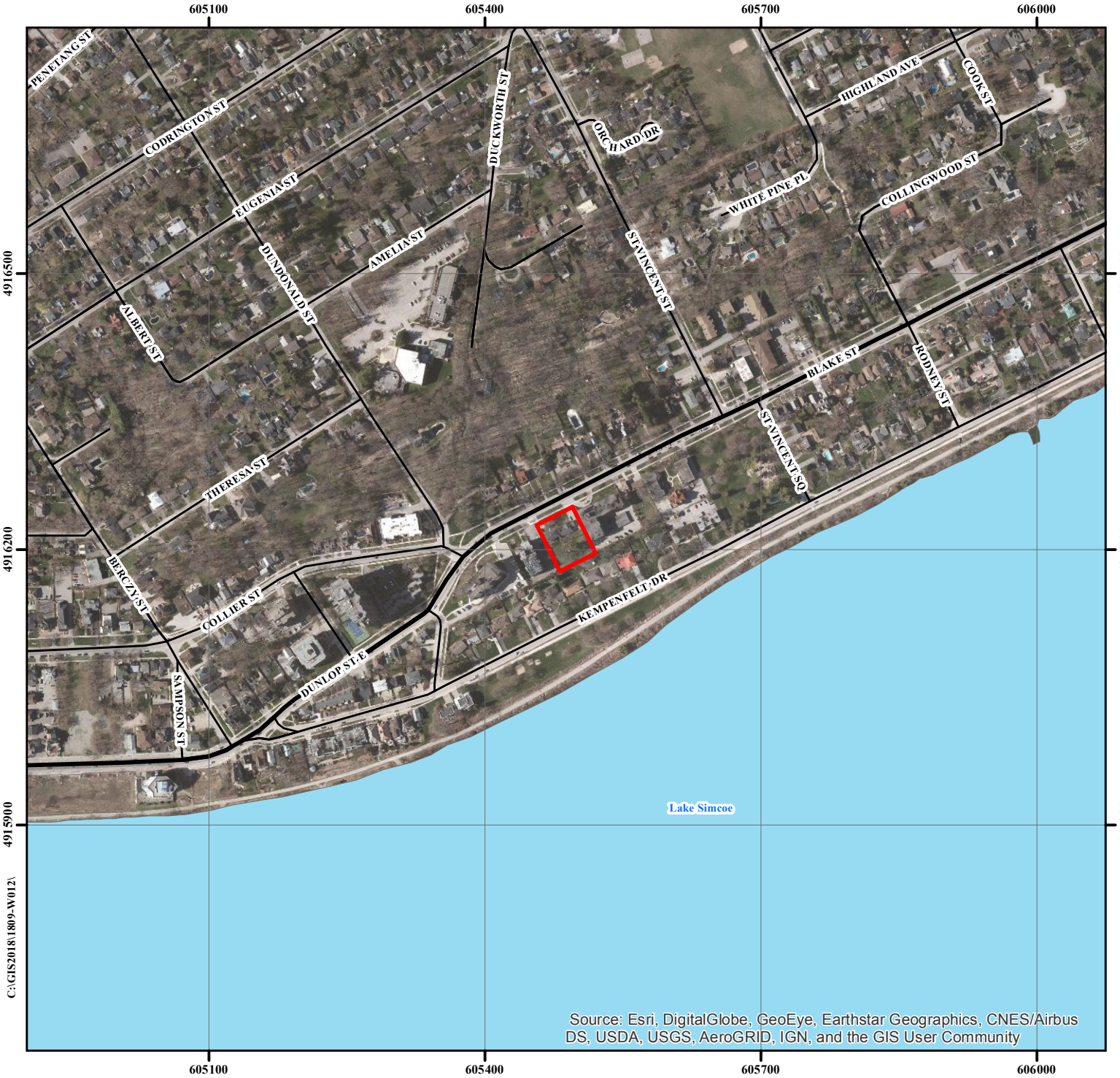
GR O'Brien

Gavin O'Brien, M.Sc., P.Geo.
AG/GO

PROFESSIONAL GEOSCIENTIST
GAVIN R. O'BRIEN
PRACTISING MEMBER
1267
JULY 27, 2021
ONTARIO

ENCLOSURES

Site Location Plan..... Drawing No. 1
Climate Data Barrie WPCC Climate Station..... Appendix 'A'
Pre- and Post Development Water Balance Assessment..... Appendix 'B'



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Source: Water Course, Ontario Ministry of Natural Resources and Forestry
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Source: Water Body, Ontario Ministry of Natural Resources and Forestry
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N

Approximate Boundary of Subject Site
Waterbody
Major Road
Local Road

Soil Engineers Ltd.

