FUNCTIONAL SERVICING & PRELIMINARY STORMWATER MANAGEMENT REPORT

LAKESIDE VILLAGE
5353 LAKESHORE ROAD

CITY OF BURLINGTON
REGIONAL MUNICIPALITY OF HALTON

PREPARED FOR:

GLANELM PROPERTY MANAGEMENT

PREPARED BY:

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CROZIER &ASSOCIATES
Consulting Engineers

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1.0 Introduction

C.F. Crozier & Associates Inc. (Crozier) was retained by Glanelm Property Management to prepare a Functional Servicing & Preliminary Stormwater Management Report to support the Official Plan and Zoning By-Law Amendments for the proposed re-development of Lakeside Village Plaza located at 5353 Lakeshore Road in the City of Burlington, Regional Municipality of Halton (Halton Region).

This report provides information concerning the water and sanitary servicing as well as stormwater management according to the applicable standards and requirements of the City of Burlington and Halton Region.

The following reports and design standards were referenced during the preparation of this report:

- Water and Wastewater Linear Design Manual, Halton Region, July 2017.
- Zoning By-Law 2020, City of Burlington

2.0 Site Description

The subject property is approximately 3.84 ha and currently consists of a commercial plaza with associated at-grade parking areas. According to City of Burlington's Zoning By-Laws, the property is currently zoned as 'CN-1 Neighbourhood Commercial' and is located in a mixed residential neighbourhood. According to the City of Burlington's Development Application Pre-Consultation form, it is required that the zoning be changed to the 'Community Commercial' designation. It is noted that the proposed urban density exceeds the general permissions for a 'Community Commercial' area, with this increase in urban density being the focus of this report. The property is also located within Priority Area 5, which is a high-risk area for basement flooding due to sanitary system surcharging.

The site is bound by:

- Skyway Park to the north.
- Lakeshore Road to the south;
- Kenwood Avenue to the west and;
- Hampton Heath Road to the east;

The proposed development is a mixed-use community site, with a number of phased development blocks. The ground floor will include commercial and office space, grocery store. The remaining space will include approximately 900 residential units in the form of townhomes and condominium apartment units located above the commercial and office space. The existing underground commercial space will be converted to underground parking for the commercial properties and residential units, with existing driveway access points maintained.

The complete development is envisioned in five phases:

- **Phase 1 –** Block B consists of a 6-storey building with a mix of townhomes and apartments, as well as site access from Kenwood Avenue via Access Lane 'A' and an entrance south of Block B.
- **Phase 2 –** Block E and F include a 14-storey building, an 18-storey building, and a 6-storey podium and consists of apartment units. Block A consists of a restaurant space.
- **Phase 3 –** Includes Block I, a 4-storey building with retail and office space, and grocery store.
- **Phase 4 –** Block C and D includes two 11-storey buildings and a 4-storey podium with a mix of retail, community, and residential use, as well as pedestrian access via a proposed Mews
- **Phase 5 –** Block G and H include an 18-storey building, a 10-storey building, and a 6-storey podium and consists of apartment units.

3.0 Water Servicing

Halton Region is responsible for the operation and maintenance of the public water supply and treatment system in the City of Burlington. Any local water supply system will connect to the Region's municipal water network.

3.1 Existing Water Servicing

A review of City of Burlington and Halton Region as-constructed drawings indicate that:

Lakeshore Road:

- There is an existing 300 mm diameter watermain along Lakeshore Road according to Halton Region drawing 'B-8083 Lakeshore Road', dated October, 1990.
- According to the topographic survey prepared by A.T. McLaren Ltd. dated March 30, 2015 (Updated July 5, 2017), there are three fire hydrants located along Lakeshore Road.

Hampton Heath Road:

- There is an existing 200 mm diameter watermain according to City of Burlington drawing 'MH-1 Hampton Heath Road', dated December, 1977. The drawing also indicates a watermain stub abutting the north-eastern portion of the property extending from the watermain on Hampton Heath Road.

Kenwood Avenue:

- There is an existing 12'' (approx. 300 mm) diameter watermain along Kenwood Avenue according to City of Burlington drawing 'MH-1 Kenwood Avenue', dated October, 1969.
- The topographic survey indicates a fire hydrant located on Kenwood Avenue, just south of Banting Crescent.

3.2 Design Water Demand

The water demands for the proposed development were calculated with reference to Halton Region watermain design criteria. An average daily water demand of 275 L/s*cap was used with an occupancy density of 1.68 persons/unit for apartments and 2.60 persons/unit for townhouses. For commercial and office areas, population densities of 90 persons/ha and 125 persons/ha were used respectively.

Table 1 summarizes the existing and proposed average daily water demands, as well as the proposed maximum day demand and peak hourly demand. Detailed water demand calculations are provided in **Appendix A**.

Table 1: Existing/Proposed Domestic Water Demand

Standard		Average Daily Demand (L/s)	Maximum Daily Demand (L/s)	Peak Hourly Demand (L/s)
Halton Region Water and Wastewater Linear Design Manual (July 2017)	**Existing**	0.30	0.67	1.18
	Proposed	5.28	11.87	21.11
	Increase	4.98	11.20	19.93

Note: Domestic water demand is sum of all residential, commercial, and office demand.

Using the Halton Region design criteria for domestic water demand, the average daily demand, maximum daily demand, and peak hourly demand for the development will be 5.28 L/s, 11.87 L/s, and 21.11 L/s, respectively.

As shown in **Table 1**, the proposed development presents an increase of 4.98 L/s for average daily demand, 11.20 L/s for maximum daily demand, and 19.93 L/s for peak hourly demand. As discussed with the Region of Halton during a meeting in April 2017, confirmation will be provided by the Region that the proposed increase in demand can be accommodated by the existing municipal water system.

3.3 Fire Flow Demand

The Fire Underwriters Survey (FUS) method was used to estimate the fire flow demand for each building within the proposed development area. This calculation estimates the preliminary watermain size required to service each building for fire protection, and is based on the preliminary site plan design by Cynthia Zahoruk Architects. This estimate compares the fire flow demand for each of the proposed buildings, and is based on the largest required fire flow demand. **Table 2** summarizes the required fire flow and duration to meet fire protection for the proposed development.

Table 2: Proposed Fire Flow Demand

Method	Demand Flow (L/s)	Duration (h)
Fire Underwriters Survey (1999)	283.3	4.0

As shown in **Table 2**, the proposed fire water service will be required to accommodate a fire flow demand of 283.3 L/s for a duration of 4.0 hours. This is based on the fire flow demand of the Grocery Store, with a GFA of 3,175 m^2, and assumes ordinary construction material (Construction Coefficient 1.0) with no automatic sprinkler system.

Please note that the Fire Underwriters Survey value is a conservative estimate for comparison purposes only. The mechanical engineer for this development will complete the required analyses for fire protection, and the architect will design fire separation methods per the determined fire flow rate, in order to meet municipally available flows and pressures.

Hydrant flow tests on the surrounding existing municipal watermains were carried out by Vipond Inc. on April 27, 2017 for the existing 300mm watermain on Kenwood Avenue, 300mm watermain on Lakeshore Road, and 200mm watermain on Hampton Heath Road.

Based on the hydrant flow test results, we anticipate at 20 psi residual pressure within the municipal watermain, that an average flow of 576 L/s (9,134 USGPM) for the 300mm watermain on Kenwood Avenue, 580 L/s (9,193 USGPM) for the 300mm watermain on Lakeshore Road, and 483 L/s (7,660 USPM) for the 200mm watermain on Hampton Heath Road will be available for fire protection.

Refer to **Appendix A** for detailed calculations of the proposed fire flow demand and projected available fire flow.

3.4 Proposed Water Servicing

The development is proposed to be serviced by a 300mm diameter PVC watermain along the proposed Access Lane 'B', with connections to the existing 300mm watermain on Kenwood Avenue and 200mm watermain on Hampton Heath Road. The proposed 300mm diameter watermain will support separate water service connections to each of the proposed buildings within the site.

The proposed restaurant (Block A) will be serviced by a 200mm diameter fire line and 150mm diameter domestic line. The proposed residential buildings (Block A, B, C, D, E, F, G and H) are proposed to each be serviced by a 200mm diameter fire line and 150mm diameter domestic line. The proposed commercial/office building (Block I) and the proposed grocery store will also be serviced separately with a 200mm diameter fire line and 150mm diameter domestic line each.

The proposed water servicing plan is shown on **Drawing C103** – Preliminary Servicing Plan. The internal building plumbing will be designed by the Mechanical Engineer.

4.0 Sanitary Servicing

Halton Region of is responsible for the operation and maintenance of the public sewage collection and treatment system in the City of Burlington. Any local sewage system will connect to the Region's municipal sanitary sewage network.

4.1 Existing Sanitary Servicing

A review of City of Burlington and Halton Region as-constructed drawings indicate that:

Lakeshore Road:

- There is an existing 600 mm diameter sanitary forcemain flowing westward towards Kenwood Avenue according to City of Burlington as-constructed drawing 'ML-9 Lakeshore Road' dated January 1989. The drawing also indicates a 750 mm sanitary sewer flowing eastward towards Hampton Heath Road.

Hampton Heath Road:

- There is an existing 600 mm diameter sanitary sewer flowing towards Lakeshore Road according to City of Burlington drawing 'MH-1 Hampton Heath Road', dated June, 2006. The sewer connects to the 750 mm sanitary sewer on Lakeshore Road.

Kenwood Avenue:

- There is an existing 200 mm diameter sanitary sewer flowing south towards Lakeshore Road as indicated in the City of Burlington drawing 'ML-9 Lakeshore Road' dated January, 1989. This sanitary line connects to the 750 mm sanitary sewer along Lakeshore Road.

4.2 Design Sanitary Flow

The sanitary flows for the proposed development were calculated with reference to Halton Region sanitary design criteria. A unit sewage flow 275 L/s*cap was used with an occupancy density of 1.68 persons/unit for apartments and 2.60 persons/unit for townhouses. For commercial and office areas, population densities of 90 persons/ha and 125 persons/ha were used respectively.

Infiltration flow and a peaking factor were applied to the unit sewage flow to obtain the total estimated design sewage flow. A summary of the results is presented in **Table 3**, and detailed calculations are provided in **Appendix B**.

Table 3: Existing/Proposed Sanitary Flows

Standard		Average Flow (L/s)	*Peaking Factor	Peak Flow (L/s)	Infiltration Flow (L/s)	Total Flow (L/s)
Halton Region Water and Wastewater Linear Design Manual (July 2017)	**Existing**	0.30	3.40	1.01	1.10	2.11
	Proposed	5.28	3.99	21.06		22.16
	Increase	4.98	0.59	20.05	-	20.05

Note: Sanitary flow is sum of all residential, commercial, and office flows.
*Proposed peaking factor shown is a weighted average of the peaking factors from each block. The proposed peak flow is a sum of all peak flows for each block. Refer to Appendix B for more details.

Using the Halton Region design criteria for sanitary flows, the average daily flow and peak flow for the development will be 5.21 L/s, and 20.70 L/s, respectively.

As shown in **Table 2**, the proposed development presents an increase of 4.98 L/s for average flow, and 20.05 L/s for peak flow. The infiltration flow remains the same for both existing and proposed conditions, with an infiltration flow of 1.10 L/s. As discussed with the Region of Halton during a meeting in April 2017, confirmation will be provided by the Region that the proposed increase in sanitary flows can be accommodated by the existing municipal sanitary sewage system.

4.3 Proposed Sanitary Servicing

The development is proposed to be serviced by a 200mm diameter sanitary sewer at a slope of 1.0% along the proposed Access Lane 'B', with connections to the existing 200mm sanitary sewer on Kenwood Avenue and 600mm sanitary sewer on Hampton Heath Road. The proposed 200mm diameter sanitary sewer will support separate 200mm diameter sanitary service connections to each of the proposed buildings within the site. The proposed sanitary servicing plan is shown on **Drawing C103**. The internal building plumbing will be designed by the Mechanical Engineer.

5.0 Drainage Conditions

5.1 Existing Drainage

The subject property currently consists of an active commercial plaza, and is dominated by the existing building and parking lot, with minor landscaping along the perimeter. Refer to the topographic survey prepare by A.T. McLaren Ltd. (July 2017) for more details. Based on the existing land cover, the pre-development runoff coefficient for the site was determined to be 0.87.

A review of the site elevations indicates that stormwater runoff flows generally south towards Lakeshore Road. A small portion of site runoff in the northeast corner of the site flows east overland towards Hampton Heath Road, where it is conveyed to a 1050mm diameter storm sewer.

A subsurface utility locate survey prepared by Terra Discovery (August 2017) indicates that the existing internal storm sewer system, with catch basins dispersed throughout the parking lot, flow towards the southwest corner of the site. From here, stormwater discharges through an existing 750mm diameter storm sewer to an existing storm manhole within the Lakeshore Road R.O.W. Stormwater runoff is then conveyed through an existing 1050mm diameter manhole further south across Lakeshore Road.

The existing drainage conditions are illustrated on **Figure 1** – Pre-Development Drainage Plan. As shown in **Figure 1**, the site is split into two catchment areas, Catchment 101 and Catchment 102. For a breakdown of each pre-development catchment area and the calculated runoff coefficient, refer to **Table 4**.

Table 4: Pre-Development Drainage Parameters

	Impervious Area (m^2)	**Pervious Area** (m^2)	**Total Area** (m^2)	**Runoff Coefficient**
Catchment 101	35,000	2,000	37,000	0.87
Catchment 102	1,350	50	1,400	0.87
OVERALL	**36,350**	**2,050**	**38,400**	**0.87**

5.2 Proposed Drainage

The proposed development, as described in Section 2.0 will consists of a mixed-use community constructed over six phases of development. The site will consist of multi-storey residential buildings, a restaurant, a multi-storey retail/office building, and a grocery store, with corresponding underground and above ground parking. The site will also provide landscaping, outdoor amenity spaces, and pedestrian walkways. Refer to the Preliminary Site Plan prepared by Cynthia Zahourk Architects (December 2017) for more details. Based on the proposed land cover, the post-development runoff coefficient for the site was determined to be 0.83.

Upon development, the site elevation will be generally maintained between the existing and proposed conditions. As discussed with the City of Burlington during a meeting in February 2017, a residential property adjacent to subject site and south of Lakeshore Road is subject to potential flooding from roadside drainage. As such, the site major overland flow has been directed away from Lakeshore Road and is being conveyed to Hampton Heath Road. A small portion of overland runoff in the northwest corner of the site along Access Lane 'A' will be conveyed to Kenwood Avenue. The major overland flow routes have been designed to ensure the maximum ponding depth on site does not exceed 0.30m.

