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FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

Georgian Court Estates Subdivision

City of Burlington

Regional Municipality of Halton

Prepared for

bcIMC Realty Corporation

Project #: 16-518

First Submission: September 2017

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1. Introduction

This report provides functional servicing design and stormwater management information in support of the proposed Draft Plan of Subdivision for the Georgian Court property in the City of Burlington, Regional Municipality of Halton. The servicing and development concept presented in this report are an extension of the information contained in the following reports:

- Report on Geotechnical Investigation (January 2017) by WSP Canada Inc.
- Hydrogeological Investigation Report (January 2017) by WSP Canada Inc.
- Watermain Hydraulic Modelling (June 2017) by WSP Canada Inc.
- Water Balance Draft Memo (July 2017) by WSP Canada Inc.

This report is also applicable for any future revisions to the Draft Plan, assuming the revisions are in general conformance with the servicing and stormwater management concepts outlined herein. The design information presented in this report considers the following guidelines:

- City of Burlington Engineering Standard Drawings Manual
- Regional Municipality of Halton Water and Wastewater Linear Design Manual
- Stormwater Management Planning and Design Manual

1.1 Subject Site

The subject property is approximately 8.4 Hectares in size and is located in the City of Burlington. The existing site is composed of low-rise rental residential units and private outdoor amenity spaces. The site is located on the north-eastern side of King Road, approximately 500 meters west of the Queen Elizabeth Way and 300 meters south of Plains Rd. East in the City of Burlington, Regional Municipality of Halton (Refer to **Figure 1 – Site Location Plan**). The site is bounded by King Road to the west, Marley Road to the south, Surrey Lane to the north, and the Francis Road Bikeway/Greenway to the east. The legal description of the site is Lots 1, 2 and part of Lot 3, Registrar's Compiled Plan 1302, Geographic Township of East Flamborough, City of Burlington.

The proposed development includes eleven blocks and a new public right of way. The blocks are a mixture of medium and high density residential rentals and park blocks (Refer to **Figure 2 – Proposed Draft Plan**). The proposed development includes approximately 200 townhouse units and 1250 apartment units, along with amenity spaces, surface and underground parking spaces and public parks. The proposed 20m right-of-way (ROW) will connect Surrey Lane to Marley Road. This ROW will be in accordance with the City of Burlington's Standard S-20). In addition, a public easement will be proposed to provide for municipal services.

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2. Background Information

2.1 Site Topography

The majority of the site is composed of existing residential development associated amenity space and parking lots. There is transitional grading between existing blocks, and retaining walls between various existing parcels. The site generally falls from northwest to southeast with a maximum grade change of approximately 5m. The average slope from King Road to the Greenway is approximately 1%.

2.2 Soil Conditions

The findings of the Geotechnical Report (January 2017) prepared by WSP Canada Inc. indicates that the soil stratigraphy at the subject site generally consists of a surface layer of topsoil/asphaltic concrete/fill material ranging in thickness from 200mm to 600mm except on the east edge of the site where the fill depths extend up to 2.3m below existing ground level. Below the surface layer, the site is underlain by a layer of cohesionless deposits (sand to silty sand), clayey deposits, glacial till deposits, till shale complex and shale bedrock. Inferred bedrock elevations were encountered at depths of 11m to 15.2m below existing ground surfaces.

The geotechnical report indicates that methane gas is anticipated in the bedrock. Suitable care is required for all confined bedrock excavations. Please refer to **Appendix D** for further information.

2.3 Francis Road Bikeway/Greenway

Directly east of the site there is a linear park/greenway including a pedestrian pathway, which is presumably the remnant watercourse / valley system associated with Indian Creek. There is a Conservation Halton (CH) Regulated Area associated with Indian Creek in this area as shown on Drawing FM-1. The existing Regional floodplain is based on the Conservation Halton HEC-2 model results. Refer to **Section 3** for further details.

2.4 Groundwater Elevations

The findings of the Hydrogeology Investigation indicate that the groundwater elevation at the site is highest in the north and east (91.0m) and falls off to the south and west (86.7m). Groundwater was encountered at elevations between 0.2m and 4.5m below existing ground. For further details please refer **Appendix E** for the Hydrogeological Investigation.

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3. Floodplain Mapping

3.1 Existing Floodplain Mapping

Indian Creek is a highly modified system in the vicinity of the subject lands. The creek was historically enclosed in an existing box culvert beneath the Francis Road Greenway which was constructed from north of Plains Road to south of Marley Road / east of Francis Road to convey Indian Creek. This culvert has insufficient capacity to convey the entire Regional flow, therefore the Greenway acts as an overland flow route when the water levels overtop the median at Plains Road. Please refer to the City drawings in **Appendix C** which illustrate the box culvert plan & profile.

The flood elevations provided by CH based on their HEC-2 model results have been plotted on the existing topography for the site and surrounding area. A 7.5m buffer is applicable to this floodplain. Please refer to the existing flood mapping and setbacks shown on **Drawing FM-1**.

A number of existing buildings along Warwick Drive are currently within the setback of the existing floodplain but are outside the floodplain itself.

A review and sensitivity analysis of the flows and model geometry indicated that the water levels in the vicinity of the subject lands are largely governed by the overtopping elevation at the various roads crossing the floodplain (i.e. Marley Road, Surrey Lane, Plains Road, etc.), but are also sensitive to the conveyance area of the cross-sections. There are no culvert crossings beneath the Marley Drive or Surrey Lane roads, therefore the water levels back up at each crossing (i.e., the crossings act as dams / barriers to flow and are responsible for the elevated flood levels along the site). There are some existing catchbasins connected to the box culvert beneath the Greenway which serve to drain the floodplain area as there are no other surface / overland flow outlets.

3.2 Proposed Floodplain Mapping

As shown on **Drawing FM-1**, a portion of the subject lands is within the existing floodplain and setback area. It is understood that CH policies do not permit new buildings with higher unit counts / area within the floodplain, but that surface parking / underground parking structures may be permitted provided that all openings are situated a minimum of 0.30m above the floodplain elevation.

In order to achieve the target densities, building configuration, connectivity to the Francis Road Greenway and overall vision for the subject lands, several development blocks are proposed adjacent to east property line, upon which the existing floodplain encroaches. In order to support the proposed development concept, it is proposed to "straighten" / realign the floodplain such that a 7.5m setback can be achieved from all

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proposed buildings. This generally limits the Regional floodplain to the edge of the property as shown on Drawing FM-2. In order to achieve this floodplain modification, the site will be filled along the east edge of the property such that the elevation of the property line matches or exceeds the Regional flood elevation, and an additional 0.3m freeboard is gained across the 7.5m setback. The proposed fill / flood protection measure is not considered to be a berm, as a large portion of the site will be raised above the flood elevation.

In order to limit the floodplain to the eastern property line, minimal transition grading is required within the Greenway area. This grading reduces the conveyance capacity of the Greenway; therefore the post-development flood elevations increase slightly along the subject lands (from Marley Road to Surrey Lane). However, there are no impacts to water levels upstream or downstream of the site and no buildings are impacted by the slight increases in water levels. To further mitigate the loss of conveyance capacity, a portion of the site near Marley Road is proposed to have short retaining walls to avoid narrowing the Greenway at the downstream end, which would have a bottle-neck effect on the backwater.

Table 3-1:
Existing and Proposed Water Levels

HEC-RAS Model Cross-Section	Existing Regional Water Level	Proposed Water Level	Difference (Proposed-Existing)	# Buildings within existing floodplain + setback	# Buildings within proposed floodplain + setback
2200	92.26	92.25	-0.01	7	5
2182	91.54	91.57	0.03		
2082	91.15	91.22	0.07		
2013	90.74	90.94	0.2		
1941	90.13	90.16	0.03		
1859	89.72	89.89	0.17		
1824	89.42	89.39	-0.03		
1804	89.35	89.33	-0.02		
1784	89.33	89.32	-0.01		

The resulting floodplain limit shifts the flood hazard away from the subject lands such that a 7.5m buffer can be achieved from all buildings. This is an improvement over existing conditions.

The proposed grading requires placement of fill in the Regional floodplain, which results in a loss of floodplain storage of approximately 400m^3 during the Regional event. Compared to the overall floodplain volume (>165,000m^3), this minor reduction of 0.2% is not expected to result in changes to peak flow routing in the system. It is recognized that CH generally requires a balanced cut/fill approach with respect to filling for the

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purposes of maintaining floodplain storage, which can be achieved in the Greenway area. The following table compares the existing and proposed flood storage for the entire channel and subject lands.

Table 3-2:
Flood Storage Comparison

Design Event (as per CH HEC-2 model)	Existing (Entire Channel) [m³]	Existing (site) [m³] XS 1824 - 02182	Proposed (Entire channel) [m³]	Proposed (site) [m³] XS 1824 - 02182	Difference in Total Storage (Existing minus Proposed [m³]	[%]
PF1	36,620	3,400	36,610	3,400	-	0.00%
PF2	49,110	4,730	49,120	4,760	(30)	-0.06%
PF3	57,690	5,720	57,700	5,760	(40)	-0.07%
PF4	69,900	7,160	69,880	7,170	(10)	-0.01%
PF5	82,020	9,040	81,950	9,010	30	0.04%
PF6	92,650	10,510	92,500	10,420	90	0.10%
PF7 (Regional)	165,620	16,010	165,110	15,610	400	0.24%

Please refer to the hydraulic analysis results in **Appendix H**.

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4. Storm Drainage

4.1 Existing Drainage

Currently the site is serviced for minor system drainage by private storm sewers connecting to existing municipal storm sewers within the surrounding road network. The existing sewers range in size from 375mm to 750mm in size. The major system generally flows to the east, to the existing right of ways. The existing roads convey flows to the south east corner of the subject lands for discharge to the existing green space. Major system drainage for the lands directly backing onto the existing green space flows to the east (Refer to Drawing STM-1).

The existing drainage system / pipe capacity was evaluated using the Rational Method / storm sewer design sheets, with conservative estimates for the contributing external areas and runoff coefficients. The existing capacity was evaluated to ensure that existing flows are not exceeded under post-development conditions. Please refer to **Appendix A** for details.

4.2 Imperviousness

Existing and proposed site imperviousness are provided in **Table 4.1 and Table 4.2**. Although the existing site imperviousness is 50% the city has requested that all development areas utilize 43% imperviousness

Table 4-1:
Existing Site Imperviousness

Existing Conditions						
	Catchment	**Land use**	**Pervious Area (ha)**	**Impervious Area (ha)**	**Total area (ha)**	**Cumulative Internal % IMP**
	All	Internal Residential Area	0.42	0.43	0.85	50

Table 4-2:
Proposed Site Imperviousness

Proposed Conditions

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Outlet	Catchment	Land use	Pervious Area (ha)	Impervious Area (ha)	Total area (ha)	%IMP	Cumulative %IMP
A	A-1, A-2	Townhouses	0.21	0.34	0.55	62	68
	A-7	Townhouses	0.08	0.09	0.17	55	
	Ext. 1 to Ext. 6, Ext. 11, Ext. 12	High Rise/Townhouse Mix	2.95	2.32	5.27	44	
	A-3 to A-5	ROW	0.14	0.21	0.35	59	
	A-6	Townhouses/Easement	0.03	0.21	0.24	89	
B	B-1, B-2	Townhouses	0.53	0.89	1.41	63	63
	Ext. 13	ROW	0.06	0.09	0.15	59	
C	Ext. 14 to Ext. 16	ROW	0.25	0.37	0.62	59	54
	C-1 to C-7	High Rise/Townhouse Mix	0.79	0.98	1.77	55	
	C-9, C-10	Townhouses	0.14	0.12	0.26	47	
D	Ext. 17 to Ext. 20	ROW/Townhouses	0.12	0.43	0.55	79	35
	D-1	Park	0.52	0.00	0.52	0	
	D-5	High Rise	0.19	0.35	0.54	66	
	D-8	High Rise	0.17	0.40	0.57	71	
	D-2, D-3, D-4, D-6	ROW	0.15	0.21	0.36	59	
	D-7	Townhouses	0.19	0.04	0.06	68	
E	Ext. 7 to Ext. 10	High Rise	1.23	4.63	5.86	79	77
	E-8	High Rise	0.15	0.59	0.74	80	
	E-5, E-6	High Rise	0.48	0.64	1.02	57	
	E-1 to E-4, E-7	ROW	0.35	0.50	0.85	59	
F	F-1	Park	0.42	0.00	0.42	0	0
Total	Total		9.13	13.43	22.28	60	56

4.3 Proposed Minor System Drainage

In general, the storm drainage and grading concept for the site has been designed to maintain the direction of flows in keeping with the existing development and to utilize the existing infrastructure where possible. Post-development drainage boundaries and grading has been designed to maintain existing drainage patterns.

New municipal storm sewers will be constructed within the proposed 20m ROW. In addition, the existing storm sewer within the west portion of the site will be relocated slightly to the west and reconstructed in a proposed municipal easement to accommodate the proposed development layout.

Refer to the storm sewer design sheet in **Appendix A**.

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Refer to **Drawing STM-2** for details of the existing and proposed municipal storm sewer network.

4.4 Major System Drainage

Major system flows (for storms in excess of the 5-year storm) will be controlled on individual blocks. Major system flows for the existing roads within the site will continue to drain as in existing conditions. The proposed ROW will be directed south to the existing Marley Road ROW. Emergency flows (for storms exceeding the 100-year or in the event of a failure in the site plan SWM controls) are directed onto the proposed and existing right-of-ways. Ultimately, major system and emergency flows are conveyed to the existing green space to the east of the proposed development.

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5. Stormwater Management

5.1 Stormwater Management Strategy

The proposed SWM strategy will consist of on-site surface and subsurface storage for quantity control and will rely on low-impact development solutions to provide a treatment train approach for quality control.

As per the City of Burlington recommendations provided in the pre-consultation meeting, stormwater controls within the subject lands are required to such that a 100-year storm under post-development conditions will be controlled to a discharge rate equal to or less than the discharge of a 5-year storm under existing conditions. The existing imperviousness is to be considered at a maximum of 43%, which is consistent with a runoff coefficient of approximately 0.50.

In order to meet this requirement, four Visual OTTHYMO 5.0 (VO5) scenarios were created using City of Burlington IDF criteria and 24hr Chicago storms.

Scenario 1: Existing Conditions – Peak flows from 24hr Chicago storms on all catchments. Results shown in **Table 5-1.**

Scenario 2: Proposed Conditions – Uncontrolled peak flows from 24hr Chicago storms on all catchments. Results shown in **Table 5-2.**

Scenario 3: Proposed Conditions - Controlled peak flows from 24hr Chicago storms on all catchments. Results shown in **Table 5-3.**

Scenario 4: Proposed Conditions – Controlled peak flow rates using a 100-year storm on internal catchments and a 5-year storm on external catchments. This scenario demonstrates that the 100-year flow from the site plan areas can be controlled to the 5-year targets / existing flows at the system outlets. Results shown in **Table 5-4.**

Scenario 4 is used to illustrate that the controlled discharge from a 100-year storm on the subject lands yields a discharge at each outlet that is equal to or less than the existing discharge from the subject lands during a 5-year storm as shown in **Scenario 1**.

In order to compare these scenarios, six outlet points were identified along the existing storm sewers surrounding the site. These outlets receive drainage from the corresponding areas identified on **STM1** and **STM2**.

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Four of the outlets (Outlets A through D) are in series, accumulating drainage from the previous outlet as well as from additional internal and external areas. Outlet D conveys drainage into the Indian Creek Storm Sewer at the eastern end of Marley Road and includes all the drainage from Outlets A, B, and C. Outlet E picks up drainage from the north-eastern portion of the site and conveys drainage to the Indian Creek Storm Sewer at the eastern end of Warwick Drive. Outlet F drains to the Indian Creek Storm Sewer through existing laterals.

The large subcatchments external to the subject lands pass through the development area and contribute drainage upstream of Outlet A and Outlet E. These external subcatchments make it difficult to directly compare 100-year proposed flows to 5-year existing flows at the outlets (i.e., the site cannot be modelled simply as a single catchment, providing control to a single target flow). Designing peak flows from a 100-year storm on **Scenario 3** to match 5-year flows from **Scenario 1** would require significant control of external areas.

In order to account for uncontrolled drainage areas in the proposed site, the discharge rates from the controlled areas were over-controlled until the final proposed flow rates at the outlets in **Scenario 4** were equal to or less than the existing 5-year flow rates at the outlets in **Scenario 1**. The results of this comparison are described in **Table 5-4**. This comparison illustrates that with 100-year storm flows on all proposed internal catchments, the flow at each outlet can be made equal to or less than the 5-year flow during existing conditions. The VO5 simulation results can be found in **Appendix H**

The allowable discharge rates determined by this analysis were used as the discharge rates for the VO5 rating curves in the ROUTE RESERVOIR command in the proposed controlled scenario (**Scenario 3**). These results are shown in **Table 5-3**.

5.2 Quantity Control

As noted in the preceding section, the City has requested that quantity control be provided on the development blocks. Post development 100-year flows are to be controlled to 5-year flows at 43% Imperviousness. The proposed public park blocks will not require quantity control. Refer to Appendix A and Drawing STM-2 for further details.

Quantity control targets were established using the calculations and assumptions outlined above. A summary of target release rates and required storage is provided in Table 5-6.

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Table 5-1:
Scenario 1 – Existing Drainage Areas and Outlet Flows

		Drainage Area [ha]			Existing Flows [m^3/s]		
Outlet	**Location**	**Site Drainage Area (internal)**	**External Drainage Area**	**Total Drainage Area**	**2-year**	**5-year**	**100-year**
A	675mm Pipe at MH 13 on Marley Road. AddHYD-7 in VO5.	2.09	5.27	7.36	0.565	0.842	1.793
B	750mm Pipe at MH 12 on Marley Road. AddHYD-14 in VO5.		0.15	7.51	0.581	0.866	1.837
C	750mm Pipe at MH 10 on Marley Road. AddHYD-15 in VO5.	2.21	0.62	10.34	0.811	1.197	2.544
D	750mm Pipe at MH 2 on Marley Road. AddHYD-16 in VO5.	1.69	0.55	12.58	1.026	1.498	3.154
E	525mm Pipe at MH 25 on Warciwck Drive. AddHYD-23 in VO5.	1.9	5.86	7.76	0.822	1.252	2.316
F	Indian Creek Storm Trunk Sewer	1.99		1.99	0.160	0.230	0.489
Total		9.88	12.45	22.33			

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Table 5-2:
Scenario 2 - Proposed Uncontrolled Drainage Areas and Outlet Flows

		Drainage Area [ha]			Proposed Flows [m^3/s]		
Outlet	**Location**	**Site Drainage Area (internal)**	**External Drainage Area**	**Total Drainage Area**	**2-year**	**5-year**	**100-year**
A	675mm Pipe at MH 13 on Marley Road. AddHYD-7 in VO5.	1.31	5.27	6.58	0.523	0.795	1.643
B	750mm Pipe at MH 12 on Marley Road. AddHYD-14 in VO5.	1.41	0.15	8.14	0.644	1.013	2.059
C	750mm Pipe at MH 10 on Marley Road. AddHYD-15 in VO5.	2.6	0.62	11.36	0.870	1.341	2.759
D	750mm Pipe at MH 2 on Marley Road. AddHYD-16 in VO5.	1.48	0.55	13.39	1.114	1.701	3.465
E	525mm Pipe at MH 25 on Warciwck Drive. AddHYD-23 in VO5.	2.67	5.86	8.53	0.968	1.453	2.622
F	Indian Creek Storm Trunk Sewer	0.42		0.42	0.024	0.035	0.086
Total		9.89	12.45	22.34			

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Table 5-3:
Scenario 3 - Proposed Controlled Drainage Areas and Outlet Flows

		Drainage Area [ha]			Proposed Flows [m^3/s]		
Outlet	**Location**	**Site Drainage Area (internal)**	**External Drainage Area**	**Total Drainage Area**	**2-year**	**5-year**	**100-year**
A	675mm Pipe at MH 13 on Marley Road. AddHYD-7 in VO5.	1.31	5.27	6.58	0.490	0.738	1.535
B	750mm Pipe at MH 12 on Marley Road. AddHYD-14 in VO5.	1.41	0.15	8.14	0.514	0.775	1.605
C	750mm Pipe at MH 10 on Marley Road. AddHYD-15 in VO5.	2.03	0.62	10.79	0.654	0.979	2.015
D	750mm Pipe at MH 2 on Marley Road. AddHYD-16 in VO5.	2.05	0.55	13.39	0.820	1.205	2.451
E	525mm Pipe at MH 25 on Warciwck Drive. AddHYD-23 in VO5.	2.67	5.86	8.53	0.806	1.213	2.171
F	Indian Creek Storm Trunk Sewer	0.42		0.42	0.024	0.035	0.086
Total		9.89	12.45	22.34			

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Table 5-4:
Scenario 1 vs. Scenario 4 - Drainage Areas and Outlet Flows

		Existing Conditions (Simulation 1)				Proposed Conditions (Simulation 4)			
Outlet	**Location**	**Internal Drainage Area [ha]**	**Total Drainage Area [ha]**	**Outlet Flow [m^3/s]**		**Internal Drainage Area [ha]**	**Total Drainage Area [ha]**	**Outlet Flow [m^3/s]**	
A	675mm Pipe at MH 13 on Marley Road. AddHYD-7 in VO5.	2.09	7.36	5-year	0.842	1.31	6.58	100-year internal 5-year external	0.815
B	750mm Pipe at MH 12 on Marley Road. AddHYD-14 in VO5.	N/A	7.51	5-year	0.866	1.41	8.14	100-year internal 5-year external	0.865
C	750mm Pipe at MH 10 on Marley Road. AddHYD-15 in VO5.	2.21	10.34	5-year	1.197	2.03	10.79	100-year internal 5-year external	1.189
D	750mm Pipe at MH 2 on Marley Road. AddHYD-16 in VO5.	1.69	12.58	5-year	1.498	2.05	13.39	100-year internal 5-year external	1.495
E	525mm Pipe at	1.9	7.76	5-year	1.252	2.67	8.53	100-year	1.252

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	MH 25 on Warciwck Drive. AddHYD-23 in VO5.							internal 5-year external	
F	Indian Creek Storm Trunk Sewer	1.99	1.99	5-year	0.230	0.42	0.42	100-year internal 5-year external	0.035
Total		9.88	22.33			9.89	22.34		

A comparison of the flows at each outlet under existing and proposed conditions is shown in **Table 5.5** below. **Table 5.5** compares Simulation 1 with Simulation 3 and shows that with the quantity controls suggested in this report the post-development peak flows at each outlet during 2-year, 5-year, and 100-year storms are lower than under existing conditions.

Table 5-5:
Summary of Flows – Proposed vs. Existing

		Existing Conditions				Proposed Conditions			
Outlet	**Location**	**Site Drainage Area (internal) [ha]**	**Total Drainage Area [ha]**	**Outlet Flow [m^3/s]**		**Site Drainage Area (internal) [ha]**	**Total Drainage Area [ha]**	**Outlet Flow [m^3/s]**	
A	675mm Pipe at MH 13 on Marley Road. AddHYD-7 in VO5.	2.09	7.36	2-year	0.565	1.31	6.58	2-year	0.490
				5-year	0.842			5-year	0.738
				100-year	1.793			100-year	1.535
B	750mm Pipe at		7.51	2-year	0.581	1.41	8.14	2-year	0.514

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	MH 12 on Marley Road. AddHYD-14 in VO5.			5-year	0.866			5-year	0.775
				100-year	1.837			100-year	1.605
C	750mm Pipe at MH 10 on Marley Road. AddHYD-15 in VO5.	2.21	10.34	2-year	0.811	2.03	10.79	2-year	0.654
				5-year	1.197			5-year	0.979
				100-year	2.544			100-year	2.015
D	750mm Pipe at MH 2 on Marley Road. AddHYD-16 in VO5.	1.69	12.58	2-year	1.026	2.05	13.39	2-year	0.820
				5-year	1.498			5-year	1.205
				100-year	3.154			100-year	2.451
E	525mm Pipe at MH 25 on Warwick Drive. AddHYD-23 in VO5.	1.9	7.76	2-year	0.822	2.67	8.53	2-year	0.806
				5-year	1.252			5-year	1.213
				100-year	2.316			100-year	2.171
F	Indian Creek Storm Trunk Sewer	1.99	1.99	2-year	0.160	0.42	0.42	2-year	0.024
				5-year	0.230			5-year	0.035
				100-year	0.489			100-year	0.086
Total		9.88	22.33			9.89	22.34		

Table 5-6:

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Summary of Required Release Rates and Storage

Proposed Conditions						
Drainage Outlet	**Catchments**	**Land use**	**Total Area [ha]**	**%IMP**	**Target Discharge [m^3/s]**	**Storage Required [m^3]**
A	A-1, A-2	Townhouses	0.55	43	0.0700	103
	A-7	Townhouses	0.17	43	-	-
	Ext. 1 to Ext. 6, Ext. 11, Ext. 12	High Rise/Townhouse Mix	5.27	44	-	-
	A-3 to A-5	ROW	0.35	59	-	-
	A-6	Townhouses/Easement	0.24	43	-	-
B	B-1, B-2	Townhouses	1.41	30	0.0550	527
	Ext. 13	ROW	0.15	59	-	-
C	Ext. 14 to Ext. 16	ROW	0.62	59	-	-
	C-1 to C-7	High Rise/Townhouse Mix	1.77	60	0.2500	260
	C-8, C-9	Townhouses	0.26	30	-	-
D	Ext. 17 to Ext. 20	ROW/Townhouses	0.55	79	-	-
	D-1	Park	0.52	20	-	-
	D-5	High Rise	0.54	43	0.0410	142
	D-2, D-3, D-4, D-6	ROW	0.36	59	-	-
	D-7	Townhouses	0.06	43	-	-
	D-8	High Rise/Townhouse Mix	0.57	0.71	0.0410	180
E	Ext. 7 to Ext. 10	High Rise	5.86	79	-	-
	E-8	High Rise	0.74	79	0.0600	226
	E-5, E-6	High Rise	1.12	79	0.0800	313
	E-1	ROW	0.11	59		
	E-2 to E-4, E-7	ROW	0.7	59	-	-
F	F-1	Park	0.42	20	-	-
	Total		22.34	0		1571

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6. Quality Control, Water Balance and Low Impact Development Measures

6.1 Quantity Control

Based on the pre-consultation meeting, we understand that the MOECC quality control objectives of Enhanced (80%) TSS apply to the subject lands. Quality control will be achieved through a treatment train approach as described below:

Private site plan blocks

- LID measures in Landscaped Areas
- On-site quality controls measures

New and Existing Roads

- Catchbasin Shields on all road CBs
- Tree pits on new roads, where sufficient boulevard width permits

Details will be provided during the site plan approval process regarding LID implementation, however the potential use of LIDs within the site plan areas may be limited due to the urban/high-density nature of the development and the lack of area on the surface / pervious portions of the site available for infiltration (topsoil depths and infiltration opportunities above underground parking structures are limited). LID measures such as rain barrels, tree pits and directing roof leaders to pervious areas are recommended as these do not rely on infiltration as heavily as other methods.

As per the City of Burlington Consultation Meeting, no erosion control is required for the site. However infiltration potential will be investigated at the site plan stage and may provide some erosion control.

6.2 Proposed LID Measures

As shown in **Table 4-1**, the imperviousness of the internal areas of the existing site is 50%. The imperviousness of the proposed site has been calculated to be 56% as shown in **Table 4-2**.

The quality control requirement for the site can be taken as the additional volume of rainfall from a 25mm event due to the sites increased imperviousness. The additional runoff due to this increased imperviousness can be calculated as shown below.

$$56\% - 50\% = 6\%$$

$$25mm * 0.06 = 1.5\ mm$$

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Internal Site Area = 9.88 ha = 98,800 m^2

Additional Volume = 98,800 m^2 * 0.0015 m = 150 m^3

This storage volume may be addressed in the detailed design stage using a combination of the following LID measures.

- Additional 150mm Topsoil (where appropriate)
- Silvacells under proposed trees
- Permeable pavements
- Infiltration trenches
- Filterra

6.3 Water Balance

A water balance memo prepared by WSP Canada Inc. (July 2017) is included in Appendix F. The findings state that as the site is to be redeveloped with similar to existing type of construction footprints, the development is not expected to affect the site water balance conditions significantly. The increase in runoff is approximately 4.2% with an associated 6% increase in imperviousness.

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7. Sanitary Drainage

7.1 Existing Sanitary Drainage

Currently the site is serviced for sanitary drainage by sewers connecting to existing municipal sanitary sewers within the surrounding road network. The existing sewers range in size from 250mm to 375mm in size. Existing flows from the development and adjacent lands are conveyed through these sewers and ultimately end up in the existing 600mm sanitary sewer within Francis Road.

7.2 Proposed Sanitary Drainage

The proposed development will provide a 250mm municipal sanitary sewer within the proposed 20m ROW and a proposed 200mm municipal sanitary sewer within a proposed 6m easement within the western portion of the property. These sanitary sewers are designed to convey to the existing municipal infrastructure.

Wastewater infrastructure will be designed in accordance with the latest Region of Halton standards and specifications as follows:

Wastewater Design Criteria

- Average Dry Weather Flow: 275 litres per capita per day
- Infiltration: 0.286 litres per second per hectare
- Peaking Factor: Section B.2.3 of Halton Standards

Population Criteria

- Equivalent Population Densities Table 2.1 Halton Linear Design Manual

Type of Development	Equivalent Pop Density (Persons/Hectare)
Single Family	55
Semi, duplex, 4-plex	100
Townhouse, 6 Storey Appt. or less	135
Apartments (over 6 storey)	285

Based on the above criteria it has been determined that there is sufficient capacity to service the subject lands.

In addition due to the high densities being proposed on some of the blocks we have reviewed our findings using the above criteria supplemented by the following population criteria:

- High Density Residential Development in Burlington: 1.62 Persons/Unit (Appendix A – Sustainable Halton Water and Wastewater Master Plan, AECOM, September 2011)

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Population Estimates can be found in Appendix A.

This supplemental analysis has determined that even with the higher population estimates for tall buildings, the existing infrastructure has sufficient capacity to service the subject development. There is only one section of sewer within Warwick Drive between MH 55 and 44 that is at 101% capacity.

Flows for the existing 600mm sewers within Francis Road have been calculated from the Region of Halton's InfoSewer model. Info sewer provides an existing flow within the Francis Road sewer directly downstream of where the subject lands contribute as 170.4 L/s. Infosewer indicates that the existing flows connecting from Marley Road are 12.7 L/s. These values were used in the sanitary design sheets.

Prior to re-development of the subject lands the existing 600mm sanitary sewer within Francis Road is at 36% capacity. Post development the sewer is at 43% capacity. The existing sewer in this location will still have over 250 L/s of capacity for future intensification.

Refer to sanitary sewer design sheets in **Appendix A**.

Refer to Drawing **SAN-1** for further details.

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8. Water Distribution

The subject site and all proposed works are within Pressure Zone x of the Region of Halton water distribution system.

WSP Canada Inc. performed a detailed hydraulic analysis and determined that the site can be adequately serviced for fire and domestic supply by a 200mm PVC watermain on the proposed ROW connecting to the existing 300mm watermain on Surrey Lane and the existing 250mm watermain on Marley Road. In addition the existing 150mm watermain within Warwick Drive from Surrey Lane to Marley Road will be replaced with a 200mm watermain. Two streteches of existing 300mm watermain in easements through private property are proposed to be abandoned.

Refer to Drawing **WM-1** for further details.

Refer to Hydraulic Analysis by WSP Canada Inc. in **Appendix E**.

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9. Utilities

Initial discussions have been held with the electrical, telecom and natural gas utilities regarding their existing facilities, and those proposed to service the Georgian Court re-development. A summary of their existing works and proposed servicing arrangements for this development are as follows:

9.1 Burlington Hydro Inc. (BHI)

- Electricity is delivered from a 2.4/4.16 kV distribution network, mainly underground within the subject lands (both on municipal road allowances and blanket easements on private lands), with overhead pole lines at the perimeters on King Road, and on the existing Francis Road Bikeway/greenbelt west of Francis Road;
- Normal operating condition provides electrical supply from an existing Municipal Substation (MS) at #719 Marley Road, at the south-east corner of the subject lands;
- Looped backup supply is also available from an existing switchgear south of Surrey Lane, mid-block in the vicinity of proposed Sunset Road, connected to a separate underground circuit running between the Francis Road Bikeway and King Road (which also supplies the existing apartments at 685/695/705 Surrey Lane);
- Existing system is an older underground network nearing the end of its useful life, not suitable for intensification and/or new development;
- However, there are existing 16.0/27.6 KV circuits along the full length of Francis Road, **suitable for and with sufficient capacity to supply in excess of 1500 dwellings for re-development** within the subject lands;
- a coordinated removal and replacement program, complete with some temporary overhead and/or underground facilities will be required to maintain supply to existing customers during the demolition and reconstruction stages;

Proposed electrical distribution system:

- A new loop-feed underground distribution system will be required, with supply points proposed at Francis Rd./Warwick Dr. and Francis Rd./Marley Rd., with main feeder cables feeding 5 or 6 new switchgears placed strategically on easements within the subject lands;
- New electrical works are proposed largely within existing or proposed municipal road allowances, with some works on temporary or permanent easements as required to maintain or provide service;
- New underground installations, or temporary overhead/underground installations are to be coordinated with other utilities in a joint-use construction arrangement wherever possible;

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- Phase 1 - new underground works (main feeder and switchgear) required on Warwick Dr. & Warwick Crt. from Francis St. (c/w road crossing of Francis);
- relocation of existing primary metering equipment, and a temporary backup supply crossing the Phase 2 park lands will be required prior to commencement of Phase 2;
- Phase 2 - new underground works (main feeder and switchgear) required on Warwick Crt. from Phase 1 through Phase 2, and on Marley Rd. to Francis St. (c/w road crossing of Francis);
- installation of a temporary overhead supply from King Road to the courtyard within existing townhouse blocks, and de-energization and removal of existing switchgear, will be required prior to commencement of Phase 3;
- Phase 3 - new underground works (main feeder and switchgear) required on Surrey Lane, Sunset Rd., and/or underground easement through Phase 3 Park;
- Phase 4 & Phase 5 – from Phase 3, and/or from new underground cables on Private Mews laneway in Phases 4 & 5;
- Phase 6 - from Phases 4 & 5, and/or new underground works (local distribution) required on Private Mews laneway and Surrey Lane;
- municipal consents and road occupancy permits required for reconstruction works within existing road allowances;

9.2 Bell Canada (BC)

Existing communication network:

- Supply is from an underground copper pair network within the subject lands (generally on blanket easements on private lands), with copper pair supply cables buried on King Road, on Francis Road, and on Marley Rd.;
- Normal operating condition provides phone/data/TV service from an existing underground copper pair cable from Francis Rd. at Warwick Dr., and Francis Rd. at Marley Rd., feeding the entire subject lands, as well as the existing apartments at 685/695/705 Surrey Lane and the extension of Warwick Crt. to the north;
- Alternate supply is also available from an existing overhead fibre cable on King Rd., via copper pair cable on Surrey Lane to Warwick Crt.
- **Existing system internal to the subject lands is obsolete by today's standards, and will be replaced by a fibre optic network with larger bandwidth – external capacity enhancements will be required at both east and west perimeters to supply the 1,450 +/- dwellings for re-development**;
- New capacity is available by upgrading fibre optic cables on King Rd. & Francis St.;
- Since Bell generally supplies from the east, and re-development generally proceeds from east to west, new fibre optic cables, and some temporary overhead cables will be required to maintain service to existing buildings;

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- a coordinated removal and replacement program, complete with some temporary overhead and/or underground facilities will be required to maintain supply to existing customers during the demolition and reconstruction stages;

Proposed communication network:

- A fibre-to-the-home (FTTH) underground distribution network will be required, with supply points proposed at Francis Rd./Warwick Dr. and King Rd./Surrey Lane, via fibre optic trunk cables feeding 1 new Central Splitting Point (CSP) located in the boulevard for townhomes, and individual CSP's located in the apartment buildings within the subject lands;
- New phone/data/TV cables & equipment are proposed largely within existing or proposed municipal road allowances, with some works on temporary or permanent easements as required to maintain or provide service;
- New underground installations, or temporary overhead/underground installations are to be coordinated with other utilities in a joint-use construction arrangement wherever possible;
- Phase 1 - new underground works (fibre optic cable and Grade Level Boxes) required on Warwick Dr. & Warwick Crt. from Francis St.;
- Phase 2 - new underground works (fibre optic cable, GLB's and CSP) required on Warwick Crt. from Phase 1 through Phase 2, and on Marley Dr. to Sunset Dr.;
- Phase 3 - new underground works (fibre optic cable and GLB's) required on Marley Rd., Sunset Rd., and/or underground easement through Phase 3 Park;
- Phase 4 & Phase 5 – from Phase 3, and/or from new underground works (fibre optic cable and GLB's) on Private Mews laneway in Phases 4 & 5;
- Phase 6 - from Phases 4 & 5, and/or new underground works (fibre optic cable and GLB's) required on Private Mews laneway and Surrey Lane;
- municipal consents and road occupancy permits required for reconstruction works within existing road allowances;

9.3 Cogeco Cable (CC)

Existing communication network:

- Supply is from an underground coaxial network within the subject lands (generally on blanket easements on private lands), with fibre optic supply cables as aerial attachments on BHI pole lines on King Road, on Francis Road, and on Marley Rd.;
- Normal operating condition provides cable TV/data/phone service from an existing overhead fibre cable crossing King Road at Townsend Ave., converted to co-axial cable feeding the entire subject lands, as well as the existing apartments at 685/695/705 Surrey Lane and the extension of Warwick Crt. to the north;
- Alternate supply is also available from an existing overhead fibre cable on Francis Rd., via co-axial cable on Warwick Dr. to Warwick Crt.

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- **Existing system internal to the subject lands is obsolete by today's standards, and will be replaced by a fibre optic network with larger bandwidth – external capacity enhancements will be required at both east and west perimeters to supply the 1,450 +/- dwellings for re-development**;
  - New capacity is available by upgrading fibre optic cables on King Rd. & Francis St.;
  - Since Cogeco generally supplies from the west, and re-development generally proceeds from east to west, existing co-axial cables supplying buildings will be decommissioned as buildings are demolished;
  - Some coordination for new installations on existing and proposed roads, complete with temporary overhead and/or underground facilities, will be required to supply to new customers during the demolition and reconstruction stages;

Proposed communication network:

- A fibre-to-the-home (FTTH) underground distribution system will be required, with supply points proposed at Francis Rd./Warwick Dr. and King Rd./Surrey Lane, with fibre optic trunk cables feeding 5 or 6 new fibre notes located strategically on boulevards within the subject lands;
- New cable TV/data/phone cables & equipment are proposed largely within existing or proposed municipal road allowances, with some works on temporary or permanent easements as required to maintain or provide service;
- New underground installations, or temporary overhead/underground installations are to be coordinated with other utilities in a joint-use construction arrangement wherever possible;
- Phase 1 - new underground works (fibre optic cable and nodes) required on Warwick Dr. & Warwick Crt. from Francis St.;
- Phase 2 - new underground works (fibre optic cable and nodes) required on Warwick Crt. from Phase 1 through Phase 2, and on Marley Rd. to Francis St. (c/w road crossing of Francis);
- Phase 3 - new underground works (fibre optic cable and nodes) required on Surrey Lane, Sunset Rd., and/or underground easement through Phase 3 Park;
- Phase 4 & Phase 5 – from Phase 3, and/or from new underground cables on Private Mews laneway in Phases 4 & 5;
- Phase 6 - from Phases 4 & 5, and/or new underground works (fibre optic cable and nodes) required on Private Mews laneway and Surrey Lane;
- municipal consents and road occupancy permits required for reconstruction works within existing road allowances;

9.4 Union Gas Company (UG)

Existing gas distribution system:

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- Supply for the Georgian Court redevelopment area is from a 420 kPA network of underground mains within the subject lands (both on municipal road allowances and blanket easements on private lands);
- Normal operating condition provides natural gas supply from an existing 6" (150mm) main on King Road, with a 2" (50mm) main immediately north of Marley Rd. feeding the south 1/3 of the subject lands, and a 4" (100mm) main along the south side of Surrey Lane feeding the north 2/3 of the subject lands, as well as the existing apartments at 685/695/705 Surrey Lane and the extension of Warwick Crt. To the north
- **Existing system is suitable for some intensification and/or new development, with supplemental capacity required for the remainder**;
- New capacity is available by installing a new 4" (100mm) main on Warwick Dr. from Francis Rd., and by tying into the existing 2" (50mm) main on Marley Rd. as required;
- Entire area is ultimately supplied from 8" (200mm) mains on Plains Road;
- As specific capacity requirements of new buildings becomes available, Union Gas will run analyses to assess system requirements and necessary expansions to supply the subject lands;
- Since Union Gas generally supplies from the west, and re-development generally proceeds from east to west, existing local mains supplying buildings will be decommissioned as buildings are demolished;
- Some coordination for new installations on existing and proposed roads will be required to supply to new customers during the demolition and reconstruction stages;

Proposed gas distribution system:

- The existing mains on municipal roads (Warwick Crt. & Surrey Lane) will remain as supply points, supplemented by a new 4" (100mm) main to be installed on Warwick Dr. from Francis Rd. to Warwick Crt., reinforcing the supply and providing additional capacity;
- Phase 1 – new main on Warwick Dr. noted above, plus new main on Warwick Crt., south from Warwick Dr.;
- Phase 2 – new main on Warwick Crt. from Phase 1 to Marley Rd. (or as needed);
- Phase 3 - new main on Sunset Rd., between Surrey Lane and Marley Rd.;
- Phase 4 & Phase 5 – from Phase 3, and/or from new main on Private Mews laneway in Phases 4 & 5;
- Phase 6 – from Phases 4 & 5, and/or existing main on Surrey Lane;
- municipal consents and road occupancy permits required for reconstruction works within existing road allowances.

For all of the above utilities, regular design and construction coordination meetings are proposed in conjunction with development works. Servicing implementation is expected

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to evolve with development scheduling and detailed plans for demolition and reconstruction.

Economic evaluations will be performed by all utilities to evaluate the capital cost implications of the re-development proposal, comparing new customer revenues against anticipated capital cost outlays.

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10. Grading

The site grading design considers the following objectives and constraints:

- Conform to City of Burlington grading criteria
- Minimize cut/fill earthworks operations
- Minimize impact to existing trees where feasible
- Match existing boundary grading conditions
- Maintain required drainage boundaries
- Provide minimum cover on proposed servicing
- Provide emergency/overland flow conveyance for major storm conditions
- Contain the Regional Floodplain within the greenway

Grading of the proposed ROW has been designed to maintain gentle centre line grades to minimize the drop across development blocks while meeting storm drainage needs. The proposed ROW falls from Surrey Lane to Marley Road on average 1.1%.

Private Blocks will be graded in accordance with the above criteria. Generally all blocks will be graded to contain drainage and direct emergency drainage to the public ROWs. The blocks adjacent to the existing greenway will direct emergency flows to the east.

Detailed grading plans for each block will be developed at the site plan approval stage.

Refer to Drawing **GR-1** for further details.

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11. Erosion and Sediment Control

The erosion and sediment control plan for the site will be designed in conformance with the City of Burlington and Conservation Halton guidelines. Erosion and sediment control will be implemented for all construction activities including topsoil stripping, foundation excavation and stockpiling of materials.

The following erosion and sediment control measures will be implemented:

- A temporary sediment control fence will be placed prior to grading
- Temporary sediment traps will be provided
- Gravel mud mats will be provided at construction vehicle access points to minimize off-site tracking of sediments
- All temporary erosion and sediment control measures will be routinely inspected and repaired during construction. Temporary controls will not be removed until the areas they serve are restored and stable.

12. Conclusion

The proposed Georgian Court Estates development can be adequately serviced via the existing storm, sanitary and water distribution infrastructure and does not adversely impact any of the surrounding infrastructure or residences.

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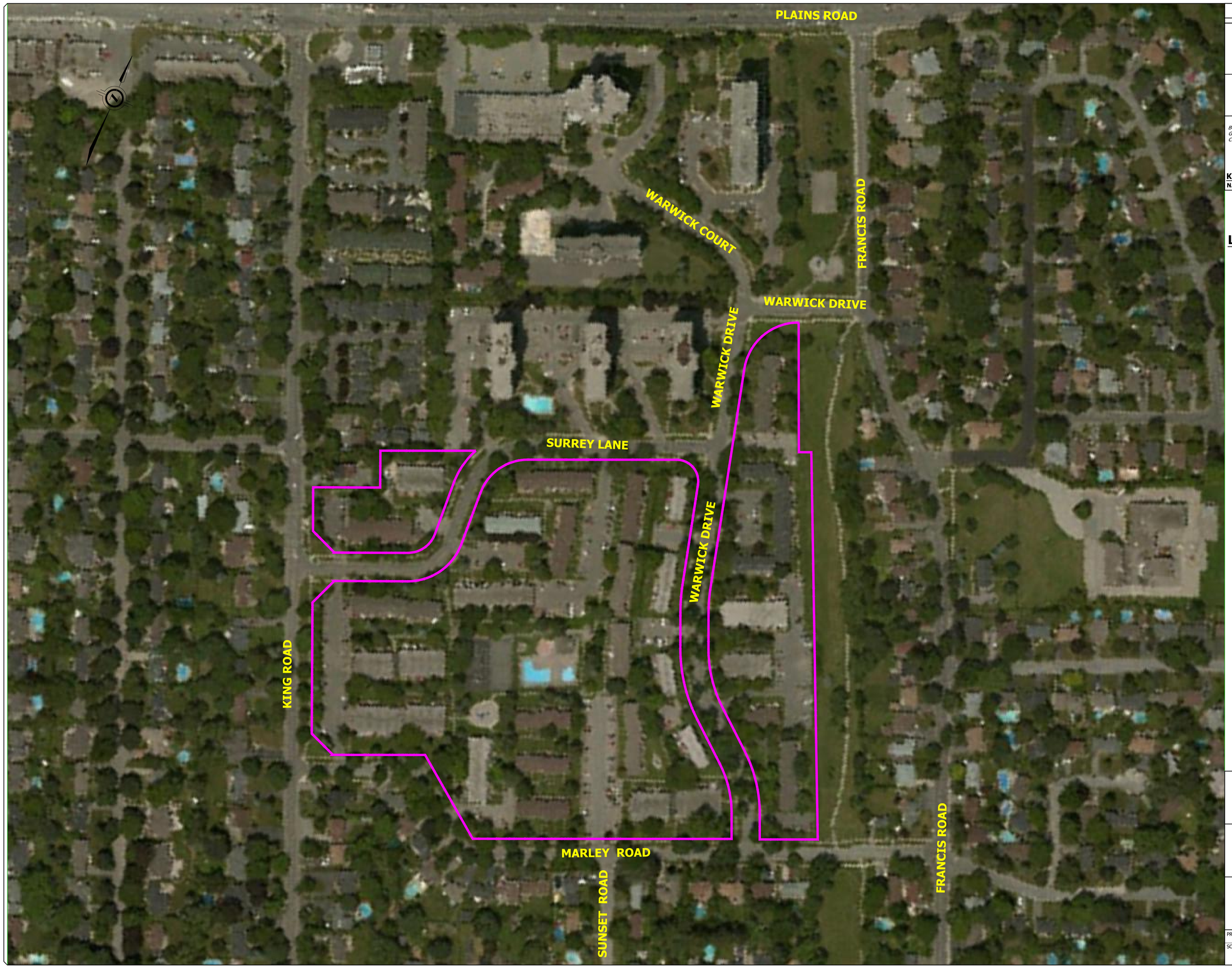
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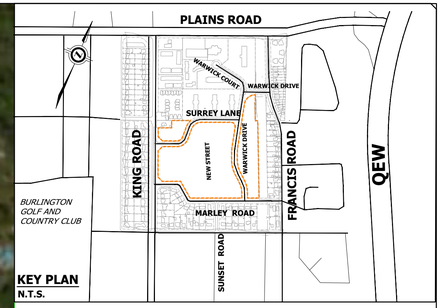
Urbantech Consulting, A Division of Leighton-Zec Ltd.
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Figures

- Figure 1 – Site Location
- Figure 2 – Predevelopment Drainage Plan

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LEGEND

PROPERTY BOUNDARY

GEORGIAN COURT REDEVELOPMENT

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SITE LOCATION PLAN

PROJECT No.:	16-518	DATE:	JULY 2017
SCALE:	H 1:1250		

Figure 1

WARWICK COURT

WARWICK DRIVE

FRANCIS ROAD

EXISTING APARTMENTS

SURREY LANE

BLOCK 6
MEDIUM DENSITY
RESIDENTIAL
0.553 ha
35u TH

BLOCK 4
HIGH DENSITY
RESIDENTIAL
0.742 ha
398u Apts

BLOCK 1
HIGH DENSITY
RESIDENTIAL
1.027 ha
260u Apts

FUT. SUNSET ROAD

BLOCK 12
PROPOSED 20.0m ROAD 0.548 ha

BLOCK 11
PARK
0.513 ha

BLOCK 10
PARK
0.424 ha

EXISTING RESIDENTIAL

KING ROAD

BLOCK 7
MEDIUM DENSITY
RESIDENTIAL
2.509 ha
147u TH

BLOCK 5
HIGH
DENSITY
RESIDENTIAL
0.794 ha
330u Apts

BLOCK 3
HIGH DENSITY
RESIDENTIAL
0.415 ha
130u Apts

BLOCK 2
HIGH DENSITY
RESIDENTIAL
0.460 ha
134u Apts

BLOCK 8
MEDIUM DENSITY
RESIDENTIAL
0.272 ha 12u TH

BLOCK 9
MEDIUM DENSITY
RESIDENTIAL
0.139 ha 6u TH

MARLEY ROAD

EXISTING RESIDENTIAL

SUNSET ROAD

FRANCIS ROAD

PLAINS ROAD

WARWICK COURT

WARWICK DRIVE

SURREY LANE

KING ROAD

NEW STREET

FRANCIS ROAD

QEW

N.T.S.

MARLEY ROAD

SUNSET ROAD

BURLINGTON GOLF AND COUNTRY CLUB

KEY PLAN
N.T.S.