Title: Site Location Plan

Project:

Hydrogeological Assessment
Proposed Residential Development
27- 31 Blake Street
City of Barrie

Reference No. 1809-W012

Date: November 27, 2018

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 1

Soil Engineers Ltd.
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APPENDIX 'A'

CLIMATE DATA BARRIE WPCC CLIMATE STATION

REFERENCE NO. 1809-W012

Climate Data 30- year average from 1981 to 2010 Barrie WPCC Climate ID 6110557- 44 degree Lattitude-150 mm moisture

Date	PET	Precipitation	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Interception	Net Precipitation
Jan-6110557	7.7	82.5	-7.7	142.3	7.7	0	82.5	0	12.7		82.5
Feb-6110557	9.4	61.8	-9.4	133.4	8.9	0.5	144.3	0	6.3		61.8
Mar-6110557	17.9	58.1	-17.9	117.5	15.9	2	202.4	0	3.2		58.1
Apr-6110557	35.9	62.2	124.4	150	35.9	0	101.2	91.9	50.7	2.49	59.712
May-6110557	67.7	82.4	61.2	150	67.7	0	50.6	61.2	58.5	3.30	79.104
Jun-6110557	101.7	84.8	4.2	150	101.7	0	25.3	4.2	33.5	3.39	81.408
Jul-6110557	120.5	77.2	-34.5	115.5	120.5	0	12.7	0	18.5	3.09	74.112
Aug-6110557	95.6	89.9	-3.9	112.5	94.7	0.9	6.3	0	11.8	3.60	86.304
Sep-6110557	55.7	94	40	150	55.7	0	0	2.5	9.6	3.76	90.24
Oct-6110557	29.3	77.5	44.3	150	29.3	0	0	44.3	28.5	3.10	74.4
Nov-6110557	15	88.9	69.5	150	15	0	0	69.5	51.5		88.9
Dec-6110557	9.2	73.6	-9.2	140.8	9.2	0	73.6	0	23.5		73.6
Total	565.6	932.9			562.2			273.6	308.3	22.72	910.18
Annual Surplus (Net Precipitation- Actual ET)											347.98

Notes:
P- Precipitation
PET- Potential Evapotranspiration
AET- Actual Evapotranspiration
RO- Runoff

Climate Data 30- year average from 1981 to 2010 Barrie WPCC Climate ID 6110557- 43 degree Lattitude-150 mm moisture

Date	PET	Precipitation	P-PET	Soil Moisture	AET	PET-AET	Snow Storage	Surplus	ROtotal	Interception	Net Precipitation
Jan-6110557	7.8	82.5	-7.8	142.2	7.8	0	82.5	0	12.7		82.5
Feb-6110557	9.5	61.8	-9.5	133.1	9	0.5	144.3	0	6.3		61.8
Mar-6110557	17.9	58.1	-17.9	117.3	15.9	2	202.4	0	3.2		58.1
Apr-6110557	35.6	62.2	124.7	150	35.6	0	101.2	91.9	50.7	2.49	59.712
May-6110557	66.9	82.4	62	150	66.9	0	50.6	62	58.9	3.30	79.104
Jun-6110557	100.1	84.8	5.8	150	100.1	0	25.3	5.8	34.5	3.39	81.408
Jul-6110557	118.8	77.2	-32.8	117.2	118.8	0	12.7	0	19	3.09	74.112
Aug-6110557	94.8	89.9	-3.1	114.8	94.1	0.7	6.3	0	12.1	3.60	86.304
Sep-6110557	55.6	94	40	150	55.6	0	0	4.9	10.9	3.76	90.24
Oct-6110557	29.5	77.5	44.1	150	29.5	0	0	44.1	29	3.10	74.4
Nov-6110557	15.3	88.9	69.2	150	15.3	0	0	69.2	51.6		88.9
Dec-6110557	9.4	73.6	-9.4	140.6	9.4	0	73.6	0	23.6		73.6
Total	561.2	932.9			558.00			277.9	312.5	22.72	910.18
Annual Surplus (Net Precipitation- Actual ET)											352.18

