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PROPOSED RESIDENTIAL CONDOMINIUM TOWER
& RETIREMENT HOME DEVELOPMENT
1157-1171 NORTH SHORE BOULEVARD EAST
CITY OF BURLINGTON

PROJECT No. : 18204

FUNCTIONAL SERVICING REPORT

Prepared For:

Spruce Partners

Prepared By:

The Odan/Detech Group Inc.

Original: September 19th, 2018

Revised: November 9th, 2018

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1.0 INTRODUCTION

The property under study is an approximately 1.23 Ha (3.0 acre) site located at 1157-1171 North Shore Boulevard East in the City of Burlington. The site is bound by the following:

- North Shore Boulevard to the south
- An existing residential highrise development to the east
- Existing detached house lots and a townhouse condominium to the north
- The Queen Elizabeth Way freeway (MTO Lands) to the west

Refer to the Key Plan in Appendix A for the site's layout and adjacent developments.

The site presently comprises two existing low rise residential buildings with associated driveway and parking structure.

For detailed topography of the existing site conditions as of March 12, 2018, refer to the topographic survey prepared by Mackay, Mackay & Peters Limited.

It is proposed to construct a residential highrise and retirement home development on the site. The proposed development comprises a driveway access from North Shore Boulevard at the site's southeast corner. The development comprises a single tower from ground floor to the 10th floor and two separate towers from the 11th floor to the 17th floor. Refer to the Site Plan by Montgomery Sisam Architects Inc. in Appendix A for the proposed development's layout.

A road widening conveyance of North Shore Boulevard of varying width (typ. 5m) is being taken by the City of Burlington in the proposed development. The site's area post-development is 1.18 Ha.

This report will evaluate the serviceability of the site with respect to sanitary waste water, water and storm water management (SWM) and will implement the City's SWM criteria.

2.0 SCOPE OF WORK

THE ODAN/DETECH GROUP INC. was retained by **Spruce Partners** to review the Site, collect data, evaluate the Site for the proposed use and present the findings in a Functional Servicing Report in support of a Rezoning Application.

a) Collecting existing servicing drawings from the CITY in order to establish availability and feasibility of Site servicing;
b) Meetings/conversations with CITY Engineers and Design Team.
c) Evaluation of the data and presentation of the findings in a Functional Servicing Report in support of a Rezoning Application.

3.0 SANITARY SEWERS

i) Existing Infrastructure

There is an existing 1800mm Region of Halton sanitary trunk sewer flowing westerly beneath the south boulevard of North Shore Boulevard, adjacent to the site's south frontage. Region plans show that the existing residential development on the site drains sanitary flows by an existing sanitary sewer connection directly into this trunk sewer. Refer to the Functional Servicing Plan for the existing sanitary lateral, to be abandoned. There is no local sanitary sewer beneath North Shore Boulevard.

Refer to the Functional Servicing Plan for the existing sanitary sewer infrastructure.

ii) Proposed Sanitary Servicing

Region of Halton engineering staff have preliminarily stated that the subject site may drain directly into the existing 1800mm sanitary trunk sewer adjacent to the site's south boundary, and that the receiving sewer has capacity for the proposed development. Refer to the email in Appendix A.

Refer to the Functional Servicing Plan for the proposed Sanitary Service Connection. Sanitary flows are calculated as follows.

The sanitary sewer design criteria and unit flow is provided in the Regional Municipality of Halton's *Water and Wastewater Linear Design Manual* (April 2015), as follows. The following information is provided in Tables 3-1 and 3-2 of the foregoing manual.

- Unit flow: q = average daily residential per capita dry weather unit flow = 0.275 m^3/cap/day
- I/I = Unit of peak inflow/infiltration = 0. 286 L/s/ha
- Apartment (over 6-storey): 285 p/Ha and 0.275 m^3/p/day or 0.003183 x 10^{-3} m^3/p/s
- Apartment (less than 6-storey): 135 p/Ha and 0.275 m^3/p/day or 0.003183 x 10^{-3} m^3/p/s
- Notwithstanding the above unit population, however, a unit population of 2.7 P/unit is assumed for the proposed condominium tower and retirement home development because the Region standard 285 P/Ha unit population would result in a unit population of approximately 1.0 P/unit for the foregoing proposed statistics, which is unrealistic

The proposed sanitary flows are as follows. Refer to the detailed calculation on the following pages.

TABLE 1 – Post-Development Sanitary Flow

Component	Population (P)	Average Flow (l/s)	Peak Sanitary Flow (l/s)	Inflow & Infiltration (l/s)	Total Flow (l/s)
Proposed	1283	3.56	13.3	0.35	13.6

Region of Halton engineering review staff confirmed in the enclosed email correspondence (Appendix A) that the receiving Halton Region sanitary trunk sewer has capacity for the proposed flows.

SANITARY & WATER FLOW CALCULATIONS **SCENARIO:** PROPOSED DEVELOPMENT

This program calculates the sanitary discharge from various land use

FILL IN COLOURED CELLS AS REQUIRED

COMMERCIAL SITE AREA (ha) =

RESIDENTIAL SITE AREA (ha) = 1.23

TOTAL SITE AREA (ha) = 1.23

NOTE:

LAND USE	NUMBER OF UNITS	SITE AREA, (ha)	GROSS FLOOR AREA, m2	TOTAL POPULATION	TOTAL DAILY FLOW (LITERS)	AVERAGE DAILY FLOW l/sec	PEAKING FACTOR, M	TOTAL FLOW FROM LAND USE, l/sec
RESIDENTIAL Detached, using 55 person/site area				0	0	0.00	4.50	0.00
RESIDENTIAL Semi Houses, using 100 persons/site area				0	0	0.00	4.50	0.00
RESIDENTIAL Apartments (<6 st), using 135 persons/site area				0	0	0.00	4.50	0.00
RESIDENTIAL Apartments (>6 st), using 285 persons/site area				0	0	0.00	4.50	0.00
RESIDENTIAL Density 3, using 2.7 persons/unit	475			1283	307800	3.56	3.73	13.28
COMMERCIAL, Using 90 persons/ha (Floor Ha)				0	0	0.00	3.60	0.00
COMMERCIAL, Using 0.60 L/sec per ha				0	0	0.00	2.50	0.00

TOTAL

V1= 307800

Q1=	13.28
Q2=	0.00
Qinfil	0.35
Qtot	13.63

Q = (MqP/86400) + A * I (L/sec)

Q1= total flow from Residential Land Use (L/sec)
Q2= total flow from Commercial Land Use (L/sec)
Qinfil = total flow from infiltration (L/sec)
Qtot = total flow (Land use + infiltration)

V1= Total Volume from Land Use in liters

where : P is population
q = 0.275 m3/d/p = 0.004 L/sec/person for residential and
q = 0.60 L/sec/ha for commercial and offices
A = gross site area
i = 0.286 L/sec/ha (infiltration rate)

Peaking Factor M = 1 + [14 / (4 + (P/1000,1/2)) (for residential)
Peaking Factor M = 0.8* {1 + [14 / (4 + (P/1000,1/2))]} (for Commercial)

4.0 WATER DISTRIBUTION

i) Background Information & Existing Infrastructure

There is an existing 250mm Ductile Iron watermain beneath the south side of North Shore Boulevard East, adjacent to the site's south frontage. Refer to the Functional Servicing Plan for the layout of the adjacent watermains.

ii) Design Considerations

Fire and domestic water service will be provided by the above existing watermain. Refer to the Functional Servicing Plan for the proposed water services.

There are existing fire hydrants on the south side of North Shore Blvd, opposite the site, and on the north side, east of the subject site. Both existing adjacent hydrants are more than 45m from any point on the proposed building (refer to the radius shown on the Functional Servicing Plan) therefore a new hydrant is proposed as shown on the Functional Servicing Plan.

The pressures and volumes must be sufficient for Peak hour conditions and under fire conditions as established by the Ministry of Environment and the Fire Underwriters Survey booklet (1999). The minimal residual pressure under fire conditions is 140 kPa (20.3 psi).

The allowable pressures are as follows:

Condition	**Allowable Pressures (kpa)**	
	min.	**max.**
1) Min. Hour	275	700
2) Peak Hour	275	700
3) Peak Day + Fire Flow	140	700

The water demand for redeveloped Building is calculated as follows:

a) Average Day domestic demand – (Table 1) 3.6 L/s

b) Peak day demand - 2.25 x average daily demand 8.1 L/s

c) Fire flow as per FUS 1999 manual 217 L/s

TABLE 2 – Fire Flow Demand for Proposed Development

	L/s	USGM
Peak Day Demand	8.1	128
Fire Flow (per FUS) Demand	217	3434
Total Development Water Demand	225	3562

In the following FUS calculations, the following assumptions were made:

a) The proposed building will be sprinklered and the sprinklers monitored according to the NFPA 13 criteria
b) The buildings will be of fire-resistive construction (reinforced concrete)
c) The building's contents will be of non-combustible nature
d) The horizontal separation distance from the adjacent buildings is as shown on the following *Fire Separation Distance* Plan

A hydrant flow test was conducted on the 250mm watermain beneath North Shore Boulevard and is provided on the following pages. The test report shows that there is a flow rate of 7392 USGM available at 20 psi residual pressure based on extrapolating from the static pressure to the First Pitot Reading.

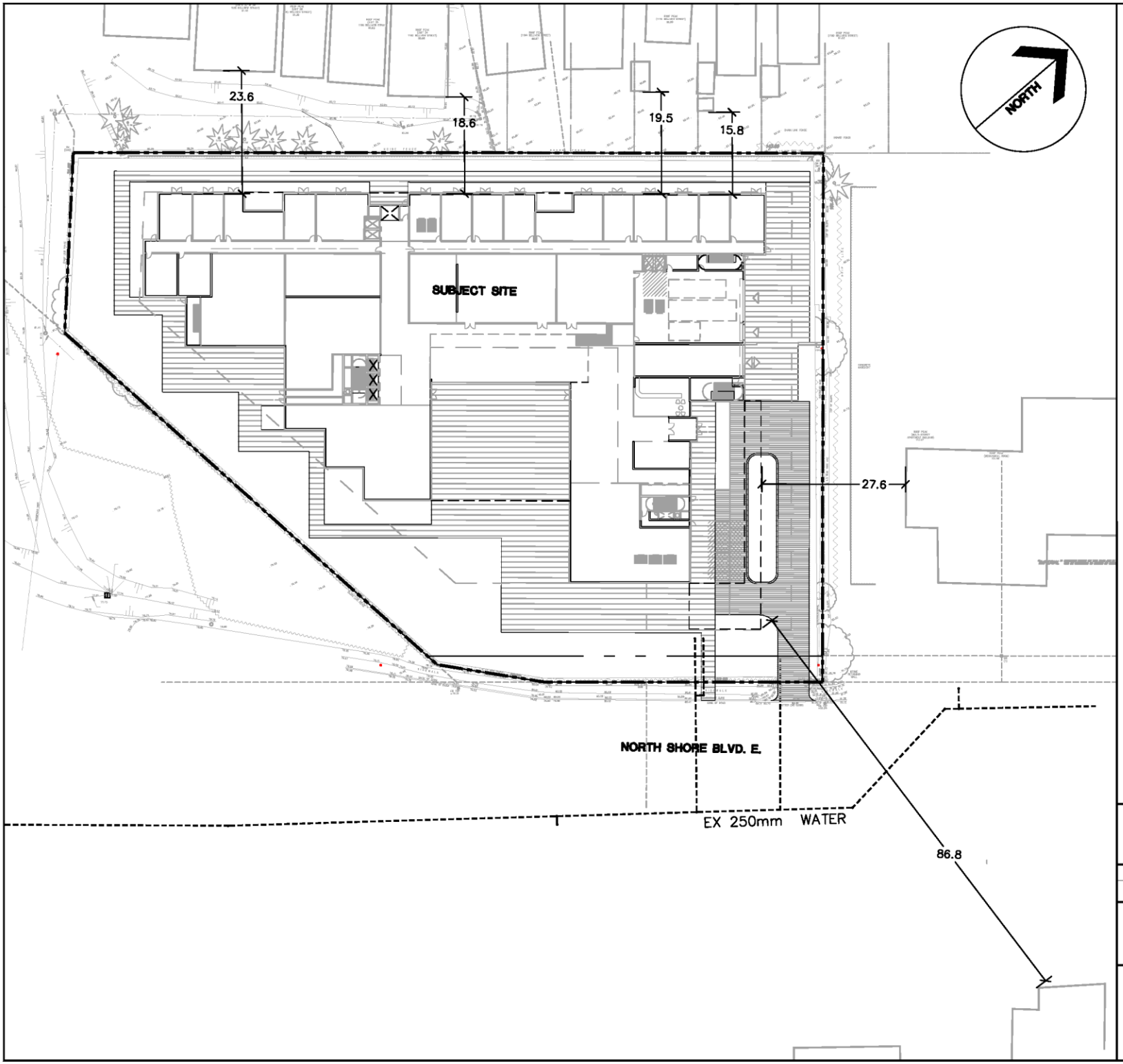
If the flow rate at 20 psi is conservatively calculated based on the static pressure and the second pitot reading using the NFPA Section 4.10.1.2 calculation, rather than the first pitot reading, as follows, there is a flow rate of 4469 USGM available at a residual pressure of 20 psi.

$$Q_R = Q_F * \frac{h_r^{0.54}}{h_f^{0.54}}$$

Where:

Q_R = Flow at 20 psi
Q_F = Total flow measured during test
h_r = Pressure drop to 20 psi
h_f = Pressure drop measured during test

The available flow (conservatively calculated based on the second, lower, pitot reading to be 4469 USGM) is greater than the development water demand – 3562 USGM – therefore it follows that the existing watermain is adequate to service the subject site.



LEGEND

PROPERTY LINE

DRAWING :

FIRE SEPARATION DISTANCE PLAN

DATE:	PROJ. NO.:	SCALE:
JUNE 2018	18204	1:1000

PROJECT :

PROPOSED RESIDENTIAL DEVELOPMENT

1157-1171 NORTH SHORE BLVD. E.
BURLINGTON, ON

ODAN•DETECH
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WATER SUPPLY FOR PUBLIC FIRE PROTECTION , FIRE UNDERWRITERS SURVEY
GUIDE FOR DETERMINATION OF REQUIRED FIRE FLOWS

$F = 220 \times C \times \sqrt{A}$
Where:

F = required fire flow in liters per minute
C= Coefficient related to the type of construction
A = the total floor area in square meters (excluding basements) in the building considered

Coefficient related to type of construction	
1.5	Wood Frame
1	Ordinary
0.8	Non combustible
0.6	Fire Resistive

LOCATION: Burlington
OBC OCCUPANCY: Residential
BUILDING FOOT PRINT (m2): 5133
OF STOREYS: 17

PROJECT: 1157 North Shore Boulevard
PROJECT No: 18204

Contents	Charge
Non-Combustible	-25%
limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Buring	25%

CONSTRUCTION CLASS: Fire Resistive

AUTOMATED SPRINKLER PROTECTION

		Credit	Total
NFPA 13 sprinkler standard	yes	30%	50%
Standard Water Supply	yes	10%	
Fully Supervised System	yes	10%	
		50%	

CONTENTS FACTOR: Limited Combustible — CHARGE: -15%

EXPOSURE 1 (south) N/A	Distance to Exposure Building (m) / Length - Height	>45	0%
EXPOSURE 2 (east) Existing Apartment	Distance to Exposure Building (m) / Length - Height	27.6	10%
EXPOSURE 3 (west) N/A	Distance to Exposure Building (m) / Length - Height	>45	0%
EXPOSURE 4 (north) Existing House Garage	Distance to Exposure Building (m) / Length - Height	15.8	15%
		Total:	25%

no more than 75%

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

ARE BUILDINGS CONTIGUOUS: Yes

FIRE RESISTANT BUILDING Are vertical openings and exterior vertical communications protected with a minimum one (1) hr rat: No

CALCULATIONS

	C =	0.6		Fire Resistive
	A =	22700	m2	2 Largest Floors + 50% floors above up to 8
	F =	19888	L/min	
Round to Nearest 1000 L/min	F =	20000	L/min	must be > 2000 L/min

STOREY AREAS m2	
5300	1
5000	2
4000	3
4000	4
4000	5
3000	6
3000	7
2500	8
2500	9
1800	10

CORRECTION FACTORS:

OCCUPANCY	-3000	L/min
FIRE FLOW ADJUSTED FOR OCCUPANCY	17000	L/min
REDUCTION FOR SPRINKLER	-8500	L/min
EXPOSURE CHARGE	4250	L/min

REQUIRED FIRE FLOW

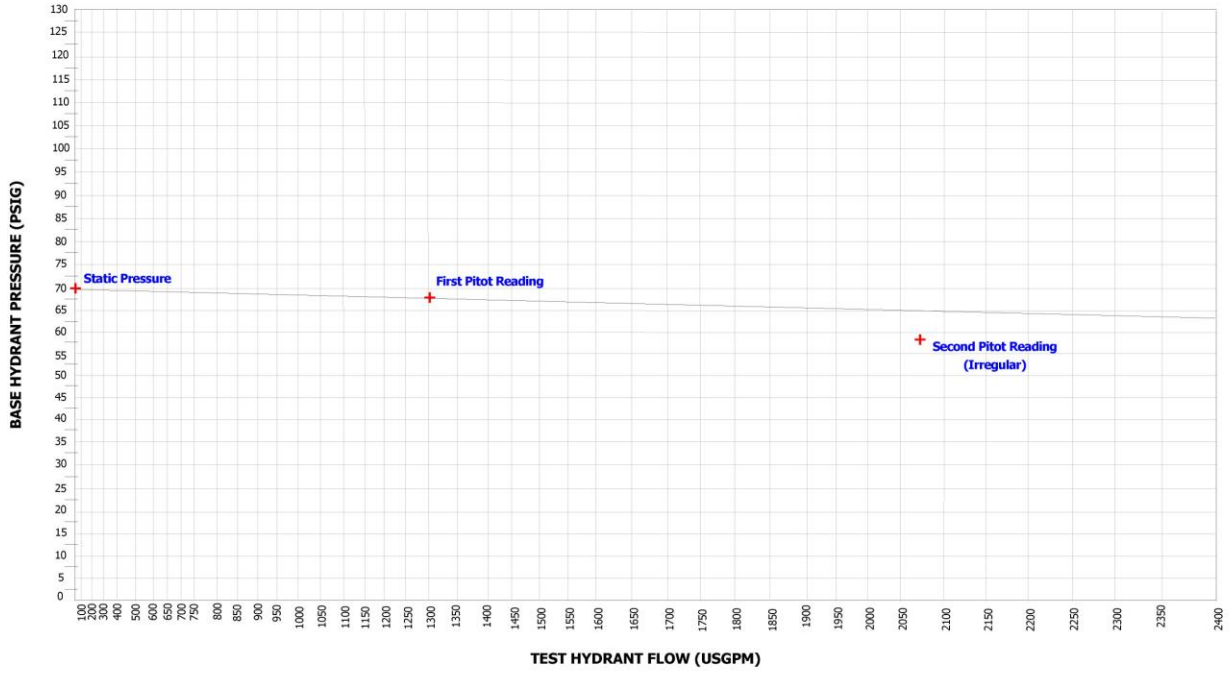
	F =	12750	L/min	
Round to Nearest 1000 L/min	**F =**	13000	L/min	3434 usgm
	F =	217	L/sec	

JACKSON WATERWORKS

Telephone: (905) 547-6770
Toll Free: (800)-734-5732
E-mail: jww@bellnet.ca
Website: www.jacksonwaterworks.ca

FIRE HYDRANT FLOW TEST RESULTS

TEST #1 of 1



No. of Ports Open	Port Dia. (in)	Pitot Reading (psig)	Pitot Conversion (usgpm) Conversion Factor = 0	Residual Pressure (psig)
1	2.50	60	1300	68
2	2.50	38/38	2068	58
THEORETICAL FLOW @ 20psi			7392	

Test Date	13 April 2018
Test Time	10:15am
Pipe Diameter (in)	10
Static Pressure (psig)	70

Site Information		
Site Name or Developer Name	Spruce Partners Inc.	Engineer: Odan Detech Group
Site Address/Municipality	1157-1171 North Shore Boulevard East, Burlington	
Location of Test Hydrant	Near 1157-1171 North Shore Boulevard East	
Location of Base Hydrant	Near 1225 North Shore Boulevard East	
Comments	Testing has been completed in accordance with NFPA-291 guidelines wherever and whenever possible and practical. Conversion factors for pitot tube readings have been used depending on hose nozzle internal design and installation profile. Refer to attached cover letter for additional information.	
Verified By	Mark Schmidt	

221 Sherman Avenue North, Hamilton, Ontario L8L 6N2

5.0 STORM DRAINAGE & STORMWATER MANAGEMENT

i) Background Information & Existing Infrastructure

The following storm sewers presently exist beneath the streets bordering the subject site:

1) There is an existing 450mm/600mm storm sewer flowing westerly beneath the south side of North Shore Boulevard, adjacent to the site's south frontage. This sewer increases in size to 600mm west of the site and ultimately discharges into the Hamilton Harbour via Indian Creek west of the Queen Elizabeth Way. The subject site appears to presently drain into this sewer via overland flow and by an existing catchbasin-manhole near the site's west property line. Refer to the Pre-Development Drainage Plan on the following page for pre-development drainage patterns.