GEORGIAN COURT REDEVELOPMENT

urbantech west
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tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

PROPOSED DRAFT PLAN

PROJECT No.: 16-518
DATE: JULY 2017
SCALE: 1:1000
20.0m 10.0m 0m 20.0m

Figure 2

Appendix A

Design Calculations

- Parcel Population Projections
- Received Preliminary Phasing and Unit Count
- Existing and Proposed Storm Sewer Design Sheet (5-Year)
- Sanitary Sewer Design Sheets

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Population Projections - Building over 6 Stories High

Based on Region of Halton Design Criteria and 1.62 Persons/Unit for Buildings above 6 stories high

Input into Sanitary Design Sheet Scenario 2

Parcel #	Total Gross Floor Area (m^2)	Apartment Units	Apartment Population	Townhouses	Townhouse Population	Total # of Units	Total Population
P01	7260	101	163.62			70	163.62
P02	16940	182	294.84			180	294.84
P03	13378	134	217.08	6	14.64	135	231.72
P05	37044	366	592.92			420	592.92
P06	13902	129	208.98	12	29.28	136	238.26
P07	17635	181	293.22	12	29.28	185	322.5
P08	18632	157	254.34	26	63.44	180	317.78
P09	5888			39	95.16	39	95.16
P10	10568			70	170.8	70	170.8
P11	5284			35	85.4	35	85.4
Total	146531	1250		200		1450	2513

2017.06.28 Preliminary Phasing Strategy

	parcels inlcuded in each phase	total # apartment units (net unit size)	# towns traditional + back-to-back)	total # units (net unit size)	existing #units	increase of unit # (proposed - existing
Phase 1				**283**	**32**	**251**
	P01	**78**	**-**	**101**		
	P02	**182**		**182**		
Phase 2				**281**	**66**	**215**
	P03	**134**	**6**	**140**		
	P06	**129**	**12**	**141**		
Phase 3				**366**	**68**	**298**
*includes completion of Sunset Rd extension	**P05**	**397**	**-**	**366**		
Phase 4				**193**	**20**	**173**
	P07	**173**	**12**	**193**		
Phase 5				**222**	**47**	**175**
	P08	**157**	**26**	**183**		
	P09		**39**	**39**		
Phase 6				**105**	**47**	**58**
	P10		**70**	**70**		
	P11		**35**	**35**		
totals				**1,450**	**280**	**1,170**



Existing Buildings



Proposed Buildings

urbantech

EXISTING STORM SEWER DESIGN SHEET

5 Year Storm

16-518

Burlington

PROJECT DETAILS

Project No: 16-518
Date: 21-Jul-17
Designed by: NM
Checked by: RM

DESIGN CRITERIA

Min. Diameter =	300	mm	Rainfall Intensity =	A / (Tc+B)^c	
Mannings 'n'=	0.013				
Starting Tc =	10	min	A =	697.4	
			B =	5	
Factor of Safety =	5	%	c =	0.764	

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
King Road	Ext. 3	Ex. MH-A0	1.19	0.75	0.89	0.89	88.1	0.218			0.218									
	Ext. 1	Ex. MH-A0	0.85	0.40	0.34	0.34	88.1	0.083			0.083									
	Ex. MH-A0	Ex. MH-A	0.38	0.61	0.23	1.46	88.1	0.358			0.358	124.0	0.50	600	0.434	1.54	10.00	1.35	11.35	83%
	Ext. 5	Ex. MH-A	1.00	0.45	0.45	0.45	88.1	0.110			0.110									
	Ext. 6	Ex. MH-A	1.09	0.45	0.49	0.49	88.1	0.120			0.120									
	Ex. MH-A	Ex. MH-B	0.37	0.61	0.23	2.63	82.5	0.603			0.603	117.0	1.62	600	0.782	2.76	11.35	0.71	12.05	77%
	Ex. MH-B	Ex. MH15A	0.15	0.61	0.09	2.72	79.9	0.604			0.604	10.9	0.50	525	0.304	1.40	12.05	0.13	12.18	199%
	Ex. MH15A	Ex. MH15		0.61		2.72	79.4	0.600			0.600	18.0	0.50	525	0.304	1.40	12.18	0.21	12.39	197%
	A-2	Ex. MH17	0.28	0.50	0.14	0.14	88.1	0.034			0.034									
Surrey Lane	Ex. MH18	Ex. MH17	0.19	0.61	0.12	0.12	88.1	0.028			0.028	46.5	0.81	375	0.158	1.43	10.00	0.54	10.54	18%
	Ex. MH17	Ex. MH16	0.05	0.61	0.03	0.29	85.7	0.068			0.068	27.8	0.91	375	0.167	1.51	10.54	0.31	10.85	41%
	Ex. MH16	Ex. MH15	0.11	0.61	0.07	0.35	84.5	0.083			0.083	55.8	0.91	450	0.272	1.71	10.85	0.54	11.39	30%
	A-1	Ex. MH15	0.27	0.50	0.14	0.14	88.1	0.033			0.033									
Easement	Ex. MH15	Ex. MH14	0.59	0.50	0.30	3.51	78.7	0.766			0.766	72.6	0.69	600	0.510	1.80	12.39	0.67	13.07	150%
Outlet A	Ex. MH14	Ex. MH13	0.60	0.50	0.30	3.81	76.4	0.808	0.000	0.000	0.808	67.1	0.68	600	0.506	1.79	13.07	0.62	13.69	160%
Marley Road	Ex. MH13A	Ex. MH13	0.24	0.61	0.15	0.15	88.1	0.036			0.036	20.0	0.50	375	0.124	1.12	10.00	0.30	10.30	29%
	Ex. MH13	Ex. MH12A	0.15	0.61	0.09	4.04	74.5	0.836			0.836	55.0	0.52	675	0.606	1.69	13.69	0.54	14.23	138%
Outlet B	Ex. MH12A	Ex. MH12	0.00	0.61	0.00	4.04	72.9	0.818	0.000	0.000	0.818	5.8	0.26	750	0.568	1.28	14.23	0.08	14.31	144%
	Ex. MH12	Ex. MH11	0.14	0.61	0.09	4.13	72.6	0.833			0.833	65.0	0.33	750	0.640	1.45	14.31	0.75	15.05	130%
	Ext. 14	Ex. MH11	0.31	0.40	0.12	0.12	88.1	0.030			0.030									
	C-1	Ex. MH11	0.67	0.50	0.34	0.34	88.1	0.082			0.082									
	Ex. MH11	Ex. MH10	0.12	0.61	0.07	4.66	70.6	0.914			0.914	80.0	0.58	750	0.848	1.92	15.05	0.69	15.75	108%
	C-2	Ex. MH10	1.54	0.50	0.77	0.77	88.1	0.188			0.188									
Outlet C	Ex. MH10	Ex. MH9	0.12	0.61	0.07	5.50	68.8	1.051	0.000	0.000	1.051	57.1	0.72	750	0.945	2.14	15.75	0.45	16.19	111%
	Ext. 18	Ex. MH2	0.22	0.40	0.09	0.09	88.1	0.022			0.022	63.4	0.90	750	1.056	2.39	10.00	0.44	10.44	2%
	Ex. MH9	Ex. MH2	0.12	0.61	0.07	5.58	67.6	1.048			1.048	63.4	0.90	750	1.056	2.39	16.19	0.44	16.64	99%
Warwick Dr.	D-1	Ex. MH7	0.38	0.50	0.19	0.19	88.1	0.046			0.046									
	D-2	Ex. MH7	0.19	0.50	0.10	0.10	88.1	0.023			0.023									
	Ex. MH7	Ex. MH6	0.08	0.61	0.05	0.33	88.1	0.082			0.082	42.2	0.39	375	0.109	0.99	10.00	0.71	10.71	75%
	D-4	Ex. MH6	0.12	0.50	0.06	0.06	88.1	0.015			0.015									
	Ex. MH6	Ex. MH5	0.07	0.61	0.04	0.44	85.0	0.103			0.103	32.8	0.74	375	0.151	1.37	10.71	0.40	11.11	68%
	D-5	Ex. MH5	0.12	0.50	0.06	0.06	88.1	0.015			0.015									
	Ex. MH5	Ex. MH4	0.10	0.61	0.06	0.56	83.4	0.129			0.129	49.5	0.62	450	0.224	1.41	11.11	0.58	11.69	58%
	D-8	Ex. MH4	0.17	0.50	0.09	0.09	88.1	0.021			0.021									
	Ex. MH4	Ex. MH3		0.61		0.64	81.2	0.145			0.145	29.7	0.69	450	0.237	1.49	11.69	0.33	12.03	61%
	Ex. MH3	Ex. MH2	0.11	0.61	0.07	0.71	80.0	0.158			0.158	31.4	0.40	450	0.180	1.13	12.03	0.46	12.49	87%
	D-10	Ex. MH2	0.35	0.50	0.18	0.18	88.1	0.043			0.043									
Outlet D	Ex. MH2	STM Outfal	0.09	0.50	0.05	6.60	66.6	1.220	0.000	0.000	1.220	52.7	1.18	750	1.209	2.74	16.64	0.32	16.96	101%
Surrey Lane	E-2	Ex. MH21	0.15	0.75	0.11	0.11	88.1	0.028			0.028									
	E-1	Ex. MH21	1.27	0.75	0.95	0.95	88.1	0.233			0.233									
	Ex. MH21	Ex. MH22	0.17	0.50	0.09	1.15	88.1	0.281			0.281	70.9	0.68	450	0.235	1.48	10.00	0.80	10.80	120%
	Ex. MH22	Ex. MH23	0.18	0.50	0.09	1.24	84.7	0.292			0.292	34.0	0.70	525	0.360	1.66	10.80	0.34	11.14	81%
	Ex. MH23	Ex. MH24	0.13	0.50	0.07	1.31	83.3	0.302			0.302	50.0	0.50	525	0.304	1.40	11.14	0.59	11.73	99%
	Ex. MH24	Ex. MH25		0.50		1.31	81.0	0.294			0.294	36.7	0.35	525	0.254	1.18	11.73	0.52	12.25	115%
Warwick Court	Ext. 7	Ex. MH1A	2.78	0.75	2.09	2.09	88.1	0.510			0.510									
	Ex. MH1A	Ex. MH2A		0.75		2.09	88.1	0.510			0.510	106.7	1.20	375	0.192	1.74	10.00	1.02	11.02	266%
	Ext. 9	Ex. MH2A	0.99	0.75	0.74	0.74	88.1	0.182			0.182									
	Ex. MH2A	Ex. MH3A		0.75		2.83	83.8	0.658			0.658	28.6	1.00	525	0.430	1.99	11.02	0.24	11.26	153%
	Ex. MH3A	Ex. MH4A		0.50		2.83	82.8	0.650			0.650	15.2	1.00	525	0.430	1.99	11.26	0.13	11.39	151%
Warwick Drive	Ex. MH26	Ex. MH4A	2.01	0.75	1.51	1.51	88.1	0.369			0.369	14.5	0.50	750	0.787	1.78	10.00	0.14	10.14	47%
Outlet E	Ex. MH4A	Ex. MH25	0.10	0.50	0.05	4.39	82.3	1.003	0.000	0.000	1.003	28.0	0.35	750	0.659	1.49	11.39	0.31	11.70	152%
	F-1	Trunk	0.22	0.50	0.11	0.11	88.1	0.027			0.027	10.0	0.50	250	0.042	0.86	10.00	0.19	10.19	64%
	F-2	Trunk	0.66	0.50	0.33	0.33	88.1	0.081			0.081	10.0	0.50	375	0.124	1.12	10.00	0.15	10.15	65%
	F-3	Trunk	0.51	0.50	0.26	0.26	88.1	0.062			0.062	10.0	0.50	300	0.068	0.97	10.00	0.17	10.17	91%
	F-4	Trunk	0.60	0.50	0.30	0.30	88.1	0.073			0.073	10.0	0.50	375	0.124	1.12	10.00	0.15	10.15	59%
Outlet F	Trunk	Outlet E	0.00	0.00	0.00	1.00	87.2	0.241	0.000	0.000	0.241	10.0	0.50	3000	31.738	4.49	10.19	0.04	10.23	1%

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PROPOSED STORM SEWER DESIGN SHEET

5 Year Storm - No Control

16-518

Burlington

PROJECT DETAILS

Project No: 16-518
Date: 21-Jul-20
Designed by: NM
Checked by: RM

DESIGN CRITERIA

Min. Diameter =	**300**	**mm**	**Rainfall Intensity =**	**A / (Tc+B)^c**
Mannings 'n' =	**0.013**			
Starting Tc =	**10**	**min**	**A =**	**697.4**
			B =	**5**
Factor of Safety =	**5**	**%**	**c =**	**0.764**

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
King Road	Ext. 3	Ex. MH-A0	1.19	0.75	0.89	0.89	88.1	0.218			0.218									
	Ext. 1	Ex. MH-A0	0.85	0.40	0.34	0.34	88.1	0.083			0.083									
	Ex. MH-A0	Ex. MH-A	0.38	0.61	0.23	1.46	88.1	0.358			0.358	124.0	0.50	525	0.304	1.40	10.00	1.47	11.47	118%
	Ext. 5	Ex. MH-A	1.00	0.45	0.45	0.45	88.1	0.110			0.110									
	Ext. 6	Ex. MH-A	1.09	0.45	0.49	0.49	88.1	0.120			0.120									
	Ex. MH-A	Ex. MH-B	0.37	0.61	0.23	2.63	82.0	0.599			0.599	117.0	1.62	525	0.547	2.53	11.47	0.77	12.24	109%
	Ex. MH-B	Ex. MH15A	0.15	0.50	0.08	2.71	79.2	0.595			0.595	10.9	0.50	525	0.304	1.40	12.24	0.13	12.37	196%
	Ex. MH15A	Ex. MH15		0.61		2.71	78.7	0.592			0.592	18.0	0.50	525	0.304	1.40	12.37	0.21	12.59	195%
	A-2	Ex. MH17	0.28	0.40	0.11	0.11	88.1	0.027			0.027									
Surrey Lane	Ex. MH18	Ex. MH17	0.19	0.61	0.12	0.12	88.1	0.028			0.028	46.5	0.81	375	0.158	1.43	10.00	0.54	10.54	18%
	Ex. MH17	Ex. MH16	0.05	0.61	0.03	0.26	85.7	0.062			0.062	27.8	0.91	375	0.167	1.51	10.54	0.31	10.85	37%
	Ex. MH16	Ex. MH15	0.11	0.61	0.07	0.33	84.5	0.076			0.076	55.8	0.91	450	0.272	1.71	10.85	0.54	11.39	28%
	A-1	Ex. MH15	0.27	0.40	0.11	0.11	88.1	0.026			0.026									
Easement	MH15	MH14	0.80	0.61	0.49	0.49	88.1	0.119			0.119	72.6	0.69	600	0.510	1.80	10.00	0.67	10.67	23%
	MH14	MH13	0.61	0.50	0.31	0.79	85.2	0.188			0.188	67.1	0.68	600	0.506	1.79	10.67	0.62	11.30	37%
	A-7	MH13	0.17	0.50	0.09	0.09	88.1	0.021			0.021									
Outlet A	Ex. MH13A	MH13	0.24	0.50	0.12	0.12	88.1	0.029	0.000	0.000	0.029	17.1	0.50	600	0.434	1.54	10.00	0.19	10.19	7%
Marley Road	Ex. MH13A	MH13	0.24	0.50	0.12	0.12	88.1	0.029			0.029	32.6	0.50	375	0.124	1.12	10.00	0.48	10.48	24%
	MH13	Ex. MH12A	0.15	0.61	0.09	1.21	82.7	0.278			0.278	37.8	0.52	675	0.606	1.69	11.30	0.37	11.67	46%
	Ex. MH12A	Ex. MH12		0.61		1.21	81.3	0.273			0.273	5.8	0.26	750	0.568	1.28	11.67	0.08	11.74	48%
Outlet B	MH12-3	MH12-2	0.80	0.40	0.32	0.32	88.1	0.078	0.000	0.000	0.078	54.8	0.50	300	0.068	0.97	10.00	0.94	10.94	115%
	MH12-2	MH12-1	0.61	0.40	0.24	0.56	84.1	0.132			0.132	39.3	0.50	300	0.068	0.97	10.94	0.68	11.62	193%
	MH12-1	Ex. MH12		0.40		0.56	81.4	0.128			0.128	36.7	0.50	300	0.068	0.97	11.62	0.63	12.25	187%
	Ex. MH12	Ex. MH11	0.14	0.50	0.07	1.84	79.2	0.405			0.405	65.0	0.33	750	0.640	1.45	12.25	0.75	13.00	63%
	Ext. 13	Ex. MH11	0.31	0.50	0.16	0.16	88.1	0.038			0.038									
	C-9	Ex. MH11	0.14	0.40	0.06	0.06	88.1	0.014			0.014									
	Ex. MH11	Ex. MH10	0.12	0.61	0.07	2.13	76.6	0.453			0.453	80.0	0.58	750	0.848	1.92	13.00	0.69	13.70	53%
	Ex. MH10	Ex. MH9	0.12	0.61	0.07	2.20	74.4	0.455			0.455	57.1	0.72	750	0.945	2.14	13.70	0.45	14.14	48%
	Ex. MH9	Ex. MH2	0.12	0.61	0.07	2.27	73.1	0.462			0.462	63.4	0.90	750	1.056	2.39	14.14	0.44	14.58	44%
	C-10	Ex. MH2	0.12	0.40	0.05	0.05	88.1	0.012			0.012									
Sunset Street	C-1	MH21-2	0.35	0.75	0.26	0.26	88.1	0.064			0.064									
	MH21-2	MH10-4	0.15	0.61	0.09	0.35	88.1	0.087			0.087	77.0	0.50	300	0.068	0.97	10.00	1.33	11.33	127%
	C-3	MH10-4	0.36	0.75	0.27	0.27	88.1	0.066			0.066									
	MH10-4	MH10-3	0.11	0.61	0.07	0.69	82.6	0.159			0.159	59.6	1.10	450	0.299	1.88	11.33	0.53	11.85	53%
	MH10-3	MH10-2	0.12	0.61	0.07	0.76	80.6	0.171			0.171	54.5	1.10	450	0.299	1.88	11.85	0.48	12.34	57%
	C-6	MH10-2	0.62	0.40	0.25	0.25	88.1	0.061			0.061									
Outlet C	MH10-2	MH10-1	0.06	0.06	0.00	1.02	78.9	0.223	0.000	0.000	0.223	38.0	1.70	450	0.372	2.34	12.34	0.27	12.61	60%
Warwick Drive	Ex. MH7	Ex. MH6	0.08	0.61	0.05	0.05	88.1	0.012			0.012	42.2	0.39	375	0.109	0.99	10.00	0.71	10.71	11%
	D-1	Ex. MH6	0.52	0.30	0.16	0.16	88.1	0.038			0.038									
	Ex. MH6	Ex. MH5	0.07	0.61	0.04	0.25	85.0	0.058			0.058	32.8	0.74	375	0.151	1.37	10.71	0.40	11.11	39%
	Ex. MH5	Ex. MH4	0.10	0.61	0.06	0.31	83.4	0.071			0.071	49.5	0.62	450	0.224	1.41	11.11	0.58	11.69	32%
	Ex. MH4	Ex. MH3		0.61		0.31	81.2	0.070			0.070	29.7	0.69	450	0.237	1.49	11.69	0.33	12.03	29%
	Ex. MH3	Ex. MH2	0.11	0.61	0.07	0.38	80.0	0.083			0.083	31.4	0.40	450	0.180	1.13	12.03	0.46	12.49	46%
	D-8	Ex. MH2	0.57	0.75	0.43	0.43	88.1	0.105			0.105									
Outlet D	D-5	Ex. MH2	0.54	0.75	0.41	0.41	88.1	0.099	0.000	0.000	0.099	0.0	0.00	0	0.000	0.00	0.00	0.00	0.00	0%
	Ex. MH2	STM Outfall	0.09	0.61	0.05	3.59	71.9	0.716			0.716	52.7	1.18	750	1.209	2.74	14.58	0.32	14.91	59%
Sunset Drive	MH21-2	MH21-1	0.11	0.61	0.07	0.33	88.1	0.081			0.081	55.4	0.50	300	0.068	0.97	10.00	0.96	10.96	118%
Surrey Lane	MH21-1	Ex. MH21	0.15	0.61	0.09	0.42	84.0	0.098			0.098	23.7	0.50	450	0.202	1.27	10.96	0.31	11.27	49%
	Ex. MH21	Ex. MH22	0.17	0.61	0.10	0.52	82.8	0.121			0.121	70.9	0.68	450	0.235	1.48	11.27	0.80	12.07	51%
Warwick Drive	E-8	MH22-1	0.74	0.75	0.56	0.56	88.1	0.136			0.136									
	E-6	MH22-1	0.68	0.75	0.51	0.51	88.1	0.125			0.125									
	MH22-1	Ex. MH22	0.20	0.61	0.12	1.19	88.1	0.290			0.290	59.9	0.50	450	0.202	1.27	10.00	0.79	10.79	144%
	E-5	Ex. MH23	0.44	0.75	0.33	0.33	88.1	0.081			0.081	34.0	0.70	525	0.360	1.66	10.00	0.34	10.34	22%
	Ex. MH23	Ex. MH23	0.13	0.61	0.08	0.41	86.6	0.098			0.098	50.0	0.50	525	0.304	1.40	10.34	0.59	10.93	32%
	Ex. MH23	Ex. MH24	0.13	0.61	0.08	0.82	84.1	0.191			0.191	50.0	0.50	525	0.304	1.40	10.93	0.59	11.53	63%
	Ex. MH24	Ex. MH25		0.61		0.82	81.8	0.186			0.186	36.7	0.35	525	0.254	1.18	11.53	0.52	12.05	73%
Warwick Court	Ext.7	Ex. MH1A	2.78	0.75	2.09	2.09	88.1	0.510			0.510									
	Ex. MH1A	Ex. MH2A		0.75		2.09	88.1	0.510			0.510	106.7	1.20	375	0.192	1.74	10.00	1.02	11.02	266%

Urbantech Consulting, A Division of Leighton-Zec Ltd.
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	Ex. MH2A	Ex. MH3A	0.99	0.75	0.74	2.83	83.8	0.658			0.658	28.6	1.00	525	0.430	1.99	11.02	0.24	11.26	153%
	Ex. MH3A	Ex. MH4A		0.61		2.83	82.8	0.650			0.650	15.2	1.00	525	0.430	1.99	11.26	0.13	11.39	151%
Warwick Drive	Ex. MH26	Ex. MH4A	2.01	0.75	1.51	1.51	88.1	0.369			0.369	14.5	0.50	525	0.304	1.40	10.00	0.17	10.17	121%
Outlet E	Ex. MH4A	Ex. MH25	0.10	0.50	0.05	4.39	82.3	1.003	0.000	0.000	1.003	28.0	0.35	750	0.659	1.49	11.39	0.31	11.70	152%
Outlet F	F-1	Trunk	0.42	0.30	0.13	0.13	88.1	0.031	0.000	0.000	0.031	10.0	0.50	3000	31.738	4.49	10.00	0.04	10.04	0%

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SANITARY SEWER DESIGN SHEET
Proposed Conditions - Population Estimates
CITY OF BURLINGTON

GEORGIAN COURT REDEVELOPMENT

REGIONAL OF HALTON

PROJECT DETAILS

Project No: 16-518
Date: 21/07/2017
Designed by: NMF
Checked by: RM

DESIGN CRITERIA

Min Diameter = 200 mm
Mannings 'n'= 0.013
Min. Velocity = 0.6 m/s
Max. Velocity = 3.0 m/s
Factor of Safety = 10 %
Avg. Domestic Flow = 275.0 l/c/d
Infiltration = 0.286 l/s/ha
Max. Peaking Factor = 4.50
Min. Peaking Factor= 2.00

*** Indicates a direct population entry based on 1.62 persons/hectare for high rise buildings over 6 storeys

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
WARWICK COURT		EX.MH2								0.66	0.66	90		60	60	0.2	60	4.30	0.8			1.0						
WARWICK COURT		EX.MH2	0.63	0.63		285		180	180							0.2	180	4.16	2.4			2.6						
WARWICK COURT		EX.MH2	0.70	0.70		135		95	95							0.2	95	4.25	1.3			1.5						
WARWICK COURT	EX.MH2	EX.MH4	0.35	1.68					275		0.66				60	0.7	335	4.06	4.3			5.0	1.20	250	65.1	1.3	0.8	8%
WARWICK COURT		EX.MH4	1.46	1.46		285		417	417							0.4	417	4.01	5.3			5.7						
WARWICK COURT		EX.MH4	0.87	0.87		285		248	248							0.2	248	4.11	3.2			3.5						
WARWICK COURT	EX.MH4	EX.MH6		4.01					940		0.66				60	1.3	1000	3.80	12.1			13.4	1.20	250	65.1	1.3	1.0	21%
WARWICK DRIVE		EX.MH50	0.35	0.35		***		164	164							0.1	164	4.18	2.2			2.3						
WARWICK DRIVE	EX.MH6	EX.MH50	0.30	4.31					940		0.66				60	1.4	1000	3.80	12.1			13.5	0.70	250	49.8	1.0	0.8	27%
SURREY LANE		EX.MH52	0.85	0.85		285		243	243							0.2	243	4.12	3.2			3.4						
SURREY LANE	EX.MH52	EX.MH51	0.33	1.18					243							0.3	243	4.12	3.2			3.5	0.93	250	57.3	1.2	0.6	6%
SURREY LANE	EX.MH51	EX.MH50		1.18					243							0.3	243	4.12	3.2			3.5	2.00	250	84.1	1.7	0.8	4%
WARWICK DRIVE		EX.MH50	1.16	1.16		285		331	331							0.3	331	4.06	4.3			4.6						
WARWICK DRIVE		EX.MH49	0.75	0.75		***		593	593							0.2	593	3.93	7.4			7.6						
WARWICK DRIVE	EX.MH50	EX.MH49	0.18	7.18					1678		0.66				60	2.2	1738	3.63	20.1			22.3	0.51	300	69.1	1.0	0.9	32%
WARWICK DRIVE		EX.MH49	0.65	0.65		***		295	295							0.2	295	4.08	3.8			4.0						
WARWICK DRIVE	EX.MH49	EX.MH48	0.09	8.67					2566		0.66				60	2.7	2626	3.49	29.2			31.8	0.37	300	58.8	0.8	0.8	54%
WARWICK DRIVE		EX.MH48	0.47	0.47												0.1						0.1						
WARWICK DRIVE		EX.MH48	0.49	0.49												0.1						0.1						
WARWICK DRIVE	EX.MH48	EX.MH47	0.04	9.67					2566		0.66				60	3.0	2626	3.49	29.2			32.1	0.64	300	77.4	1.1	1.0	42%
WARWICK DRIVE	EX.MH47	EX.MH46	0.07	9.74					2566		0.66				60	3.0	2626	3.49	29.2			32.2	0.85	300	89.2	1.3	1.1	36%
WARWICK DRIVE		EX.MH45	0.50	0.50		***		209	209							0.1	209	4.14	2.8			2.9						
WARWICK DRIVE		EX.MH45	0.45	0.45		***		217	217							0.1	217	4.13	2.9			3.0						
WARWICK DRIVE	EX.MH46	EX.MH45	0.09	9.83					2566		0.66				60	3.0	2626	3.49	29.2			32.2	0.83	300	88.1	1.2	1.1	37%
WARWICK DRIVE	EX.MH45	EX.MH44	0.07	10.85					2992		0.66				60	3.3	3052	3.44	33.4			36.7	0.14	300	36.2	0.5	0.6	101%
WARWICK DRIVE		EX.MH44	0.13	0.13		135		18	18							0.0	18	4.39	0.3			0.3						
WARWICK DRIVE		EX.MH44	0.24	0.24		135		33	33							0.1	33	4.35	0.5			0.5						
WARWICK DRIVE	EX.MH44	EX.MH32	0.06	11.28					3043		0.66				60	3.4	3103	3.43	33.9			37.3	0.43	300	63.4	0.9	0.9	59%
SURREY LANE		EX.MH43	0.34	0.34		135		46	46							0.1	46	4.32	0.6			0.7						
SURREY LANE	EX.MH43	EX.MH42	0.36	0.70					46							0.2	46	4.32	0.6			0.8	0.63	200	26.0	0.8	0.4	3%
SURREY LANE	EX.MH42	EX.MH41		0.70					46							0.2	46	4.32	0.6			0.8	0.72	200	27.8	0.9	0.4	3%
SURREY LANE	EX.MH41	MH1A	0.21	0.91		135		29	75							0.3	75	4.28	1.0			1.3	0.55	200	24.3	0.8	0.4	5%
EASEMENT		MH1A	0.14	0.14												0.0						0.0						
EASEMENT	MH1A	MH2A	0.61	1.66		135		83	158							0.5	158	4.18	2.1			2.6	0.60	200	25.4	0.8	0.5	10%
			0.31			135																						
LANE		MH1B	0.21	0.21		135		29	29							0.1	29	4.36	0.4			0.5						
LANE	MH1B	MH2B	0.17	0.38					29							0.1	29	4.36	0.4			0.5	1.00	200	32.8	1.0	0.3	2%
LANE		MH2B	0.22	0.22		135		30	30							0.1	30	4.35	0.4			0.5						
LANE	MH2B	EX.MH37	0.03	0.63					59							0.2	59	4.30	0.8			1.0	1.00	200	32.8	1.0	0.4	3%
MARLEY ROAD	MH2A	EX.MH37	0.17	1.83					158							0.5	158	4.18	2.1			2.6	0.70	200	27.4	0.9	0.6	10%
MARLEY ROAD		EX.MH37	0.32	0.32		55		18	18							0.1	18	4.39	0.3			0.3						
MARLEY ROAD	EX.MH37	EX.MH36	0.15	2.93					235							0.8	235	4.12	3.1			3.9	0.41	200	21.0	0.7	0.5	19%
MARLEY ROAD	EX.MH36	EX.MH35	0.35	3.28		55		20	255							0.9	255	4.11	3.3			4.3	0.24	200	16.1	0.5	0.4	27%
MARLEY ROAD	EX.MH35	EX.MH34	0.19	3.47					255							1.0	255	4.11	3.3			4.3	0.56	200	24.5	0.8	0.6	18%
MARLEY ROAD	EX.MH34	MH7A		3.47					255							1.0	255	4.11	3.3			4.3	0.82	200	29.7	0.9	0.7	15%
FUT. SUNSET ROAD		MH2A	0.37	0.37		***		209	209							0.1	209	4.14	2.8			2.9						
FUT. SUNSET ROAD	MH2A	MH3A	0.21	2.24		135		29	396							0.6	396	4.02	5.1			5.7	1.00	200	32.8	1.0	0.8	17%
FUT. SUNSET ROAD	MH3A	MH4A	0.10	2.34					396							0.7	396	4.02	5.1			5.7	1.00	200	32.8	1.0	0.8	18%
FUT. SUNSET ROAD		MH4A	0.42	0.42		***		254	254							0.1	254	4.11	3.3			3.4						
FUT. SUNSET ROAD	MH4A	MH5A	0.08	2.84					650							0.8	650	3.91	8.1			8.9	1.00	250	59.5	1.2	0.9	15%
FUT. SUNSET ROAD	MH5A	MH6A	0.10	2.94					650							0.8	650	3.91	8.1			8.9	1.00	250	59.5	1.2	0.9	15%
FUT. SUNSET ROAD		MH6A	0.62	0.62		135		84	84							0.2	84	4.26	1.1			1.3						
FUT. SUNSET ROAD	MH6A	MH7A	0.07	3.63					734							1.0	734	3.88	9.1			10.1	1.00	250	59.5	1.2	0.9	17%
FUT. SUNSET ROAD	MH7A	EX.MH33		7.10					989							2.0	989	3.80	12.0			14.0	0.82	250	53.9	1.1	0.9	26%
MARLEY ROAD	EX.MH33	EX.MH32	0.31	7.41		55		18	1007							2.1	1007	3.80	12.2			14.3	1.52	250	73.3	1.5	1.1	19%
			0.19			55																						
MARLEY ROAD	EX.MH32	EX.MH31	0.15	18.84					4050		0.66				60	5.6	4110	3.32	43.5			49.0	0.33	375	100.7	0.9	0.9	49%
MARLEY ROAD	EX.MH31	EX.MH30		18.84					4050		0.66				60	5.6	4110	3.32	43.5			49.0	0.60	375	135.8	1.2	1.1	36%
FRANCIS ROAD	EX.MH30	EX.MH		18.84						Flow calculated as InfoSewer flow (170.4L/S) + difference between proposed and existing flow from Marley Road (47.3-12.7=34.6L/S)**							205.0	0.60	600	475.6	1.7	1.6	43%

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SANITARY SEWER DESIGN SHEET
Proposed Conditions - Population Estimates
CITY OF BURLINGTON

GEORGIAN COURT REDEVELOPMENT

REGIONAL OF HALTON

PROJECT DETAILS

Project No: 16-518
Date: 21/07/2017
Designed by: NMF
Checked by: RM

DESIGN CRITERIA

Min Diameter = 200 mm
Mannings 'n'= 0.013
Min. Velocity = 0.6 m/s
Max. Velocity = 3.0 m/s
Factor of Safety = 10 %
Avg. Domestic Flow = 275.0 l/c/d
Infiltration = 0.286 l/s/ha
Max. Peaking Factor = 4.50
Min. Peaking Factor= 2.00

*** Indicates a direct population entry based on 1.62 persons/hectare for high rise buildings over 6 storeys

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
WARWICK COURT		EX.MH2								0.66	0.66	90		60	60	0.2	60	4.30	0.8			1.0						
WARWICK COURT		EX.MH2	0.63	0.63		285		180	180							0.2	180	4.16	2.4			2.6						
WARWICK COURT		EX.MH2	0.70	0.70		135		95	95							0.2	95	4.25	1.3			1.5						
WARWICK COURT	EX.MH2	EX.MH4	0.35	1.68					275		0.66				60	0.7	335	4.06	4.3			5.0	1.20	250	65.1	1.3	0.8	8%
WARWICK COURT		EX.MH4	1.46	1.46		285		417	417							0.4	417	4.01	5.3			5.7						
WARWICK COURT		EX.MH4	0.87	0.87		285		248	248							0.2	248	4.11	3.2			3.5						
WARWICK COURT	EX.MH4	EX.MH6		4.01					940		0.66				60	1.3	1000	3.80	12.1			13.4	1.20	250	65.1	1.3	1.0	21%
WARWICK DRIVE		EX.MH50	0.35	0.35		***		164	164							0.1	164	4.18	2.2			2.3						
WARWICK DRIVE	EX.MH6	EX.MH50	0.30	4.31					940		0.66				60	1.4	1000	3.80	12.1			13.5	0.70	250	49.8	1.0	0.8	27%
SURREY LANE		EX.MH52	0.85	0.85		285		243	243							0.2	243	4.12	3.2			3.4						
SURREY LANE	EX.MH52	EX.MH51	0.33	1.18					243							0.3	243	4.12	3.2			3.5	0.93	250	57.3	1.2	0.6	6%
SURREY LANE	EX.MH51	EX.MH50		1.18					243							0.3	243	4.12	3.2			3.5	2.00	250	84.1	1.7	0.8	4%
WARWICK DRIVE		EX.MH50	1.16	1.16		285		331	331							0.3	331	4.06	4.3			4.6						
WARWICK DRIVE		EX.MH49	0.75	0.75		***		593	593							0.2	593	3.93	7.4			7.6						
WARWICK DRIVE	EX.MH50	EX.MH49	0.18	7.18					1678		0.66				60	2.2	1738	3.63	20.1			22.3	0.51	300	69.1	1.0	0.9	32%
WARWICK DRIVE		EX.MH49	0.65	0.65		***		295	295							0.2	295	4.08	3.8			4.0						
WARWICK DRIVE	EX.MH49	EX.MH48	0.09	8.67					2566		0.66				60	2.7	2626	3.49	29.2			31.8	0.37	300	58.8	0.8	0.8	54%
WARWICK DRIVE		EX.MH48	0.47	0.47												0.1						0.1						
WARWICK DRIVE		EX.MH48	0.49	0.49												0.1						0.1						
WARWICK DRIVE	EX.MH48	EX.MH47	0.04	9.67					2566		0.66				60	3.0	2626	3.49	29.2			32.1	0.64	300	77.4	1.1	1.0	42%
WARWICK DRIVE	EX.MH47	EX.MH46	0.07	9.74					2566		0.66				60	3.0	2626	3.49	29.2			32.2	0.85	300	89.2	1.3	1.1	36%
WARWICK DRIVE		EX.MH45	0.50	0.50		***		209	209							0.1	209	4.14	2.8			2.9						
WARWICK DRIVE		EX.MH45	0.45	0.45		***		217	217							0.1	217	4.13	2.9			3.0						
WARWICK DRIVE	EX.MH46	EX.MH45	0.09	9.83					2566		0.66				60	3.0	2626	3.49	29.2			32.2	0.83	300	88.1	1.2	1.1	37%
WARWICK DRIVE	EX.MH45	EX.MH44	0.07	10.85					2992		0.66				60	3.3	3052	3.44	33.4			36.7	0.14	300	36.2	0.5	0.6	101%
WARWICK DRIVE		EX.MH44	0.13	0.13		135		18	18							0.0	18	4.39	0.3			0.3						
WARWICK DRIVE		EX.MH44	0.24	0.24		135		33	33							0.1	33	4.35	0.5			0.5						
WARWICK DRIVE	EX.MH44	EX.MH32	0.06	11.28					3043		0.66				60	3.4	3103	3.43	33.9			37.3	0.43	300	63.4	0.9	0.9	59%
SURREY LANE		EX.MH43	0.34	0.34		135		46	46							0.1	46	4.32	0.6			0.7						
SURREY LANE	EX.MH43	EX.MH42	0.36	0.70					46							0.2	46	4.32	0.6			0.8	0.63	200	26.0	0.8	0.4	3%
SURREY LANE	EX.MH42	EX.MH41		0.70					46							0.2	46	4.32	0.6			0.8	0.72	200	27.8	0.9	0.4	3%
SURREY LANE	EX.MH41	MH1A	0.21	0.91		135		29	75							0.3	75	4.28	1.0			1.3	0.55	200	24.3	0.8	0.4	5%
EASEMENT		MH1A	0.14	0.14												0.0						0.0						
EASEMENT	MH1A	MH2A	0.61	1.66		135		83	158							0.5	158	4.18	2.1			2.6	0.60	200	25.4	0.8	0.5	10%
			0.31			135																						
LANE		MH1B	0.21	0.21		135		29	29							0.1	29	4.36	0.4			0.5						
LANE	MH1B	MH2B	0.17	0.38					29							0.1	29	4.36	0.4			0.5	1.00	200	32.8	1.0	0.3	2%
LANE		MH2B	0.22	0.22		135		30	30							0.1	30	4.35	0.4			0.5						
LANE	MH2B	EX.MH37	0.03	0.63					59							0.2	59	4.30	0.8			1.0	1.00	200	32.8	1.0	0.4	3%
MARLEY ROAD	MH2A	EX.MH37	0.17	1.83					158							0.5	158	4.18	2.1			2.6	0.70	200	27.4	0.9	0.6	10%
MARLEY ROAD		EX.MH37	0.32	0.32		55		18	18							0.1	18	4.39	0.3			0.3						
MARLEY ROAD	EX.MH37	EX.MH36	0.15	2.93					235							0.8	235	4.12	3.1			3.9	0.41	200	21.0	0.7	0.5	19%
MARLEY ROAD	EX.MH36	EX.MH35	0.35	3.28		55		20	255							0.9	255	4.11	3.3			4.3	0.24	200	16.1	0.5	0.4	27%
MARLEY ROAD	EX.MH35	EX.MH34	0.19	3.47					255							1.0	255	4.11	3.3			4.3	0.56	200	24.5	0.8	0.6	18%
MARLEY ROAD	EX.MH34	MH7A		3.47					255							1.0	255	4.11	3.3			4.3	0.82	200	29.7	0.9	0.7	15%
FUT. SUNSET ROAD		MH2A	0.37	0.37		***		209	209							0.1	209	4.14	2.8			2.9						
FUT. SUNSET ROAD	MH2A	MH3A	0.21	2.24		135		29	396							0.6	396	4.02	5.1			5.7	1.00	200	32.8	1.0	0.8	17%
FUT. SUNSET ROAD	MH3A	MH4A	0.10	2.34					396							0.7	396	4.02	5.1			5.7	1.00	200	32.8	1.0	0.8	18%
FUT. SUNSET ROAD		MH4A	0.42	0.42		***		254	254							0.1	254	4.11	3.3			3.4						
FUT. SUNSET ROAD	MH4A	MH5A	0.08	2.84					650							0.8	650	3.91	8.1			8.9	1.00	250	59.5	1.2	0.9	15%
FUT. SUNSET ROAD	MH5A	MH6A	0.10	2.94					650							0.8	650	3.91	8.1			8.9	1.00	250	59.5	1.2	0.9	15%
FUT. SUNSET ROAD		MH6A	0.62	0.62		135		84	84							0.2	84	4.26	1.1			1.3						
FUT. SUNSET ROAD	MH6A	MH7A	0.07	3.63					734							1.0	734	3.88	9.1			10.1	1.00	250	59.5	1.2	0.9	17%
FUT. SUNSET ROAD	MH7A	EX.MH33		7.10					989							2.0	989	3.80	12.0			14.0	0.82	250	53.9	1.1	0.9	26%
MARLEY ROAD	EX.MH33	EX.MH32	0.31	7.41		55		18	1007							2.1	1007	3.80	12.2			14.3	1.52	250	73.3	1.5	1.1	19%
			0.19			55																						
MARLEY ROAD	EX.MH32	EX.MH31	0.15	18.84					4050		0.66				60	5.6	4110	3.32	43.5			49.0	0.33	375	100.7	0.9	0.9	49%
MARLEY ROAD	EX.MH31	EX.MH30		18.84					4050		0.66				60	5.6	4110	3.32	43.5			49.0	0.60	375	135.8	1.2	1.1	36%
FRANCIS ROAD	EX.MH30	EX.MH		18.84						Flow calculated as InfoSewer flow (170.4L/S) + difference between proposed and existing flow from Marley Road (47.3-12.7=34.6L/S)**							205.0	0.60	600	475.6	1.7	1.6	43%

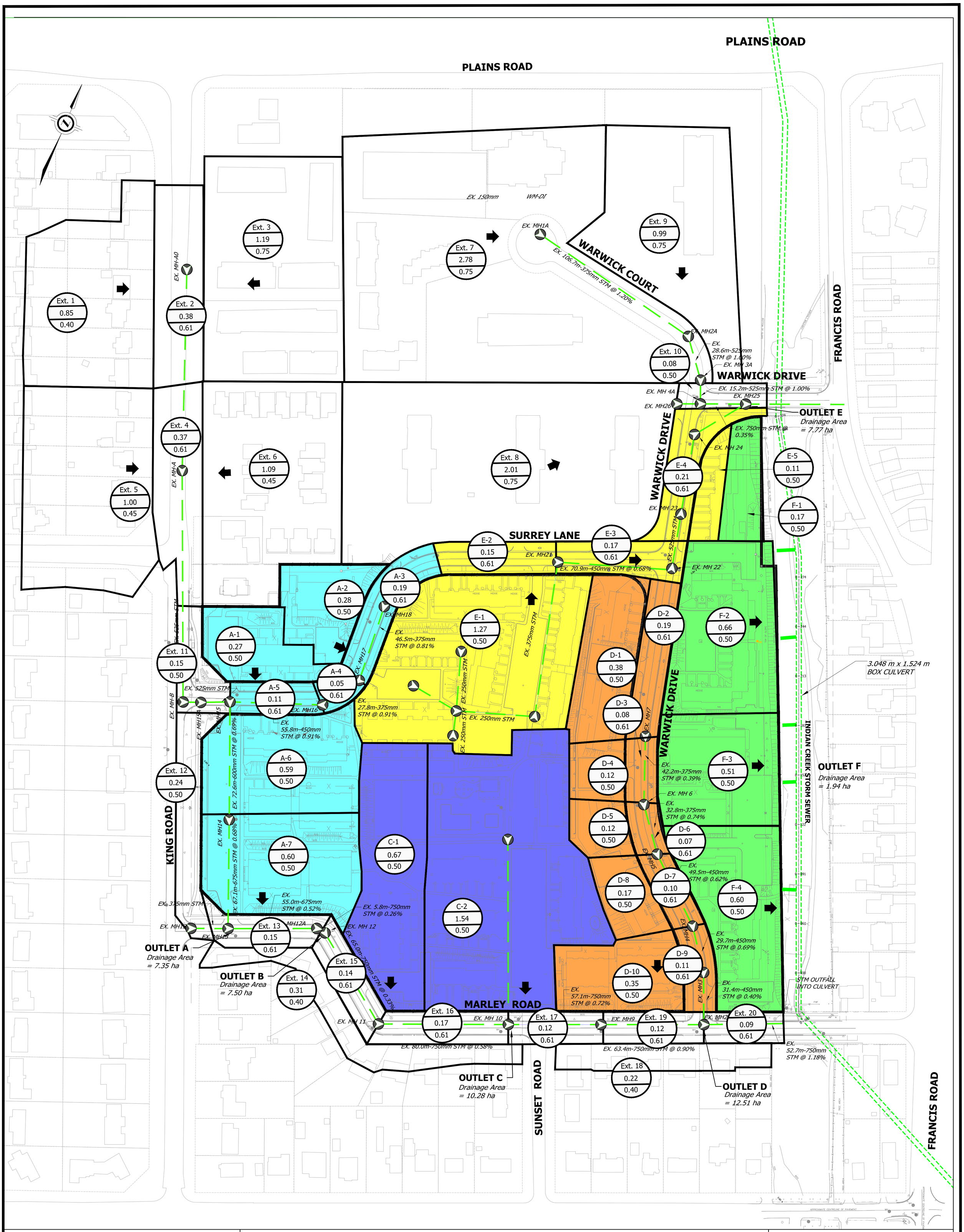
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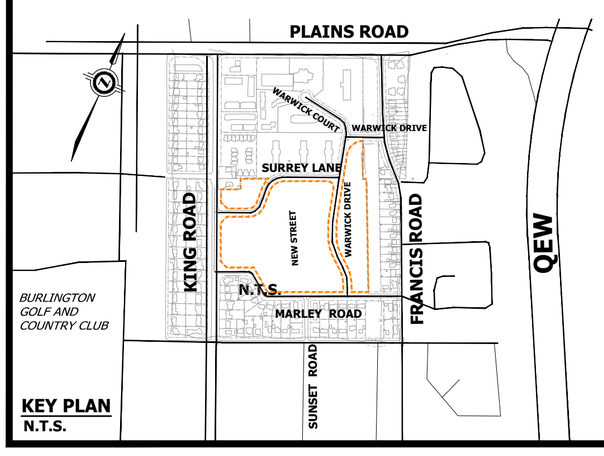
Appendix B

Drawings

- STM-1 – Pre-Development Storm Servicing and Drainage Area Plan
- STM-2 – Proposed Storm Servicing and Drainage Area Plan
- SAN-1 – Sanitary Servicing & Drainage Area Plan
- FM-1 – Pre-Development Flood Mapping
- FM-2 – Post-Development Flood Mapping
- WM-1 – Water Distribution Plan
- GR-1 – Grading Plan

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KEY PLAN
N.T.S.

LEGEND

- EXISTING STORM SEWER
- DRAINAGE BOUNDARY
- *INTERNAL DRAINAGE AREA*
  - 03 — AREA ID
  - 19.36 — DRAINAGE AREA (ha)
  - 0.75 — COMPOSITE RUNOFF COEFFICIENT
- OVERLAND FLOW ROUTE

SWM STRATEGY

- NO CONTROL
- DRAINAGE TO OUTLET A
- DRAINAGE TO OUTLET C
- DRAINAGE TO OUTLET D
- DRAINAGE TO OUTLET E
- DRAINAGE TO OUTLET F
- CONTROLLED DRAINAGE

REFERENCE DRAWINGS

DRAFT PLAN: URBAN STRATEGIES, GEORGIAN COURT MASTER PLAN, DATE: JUNE 8TH, 2017
SURVEY: R. AVIS SURVEYING INC., PLAN No. 3048-0, DATE: MAY 15TH, 2017

BENCHMARK

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE REFERRED TO CITY OF BURLINGTON BENCH MARK No. 0011963U3488, HAVING AN ELEVATION = 98.754 meters.

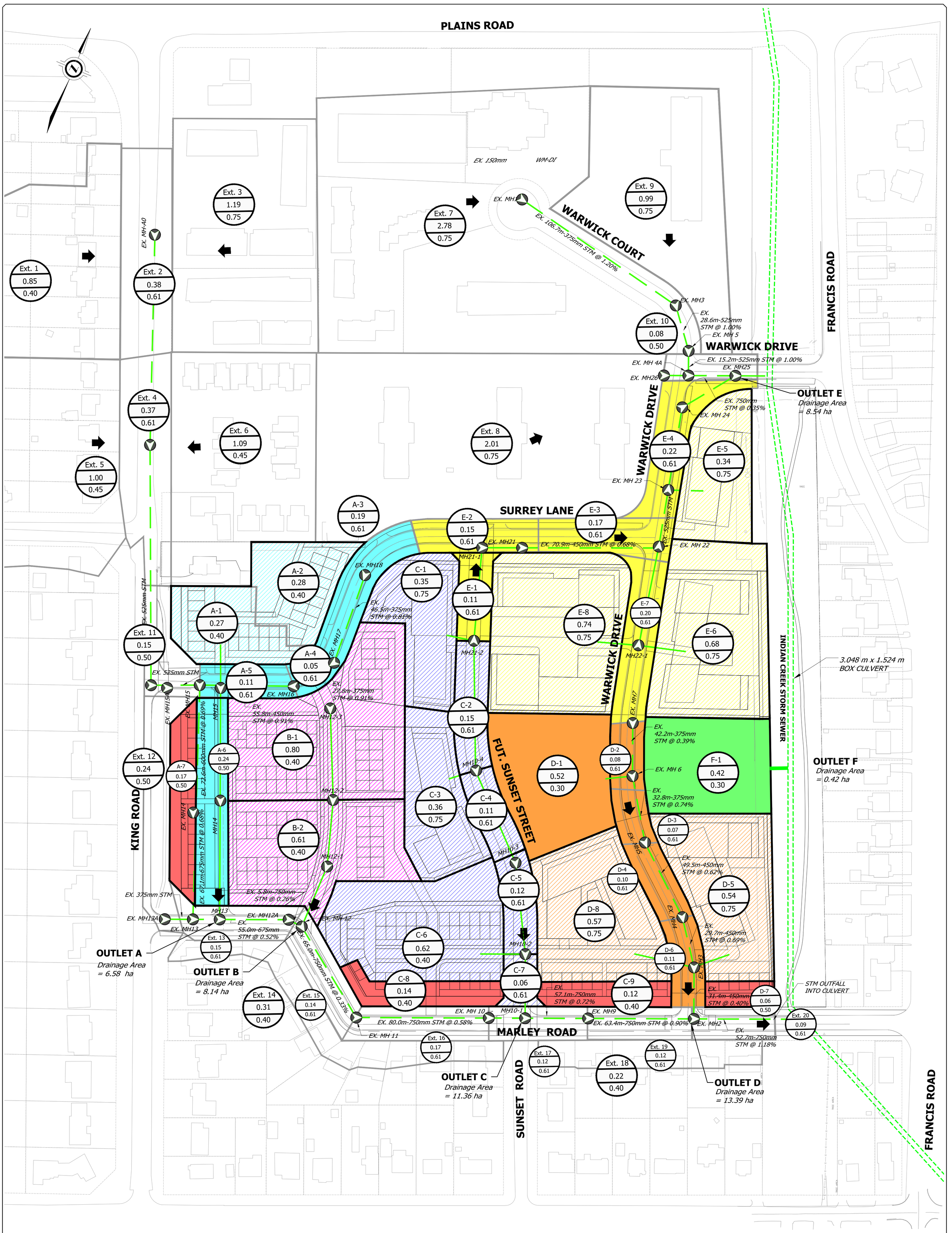
NOTE: EXTERNAL DRAINAGE PATTERNS ARE APPROXIMATE AND BASED ON AVAILABLE TOPOGRAPHIC MAPPING, DRAWINGS, AND CITY GIS DATA

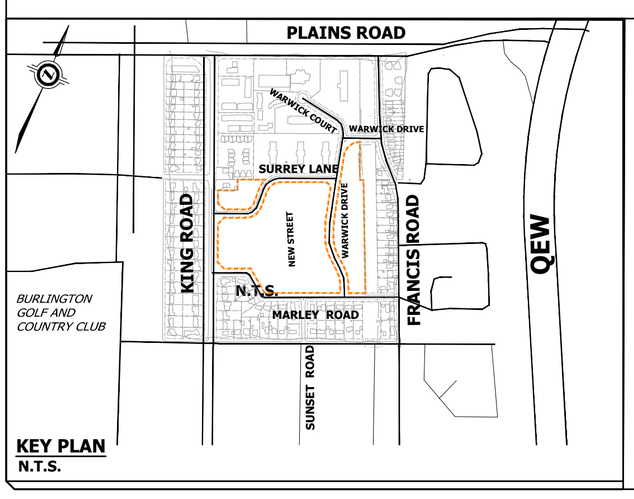
GEORGIAN COURT REDEVELOPMENT

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EXISTING STORM DRAINAGE PLAN

PROJECT No.:	16-518	DATE:	JULY 2017	DRAWING No.:
SCALE: H 1:1250				STM-1





LEGEND

- PROPOSED STORM SEWER
- EXISTING STORM SEWER
- INTERNAL DRAINAGE BOUNDARY
- *INTERNAL DRAINAGE AREA*
  - O3 — AREA ID
  - 19.36 — DRAINAGE AREA (ha)
  - 0.75 — COMPOSITE RUNOFF COEFFICIENT
- PROPOSED OVERLAND FLOW ROUTE

SWM STRATEGY

- NO CONTROL
- DRAINAGE TO OUTLET A
- DRAINAGE TO OUTLET B
- DRAINAGE TO OUTLET C
- DRAINAGE TO OUTLET D
- DRAINAGE TO OUTLET E
- DRAINAGE TO OUTLET F
- CONTROLLED DRAINAGE

REFERENCE DRAWINGS

DRAFT PLAN: URBAN STRATEGIES, GEORGIAN COURT MASTER PLAN, DATE: JUNE 8TH, 2017
SURVEY: R. AVIS SURVEYING INC., PLAN No. 30484, DATE: MAY 15TH, 2017

BENCHMARK

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE REFERRED TO CITY OF BURLINGTON BENCH MARK No. 001196JU3488, HAVING AN ELEVATION = 98.754 meters.

NOTE: EXTERNAL DRAINAGE PATTERNS ARE APPROXIMATE AND BASED ON AVAILABLE TOPOGRAPHIC MAPPING, DRAWINGS, AND CITY GIS DATA

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PROPOSED STORM DRAINAGE PLAN

PROJECT No.:	16-518	DATE:	JULY 2017	STM-2
SCALE: 1:1000				

PLAINS ROAD

WARWICK COURT

WARWICK DRIVE

FRANCIS ROAD

SURREY LANE

KING ROAD

FUT. SUNSET ROAD

MARLEY ROAD

SUNSET ROAD

0.66ha 90 60

0.63ha 285 180

0.70ha 135 95

1.46ha 285 417

0.35ha - -

0.87ha 285 248

0.30ha - -

0.85ha 285 243

0.33ha - -

1.16ha 285 331

0.35ha 469 164

0.34ha 135 46

0.36ha - -

0.21ha - -

0.75ha 791 593

0.21ha 135 28

0.37ha 486 209

0.18ha - -

0.65ha 454 295

0.20ha 158 30

0.14ha - -

0.09ha - -

0.47ha - -

0.61ha 135 82

0.31ha 126 39

0.21ha 135 30

0.10ha - -

0.49ha - -

0.04ha - -

0.17ha - -

0.42ha 651 254

0.08ha - -

0.07ha - -

0.22ha 135 30

0.50ha 418 209

0.09ha - -

0.45ha 482 217

0.17ha - -

0.03ha - -

0.62ha 135 83.7

0.10ha - -

0.07ha - -

0.15ha - -

0.24ha 135 32

0.06ha - -

0.13ha 135 18

0.19ha - -

0.07ha - -

0.24ha - -

0.15ha - -

0.32ha 55 18

0.20ha 55 30

0.31ha 55 18

0.19ha 55 11

EX. MH2
TOP 94.30
OBV 90.65

EX. 106.7m-250mm SAN @ 1.20%

EX. MH4

EX. 25.9m-250mm SAN @ 1.20%

EX. MH6

EX. 109.7m-250mm SAN @ 0.70%

EX. MH52
TOP 94.30
OBV 90.21

EX. MH50
TOP 92.07
OBV 88.20

EX. MH51

EX. 70.1m-250mm SAN @ 0.93%

EX. 70.3m-250mm SAN @ 2.00%

EX. 86.9m-300mm SAN @ 0.51%

EX. MH43
TOP 94.11
OBV 91.22

EX. MH42

EX. 37.7m-200mm SAN @ 0.55%

EX. 35.4m-200mm SAN @ 0.63%

EX. 21.6m-200mm SAN @ 0.72%

MH1A
TOP 93.60
OBV 90.30

EX. MH40

EX. MH41

MH2A
TOP 93.50
OBV 90.50

EX. MH49

EX. 45.2m-300mm SAN @ 0.37%

MH3A

EX. MH48

EX. 23.2m-300mm SAN @ 0.64%

EX. MH47

EX. 32.9m-300mm SAN @ 0.85%

MH4A

MH1B

MH2B

MH5A

EX. MH46

EX. MH45

EX. 49.3m-300mm SAN @ 0.83%

EX. 28.2m-300mm SAN @ 0.14%

150m-200mm SAN @ 0.60%
(WITHIN 6m EASEMENT)

EX. MH39

EX. MH38

EX. MH37

EX. 65.8m-200mm SAN @ 0.41%

MH2A
TOP 92.40
OBV 89.30

EX. 36.9m-200mm SAN @ 0.70%

EX. MH36

EX. 39.0m-250mm SAN @ 0.82%

EX. MH44

EX. 36.0m-300mm SAN @ 0.43%

MH6A

EX. MH35

EX. MH34

EX. MH33

MH7A

EX. 74.6m-200mm SAN @ 0.56%

EX. 59.3m-250mm SAN @ 1.52%

EX. 78.1m-375mm SAN @ 0.33%

EX. 56.7m-375mm SAN @ 0.60%

EX. MH30
TOP 89.85
OBV 85.65

EX. 600mm SAN

EX. 5.1m-200mm SAN @ 0.24%

EX. 23.3m-250mm SAN @ 0.82%

EX. MH32
TOP 89.75
OBV 86.75

EX. MH31
TOP 89.10
OBV 86.00

TOTAL FLOW TO EX. MH30
FROM WEST
PROPOSED= 37.5L/S
EXISTING=12.7L/S
TOTAL CAPACITY=135.8L/S

EX. 55.0m-600mm SAN @ 0.60%

TOTAL FLOW IN 600mm SAN
PROPOSED= 195.2L/S
EXISTING=170.4L/S
TOTAL CAPACITY=475.6L/S

BURLINGTON GOLF AND COUNTRY CLUB

N.T.S.

