Hydrogeological Brief - Block 193, 953 Mapleview Drive, Barrie

Mapleview South (Innisfil) Ltd.
Barrie, Ontario

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Mapleview South (Innisfil) Ltd.
Barrie, Ontario

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June 2024
300042309.0003

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Record of Revisions

Revision	Date	Description
-	June 21, 2024	Initial Submission to Mapleview South (Innisfil) Ltd. and The Jones Consulting Group Ltd.

R.J. Burnside & Associates Limited

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been requested to prepare the following hydrogeological brief to support submission of an application for Site Plan Approval for Block 193 at 953 Mapleview Drive, Barrie Ontario (herein referred to as the subject lands). The legal address is Block 193 – 953 Mapleview Drive, City of Barrie, Ontario.

The subject lands are located within the Mapleview South lands that were previously studied by Burnside and for which a report entitled “Hydrogeological Assessment, Mapleview South (Innisfil) Ltd. Barrie, Ontario” was completed in May 2023. The current hydrogeology brief draws from the work previously completed as the hydrogeological conditions are consistent with the previous work.

The subject lands are approximately 0.63 ha located on Mapleview Drive East in the northeast portion of the Mapleview South lands (Figure 1). The subject lands are currently used for agriculture and rural residential. Adjacent lands uses are agriculture and residential (Figure 2).

The Site Plan includes a 5-Storey residential building with surface and underground parking (Appendix A).

2.0 Physical Setting

The subject lands are located within the Sandy Cove Creek subwatershed of the larger Lake Simcoe watershed. The topography of the subject lands slopes from the north and the south towards the tributary of Sandy Cove Creek that is located south of subject lands (Figure 3). Elevations on the subject lands range from 260 masl to 262 masl.

A review of the quaternary geology mapping for the area (OGS, 2003) indicates that the overburden sediments of the subject lands are ice contact stratified drift (Figure 3). South of the subject lands the surficial sediments are mapped as silty to sandy glacial till. The bedrock underlying the subject lands is mapped as the Verulum Formation of the Simcoe Group, which consists of limestone and shale (OGS, 2007).

3.0 Hydrogeological Setting

The local soils underlying the subject lands were investigated as a part of a previous geotechnical study completed by Cambium in 2018 which included boreholes on and in the vicinity of the subject lands. The locations of boreholes drilled in the area of the subject lands are shown on Figure 2 and boreholes logs are provided in Appendix B.

The boreholes (BH102-18 and MS-103) indicate that the local soils on the subject lands consist of silty sand underlain by sandy silt till.

To illustrate the shallow stratigraphy of the subject lands, schematic geologic cross-sections have been prepared (Figures 4 and 5) using borehole logs and MECP well records. The locations of the cross sections are illustrated on Figure 2 along with the locations of water wells and boreholes used in the construction of the cross-sections. Cross-sections A-A’ and B-B’ across the subject lands (Figures 4 and 5) illustrate the presence of coarse-textured sand deposits underlying the subject lands with thickness of 8 to 10 m. A layer of silty sand clay deposits is mapped south of the subject lands at surface overlying sand.

Shallow groundwater flow direction on the subject lands is to the south, southeast (Burnside, 2023).

3.1 Regional Hydrostratigraphy

The overburden deposits of the subject lands influence groundwater occurrence and flow. The overburden has been interpreted by regional studies such as the Tier 3 Water Balance (AquaResource, 2011) and Source Water Protection Assessment Report (LSRCA, 2012) to consist of alternating sequences of coarser-grained permeable layers (aquifers) and finer-grained less permeable areas (aquitards) of varying thicknesses. The basic hydrostratigraphic sequence that was modelled in the regional studies (AquaResource, 2011) consists of four main aquifer areas (A1-A4) and four main aquitards (C1 to C4) with a confining layer (UC) over the uppermost aquifer (A1).

A description of the interpreted regional hydrostratigraphic framework is provided below (LSRCA, 2012):

- Surficial Geology Layer – This layer represents coarse grained sediments in stream beds and at surface surficial geology areas that overly the UC. The thickness ranges from 0.1 m to 3 m.
- UC – Upper Confining Layer – Represents smaller areas of less permeable surficial material. The upper confining layer has been mapped as coarse-grained lacustrine deposits which are part of a regionally extensive sand plain (LSRCA, 2012). Regional studies such as the AquaResource (2011) report indicate that the confining layer (UC) is patchy in the area of the study area.
- A1 – Represents the uppermost aquifer. Frequently exists as a surficial unconfined aquifer and is stratigraphically equivalent to the Oak Ridges Moraine. It is generally associated with coarse grained glacial and interglacial sediments mapped as ice contact stratified drift. The majority of the local domestic wells are completed within

this area. The upper aquifer A1 is reported to be present throughout the larger Barrie area and has been interpreted to occur extensively in the study area.

- C1 – Upper aquitard. Described as varved clay and silt (LRSCA, 2012).
- A2 – Intermediate aquifer which is stratigraphically equivalent to areas within the Northern Till. The aquifer is generally described as being composed of sand with some clast rich portions (LRSCA, 2012). This area is used for the Innisfil Heights water supply.
- C2 – Intermediate aquitard.
- A3 – This area constitutes the main Barrie municipal aquifer and is the source of the Stroud water supply; it is stratigraphically equivalent to the Thorncliffe deposits in the Upland regions.
- C3 – Lower aquitard.
- A4 – Lower aquifer, thin and sometimes combined with A3 where C3 is thin or absent.
- C4 – Lower aquitard but may also represent weathered bedrock.

3.2 Hydraulic Conductivity

In situ hydraulic conductivity testing was completed at wells in the vicinity of the subject lands (MS-103 and MS-106s) as part of previous studies. The results are provided in Appendix C and summarized below in Table 1.

Table 1: Estimated Hydraulic Conductivity from In Situ Well Tests

Well	Screened Formation	Depth of Screen (mbgl)	Hydraulic Conductivity (m/sec) In Situ Test
MS-103	Sandy Silt Till	5.7 – 7.2	2.8×10^{-5}
MS-106s	Silty Sandy Clay	4.5 – 6.1	8.0×10^{-8}

*meters below ground level

The results of the in situ hydraulic conductivity testing indicate that hydraulic conductivity of the surficial till is in the range of 10^{-5} to 10^{-8} m/s.

3.3 Seasonal Groundwater High

Groundwater monitoring was completed as part of previous studies at monitoring wells in the vicinity of the subject lands. Hydrographs from these studies are provided in Appendix D. The groundwater data are summarized below in Table 2 for wells located in the vicinity of the subject lands.

Table 2: Seasonal Groundwater Levels

Well	Screened Formation and Depth	Highest GW Elevation (masl)	Distance to Subject Lands
MS-101	Sandy silt and sand (7.2 m)	256.79	~200 m west
MS-103	Sandy silt till (7.3 m)	256.84	0 m
MS-106s	Silty sandy clay (6.0 m)	Flowing (>253.16)	100 m south
MS-106d	Sand (11.7 m)	Flowing (>253.16)	100 m south

MS-101 located 200 m west of the subject lands, was screened in sandy silt and sand. Water levels at MS-101 ranged from 255.1 masl to 256.8 masl and varied by 1.7 m seasonally (Figure D-1, Appendix D).

Monitoring well MS-103 is located within the subject lands. The well is installed in a sandy silt till layer and groundwater was reported at elevations ranging from 254.45 masl and 256.84 masl, varying by 2.4 m seasonally (Figure D-2, Appendix D).

At MS-106 s/d, the shallow well is installed in finer grain silty sandy clay and the deeper well is installed in sand creating confined conditions. An upward gradient is observed at this location with flowing conditions recorded during most monitoring events (2018 to 2021) (Figure D-3, Appendix D).

3.4 Significant Groundwater Recharge Areas

The available LSRCA mapping indicates that the subject lands are located within a Significant Groundwater Recharge Area (SGRA). Boreholes in the vicinity of the subject lands (Appendix B) indicate that surficial sediments consist of silty sand and compact to dense sandy silt till. When combined with the water level information, these data suggest that groundwater recharge may be occurring in the area.

3.5 Groundwater Quality

Water quality data was collected in May 2019 from monitoring well (MS-103) to typify the groundwater quality on the subject lands. The water sample was submitted to a certified laboratory for analyses of general water quality indicators (e.g., pH, hardness, and conductivity), basic ions (including chloride and nitrate) and selected metals to characterize the background water quality. The groundwater testing results from the analytical laboratory are provided in Table E-1, Appendix E and discussed below:

- High turbidity was reported with a value of 26,400 NTU (MS-103). This is likely a result of high silt content in the sample caused by a lack of well development after drilling.

- Nitrate was detected in the sample with a value of 1.75 mg/L (MS-103). Nitrate in shallow groundwater is typically associated with areas where agricultural land use results in elevated nitrates in groundwater. Current land use on the subject lands is agricultural and is interpreted to be the cause of the slightly elevated nitrate. The sample concentration is below the ODWQS for nitrate, 10 mg/L.

- Total phosphorus was reported in the sample at a concentration of 0.03 mg/L. Total phosphorus is a measure of all forms of phosphorus (dissolved or particulate) that are found in the water sample. There was no dissolved phosphorus (ortho-phosphate) reported in the groundwater sample suggesting the reported concentrations are particulate.

4.0 Groundwater Balance

Development of an area affects the natural water balance. The most significant difference between pre- and post-development conditions is the addition of impervious surfaces as a type of surface cover (i.e., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance resulting in evaporation as the only remaining loss mechanism (beside runoff).

4.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

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

Where:

Where:	P	=	precipitation
	S	=	change in groundwater storage
	ET	=	evapotranspiration/evaporation
	R	=	surface water runoff
	I	=	infiltration

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a property. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations.

The groundwater balance components for the subject area are discussed below:

Precipitation (P)

The long-term average annual precipitation for the area is 933 mm based on data from the Environment Canada Barrie WPCC (Station 6110557, 44°22'33.012" N, 79°41'23.010" W, elevation 221.0 masl) for the period between 1981 and 2010. The climate station is located 5.2 km northwest of the subject lands. Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (Appendix F).

Storage (S)

Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET)

Evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the PET and AET have been calculated using a soil-moisture balance approach.

Water Surplus (R + I)

The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates the surficial soil (I). The infiltration is comprised of two end member components: one component that moves vertically downward to the groundwater table (referred to as recharge) and a second component that moves laterally through the topsoil profile or shallow soils as interflow that re-emerges locally to surface (i.e., as runoff) at some short time following cessation of precipitation. As opposed to the “direct” component of surface runoff that occurs during precipitation or snowmelt events, interflow becomes an “indirect” component of runoff. The interflow component of surface runoff is not accounted for in the water balance equation cited above since it is often difficult to distinguish between interflow and direct (overland) runoff, however both interflow and direct runoff together form the total surface water runoff component.

4.2 Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre-development (based on existing land use) infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

A soil moisture storage capacity of 150 mm was selected as a representative value for the existing vegetation and soil conditions which consists of predominantly short to moderate-rooted vegetation in the fields and agricultural areas (Table F-1, Appendix F). A soil moisture storage capacity of 75 mm was used to represent residential urban lawn (Table F-2, Appendix F). Tables F-1 and F-2 in Appendix F details the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculate the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The MECP SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated for the soil moisture storage conditions. The calculated water balance components from this table are then used to assess the pre-development volumes for runoff and infiltration as presented on Table F-3 in Appendix F.

4.3 Water Balance Component Values

The detailed monthly calculations of the water balance components are provided in Tables F-1 and F-2 in Appendix F. For these calculations, it has been assumed that sandy loam soils are representative for the subject lands for estimating the soil infiltration factor.

The detailed monthly calculations show that a water surplus is generally available from November to May. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables F-1 and F-2, Appendix F). A summary of these values is provided in Table 3.

Table 3: Water Balance Component Values

Water Balance Component	Agricultural Land Use	Urban Lawn
Average Precipitation	933 mm/year	933 mm/year
Actual Evapotranspiration	593 mm/year	555 mm/year
Water Surplus	340 mm/year	378 mm/year
Infiltration	204 mm/year	246 mm/year
Runoff	136 mm/year	132 mm/year

A water balance calculation of the potential water surplus for impervious areas is shown at the bottom of Table F-1 in Appendix F. There is an evaporation component from impervious surfaces, and this is typically estimated to be between about 10% and 20% of the total precipitation. For the purposes of the calculations in this study, the evaporation has been estimated to be 15% of precipitation. The remaining 85% of the precipitation that falls on impervious surfaces is assumed to become runoff. Therefore, assuming an evaporation/loss from impervious surfaces of 15% of the precipitation, there is a potential water surplus from impervious areas of 793 mm/year.

4.4 Pre-Development Water Balance (Existing Conditions)

The pre-development water balance calculations are presented in Table F-3 in Appendix F. The water balance component values from Table F-1 were used to calculate the average annual volume of infiltration for the subject lands which is calculated to be about 1,251 m^3/year (Table F-3, Appendix F).

4.5 Post-Development Water Balance with No Mitigation

To assess potential development impacts on infiltration, the post development infiltration volumes on the subject lands have been calculated on Table F-3 in Appendix F. The total areas for the proposed land cover were provided by Jones Consulting Group.

The infiltration and runoff components for the post-development land uses have been calculated using the MECP SWM Planning and Design Manual (2003) methodology based on topography, soil type and land cover as shown on Tables F-1 and F-2 in Appendix F.

As shown in the appendix tables, the post-development infiltration volume (without mitigation) is estimated at about 344 m^3/year (Table F-3, Appendix F). Comparing the pre- and post-development infiltration volumes, shows that development has the potential to reduce the infiltration on the subject lands from 1,251 m^3/year to

344 m^3/year, i.e., a reduction of about 907 m^3/year or 73%. These calculations assume no LID measures for stormwater management are in place.

4.6 Mitigation Measures for Infiltration

To minimize the potential impacts of development on the water balance, the use of Low Impact Development (LID) measures for stormwater management are generally recommended. It is our understanding that an infiltration gallery which collects runoff is proposed for the subject lands. The infiltration gallery will be designed to collect about 72% of runoff from the site (see Table F-4, Appendix F) which will result in approximately 2,931 m^3/year of infiltration.

The bottom of the infiltration gallery has been designed to be located above the seasonal high water level (see Figure 4) within sandy sediments which will be conducive to infiltration. Specific information on the design of the infiltration gallery is included in the SWM report completed by Jones Consulting.

5.0 Development Considerations

5.1 Construction Below the Water Table

The Ministry of the Environment, Conservation and Parks (MECP) has regulations that govern water taking for construction dewatering. Water takings above 50,000 L/day but below 400,000 L/day require registration under Environmental Activity Sector Registry (EASR). Takings above 400,000 L/day require a Category 3 Permit to Take Water (PTTW).