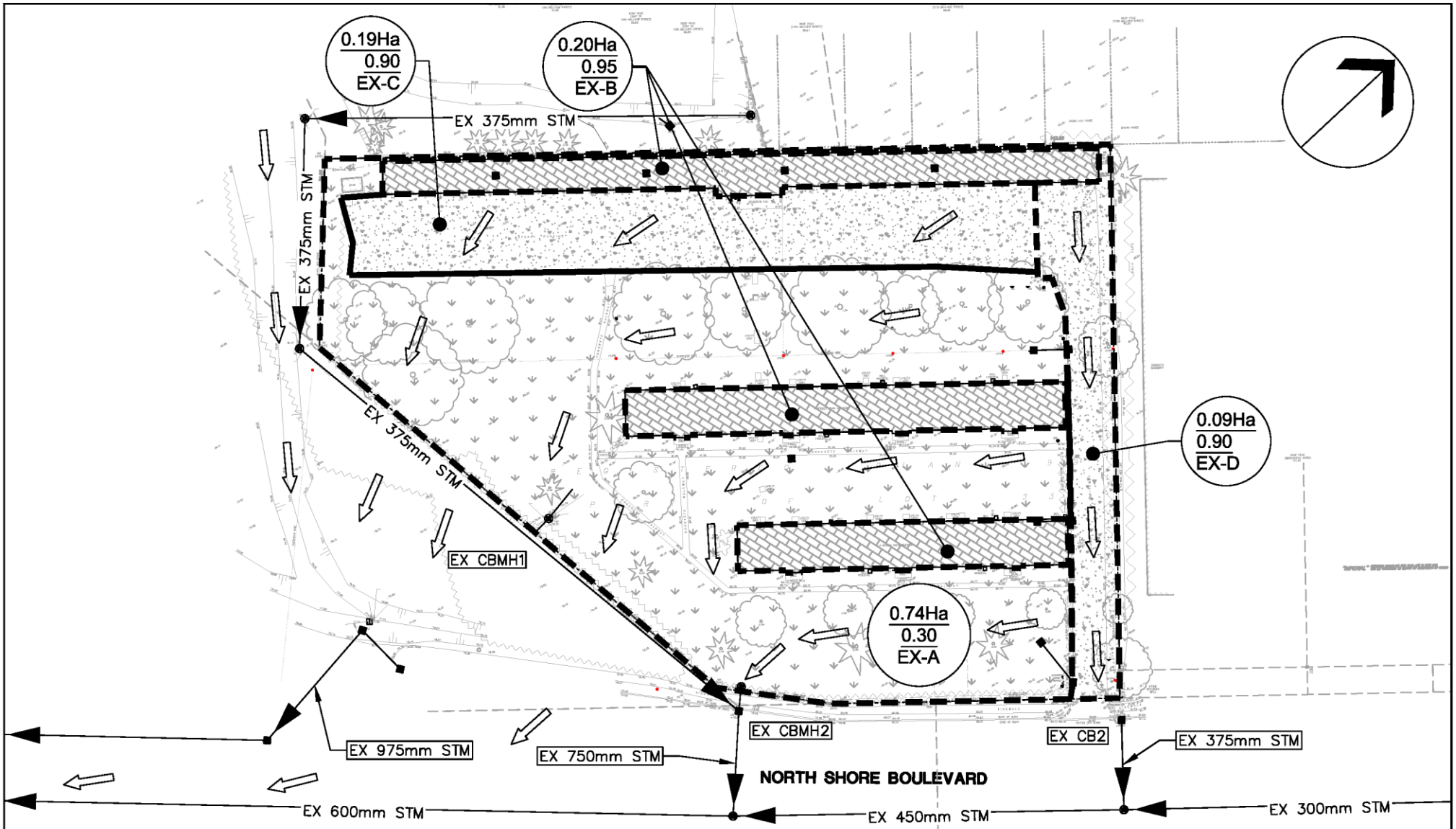
    a. There is a catchbasin-manhole structure (EX CBMH2) in the north gutter of North Shore Boulevard which drains by a 750mm pipe southerly beneath North Shore Boulevard into the 600mm storm pipe flowing westerly beneath the south side of North Shore. The subject site existing topography is such that it generally sheet flows overland into this structure as shown on the Pre-Development Drainage Plan on the following page.

    b. There is additionally a catchbasin-manhole structure within the site which City GIS information show also drains to the foregoing catchbasin structure on North Shore Blvd.

2) There is an existing 975mm storm sewer flowing westerly beneath the north side of North Shore Boulevard, commencing southwest of the site in the adjacent MTO lands. This sewer receives flows from the adjacent MTO lands to the west.

3) There is an existing 375mm storm sewer adjacent to the north and west site limits. This sewer receives flows from the existing townhouse condominium to the north and conveys it into the 750mm storm sewer on North Shore Boulevard. The surveyor conducted a site investigation, obtaining inverts in all structures on this sewer, showing that it does not drain through the subject site but is diverted around the site to the west. This is different from what appears in the City GIS information, however it makes sense given that the townhouse is newer than the existing subject site garage structure at the rear of the property, and it is unlikely the pipe was installed beneath the subject site existing garage structure as the City GIS information indicates.

Refer to the Pre-Development Drainage Plan on the following page for an overview of existing infrastructure and drainage patterns.



LEGEND

CATCHMENT BOUNDARY

0.44Ha / 0.30 / EX-C — CATCHMENT ID, C-VALUE & AREA

MAJOR OVERLAND FLOW ROUTE

DRAWING :

PRE-DEVELOPMENT DRAINAGE PLAN

DATE:	PROJ. NO.:	SCALE:
JUNE 2018	18204	1:1000

PROJECT : PROPOSED RESIDENTIAL DEVELOPMENT
1157-1171 NORTH SHORE BLVD. E.
BURLINGTON, ON

ODAN•DETECH CONSULTING ENGINEERS
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5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2

ii) Design Criteria

City of Burlington staff have provided the following stormwater management design criteria.

1) Quantity Control: Control 2-year to 100-year post-development storm flows to their respective pre-development storm flows.
2) Quality Control: 80% TSS Removal with a treatment train approach.

Design storm data for the City of Burlington 2-year to 100-year storms are shown below as per City standard S-IDF.

IDF-Curve	***Intensity when t, time of concentration, is 10 minutes:***
$I_2 = 592.6 / (6 + t)^{0.780}$	$I_2 = 68.2$ mm/hr
$I_5 = 697.4 / (5 + t)^{0.764}$	$I_5 = 88.1$ mm/hr
$I_{10} = 798.5 / (5 + t)^{0.763}$	$I_{10} = 101.1$ mm/hr
$I_{25} = 926.9 / (5 + t)^{0.762}$	$I_{25} = 117.7$ mm/hr
$I_{50} = 1019.4 / (5 + t)^{0.761}$	$I_{50} = 129.8$ mm/hr
$I_{100} = 1114.1 / (5 + t)^{0.761}$	$I_{100} = 141.9$ mm/hr

iii) Pre-Development (Allowable) Discharge Flow Rate

City staff have stated that the post-development storm flows should be controlled to the pre-development flows for 2-year through 100-year storms. The pre-development 2-year to 100-year storms are therefore determined as follows.

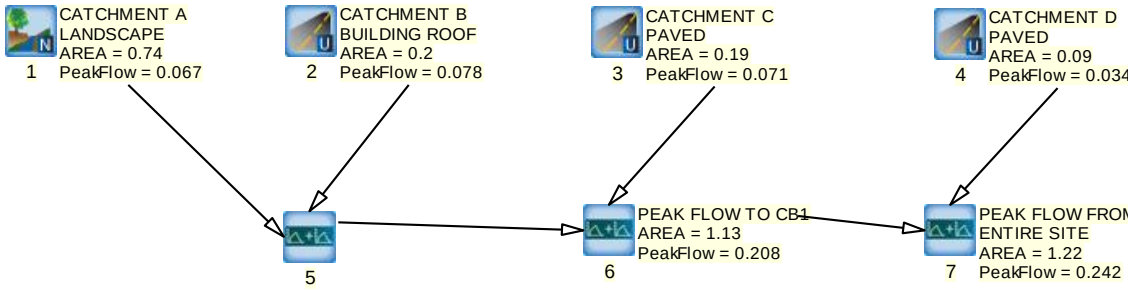
The pre-development catchment areas appear on the Pre-Development Drainage Plan on the prior page. The pre-development storm flows will be modelled using Visual OTTHYMO 2.3.2, with catchment statistics as follows. For drainage areas with significant imperviousness the calculation of effective rainfall in Visual OTTHYMO is accomplished using the “Standhyd” method. This method is used in urban watersheds to simulate runoff by combining two parallel standard unit hydrographs resulting from the effective rainfall intensity over the pervious and impervious surfaces. For pervious surfaces, losses are calculated using the SCS modified CN method.

TABLE 3 - Catchment Characteristics for the Site, Pre-Development

Area I.D.	Area (ha)	Hydrograph Method	% impervious	imperviousness directly connected %	Loss Method for Pervious Area	CN for Pervious Area	Initial Abstraction for Pervious (mm)	Time to peak (T_p)
A - Landscaping	0.74	NashHyd	-	-	SCS	80	5	0.11
B – Building Roofs	0.20	StandHyd	99	99	SCS	80	1	-
C – Paved Areas (to EX CB1)	0.19	StandHyd	90	90	SCS	80	1	-
D – Paved Areas (to EX CB2)	0.09	StandHyd	90	90	SCS	80	1	-

The foregoing areas were inputted into the Pre-Development Visual OTTHYMO Model as follows. Refer to the model output in Appendix B for the detailed output etc.

Figure 1 - Pre-Development Visual OTTHYMO Model showing Peak Flows in 100-Y Storm



The pre-development flows in each of the design storms based on the Visual OTTHYMO Output is as follows.

TABLE 4 – Allowable Flow Rate

Location	Design Storm	Pre-Development or Site Allowable Discharge (L/s)
Entire Site Pre-Development	2-year	98
Entire Site Pre-Development	5-year	135
Entire Site Pre-Development	10-year	159
Entire Site Pre-Development	25-year	192
Entire Site Pre-Development	50-year	217
Entire Site Pre-Development	100-year	242

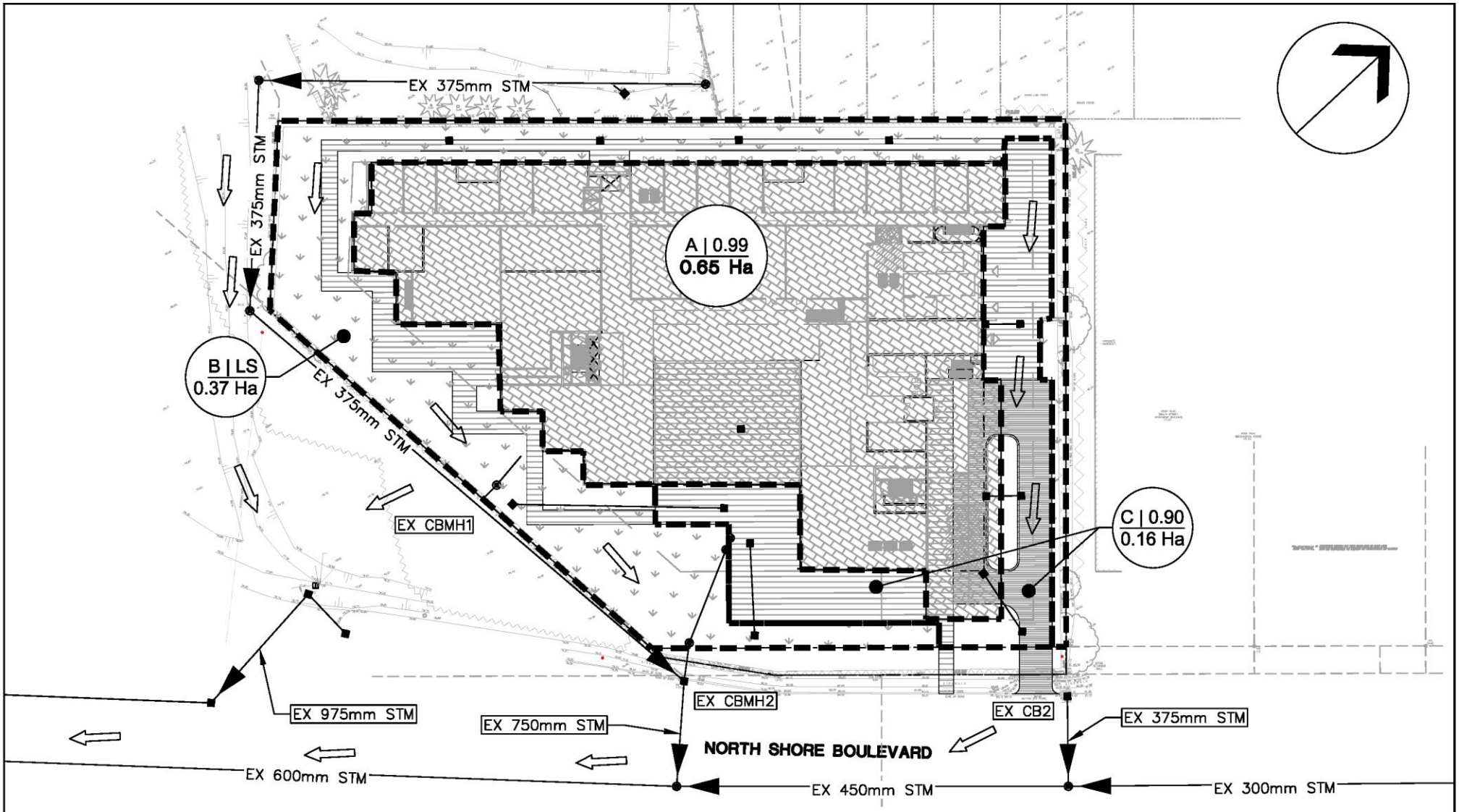
iv) Post Development Flow Analysis

City staff have stated that stormwater management quantity controls should be provided in the proposed development such that post-development flows are controlled so that they are no more than pre-development for each of the respective design storms as shown in Table 4, above.

Stormwater storage with controlled discharge will be required based on the foregoing criteria. The site has therefore been modelled using Visual OTTHYMO 2.3.2, as follows. For drainage areas with significant imperviousness the calculation of effective rainfall in Visual OTTHYMO is accomplished using the "Standhyd" method. This method is used in urban watersheds to simulate runoff by combining two parallel standard unit hydrographs resulting from the effective rainfall intensity over the pervious and impervious surfaces. For pervious surfaces, losses are calculated using the SCS modified CN method.

TABLE 5 - Catchment Characteristics for the Post-Developed Site

Area I.D.	Area (ha)	Hydrograph Method	% impervious	imperviousness directly connected %	Loss Method for Pervious Area	CN for Pervious Area	Initial Abstraction for Pervious (mm)	Time to peak (T_p)
A – Roof	0.65	StandHyd	99	99	SCS	80	1	-
B – Landscape	0.37	NashHyd	-	-	SCS	80	5	0.11
C - Paved	0.16	StandHyd	90	90	SCS	80	1	-



LEGEND

- CATCHMENT BOUNDARY
- BUILDING ROOF & IMPERVIOUS
- LANDSCAPING
- A | 0.99 / 0.50 Ha — CATCHMENT ID, % IMPERVIOUSNESS & AREA

DRAWING : **POST-DEVELOPMENT DRAINAGE PLAN**

DATE:	PROJ. NO.:	SCALE:
JUNE 2018	18204	1:1000

PROJECT : PROPOSED RESIDENTIAL DEVELOPMENT
1157-1171 NORTH SHORE BLVD. E.
BURLINGTON, ON

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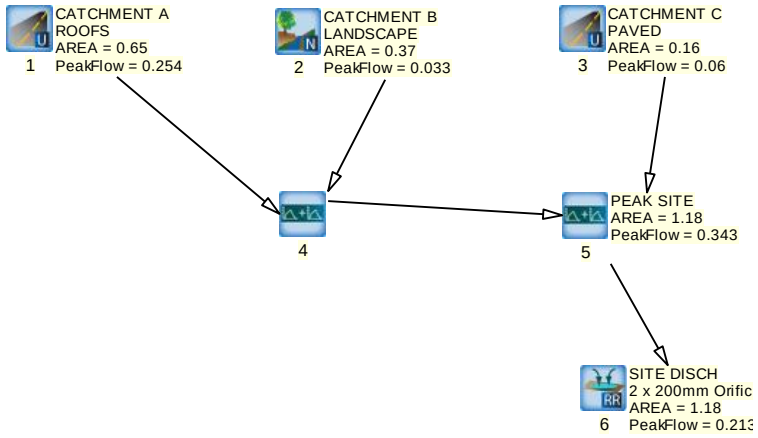
5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2

The runoff from the proposed development is greater than the pre-development scenario, therefore stormwater quantity controls are required to meet the pre-development stormwater quantity control criteria identified above.

Stormwater quantity control will be provided by a concrete storm tank located as shown on the Functional Servicing Plan. Two orifice tubes, as shown on the Functional Servicing Plan, will address the quantity control criteria.

The post-development Visual OTTHYMO hydrology and reservoir routing Model is as follows. Refer to the detailed output in Appendix B.

Figure 2 - Post-Development Visual OTTHYMO Model



The results of the Visual OTTHYMO model for the controlled discharge from the two orifices is as follows.

TABLE 6 – Controlled discharge rate and stormwater storage volume

Location	Design Storm	Site Allowable Discharge (L/s)	Controlled Discharge (L/s)	Required Stormwater Storage (m^3)
Entire Site Post-Development	2-year	98	90	68
Entire Site Post-Development	5-year	135	129	87
Entire Site Post-Development	10-year	159	151	100
Entire Site Post-Development	25-year	192	179	118
Entire Site Post-Development	50-year	217	197	132
Entire Site Post-Development	100-year	242	213	145

The stage/storage/discharge relationship for the orifices is as follows. The footprint of the storm tank must be $100m^2$ which can be accommodated on the site as shown on the Functional Servicing Plan. A tank volume of $145m^3$ is required in the 100-year storm, which is provided as shown on the Functional Servicing Plan to storage depth 1.45m.

The stage/storage/discharge relationship for the storm tank is as follows. Two orifices are required to meet the storm-to-storm criteria for 2-year through 100-year storms.

The two orifices are both 200mm in diameter and will be installed at invert elevations 78.25 and 78.85, as shown in the below Stage/Discharge relationship.

The 145m^3 storage tank will be a concrete tank constructed with the subject site below-grade parking garage structure.

Stage Discharge								
	orifice 1		orifice 2					
Elevation Increment:	0.20	m	0.20					
Orifice Coefficient:	0.8		0.8					
Orifice area	0.0314	m2	0.0314					
Orifice Size:	200	mm	200					
Orifice Invert	78.25	m	78.85					
Orifice centroid	78.35		78.95					

Elevation Description	Bottom Elevation (m)	Top Elevation (m)	Volume (m^3)	Discharge orifice1 (m^3/s)	Discharge orifice2 (m^3/s)	Total Discharge (m^3/s)	Stage (m)	Tank Area (m2)
Bottom of Tank	78.25	78.25	0			0.000	0.00	0
	78.25	78.45	20	0.035		0.035	0.20	100
	78.25	78.65	40	0.061		0.061	0.40	100
	78.25	78.85	60	0.079		0.079	0.60	100
	78.25	79.05	80	0.093	0.035	0.128	0.80	100
	78.25	79.25	100	0.106	0.061	0.167	1.00	100
	78.25	79.45	120	0.117	0.079	0.195	1.20	100
Roof of Tank	78.25	79.70	145	0.129	0.096	0.226	1.45	100

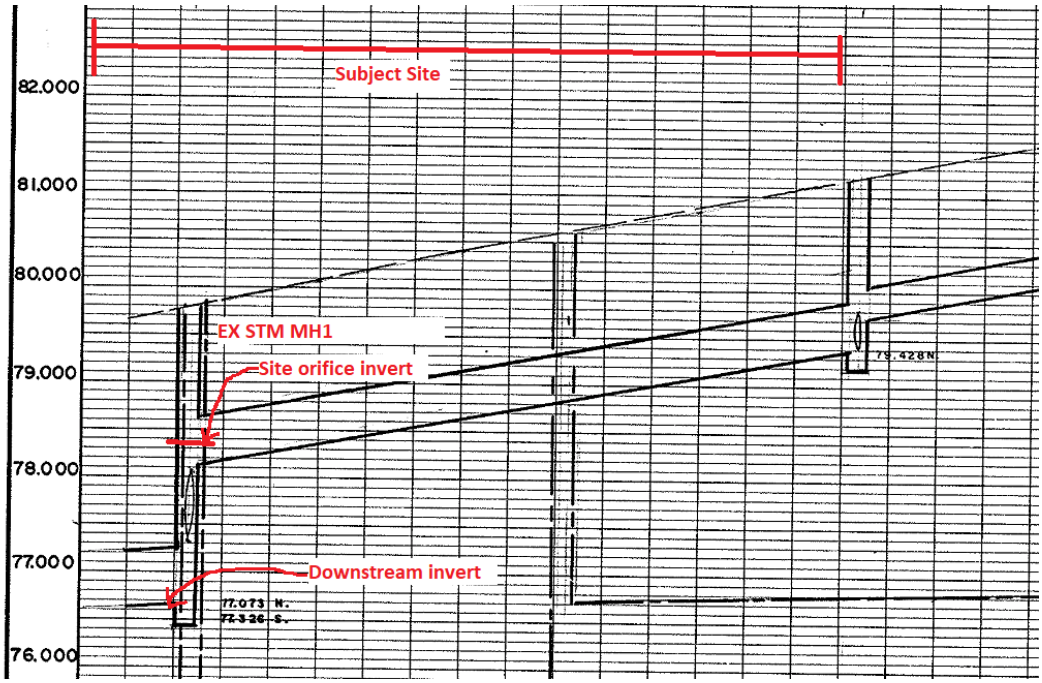
This analysis assumes the following:

1) There is capacity in the receiving North Shore Boulevard storm sewer for the subject site. This, given that the site drained to this outlet pre-development and stormwater quantity can be controlled such that it is in compliance with each respective pre-development storm in the post-development scenario as per the foregoing analysis.

2) There is no backwater/tailwater effect in the receiving storm sewer system impacting free-flow of water through the site orifices. That is, the two orifices flow by free-flow from the outlet and the driving head is as per the above orifice relationship. The rationale for this downstream condition assumption is as follows:

    a. There is a significant fall across the manhole on the mainline North Shore Boulevard 600mm storm sewer that the site drains into. Figure 3, as follows, is an excerpt from City Plan-Profile drawing no. MN-5_21 showing EX STM MH2 – note that the site orifice invert is 78.25, whereas the invert of the outlet is 76.64; 1.6m lower. This is a significant freeboard – the effect of flows and surcharging in the downstream 600mm storm sewer will be mitigated by this freeboard.