NEW STREET

QEW

KEY PLAN
N.T.S.

LEGEND

- PROPOSED SANITARY SE□ER AND FLO□ DIRECTION
- E□ISTING SANITARY SE□ER AND FLO□ DIRECTION
- E□ISTING SANITARY SE□ER TO BE REMO□ED
- 0.42ha / 175 / 74 — DRAINAGE AREA □ha□, POPULATION, POPULATION PER Ha □□ha□
- REDE□ELOPED DRAINAGE AREA BOUNDARY
- E□ISTING DRAINAGE AREA BOUNDARY

REALSTAR

CITY OF □URLINGTON
REGIONAL MUNICIPALITY OF □ALTON

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GEORGIAN COURT REDEVELOPMENT
PRELIMINARY SANITARY DRAINAGE PLAN

PROJECT No.: 16-518	FIGURE No.: SAN-1
DATE: JANUARY 2017	
SCALE: 1:1000	

File: P:\Projects\16-518\Drawings\Preliminary Engineering\17-01-03-Sanitary Drainage Plan\16-518-Preliminary Sanitary Drainage.dwg - Revised by <SRIEMER> : Fri, Jan 06 2017 - 10:18am

PLAINS ROAD

SURREY LANE

WARWICK DRIVE

FRANCIS RD.

WARWICK DRIVE

KING ROAD

MARLEY ROAD

INDIAN CREEK STORM SEWER

3.048 m x 1.524 m BOX CULVERT

2082 91.15

2082 91.15

2338 91.15

2266 92.46

2220 92.44

2200 92.25

2182 91.54

2082 91.15

2013 90.74

1941 90.13

1859 89.72

1824 89.42

1804 89.35

1784 89.33

1769 89.27

89.02 EX

89.02 EX

89.59 EX

89.52 EX

89.50 EX

89.43 EX

88.93 EX

88.91 EX

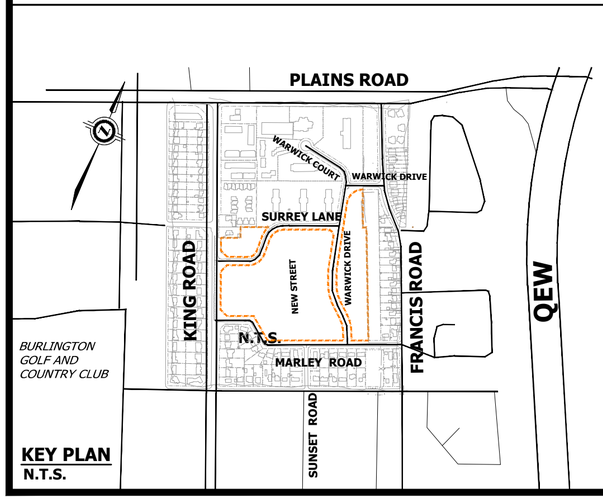
88.70 EX

88.63 EX

88.60 EX

88.36 EX

88.33 EX



KEY PLAN
N.T.S.

LEGEND

PROPERTY BOUNDARY

263.00× EXISTING GRADE

PROPOSED OVERLAND FLOW ROUTE

ID # — FLOODPLAIN CROSS-SECTION DATA

EXISTING W.S.E

EXISTING REGIONAL FLOODPLAIN

7.5 m SETBACK

BUILDINGS WITHIN FLOODPLAIN

REFERENCE DRAWINGS

DRAFT PLAN: URBAN STRATEGIES, GEORGIAN COURT MASTER PLAN, DATE: JUNE 8TH, 2017
SURVEY: R. AVIS SURVEYING INC., PLAN No. 3048-0, DATE: MAY 15TH, 2017

BENCHMARK

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE REFERRED TO CITY OF BURLINGTON BENCH MARK No. 0211963U3488, HAVING AN ELEVATION = 98.754 meters.

NOTE: EXTERNAL DRAINAGE PATTERNS ARE APPROXIMATE AND BASED ON AVAILABLE TOPOGRAPHIC MAPPING, DRAWINGS, AND CITY GIS DATA

GEORGIAN COURT REDEVELOPMENT

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EXISTING FLOODPLAIN MAPPING

PROJECT No.:	16-518	DATE:	JULY 2017	DRAWING No.:
SCALE: H 1:1250				FM-1

PLAINS ROAD

WARWICK DRIVE

SURREY LANE

FUT. SUNSET ROAD

WARWICK DRIVE

FRANCIS RD.

INDIAN CREEK STORM SEWER

KING ROAD

MARLEY ROAD

ROAD

3.048 m x 1.524 m BOX CULVERT

PROPOSED RETAINING WALL

2436 95.10 | 95.10

2415 94.83 | 94.83

2391 93.53 | 93.53

2338 93.07 | 93.07

2266 92.46 | 92.46

2220 92.44 | 92.44

2200 92.25 | 92.25

2182 91.54 | 91.57

2082 91.15 | 91.22

2013 90.74 | 90.94

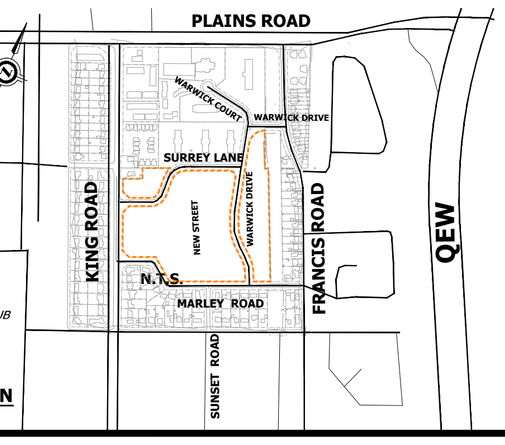
1941 90.13 | 90.25

1859 89.72 | 90.16

1824 89.39 | 89.42

1804 89.33 | 89.35

1769 89.31 | 89.27



KEY PLAN
N.T.S.

LEGEND

- PROPERTY BOUNDARY
- 263.00× PROPOSED GRADE
- 262.000× EXISTING GRADE
- 2.0% PROPOSED SLOPE
- *FFF = 92.00* PROPOSED FIRST FINISHED FLOOR ELEVATION
- PROPOSED OVERLAND FLOW ROUTE
- EXISTING TREE TO BE REMOVED (WITHIN PRIVATE PROPERTY)
- EXISTING TREE WHICH CAN BE MAINTAINED
- ID # — FLOODPLAIN CROSS-SECTION DATA, EXISTING W.S.E, PROPOSED W.S.E
- PROPOSED REGIONAL FLOODPLAIN
- 7.5m SETBACK
- BUILDINGS WITHIN FLOODPLAIN

REFERENCE DRAWINGS

DRAFT PLAN: URBAN STRATEGIES, GEORGIAN COURT MASTER PLAN, DATE: JUNE 8TH, 2017
SURVEY: R. AVIS SURVEYING INC., PLAN No. 3048-0, DATE: MAY 15TH, 2017

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PROPOSED FLOODPLAIN MAPPING

PROJECT No.:	16-518	DATE:	JULY 2017	DRAWING No.:
SCALE: H 1:1250				FM-2

PLAINS ROAD

WARWICK COURT

WARWICK DRIVE

FRANCIS ROAD

SURREY LANE

KING ROAD

MARLEY ROAD

SUNSET ROAD

FUT. SUNSET ROAD

EX. 300mm WM-CI

EX. 300mm WM-CPP

EX. 300mm WM-PVC

EX. 600mm WM-CCP

EX. 600mm WM-CPP

EX. 200mm WM-AC

EX. 300mm WM-AC

EX. 150mm WM-AC

EX. 250mm WM-AC

EX. 150mm WM-PVC

PROPOSED 150 mm WATERMAIN

Ex. 150 mm watermain within Warwick Drive to be rebuilt as a 200mm watermain

BLOCK 6
MEDIUM DENSITY RESIDENTIAL
0.553 ha
35u TH

BLOCK 12
PROPOSED 20.0m ROAD 0.548 ha

BLOCK 4
HIGH DENSITY RESIDENTIAL
0.742 ha
398u Apts

BLOCK 1
HIGH DENSITY RESIDENTIAL
1.027 ha
260u Apts

BLOCK 11
PARK
0.513 ha

BLOCK 10
PARK
0.424 ha

BLOCK 7
MEDIUM DENSITY RESIDENTIAL
2.509 ha
147u TH

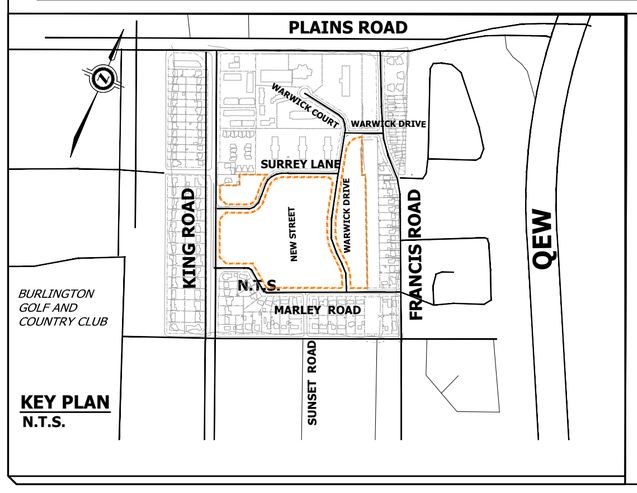
BLOCK 5
HIGH DENSITY RESIDENTIAL
0.794 ha
330u Apts

BLOCK 3
HIGH DENSITY RESIDENTIAL
0.415 ha
130u Apts

BLOCK 2
HIGH DENSITY RESIDENTIAL
0.460 ha
134u Apts

BLOCK 8
MEDIUM DENSITY RESIDENTIAL
0.272 ha 12u TH

BLOCK 9
MEDIUM DENSITY RESIDENTIAL
0.139 ha 6u TH



KEY PLAN
N.T.S.

LEGEND

- PROPOSED WATER SERVICING
- EXISTING WATER SERVICING
- EXISTING WATER SERVICING TO BE REMOVED

REFERENCE DRAWINGS

DRAFT PLAN: URBAN STRATEGIES, GEORGIAN COURT MASTER PLAN, DATE: JUNE 8TH, 2017
SURVEY: R. AVIS SURVEYING INC., PLAN No. 3048-0, DATE: MAY 15TH, 2017

BENCHMARK

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE REFERRED TO CITY OF BURLINGTON BENCH MARK No. 001196JU498, HAVING AN ELEVATION = 98.754 meters.

GEORGIAN COURT REDEVELOPMENT

urbantech
Urbantech Consulting, A Division of Leighton-Zec Ltd.
3760 14th Avenue, Suite 301, Markham, Ontario L3R 3T7
tel: 905.946.9461 fax: 905.946.9595
www.urbantech.com

WATER SERVICING PLAN

PROJECT No.:	16-518	DATE:	JULY 2017	WTR-1

SCALE: 1:1000 (20.0m 10.0m 0m 20.0m)

WARWICK DRIVE

SURREY LANE

FRANCIS RD.

KING ROAD

FUT. SUNSET ROAD

WARWICK DRIVE

MARLEY ROAD

ROAD

2182 91.54 91.57

2082 91.15 91.23

2013 90.74 90.96

1941 90.13 90.16

1859 89.72 89.89

1824 89.42 89.33

1804 89.35 89.33

3.048 m x 1.524 m BOX CULVERT

PROPOSED RETAINING WALL

FFF = 92.50

FFF = 94.60

FFF = 94.50

FFF = 94.30

FFF = 94.25

FFF = 94.00

FFF = 93.00

FFF = 93.80

FFF = 93.65

FFF = 93.70

FFF = 93.50

FFF = 93.15

FFF = 93.30

FFF = 93.15

FFF = 93.02

FFF = 92.15

FFF = 92.15

FFF = 92.15

FFF = 92.15

FFF = 92.80

FFF = 92.20

FFF = 92.00

FFF = 90.60

FFF = 90.60

FFF = 90.20

FFF = 90.40

FFF = 92.15

FFF = 92.15

FFF = 90.80

FFF = 90.20

FFF = 91.50

FFF = 93.00

FFF = 93.15

KEY PLAN
N.T.S.

LEGEND

- PROPERTY BOUNDARY
- 263.00× PROPOSED GRADE
- 262.000× EXISTING GRADE
- 2.0% PROPOSED SLOPE
- PROPOSED 20m ROW
- PROPOSED OVERLAND FLOW ROUTE
- FFF = 92.00 PROPOSED FIRST FINISHED FLOOR ELEVATION
- ID # FLOODPLAIN CROSS-SECTION DATA
  EXISTING W.S.E (AS DETERMINED BY CONSERVATION HALTON)
  PROPOSED W.S.E
- EXISTING TREE TO BE REMOVED (WITHIN PRIVATE PROPERTY)
- EXISTING TREE WHICH CAN BE MAINTAINED
- PROPOSED REGIONAL FLOODPLAIN
- 7.5m SETBACK
- INDIAN CREEK STORM SEWER

REFERENCE DRAWINGS

DRAFT PLAN: URBAN STRATEGIES, GEORGIAN COURT MASTER PLAN, DATE: JUNE 8TH, 2017
SURVEY: R. AVIS SURVEYING INC., PLAN No. 3048-0, DATE: MAY 15TH, 2017

BENCHMARK

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE REFERRED TO CITY OF BURLINGTON BENCH MARK No. 001963U3488, HAVING AN ELEVATION = 98.754 meters.

GEORGIAN COURT REDEVELOPMENT

urbantech
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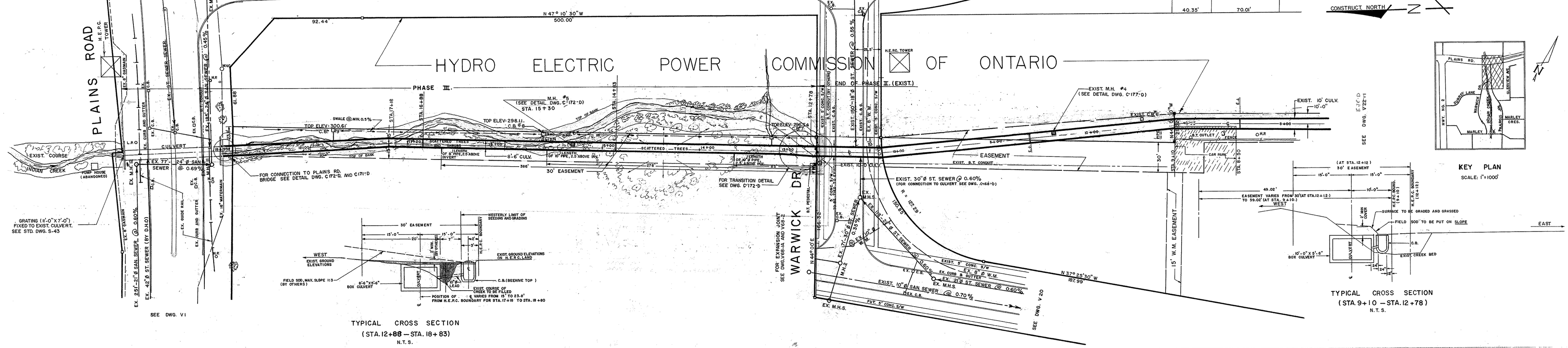
PRELIMINARY GRADING PLAN

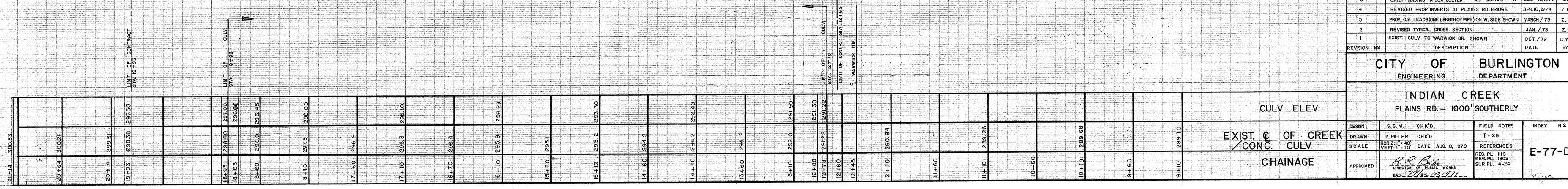
PROJECT No.:	16-518	DATE:	JULY 2017	DRAWING No.:
SCALE: H 1:750				GR-1

Appendix C

Indian Creek Enclosure Plan and Profiles

Urbantech Consulting, A Division of Leighton-Zec Ltd.
25 Royal Crest Court, Suite 201 Markham, Ontario L3R 9X4
TEL: 905.946.9461 FAX: 905.946.9595
www.urbantech.com





NOTE:
1. B.M. - CUT + TOP WEST END, NORTH HEADWALL OF CONC. CULV. AT INDIAN CREEK AND PLAINS ROAD. ELEV. 307.37
2. B.M. - N.W. CORNER CONC. CULV. AT INDIAN CREEK & MARLEY RD. ELEV. 290.89
3. —— GROUTED RIP-RAP TO BE PROVIDED FOR 2' ON ALL SIDES OF C.B.'S
4. CHAINAGES ARE ALONG ℄ OF PROP. CULVERT.
5. EXIST. COURSE OF CREEK TO BE BACKFILLED. SWALE ON EAST SIDE OF EASEMENT TO HAVE A MIN. SLOPE OF 0.5% TOWARDS CATCH BASINS.
6. ALL EXIST. HEADWALLS OF OUT FALLS TO BE DEMOLISHED AND SEWERS CONNECTED TO PROPOSED CULVERT.
7. FOR STRUCTURAL DETAIL SEE DWG. V 68-1-A.
8. OTHER MATERIAL MAY BE ACCEPTABLE, PROVIDED APPROVAL HAS FIRST BEEN OBTAINED FROM THE ENGINEER.

REVISION No	DESCRIPTION	DATE	BY
5	CATCH BASINS IN BOX CULVERT "AS CONST." I-41	DEC 15,1976	C.S
4	REVISED PROP INVERTS AT PLAINS RD. BRIDGE	APR.10,1973	Z.P.
3	PROP. C.B. LEADS (ONE LENGTH OF PIPE) ON W. SIDE SHOWN	MARCH / 73	Z.P.
2	REVISED TYPICAL CROSS SECTION.	JAN. / 73	Z.P.
1	EXIST. CULV. TO WARWICK DR. SHOWN	OCT. / 72	D.Y.


CITY OF BURLINGTON
ENGINEERING DEPARTMENT

INDIAN CREEK
PLAINS RD. — 1000' SOUTHERLY

DESIGN	S.S.M.	CHK'D	
DRAWN	Z.PILLER	CHK'D	
SCALE	HORIZ. 1"=50 VERT. 1"=10	DATE AUG.18, 1970	
APPROVED	R.R. Bibby DIRECTOR OF PUBLIC WORKS DATE Nov 19 1971		

FIELD NOTES: 1-28
REFERENCES: REG. PL. 1116, REG. PL. 1302, SUR. PL. 4-24
INDEX No: E-77-D

	21+14	20+64	20+14	19+93	18+93	18+60	18+10	17+60	17+10	16+70	16+10	15+60	15+10	14+60	14+10	13+60	13+10	12+88	12+60	12+45	12+10	11+60	11+10	10+60	10+10	9+60	9+10
CULV. ELEV.	300.53	300.21	299.51	298.38	297.00	296.66	296.45	296.00	295.10	294.20	293.30	292.40	291.50	291.30	291.22												
EXIST. ℄ OF CREEK / CONC. CULV.					298.60	298.0	297.3	296.9	296.3	295.4	295.9	295.1	295.2	294.2	294.2	294.2	292.0	291.22			290.84		289.26		289.68		289.10
CHAINAGE					18+83	18+60	18+10	17+60	17+10	16+70	16+10	15+60	15+10	14+60	14+10	13+60	13+10	12+88	12+78	12+60	12+10	11+60	11+10	10+60	10+10	9+60	9+10



Chainage	-0+74	-1+05	-1+55	-1+83	-1+93	-2+05	-2+55	-3+05	-3+45	-3+53
Exist. ℄ of creek	284.44	283.02	282.82	282.22	282.22	288.12	282.02	281.48	281.38	
Culv. elev.	283.52	283.30				282.63		281.96		281.60

CHAINAGE	EXIST. ℄ OF CREEK	CULV. ELEV.
12+10	292.2	290.84
11+60	291.3	
11+10	291.3	290.26
10+60	290.8	
10+10	290.6	289.68
9+60	290.4	
9+10	289.8	289.10
8+60	289.8	
8+10	289.3	288.52
7+50	288.5	
7+10	288.6	287.94
6+60	288.00	
6+10	287.9	287.36
5+60	287.4	
5+10	287.3	286.78
4+60	287.2	
4+10	286.7	286.20
3+60	286.1	
3+10	285.6	285.62
2+60	285.4	
2+10	285.1	285.04
1+60	285.2	
1+10	284.1	284.46
0+60	284.2	
0+10	284.6	
0+00	284.6	283.90 (INV. OF CULV.)

REVISION Nº	DESCRIPTION	DATE	BY

CITY OF BURLINGTON
ENGINEERING DEPARTMENT

INDIAN CREEK
MARLEY RD. – 1200' NORTHERLY

DESIGN	S.S.M.	CHK'D		FIELD NOTES	INDEX Nº
DRAWN BY	Z. PILLER	CHK'D		I-28	E-78-D
SCALE	HORIZ. 1"=40 VERT. 1"=10	DATE	AUG.18,1970	REFERENCES	
APPROVED	R.R. Bailey, DIRECTOR OF PUBLIC WORKS, DATE Mar. 10 1971			REG. PL. 1116 REG. PL. 1302 SUR. PL. 4-24	

Appendix D

Geotechnical Report

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www.urbantech.com

REPORT ON GEOTECHNICAL INVESTIGATION GEORGIAN COURT BURLINGTON, ONTARIO

bcIMC Realty Corp.
o/a Georgian Court Estates

Project n^{o} : 161-15952-00
Date: January 5, 2017

WSP Canada Inc.
180 Shearson Crescent, Unit 1 & 2
Cambridge, ON N1T 1P4 Canada

Phone: +1 519-740-0065
Fax: +1 519-740-0045
www.wspgroup.com

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APPENDIX B	GRAIN SIZE DISTRIBUTION CURVES AND PLASTICITY CHART
APPENDIX C	GENERAL COMMENTS – BEDROCK IN METRO TORONTO AREA

1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by bcIMC Realty Corporation o/a Georgian Court Estates to undertake a preliminary geotechnical investigation for the proposed redevelopment at 611-633 & 645 Surrey Lane, 610-740 Surrey Lane, 858-916 Warwick Road, 615-693 & 699 Marley Road, and 847-937 Warwick Road in Burlington, Ontario.

We understand that preliminary Geotechnical and Hydrogeological Investigations are required as part of a redevelopment/official plan amendment application and development feasibility study. It is understood that the proposed residential development will consist of mid- to high-rise (6 to 18-storey) apartment buildings with 3 underground basement levels, as well as townhouse units.

This report deals with the geotechnical aspects of the site. Hydrogeological aspects will be discussed in a separate report.

The purpose of this geotechnical investigation is to determine the subsurface conditions at eighteen (18) borehole locations and from the findings in the boreholes make preliminary engineering recommendations for the following:

1. Foundations
2. Floor slabs and permanent drainage
3. Excavations and Backfill
4. Earth pressures
5. Earthquake considerations
6. Temporary Shoring

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for bcIMC Realty Corporation o/a Georgian Court Estates and its architect and designers. Third party use of this report without WSP consent is prohibited. The limitation conditions presented in this report form an integral part of the report and they must be considered in conjunction with this report.

2 FIELD AND LABORATORY WORK

Eighteen boreholes (BH16-1 through BH16-18) were drilled at the subject site to depths ranging from 6.2 to 15.5m.

The boreholes were drilled with hollow stem augers under the direction and supervision of WSP personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the WSP laboratory for detailed examination by the project engineer who assigned geotechnical laboratory testing.

As well as visual examination in the laboratory, all soil samples were tested for moisture contents. Grain size distribution testing is conducted for selected soil samples. Selected soil samples were subjected to Atterberg Limits Tests and results are presented on the respective borehole logs. The gradation curves for the grain size analyses and the Plasticity Chart are presented in **Appendix B**.

Water level observations were made during drilling and in open boreholes upon completion of the drilling operations. For the monitoring of the long-term groundwater levels, seven (7) monitoring wells of 50mm dia. were installed in boreholes BH16-1, BH16-3, BH16-6, BH16-7, BH16-11, BH16-16, and BH16-17.

The surface elevations at the borehole locations were surveyed by WSP and were referenced to a geodetic benchmark.

3 SITE AND SUBSURFACE CONDITIONS

The Borehole locations are shown on **Drawing 1**. Generalized subsurface profile is attached in **Drawings 2 and 3**. The subsurface conditions in the boreholes are presented in the individual borehole logs in **Appendix A** and are summarized in the following paragraphs.

3.1 SOIL CONDITIONS

TOPSOIL/ASPHALTIC CONCRETE/FILL MATERIAL

A surficial topsoil layer varying from 200 to 600mm in thickness was found in Boreholes BH16-7, BH16-9, BH16-11, and BH16-14. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site.

At the remaining borehole locations, a pavement structure consisting of asphaltic concrete varying from 35 to 150mm underlain by granular base/subbase materials of 75 to 475 mm in thickness was contacted at the surface.

Along the north-east side of the site, fill material consisting of sand to silt with some sand and gravel was found in boreholes BH16-1, BH16-2, BH16-3, and BH16-8 extending to depths varying from 0.9 to 2.3m below ground surface. The fill material was found to be in a very loose to compact state with measured SPT ‘N’ values ranging from 3 to 16 blows per 300mm penetration.

UPPER COHESIONLESS DEPOSITS: SAND TO SILTY SAND

An upper layer of cohesionless deposits of sand, some silt to silty sand with trace to some clay was encountered in most boreholes and was found to be in a very loose to compact state, with measured SPT

'N' values of 1 to 26 blows per 300mm penetration. These deposits were found to be saturated below the depths ranging from 1.5 to 4.5m below ground surface.

Grain size analysis of four samples from the sand to silty sand deposits (BH16-6/SS6, BH16-11/SS5, BH16-16/SS6, and BH16-17/SS6) were conducted and the results are presented in **Figure 1 in Appendix B**, with the following fractions:

Clay: 6 to 18%
Silt: 19 to 28%
Sand: 53 to 73%
Gravel: 1 to 2%

CLAYEY DEPOSITS

Cohesive deposits of clayey silt to silty clay were encountered below the upper cohesionless deposits and/or interbedded with the lower glacial till deposits in BH16-1 through BH16-3, and BH16-5, BH16-6, BH16-9, BH16-13, BH16-14, and BH16-17.

These deposits were found to be in a firm to hard consistency with measured SPT 'N' values ranging from 5 to 41 per 300mm penetration.

Grain size analysis of one sample from the clayey deposits (BH16-1/SS9) was conducted and the results are presented in **Figure 3 in Appendix B**, with the following fractions:

Clay: 29%
Silt: 62%
Sand: 9%
Gravel: -

One sample from the clayey deposits was subjected to Atterberg Limits Testing (BH16-1/SS9). The results are shown on the respective borehole log and on the Plasticity Chart on Figure 4 in Appendix B and are summarized as follows:

Liquid limit (W_L): 31%
Plastic limit (W_P): 18%
Plasticity index (PI): 13%

These values are characteristic of clays of low plasticity.

GLACIAL TILL DEPOSITS

Glacial till deposits consisting of clayey silt to silty clay till, sandy silt to silt to silty sand till were encountered in most boreholes and were found to be in a very stiff to hard consistency or compact to very dense state with measured SPT 'N' values of 15 to more than 50 blows per 300mm penetration.

Grain size analysis of two samples from the till deposits (BH16-3/SS10, BH16-7/SS6) were conducted and the results are presented in **Figure 2 in Appendix B**, with the following fractions:

Clay: 10 to 19%
Silt: 26 to 48%
Sand: 23 to 53%
Gravel: 10 to 11%

Two samples from the glacial till deposits were subjected to Atterberg Limits Testing (BH16-3/SS10, BH16-7/SS6). The results are shown on the respective borehole logs and on the Plasticity Chart on Figure 4 in Appendix B and are summarized as follows:

Liquid limit (W_L): 21 to 24%
Plastic limit (W_P): 15 to 18%
Plasticity index (PI): 6%

These values are characteristic of clayey silts of low plasticity.

TILL/SHALE COMPLEX

Below the glacial till deposits, a clayey silt to silt to silty sand till/shale complex deposit was encountered in BH16-1 through BH16-3 and BH16-6. The till/shale complex consists of a mixture of clayey silt to silt to sandy silt till and highly/completely weathered shale. The consistency/relative density of the till/shale complex was hard/dense to very dense with measured SPT 'N' values of 33 to more than 50 blows per 300 mm penetration. Water contents measured in test samples ranged from 9% to 12%. There is a gradual transition from this till/shale complex into shale bedrock and the shale bedrock surface may vary and can be higher. Some of the contractors may assume the till/shale complex as shale bedrock. The till/shale complex may also contain limestone seams/layers.

INFERRED SHALE BEDROCK

Shale bedrock of the Queenston Formation was encountered in BH16-1 through BH16-7. The inferred top of bedrock level varies from Elev. 77.3m to 80.2m as summarized in Table 3.1. Shale bedrock was not proven by bedrock coring. It is noted that variations in the bedrock surface should be expected. It is often difficult to distinguish where shale/till complex ends and bedrock begins, particularly where the bedrock surface is weathered. As such, the inferred bedrock surface level should not be considered accurate to better than ±1m.

Table 3.1: Approximate Depth and Elevation of Shale Bedrock Surface

BOREHOLE NO.	APPROXIMATE DEPTH OF SHALE BEDROCK SURFACE (m)	APPROXIMATE ELEVATION OF SHALE BEDROCK SURFACE (ASSUMED) (m)	NOTES
BH16-1	11.0	80.2	Hard augering at inferred bedrock surface
BH16-2	11.3	79.4	Hard augering at inferred bedrock surface
BH16-3	12.2	77.3	Sampler refusal at inferred bedrock surface

BOREHOLE NO.	APPROXIMATE DEPTH OF SHALE BEDROCK SURFACE (m)	APPROXIMATE ELEVATION OF SHALE BEDROCK SURFACE (ASSUMED) (m)	NOTES
BH16-4	11.9	80.0	Hard augering at inferred bedrock surface
BH16-5	11.6	80.2	Hard augering at inferred bedrock surface
BH16-6	15.2	79.5	Hard augering/Sampler refusal at inferred bedrock surface
BH16-7	12.5	80.1	Hard augering at inferred bedrock surface

The shale bedrock generally contains layers of sandstone, limestone and dolostone. Typically the hard layers comprise about 15 to 20 percent of the unit. However, higher concentrations of hard layers can be present. The hard layers are usually less than 200 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at other sites. The layers are actually lenses and they can vary significantly in thickness over short distance.

Methane gas is anticipated in the bedrock. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly for caissons. Stress relief features such as folds and faults are common in the shale bedrock. Appendix C presents more details and general comments about the shale bedrock.

3.2 GROUNDWATER CONDITIONS

During drilling, groundwater was found in the open boreholes at depths ranging from 5.6 to 7.6m below ground surface. The groundwater table observed in the monitoring wells on December 12 and 16, 2016 was reported to be at depths ranging from 4.3 to 10.6m, corresponding to elevations ranging from 171.2 to 177.2m, as listed on Table 3.2.

Table 3.2 - Groundwater Levels Observed in Open Boreholes and Monitoring Wells

BH NO.	GROUND SURFACE ELEV. (m)	SOIL TYPE AT SCREEN LOCATION (DEPTH, m)	DEPTH / WATER LEVEL ELEVATION (M)			NOTES
			ON COMPLETION	DEC. 12, 2016	DEC. 16, 2016	
BH16-1	91.2	Silty Clay (7.6 – 9.1)	-	0.2 / 91.0	0.2 / 91.0	50mm dia. monitoring well
BH16-2	90.7	N/A	7.2 / 83.5	N/A	N/A	-
BH16-3	89.5	Silty Sand Till/Shale Complex (10.6 – 12.1)	-	2.8 / 86.7	2.8 / 86.7	50mm dia. monitoring well
BH16-4	91.9	N/A	3.7 / 88.2	N/A	N/A	-
BH16-5	91.8	N/A	4.3 / 87.5	N/A	N/A	-
BH16-6	94.7	Silty Sand (3.1 – 6.1)	-	4.4 / 90.3	4.3 / 90.4	50mm dia. monitoring well

BH NO.	GROUND SURFACE ELEV. (m)	SOIL TYPE AT SCREEN LOCATION (DEPTH, m)	DEPTH / WATER LEVEL ELEVATION (M)			NOTES
			ON COMPLETION	DEC. 12, 2016	DEC. 16, 2016	
BH16-7	92.6	Silt Till (4.6 – 6.1)	-	2.9 / 89.7	2.8 / 89.8	50mm dia. monitoring well
BH16-8	89.6	N/A	1.5 / 88.1	N/A	N/A	Saturated soils at 1.5 m depth
BH16-9	90.6	N/A	2.4 / 88.2	N/A	N/A	Saturated soils at 2.4 m depth
BH16-10	91.1	N/A	2.1 / 89.0	N/A	N/A	-
BH16-11	91.6	Sand/Silty Clay Till (3.1 – 6.1)	-	2.6 / 89.0	2.6 / 89.0	50mm dia. monitoring well
BH16-12	91.6	N/A	2.3 / 89.3	N/A	N/A	-
BH16-13	93.0	N/A	2.6 / 90.4	N/A	N/A	-
BH16-14	93.1	N/A	2.4 / 90.7	N/A	N/A	Saturated soils at 2.4 m depth
BH16-15	92.8	N/A	2.6 / 90.2	N/A	N/A	-
BH16-16	92.8	Silty Sand (4.6 – 6.1)	-	2.5 / 90.3	2.5 / 90.3	50mm dia. monitoring well
BH16-17	94.2	Silty Sand (3.1 – 6.1)	-	3.4 / 90.3	3.4 / 90.8	50mm dia. monitoring well
BH16-18	93.9	N/A	3.1 / 90.8	N/A	N/A	-

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

The groundwater elevation at the site is highest in the north and east (approximately 91 meters above sea level (masl)) and declines toward the south (89 masl) and west (86.7 masl). The groundwater flow direction at the site is consistent with the regional groundwater flow regime, such that groundwater flows towards and discharges into Lake Ontario, located south of the project site.

Grain size analyses were performed on soil samples from seven boreholes. Hydraulic Conductivity was estimated using the Hazen Method for sandy soils and the Puckett et al Method for fine grained soil and the combined results are summarized below:

Geometric Mean K	6.2E-07 m/s
Highest K	5.0E-06 m/s
Lowest K	2.4E-08 m/s

4 FOUNDATIONS

It is understood that the proposed residential development will consist of mid- to high-rise (6 to 18-storey) apartment buildings with 3 underground basement levels in the areas of BH16-1 through BH16-7, as well as townhouse units in the areas of the remaining boreholes.

The basement floor elevations are not known to us at the time of writing this report. The basement floor of P3 will be about 9m below ground surface. The footings are expected to be about 1 to 2m below the P3 basement floor slab. For townhouses with 1 level of basement, the footings are expected to be around 3m below ground surface.

At the anticipated footing levels, the proposed mid to high-rise buildings with 3-level basement can be supported by spread and strip footings/raft foundations founded on the undisturbed hard/very dense till/shale complex for a bearing capacity value of 300 to 400 kPa at SLS (Serviceability Limit State), and 450 to 600 kPa at ULS (Ultimate Limit State), or on shale bedrock bedrock for a bearing capacity value of 1,500 kPa at SLS (Serviceability Limit State), and for a factored geotechnical resistances of 2,250 kPa at ULS.

Townhouses can be supported by spread and strip footings founded on the undisturbed native soils for a bearing capacity values of 150 kPa at SLS (Serviceability Limit State), and 225 kPa at ULS (Ultimate Limit State) in compact sand below 2 to 3m from existing grade, as the upper sandy soils are very loose and not suitable for founding the footings nor the slab-on-grade. The bearing pressures and the founding depth are given in Table 4-1 at the borehole locations.

Table 4-1 Bearing Values and Founding Levels of Spread Footings on native soils

BH No.	Material	Geotechnical Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Founding level at or below (m)	
				Depth Below Existing Grade	Elevation
BH16-1	Silty Clay Till	300	450	3.0	88.2
	Till/Shale Complex	400	600	9.1	82.1
	Bedrock	1500	2250	11.0	80.2
BH16-2	Silty Clay Till	200	300	2.3	88.4
	Till/Shale Complex	400	600	9.1	81.6
	Bedrock	1500	2250	11.3	79.4
BH16-3	Clayey Silt Till	300	450	2.3	87.2
	Silty Clay/Till/Shale Complex	400	600	6.1	83.4
	Bedrock	1500	2250	10.6	78.9
BH16-4	Sand	150	225	1.5	90.4
	Silty Clay Till	300	450	4.5	87.4
	Bedrock	1500	2250	11.9	80.0
BH16-5	Silty Clay	250	375	3.0	88.8
	Silty Clay	300	450	4.5	87.3
	Bedrock	1500	2250	11.6	80.2

BH No.	Material	Geotechnical Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Founding level at or below (m)	
				Depth Below Existing Grade	Elevation
BH16-6	Silty Sand	150	225	4.5	90.2
	Silty Clay Till	300	450	6.1	88.6
	Till/Shale Complex	600	900	12.2	82.5
	Bedrock	1500	2250	15.2	79.5
BH16-7	Sand	150	225	2.3	90.3
	Silt Till	300	450	6.0	86.6
	Bedrock	1500	2250	12.5	80.1
BH16-8	Clayey Silt Till	300	450	2.4	87.2
BH16-9	Sand/Clayey Silt	150	225	0.8	89.8
	Clayey Silt	300	450	4.5	86.1
BH16-10	Sand	150	225	3.5	87.6
	Silty Clay Till	300	450	4.6	86.5
BH16-11	Sand	150	225	1.5	90.1
	Silty Clay Till	300	450	4.6	87.0
BH16-12	Sand	150	225	1.5	90.1
	Silty Clay Till	300	450	4.6	87.0
BH16-13	Sand	200	300	2.3	90.7
	Silty Clay	300	450	4.5	88.5
BH16-14	Sand	150	225	2.3	90.8
	Silty Clay	300	450	6.0	87.1
BH16-15	Sand	200	300	2.3	90.5
	Silty Clay Till	300	450	4.6	88.2
BH16-16	Sand	150	225	3.0	89.8
	Clayey Silt Till	300	450	6.1	86.7
BH16-17	Silty Sand	150	225	2.3	91.9
	Silty Clay	300	450	6.1	88.1
BH16-18	Sand	150	225	3.0	90.9
	Clayey Silt Till	300	450	6.1	87.8

Based on the borehole and monitoring well information, the groundwater at the site is expected to be about 0.2 to 4.4m m below grade (Elev. 86.7 m to 91.0 m). Dewatering will be required prior to the excavation in wet sands, otherwise it will result in loss of soil and bearing capacity. The groundwater table must be lowered to at least 1.0 m below the deepest excavation base. A contractor specializing in dewatering should be retained to design the dewatering systems. Groundwater can be lowered by 0.3 m to 0.5 m by pumping from oversized excavations and flatter side slopes as illustrated on Drawing 4. For deeper excavations, positive dewatering will be required.

If the sandy soils at the anticipated townhouse footing levels are wet, they can be easily disturbed to foot traffic. In this case, the base must be covered with 50 mm thick mud slab immediately after inspection and cleaning.

Footings designed to the specified allowable bearing capacity at the serviceability limit states (SLS) are expected to settle 25 mm total and 19 mm differential.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

All foundation bases must be inspected by this office prior to pouring concrete. Where the excavated footings base are in wet to saturated sandy deposits these should be covered with 50 mm thick mud slab immediately after inspection and cleaning, in order to avoid disturbance of the founding soil due to construction activity and weathering /drying.

It should be noted that the recommended bearing capacities have been calculated by WSP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by WSP to validate the information for use during the construction stage.

5 FROST PROTECTION

All foundations exposed to seasonal freezing conditions must have at least 1.2 metres of soil cover for frost protection.

There is no official rule governing the required founding depth for footings below unheated basement floors. Certainly, it will not be greater than the 1.2 m required in Southern Ontario for exterior footings. Un-monitored experience indicates that a shallower depth ranging from 0.82 to 0.9 m for interior column footings and 0.4 m for wall footings has been successful where 2 or more basement levels apply. The 0.82 m depth is believed to be close to the minimum structural requirement for interior column footings. Adjacent to air shafts and entrance and exit doors, a footing depth of 1.2 m below floor level is required or, alternatively, insulation protection must be provided.

It is also emphasized that underfloor drainage and/or an adequate free draining gravel base is required to minimize the risk of floor dampness. Floor dampness could lead to temporary icing and the risk of accidents.

6 FLOOR SLAB AND PERMANENT DRAINAGE

The floor slab can be supported on grade provided all loose to very loose fill and native sands, and any disturbed native soils are removed and the base thoroughly proof rolled. The loose sands must be removed and replaced by engineered fill or improved by dynamic compaction. The fill required to raise the grade can consist of inorganic soil, placed in shallow lifts and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200mm of 19mm clear crushed stone should be installed under the floor slab.

A perimeter and underfloor drainage system will be required around the exterior basement walls, as shown on Drawings 5 to 7. Where the exposed subgrade consists of cohesionless soil below the water table, all openings including the subgrade must be covered or wrapped with filter fabric, typically a Class II non-woven textile with a filtration opening size (F.O.S.) of 50 to 100 µm. Above the filter fabric, we recommend that 60 mm thick concrete sand be placed to prevent the loss of silt fines through the filter fabric. It is imperative that both the filter fabric and concrete sand are placed on the subgrade.

As to be discussed in Section 8 of this report, a detailed hydrogeologic study is required for the design of the permanent perimeter and underfloor drainages, as well as for the temporary groundwater control during the construction stage.

7 ELEVATOR PITS AND SUMP PITS

It is anticipated that some elevator pits in the P3 level and sump pits for the townhouses will be installed in cohesionless soils below the water table. In this case, drainage systems at the base level of the elevator pits / sump pits are not recommended, due to the concern of loss of fines. The elevator pits/ sump pits can be designed as water-tight structures, and water pressure on the pit walls and the slab should be considered, assuming the water table at about 0.3m below the adjacent basement floor.

8 EXCAVATIONS AND GROUNDWATER CONTROL

Excavations can be carried out with heavy hydraulic backhoe. Stabilized groundwater table in the monitoring wells was reported to be in the range of 0.2 to 4.4m below ground surface, corresponding to Elev. 86.7 to 91.0m. Any excavation in sandy and silty deposits below the groundwater will require positive dewatering such as well points/eductors; otherwise, it will result in an unstable base and flowing sides. The groundwater encountered at higher elevations may be handled by pumping from sumps/trenches.

The groundwater pressure levels measured in the monitoring wells installed in the lower deposits (aquifer) in BH16-1 and BH16-3 were at about elevation 86.7 to 91.0m. The groundwater table must be lowered to at least 1.0m below the deepest excavation. A contractor specializing in dewatering should be retained to design the dewatering systems.

It should be noted that the till is a non-sorted sediment and therefore may contain boulders. Possible large obstructions such as buried concrete pieces are also anticipated in the fill material. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the existing fill, stiff silty clay to clayey silt can be classified as Type 3 Soil above the groundwater table and Type 4 below groundwater table. The very stiff to hard clayey silt till can be classified as Type 2 Soil above the groundwater table and Type 3 Soil below groundwater table. Cohesionless sands and silts below the groundwater can be classified as Type 4 Soil and Type 3 Soil above groundwater (with dewatering).

Select existing fill and the native soils free from topsoil and organics can be used as general construction backfill. Loose lifts of soil, which are to be compacted, should not exceed 200mm. Depending on the time of construction and weather, some excavated material may be too wet to compact and will require aeration prior to its use.

The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular B should be used. Imported granular fill used in confined areas can be compacted with hand held equipment. Underfloor fill should be compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

9 TEMPORARY SHORING

A caisson wall may be required to support adjacent structures. The requirement for caisson wall to support adjacent structures is given on **Drawing 8**.

Dewatering will be required for the installation of shoring lagging in the sand, sandy silt till and sandy silt deposits.

The shoring system must be designed in accordance with the Fourth Edition of the Canadian Foundation Engineering Manual. The soil parameters estimated to be applicable for this design are as follows:

1) Earth Pressure Coefficients

   (a) where movement must be minimal K=0.45

   (b) where minor movement (.002H) can be tolerated K=0.28

   (c) passive earth pressure for soldier piles (unfactored) Kp=3.0

2) For stability check

   ϕ= 32°

   c= 0

   γ = 21 kN/m^3

Surcharge is to be determined by shoring contractor

3) For earth anchors

Based on the borehole information, an allowable bond value of 50 kPa is suggested for the dense or hard soils and 30 kPa for very stiff soils; this value depends on anchor installation methods and grouting procedures. Gravity poured concrete can result in low bond values while pressure grouted anchors will give higher values and produce a more satisfactory anchor.

Casing will be required during the construction of the tiebacks to prevent caving of soils. The soldier piles should be installed in pre-augered holes taken below the deepest excavation. The holes should be filled with concrete below the excavation level and half bag mix above the base of the excavation. The concrete strength must be specified by the shoring designer. Temporary liners may be required to help prevent the sandy and sandy silt deposits from caving during the installation period. Positive measures may be required to prevent the loss of soil through the spaces between the lagging boards. This could probably be achieved by placing well-graded sand and gravel behind the lagging boards or by installing a geotextile filter cloth.

Soil anchors will be required to support the shoring. The anchors must be of a length that meets the Canadian Foundation Manual recommendations. It is important to note that the minimum length lies beyond the 45 - $\phi/2$ + .15H line drawn from the base of the soldier pile and the overall stability of the system must be checked at each anchor level.

The top anchor must not be placed lower than 3.0 metres below the top of level ground surface. Anchors will require casing when penetrating through wet sand and sandy silt layers. Allowable bond values suggested above are arbitrary; hence, the contractor must decide on a capacity and confirm its availability. All anchors must be tested as indicated in the Foundation Manual, 4th edition.

Adhesion on the buried caisson shaft or behind the shoring system must be neglected when designing this shoring system.

Movement of the shoring system is inevitable. Vertical movements will result from the vertical load on the soldier piles resulting from the inclined tiebacks and inward horizontal movement results from earth and water pressures. The magnitude of this movement can be controlled by sound construction practices, and it is anticipated that the horizontal movement will be in the range of 0.1 to 0.25%H.

To ensure that movements of the shoring are within an acceptable range, monitoring must be carried out. Vertical and horizontal targets on the soldier piles must be located and surveyed before excavation begins. Weekly readings during excavation should show that the movements will be within those predicted; if not, the monitoring results will enable directions to be given to improve the shoring.

10 EARTH PRESSURES

The lateral earth pressures acting on basement walls may be calculated from the following expression:

$$p = K(\gamma h + q)$$

where p = Lateral earth pressure in kPa acting at depth h

K = Earth pressure coefficient equal to 0.4 for vertical walls and horizontal backfill.

γ = Unit weight of backfill, a value of 21 kN/m^3 may be assumed

h = Depth to point of interest in metres

q = Equivalent value of surcharge on the ground surface in kPa

The above expression assumes that the perimeter drainage system prevents the build-up of any hydrostatic pressure behind the wall. When the foundation wall is poured against the caisson wall, the foundation wall as well as the caisson wall should be designed for hydrostatic pressure, even though the drainage board is provided between the caisson wall and the basement wall.

11 EARTHQUAKE CONSIDERATIONS

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed buildings can be classified as Class 'C' for seismic site response for buildings with 1 to 3 levels of basement.

12 LIMITATIONS OF REPORT

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to WSP Canada Inc.at the time of preparation. Unless otherwise agreed in writing by WSP Consultants Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

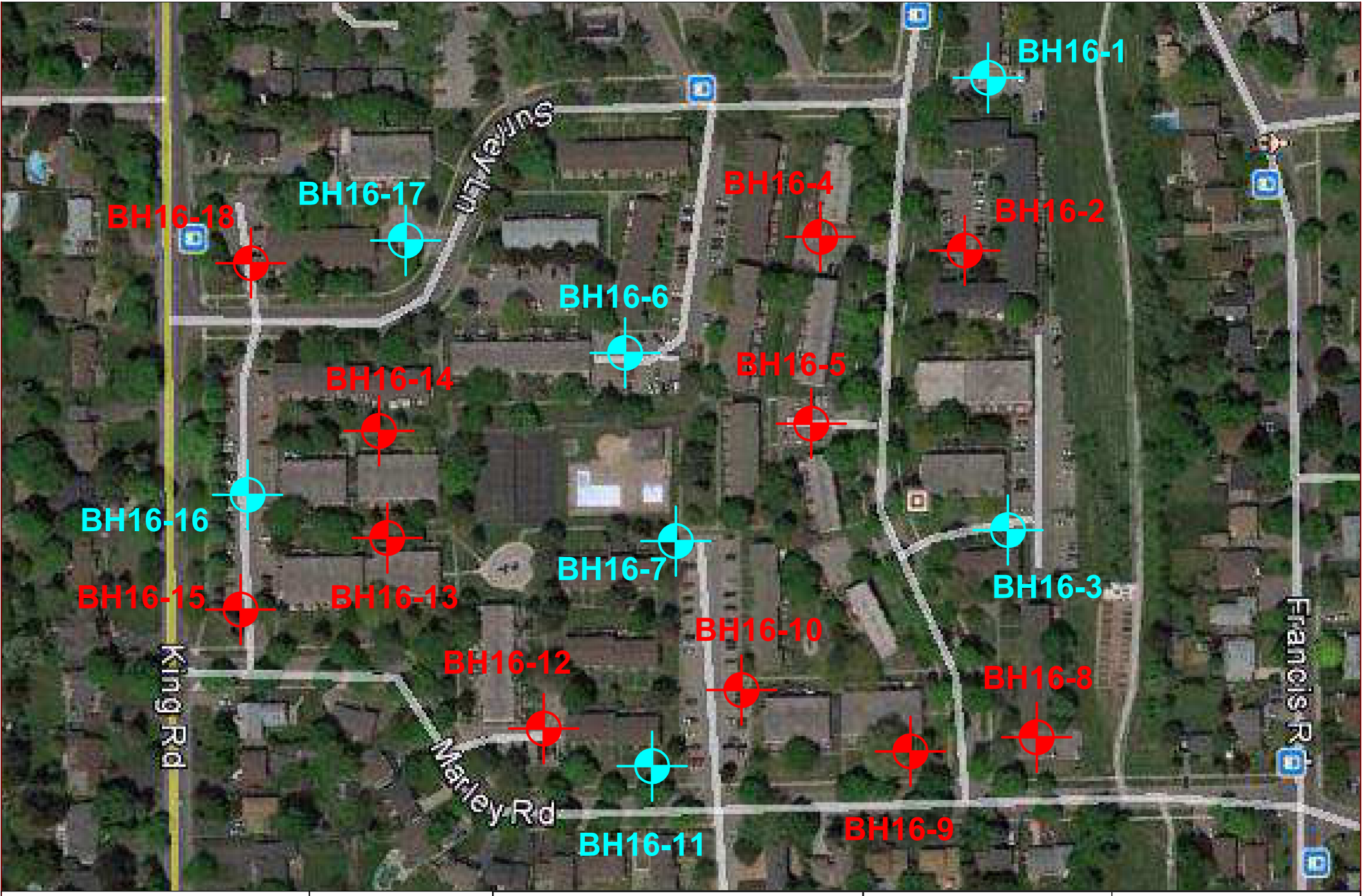
Eva Papp, P.Eng.



Shabbir Bandukwala, M.Eng., P.Eng.