Groundwater levels on the subject lands measured at monitoring well MS-103 ranged between 3.7 m and 6.0 m below existing grade. A review of proposed grading plans indicates that fill on the site will raise proposed grades up to 3 m. The site plan includes an underground parking garage with a proposed invert above the seasonal high groundwater table (see Figure 4, Cross-section A-A’). No short-term or long-term dewatering is expected for the underground parking garage.

Based on the anticipated depth of fill and the depth to water table, the need for dewatering at volumes greater than 50,000 L/day (requiring an EASR or PTTW) for installation of municipal services is not anticipated.

5.2 Excavations into Municipal Aquifer

All excavations associated with the proposed development will occur in the surficial geology layer as described in Section 3.1. No excavations will occur in the confining layers to the municipal aquifer located more than 40 m below the subject lands.

5.3 Impacts to Private Wells

The area surrounding the subject lands is not currently serviced and residences are supplied by private wells. The subject lands are mainly surrounded by agricultural lands and a nearby subdivision is municipally serviced (Figure 2). There are relatively few domestic wells located in the vicinity of the subject lands and since construction dewatering and foundation drain dewatering is not proposed, there should be no impact to any private supply wells within 300 m of the subject lands.

In support of the ongoing development within the SPA, a water well survey was completed on behalf of the Hewitt's Landowners Group to identify private water supply wells within 300 m of the Hewitt's SPA area (Burnside, 2019). The report, which included the subject lands identified potentially vulnerable wells in the vicinity of the subject lands and outlined a monitoring and mitigation plan. This report was submitted to the Town of Barrie and a domestic well monitoring program was initiated in 2019. It is expected that the monitoring will continue for at least five years. During this period, the interference protocol outlined in the report will be implemented should any episode of interference occur.

5.4 Well Decommissioning

Prior to or during construction, it is necessary to ensure that all inactive wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903. This regulation applies to private domestic wells and to any groundwater observation wells on the subject lands unless they are maintained throughout the construction for monitoring purposes.

6.0 References

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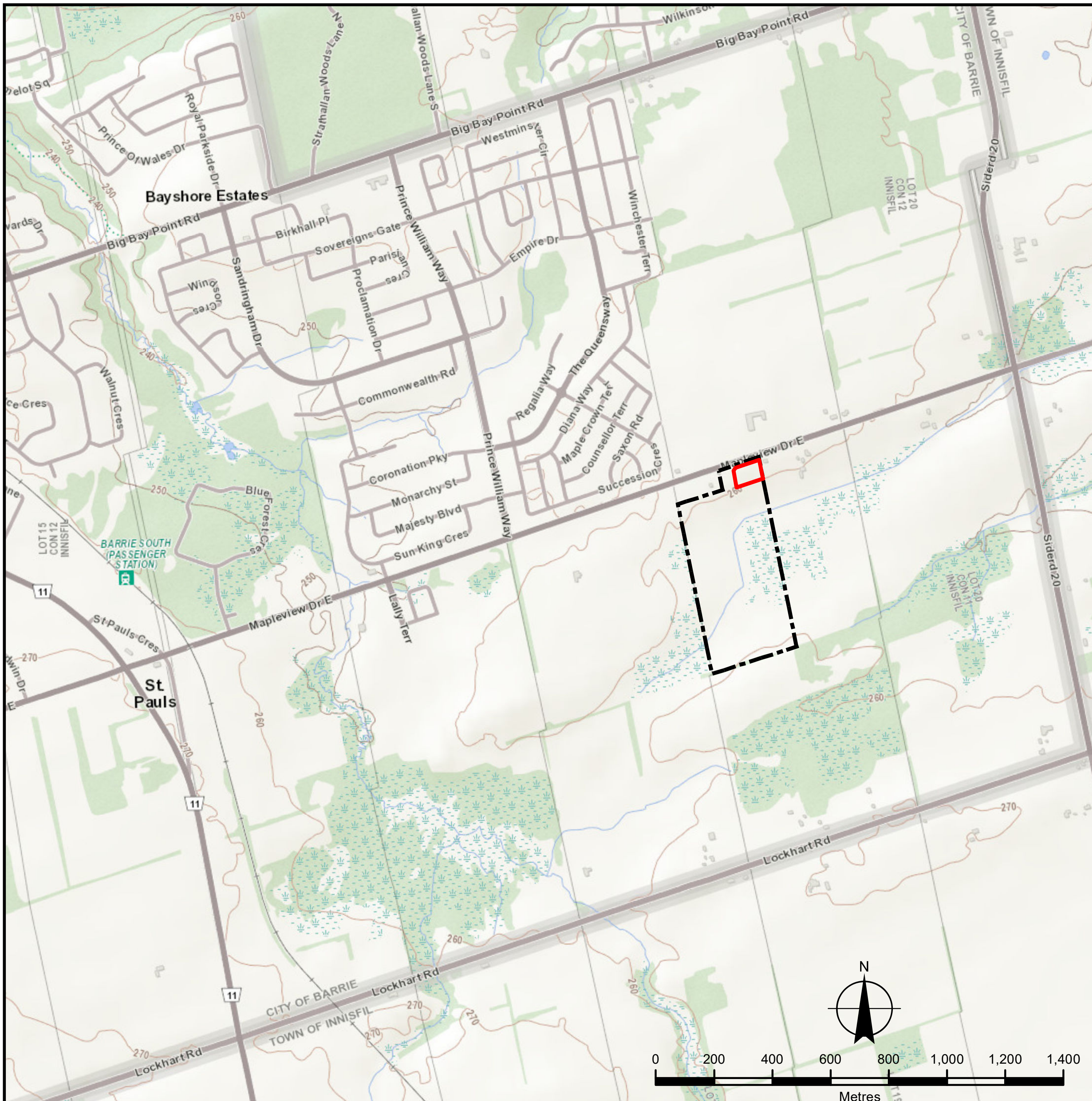
Figures



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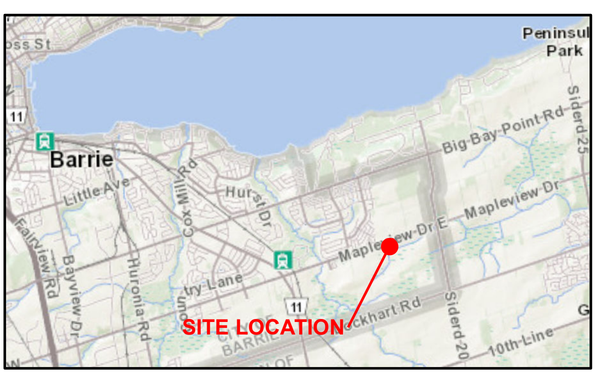
MAPLEVIEW SOUTH LANDS

BLOCK 193



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BLOCK 193 SITE PLAN APPLICATION
HYDROGEOLOGICAL BRIEF

Figure Title:

SITE LOCATION

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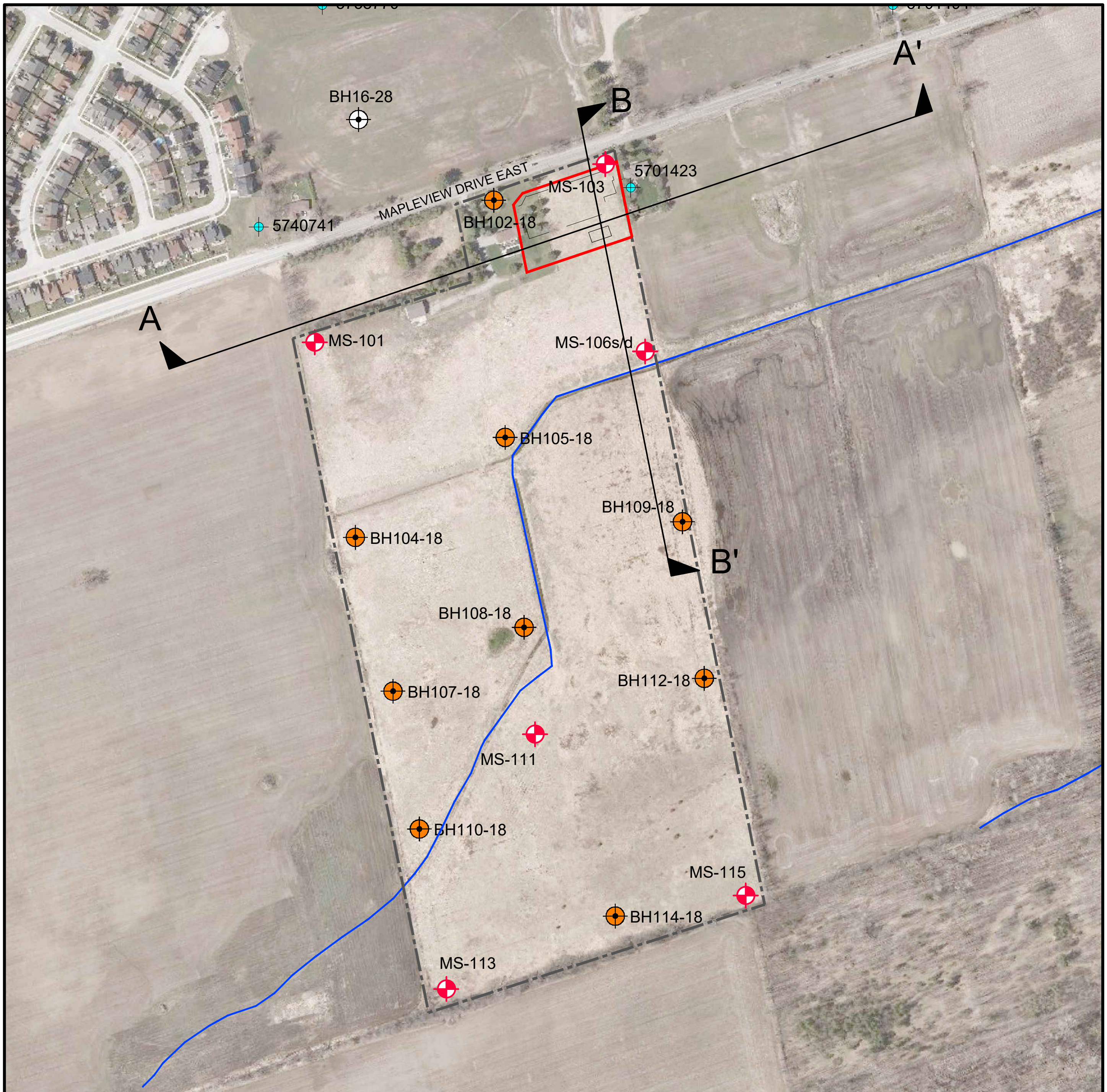

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- MAPLEVIEW SOUTH LANDS
- BLOCK 193
- WATERCOURSE
- MONITORING WELL (CAMBIUM, 2018)
- BOREHOLE (CAMBIUM, 2018)
- MECP WELL RECORD LOCATION
- A A' CROSS-SECTION LOCATION KEY

0 100 200 300 400
Metres

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Figure Title
BOREHOLE, WELL AND CROSS-SECTION LOCATIONS

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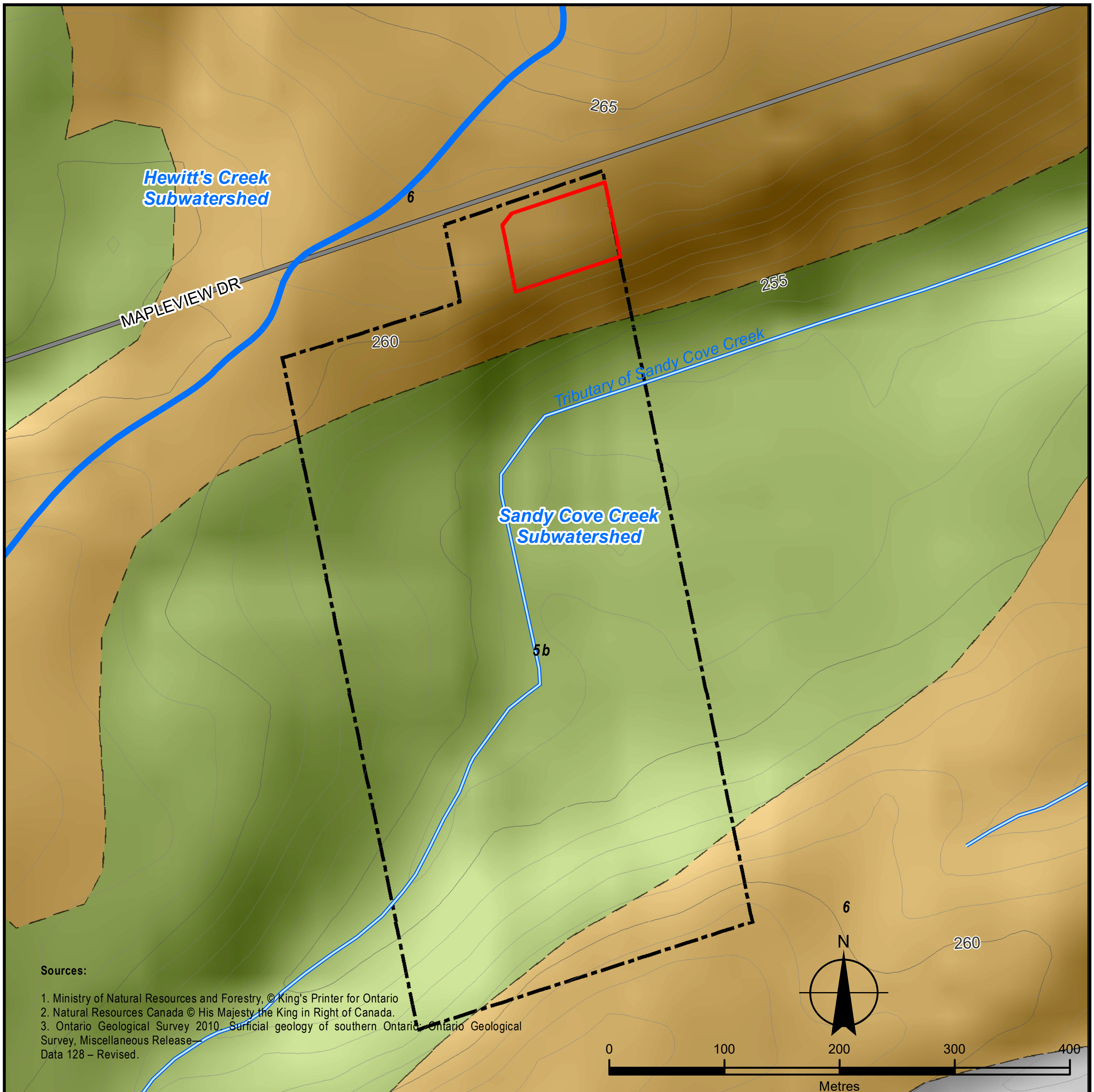

