S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

401-413 BRANT STREET, 444-450 JOHN STREET & 2012 JAMES STREET

CITY OF BURLINGTON

Reserve Properties Limited

December 2017

SLA File: 17135

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Reserve Properties Limited to provide consulting engineering services for the proposed development at 401-413 Brant Street, 444-450 John Street and 2012 James Street in the City of Burlington (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of demolishing four existing retail buildings and constructing a 23-storey mixed-use condominium building. The 23-storey mixed-use condominium building will contain approximately 227 residential units and 6,500ft^2 of commercial space. The proposed building will also include underground parking and rooftop amenity areas.

This Functional Servicing Report will provide detailed information of the proposed servicing scheme for this development. Please refer to the preliminary site engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by Graziani & Corazza Architects Inc. for additional information.

1.2 BACKGROUND INFORMATION

The following documents were referenced in the preparation of this report:

Ref. 1: MOE Stormwater Management Practices Planning and Design Manual (Ministry of Environment, March 2003)

Ref. 2: City of Burlington Standard Drawings (City of Burlington, March 2004)

Ref. 3: Halton Region Water and Wastewater Linear Design Manual (Halton Region, May 2014)

Ref. 4: Erosion & Sediment Control Guidelines for Urban Construction (December 2006)

Ref. 5: Hydrogeological Assessment, Proposed Residential Development, Brant and James Street, Burlington, Ontario (Golder Associates December 1, 2017)



Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Burlington:

Quantity Control

The stormwater discharge rates in the post-development condition will not exceed discharge rates in the pre-development condition.

Quality Control

The proposed development does not require stormwater quality control as stormwater runoff from the site will be captured from the rooftops of the proposed building.

Erosion Control

Erosion and sediment control measures will be implemented in accordance with the standards of the City of Burlington.

2.1 PRE-DEVELOPMENT CONDITIONS

In the pre-development condition, the 0.2 ha site contains six existing retail buildings with an associated asphalt driveway. The site is bound by James Street to the north, John Street to the East, Brant Street to the west and an existing parking lot to the south.
There is an existing 825mmø storm sewer along Brant Street, which acts as the outlet for 75% of the subject lands. The drainage from the remaining 25% of the subject lands drains to the existing 375mmø storm sewer along John Street.

Two catchment areas, Catchment 101 and 102 have been identified in the pre-development condition. Catchment 101 represents the drainage area captured by the roof of the existing retail buildings that discharges to the existing 825mmø storm sewer along Brant Street. Catchment 102 represents the drainage area captured by the roof if the remaining buildings and the existing asphalt driveway that discharges to the existing 375mmø storm sewer along John Street. See Table 2.1 below and the Pre-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.1- Pre-Development Catchment Areas

Catchment ID	Description	Area (ha)	% Imp.	Runoff Coefficient
101	To Brant Street	0.15	100	0.95
102	To John Street	0.05	100	0.93

An analysis was performed on Catchment 101 and 102 using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Burlington Design Storms. A summary of the results can be found in Table 2.2 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.2 - Pre-Development Condition Site Discharge (Catchment 101 & 102)

Storm Event	Catchment 101 Discharge (m^3/s)	Catchment 102 Discharge (m^3/s)
2-Yr Event	0.028	0.009
5-Yr Event	0.037	0.012
10-Yr Event	0.042	0.014
25-Yr Event	0.049	0.016
50-Yr Event	0.054	0.018
100-Yr Event	0.059	0.020

2.2 POST-DEVELOPMENT CONDITIONS

It is proposed to develop the site by constructing a 23-storey mixed-use condominium building which will contain approximately 227 residential units and 6,500ft^2 of commercial space, underground parking and amenity areas. It is proposed to service the site with a private storm sewer system, designed and constructed in accordance with the City of Burlington Standards.

Two catchment areas, Catchment 201 and 202, have been identified in the post-development condition. Catchment 201 represents the drainage area for the rooftop of the proposed condominium building which will be subject to stormwater management controls before discharging to the existing 825mmø storm sewer along Brant Street. Catchment 202 represents the drainage area that will sheet drain uncontrolled to the right-of-way. See Table 2.3 below and the Post-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.3- Post-Development Catchment Area

Catchment ID	Description	Area (ha)	% Imp.	Runoff Coefficient
201	Controlled to Brant St	0.17	100	0.95
202	Uncontrolled to ROW	0.03	100	0.90

Permanent Dewatering Control

It is required to provide a permanent subfloor drainage system, as it is proposed to construct five stories of underground parking. It has been proposed to install a sump pump beneath the concrete slab of the level 5 underground parking garage (Refer to Preliminary Servicing Plan). The sump pump unit will connect to the internal storm system within the building. A hydrogeological investigation was completed on-site to determine the ground water conditions and dewatering requirements. It was determined ground water takings of 0.00077 m^3/s is possible. This flow rate will be accounted for in the discharge rate leaving the site.