Notes:
P- Precipitation
PET- Potential Evapotranspiration
AET- Actual Evapotranspiration
RO- Runoff

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APPENDIX 'B'

PRE- AND POST DEVELOPMENT WATER BALANCE ASSESSMENT

REFERENCE NO. 1809-W012

Pre-Development Water Balance/Budget

ET Estimates

Average for 150 mm sand and siltyclay 43 and 44 deg N. lat
from USGS model: **560.1 mm/yr**

sand and silty clay 150 mm 44 lat
562.20 mm/yr

Sand and silty clay 150 mm 43 lat
558.00 mm/yr

Site Area **2,424.00 m^2**

Avg Annual Precipitation: **910.18 mm/yr** after removing 4% for interception; **932.90 mm/yr** prior to removal of 4% for interception

ET	impervious surfaces	0.1	10%
R	impervious surfaces	0.9	90%

Type	MOE factors: Grass covered and wood Lot	
cover	0.15	grass land, wooodland
slope	0.3	Flat land
soil texture	0.25	sand, silty clay
MOECC Inf. F	0.70	

Site Areas	Areas	Impervious factor	Cum. Infilt	Assigned ET	Water Surplus	Infiltration	Runoff	precipitation	Infilt Vol	RO Vol	ET Vol	
	m^2			mm/yr	mm/yr	mm/yr	mm/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	
Grass /Tree Covered Area	**1,924.00**	**0**	**0.70**	**560.10**	**350.08**	**245.06**	**105.02**	**1,751.19**	**471.49**	**202.07**	**1,077.63**	
Roads, Buildings	**500.00**	**1**	**0.00**	**91.02**	**819.16**	**0.00**	**819.16**	**455.09**	**0.00**	**409.58**	**45.51**	
Total Area	**2,424.00**							**2,206.28**	**471.49**	**611.65**	**1,123.14**	check
							percentages	**2,206.28**	**0.21**	**0.28**	**0.51**	1.00

Parcel A: Pre Development Water Balance/Budget

P	=	ET	+	I	+	R	+	DS		Check
910.18	=	**463.34**	+	**194.51**	+	**252.33**	+	0.00		**910.18**

Total Area **2,424.00 m^2**

Post-Development Water Balance/Budget

ET Estimates

Average for 150 mm sand and silty clay 43 and 44 deg N. lat
from USGS model: **560.1 mm/yr**

sand and silty clay 150 mm 44 lat
562.20 mm/yr

Sand and silty clay 150 mm 43 lat
558.00 mm/yr

2,424.00
Site Area **2,424.00 m²**

Avg Annual Precipitation		
910.18 mm/yr	after removing 4% for interception	
932.90 mm/yr	prior to removal of 4% for interception	

ET	impervious surfaces	0.1	10%
R	impervious surfaces	0.9	90%

Type	MOE factors: Grass covered and wood Lot	
cover	0.15	grass land, wooodland
slope	0.3	Flat land
soil texture	0.25	sand, silty clay
MOECC Inf. F.	0.70	

Future Developed Site Areas	Areas	Impervious factor	Cum. Infiltration	Assigned ET Pervious Portion	Water Surplus	Infiltration - Pervious Portion	ET - Impervious Portion	Runoff - Impervious Areas	Runoff Pervious Portion	precipitation	Pervious Area: Infilt Vol. Pervious Areas	Pervious Area: RO Vol. Pervious Areas	Pervious Area: ET Vol Pervious Areas	Impervious Area: RO Vol. Impervious Areas	Impervious Area: ET Vol Imperv Areas	Total Et and Ro.: Total ET	Total Et and Ro.: Total RO
	m^2			mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr
Pervious Areas (Landscaped Open Areas)	624.00	0	0.70	560.10	350.08	245.06	0.00	0.00	105.02	567.95	152.91	65.53	349.50	0.00	0.00	349.50	65.53
Driveway, Roads, Sidewalks and Parking Lots	1,800.00	1	0.00	0.00	910.18	0.00	91.02	819.16	0.00	1,638.32	0.00	0.00	0.00	1,474.49	163.83	163.83	1,474.49
Total Area	2,424.00								Total	2,206.28	152.91	65.53	349.50	1,474.49	163.83	513.33	1,540.03
										Totals				Total RO	1,540.03	Total ET	513.33