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- BLOCK 193
- MAPLEVIEW SOUTH LANDS
- SUBWATERSHED BOUNDARY
- ROADWAY
- CONTOUR (5m intervals - masl)
- CONTOUR (1m intervals)
- WATERCOURSE
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 20: Organic deposits

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Figure Title:

SURFICIAL GEOLOGY

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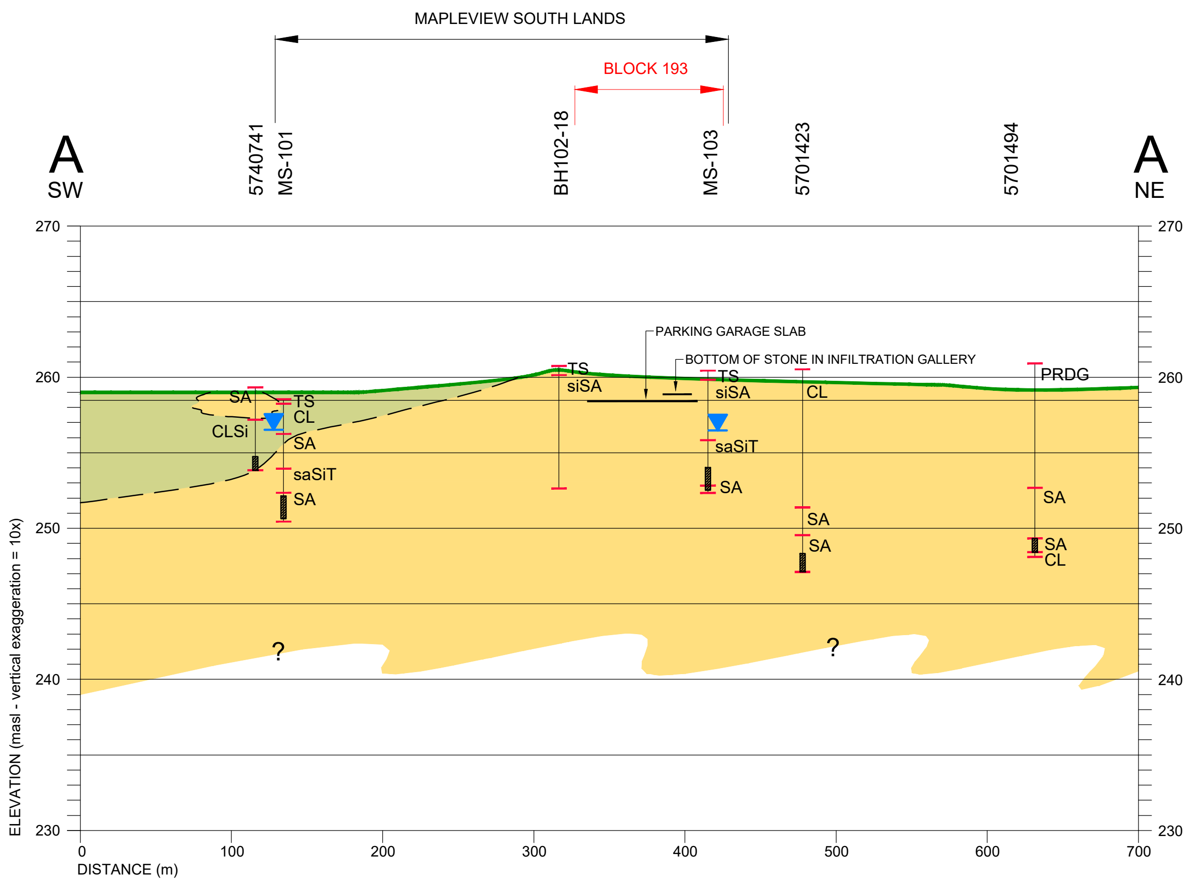

LEGEND

BH1	WELL NUMBER / ID	si	SILTY
		sa	SANDY
		cl	CLAYEY
	EXISTING GROUND PROFILE	GR	GRAVEL
		SA	SAND
	GEOLOGICAL CONTACT	Si	SILT
		CL	CLAY
	STATIC WATER LEVEL (MOECC WELL RECORD)	ST	STONES
		LSMN	LIMESTONE
	MEASURED WATER LEVEL (MAY 29, 2019)		
	WELL SCREEN		SAND / SILT / GRAVEL
			SILT CLAY TILL
	INTERPRETED STRATIGRAPHY		

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Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION A-A'

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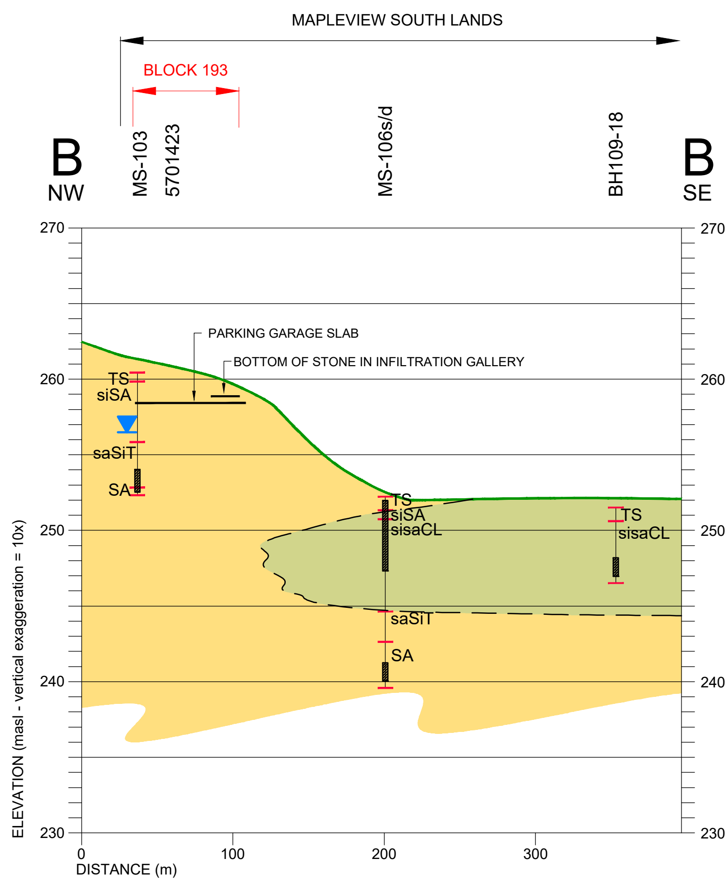

LEGEND

BH1	WELL NUMBER / ID
	EXISTING GROUND PROFILE
	GEOLOGICAL CONTACT
	STATIC WATER LEVEL (MOECC WELL RECORD)
	MEASURED WATER LEVEL (MAY 29, 2019)
	WELL SCREEN
- - - - -	INTERPRETED STRATIGRAPHY

si	SILTY
sa	SANDY
cl	CLAYEY
GR	GRAVEL
SA	SAND
Si	SILT
CL	CLAY
ST	STONES
LSMN	LIMESTONE

	SAND / SILT / GRAVEL
	SILT CLAY TILL

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Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION B-B'

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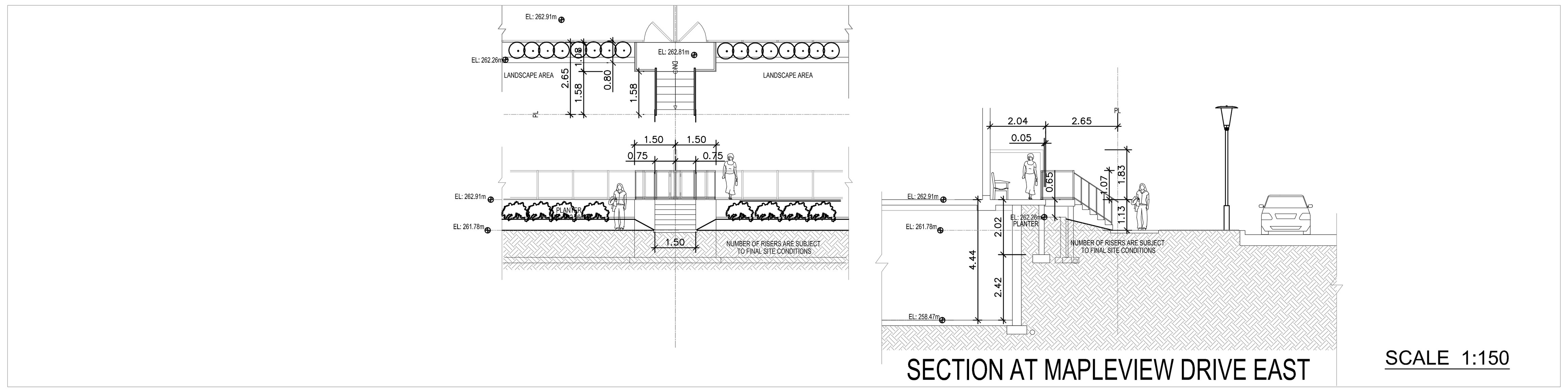
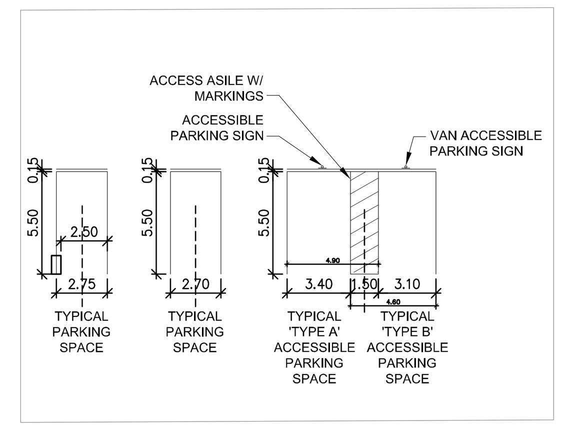
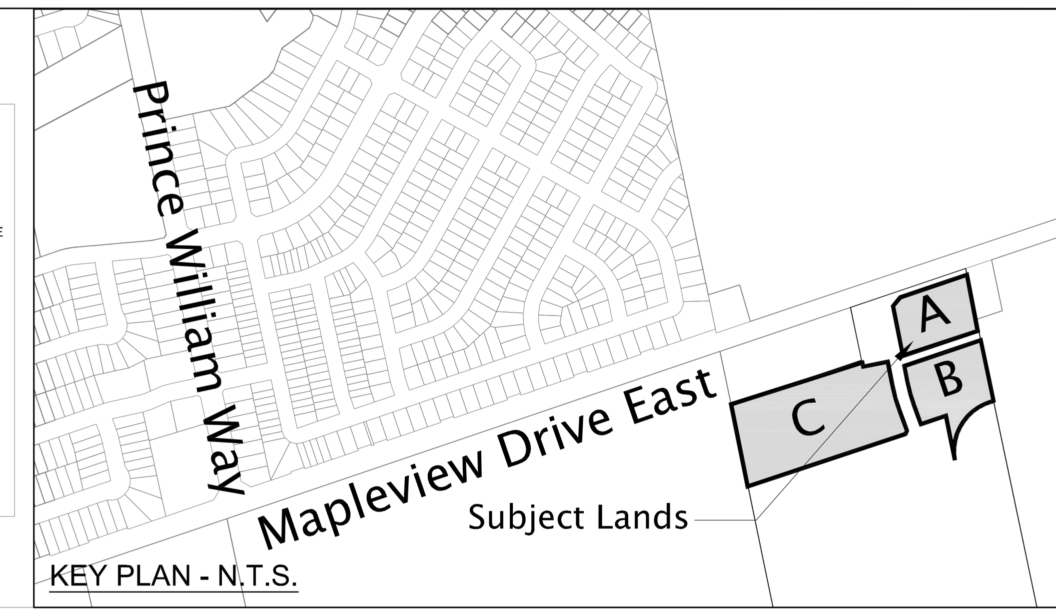
Appendix A

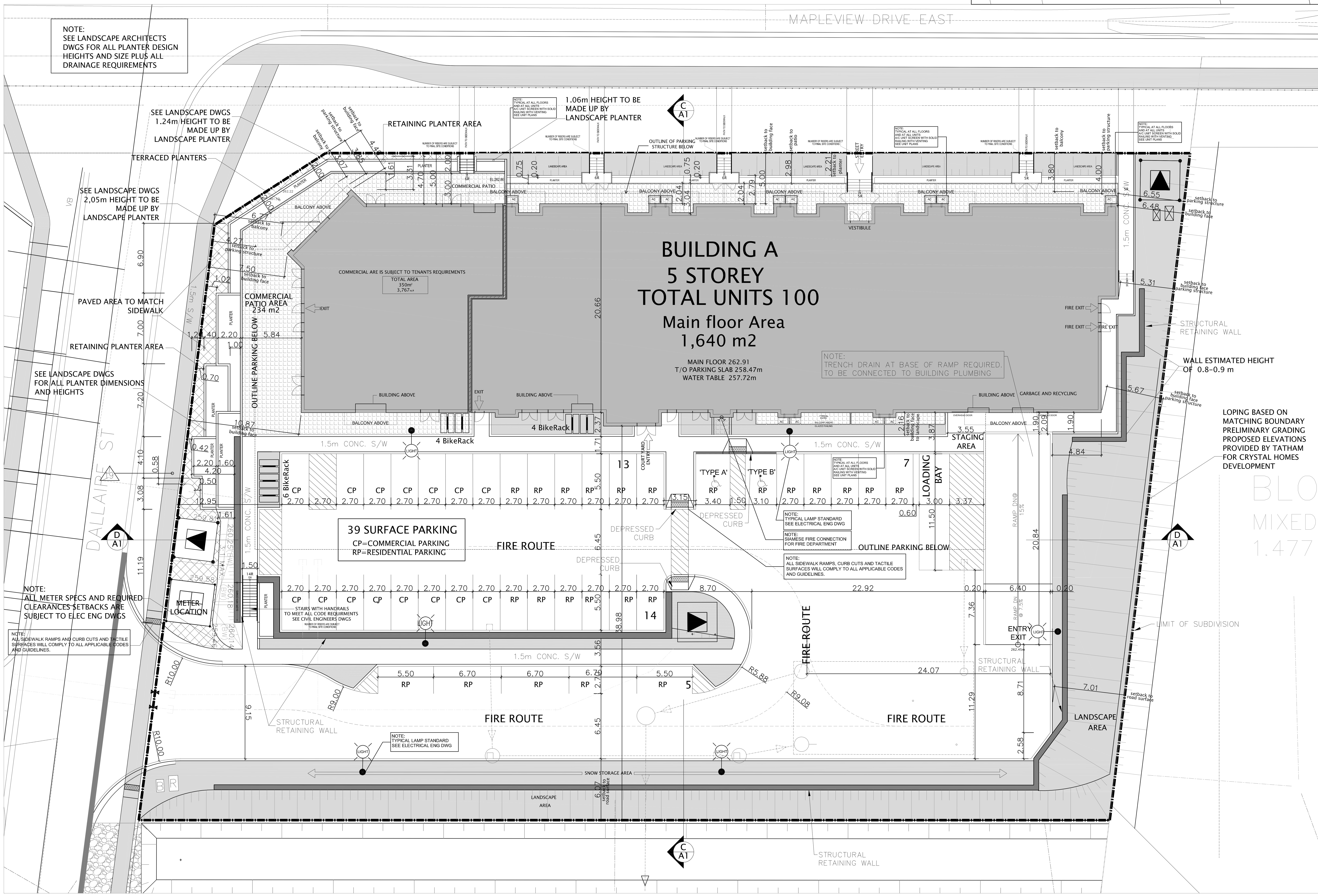
Site Plan

Appendix A









Block 'A' Details

Unit Count:
BLOCK 'A' Apartment Building (5 Storey) 100 units

A BUILDING FOOT
(3.2.2.43A GROUP C)
ALLOWABLE 1,800 m2
PROPOSED 1,649 m2

Total 100 units

	REQUIRED	PROPOSED
Site Plan Area	-	0.63 ha.(6,267.66m2)
Lot Frontage	24.0 m	85.4 m
Front Yard	3.0 m	5.33 m
Interior Side Yard	5.0 m	5.31m
Exterior Side Yard	2.0 m	7.50m
Rear Yard	5.0 m	38.98 m
Lot Coverage	max 50 % (0.931 ha.)	26 % (0.18 ha.)
Accessory Structures	max 10 % (0.06 ha.)	0 % (0.00 ha.)
Landscape Open Space	min. 25 % (0.16 ha.)	39 % (0.25 ha.)
Paved Area	max 35 %	35 % (0.22 ha.)
Density Index	min 120 max 300	158.73
Floor Space Index	min 0.5 max 2.5	1.31
Commercial Area	50% of the ground floor 816 m2	21.45% 350 m2