Figure 3 - Excerpt from plan-profile MN-5_21 of North Shore Boulevard marked-up showing outlet condition at subject site storm sewer connection



v) Water Quality

City engineering staff identified the stormwater quality control criteria applying to the runoff from this site to be Enhanced Quality Control (80% total suspended solids removal), with a treatment-train approach to quality control.

City engineering staff recognize conventional Oil-Grit Separators as providing 50% TSS Removal. Most Canadian municipalities now consider the *Canadian Environmental Verification (CETV)* the approval authority for Oil-Grit Separators.

The CETV certification for the *Stormceptor STC*-model conventional Oil-Grit Separator by Imbrium Systems Inc. concurs with the town engineering staff comment that the conventional OGS provides 50% TSS removal. Figure 4, as follows, is an excerpt from the CETV *Verification Statement – Imbrium Systems Inc. Stormceptor … Oil-Grit Separators* (November 2017).

Figure 4 shows that the Stormceptor conventional OGS provides typically 50-70% TSS removal, therefore the conclusion holds that a conventional OGS does not satisfactorily address the stormwater quality criteria for this site because it does not provide 80% TSS.

Figure 4 - Excerpt from CETV Verification Statement for Stormceptor OGS

Table 1. Removal efficiencies (%) of the EF4 at specified surface loading rates

Particle size fraction (µm)	Surface loading rate (L/min/m²)						
	40	80	200	400	600	1000	1400
>500	90	58	58	100*	86	72	100*
250 - 500	100*	100*	100	100*	100*	100*	100*
150 - 250	90	82	26	100*	100*	67	90
105 - 150	100*	100*	100*	100*	100*	100*	100
75 - 105	100*	92	74	82	77	68	76
53 - 75	Undefined [a]	56	100*	72	69	50	80
20 - 53	54	100*	54	33	36	40	31
8 - 20	67	52	25	21	17	20	20
5 – 8	33	29	11	12	9	7	19
<5	13	0	0	0	0	0	4
All particle sizes by mass balance	**70.4**	**63.8**	**53.9**	**47.5**	**46.0**	**43.7**	**49.0**

TSS Removal efficiency is ~50%

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%).
See text and Bulletin # CETV 2016-11-0001 for more information.

The CETV also provides certification for stormwater quality filters that provide TSS removal by mechanical filtration through a filter media. One such model is the Jellyfish Filter by Imbrium Systems. The CETV verification statement for the Jelllyfish Filter by Imbrium Systems states that it provides a minimum 80% TSS Removal. Figure 5, as follows, is an excerpt from the CETV *Verification Statement – Imbrium Systems Inc. Jellyfish Filter …* (August 2017).

Figure 5 shows that the Jellyfish Filter provides 80% TSS Removal, therefore it addresses the City criteria for 80% TSS Removal. The entire Jellyfish Filter CETV Verification Statement is provided here in Appendix B.

Figure 5 - Excerpt from CETV Verification Statement for Jellyfish Filter

Table 4. Summary statistics for influent and effluent event mean concentrations for selected constituents

Water Quality Variable	Sampling Location	Min	Max	Median	Range	Mean	SD	Load based removal efficiency (%)
TSS	Influent (mg/L)	16.30	261.00	79.30	244.70	86.26	51.37	87.2
	Effluent (mg/L)	3.20	21.70	11.80	18.50	10.99	4.79	
SSC	Influent (mg/L)	78.20	1401.70	444.50	1323.50	482.26	338.34	98.6
	Effluent (mg/L)	2.80	18.10	7.30	15.30	7.88	3.77	
TP	Influent (µg/L)	887.00	8793.00	3063.00	7906.00	3550.20	1914.50	64.2
	Effluent (µg/L)	472.00	4769.00	1480.00	4297.00	1688.08	1059.98	
TN	Influent (µg/L)	1170.00	10479.00	3110.00	9309.00	3519.32	2161.47	46.3
	Effluent (µg/L)	553.00	6579.00	1610.00	6026.00	2091.76	1613.61	
Zn	Influent (µg/L)	0.005	7600.00	1500.00	7600.00	1792.00	1852.91	76.1
	Effluent (µg/L)	0.005	2760.00	450.00	2760.00	561.64	594.70	
Cu	Influent (µg/L)	0.001	880.40	79.50	880.40	171.28	229.33	92.1
	Effluent (µg/L)	0.001	51.30	6.90	51.30	14.36	17.22	
Oil and Grease	Influent (mg/L)	0.20	4.06	0.93	3.86	1.07	0.82	46.4
	Effluent (mg/L)	0.00	2.32	0.35	2.32	0.50	0.60	

It is accordingly proposed to provide a Jellyfish Filter by Imbrium to address City criteria for 80% TSS Removal. This is lieu of providing a conventional OGS with a treatment-train approach to providing 80% TSSR. The Jellyfish filter will be sized at the SPA stage.

6.0 GROUNDWATER

A Geotechnical Report was prepared by Pinchin Environmental dated March 23, 2018 and updated November 2018. The geotechnical report includes observations of groundwater levels derived from geotechnical boreholes.

Section 4.2 *Groundwater Conditions* of the November 2018 revision of the Geotechnical report observes groundwater table levels as high as 4.9m below ground surface (elevation 75.5m). The report continues that the proposed second underground finished floor elevation is 75.3m (Section 5.6), therefore it follows that some groundwater from the groundwater table will enter the foundation drains.

Any water collected by foundation drains may be collected in a sump in the underground levels and pumped into the site's stormwater management tank upstream of the orifice control. Thus, the discharge of water collected by foundation drains will be controlled (along with storm flows) by the orifice control. The 100-year storm tank will be sized in the future at the SPA stage considering the additional constant flow of groundwater from the building foundation drain sump.

Monitoring wells will be installed in the future at the SPA stage to further determine the stabilized groundwater table and understand the quantity of water entering the foundation drains. This is discussed in Section 4.2 of the November 2018 revision of the Geotechnical Report.

7.0 CONCLUSIONS

From the foregoing investigation, the site is serviceable utilizing existing sanitary, storm and watermain infrastructure within and adjacent to the site. Storm water management can be accommodated with on-site storage as described in this report.

The following table summarizes the SWM and Servicing components of the proposed development.

TABLE 7 - Summary

	Proposed Development
Peak Sanitary Discharge (L/s)	13.6
Proposed Sanitary Service	Proposed 300mm Sanitary Service
Receiving Sanitary Sewer	Existing Receiving 1800mm Regional Trunk Sewer
Existing Watermain	North Shore Blvd – 250mm
Development Water Demand	3562 USGM
Available Flow in Watermain at 20 psi	4469 USGM
Allowable release rate from site (100-Y)	242 L/s
Proposed Controlled release rate from site (100-Y)	213 L/s
100-Y Storm SWM Storage (m^3)	145

8.0 REFERENCES

1. Regional Municipality of Halton's *Water and Wastewater Linear Design Manual* (April 2015)

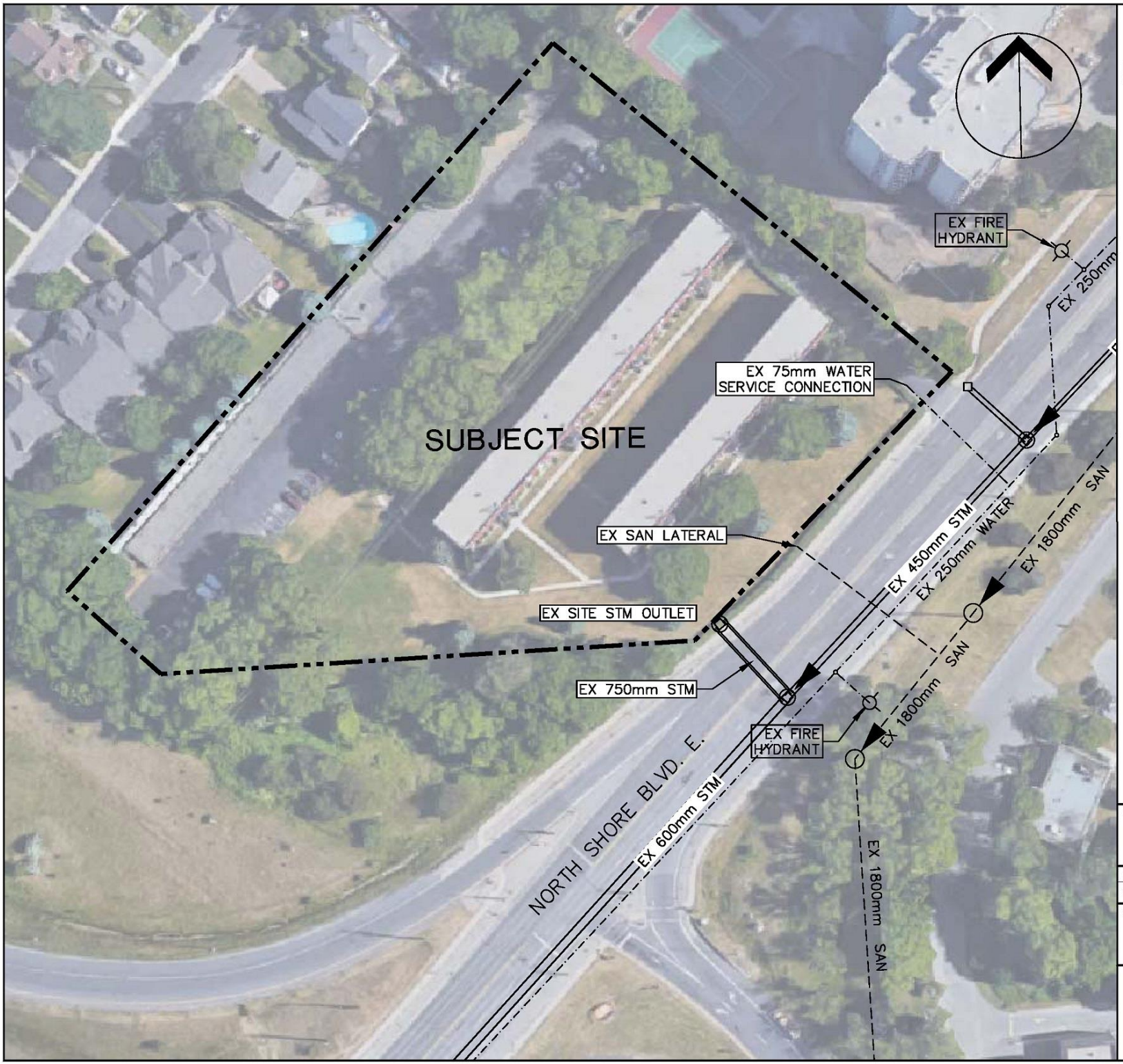
Respectfully Submitted;
The Odan Detech Group Inc.

Daniel Bancroft, P.Eng.

APPENDIX A

Existing Site	Aerial view of Site and surrounding areas
Site Plan	by MontgomerySisam
Statistics	by MontgomerySisam

Correspondence from Region Engineering Staff



LEGEND

PROPERTY LINE

DRAWING :

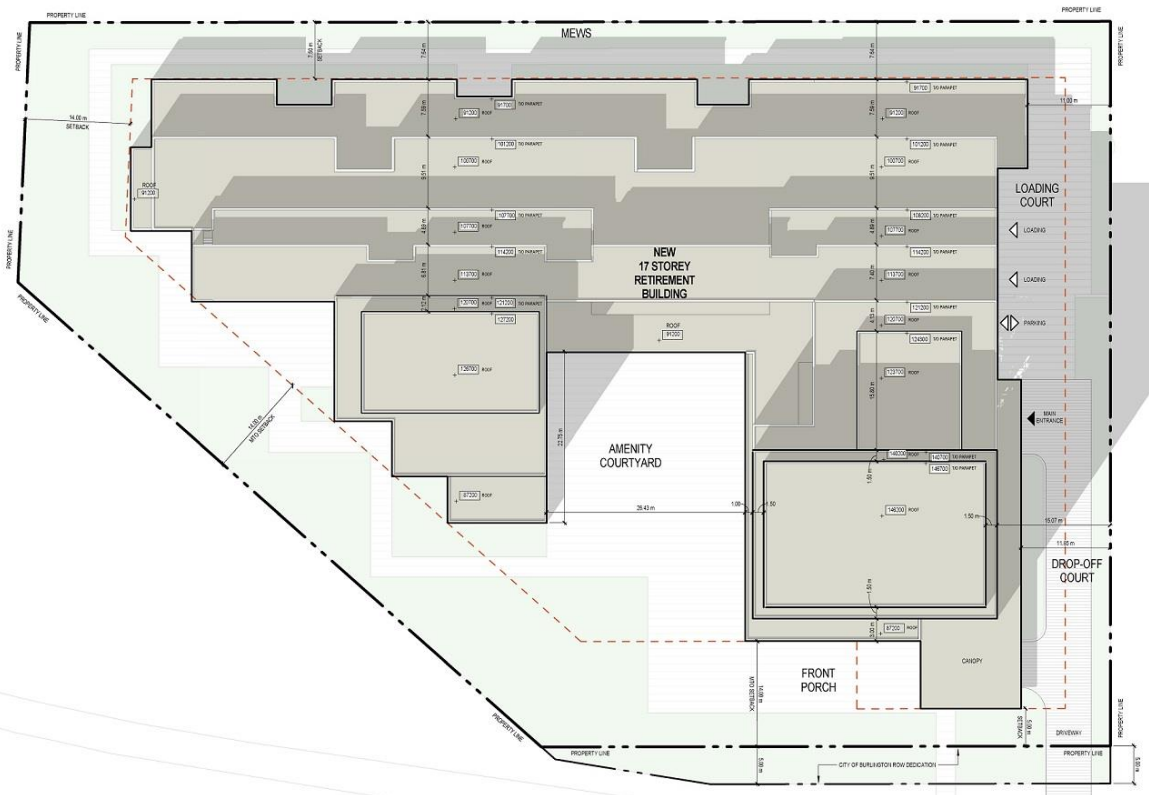
KEY PLAN & EXISTING SERVICES

DATE:	PROJ. NO.:	SCALE:
FEB. 2018	18204	N.T.S.

PROJECT :

PROPOSED RESIDENTIAL DEVELOPMENT
1157-1171 NORTH SHORE BLVD. E.
BURLINGTON, ON

ODAN·DETECH
CONSULTING ENGINEERS
The Odan/Detech Group Inc. P: (905) 632-3811 F: (905) 632-3363
5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2



NORTH SHORE BOULEVARD EAST

1 A1.02 ROOF SITE PLAN
1 : 300

Montgomery Sisam Architects Inc.
197 Spadina Avenue, Toronto, Ontario M5T 2C8 montgomerysisam.com
Tel 416.364.8079 Fax 416.364.7723
MontgomerySisam

Amica North Shore
1157-1171 North Shore Boulevard
Burlington, ON L7S 1C3

SITE PLAN - ROOF PLAN

scale:	As indicated
drawn by:	RK
reviewed by:	KH
job number:	17099
plot date:	2018-09-05

drawing number: A1.02

Key Development Stats For Submission

Montgomery Sisam Architects

18.09.05

DRAFT

			Assumption / Comments
GFA	*Potential By-Law Figure*	**450,000**	**excludes penthouse* **excludes levels below grade* **excludes double-height spaces*
Unit Count	*Potential By-Law Figure*	**475**	**This number represents 950sf per unit against GFA.*
Resident Population		**600**	**the following assumptions are used to derive this number:* *MC = 1 resident per suite* *AL = 1 resident per suite* *IL = 1.5 resident per suite (50% of units)*
Staff Population		**180**	** on site at any given time*
Total Population on Site		**780**	
Parking Count	*Potential By-Law Figure*	**200**	**based on current layout*

Unit Parking Ratio (B/F)	**0.42**	**included here for illustrative purposes only. Will defer to Traffic's calculations*
Population Parking Ratio (E/F)	**0.26**	**included here for illustrative purposes only. Will defer to Traffic's calculations*

Table E: GROSS FLOOR AREA

Level	*Area (sm)*	*Area (sf)*	*Comments*
Penthouse	640	6,889	*excluded from GFA Calculation*
17	**805**	**8,665**	
16	**805**	**8,665**	
15	**805**	**8,665**	
14	**805**	**8,665**	
13	**805**	**8,665**	
12	**1,000**	**10,764**	
11	**1,800**	**19,375**	
10	**1,800**	**19,375**	
9	**2,500**	**26,910**	
8	**2,500**	**26,910**	
7	**3,000**	**32,292**	
6	**3,000**	**32,292**	
5	**4,000**	**43,056**	
4	**4,000**	**43,056**	
3	**4,000**	**43,056**	
2	**5,000**	**53,820**	
1	**5,300**	**57,049**	
P1	6,300	67,813	*excluded from GFA Calculation*
P2	6,300	67,813	*excluded from GFA Calculation*
	41,925	**451,277**	

From: Kisneris, John [mailto:John.Kisneris@halton.ca]
Sent: Wednesday, February 28, 2018 2:25 PM
To: 'daniel@odandetech.com' <daniel@odandetech.com>
Cc: drago@odandetech.com
Subject: RE: 1157 - 1171 North Shore Blvd E. sanitary sewers

Hi Daniel.

Regarding your preliminary water and wastewater servicing capacity inquiry for a preliminary development proposal at 1157 - 1171 North Shore Boulevard East for a total of 407 units. Please be advised that I have been informed by the Region's Public Works department that the capacity can be accommodated in the Region's systems.

As for the sanitary sewer connection lateral, the Region cannot confirm at this time whether it is adequate for the proposed development. It can only be confirmed when more work is done toward the future site plan application submission by the owner. For example when the engineering consultant undertakes to complete an existing sanitary sewer connection lateral physical locate, a physical size confirmation, a condition inspection and assessment (CCTV) of the existing sanitary lateral, a confirmation of the development size and scope, a confirmation whether any land division severance will be requested by the developer (individual water and wastewater services, and cannot cross lot lines), whether there would be an need for a local wastewater main (sanitary sewer), etc., whether any sewage pumping is required, and the developer's engineering consultant has proposed site services on proposed draft site servicing plan drawings, and completes a Functional Servicing Report (if required). Only then can the Region review the information.

As you know, watermain and wastewater main (sanitary) servicing capacity is not guaranteed at the preliminary proposal stage. Servicing of development in the Burlington area of Halton Region is on a first-come-first-serve basis. The owner can pre-consult about servicing capacity with the Region at any time in the future going forward. Capacity will be reviewed again and commented upon at the time of Planning application receipt. Should a servicing capacity issue be identified at that time then it will have to be dealt with, working through it with the Region. Servicing capacity is deemed to be in hand at the issuance of a Regional Servicing Agreement, Special Financial Agreement, and Regional Services Permit (all if required), which is reviewed and obtained toward the end of the City's Site Plan approval process.

Please let me know if you have any questions. Thanks.

…Interim emails omitted - DB

From: Daniel Bancroft - Odan Detech Group [mailto:daniel@odandetech.com]
Sent: Monday, February 05, 2018 12:21 PM
To: 'Kisneris, John' <John.Kisneris@halton.ca>
Cc: 'drago@odandetech.com' <drago@odandetech.com>
Subject: RE: 1171 North Shore Blvd E. sanitary sewers

Hi John,

In red:

So just to be clear, you would like me to find out whether there is capacity in the Region's trunk sewer across the street ? **Correct.**
You do not have any other information that I described below that has an impact on servicing. **Correct.**
Can you please tell me what is going to happen to the existing buildings on the property ? **They would be demolished in the proposed development.**
Can you please tell me how many units currently exist in each building ? **56 Units**
Can you please tell me how many bedrooms there are in each unit ?
Existing: 3 x 1BR, 53 x 2BR
Proposed:

1. **Tower 1 (24 storey)**
    a. **130 x 1BR**
    b. **80 x 2BR**
    c. **25 x 3BR**
2. **Tower 2 (12 storey)**
    a. **120 x Studio + 52 x 1BR**

Can you please tell me how big the property is ? **Approx. 1.18 Ha**

Thanks for your help. Let us know next steps/any other info required from us.

Regards
Daniel

ODAN·DETECH
CONSULTING ENGINEERS

Daniel Bancroft, P.Eng.
The Odan/Detech Group Inc.