Total Area **2,424.00 m²**

Parcel A: Post Development Water Balance/Budget

P	=	ET	+	I	+	R	+	DS		Check
910.18	=	**211.77**	+	**63.08**	+	**635.32**	+	0		**910.18**

Pre Development Water Balance/Budget

P	=	ET	+	I	+	R	+	DS		Check
910.18	**=**	**463.34**	+	**194.51**	+	**252.33**	+	**0**		**910.18**

	ET	I	R	DS
Loss/Gain in Post	loss: **251.57**	loss: **131.42**	gain: **382.99**	0
	% loss: **54.29**	%loss: **67.57**	%gain **151.78**	

Mitigated Post-Development Water Balance/Budget

ET Estimates

Average for 150 mm sand and silty clay 43 and 44 deg N. lat
from USGS model: **560.1 mm/yr**

sand and silty clay 150 mm 44 lat
562.20 mm/yr

Sand and silty clay 150 mm 43 lat
558.00 mm/yr

Site Area **2,424.00 m²**

Avg Annual Precipitation	**910.18 mm/yr**	after removing 4% for interception
	932.90 mm/yr	prior to removal of 4% for interception

ET	impervious surfaces	0.1	10%
R	impervious surfaces	0.9	90%

Type	MOE factors: Grass covered and wood Lot	
cover	0.15	grass land, wooodland
slope	0.3	Flat land
soil texture	0.25	sand, silty clay
MOECC Inf. F	0.70	

Future Developed Site Areas	Areas	Impervious factor	Cum. Infiltration	Assigned ET Pervious Portion	Water Surplus	Infiltration - Pervious Portion	ET - Impervious Portion	Runoff - Impervious Areas	Runoff Pervious Portion	precipitation	Pervious Area: Infilt Vol. Pervious Areas	Pervious Area: RO Vol. Pervious Areas	Pervious Area: ET Vol Pervious Areas	Impervious Area: RO Vol. Impervious Areas	Impervious Area: ET Vol Imperv Areas	Impervious Areas: Re-directed Runoff to LID Infiltration Infrastructure	Total Et and Ro.: Total ET	Total Et and Ro.: Total RO
	m^2			mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr
Pervious Areas (Landscaped and Planting Strips)	624.00	0	0.70	560.10	350.08	245.06	0.00	0.00	105.02	567.95	152.91	65.53	349.50	0.00	0.00		349.50	65.53
Impervious Areas (Buildings)	860.00	1	0.00	0.00	na	0.00	91.02	819.16	0.00	782.75	0.00	0.00	0.00	704.48	78.28		78.28	704.48
Impervious Areas (Roads and Driveways)	940.00	1	0.00	0.00	na	0.00	91.02	819.16	0.00	855.57	0.00	0.00	0.00	770.01	85.56		85.56	770.01
Redirected Runoff From Impervious Areas	1,800	1	0.00	91.02	na	0.00	91.02	91.02	0.00	709.56	5mm rainfall depth convesion to annual depth		394.20	638.60	71	638.60	na	na
Total Area	2,424.00								Total	2,206.28	152.91	65.53	349.50	1,474.49	163.83	638.60	513.33	1,540.03

Parcel A: Post Development Water Balance/Budget

P	=	ET	+	I	+	R	+	DS		Check
910.18	=	211.77	+	63.08	+	635.32	+	0.00		910.18

Pre Development Water Balance/Budget

P	=	ET	+	I	+	R	+	DS		Check
910.18	=	463.34	+	194.51	+	252.33	+	0		910.18

Mitigated Post Development Water Balance

P	=	ET	+	I	+	R	+	ΔS		Check
910.18	=	211.77	+	326.53	+	371.87	+	0		910.18

		ET		I		R	ΔS
Mitigated comparison to predevelopment wb	Loss/Gain in Post	loss:	251.57	gain:	132.03	gain:	119.54	0
		% loss	54.29	%gain:	67.88	%gain	251.78	

Totals				Total RO	1,540.03	Total ET	513.33
	Annual Precipitation Depth			Total Mit Inf	791.52		
				Total Mitigated Runoff	901.42		

Mitigation	annual depth
5 mm retention	394.2 mm/yr
Total Impervious Ar	1,800.00 m2
Total Runoff	638.60 m3/year

Total Precipitation 709.56

Volume Deficits pre and post	Infiltration	Ruonff	ET	
	320.03	289.78	-609.81	m3/yr
	gain	gain	loss	m3/yr