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 100mmø orifice pipe between the proposed storage vault and MH1. The orifice pipe will prevent the post development discharge rate from exceeding the pre-development discharge rate in all storm events up to and including the 100-year event. See the Preliminary Site Servicing Plan for orifice location.

With the installation of on-site quantity control measures for Catchment 202, it will be required to provide stormwater storage during storm events up to and including the 100-year event. To provide the required storage, it is proposed to install a stormwater storage vault within the level 1 underground parking garage. This storage vault will be cast into the foundation of the mixed-use building and will accommodate the required stormwater storage.

Preliminary details of the proposed storage vault can be found on the Preliminary Site Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.4 below and Appendix A for details.

Table 2.4 – Post-Development Condition Stage-Storage-Discharge (Catchment 201)		
Storm Event	Total Storage (m^3)	Discharge (m^3/s)
82.95 (Orifice Pipe/Bottom of Tank)	0	0.0000
82.72 (0.5m Depth)	16	0.0187
82.97 (1.0m Depth)	32	0.0271
93.22 (1.3m Depth/Top of Tank)	42	0.0311

An analysis was performed on Catchment 201 using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Burlington Design Storms. A summary of the results can be found in Table 2.5 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.5 – Post-Development Condition Site Discharge						
Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Ground Water Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
2-Yr	0.018	0.006	0.00077	0.025	0.028	15.8
5-Yr	0.021	0.007	0.00077	0.029	0.037	20.8
10-Yr	0.023	0.008	0.00077	0.032	0.042	24.3
25-Yr	0.025	0.010	0.00077	0.036	0.049	28.9
50-Yr	0.027	0.011	0.00077	0.039	0.054	32.3
100-Yr	0.029	0.012	0.00077	0.042	0.059	35.8

This analysis determined the following:

- The post-development discharge rated will not exceed the pre-development discharge rates during all storm events up to and including the 100-year storm, with the installation of an orifice pipe between the stormwater storage vault and MH1;

- 35.8m^3 of stormwater storage is required during the 100-year event, which can be accommodated by the proposed storage vault, having a volume of 42m^3.

Water Quality Control

There will be no quality control measures implemented for this proposed development. All stormwater drainage on-site will be captured by roof area, which is considered “clean runoff”.

2.3 SEDIMENT AND EROSION CONTROL

In order to minimize erosion during the grading and site servicing period of construction, the following measures will be implemented:

- Install silt fencing along the outer boundary of the site to ensure that sediment does not migrate to the adjacent properties;
- Install sediment control (silt sacks) in the proposed catchbasins as well as the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system;
- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion;
- Install a mud mat at the construction entrance of the site to reduce mud tracking and sediment leave the site via construction traffic;

To ensure and document the effectiveness of the erosion and sediment control structures, an appropriate inspection and maintenance program is necessary. The program will include the following activities:

- Inspection of the erosion and sediment controls (e.g. silt fences, sediment traps, outlets, vegetation, etc.) with follow up reports to the governing municipality; and
- The developer and/or his contractor shall be responsible for any costs incurred during the remediation of problem areas;

Details of the proposed erosion & sediment control measures will be provided on the Erosion and Sediment Control Plans, which will be provided upon final design.

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

There are two existing sanitary mains which are located adjacent to the subject site. There is an existing 600mmø sanitary sewer along Brant Street and an existing 250mmø sanitary sewer along John Street. There are a series of existing sanitary laterals, which are currently servicing the existing buildings on-site. These lateral connects into the 250mmø sanitary sewer along John Street and the 600mmø sanitary sewer along Brant Street.

3.2 SANITARY DEMAND

Sanitary discharge from the site was estimated in accordance with the Halton Region Water and Wastewater Linear Design Manual. Tables 3.1 and 3.2 summarizes the sanitary sewer discharge rate for the subject lands.

Table 3.1- Post-Development Sanitary Sewer Discharge (Residential Units)				
Population [A]	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
718 persons	2.29	3.89	0.057	**8.97**

[A] Population = (125 x 1 bdr units x 2 cap/bdr) + (75 x 2 bdr units x 2 cap/bdr) + (28 x 3 bdr units x 2 cap/bdr) = 718 persons
[B] Average demand = 275 l/cap/day x population
[C] Peaking Factor = $1+((14/(4+P^{0.5})))$ with P expressed in thousands Min=2.0
[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Site Area (0.2 hectares)
[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

Table 3.2- Post-Development Sanitary Sewer Discharge (Commercial Units)					
Total Floor Area [A] (ha)	Population [B]	Avg. Demand [C] (l/s)	Peaking Factor [D]	Infiltration [E] (l/s)	**Peak Flow [F] (l/s)**
0.0593	6 persons	0.0169	4.43	0.017	**0.0919**

[A] Total Floor Area = 593m^2 of commercial space
[B] Light Commercial Areas = 90 persons/hectare
[C] Average demand = 24.75 m^3/ha/day x total floor area
[D] Peaking Factor = $1+((14/(4+P^{0.5})))$ with P expressed in thousands Min=2.0
[E] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Site Area (0.2 hectares)
[F] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

Total Sanitary Sewer Discharge = 8.97 l/s + 0.0919 l/s
Total Sanitary Sewer Discharge = 9.06 l/s

3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed condominium building will be serviced by a private 200mmø sanitary sewer, designed and constructed in accordance with the Region of Halton standards. Drainage from this sewer will discharge to the existing 600mmø sanitary sewer along Brant Street.