Commercial Floor to Floor Height Required 4.5m Provided 4.5m

5m setback at street frontage

	Required min	Provided
Percentage of building at the 5m setback to all street frontage	50%	74%
	Required max	Provided
Percentage of building with in the 5m setback to all street frontage	50%	26%

Building
- GFA 8184 m2
- Height in Stories 5
- Units 100

Parking Calculations

	Required	Provided
Required Parking (100(units) x 1.0)	100 spaces	107 spaces
Required Parking Commercial (1 per 24m2)(350/24=15)	15 spaces	15 spaces
Total Required	115 spaces	122 spaces

*Parking Breakdown

Typical Surface Spaces	22 spaces
Typical Surface Spaces Commercial	15 spaces
Surface Barrier Free Spaces	2 spaces
Underground Barrier Free Spaces	2 spaces
Typical Underground Spaces	81 spaces
Total Provided	122 spaces

Barrie Zoning Bylaw 4.6.4 Barrier Free Parking
Barrier Free spaces calculated using Accessibility Parking for Barrie Ont.
Required over 100 spaces 1 space plus 3% of the required parking spaces
3% of 122 =3.66 (4) plus 1 = 5(5 required, provided 5)
(Type A - 3.4 x 1.5 - 2 spaces)
(Type B - 3.1 x 1.5 - 3 spaces)

Bicycle Rack Storage (0.2 x 100) 20 Required 16 Secure Storage Provided
14 Surface Bike Racks Provided
Total 30 Bikes

Required Outdoor Amenity Area (12m²/unit-12x100) 1200 m²

Proposed Outdoor Amenity

Patio area at ground floor Apartments, Plus Patio area over parking structure	161.08 m²
Balcony area at typical floors	551.96 m²
Roof Deck	544.00 m²
Total Outdoor Amenity	1257.04 m²

Proposed Indoor Amenity

lounge/meeting rooms and 1st and 5th Floor washroom	197.50 m²
Total Indoor Amenity	197.50 m²

Fire Route

Unit type and area per floor AFFORDABLE UNIT *

Unit	Area	Unit Type	Main floor	2nd floor	3rd floor	4th floor	5th floor	
A	55m²	1 bed 1 bath	2	2	2	2	2	10
B*	34m²	Studio	2	4	4	4	4	18
C	55m²	1 bed/1 bath/den	2	4	4	4	4	18
D	49m²	1 bed/1 bath		1	1	1	1	4
E	57m²	1 bed/1 bath/den	3	2	2	2	2	11
F	81m²	2 bed/2 bath	2	4	4	4	4	18
F+	83m²	2 bed/2 bath	1	1	1	1	1	5
G	109m²	3 bed/2.5 bath		1	1	1		3
G+	111m²	3 bed 2.5 bath					1	1
H	70m²	2 bed 2 bath		1	1	1		3
H+	72m²	2 bed/2 bath					1	1
I	103m²	2 bed/2 bath/den		1	1	1	1	4
J	57m²	1 bed/1 bath		1	1	1		3
K	52m²	1 bed/1 bath					1	1
			12	22	22	22	22	100

Total Units	100
Affordable Units *	18

No.	Description	Date	Rev.
22	EAST RETAINING WALL REVISED	JUN 06, 2024	
21	DALLAIRE ST, PLANTER REVISED	JUN 03, 2024	
20	DALLAIRE ST, PLANTER REVISED	May 27, 2024	
19	DALLAIRE ST, PLANTER REVISED	April 22, 2024	
18	ISSUED FOR PRE-CONSULTATION MEETING	April 15, 2024	
17	ISSUED FOR PRE-CONSULTATION MEETING	April 12, 2024	
16	ISSUED FOR PRE-CONSULTATION MEETING	April 11, 2024	
15	ISSUED FOR PRE-CONSULTATION MEETING	April 05, 2024	
14	ISSUED FOR PRE-CONSULTATION MEETING	March 08, 2024	
13	ISSUED FOR PRE-CONSULTATION MEETING	Feb 26,2024	
12	ISSUED FOR PRE-CONSULTATION MEETING	Feb 21,2024	
11	ISSUED FOR PRE-CONSULTATION MEETING	Feb 07,2024	
10	ISSUED FOR PRE-CONSULTATION MEETING	Nov 30,2023	
9	ISSUED FOR PRE-CONSULTATION MEETING	Nov 27,2023	
8	ISSUED FOR PRE-CONSULTATION MEETING	Nov 23,2023	
7	ISSUED FOR PRE-CONSULTATION MEETING	Nov 16,2023	
6	ISSUED FOR PRE-CONSULTATION MEETING	Oct 24,2023	
5	ISSUED FOR PRE-CONSULTATION MEETING	Oct 04,2023	
4	ISSUED FOR PRE-CONSULTATION MEETING	July 18,2023	
3	ISSUED FOR CLIENT AND CONSULTANT REVIEW	May 23,2023	
2	ISSUED FOR CLIENT AND CONSULTANT REVIEW	Aril 20,2023	
1	ISSUED FOR CLIENT AND CONSULTANT REVIEW	March 30,2023	SA

maple glen IN BARRIE

CLIENT: MAPLEVIEW SOUTH (INNISFIL) LTD.

953 MAPLEVIEW DRIVE-BLOCK-193
SITE PLAN

ELEVATION:
Drawing No. A-101
TOTAL AREA:
DATE ISSUED: March 30,2023
PROJECT #: 2023-05
MARKETING NAME: -
SCALE: 1:200
MUNICIPALITY: City of Barrie

S&C ARCHITECTS INC.
T:(416)848-0991 F:(416)860-6101
INFO@SCARCHITECTS.CA
60 RANDALL DRIVE SUITE 10
AJAX, ONTARIO L1S 6L3

BURNSIDE

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Appendix B

Borehole Logs

Appendix B

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
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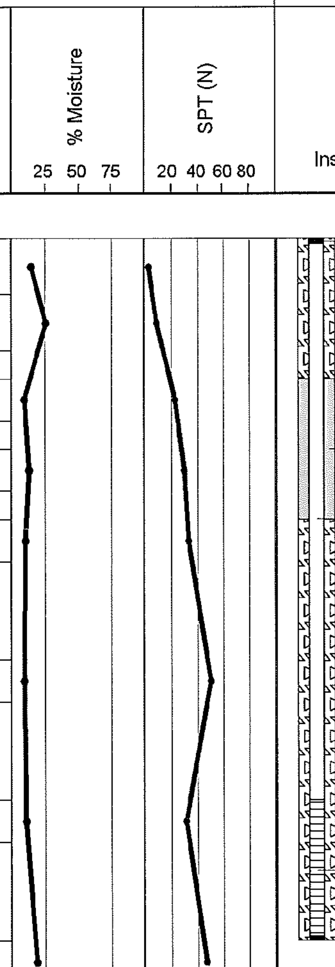
Log of Borehole: BH101-18

Client: The Jones Consulting Group Ltd. **Project Name:** Mapleview South Development Project **Project No.:** 7468-001

Contractor: Walker Drilling **Method:** Hollow Stem Auger **Date Completed:** 2018-05-14

Location: 953 Mapleview Dr. East, Barrie **UTM:** 17T, 611321, 4912044 **Elevation:** 258.25m

SUBSURFACE PROFILE		SAMPLE					Remarks
Depth (m)	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
0	Topsoil: Black topsoil, organics, sand and silt, loose, moist	1	SS	80	3	Cap; Backfill	
~0.6	Clay: Brown Silty Sandy Clay, trace to some sand, stiff, moist	2	SS	100	9		
	trace gravel, very stiff	3	SS	80	23	Bentonite Plug	
~2.3	Sand: Brown Sand and Silt, some clay, trace gravel, fine, some silt, dense, moist	4	SS	70	30	PVC Riser	
		5	SS	90	33		SS5 GSA: Gravel 2% Sand 41% Silt 39% Clay 18%
~4.6	Till: Brown Sandy Silt, trace gravel, some cobble, very dense, moist	6	SS	40	50	Caved material	Ground water level encounterd at 3.05 mbgs. Ground water measured at 1.73 mbgs on May 22, 2018
~6.1	Sand: Brown fine Sand, trace to some silt, saturated, dense	7	SS	70	31	PVC Screen	
		8	SS	40	47	Cap	
8.08	Borehole terminated at 8.08 mbgs						



Logged By: AG **Input By:** AG

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Barrie
Oshawa
Kingston
T: 866-217-7900
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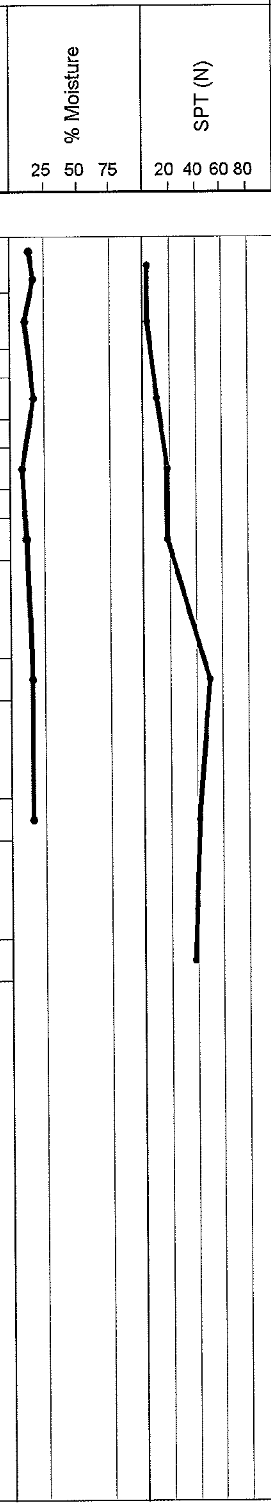
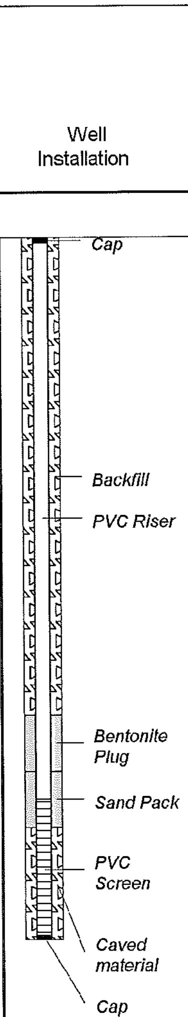
Log of Borehole: BH102-18

Client: The Jones Consulting Group Ltd.
Contractor: Walker Drilling
Location: 953 Mapleview Dr. East, Barrie
Project Name: Mapleview South Development Project
Method: Hollow Stem Auger
UTM: 17T, 611471, 4912163
Project No.: 7468-001
Date Completed: 2018-05-14
Elevation: 260.66m

Subsurface Profile: Description	Sample Number	Type	% Recovery	SPT (N)	Remarks
Topsoil: Black topsoil, sand and silt, organics, loose, moist	1A	SS	90	3	
	1B	SS			
Silty Sand: Brown Silty Sand, some clay, trace gravel, loose, moist	2	SS	70	3	
no clay, compact	3	SS	80	10	
	4	SS	100	18	
	5	SS	90	18	
very dense	6	SS	100	50	
Silty Sand: Brown Silty Sand, trace gravel, saturated, very dense	7	SS	90	42	Ground water level encounterd at 6.40 mbgs. Ground water measured at 3.7 mbgs on May 22, 2018
	8	SS	90	38	
Borehole terminated at 8.08 mbgs					