The proposed drainage conditions are illustrated on **Figure 2** – Post-Development Drainage Plan. As shown in **Figure 2**, stormwater runoff from the proposed parking lot area will be captured in catch basins and areas drains located throughout the site. Stormwater runoff will be conveyed to underground storage cisterns and chambers located within the building underground parking and parking lot areas respectively. From the underground storage, stormwater will be conveyed via the site internal storm sewer system to two outlets:

- **Catchment 201**: Consists of Phases 1-2 and Phases 4-5, and will discharge to Lakeshore Road via the existing 750mm diameter storm sewer at the southwest corner of the site.

- **Catchment 202**: Consists of Phase 3 and portions of the north area of Phases 1 and 4, and will discharge to Hampton Heath Road via a proposed 300mm diameter storm sewer at the northeast corner of the site.

The proposed drainage design maintains the general drainage divide, however, due to insufficient pipe cover, a larger drainage area (Catchment 202) will be conveyed to Hampton Heath Road. For a breakdown of each post-development catchment area and the calculated runoff coefficients, refer to **Table 5**.

Table 5: Post-Development Drainage Parameters

	Impervious Area RC = 0.90 (m^2)	**Pervious Area RC =0.25** (m^2)	**Total Area** (m^2)	**Runoff Coefficient**
Catchment 201	19,500	2,700	22,200	0.82
Catchment 202	15,200	1,000	16,200	0.86
OVERALL	**34,700**	**3,700**	**38,400**	**0.84**

Based on the proposed grading design, external drainage from the arena north of the subject site will be received. The drainage plan for the arena will be designed by others to ensure that stormwater runoff from the site remains self-contained. As such, the external drainage has not been accounted for in the subject site.

In accordance with City of Burlington Std. S-3D, to account for antecedent precipitation conditions for higher-intensity storm events, adjustment factors must be applied to the 25-year, 50-year, and100-year storm events. Refer to **Table 6** for a comparison of adjusted runoff coefficients for the 2-100-year storm events for pre-development and post-development conditions.

Table 6: Adjusted Runoff Coefficients

Storm	**Adjustment Factor**	**Adjusted Pre-Development Runoff Coefficient**	**Adjusted Post-Development Runoff Coefficient**
5-year	1.00	0.86	0.83
10-year	1.00	0.86	0.83
25-year	1.10	0.95	0.92
50-year	1.20	1.00	1.00
100-year	1.25	1.00	1.00

6.0 Stormwater Management

The site stormwater management criteria for the proposed development were established in consultation with the City of Burlington. The governing stormwater management criteria include:

Quantity Control

Provide quantity control for100-year post-development to 5-year pre-development control

Quality Control

Provide a minimum 80% TSS removal (Enhanced Protection) as stated in the MOECC SWM Criteria (2003)

The subject site falls within the Burlington Urban Creeks - Appleby Creek subwatershed, which is managed by Conservation Halton. A review of conservation regulation mapping indicates that the subject site does not fall within regulation limits.

6.1 Stormwater Quantity Control

Using the City of Burlington intensity-duration-frequency (IDF) data, the Modified Rational Method was used to determine the pre-development and post-development peak flow rates for site stormwater runoff. The amount of on-site storage was determined by comparing the post-development peak flow rates to the maximum allowable release rate. Based on the 5-year pre-development peak flow rate, the maximum allowable release rate was determined to be 815 L/s.

The proposed stormwater quantity controls consist of a combination of underground storage in the form of cisterns within the underground parking levels, and chambers within the parking lot. Rooftop controls are also proposed for Block A (Restaurant). Discharge to the municipal storm sewers from the subject site will be controlled via two orifice tubes, with connections to Lakeshore Road and Hampton Heath Road. The proposed quantity control design for Catchment 201 and Catchment 202 is described below.

Catchment 201

Catchment 201 consists of the development elements for Phases 1-2 and Phases 4-5, which includes the proposed restaurant (Block A) and multi-storey residential buildings (Block B-H). The total area for Catchment 201 is 2.22 ha with a composite runoff coefficient of 0.82.

Stormwater runoff for Catchment 201 is proposed to discharge to Lakeshore Road via the existing 750mm diameter storm sewer at the southwest corner of the site. In order to control discharge to the municipal storm sewer system, a 375mm dia. orifice tube located downstream of STM MH 1 at the southwest corner of the site is recommended. The provided orifice tube will control stormwater runoff to a maximum flow rate of 343 L/s. Stormwater runoff from the landscape areas along the frontage of Lakeshore Road and Kenwood Avenue will flow uncontrolled to the respective municipal right-of-way. Stormwater runoff from these areas accounts for 36 L/s of uncontrolled discharge from the site during the 100-year storm event.

Catchment 202

Catchment 202 consists of Phase 3 and portions of the north area of Phases 1 and 4, which includes the proposed retail/office building (Block I) and the grocery store. The total area for Catchment 202 is 1.62 ha, with a composite runoff coefficient of 0.86

Stormwater runoff for Catchment 202 is proposed to discharge to Hampton Heath Road via a proposed 300mm dia. storm sewer at a slope of 1.0%. The proposed 300mm dia. storm sewer will act as an orifice tube, with a full flow capacity of 346 L/s.

A summary of site flows and required storage volumes have been provided in **Table 7.**

Table 7: Pre- and Post-Development Flow Rates and Required Storage Volumes

Storm Event (year)	Peak Flow Rate					**Volume Control (m^3)	
	Pre-Development (L/s)	Post-Development (L/s)					
		[1]Site Allowable Release Rate	Controlled	Uncontrolled	[3]Total Post-Development Flow Rate	Required Storage	Provided Storage
5	815	815	690	18	707	21	520
10	935			20	710	86	
25	1197			26	716	253	
50	1386			31	721	422	
100	1515			36	725	518	

Note: 1. Site allowable release rate based on 5-year pre-development peak flow rate.
2. Controlled release rate is sum of orifice release rate for Catchment 201 and Catchment 202.
3. Total post-development flow rate is sum of all controlled and uncontrolled flows.

As shown in **Table 7**, the sum of all controlled and uncontrolled flow rates generates a maximum release rate of 725 L/s during the 100-year storm event. As such, stormwater quantity control objectives are being met, as the proposed flows are less than the allowable release rate of 815 L/s.

In order to meet quantity control requirements for the proposed development, 518 m^3 of storage will be required. The proposed site stormwater storage will be designed to contain a maximum volume of 520 m^3, as required to control the100-year storm event to the site release rate. The proposed stormwater storage facilities located within the parking lot and underground parking will be sized according to the respective drainage areas. Refer to **Appendix C** for complete stormwater calculations. The Preliminary Servicing Plan (**Drawing C103**) illustrates the location of the proposed internal storm sewers, orifice tubes, and underground storage systems.

6.2 Stormwater Quality Control

The Ontario Ministry of the Environment and Climate Change (MOECC) "Enhanced" level of protection requires the stormwater runoff be treated for 80% annual average total suspended solids (TSS) removal from 90% of the discharge volume. To meet the criteria, the

installation of four stormwater treatment devices are proposed to provide treatment for parking lot runoff. Refer to **Table 8** for a breakdown of the site stormwater quality controls.

Table 8: Summary of Stormwater Quality Controls

Water Quality Calculations				
Land Use	**Area** (m^2)	**% of Total Site Area**	**TSS Removal Credit**	**Total TSS Removal**
Proposed Roadway/Parking Lot	19,380	50.5%	80.00%	40.4%
Proposed Building	15,320	39.9%	80.00%	31.9%
Proposed Landscaped	3,700	9.6%	80.00%	7.7%
TOTAL SITE	**38,400**	**100.0%**	**-**	**80.0%**

The Stormceptor STC oil-grit separator system (OGS) has been proposed to provide an Enhanced Level of Protection as stated by the MOECC (80% removal of total suspended solids from 90% of the runoff volume). Sizing calculations for the proposed four quality control devices have been provided in **Appendix D**. The various Stormceptor units (STC 300 – STC 2000) have been sized according to the specific parking lot subcatchment areas draining to each unit. The OGS systems have been sized assuming a fine particle size distribution.

In addition to the provided OGS systems, bioswale systems have been proposed at islands within the parking lot where stormwater runoff is collected by catch basins. The bioswale systems located within the parking area will provide pre-treatment of stormwater runoff prior to entering the proposed OGS systems.

Runoff captured on rooftops is generally assumed to be clean, we can attribute an 80% TSS removal credit for rainfall captured on the rooftop of the proposed building. Rainfall over the landscaped area is also generally assumed to be clean and has been attributed with an 80% TSS removal credit. Using a weighted TSS removal for the development area we find a total 80.0% TSS removal for 100% runoff volume.

7.0 Conclusions and Recommendations

Based on the information offered in this report, we offer the following conclusions:

1. The development is proposed to be serviced by a 300mm diameter PVC watermain along the proposed Access Lane 'B', with connections to the existing 300mm watermain on Kenwood Avenue and 200mm watermain on Hampton Heath Road. Each building will be serviced by a 200mm diameter fire line and 150mm diameter domestic line. Confirmation will be provided by the Region that the proposed increase in demand can be accommodated by the existing municipal water system.
2. The development is proposed to be serviced by a 200mm diameter sanitary sewer at a slope of 1.0% along the proposed Access Lane 'B', with connections to the existing 200mm sanitary sewer on Kenwood Avenue and 600mm sanitary sewer on Hampton Heath Road. Confirmation will be provided by the Region that the proposed increase in sanitary flow can be accommodated by the existing municipal sewage system.
3. The stormwater quantity control target for the site will be the100-year post-development peak flow rate to the 5-year pre-development peak flow rate. This target can be met through the use of orifice control at the downstream end of the site storm sewer system. In order to meet quantity control targets, 520 m^3 of storage will be provided via cisterns within the underground parking, underground chambers within the parking lot, and rooftop storage.
4. The stormwater quality control target for the site will be 80% TSS Removal for 90% of the runoff volume (Enhanced Level). Stormwater quality control will be achieved by four oil-grit separators (OGS) within the parking lot. The remaining stormwater runoff from the roofs and landscape areas are considered clean and will discharge untreated. Bioswales within the parking lot will provided pre-treatment for stormwater runoff prior to treatment by the proposed OGS systems.

Based on the aforementioned conclusions and recommendations, we recommend the approval of the re-zoning application from the perspective of functional servicing and stormwater management.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

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APPENDIX A

Domestic/Fire Water Demand

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road
Project No.: 1281-4451

Date: 2018.04.20
Revised: -
Design: HAS
Check: NC

Existing Population Estimate

	Commercial (m2)	Residential (# of units)
Food Basics Store	3195	0
Retail Area	7145	0
TOTAL	10,340	0

Commercial Population:

Light Commercial:	90	persons/ha
Commercial Population:	**93**	persons

Source: Halton Region Water and Wastewater Linear Design Manual, April 2015

Residential Population:

Apartment:	1.68	persons/unit
Residential Population:	**0**	persons

Source: Population density per email confirmation from Region of Halton, dated September 29, 2015

TOTAL POPULATION	**93**	persons

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road
Project No.: 1281-4451

Date: 2018.04.20
Revised: -
Design: HAS
Check: NC

Proposed Population Estimate

PHASE	BLOCK	Commercial (m^2)	Residential (# of units)		Office (m^2)
			Apartment	Townhouse	
PHASE 2	BLOCK A	560	0	0	0
PHASE 1	BLOCK B	0	51	5	0
PHASE 4	BLOCK C	2,320	112	0	0
	BLOCK D		112	0	0
PHASE 2	BLOCK E	2,520	166	0	0
	BLOCK F		170	0	0
PHASE 5	BLOCK G	2,480	170	0	0
	BLOCK H		114	0	0
PHASE 3	BLOCK I	900	0	0	2,700
	GROCERY STORE	3,175	0	0	0
TOTAL		11,955	895	5	2,700

Commercial Population:

Light Commercial:	90	persons/ha
Commercial Population:	**108**	persons

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

Residential Population:

Apartment:	1.68	persons/unit
Townhouse:	2.60	persons/unit
Residential Population:	**1517**	persons

Source: Population density per email confirmation from Region of Halton, dated September 29, 2015

Office (Light Industrial) Population:

Apartment:	125	persons/ha
Office Population:	**34**	persons

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

TOTAL POPULATION **1658** persons

CROZIER & ASSOCIATES Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road, Burlington
Project No.: 1281-4451

Date: 2018.02.08
Revised: -
Design: HAS
Check: NC

Existing Water Demand

Population Estimate:

Commercial:	93 persons
Residential:	0 persons
TOTAL POPULATION:	93 persons

Design Criteria:

Average Daily Demand:	0.275 m^3/cap.day
Maximum Daily Demand Peaking Factor:	2.25
Maximum Hourly Demand Peaking Factor:	4.00

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

Commercial Demand:

Average Daily Demand:	25.59 m^3/day
	0.30 L/s
Maximum Day Demand:	57.58 m^3/day
	0.67 L/s
Maximum Hourly Demand:	102.37 m^3/day
	1.18 L/s

Residential Demand:

Maximum Day Demand:	0.00 m^3/day
	0.00 L/s
Maximum Day Demand:	0.00 m^3/day
	0.00 L/s
Maximum Hourly Demand:	0.00 m^3/day
	0.00 L/s

Total Average Day Demand:	**0.30** L/s
Total Maximum Day Demand:	**0.67** L/s
Total Maximum Hourly Demand:	**1.18** L/s

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road, Burlington
Project No.: 1281-4451

Date: 2018.02.08
Revised: -
Design: HAS
Check: NC

Proposed Water Demand

Population Estimate:

Commercial:	108	persons
Residential:	1517	persons
Community:	34	persons
TOTAL POPULATION:	**1658**	**persons**

Design Criteria:

Average Daily Demand:	0.275 m^3/cap.day
Maximum Daily Demand Peaking Factor:	2.25
Maximum Hourly Demand Peaking Factor:	4.00

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

Commercial and Office Water Demand:

		Commercial (L/s)			Office (L/s)		
PHASE	**BLOCK**	**Average Daily Demand**	**Maximum Daily Demand**	**Maximum Hourly Demand**	**Average Daily Demand**	**Maximum Daily Demand**	**Maximum Hourly Demand**
PHASE 2	BLOCK A	0.02	0.04	0.06	0.00	0.00	0.00
PHASE 1	BLOCK B	0.00	0.00	0.00	0.00	0.00	0.00
PHASE 4	BLOCK C	0.07	0.15	0.27	0.00	0.00	0.00
	BLOCK D	0.00	0.00	0.00	0.00	0.00	0.00
PHASE 2	BLOCK E	0.07	0.16	0.29	0.00	0.00	0.00
	BLOCK F	0.00	0.00	0.00	0.00	0.00	0.00
PHASE 5	BLOCK G	0.07	0.16	0.28	0.00	0.00	0.00
	BLOCK H	0.00	0.00	0.00	0.00	0.00	0.00
PHASE 3	BLOCK I	0.03	0.06	0.10	0.11	0.24	0.43
	GROCERY STORE	0.09	0.20	0.36	0.00	0.00	0.00
TOTAL		**0.34**	**0.77**	**1.37**	**0.11**	**0.24**	**0.43**

Residential Water Demand:

		Residential (L/s)					
		Apartments			Townhouses		
PHASE	**BLOCK**	**Average Daily Demand**	**Maximum Daily Demand**	**Maximum Hourly Demand**	**Average Daily Demand**	**Maximum Daily Demand**	**Maximum Hourly Demand**
PHASE 2	BLOCK A	0.00	0.00	0.00	0.00	0.00	0.00
PHASE 1	BLOCK B	0.27	0.61	1.09	0.04	0.09	0.17
PHASE 4	BLOCK C	0.60	1.35	2.40	0.00	0.00	0.00
	BLOCK D	0.60	1.35	2.40	0.00	0.00	0.00
PHASE 2	BLOCK E	0.89	2.00	3.55	0.00	0.00	0.00
	BLOCK F	0.91	2.05	3.64	0.00	0.00	0.00
PHASE 5	BLOCK G	0.91	2.05	3.64	0.00	0.00	0.00
	BLOCK H	0.61	1.37	2.44	0.00	0.00	0.00
PHASE 3	BLOCK I	0.00	0.00	0.00	0.00	0.00	0.00
	GROCERY STORE	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL		**4.79**	**10.77**	**19.14**	**0.04**	**0.09**	**0.17**

Total Water Demand:

PHASE	BLOCK	Average Daily Demand (L/s)	Maximum Daily Demand (L/s)	Maximum Hourly Demand (L/s)
PHASE 2	BLOCK A	0.02	0.04	0.06
PHASE 1	BLOCK B	0.31	0.71	1.26
PHASE 4	BLOCK C	0.67	1.50	2.66
	BLOCK D	0.60	1.35	2.40
PHASE 2	BLOCK E	0.96	2.16	3.84
	BLOCK F	0.91	2.05	3.64
PHASE 5	BLOCK G	0.98	2.21	3.92
	BLOCK H	0.61	1.37	2.44
PHASE 3	BLOCK I	0.13	0.30	0.53
	GROCERY STORE	0.09	0.20	0.36
TOTAL		**5.28**	**11.87**	**21.11**

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block A (Restaurant) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

1.0 C-Value 560.0 sq.m

Therefore F = 5,200 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 5,200 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☐ **Assume complete automatic sprinkler protection (50% reduction)**
0 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	22	10%	520
East	0	25%	1,300
South	N/A	0%	0
West	N/A	0%	0
		Total Surcharge	**1,820**

Determine Required Fire Flow

No.1	5,200		
No. 2	0	reduction	
No. 3	0	reduction	
No. 4	1,820	surcharge	
Required Flow:	**7,020**	**L/min**	
Rounded to nearest 1000 L/min:	**8,000**	**L/min**	or **133.3 L/s**
			2,112.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block B (6-Storey Townhouse/Apartments) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

1.0	C-Value	Largest Floor	1090 sq.m
		(Plus 25% of Adjoining Floors)	545 sq.m
			1635.0 sq.m

Therefore F = 8,900 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 8,900 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☐ **Assume complete automatic sprinkler protection (50% reduction)**
0 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	13	15%	1,335
South	22	10%	890
West	N/A	0%	0
		Total Surcharge	**2,225**

Determine Required Fire Flow

No.1	8,900			
No. 2	0	reduction		
No. 3	0	reduction		
No. 4	2,225	surcharge		
Required Flow:	**11,125**	**L/min**		
Rounded to nearest 1000 L/min:	**12,000**	**L/min**	or	**200.0 L/s**
				3,168.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Retail/Community/Residential (Phase 4) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	3050 sq.m
		(Plus 25% of Adjoining Floors)	1525 sq.m
			4575.0 sq.m

Therefore F = 8,900 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 8,900 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-2,670 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	15	15%	1,335
South	N/A	0%	0
West	13	15%	1,335
		Total Surcharge	**2,670**

Determine Required Fire Flow

No.1	8,900		
No. 2	0	reduction	
No. 3	-2,670	reduction	
No. 4	2,670	surcharge	
Required Flow:	**8,900**	**L/min**	
Rounded to nearest 1000 L/min:	**9,000**	**L/min**	or **150.0 L/s**
			2,376.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block C (11-Storey Apartment Building) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	729 sq.m
		(Plus 25% of Adjoining Floors)	364.5 sq.m
			1093.5 sq.m

Therefore F = 4,400 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 4,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-1,320 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	20.4	10%	440
South	N/A	0%	0
West	13	15%	660
		Total Surcharge	**1,100**

Determine Required Fire Flow

No.1	4,400		
No. 2	0	reduction	
No. 3	-1,320	reduction	
No. 4	1,100	surcharge	
Required Flow:	**4,180 L/min**		
Rounded to nearest 1000 L/min:	**5,000 L/min**	or	**83.3 L/s**
			1,320.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block D (11-Storey Apartment Building) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	729 sq.m
		(Plus 25% of Adjoining Floors)	364.5 sq.m
			1093.5 sq.m

Therefore F = 4,400 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 4,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-1,320 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	15	15%	660
South	N/A	0%	0
West	20.4	10%	440
		Total Surcharge	**1,100**

Determine Required Fire Flow

No.1	4,400		
No. 2	0	reduction	
No. 3	-1,320	reduction	
No. 4	1,100	surcharge	
Required Flow:	**4,180 L/min**		
Rounded to nearest 1000 L/min:	**5,000 L/min**	or	**83.3 L/s**
			1,320.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Podium (6-Storey Apartment - Phase 4) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	3168.5 sq.m
		(Plus 25% of Adjoining Floors)	1584.25 sq.m
			4752.8 sq.m

Therefore F = 9,100 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 9,100 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-2,730 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	15.2	15%	1,365
South	N/A	0%	0
West	0	25%	2,275
		Total Surcharge	**3,640**

Determine Required Fire Flow

No.1	9,100		
No. 2	0	reduction	
No. 3	-2,730	reduction	
No. 4	3,640	surcharge	
Required Flow:	**10,010**	**L/min**	
Rounded to nearest 1000 L/min:	**11,000**	**L/min**	or **183.3 L/s**
			2,904.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block E (14-Storey Apartment Building) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	729 sq.m
		(Plus 25% of Adjoining Floors)	364.5 sq.m
			1093.5 sq.m

Therefore F = 4,400 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 4,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-1,320 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	21	10%	440
South	N/A	0%	0
West	4.5	20%	880
		Total Surcharge	**1,320**

Determine Required Fire Flow

No.1	4,400		
No. 2	0	reduction	
No. 3	-1,320	reduction	
No. 4	1,320	surcharge	
Required Flow:	**4,400**	**L/min**	
Rounded to nearest 1000 L/min:	**5,000**	**L/min**	or **83.3 L/s**
			1,320.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block F (18-Storey Apartment Building) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	729 sq.m
		(Plus 25% of Adjoining Floors)	364.5 sq.m
			1093.5 sq.m

Therefore F = 4,400 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 4,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-1,320 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	17.7	15%	660
South	N/A	0%	0
West	21	10%	440
		Total Surcharge	**1,100**

Determine Required Fire Flow

No.1	4,400		
No. 2	0	reduction	
No. 3	-1,320	reduction	
No. 4	1,100	surcharge	
Required Flow:	**4,180**	**L/min**	
Rounded to nearest 1000 L/min:	**5,000**	**L/min**	or **83.3 L/s**
			1,320.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Podium (6-Storey Apartment - Phase 5) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	3168.5 sq.m
		(Plus 25% of Adjoining Floors)	1584.25 sq.m
			4752.8 sq.m

Therefore F = 9,100 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 9,100 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-2,730 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	39	5%	455
East	29.7	10%	910
South	N/A	0%	0
West	15.2	15%	1,365
		Total Surcharge	**2,730**

Determine Required Fire Flow

No.1	9,100			
No. 2	0	reduction		
No. 3	-2,730	reduction		
No. 4	2,730	surcharge		
Required Flow:	**9,100**	**L/min**		
Rounded to nearest 1000 L/min:	**10,000**	**L/min**	or	**166.7 L/s**
				2,640.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block G (18-Storey Apartment Building) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	729 sq.m
		(Plus 25% of Adjoining Floors)	364.5 sq.m
			1093.5 sq.m

Therefore F = 4,400 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 4,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-1,320 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	55	0%	0
East	18	15%	660
South	N/A	0%	0
West	17.7	15%	660
		Total Surcharge	**1,320**

Determine Required Fire Flow

No.1	4,400		
No. 2	0	reduction	
No. 3	-1,320	reduction	
No. 4	1,320	surcharge	
Required Flow:	**4,400**	**L/min**	
Rounded to nearest 1000 L/min:	**5,000**	**L/min**	or **83.3 L/s**
			1,320.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block H (10-Storey Apartment Building) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	729 sq.m
		(Plus 25% of Adjoining Floors)	364.5 sq.m
			1093.5 sq.m

Therefore F = 4,400 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 4,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-1,320 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	45.4	0%	0
East	34.2	5%	220
South	N/A	0%	0
West	18	15%	660
		Total Surcharge	**880**

Determine Required Fire Flow

No.1	4,400		
No. 2	0	reduction	
No. 3	-1,320	reduction	
No. 4	880	surcharge	
Required Flow:	**3,960 L/min**		
Rounded to nearest 1000 L/min:	**4,000 L/min**	or	**66.7 L/s**
			1,056.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Block I (4_Storey Retail/Office) - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

0.6	C-Value	Largest Floor	1194.6 sq.m
		(Plus 25% of Adjoining Floors)	597.3 sq.m
			1791.9 sq.m

Therefore F = 5,600 L/min

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 5,600 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☑ **Assume complete automatic sprinkler protection (50% reduction)**
-2,800 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	N/A	0%	0
East	0	25%	1,400
South	55	0%	0
West	15	15%	840
		Total Surcharge	**2,240**

Determine Required Fire Flow

No.1	5,600		
No. 2	0	reduction	
No. 3	-2,800	reduction	
No. 4	2,240	surcharge	
Required Flow:	**5,040**	**L/min**	
Rounded to nearest 1000 L/min:	**6,000**	**L/min**	or **100.0 L/s**
			1,584.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Project NO.: 1281-4451

Date: 1/23/2018
Designed By: HAS
Checked By: NC

Grocery Store - Fire Flow Calculations - Fire Underwriters Survey Method

Water Supply for Public Fire Protection (1999)
Fire Underwriters Survey
Notes:

1.) The development will use ordinary construction (C-value = 1.0).
2.) The building is assumed to have no automatic sprinkler protection.
3.) The building is classified as a low hazard occupancy as per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

Where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Development

1.0 C-Value 3172.0 sq.m

Therefore F = 12,400 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No change)		

0% Reduction(%)
0 L/min reduction

Subtotal = 12,400 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above may be reduced by up to 50% for complete automatic sprinkler protection.

☐ **Assume complete automatic sprinkler protection (50% reduction)**
0 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%	>45 m	0%

Exposed buildings

Name	Distance (m)	Charge	Surcharge (L/min)
North	22	10%	1,240
East	0	25%	3,100
South	N/A	0%	0
West	N/A	0%	0
		Total Surcharge	**4,340**

Determine Required Fire Flow

No.1	12,400			
No. 2	0	reduction		
No. 3	0	reduction		
No. 4	4,340	surcharge		
Required Flow:	**16,740**	**L/min**		
Rounded to nearest 1000 L/min:	**17,000**	**L/min**	or	**283.3 L/s**
				4,488.0 USGPM

Note: USGPM = 0.264*(L/min)

Required Duration of Fire Flow	
Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

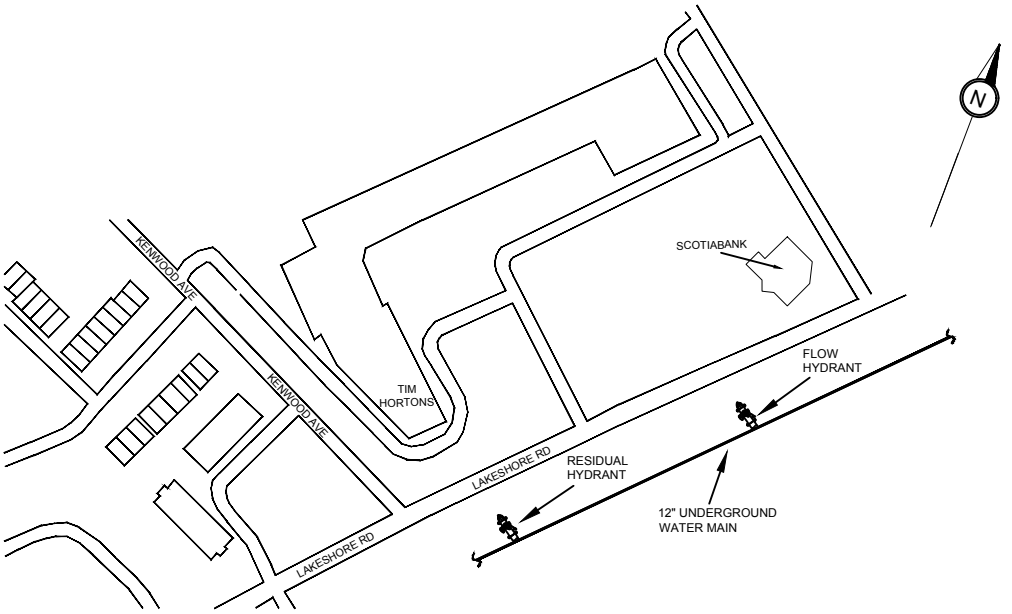
FIRST FOR FIRE PROTECTION
VIPOND INC
est. 1945