P : (905) 632-3811 ext.133 | **F :** (905) 632-3363
5230, SOUTH SERVICE ROAD, UNIT 107 | BURLINGTON, ONTARIO | L7L 5K2
www.odandetech.com | daniel@odandetech.com

APPENDIX B

Pre-Development Visual OTTHYMO Output (2-year to 100-year storms)

Post-Development Visual OTTHYMO Output (2-year to 100-year storms)

CETV Verification Statement – Imbrium Systems Inc. Stormceptor OGS

CETV Verification Statement – Imbrium Systems Inc. Jellyfish Filter

Pre-Development Visual OTTHYMO Output (2-year to 100-year storms)

```
================================================================================================================================

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO

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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.3\voin.dat
  Output  filename: p:\2018\18204\Visual OTTHYMO\Rev0\18204 vo2\Pre-Development.out
  Summary filename: p:\2018\18204\Visual OTTHYMO\Rev0\18204 vo2\Pre-Development.sum


DATE: 6/20/2018                           TIME: 9:49:40 AM

USER:


COMMENTS: _____________________________________________________

--------------------------------------------------------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 592.600
| Ptotal= 32.34 mm |                          B=   6.000
--------------------                          C=    .780
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.21 |  1.17   17.15 |  2.17    5.20 |  3.17    2.63
                 .33    2.53 |  1.33   68.16 |  2.33    4.43 |  3.33    2.44
                 .50    2.98 |  1.50   22.38 |  2.50    3.87 |  3.50    2.28
                 .67    3.65 |  1.67   11.94 |  2.67    3.45 |  3.67    2.14
                 .83    4.81 |  1.83    8.24 |  2.83    3.11 |  3.83    2.02
                1.00    7.29 |  2.00    6.35 |  3.00    2.85 |  4.00    1.92


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=    .09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .08          .01
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      24.50        40.00
     Mannings n             =     .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    2.21 | 1.083   17.15 | 2.083    5.20 |  3.08    2.63
               .167    2.21 | 1.167   17.15 | 2.167    5.20 |  3.17    2.63
               .250    2.53 | 1.250   68.16 | 2.250    4.43 |  3.25    2.44
               .333    2.53 | 1.333   68.16 | 2.333    4.43 |  3.33    2.44
               .417    2.98 | 1.417   22.38 | 2.417    3.87 |  3.42    2.28
               .500    2.98 | 1.500   22.38 | 2.500    3.87 |  3.50    2.28
               .583    3.65 | 1.583   11.94 | 2.583    3.45 |  3.58    2.14
               .667    3.65 | 1.667   11.94 | 2.667    3.45 |  3.67    2.14
               .750    4.81 | 1.750    8.24 | 2.750    3.11 |  3.75    2.02
               .833    4.81 | 1.833    8.24 | 2.833    3.11 |  3.83    2.02
               .917    7.29 | 1.917    6.35 | 2.917    2.85 |  3.92    1.92
              1.000    7.29 | 2.000    6.35 | 3.000    2.85 |  4.00    1.92

     Max.Eff.Inten.(mm/hr)=      68.16        18.95
                 over (min)       5.00         5.00
     Storage Coeff.  (min)=       1.28 (ii)    4.70 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .02          .00          .016 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      31.34        10.36         29.23
     TOTAL RAINFALL   (mm)=      32.34        32.34         32.34
     RUNOFF COEFFICIENT   =        .97          .32           .90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .19
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      35.60        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      68.16        18.95
                 over (min)       5.00        10.00
     Storage Coeff.  (min)=       1.60 (ii)    5.02 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .32          .16
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .00          .033 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42          1.33
     RUNOFF VOLUME    (mm)=      31.34        10.36         29.22
     TOTAL RAINFALL   (mm)=      32.34        32.34         32.34
     RUNOFF COEFFICIENT   =        .97          .32           .90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0002) |   Area    (ha)=    .20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
```

```
     Length            (m)=      36.50        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      68.16        94.77
               over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.63 (ii)    2.94 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .32          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .038 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      31.34        10.36         31.12
     TOTAL RAINFALL   (mm)=      32.34        32.34         32.34
     RUNOFF COEFFICIENT   =        .97          .32           .96

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=    .74   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    2.21 | 1.167   17.15 | 2.167    5.20 |  3.17    2.63
                .333    2.53 | 1.333   68.16 | 2.333    4.43 |  3.33    2.44
                .500    2.98 | 1.500   22.38 | 2.500    3.87 |  3.50    2.28
                .667    3.65 | 1.667   11.94 | 2.667    3.45 |  3.67    2.14
                .833    4.81 | 1.833    8.24 | 2.833    3.11 |  3.83    2.02
               1.000    7.29 | 2.000    6.35 | 3.000    2.85 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .141

     PEAK FLOW       (cms)=    .016 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   7.856
     TOTAL RAINFALL   (mm)=  32.020
     RUNOFF COEFFICIENT   =    .245

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .20    .038     1.33    31.12
        + ID2= 2 (0001):      .74    .016     1.50     7.86
          ================================================
          ID = 3 (0005):      .94    .050     1.33    12.77

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0006) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .19    .033     1.33    29.22
        + ID2= 2 (0005):      .94    .050     1.33    12.77
          ================================================
          ID = 3 (0006):     1.13    .083     1.33    15.54

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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```

ADD HYD (0007)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0004):	.09	.016	1.33	29.23
	+ ID2= 2 (0006):	1.13	.083	1.33	15.54
	ID = 3 (0007):	1.22	.098	1.33	16.55

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
** SIMULATION NUMBER: 2 **
****

CHICAGO STORM	IDF curve parameters: A= 697.400
Ptotal= 41.69 mm	B= 5.000
	C= .764

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	2.98	1.17	21.37	2.17	6.78	3.17	3.52
.33	3.40	1.33	88.09	2.33	5.81	3.33	3.28
.50	3.97	1.50	27.73	2.50	5.11	3.50	3.08
.67	4.84	1.67	15.03	2.67	4.57	3.67	2.90
.83	6.29	1.83	10.53	2.83	4.15	3.83	2.74
1.00	9.36	2.00	8.21	3.00	3.81	4.00	2.60

CALIB	
STANDHYD (0004)	Area (ha)= .09
ID= 1 DT= 5.0 min	Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.08	.01
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	24.50	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.98	1.083	21.37	2.083	6.78	3.08	3.52
.167	2.98	1.167	21.37	2.167	6.78	3.17	3.52
.250	3.40	1.250	88.09	2.250	5.81	3.25	3.28
.333	3.40	1.333	88.09	2.333	5.81	3.33	3.28
.417	3.97	1.417	27.73	2.417	5.11	3.42	3.08
.500	3.97	1.500	27.73	2.500	5.11	3.50	3.08
.583	4.84	1.583	15.03	2.583	4.57	3.58	2.90
.667	4.84	1.667	15.03	2.667	4.57	3.67	2.90
.750	6.29	1.750	10.53	2.750	4.15	3.75	2.74
.833	6.29	1.833	10.53	2.833	4.15	3.83	2.74
.917	9.36	1.917	8.21	2.917	3.81	3.92	2.60
1.000	9.36	2.000	8.21	3.000	3.81	4.00	2.60

Max.Eff.Inten.	(mm/hr)=	88.09	30.00	
over	(min)	5.00	5.00	
Storage Coeff.	(min)=	1.16 (ii)	4.24 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	5.00	
Unit Hyd. peak	(cms)=	.34	.24	
				TOTALS
PEAK FLOW	(cms)=	.02	.00	.021 (iii)
TIME TO PEAK	(hrs)=	1.33	1.33	1.33
RUNOFF VOLUME	(mm)=	40.69	15.89	38.20
TOTAL RAINFALL	(mm)=	41.69	41.69	41.69
RUNOFF COEFFICIENT	=	.98	.38	.92

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .19
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      35.60        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      88.09        30.00
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.45 (ii)    4.53 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .23
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .043 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      40.69        15.89         38.20
     TOTAL RAINFALL   (mm)=      41.69        41.69         41.69
     RUNOFF COEFFICIENT   =        .98          .38           .92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0002) |   Area    (ha)=    .20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      36.50        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      88.09       150.02
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.47 (ii)    2.65 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .29
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .05          .00          .049 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      40.69        15.89         40.44
     TOTAL RAINFALL   (mm)=      41.69        41.69         41.69
     RUNOFF COEFFICIENT   =        .98          .38           .97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=    .74   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
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```
--------------------  U.H. Tp(hrs)=    .20

        NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    2.98 | 1.167   21.37 | 2.167    6.78 |  3.17    3.52
               .333    3.40 | 1.333   88.09 | 2.333    5.81 |  3.33    3.28
               .500    3.97 | 1.500   27.73 | 2.500    5.11 |  3.50    3.08
               .667    4.84 | 1.667   15.03 | 2.667    4.57 |  3.67    2.90
               .833    6.29 | 1.833   10.53 | 2.833    4.15 |  3.83    2.74
              1.000    9.36 | 2.000    8.21 | 3.000    3.81 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .141

     PEAK FLOW       (cms)=    .027 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  12.836
     TOTAL RAINFALL   (mm)=  41.259
     RUNOFF COEFFICIENT   =    .311

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .20    .049     1.33    40.44
        + ID2= 2 (0001):      .74    .027     1.50    12.84
          ================================================
          ID = 3 (0005):      .94    .071     1.33    18.66

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------

--------------------
| ADD HYD   (0006) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .19    .043     1.33    38.20
        + ID2= 2 (0005):      .94    .071     1.33    18.66
          ================================================
          ID = 3 (0006):     1.13    .114     1.33    21.95

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------

--------------------
| ADD HYD   (0007) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0004):      .09    .021     1.33    38.20
        + ID2= 2 (0006):     1.13    .114     1.33    21.95
          ================================================
          ID = 3 (0007):     1.22    .135     1.33    23.15

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
  ***************************
  ** SIMULATION NUMBER:   3 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 798.500
| Ptotal= 48.00 mm |                          B=   5.000
--------------------                          C=    .763
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
```

hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.45	1.17	24.60	2.17	7.83	3.17	4.07
.33	3.93	1.33	101.14	2.33	6.71	3.33	3.79
.50	4.59	1.50	31.91	2.50	5.90	3.50	3.55
.67	5.58	1.67	17.31	2.67	5.28	3.67	3.35
.83	7.26	1.83	12.14	2.83	4.79	3.83	3.17
1.00	10.79	2.00	9.47	3.00	4.40	4.00	3.01

CALIB			
STANDHYD (0004)	Area (ha)=	.09	
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.08	.01
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	24.50	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	3.45	1.083	24.60	2.083	7.83	3.08	4.07
.167	3.45	1.167	24.60	2.167	7.83	3.17	4.07
.250	3.93	1.250	101.14	2.250	6.71	3.25	3.79
.333	3.93	1.333	101.14	2.333	6.71	3.33	3.79
.417	4.59	1.417	31.91	2.417	5.90	3.42	3.55
.500	4.59	1.500	31.91	2.500	5.90	3.50	3.55
.583	5.58	1.583	17.31	2.583	5.28	3.58	3.35
.667	5.58	1.667	17.31	2.667	5.28	3.67	3.35
.750	7.26	1.750	12.14	2.750	4.79	3.75	3.17
.833	7.26	1.833	12.14	2.833	4.79	3.83	3.17
.917	10.79	1.917	9.47	2.917	4.40	3.92	3.01
1.000	10.79	2.000	9.47	3.000	4.40	4.00	3.01

Max.Eff.Inten.(mm/hr)=	101.14	38.24		
over (min)	5.00	5.00		
Storage Coeff. (min)=	1.09 (ii)	4.01 (ii)		
Unit Hyd. Tpeak (min)=	5.00	5.00		
Unit Hyd. peak (cms)=	.34	.24		
			TOTALS	
PEAK FLOW (cms)=	.02	.00	.024 (iii)	
TIME TO PEAK (hrs)=	1.33	1.33	1.33	
RUNOFF VOLUME (mm)=	47.00	19.99	44.29	
TOTAL RAINFALL (mm)=	48.00	48.00	48.00	
RUNOFF COEFFICIENT =	.98	.42	.92	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0003)	Area (ha)=	.19	
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.17	.02
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	35.60	40.00
Mannings n	=	.013	.250

Max.Eff.Inten.(mm/hr)=	101.14	38.24		
over (min)	5.00	5.00		
Storage Coeff. (min)=	1.37 (ii)	4.29 (ii)		
Unit Hyd. Tpeak (min)=	5.00	5.00		
Unit Hyd. peak (cms)=	.33	.23		
			TOTALS	

```
     PEAK FLOW       (cms)=        .05          .00          .050 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      47.00        19.99         44.29
     TOTAL RAINFALL   (mm)=      48.00        48.00         48.00
     RUNOFF COEFFICIENT   =        .98          .42           .92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0002) |   Area    (ha)=    .20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      36.50        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     101.14       191.19
               over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.39 (ii)    2.51 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .29
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .056 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      47.00        19.99         46.72
     TOTAL RAINFALL   (mm)=      48.00        48.00         48.00
     RUNOFF COEFFICIENT   =        .98          .42           .97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=    .74   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    3.45 | 1.167   24.60 | 2.167    7.83 |  3.17    4.07
               .333    3.93 | 1.333  101.14 | 2.333    6.71 |  3.33    3.79
               .500    4.59 | 1.500   31.91 | 2.500    5.90 |  3.50    3.55
               .667    5.58 | 1.667   17.31 | 2.667    5.28 |  3.67    3.35
               .833    7.26 | 1.833   12.14 | 2.833    4.79 |  3.83    3.17
              1.000   10.79 | 2.000    9.47 | 3.000    4.40 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .141

     PEAK FLOW       (cms)=    .036 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  16.596
     TOTAL RAINFALL   (mm)=  47.499
     RUNOFF COEFFICIENT   =    .349

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):       .20     .056     1.33    46.72
        + ID2= 2 (0001):       .74     .036     1.50    16.60
          ================================================
          ID = 3 (0005):       .94     .086     1.33    22.95

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------
| ADD HYD   (0006) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):       .19     .050     1.33    44.29
        + ID2= 2 (0005):       .94     .086     1.33    22.95
          ================================================
          ID = 3 (0006):      1.13     .136     1.33    26.54

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------
| ADD HYD   (0007) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0004):       .09     .024     1.33    44.29
        + ID2= 2 (0006):      1.13     .136     1.33    26.54
          ================================================
          ID = 3 (0007):      1.22     .159     1.33    27.85

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
  ****************************
  ** SIMULATION NUMBER:   4 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 926.900
| Ptotal= 56.03 mm |                          B=   5.000
--------------------                          C=    .762
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    4.04 |  1.17   28.70 |  2.17    9.15 |  3.17    4.77
                 .33    4.60 |  1.33  117.72 |  2.33    7.85 |  3.33    4.44
                 .50    5.37 |  1.50   37.22 |  2.50    6.90 |  3.50    4.16
                 .67    6.54 |  1.67   20.22 |  2.67    6.18 |  3.67    3.92
                 .83    8.49 |  1.83   14.18 |  2.83    5.61 |  3.83    3.71
                1.00   12.61 |  2.00   11.07 |  3.00    5.15 |  4.00    3.53
```

```
--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=    .09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .08          .01
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      24.50        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
```

```
                .083    4.04 | 1.083   28.70 | 2.083    9.15 |  3.08    4.77
                .167    4.04 | 1.167   28.70 | 2.167    9.15 |  3.17    4.77
                .250    4.60 | 1.250  117.72 | 2.250    7.85 |  3.25    4.44
                .333    4.60 | 1.333  117.72 | 2.333    7.85 |  3.33    4.44
                .417    5.37 | 1.417   37.22 | 2.417    6.90 |  3.42    4.16
                .500    5.37 | 1.500   37.22 | 2.500    6.90 |  3.50    4.16
                .583    6.54 | 1.583   20.22 | 2.583    6.18 |  3.58    3.92
                .667    6.54 | 1.667   20.22 | 2.667    6.18 |  3.67    3.92
                .750    8.49 | 1.750   14.18 | 2.750    5.61 |  3.75    3.71
                .833    8.49 | 1.833   14.18 | 2.833    5.61 |  3.83    3.71
                .917   12.61 | 1.917   11.07 | 2.917    5.15 |  3.92    3.53
               1.000   12.61 | 2.000   11.07 | 3.000    5.15 |  4.00    3.53

     Max.Eff.Inten.(mm/hr)=     117.72        49.58
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.03 (ii)    3.77 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .34          .25
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .03          .00          .028 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.33
     RUNOFF VOLUME    (mm)=      55.03        25.55        52.07
     TOTAL RAINFALL   (mm)=      56.03        56.03        56.03
     RUNOFF COEFFICIENT   =        .98          .46          .93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .19
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      35.60        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     117.72        49.58
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.29 (ii)    4.03 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .24
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .059 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.33
     RUNOFF VOLUME    (mm)=      55.03        25.55        52.06
     TOTAL RAINFALL   (mm)=      56.03        56.03        56.03
     RUNOFF COEFFICIENT   =        .98          .46          .93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0002) |   Area    (ha)=    .20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      36.50        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     117.72       247.88
```

```
                over (min)        5.00          5.00
     Storage Coeff.  (min)=       1.31 (ii)     2.36 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=        .33           .30
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .06           .00           .065 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.33          1.33
     RUNOFF VOLUME    (mm)=      55.03         25.55         54.72
     TOTAL RAINFALL   (mm)=      56.03         56.03         56.03
     RUNOFF COEFFICIENT   =        .98           .46           .98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=    .74   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    4.04 | 1.167   28.70 | 2.167    9.15 |  3.17    4.77
                .333    4.60 | 1.333  117.72 | 2.333    7.85 |  3.33    4.44
                .500    5.37 | 1.500   37.22 | 2.500    6.90 |  3.50    4.16
                .667    6.54 | 1.667   20.22 | 2.667    6.18 |  3.67    3.92
                .833    8.49 | 1.833   14.18 | 2.833    5.61 |  3.83    3.71
               1.000   12.61 | 2.000   11.07 | 3.000    5.15 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .141

     PEAK FLOW       (cms)=    .048 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  21.748
     TOTAL RAINFALL   (mm)=  55.439
     RUNOFF COEFFICIENT   =    .392

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .20    .065     1.33    54.72
        + ID2= 2 (0001):      .74    .048     1.50    21.75
          ================================================
          ID = 3 (0005):      .94    .106     1.33    28.70

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0006) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .19    .059     1.33    52.06
        + ID2= 2 (0005):      .94    .106     1.33    28.70
          ================================================
          ID = 3 (0006):     1.13    .164     1.33    32.63

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0007) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
```

```
--------------------          (ha)     (cms)     (hrs)      (mm)
          ID1= 1 (0004):       .09     .028      1.33     52.07
        + ID2= 2 (0006):      1.13     .164      1.33     32.63
          ================================================
          ID = 3 (0007):      1.22     .192      1.33     34.06

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   5 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1019.400
| Ptotal= 61.96 mm |                          B=   5.000
--------------------                          C=    .761
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    4.48 |  1.17   31.74 |  2.17   10.15 |  3.17    5.29
                 .33    5.10 |  1.33  129.82 |  2.33    8.70 |  3.33    4.93
                 .50    5.96 |  1.50   41.13 |  2.50    7.66 |  3.50    4.62
                 .67    7.25 |  1.67   22.38 |  2.67    6.86 |  3.67    4.35
                 .83    9.41 |  1.83   15.71 |  2.83    6.23 |  3.83    4.12
                1.00   13.97 |  2.00   12.26 |  3.00    5.71 |  4.00    3.91


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=    .09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .08          .01
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      24.50        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083    4.48 | 1.083   31.74 | 2.083   10.15 |  3.08    5.29
                .167    4.48 | 1.167   31.74 | 2.167   10.15 |  3.17    5.29
                .250    5.10 | 1.250  129.82 | 2.250    8.70 |  3.25    4.93
                .333    5.10 | 1.333  129.82 | 2.333    8.70 |  3.33    4.93
                .417    5.96 | 1.417   41.13 | 2.417    7.66 |  3.42    4.62
                .500    5.96 | 1.500   41.13 | 2.500    7.66 |  3.50    4.62
                .583    7.25 | 1.583   22.38 | 2.583    6.86 |  3.58    4.35
                .667    7.25 | 1.667   22.38 | 2.667    6.86 |  3.67    4.35
                .750    9.41 | 1.750   15.71 | 2.750    6.23 |  3.75    4.12
                .833    9.41 | 1.833   15.71 | 2.833    6.23 |  3.83    4.12
                .917   13.97 | 1.917   12.26 | 2.917    5.71 |  3.92    3.91
               1.000   13.97 | 2.000   12.26 | 3.000    5.71 |  4.00    3.91

     Max.Eff.Inten.(mm/hr)=     129.82        58.42
                over (min)        5.00         5.00
     Storage Coeff.  (min)=        .99 (ii)    3.63 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .34          .25
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .03          .00           .031 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      60.96        29.86         57.84
     TOTAL RAINFALL   (mm)=      61.96        61.96         61.96
     RUNOFF COEFFICIENT   =        .98          .48           .93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
```

```
           CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .19
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      35.60        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     129.82        58.42
               over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.24 (ii)    3.88 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .25
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .065 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      60.96        29.86         57.83
     TOTAL RAINFALL   (mm)=      61.96        61.96         61.96
     RUNOFF COEFFICIENT   =        .98          .48           .93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0002) |   Area    (ha)=    .20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      36.50        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     129.82       292.09
               over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.26 (ii)    2.27 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .30
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .07          .00          .072 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      60.96        29.86         60.64
     TOTAL RAINFALL   (mm)=      61.96        61.96         61.96
     RUNOFF COEFFICIENT   =        .98          .48           .98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=    .74   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.
```

```
                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    4.48 | 1.167   31.74 | 2.167   10.15 |  3.17    5.29
               .333    5.10 | 1.333  129.82 | 2.333    8.70 |  3.33    4.93
               .500    5.96 | 1.500   41.13 | 2.500    7.66 |  3.50    4.62
               .667    7.25 | 1.667   22.38 | 2.667    6.86 |  3.67    4.35
               .833    9.41 | 1.833   15.71 | 2.833    6.23 |  3.83    4.12
              1.000   13.97 | 2.000   12.26 | 3.000    5.71 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .141

     PEAK FLOW       (cms)=    .057 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  25.774
     TOTAL RAINFALL   (mm)=  61.305
     RUNOFF COEFFICIENT   =    .420

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):       .20    .072     1.33    60.64
        + ID2= 2 (0001):       .74    .057     1.50    25.77
          ================================================
          ID = 3 (0005):       .94    .121     1.33    33.12

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0006) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):       .19    .065     1.33    57.83
        + ID2= 2 (0005):       .94    .121     1.33    33.12
          ================================================
          ID = 3 (0006):      1.13    .186     1.33    37.28

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0007) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0004):       .09    .031     1.33    57.84
        + ID2= 2 (0006):      1.13    .186     1.33    37.28
          ================================================
          ID = 3 (0007):      1.22    .217     1.33    38.79

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1114.100
| Ptotal= 67.71 mm |                          B=   5.000
--------------------                          C=    .761
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =   .33

               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .17    4.90 |  1.17   34.68 |  2.17   11.09 |  3.17    5.78
                .33    5.58 |  1.33  141.88 |  2.33    9.51 |  3.33    5.39
                .50    6.52 |  1.50   44.96 |  2.50    8.37 |  3.50    5.05
```

.67	7.92	1.67	24.46	2.67	7.49	3.67	4.76
.83	10.29	1.83	17.17	2.83	6.80	3.83	4.50
1.00	15.27	2.00	13.40	3.00	6.24	4.00	4.28