Drawings

BOREHOLE LOCATION PLAN (DRAWING 1)
GENERALIZED SUBSURFACE PROFILES (DRAWINGS 2-3)
TYPICAL EXCAVATION PROCEDURE FOR SHALLOW DEPTHS
BELOW THE WATER TABLE IN SAND (DAWING 4)
DRAINAGE AND BACKFILL RECOMMENDATIONS (DRAWINGS 5-7)
GUIDELINES FOR UNDERPINNING (DRAWING 8)



SCALE:

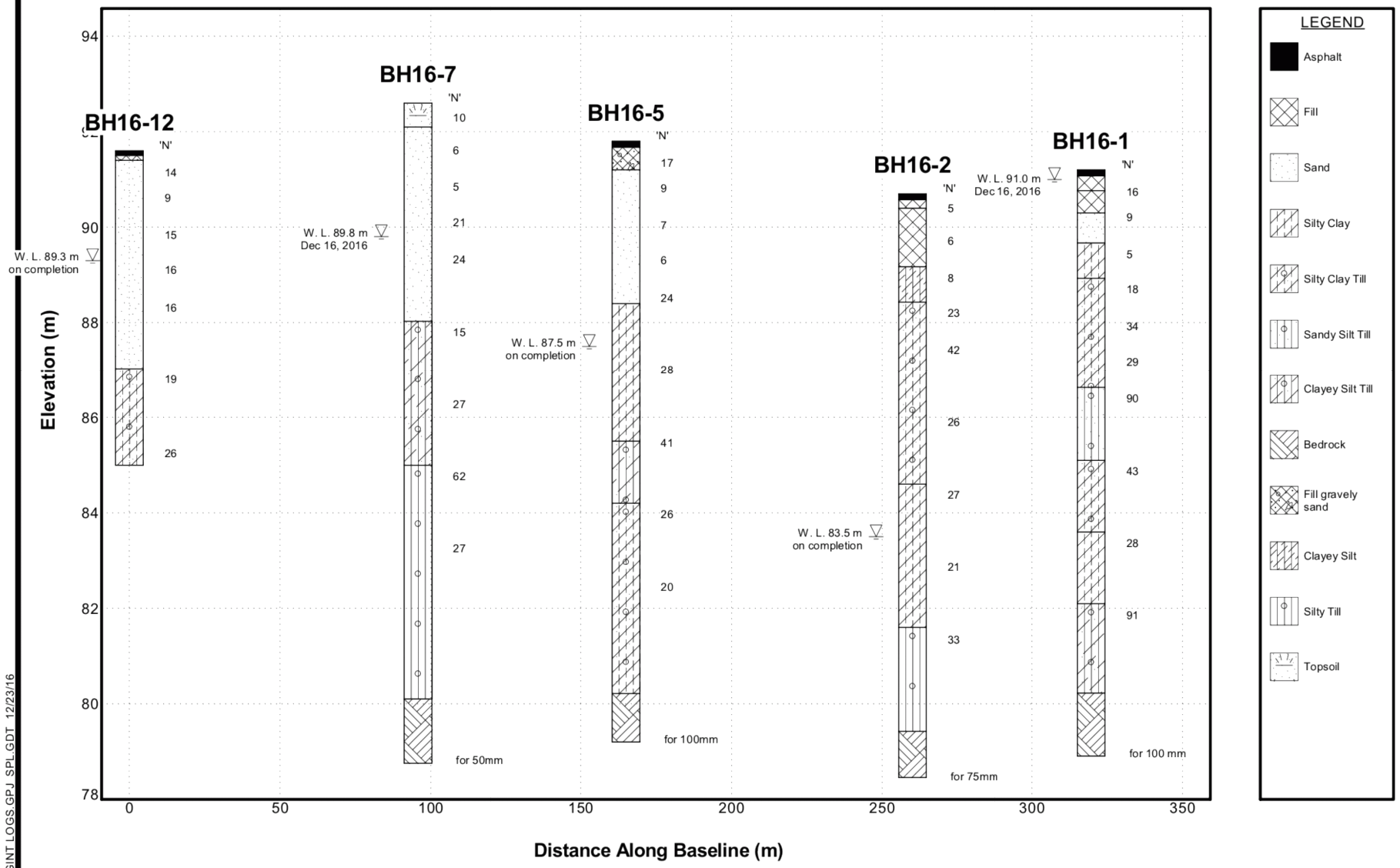
5M

0M 10M 30M 50M 100M

BOREHOLES:
BH16–13

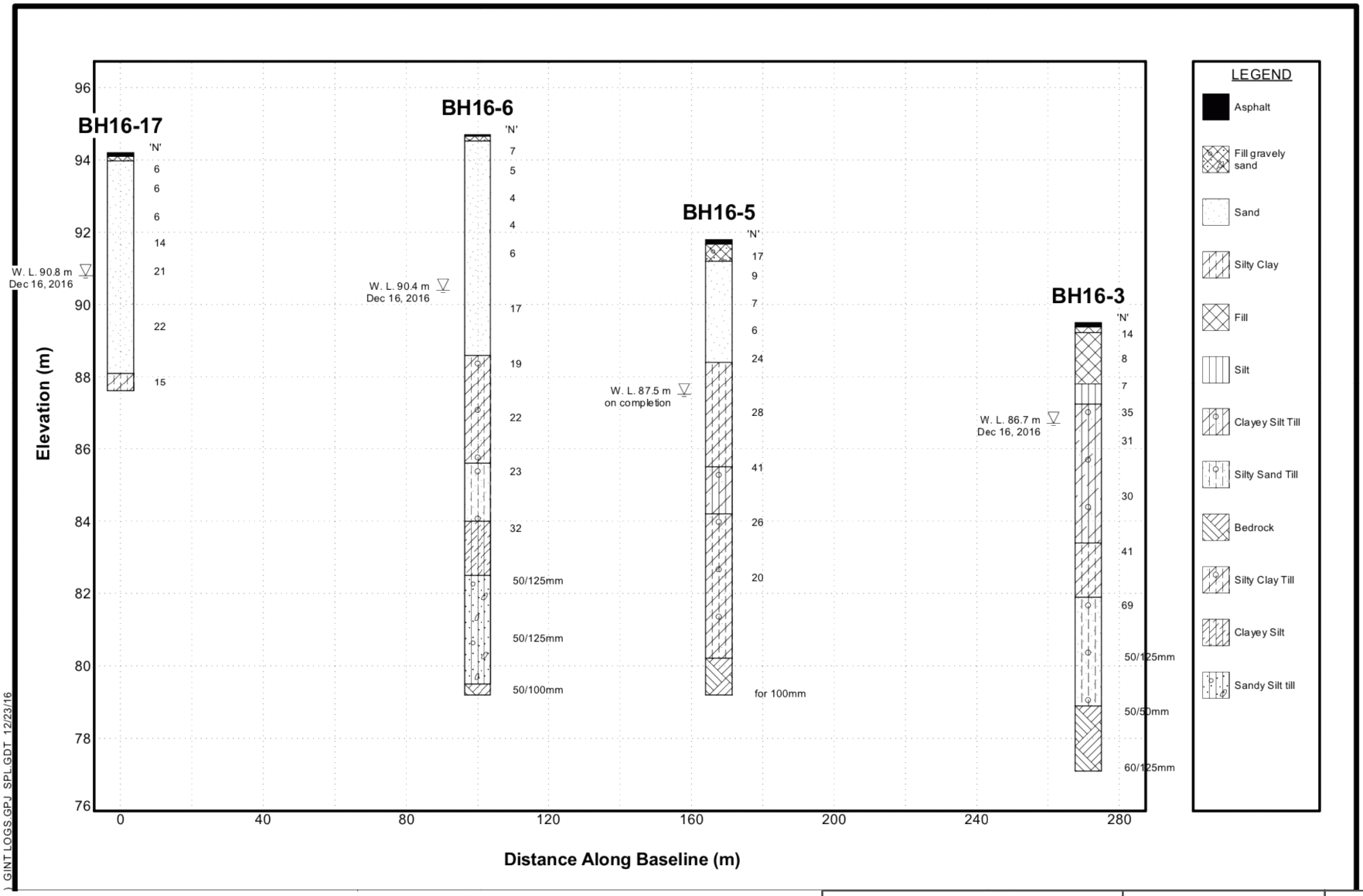
MONITORING WELLS:
BH16–1

Client: **bc IMC Realty Corp. o/a Georgina Court Estates**				Project No.: **161-15952-00**	Drawing No.: **1**
Drawn: **AP**		Approved: **EP**		Title: **Borehole Location Plan**	
Date: **Nov, 2016**		Scale: **As Shown**		Project: **Geotechnical and Hydrogeological Investigation Georgian Court, Burlington, Ontario**	
Original Size: **Tabloid**		Rev: **N/A**		WSP	



GINT LOGS.GPJ SPL.GDT 12/23/16

Client:	bcIMC Realty Corp. o/a Georgina Court Estates			Project No.: 161-15952-00	Drawing No.: 2
Drawn:	AP	Approved:	EP	Title:	Cross Section, South to North
Date:	DEC, 2016	Scale:	NTS	Project:	Geotechnical and Hydrogeological Investigation Georgian Court, Burlington, Ontario
Original Size:	Tabloid	Rev:	N/A		WSP

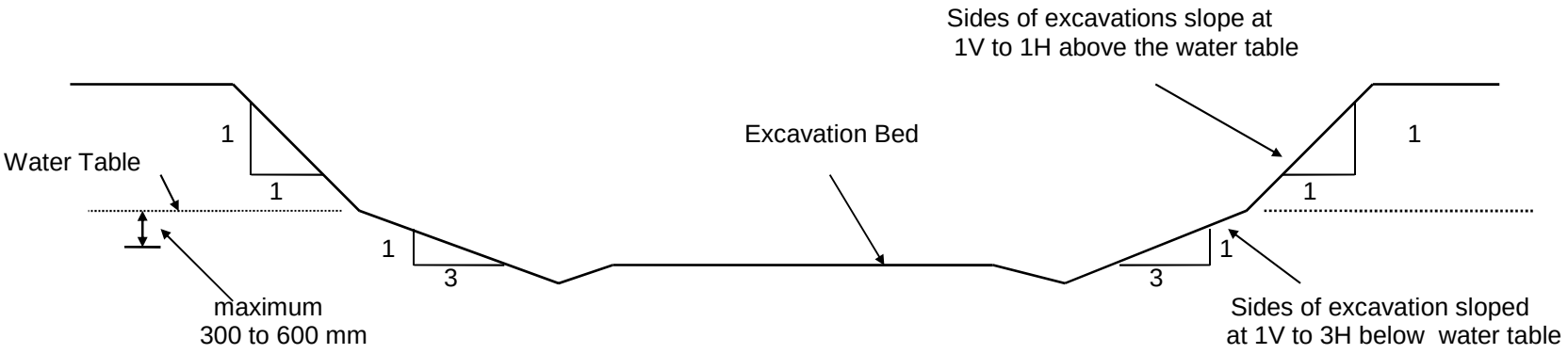


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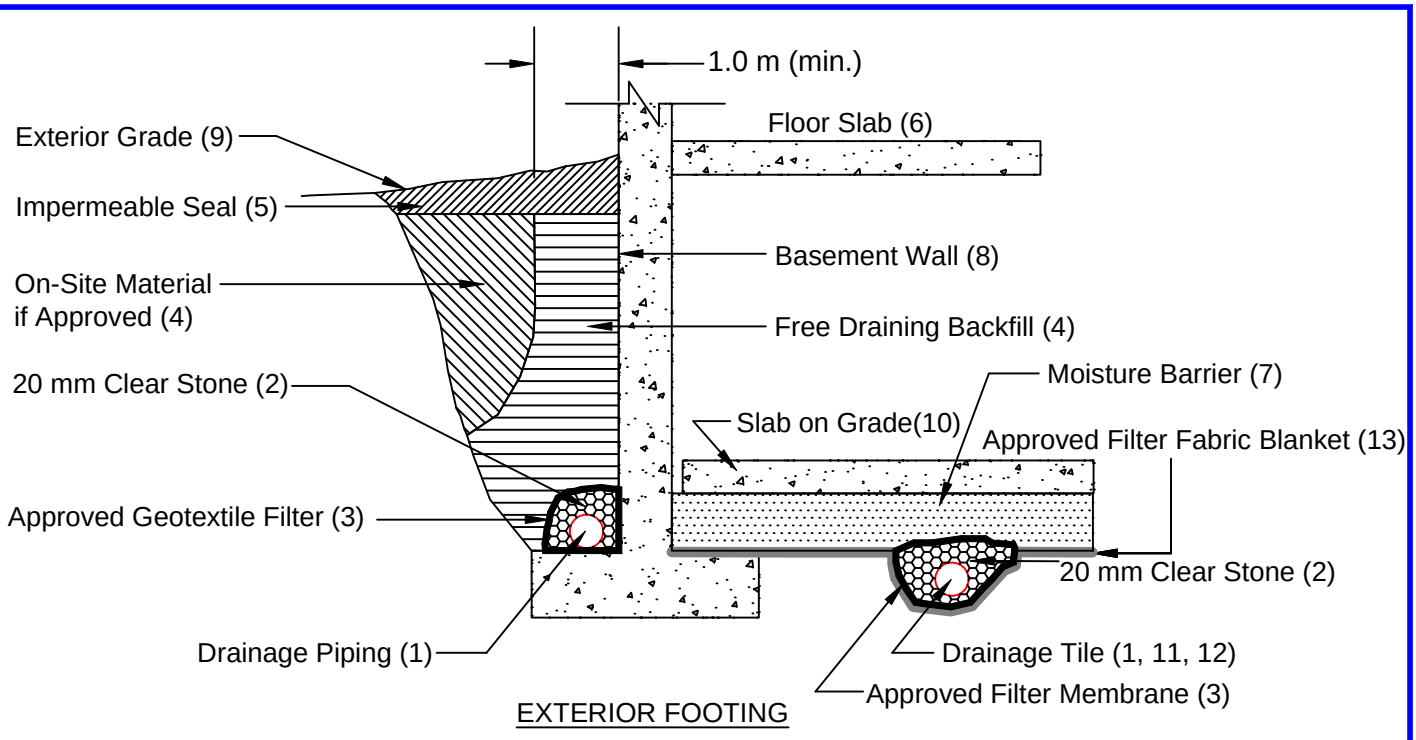
Client:	bc IMC Realty Corp. o/a Georgina Court Estates			Project No.: 161-15952-00	Drawing No.: 3
Drawn:	AP	Approved:	EP	Title:	Cross Section, West to East
Date:	DEC, 2016	Scale:	NTS	Project:	Geotechnical Hydrogeological Investigation Georgian Court, Burlington, Ontario
Original Size:	Tabloid	Rev:	N/A		WSP

PROJECT : 161-15952-00 **DRAWING 4**

TYPICAL EXCAVATION PROCEDURE FOR SHALLOW DEPTHS BELOW THE WATER TABLE IN SAND



Ditches dug at least 300 mm below the excavation bed to depress the water table (May be deeper if necessary)



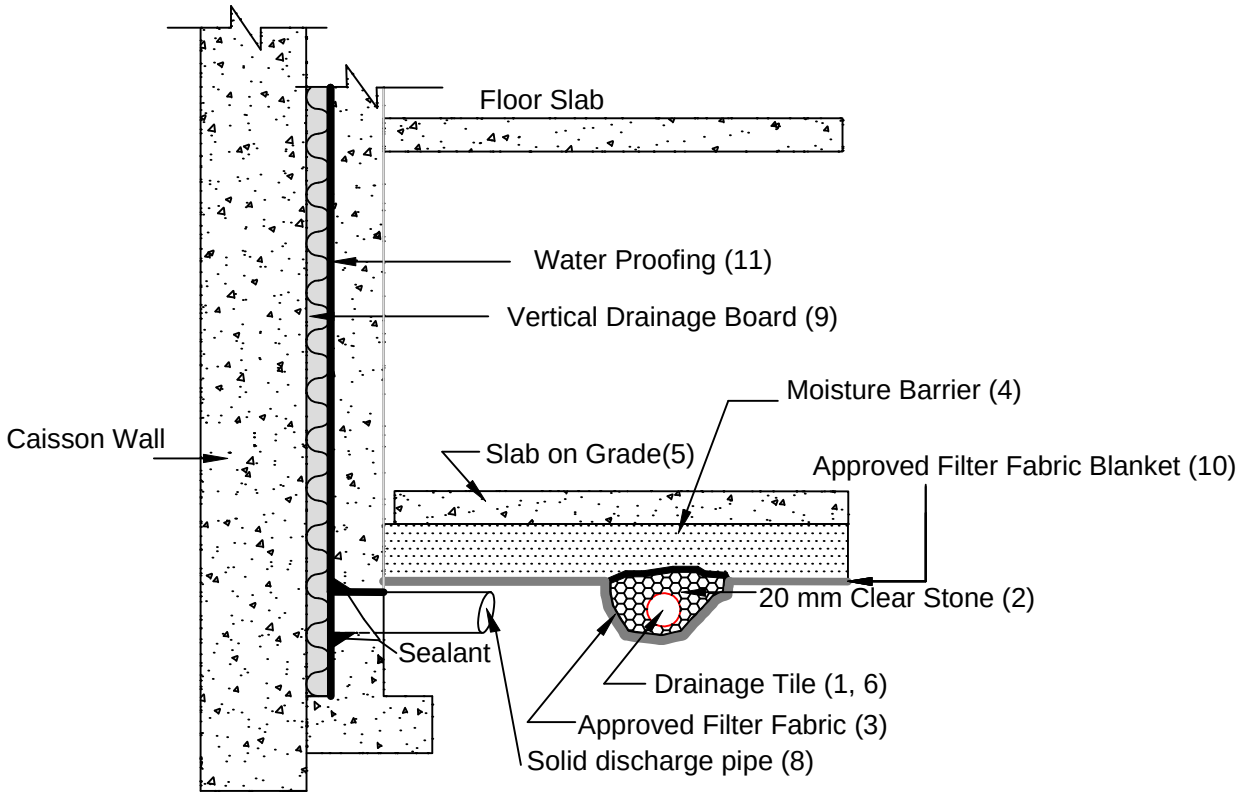
EXTERIOR FOOTING

Notes

1. Drainage piping to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved geotextile filter fabrics (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed as per OBC requirements.
9. Exterior grade to slope away from building min 2%.
10. Slab on grade should not be structurally connected to the wall or footing. Waterproof the slab and the slab-to-wall joint.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage piping placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be covered with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)

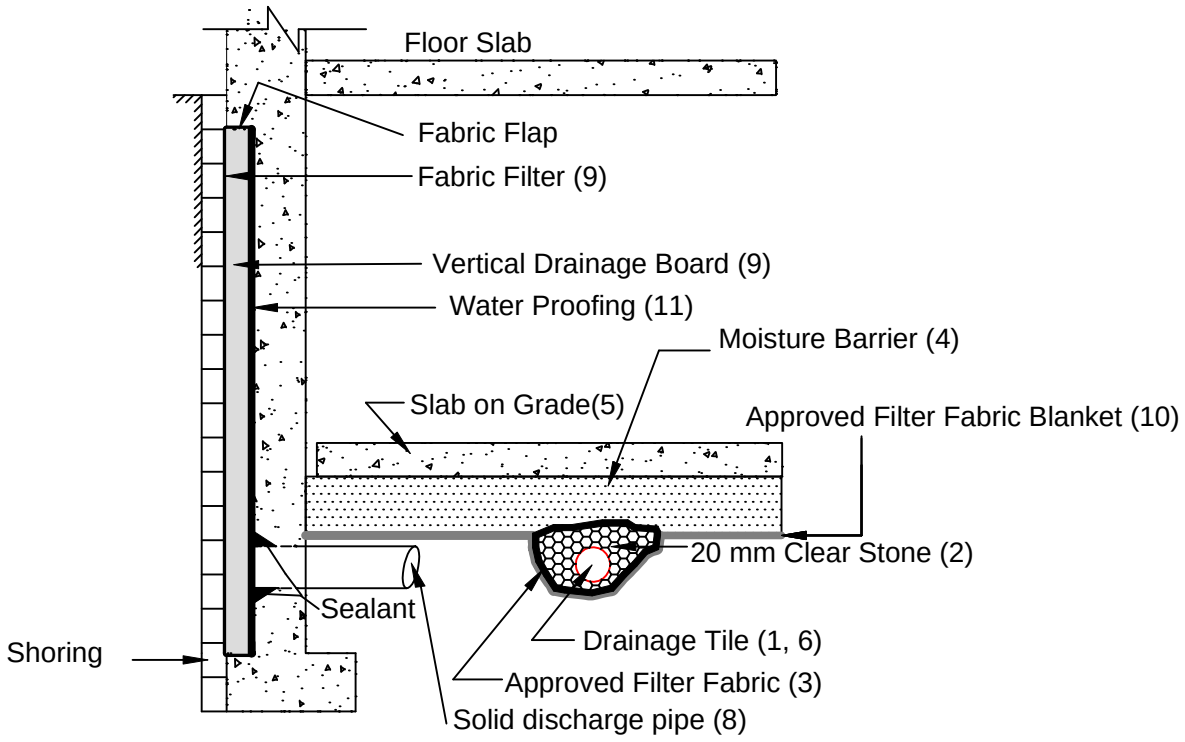


EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board mira-drain 6000 or eqivalent with filter cloth should be continous from bottom to 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls must be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System
(not to scale)



EXTERIOR FOOTING

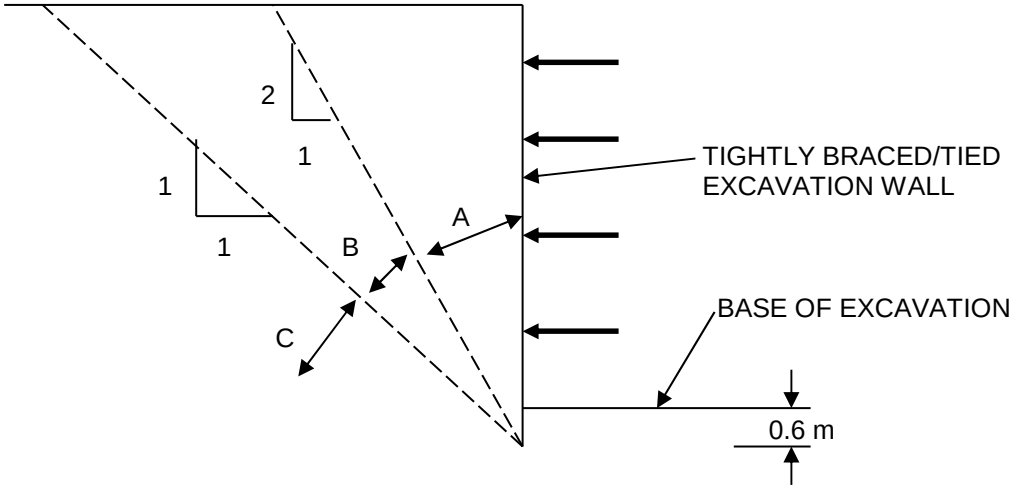
Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System
(not to scale)

Guidelines for Underpinning in Soil and Excavation Support

Existing foundations located within Zone A normally require underpinning, especially for heavy structures. For some foundations in Zone A, it may be possible to eliminate underpinning and control foundation movement by tightly braced excavation walls, such as caisson walls.



Zone A Foundations located within this zone normally require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered

Zone B Foundations located within this zone normally do not require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered

Zone C Underpinning to structures is normally founded in this zone. Lateral pressure from underpinning is not normally considered

(Reference: Figure 26.27 from Canadian Foundation Engineering Manual, 4th Edition)

Appendix A

EXPLANATION OF TERMS USED IN BOREHOLE LOG
LOGS OF BOREHOLES

Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

WH – Samples sinks under "weight of hammer"

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

Textural Classification of Soils (ASTM D2487-10)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm - 4.75 mm
Silt	0.002 mm - 0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction
1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

LOG OF BOREHOLE BH16-1

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797248 E 595103

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 2

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
91.2 / 0.0	**ASPHALTIC CONCRETE:** 125mm			
90.8 / 0.1	**GRANULAR BASE/SUBBASE:** 305mm	1	SS	16
90.3 / 0.4	**FILL:** silt with some sand and gravel, reddish brown/brown/black, very moist, compact			
89.7 / 0.9	**SAND:** some silt, trace organics, brown, very moist, loose	2	SS	9
88.9 / 1.5	**SILTY CLAY:** trace organics, dark brown, very moist, firm	3	SS	5
86.6 / 2.3	**SILTY CLAY TILL:** trace sand, brown, moist, very stiff	4	SS	18
	hard	5	SS	34
		6	SS	29
85.1 / 4.6	**SANDY SILT TILL:** trace gravel, trace clay, brown, moist, very dense	7	SS	90
83.6 / 6.1	**SILTY CLAY TILL:** some sand, trace gravel, grey, moist, hard	8	SS	43
82.1 / 7.6	**SILTY CLAY:** grey, moist, very stiff	9	SS	28
81.0 / 9.1	**CLAYEY SILT TILL/ SHALE COMPLEX:** trace sand, trace gravel, trace shale, reddish brown, very moist to wet, hard	10	SS	91

GROUND WATER CONDITIONS: W. L. 91.0 m Dec 16, 2017

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

DEPTH (m)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1.5	75		
2.3	225		
3.8	225		
4.6			
7.6			9 62 29

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-1

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797248 E 595103

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 2

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT TILL/ SHALE COMPLEX: trace sand, trace gravel, trace shale, reddish brown, very moist to wet, hard(Continued)						81				
80.2											
11.0	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown **(Queenston Formation)**						80				Hard augering
78.9			11	SS	for 100 mm		79				
12.3	**Refusal:** on assumed bedrock **Notes:** Water levels Dec 12 0.2 m.B.G.S. Dec 16 0.2 m.B.G.S. Combustible gas reading: 1200ppm in open borehole upon completion.										

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH16-2

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797196 E 595144

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
90.7												
90.6	**ASPHALTIC CONCRETE:** 125mm											
90.4 0.3	**GRANULAR BASE/ SUBBASE:** 175mm		1	SS	5		90					
	FILL: medium to fine sand, trace organics, brown, black layers, wet, loose		2	SS	6							
89.2							89			75		
1.5	**CLAYEY SILT:** trace organics, trace sand, reddish brown, moist, stiff		3	SS	8							
88.4							88			225		
2.3	**SILTY CLAY TILL:** trace sand, brown, moist, very stiff		4	SS	23							
	trace shale fragments, grey, hard		5	SS	42		87					
	very stiff		6	SS	26		86					
84.6							85					
6.1	**SILTY CLAY:** trace sand and gravel, grey, moist, very stiff		7	SS	27	▽	84			225		
								W. L. 83.5 m on completion				
			8	SS	21		83			125		
81.6							82					
9.1	**SILT TILL/ SHALE COMPLEX:** trace sand and gravel, reddish brown, wet, dense		9	SS	33							
							81					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-2

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797196 E 595144

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 3

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILT TILL/ SHALE COMPLEX: trace sand and gravel, reddish brown, wet, dense(Continued)						80				
11 79.4											
11.3	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown **(Queenston Formation)**						79				Hard augering
12 78.5											
12.2	**Refusal:** on assumed bedrock		10	SS	for 75mm						

Notes:
Combustible gas reading: 560 ppm in open borehole upon completion.
Water level at 7.2 m.b.g.l. upon completion.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797133 E 595244

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/02/2016

REF. NO.: 161-15952-00
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.5												
89.4	**ASPHALTIC CONCRETE:** 115mm											
89.2 / 0.3	**GRANULAR BASE/ SUBBASE:** 165mm		1	SS	14		89					
	FILL: sand, some silt, trace clay, trace organics, dark brown, very moist to wet, compact to loose		2	SS	8		88					
87.8			3	SS	7							
1.7 / 87.2	**SILT:** some sand, some clay, sand layers, brown, satured, loose											
2.3	**CLAYEY SILT TILL:** trace sand and gravel, brown, moist, hard		4	SS	35	▽	87					
								W. L. 86.7 m Dec 16, 2017				
			5	SS	31		86					
			6	SS	30		85					
83.4							84					
6.1	**SILTY CLAY:** trace sand, trace shale, occassional red layers, grey, moist, hard		7	SS	41		83					
81.9							82					
7.6	**SILTY SAND TILL/SHALE COMPLEX:** some clay, some gravel, reddish brown, moist, very dense		8	SS	69		81					
			9	SS	50/ 125mm		80					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-3

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797133 E 595244

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/02/2016

REF. NO.: 161-15952-00
ENCL NO.: 4

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY SAND TILL/SHALE COMPLEX: some clay, some gravel, reddish brown, moist, very dense(Continued)											
			10	SS	50/ 50mm		79					Hard augering 11 53 26 10
11												
							78					
12												
77.3 12.2	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown (**Queenston Formation**)		11	SS	60/ 125mm							
77.1 12.4	**Refusal:** on assumed bedrock											

Notes:
Water levels
Dec 12 2.8 m.B.G.S.
Dec 16 2.8 m.B.G.S.
Combustible gas reading: 560 ppm in open borehole upon completion.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-4

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797149 E 595106

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 5

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
91.9 / 0.0	**ASPHALTIC CONCRETE:** 125mm				
91.7 / 0.2	**GRANULAR BASE/SUBBASE:** 75mm	1	SS	8	
	SAND: some to trace silt, trace clay, reddish brown, wet, loose				
1	brown	2	SS	9	91
	saturated, compact	3	SS	16	
2		4	SS	18	90
88.9 / 3					89
3.1	**SILTY CLAY TILL:** trace sand, grey, moist, very stiff	5	SS	17	
4					
	trace gravel	6	SS	29	87
5					
6					86
85.6 / 6.3	**CLAYEY SILT TILL:** grey, moist, hard	7	SS	39	
7					85
8		8	SS	43	84
9	very stiff	9	SS	17	83
10					82

GROUND WATER CONDITIONS: ▽ W. L. 88.2 m on completion

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa): 225 (NUMBER 6), 225 (NUMBER 7)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-4

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797149 E 595106

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT TILL: grey, moist, hard(Continued)											
11							81					
80.0												
12 11.9	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown **(Queenston Formation)**						80					Hard augering
79.0			10	SS	for 75mm							
12.9	**Refusal:** on assumed bedrock											

Notes:
Combustible gas reading: 0 ppm in open borehole upon completion.
Water level at 3.7 m.b.g.l. upon completion.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-5

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797099 E 595146

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
91.8 / 0.0	**ASPHALTIC CONCRETE:** 125mm				
91.7 / 0.1	**GRANULAR BASE/ SUBBASE:** 475mm	1	SS	17	
91.2 / 0.6	**SAND:** trace silt, reddish brown, very moist trace organics, brown, wet, loose	2	SS	9	91
1	reddish brown, saturated	3	SS	7	90
2		4	SS	6	89
3		5	SS	24	
88.4 / 3.4	**SILTY CLAY:** trace sand, grey, very moist, very stiff				88
4		6	SS	28	87
5					
6					86
85.5 / 6.3	**CLAYEY SILT TILL:** grey, moist, hard	7	SS	41	
7					85
84.2 / 7.6	**SILTY CLAY TILL:** grey, very moist, very stiff	8	SS	26	84
8					
9					83
9		SS	20		
10					82

GROUND WATER CONDITIONS: ▽ W. L. 87.5 m on completion

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa): 125; 225; 225

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-5

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797099 E 595146

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/01/2016

REF. NO.: 161-15952-00
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY TILL: grey, very moist, very stiff(Continued)											
11							81					
80.2												
11.6	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown **(Queenston Formation)**											Hard augering
12							80					
79.2			10	SS	for 100mm							
12.6	**Refusal:** on assumed bedrock **Notes:** Combustible gas reading: 590 ppm in open borehole upon completion. Water level at 4.3 m.b.g.l. upon completion.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH16-6

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797069 E 595085

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/05/2016

REF. NO.: 161-15952-00
ENCL NO.: 7

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
94.7 / 0.0	**ASPHALTIC CONCRETE:** 35mm				
94.5 / 0.2	**GRANULAR BASE/ SUBBASE:** 145mm				
	SILTY SAND: some clay, trace organics, reddish brown, very moist, loose	1	SS	7	94
		2	SS	5	
	wet	3	SS	4	93
		4	SS	4	92
		5	SS	6	91
	W. L. 90.4 m Dec 16, 2017				
	grey, saturated, compact	6	SS	17	90
88.6 / 6.1	**SILTY CLAY TILL:** trace sand, grey, moist, very stiff	7	SS	19	89
		8	SS	22	88
85.6 / 9.1	**SILTY SAND TILL:** trace clay, grey, very moist, compact	9	SS	23	87
					86
					85

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		1 53 28 18
225		
175		

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-6

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797069 E 595085

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/05/2016

REF. NO.: 161-15952-00
ENCL NO.: 7

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.0	**SILTY SAND TILL:** trace clay, grey, very moist, compact(Continued)										
10.7	**CLAYEY SILT:** grey, moist, hard		10	SS	32		84	○	○	225	
11											
12 82.5							83				
12.2	**SANDY SILT TILL/SHALE COMPLEX:** reddish brown, moist, very dense		11	SS	50/ 125mm				○	150	
13							82				
14			12	SS	50/ 125mm		81		○		
15 79.5							80				
15.2 79.2	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown **(Queenston Formation)**		13	SS	50/ 100mm				○		Hard augering
15.5	**Refusal:** on assumed bedrock										

Notes:
Water levels
Dec 12 4.4 m.B.G.S.
Dec 16 4.3 m.B.G.S.
Combustible gas reading: 0ppm in open borehole upon completion.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-7

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797029 E 595150

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/02/2016

REF. NO.: 161-15952-00
ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
92.6					
0.0 / 92.1	**TOPSOIL:** dark brown, very moist, loose, 500 mm	1	SS	10	
0.5	**SAND:** trace silt, trace gravel, reddish brown, very moist, loose				92
	wet	2	SS	6	
		3	SS	5	91
	saturated, compact	4	SS	21	90
		5	SS	24	89
88.0					
4.6	**SILT TILL:** some clay to clayey, sandy, trace to some gravel, grey, very moist, very stiff	6	SS	15	88
		7	SS	27	87
85.0					86
7.6	**SILT TILL:** with some sand, trace gravel, trace clay, grey, very moist, very dense	8	SS	62	85
	compact	9	SS	27	84
					83

W. L. 89.8 m
Dec 16, 2017

10 23 48 19

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-7

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797029 E 595150

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/02/2016

REF. NO.: 161-15952-00
ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILT TILL: with some sand, trace gravel, trace clay, grey, very moist, very dense(Continued)						82					
11												
12							81					
80.1												
12.5	**INFERRED BEDROCK:** shale interbedded with siltstone/ limestone, reddish brown **(Queenston Formation)**						80					Hard augering
13												
78.8			10	SS	for 50mm		79					
13.8	**Refusal:** on assumed bedrock **Notes:** Water levels Dec 12 2.9 m.B.G.S. Dec 16 2.8 m.B.G.S. Combustible gas reaidng: 1200 ppm in open borehole upon completion.											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-8

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797080 E 595312

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/02/2016

REF. NO.: 161-15952-00
ENCL NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.6												
89.6	**ASPHALTIC CONCRETE:** 110mm											
89.3 0.3	**GRANULAR BASE/ SUBBASE:** 165mm		1	SS	7							
	FILL: sand, some silt, reddish brown, very moist, loose						89					
1	very loose		2	SS	3							
	saturated		3	SS	3		88					
2 87.2												
2.4	**CLAYEY SILT TILL:** trace sand, red, moist, very stiff		4	SS	19		87			225		
3			5	SS	20					225		
4	with occassional silt layers, hard		6	SS	34		86 85					
5 6			7	SS	30		84					
83.0							83					
6.6	**End of Borehole:**											
	Notes: Borehole dry on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-9

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797038 E 595283

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/07/2016

REF. NO.: 161-15952-00
ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
90.6												
0.0 90.3	**TOPSOIL:** dark brown, very moist, loose, 300 mm		1	SS	6							
0.3	**SAND:** trace topsoil, reddish brown, very moist, compact						90					
1	trace silt		2	SS	17							
	reddish brown/brown layers		3	SS	16		89					
2	saturated		4	SS	21		88					
87.6												
3.1	**CLAYEY SILT:** trace sand, grey, moist, very stiff		5	SS	17		87			225		
4	hard		6	SS	31		86					
5							85					
6	very stiff		7	SS	29							
84.0							84					
6.6	**End of Borehole:** **Notes:** Borehole dry on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-10

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797001 E 595211

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/02/2016

REF. NO.: 161-15952-00
ENCL NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.1												
90.9	**ASPHALTIC CONCRETE:** 110mm											
90.6	**GRANULAR BASE/ SUBBASE:** 140mm											
0.3	**SAND:** trace to some silt, reddish brown, very moist, compact		1	SS	12		91					
1	loose		2	SS	9		90					
	saturated, loose to very loose		3	SS	4	▽						
2							89	W. L. 89.0 m on completion				
			4	SS	3							
3	compact		5	SS	12		88					
4							87					
86.5												
4.6	**SILTY CLAY TILL:** trace shale, trace sand and gravel, grey, moist, very stiff		6	SS	22					225		
5							86					
6												
84.9			7	SS	50/ 100mm		85			125		
6.2	**End of Borehole:**											

Notes:
Water level at 2.1 m.b.g.l. upon completion.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH16-11

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796956 E 595211

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/07/2016

REF. NO.: 161-15952-00
ENCL NO.: 12

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.6												
90.6 0.2	**TOPSOIL:** dark brown, very moist, loose, 200 mm		1	SS	5		91					
	SAND: some silt, trace clay, trace gravel, reddish brown, very moist, loose											
1	very moist to wet, compact		2	SS	10							
	trace gravel, very moist		3	SS	13		90					
2												
	saturated		4	SS	19		89					
						▽		W. L. 89.0 m Dec 16, 2017				
3			5	SS	12							2 73 19 6
							88					
4												
87.0 4.6	**SILTY CLAY TILL:** trace gravel, moist, very stiff		6	SS	24		87			225		
5												
							86					
6												
	hard		7	SS	35							
85.0 6.6	**End of Borehole:**						85					
	Notes: Water levels Dec 12 2.6 m.B.G.S. Dec 16 2.6 m.B.G.S.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-12

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796935 E 595168

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/06/2016

REF. NO.: 161-15952-00
ENCL NO.: 13

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.6												
91.4 0.2	**ASPHALTIC CONCRETE:** 100mm **GRANULAR BASE/ SUBBASE:** 100mm **SAND:** trace to some silt, reddish brown, very moist, loose		1	SS	14		91					
1	trace silt, brown, compact		2	SS	9							
2			3	SS	15		90					
	saturated		4	SS	16	▽	W. L. 89.3 m on completion					
3			5	SS	16		89					
4							88					
87.0 4.6	**SILTY CLAY TILL:** trace silt, grey, moist, very stiff		6	SS	19		87			200		
5												
6	trace clay, trace gravel		7	SS	26		86					
85.0 6.6	**End of Borehole:** **Notes:** Water level at 2.3 m.b.g.l. upon completion.						85					

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-13

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796947 E 595067

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/07/2016

REF. NO.: 161-15952-00
ENCL NO.: 14

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.0												
92.9 / 0.1	**ASPHALTIC CONCRETE:** 50mm											
	GRANULAR BASE/ SUBBASE: 50mm											
92.2	**SAND:** trace silt, reddish brown, very moist, loose		1	SS	6							
0.8 / 91.5	**SILT:** some sand, reddish brown, very moist, loose		2	SS	8		92					
1.5	**SAND:** trace silt, brown/ reddish brown, very moist, loose		3	SS	4		91					
	saturated, compact		4	SS	17	▽						
							W. L. 90.4 m on completion					
88.5			5	SS	20		90					
4.5	**SILTY CLAY:** trace sand, grey, very moist to moist, very stiff		6	SS	15		89			175		
							88					
			7	SS	20		87			225		
86.4												
6.6	**End of Borehole:**											
	Notes: Water level at 2.6 m.b.g.l. upon completion.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-14

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796974 E 595039

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/07/2016

REF. NO.: 161-15952-00
ENCL NO.: 15

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.1												
0.0 / 92.5	**TOPSOIL:** dark brown, very moist, loose, 600 mm		1	SS	10		93					
0.6 / 88.5	**SAND:** trace to some silt, reddish brown, very moist, loose - - - - - - - - - - - - - - - - brown - - - - - - - - - - - - - - - - saturated, compact		2	SS	4		92					
			3	SS	6		91					
			4	SS	15		90					
			5	SS	20		89					
4.6 / 86.5	**SILTY CLAY:** trace sand, grey, moist, stiff - - - - - - - - - - - - - - - - very stiff		6	SS	14		88			225		
			7	SS	25		87					
6.6	**End of Borehole:** **Notes:** Borehole dry on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-15

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796884 E 595049

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/05/2016

REF. NO.: 161-15952-00
ENCL NO.: 16

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
92.8												
92.7 0.1	**ASPHALTIC CONCRETE:** 100mm											
92.6 0.3	**GRANULAR BASE/ SUBBASE:** 150mm											
	SAND: some silt, reddish brown, very moist, compact		1	SS	10		92					
1			2	SS	10							
	loose		3	SS	5		91					
2												
	trace silt, grey, compact, saturated		4	SS	23	▽	W. L. 90.2 m on completion					
3			5	SS	26		89					
4												
88.2 4.6	**SILTY CLAY TILL:** trace sand, grey, moist, very stiff		6	SS	17		88			225		
5												
6 86.7							87					
6.1 86.4	**SILT TILL:** some sand, trace gravel, very moist, very dense		7	SS	50/ 150mm							
6.4	**End of Borehole:** **Notes:** Water level at 2.6 m.b.g.l. upon completion.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-16

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796916 E 595016

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/05/2016

REF. NO.: 161-15952-00
ENCL NO.: 17

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
92.8 / 0.0	**ASPHALTIC CONCRETE:** 100mm				
92.7 / 0.1	**GRANULAR BASE/ SUBBASE:** 100mm				
92.6 / 0.2	**SAND:** trace to some silt, reddish brown, very moist, loose	1	SS	5	
		2	SS	4	92
		3	SS	7	91
	saturated	4	SS	6	W. L. 90.3 m Dec 16, 2017
	compact	5	SS	13	90
					89
88.2 / 4.6	**SILTY SAND:** some clay, trace gravel, grey, very moist, compact	6	SS	18	88
86.7 / 6.1	**CLAYEY SILT TILL:** grey, moist, hard	7	SS	31	87
86.2 / 6.6	**End of Borehole:** **Notes:** Water levels Dec 12 2.5 m.B.G.S. Dec 16 2.5 m.B.G.S.				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa): 225

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
2	67	20	11

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-17

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4797035 E 594991

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/06/2016

REF. NO.: 161-15952-00
ENCL NO.: 18

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
94.2												
94.0 0.1	**ASPHALTIC CONCRETE:** 100mm											
93.9 0.2	**GRANULAR BASE/ SUBBASE:** 125mm											
	SILTY SAND: some clay, trace gravel, reddish brown, very moist, loose		1	SS	6		94					
1			2	SS	6							
	trace silt, brown		3	SS	6		93					
2	compact		4	SS	14		92					
3	reddish brown, saturated		5	SS	21		91					
						W. L. 90.8 m Dec 16, 2017						
4							90					
5			6	SS	22							1 61 22 16
6 88.1							89					
6.1 87.6	**SILTY CLAY:** trace sand, grey, very moist, very stiff		7	SS	15		88			150		
6.6	**End of Borehole:**											

Notes:
Water levels
Dec 12 3.4 m.B.G.S.
Dec 16 3.4 m.B.G.S.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

LOG OF BOREHOLE BH16-18

PROJECT: Geotechnical Investigation
CLIENT: bcIMC Realty Corp. o/a Georgian Court Estates
PROJECT LOCATION: Georgina Court Redevelopment
DATUM: Geodetic
BH LOCATION: N 4796984 E 594949

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 0.2
Date: Dec/06/2016

REF. NO.: 161-15952-00
ENCL NO.: 19

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.9												
90.0	**ASPHALTIC CONCRETE:** 150mm											
0.2 / 93.4	**GRANULAR BASE/ SUBBASE:** 350mm		1	SS	22				○			
0.5	**SAND:** trace to some silt, reddish brown, very moist, compact		2	SS	17		93		○			
1	very loose		3	SS	3				○			
2	wet		4	SS	1		92		○			
3	saturated, compact		5	SS	17	▽	91		○			
							W. L. 90.8 m on completion					
4							90					
			6	SS	25				○			
5							89					
6 / 87.8							88					
6.1 / 87.3	**CLAYEY SILT TILL:** trace sand, grey, moist, very stiff		7	SS	24				○			
6.6	**End of Borehole:** **Notes:** Water level at 3.1 m.b.g.l. upon completion.											

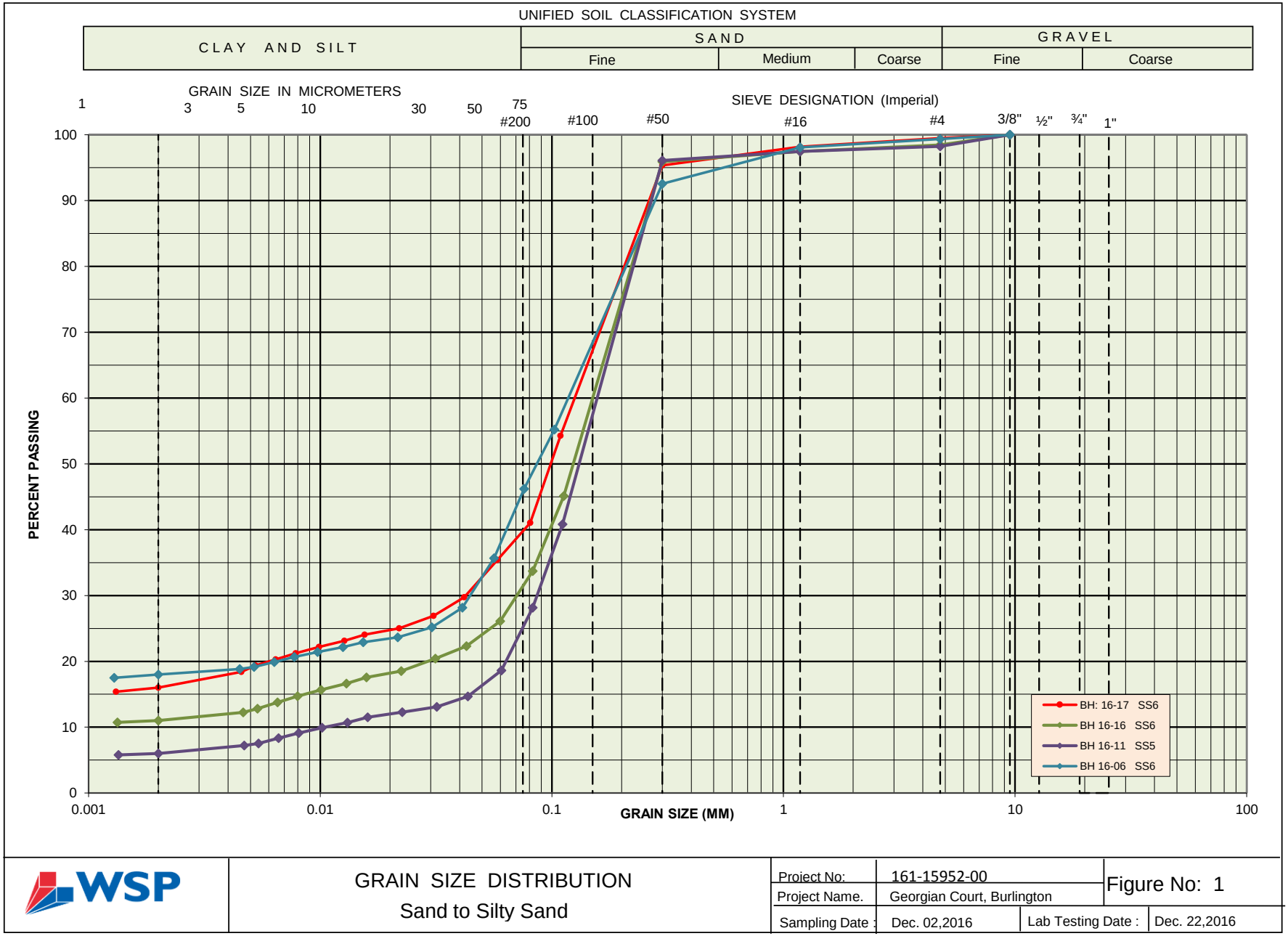
GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP SOIL LOG GINT LOGS.GPJ SPL.GDT 1/3/17

Appendix B

GRAIN SIZE DISTRIBUTION CURVES
PLASTICITY CHART

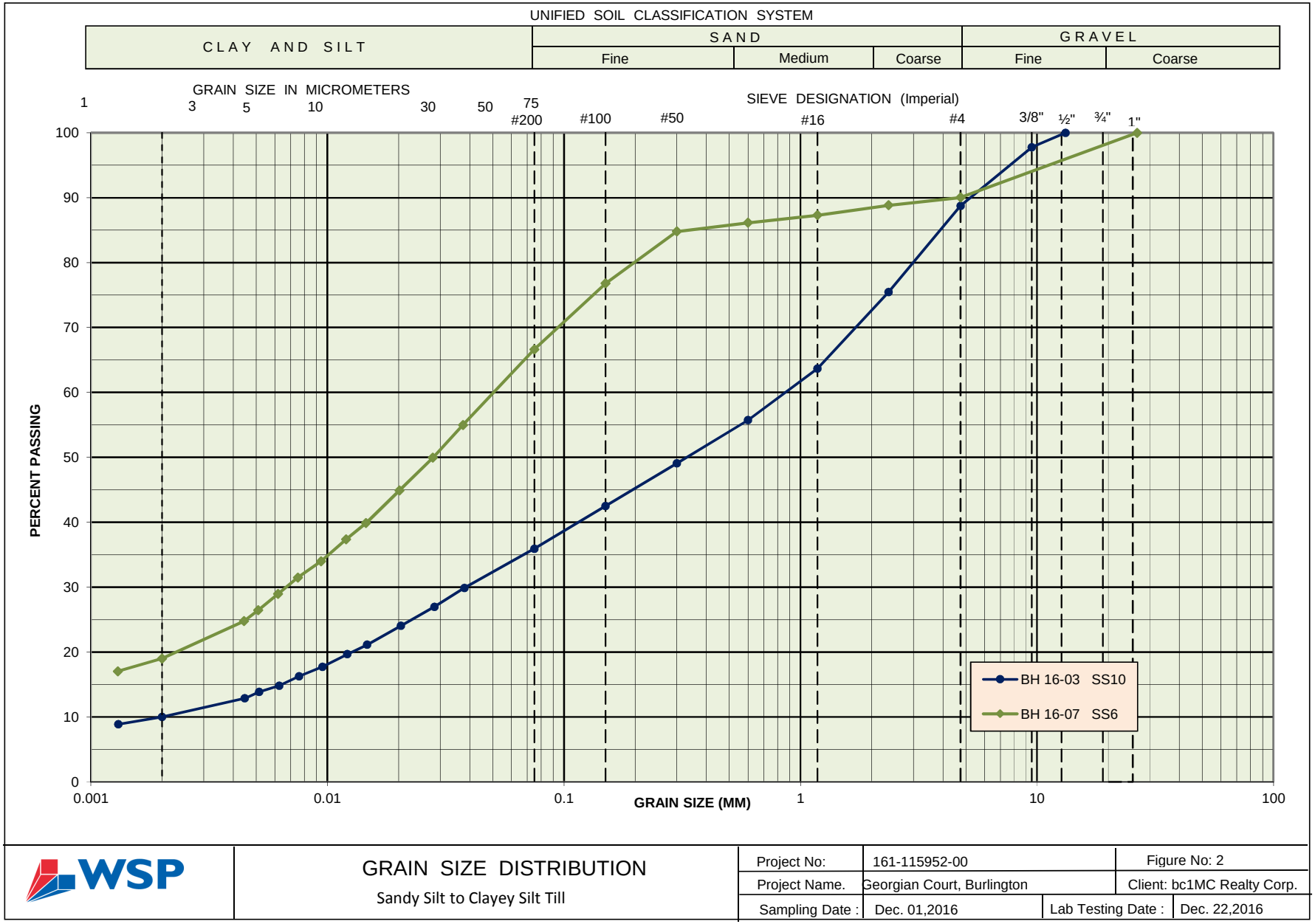


WSP

GRAIN SIZE DISTRIBUTION

Sand to Silty Sand

Project No:	161-15952-00	Figure No: 1	
Project Name.	Georgian Court, Burlington		
Sampling Date :	Dec. 02,2016	Lab Testing Date :	Dec. 22,2016

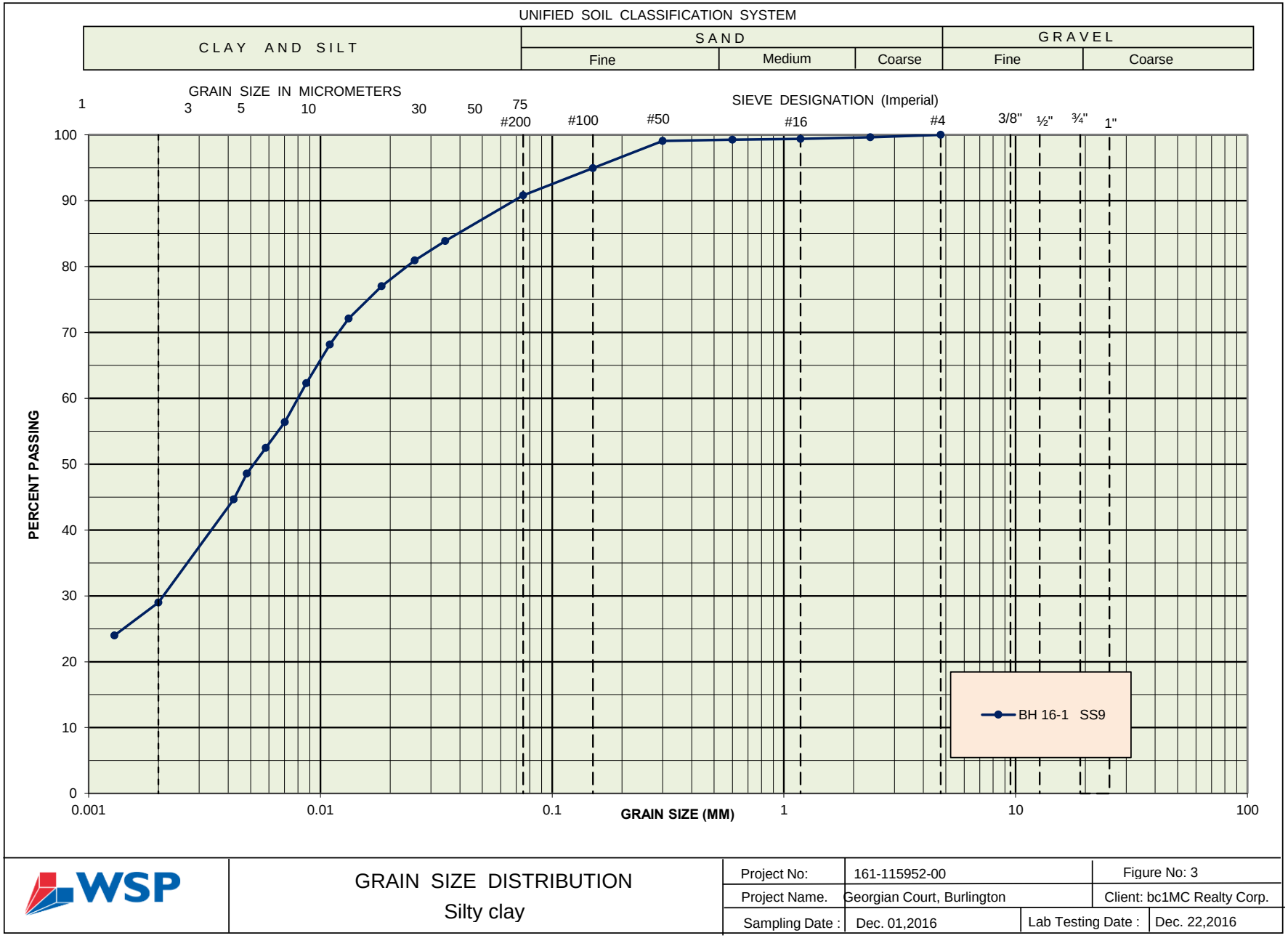


WSP

GRAIN SIZE DISTRIBUTION

Sandy Silt to Clayey Silt Till

Project No:	161-115952-00		Figure No: 2
Project Name.	Georgian Court, Burlington		Client: bc1MC Realty Corp.
Sampling Date :	Dec. 01,2016	Lab Testing Date :	Dec. 22,2016

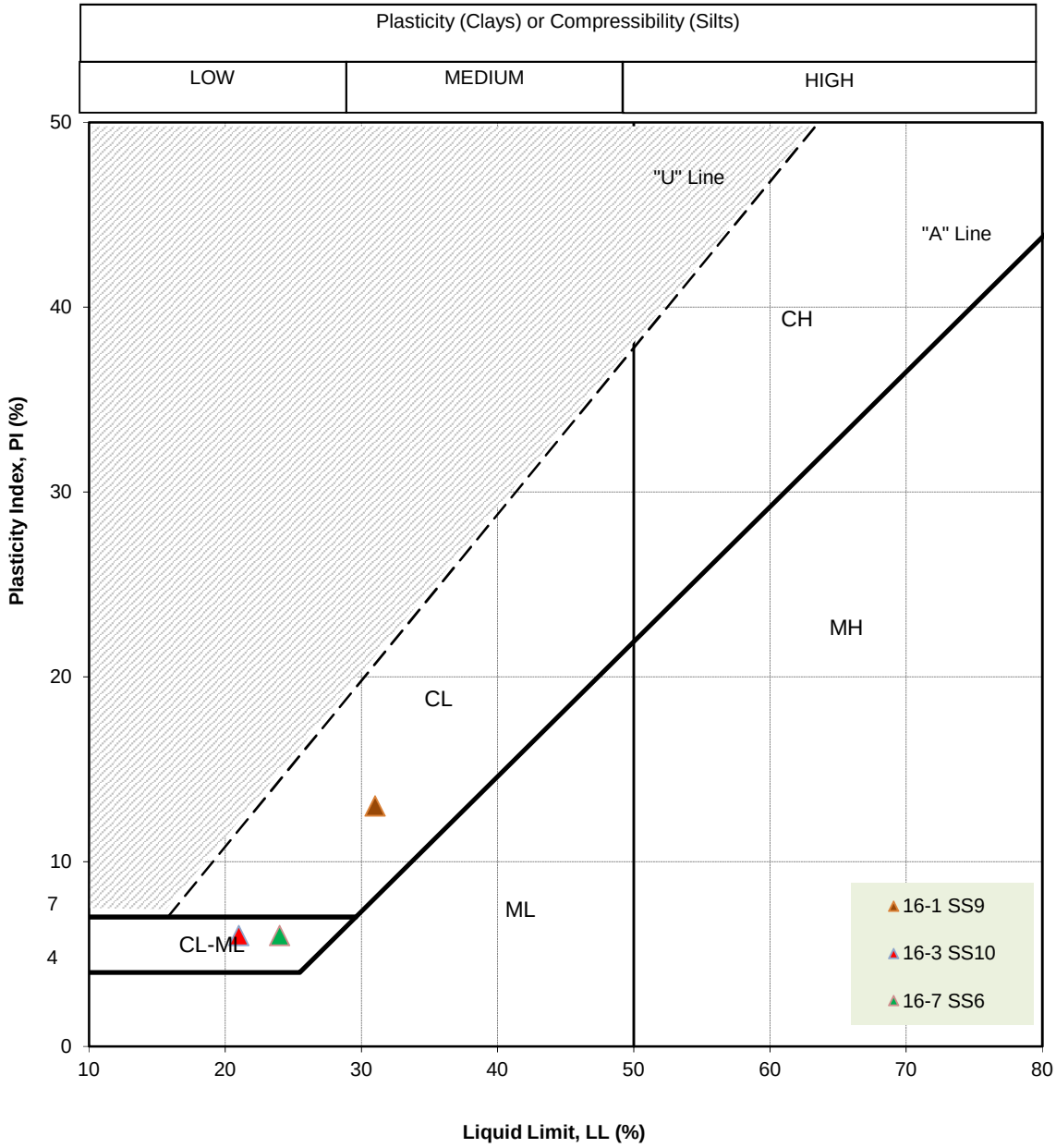


WSP

GRAIN SIZE DISTRIBUTION

Silty clay

Project No:	161-115952-00		Figure No: 3
Project Name.	Georgian Court, Burlington		Client: bc1MC Realty Corp.
Sampling Date :	Dec. 01,2016	Lab Testing Date :	Dec. 22,2016



WSP	**PLASTICITY CHART**	Project No: 161-15952-00
		Project Name: Georgian Court, Burlington
	Sampling Date: Dec. 02,2016	**Figure No**: 4

Appendix C

GENERAL COMMENTS – BEDROCK IN METRO TORONTO AREA

General Comments – Bedrock in Metro Toronto Area

The bedrock that makes spread footings or caissons a popular choice for high-rise foundation support is a shale or shale limestone composition. The highest member, the Queenston Formation, is generally found west of Toronto, while the Georgian Bay Formation underlies most of Metro Toronto, with the Collingwood Formation east of Toronto. The Queenston is, relatively speaking, the weaker of the three formations that are likely to support caissons or footings.