FLOW TEST RESULTS

DATE : APRIL 27, 2017 TIME : 10:50 AM

LOCATION : 5353 LAKESHORE ROAD
BURLINGTON
ONTARIO

TEST BY : F.ZHANG & D.MANZHAY & P.U.C



STATIC PRESSURE : 77 ---------- PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4"	0.997	76	70	761
2	1	2-1/2"	0.9	75	66	1353
3	2	2-1/2"	0.9	74	46/44	2251

FIRST FOR FIRE PROTECTION
VIPOND INC
est. 1945

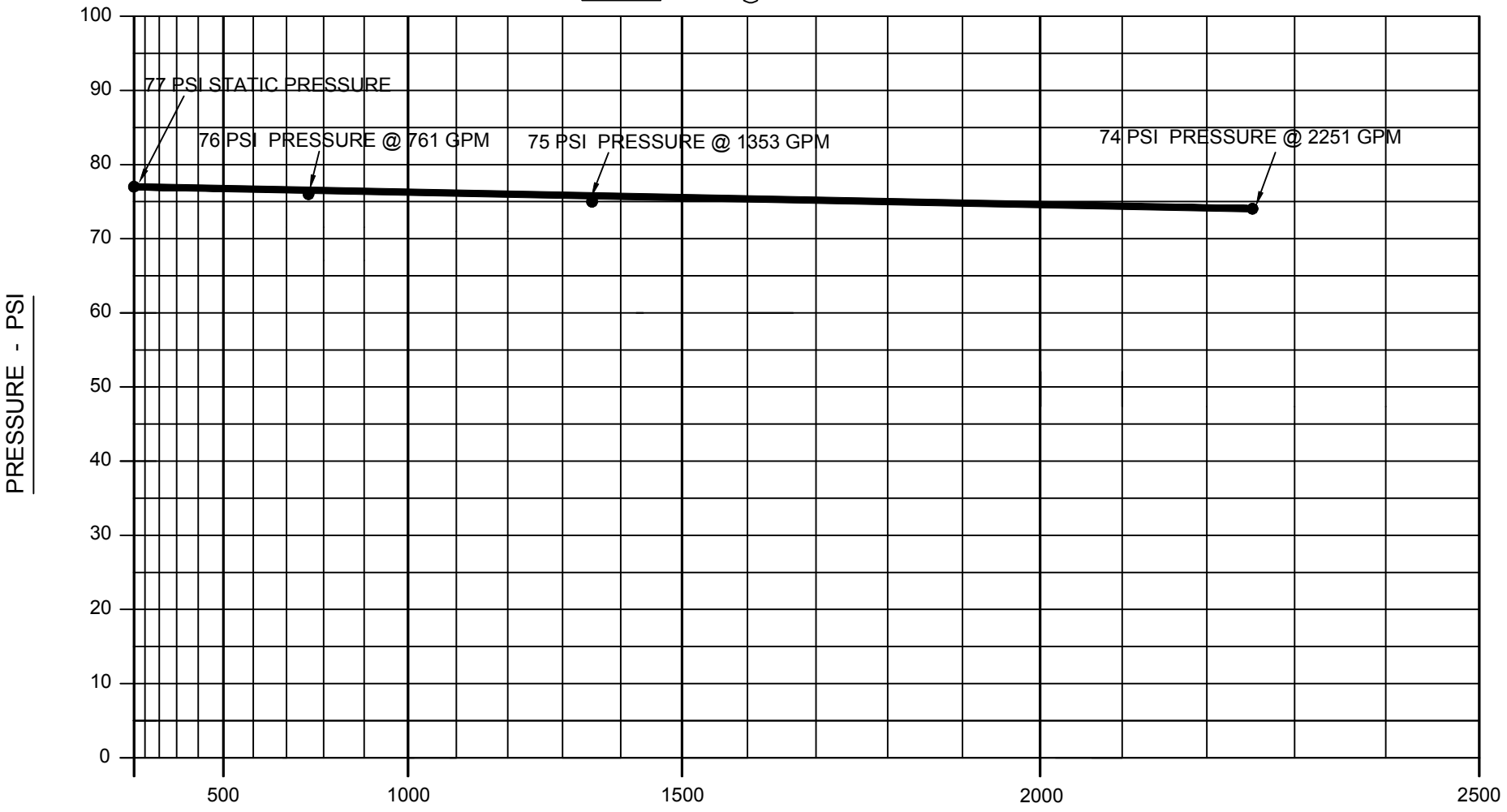
5353 LAKESHORE ROAD	TEST BY : VIPOND FIRE PROTECTION
BURLINGTON	OFFICE : MISSISSAUGA
ONTARIO	BY : F.ZHANG & D.MANZHAY & P.U.C
	DONE : APRIL 27, 2017 AT 10:50 AM

STATIC : 77 PSI

76 PSI @ 761 GPM

75 PSI @ 1353 GPM

74 PSI @ 2251 GPM



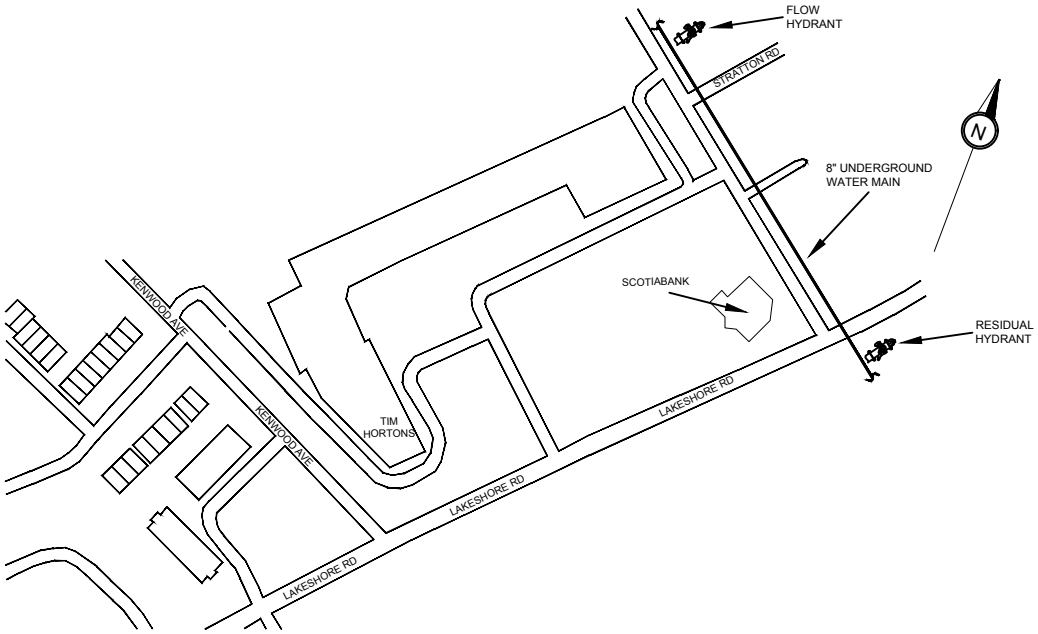
VIP-DES-FO5-C

FLOW TEST RESULTS

DATE : APRIL 27, 2017 TIME : 11:25 AM

LOCATION : 5353 LAKESHORE ROAD
BURLINGTON
ONTARIO

TEST BY : F.ZHANG & D.MANZHAY & P.U.C



STATIC PRESSURE : 76 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4"	0.997	75	64	727
2	1	2-1/2"	0.9	75	54	1233
3	2	2-1/2"	0.9	73	30/28	1807

FIRST FOR FIRE PROTECTION
VIPOND INC
est. 1945

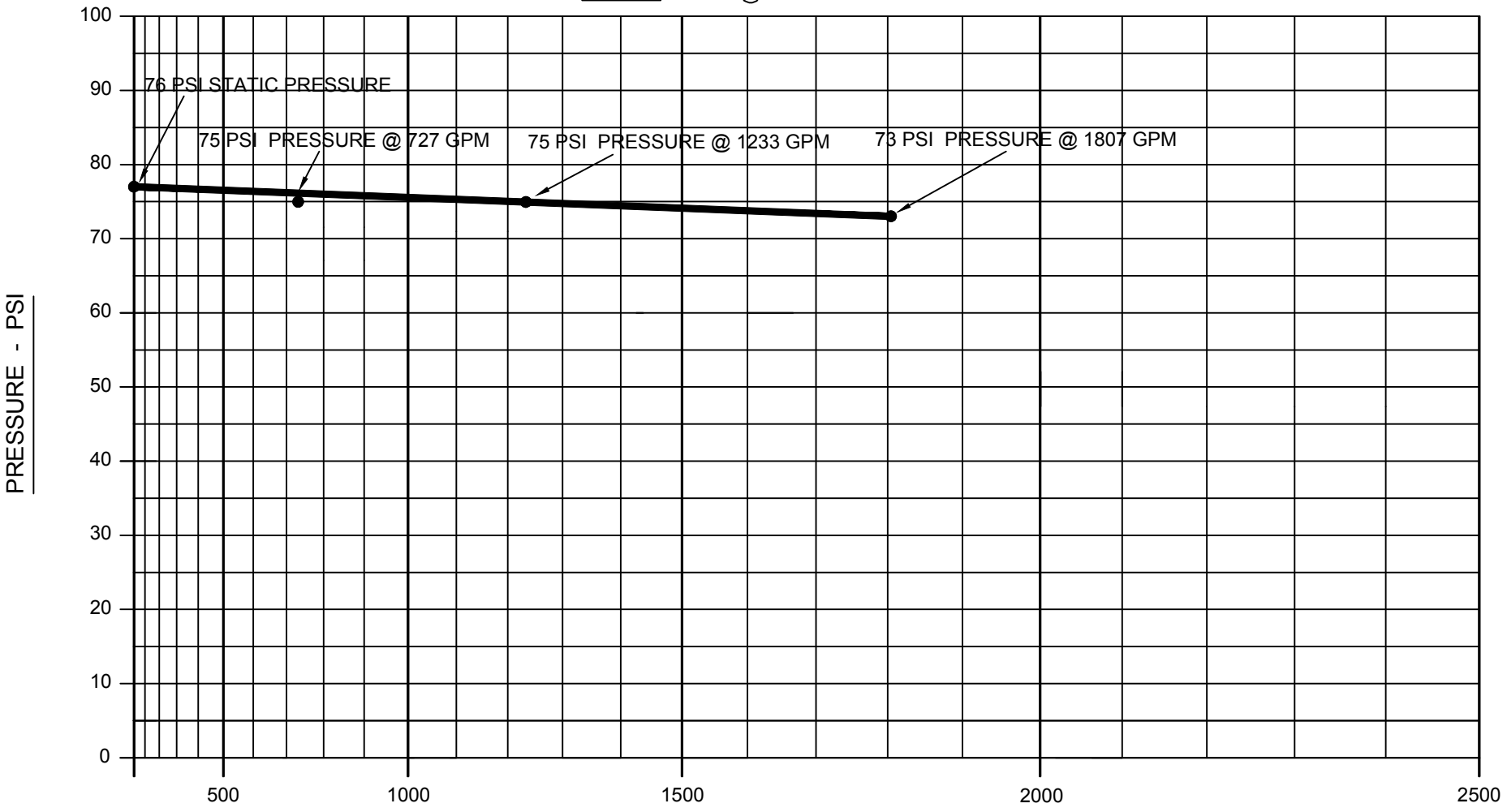
5353 LAKESHORE ROAD	TEST BY : VIPOND FIRE PROTECTION
BURLINGTON	OFFICE : MISSISSAUGA
ONTARIO	BY : F.ZHANG & D.MANZHAY & P.U.C
	DONE : APRIL 27, 2017 AT 11:25 AM

STATIC : 76 PSI

75 PSI @ 727 GPM

75 PSI @ 1233 GPM

73 PSI @ 1807 GPM



VIP-DES-FO5-C

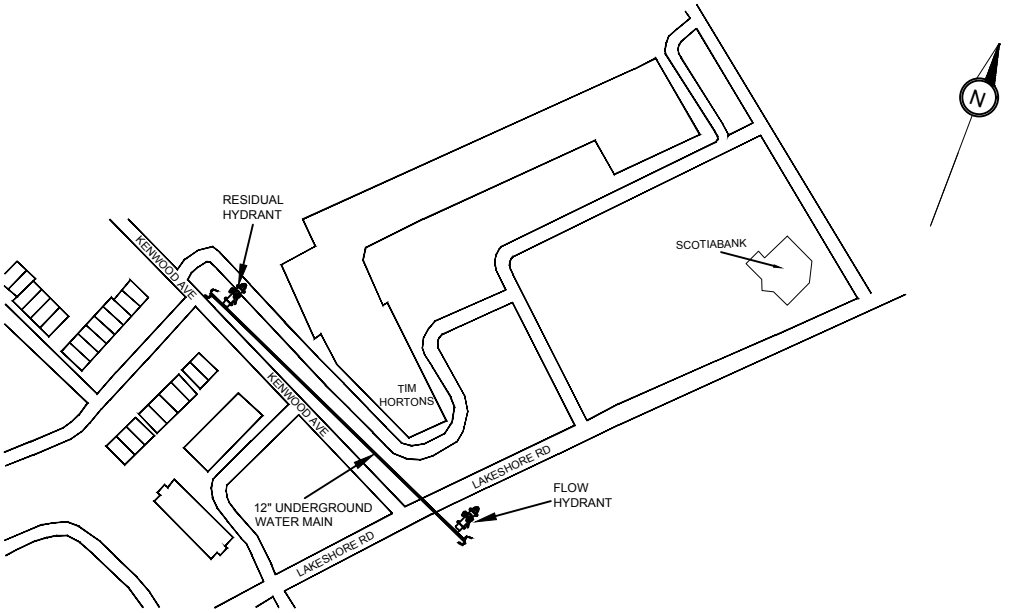
FIRST FOR FIRE PROTECTION
VIPOND INC
est. 1945