Logged By: AG
Input By: AG

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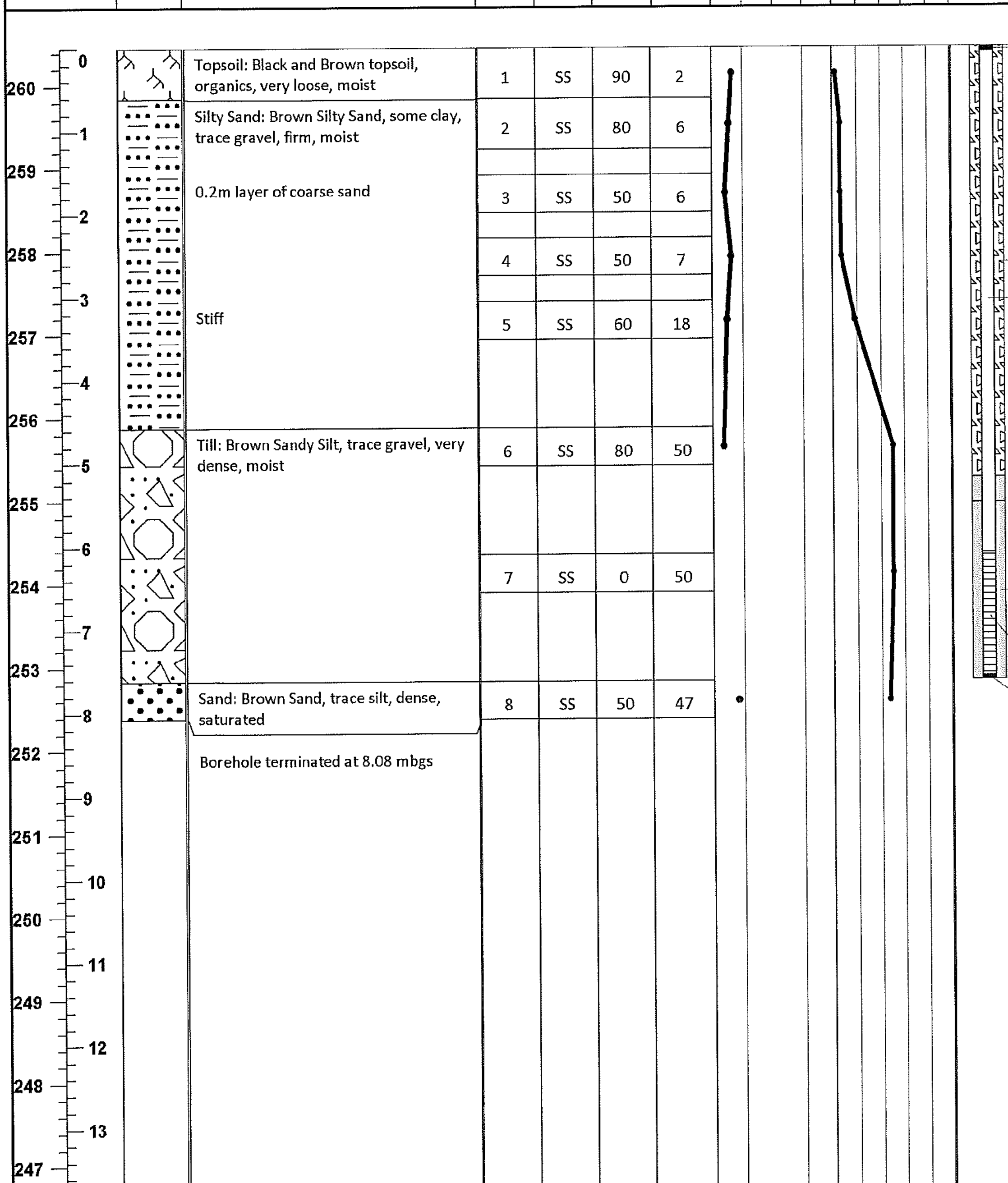
Log of Borehole: BH103-18

Client:	The Jones Consulting Group Ltd.	**Project Name:**	Mapleview South Development Project	**Project No.:**	7468-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Auger	**Date Completed:**	2018-05-14
Location:	953 Mapleview Dr. East, Barrie	**UTM:**	17T, 611572, 4912192	**Elevation:**	260.45m

SUBSURFACE PROFILE / SAMPLE

Depth (m)	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
0	Topsoil: Black and Brown topsoil, organics, very loose, moist	1	SS	90	2	Cap	
	Silty Sand: Brown Silty Sand, some clay, trace gravel, firm, moist	2	SS	80	6		
	0.2m layer of coarse sand	3	SS	50	6		
		4	SS	50	7	Backfill	
	Stiff	5	SS	60	18	PVC Riser	SS2 GSA: Gravel 3% Sand 49% Silt 32% Clay 16%
	Till: Brown Sandy Silt, trace gravel, very dense, moist	6	SS	80	50	Bentonite Plug	Ground water level encounterd at 4.57 mbgs. Ground water measured at 3.69 mbgs on May 22, 2018
		7	SS	0	50	Sand Pack	
						PVC Screen	
	Sand: Brown Sand, trace silt, dense, saturated	8	SS	50	47	Cap	
	Borehole terminated at 8.08 mbgs						



Logged By: AG **Input By:** AG

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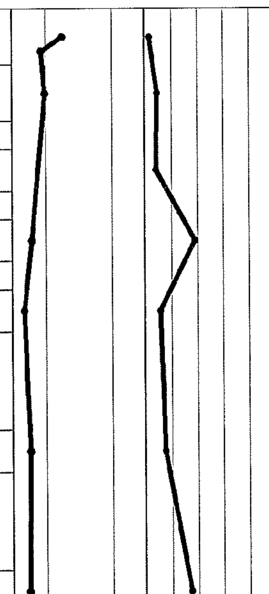
Log of Borehole: BH104-18

Client:	The Jones Consulting Group Ltd.	**Project Name:**	Mapleview South Development Project	**Project No.:**	7468-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Auger	**Date Completed:**	2018-05-14
Location:	953 Mapleview Dr. East, Barrie	**UTM:**	17T, 611363, 4911873	**Elevation:**	253.93m

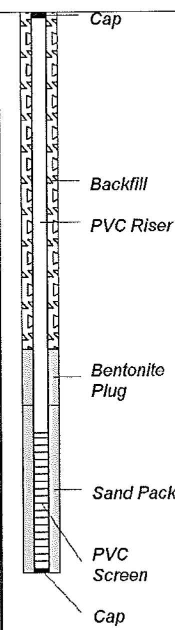
SUBSURFACE PROFILE / SAMPLE

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)
	0	Topsoil: Black topsoil, some sand and silt, organics, loose, wet to saturated	1A / 1B	SS / SS	50	3
253	1	Clay: Brown Silty Sandy Clay, trace sand, trace gravel, stiff, wet	2	SS	100	9
252	2	Grey, moist to wet	3	SS	100	8
		very stiff	4	SS	30	38
251	3	stiff	5	SS	50	11
250	4					
249	5		6	SS	40	15
248	6	some sand, very stiff	7	SS	40	35
247	7	Borehole terminated at 6.55 mbgs				
246	8					
245	9					
244	10					
243	11					
242	12					
241	13					

% Moisture: 25 50 75 — SPT (N): 20 40 60 80



Well Installation



Remarks

Ground water level encounterd at 3.05 mbgs. Ground water measured at -0.93 mbgs (over flowing) on May 22, 2018

Logged By: AG **Input By:** AG

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Log of Borehole: BH105-18

Client:	The Jones Consulting Group Ltd.	***Project Name:***	Mapleview South Development Project	***Project No.:***	7468-001
Contractor:	Walker Drilling	***Method:***	Hollow Stem Auger	***Date Completed:***	2018-05-14
Location:	953 Mapleview Dr. East, Barrie	***UTM:***	17T, 611481, 4911961	***Elevation:***	252.82m

SUBSURFACE PROFILE / **SAMPLE**

Depth (m)	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
0	Topsoil: Black topsoil, organics, loose, moist	1	SS	25	5	Cap	
		2A	SS	25	10		
	Clay: Grey Silty Sandy Clay, trace gravel, stiff, moist	2B	SS				
		3	SS	100	8	Backfill	
		4	SS	100	10	PVC Riser	
	no gravel	5	SS	100	8		
						Bentonite Plug	
	Till: Grey Sandy Silt, trace clay, compact, saturated	6	SS	60	19	Sand Pack	Ground water level encounterd at 4.57 mbgs. Ground water measured at -1 mbgs (over flowing) on May 22, 2018
	possible cobble, trace gravel, saturated	7	SS	50	18	PVC Screen, Cap	
	Borehole terminated at 6.55 mbgs						

Elevation (m): 252, 251, 250, 249, 248, 247, 246, 245, 244, 243, 242, 241, 240
Depth: 0–13

% Moisture: 25 50 75
SPT (N): 20 40 60 80

Logged By: AG ***Input By:*** AG

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Log of Borehole: BH106-18A

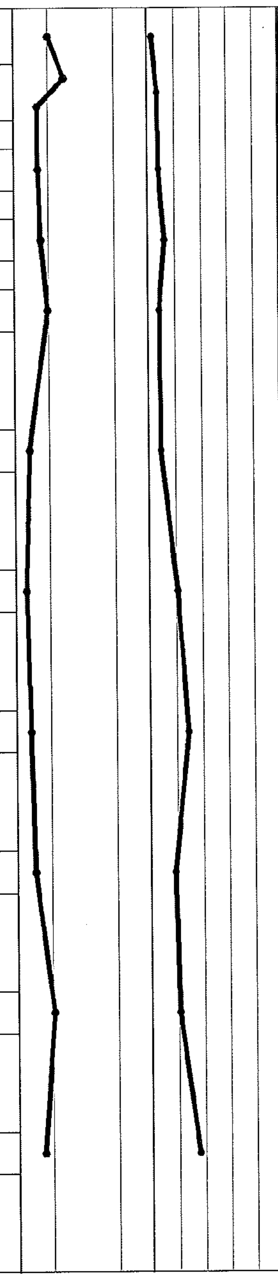
Client: The Jones Consulting Group Ltd.
Contractor: Walker Drilling
Location: 953 Mapleview Dr. East, Barrie

Project Name: Mapleview South Development Project
Method: Hollow Stem Auger
UTM: 17T, 611598, 4912035

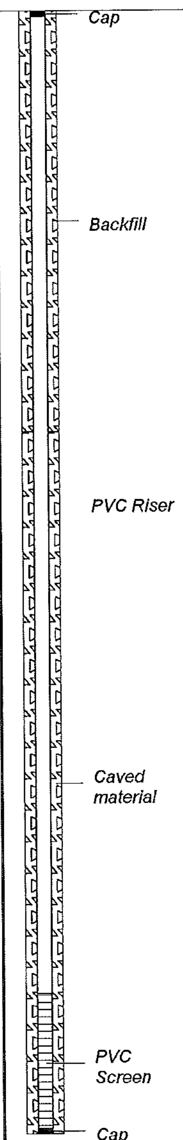
Project No.: 7468-001
Date Completed: 2018-05-14
Elevation: 252.25m

SUBSURFACE PROFILE		SAMPLE				Remarks
Depth (m)	Description	Number	Type	% Recovery	SPT (N)	
0	Topsoil: Black topsoil, organics, loose, moist	1	SS	50	3	
		2A	SS	50	7	
~0.9	Silty Sand: Brown fine Silty Sand, some clay, trace gravel, loose, wet	2B	SS			
~1.5	Clay: Grey Silty Sandy Clay, stiff, moist	3	SS	70	8	
		4	SS	80	12	
	saturated	5	SS	80	8	
		6	SS	90	9	SS9 GSA: Gravel 8% Sand 59% Silt 12% Clay 21%
	some cobble, very stiff	7	SS	50	21	
~7.6	Till: Grey Sandy Silt, trace clay and gravel, compact, saturated	8	SS	60	29	Ground water level encounterd at 3.05 mbgs. Ground water measured at -0.83 mbgs (over flowing) on May 22, 2018
		9	SS	100	18	
~9.6	Sand: Brown fine Sand, some gravel, trace silt, compact, saturated	10	SS	100	21	
	dense	11	SS	100	36	
12.65	Borehole terminated at 12.65 mbgs					

% Moisture (25 50 75) / SPT (N) (20 40 60 80)



Well Installation



Logged By: AG **Input By:** AG

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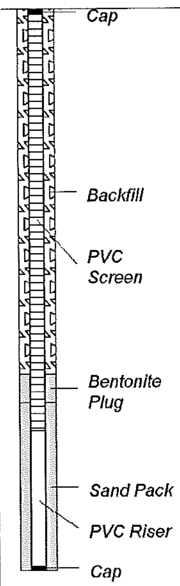
Log of Borehole: BH106-18B

Client:	The Jones Consulting Group Ltd.	***Project Name:***	Mapleview South Development Project	***Project No.:***	7468-001
Contractor:	Walker Drilling	***Method:***	Hollow Stem Auger	***Date Completed:***	2018-05-14
Location:	953 Mapleview Dr. East, Barrie	***UTM:***	17T, 611598, 4912036	***Elevation:***	252.28m

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture 25 50 75	SPT (N) 20 40 60 80	Well Installation	Remarks
252 / 0										Ground water level encounterd at 3.05 mbgs. Ground water measured at 0.17 mbgs (water level rising when measured) on May 22, 2018

Elevation (m): 252, 251, 250, 249, 248, 247, 246, 245, 244, 243, 242, 241, 240, 239
Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

Logged By: AG ***Input By:*** AG

BURNSIDE

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Appendix C

Hydraulic Conductivity Data

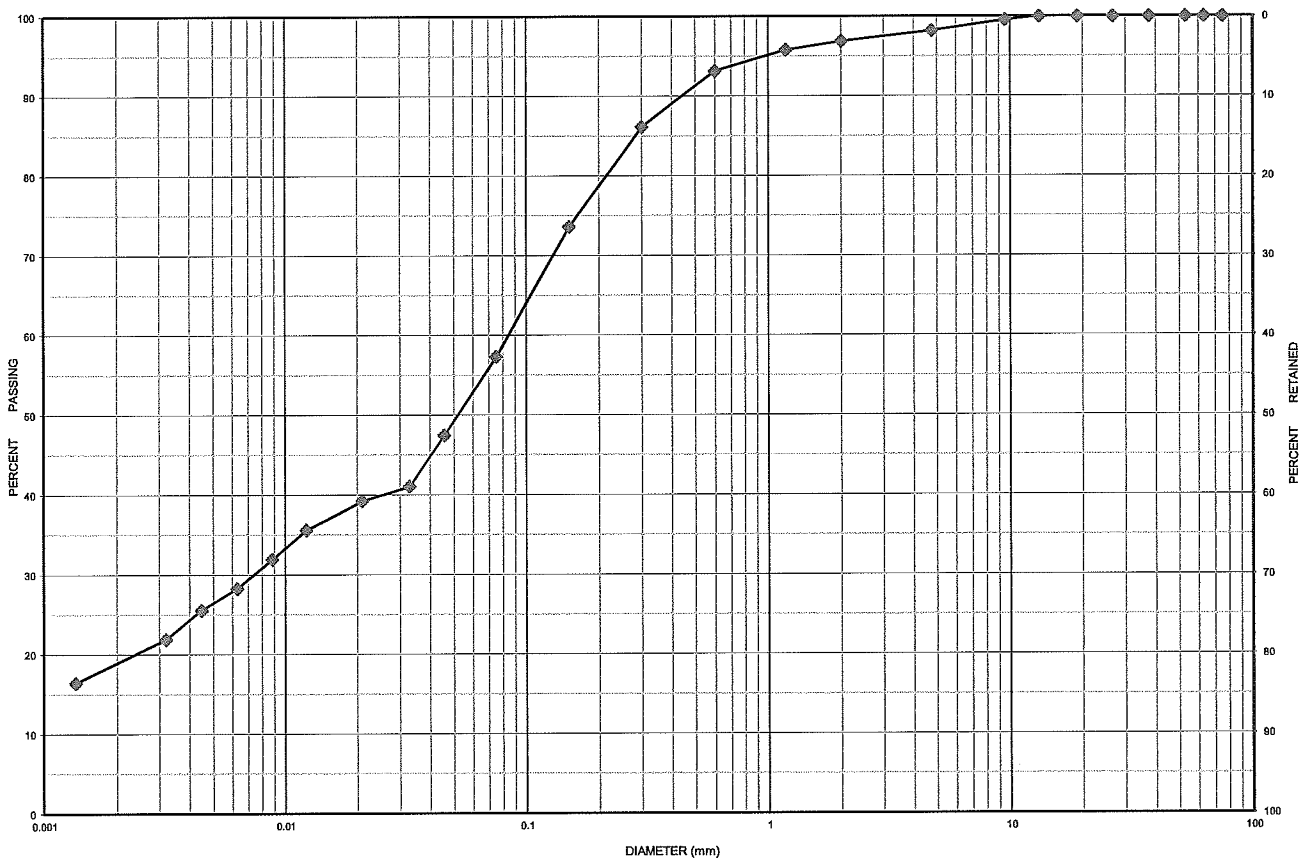
Appendix C

Grain Size Distribution Chart

Project Number:	*7468-001*	**Client:**	*The Jones Consulting Group Ltd.*		
Project Name:	*Geotech - Mapleview South Development, Innisfil*				
Sample Date:	*May 9, 2018*	**Sampled By:**	*Alex Griffin - Cambium Inc.*		
Location:	*BH 101-18 SS 5*	**Depth:**	*3 m to 3.5 m*	**Lab Sample No:**	*S-18-0444*