The minimum grade of the proposed 200mmø sanitary will be 2.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.046 m^3/s (46 l/s). Therefore, the proposed 200mmø sanitary sewer at 2.0% grade is adequately sized to service the proposed development.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 400mmø watermain located along Brant Street and James Street and a 200mmø watermain located along John Street. The nearest existing fire hydrants are located at 426 Brant Street and 2013 James Street.

4.2 DOMESTIC WATER DEMAND

Water demand for the site was estimated in accordance with the Halton Region Water and Wastewater Linear Design Manual (Ref. 3). Tables 4.1 and 4.2 summarizes the domestic water demand requirements for the Average Daily, Maximum Daily and Peaking Hourly demand scenarios.

Table 4.1 - Post-Development Domestic Water Demand (Residential Units)

Population [A]	Average Daily Demand [B] (l/s)	Max. Daily Peaking Factor [C]	Max. Hourly Peaking Factor [D]	**Max. Daily Demand [E] (l/s)**	**Max. Hourly Demand [F] (l/s)**
718 persons	2.29	2.25	4	**5.15**	**9.16**

[A] Population = (125 x 1 bdr units x 2 cap/bdr) + (75 x 2 bdr units x 2 cap/bdr) + (28 x 3 bdr units x 2 cap/bdr) = 718 persons
[B] Average Daily Demand = 275 l/cap/day x population
[C] Max. Daily Peaking Factor = 2.25 (refer to sentence 2.4.1 in Ref.3)
[D] Max. Hourly Peaking Factor = 4.00 (refer to Table 2-2 in Ref. 3)
[E] Max. Daily Demand = Average Daily Demand x Max. Daily Peaking Factor
[F] Max. Hourly Demand = Average Daily Demand x Max. Hourly Peaking Factor

Table 4.2 - Post-Development Domestic Water Demand (Commercial Units)

Total Floor Area [A] (ha)	Average Daily Demand [B] (l/s)	Max. Daily Peaking Factor [C]	Max. Hourly Peaking Factor [D]	**Max. Daily Demand [E] (l/s)**	**Max. Hourly Demand [F] (l/s)**
0.0593	0.0169	2.25	2.25	**0.038**	**0.038**

[A] Total Floor Area = 593m^2 of commercial space
[B] Average Daily Demand = 24.75 m^3/ha/day x total floor area
[C] Max. Daily Peaking Factor = 2.25 (refer to sentence 2.4.1 in Ref.3)
[D] Max. Hourly Peaking Factor = 2.25 (refer to Table 2-2 in Ref. 3)
[E] Max. Daily Demand = Average Daily Demand x Max. Daily Peaking Factor
[F] Max. Hourly Demand = Average Daily Demand x Max. Hourly Peaking Factor

Total Max. Daily Demand = 5.15 l/s + 0.038 l/s
Total Max. Daily Demand = 5.19 l/s

Total Max. Hourly Demand = 9.16 l/s + 0.038 l/s
Total Max. Hourly Demand = 9.20 l/s

4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA). Since the FUS criteria provides adjustment for sprinklered buildings (OBC does not), the FUS method was used to determine the fire flow demand for the proposed development.

The condominium building is a non-combustible construction building (C=0.8), with limited combustible occupancy (-15% correction) and sprinkler system (-50% correction). Exposure corrections are based on the following:
North Face: 15% correction (10.1m to 20m)
South Face: 5% correction (30.1m to 45m)
East Face: 10% correction (20.1m to 30m)
West Face: 15% correction (10.1m to 20m)

Based on hydrant flow tests completed on September 28, 2016 the theoretical maximum available flow rate is **450 l/s**. It is estimated that the required fire flow for the proposed development will be **333 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the subject site. See Fire Flow Demand Requirements in Appendix C for calculations and details.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

The proposed water servicing for the subject site consists of installing a 150mmø watermain which will be split at property line to provide a 100mmø domestic and 150mmø fire water service for the proposed development. The proposed 150mmø watermain will connect into the existing 400mmø watermain along James Street. Water services for the site are to be designed and constructed in accordance with the Halton Region standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development of 401-413 Brant Street, 444-450 John Street and 2012 James Street can be constructed to meet the requirements of the City of Burlington and Halton Region. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Preliminary Grading Plan and the Preliminary Site Servicing Plan prepared by S.Llewellyn & Associates Limited;

- A 100mmø orifice pipe be installed as per the Preliminary Site Servicing Plan and this report to provide adequate quantity control;