CALIB			
STANDHYD (0004)	Area (ha)=	.09	
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.08	.01
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	24.50	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	4.90	1.083	34.68	2.083	11.09	3.08	5.78
.167	4.90	1.167	34.68	2.167	11.09	3.17	5.78
.250	5.58	1.250	141.88	2.250	9.51	3.25	5.39
.333	5.58	1.333	141.88	2.333	9.51	3.33	5.39
.417	6.52	1.417	44.96	2.417	8.37	3.42	5.05
.500	6.52	1.500	44.96	2.500	8.37	3.50	5.05
.583	7.92	1.583	24.46	2.583	7.49	3.58	4.76
.667	7.92	1.667	24.46	2.667	7.49	3.67	4.76
.750	10.29	1.750	17.17	2.750	6.80	3.75	4.50
.833	10.29	1.833	17.17	2.833	6.80	3.83	4.50
.917	15.27	1.917	13.40	2.917	6.24	3.92	4.28
1.000	15.27	2.000	13.40	3.000	6.24	4.00	4.28

Max.Eff.Inten.(mm/hr)=	141.88	67.54		
over (min)	5.00	5.00		
Storage Coeff. (min)=	.96 (ii)	3.50 (ii)		
Unit Hyd. Tpeak (min)=	5.00	5.00		
Unit Hyd. peak (cms)=	.34	.26		
			TOTALS	
PEAK FLOW (cms)=	.03	.00	.034 (iii)	
TIME TO PEAK (hrs)=	1.33	1.33	1.33	
RUNOFF VOLUME (mm)=	66.71	34.18	63.45	
TOTAL RAINFALL (mm)=	67.71	67.71	67.71	
RUNOFF COEFFICIENT =	.99	.50	.94	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0003)	Area (ha)=	.19	
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.17	.02
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	35.60	40.00
Mannings n	=	.013	.250

Max.Eff.Inten.(mm/hr)=	141.88	67.54		
over (min)	5.00	5.00		
Storage Coeff. (min)=	1.20 (ii)	3.74 (ii)		
Unit Hyd. Tpeak (min)=	5.00	5.00		
Unit Hyd. peak (cms)=	.33	.25		
			TOTALS	
PEAK FLOW (cms)=	.07	.00	.071 (iii)	
TIME TO PEAK (hrs)=	1.33	1.33	1.33	
RUNOFF VOLUME (mm)=	66.71	34.18	63.45	
TOTAL RAINFALL (mm)=	67.71	67.71	67.71	

```
     RUNOFF COEFFICIENT   =        .99          .50           .94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0002) |   Area    (ha)=    .20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      36.50        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     141.88       337.68
               over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.21 (ii)    2.19 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .31
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .08          .00          .078 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      66.71        34.18         66.38
     TOTAL RAINFALL   (mm)=      67.71        67.71         67.71
     RUNOFF COEFFICIENT   =        .99          .50           .98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=    .74   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    4.90 | 1.167   34.68 | 2.167   11.09 |  3.17    5.78
               .333    5.58 | 1.333  141.88 | 2.333    9.51 |  3.33    5.39
               .500    6.52 | 1.500   44.96 | 2.500    8.37 |  3.50    5.05
               .667    7.92 | 1.667   24.46 | 2.667    7.49 |  3.67    4.76
               .833   10.29 | 1.833   17.17 | 2.833    6.80 |  3.83    4.50
              1.000   15.27 | 2.000   13.40 | 3.000    6.24 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .141

     PEAK FLOW       (cms)=    .067 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  29.833
     TOTAL RAINFALL   (mm)=  67.000
     RUNOFF COEFFICIENT   =    .445

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .20    .078     1.33    66.38
```

```
        + ID2= 2 (0001):      .74    .067     1.50    29.83
          ================================================
          ID = 3 (0005):      .94    .137     1.33    37.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0006) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .19    .071     1.33    63.45
        + ID2= 2 (0005):      .94    .137     1.33    37.53
          ================================================
          ID = 3 (0006):     1.13    .208     1.33    41.89

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0007) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0004):      .09    .034     1.33    63.45
        + ID2= 2 (0006):     1.13    .208     1.33    41.89
          ================================================
          ID = 3 (0007):     1.22    .242     1.33    43.48

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

 FINISH
================================================================================================================================
```

Post-Development Visual OTTHYMO Model Output (2-year to 100-year storms)

```
================================================================================================================

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO

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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.3\voin.dat
  Output  filename: P:\2018\18204\Visual OTTHYMO\Rev0.1\18204 vo2\Post-Development.out
  Summary filename: P:\2018\18204\Visual OTTHYMO\Rev0.1\18204 vo2\Post-Development.sum


DATE: 9/13/2018                           TIME: 11:16:48 AM

USER:


COMMENTS: _____________________________________________________

----------------------------------------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 592.600
| Ptotal= 32.34 mm |                          B=   6.000
--------------------                          C=    .780
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.21 |  1.17   17.15 |  2.17    5.20 |  3.17    2.63
                 .33    2.53 |  1.33   68.16 |  2.33    4.43 |  3.33    2.44
                 .50    2.98 |  1.50   22.38 |  2.50    3.87 |  3.50    2.28
                 .67    3.65 |  1.67   11.94 |  2.67    3.45 |  3.67    2.14
                 .83    4.81 |  1.83    8.24 |  2.83    3.11 |  3.83    2.02
                1.00    7.29 |  2.00    6.35 |  3.00    2.85 |  4.00    1.92


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .14          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      32.70        40.00
     Mannings n             =     .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    2.21 | 1.083   17.15 | 2.083    5.20 |  3.08    2.63
               .167    2.21 | 1.167   17.15 | 2.167    5.20 |  3.17    2.63
               .250    2.53 | 1.250   68.16 | 2.250    4.43 |  3.25    2.44
               .333    2.53 | 1.333   68.16 | 2.333    4.43 |  3.33    2.44
               .417    2.98 | 1.417   22.38 | 2.417    3.87 |  3.42    2.28
               .500    2.98 | 1.500   22.38 | 2.500    3.87 |  3.50    2.28
               .583    3.65 | 1.583   11.94 | 2.583    3.45 |  3.58    2.14
               .667    3.65 | 1.667   11.94 | 2.667    3.45 |  3.67    2.14
               .750    4.81 | 1.750    8.24 | 2.750    3.11 |  3.75    2.02
               .833    4.81 | 1.833    8.24 | 2.833    3.11 |  3.83    2.02
               .917    7.29 | 1.917    6.35 | 2.917    2.85 |  3.92    1.92
              1.000    7.29 | 2.000    6.35 | 3.000    2.85 |  4.00    1.92

     Max.Eff.Inten.(mm/hr)=      68.16        18.95
                 over (min)       5.00         5.00
     Storage Coeff.  (min)=       1.52 (ii)    4.94 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .00          .028 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      31.34        10.36         29.23
     TOTAL RAINFALL   (mm)=      32.34        32.34         32.34
     RUNOFF COEFFICIENT   =        .97          .32           .90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=    .37   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    2.21 | 1.167   17.15 | 2.167    5.20 |  3.17    2.63
               .333    2.53 | 1.333   68.16 | 2.333    4.43 |  3.33    2.44
               .500    2.98 | 1.500   22.38 | 2.500    3.87 |  3.50    2.28
               .667    3.65 | 1.667   11.94 | 2.667    3.45 |  3.67    2.14
               .833    4.81 | 1.833    8.24 | 2.833    3.11 |  3.83    2.02
              1.000    7.29 | 2.000    6.35 | 3.000    2.85 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .071

     PEAK FLOW       (cms)=    .008 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   7.855
     TOTAL RAINFALL   (mm)=  32.020
     RUNOFF COEFFICIENT   =    .245

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=    .65
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .64          .01
     Dep. Storage     (mm)=      1.00         1.00
     Average Slope     (%)=      1.00         2.00
     Length            (m)=     65.80        40.00
     Mannings n           =      .013         .250
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.21	1.083	17.15	2.083	5.20	3.08	2.63
.167	2.21	1.167	17.15	2.167	5.20	3.17	2.63
.250	2.53	1.250	68.16	2.250	4.43	3.25	2.44
.333	2.53	1.333	68.16	2.333	4.43	3.33	2.44
.417	2.98	1.417	22.38	2.417	3.87	3.42	2.28
.500	2.98	1.500	22.38	2.500	3.87	3.50	2.28
.583	3.65	1.583	11.94	2.583	3.45	3.58	2.14
.667	3.65	1.667	11.94	2.667	3.45	3.67	2.14
.750	4.81	1.750	8.24	2.750	3.11	3.75	2.02
.833	4.81	1.833	8.24	2.833	3.11	3.83	2.02
.917	7.29	1.917	6.35	2.917	2.85	3.92	1.92
1.000	7.29	2.000	6.35	3.000	2.85	4.00	1.92

			TOTALS
Max.Eff.Inten.(mm/hr)=	68.16	94.77	
over (min)	5.00	5.00	
Storage Coeff. (min)=	2.32 (ii)	3.63 (ii)	
Unit Hyd. Tpeak (min)=	5.00	5.00	
Unit Hyd. peak (cms)=	.30	.25	
PEAK FLOW (cms)=	.12	.00	.121 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	31.34	10.36	31.13
TOTAL RAINFALL (mm)=	32.34	32.34	32.34
RUNOFF COEFFICIENT =	.97	.32	.96

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0004)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0002):	.37	.008	1.50	7.85
	+ ID2= 2 (0001):	.65	.121	1.33	31.13
	ID = 3 (0004):	1.02	.127	1.33	22.68

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0005)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0003):	.16	.028	1.33	29.23
	+ ID2= 2 (0004):	1.02	.127	1.33	22.68
	ID = 3 (0005):	1.18	.155	1.33	23.57

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0006)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.1280	.0080
	.0350	.0020	.1670	.0100
	.0610	.0040	.1950	.0120
	.0790	.0060	.2260	.0145

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0005)	1.180	.155	1.33	23.57
OUTFLOW: ID= 1 (0006)	1.180	.090	1.42	23.56

```
                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 58.28
                  TIME SHIFT OF PEAK FLOW          (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=   .0068

--------------------------------------------------------------------------------
  ***************************
  ** SIMULATION NUMBER:   2 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 697.400
| Ptotal= 41.69 mm |                          B=   5.000
--------------------                          C=    .764
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .17    2.98 |  1.17   21.37 |  2.17    6.78 |  3.17    3.52
                .33    3.40 |  1.33   88.09 |  2.33    5.81 |  3.33    3.28
                .50    3.97 |  1.50   27.73 |  2.50    5.11 |  3.50    3.08
                .67    4.84 |  1.67   15.03 |  2.67    4.57 |  3.67    2.90
                .83    6.29 |  1.83   10.53 |  2.83    4.15 |  3.83    2.74
               1.00    9.36 |  2.00    8.21 |  3.00    3.81 |  4.00    2.60


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .14          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      32.70        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                           ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    2.98 | 1.083   21.37 | 2.083    6.78 |  3.08    3.52
               .167    2.98 | 1.167   21.37 | 2.167    6.78 |  3.17    3.52
               .250    3.40 | 1.250   88.09 | 2.250    5.81 |  3.25    3.28
               .333    3.40 | 1.333   88.09 | 2.333    5.81 |  3.33    3.28
               .417    3.97 | 1.417   27.73 | 2.417    5.11 |  3.42    3.08
               .500    3.97 | 1.500   27.73 | 2.500    5.11 |  3.50    3.08
               .583    4.84 | 1.583   15.03 | 2.583    4.57 |  3.58    2.90
               .667    4.84 | 1.667   15.03 | 2.667    4.57 |  3.67    2.90
               .750    6.29 | 1.750   10.53 | 2.750    4.15 |  3.75    2.74
               .833    6.29 | 1.833   10.53 | 2.833    4.15 |  3.83    2.74
               .917    9.36 | 1.917    8.21 | 2.917    3.81 |  3.92    2.60
              1.000    9.36 | 2.000    8.21 | 3.000    3.81 |  4.00    2.60

     Max.Eff.Inten.(mm/hr)=      88.09        30.00
                 over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.37 (ii)    4.46 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .23
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .037 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.33
     RUNOFF VOLUME    (mm)=      40.69        15.89        38.20
     TOTAL RAINFALL   (mm)=      41.69        41.69        41.69
     RUNOFF COEFFICIENT   =        .98          .38          .92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
```

(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0002)	Area (ha)= .37	Curve Number (CN)= 80.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .20		

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	2.98	1.167	21.37	2.167	6.78	3.17	3.52
.333	3.40	1.333	88.09	2.333	5.81	3.33	3.28
.500	3.97	1.500	27.73	2.500	5.11	3.50	3.08
.667	4.84	1.667	15.03	2.667	4.57	3.67	2.90
.833	6.29	1.833	10.53	2.833	4.15	3.83	2.74
1.000	9.36	2.000	8.21	3.000	3.81	4.00	.00

Unit Hyd Qpeak (cms)= .071

PEAK FLOW (cms)= .014 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 12.835
TOTAL RAINFALL (mm)= 41.259
RUNOFF COEFFICIENT = .311

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0001)	Area (ha)= .65		
ID= 1 DT= 5.0 min	Total Imp(%)= 99.00	Dir. Conn.(%)= 99.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.64	.01
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	65.80	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.98	1.083	21.37	2.083	6.78	3.08	3.52
.167	2.98	1.167	21.37	2.167	6.78	3.17	3.52
.250	3.40	1.250	88.09	2.250	5.81	3.25	3.28
.333	3.40	1.333	88.09	2.333	5.81	3.33	3.28
.417	3.97	1.417	27.73	2.417	5.11	3.42	3.08
.500	3.97	1.500	27.73	2.500	5.11	3.50	3.08
.583	4.84	1.583	15.03	2.583	4.57	3.58	2.90
.667	4.84	1.667	15.03	2.667	4.57	3.67	2.90
.750	6.29	1.750	10.53	2.750	4.15	3.75	2.74
.833	6.29	1.833	10.53	2.833	4.15	3.83	2.74
.917	9.36	1.917	8.21	2.917	3.81	3.92	2.60
1.000	9.36	2.000	8.21	3.000	3.81	4.00	2.60

Max.Eff.Inten.(mm/hr)=		88.09	150.02	
over (min)		5.00	5.00	
Storage Coeff. (min)=		2.09 (ii)	3.27 (ii)	
Unit Hyd. Tpeak (min)=		5.00	5.00	
Unit Hyd. peak (cms)=		.31	.27	
				TOTALS
PEAK FLOW	(cms)=	.16	.00	.157 (iii)
TIME TO PEAK	(hrs)=	1.33	1.33	1.33
RUNOFF VOLUME	(mm)=	40.69	15.89	40.44
TOTAL RAINFALL	(mm)=	41.69	41.69	41.69
RUNOFF COEFFICIENT	=	.98	.38	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)

```
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD   (0004) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .37    .014     1.50    12.83
        + ID2= 2 (0001):      .65    .157     1.33    40.44
          ================================================
          ID = 3 (0004):     1.02    .168     1.33    30.43

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .16    .037     1.33    38.20
        + ID2= 2 (0004):     1.02    .168     1.33    30.43
          ================================================
          ID = 3 (0005):     1.18    .205     1.33    31.48

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000    |    .1280       .0080
                           .0350      .0020    |    .1670       .0100
                           .0610      .0040    |    .1950       .0120
                           .0790      .0060    |    .2260       .0145

                                 AREA      QPEAK       TPEAK       R.V.
                                 (ha)      (cms)       (hrs)       (mm)
     INFLOW : ID= 2 (0005)      1.180       .205        1.33       31.48
     OUTFLOW: ID= 1 (0006)      1.180       .129        1.42       31.47

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 62.99
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=   .0087

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  ***************************
  ** SIMULATION NUMBER:   3 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 798.500
| Ptotal= 48.00 mm |                          B=   5.000
--------------------                          C=    .763
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .17    3.45 |  1.17   24.60 |  2.17    7.83 |  3.17    4.07
                .33    3.93 |  1.33  101.14 |  2.33    6.71 |  3.33    3.79
                .50    4.59 |  1.50   31.91 |  2.50    5.90 |  3.50    3.55
                .67    5.58 |  1.67   17.31 |  2.67    5.28 |  3.67    3.35
                .83    7.26 |  1.83   12.14 |  2.83    4.79 |  3.83    3.17
               1.00   10.79 |  2.00    9.47 |  3.00    4.40 |  4.00    3.01


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--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
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--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .14          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      32.70        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    3.45 | 1.083   24.60 | 2.083    7.83 |  3.08    4.07
               .167    3.45 | 1.167   24.60 | 2.167    7.83 |  3.17    4.07
               .250    3.93 | 1.250  101.14 | 2.250    6.71 |  3.25    3.79
               .333    3.93 | 1.333  101.14 | 2.333    6.71 |  3.33    3.79
               .417    4.59 | 1.417   31.91 | 2.417    5.90 |  3.42    3.55
               .500    4.59 | 1.500   31.91 | 2.500    5.90 |  3.50    3.55
               .583    5.58 | 1.583   17.31 | 2.583    5.28 |  3.58    3.35
               .667    5.58 | 1.667   17.31 | 2.667    5.28 |  3.67    3.35
               .750    7.26 | 1.750   12.14 | 2.750    4.79 |  3.75    3.17
               .833    7.26 | 1.833   12.14 | 2.833    4.79 |  3.83    3.17
               .917   10.79 | 1.917    9.47 | 2.917    4.40 |  3.92    3.01
              1.000   10.79 | 2.000    9.47 | 3.000    4.40 |  4.00    3.01

     Max.Eff.Inten.(mm/hr)=     101.14        38.24
               over (min)          5.00         5.00
     Storage Coeff.  (min)=       1.30 (ii)    4.22 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .33          .24
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .042 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      47.00        19.99         44.29
     TOTAL RAINFALL   (mm)=      48.00        48.00         48.00
     RUNOFF COEFFICIENT   =        .98          .42           .92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=    .37   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    3.45 | 1.167   24.60 | 2.167    7.83 |  3.17    4.07
               .333    3.93 | 1.333  101.14 | 2.333    6.71 |  3.33    3.79
               .500    4.59 | 1.500   31.91 | 2.500    5.90 |  3.50    3.55
               .667    5.58 | 1.667   17.31 | 2.667    5.28 |  3.67    3.35
               .833    7.26 | 1.833   12.14 | 2.833    4.79 |  3.83    3.17
              1.000   10.79 | 2.000    9.47 | 3.000    4.40 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .071

     PEAK FLOW       (cms)=    .018 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  16.596
     TOTAL RAINFALL   (mm)=  47.499
     RUNOFF COEFFICIENT   =    .349

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB            |
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| STANDHYD (0001) | Area (ha)= .65
|ID= 1 DT= 5.0 min | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.64	.01
Dep. Storage (mm)=	1.00	1.00
Average Slope (%)=	1.00	2.00
Length (m)=	65.80	40.00
Mannings n =	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	3.45	1.083	24.60	2.083	7.83	3.08	4.07
.167	3.45	1.167	24.60	2.167	7.83	3.17	4.07
.250	3.93	1.250	101.14	2.250	6.71	3.25	3.79
.333	3.93	1.333	101.14	2.333	6.71	3.33	3.79
.417	4.59	1.417	31.91	2.417	5.90	3.42	3.55
.500	4.59	1.500	31.91	2.500	5.90	3.50	3.55
.583	5.58	1.583	17.31	2.583	5.28	3.58	3.35
.667	5.58	1.667	17.31	2.667	5.28	3.67	3.35
.750	7.26	1.750	12.14	2.750	4.79	3.75	3.17
.833	7.26	1.833	12.14	2.833	4.79	3.83	3.17
.917	10.79	1.917	9.47	2.917	4.40	3.92	3.01
1.000	10.79	2.000	9.47	3.000	4.40	4.00	3.01

			TOTALS
Max.Eff.Inten.(mm/hr)=	101.14	191.19	
over (min)	5.00	5.00	
Storage Coeff. (min)=	1.98 (ii)	3.10 (ii)	
Unit Hyd. Tpeak (min)=	5.00	5.00	
Unit Hyd. peak (cms)=	.31	.27	
PEAK FLOW (cms)=	.18	.00	.181 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	47.00	19.99	46.73
TOTAL RAINFALL (mm)=	48.00	48.00	48.00
RUNOFF COEFFICIENT =	.98	.42	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0004)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0002):	.37	.018	1.50	16.60
	+ ID2= 2 (0001):	.65	.181	1.33	46.73
	ID = 3 (0004):	1.02	.196	1.33	35.80

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0005)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0003):	.16	.042	1.33	44.29
	+ ID2= 2 (0004):	1.02	.196	1.33	35.80
	ID = 3 (0005):	1.18	.238	1.33	36.95

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0006)					
IN= 2---> OUT= 1					
DT= 5.0 min	OUTFLOW	STORAGE	OUTFLOW	STORAGE	

	(cms)	(ha.m.)		(cms)	(ha.m.)
	.0000	.0000		.1280	.0080
	.0350	.0020		.1670	.0100
	.0610	.0040		.1950	.0120
	.0790	.0060		.2260	.0145

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0005)	1.180	.238	1.33	36.95
OUTFLOW: ID= 1 (0006)	1.180	.151	1.42	36.94

PEAK FLOW REDUCTION [Qout/Qin](%)= 63.67
TIME SHIFT OF PEAK FLOW (min)= 5.00
MAXIMUM STORAGE USED (ha.m.)= .0100

****
** SIMULATION NUMBER: 4 **
****

CHICAGO STORM	IDF curve parameters: A= 926.900
Ptotal= 56.03 mm	B= 5.000
	C= .762

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	4.04	1.17	28.70	2.17	9.15	3.17	4.77
.33	4.60	1.33	117.72	2.33	7.85	3.33	4.44
.50	5.37	1.50	37.22	2.50	6.90	3.50	4.16
.67	6.54	1.67	20.22	2.67	6.18	3.67	3.92
.83	8.49	1.83	14.18	2.83	5.61	3.83	3.71
1.00	12.61	2.00	11.07	3.00	5.15	4.00	3.53