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	SAND			GRAVEL			BOULDERS
		FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-18	SS 5	3 m to 3.5 m	2	41	57		10.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Silty some Clay trace Gravel	SP-ML	0.085	0.0074	-	-	-

Issued By: ______ (Senior Project Manager)

Date Issued: *June 5, 2018*

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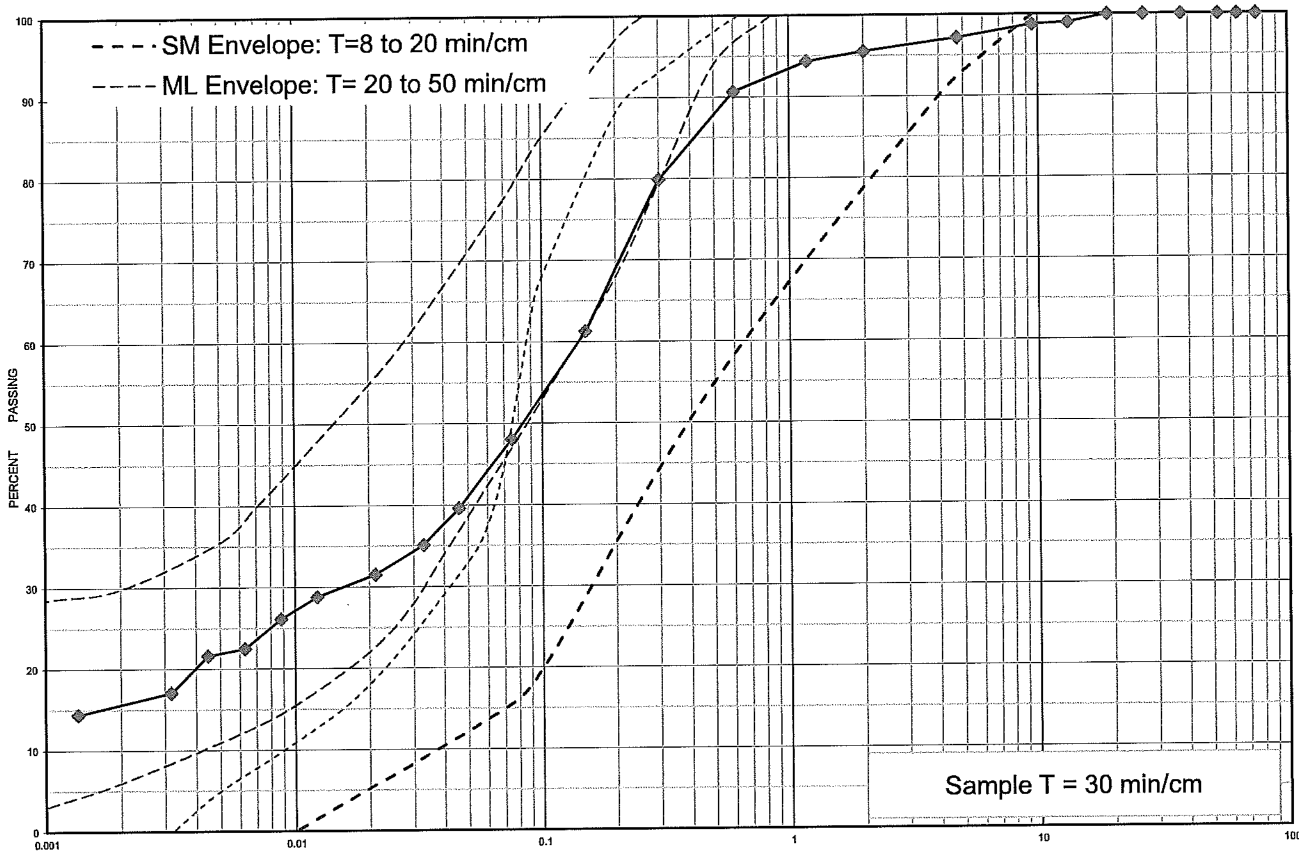
CERTIFIED BY CCIL

Grain Size Distribution Chart

Project Number:	*7468-001*	**Client:**	*The Jones Consulting Group Ltd.*		
Project Name:	*Geotech - Mapleview South Development, Innisfil*				
Sample Date:	*May 9, 2018*	**Sampled By:**	*Alex Griffin - Cambium Inc.*		
Hole No.:	*BH 103-18 SS 2*	**Depth:**	*0.6 m to 1.2 m*	**Lab Sample No:**	*S-18-0441*

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



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

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-18	SS 2	0.6 m to 1.2 m	3	49	48		13.7

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Clay trace Gravel	SM	0.14	0.02	-	-	-

Issued By: (Senior Project Manager)

Date Issued: *June 7, 2018*

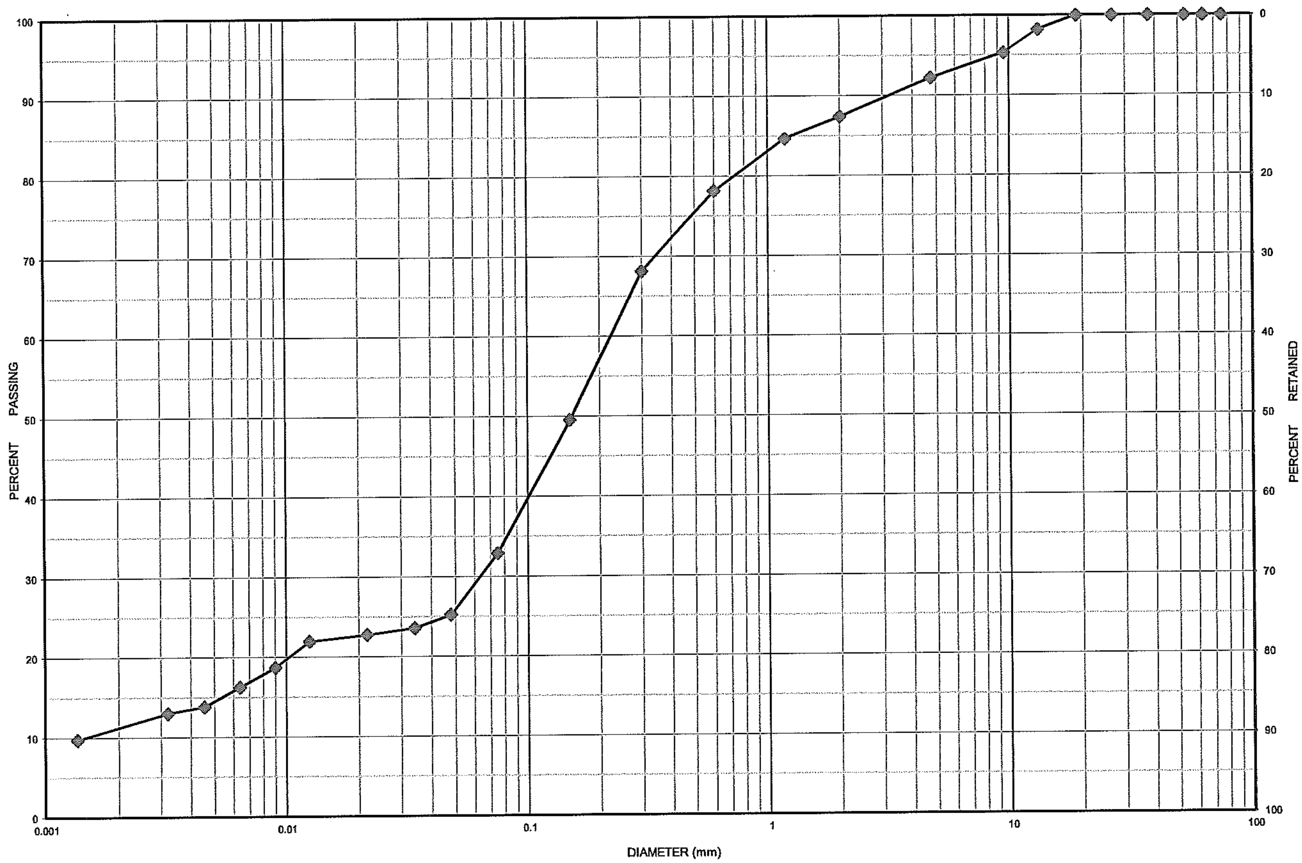
CAMBIUM

Grain Size Distribution Chart

CERTIFIED BY CCIL

Project Number: *7468-001* **Client:** *The Jones Consulting Group Ltd.*
Project Name: *Geotech - Mapleview South Development, Innisfil*
Sample Date: *May 9, 2018* **Sampled By:** *Alex Griffin - Cambium Inc.*
Location: *BH 106-18 SS 9* **Depth:** *9.1 m to 9.6 m* **Lab Sample No:** *S-18-0442*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 106-18	SS 9	9.1 m to 9.6 m	8	59	33		13.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Clay trace Gravel	SM	0.220	0.064	0.0014	157.14	13.30

Issued By: (Senior Project Manager) *Date Issued:* *June 7, 2018*

Cambium Inc. (Laboratory)
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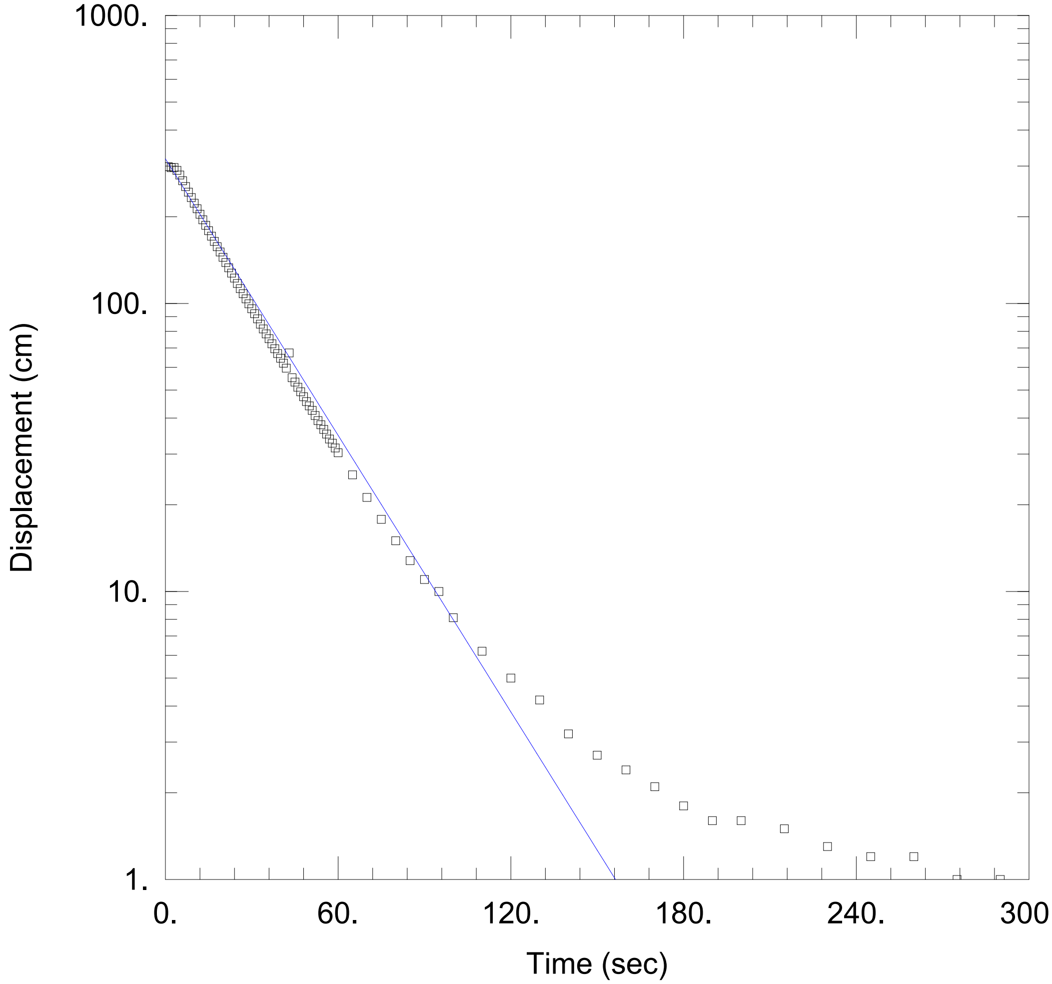
701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Form: L6V.2 - Grad.Hydo



HYDRAULIC CONDUCTIVITY TEST AT MS-103 (SCREENED IN SANDY SILT TILL)

PROJECT INFORMATION

Company: R.J Burnside & Associates Limi
Project: 300042309
Location: Barrie
Test Well: MS-103
Test Date: June 18, 2019