- An underground storage vault be incorporated into the underground parking garage as per the Preliminary Site Servicing Plan to provide stormwater storage;

- Erosion and sediment controls be installed as described in this report to meet City of Burlington requirements;

- The proposed sanitary and water servicing system be installed as per the Preliminary Site Servicing Plan and this report to adequately service the proposed development;

- This report be used as the basis for the servicing and stormwater management design. All design data, assumptions and calculations will be confirmed and/or updated as part of the future Site Plan Approval submission;

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

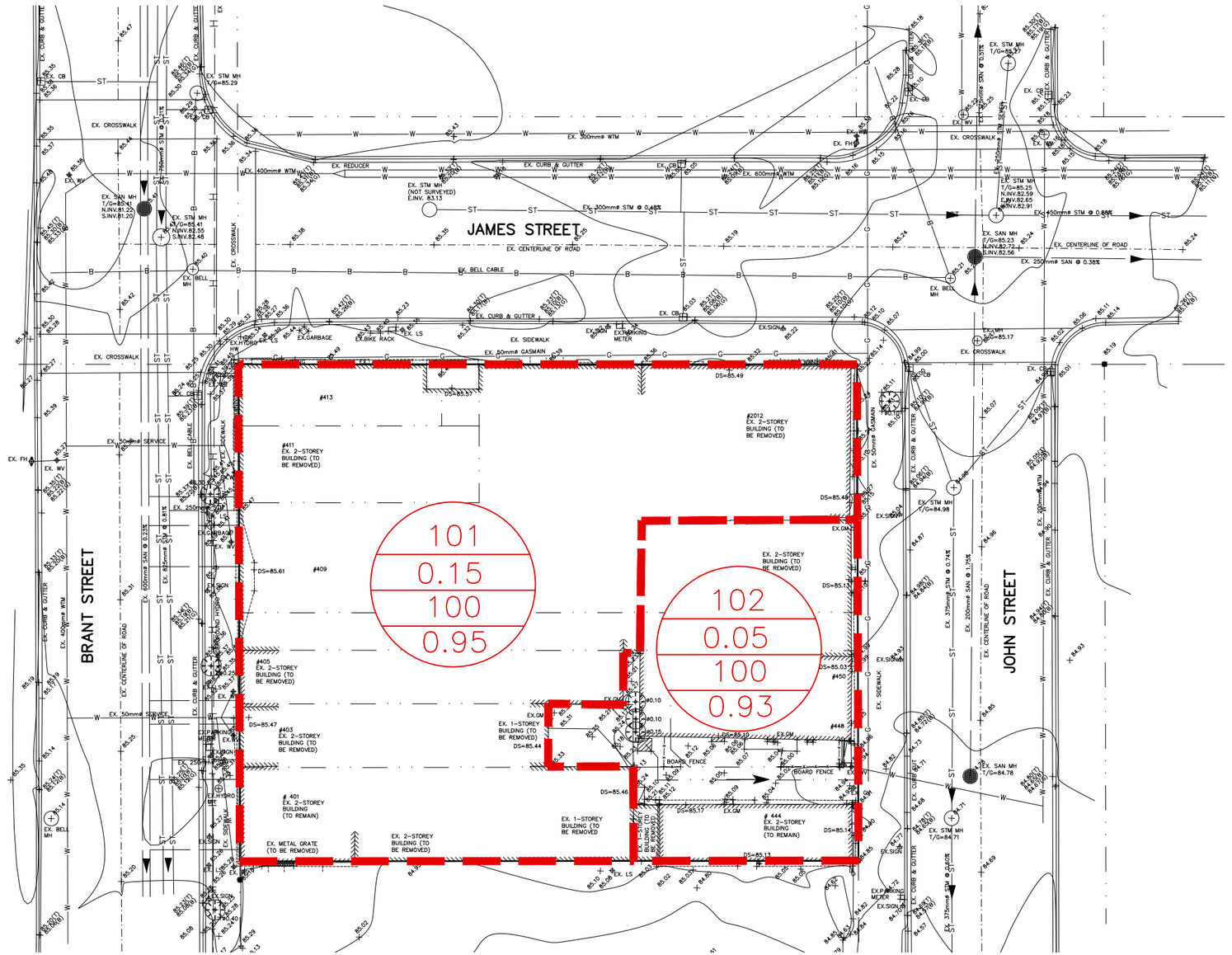
S. LLEWELLYN & ASSOCIATES LIMITED



M. Colosimo, Dipl.T

S. Frankovich, P.Eng.

APPENDIX A
STORMWATER MANAGEMENT INFORMATION



LEGEND

PERVIOUS AREA

101
0.39
11
0.32

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DIRECTION OF SHEET FLOW

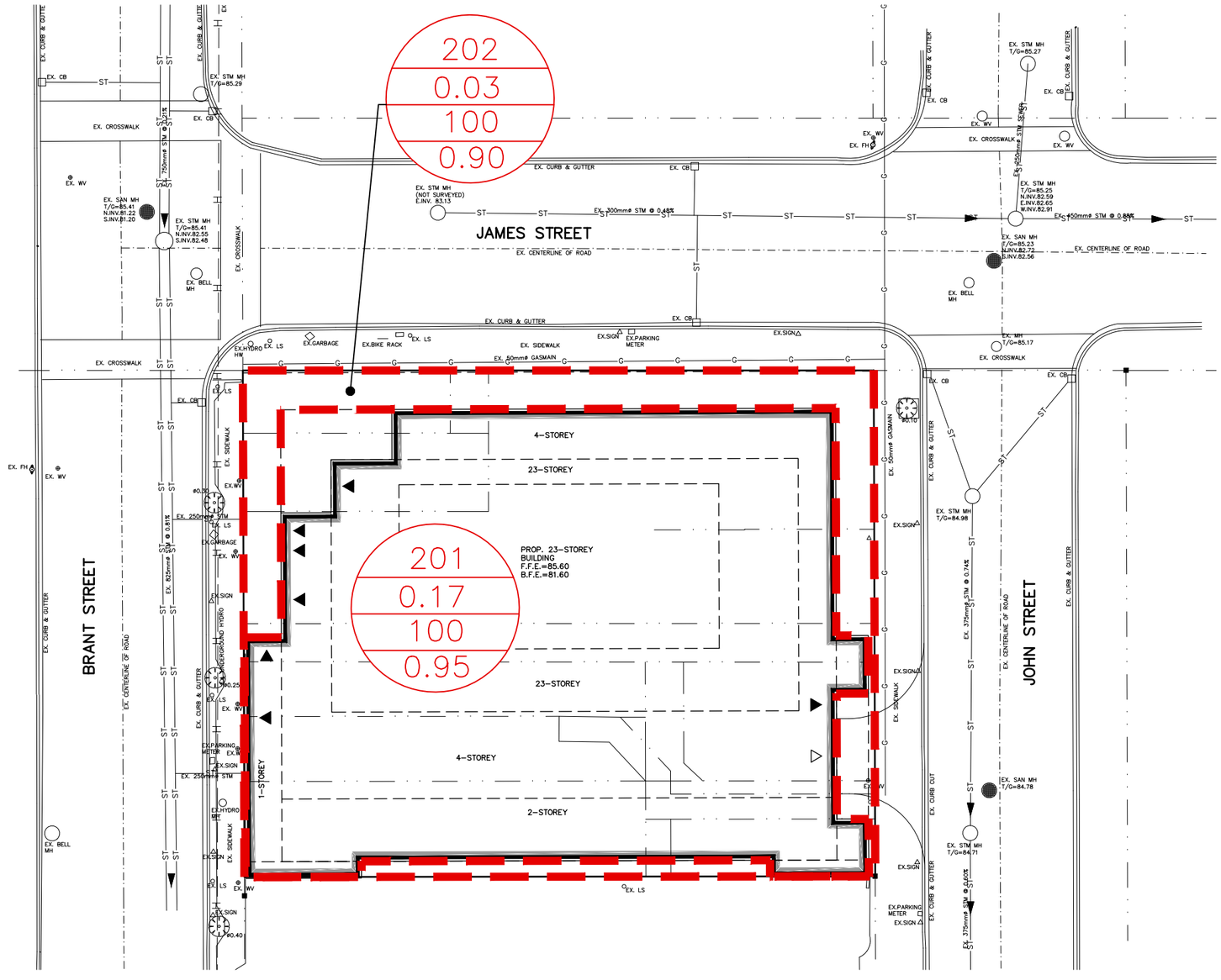
FIGURE 1.0
PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