The Georgian Bay as well as the Queenston and Collingwood Formation are of Middle Ordovician Age. It is defined as the rock unit that overlies the bluish grey shales of the Collingwood Formation and is in turn overlain by the red shale of the Queenston Formation. The Georgian Bay Formation consists of bluish and grey shale with interbeds of sandstone, limestone and dolostone. Towards the west where the Georgian Bay formation underlies the Queenston Formation, the limestone content increases significantly and limestone and/or sandstone may comprise as much as 70 to 90 percent of the bedrock. The hard layers are usually less than about 100 to 150 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at some sites. The layers are actually lenses and they can vary significantly in thickness over short distances.

The upper portion of the bedrock is commonly weathered for a depth of 600 to 1000 mm and within this weathered zone hard limestone layers or lenses are common. These hard limestone layers can result in contractual problems for augers, and can provide misleading bedrock elevations. Where the weathering is more extensive a shale till layer may be found above the bedrock. In the sound bedrock, the limestone, sandstone, dolostone is hard to very hard.

Stress relief features such as folds and faults are common in the bedrock. In these features, the rock is heavily fractured and sheared, and contains layers of shale rubble and clay. Weathering is much deeper than the surrounding rock in these features and often there is a lateral migration of the stress relief features resulting in sound unweathered bedrock overlying fractured and weather bedrock. The stress relief features are usually in the order of 4 to 6 m wide, but the depth can vary from 4 to 5 m to in excess of 10 m. These features occur randomly.

The bedrock contains significant high locked in horizontal stresses. These stresses can impose significant loads on tunnel walls but the slower rate of construction for basements allows for a relaxation of these stresses and they are not normally a problem for basement construction.

Groundwater seepage below the top 1000 mm is generally small, however, at several locations in Toronto and Mississauga large quantities have been encountered.

Bedding joints in the bedrock are very close-to-close, smooth planar in the shale and rough planar in the limestone. Significant vertical jointing is common.

Where the bedrock was cored, a detailed description of the rock core is appended to the borehole log.

Design features related to the bedrock are discussed in other sections of this report, and these general comments must be considered with these comments.

Methane gas exists in the bedrock, normally below the top 1000 mm and more concentrated with depth. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly caissons and tunnels.

The methane is generally more prevalent with depth below the bedrock surface. In the event that methane gas is detected during the construction of the caissons taken to sound bedrock, it will not likely be possible to inspect the caisson base to ensure that it is founded in sound rock and that the recommended safe net bearing value of 5.0 to 7.5 MPa can be used.

If this occurs the design can be changed from end bearing to skin friction where a value of concrete to bedrock of 600 kPa is utilized. In this event the top 0.6 to 1.0 m of bedrock should be ignored in the design of the skin friction. Alternatively, the caissons can terminate at about 0.3 m below the surface of the bedrock and provided no methane is detected, and inspection is possible, the caissons can be designed using a safe net bearing value of 3.0 MPa.

There are significant cost implications in this change of design and the owners and designers should provide in the contract for the possible change in their design, and the higher costs associated with this change must be appreciated.

Appendix E

Hydrogeological Investigation

Urbantech Consulting, A Division of Leighton-Zec Ltd.
25 Royal Crest Court, Suite 201 Markham, Ontario L3R 9X4
TEL: 905.946.9461 FAX: 905.946.9595
www.urbantech.com



Prepared for: bcIMC Realty Corporation o/a Georgian Court Estates c/o Realstar Management

HYDROGEOLOGICAL INVESTIGATION REPORT

PROPOSED RESIDENTIAL REDEVELOPMENT AT 611-633 AND 645 SURREY LANE, 610-740 SURREY LANE, 858-916 WARWICK ROAD, 615-693 AND 699 MARLEY ROAD, AND 847-937 WARWICK ROAD

BURLINGTON, ON

January 2017

WSP | MMM GROUP

Hydrogeological Investigation Report

Proposed Residential Redevelopment at 611-633 and 645 Surrey Lane, 610-740 Surrey Lane, 858-916 Warwick Road, 615-693 and 699 Marley Road, and 847-937 Warwick Road

Burlington, Ontario

Prepared For:
bcIMC Realty Corporation o/a Georgian Court Estates c/o Realstar Management

WSP Group / MMM Group Limited
January 2017

3316497-000-HG1

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APPENDIX A – WSP (2017) Geotechnical Investigation Report

APPENDIX B – Hydraulic Conductivity Evaluation from Grain Size Analysis

APPENDIX E – AGAT Laboratories Certificate of Analysis for Groundwater Samples

APPENDIX F – Ecolog ERIS Report

APPENDIX G – Dewatering Calculation Worksheets

APPENDIX I – Standard Conditions and Limitations

1.0 INTRODUCTION

bcIMC Realty Corporation operating as (o/a) Georgian Court Estates care of (c/o) Realstar Management has retained WSP to undertake the geotechnical and hydrogeological investigations for the proposed residential redevelopment at 611 - 633 and 645 Surrey Lane, 610 - 740 Surrey Lane, 858 - 916 Warwick Road, 615 -693 and 699 Marley Road, and 847 - 937 Warwick Road, in Burlington, Ontario.

For the purposes of this study, a 500 m Study Area was added around the project limits, as shown on **Figure 1**.

1.1 GEOTECHNICAL INVESTIGATION

A geotechnical investigation was carried out by WSP (2017) for the proposed redevelopment at the project site. Eighteen (18) boreholes were advanced across the project site, with seven (7) boreholes completed as monitoring wells. The geotechnical report is presented in **Appendix A**.

1.2 PROJECT BACKGROUND

The objective of the Hydrogeological Assessment is to broadly characterize the local hydrogeological conditions within the Study Area and provide technical hydrogeological input into the potential dewatering requirements.

This study discusses potential impacts resulting from the proposed Georgian Court Redevelopment construction in the context of the following:

- Potential impacts to municipal, commercial and private water wells;
- Existing source water protection areas;
- Likelihood of release of contaminants; and
- Impacts to groundwater and surface water from construction activities.

Scope of Work

The Scope of Work undertaken in this hydrogeological assessment includes the following tasks:

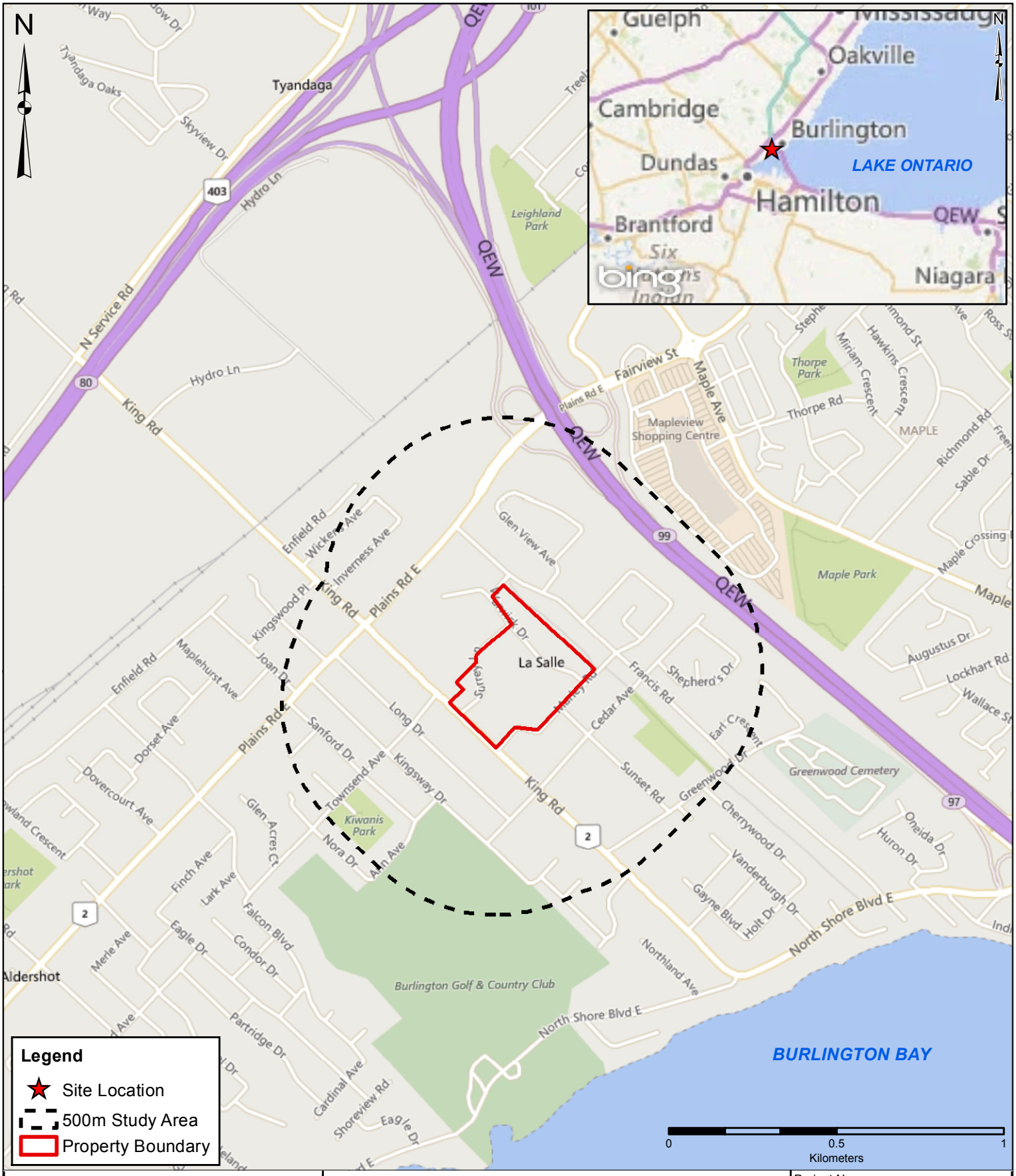
- Review of Available Physiographic, Geological, Geotechnical, and Hydrogeological Maps and Reports – to help characterize the general physiography, geology and hydrogeology within and surrounding the Study Area, in an effort to understand the general groundwater flow system(s);

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- Review of the Ontario Ministry of Environment and Climate Change (MOECC) Water Well Records, to provide any relevant information on the construction of wells, well depth, location, static water levels, stratigraphy and pumping rates; and,
- Review of Permits to Take Water (PTTWs) - to identify existing heavy water users within and adjacent to the Study Area.

If there are any questions regarding this report, please contact Peter Hayes, P. Geo. of WSP/MMM Group Limited (MMM) at (519) 743-8777 Ext. 2267

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WSP	Client: bcIMC Realty Corp. o/a Georgian Court Estates	Project No.: 161-15952-00	
	Title: Site Location	Drawn: JS	Approved: PH
	Project: Hydrogeological Assessment Georgian Court Redevelopment	Date: January 2017	Scale: As Shown
	Discipline: ENVIRONMENT	Original Size: Letter	Figure: 1

2.0 STUDY AREA DESCRIPTION AND SETTING

2.1 DESCRIPTION OF THE STUDY AREA

The Study Area includes a 500 m area around the redevelopment extent within the City of Burlington, Ontario. The Study Area boundary is shown on **Figure 1**.

The project site is located within an urban section of the City of Burlington, surrounded by primarily residential and commercial land uses. The area is municipally serviced (water and sanitary sewer).

2.2 CURRENT LAND USE

The land use within the Study Area is primarily residential, with commercial properties on Plains Road, located 300 m east of the site, a golf course located 200 m south, and the Queen Elizabeth Way (QEW) located approximately 400 m north of the site.

2.3 PHYSIOGRAPHY

As shown on **Figure 2**, the project site lies within the Iroquois Plain, a physiographic region that extends around the shore of Lake Ontario and is characterized by fine silty sands overlying Halton Till, which in turn overlies Queenston shale bedrock.

2.4 TOPOGRAPHY, DRAINAGE AND NATURAL FEATURES

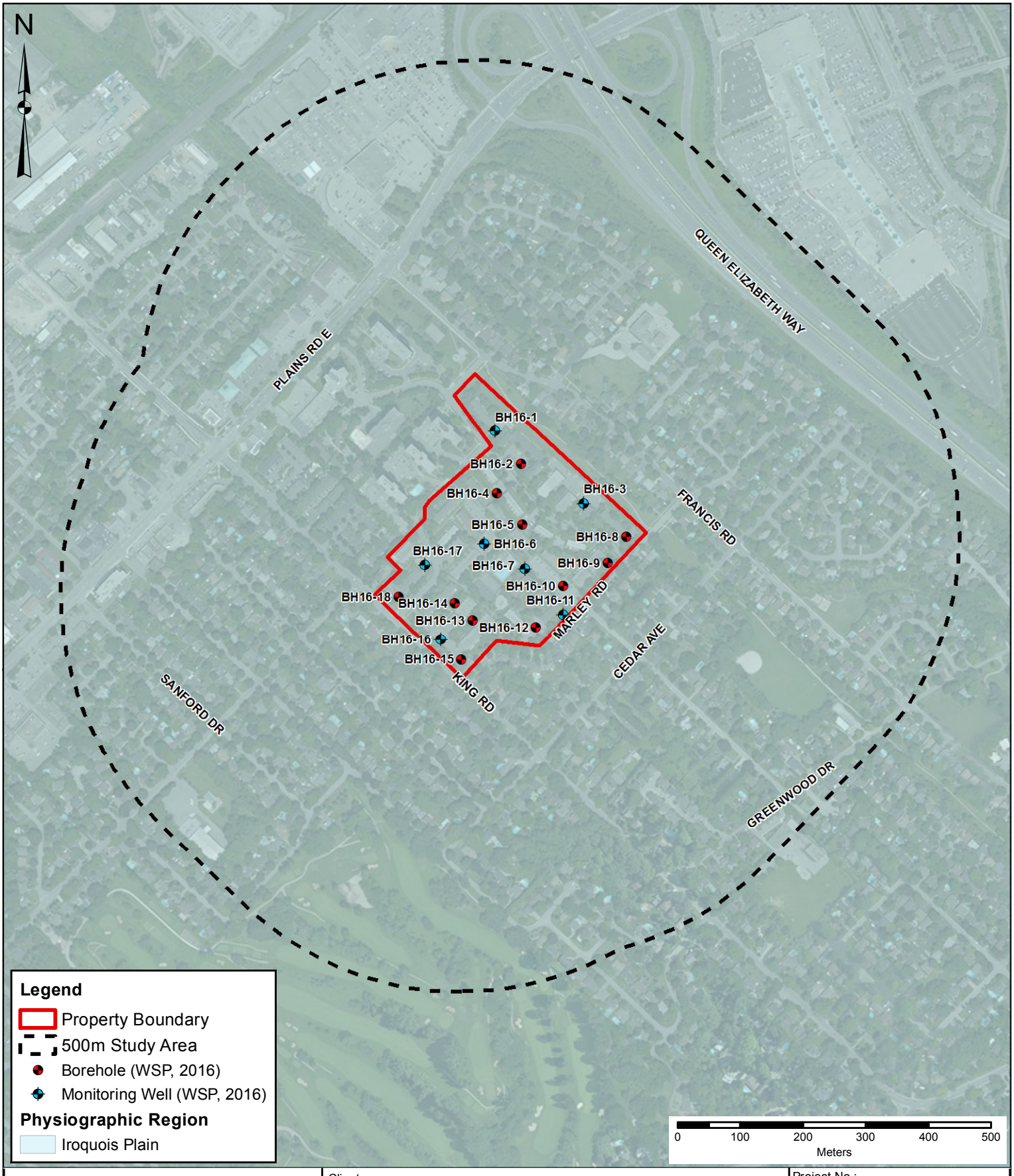
The ground surface elevation dips from 95 meters above sea level (masl) north and west of the site to approximately 90 masl south and east of the site. The ground surface progressively declines to 75 masl at the shore of Lake Ontario, located approximately 1 km south of the project site.

Much of the Study Area is covered by impermeable surfaces as a result of urban development. Native soils are well drained, which allows groundwater infiltration. Surface water runoff that does not infiltrate into the subsurface is directed into storm sewers which are interpreted to discharge into Indian Creek north and east of the site, and Stillwater, Edgewater and Falcon Creeks, south-southwest of the site, which all discharge into Lake Ontario.

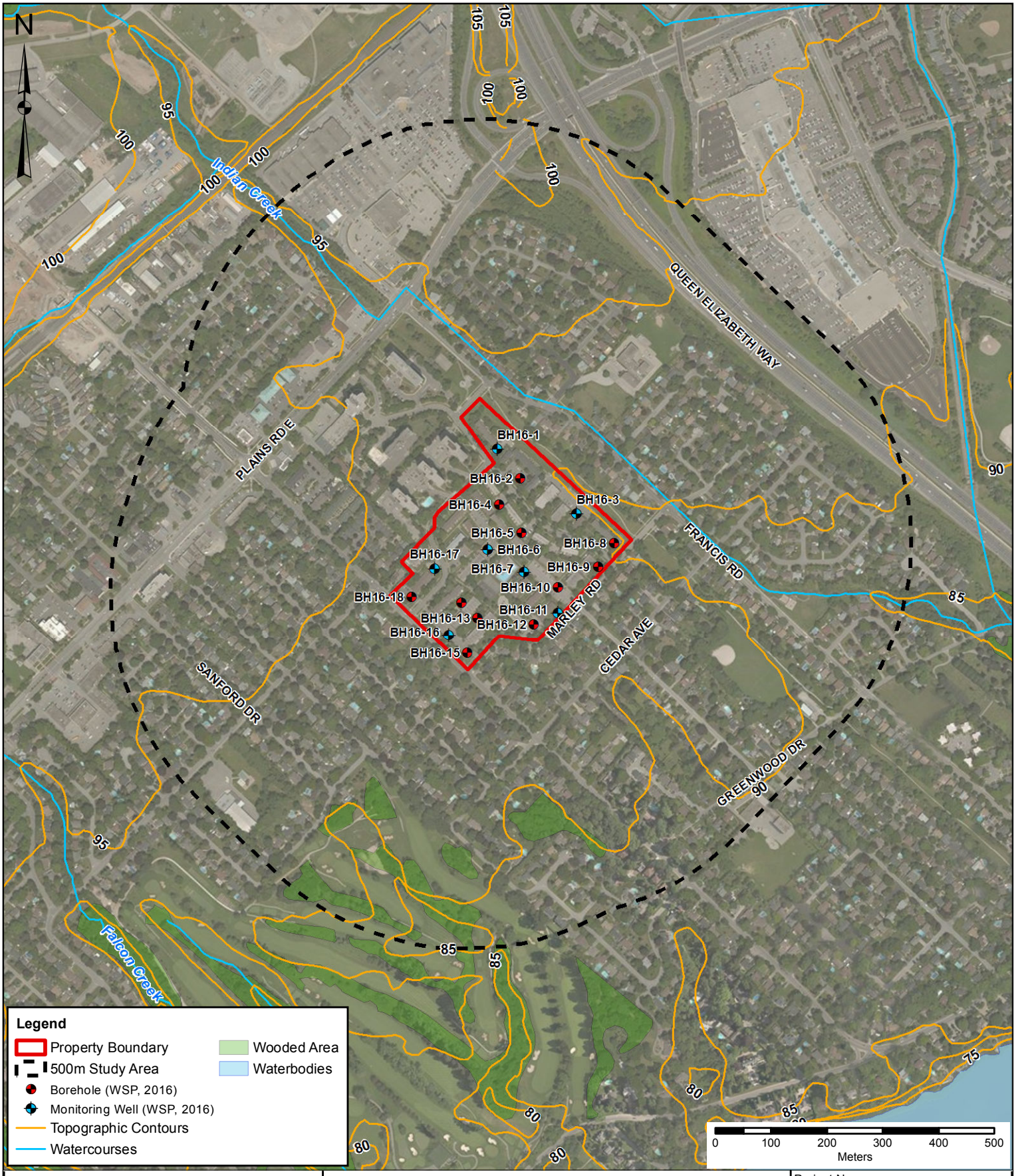
A review of the Ontario Ministry of Natural Resources and Forestry (OMNRF) – Natural Heritage Areas map confirmed that there are no designated areas within 500 m of the project site, including Environmentally Significant Policy Areas, Areas of Natural and Scientific Interest or Provincially Significant Wetlands.

The topography, drainage and location of natural features is shown on **Figure 3**.

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Client: bcIMC Realty Corp. o/a Georgian Court Estates		Project No.: 161-15952-00	
Title: Physiography		Drawn: JS	Approved: PH
Project: Hydrogeological Assessment Georgian Court Redevelopment		Date: January 2017	Scale: As Shown
Discipline: ENVIRONMENT		Original Size: Letter	Figure: 2



WSP	Client: bcIMC Realty Corp. o/a Georgian Court Estates	Project No.: 161-15952-00	
	Title: Topography and Natural Features	Drawn: JS	Approved: PH
	Project: Hydrogeological Assessment Georgian Court Redevelopment	Date: January 2017	Scale: As Shown
	Discipline: ENVIRONMENT	Original Size: Letter	Figure: 3

2.5 QUATERNARY GEOLOGY

The surficial geology of the Study Area is shown on **Figure 4**, and consists of Late Wisconsinan lacustrine and outwash sand overlying silty-clay Halton Till. The Halton Till grades downward into the bedrock which consists of soft red-brown shale (Queenston Shale).

2.6 BEDROCK GEOLOGY

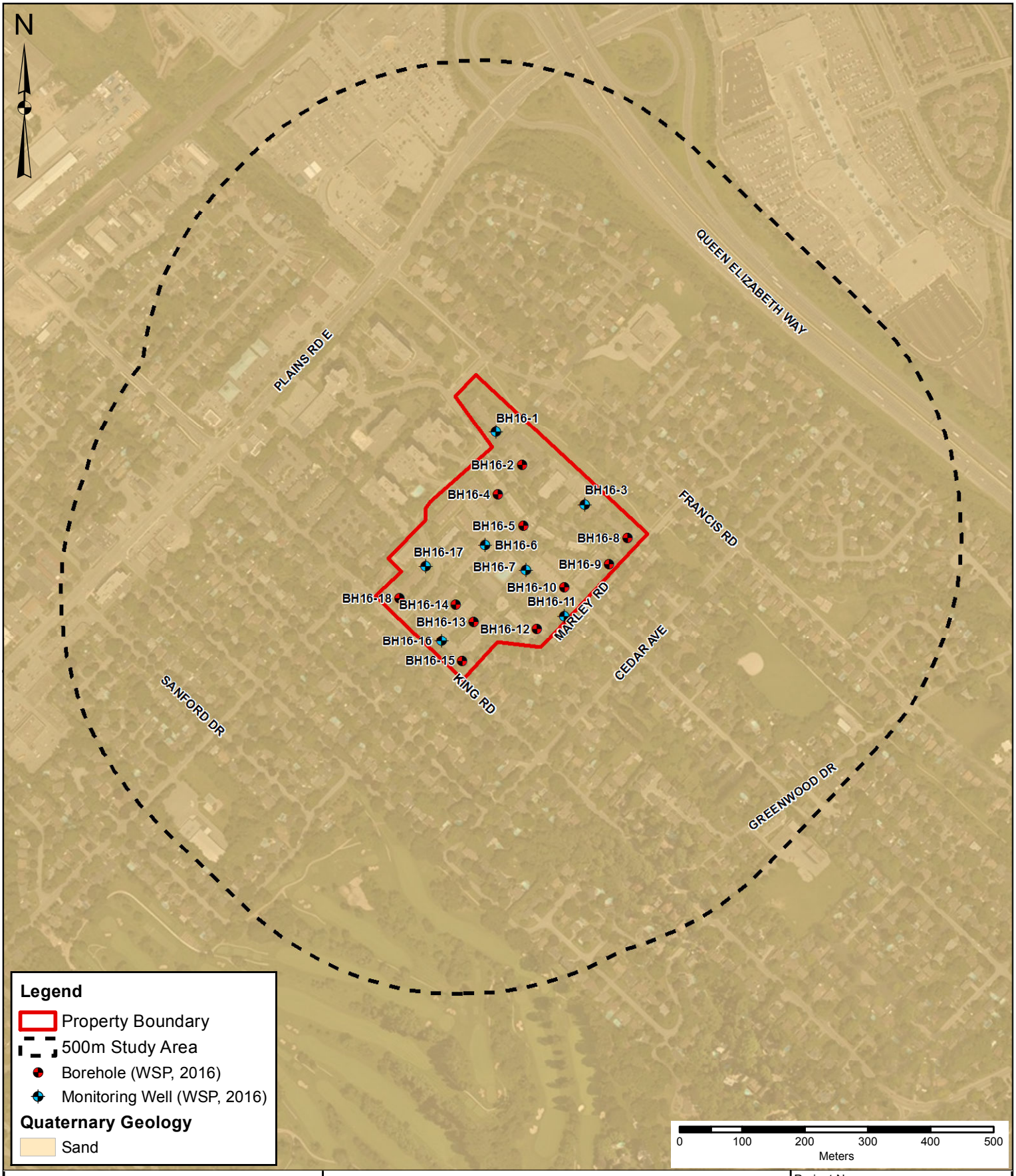
The Queenston Formation is the uppermost bedrock formation within the Study Area. The Queenston Shale bedrock consists of reddish brown and thinly bedded shale with frequent hard grey limestone layers with occasional siltstone and some clay seams (Holysh, 1995). The limestone beds are typically more competent in comparison to the shale. The Queenston Formation is regionally extensive, found as the uppermost bedrock formation in most areas of Halton Region which are below the Niagara Escarpment.

The bedrock geology within the Study Area is shown on **Figure 5**.

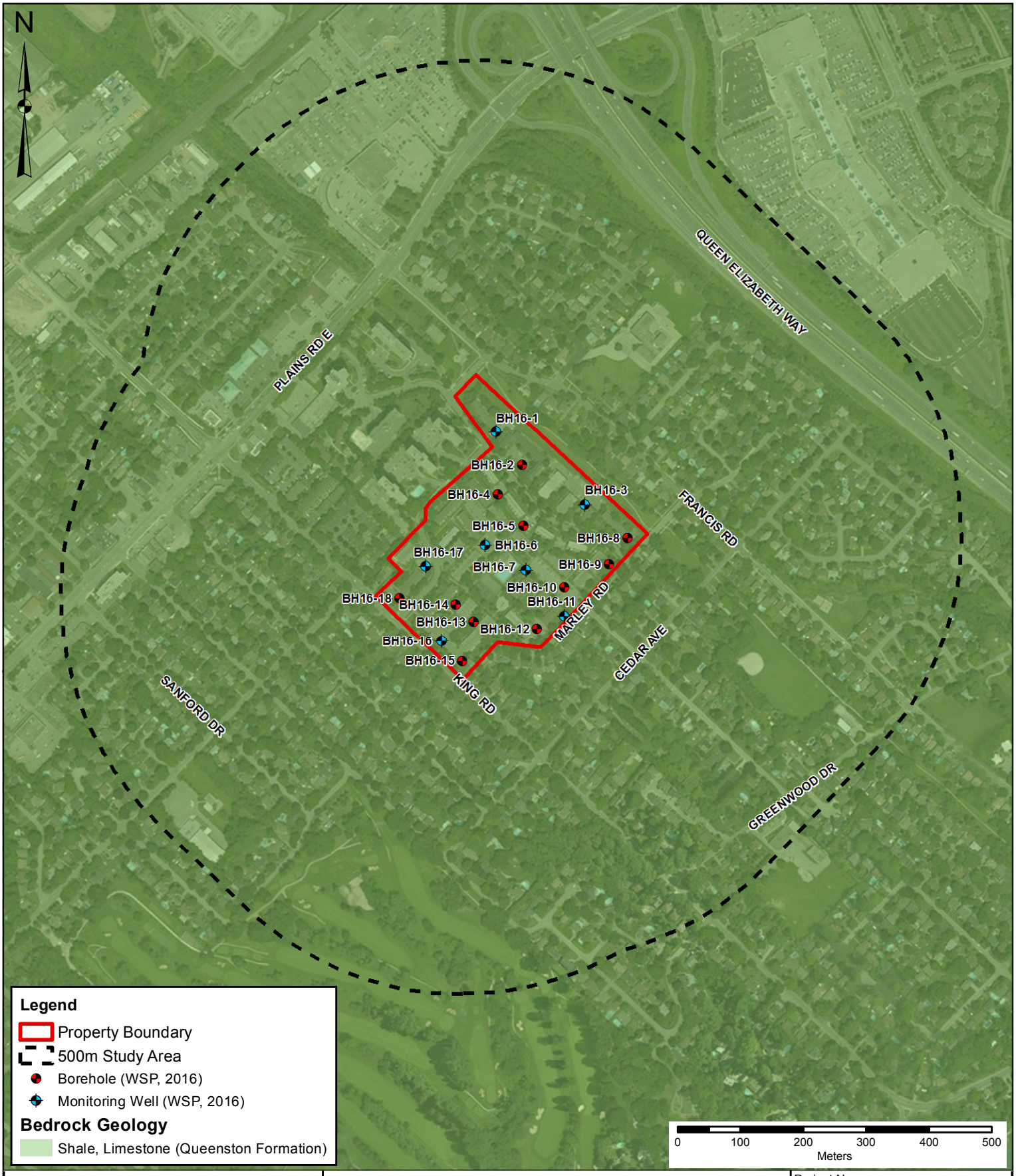
2.7 SURFACE WATER

The project site is located within the Indian Creek watershed. Indian Creek exists as a buried channel immediately north and west of the project site and emerges further west, running parallel to the QEW. South-southwest of the Study Area are Stillwater Creek (inferred as buried), Edgewater Creek (inferred as buried) and Falcon Creek (Conservation Halton, 2012), all part of the Falcon Creek watershed. All of these creeks flow towards Lake Ontario, located approximately 1 km south-southeast of the site.

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WSP	Client: bcIMC Realty Corp. o/a Georgian Court Estates	Project No.: 161-15952-00	
	Title: Quaternary Geology	Drawn: JS	Approved: PH
	Project: Hydrogeological Assessment Georgian Court Redevelopment	Date: January 2017	Scale: As Shown
	Discipline: ENVIRONMENT	Original Size: Letter	Figure: 4



WSP	Client: bcIMC Realty Corp. o/a Georgian Court Estates	Project No.: 161-15952-00	
	Title: Bedrock Geology	Drawn: JS	Approved: PH
	Project: Hydrogeological Assessment Georgian Court Redevelopment	Date: January 2017	Scale: As Shown
	Discipline: ENVIRONMENT	Original Size: Letter	Figure: 5

3.0 GROUNDWATER RESOURCES

3.1 WATER WELL RECORDS

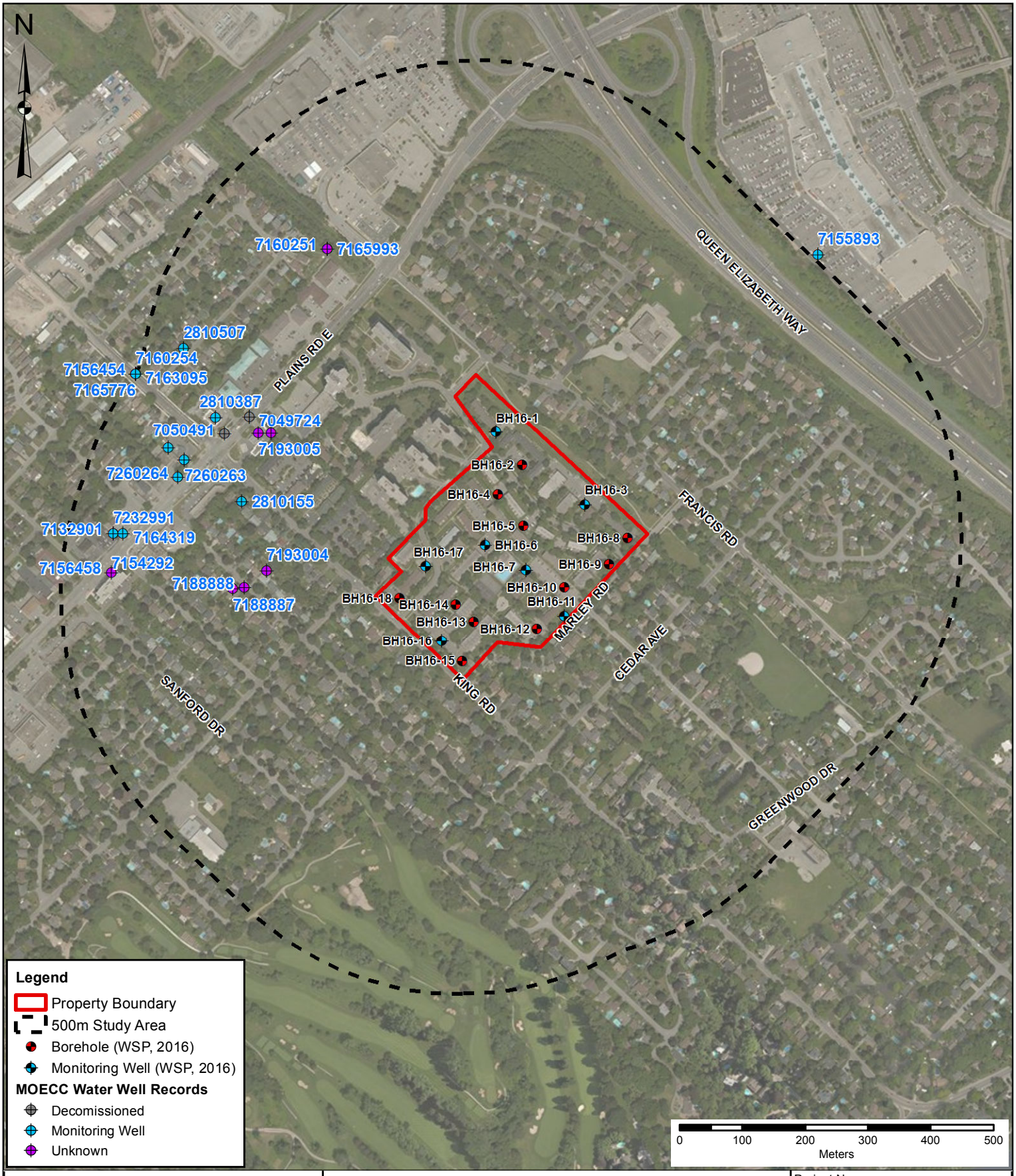
The Ministry of the Environment and Climate Change's (MOECC) Water Well Information System (WWIS) is a compilation of records for water wells drilled in the Province of Ontario for the purpose of human, agricultural and industrial consumption. Pursuant to the Ontario Water Resources Act (1990), any well drilled for these purposes must be drilled by a MOECC licensed well drilling contractor and documented on a water well record. The record is then filed with the MOECC. Examples of data recorded on a water well record include: well location, date drilled, depth to where water is found, static water level and subsurface stratigraphy. Given that well records have been completed by many different drillers during the past 50 years, data accuracy and consistency is variable, and the measurement accuracy for older well records is often approximate. The information in the records cannot always be taken as precise and must be interpreted in the context of the overall regional setting, and geological conditions.

As per information available on the MOECC website (accessed January, 2017), there are 29 Water Well Records (WWRs) within 500 m of the Project Site. The well records are shown on **Figure 6** and are summarized below:

1) 14 records are for monitoring wells,
2) Ten records have incomplete/inconclusive information,
3) Three (3) records are for well abandonment,
4) Two (2) records are for monitoring well clusters.

The project site is located within an urban setting which is municipally serviced. Upon review of the MOECC well records, it has been inferred that there are no water wells currently in use within 500 m of the project site.

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Client: bcIMC Realty Corp. o/a Georgian Court Estates		Project No.: 161-15952-00	
Title: MOECC Water Well Records		Drawn: JS	Approved: PH
Project: Hydrogeological Assessment Georgian Court Redevelopment		Date: January 2017	Scale: As Shown
Discipline: ENVIRONMENT		Original Size: Letter	Figure: 6

3.2 PERMIT TO TAKE WATER RECORDS

Under Section 34 of the Ontario Water Resources Act, the MOECC requires ground and/or surface water users who require higher volumes of water (>50,000 L/day) to obtain a Permit to Take Water (PTTW). As per information available on the MOECC website (accessed January 2017), there are three (3) active PTTWs within 2 km of the project site, as summarized below:

Table 1: Active PTTWs within 2 km of the construction alignment

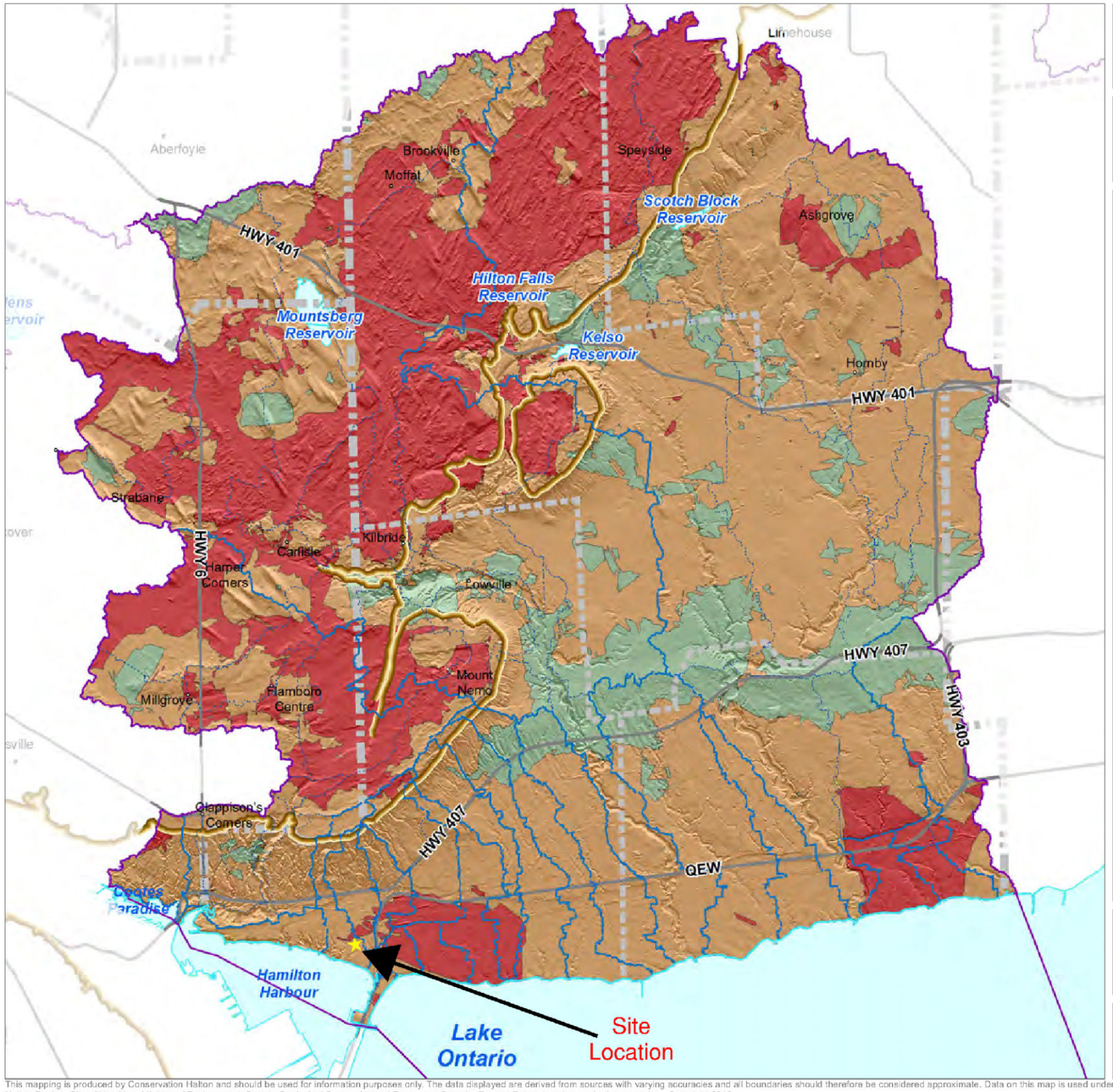
Permit Number	Permit Holder Name	Purpose	Specific Purpose	Maximum (L/day)	Source Type	Distance to Project
1268-8YWQLE	Burlington Golf and Country Club Limited	Commercial	Golf Course Irrigation	1,726,142	Surface Water	1 km to the South, and topographically lower
8173-A8JGEK	The Regional Municipality of Halton	Dewatering Construction	Construction	500,000	Ground Water	1.8 km to the East, and topographically lower
6752-9YGPH3	Ellis-Don Design Build Inc.	Dewatering Construction	Construction	1,500,000	Ground Water	1.9 km to the East, and topographically lower

These ongoing water takings are located far away from the project site and will not likely be affected by construction dewatering for this project.

3.3 SOURCE PROTECTION AREA

As per the Halton Region Source Protection Area Assessment Report (2015), the Project Site is not located within a Significant Groundwater Recharge Area, but is located within an area of medium to high intrinsic groundwater susceptibility, as shown on **Figure 7**, and is adjacent to a highly vulnerable aquifer, as shown on **Figure 8**.

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DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Figure 6.9

Intrinsic Groundwater Susceptibility

Legend

- Source Protection Area
- Watersheds
- Subwatersheds
- Upper Tier Municipality
- Lower Tier Municipality
- Niagara Escarpment
- Highway
- Waterbody

Intrinsic Susceptibility Index (ISI)

- High
- Medium
- Low

Source : Conservation Halton / Ontario Geological Survey, Groundwater Resources Improvement Project (2006).

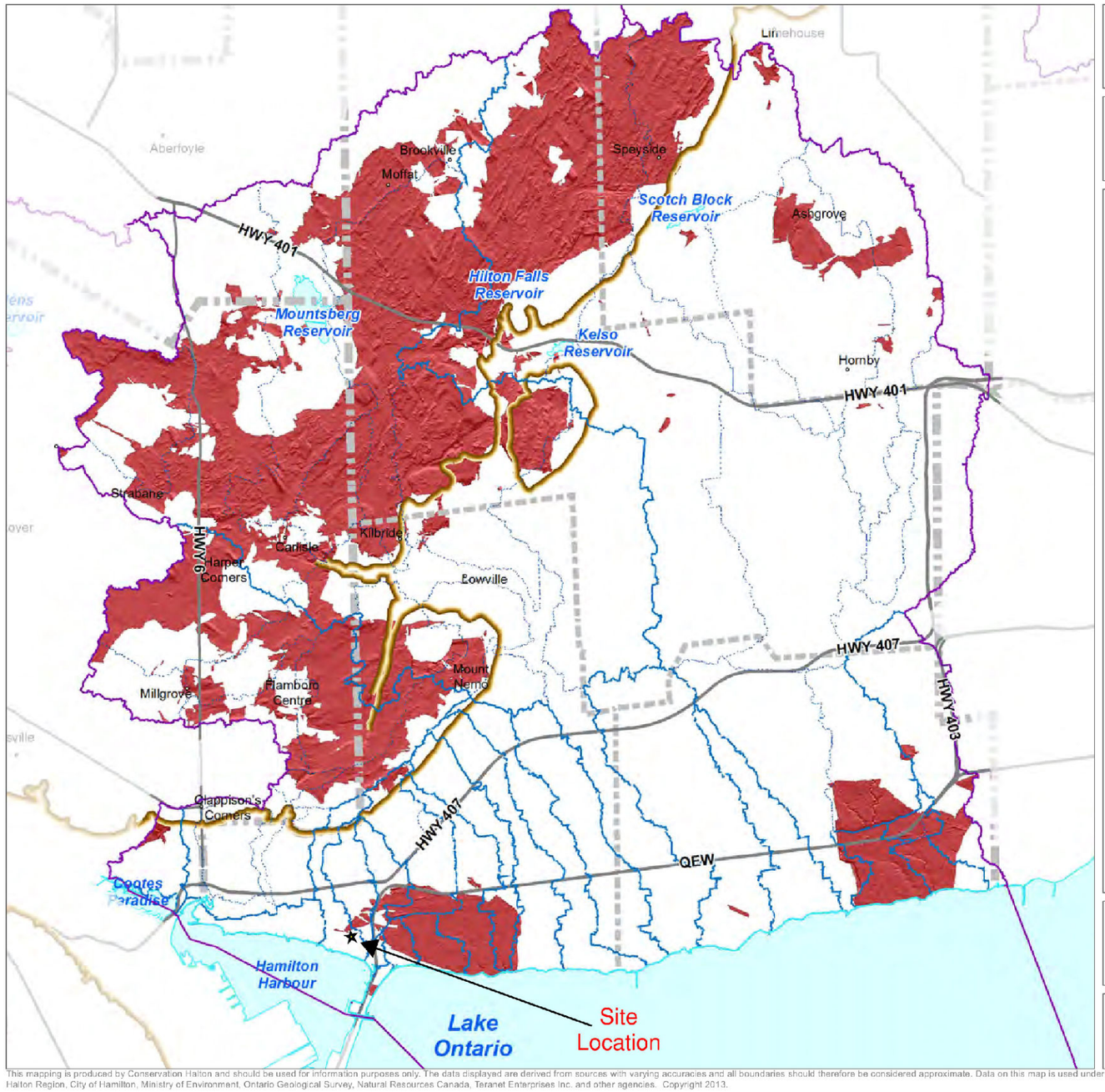
Projection : UTM NAD 83 Zone 17

Date : November 2014

0 1 2 4 6
Kilometers
1:200,000

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Client:	bcIMC Realty Corp. o/a Georgian Court Estates			Project No.: 161-15952-00	Figure: 7
Drawn: JS		Approved: PH		Title: INTRINSIC GROUNDWATER SUSCEPTIBILITY	
Date: January 2017		Scale: As Shown		Project: HYDROGEOLOGICAL ASSESSMENT GEORGIAN COURT REDEVELOPMENT	
Original Size: Tabloid		Rev: 0		WSP	



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DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Figure 6.10

Highly Vulnerable Aquifers (HVA)

Legend

- Source Protection Area
- Watersheds
- Subwatersheds
- Upper Tier Municipality
- Lower Tier Municipality
- Niagara Escarpment
- Highway
- Waterbody
- Highly Vulnerable Aquifer (Vulnerability = 6)

Source : Conservation Halton / Ontario Geological Survey, Groundwater Resources Improvement Project (2006).
Projection : UTM NAD 83 Zone 17
Date : November 2014

0 1 2 4 6
Kilometers
1:200,000

Conservation Halton | Hamilton Conservation Authority | Ontario

Client: bcIMC Realty Corp. o/a Georgian Court Estates		Project No.: 161-15952-00	Figure: 8
Drawn: JS	Approved: PH	Title: HIGHLY VULNERABLE AQUIFERS	
Date: January 2017	Scale: As Shown	Project: HYDROGEOLOGICAL ASSESSMENT GEORGIAN COURT REDEVELOPMENT	
Original Size: Tabloid	Rev: 0	WSP	

3.4 HYDROGEOLOGY

3.4.1 Regional Hydrogeology

Within the greater site vicinity, there are two main aquifers; the overburden sand aquifer and the Queenston Shale bedrock aquifer. Groundwater flow in both aquifers is to the south-southeast, towards Lake Ontario. However, on a local scale, smaller creeks are discharge points for the aquifers.