CALIB	
STANDHYD (0003)	Area (ha)= .16
ID= 1 DT= 5.0 min	Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.14	.02
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	32.70	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	4.04	1.083	28.70	2.083	9.15	3.08	4.77
.167	4.04	1.167	28.70	2.167	9.15	3.17	4.77
.250	4.60	1.250	117.72	2.250	7.85	3.25	4.44
.333	4.60	1.333	117.72	2.333	7.85	3.33	4.44
.417	5.37	1.417	37.22	2.417	6.90	3.42	4.16
.500	5.37	1.500	37.22	2.500	6.90	3.50	4.16
.583	6.54	1.583	20.22	2.583	6.18	3.58	3.92
.667	6.54	1.667	20.22	2.667	6.18	3.67	3.92
.750	8.49	1.750	14.18	2.750	5.61	3.75	3.71
.833	8.49	1.833	14.18	2.833	5.61	3.83	3.71
.917	12.61	1.917	11.07	2.917	5.15	3.92	3.53
1.000	12.61	2.000	11.07	3.000	5.15	4.00	3.53

Max.Eff.Inten.	(mm/hr)=	117.72	49.58	
over	(min)	5.00	5.00	
Storage Coeff.	(min)=	1.22 (ii)	3.97 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	5.00	
Unit Hyd. peak	(cms)=	.33	.24	
				TOTALS
PEAK FLOW	(cms)=	.05	.00	.049 (iii)
TIME TO PEAK	(hrs)=	1.33	1.33	1.33

```
     RUNOFF VOLUME     (mm)=      55.03        25.55          52.07
     TOTAL RAINFALL    (mm)=      56.03        56.03          56.03
     RUNOFF COEFFICIENT   =        .98          .46            .93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=    .37   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    4.04 | 1.167   28.70 | 2.167    9.15 |  3.17    4.77
                .333    4.60 | 1.333  117.72 | 2.333    7.85 |  3.33    4.44
                .500    5.37 | 1.500   37.22 | 2.500    6.90 |  3.50    4.16
                .667    6.54 | 1.667   20.22 | 2.667    6.18 |  3.67    3.92
                .833    8.49 | 1.833   14.18 | 2.833    5.61 |  3.83    3.71
               1.000   12.61 | 2.000   11.07 | 3.000    5.15 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .071

     PEAK FLOW       (cms)=    .024 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  21.748
     TOTAL RAINFALL   (mm)=  55.439
     RUNOFF COEFFICIENT   =    .392

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=    .65
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .64          .01
     Dep. Storage     (mm)=      1.00         1.00
     Average Slope     (%)=      1.00         2.00
     Length            (m)=     65.80        40.00
     Mannings n           =      .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083    4.04 | 1.083   28.70 | 2.083    9.15 |  3.08    4.77
                .167    4.04 | 1.167   28.70 | 2.167    9.15 |  3.17    4.77
                .250    4.60 | 1.250  117.72 | 2.250    7.85 |  3.25    4.44
                .333    4.60 | 1.333  117.72 | 2.333    7.85 |  3.33    4.44
                .417    5.37 | 1.417   37.22 | 2.417    6.90 |  3.42    4.16
                .500    5.37 | 1.500   37.22 | 2.500    6.90 |  3.50    4.16
                .583    6.54 | 1.583   20.22 | 2.583    6.18 |  3.58    3.92
                .667    6.54 | 1.667   20.22 | 2.667    6.18 |  3.67    3.92
                .750    8.49 | 1.750   14.18 | 2.750    5.61 |  3.75    3.71
                .833    8.49 | 1.833   14.18 | 2.833    5.61 |  3.83    3.71
                .917   12.61 | 1.917   11.07 | 2.917    5.15 |  3.92    3.53
               1.000   12.61 | 2.000   11.07 | 3.000    5.15 |  4.00    3.53

     Max.Eff.Inten.(mm/hr)=     117.72       247.88
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.86 (ii)    2.91 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .32          .28
                                                      *TOTALS*
```

```
     PEAK FLOW       (cms)=        .21          .00          .211 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      55.03        25.55         54.73
     TOTAL RAINFALL   (mm)=      56.03        56.03         56.03
     RUNOFF COEFFICIENT   =        .98          .46           .98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0004) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .37    .024     1.50    21.75
        + ID2= 2 (0001):      .65    .211     1.33    54.73
          ================================================
          ID = 3 (0004):     1.02    .231     1.33    42.77

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .16    .049     1.33    52.07
        + ID2= 2 (0004):     1.02    .231     1.33    42.77
          ================================================
          ID = 3 (0005):     1.18    .280     1.33    44.03

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |    (cms)     (ha.m.)
                          .0000      .0000    |    .1280       .0080
                          .0350      .0020    |    .1670       .0100
                          .0610      .0040    |    .1950       .0120
                          .0790      .0060    |    .2260       .0145

                                AREA      QPEAK       TPEAK       R.V.
                                (ha)      (cms)       (hrs)       (mm)
     INFLOW : ID= 2 (0005)     1.180       .280        1.33       44.03
     OUTFLOW: ID= 1 (0006)     1.180       .179        1.42       44.02

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 63.73
                   TIME SHIFT OF PEAK FLOW         (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .0118

--------------------------------------------------------------------------------
  ***************************
  ** SIMULATION NUMBER:   5 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1019.400
| Ptotal= 61.96 mm |                          B=   5.000
--------------------                          C=    .761
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    4.48 |  1.17   31.74 |  2.17   10.15 |  3.17    5.29
                 .33    5.10 |  1.33  129.82 |  2.33    8.70 |  3.33    4.93
                 .50    5.96 |  1.50   41.13 |  2.50    7.66 |  3.50    4.62
```

.67	7.25	1.67	22.38	2.67	6.86	3.67	4.35
.83	9.41	1.83	15.71	2.83	6.23	3.83	4.12
1.00	13.97	2.00	12.26	3.00	5.71	4.00	3.91

CALIB			
STANDHYD (0003)	Area (ha)=	.16	
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.14	.02
Dep. Storage	(mm)=	1.00	1.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	32.70	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	4.48	1.083	31.74	2.083	10.15	3.08	5.29
.167	4.48	1.167	31.74	2.167	10.15	3.17	5.29
.250	5.10	1.250	129.82	2.250	8.70	3.25	4.93
.333	5.10	1.333	129.82	2.333	8.70	3.33	4.93
.417	5.96	1.417	41.13	2.417	7.66	3.42	4.62
.500	5.96	1.500	41.13	2.500	7.66	3.50	4.62
.583	7.25	1.583	22.38	2.583	6.86	3.58	4.35
.667	7.25	1.667	22.38	2.667	6.86	3.67	4.35
.750	9.41	1.750	15.71	2.750	6.23	3.75	4.12
.833	9.41	1.833	15.71	2.833	6.23	3.83	4.12
.917	13.97	1.917	12.26	2.917	5.71	3.92	3.91
1.000	13.97	2.000	12.26	3.000	5.71	4.00	3.91

Max.Eff.Inten.(mm/hr)=	129.82	58.42		
over (min)	5.00	5.00		
Storage Coeff. (min)=	1.18 (ii)	3.82 (ii)		
Unit Hyd. Tpeak (min)=	5.00	5.00		
Unit Hyd. peak (cms)=	.33	.25		
			TOTALS	
PEAK FLOW (cms)=	.05	.00	.055 (iii)	
TIME TO PEAK (hrs)=	1.33	1.33	1.33	
RUNOFF VOLUME (mm)=	60.96	29.86	57.83	
TOTAL RAINFALL (mm)=	61.96	61.96	61.96	
RUNOFF COEFFICIENT =	.98	.48	.93	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0002)	Area	(ha)=	.37	Curve Number (CN)=	80.0
ID= 1 DT=10.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.20		

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	4.48	1.167	31.74	2.167	10.15	3.17	5.29
.333	5.10	1.333	129.82	2.333	8.70	3.33	4.93
.500	5.96	1.500	41.13	2.500	7.66	3.50	4.62
.667	7.25	1.667	22.38	2.667	6.86	3.67	4.35
.833	9.41	1.833	15.71	2.833	6.23	3.83	4.12
1.000	13.97	2.000	12.26	3.000	5.71	4.00	.00