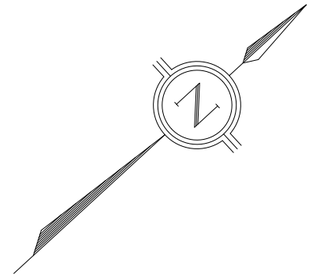
SCALE: 1:400

PROJECT: BRANT ST & JAMES ST. BURLINGTON, ON
PROJECT No.: 17135

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LEGEND

PERVIOUS AREA

201
0.39
11
0.32

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DIRECTION OF SHEET FLOW

FIGURE 2.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: BRANT ST & JAMES ST. BURLINGTON, ON
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409 Brant Street
Burlington, Ontario

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	100
Area (m^2)	0.00785
Invert Elev. (m)	82.95
C/L Elev. (m)	83.00
Disch. Coeff. (C_d)	0.8
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes					Outlet No. 1	
	Elevation m	Area m^2	Incremental Volume m^3	Cumulative Volume m^3	**Total Active Storage Volume m^3**	H m	Discharge m^3/s	**Total Discharge m^3/s**
Orifice Invert/Bottom of Tank	82.95				**0**	0.000	0.0000	**0.0000**
0.5m Depth	83.45	32	16	16	**16**	0.450	0.0187	**0.0187**
1.0m Depth	83.95	32	16	32	**32**	0.950	0.0271	**0.0271**
Top of Tank	84.25	32	10	42	**42**	1.250	0.0311	**0.0311**