3.4.2 Site-Specific Hydrogeology

The boreholes advanced east of Warwick Drive (BH16-1 to BH16-3 and BH16-8) encountered fill overlying clayey-silt/clayey-silt till (Halton Till) overlying bedrock. BH16-1, encountered a 0.6 m thick unit of sand below fill.

In general, the boreholes advanced west of Warwick Drive (BH16-4 to BH16-7 and BH16-9 to BH16-18) encountered fill overlying sand, clayey-silt/clayey-silt Halton Till and bedrock. The thickness of the sand unit in these boreholes is approximately 3 m at the south and central site area and increases to 6 m at the east project extent.

Seven boreholes (BH16-1 to BH16-7) were advanced into the Queenston Shale bedrock. The depth to bedrock to the east of Warwick Drive is between 10.6 and 11.3 m, while the depth to bedrock increases from 11.6 to 15.2 m west of Warwick Drive.

The groundwater elevation at the site is highest in the north and east (approximately 91 meters above sea level (masl)) and declines toward the south (89 masl) and west (86.7 masl). The groundwater flow direction at the site is consistent with the regional groundwater flow regime, such that groundwater flows towards and discharges into Lake Ontario, located south-southeast of the project site. The groundwater elevations across the project site are shown on **Figure 9**.

The borehole logs are summarized in **Table 2**.

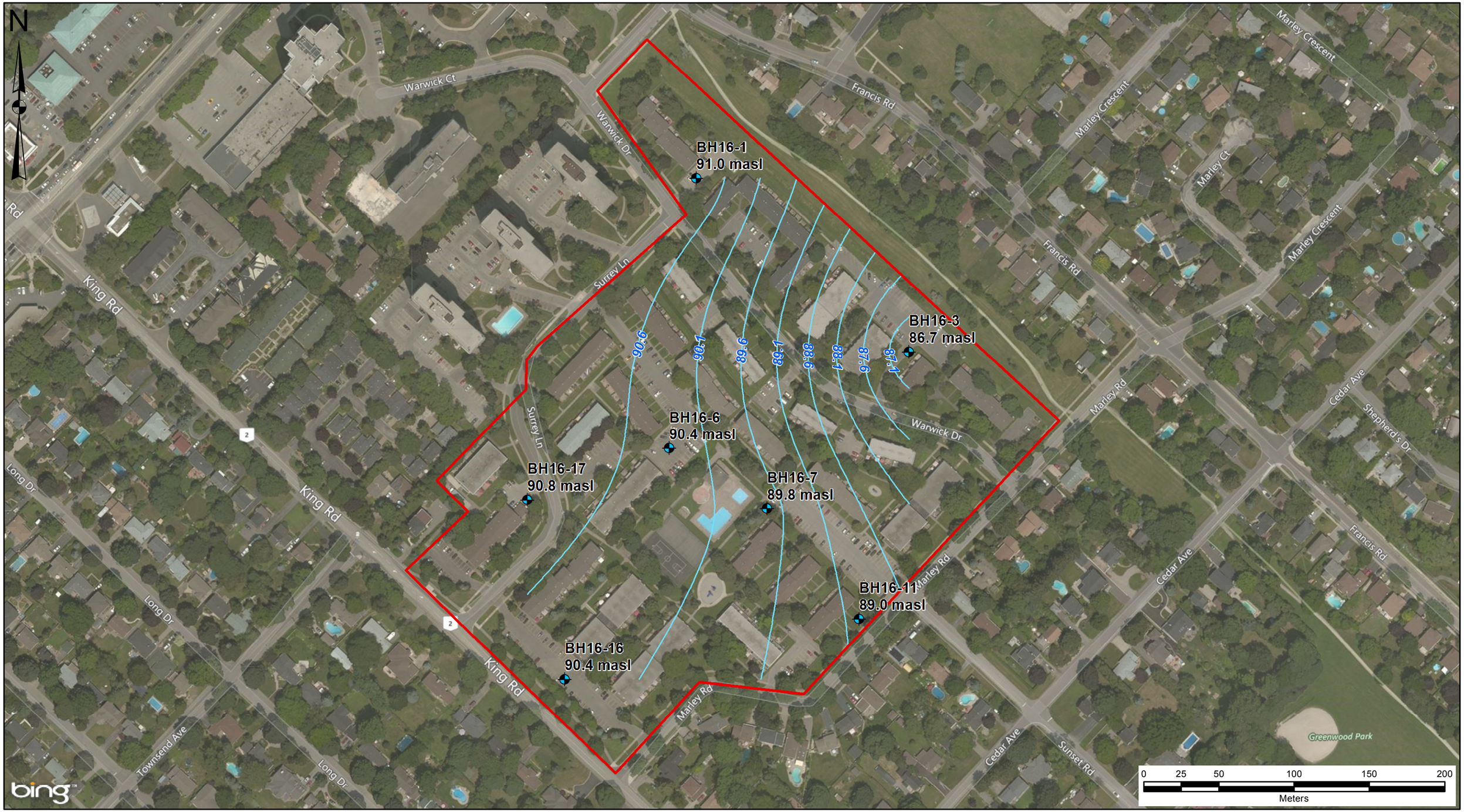
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Table 2: Summary of the Borehole Logs

Borehole ID	Monitoring Well Installed? (Y/N)	Ground Surface Elevation (masl)	Thickness of Overburden Sand Unit (m)	Thickness of Halton Till (m)	Depth to Bedrock (mbgs)	Groundwater Elevation in Monitoring Well or Groundwater Elevation in Open Borehole (masl)
BH16-1	Y	91.2	0.6	4.9	11.0	91.0
BH16-2	N	90.7	-	9.0	11.3	83.5*
BH16-3	Y	89.5	-	9.9	12.2	86.7
BH16-4	N	91.9	2.8	8.9	11.9	88.2*
BH16-5	N	91.8	2.8	8.2	11.6	87.5*
BH16-6	Y	94.7	5.9	7.1	15.2	90.4
BH16-7	Y	92.6	4.1	7.9	12.5	89.8
BH16-8	N	89.6	-	4.2	N/A	Dry
BH16-9	N	90.6	2.7	3.6	N/A	Dry
BH16-10	N	91.1	4.4	1.6	N/A	89.0*
BH16-11	Y	91.6	4.5	2	N/A	89.0
BH16-12	N	91.6	4.4	2	N/A	89.3*
BH16-13	N	93.0	3.7	2.1	N/A	90.4*
BH16-14	N	93.1	4.0	2	N/A	Dry
BH16-15	N	92.8	4.4	1.8	N/A	90.2
BH16-16	Y	92.8	4.4	0.5	N/A	90.3
BH16-17	Y	94.2	5.9	0.5	N/A	90.8
BH16-18	N	93.9	5.6	0.5	N/A	90.8*

* Elevation of groundwater found in open borehole.

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Legend

- Property Boundary
- Inferred Groundwater Elevations - 0.5m Interval
- Monitoring Well (WSP, 2016)

Client:	bcIMC Realty Corp. o/a Georgian Court Estates			Project No.: 161-15952-00	Figure: 9
Drawn: JS		Approved: PH		Title: GROUNDWATER CONTOURS ACROSS THE PROJECT SITE	
Date: January 2017		Scale: As Shown		Project: HYDROGEOLOGICAL ASSESSMENT GEORGIAN COURT REDEVELOPMENT	
Original Size: Tabloid		Rev: 0		WSP	

WSP (2017) performed grain size analyses on 16 soil samples (two analyses per borehole), which are provided in the Geotechnical Report (**Appendix A**). Two methods were utilized, as applicable, to calculate hydraulic conductivity values namely, the Hazen approximation (Fetter, 2001) and Puckett et al. (Bradbury and Muldoon, 1990) method. The following provides an explanation of each method.

Hazen Approximation Method: $K = C (D_{10})^2$

Where:

- D_{10} refers to the diameter of the 10th percentile grain size of the material
- C refers to Hazen's empirical coefficient (ranging from 40 to 150), based on the following deductions:
  - Very fine, poorly sorted sand has a C value of 40;
  - Fine sand has a C value ranging from 40 to 80;
  - Medium-sized, well sorted sand has a C value ranging from 80 to 100;
  - Coarse, poorly sorted sand has a C value ranging from 100 to 120; and
  - Coarse, well sorted sand (to gravel) has a C value ranging from 120 to 150.

Puckett Method: $K = (4.36 \times 10^{-5}) (e^{(-0.1975 \times \%clay)})$

Where:

- % clay refers to the percentage of clay (< 0.002 mm) in the soil sample.

The Hazen method was applied to all the samples where a 10th percentile grain size value was available. The hydraulic conductivity values identified by the Hazen method ranged from 2.4E-08 m/s to 6.0E-07 m/s.

The Puckett method was applied to all the samples which contained a minimum of 10% clay. The hydraulic conductivity values identified by the Puckett method ranged from 6.0E-06 m/s to 2.1E-07 m/s.

The geometric mean hydraulic conductivity estimated by both methods is **8.3E-07 m/s**. This hydraulic conductivity value will be used in the dewatering calculations.

The hydraulic conductivity estimations for both the Hazen and Puckett methods are provided in **Appendix B**.

3.5 CONTAMINANT INVENTORY

3.5.1 Ecolog ERIS Database

A comprehensive environmental database search (Ecolog ERIS) was procured in order to identify possible environmental concerns within a 500 m radius of the project. The Ecolog Environmental Risk Information Service (ERIS) is a national database service, which compiles records of environmental risks, historical incidents, and environmental permits and authorizations, as could relate to air, water, and soil quality. The database query contains Government of Ontario, Government of Canada and Environment Canada public

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records, and private sector records, which provide information pertaining to environmental liabilities associated with the property in question and surrounding area. The report includes site diagrams with locations of the database search results.

The Ecolog ERIS report for the Study Area, dated January 3, 2017, is provided in **Appendix C** and the Ecolog map is shown in **Figure 10**. The search identified two hundred and nineteen (219) records in 20 different database categories. A review of the Ecolog ERIS database records is summarized in **Table 3.**

The pertinent risks identified in the Ecolog ERIS database are as follows:

1. The presence of several active and former gas stations on Plains Road with associated fuel storage tanks.
2. Presence of Waste Generators with wastes including PCBs, oil skimmings and sludges, light fuels, pathological wastes, pharmaceuticals, photo-processing wastes, petroleum distillates,
3. Multiple historic spills particularly on Plains Road and on Highway QEW.

The environmental risk associated with adjacent property uses, implies that soil or groundwater contamination may be present and will need to be managed and/or treated during construction dewatering, if encountered. Contamination migration flow paths may potentially be modified during groundwater pumping. In addition, any unused wells found associated with historical land uses should be decommissioned as per O. Reg. 903 as amended, to eliminate preferential pathways for contamination to enter deeper aquifers.

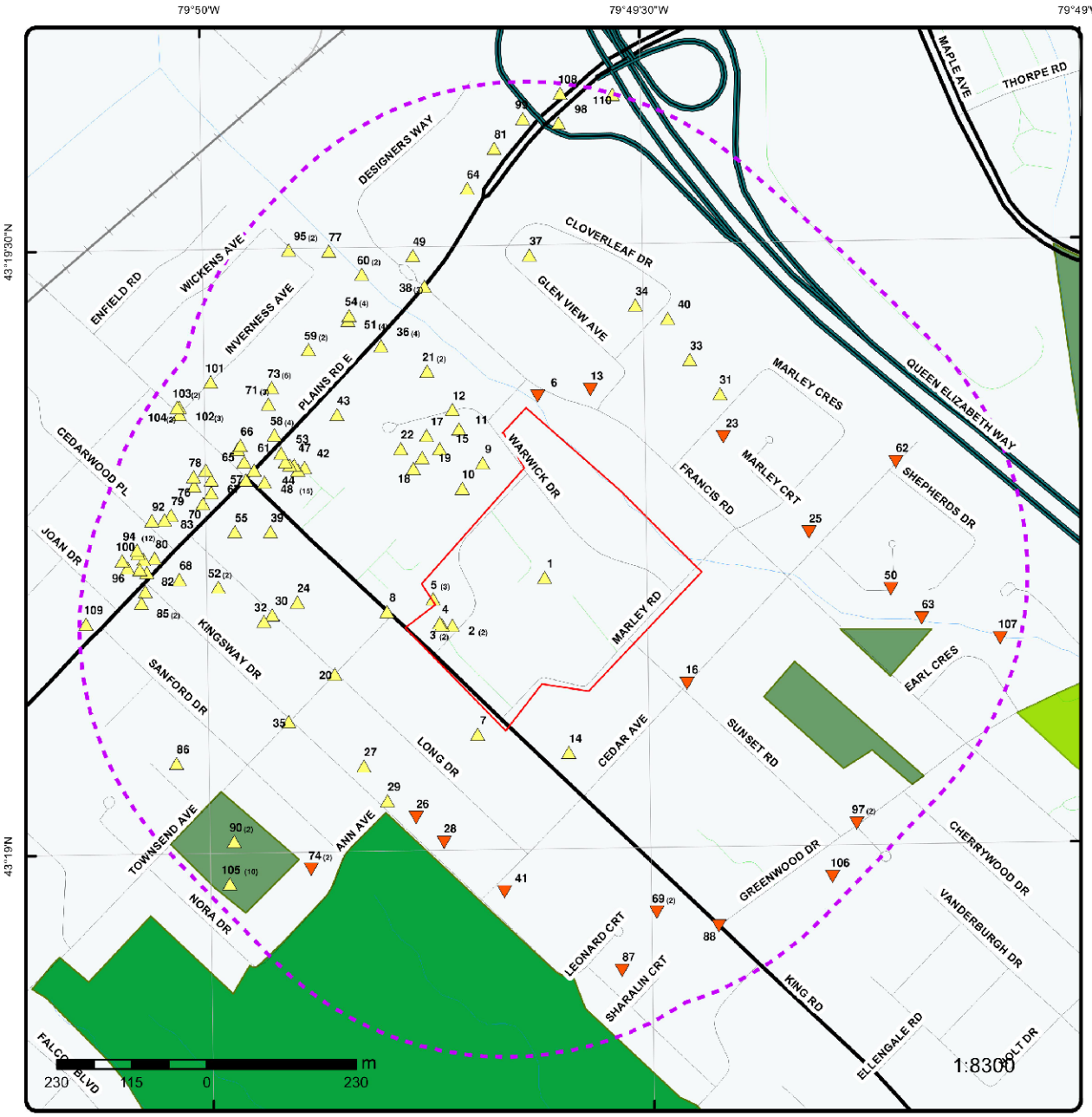
A recommended monitoring program is described in **Section 6.0** of this report.

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Table 3: Summary of the Ecolog ERIS Database Search

Database Acronym	Database Name	Number of Records within 500 m
BORE	Borehole	22
CA	Certificates of Approval	15
CFOT	Commercial Fuel Oil Tanks	2
EASR	Environmental Activity and Sector Registry	2
EBR	Environmental Registry	1
ECA	Environmental Compliance Approval	2
EXP	List of TSSA Expired Facilities	29
FST	Fuel Storage Tank	9
FSTH	Fuel Storage Tank – Historic	4
GEN	O. Reg. 347 Waste Generators Summary	51
HINC	TSSA Historic Incidents	4
INC	TSSA Incidents	4
PINC	TSSA Pipeline Incidents	4
PRT	Private and Retail Fuel Storage Tanks	4
REC	O. Reg. 347 Waste Receivers Summary	2
RSC	Record of Site Condition	1
RST	Retail Fuel Storage Tanks	4
SCT	Scott's Manufacturing Directory	5
SPL	Ontario Spills	14
TANK	Anderson's Storage Tanks	0
WWIS	Water Well Information System	27

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Map : 0.5 Kilometer Radius

Order No: 20161222109

Address: King Road And Surrey Lane, Burlington, ON

ERIS ENVIRONMENTAL RISK INFORMATION SERVICES

- Project Property
- Buffer Outline
- Eris Sites with Higher Elevation
- Eris Sites with Same Elevation
- Eris Sites with Lower Elevation
- Eris Sites with Unknown Elevation
- Expressway
- Principal Highway
- Secondary Highway
- Major Road
- Local road
- Trail
- Proposed Road
- Ferry Route/Ice Road
- Industrial and Resource - Regions
- Main Line
- Sidetrack
- Transit Line
- Abandoned Line
- National Park
- Provincial or Territorial Park
- Other Park
- Golf Course or Driving Range
- Park or Sports Field
- Other Recreation Area

Source: © 2015 DMTI Spatial Inc.

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Client: **bcIMC Realty Corp. o/a Georgian Court Estates**		Project No.: **161-15952-00**	
Title: **Ecolog ERIS**		Drawn: **JS**	Approved: **PH**
Project: **Hydrogeological Assessment Georgian Court Redevelopment**		Date: **January 2017**	Scale: **As Shown**
Discipline: **ENVIRONMENT**		Original Size: **Letter**	Figure: **10**

3.5.2 Groundwater Quality

Groundwater samples were collected on December 16, 2016 from all seven (7) monitoring wells (BH16-1, BH16-3, BH16-6, BH16-7, BH16-11, BH16-16 and BH16-11), and were analyzed for Inorganic Parameters, Total Metals, Dissolved Metals (Field Filtered), Volatile Organic Compounds (VOCs), Petroleum Hydrocarbons (PHCs) in the F1-F4 ranges, Mineral Oil and Grease. Groundwater samples from three wells (BH16-1, BH16-11 and BH16-17) were also analysed for Polycyclic Aromatic Hydrocarbons (PAHs). The sample results were compared to the following criteria:

1) Provincial Water Quality Objectives (PWQO);

2) O. Reg. 153/04 (as amended) Table 2 (coarse grained);

3) Halton Region Storm Sewer-Use; and,

4) Halton Region Sanitary Sewer-Use.

The Certificate of Analysis is provided in **Appendix D** and the analytical results are summarized in **Table A** (presented after the text report).

The groundwater analytical results indicate that several dissolved metals namely Boron, Cobalt, Molybdenum, Uranium and Vanadium, along with un-ionized Ammonia and Total Phosphorus exceed the PWQO criteria. Sodium and Chloride exceed the O. Reg. 153/04 (as amended) Table 2 criteria. VOCs, PHCs, PAHs and Mineral Oil/Grease were all below the PWQO guideline.

Upon the Contractor applying for and receiving Sewer Use discharge approval, the dewatering discharge needs to be filtered (eg. Fractionation tank, filter bags) prior to being discharged into the Halton Region Storm Sewer or Sanitary Sewer.

Dewatering for the construction of the foundations may alter groundwater and contaminant flow paths. Dewatering discharge quality will have to be monitored on a regular basis to ensure that the discharge meets the Sanitary Sewer-Use Criteria.

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4.0 DEWATERING REQUIREMENTS

The below-grade construction elements for this project include excavations for the construction of the buildings and townhouse complex foundations. For sections where the water table is above the excavation depth, it is assumed no dewatering will be required.

4.1 GROUNDWATER CONTRIBUTIONS

Groundwater dewatering rates have been calculated using the method of Powers et al. (2007) for dewatering of a large cylindrical excavation into an unconfined aquifer. Even though the excavation is roughly square in shape, this equation will provide a reasonably accurate calculation of construction dewatering rates if the area (and radius) of the circle excavation is the same as the actual area covered by the planned excavation in a square shape. The dewatering worksheets are provided in **Appendix E**.

Assumptions made during these calculations are as follows:

- The depth to groundwater along the different construction alignments is based on the water levels as reported by WSP (2017);
- The aquifer is unconfined, with a uniform hydraulic conductivity, is infinite in lateral extent, and the aquifer base elevation is identified as the lowest elevation where the specific aquifer unit was encountered in the geotechnical boreholes advanced by WSP (2017).
- Hydraulic conductivity values used in these calculations were calculated from the grain size analyses by using the Hazen and Puckett analytical methods.
- The calculated dewatering rate for the **Anticipated Case Scenario** is based on the highest hydraulic conductivity value identified from grain size analyses.
- The **Worst Case Scenario** calculated dewatering rate is based on **an order of magnitude increase** in the Anticipated Case Scenario's hydraulic conductivity value.
- The **Worst Rate Scenario** calculated dewatering rate **with a 2:1 Factor of Safety** is based on the Worst Case Scenario calculated dewatering rate multiplied by 2;

For this hydrogeological assessment, dewatering requirements were estimated for four (4) specific construction elements, as illustrated in **Table 4**. Each of these segments will be built below the water table into saturated units where construction dewatering will or may be required.

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Table 4: Dewatering Source Description

Location ID	Description of Construction Element	Water Source
1	Building Tower Foundation (BH16-1 to BH16-3)	Groundwater
2	Building Tower Foundation (BH16-4 to BH16-7)	Groundwater
3	Townhouse Complex Foundation (BH16-8 to BH16-12)	Groundwater
4	Townhouse Complex Foundation (BH16-13 to BH16-18)	Groundwater

The maximum calculated dewatering rates, as calculated in this hydrogeological assessment and listed in Table 5, will provide the contractor with the flexibility to address more difficult dewatering conditions which may be encountered.

Table 5: Dewatering Requirements

Location ID	Calculated Anticipated Dewatering Rates (L/day)	Calculated Worst Case Dewatering Rates (L/day)	Calculated Worst Case (with 2:1 safety factor) Dewatering Rates (L/day)
1	116,793	449,888	899,775
2	130,998	501,254	1,002,509
3	56,135	194,873	389,745
4	49,572	172,666	345,332

The Zone of Influence (ZOI) represents the area where groundwater levels may be temporarily affected by dewatering activities as a result of groundwater withdrawal. The ZOI is dependent on the hydraulic conductivity, the type of aquifer and the amount by which the water level is to be lowered (Powers et al., 2007). The ZOI for the anticipated and worst case scenarios are presented in Table 6.

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Table 6: Zone of Influence of Groundwater Dewatering

Location ID	ZOI under Anticipated Dewatering (m)	ZOI under Worst Case Dewatering (m)	ZOI under Worst Case (with 2:1 safety factor) Dewatering (m)
1	132.37	191.47	277.90
2	143.02	204.48	294.36
3	119.16	142.80	177.37
4	109.06	131.52	164.36

4.2 EASR AND MOECC CATEGORY 3 PERMIT TO TAKE WATER APPLICATION REQUIREMENTS

The construction staging plan will determine whether an Environmental Activity and Sector Registry (EASR) and/ or Category 3 Permit to Take Water (PTTW) will be required. An EASR will be required if dewatering rates are less than 400,000 L/day, while a Category 3 PTTW will be required in dewatering rates are greater than 400,000 L/day.

The dewatering rates to be requested in the PTTW application(s) will be based on Worst Case (2:1 Safety Factor) dewatering rates listed in Table 5. Four dewatering locations have been identified which correspond with the dewatering calculation sheets provided in Appendix E.

4.3 DEWATERING/TREATMENT METHODS AND DISCHARGE MANAGEMENT

The task of determining dewatering/treatment methods and discharge management is the responsibility of the contractor. An environmental management plan will be established and implemented, as per Section 6.0 of this report, in order to ensure that surrounding properties and municipal infrastructure are protected.

Depending on the conditions encountered along particular lengths of these excavations, sumps and filtered pumps may be a suitable methodology to remove water from the trenches where low infiltration rates are encountered. However, saturated silty-sand deposits are anticipated at these excavations and active dewatering methods (e.g., well points) may be more appropriate to lower the water table below the excavation base. The dewatering system configuration (pump type, treatment, discharge locations, etc.) is the responsibility of the contractor. Surface water run-off should be diverted away from the excavations to minimize dewatering requirements.

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Upon the Contractor applying for and receiving Sewer Use discharge approval, the dewatering discharge will require treatment to meet Halton Region Sanitary Sewer-Use Criteria.

5.0 IMPACTS ON RECEPTORS

5.1 POTENTIAL WATER WELL IMPACTS

Given the urban setting of the project area and based on a review of MOECC water well records, there are no confirmed water supply wells owned by others that are active and within 500 meters of any of the proposed works. Therefore no groundwater impacts or instances of interference are anticipated as a result of construction dewatering.

5.2 RELEASE OF CONTAMINANTS

During any phase of the construction activities, due care should be exercised to avoid fuel, lubricant and fluid spills. Spill and contamination prevention practices should be implemented to avoid potential environmental impacts and costly clean-ups. Where practical, activities such as refuelling should not be undertaken in areas with high susceptibility to groundwater contamination, such as within 30 m of watercourses, as well as ditches and storm sewers, unless appropriate best management practices are used.

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6.0 IMPACT MITIGATION

Construction source locations and corresponding dewatering rates are indicated in **Table 5**.

During this construction phase, the following monitoring and mitigation plan will be implemented:

6.1 ADAPTIVE MONITORING, INSPECTION AND MITIGATION PROGRAM

Environmental monitoring and mitigation measures will be conducted as summarized in the following:

1. Work within or immediately adjacent to any body of water or regulated area, including construction dewatering, will occur in accordance to any applicable permits as administered by regulatory agencies, including Conservation Halton, Federal Department of Fisheries and Oceans, Parks Canada, MOECC, and the Ontario Ministry of Natural Resources and Forestry.

2. Daily dewatering flow rates and volumes are to be monitored and reported as per the requirements of O. Reg. 387/04. The methodology of determining dewatering flow rates and volumes will be the responsibility of the contractor. Construction dewatering rates shall be measured by a flow meter or calculated using a method acceptable to the MOECC (calculated or measured);

3. The presence of turbid water, oily sheen, precipitates/solids or other visible contamination of any dewatering discharge water released from the site is to be visually checked and observations recorded, twice daily;

4. Daily inspection of the discharge system will be carried out at each discharge location to verify the dewatering discharge system is functioning as designed;

5. Erosion and Sediment Control (ESC) measures will be implemented and maintained during the construction, clean-up, and restoration phases of work to prevent sediment-laden runoff from leaving the work area. Construction zones will be isolated using standard perimeter silt fencing and additional erosion and sediment controls as required. ESC controls will be inspected regularly and maintained by the contractor. The contractor shall prepare and submit an Erosion and Sediment Control plan prior to starting work;

6. A suitable Soil Management Plan will have to be developed to handle soil that is excavated.

7. Halton Region Sewer-Use approvals are required prior to dewatering discharge into the storm or sanitary sewer.

    - The contractor is to apply for the Sewer-Use Permit and pay all applicable Sewer-Use fees.
    - Any water released to a sanitary sewer shall need to be treated to meet **Sanitary Sewer-Use Criteria** as stipulated by Halton Region By-law No. 2-03;

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- Any water released to a storm sewer shall need to be treated to meet **Storm Sewer-Use Criteria** as stipulated by Halton Region By-Law No. 2-03. PWQO Criteria will apply for parameters where no Storm Sewer-Use Criteria is stipulated;
- As a minimum, all dewatering discharge will be laminar and directed through energy dissipating/settling/filtration systems (e.g. filter bag, fractionation tank) prior to discharge to the sewer.
- If dewatering discharge cannot be treated to meet Sewer-Use criteria, it will be further treated or contained and taken to an appropriate MOECC-licensed facility for treatment and disposal, as appropriate.

8. During dewatering, dewatering discharge water samples (post-treatment) will be collected for confirmatory water quality analyses as follows: Within 1 hour of start-up, weekly for the first three weeks upon start-up in any new areas, and monthly thereafter in the same area until dewatering is no longer required. These water samples are to be analysed for total suspended solids (TSS), field chemistry (pH, Temperature and Electrical Conductivity), inorganic parameters, total metals, VOCs, PHCs, PAHs, mineral oil and grease, and additional parameters as deemed necessary, to meet sewer-use provisions. Samples shall be analysed on rush turnaround time at a CALA accredited analytical laboratory and the results will be used to affirm water quality compliance to the appropriate Halton Region Sewer-Use Criteria. If dewatering discharge samples exceed the Sewer-Use guideline, treatment improvements will need to be made, and the sampling frequency will return to weekly intervals.

6.2 PROPOSED CONTINGENCY PLAN

In the event that an adverse impact is observed through the monitoring program, a spill occurs, a complaint is received, or if the MOECC determines that unacceptable interference is occurring, the following response will be initiated:

- All appropriate stakeholders and regulatory agencies will be notified as required, including the construction manager responsible for onsite activities, the Halton Region Sewer-Use Authority and the MOECC;
- Additional treatment of dewatering discharge may be required to meet Sewer-Use permit rate and quality thresholds.
- Water taking/construction will be stopped until the problem is fixed, as circumstances allow;

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7.0 STANDARD LIMITATIONS

Standard conditions and limitations are presented in **Appendix F** as they apply to this report.

All of which is respectfully submitted.

MMM Group Limited, a member of WSP Group.

Lionel Sequeira, M. Sc.
Environmental Scientist

Peter Hayes, P. Geo.
Senior Hydrogeologist

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Table A

Georgian Court Redevelopment
Burlington ON
3316497

Parameter	Unit	PWQO	Halton Sewer Use By-Law 2-03		O. Reg. 153/04 (as amended)	BH16-1	BH16-3	BH16-6	BH16-7	BH16-11	BH16-16	BH16-17	Trip Blank
			Sanitary & Combined	Storm	Table 2	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016
General Chemistry													
Electrical Conductivity	µS/cm	-	-	-	-	8,920	11,800	3,680	2,170	2,160	2,070	2,220	-
pH	pH Units	6.5-8.5	6.0-10.0	6.5-8.5	-	7.26	7.66	8.08	7.88	7.97	7.93	7.93	-
Saturation pH	-	-	-	-	-	6.97	6.52	6.63	6.74	6.71	6.62	6.65	-
Langelier Index	-	-	-	-	-	0.29	1.14	1.45	1.14	1.26	1.31	1.28	-
Total Hardness (as CaCO3)	mg/L	-	-	-	-	1,550	2,610	463	522	487	576	521	-
Total Dissolved Solids	mg/L	-	-	-	-	5,280	7,330	2,040	1,340	1,260	1,240	1,270	-
Alkalinity (as CaCO3)	mg/L	-	-	-	-	55	93	406	274	321	334	342	-
Bicarbonate (as CaCO3)	mg/L	-	-	-	-	55	93	406	274	321	334	342	-
Carbonate (as CaCO3)	mg/L	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	-
Hydroxide (as CaCO3)	mg/L	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	-
Fluoride	mg/L	-	10	-	-	<5	<5	<2.5	<1.0	<0.5	<0.5	<1.0	-
Chloride	mg/L	-	-	-	790	3,260	4,560	963	531	508	448	477	-
Nitrate as N	mg/L	-	-	-	-	<5	<5	5.7	2.1	7.7	7.5	6.4	-
Nitrite as N	mg/L	-	-	-	-	<5	<5	<2.5	<1.0	<0.5	<0.5	<1.0	-
Bromide	mg/L	-	-	-	-	62	135	<2.5	<1.0	<0.5	<0.5	<1.0	-
Sulphate	mg/L	-	1500	-	-	65	19	134	67.0	59.1	94.8	111	-
Ortho Phosphate as P	mg/L	-	-	-	-	<10	<10	<5.0	<2.0	<1.0	<1.0	<2.0	-
Reactive Silica	mg/L	-	-	-	-	8.27	9.57	16.4	12.7	15.4	16.8	15.6	-
Ammonia as N	mg/L	-	-	-	-	2.47	4.7	0.40	0.33	0.04	0.09	<0.02	-
Ammonia-Un-ionized	mg/L	0.02	-	*	-	0.022	0.11	0.024	0.013	0.002	0.0042	NR	-
Total Phosphorus	mg/L	0.03	10	*	-	0.15	0.12	1.67	0.10	0.84	0.12	1.03	-
Total Organic Carbon	mg/L	-	-	-	-	4.4	3.3	3.1	2.3	2.8	2.8	2.9	-
Colour	TCU	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	-
Turbidity	NTU	-	-	-	-	154	221	6,750	1,550	5,910	273	6,390	-
Calcium	mg/L	-	-	-	-	352	586	148	148	163	179	169	-
Magnesium	mg/L	-	-	-	-	163	278	22.8	37.0	19.4	31.4	24.1	-
Sodium	mg/L	-	-	-	490	1,240	1,380	602	218	250	196	277	-
Potassium	mg/L	-	-	-	-	28.9	93.9	8.08	24.4	11.8	9.08	12.4	-
Aluminum (dissolved)	mg/L	0.075	-	*	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-
Mercury (dissolved)	mg/L	0.0002	-	*	0.00029	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Total Metals													
Antimony	mg/L	0.02	5	*	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Arsenic	mg/L	0.1	1	*	-	<0.003	<0.003	0.016	<0.003	0.007	<0.003	0.009	-
Barium	mg/L	-	-	-	-	0.344	9.51	0.355	0.373	0.315	0.280	0.252	-
Beryllium	mg/L	0.011	5	*	-	<0.001	<0.001	0.002	<0.001	0.001	<0.001	0.001	-
Boron	mg/L	0.2	-	*	-	2.03	3.18	0.203	0.186	0.067	0.114	0.096	-
Cadmium	mg/L	0.0002	1	*	-	<0.0001	0.0001	0.0006	<0.0001	0.0003	<0.0001	0.0006	-
Chromium	mg/L	-	3	-	-	<0.003	<0.003	0.017	0.005	0.010	0.004	0.015	-
Cobalt	mg/L	0.0009	5	*	-	0.0011	0.0024	0.0203	0.0016	0.0119	0.0017	0.0270	-
Copper	mg/L	0.005	3	*	-	0.002	0.004	0.086	0.010	0.045	0.007	0.066	-
Iron	mg/L	0.3	50	*	-	0.79	0.96	28.4	2.02	10.9	1.43	17.0	-
Lead	mg/L	0.005	3	*	-	<0.001	0.001	0.043	0.004	0.024	0.003	0.035	-
Manganese	mg/L	-	5	-	-	0.254	0.401	3.94	0.229	2.15	0.387	4.33	-
Molybdenum	mg/L	0.04	5	*	-	0.010	0.016	0.025	0.004	<0.002	<0.002	<0.002	-
Nickel	mg/L	0.025	3	*	-	<0.003	<0.003	0.018	0.005	0.012	0.003	0.017	-
Selenium	mg/L	0.1	5	*	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-
Silver	mg/L	0.0001	5	*	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Strontium	mg/L	-	-	-	-	26.8	79.2	1.64	1.97	1.35	1.08	1.58	-
Thallium	mg/L	0.0003	-	*	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-
Tin	mg/L	-	5	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Titanium	mg/L	-	5	-	-	0.017	0.015	0.048	0.022	0.084	0.022	0.075	-
Tungsten	mg/L	0.03	-	*	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-
Uranium	mg/L	0.005	-	*	-	<0.002	0.002	0.011	<0.002	0.004	<0.002	0.005	-
Vanadium	mg/L	0.006	-	*	-	<0.002	<0.002	0.034	0.004	0.021	0.003	0.046	-
Zinc	mg/L	0.02	3	*	-	0.007	0.008	0.080	0.013	0.044	0.007	0.056	-
Zirconium	mg/L	0.004	-	*	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-
Cation Sum	meq/L	-	-	-	-	85.8	115	35.7	20.6	20.9	20.3	22.8	-
Anion Sum	meq/L	-	-	-	-	94.4	131	38.5	22.0	22.5	21.8	23.1	-
% Difference/ Ion Balance	%	-	-	-	-	4.79	6.54	3.78	3.39	3.72	3.66	0.604	-
Dissolved Metals													
Aluminum	mg/L	-	-	-	-	0.006	0.007	<0.004	0.009	<0.004	<0.004	<0.004	-
Antimony	mg/L	0.02	-	*	0.006	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Arsenic	mg/L	0.1	-	*	0.025	0.005	0.009	0.003	<0.003	<0.003	<0.003	<0.003	-
Barium	mg/L	-	-	-	1	0.370	9.83	0.196	0.449	0.171	0.262	0.088	-
Beryllium	mg/L	0.011	-	*	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	mg/L	0.2	-	*	5	2.11	3.26	0.18	0.22	0.06	0.10	0.09	-
Cadmium	mg/L	0.0002	-	*	0.0027	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Chromium	mg/L	-	-	-	0.05	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Cobalt	mg/L	0.0009	-	*	0.0038	0.0006	0.0020	0.0010	<0.0005	0.0005	0.0005	0.0009	-
Copper	mg/L	0.005	-	*	0.087	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	-
Iron	mg/L	0.3	-	*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Lead	mg/L	0.005	-	*	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Manganese	mg/L	-	-	-	-	0.193	0.250	0.165	0.054	0.061	0.183	0.103	-
Molybdenum	mg/L	0.04	-	*	0.07	0.011	0.017	0.041	0.007	0.002	<0.002	<0.002	-
Nickel	mg/L	0.025	-	*	0.1	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Selenium	mg/L	0.1	-	*	0.01	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-
Silver	mg/L	0.0001	-	*	0.0015	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Strontium	mg/L	-	-	-	-	25.4	79.3	0.757	2.35	0.788	1.01	0.517	-
Thallium	mg/L	0.0003	-	*	0.002	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-
Titanium	mg/L	-	-	-	-	0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Tungsten	mg/L	0.03	-	*	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-
Uranium	mg/L	0.005	-	*	0.02	<0.002	0.002	0.008	0.002	0.002	<0.002	<0.002	-
Vanadium	mg/L	0.006	-	*	0.0062	<0.002	0.016	<0.002	<0.002	<0.002	<0.002	<0.002	-
Zinc	mg/L	0.02	-	*	1	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zirconium	mg/L	0.004	-	*	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-

Notes:

* The associated PWQO criteria applies for these parameters as per Section 5: 1(e) of The Regional Municipalty of Halton By-Law 2-03 (2003)

PWQO: Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ontario Ministry of Environment and Energy, July 1994, Reprinted 1999.

Halton Sewer Use By-Law 2-03: The Regional Municipality of Halton By-Law 2-03 (2003)

O. Reg. 153/04 (as amended) Table 2: Ontario Regulation 153/04 (as amended) Table 2: Potable Groundwater All Types of Property Use Coarse Grained.

mg/L: Milligrams per liter

µS/cm: Microsiemens per centimeter

TCU: True Colour Units.

NTU: Nephelometric Turbidity Units

meq/L: Milliequivalents per litre.

3,260 O. Reg. 153/04 (as amended) Table 2 Exceedance

0.022 PWQO Exceedance

Table A

Georgian Court Redevelopment
Burlington ON
3316497

Parameter	Unit	PWQO	Halton Sewer Use By-Law 2-03		O. Reg. 153/04 (as amended)	BH16-1	BH16-3	BH16-6	BH16-7	BH16-11	BH16-16	BH16-17	Trip Blank
			Sanitary & Combined	Storm	Table 2	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016	12/16/2016
Polyaromatic Hydrocarbons													
Naphthalene	µg/L	7	140	*	11	<0.20	-	-	-	<0.20	-	<0.20	-
Acenaphthylene	µg/L	-	-	-	1	<0.20	-	-	-	<0.20	-	<0.20	-
Acenaphthene	µg/L	-	-	-	4.1	<0.20	-	-	-	<0.20	-	<0.20	-
Fluorene	µg/L	0.2	-	*	120	<0.20	-	-	-	<0.20	-	<0.20	-
Phenanthrene	µg/L	0.03	-	*	1	<0.10	-	-	-	<0.10	-	<0.10	-
Anthracene	µg/L	0.0008	-	*	2.4	<0.10	-	-	-	<0.10	-	<0.10	-
Fluoranthene	µg/L	0.0008	-	*	0.41	<0.20	-	-	-	<0.20	-	<0.20	-
Pyrene	µg/L	-	-	-	4.1	<0.20	-	-	-	<0.20	-	<0.20	-
Benz(a)anthracene	µg/L	0.0004	-	*	1	<0.20	-	-	-	<0.20	-	<0.20	-
Chrysene	µg/L	0.0001	-	*	0.1	<0.10	-	-	-	<0.10	-	<0.10	-
Benzo(b)fluoranthene	µg/L	-	-	-	0.1	<0.10	-	-	-	<0.10	-	<0.10	-
Benzo(k)fluoranthene	µg/L	0.0002	-	*	0.1	<0.10	-	-	-	<0.10	-	<0.10	-
Benzo(a)pyrene	µg/L	-	-	-	0.01	<0.01	-	-	-	<0.01	-	<0.01	-
Indeno(1,2,3-cd)pyrene	µg/L	-	-	-	0.2	<0.20	-	-	-	<0.20	-	<0.20	-
Dibenz(a,h)anthracene	µg/L	0.002	-	*	0.2	<0.20	-	-	-	<0.20	-	<0.20	-
Benzo(g,h,i)perylene	µg/L	0.00002	-	*	0.2	<0.20	-	-	-	<0.20	-	<0.20	-
2-and 1-methyl Naphthalene	µg/L	2	-	*	3.2	<0.20	-	-	-	<0.20	-	<0.20	-
Chrysene-d12	%	-	-	-	-	75	-	-	-	77	-	75	-
Volatile Organic Compounds													
1,1 Dichloroethylene	µg/L	40	-	*	1.6	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,1,1,2-Tetrachloroethane	µg/L	20	-	*	1.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,1,1-Trichloroethane	µg/L	10	-	*	200	<0.30	0.41	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,1,2,2-Tetrachloroethane	µg/L	70	-	*	1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,1,2-Trichloroethane	µg/L	800	-	*	4.7	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
1,1-Dichloroethane	µg/L	200	-	*	5	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,2 - Dichloroethane	µg/L	100	-	*	1.6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
1,2,4-Trichlorobenzene	µg/L	0.5	-	*	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,2-Dichlorobenzene	µg/L	2.5	-	*	3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-Dichloropropane	µg/L	0.7	-	*	5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
1,3-Dichlorobenzene	µg/L	2.5	-	*	59	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,3-Dichloropropene (Cis + Trans)	µg/L	-	-	-	0.5	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,4-Dichlorobenzene	µg/L	4	80	*	1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
2-Hexanone	µg/L	-	-	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acetone	µg/L	-	-	-	2700	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	µg/L	100	10	*	5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Bromodichloromethane	µg/L	200	-	*	16	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Bromoform	µg/L	60	-	*	25	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bromomethane	µg/L	0.9	-	*	0.89	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Carbon Tetrachloride	µg/L	-	-	-	0.79	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Chlorobenzene	µg/L	15	-	*	30	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloroethane	µg/L	-	-	-	30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Chloroform	µg/L	-	40	-	2.4	<0.20	<0.20	<0.20	28	<0.20	<0.20	<0.20	<0.20
Chloromethane	µg/L	700	-	*	-	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
cis- 1,2-Dichloroethylene	µg/L	200	-	*	1.6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
cis-1,3-Dichloropropene	µg/L	-	-	-	0.5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Dibromochloromethane	µg/L	40	-	*	25	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dichlorodifluoromethane	µg/L	-	-	-	590	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Ethylbenzene	µg/L	8	160	*	2.4	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene Dibromide	µg/L	5	-	*	0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
m & p-Xylene	µg/L	32	-	*	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Methyl Ethyl Ketone	µg/L	400	-	*	1800	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methyl Isobutyl Ketone	µg/L	-	-	-	640	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methyl tert-butyl ether	µg/L	200	-	*	15	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Methylene Chloride	µg/L	100	2000	*	50	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
n-Hexane	µg/L	-	-	-	51	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
o-Xylene	µg/L	40	-	*	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Styrene	µg/L	4	-	*	5.4	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tetrachloroethylene	µg/L	50	1000	*	1.6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Toluene	µg/L	0.8	16	*	24	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.31	<0.20
trans- 1,2-dichloroethylene	µg/L	200	-	*	1.6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
trans-1,3-Dichloropropene	µg/L	7	-	*	0.5	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Trichloroethylene	µg/L	20	400	*	1.6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Trichlorofluoromethane	µg/L	-	-	-	150	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Vinyl Chloride	µg/L	600	-	*	0.5	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Xylene Mixture (Total)	µg/L	-	-	-	300	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Toluene-d8	% Recovery	-	-	-	-	100	101	101	103	107	103	101	102
4-Bromofluorobenzene	% Recovery	-	-	-	-	83	81	84	81	76	75	80	114
Petroleum Hydrocarbons													
Oil and Grease (animal/vegetable)	mg/L	NA	150	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
Oil and Grease (mineral) in water	mg/L	NA	15	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
Oil and Grease (Total) in water	mg/L	NA	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
F1 (C6 to C10)	µg/L	NA	NA	NA	750	<25	<25	<25	<25	<25	<25	<25	-
F1 (C6 to C10) minus BTEX	µg/L	NA	NA	NA	750	<25	<25	<25	<25	<25	<25	<25	-
F2 (C10 to C16)	µg/L	NA	NA	NA	150	<100	<100	<100	<100	<100	<100	<100	-
F2 (C10 to C16) minus Naphthalene	µg/L	NA	NA	NA	-	<100	-	-	-	<100	-	<100	-
F3 (C16 to C34)	µg/L	NA	NA	NA	500	<100	<100	100	<100	<100	<100	<100	-
F3 (C16 to C34) minus PAHs	µg/L	NA	NA	NA	-	<100	-	-	-	<100	-	<100	-
F4 (C34 to C50)	µg/L	NA	NA	NA	500	<100	<100	<100	<100	<100	<100	<100	-
Gravimetric Heavy Hydrocarbons	µg/L	NA	-	-	500	NA	NA	NA	NA	NA	NA	NA	-
Terphenyl	%	-	-	-	-	65	91	86	68	67	68	70	-

Notes:

* The associated PWQO criteria applies for these parameters as per Section 5: 1(e) of The Regional Municipalty of Halton By-Law 2-03 (2003)

PWQO: Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ontario Ministry of Environment and Energy, July 1994, Reprinted 1999.

Halton Sewer Use By-Law 2-03: The Regional Municipality of Halton By-Law 2-03 (2003)

O. Reg. 153/04 (as amended) Table 2: Ontario Regulation 153/04 (as amended) Table 2: Potable Groundwater All Types of Property Use Coarse Grained.

mg/L: Milligrams per liter

µg/L: Micrograms per liter

NA: Not Available

28 O. Reg. 153/04 (as amended) Table 2 Exceedance

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APPENDIX A – WSP (2017) GEOTECHNICAL INVESTIGATION REPORT

APPENDIX B – HYDRAULIC CONDUCTIVITY EVALUATION

HYDRAULIC CONDUCTIVITY ESTIMATION

GEORGIAN COURT REDEVELOPMENT
BURLINGTON ON

Soil Sample (SS) Location				Hazen Approximation: $K = C (D_{10})^2$					Puckett Method: $K = (4.36 \times 10^{-5}) e^{(-0.1975 \times \%clay)}$	
Borehole ID	Type and Number	Depth of SS		Diameter (mm) (10th percentile)	Diameter (cm) (10th percentile)	C	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (m/sec)	% Clay (< 0.002 mm)	K value (m/sec)
		Depth (mBGS)	Elevation (mASL)							
BH16-01	SS9	7.6	83.6						27	2.1E-07
BH16-03	SS10	10.7	78.8	0.002	0.0002	60	2.4E-06	2.4E-08	10	6.0E-06
BH16-06	SS6	4.6	90.1						18	1.2E-06
BH16-07	SS6	4.6	88.0						19	1.0E-06
BH16-11	SS5	3.1	88.5	0.01	0.001	60	6.0E-05	6.0E-07		
BH16-16	SS6	4.6	88.2						11	5.0E-06
BH16-17	SS6	4.6	89.6						16	1.8E-06

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APPENDIX C – ECOLOG ERIS REPORT

APPENDIX D – AGAT LABORATORIES – CERTIFICATE OF ANALYSIS

APPENDIX E – DEWATERING CALCULATIONS

CONSTRUCTION DEWATERING CALCULATIONS
Georgian Court Redevelopment
Burlington ON

Worksheet 1a: Building Tower Foundation (BH16-1 to BH16-3)

$$Q_T = \left[\frac{K\left(H^2-h^2\right)}{5.31\times10^{-6}\ \ln{}^{R_o}/_{r_s}}\right]$$ (Powers et al., 2007)

		Dewatering parameters:	
Constant		5.31E-06	
Length	a	260	m
Width	b	70	m
Hydraulic conductivity (Anticipated)	K	8.30E-07	m/s
Hydraulic conductivity (Worst Case)		8.30E-06	m/s
Static Groundwater Elevation		91	masl
Excavation Base Elevation		81	masl
Aquifer Base Elevation		80	masl
Aquifer thickness	H	11	m
Height of bottom of excavation above bottom of aquifer	h	1	m
Radius of circle equivalent to area of the open trench	rs	105.04	m

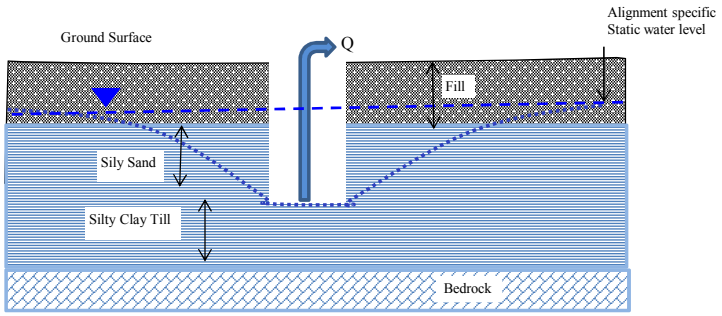
$$R_o = \left[3000(H-h)\sqrt{K}\right]$$ (Sichardt, 1930)

		Zone of Influence:	
Zone of Influence (Anticipated Case)		27.33	m
Zone of Influence (Worst Case)		86.43	m
Zone of Influence (Worst Case plus Factor of Safety of 2:1)		172.86	m
Zone of Influence Plus Zone of Circle (Anticipated)	Ro	132.37	m
Zone of Influence Plus Zone of Circle (Worst)	Ro	191.47	m
Zone of Influence Plus Zone of Circle (Safety 2:1)	Ro	277.90	m

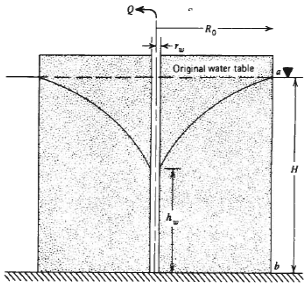
Q (Anticipated)	81.11	L/min
Q (Worst)	312.42	L/min
2x Factor of Safety	625	L/min

	Per Access Pit	
Q (Anticipated)	**116,793**	**L/day**
Q (Worst)	**449,888**	**L/day**
2x Factor of Safety	**899,775**	**L/day**

Hydrogeological Schematic Diagram:



Equation Schematic Diagram:



Assumptions for Construction Dewatering:
Groundwater levels measured by WSP (2017)
Construction dewatering rates are as calculated as per Powers, J.P. et al. (2007), based on groundwater inflow to a large diameter circular excavation, with equivalent area as per the roughly square excavation shape, as required for this project.
The aquifer base is defined as 1 m below excavation base

The **Anticipated Case Scenario** calculated dewatering rate is based on the geometric mean hydraulic conductivity estimated from the Hazen and Puckett methods.

The **Worst Case Scenario** calculated dewatering rate is based on an order of magnitude increase in the K from the Anticipated Case Scenario.
Hydraulic conductivity values used in these calculations were calculated from grain size distribution curves using the Hazen and Puckett approximations.

masl - meters above mean sea level
mbgs - meters below ground surface.

CONSTRUCTION DEWATERING CALCULATIONS
Georgian Court Redevelopment
Burlington ON

Worksheet 1b: Building Tower Foundation (BH16-4 to BH16-7)

$$Q_T = \left[\frac{K\left(H^2-h^2\right)}{5.31\times10^{-6}\ln{}^{R_o}/_{r_s}}\right]$$ (Powers et al., 2007)

		Dewatering parameters:	
Constant		5.31E-06	
Length	a	180	m
Width	b	180	m
Hydraulic conductivity (Anticipated)	K	8.30E-07	m/s
Hydraulic conductivity (Worst Case)		8.30E-06	m/s
Static Groundwater Elevation		90.4	masl
Excavation Base Elevation		80	masl
Aquifer Base Elevation		79	masl
Aquifer thickness	H	11.4	m
Height of bottom of excavation above bottom of aquifer	h	1	m
Radius of circle equivalent to area of the open trench	rs	114.59	m

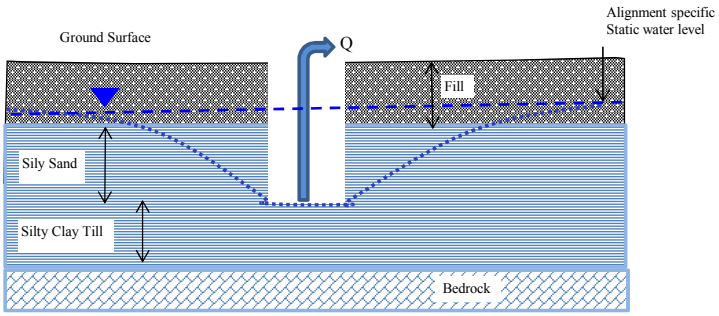
$$R_o = \left[3000(H-h)\sqrt{K}\right]$$ (Sichardt, 1930)

		Zone of Influence:	
Zone of Influence (Anticipated Case)		28.42	m
Zone of Influence (Worst Case)		89.89	m
Zone of Influence (Worst Case plus Factor of Safety of 2:1)		179.77	m
Zone of Influence Plus Zone of Circle (Anticipated)	Ro	143.02	m
Zone of Influence Plus Zone of Circle (Worst)	Ro	204.48	m
Zone of Influence Plus Zone of Circle (Safety 2:1)	Ro	294.36	m

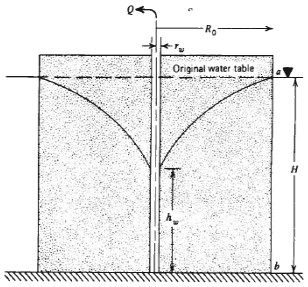
Q (Anticipated)	90.97	L/min
Q (Worst)	348.09	L/min
2x Factor of Safety	696	L/min

	Per Access Pit	
Q (Anticipated)	**130,998**	**L/day**
Q (Worst)	**501,254**	**L/day**
2x Factor of Safety	**1,002,509**	**L/day**

Hydrogeological Schematic Diagram:



Equation Schematic Diagram:



Assumptions for Construction Dewatering:
Groundwater levels measured by WSP (2017)
Construction dewatering rates are as calculated as per Powers, J.P. et al. (2007), based on groundwater inflow to a large diameter circular excavation, with equivalent area as per the roughly square excavation shape, as required for this project.
The aquifer base is defined as 1 m below excavation base

The **Anticipated Case Scenario** calculated dewatering rate is based on the geometric mean hydraulic conductivity estimated from the Hazen and Puckett methods.