FLOW TEST RESULTS

DATE : APRIL 27, 2017 TIME : 10:15 AM

LOCATION : 5353 LAKESHORE ROAD
BURLINGTON
ONTARIO

TEST BY : F.ZHANG & D.MANZHAY & P.U.C



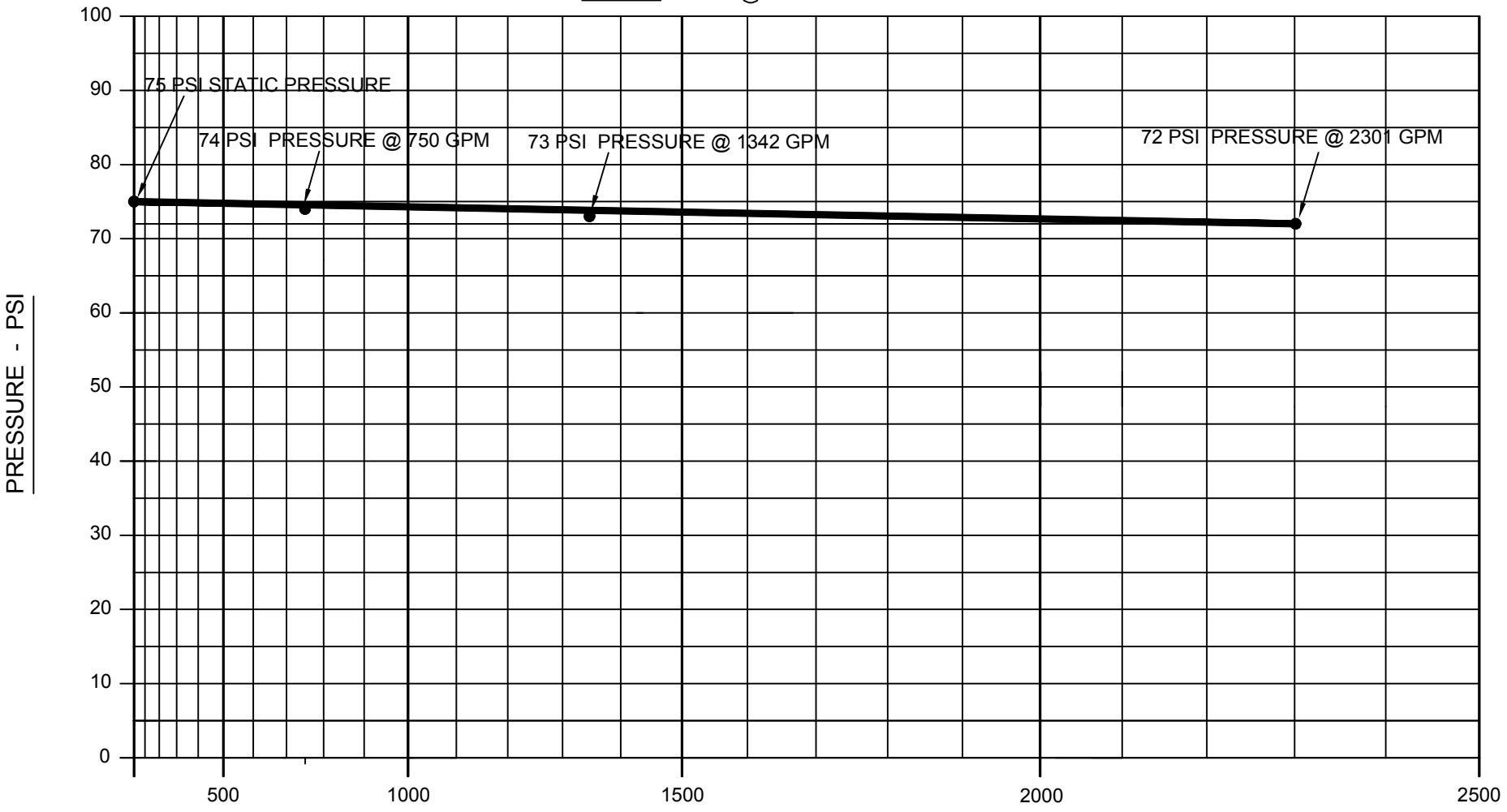
STATIC PRESSURE : 75 ---------- PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4"	0.997	74	68	750
2	1	2-1/2"	0.9	73	64	1342
3	2	2-1/2"	0.9	72	48/46	2301

FIRST FOR FIRE PROTECTION
VIPOND INC
est. 1945

5353 LAKESHORE ROAD	TEST BY : VIPOND FIRE PROTECTION
BURLINGTON	OFFICE : MISSISSAUGA
ONTARIO	BY : F.ZHANG & D.MANZHAY & P.U.C
	DONE : APRIL 27, 2017 AT 10:15 AM

STATIC : 75 PSI
74 PSI @ 750 GPM
73 PSI @ 1342 GPM
72 PSI @ 2301 GPM



VIP-DES-FO5-C

PROJECT: Lakeside Plaza
PROJECT No.: 1281-4451
DATE: 1/23/2018

DESIGN: HS
CHECK: NC

Projected Fire Flows - Hydrant Test dated April 27, 2017 - Test #1

Test	Hydrant Location / ID	Static Pressure	Residual Pressure during Test	Flow from Hydrant Test	Desired Residual Pressure	Projected Fire Flow Available at 20 psi	
		Ps	Pt	Qt	Pr	Qr	
		(psi)	(psi)	(USGPM)	(psi)	(USGPM)	(L/s)
1	SE of Kenwood Ave. and Banting Court	75	74	750	20	6,529	412
2			73	1342		9,500	599
3			72	2301		11,068	698

$Q_r = Q_t \times ((P_s - P_r)/(P_s - P_t))^{0.54}$ Formula to determine available flow as per AWWA M17 (1989)

Qr= Qr/15.85 Formula to convert flows at 20 psi from USGPM to L/s

NOTE: Projected fire flows are calculated on the basis of hydrant tests carried out by Vipond Inc. on April 27, 2017 at 10:15 am on 300mm municipal watermain along Kenwood Ave., SE of the intersection with Banting Court

Location of Test: Flow: SE Hydrant Kenwood Ave./Lakeshore Rd.
Residual: SE Hydrant Kenwood Ave./Banting Court

CROZIER CONSULTING ENGINEERS

PROJECT: Lakeside Plaza
PROJECT No.: 1281-4451
DATE: 1/23/2018

DESIGN: HS
CHECK: NC

Projected Fire Flows - Hydrant Test dated April 27, 2017 - Test #2

Test	Hydrant Location / ID	Static Pressure	Residual Pressure during Test	Flow from Hydrant Test	Desired Residual Pressure	Projected Fire Flow Available at 20 psi	
		Ps	Pt	Qt	Pr	Qr	
		(psi)	(psi)	(USGPM)	(psi)	(USGPM)	(L/s)
1	SE of Kenwood Ave. and Lakeshore Rd.	77	76	761	20	6,754	426
2			75	1353		9,715	613
3			74	2251		11,038	696

$Q_r = Q_t \times ((P_s - P_r)/(P_s - P_t))^{0.54}$ Formula to determine available flow as per AWWA M17 (1989)

Qr= Qr/15.85 Formula to convert flows at 20 psi from USGPM to L/s

NOTE: Projected fire flows are calculated on the basis of hydrant tests carried out by Vipond Inc. on April 27, 2017 at 10:50 am on 300mm municipal watermain along Lakeshore Rd., SE of the intersection with Kenwood Ave.

Location of Test: Flow: 5348 Lakeshore Road
Residual: SE Hydrant Kenwood Ave./Lakeshore Rd.

CROZIER CONSULTING ENGINEERS

PROJECT: Lakeside Plaza
PROJECT No.: 1281-4451
DATE: 1/23/2018

DESIGN: HS
CHECK: NC

Projected Fire Flows - Hydrant Test dated April 27, 2017 - Test #2

Test	Hydrant Location / ID	Static Pressure	Residual Pressure during Test	Flow from Hydrant Test	Desired Residual Pressure	Projected Fire Flow Available at 20 psi	
		Ps	Pt	Qt	Pr	Qr	
		(psi)	(psi)	(USGPM)	(psi)	(USGPM)	(L/s)
1	SE of Hampton Heath Road and Lakeshore Rd.	76	75	727	20	6,391	403
2			75	1233		12,782	806
3			73	1807		8,777	554

$Q_r = Q_t \times ((P_s - P_r)/(P_s - P_t))^{0.54}$ Formula to determine available flow as per AWWA M17 (1989)

Qr= Qr/15.85 Formula to convert flows at 20 psi from USGPM to L/s

NOTE: Projected fire flows are calculated on the basis of hydrant tests carried out by Vipond Inc. on April 27, 2017 at 11:25 am on 200mm municipal watermain along Hampton Heath Rd., SE of intersection with Kenwood Ave.

Location of Test: Flow: 133 Hampton Heath Rd.
Residual: SE Hydrant Kenwood Ave./Lakeshore Rd.

APPENDIX B

Sanitary Flow

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road
Project No.: 1281-4451

Date: 2018.04.20
Revised: -
Design: HAS
Check: NC

Existing Population Estimate

	Commercial (m2)	Residential (# of units)
Food Basics Store	3195	0
Retail Area	7145	0
TOTAL	10,340	0

Commercial Population:

Light Commercial:	90	persons/ha
Commercial Population:	**93**	persons

Source: Halton Region Water and Wastewater Linear Design Manual, April 2015

Residential Population:

Apartment:	1.68	persons/unit
Residential Population:	**0**	persons

Source: Population density per email confirmation from Region of Halton, dated September 29, 2015

TOTAL POPULATION	**93**	persons

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road
Project No.: 1281-4451

Date: 2018.04.20
Revised: -
Design: HAS
Check: NC

Proposed Population Estimate

PHASE	BLOCK	Commercial (m^2)	Residential (# of units)		Office (m^2)
			Apartment	Townhouse	
PHASE 2	BLOCK A	560	0	0	0
PHASE 1	BLOCK B	0	51	5	0
PHASE 4	BLOCK C	2,320	112	0	0
	BLOCK D		112	0	0
PHASE 2	BLOCK E	2,520	166	0	0
	BLOCK F		170	0	0
PHASE 5	BLOCK G	2,480	170	0	0
	BLOCK H		114	0	0
PHASE 3	BLOCK I	900	0	0	2,700
	GROCERY STORE	3,175	0	0	0
TOTAL		11,955	895	5	2,700

Commercial Population:

Light Commercial:	90	persons/ha
Commercial Population:	**108**	persons

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

Residential Population:

Apartment:	1.68	persons/unit
Townhouse:	2.60	persons/unit
Residential Population:	**1517**	persons

Source: Population density per email confirmation from Region of Halton, dated September 29, 2015

Office (Light Industrial) Population:

Apartment:	125	persons/ha
Office Population:	**34**	persons

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

TOTAL POPULATION **1658** persons

CROZIER & ASSOCIATES Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road, Burlington
Project No.: 1281-4451

Date: 2018.04.20
Revised: -
Design: HAS
Check: NC

Existing Sanitary Flow

Site Area:

38,415	m^2
3.84	ha

Population Estimates:

Commercial:	93	persons
Residential:	0	persons
TOTAL POPULATION:	93	persons

Design Criteria:

Unit Sewage Flow:	0.275	m^3/cap.day
Infiltration:	0.286	L/s/ha
Peaking Factor (Commercial Land Use):	**Modified Harmon Formula** $M_e = 0.8 \bullet (1+\frac{14}{4+\sqrt{Pe}})$	

Source: Halton Region Water and Wastewater Linear Design Manual, April 2015

Source: Halton Region Water and Wastewater Linear Design Manual, April 2015

Commercial Sanitary Flow:

Average Dry Weather Flow:	25.59	m^3/day
	0.30	L/s

Residential Sanitary Flow:

Average Dry Weather Flow:	0.00	m^3/day
	0.00	L/s

Total Dry Weather Sanitary Flow:	0.30	L/s
Peaking Factor:	3.40	
Total Peak Sanitary Flow:	1.01	L/s
Inflow/Infiltration Allowance:	1.10	L/s
Total Design Sanitary Flow:	2.11	L/s

CROZIER & ASSOCIATES Consulting Engineers

Project: Lakeside Plaza
Address: 5353 Lakeshore Road, Burlington
Project No.: 1281-4451

Date: 2018.04.20
Revised: -
Design: HAS
Check: NC

Proposed Sanitary Flow

Site Area:

38,415 m^2
3.84 ha

Population Estimates:

Commercial:	108	persons
Residential:	1517	persons
Community:	34	persons
TOTAL POPULATION:	1658	persons

Design Criteria:

Unit Sewage Flow: 0.275 m^3/cap.day
Infiltration: 0.286 L/s/ha
Peaking Factor (Combined Land Use):

Modified Harmon Formula

$$M_{av} = K_{av} \bullet \left(1+\frac{14}{4+\sqrt{P+Pe}}\right) \quad K_{av} = \frac{A_R+0.80*(AI+AC)}{A_R+AI+AC}$$

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

Source: Halton Region Water and Wastewater Linear Design Manual, July 2017

Commercial and Community Sanitary Flow:

		Average Dry Weather Flow (L/s)	
PHASE	**BLOCK**	**Commercial**	**Office**
PHASE 2	BLOCK A	0.02	0.00
PHASE 1	BLOCK B	0.00	0.00
PHASE 4	BLOCK C	0.07	0.00
	BLOCK D	0.00	0.00
PHASE 2	BLOCK E	0.07	0.00
	BLOCK F	0.00	0.00
PHASE 5	BLOCK G	0.07	0.00
	BLOCK H	0.00	0.00
PHASE 3	BLOCK I	0.03	0.11
	GROCERY STORE	0.09	0.00
TOTAL		**0.34**	**0.11**

Residential Sanitary Flow:

		Average Dry Weather Flow (L/s)	
PHASE	**BLOCK**	**Apartments**	**Townhouses**
PHASE 2	BLOCK A	0.00	0.00
PHASE 1	BLOCK B	0.27	0.04
PHASE 4	BLOCK C	0.60	0.00
	BLOCK D	0.60	0.00
PHASE 2	BLOCK E	0.89	0.00
	BLOCK F	0.91	0.00
PHASE 5	BLOCK G	0.91	0.00
	BLOCK H	0.61	0.00
PHASE 3	BLOCK I	0.00	0.00
	GROCERY STORE	0.00	0.00
TOTAL		**4.79**	**0.04**

Total Sanitary Flow:

PHASE	BLOCK	Total Dry Weather Sanitary Flow (L/s)	Total Population (persons)	Peaking Factor (Combined Land Use)	Total Peak Sanitary Flow (L/s)	Inflow/ Infiltration (L/s)	Total Design Sanitary Flow (L/s)
PHASE 2	BLOCK A	0.02	5	3.551	0.06	**1.10**	**22.16**
PHASE 1	BLOCK B	0.31	99	4.245	1.33		
PHASE 4	BLOCK C	0.67	209	4.028	2.68		
	BLOCK D	0.60	188	4.045	2.42		
PHASE 2	BLOCK E	0.96	302	3.923	3.77		
	BLOCK F	0.91	286	3.933	3.58		
PHASE 5	BLOCK G	0.98	308	3.922	3.84		
	BLOCK H	0.61	192	3.961	2.41		
PHASE 3	BLOCK I	0.13	42	4.330	0.58		
	GROCERY STORE	0.09	29	4.358	0.40		
TOTAL		**5.28**	**1658**	**3.99**	**21.06**	**1.10**	

APPENDIX C

Stormwater Quantity Control

CROZIER & ASSOCIATES
Consulting Engineers

Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

SUMMARY TABLE

Storm Event (year)	Peak Flow Rate					**Volume Control (m3)	
	Pre-Development (L/s)	Post-Development (L/s)					
		[1]Site Allowable Release Rate (L/s)	Controlled	Uncontrolled	[3]Total Post-Development Flow Rate	Required Storage	Provided Storage
5	815	815	690	18	707	23	520
10	935			20	710	88	
25	1197			26	716	256	
50	1386			31	721	422	
100	1515			36	725	518	

1. Site allowable release rate based on 5-year pre-development peak flow rate.
2. Controlled release rate is sum of orifice release rate for Catchment 201 and Catchment 202.
3. Total post-development flow rate is sum of all controlled and uncontrolled flows.