APPENDIX B
SWMHYMO INPUT/OUTPUT INFORMATION

```
2     Metric units
*#*************************************************************************|
*#  Project Name: 409 BRANT STREET
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*************************************************************************|
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    BURL_002.stm
*
READ STORM          STORM_FILENAME "STORM.001"
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.15](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[0.1](%),
                                         LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.5](%),
                                         LGI=[15](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
**#*************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[0.1](%),
                                         LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[10](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-------------------------------------------------------|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
CALIB STANDHYD      ID=[1], NHYD=["201"], DT=[1](min), AREA=[0.17](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[0.1](%),
                                         LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.0](%),
                                         LGI=[10](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-------------------------------------------------------|
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["201"],  IDin=[1],
                    RDT=[    ](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                       0.0    , 0.0
                                       0.0187 , 0.0016
                                       0.0271 , 0.0032
                                       0.0311 , 0.0042
                                       -1   ,  -1    (max twenty pts)
                          IDovf=[3], NHYDovf=["OVF"]
*%-----------------|-------------------------------------------------------|
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
CALIB STANDHYD      ID=[4], NHYD=["202"], DT=[1](min), AREA=[0.03](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[0.1](%),
                                         LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[10](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-------------------------------------------------------|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    BURL_005.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
                    BURL_010.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
                    BURL_025.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
                    BURL_050.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                    BURL_100.stm
*
*%-----------------|-------------------------------------------------------|
FINISH
```

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

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO            9      9   =========
                                                         9   9  9   9   # 3902680
        StormWater Management HYdrologic Model           999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: S. Llewellyn & Associates Ltd                +++++++++
 +++++++++                Burlington            SERIAL#:3902680       +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++             *********
 *********           Maximum value for ID numbers  :     10            *********
 *********           Max. number of rainfall points: 105408            *********
 *********           Max. number of flow points    : 105408            *********
 ********************************************************************************


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2017-12-07     TIME: 17:54:17     RUN COUNTER: 000695          *
 ********************************************************************************
 * Input   filename: T:\projects\17135\FSR\SWMHYMO\17135.dat                     *
 * Output  filename: T:\projects\17135\FSR\SWMHYMO\17135.out                     *
 * Summary filename: T:\projects\17135\FSR\SWMHYMO\17135.sum                     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________________*
 * 2:_____________________________________________________________________________*
 * 3:_____________________________________________________________________________*
 ********************************************************************************


--------------------------------------------------------------------------------
001:0001----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*****************************************************************************|
*
  ** END OF RUN :   1

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17135\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17135\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
            #  1=BURL_002.stm
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 2-YR BURLINGTON CHICAGO STORM (4-HR DURA
| Ptotal=  32.34 mm|    Comments: 2-YR BURLINGTON CHICAGO STORM (4-HR DURA
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   2.193 |   1.17  17.083 |   2.17   5.221 |   3.17   2.635
              .33   2.511 |   1.33  68.163 |   2.33   4.444 |   3.33   2.448
              .50   2.955 |   1.50  22.413 |   2.50   3.884 |   3.50   2.289
              .67   3.627 |   1.67  11.979 |   2.67   3.459 |   3.67   2.151
              .83   4.775 |   1.83   8.270 |   2.83   3.126 |   3.83   2.031
             1.00   7.239 |   2.00   6.374 |   3.00   2.857 |   4.00   1.925

--------------------------------------------------------------------------------
002:0003----------------------------------------------------------------------
*
*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .15          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.50          .10
     Length            (m)=     15.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=     68.16        64.44
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .84 (ii)    1.41 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.18          .86
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .03          .00          .028 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     31.34        27.36        31.302
     TOTAL RAINFALL   (mm)=     32.34        32.34        32.342
     RUNOFF COEFFICIENT   =       .97          .85          .968

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
002:0004----------------------------------------------------------------------
**#*************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .05          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=     68.16        64.44
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .61 (ii)    1.18 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.37          .98
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .009 (iii)
     TIME TO PEAK    (hrs)=      1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=     31.34        27.36        31.302
     TOTAL RAINFALL   (mm)=     32.34        32.34        32.342
     RUNOFF COEFFICIENT   =       .97          .85          .968

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
002:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .17          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.00          .10
     Length            (m)=     10.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=     68.16        64.44
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .75 (ii)    1.32 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.25          .90
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .03          .00          .032 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     31.34        27.36        31.302
     TOTAL RAINFALL   (mm)=     32.34        32.34        32.342
     RUNOFF COEFFICIENT   =       .97          .85          .968

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<02:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .027  .3200E-02
                            .019  .1600E-02   |     .031  .4200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .17      .032     1.333     31.302
     OUTFLOW<02: (201   )        .17      .018     1.350     31.302
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
```