The **Worst Case Scenario** calculated dewatering rate is based on an order of magnitude increase in the K from the Anticipated Case Scenario.
Hydraulic conductivity values used in these calculations were calculated from grain size distribution curves using the Hazen and Puckett approximations.

masl - meters above mean sea level
mbgs - meters below ground surface.

CONSTRUCTION DEWATERING CALCULATIONS
Georgian Court Redevelopment
Burlington ON

Worksheet 1c: Townhouse Foundation (BH16-8 to BH16-12)

$$Q_T = \left[\frac{K\left(H^2-h^2\right)}{5.31\times10^{-6}\ln{}^{Ro}/_{r_s}}\right]$$ (Powers et al., 2007)

		Dewatering parameters:	
Constant		5.31E-06	
Length	a	270	m
Width	b	70	m
Hydraulic conductivity (Anticipated)	K	8.30E-07	m/s
Hydraulic conductivity (Worst Case)		8.30E-06	m/s
Static Groundwater Elevation		89	masl
Excavation Base Elevation		85	masl
Aquifer Base Elevation		84	masl
Aquifer thickness	H	5	m
Height of bottom of excavation above bottom of aquifer	h	1	m
Radius of circle equivalent to area of the open trench	rs	108.23	m

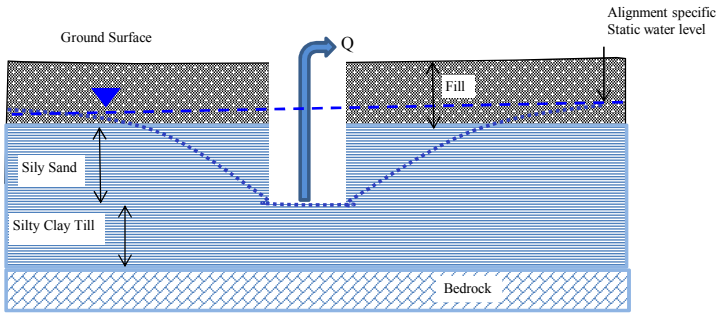
$$R_o = \left[3000(H-h)\sqrt{K}\right]$$ (Sichardt, 1930)

		Zone of Influence:	
Zone of Influence (Anticipated Case)		10.93	m
Zone of Influence (Worst Case)		34.57	m
Zone of Influence (Worst Case plus Factor of Safety of 2:1)		69.14	m
Zone of Influence Plus Zone of Circle (Anticipated)	Ro	119.16	m
Zone of Influence Plus Zone of Circle (Worst)	Ro	142.80	m
Zone of Influence Plus Zone of Circle (Safety 2:1)	Ro	177.37	m

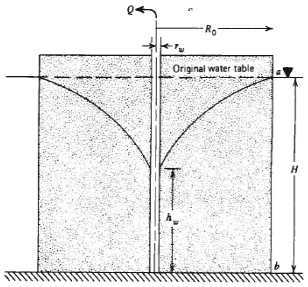
Q (Anticipated)	38.98	L/min
Q (Worst)	135.33	L/min
2x Factor of Safety	271	L/min

	Per Access Pit	
Q (Anticipated)	**56,135**	**L/day**
Q (Worst)	**194,873**	**L/day**
2x Factor of Safety	**389,745**	**L/day**

Hydrogeological Schematic Diagram:



Equation Schematic Diagram:



Assumptions for Construction Dewatering:
Groundwater levels measured by WSP (2017)
Construction dewatering rates are as calculated as per Powers, J.P. et al. (2007), based on groundwater inflow to a large diameter circular excavation, with equivalent area as per the roughly square excavation shape, as required for this project.
The aquifer base is defined as 1 m below excavation base

The **Anticipated Case Scenario** calculated dewatering rate is based on the geometric mean hydraulic conductivity estimated from the Hazen and Puckett methods.

The **Worst Case Scenario** calculated dewatering rate is based on an order of magnitude increase in the K from the Anticipated Case Scenario.
Hydraulic conductivity values used in these calculations were calculated from grain size distribution curves using the Hazen and Puckett approximations.

masl - meters above mean sea level
mbgs - meters below ground surface.

CONSTRUCTION DEWATERING CALCULATIONS
Georgian Court Redevelopment
Burlington ON

Worksheet 1d: Townhouse Foundation (BH16-8 to BH16-12)

$$Q_T = \left[\frac{K\left(H^2-h^2\right)}{5.31\times10^{-6}\ln{}^{Ro}/_{r_s}}\right]$$ (Powers et al., 2007)

		Dewatering parameters:	
Constant		5.31E-06	
Length	a	200	m
Width	b	110	m
Hydraulic conductivity (Anticipated)	K	8.30E-07	m/s
Hydraulic conductivity (Worst Case)		8.30E-06	m/s
Static Groundwater Elevation		90.8	masl
Excavation Base Elevation		87	masl
Aquifer Base Elevation		86	masl
Aquifer thickness	H	4.8	m
Height of bottom of excavation above bottom of aquifer	h	1	m
Radius of circle equivalent to area of the open trench	rs	98.68	m

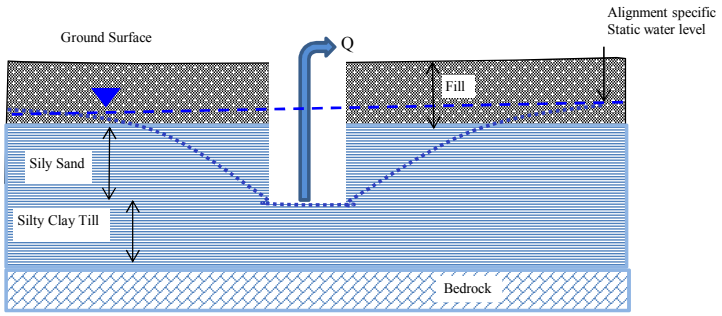
$$R_o = \left[3000(H-h)\sqrt{K}\right]$$ (Sichardt, 1930)

		Zone of Influence:	
Zone of Influence (Anticipated Case)		10.39	m
Zone of Influence (Worst Case)		32.84	m
Zone of Influence (Worst Case plus Factor of Safety of 2:1)		65.69	m
Zone of Influence Plus Zone of Circle (Anticipated)	Ro	109.06	m
Zone of Influence Plus Zone of Circle (Worst)	Ro	131.52	m
Zone of Influence Plus Zone of Circle (Safety 2:1)	Ro	164.36	m

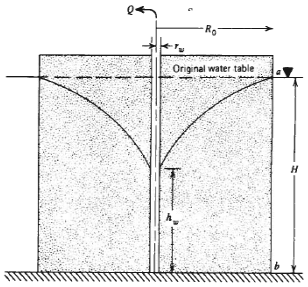
Q (Anticipated)	34.43	L/min
Q (Worst)	119.91	L/min
2x Factor of Safety	240	L/min

	Per Access Pit	
Q (Anticipated)	**49,572**	**L/day**
Q (Worst)	**172,666**	**L/day**
2x Factor of Safety	**345,332**	**L/day**

Hydrogeological Schematic Diagram:



Equation Schematic Diagram:



Assumptions for Construction Dewatering:
Groundwater levels measured by WSP (2017)
Construction dewatering rates are as calculated as per Powers, J.P. et al. (2007), based on groundwater inflow to a large diameter circular excavation, with equivalent area as per the roughly square excavation shape, as required for this project.
The aquifer base is defined as 1 m below excavation base

The **Anticipated Case Scenario** calculated dewatering rate is based on the geometric mean hydraulic conductivity estimated from the Hazen and Puckett methods.

The **Worst Case Scenario** calculated dewatering rate is based on an order of magnitude increase in the K from the Anticipated Case Scenario.
Hydraulic conductivity values used in these calculations were calculated from grain size distribution curves using the Hazen and Puckett approximations.

masl - meters above mean sea level
mbgs - meters below ground surface.

APPENDIX F – STANDARD CONDITIONS AND LIMITATIONS

Appendix F

Hydraulic Analysis (WSP Canada Inc.)

Urbantech Consulting, A Division of Leighton-Zec Ltd.
25 Royal Crest Court, Suite 201 Markham, Ontario L3R 9X4
TEL: 905.946.9461 FAX: 905.946.9595
www.urbantech.com

MEMO

TO: Andrew Fata, P. Eng., Associate, Urbantech Consulting; afata@urbantech.com

FROM: Delwar Ahmed, P. Geo., Hydrogeologist, WSP Canada

SUBJECT: **Precipitation Water Balance Calculations – Georgian Court Redevelopment Site, Burlington, ON**

DATE: **July 7, 2017**

1. INTRODUCTION

The following is a summary of the water balance calculations that has been completed for the Georgian Court Redevelopment Site in Burlington, Ontario. The basic information about the area of pre- and post-development imperviousness was provided by Urbantech. The information was used in the water balance calculations for this site. The precipitation data from the nearest weather station at Royal Botanical Gardens in Hamilton (Hamilton RBG CS, ID: 6153301, Lat. 43.29, Long. -79-91) was used and the data was provided by Environment Canada.

The site is bounded by Marley Road on the south, King Road on the west, Surrey Lane on the north and Warwick Drive on the east including some properties approximately 75 m east of Warwick Drive. It is located in the Town of Burlington and is currently a developed site with a mix of urban townhomes and low-rise apartment complexes. This site will be redeveloped with a mix of townhomes and mid and high-rise condominium towers. The total area of the existing and proposed redeveloped site is 8.4 hectares (ha).

Under existing conditions, 4.2 ha of land is impervious that includes buildings, driveways, parking areas and paved surfaces. The remaining 4.2 ha of land is pervious that includes lawns and gardens, boulevards and grassed ROWs and also includes 0.57 ha (estimated from Google Earth) of park space located approximately in the central part of the site.

The future development will include 4.7 ha of impervious and 3.7 ha of pervious lands including two park areas (one in the central and the second one on the east side) totalling to about 0.94 ha.

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The surficial soils within the site may be classified as Fine Sandy Loam based on their physical properties. This soil type (Hydrologic Soil Group B) is relatively permeable and therefore does not contribute significantly to runoff.

A water balance analysis was performed for this site. Site specific inputs used in the water balance analysis are summarized in the following table and the inputs under post-development case are explained in the following text. The rationale for the pre-development and post-development inputs are discussed in the following table.

Table – 1: Site Specific Inputs Used in the Water Balance

Infiltration Factor Based on Land Conditions	**Pre-Development**	**Post-Development**
Topography – Flat land, average slope <0.06 m/km	0.3	0.3
Soils – Fine Sandy Loam	0.3	0.3
Land Cover – Urban Lawns	0.05	0.05
Sum of the i-factor for the Development Area	**0.65**	**0.65**
Site Areas for Use in Calculations (ha)	**Pre-Development**	**Post-Development**
Pervious (lawns, park spaces, boulevards/ROWs)	4.2	3.7
Impervious (driveways, parking areas, roofs)	4.2	4.7
Subtotal for Future Development Lands	8.4	**8.4**
Water Holding Capacity of Soils (mm)	**Pre-Development**	**Post-Development**
Pervious Area - Lawns/Gardens	75	75
Notes: The site is developed. It will be redeveloped with a mix of townhomes, mid-rise and high-rise condo towers. So land use type will not change, however only the size of pervious and impervious areas will change. Existing developed areas and Post-Redevelopment areas are based on the conceptual plan of development, which is subject to revision and was provided by Urbantech. Water Holding Capacity (WHC) of Soils is based on values presented on Table 3.1 from the MOE Stormwater Management Manual (2003).		

2. EXISTING BUILT CONDITIONS

The surficial soils at the site as encountered in most of the boreholes corresponds to sand to silty sand (as per geotechnical investigations by WSP, January 2017) underlain by a Till deposit locally known as Halton Till overlying the Shale Bedrock inferred to be Queenston Formation.. The existing soil cover at the site is mostly lawns and gardens with some grassed boulevards and park space and the grain size analysis data provided in the geotechnical investigation report and all these information about this site leads to a Fine Sandy Loam soil with Water Holding Capacity of 75 mm as defined on Table 3.1 of the MOE Stormwater Planning and Design Manual.

The existing conditions infiltration factor for the site, "i" was set to 0.65 based on the following:

- Topography is considered to be flat as site slope is calculated at 1.27%, $i_{topo} = 0.3$
- Soils are considered to be fine sandy loam based on grain size analyses and soil descriptions, $i_{soils} = 0.3$
- Cover is equivalent to lawn and garden within the development area, $i_{cover} = 0.05$

The pervious surface area under the existing and future redevelopment stage changes by a small area (4.2 ha in pre-development to 3.7 ha in the redeveloped stage) including the park spaces. In general the site grades towards southeast from northwest (based on OBM contours) and is not expected to change after the site is redeveloped.

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Based on Table 3.1 from the MOE Stormwater Management Manual (2003), Fine Sandy Loam with short rooted vegetation such as lawns are identified with a Water Holding Capacity (WHC) on the order of 75 mm. This value was used to estimate the future water surplus across the developed portion of the site. The data is presented in **Table WB-1**.

3. POST- RE DEVELOPMENT CONDITIONS

The proposed redevelopment of the site is not expected to change the evapotranspiration, infiltration and runoff by a very large number as the ratio of the pervious and imperviousness at the site will not change significantly.

Under the redeveloped conditions, a significant change in land-use type is not expected as the average imperviousness will change from current 50% to 56% in the redevelopment stage and runoff is likely to increase by a small volume due to the increase in imperviousness of the site.

Since the change in perviousness of the site is relatively minor, a significant change in infiltration volume is not anticipated and mitigation measures to enhance infiltration may not be required at the site. However if required mitigation measures such as infiltration through grassed swale or infiltration gallery or pond may be utilized.

4. PRECIPITATION WATER BALANCE ANALYSIS

A precipitation water balance analyses was performed for the entire site area. One existing pre-development and one post-development water balance scenarios were examined.

The post-redevelopment scenario examined a condition with no mitigation measures applied at the site (all impervious runoff directed to storm sewer) and the results were compared against the current conditions. The water balance calculations and findings are described below.

The following assumptions have also been made to estimate the post-development precipitation water balance determinations:

- There is no infiltration occurring on hard surface areas;
- There would be 10% evaporative loss from non-connected depressions in the impervious area that will hold water after rain that will not form part of runoff but will evaporate directly back to the atmosphere;
- The imperviousness of the site after redevelopment is calculated at about 56% of the total area, or about 4.7 ha; and
- Runoff from the road network, driveways and sidewalks will be discharged directly into the storm sewer network.

A. EXISTING BUILT CONDITIONS PRECIPITATION WATER BALANCE

Under the existing conditions the site is considered pervious over 4.2 ha area. The water surplus under these conditions was calculated as 343 mm/year for the pervious area of the site (see **Table WB-2**). Therefore, pre-development infiltration across the pervious area of the property (4.2 ha) area was estimated at about 189 mm/year (7,923m^3/year), which is consistent with the reported infiltration values for these types of soils. Most groundwater recharge occurs during the spring melt period when soil moisture content is high. The remaining 154 mm/year of water surplus (6,483 m^3/year) would be available for surface runoff, most of which occurs during the spring melt period.

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B. REDEVELOPED STAGE PRECIPITATION WATER BALANCE WITH NO MITIGATION

This water balance scenario examines a worst-case condition, which presumes a traditional stormwater management scheme with no infiltration mitigation measures incorporated. This assumes that all impervious area runoff (less impervious surface losses to evaporation), including all roof runoff, is directed into the storm sewer system. This scenario considers that groundwater infiltration is supplied only by precipitation that falls upon pervious areas. The potential maximum loss of infiltration from the proposed development was calculated to provide a worst-case estimate of the potential impacts on infiltration due to the introduction of hard surfaces. Detailed monthly water balance calculations are presented on **Table WB-3**.

Under this hypothetical worst case scenario, the water balance analysis does not result in significant change in groundwater infiltration at the site. The results indicated that the groundwater infiltration volumes in existing and post-redeveloped stage is in balance. So it is anticipated that after redevelopment the site may not require any infiltration enhancing measures implemented other than the natural recharge process that is occurring currently at the site.

The runoff is calculated to increase only by about 4.2% as a response to 6% increase in imperviousness. All runoff from hard surfaces is conveyed to the storm sewer network. Some loss of groundwater flow may occur due to foundation drains and permeable backfill surrounding services, however, groundwater recharge potential is not anticipated to be impacted significantly due to the redevelopment of the site.

Table – 2: Existing and Redeveloped Stage Precipitation Water Balance

GEORGIAN COURT SITE, BURLINGTON	EXISTING CONDITIONS		REDEVELOPED SITE CONDITIONS		CHANGE	
Parameters	**mm/yr.**	**m^3/yr.**	**mm/yr.**	**m^3/yr.**	**m^3/yr.**	**%**
Precipitation	861.0	72,324	861.0	72,324	0	0.0%
Total Actual Evapo-Transpiration (AET)	259.0	21,756	228.2	19,166	-2,590	-11.9%
Evaporative Losses at 10% Precipitation	37.2	3,125	48.2	4,047	922	29.5%
Infiltration	94.3	7,923	94.4	7,927	3	0.0%
Runoff	470.5	39,520	490.3	41,185	1,665	4.2%

Notes:
Evaporative losses are losses of precipitation through simple evaporation on impervious surfaces (such as from ponding at puddles). The mm/year equivalencies presented based on the total site area of 8.4 ha.

A minor decrease in AET (-12%) may occur due to the fact that there would be slight overall increase in imperviousness in the redeveloped stage which is likely to reduce the evapo-

transpiration potential of the site. Evaporative loss from impervious surfaces increased by about 29% after redevelopment of the site.

There is no significant change in infiltration or recharge condition of the site in post-development stage since the change in perviousness is rather small (only about 6% less than the existing conditions). However if required to increase the groundwater recharge potential of the site there are measures such as redirecting roof runoff to the ground surface or into infiltration works such as infiltration swales beyond the rear edges of lots bordering the natural area can be implemented. The simplest approach is to direct the residential roof runoff onto the ground and while this is recommended its effects are not explicitly modelled in this scenario.

5. DISCUSSION OF PRECIPITATION WATER BALANCE RESULTS

Since it is a site that will be redeveloped with similar to existing type of construction footprints, the proposed construction is not expected to affect the site water balance conditions significantly. The change in the infiltration volume for this site from current to redeveloped stage remain virtually unchanged. The increase in runoff by about 4.2% is the result of 6% increase in imperviousness during post-redeveloped stage. Since the site design is still evolving, water balance model will require update if there is a change in the perviousness of the site.

6. GROUNDWATER FROM PERMANENT DRAINAGE SYSTEM

The site in the redeveloped stage will have townhomes and condominium towers with deep foundations below groundwater table encountered at the site. Based on the foundation design and the hydrogeological information acquired during the geotechnical investigation at the site. The site will have condominium towers with 2 levels of underground parking structures and townhomes with underground basement structures that will be below groundwater table at the site. This will require installation of permanent drainage systems/sub-drains underneath the foundations to reduce buildup of hydrostatic pressure. This is going to be a long term or permanent measure and the pumping volume may fluctuate along with the seasonal changes of water levels.

Calculations were performed to estimate the volumes of long term groundwater drainage for the two (2) condo towers and two (2) townhome blocks based on the information included in the draft hydrogeological report and the geotechnical investigation report. The volumes were calculated based on anticipated hydraulic conductivity (K) of the aquifer and the worst-case scenario hydraulic conductivity of the aquifer which was assumed to be one order magnitude higher than the anticipated K value. Based on the above assumptions and designed dimensions of foundation footprint areas and the requirement of maintaining the groundwater at the bottom of the foundations, approximately 30.7 million to 121.3 million litres of groundwater respectively for anticipated and worst-case conditions will be required to be pumped and directed into the storm sewers on an annual basis. However these calculation will be updated based on the site data when dewatering commences during construction stage. The detail of the calculations are provided in the enclosed table.

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If there are any questions or concerns, please feel free to contact the undersigned.

Yours sincerely,

WSP Canada Group Limited



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Delwar Ahmed, P. Geo.
Hydrogeologist, Environmental Management

DA/

Enclosed:
16-518 Existing and Proposed Imperviousness
MOECC Water Balance Table 3.1
Basic Dewatering Equations
Georgian Court Redevelopment Site Potential Long Term Foundation Dewatering Pumping Estimate
***Table WB-1** Existing and Post-Redevelopment Water Balance Data (mm Equivalents)*
***Table WB-2** Existing Water Balance (Volumetric Calculations based on existing conditions)*
***Table WB-3** Post-Redevelopment Water Balance – No Mitigation*
Plot WB-3: Monthly and Cumulative Infiltration, Existing and Post-Redevlopment without Mitigation

CC:
Peter J. Hayes, P. Geo., Senior Project Manager/Hydrogeologist, WSP Canada
J. David Leighton, CET, President, Urbantech Consulting

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Appendix G

Water Balance Report

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www.urbantech.com

IMPERVIOUSNESS CALCULATIONS

urbantech

Project Name: Georgian Court Estates Redevelopment
Municipality: City of Burlington
Project No.: 16-518
Date: 28-Jun-17

Prepared by: D.L.
Checked by: A.F.
Last Revised: 28-Jun-17

Proposed Conditions

Lot Number	Land use	Pervious Area (ha)	Impervious Area (ha)	Total area (ha)	%IMP
P01	High-rise	0.1270	0.2183	0.3453	63%
P02	High Rise	0.3160	0.3659	0.6819	54%
Park 1	Park	0.4237	0.0000	0.4237	0%
Park 2	Park	0.5153	0.0000	0.5153	0%
P03	High Rise/Townhouse Mix	0.2051	0.3906	0.5957	66%
P05	High Rise	0.1480	0.5964	0.7444	80%
P06	High Rise	0.2231	0.4639	0.6870	68%
P07	High Rise	0.1887	0.4165	0.6052	69%
P08	High Rise/Townhouse Mix	0.4047	0.4310	0.8357	52%
P09	Townhouses	0.2433	0.3511	0.5944	59%
P10	Townhouses	0.4232	0.8391	1.2623	66%
P11	Townhouses	0.2082	0.3447	0.5529	62%
ROW	ROW	0.2287	0.3238	0.5525	59%
Summary		**3.7**	**4.7**	**8.4**	
				Average %IMP	**56%**

Existing Conditions

Lot Number	Land use	Pervious Area (ha)	Impervious Area (ha)	Total area (ha)	%IMP
Entire Site	Existing Residential	4.1982	4.2530	8.4512	**50%**

Summary	**4.2**	**4.3**	**8.5**	
			Average %IMP	**50%**

This table provides an example of values. It assumes rolling topography (**i-Topo = 0.20**) and we have shown what corresponding i-values are for overall total, soil types and ground cover types

Table 3.1: Hydrologic Cycle Component Values

	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm	i-Soil	i-Total
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots) i-Cover = 0.05								
Fine Sand	50	A	940	515	149	276	0.40	0.65
Fine Sandy Loam	75	B	940	525	187	228	0.30	0.55
Silt Loam	125	C	940	536	222	182	0.20	0.45
Clay Loam	100	CD	940	531	245	164	0.15	0.40
Clay	75	D	940	525	270	145	0.10	0.35
Moderately Rooted Crops (corn and cereal grains) i-Cover = 0.10								
Fine Sand	75	A	940	525	125	291		0.70
Fine Sandy Loam	150	B	940	539	160	241		0.60
Silt Loam	200	C	940	543	199	199		0.50
Clay Loam	200	CD	940	543	218	179		0.45
Clay	150	D	940	539	241	160		0.40
Pasture and Shrubs i-Cover = 0.15								
Fine Sand	100	A	940	531	102	307		0.75
Fine Sandy Loam	150	B	940	539	140	261		0.65
Silt Loam	250	C	940	546	177	217		0.55
Clay Loam	250	CD	940	546	197	197		0.50
Clay	200	D	940	543	218	179		0.45
Mature Forests i-Cover = 0.20								
Fine Sand	250	A	940	546	79	315		0.80
Fine Sandy Loam	300	B	940	548	118	274		0.75
Silt Loam	400	C	940	550	156	234		0.65
Clay Loam	400	CD	940	550	176	215		0.60
Clay	350	D	940	549	196	196		0.50

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

**This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	<0.06%	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.28% - 0.38%	0.2
	Hilly Land, average slope 28 m to 47 m/km	2.8% - 4.7%	0.1
Soils	Tight impervious clay		0.1
	Medium combinations of clay and loam		0.2
	Open Sandy loam		0.4
Cover	Cultivated Land		0.1
	Woodland		0.2

Dewatering Flow Estimation Equations

Basic Dewatering Equations Used Consistent Units

Equation for Confined Aquifer		Refer to Table 6.1, p. 67, Powers et al., 2007
Radial Flow Confined Aquifer $Q_{cr} = [2\pi KB(H-h)]/\ln(R_o/r_w)$		<---Radial flow = contributions from end wells
Trench Flow Confined Aquifer $Q_{ct} = 2xKB(H-h)/L$		<---Trench flow = contributions from both sides of the trench.
where	K = hydraulic conductivity in **m/day**	
	B = saturated thickness of the aquifer in **m**	
	H = initial GW elevation measured from ref. datum in **m**	<---Initial GW elevation
	h = GW elevation in the well measured from ref. datum in **m**	<---Target to lower the GW to!
	R_o = radius of influence in **m**	<--- Sichart & Krylis Eq. $R_o = 3000(H-h)*(K)^{0.5}$ **where H & h are in feet and K in m/sec.R_o** will be in **metres**. Alternative equation by Bear (Bear, J., 1979. **Hydraulics of Groundwater**, McGraw-Hill, New York, 569p) $R_o = 1.5(Tt/S)^{0.5}$ where **T** is transmissivity in **m^2/day**, **t** is pumping duration in **days**, **S** is dimensionless storage coefficient. **R_o** will be in **metres**.
	r_w = radius of of the well in **m**	
	L = distance of influence for trench flow in **m**	<--- Similar to R_o = ZOI for radial flow
Q = volume in m^3/day		
Equation for Unconfined Aquifer		
Radial Flow Unconfined Aquifer $Q_{ur} = \pi K(H^2-h^2)]/\ln(R_o/r_w)$		<---Radial flow = contributions from end wells
Trench Flow Unconfined $Q_{ut} = xK(H^2-h^2)/L$		<---Trench flow = contributions from both sides of the trench.
These eqs have been used in dewatering calculations.		

Refer to Figs 6.7 and 6.8, p.70, Powers et al., 2007

Equivalent Radius Approximation

Circular System **$r_s = (ab/\pi)^{0.5}$** <--- Circular system with aspect ratio a/b close to 1[Figure 6.7(a), p-70, Construction Dewatering & Groundwater Control, 3rd Ed, 2007, Powers et al].

Rectangular System **$r_s = a+b/\pi$** <--- Where the system is rectangular with unequal dimensions of length 'a' and width 'b' and when the raio of a/b is >1 but <1.5 [Figure 6.7(b), p-70, Construction Dewatering & Groundwater Control, 3rd Ed, 2007, Powers et al].

If the well array is as shown in Fig. 6.7 substitute r_w with r_s and use the equation for radial flow shown above based on confined or unconfined aquifer condition

Where the aspect ratio is > 1.5 or large and the well array is double sided as shown in Fig. 6.8, use the equations 6.10a nd 6.10b shown on p. 71 of Powers et. al., 2007

Figure 6.7

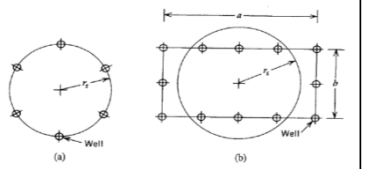


Figure 6.7 Approximation of equivalent radius r_s (a) Circular systems. (b) Rectangular systems.

Figure 6.8

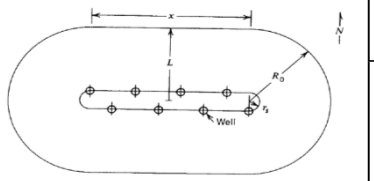
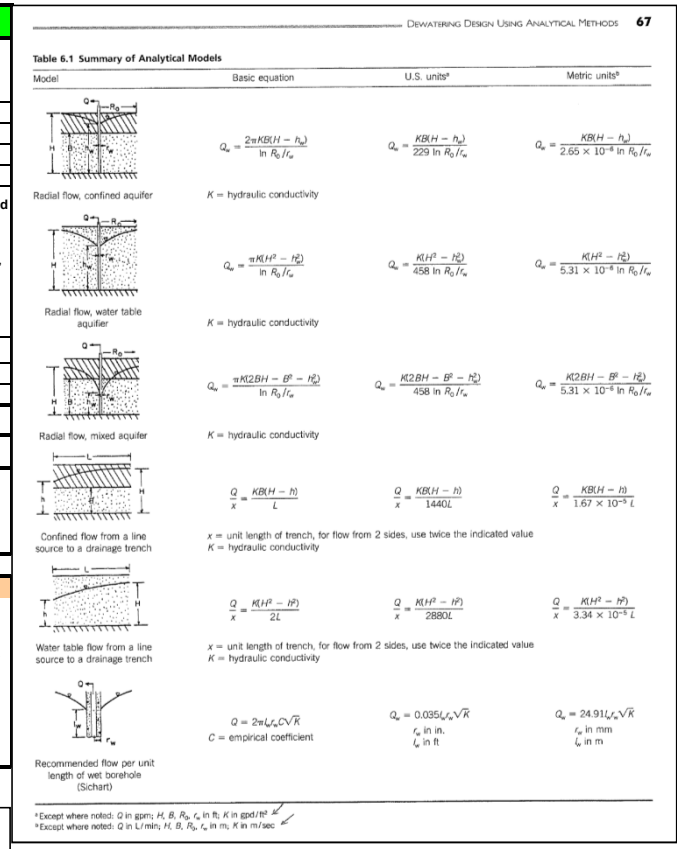


Figure 6.8 Approximate analysis of long, narrow systems.

Equations 6.10a and 6.10b

$$Q = \frac{2\pi KB(H-h)}{\ln R_o/r_s} + 2\left[\frac{xKB(H-h)}{L}\right] \quad (6.10a)$$

$$Q = \frac{\pi K(H^2-h^2)}{\ln R_o/r_s} + 2\left[\frac{xK(H^2-h^2)}{2L}\right] \quad (6.10b)$$



DEWATERING DESIGN USING ANALYTICAL METHODS 67

Table 6.1 Summary of Analytical Models

Model	Basic equation	U.S. units[a]	Metric units[b]
Radial flow, confined aquifer	$Q_w = \frac{2\pi KB(H-h_w)}{\ln R_o/r_w}$	$Q_w = \frac{KB(H-h_w)}{229 \ln R_o/r_w}$	$Q_w = \frac{KB(H-h_w)}{2.65\times10^{-6} \ln R_o/r_w}$
	K = hydraulic conductivity		
Radial flow, water table aquifer	$Q_w = \frac{\pi K(H^2-h_w^2)}{\ln R_o/r_w}$	$Q_w = \frac{K(H^2-h_w^2)}{458 \ln R_o/r_w}$	$Q_w = \frac{K(H^2-h_w^2)}{5.31\times10^{-8} \ln R_o/r_w}$
	K = hydraulic conductivity		
Radial flow, mixed aquifer	$Q_w = \frac{\pi K(2BH-B^2-h_w^2)}{\ln R_o/r_w}$	$Q_w = \frac{K(2BH-B^2-h_w^2)}{458 \ln R_o/r_w}$	$Q_w = \frac{K(2BH-B^2-h_w^2)}{5.31\times10^{-8} \ln R_o/r_w}$
	K = hydraulic conductivity		
Confined flow from a line source to a drainage trench	$\frac{Q}{x} = \frac{KB(H-h)}{L}$	$\frac{Q}{x} = \frac{KB(H-h)}{1440L}$	$\frac{Q}{x} = \frac{KB(H-h)}{1.67\times10^{-5}L}$
	x = unit length of trench, for flow from 2 sides, use twice the indicated value K = hydraulic conductivity		
Water table flow from a line source to a drainage trench	$\frac{Q}{x} = \frac{K(H^2-h^2)}{2L}$	$\frac{Q}{x} = \frac{K(H^2-h^2)}{2880L}$	$\frac{Q}{x} = \frac{K(H^2-h^2)}{3.34\times10^{-5}L}$
	x = unit length of trench, for flow from 2 sides, use twice the indicated value K = hydraulic conductivity		
Recommended flow per unit length of wet borehole (Sichart)	$Q = 2\pi l_w r_w C\sqrt{K}$ C = empirical coefficient	$Q_w = 0.035 l_w r_w \sqrt{K}$ r_w in in. l_w in ft	$Q_w = 24.91 l_w r_w \sqrt{K}$ r_w in mm l_w in m

[a] Except where noted: Q in gpm; H, B, R_o, r_w in ft; K in gpd/ft²
[b] Except where noted: Q in L/min; H, B, R_o, r_w in m; K in m/sec

Potential Long-Term Foundation Pumping, Georgina Court Redevlopment Site in Burlington, ON.

REFERENCE AREA	Bld. Tower 1 (1A)	Bld. Tower 2 (1B)	Townhome 1 (1C)	Townhome 2 (1D)
DEWATERING SYSTEM CONFIGURATION =	**Rectangular**	**Rectangular**	**Rectangular**	**Rectangular**
SOIL TYPE AT FOUNDATION LEVEL=	Assumed granular material mostly composed of silt with sand.	Assumed granular material mostly composed of silt with sand.	Assumed granular material mostly composed of silt with sand.	Assumed granular material mostly composed of silt with sand.
FOUNDATION ELEVATION =	83	82	86	88
Aquifer Top Elevation (masl) =	91	90.4	89	90.8
Aquifer Bottom Elevation (masl) =	80	79	84	86
Initial GW Elevation (masl) =	91	90.4	89	90.8
GW Elevation at Invert (masl) =	82	81	86	87
Drawdown (m) =	**9.0**	**9.4**	**3.0**	**3.8**
Excavation Bottom Elevation (masl) =	**82**	**81**	**86**	**87**
Target GW Elevation (masl) =	82	81	86	87
Ro from Sichart & Kryieleis (1982) =	**78**	**81**	**26**	**33**
Ro from Bear (1979) =	**805**	**819**	**543**	**532**
Worst Case Scenario Ro =	**78**	**81**	**26**	**33**
If rectangular than length 'a' (m) =	260	180	270	200
If rectangular than width 'b' (m) =	70	180	70	110
rs = (ab/p)^0.5	**76.11**	**101.55**	**77.56**	**83.68**
rs = a+b/p	**105.04**	**114.59**	**108.23**	**98.68**
Radius of the well rw =	0.25	0.25	0.25	0.25
Storage Coefficient 'S' =	0.01	0.01	0.01	0.01
Pumping Duration 't' in days =	**365**	**365**	**365**	**365**
Aquifer Thickness 'B' (m) =	11	11.4	5	4.8
K (m/sec) =	**8.30E-06**	**8.30E-06**	**8.30E-06**	**8.30E-06**
rw (m) =	0.25	0.25	0.25	0.25
Aquifer Type: Confined/Unconfined	**UNCONFINED**	**UNCONFINED**	**UNCONFINED**	**UNCONFINED**
ZOI in 'm' where 's' is 0.50m (2) =	**611**	**634**	**312**	**313**
Average Litres/min	**89.9**	**100.2**	**20.4**	**20.5**
Average Litres/day	**129,443**	**144,255**	**29,345**	**29,482**
Average Per year	**47,246,840**	**52,653,124**	**10,710,816**	**10,760,943**

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Table WB-1: Existing and Post-Redevelopment Water Balance Data (mm Equivalents)

Weather Station Data: Hamilton RBG, Hamilton, ON. Data Range: 1951 - 1996

Latitude: 43 degrees 12 minutes N

Data Provided by Environment Canada - Atmospheric Environment Services - data may exhibit round off error

Longitude 79 degrees 55 minutes W

PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Re-Development Lands													
Existing Conditions- Urban Residential Uses													
Soil Moisture Storage 75 mm													
Annual Precipitation Factor 1.00 x Normal													
Average Temperature (C)	-4.9	-4.2	0.4	7	13.2	18.8	21.8	20.9	16.6	10.4	4.4	-1.7	**6.8**
Precipitation (P) (mm)	62	55	71	77	75	69	74	84	76	70	75	73	**861**
Rainfall (mm)	25	27	54	75	75	69	74	84	76	70	70	48	
Melt (mm)	22	32	37	4	0	0	0	0	0	0	4	14	
Potential Evapotranspiration (PET) (mm)	2	2	9	34	77	115	139	122	83	44	16	4	**647**
Actual Evapotranspiration (AET) (mm)	2	2	9	34	77	101	92	77	64	40	16	4	**518**
Deficit (mm)	0	0	0	0	0	-14	-47	-45	-19	-4	0	0	
Surplus - available for infiltration/runoff (mm)	44	57	82	45	17	1	0	2	3	9	32	51	**343**
Snowfall (mm)	26	22	2	0	0	0	0	0	0	0	1	11	
Soil Moisture (mm)	74	75	75	75	57	23	5	10	19	39	66	73	
Change in Soil Moisture Storage (mm)	1	1	0	0	-18	-34	-18	5	9	20	27	7	
Data for Use with Pre-Development Water Balance - Future Development Lands													
Precipitation (P) (mm)	62.0	55.0	71.0	77.0	75.0	69.0	74.0	84.0	76.0	70.0	75.0	73.0	**861.0**
Actual Evapotranspiration (AET) (mm)	2.0	2.0	9.0	34.0	77.0	101.0	92.0	77.0	64.0	40.0	16.0	4.0	**518.0**
Surplus - available for infiltration/runoff (mm)	44.0	57.0	82.0	45.0	17.0	1.0	0.0	2.0	3.0	9.0	32.0	51.0	**343.0**
Infiltration (MOE Methodology) (m^3) **i = 0.65**	28.6	37.1	53.3	29.3	11.1	0.7	0.0	1.3	2.0	5.9	20.8	33.2	**223.0**
Runoff (MOE Methodology) (m^3)	15.4	20.0	28.7	15.8	6.0	0.4	0.0	0.7	1.1	3.2	11.2	17.9	**120.1**
Post-Redevelopment - Manicured Lawns/Gardens													
Soil Moisture Storage 75 mm													
Annual Precipitation Factor 1.00 x Normal													
Average Temperature (C)	-4.9	-4.2	0.4	7	13.2	18.8	21.8	20.9	16.6	10.4	4.4	-1.7	**6.8**
Precipitation (P) (mm)	62	55	71	77	75	69	74	84	76	70	75	73	**861**
Rainfall (mm)	25	27	54	75	75	69	74	84	76	70	70	48	
Melt (mm)	22	32	37	4	0	0	0	0	0	0	4	14	
Potential Evapotranspiration (PET) (mm)	2	2	9	34	77	115	139	122	83	44	16	4	**647**
Actual Evapotranspiration (AET) (mm)	2	2	9	34	77	101	92	77	64	40	16	4	**518**
Deficit (mm)	0	0	0	0	0	-14	-47	-45	-19	-4	0	0	
Surplus - available for infiltration/runoff (mm)	44	57	82	45	17	1	0	2	3	9	32	51	**343**
Snowfall (mm)	26	22	2	0	0	0	0	0	0	0	1	11	
Soil Moisture (mm)	74	75	75	75	57	23	5	10	19	39	66	73	
Change in Soil Moisture Storage (mm)	1	1	0	0	-18	-34	-18	5	9	20	27	7	
Data for Use with Post-Redevelopment Water Balance													
Precipitation (P) (mm)	62.0	55.0	71.0	77.0	75.0	69.0	74.0	84.0	76.0	70.0	75.0	73.0	**861.0**
Actual Evapotranspiration (AET) (mm)	2.0	2.0	9.0	34.0	77.0	101.0	92.0	77.0	64.0	40.0	16.0	4.0	**518.0**
Surplus - available for infiltration/runoff (mm)	44.0	57.0	82.0	45.0	17.0	1.0	0.0	2.0	3.0	9.0	32.0	51.0	**343.0**
Infiltration (MOE Methodology) (m^3) **i = 0.55**	24.2	31.4	45.1	24.8	9.4	0.6	0.0	1.1	1.7	5.0	17.6	28.1	**188.7**
Runoff (MOE Methodology) (m^3)	19.8	25.7	36.9	20.3	7.7	0.5	0.0	0.9	1.4	4.1	14.4	23.0	**154.4**

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Table WB-2: Existing Conditions Water Balance (Volumetric Calculations based on existing conditions)

Weather Station Data: Hamilton RBG, Hamilton, ON. Data Range: 1951 - 1996

Latitude: 43 degrees 12 minutes N

Data Provided by Environment Canada - Atmospheric Environment Services - data may exhibit round off error

Longitude: 79 degrees 55 minutes W

PARAMETER		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Water Balance for Georgina Court Redevlopment Site, Burlington, ON														
Impervious Area	*4.20 ha*													
Precipitation (m^3)		2,604	2,310	2,982	3,234	3,150	2,898	3,108	3,528	3,192	2,940	3,150	3,066	**36,162**
Evaporative Loss at 10% Precipitation (m^3)	10%	260	260	260	260	260	260	260	260	260	260	260	260	**3,125**
Water Surplus (m^3)		2,344	2,050	2,722	2,974	2,890	2,638	2,848	3,268	2,932	2,680	2,890	2,806	**33,037**
Infiltration (MOE Methodology) (m^3)	**i = 0.65**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Runoff (MOE Methodology) (m^3)		2,344	2,050	2,722	2,974	2,890	2,638	2,848	3,268	2,932	2,680	2,890	2,806	**33,037**
Pervious Area	*4.20 ha*													
Precipitation (m^3)		2,604	2,310	2,982	3,234	3,150	2,898	3,108	3,528	3,192	2,940	3,150	3,066	**36,162**
Total AET (m^3)		84	84	378	1,428	3,234	4,242	3,864	3,234	2,688	1,680	672	168	**21,756**
Water Surplus (m^3)		1,848	2,394	3,444	1,890	714	42	0	84	126	378	1,344	2,142	**14,406**
Infiltration (MOE Methodology) (m^3)	**i = 0.65**	1,016	1,317	1,894	1,040	393	23	0	46	69	208	739	1,178	**7,923**
Runoff (MOE Methodology) (m^3)		832	1,077	1,550	851	321	19	0	38	57	170	605	964	**6,483**
Water Balance for Georgina Court Redevlopment Site, Burlington, ON - combined pervious and impervious areas														
Precipitation (m^3)		5,208	4,620	5,964	6,468	6,300	5,796	6,216	7,056	6,384	5,880	6,300	6,132	**72,324**
Total AET (m^3)		84	84	378	1,428	3,234	4,242	3,864	3,234	2,688	1,680	672	168	**21,756**
Evaporative Losses at 10% Precipitation (m^3)		260	260	260	260	260	260	260	260	260	260	260	260	**3,125**
Infiltration (MOE Methodology) (m^3)	**equivalent i 0.17**	1,016	1,317	1,894	1,040	393	23	0	46	69	208	739	1,178	**7,923**
Runoff (MOE Methodology) (m^3)		3,175	3,127	4,271	3,824	3,211	2,657	2,848	3,305	2,988	2,850	3,494	3,770	**39,520**

DRAFT

Notes:

1. Monthly climate data, including soil deficits, soil moisture storage, evapotranspiration and water surplus were provided by Environment Canada, and modeled for different soil Water Holding Capacities (WHCs). In this case WHCs of 75 MM is used.
2. Infiltration and Runoff volumes are calculated using the methodology described in the MOE Stormwater Design Manual (2003). Calculation of the infiltration factors used in the analyses is described in the text and presented on table of the memo.
3. Evaporative losses of 10% are modeled for impervious surfaces. This accounts for losses of water, such as water that collects in shallow depressions on these surfaces and does not reach the stormwater system.
4. There is minor round-off error within the Environment Canada data.

Table WB-3: Post-Redevelopment Water Balance - No Mitigation

Weather Station Data: Hamilton RBG, Hamilton, ON. Data Range: 1951 - 1996

Latitude: 43 degrees 12 minutes N

Data Provided by Environment Canada - Atmospheric Environment Services - data may exhibit round off error

Longitude: 79 degrees 55 minutes W

PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Water Balance for Georgian Court Redevelopment Site - lands to be redeveloped													
Impervious Area - Connected (Roads, Sidewalks, Driveways) a 4.70 ha													
Precipitation (m^3)	2,914	2,585	3,337	3,619	3,525	3,243	3,478	3,948	3,572	3,290	3,525	3,431	**40,467**
Evaporative Losses at 10% Precipitation (m^3) 10%	291	259	334	362	353	324	348	395	357	329	353	343	**4,047**
Water Surplus (m^3)	2,623	2,327	3,003	3,257	3,173	2,919	3,130	3,553	3,215	2,961	3,173	3,088	**36,420**
Infiltration (MOE Methodology) (m^3) **i = 0.00**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Runoff (MOE Methodology) (m^3)	2,623	2,327	3,003	3,257	3,173	2,919	3,130	3,553	3,215	2,961	3,173	3,088	**36,420**
Pervious Area - Land area for redevlopment 2.76 ha													
Precipitation (m^3)	1,711	1,518	1,960	2,125	2,070	1,904	2,042	2,318	2,098	1,932	2,070	2,015	**23,764**
Total AET (m^3)	55	55	248	938	2,125	2,788	2,539	2,125	1,766	1,104	442	110	**14,297**
Water Surplus (m^3)	1,214	1,573	2,263	1,242	469	28	0	55	83	248	883	1,408	**9,467**
Infiltration (MOE Methodology) (m^3) **i = 0.65**	789	1,023	1,471	807	305	18	0	36	54	161	574	915	**6,153**
Runoff (MOE Methodology) (m^3)	425	551	792	435	164	10	0	19	29	87	309	493	**3,313**
Pervious Area - Park spaces (Park 1 and 2) 0.94 ha													
Precipitation (m^3)	583	517	667	724	705	649	696	790	714	658	705	686	**8,093**
Total AET (m^3)	19	19	85	320	724	949	865	724	602	376	150	38	**4,869**
Water Surplus (m^3)	414	536	771	423	160	9	0	19	28	85	301	479	**3,224**
Infiltration (MOE Methodology) (m^3) **i = 0.65**	227	295	424	233	88	5	0	10	16	47	165	264	**1,773**
Runoff (MOE Methodology) (m^3)	186	241	347	190	72	4	0	8	13	38	135	216	**1,451**
Water Balance for Georgian Court Redevelopment Site, Burlington, ON - combined pervious and impervious areas.													
Precipitation (m^3)	5,208	4,620	5,964	6,468	6,300	5,796	6,216	7,056	6,384	5,880	6,300	6,132	**72,324**
Total AET (m^3)	74	74	333	1,258	2,849	3,737	3,404	2,849	2,368	1,480	592	148	**19,166**
Evaporative Losses at 10% Precipitation (m^3)	291	259	334	362	353	324	348	395	357	329	353	343	**4,047**
Infiltration (MOE Methodology) (m^3) **valent i= 0.16**	1,017	1,317	1,895	1,040	393	23	0	46	69	208	740	1,179	**7,927**
Runoff (MOE Methodology) (m^3)	3,234	3,118	4,142	3,882	3,409	2,933	3,130	3,581	3,256	3,086	3,617	3,796	**41,185**

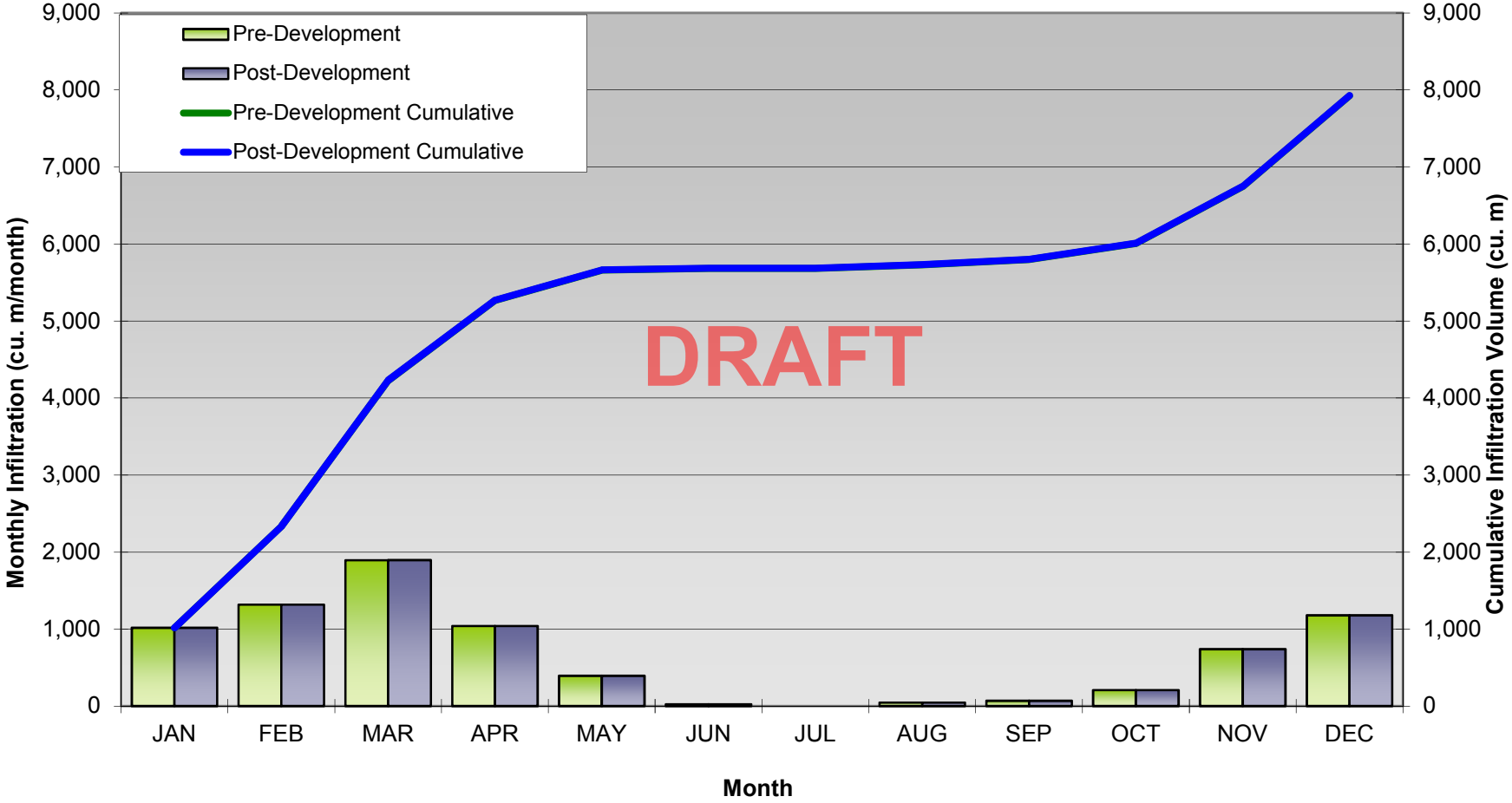
DRAFT

Comparisons	Existing	Post-Redev	Change	Change (%)
Precipitation (m^3)	72,324	72,324	0	0.0%
Total AET (m^3)	21,756	19,166	-2,590	-11.9%
Evaporative Losses at 10% Precipitation (m^3)	3,125	4,047	922	29.5%
Infiltration (MOE Methodology) (m^3)	**7,923**	**7,927**	**3**	**0.0%**
Runoff (MOE Methodology) (m^3)	**39,520**	**41,185**	**1,665**	**4.2%**

Notes:

1. Monthly climate data, including soil deficits, soil moisture storage, evapotranspiration and water surplus were provided by Environment Canada, and modeled for different soil Water Holding Capacities (WHCs). In this case WHCs of 75 MM is used.
2. Infiltration and Runoff volumes are calculated using the methodology described in the MOE Stormwater Design Manual (2003). Calculation of the infiltration factors used in the analyses is described in the text and presented on Table **X** of the memo.
3. Evaporative losses of 10% are modeled for impervious surfaces. This accounts for losses of water, such as water that collects in shallow depressions on these surfaces and does not reach the stormwater system.
4. There is minor round-off error within the Environment Canada data

Plot WB-3: Monthly and Cumulative Infiltration
Existing and Post-Redevelopment without Mitigation



Appendix H

Floodplain Modelling

- GeoHEC-RAS Model Resuts
- CH Correspondence

Urbantech Consulting, A Division of Leighton-Zec Ltd.
25 Royal Crest Court, Suite 201 Markham, Ontario L3R 9X4
TEL: 905.946.9461 FAX: 905.946.9595
www.urbantech.com

Water level comparison

HEC-RAS Model Cross-Section	Existing Regional Water Level	Proposed Water Level	Difference (Proposed-Existing)	# Buildings within existing floodplain + setback	# Buildings within proposed floodplain + setback
2200	92.26	92.25	-0.01	7	5
2182	91.54	91.57	0.03		
2082	91.15	91.22	0.07		
2013	90.74	90.94	0.2		
1941	90.13	90.16	0.03		
1859	89.72	89.89	0.17		
1824	89.42	89.39	-0.03		
1804	89.35	89.33	-0.02		
1784	89.33	89.32	-0.01		

Flood storage comparison

Design Event (as per CH HEC-2 model)	Existing (Entire Channel) [m³]	Existing (site) [m³] XS 1824 -02182	Proposed (Entire channel) [m³]	Proposed (site) [m³] XS 1824 -02182	Difference in Total Storage (Existing minus Proposed [m³]	[%]
PF1	36,620	3,400	36,610	3,400	-	0.00%
PF2	49,110	4,730	49,120	4,760	(30)	-0.06%
PF3	57,690	5,720	57,700	5,760	(40)	-0.07%
PF4	69,900	7,160	69,880	7,170	(10)	-0.01%
PF5	82,020	9,040	81,950	9,010	30	0.04%
PF6	92,650	10,510	92,500	10,420	90	0.10%
PF7 (Regional)	165,620	16,010	165,110	15,610	400	0.24%