Unit Hyd Qpeak (cms)= .071

PEAK FLOW (cms)= .029 (i)

```
     TIME TO PEAK     (hrs)=   1.500
     RUNOFF VOLUME     (mm)=  25.774
     TOTAL RAINFALL    (mm)=  61.305
     RUNOFF COEFFICIENT   =    .420

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=    .65
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .64          .01
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      65.80        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    4.48 | 1.083   31.74 | 2.083   10.15 |  3.08    5.29
               .167    4.48 | 1.167   31.74 | 2.167   10.15 |  3.17    5.29
               .250    5.10 | 1.250  129.82 | 2.250    8.70 |  3.25    4.93
               .333    5.10 | 1.333  129.82 | 2.333    8.70 |  3.33    4.93
               .417    5.96 | 1.417   41.13 | 2.417    7.66 |  3.42    4.62
               .500    5.96 | 1.500   41.13 | 2.500    7.66 |  3.50    4.62
               .583    7.25 | 1.583   22.38 | 2.583    6.86 |  3.58    4.35
               .667    7.25 | 1.667   22.38 | 2.667    6.86 |  3.67    4.35
               .750    9.41 | 1.750   15.71 | 2.750    6.23 |  3.75    4.12
               .833    9.41 | 1.833   15.71 | 2.833    6.23 |  3.83    4.12
               .917   13.97 | 1.917   12.26 | 2.917    5.71 |  3.92    3.91
              1.000   13.97 | 2.000   12.26 | 3.000    5.71 |  4.00    3.91

     Max.Eff.Inten.(mm/hr)=     129.82       292.09
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.79 (ii)    2.80 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .32          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .23          .00          .233 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      60.96        29.86         60.65
     TOTAL RAINFALL   (mm)=      61.96        61.96         61.96
     RUNOFF COEFFICIENT   =        .98          .48           .98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0004) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (0002):      .37    .029     1.50    25.77
       + ID2= 2 (0001):      .65    .233     1.33    60.65
         ================================================
         ID = 3 (0004):     1.02    .257     1.33    48.00

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (0003):      .16    .055     1.33    57.83
       + ID2= 2 (0004):     1.02    .257     1.33    48.00
```

```
          ================================================
          ID = 3 (0005):     1.18    .312     1.33    49.33

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1280       .0080
                           .0350      .0020   |    .1670       .0100
                           .0610      .0040   |    .1950       .0120
                           .0790      .0060   |    .2260       .0145

                                  AREA      QPEAK       TPEAK       R.V.
                                  (ha)      (cms)       (hrs)       (mm)
     INFLOW : ID= 2 (0005)      1.180       .312        1.33       49.33
     OUTFLOW: ID= 1 (0006)      1.180       .197        1.42       49.32

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 63.11
                    TIME SHIFT OF PEAK FLOW         (min)=  5.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=   .0132

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1114.100
| Ptotal= 67.71 mm |                          B=   5.000
--------------------                          C=    .761
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    4.90 |  1.17   34.68 |  2.17   11.09 |  3.17    5.78
                 .33    5.58 |  1.33  141.88 |  2.33    9.51 |  3.33    5.39
                 .50    6.52 |  1.50   44.96 |  2.50    8.37 |  3.50    5.05
                 .67    7.92 |  1.67   24.46 |  2.67    7.49 |  3.67    4.76
                 .83   10.29 |  1.83   17.17 |  2.83    6.80 |  3.83    4.50
                1.00   15.27 |  2.00   13.40 |  3.00    6.24 |  4.00    4.28


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--------------------
| CALIB            |
| STANDHYD  (0003) |   Area    (ha)=    .16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .14          .02
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      32.70        40.00
     Mannings n             =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083    4.90 | 1.083   34.68 | 2.083   11.09 |  3.08    5.78
                .167    4.90 | 1.167   34.68 | 2.167   11.09 |  3.17    5.78
                .250    5.58 | 1.250  141.88 | 2.250    9.51 |  3.25    5.39
                .333    5.58 | 1.333  141.88 | 2.333    9.51 |  3.33    5.39
                .417    6.52 | 1.417   44.96 | 2.417    8.37 |  3.42    5.05
                .500    6.52 | 1.500   44.96 | 2.500    8.37 |  3.50    5.05
                .583    7.92 | 1.583   24.46 | 2.583    7.49 |  3.58    4.76
                .667    7.92 | 1.667   24.46 | 2.667    7.49 |  3.67    4.76
                .750   10.29 | 1.750   17.17 | 2.750    6.80 |  3.75    4.50
                .833   10.29 | 1.833   17.17 | 2.833    6.80 |  3.83    4.50
                .917   15.27 | 1.917   13.40 | 2.917    6.24 |  3.92    4.28
```

```
               1.000   15.27 | 2.000   13.40 | 3.000    6.24 |  4.00    4.28

     Max.Eff.Inten.(mm/hr)=     141.88        67.54
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.14 (ii)    3.68 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .34          .25
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .060 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      66.71        34.18         63.45
     TOTAL RAINFALL   (mm)=      67.71        67.71         67.71
     RUNOFF COEFFICIENT   =        .99          .50           .94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD    (0002) |   Area    (ha)=    .37   Curve Number   (CN)= 80.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    4.90 | 1.167   34.68 | 2.167   11.09 |  3.17    5.78
                .333    5.58 | 1.333  141.88 | 2.333    9.51 |  3.33    5.39
                .500    6.52 | 1.500   44.96 | 2.500    8.37 |  3.50    5.05
                .667    7.92 | 1.667   24.46 | 2.667    7.49 |  3.67    4.76
                .833   10.29 | 1.833   17.17 | 2.833    6.80 |  3.83    4.50
               1.000   15.27 | 2.000   13.40 | 3.000    6.24 |  4.00     .00

     Unit Hyd Qpeak  (cms)=    .071

     PEAK FLOW       (cms)=    .033 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  29.833
     TOTAL RAINFALL   (mm)=  67.000
     RUNOFF COEFFICIENT   =    .445

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0001) |   Area    (ha)=    .65
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .64          .01
     Dep. Storage     (mm)=       1.00         1.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      65.80        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083    4.90 | 1.083   34.68 | 2.083   11.09 |  3.08    5.78
                .167    4.90 | 1.167   34.68 | 2.167   11.09 |  3.17    5.78
                .250    5.58 | 1.250  141.88 | 2.250    9.51 |  3.25    5.39
                .333    5.58 | 1.333  141.88 | 2.333    9.51 |  3.33    5.39
                .417    6.52 | 1.417   44.96 | 2.417    8.37 |  3.42    5.05
                .500    6.52 | 1.500   44.96 | 2.500    8.37 |  3.50    5.05
                .583    7.92 | 1.583   24.46 | 2.583    7.49 |  3.58    4.76
                .667    7.92 | 1.667   24.46 | 2.667    7.49 |  3.67    4.76
                .750   10.29 | 1.750   17.17 | 2.750    6.80 |  3.75    4.50
```

```
                .833   10.29 | 1.833   17.17 | 2.833    6.80 |  3.83    4.50
                .917   15.27 | 1.917   13.40 | 2.917    6.24 |  3.92    4.28
               1.000   15.27 | 2.000   13.40 | 3.000    6.24 |  4.00    4.28

     Max.Eff.Inten.(mm/hr)=     141.88       337.68
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.73 (ii)    2.70 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=        .32          .29
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .25          .00          .254 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      66.71        34.18         66.39
     TOTAL RAINFALL   (mm)=      67.71        67.71         67.71
     RUNOFF COEFFICIENT   =        .99          .50           .98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0004) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0002):      .37    .033     1.50    29.83
        + ID2= 2 (0001):      .65    .254     1.33    66.39
          ================================================
          ID = 3 (0004):     1.02    .284     1.33    53.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0003):      .16    .060     1.33    63.45
        + ID2= 2 (0004):     1.02    .284     1.33    53.13
          ================================================
          ID = 3 (0005):     1.18    .343     1.33    54.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000    |    .1280       .0080
                           .0350      .0020    |    .1670       .0100
                           .0610      .0040    |    .1950       .0120
                           .0790      .0060    |    .2260       .0145

                                 AREA      QPEAK       TPEAK       R.V.
                                 (ha)      (cms)       (hrs)       (mm)
     INFLOW : ID= 2 (0005)      1.180       .343        1.33       54.53
     OUTFLOW: ID= 1 (0006)      1.180       .213        1.42       54.52

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 61.96
                   TIME SHIFT OF PEAK FLOW         (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .0145

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 FINISH
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ETV Canada Verified

The Stormceptor® STC

Technology Fact Sheet for Imbrium Systems Inc.

Performance Claim

The Stormceptor® STC is capable of removing the following pollutants from stormwater runoff when designed in accordance with the PCSWMM for Stormceptor:

- Total Suspended Solids (TSS) overall loading removal range from 76% to 94%
- Total Kjeldahl Nitrogen (TKN) overall loading removal range from 43% to 65%

The TSS claim is based on three overall loading tests performed at three geographically different sites. Site 1 included eight rain events, site 2 had three rain events and site 3 had four rain events. The rain events varied in intensity and duration.

The TKN claim is based on two overall loading tests performed at two geographically different sites. Site 1 included eight rain events and site 3 had four rain events. The rain events varied in intensity and duration.

Simulations produced by the PCSWMM for Stormceptor are based on runoff that is generated from a stabilized catchment with all areas covered by vegetation, concrete, asphalt, structures and/or other non-erodible surfaces.

Technology Application

The patented Stormceptor® STC is a stormwater quality treatment device that can be installed in place of a conventional maintenance hole in a storm drainage system.

The Stormceptor® STC is a vertically oriented precast concrete cylindrical chamber that is separated into upper and lower compartments by a fiberglass insert.

Technology Operation

Stormceptor® STC flows into the upper by-pass chamber from the sewer. Inflows less than the design flow rate are diverted by a weir and orifice/drop pipe-assembly through the fibreglass insert into the lower treatment chamber. The drop pipe discharges water parallel to the circular chamber wall to increase detention time and inhibit mixing. From the treatment chamber, water flows up through the riser pipe into the by-pass chamber on the downstream side of the weir and is discharged into the storm sewer.

The water velocity slows when it enters the treatment chamber. Oil or other liquids with a specific gravity less than water will rise and become trapped beneath the fiberglass insert. These pollutants are retained in the treatment chamber because the entrance to the outlet riser pipe is submerged. Sediment will settle to the bottom of the chamber by gravity.

Flows in excess of the orifice/drop pipe capacity will flow over the weir and into the downstream sewer. This action prevents high flows from entering the lower treatment chamber and ensures that captured pollutants are not resuspended.

Performance Claim Conditions

The conditions for this performance claim are as follows:

St. Paul, MN, COMO PARK - SITE 1 0.4 ha

	3 Aug 98	7 Aug 98	27 Aug 98	19 Sep 98	23 Sep 98	7 Sep 99	11 Sep 99	19 Sep 99	**OVERALL**
TSS in, kg	5.22	19.47	1.35	1.42	0.72	0.25	14.59	0.13	43.15
TSS out, kg	1.30	3.61	0.40	1.70	0.89	0.21	2.31	0.03	10.45
TSS removed, kg	3.92	15.86	0.95	-0.28	-0.17	0.04	12.28	0.10	**32.70**
removal % mass	75	81	70	-19	-24	16	84	77	**76**
TKN in, kg	0.188	0.141	0.011	0.153	0.011	0.013	0.486	0.002	1.005
TKN out, kg	0.166	0.055	0.012	0.066	0.011	0.001	0.091	0.001	0.345
TKN removed, kg	0.08	0.09	0.00	0.09	0.00	0.01	0.40	0.00	**0.66**
removal % mass	44	61	-9	57	0	92	81	50	**65**

Boston, MA, Westwood - SITE 2 0.3 ha

	5 Aug 97	21 Aug 97	29 Sep 97	**OVERALL**
TSS in, kg	0.185	0.099	0.120	0.404
TSS out, kg	0.002	0.008	0.013	0.023
TSS removed, kg	0.183	0.091	0.107	**0.381**
removal % mass	99	92	89	**94**
TKN in, kg	-	-	-	-
TKN out, kg				
TKN removed, kg	-	-	-	-
removal % mass	-	-	-	-

Seattle, WA, Seatac - SITE 3 0.4 ha

	13 Mar 99	25 Apr 99	3 May 99	28 Oct 99	**OVERALL**
TSS in, kg	1.891	0.699	0.296	7.401	10.287
TSS out, kg	0.658	0.315	0.093	0.308	1.373
TSS removed, kg	1.233	0.384	0.203	7.093	**8.914**
removal % mass	65	55	69	96	**87**
TKN in, kg	0.099	0.024	0.028	0.083	0.234
TKN out, kg	0.033	0.024	0.024	0.052	0.133
TKN removed, kg	0.066	0.000	0.004	0.031	**0.101**
removal % mass	67	0	14	37	**43**

The performance claim is based on the above data from three field studies conducted at three geographically different locations, comprising fourteen storm events of varying intensity (1 to 131 mm/hr, 1 to 24 hrs duration).

Verification

Testing was done by the following: Service Environmental & Engineering (St. Paul, MN site); Environmental Sampling Technology (Boston, MA site); Associated Earth Sciences Inc. (Seattle, WA site). The evaluation was conducted by Pollutech Group of Companies Inc. following the Canadian ETV Program's General Verification Protocol (March 2000).

What is the ETV Program?

The Canadian Environmental Technology Verification (ETV) Program is delivered by The Bloom Centre for Sustainability (BLOOM) under a license agreement from Environment Canada. The Canadian ETV Program is designed to support Canada's environment industry by providing credible and independent verification of technology performance claims.

Stormceptor® STC Contact Information:

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BLOOM
2070 Hadwen Road, Suite 101A
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Fax: (905) 822-3558
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www.etvcanada.ca

Printed March 2000 Revised March 2009 Revised May 2012 Expires March 2015

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter JF4-2-1

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

August 3, 2017
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The Jellyfish® Filter is an engineered stormwater quality treatment technology designed to remove a variety of stormwater pollutants including floatable trash and debris, oil, coarse and fine suspended sediments, and particulate-bound pollutants such as nutrients, heavy metals, and hydrocarbons. The Jellyfish Filter combines gravitational pre-treatment (sedimentation and floatation) and membrane filtration in a single compact structure. The system utilizes membrane filtration cartridges comprised of multiple pleated filter elements ("filtration tentacles") that provide high filtration surface area with the associated advantages of high flow rate, high sediment capacity, and low filtration flux rate.

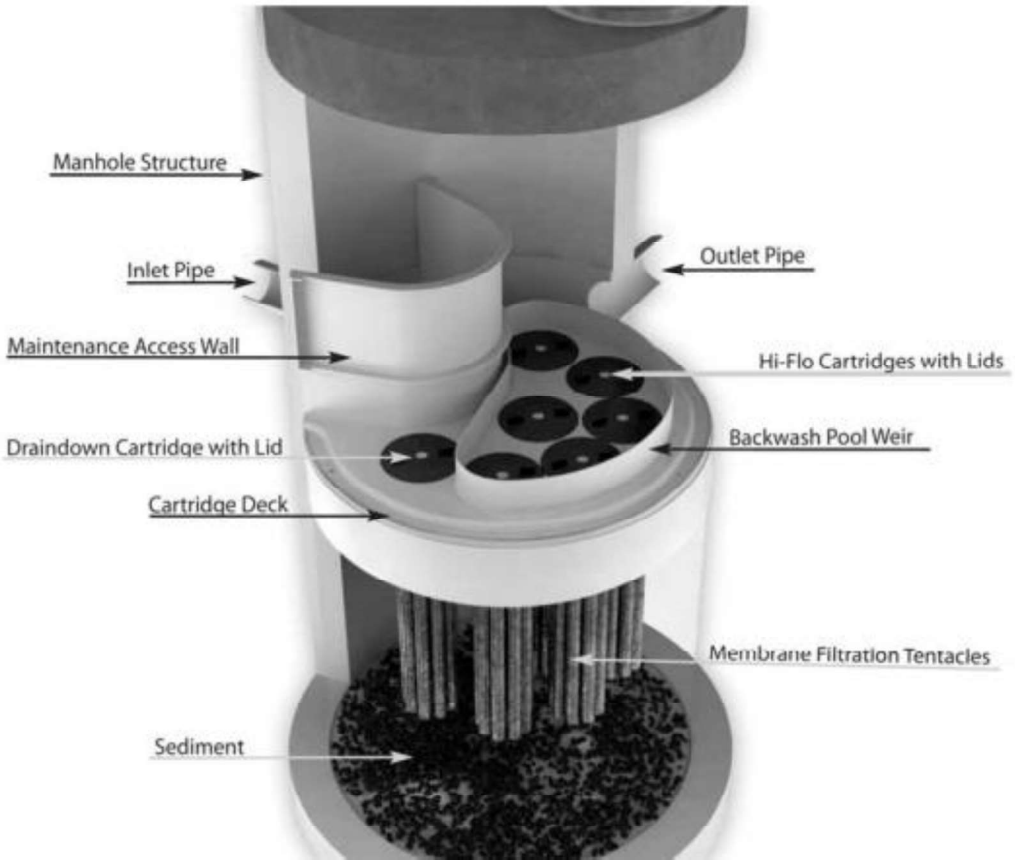

Figure 1. Cut-away graphic of a Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge

Figure 1 depicts a cut-away graphic of a typical 6-ft diameter Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge (JF6-6-1). Stormwater influent enters the system through the inlet pipe and builds a pond behind the maintenance access wall, with the pond elevation providing driving head. Flow is channeled downward into the lower chamber beneath the cartridge deck. A flexible separator skirt (not shown in the graphic) surrounds the filtration zone where the filtration tentacles of each cartridge are suspended, and the volume between the vessel wall and the outside surface of the separator skirt comprises a pretreatment channel. As flow spreads throughout the pretreatment channel, floatable pollutants accumulate at the surface of the pond behind the maintenance access wall and also beneath the cartridge deck in the pretreatment channel, while coarse sediments settle to the sump. Flow proceeds under the separator skirt and upward into the filtration zone, entering each filtration tentacle and depositing fine suspended sediment and associated particulate-bound pollutants on the outside surface of the membranes. Filtered water proceeds up the center tube of each tentacle, with the flow from each tentacle combining under the cartridge lid, and discharging to the top of the

cartridge deck through the cartridge lid orifice. Filtered effluent from the hi-flo cartridges enters a pool enclosed by a 15-cm high weir, and if storm intensity and resultant driving head is sufficient, filtered water overflows the weir and proceeds across the cartridge deck to the outlet pipe. Filtered effluent discharging from the draindown cartridge(s) passes directly to the outlet pipe, and requires only a minimal amount of driving head (2.5 cm) to provide forward flow. As storm intensity subsides and driving head drops below 15 cm, filtered water within the backwash pool reverses direction and passes backward through the hi-flo cartridges, and thereby dislodges sediment from the membranes which subsequently settles to the sump below the filtration zone. During this passive backwashing process, water in the lower chamber is displaced only through the draindown cartridge(s). Additional self-cleaning processes include gravity, as well as vibrational pulses emitted when flow exits the orifice of each cartridge lid, and these combined processes significantly extend the cartridge service life and maintenance cleaning interval. Sediment removal from the sump by vacuum is required when sediment depths reach 30 cm, and cartridges are typically removed, externally rinsed, and recommissioned on an annual basis, or as site-specific maintenance conditions require. Filtration tentacle replacement is typically required every 3 – 5 years.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from a field monitoring program conducted on a Jellyfish® Filter JF4-2-1 (4-ft diameter manhole with 2 hi-flo cartridges and 1 draindown cartridge), in accordance with the provisions of the TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements—Amendments to TARP Tier II Protocol (NJDEP, 2009). Testing was completed by researchers led by Dr. John Sansalone at the University of Florida's Engineering School of Sustainable Infrastructure and Environment. The drainage area providing stormwater runoff to the test unit varied between 502 m^2 and 799 m^2 (5400 ft^2 to 8600 ft^2) depending on storm intensity and wind direction. The unit was monitored for a total of 25 TARP qualifying storm events (i.e. $\geq$ 2.5 mm of rainfall) contributing cumulative rainfall of 381 mm (15 in) over the 13-month period between May 28, 2010 and June 27, 2011. Only TARP-qualified storms were routed through the unit, and maintenance was not required during the testing period based on sediment accumulation less than the depth indicated for maintenance, and also based on hydraulic testing performed on the system after the conclusion of monitoring.

Table 1 shows the specified and achieved amended TARP criteria for storm selection and sampling.
Table 2 shows the observed ranges of operational conditions that occurred over the testing period.