```
                PEAK   FLOW   REDUCTION [Qout/Qin](%)=   57.246
                TIME SHIFT OF PEAK FLOW         (min)=     1.00
                MAXIMUM  STORAGE   USED       (ha.m.)=.1582E-02

------------------------------------------------------------------------------
002:0007----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     68.16        64.44
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .61 (ii)    1.18 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.37          .98
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .006 (iii)
     TIME TO PEAK    (hrs)=      1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=     31.34        27.36        31.302
     TOTAL RAINFALL   (mm)=     32.34        32.34        32.342
     RUNOFF COEFFICIENT   =       .97          .85          .968

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

------------------------------------------------------------------------------
002:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
  ** END OF RUN :   4

*******************************************************************************




---------------------
| START            |  Project  dir.: T:\projects\17135\FSR\SWMHYMO\
----------------------  Rainfall dir.: T:\projects\17135\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
           #  1=BURL_005.stm
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*****************************************************************************|
*
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 5-YR BURLINGTON CHICAGO STORM (4-HR DURA
| Ptotal=  41.70 mm|    Comments: 5-YR BURLINGTON CHICAGO STORM (4-HR DURA
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   2.963 |   1.17  21.285 |   2.17   6.805 |   3.17   3.535
               .33   3.374 |   1.33  88.094 |   2.33   5.834 |   3.33   3.293
               .50   3.946 |   1.50  27.774 |   2.50   5.128 |   3.50   3.087
               .67   4.803 |   1.67  15.072 |   2.67   4.590 |   3.67   2.908
               .83   6.247 |   1.83  10.561 |   2.83   4.165 |   3.83   2.751
              1.00   9.295 |   2.00   8.234 |   3.00   3.820 |   4.00   2.612

------------------------------------------------------------------------------
005:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#****************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .15          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.50          .10
     Length            (m)=     15.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     88.09        84.91
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .76 (ii)    1.27 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.24          .93
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .04          .00          .037 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     40.70        36.57        40.655
     TOTAL RAINFALL   (mm)=     41.70        41.70        41.696
     RUNOFF COEFFICIENT   =       .98          .88          .975

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

------------------------------------------------------------------------------
005:0004----------------------------------------------------------------------
**#****************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .05          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     88.09        84.91
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .55 (ii)    1.06 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.42         1.04
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .012 (iii)
     TIME TO PEAK    (hrs)=      1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=     40.70        36.57        40.655
     TOTAL RAINFALL   (mm)=     41.70        41.70        41.696
     RUNOFF COEFFICIENT   =       .98          .88          .975

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

------------------------------------------------------------------------------
005:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .17          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     88.09        84.91
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .68 (ii)    1.18 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.31          .97
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .04          .00          .042 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=     40.70        36.57        40.655
     TOTAL RAINFALL   (mm)=     41.70        41.70        41.696
     RUNOFF COEFFICIENT   =       .98          .88          .975

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

------------------------------------------------------------------------------
005:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .027  .3200E-02
                            .019  .1600E-02   |     .031  .4200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .17      .042     1.333     40.655
     OUTFLOW<02: (201   )        .17      .021     1.350     40.655
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   50.929
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2077E-02

------------------------------------------------------------------------------
005:0007----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250
```

```
     Max.eff.Inten.(mm/hr)=      88.09        84.91
               over (min)         1.00         1.00
     Storage Coeff.  (min)=        .55 (ii)    1.06 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.42         1.04
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .007 (iii)
     TIME TO PEAK    (hrs)=       1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=      40.70        36.57        40.655
     TOTAL RAINFALL   (mm)=      41.70        41.70        41.696
     RUNOFF COEFFICIENT   =        .98          .88          .975

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
005:0008---------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
-------------------------------------------------------------------------------
005:0002---------------------------------------------------------------------
*
  ** END OF RUN :   9

*******************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17135\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17135\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 010
    NSTORM=   1
           #  1=BURL_010.stm
-------------------------------------------------------------------------------
010:0002---------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET                                             |
*#               BURLINGTON, ONTARIO                                           |
*#  JOB NUMBER  : 17135                                                        |
*#       Date   : DECEMBER 2017                                                |
*#    Revised   :                                                              |
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.                             |
*#       File   : 17135.DAT                                                    |
*#*****************************************************************************|
*
-------------------------------------------------------------------------------
010:0002---------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 10-YR BURLINGTON CHICAGO STORM (4-HR DUR
| Ptotal=  48.00 mm|    Comments: 10-YR BURLINGTON CHICAGO STORM (4-HR DUR
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   3.423 |   1.17  24.501 |   2.17   7.852 |   3.17   4.083
              .33   3.898 |   1.33 101.139 |   2.33   6.733 |   3.33   3.805
              .50   4.558 |   1.50  31.955 |   2.50   5.920 |   3.50   3.567
              .67   5.545 |   1.67  17.363 |   2.67   5.300 |   3.67   3.360
              .83   7.210 |   1.83  12.175 |   2.83   4.810 |   3.83   3.179
             1.00  10.719 |   2.00   9.497 |   3.00   4.413 |   4.00   3.019