Appendix I

Hydrologic Calculations

- Visual OTTHYMO 5.0 Node/Catchment Correlation Table
- Model Output

Urbantech Consulting, A Division of Leighton-Zec Ltd.
25 Royal Crest Court, Suite 201 Markham, Ontario L3R 9X4
TEL: 905.946.9461 FAX: 905.946.9595
www.urbantech.com

Existing Conditions (Simulation 1) Summary Output

```
*******************************
** SIMULATION:A-2YR           **
*******************************
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\60d2338a-61fb-4853-a799-5a4e8f346c9a\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.39  8.00  32.37 0.66   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.04  8.00  31.68 0.65   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0002]  0006  3  5.0       5.82    0.43  8.00  32.30  n/a   0.000
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0005+  0006]  0024  3  5.0       6.17    0.47  8.00  32.53  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       1.19    0.10  8.00  32.21 0.66   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0024+  0004]  0007  3  5.0       7.36    0.56  8.00  32.47  n/a   0.000
*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  36.19 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0007+  0008]  0014  3  5.0       7.51    0.58  8.00  32.55  n/a   0.000
*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.07  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0014+  0009]  0025  3  5.0       8.13    0.65  8.00  32.83  n/a   0.000
*
 *  CALIB STANDHYD       0010  1  5.0       2.21    0.16  8.00  31.70 0.65   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0010+  0025]  0015  3  5.0      10.34    0.81  8.00  32.59  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.55    0.06  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.50    0.04  8.00  32.20 0.66   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0011+  0012]  0027  3  5.0       1.05    0.10  8.00  34.31  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.64    0.05  8.00  32.21 0.66   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0013+  0027]  0026  3  5.0       1.69    0.15  8.00  33.51  n/a   0.000
*
 *  CALIB STANDHYD       0028  1  5.0       0.55    0.06  8.00  37.26 0.76   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0026]  0016  3  5.0      12.03    0.96  8.00  32.72  n/a   0.000
*
    ADD [  0016+  0028]  0016  1  5.0      12.58    1.03  8.00  32.92  n/a   0.000
```

```
*
 *  CALIB STANDHYD       0018  1  5.0       1.94    0.16  8.00  32.21 0.66   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       1.27    0.11  8.00  33.32 0.68   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0020  1  5.0       0.64    0.07  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0019+  0020]  0022  3  5.0       1.91    0.18  8.00  34.30  n/a   0.000
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    0.65  8.00  40.33 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0021+  0022]  0023  3  5.0       7.77    0.82  8.00  38.85  n/a   0.000
*
*********************************
** SIMULATION:B-5YR            **
*********************************
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\60d2338a-61fb-4853-a799-5a4e8f346c9a\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.59  8.00  46.04 0.71   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.06  8.00  45.34 0.70   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0002]  0006  3  5.0       5.82    0.65  8.00  45.98  n/a   0.000
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.05  8.00  50.47 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0005+  0006]  0024  3  5.0       6.17    0.70  8.00  46.23  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       1.19    0.14  8.00  45.85 0.71   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0024+  0004]  0007  3  5.0       7.36    0.84  8.00  46.17  n/a   0.000
*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  50.44 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0007+  0008]  0014  3  5.0       7.51    0.87  8.00  46.26  n/a   0.000
*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.09  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0014+  0009]  0025  3  5.0       8.13    0.96  8.00  46.58  n/a   0.000
*
 *  CALIB STANDHYD       0010  1  5.0       2.21    0.24  8.00  45.35 0.70   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0010+  0025]  0015  3  5.0      10.34    1.20  8.00  46.32  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.55    0.08  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
```

```
*
 *  CALIB STANDHYD       0012  1  5.0       0.50    0.06  8.00  45.84 0.71   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0011+  0012]  0027  3  5.0       1.05    0.14  8.00  48.27  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.64    0.08  8.00  45.84 0.71   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0013+  0027]  0026  3  5.0       1.69    0.22  8.00  47.35  n/a   0.000
*
 *  CALIB STANDHYD       0028  1  5.0       0.55    0.08  8.00  51.77 0.80   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0026]  0016  3  5.0      12.03    1.41  8.00  46.46  n/a   0.000
*
    ADD [  0016+  0028]  0016  1  5.0      12.58    1.50  8.00  46.69  n/a   0.000
*
 *  CALIB STANDHYD       0018  1  5.0       1.94    0.22  8.00  45.85 0.71   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       1.27    0.15  8.00  47.25 0.73   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0020  1  5.0       0.64    0.10  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0019+  0020]  0022  3  5.0       1.91    0.25  8.00  48.33  n/a   0.000
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    1.00  8.00  55.46 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0021+  0022]  0023  3  5.0       7.77    1.25  8.00  53.71  n/a   0.000
*
*********************************
** SIMULATION:C-100YR          **
*********************************
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\60d2338a-61fb-4853-a799-5a4e8f346c9a\29703c96
-6c9f-4402-b476-1
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0001  1  5.0       5.27    1.26  8.00  83.54 0.79   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.14  8.00  82.85 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0002]  0006  3  5.0       5.82    1.40  8.00  83.47  n/a   0.000
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.10  8.00  88.90 0.84   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0005+  0006]  0024  3  5.0       6.17    1.50  8.00  83.78  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       1.19    0.30  8.00  83.26 0.79   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0024+  0004]  0007  3  5.0       7.36    1.79  8.00  83.70  n/a   0.000
*
```

*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0008	1	5.0	0.15	0.04	8.00	88.88	0.84	0.000
*	ADD [0007+ 0008]	0014	3	5.0	7.51	1.84	8.00	83.80	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0009	1	5.0	0.62	0.18	8.00	88.91	0.84	0.000
*	ADD [0014+ 0009]	0025	3	5.0	8.13	2.02	8.00	84.19	n/a	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0010	1	5.0	2.21	0.53	8.00	82.85	0.79	0.000
*	ADD [0010+ 0025]	0015	3	5.0	10.34	2.54	8.00	83.90	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0011	1	5.0	0.55	0.16	8.00	88.90	0.84	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0012	1	5.0	0.50	0.13	8.00	83.26	0.79	0.000
*	ADD [0011+ 0012]	0027	3	5.0	1.05	0.29	8.00	86.22	n/a	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0013	1	5.0	0.64	0.16	8.00	83.26	0.79	0.000
*	ADD [0013+ 0027]	0026	3	5.0	1.69	0.45	8.00	85.10	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0028	1	5.0	0.55	0.16	8.00	90.64	0.86	0.000
*	ADD [0015+ 0026]	0016	3	5.0	12.03	2.99	8.00	84.07	n/a	0.000
*	ADD [0016+ 0028]	0016	1	5.0	12.58	3.15	8.00	84.36	n/a	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0018	1	5.0	1.94	0.48	8.00	83.27	0.79	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0019	1	5.0	1.27	0.33	8.00	85.22	0.81	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0020	1	5.0	0.64	0.19	8.00	88.91	0.84	0.000
*	ADD [0019+ 0020]	0022	3	5.0	1.91	0.51	8.00	86.46	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0021	1	5.0	5.86	1.80	8.00	95.39	0.91	0.000
*	ADD [0021+ 0022]	0023	3	5.0	7.77	2.32	8.00	93.19	n/a	0.000

Proposed Conditions (Simulation 2) Summary Output

```
*******************************
** SIMULATION:A-2YR           **
*******************************
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\e4d96e68-8add-4c3a-a773-7fd4ac39fcf9\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.02  8.00  27.24 0.56   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.10  8.00  40.59 0.83   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.13  8.00  40.33 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0019+  0032]  0022  3  5.0       1.76    0.23  8.00  40.44  n/a   0.000
*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.09  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    0.65  8.00  40.33 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    0.74  8.00  39.81  n/a   0.000
*
    ADD [  0023+  0022]  0023  1  5.0       8.47    0.97  8.00  39.94  n/a   0.000
*
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.39  8.00  32.37 0.66   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0047  1  5.0       0.17    0.01  8.00  35.16 0.72   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0047]  0048  3  5.0       5.44    0.40  8.00  32.45  n/a   0.000
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.05  8.00  35.34 0.72   0.000
    [I%=30.0:S%= 2.00]
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0002+  0048]  0006  3  5.0       5.99    0.45  8.00  32.72  n/a   0.000
*
    ADD [  0006+  0005]  0006  1  5.0       6.34    0.49  8.00  32.91  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       0.24    0.03  8.00  43.41 0.89   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0004+  0006]  0007  3  5.0       6.58    0.52  8.00  33.30  n/a   0.000
*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  36.19 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0024  1  5.0       1.41    0.10  8.00  35.01 0.72   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0024+  0007]  0014  3  5.0       7.99    0.63  8.00  33.60  n/a   0.000
*
```

```
    ADD [  0014+  0008]  0014  1  5.0       8.14    0.64  8.00  33.65  n/a   0.000
*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.07  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0025  1  5.0       0.26    0.02  8.00  31.50 0.65   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.14  8.00  33.82 0.69   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0010+  0014]  0015  3  5.0       9.91    0.79  8.00  33.68  n/a   0.000
*
    ADD [  0015+  0025]  0015  1  5.0      10.17    0.80  8.00  33.62  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    0.87  8.00  33.77  n/a   0.000
*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.06  8.00  37.26 0.76   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    0.93  8.00  33.94  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.03  8.00  27.24 0.56   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.07  8.00  30.91  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.07  8.00  38.63 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0046+  0050]  0049  3  5.0       1.45    0.13  8.00  33.95  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.05  8.00  34.21 0.70   0.000
    [I%=30.0:S%= 2.00]
*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.00  8.00  28.33 0.58   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0013+  0016]  0031  3  5.0      11.88    0.98  8.00  33.95  n/a   0.000
*
    ADD [  0031+  0026]  0031  1  5.0      11.94    0.98  8.00  33.92  n/a   0.000
*
    ADD [  0031+  0049]  0031  3  5.0      13.39    1.11  8.00  33.93  n/a   0.000
*
*******************************
** SIMULATION:B-5YR           **
*******************************
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\e4d96e68-8add-4c3a-a773-7fd4ac39fcf9\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.04  8.00  39.98 0.62   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.14  8.00  55.77 0.86   0.000
    [I%=50.0:S%= 2.00]
```

*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0032	1	5.0	1.02	0.19	8.00	55.46	0.86	0.000
*	ADD [0019+ 0032]	0022	3	5.0	1.76	0.32	8.00	55.59	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0020	1	5.0	0.85	0.13	8.00	50.48	0.78	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0021	1	5.0	5.86	1.00	8.00	55.46	0.86	0.000
*	ADD [0020+ 0021]	0023	3	5.0	6.71	1.13	8.00	54.83	n/a	0.000
*	ADD [0023+ 0022]	0023	1	5.0	8.47	1.45	8.00	54.99	n/a	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0001	1	5.0	5.27	0.59	8.00	46.04	0.71	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0047	1	5.0	0.17	0.03	8.00	49.63	0.77	0.000
*	ADD [0001+ 0047]	0048	3	5.0	5.44	0.61	8.00	46.16	n/a	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0002	1	5.0	0.55	0.08	8.00	49.85	0.77	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0005	1	5.0	0.35	0.05	8.00	50.47	0.78	0.000
*	ADD [0002+ 0048]	0006	3	5.0	5.99	0.69	8.00	46.50	n/a	0.000
*	ADD [0006+ 0005]	0006	1	5.0	6.34	0.75	8.00	46.72	n/a	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0004	1	5.0	0.24	0.05	8.00	58.98	0.91	0.000
*	ADD [0004+ 0006]	0007	3	5.0	6.58	0.79	8.00	47.16	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0008	1	5.0	0.15	0.02	8.00	50.44	0.78	0.000
*	CALIB STANDHYD [I%=20.0:S%= 2.00]	0024	1	5.0	1.41	0.19	8.00	49.61	0.77	0.000
*	ADD [0024+ 0007]	0014	3	5.0	7.99	0.99	8.00	47.59	n/a	0.000
*	ADD [0014+ 0008]	0014	1	5.0	8.14	1.01	8.00	47.65	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0009	1	5.0	0.62	0.09	8.00	50.48	0.78	0.000
*	CALIB STANDHYD [I%=20.0:S%= 2.00]	0025	1	5.0	0.26	0.03	8.00	45.39	0.70	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0010	1	5.0	1.77	0.20	8.00	48.00	0.74	0.000
*	ADD [0010+ 0014]	0015	3	5.0	9.91	1.22	8.00	47.71	n/a	0.000
*	ADD [0015+ 0025]	0015	1	5.0	10.17	1.25	8.00	47.65	n/a	0.000
*	ADD [0015+ 0009]	0015	3	5.0	10.79	1.34	8.00	47.81	n/a	0.000

```
*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.08  8.00  51.77 0.80   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    1.43  8.00  48.00  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.05  8.00  50.47 0.78   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.04  8.00  39.99 0.62   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.10  8.00  44.28  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.09  8.00  53.70 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0046+  0050]  0049  3  5.0       1.45    0.19  8.00  47.98  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.08  8.00  48.48 0.75   0.000
    [I%=30.0:S%= 2.00]
*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.01  8.00  44.66 0.69   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0013+  0016]  0031  3  5.0      11.88    1.50  8.00  48.03  n/a   0.000
*
    ADD [  0031+  0026]  0031  1  5.0      11.94    1.51  8.00  48.01  n/a   0.000
*
    ADD [  0031+  0049]  0031  3  5.0      13.39    1.70  8.00  48.01  n/a   0.000
*
*********************************
** SIMULATION:C-100YR          **
*********************************
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\e4d96e68-8add-4c3a-a773-7fd4ac39fcf9\29703c96
-6c9f-4402-b476-1
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.09  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.24  8.00  95.77 0.91   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.33  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0019+  0032]  0022  3  5.0       1.76    0.57  8.00  95.55  n/a   0.000
*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.25  8.00  88.91 0.84   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    1.80  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    2.05  8.00  94.57  n/a   0.000
*
    ADD [  0023+  0022]  0023  1  5.0       8.47    2.62  8.00  94.77  n/a   0.000
*
```

*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0001	1	5.0	5.27	1.26	8.00	83.54	0.79	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0047	1	5.0	0.17	0.05	8.00	88.55	0.84	0.000
*	ADD [0001+ 0047]	0048	3	5.0	5.44	1.31	8.00	83.70	n/a	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0002	1	5.0	0.55	0.15	8.00	88.82	0.84	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0005	1	5.0	0.35	0.10	8.00	88.90	0.84	0.000
*	ADD [0002+ 0048]	0006	3	5.0	5.99	1.46	8.00	84.17	n/a	0.000
*	ADD [0006+ 0005]	0006	1	5.0	6.34	1.56	8.00	84.43	n/a	0.000
*	CALIB STANDHYD [I%=35.0:S%= 2.00]	0004	1	5.0	0.24	0.08	8.00	99.58	0.95	0.000
*	ADD [0004+ 0006]	0007	3	5.0	6.58	1.64	8.00	84.98	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0008	1	5.0	0.15	0.04	8.00	88.88	0.84	0.000
*	CALIB STANDHYD [I%=20.0:S%= 2.00]	0024	1	5.0	1.41	0.37	8.00	88.76	0.84	0.000
*	ADD [0024+ 0007]	0014	3	5.0	7.99	2.02	8.00	85.65	n/a	0.000
*	ADD [0014+ 0008]	0014	1	5.0	8.14	2.06	8.00	85.71	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0009	1	5.0	0.62	0.18	8.00	88.91	0.84	0.000
*	CALIB STANDHYD [I%=20.0:S%= 2.00]	0025	1	5.0	0.26	0.06	8.00	83.36	0.79	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0010	1	5.0	1.77	0.46	8.00	86.43	0.82	0.000
*	ADD [0010+ 0014]	0015	3	5.0	9.91	2.52	8.00	85.84	n/a	0.000
*	ADD [0015+ 0025]	0015	1	5.0	10.17	2.58	8.00	85.77	n/a	0.000
*	ADD [0015+ 0009]	0015	3	5.0	10.79	2.76	8.00	85.95	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0045	1	5.0	0.55	0.16	8.00	90.64	0.86	0.000
*	ADD [0015+ 0045]	0016	3	5.0	11.34	2.92	8.00	86.18	n/a	0.000
*	CALIB STANDHYD [I%=50.0:S%= 2.00]	0011	1	5.0	0.36	0.11	8.00	88.90	0.84	0.000
*	CALIB STANDHYD [I%=20.0:S%= 2.00]	0012	1	5.0	0.52	0.11	8.00	75.85	0.72	0.000
*	ADD [0011+ 0012]	0046	3	5.0	0.88	0.21	8.00	81.19	n/a	0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0050	1	5.0	0.57	0.17	8.00	93.56	0.89	0.000

	ADD [0046+ 0050]	0049	3	5.0	1.45	0.38	8.00	86.06	n/a		0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0013	1	5.0	0.54	0.14	8.00	87.07	0.83		0.000
*	CALIB STANDHYD [I%=30.0:S%= 2.00]	0026	1	5.0	0.06	0.02	8.00	82.76	0.79		0.000
	ADD [0013+ 0016]	0031	3	5.0	11.88	3.07	8.00	86.22	n/a		0.000
	ADD [0031+ 0026]	0031	1	5.0	11.94	3.08	8.00	86.20	n/a		0.000
	ADD [0031+ 0049]	0031	3	5.0	13.39	3.46	8.00	86.19	n/a		0.000

```
*******************************
** SIMULATION:A-2YR           **
*******************************
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.02  8.00  27.24 0.56   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.10  8.00  40.59 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0019]   0055  1  5.0       0.74    0.03  8.42  40.47  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.13  8.00  40.33 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0032]   0056  1  5.0       1.02    0.03  8.42  40.24  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0055+  0056]  0022  3  5.0       1.76    0.06  8.42  40.34  n/a   0.000
*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.09  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    0.65  8.00  40.33 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0057  1  5.0       0.11    0.03  8.00  90.62 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    0.74  8.00  39.81  n/a   0.000
*
    ADD [  0023+  0022]  0023  1  5.0       8.47    0.77  8.00  39.92  n/a   0.000
*
    ADD [  0023+  0057]  0023  3  5.0       8.58    0.81  8.00  40.57  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.39  8.00  32.37 0.66   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0047  1  5.0       0.17    0.01  8.00  35.16 0.72   0.000
```

```
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0047]  0048  3  5.0       5.44    0.40  8.00  32.45  n/a   0.000
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.05  8.00  35.34 0.72   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0002]   0051  1  5.0       0.55    0.03  8.33  35.28  n/a   0.000
      {ST=  0.00 ha.m }
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0048+  0005]  0006  3  5.0       5.79    0.44  8.00  32.68  n/a   0.000
*
    ADD [  0006+  0051]  0006  1  5.0       6.34    0.46  8.00  32.91  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       0.24    0.03  8.00  43.41 0.89   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0004+  0006]  0007  3  5.0       6.58    0.49  8.00  33.29  n/a   0.000
*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  36.19 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0024  1  5.0       1.41    0.10  8.00  35.01 0.72   0.000
    [I%=20.0:S%= 2.00]
*
    RESRVR [ 2:  0024]   0052  1  5.0       1.41    0.02  8.92  34.84  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0052+  0007]  0014  3  5.0       7.99    0.50  8.00  33.56  n/a   0.000
*
    ADD [  0014+  0008]  0014  1  5.0       8.14    0.51  8.00  33.61  n/a   0.000
*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.07  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0025  1  5.0       0.26    0.02  8.00  31.50 0.65   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.14  8.00  33.82 0.69   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0010]   0053  1  5.0       1.77    0.09  8.25  33.81  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0014+  0025]  0015  3  5.0       8.40    0.53  8.00  33.55  n/a   0.000
*
    ADD [  0015+  0053]  0015  1  5.0      10.17    0.59  8.00  33.59  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    0.65  8.00  33.74  n/a   0.000
*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.06  8.00  37.26 0.76   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    0.72  8.00  33.91  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.03  8.00  27.24 0.56   0.000
    [I%=20.0:S%= 2.00]
```

```
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.07  8.00  30.91  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.07  8.00  38.63 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0050]   0058  1  5.0       0.57    0.02  8.50  38.44  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0046+  0058]  0049  3  5.0       1.45    0.08  8.00  33.87  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.14  8.00  87.07 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0013]   0054  1  5.0       0.54    0.04  8.33  86.91  n/a   0.000
      {ST=  0.01 ha.m }
*
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.00  8.00  28.33 0.58   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0016+  0026]  0031  3  5.0      11.40    0.72  8.00  33.89  n/a   0.000
*
    ADD [  0031+  0049]  0031  1  5.0      12.85    0.80  8.00  33.88  n/a   0.000
*
    ADD [  0031+  0054]  0031  3  5.0      13.39    0.82  8.00  36.02  n/a   0.000
*
********************************
** SIMULATION:B-5YR           **
********************************
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.04  8.00  39.98 0.62   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.14  8.00  55.77 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0019]   0055  1  5.0       0.74    0.03  8.33  55.65  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.19  8.00  55.46 0.86   0.000
```

```
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0032]   0056  1  5.0       1.02    0.05  8.33  55.37  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0055+  0056]  0022  3  5.0       1.76    0.08  8.33  55.49  n/a   0.000
*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.13  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    1.00  8.00  55.46 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0057  1  5.0       0.11    0.03  8.00  90.62 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    1.13  8.00  54.83  n/a   0.000
*
    ADD [  0023+  0022]  0023  1  5.0       8.47    1.18  8.00  54.97  n/a   0.000
*
    ADD [  0023+  0057]  0023  3  5.0       8.58    1.21  8.00  55.42  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.59  8.00  46.04 0.71   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0047  1  5.0       0.17    0.03  8.00  49.63 0.77   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0047]  0048  3  5.0       5.44    0.61  8.00  46.16  n/a   0.000
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.08  8.00  49.85 0.77   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0002]   0051  1  5.0       0.55    0.04  8.25  49.80  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.05  8.00  50.47 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0048+  0005]  0006  3  5.0       5.79    0.67  8.00  46.42  n/a   0.000
*
    ADD [  0006+  0051]  0006  1  5.0       6.34    0.69  8.00  46.71  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       0.24    0.05  8.00  58.98 0.91   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0004+  0006]  0007  3  5.0       6.58    0.74  8.00  47.16  n/a   0.000
```

```
*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  50.44 0.78   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0024  1  5.0       1.41    0.19  8.00  49.61 0.77   0.000
    [I%=20.0:S%= 2.00]
*
    RESRVR [ 2:  0024]   0052  1  5.0       1.41    0.03  8.75  49.44  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0052+  0007]  0014  3  5.0       7.99    0.75  8.00  47.56  n/a   0.000
*
    ADD [  0014+  0008]  0014  1  5.0       8.14    0.78  8.00  47.61  n/a   0.000
*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.09  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0025  1  5.0       0.26    0.03  8.00  45.39 0.70   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.20  8.00  48.00 0.74   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0010]   0053  1  5.0       1.77    0.13  8.25  47.99  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0014+  0025]  0015  3  5.0       8.40    0.81  8.00  47.54  n/a   0.000
*
    ADD [  0015+  0053]  0015  1  5.0      10.17    0.89  8.00  47.62  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    0.98  8.00  47.79  n/a   0.000
*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.08  8.00  51.77 0.80   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    1.06  8.00  47.98  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.05  8.00  50.47 0.78   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.04  8.00  39.99 0.62   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.10  8.00  44.28  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.09  8.00  53.70 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0050]   0058  1  5.0       0.57    0.02  8.42  53.52  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0046+  0058]  0049  3  5.0       1.45    0.11  8.00  47.91  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.14  8.00  87.07 0.83   0.000
    [I%=30.0:S%= 2.00]
```

```
*
    RESRVR [ 2:  0013]   0054  1  5.0       0.54    0.04  8.33  86.91  n/a   0.000
      {ST=  0.01 ha.m }
*
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.01  8.00  44.66 0.69   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0016+  0026]  0031  3  5.0      11.40    1.07  8.00  47.96  n/a   0.000
*
    ADD [  0031+  0049]  0031  1  5.0      12.85    1.18  8.00  47.96  n/a   0.000
*
    ADD [  0031+  0054]  0031  3  5.0      13.39    1.20  8.00  49.53  n/a   0.000
*
********************************
** SIMULATION:C-100YR          **
********************************
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\6ce1b576-f5a3-4095-a482-e4478a45728e\29703c96
-6c9f-4402-b476-1
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.09  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.24  8.00  95.77 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0019]   0055  1  5.0       0.74    0.06  8.33  95.64  n/a   0.000
      {ST=  0.02 ha.m }
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.33  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0032]   0056  1  5.0       1.02    0.08  8.33  95.30  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0055+  0056]  0022  3  5.0       1.76    0.14  8.33  95.44  n/a   0.000
*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.25  8.00  88.91 0.84   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    1.80  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0057  1  5.0       0.11    0.03  8.00  90.62 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    2.05  8.00  94.57  n/a   0.000
*
    ADD [  0023+  0022]  0023  1  5.0       8.47    2.14  8.00  94.75  n/a   0.000
*
    ADD [  0023+  0057]  0023  3  5.0       8.58    2.17  8.00  94.70  n/a   0.000
```

```
*
 *  CALIB STANDHYD       0001  1  5.0       5.27    1.26  8.00  83.54 0.79   0.000
    [I%=35.0:S%= 2.00]
*
 *  CALIB STANDHYD       0047  1  5.0       0.17    0.05  8.00  88.55 0.84   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0047]  0048  3  5.0       5.44    1.31  8.00  83.70  n/a   0.000
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.15  8.00  88.82 0.84   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0002]   0051  1  5.0       0.55    0.07  8.25  88.77  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.10  8.00  88.90 0.84   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0048+  0005]  0006  3  5.0       5.79    1.41  8.00  84.01  n/a   0.000
*
    ADD [  0006+  0051]  0006  1  5.0       6.34    1.45  8.00  84.42  n/a   0.000
*
 *  CALIB STANDHYD       0004  1  5.0       0.24    0.08  8.00  99.58 0.95   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0004+  0006]  0007  3  5.0       6.58    1.53  8.00  84.98  n/a   0.000
*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.04  8.00  88.88 0.84   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0024  1  5.0       1.41    0.37  8.00  88.76 0.84   0.000
    [I%=20.0:S%= 2.00]
*
    RESRVR [ 2:  0024]   0052  1  5.0       1.41    0.05  8.67  88.59  n/a   0.000
      {ST=  0.05 ha.m }
*
    ADD [  0052+  0007]  0014  3  5.0       7.99    1.56  8.00  85.61  n/a   0.000
*
    ADD [  0014+  0008]  0014  1  5.0       8.14    1.60  8.00  85.67  n/a   0.000
*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.18  8.00  88.91 0.84   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0025  1  5.0       0.26    0.06  8.00  83.36 0.79   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.46  8.00  86.43 0.82   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0010]   0053  1  5.0       1.77    0.25  8.17  86.42  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0014+  0025]  0015  3  5.0       8.40    1.67  8.00  85.60  n/a   0.000
*
    ADD [  0015+  0053]  0015  1  5.0      10.17    1.84  8.00  85.75  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    2.02  8.00  85.93  n/a   0.000
*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.16  8.00  90.64 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    2.18  8.00  86.16  n/a   0.000
*
```

```
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.11  8.00  88.90 0.84   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.11  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.21  8.00  81.19  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.17  8.00  93.56 0.89   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0050]   0058  1  5.0       0.57    0.04  8.42  93.38  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0046+  0058]  0049  3  5.0       1.45    0.23  8.00  85.98  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.14  8.00  87.07 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0013]   0054  1  5.0       0.54    0.04  8.33  86.91  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.02  8.00  82.76 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0016+  0026]  0031  3  5.0      11.40    2.19  8.00  86.14  n/a   0.000
*
    ADD [  0031+  0049]  0031  1  5.0      12.85    2.43  8.00  86.12  n/a   0.000
*
    ADD [  0031+  0054]  0031  3  5.0      13.39    2.45  8.00  86.15  n/a   0.000
*
```

```
*******************************
** SIMULATION:A-2YR           **
*******************************
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.02  8.00  27.24 0.56   0.000
    [I%=20.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.24  8.00  95.77 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0019]   0055  1  5.0       0.74    0.06  8.33  95.64  n/a   0.000
      {ST=  0.02 ha.m }
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.33  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0032]   0056  1  5.0       1.02    0.08  8.33  95.30  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0055+  0056]  0022  3  5.0       1.76    0.14  8.33  95.45  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.09  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    0.65  8.00  40.33 0.83   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0057  1  5.0       0.11    0.03  8.00  90.62 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    0.74  8.00  39.81  n/a   0.000
*
```

```
    ADD [  0023+  0022]  0023  1  5.0       8.47    0.83  8.00  51.37  n/a   0.000
*
    ADD [  0023+  0057]  0023  3  5.0       8.58    0.86  8.00  51.88  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.39  8.00  32.37 0.66   0.000
    [I%=35.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0047  1  5.0       0.17    0.05  8.00  88.55 0.84   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0047]  0048  3  5.0       5.44    0.43  8.00  34.12  n/a   0.000
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.15  8.00  88.82 0.84   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0002]   0051  1  5.0       0.55    0.07  8.25  88.77  n/a   0.000
      {ST=  0.01 ha.m }
*
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0048+  0005]  0006  3  5.0       5.79    0.47  8.00  34.25  n/a   0.000
*
    ADD [  0006+  0051]  0006  1  5.0       6.34    0.52  8.00  38.98  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0004  1  5.0       0.24    0.08  8.00  99.58 0.95   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0004+  0006]  0007  3  5.0       6.58    0.60  8.00  41.19  n/a   0.000
*
    READ STORM                 10.0
```

```
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  36.19 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0024  1  5.0       1.41    0.37  8.00  88.76 0.84   0.000
    [I%=20.0:S%= 2.00]
*
    RESRVR [ 2:  0024]   0052  1  5.0       1.41    0.05  8.67  88.59  n/a   0.000
      {ST=  0.05 ha.m }
*
    ADD [  0052+  0007]  0014  3  5.0       7.99    0.62  8.00  49.56  n/a   0.000
*
    ADD [  0014+  0008]  0014  1  5.0       8.14    0.64  8.00  49.31  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.07  8.00  36.23 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0025  1  5.0       0.26    0.06  8.00  83.36 0.79   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.46  8.00  86.43 0.82   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0010]   0053  1  5.0       1.77    0.25  8.17  86.42  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0014+  0025]  0015  3  5.0       8.40    0.70  8.00  50.36  n/a   0.000
*
    ADD [  0015+  0053]  0015  1  5.0      10.17    0.87  8.00  56.64  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    0.94  8.00  55.47  n/a   0.000
*
    READ STORM                 10.0
```

```
    [ Ptot= 48.76 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\d7b7255f
-bec6-43c9-b603-f
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.06  8.00  37.26 0.76   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    1.00  8.00  54.58  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.04  8.00  36.22 0.74   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\c192a4e8
-6614-4c23-893e-7
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.11  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.15  8.00  59.64  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.17  8.00  93.56 0.89   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0050]   0058  1  5.0       0.57    0.04  8.42  93.38  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0046+  0058]  0049  3  5.0       1.45    0.17  8.00  72.90  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.14  8.00  87.07 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0013]   0054  1  5.0       0.54    0.04  8.33  86.91  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.02  8.00  82.76 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0016+  0026]  0031  3  5.0      11.40    1.01  8.00  54.73  n/a   0.000
*
    ADD [  0031+  0049]  0031  1  5.0      12.85    1.18  8.00  56.78  n/a   0.000
*
    ADD [  0031+  0054]  0031  3  5.0      13.39    1.21  8.00  58.00  n/a   0.000
*
********************************
** SIMULATION:B-5YR           **
********************************
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.04  8.00  39.98 0.62   0.000
```

```
    [I%=20.0:S%= 2.00]
*
    READ STORM                  10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.24  8.00  95.77 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0019]   0055  1  5.0       0.74    0.06  8.33  95.64  n/a   0.000
      {ST=  0.02 ha.m }
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.33  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0032]   0056  1  5.0       1.02    0.08  8.33  95.30  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0055+  0056]  0022  3  5.0       1.76    0.14  8.33  95.45  n/a   0.000
*
    READ STORM                  10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0020  1  5.0       0.85    0.13  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0021  1  5.0       5.86    1.00  8.00  55.46 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                  10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0057  1  5.0       0.11    0.03  8.00  90.62 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0020+  0021]  0023  3  5.0       6.71    1.13  8.00  54.83  n/a   0.000
*
    ADD [  0023+  0022]  0023  1  5.0       8.47    1.22  8.00  63.27  n/a   0.000
*
    ADD [  0023+  0057]  0023  3  5.0       8.58    1.26  8.00  63.62  n/a   0.000
*
    READ STORM                  10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
```

```
 *  CALIB STANDHYD       0001  1  5.0       5.27    0.59  8.00  46.04 0.71   0.000
    [I%=35.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0047  1  5.0       0.17    0.05  8.00  88.55 0.84   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0001+  0047]  0048  3  5.0       5.44    0.64  8.00  47.37  n/a   0.000
*
 *  CALIB STANDHYD       0002  1  5.0       0.55    0.15  8.00  88.82 0.84   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0002]   0051  1  5.0       0.55    0.07  8.25  88.77  n/a   0.000
      {ST=  0.01 ha.m }
*
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0005  1  5.0       0.35    0.05  8.00  50.47 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0048+  0005]  0006  3  5.0       5.79    0.69  8.00  47.56  n/a   0.000
*
    ADD [  0006+  0051]  0006  1  5.0       6.34    0.73  8.00  51.14  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0004  1  5.0       0.24    0.08  8.00  99.58 0.95   0.000
    [I%=35.0:S%= 2.00]
*
    ADD [  0004+  0006]  0007  3  5.0       6.58    0.81  8.00  52.90  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0008  1  5.0       0.15    0.02  8.00  50.44 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
```

```
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0024  1  5.0       1.41    0.37  8.00  88.76 0.84   0.000
    [I%=20.0:S%= 2.00]
*
    RESRVR [ 2:  0024]   0052  1  5.0       1.41    0.05  8.67  88.59  n/a   0.000
      {ST=  0.05 ha.m }
*
    ADD [  0052+  0007]  0014  3  5.0       7.99    0.84  8.00  59.20  n/a   0.000
*
    ADD [  0014+  0008]  0014  1  5.0       8.14    0.87  8.00  59.04  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0009  1  5.0       0.62    0.09  8.00  50.48 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0025  1  5.0       0.26    0.06  8.00  83.36 0.79   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.46  8.00  86.43 0.82   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0010]   0053  1  5.0       1.77    0.25  8.17  86.42  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0014+  0025]  0015  3  5.0       8.40    0.93  8.00  59.79  n/a   0.000
*
    ADD [  0015+  0053]  0015  1  5.0      10.17    1.10  8.00  64.43  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    1.19  8.00  63.62  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 64.52 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\ef3cf9fc
-a37f-4908-9b4e-6
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.08  8.00  51.77 0.80   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    1.27  8.00  63.05  n/a   0.000
*
```

```
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.05  8.00  50.47 0.78   0.000
    [I%=50.0:S%= 2.00]
*
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\7c559af9
-07c5-45db-864d-2
    remark: created from IDF Group City of Burlington

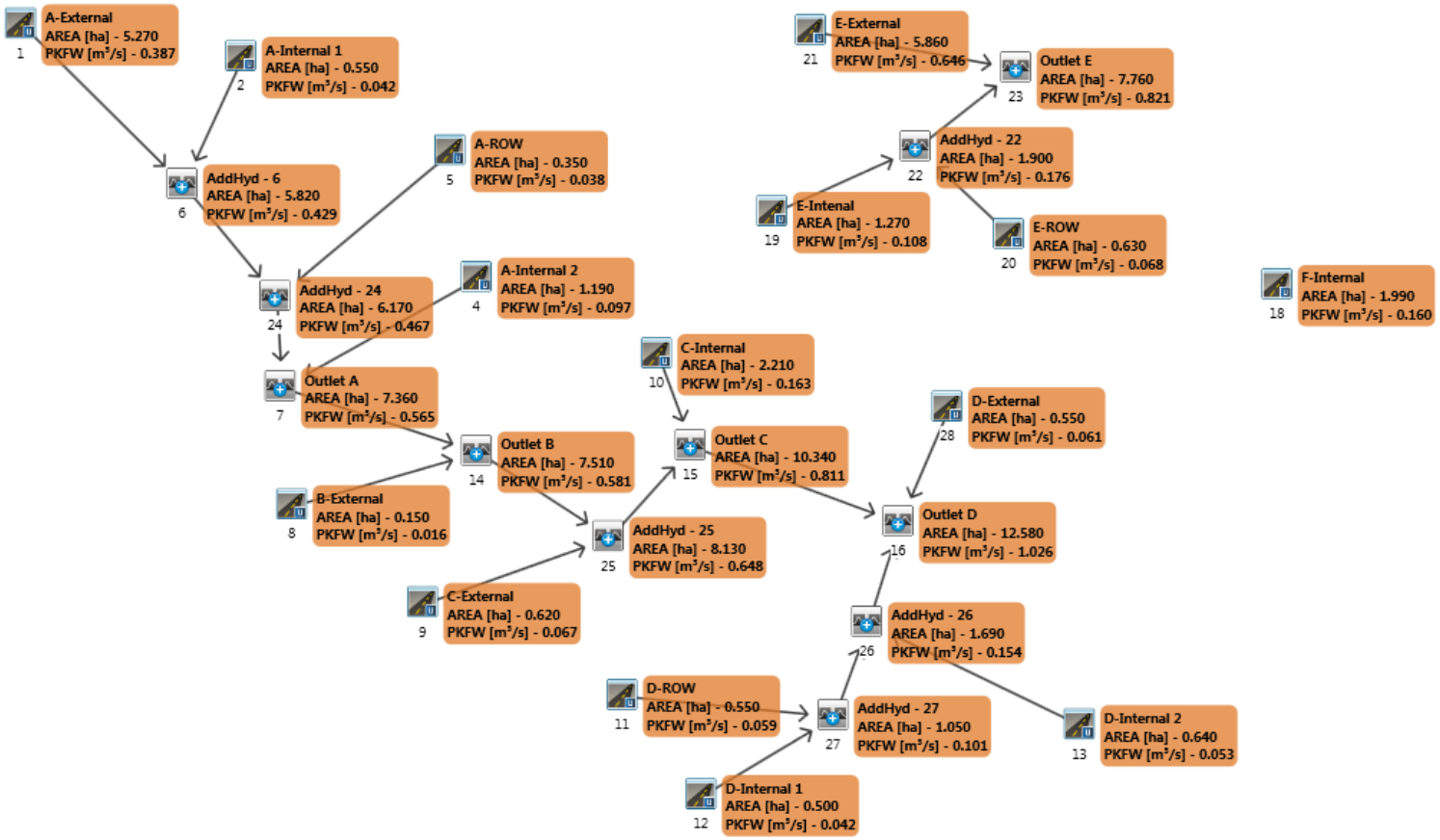
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.11  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.16  8.00  65.47  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.17  8.00  93.56 0.89   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0050]   0058  1  5.0       0.57    0.04  8.42  93.38  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0046+  0058]  0049  3  5.0       1.45    0.18  8.00  76.44  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.14  8.00  87.07 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0013]   0054  1  5.0       0.54    0.04  8.33  86.91  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.02  8.00  82.76 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0016+  0026]  0031  3  5.0      11.40    1.29  8.00  63.15  n/a   0.000
*
    ADD [  0031+  0049]  0031  1  5.0      12.85    1.47  8.00  64.65  n/a   0.000
*
    ADD [  0031+  0054]  0031  3  5.0      13.39    1.49  8.00  65.55  n/a   0.000
*
********************************
** SIMULATION:C-100YR         **
********************************
    READ STORM                 10.0
    [ Ptot=105.35 mm ]
    fname :
C:\Users\nmead-fox\AppData\Local\Temp\7ce5f174-3c17-4638-bada-adfe262690bc\29703c96
-6c9f-4402-b476-1
    remark: created from IDF Group City of Burlington

*
 *  CALIB STANDHYD       0018  1  5.0       0.42    0.09  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
 *  CALIB STANDHYD       0019  1  5.0       0.74    0.24  8.00  95.77 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0019]   0055  1  5.0       0.74    0.06  8.33  95.64  n/a   0.000
      {ST=  0.02 ha.m }
*
 *  CALIB STANDHYD       0032  1  5.0       1.02    0.33  8.00  95.39 0.91   0.000
    [I%=50.0:S%= 2.00]
*
    RESRVR [ 2:  0032]   0056  1  5.0       1.02    0.08  8.33  95.30  n/a   0.000
```

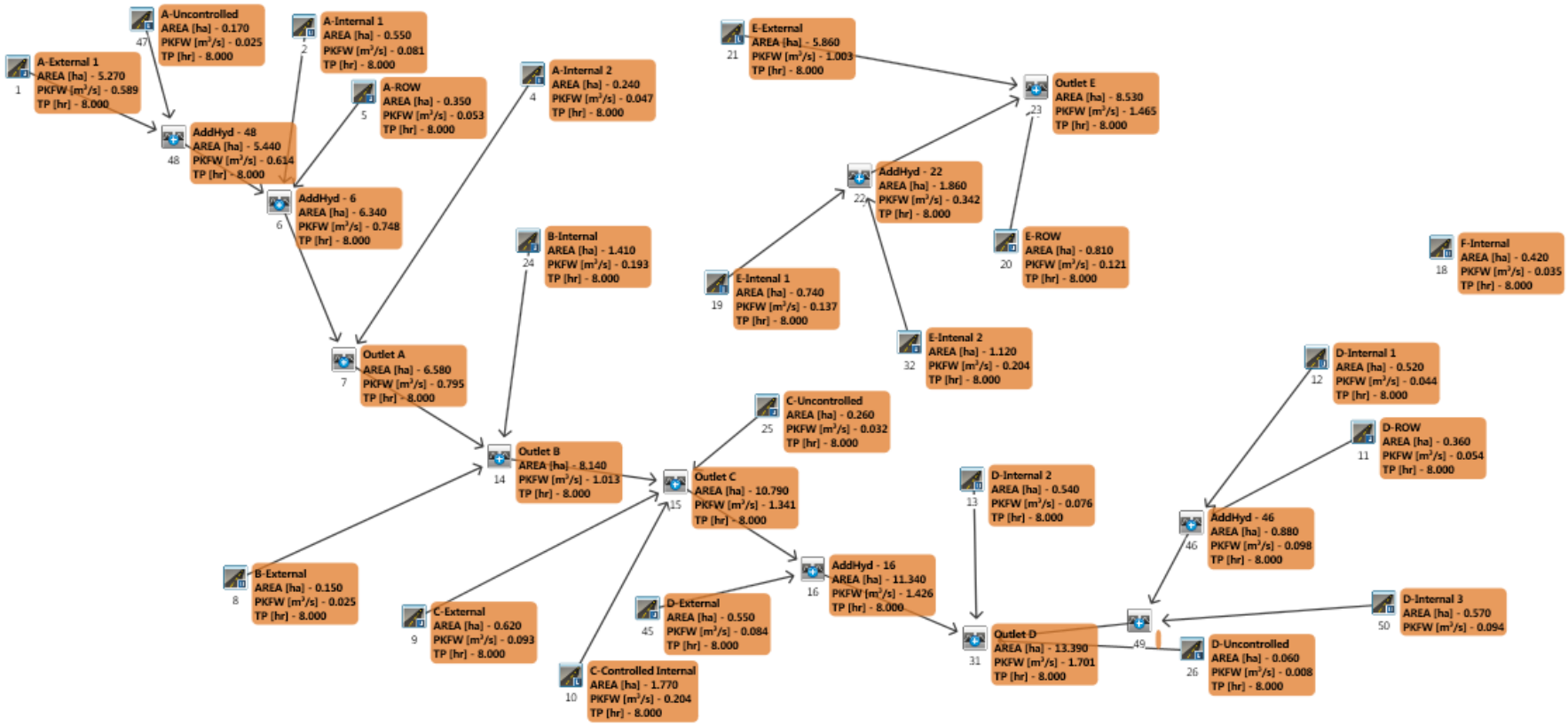
```
      {ST=  0.03 ha.m }
*
     ADD [  0055+  0056]  0022  3  5.0       1.76    0.14  8.33  95.45  n/a   0.000
*
 *   CALIB STANDHYD       0020  1  5.0       0.85    0.25  8.00  88.91 0.84   0.000
     [I%=50.0:S%= 2.00]
*
 *   CALIB STANDHYD       0021  1  5.0       5.86    1.80  8.00  95.39 0.91   0.000
     [I%=50.0:S%= 2.00]
*
 *   CALIB STANDHYD       0057  1  5.0       0.11    0.03  8.00  90.62 0.86   0.000
     [I%=50.0:S%= 2.00]
*
     ADD [  0020+  0021]  0023  3  5.0       6.71    2.05  8.00  94.57  n/a   0.000
*
     ADD [  0023+  0022]  0023  1  5.0       8.47    2.14  8.00  94.75  n/a   0.000
*
     ADD [  0023+  0057]  0023  3  5.0       8.58    2.17  8.00  94.70  n/a   0.000
*
 *   CALIB STANDHYD       0001  1  5.0       5.27    1.26  8.00  83.54 0.79   0.000
     [I%=35.0:S%= 2.00]
*
 *   CALIB STANDHYD       0047  1  5.0       0.17    0.05  8.00  88.55 0.84   0.000
     [I%=30.0:S%= 2.00]
*
     ADD [  0001+  0047]  0048  3  5.0       5.44    1.31  8.00  83.70  n/a   0.000
*
 *   CALIB STANDHYD       0002  1  5.0       0.55    0.15  8.00  88.82 0.84   0.000
     [I%=30.0:S%= 2.00]
*
     RESRVR [ 2:  0002]   0051  1  5.0       0.55    0.07  8.25  88.77  n/a   0.000
       {ST=  0.01 ha.m }
*
 *   CALIB STANDHYD       0005  1  5.0       0.35    0.10  8.00  88.90 0.84   0.000
     [I%=50.0:S%= 2.00]
*
     ADD [  0048+  0005]  0006  3  5.0       5.79    1.41  8.00  84.01  n/a   0.000
*
     ADD [  0006+  0051]  0006  1  5.0       6.34    1.45  8.00  84.42  n/a   0.000
*
 *   CALIB STANDHYD       0004  1  5.0       0.24    0.08  8.00  99.58 0.95   0.000
     [I%=35.0:S%= 2.00]
*
     ADD [  0004+  0006]  0007  3  5.0       6.58    1.53  8.00  84.98  n/a   0.000
*
 *   CALIB STANDHYD       0008  1  5.0       0.15    0.04  8.00  88.88 0.84   0.000
     [I%=50.0:S%= 2.00]
*
 *   CALIB STANDHYD       0024  1  5.0       1.41    0.37  8.00  88.76 0.84   0.000
     [I%=20.0:S%= 2.00]
*
     RESRVR [ 2:  0024]   0052  1  5.0       1.41    0.05  8.67  88.59  n/a   0.000
       {ST=  0.05 ha.m }
*
     ADD [  0052+  0007]  0014  3  5.0       7.99    1.56  8.00  85.61  n/a   0.000
*
     ADD [  0014+  0008]  0014  1  5.0       8.14    1.60  8.00  85.67  n/a   0.000
*
 *   CALIB STANDHYD       0009  1  5.0       0.62    0.18  8.00  88.91 0.84   0.000
     [I%=50.0:S%= 2.00]
*
 *   CALIB STANDHYD       0025  1  5.0       0.26    0.06  8.00  83.36 0.79   0.000
     [I%=20.0:S%= 2.00]
```

```
*
 *  CALIB STANDHYD       0010  1  5.0       1.77    0.46  8.00  86.43 0.82   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0010]   0053  1  5.0       1.77    0.25  8.17  86.42  n/a   0.000
      {ST=  0.03 ha.m }
*
    ADD [  0014+  0025]  0015  3  5.0       8.40    1.67  8.00  85.60  n/a   0.000
*
    ADD [  0015+  0053]  0015  1  5.0      10.17    1.84  8.00  85.75  n/a   0.000
*
    ADD [  0015+  0009]  0015  3  5.0      10.79    2.02  8.00  85.93  n/a   0.000
*
 *  CALIB STANDHYD       0045  1  5.0       0.55    0.16  8.00  90.64 0.86   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0015+  0045]  0016  3  5.0      11.34    2.18  8.00  86.16  n/a   0.000
*
 *  CALIB STANDHYD       0011  1  5.0       0.36    0.11  8.00  88.90 0.84   0.000
    [I%=50.0:S%= 2.00]
*
 *  CALIB STANDHYD       0012  1  5.0       0.52    0.11  8.00  75.85 0.72   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0011+  0012]  0046  3  5.0       0.88    0.21  8.00  81.19  n/a   0.000
*
 *  CALIB STANDHYD       0050  1  5.0       0.57    0.17  8.00  93.56 0.89   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0050]   0058  1  5.0       0.57    0.04  8.42  93.38  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0046+  0058]  0049  3  5.0       1.45    0.23  8.00  85.98  n/a   0.000
*
 *  CALIB STANDHYD       0013  1  5.0       0.54    0.14  8.00  87.07 0.83   0.000
    [I%=30.0:S%= 2.00]
*
    RESRVR [ 2:  0013]   0054  1  5.0       0.54    0.04  8.33  86.91  n/a   0.000
      {ST=  0.01 ha.m }
*
 *  CALIB STANDHYD       0026  1  5.0       0.06    0.02  8.00  82.76 0.79   0.000
    [I%=30.0:S%= 2.00]
*
    ADD [  0016+  0026]  0031  3  5.0      11.40    2.19  8.00  86.14  n/a   0.000
*
    ADD [  0031+  0049]  0031  1  5.0      12.85    2.43  8.00  86.12  n/a   0.000
*
    ADD [  0031+  0054]  0031  3  5.0      13.39    2.45  8.00  86.15  n/a   0.000
*
```

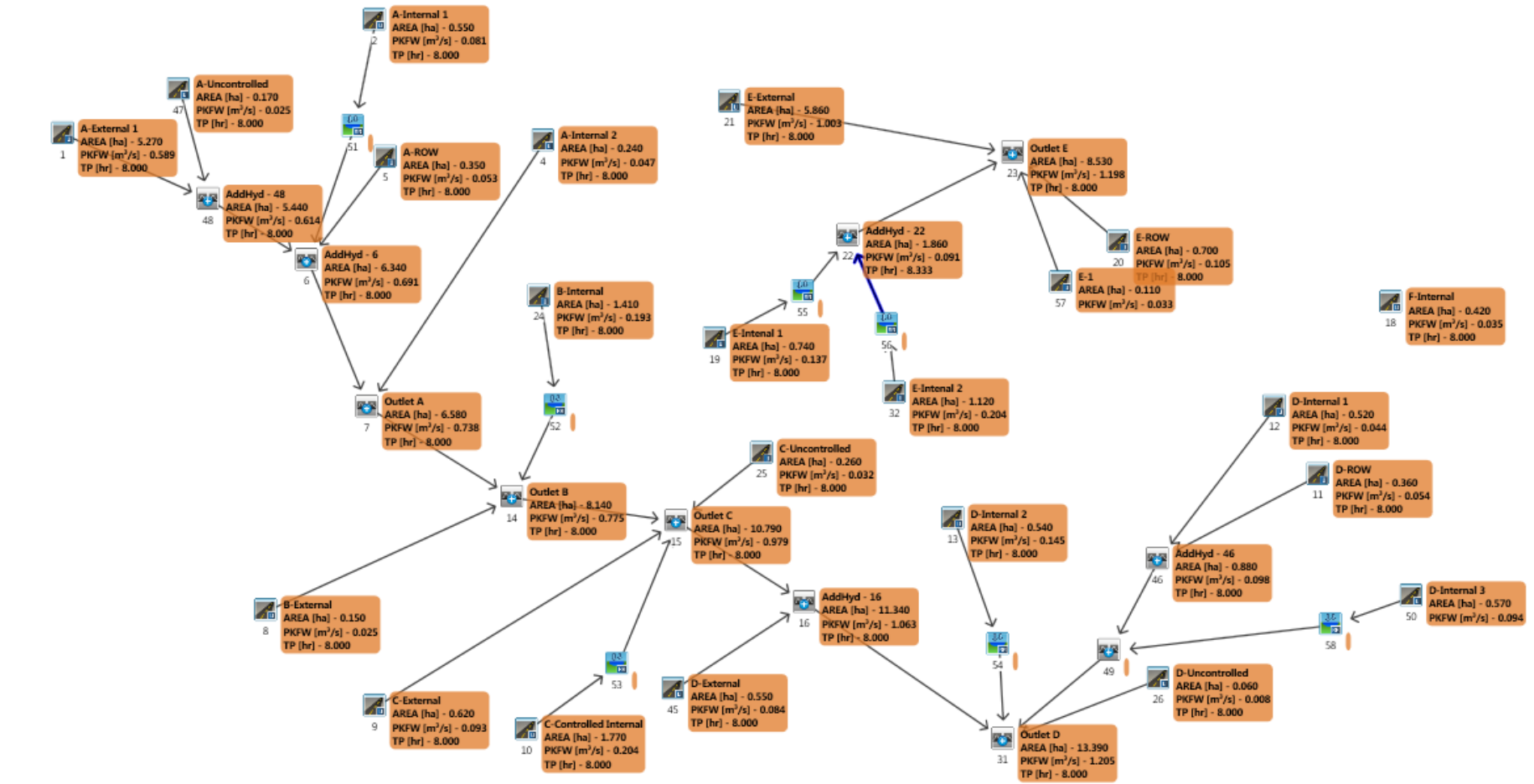
Existing Conditions (Simulation 1) – 5YR Results



Proposed Conditions (Simulation 2) – 5YR Results



Proposed Conditions (Simulation 3) – 5YR Results



Proposed Conditions (Simulation 4) – 5YR Results