Table 1. Specified and achieved amended TARP criteria for storm selection and sampling

Description	Criteria value	Achieved value
Total rainfall	$\geq$ 2.5 mm (0.1 in)	> 2.5 mm (0.1 in)
Minimum inter-event period	6 hrs	10 hrs
Minimum flow-weighted composite sample storm coverage	70% including as much of the first 20% of the storm	100%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	Minimum of 8 subsamples for composite samples
Total sampled rainfall	Minimum 381 mm (15 in)	384 mm (15.01 in)
Number of storms	Minimum 20	25

Table 2. Observed operational conditions for events monitored over the study period

Operational condition	Observed range
Storm durations	26 – 691 min
Previous dry hours	10 - 910 hrs
Rainfall depth	3 – 50 mm
Initial rainfall to runoff lag time	1 – 34 min
Runoff volume	206 – 13,229 L
Peak rainfall intensity	5 – 137 mm/hr
Peak runoff flow rate	0.5 – 14.3 L/s
Event median flow rate	0.01 – 5.5 L/s

The 4-ft diameter test unit has sedimentation surface area of 1.17 m^2 (12.56 ft^2). Each of the three filter cartridges employed in the test unit uses filtration tentacles of 137 cm (54 in) length, with filter surface area of 35.4 m^2 (381 ft^2) per cartridge, and total filter surface area of 106.2 m^2 (1143 ft^2) for the three cartridges combined. The design treatment flow rate is 5 L/s (80 gal/min) for each of the two hi-flo cartridges and 2.5 L/s (40 gal/min) for the single draindown cartridge, for a total design treatment flow rate of 12.6 L/s (200 gal/min) at design driving head of 457 mm (18 in). This translates to a filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m^2 (0.21 gal/min/ft^2) for each hi-flo cartridge and 0.07 L/s/m^2 (0.11 gal/min/ft^2) for the draindown cartridge. The design flow rate for each cartridge is controlled by the sizing of the orifice in the cartridge lid. The distance from the bottom of the filtration tentacles to the sump is 61 cm (24 in).

Performance claims

The Jellyfish® Filter demonstrated the removal efficiencies indicated in **Table 3** for respective constituents during field monitoring of 25 TARP qualified storm events with cumulative rainfall of 381 mm, conducted in accordance with the provisions of the TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements—Amendments to TARP Tier II Protocol (NJDEP, 2009), and using the following design parameters:

- System hydraulic loading rate (system treatment flow rate per unit of sedimentation surface area) of 10.8 L/s/m^2 (15.9 gal/min/ft^2) or lower
- Filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m^2 (0.21 gal/min/ft^2) or lower for each hi-flo cartridge and 0.07 L/s/m^2 (0.11 gal/min/ft^2) or lower for each draindown cartridge
- Distance from the bottom of the filtration tentacles to the sump of 61 cm (24 in) or greater
- Driving head of 457 mm (18 in) or greater

Table 3. Mean, median and 95% confidence interval (median) for removal efficiencies of selected stormwater constituents

Parameter	Mean	Median	Median - 95% Lower Limit	Median - 95% Upper Limit
TSS	84.7	85.6	82.8	89.8
SSC	97.5	98.3	97.1	98.7
Total phosphorus	48.8	49.1	43.3	60.1
Total nitrogen	37.9	39.3	31.2	54.6
Zinc	55.3	69	39	75
Copper	83.0	91.7	75.1	98.9
Oil and grease	60.1	60	42.7	100

N.B. As with any field test of stormwater treatment devices, removal efficiencies will vary based on pollutant influent concentrations and other site specific conditions.

Performance results

The frequency of rainfall depths monitored during the study is presented in **Figure 2**. The median and 90th percentile rainfall depths were 11 mm and 31.7 mm, respectively. These values represent the depth of rainfall that is not exceeded in 50 and 90 percent of the monitored rainfall events.

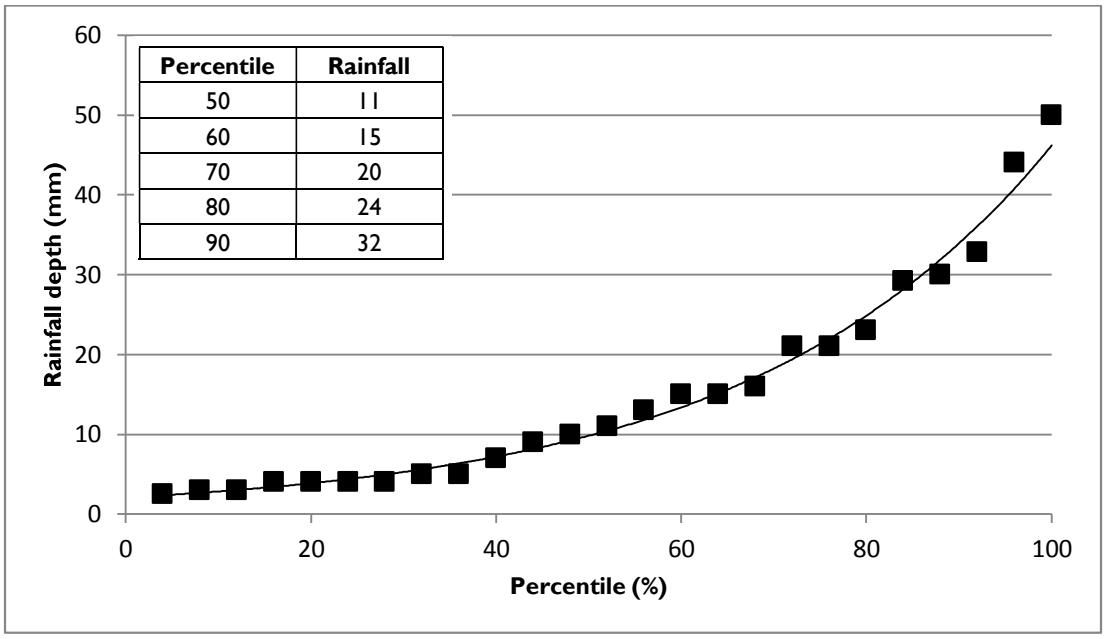

Figure 2. Rainfall depth frequency curve

Sediment removal performance was assessed by measuring the event mean concentration and mass of suspended sediment entering and leaving the unit during runoff events. This involved sampling the full cross-section of influent and effluent flows manually at 2 - 10 minute intervals for the full duration of each storm event and combining discrete samples into flow-weighted composites. Comparing the theoretical mass recovery from the sump calculated by the difference between the influent and effluent mass to the actual dry weight of the recovered sump mass showed an overall mass balance recovery of 94.5% over the study period.

The median d50 particle size (i.e. 50th percentile particle size) of the influent and effluent was 82 and 3 µm, respectively (**Figure 3**). The median influent particles sizes ranged between 22 and 263 µm, whereas median effluent particle sizes ranged between 1 and 11 µm.

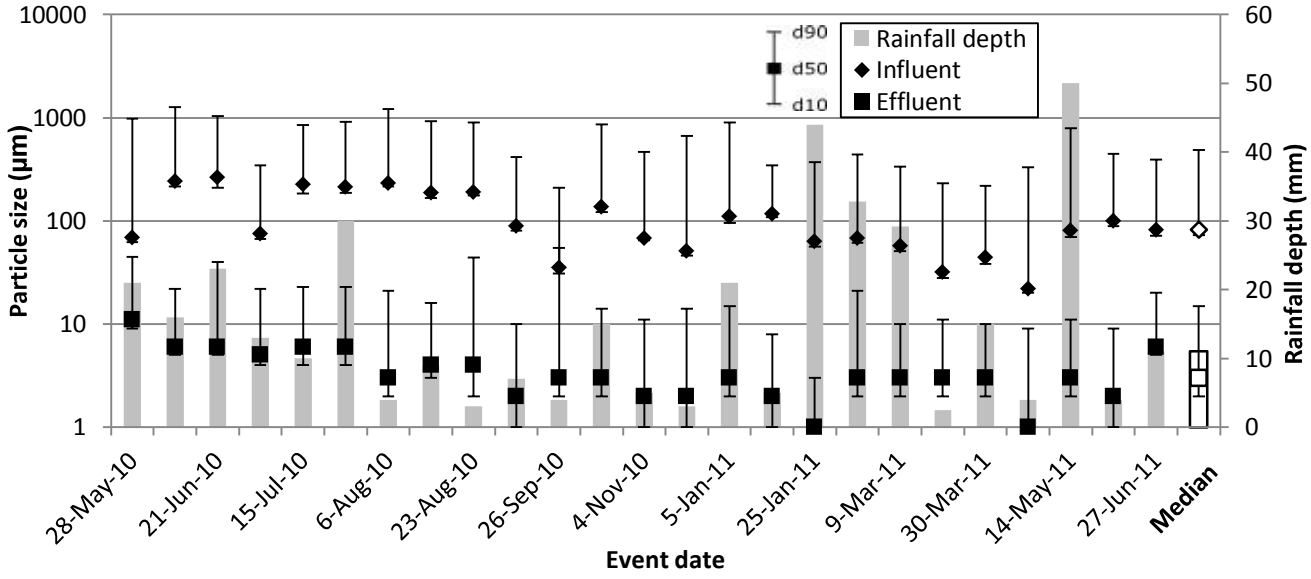

Figure 3. The rainfall depth and d10, d50, and d90 particle sizes of the influent and effluent composite samples for each monitored storm event over the 13-month testing period

Sampling of flows into and out of the Jellyfish Filter over the testing period showed statistically significant reductions ($p < 0.05$; Wilcoxon signed-rank test) in influent event mean concentrations for all selected stormwater constituents (**Table 4** and **Figure 4**). Effluent event mean Suspended Sediment Concentrations (SSC) were below 19 mg/L during all monitored events. Load-based removal rates were also calculated based on the sum of loads over the study period. These removal rages ranged from 46.3 for Total Nitrogen to 98.6 for SSC (**Table 4**).

Table 4. Summary statistics for influent and effluent event mean concentrations for selected constituents

Water Quality Variable	Sampling Location	Min	Max	Median	Range	Mean	SD	Load based removal efficiency (%)
TSS	Influent (mg/L)	16.30	261.00	79.30	244.70	86.26	51.37	87.2
	Effluent (mg/L)	3.20	21.70	11.80	18.50	10.99	4.79	
SSC	Influent (mg/L)	78.20	1401.70	444.50	1323.50	482.26	338.34	98.6
	Effluent (mg/L)	2.80	18.10	7.30	15.30	7.88	3.77	
TP	Influent (µg/L)	887.00	8793.00	3063.00	7906.00	3550.20	1914.50	64.2
	Effluent (µg/L)	472.00	4769.00	1480.00	4297.00	1688.08	1059.98	
TN	Influent (µg/L)	1170.00	10479.00	3110.00	9309.00	3519.32	2161.47	46.3
	Effluent (µg/L)	553.00	6579.00	1610.00	6026.00	2091.76	1613.61	
Zn	Influent (µg/L)	0.005	7600.00	1500.00	7600.00	1792.00	1852.91	76.1
	Effluent (µg/L)	0.005	2760.00	450.00	2760.00	561.64	594.70	
Cu	Influent (µg/L)	0.001	880.40	79.50	880.40	171.28	229.33	92.1
	Effluent (µg/L)	0.001	51.30	6.90	51.30	14.36	17.22	
Oil and Grease	Influent (mg/L)	0.20	4.06	0.93	3.86	1.07	0.82	46.4
	Effluent (mg/L)	0.00	2.32	0.35	2.32	0.50	0.60	

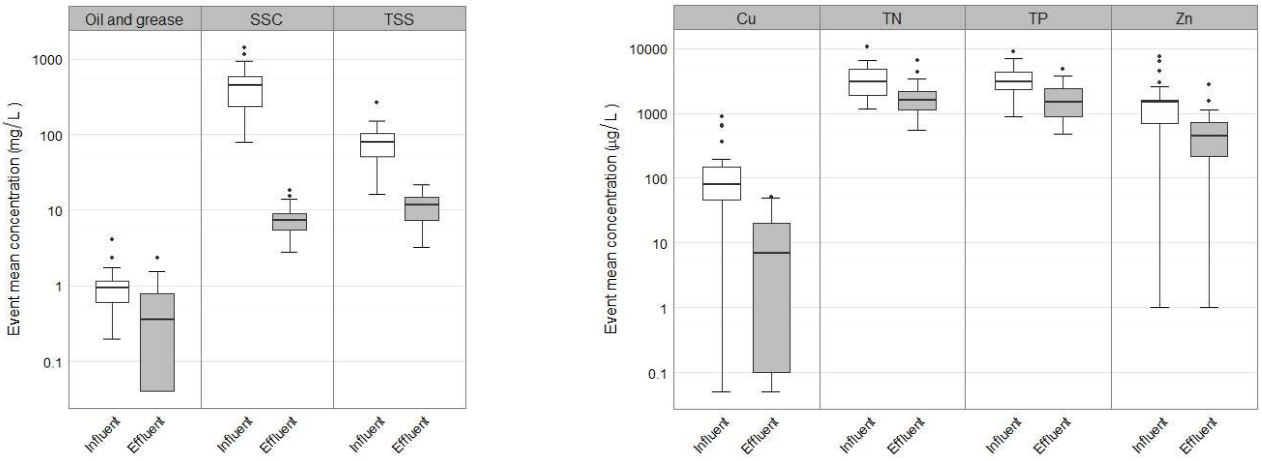

Figure 4. Boxplots showing the distribution of influent and effluent event mean concentrations (EMC) for selected stormwater constituents over the study period

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems to support the performance claim included the performance monitoring report prepared by University of Florida, Engineering School of Sustainable Infrastructure and Environment, and dated November 2011. This report is based on testing completed in accordance with the Technology Acceptance Reciprocity Partnership (TARP) Tier II Protocol (2003) and New Jersey Tier II Stormwater Test Requirements--Amendments to TARP Tier II Protocol (NJDEP, 2009).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Jellyfish® Filter please contact:

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Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

For more information on ISO 14034:2016 / ETV please contact:

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Vancouver, BC
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Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com

APPENDIX C

Functional Servicing Plan

Functional Grading Plan

Functional Grading Sections

EX. TOWNHOUSE CONDO

EX. DETACHED HOUSES

EX. APARTMENT BUILDING

MTO LANDS

NORTH SHORE BLVD. E.

EX STM MH11
RIM ELEV 83.58
NE INV EL 79.80
SE INV EL 79.80

EX RLCB1
RIM ELEV 82.00
SW INV EL 80.37

EX 81.67m 375mm PVC STM @ 0.70%

EX 42.12m 375mm PVC STM @ 0.59%

EX STM MH12
RIM ELEV 81.19
NW INV EL 79.55
E INV EL 79.51

EX 104.28m 375mm PVC STM @ 1.64%

EX 6.91m 300mm PVC STM TO BE REMOVED

EX 3.29m 300mm PVC STM TO BE REMOVED

EX CBMH1 TO BE REMOVED

EX 9.34m 300mm STM

EX 25.64m 975mm STM

PROP RETAINING WALL
MAX HEIGHT 1.85m (APPROX)

EXTENT OF BELOW-GRADE STRUCTURE

F.F.E. 81.70m

RETAINING WALL
MAX HEIGHT 1.1m

LOBBY

CANOPY ABOVE

BUILDING ABOVE

CB5
RIM ELEV 81.32
SW INV EL 80.00

45m RADIUS AROUND
HYDRANT

45m RADIUS AROUND
EX. HYDRANT

ROOF PEAK
(MULTI-STOREY
APARTMENT BUILDING)

ROOF PEAK
(COMMERCIAL PODIUM)

CONCRETE
BASEMENT

PROP 41.53m 300mmø PVC STM @ 0.6%

STM MH2 - OUTLET
RIM ELEV 81.37
S INV EL 78.24

CB2
RIM ELEV 79.83
NE INV EL 78.58

PROP 4.21m 300mm PVC STM @ 0.45%

JELLYFISH FILTER
RIM ELEV 81.26
N INV EL 78.22
S INV EL 78.22

100-Y STORM TANK
AREA 10m X 10m
MIN VOL 141cu.m.
DETAIL DESIGN AT SPA
REFER TO FSR

200mm ORIFICE TUBE 1
@ INV 79.25
200mm ORIFICE TUBE 2
@ INV 78.85

CB4
RIM ELEV 81.22
SW INV EL 80.00

PROP 78.85m 300mmø PVC STM @ 0.95%

PROP 181.0m 300mm PVC STM @ 0.95%

CB1
RIM ELEV 79.82
NW INV EL 78.48

PROP HYD
FL EL 81.10

PROP 150mm PVC W/M
(DOMESTIC)

PROP 200mm PVC W/M
(FIRE)

BUILDING ABOVE

CB3
RIM ELEV 81.04
W INV EL 80.00

5.00m ROAD WIDENING CONVEYANCE

EX FIRE
HYDRANT
(APPROX)

EX CB2
RIM ELEV 81.03
SE INV EL 79.60

EX CBMH2
RIM ELEV 78.51
SE INV EL 77.61
NW INV EL 77.90
W INV EL 77.80

STM MH1 - CONTROL MH
RIM ELEV 80.11
N INV EL 78.85
SE INV EL 77.99

PROP 7.05m 300mm PVC STM @ 1.27%

SAN MH1 - CONTROL MH
RIM ELEV 80.43
NW INV EL 78.10
SE INV EL 78.10

EX 19.28m 750mm CONC STM @ 2.78%

PROP 43.97m 300mm PVC SAN @ 0.68%

PROP 200mm DVCV W/M

EX 75mm WATER
(TO BE ABANDONED)

EX 16.94m 250mm STM @ 1.89%

EX STM MH2
RIM ELEV 79.90
NE INV EL 78.14
SW INV EL 76.64
NW INV EL 77.07

EX STM INV=78.83
PROP SAN OBV=78.19

EX STM MH1
RIM ELEV 81.32
NE INV EL 79.71
SW INV EL 79.36
NW INV EL 79.43

EX 135.45m 600mm STM

EX 71.60m 450mm STM @ 1.70%

EX 75.38m 300mm STM @ 1.73%

EX 250mm WATER

EX FIRE
HYDRANT
(APPROX)

EX SAN CONNECTION
TO BE
ABANDONED

EX SAN MH3
RIM ELEV 78.20
NE INV EL 73.74
S INV EL 73.74

EX SAN MH2
RIM ELEV 79.32
NE INV EL 74.93
SW INV EL 73.84
NW INV EL 77.71

EX 39.66m 1800mm CONC SAN @ 0.26%

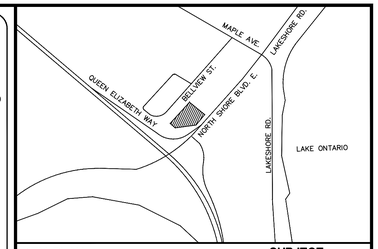
EX 108.89m 1800mm CONC SAN @ 0.21%

EX 65.56m 1800mm CONC SAN

"IMPERIAL" DISTANCES SHOWN ON THIS PLAN CAN BE CONVERTED TO METRIC

SERVICING LEGEND:

- DENOTES EXISTING STORM MANHOLE
- DENOTES PROPOSED STORM MANHOLE
- DENOTES EXISTING CATCH BASIN
- DENOTES PROPOSED CATCHBASIN
- DENOTES PROPOSED STORMCEPTOR
- DENOTES PROPOSED INLET CONTROL DEVICE (ICD)
- DENOTES EXISTING STORM SEWER
- DENOTES PROPOSED STORM SEWER
- DENOTES EXISTING SANITARY MANHOLE
- DENOTES PROPOSED SANITARY MANHOLE
- DENOTES PROPOSED SANITARY SEWER
- DENOTES EXISTING SANITARY SEWER
- DENOTES PROPOSED HYDRANT
- DENOTES EXISTING HYDRANT
- DENOTES PROPOSED WATER VALVE & BOX
- DENOTES EXISTING WATER VALVE & BOX
- DENOTES PROPOSED WATER METER
- DENOTES EXISTING WATER MAIN
- DENOTES PROPOSED WATER MAIN
- DENOTES PROPOSED SIAMESE CONNECTION
- DENOTES PROPOSED CAP FOR SANITARY, STORM, AND/OR WATER AS NOTED
- DENOTES PROPOSED ENTRANCE LOCATION
- DENOTES PROPOSED LIMIT OF CONSTRUCTION
- DENOTES PROPOSED HEAVY DUTY ASPHALT AREA



KEY PLAN
Scale : N.T.S.

SUBJECT LANDS

NOTE :

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND UNDERGROUND AND ABOVE GROUND UTILITIES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING THE WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE ARCHITECTS/ENGINEERS BEFORE PROCEEDING WITH THE WORKS.

ALL DRAWINGS AND SPECIFICATIONS ARE INSTRUMENTS OF SERVICE AND THE PROPERTY OF THE ENGINEER WHICH MUST BE RETURNED AT THE COMPLETION OF WORK.

THIS DRAWING IS NOT TO BE SCALED. CONTRACTOR TO USE DIGITAL FILES FOR LAYOUT PROVIDED BY ENGINEER.

THIS PLAN MUST NOT BE USED TO SITE THE PROPOSED BUILDINGS.

THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S CONTRACTOR FROM OBTAINING, BUT NOT LIMITED TO THE FOLLOWING PERMITS: ROAD CUT, SEWER PERMITS, RELOCATION OF SERVICES, ENCROACHMENT AGREEMENTS, APPROACH APPROVAL PERMITS, ETC...

EXISTING TOPOGRAPHIC AND BOUNDARY INFORMATION PROVIDED BY MACKAY MACKAY & PETERS LTD. IN THEIR BOUNDARY AND TOPOGRAPHIC SURVEY DATED MARCH 12, 2018

BENCH MARK:

CITY OF BURLINGTON BENCHMARK No. 292 ELEVATION = 83.706 METRES (CGVD-1929: 1978 ADJUSTMENT)

BRASS CAP IN SIDEWALK LOCATED AT THE NORTHEAST CORNER OF THE INTERSECTION OF NORTH SHORE BOULEVARD AND FRANCIS ROAD, MONUMENT LOCATED 15.25 METRES SOUTHWESTERLY FROM THE SOUTHWEST CORNER OF HOUSE NO. 1007 NORTH SHORE BOULEVARD, 6 METRES SOUTHEAST FROM THE HYDRO POLE (LIGHT POLE), FIRST POLE NORTH OF NORTH SHORE BOULEVARD ON THE EAST SIDE OF FRANCIS ROAD AND 8.2 METRES FROM THE CENTER LINE OF FRANCIS ROAD.

BEARING NOTE:

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE NORTHWESTERLY LIMIT OF PLAN 20R-6415, HAVING A BEARING OF N42°26'50"E.

METRIC NOTE:

DISTANCES AND ELEVATIONS ON THIS PLAN ARE TYPICALLY SHOWN IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

NO.	REVISIONS	DATE	BY
1.	ISSUED FOR ZBA SUBMISSION	SEP 19/18	DB

SCALE : 0 10 20 30

DRAWING :

FUNCTIONAL SERVICING PLAN

CLIENT :

SPRUCE PARTNERS

PROJECT :

PROPOSED RESIDENTIAL & RETIREMENT HOME DEVELOPMENT
1157-1171 NORTH SHORE BOULEVARD EAST
BURLINGTON, ON

ODAN·DETECH
CONSULTING ENGINEERS
The Odan/Detech Group Inc. P: (905) 632-3811 F: (905) 632-3363
5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2

SCALE :	PROJ. NO.:	DATE STARTED:	DESIGN BY:
1:300	18204	MAY 2018	D.B.
			DRAWN BY: D.B.
18204-1A.dwg			CHECKED BY: D.C.S.
			APPROVED BY: D.C.S.
			DRWG. NO.: 1 OF 3

LICENSED PROFESSIONAL ENGINEER
SEPT. 19/18
D. T. BANCROFT
100200672
PROVINCE OF ONTARIO
ENGINEER

EX. TOWNHOUSE CONDO

EX. DETACHED HOUSES

EX. APARTMENT BUILDING

MTO LANDS

NORTH SHORE BLVD. E.

LOBBY
F.F.E. 81.70m

EX STM MH1
RIM ELEV 83.58
NE INV EL 79.80
SE INV EL 79.80

EX STM MH2
RIM ELEV 81.19
NW INV EL 79.55
E INV EL 79.51

EX RLCB1
RIM ELEV 82.00
SW INV EL 80.37

EX NOISE WALL & RETAINING WALL ON ADJACENT PROPERTY TO REMAIN

PROP RETAINING WALL
MAX HEIGHT 0.42m

EX FENCE ON ADJACENT PROPERTY

PROP RETAINING WALL
MAX HEIGHT 1.85m (APPROX)

RETAINING WALL (BY OTHERS)
MAX HEIGHT 1.1m

EXTENT OF BELOW-GRADE STRUCTURE

F.F.E. 81.70m

PROP RETAINING WALL
RAILING ON TOP
MAX HEIGHT 0.95m

EX CBMH1
TO BE REMOVED

CB2
RIM ELEV 79.83
NE INV EL 78.58

STM MH2 - OUTLET
RIM ELEV 81.37
S INV EL 78.24

JELLYFISH FILTER
RIM ELEV 81.26
N INV EL 78.22
S INV EL 78.22

CB1
RIM ELEV 79.82
NW INV EL 78.48

PROP HYD
FF EL 81.10

EX CBMH2
RIM ELEV 78.51
SE INV EL 77.61
NW INV EL 77.90
W INV EL 77.80

STM MH1 - CONTROL MH
RIM ELEV 80.11
N INV EL 78.05
SE INV EL 77.99

SAN MH1 - CONTROL MH
RIM ELEV 80.43
NW INV EL 78.10
SE INV EL 78.10

5.00m ROAD WIDENING CONVEYANCE

CB5
RIM ELEV 81.32
SW INV EL 80.00

CB4
RIM ELEV 81.22
SW INV EL 80.00

CB3
RIM ELEV 81.04
W INV EL 80.00

EX CB2
RIM ELEV 81.03
SE INV EL 79.60

EX FIRE HYDRANT (APPRDX)

EX STM MH2
RIM ELEV 79.90
NE INV EL 78.14
SW INV EL 76.64
NW INV EL 77.07

EX STM MH1
RIM ELEV 81.32
NE INV EL 79.71
SW INV EL 79.36
NW INV EL 79.43

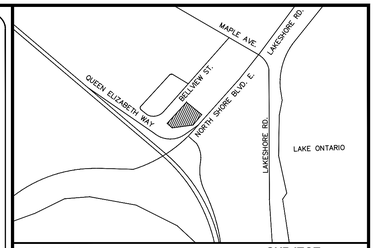
EX FIRE HYDRANT (APPRDX)

EX SAN MH1
RIM ELEV 78.20
NE INV EL 73.74
S INV EL 73.74

EX SAN MH2
RIM ELEV 79.32
NE INV EL 74.93
SW INV EL 73.84
NW INV EL 77.71

GRADING LEGEND:

- DENOTES EXISTING STORM MANHOLE
- DENOTES PROPOSED STORM MANHOLE
- DENOTES EXISTING CATCH BASIN
- DENOTES PROPOSED CATCHBASIN
- DENOTES PROPOSED STORMCEPTOR
- DENOTES EXISTING SANITARY MANHOLE
- DENOTES PROPOSED SANITARY MANHOLE
- DENOTES PROPOSED HYDRANT
- DENOTES EXISTING HYDRANT
- DENOTES PROPOSED WATER VALVE & BOX
- DENOTES EXISTING WATER VALVE & BOX
- DENOTES PROPOSED WATER METER
- DENOTES PROPOSED SIAMESE CONNECTION
- 123.44 / 100.00 DENOTES EXISTING SPOT ELEVATION
- 100.00 DENOTES PROPOSED ELEVATION
- 100.00DT/C DENOTES PROPOSED TOP OF CURB ELEVATION
- 100.00DG/L DENOTES PROPOSED GUTTER LINE ELEVATION
- 100.00D HP DENOTES PROPOSED HIGH POINT
- 100.00D DENOTES PROPOSED SWALE INVERT ELEVATION
- 100.00T DENOTES PROPOSED ELEVATION BY OTHERS
- 1.0% DENOTES PROPOSED FLOW ARROW AND SLOPE
- DENOTES PROPOSED FLOW ARROW
- DENOTES EMERGENCY OVERLAND FLOW
- DENOTES PROPOSED SLOPE (3:1 OR HIGHER)
- DENOTES EXISTING CONTOUR
- DENOTES PROPOSED SILT FENCE
- DENOTES PROPOSED ENTRANCE LOCATION
- DENOTES EXTENT OF MAX. PONDING (0.30m) 100 YEAR STORM.
- DENOTES PROPOSED LIMIT OF CONSTRUCTION
- DENOTES TREE PROTECTION ZONE



KEY PLAN
Scale : N.T.S.

SUBJECT LANDS

NOTE :

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND UNDERGROUND AND ABOVE GROUND UTILITIES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING THE WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

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THIS PLAN MUST NOT BE USED TO SITE THE PROPOSED BUILDINGS.

THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S CONTRACTOR FROM OBTAINING, BUT NOT LIMITED TO THE FOLLOWING PERMITS: ROAD CUT, SEWER PERMITS, RELOCATION OF SERVICES, ENCROACHMENT AGREEMENTS, APPROACH APPROVAL PERMITS, ETC...

EXISTING TOPOGRAPHIC AND BOUNDARY INFORMATION PROVIDED BY MACKAY MACKAY & PETERS LTD. IN THEIR BOUNDARY AND TOPOGRAPHIC SURVEY DATED MARCH 12, 2018

BENCH MARK:

CITY OF BURLINGTON BENCHMARK No. 292 ELEVATION = 83.706 METRES (CGVD-1929: 1978 ADJUSTMENT)

BRASS CAP IN SIDEWALK LOCATED AT THE NORTHEAST CORNER OF THE INTERSECTION OF NORTH SHORE BOULEVARD AND FRANCIS ROAD. MONUMENT LOCATED 15.25 METRES SOUTHWESTERLY FROM THE SOUTHWEST CORNER OF HOUSE NO. 1007 NORTH SHORE BOULEVARD, 6 METRES SOUTHEAST FROM THE HYDRO POLE (LIGHT POLE), FIRST POLE NORTH OF NORTH SHORE BOULEVARD ON THE EAST SIDE OF FRANCIS ROAD AND 8.2 METRES FROM THE CENTER LINE OF FRANCIS ROAD.

BEARING NOTE:

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE NORTHWESTERLY LIMIT OF PLAN 20R-6415, HAVING A BEARING OF N42°26'50"E.

METRIC NOTE:

DISTANCES AND ELEVATIONS ON THIS PLAN ARE TYPICALLY SHOWN IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

NO.	REVISIONS	DATE	BY
1.	ISSUED FOR ZBA SUBMISSION	SEP 19/18	DB

"IMPERIAL" DISTANCES SHOWN ON THIS PLAN ARE IN FEET AND CAN BE CONVERTED TO METRES BY MULTIPLYING BY 0.3048

SCALE : 0 10 20 30

DRAWING :

FUNCTIONAL GRADING PLAN

CLIENT :

SPRUCE PARTNERS

PROJECT :

PROPOSED RESIDENTIAL & RETIREMENT HOME DEVELOPMENT
1157-1171 NORTH SHORE BOULEVARD EAST
BURLINGTON, ON

ODAN·DETECH CONSULTING ENGINEERS
The Odan/Detech Group Inc. P: (905) 632-3811 F: (905) 632-3363
5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2

SCALE :	PROJ. NO.:	DATE STARTED:	DESIGN BY:
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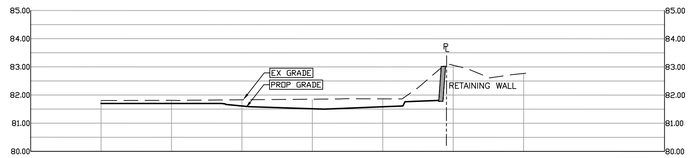
			DRAWN BY: D.B.
18204-2A.dwg			CHECKED BY: D.C.S.
			APPROVED BY: D.C.S.
			DRWG. NO.: 2 OF 3

LICENSED PROFESSIONAL ENGINEER
SEPT. 19/18
D. T. BANCROFT
100200672
PROVINCE OF ONTARIO

ENGINEER



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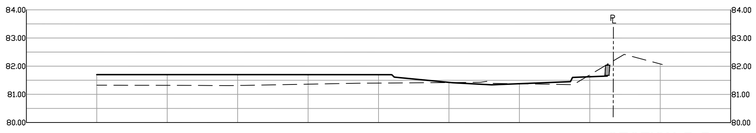

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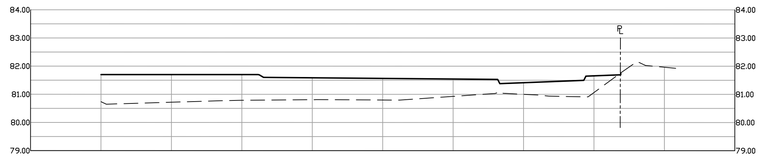

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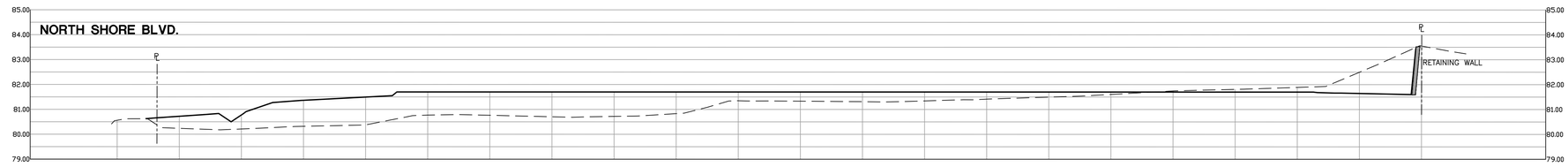

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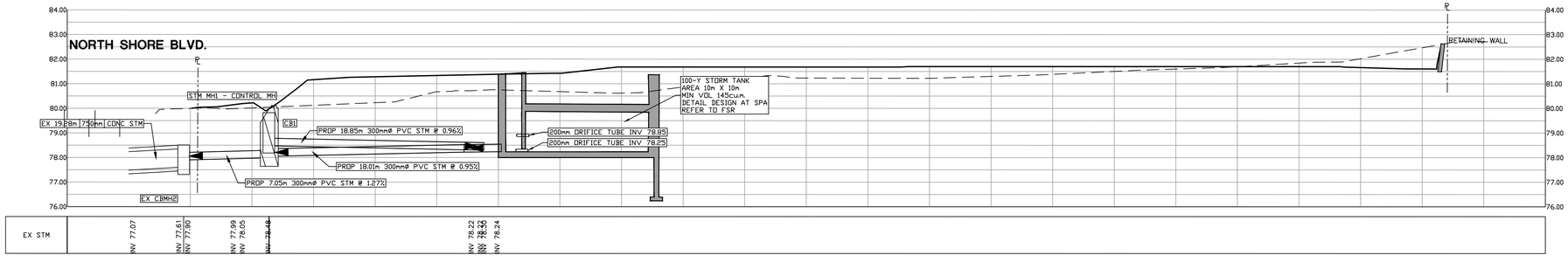
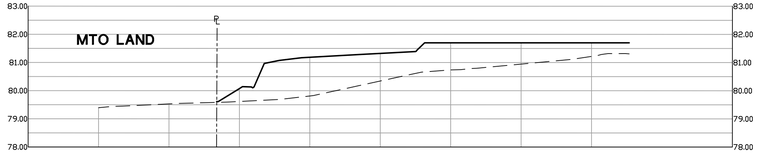
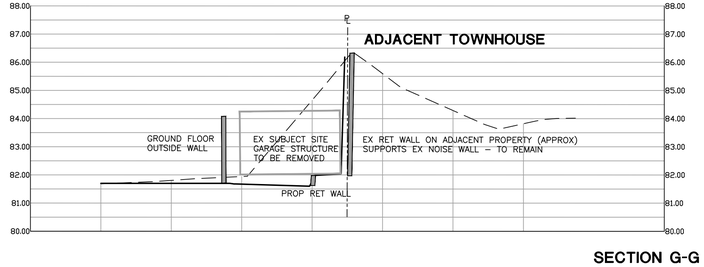


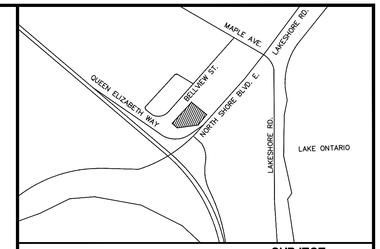
SECTION E-E
SCALE H:1:200 V:1:100



SECTION F-F
SCALE H:1:200 V:1:100



SECTION G-G
SCALE H:1:200 V:1:100



KEY PLAN
Scale : N.T.S.

SUBJECT LANDS

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NO.	REVISIONS	DATE	BY
1.	ISSUED FOR ZBA SUBMISSION	SEP 19/18	DB

SCALE : 0 5 10 15 20

DRAWING :

FUNCTIONAL GRADING SECTIONS

CLIENT :

SPRUCE PARTNERS

PROJECT :

PROPOSED RESIDENTIAL & RETIREMENT HOME DEVELOPMENT
1157-1171 NORTH SHORE BOULEVARD EAST
BURLINGTON, ON

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SCALE :	PROJ. NO.:	DATE STARTED:	DESIGN BY:
H: 1:200 V: 1:100	18204	MAY 2018	D.B.
			DRAWN BY: D.B.
18204-3A.dwg			CHECKED BY: D.C.S.
			APPROVED BY: D.C.S.
			DRWG. NO.: 3 OF 3

LICENSED PROFESSIONAL ENGINEER
SEPT. 19/18
D. T. BANCROFT
100200672
PROVINCE OF ONTARIO

ENGINEER