AQUIFER DATA

Saturated Thickness: 314. cm
Anisotropy Ratio (Kz/Kr): 0.1

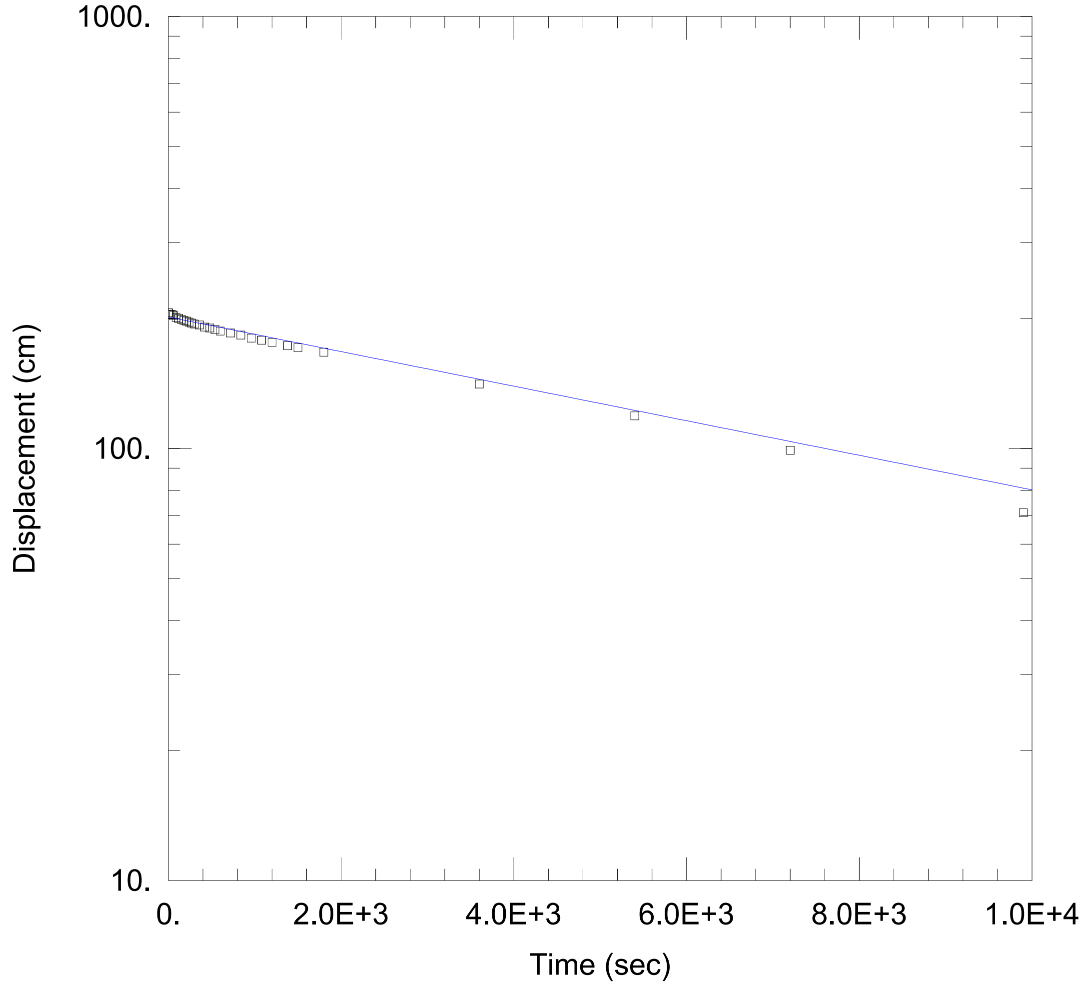
WELL DATA (MS-103)

Initial Displacement: 298.5 cm
Total Well Penetration Depth: 314. cm
Casing Radius: 2.54 cm
Static Water Column Height: 314. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002844 cm/sec
y0 = 317.6 cm



HYDRAULIC CONDUCTIVITY TEST AT MS-106S (SCREENED IN SILTY SANDY CLAY)

PROJECT INFORMATION

Company: R.J Burnside & Associates Limi
Project: 300042309
Location: Barrie
Test Well: MS-106s
Test Date: November 12, 2019

AQUIFER DATA

Saturated Thickness: 698. cm
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MS-106s)

Initial Displacement: 206. cm
Total Well Penetration Depth: 698. cm
Casing Radius: 2.54 cm
Static Water Column Height: 698. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 8.039E-6 cm/sec
y0 = 201.4 cm

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Appendix D

Groundwater Level Data

Appendix D

Table D-1
Groundwater Elevations

	Well Depth (mbgl)	Ground Surface Elevation (masl)	22-May-2018		2-Aug-2018		6-Sep-2018		28-Sep-2018	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
MS-101	7.24	258.25	1.73	256.52	2.59	255.66	2.68	255.57	2.85	255.40
MS-103	7.32	260.45	3.69	256.76	4.70	255.75	4.87	255.58	5.05	255.40
MS-106s	6.06	252.25	0.17	252.08	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
MS-106d	11.71	252.28	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing

Notes:
"-" denotes data unavailable
Ground elevations from Cambium Incorporated

Table D-1
Groundwater Elevations

	Well Depth (mbgl)	Ground Surface Elevation (masl)	24-Oct-2018		29-Nov-2018		17-Dec-2018		1-Feb-2019	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
MS-101	7.24	258.25	2.92	255.33	2.15	256.10	2.19	256.06	2.55	255.70
MS-103	7.32	260.45	5.14	255.31	4.62	255.83	4.47	255.98	4.68	255.77
MS-106s	6.06	252.25	Flowing	Flowing	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen
MS-106d	11.71	252.28	Flowing	Flowing	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen

Notes:
"-" denotes data unavailable
Ground elevations from Cambium Incorporated

Table D-1
Groundwater Elevations

	Well Depth (mbgl)	Ground Surface Elevation (masl)	1-Mar-2019		2-Apr-2019		6-May-2019		29-May-2019	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
MS-101	7.24	258.25	2.69	255.56	2.37	255.88	1.46	256.79	1.87	256.38
MS-103	7.32	260.45	4.83	255.62	4.70	255.75	3.61	256.84	4.00	256.45
MS-106s	6.06	252.25	Frozen	Frozen	Frozen	Frozen	Flowing	Flowing	Flowing	Flowing
MS-106d	11.71	252.28	Frozen	Frozen	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing

Notes:

"-" denotes data unavailable

Ground elevations from Cambium Incorporated

Table D-1
Groundwater Elevations

	Well Depth (mbgl)	Ground Surface Elevation (masl)	25-Jun-2019		26-Aug-2019		23-Oct-2019		16-Dec-2019	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
MS-101	7.24	258.25	2.19	256.06	-	-	3.18	255.07	2.62	255.63
MS-103	7.32	260.45	4.34	256.11	6.00	254.45	5.36	255.09	4.93	255.52
MS-106s	6.06	252.25	Flowing	Flowing	-	-	Flowing	Flowing	Frozen	Frozen
MS-106d	11.71	252.28	Flowing	Flowing	-	-	Flowing	Flowing	Frozen	Frozen

Notes:

"-" denotes data unavailable

Ground elevations from Cambium Incorporated

Table D-1
Groundwater Elevations

	Well Depth (mbgl)	Ground Surface Elevation (masl)	26-Mar-2020		24-Jun-2020		21-Sep-2020		17-Dec-2020	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
MS-101	7.24	258.25	1.49	256.76	2.27	255.98	-	-	Removed	-
MS-103	7.32	260.45	3.68	256.77	4.24	256.21	4.03	256.42	Removed	-
MS-106s	6.06	252.25	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing	Frozen	Frozen
MS-106d	11.71	252.28	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing

Notes:
"-" denotes data unavailable
Ground elevations from Cambium Incorporated

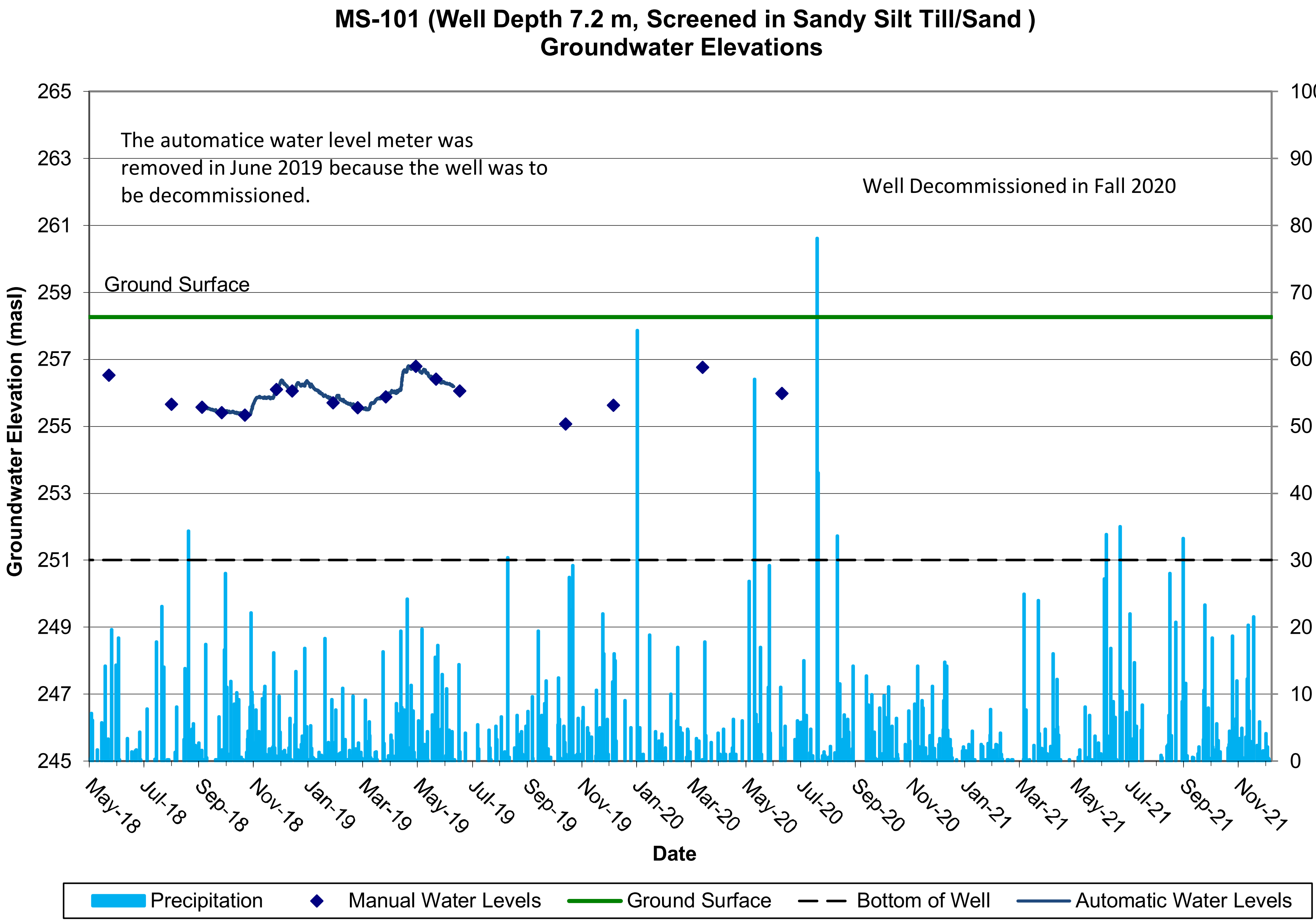
Table D-1
Groundwater Elevations

	Well Depth (mbgl)	Ground Surface Elevation (masl)	1-Apr-2021		24-Aug-2021		14-Dec-2021	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
MS-101	7.24	258.25	Removed	-	Removed	-	Removed	-
MS-103	7.32	260.45	Removed	-	Removed	-	Removed	-
MS-106s	6.06	252.25	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
MS-106d	11.71	252.28	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing

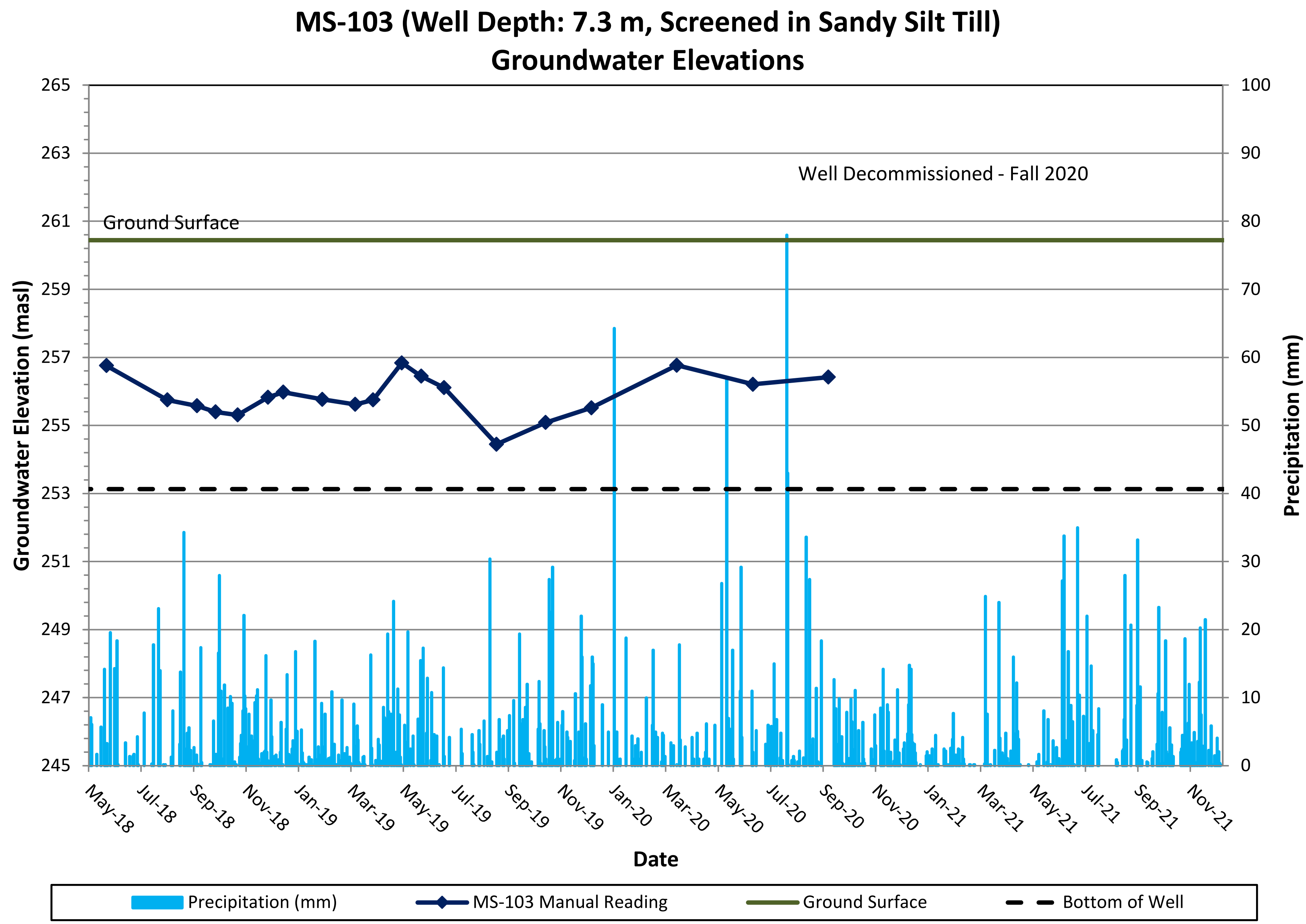
Notes:

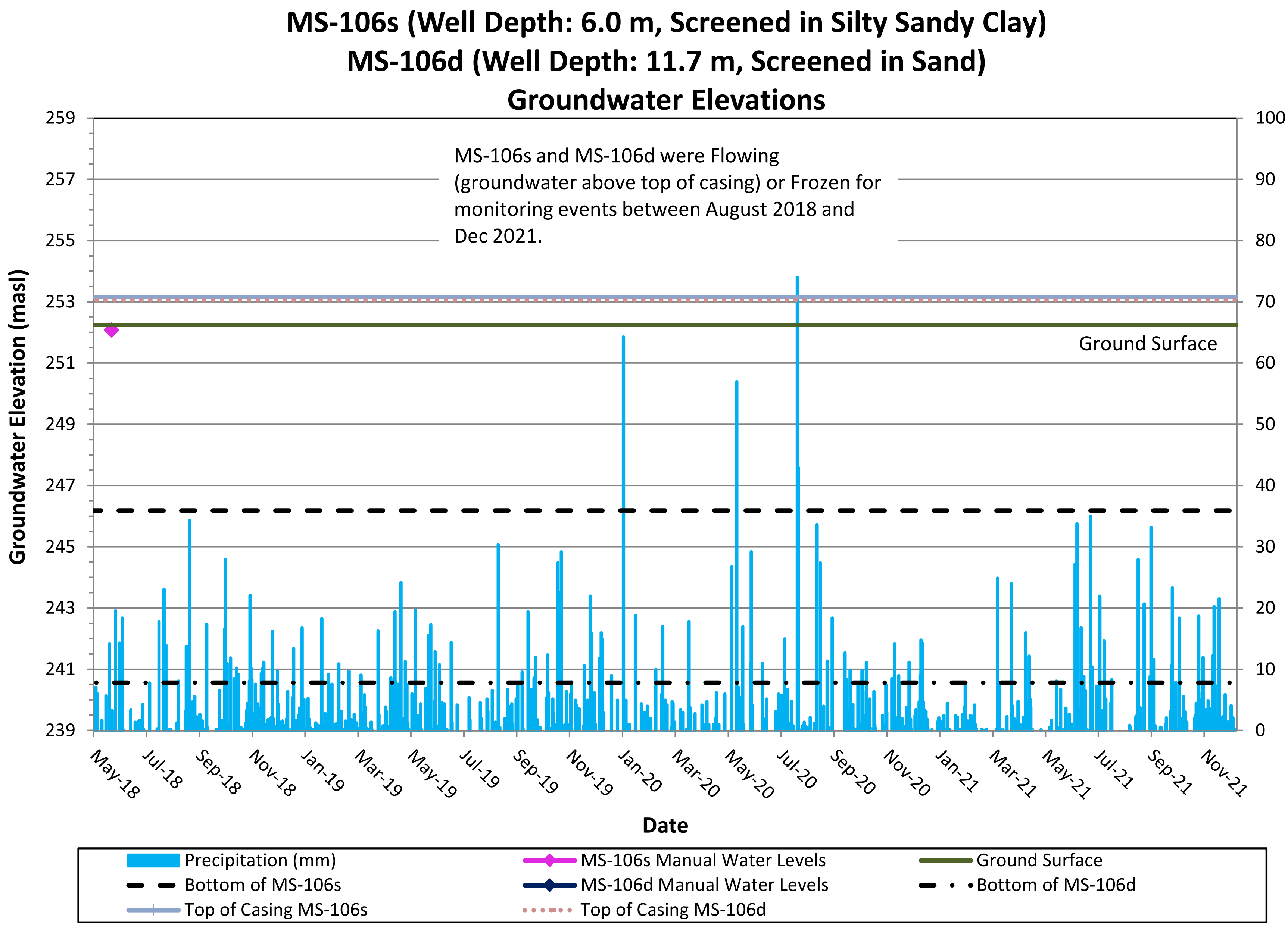
"-" denotes data unavailable

Ground elevations from Cambium Incorporated



MS-101 (Well Depth 7.2 m, Screened in Sandy Silt Till/Sand)
Groundwater Elevations
The automatice water level meter was removed in June 2019 because the well was to be decommissioned.
Well Decommissioned in Fall 2020
Ground Surface
Groundwater Elevation (masl)
Daily Precipitation (mm)
265
263
261
259
257
255
253
251
249
247
245
100
90
80
70
60
50
40
30
20
10
0
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Jan-20
Mar-20
May-20
Jul-20
Sep-20
Nov-20
Jan-21
Mar-21
May-21
Jul-21
Sep-21
Nov-21
Date
Precipitation
Manual Water Levels
Ground Surface
Bottom of Well
Automatic Water Levels


MS-103 (Well Depth: 7.3 m, Screened in Sandy Silt Till)
Groundwater Elevations
Well Decommissioned - Fall 2020
Ground Surface
Groundwater Elevation (masl)
Precipitation (mm)
265
263
261
259
257
255
253
251
249
247
245
100
90
80
70
60
50
40
30
20
10
0
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Jan-20
Mar-20
May-20
Jul-20
Sep-20
Nov-20
Jan-21
Mar-21
May-21
Jul-21
Sep-21
Nov-21
Date
Precipitation (mm)
MS-103 Manual Reading
Ground Surface
Bottom of Well


MS-106s (Well Depth: 6.0 m, Screened in Silty Sandy Clay)
MS-106d (Well Depth: 11.7 m, Screened in Sand)
Groundwater Elevations
MS-106s and MS-106d were Flowing (groundwater above top of casing) or Frozen for monitoring events between August 2018 and Dec 2021.
Ground Surface
Groundwater Elevation (masl)
Daily Precipitation (mm)
Date
259
257
255
253
251
249
247
245
243
241
239
100
90
80
70
60
50
40
30
20
10
0
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Jan-20
Mar-20
May-20
Jul-20
Sep-20
Nov-20
Jan-21
Mar-21
May-21
Jul-21
Sep-21
Nov-21
Precipitation (mm)
MS-106s Manual Water Levels
Ground Surface
Bottom of MS-106s
MS-106d Manual Water Levels
Bottom of MS-106d
Top of Casing MS-106s
Top of Casing MS-106d

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Appendix E

Appendix E

Water Quality

Table E-1
Groundwater Quality

Monitoring Well				MS-103
Date Sampled				**6-May-19**
Parameter	**Unit**	**RDL**	**PWQO**	
Electrical Conductivity	µS/cm	2		536
pH	pH Units	NA	(6.5-8.5)	7.79
Saturation pH				7.23
Langelier Index				0.56
Total Hardness (as CaCO3)	mg/L	0.5		239
Total Dissolved Solids	mg/L	20		306
Alkalinity (as CaCO3)	mg/L	5		179
Bicarbonate (as CaCO3)	mg/L	5		179
Carbonate (as CaCO3)	mg/L	5		<5
Hydroxide (as CaCO3)	mg/L	5		<5
Fluoride	mg/L	0.05		<0.05
Chloride	mg/L	0.10		18
Nitrate as N	mg/L	0.05		1.75
Nitrite as N	mg/L	0.05		<0.05
Bromide	mg/L	0.05		<0.05
Sulphate	mg/L	0.10		10.3
Ortho Phosphate as P	mg/L	0.10		<0.10
Ammonia as N	mg/L	0.02		<0.02
Total Phosphorus	mg/L	0.02	0.03	0.03
Total Organic Carbon	mg/L	1.0		4.8
Colour	TCU	5		<5
Turbidity	NTU	15		26400
Calcium	mg/L	0.05		85.5
Magnesium	mg/L	0.05		6.24
Sodium	mg/L	0.05		7.52
Potassium	mg/L	0.05		0.83
Aluminum (Dissolved)	mg/L	0.004	0.075	0.007
Antimony	mg/L	0.003		<0.003
Arsenic	mg/L	0.003	1	<0.003
Barium	mg/L	0.002		0.023
Beryllium	mg/L	0.001		<0.001
Boron	mg/L	0.010	2	<0.010
Cadmium	mg/L	0.001	0.0002	<0.001
Chromium	mg/L	0.003	0.009	<0.003
Cobalt	mg/L	0.001		<0.001
Copper	mg/L	0.003	0.005	<0.003
Iron	mg/L	0.010	0.3	<0.010
Lead	mg/L	0.001	0.001	<0.001
Manganese	mg/L	0.002		<0.002
Mercury (Dissolved)	mg/L	0.0001	0.0002	<0.0001
Molybdenum	mg/L	0.002	0.04	<0.002
Nickel	mg/L	0.003	0.025	<0.003
Selenium	mg/L	0.004	0.01	<0.004
Silver	mg/L	0.002	<0.002	<0.002
Strontium	mg/L	0.005		0.161
Thallium	mg/L	0.006	0.0003	<0.006
Tin	mg/L	0.002		<0.002
Titanium	mg/L	0.002		<0.002
Tungsten	mg/L	0.010		<0.010
Uranium	mg/L	0.002	0.005	<0.002
Vanadium	mg/L	0.002		<0.002
Zinc	mg/L	0.005	0.03	<0.005
Zirconium	mg/L	0.004		<0.004
% Difference/ Ion Balance	%	NA		7.4

RDL - Reported Detection Limit

PWQS - Provincial Water Quality Standards

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Appendix F

Water Balance

WATER BALANCE CALCULATIONS
Mapleview South - Block 193
Mapleview South (Innisfil) Ltd.
Barrie, ON
PROJECT No.300042309

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TABLE F-1

Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 150 mm (moderately-rooted vegetation in sandy loam soils)

Precipitation data from Barrie WPCC Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	**6.9**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	**36.8**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	**499**
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	**933**
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	**340**
Change in Soil Moisture Storage	0	0	0	0	0	-29	-57	-27	17	39	58	0	**0**
Soil Moisture Storage max 150 mm	150	150	150	150	150	121	64	37	53	92	150	150	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
Soil Moisture Deficit max 150 mm	0	0	0	0	0	29	86	113	97	58	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	22	74	**340**
Potential Infiltration (based on MOE methodology*; independent of temperature)	50	37	35	20	5	0	0	0	0	0	13	44	**204**
Potential Direct Surface Water Runoff (independent of temperature)	33	25	23	13	3	0	0	0	0	0	9	29	**136**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 150 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - hilly land (avg slope ~ 5%)	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - combinations of sandy loam and loam	0.4	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - predominantly cultivated land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.6**	

Latitude of site (or climate station) 44 °N.

WATER BALANCE CALCULATIONS
Mapleview South - Block 193
Mapleview South (Innisfil) Ltd.
Barrie, ON
PROJECT No.300042309

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TABLE F-2

Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 75 mm (urban lawn in sandy loam soils)

Precipitation data from Barrie WPCC Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	**6.9**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	**36.8**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	**499**
Adjusting Factor for U (Latitude 44^{o} 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	**933**
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	**340**
Change in Soil Moisture Storage	0	0	0	0	0	-29	-46	0	17	39	19	0	**0**
Soil Moisture Storage max 75 mm	75	75	75	75	75	46	0	0	17	56	75	75	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	123	90	77	38	9	0	**555**
Soil Moisture Deficit max 75 mm	0	0	0	0	0	29	75	75	58	19	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	60	74	**378**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	54	40	38	22	5	0	0	0	0	0	39	48	**246**
Potential Direct Surface Water Runoff (independent of temperature)	29	22	20	12	3	0	0	0	0	0	21	26	**132**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 75 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - hilly land (avg slope ~ 5%)	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - combinations of sandy loam and loam	0.4	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawn	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.65**	

Latitude of site (or climate station) 44 ^{O} N.

WATER BALANCE CALCULATIONS
Mapleview South - Block 193
Mapleview South (Innisfil) Ltd.
Barrie, ON
PROJECT No.300042309

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TABLE F-3

Water Balance for Pre- and Post-Development Land Use Conditions (with no SWM/LID measures in place)
Site Plan Block 193

Land Use Description	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Pre-Development Land Use												
Open Space /Agricultural	4,620	0.00	0	0.793	0	4,620	0.136	628	0.204	942	628	942
Rural Residential	1,680	0.25	420	0.793	333	1,260	0.132	167	0.246	310	500	310
TOTAL PRE-DEVELOPMENT	**6,300**		**420**		**333**	**5,880**		**795**		**1,251**	**1,127**	**1,251**
Post-Development Land Use (with no LID measures in place)												
Buildings	1,800	1.00	1,800	0.793	1,427	0	0.132	0	0.246	0	1,427	0
Pavement	3,000	1.00	3,000	0.793	2,379	0	0.132	0	0.246	0	2,379	0
Landscaped	1,400	0.00	0	0.793	0	1,400	0.132	185	0.246	344	185	344
Landscaped with Underground Parking	100	1.00	100	0.793	79	0	0.132	0	0.246	0	79	0
TOTAL POST-DEVELOPMENT	**6,300**		**4,900**		**3,886**	**1,400**		**185**		**344**	**4,071**	**344**
% Change from Pre to Post											361	73
Effect of development (with no mitigation)											3.6 times increase in runoff	73% reduction of infiltration

* data provided by Jones Consulting Group Ltd.
** figures from Tables F-1 and F-2

To balance pre- to post-,
the infiltration target (m^3/a)= **907**

WATER BALANCE CALCULATIONS
Mapleview South - Block 193
Mapleview South (Innisfil) Ltd.
Barrie, ON
PROJECT No.300042309

BURNSIDE

TABLE F-4

Water Balance Mitigation Strategy Direct Runoff to Infiltration Facility					
Total Area (m^2)	Total Annual Precipitation (m)*	Runoff Volume from Impervious Area (m^3/a)***	Runoff Volume from Pervious Area (m^3/a)***	Total Runoff Volume (m^3/a)	Potential Infiltration (m^3/a) in Facility (assume 72% capture of annual runoff volume)**
6,300	0.933	3,886	185	4,071	2,931

* values from Barrie WPCC climate station

** based on data Lake Simcoe Watershed Precipitation Frequency

*** figures from Table F-3

Infiltration gallery - will accommodate up to a 25 mm storm; 25 mm storms account for 95% of total rainfall** (72% of total precipitation); therefore 72% of annual runoff from site will be captured for infiltration.

R.J. Burnside & Associates Limited