Water Quality Calculations				
Land Use	Area (m^2)	% of Total Site Area	TSS Removal Credit	Total TSS Removal
Proposed Roadway/Parking Lot	19,380	50.5%	80.00%	40.4%
Proposed Building	15,320	39.9%	80.00%	31.9%
Proposed Landscaped	3,700	9.6%	80.00%	7.7%
TOTAL SITE	**38,400**	**100.0%**	**-**	**80.0%**

Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

Storm Data: City of Burlington IDF Parameters

Time of Concentration: **10 min**

Return Period	A	B	C	i (mm/hr)
2 yr	592.6	6	0.78	68.16
5 yr	697.4	5	0.764	88.09
10 yr	798.5	5	0.763	101.14
25 yr	926.9	5	0.762	117.72
50 yr	1019.4	5	0.761	129.82
100 yr	1114.2	5	0.761	141.89

*Rainfall intensity determined according to City of Burlington Std. S-IDF (Jun, 1998)

Pre-Development/Existing Conditions Weighted Runoff Coefficient

	C	A (ha)	Weighted RC
Pervious	0.25	0.20	0.01
Impervious	0.90	3.64	0.85
TOTAL		**3.84**	**0.87**

Post-Development Weighted Runoff Coefficient

	C	A (ha)	Weighted RC
Pervious	0.25	0.37	0.02
Impervious	0.90	3.47	0.81
TOTAL		**3.84**	**0.84**

Adjusted Runoff Coefficient

Storm Event	Adjustment Factor	Adjusted Pre-Dev RC	Adjusted Post-Dev RC (Controlled)	Adjusted Post-Dev RC (Uncontrolled)
5-year	1.00	0.87	0.84	0.25
10-year	1.00	0.87	0.84	0.25
25-year	1.10	0.95	0.92	0.28
50-year	1.20	1.00	1.00	0.30
100-year	1.25	1.00	1.00	0.31

Site Allowable Release Rate

Site Area =	3.84	ha			
5-yr Pre Flow Rate =	815	L/s	100-yr Uncontrolled Rate =	36	L/s
Unit Flow Rate =	212	L/s*ha			
Orifice Release Rate =	690	L/s			

Note - The maximum controlled flow rate is the site allowable release rate less the 100-year uncontrolled flow rate. Orifice Control Rate is the maximum flow that will be discharged from the controlled site area.

CROZIER & ASSOCIATES
Consulting Engineers

PROJECT: Lakeside Village
PROJECT No.: 1281-4451
FILE: Orifice Design
DATE: 20/4/2018
UPDATE: -
DESIGN: HS
CHECK: NC

Orifice Design Summary - 201 (Lakeshore Road)

Orifice Type	=	Tube	
Invert Elevation	=	79.88	m
Diameter of Orifice	=	375	mm
Area of Orifice (A)	=	0.1104	sq.m
Orifice Coefficient (Cd)	=	0.820	

Calculation of Head

Centroid Elevation	=	80.07	m
Water Elevation	=	80.80	m
Upstream Head*, (h)	=	0.73	m

Qa = (Cd)(A)(2gh)^0.5

Actual Controlled Discharge, Qa	**=**	0.34334	cms
Qa	**=**	**343**	**L/s**

*Head is based upon orifice area @ orifice face not Vena Contracta

CROZIER & ASSOCIATES
Consulting Engineers

PROJECT: Lakeside Village
PROJECT No.: 1281-4451
FILE: Orifice Design
DATE: 20/4/2018
UPDATE: -
DESIGN: HS
CHECK: NC

Orifice Design Summary - 202 (Hampton Heath Road)

Orifice Type =	Tube	
Invert Elevation =	78.40	m
Diameter of Orifice =	300	mm
Area of Orifice (A) =	0.0707	sq.m
Orifice Coefficient (Cd) =	0.820	

Calculation of Head

Centroid Elevation =	78.55	m
Water Elevation =	80.37	m
Upstream Head*, (h) =	1.82	m

Qa = (Cd)(A)(2gh)^0.5

Actual Controlled Discharge, Qa =	0.34636	cms
Qa =	**346**	**L/s**

*Head is based upon orifice area @ orifice face not Vena Contracta

CROZIER & ASSOCIATES Consulting Engineers

Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

MUNICIPALITY: City of Burlington

IDF Values	
A	697.4
B	5
C	0.764
Tc (min)	10

5-yr Pre-Development Peak Flow		
C	0.87	-
i	88.09	mm/hr
A	3.84	ha
Qpre	0.8145	m3/s
Qtarget	0.8145	m3/s

5-yr Post-Development Peak Flow					
Controlled			Uncontrolled Flows		
C	0.84	-	C	0.25	-
i	88.09	mm/hr	i	88.09	mm/hr
A	3.55	ha	A	0.29	ha
Qpost	0.7280	m3/s	Quncontr.	0.0178	m3/s
Qcontr.	0.690	m3/s			

Storage Volume Determination

T_d min	i mm/hr	T_d sec	Q_{Uncont} m^3/s	S_d m^3
5	120.08	300	0.992	-12.65
10	88.09	600	0.728	22.99
15	70.71	900	0.584	8.66
20	59.63	1200	0.493	-29.40
25	51.88	1500	0.429	-81.14
30	46.11	1800	0.381	-141.71
35	41.64	2100	0.344	-208.46
40	38.06	2400	0.314	-279.75
45	35.11	2700	0.290	-354.53
50	32.65	3000	0.270	-432.07
55	30.55	3300	0.252	-511.85
60	28.74	3600	0.237	-593.48
65	27.15	3900	0.224	-676.67
70	25.76	4200	0.213	-761.20
75	24.52	4500	0.203	-846.88
80	23.41	4800	0.193	-933.57
85	22.41	5100	0.185	-1021.14
90	21.50	5400	0.178	-1109.51

REQUIRED PARKING LOT STORAGE : 23.0 m^3

Equations:

Intensity

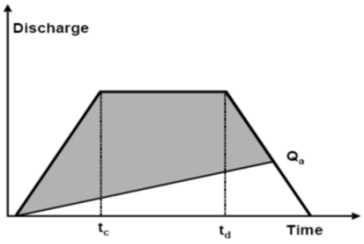
$I = A / (T+B)^C$

Peak Flow

$Q_{pre} = 0.00278 \bullet C_{pre} \bullet i_{(Td)} \bullet A$

Storage

$S_d = Q_{post} \bullet T_d - Q_{contr} (T_d + T_c) / 2$



Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

MUNICIPALITY: City of Burlington

IDF Values	
A	798.5
B	5
C	0.763
Tc (min)	10

10-yr Pre-Development Peak Flow		
C	0.87	-
i	101.14	mm/hr
A	3.84	ha
Qpre	0.9352	m3/s
Qtarget	0.8145	m3/s

10-yr Post-Development Peak Flow					
Controlled			Uncontrolled Flows		
C	0.84	-	C	0.25	-
i	101.14	mm/hr	i	101.14	mm/hr
A	3.55	ha	A	0.29	ha
Qpost	0.8358	m3/s	Quncontr.	0.0204	m3/s
Qcontr.	0.690	m3/s			

Storage Volume Determination

T_d min	i mm/hr	T_d sec	Q_{Uncont} m^3/s	S_d m^3
5	137.81	300	1.139	31.29
10	101.14	600	0.836	87.67
15	81.21	900	0.671	86.70
20	68.49	1200	0.566	58.50
25	59.60	1500	0.493	14.59
30	52.98	1800	0.438	-39.48
35	47.85	2100	0.395	-100.65
40	43.74	2400	0.361	-167.04
45	40.36	2700	0.334	-237.44
50	37.53	3000	0.310	-311.02
55	35.12	3300	0.290	-387.17
60	33.04	3600	0.273	-465.46
65	31.22	3900	0.258	-545.54
70	29.62	4200	0.245	-627.16
75	28.20	4500	0.233	-710.11
80	26.92	4800	0.222	-794.22
85	25.77	5100	0.213	-879.35
90	24.73	5400	0.204	-965.38

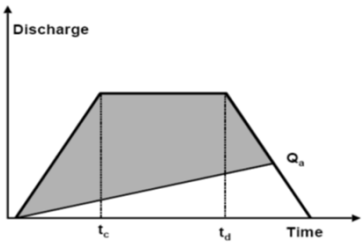
REQUIRED PARKING LOT STORAGE : 87.7 m^3

Equations:

Intensity
$I = A / (T+B)^C$

Peak Flow
$Q_{pre} = 0.00278 \bullet C_{pre} \bullet i_{(Td)} \bullet A$

Storage
$S_d = Q_{post} \bullet T_d - Q_{contr} (T_d + T_c) / 2$



CROZIER & ASSOCIATES Consulting Engineers

Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

MUNICIPALITY: City of Burlington

IDF Values	
A	926.9
B	5
C	0.762
Tc (min)	10

25-yr Pre-Development Peak Flow		
C	0.95	-
i	117.72	mm/hr
A	3.84	ha
Qpre	1.1973	m3/s
Qtarget	0.8145	m3/s

25-yr Post-Development Peak Flow					
Controlled			Uncontrolled Flows		
C	0.92	-	C	0.28	-
i	117.72	mm/hr	i	117.72	mm/hr
A	3.55	ha	A	0.29	ha
Qpost	1.0701	m3/s	Quncontr.	0.0261	m3/s
Qcontr.	0.690	m3/s			

Storage Volume Determination

T_d min	i mm/hr	T_d sec	Q_{Uncont} m^3/s	S_d m^3
5	160.34	300	1.458	126.89
10	117.72	600	1.070	228.26
15	94.55	900	0.859	256.25
20	79.76	1200	0.725	249.37
25	69.42	1500	0.631	222.36
30	61.72	1800	0.561	182.33
35	55.75	2100	0.507	133.21
40	50.97	2400	0.463	77.39
45	47.03	2700	0.428	16.42
50	43.74	3000	0.398	-48.62
55	40.93	3300	0.372	-116.97
60	38.51	3600	0.350	-188.05
65	36.40	3900	0.331	-261.45
70	34.53	4200	0.314	-336.81
75	32.88	4500	0.299	-413.88
80	31.39	4800	0.285	-492.44
85	30.05	5100	0.273	-572.31
90	28.84	5400	0.262	-653.35

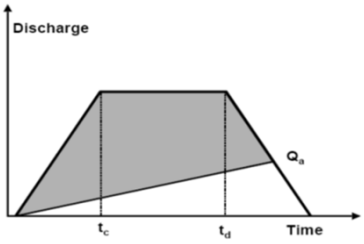
REQUIRED PARKING LOT STORAGE : 256.2 m^3

Equations:

Intensity
$I = A / (T+B)^C$

Peak Flow
$Q_{pre} = 0.00278 \bullet C_{pre} \bullet i_{(Td)} \bullet A$

Storage
$S_d = Q_{post} \bullet T_d - Q_{contr} (T_d + T_c) / 2$



Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

MUNICIPALITY: Town of Ajax

IDF Values	
A	1019.4
B	5
C	0.761
Tc (min)	10

50-yr Pre-Development Peak Flow		
C	1.00	-
i	129.82	mm/hr
A	3.84	ha
Qpre	1.3858	m3/s
Qtarget	0.8145	m3/s

50-yr Post-Development Peak Flow					
Controlled			Uncontrolled Flows		
C	1.00	-	C	0.30	-
i	129.82	mm/hr	i	129.82	mm/hr
A	3.55	ha	A	0.29	ha
Qpost	1.2812	m3/s	Quncontr.	0.0314	m3/s
Qcontr.	0.690	m3/s			

Storage Volume Determination

T_d min	i mm/hr	T_d sec	Q_{Uncont} m^3/s	S_d m^3
5	176.74	300	1.744	212.92
10	129.82	600	1.281	354.89
20	88.01	1200	0.869	421.51
30	68.13	1800	0.672	382.55
40	56.27	2400	0.555	298.16
50	48.30	3000	0.477	188.50
60	42.53	3600	0.420	62.73
70	38.14	4200	0.376	-74.23
80	34.68	4800	0.342	-219.44
90	31.86	5400	0.314	-371.00
100	29.53	6000	0.291	-527.59
110	27.55	6600	0.272	-688.30
120	25.86	7200	0.255	-852.43
130	24.39	7800	0.241	-1019.46
140	23.10	8400	0.228	-1188.97
150	21.95	9000	0.217	-1360.63
160	20.93	9600	0.207	-1534.19
170	20.02	10200	0.198	-1709.42

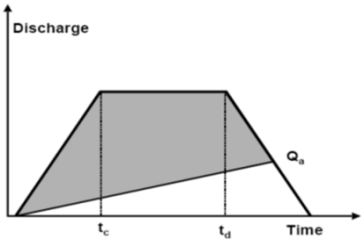
REQUIRED PARKING LOT STORAGE : 421.5 m^3

Equations:

Intensity
$I = A / (T+B)^C$

Peak Flow
$Q_{pre} = 0.00278 \bullet C_{pre} \bullet i_{(Td)} \bullet A$

Storage
$S_d = Q_{post} \bullet T_d - Q_{contr} (T_d + T_c) / 2$



CROZIER & ASSOCIATES Consulting Engineers

Project: Lakeside Village
Project No.: 1281-4451

Date: 20/4/2018
Revised: -
Designed By: HS
Checked By: NC

MODIFIED RATIONAL METHOD

MUNICIPALITY: City of Burlington

IDF Values	
A	1114.2
B	5
C	0.761
Tc (min)	10

100-yr Pre-Development Peak Flow		
C	1.00	-
i	141.89	mm/hr
A	3.84	ha
Qpre	1.5147	m3/s
Qtarget	0.8145	m3/s

100-yr Post-Development Peak Flow					
Controlled			Uncontrolled Flows		
C	1.00	-	C	0.31	-
i	141.89	mm/hr	i	141.89	mm/hr
A	3.55	ha	A	0.29	ha
Qpost	1.4003	m3/s	Quncontr.	0.0357	m3/s
Qcontr.	0.690	m3/s			

Storage Volume Determination

T_d min	i mm/hr	T_d sec	Q_{Uncont} m^3/s	S_d m^3
5	193.18	300	1.906	261.58
10	141.89	600	1.400	426.38
20	96.19	1200	0.949	518.43
30	74.46	1800	0.735	495.10
40	61.50	2400	0.607	422.09
50	52.79	3000	0.521	321.48
60	46.49	3600	0.459	203.26
70	41.69	4200	0.411	72.80
80	37.90	4800	0.374	-66.67
90	34.83	5400	0.344	-213.08
100	32.27	6000	0.319	-365.00
110	30.11	6600	0.297	-521.41
120	28.26	7200	0.279	-681.57
130	26.66	7800	0.263	-844.88
140	25.24	8400	0.249	-1010.91
150	23.99	9000	0.237	-1179.30
160	22.88	9600	0.226	-1349.75
170	21.88	10200	0.216	-1522.03

REQUIRED PARKING LOT STORAGE : 518.4 m^3

Equations:

Intensity

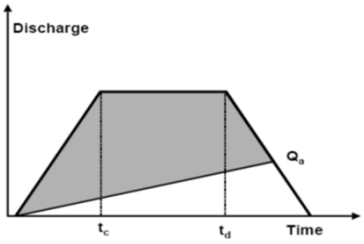
$I = A / (T+B)^C$

Peak Flow

$Q_{pre} = 0.00278 \bullet C_{pre} \bullet i_{(Td)} \bullet A$

Storage

$S_d = Q_{post} \bullet T_d - Q_{contr} (T_d + T_c) / 2$



APPENDIX D

Stormwater Quality Control

Brief Stormceptor Sizing Report - Lakeside Plaza OGS 1 (STM MH 81)

Project Information & Location			
Project Name	Lakeside Village	**Project Number**	1281-4451
City	Burlington	**State/ Province**	Ontario
Country	Canada	**Date**	1/30/2018
Designer Information		**EOR Information (optional)**	
Name	Hamdy Shafi	**Name**	
Company	Crozier & Associates	**Company**	
Phone #	416-477-3392	**Phone #**	
Email	hshafi@cfcrozier.ca	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Lakeside Plaza OGS 1 (STM MH 81)
Target TSS Removal (%)	80
TSS Removal (%) Provided	80
Recommended Stormceptor Model	STC 2000

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	64	79
STC 750	75	90
STC 1000	76	90
STC 1500	77	90
STC 2000	80	94
STC 3000	82	94
STC 4000	85	97
STC 5000	86	97
STC 6000	88	98
STC 9000	91	99
STC 10000	91	99
STC 14000	93	100
StormceptorMAX	Custom	Custom

Stormceptor®

FORTERRA

Sizing Details

Drainage Area	
Total Area (ha)	0.733
Imperviousness %	98.0

Rainfall	
Station Name	TORONTO CENTRAL
State/Province	Ontario
Station ID #	0100
Years of Records	18
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - Lakeside Plaza OGS 2 (STM MH 62)

Project Information & Location			
Project Name	Lakeside Village	**Project Number**	1281-4451
City	Burlington	**State/ Province**	Ontario
Country	Canada	**Date**	1/30/2018
Designer Information		**EOR Information (optional)**	
Name	Hamdy Shafi	**Name**	
Company	Crozier & Associates	**Company**	
Phone #	416-477-3392	**Phone #**	
Email	hshafi@cfcrozier.ca	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Lakeside Plaza OGS 2 (STM MH 62)
Target TSS Removal (%)	80
TSS Removal (%) Provided	84
Recommended Stormceptor Model	STC 750

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	75	91
STC 750	84	96
STC 1000	85	96
STC 1500	86	96
STC 2000	88	99
STC 3000	89	99
STC 4000	92	100
STC 5000	92	100
STC 6000	94	100
STC 9000	95	100
STC 10000	96	100
STC 14000	97	100
StormceptorMAX	Custom	Custom

Sizing Details

Drainage Area	
Total Area (ha)	0.299
Imperviousness %	98.0

Rainfall	
Station Name	TORONTO CENTRAL
State/Province	Ontario
Station ID #	0100
Years of Records	18
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - Lakeside Plaza OGS 3 (STM MH 73)

Project Information & Location			
Project Name	Lakeside Village	**Project Number**	1281-4451
City	Burlington	**State/ Province**	Ontario
Country	Canada	**Date**	1/30/2018
Designer Information		**EOR Information (optional)**	
Name	Hamdy Shafi	**Name**	
Company	Crozier & Associates	**Company**	
Phone #	416-477-3392	**Phone #**	
Email	hshafi@cfcrozier.ca	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Lakeside Plaza OGS 3 (STM MH 73)
Target TSS Removal (%)	80
TSS Removal (%) Provided	80
Recommended Stormceptor Model	STC 1000

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	69	85
STC 750	78	93
STC 1000	80	93
STC 1500	80	93
STC 2000	83	96
STC 3000	85	96
STC 4000	88	98
STC 5000	89	98
STC 6000	90	99
STC 9000	93	100
STC 10000	93	100
STC 14000	95	100
StormceptorMAX	Custom	Custom

Sizing Details

Drainage Area	
Total Area (ha)	0.604
Imperviousness %	85.0

Rainfall	
Station Name	TORONTO CENTRAL
State/Province	Ontario
Station ID #	0100
Years of Records	18
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - Lakeside Plaza OGS 4 (STM MH 85)

Project Information & Location			
Project Name	Lakeside Village	**Project Number**	1281-4451
City	Burlington	**State/ Province**	Ontario
Country	Canada	**Date**	1/30/2018
Designer Information		**EOR Information (optional)**	
Name	Hamdy Shafi	**Name**	
Company	Crozier & Associates	**Company**	
Phone #	416-477-3392	**Phone #**	
Email	hshafi@cfcrozier.ca	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Lakeside Plaza OGS 4 (STM MH 85)
Target TSS Removal (%)	80
TSS Removal (%) Provided	83
Recommended Stormceptor Model	STC 750

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	74	90
STC 750	83	96
STC 1000	84	96
STC 1500	85	96
STC 2000	87	98
STC 3000	89	98
STC 4000	91	99
STC 5000	92	99
STC 6000	93	100
STC 9000	95	100
STC 10000	95	100
STC 14000	96	100
StormceptorMAX	Custom	Custom

Stormceptor®

FORTERRA

Sizing Details

Drainage Area	
Total Area (ha)	0.357
Imperviousness %	90.0

Rainfall	
Station Name	TORONTO CENTRAL
State/Province	Ontario
Station ID #	0100
Years of Records	18
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - Lakeside Plaza OGS 5 (STM MH 105)

Project Information & Location			
Project Name	Lakeside Village	**Project Number**	1281-4451
City	Burlington	**State/ Province**	Ontario
Country	Canada	**Date**	1/30/2018
Designer Information		**EOR Information (optional)**	
Name	Hamdy Shafi	**Name**	
Company	Crozier & Associates	**Company**	
Phone #	416-477-3392	**Phone #**	
Email	hshafi@cfcrozier.ca	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Lakeside Plaza OGS 5 (STM MH 105)
Target TSS Removal (%)	80
TSS Removal (%) Provided	89
Recommended Stormceptor Model	STC 300

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	89	99
STC 750	94	100
STC 1000	95	100
STC 1500	95	100
STC 2000	96	100
STC 3000	97	100
STC 4000	98	100
STC 5000	98	100
STC 6000	98	100
STC 9000	99	100
STC 10000	99	100
STC 14000	99	100
StormceptorMAX	Custom	Custom

Sizing Details

Drainage Area	
Total Area (ha)	0.06
Imperviousness %	100.0

Rainfall	
Station Name	TORONTO CENTRAL
State/Province	Ontario
Station ID #	0100
Years of Records	18
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

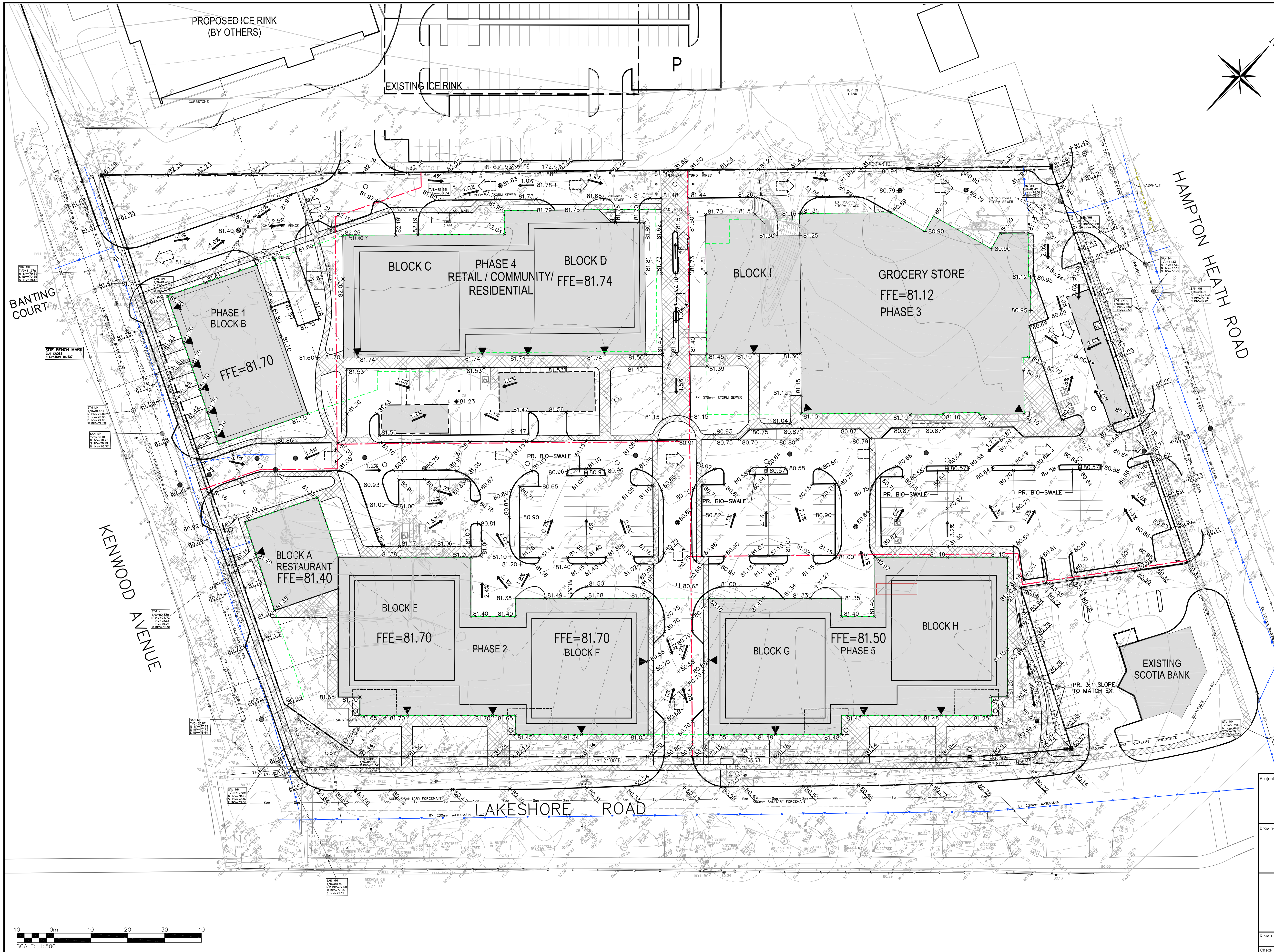
Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

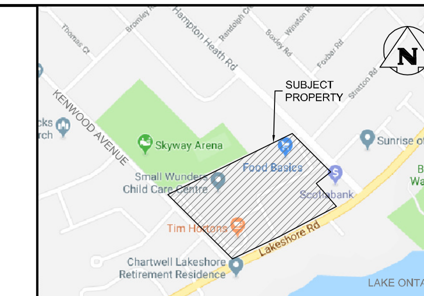
Notes

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- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

FIGURES





KEY PLAN
SCALE: N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING FENCE
- ×215.00 EXISTING GRADE
- ×215.00 PROPOSED GRADE
- ×215.00 PROPOSED GRADE (TO MATCH EXISTING)
- 2.0% PROPOSED MINOR FLOW DIRECTION
- 2.0% PROPOSED GRASSED SWALE
- PROPOSED SLOPE (3:1 MAX.)
- BUILDING ENTRANCE (PERSONNEL DOOR)
- PROPOSED MAJOR OVERLAND FLOW DIRECTION
- PROPOSED FIRE HYDRANT & GATE VALVE
- PROPOSED SIAMESE (FIRE DEPT.) CONNECTION
- PROPOSED LIMIT OF UNDERGROUND PARKING
- PROPOSED DEVELOPMENT PHASE LINES

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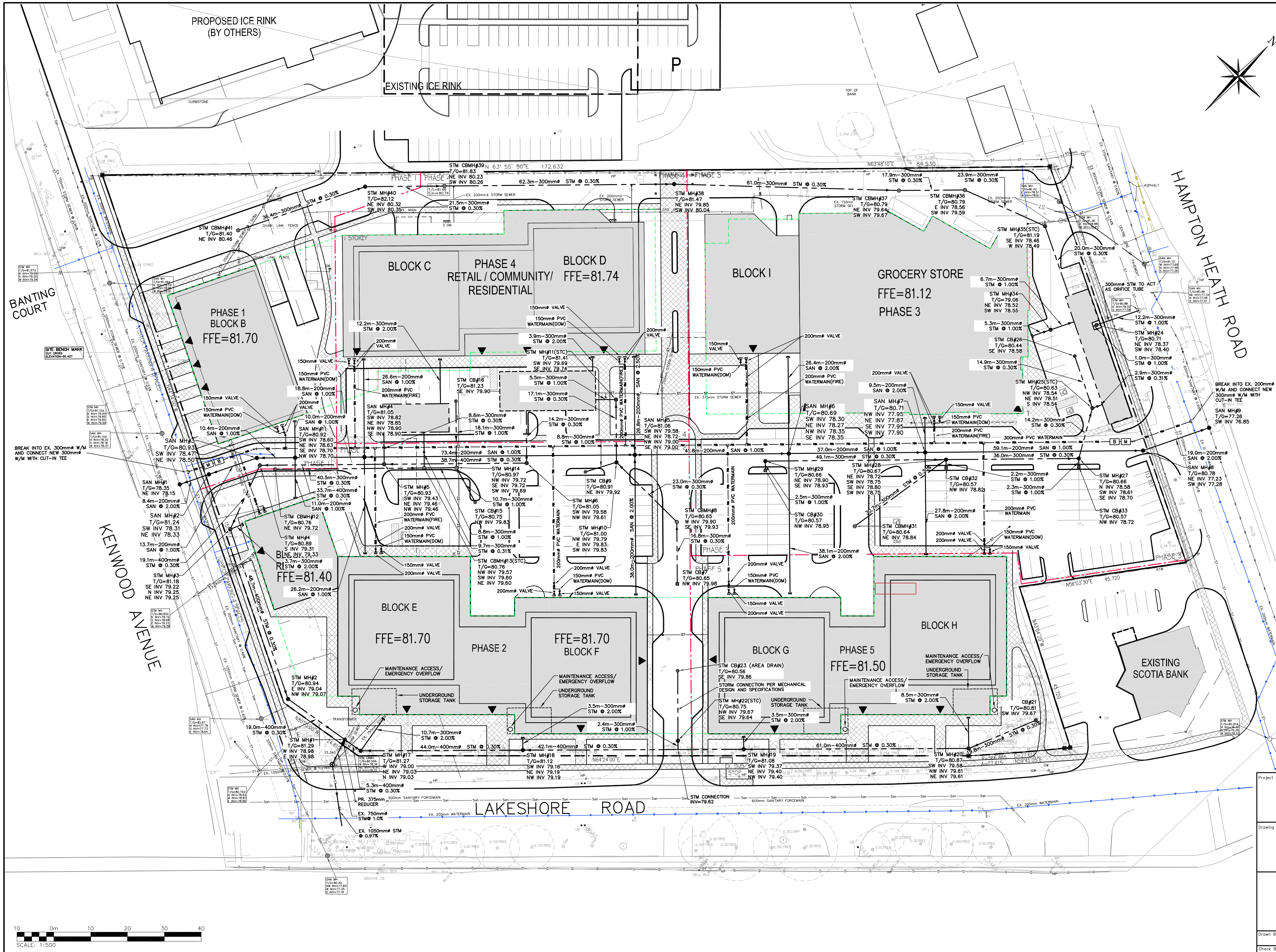
5353 LAKESHORE ROAD
CITY OF BURLINGTON

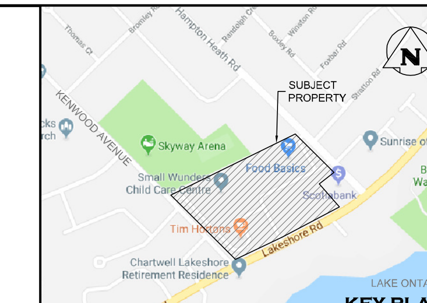
Drawing

PRELIMINARY GRADING PLAN

CROZIER & ASSOCIATES
Consulting Engineers
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905-875-0026 T
905-875-4915 F
WWW.CFCROZIER.CA

Drawn By	M.I.M.	Design By	N.C.	Project	1281–4451
Check By	S.C.	Check By	N.M.	Scale 1:500	Drawing C 102





KEY PLAN
SCALE: N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING WATERMAIN & GATE VALVE
- EXISTING STORM SEWER & MANHOLE
- EXISTING SINGLE / DOUBLE CATCHBASIN
- EXISTING SANITARY SEWER & MANHOLE
- PROPOSED WATERMAIN & GATE VALVE
- PROPOSED WATER SERVICE LATERAL (XXmmø)
- PROPOSED FIRE HYDRANT & GATE VALVE
- PROPOSED SIAMESE CONNECTION
- M PROPOSED WATER METER
- B PROPOSED BACKFLOW PREVENTOR
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED SINGLE / DOUBLE CATCHBASIN
- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED SAN. SERVICE LATERAL (XXXmmø)
- PROPOSED ELECTRICAL TRANSFORMER
- PROPOSED LIMIT OF UNDERGROUND PARKING
- PROPOSED DEVELOPMENT PHASE LINES

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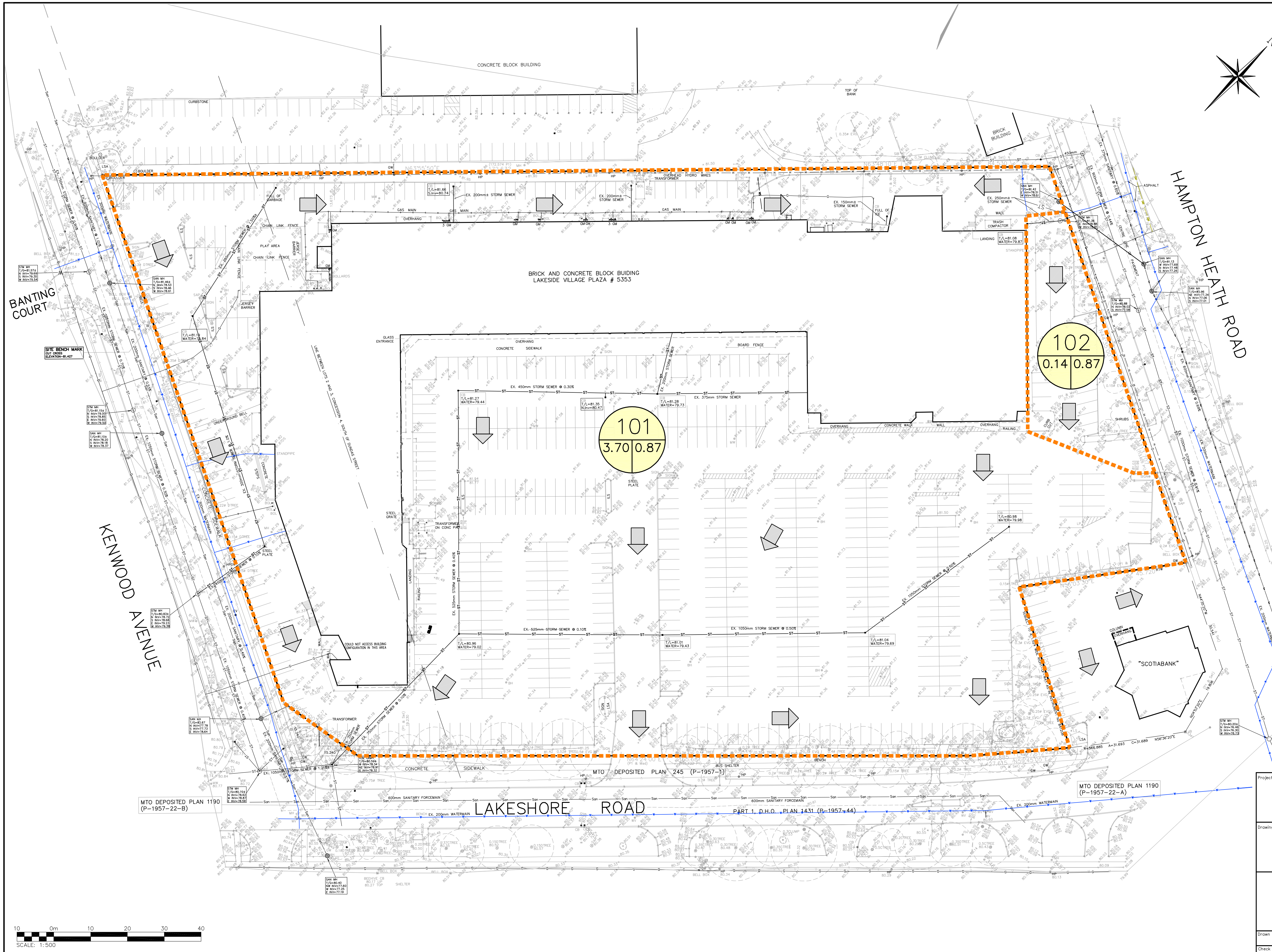
5353 LAKESHORE ROAD
CITY OF BURLINGTON

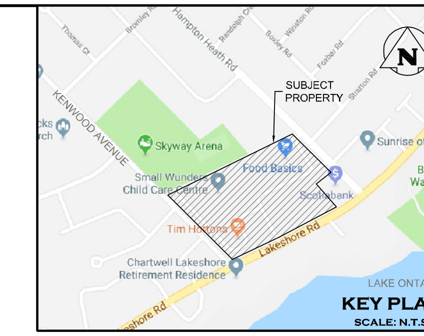
Drawing

PRELIMINARY SERVICING PLAN

CROZIER & ASSOCIATES Consulting Engineers
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905-875-0026 T
905-875-4915 F
WWW.CFCROZIER.CA

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Check By	S.C.	Check By	N.M.	Scale 1:500	Drawing C 103





LEGEND

— — —	PROPERTY LINE
	EXISTING CONTOUR (0.5m)
	EXISTING CONTOUR (1.0m)
	EXISTING DITCH
× 215.00	EXISTING GRADE
⇨	EXISTING OVERLAND FLOW DIRECTION
▪▪▪▪	PRE–DEVELOPMENT STORM DRAINAGE CATCHMENT
ID	CATCHMENT I.D.
A | RC	AREA (ha) | RUNOFF COEFFICIENT

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CITY OF BURLINGTON

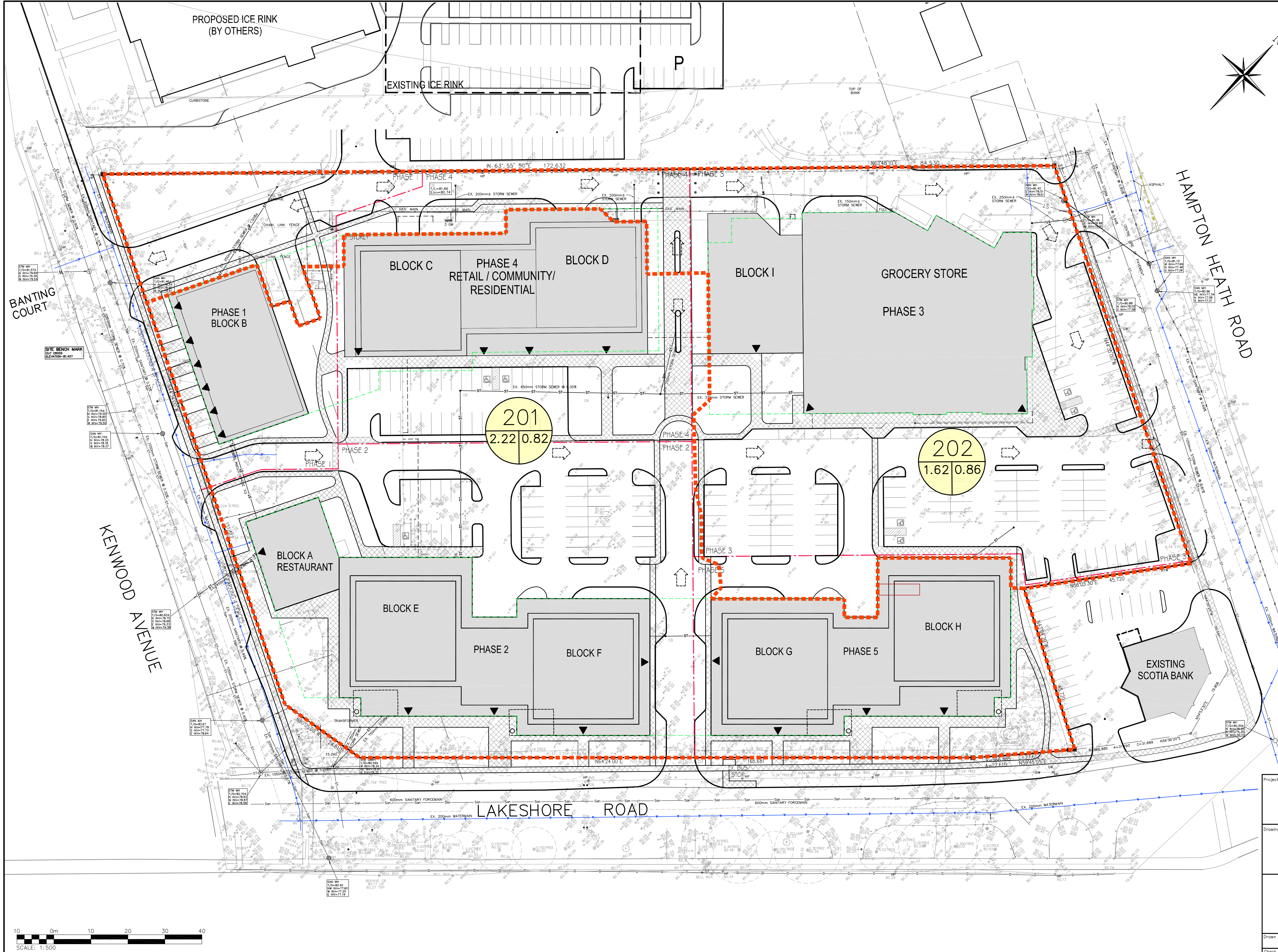
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PRE–DEVELOPMENT DRAINAGE PLAN

CROZIER & ASSOCIATES
Consulting Engineers

2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905-875-0026 T
905-875-4915 F
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Check By	S.C.	Check By	N.M.	Scale 1:500	Drawing FIG 1





LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING GRADE
- PROPOSED OVERLAND FLOW DIRECTION
- POST DEVLOPMENT STORM DRAINAGE CATCHMENT
- CATCHMENT I.D.
- AREA (ha) | RUNOFF COEFFICIENT

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CITY OF BURLINGTON

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POST DEVELOPMENT DRAINAGE PLAN

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