-------------------------------------------------------------------------------
010:0003---------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#****************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .15          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       1.50          .10
     Length            (m)=      15.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.14        98.24
               over (min)         1.00         1.00
     Storage Coeff.  (min)=        .72 (ii)    1.20 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.27          .96
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .042 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=      47.00        42.81        46.962
     TOTAL RAINFALL   (mm)=      48.00        48.00        48.004
     RUNOFF COEFFICIENT   =        .98          .89          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
010:0004---------------------------------------------------------------------
**#****************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.14        98.24
               over (min)         1.00         1.00
     Storage Coeff.  (min)=        .52 (ii)    1.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.45         1.08
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .014 (iii)
     TIME TO PEAK    (hrs)=       1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=      47.00        42.81        46.962
     TOTAL RAINFALL   (mm)=      48.00        48.00        48.004
     RUNOFF COEFFICIENT   =        .98          .89          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
010:0005---------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       1.00          .10
     Length            (m)=      10.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.14        98.24
               over (min)         1.00         1.00
     Storage Coeff.  (min)=        .64 (ii)    1.12 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.34         1.00
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .05          .00          .048 (iii)
     TIME TO PEAK    (hrs)=       1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=      47.00        42.81        46.962
     TOTAL RAINFALL   (mm)=      48.00        48.00        48.004
     RUNOFF COEFFICIENT   =        .98          .89          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
010:0006---------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<02:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .027  .3200E-02
                           .019  .1600E-02   |     .031  .4200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .17      .048     1.333     46.962
     OUTFLOW<02: (201   )        .17      .023     1.350     46.962
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   48.245
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2429E-02

-------------------------------------------------------------------------------
010:0007---------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .03          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.14        98.24
               over (min)         1.00         1.00
     Storage Coeff.  (min)=        .52 (ii)    1.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.45         1.08
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .008 (iii)
     TIME TO PEAK    (hrs)=       1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=      47.00        42.81        46.962
     TOTAL RAINFALL   (mm)=      48.00        48.00        48.004
     RUNOFF COEFFICIENT   =        .98          .89          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
010:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
  ** END OF RUN :  24

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17135\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17135\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
          #  1=BURL_025.stm
--------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 25-YR BURLINGTON CHICAGO STORM (4-HR DUR
| Ptotal=  56.03 mm|    Comments: 25-YR BURLINGTON CHICAGO STORM (4-HR DUR
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.010 |   1.17  28.592 |   2.17   9.185 |   3.17   4.782
               .33   4.566 |   1.33 117.720 |   2.33   7.879 |   3.33   4.457
               .50   5.337 |   1.50  37.274 |   2.50   6.929 |   3.50   4.178
               .67   6.491 |   1.67  20.279 |   2.67   6.204 |   3.67   3.937
               .83   8.435 |   1.83  14.230 |   2.83   5.632 |   3.83   3.725
              1.00  12.531 |   2.00  11.105 |   3.00   5.167 |   4.00   3.538

--------------------------------------------------------------------------------
025:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#***************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .15          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.50          .10
     Length            (m)=     15.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       115.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .68 (ii)    1.13 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.31         1.00
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .05          .00          .049 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        54.988
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
025:0004----------------------------------------------------------------------
**#***************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .05          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       115.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .49 (ii)    .94 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.48         1.11
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .02          .00          .016 (iii)
     TIME TO PEAK    (hrs)=      1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        54.988
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
025:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#***************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .17          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.00          .10
     Length            (m)=     10.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       115.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .60 (ii)    1.05 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.38         1.04
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .06          .00          .056 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        54.988
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
025:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00    |     .027  .3200E-02
                           .019  .1600E-02    |     .031  .4200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .17      .056     1.333     54.988
     OUTFLOW<02: (201   )        .17      .025     1.350     54.988
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   45.800
                   TIME SHIFT OF PEAK FLOW         (min)=    1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2888E-02

--------------------------------------------------------------------------------
025:0007----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       115.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .49 (ii)    .94 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.48         1.12
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .010 (iii)
     TIME TO PEAK    (hrs)=      1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        54.988
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
025:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
--------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
```

```
025:0002----------------------------------------------------------------------------
*
  ** END OF RUN :  49

*******************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17135\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17135\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
           #  1=BURL_050.stm
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*****************************************************************************|
*
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 50-YR BURLINGTON CHICAGO STORM (4-HR DUR
| Ptotal=  61.96 mm|    Comments: 50-YR BURLINGTON CHICAGO STORM (4-HR DUR
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.451 |   1.17  31.613 |   2.17  10.180 |   3.17   5.306
               .33   5.067 |   1.33 129.819 |   2.33   8.734 |   3.33   4.946
               .50   5.921 |   1.50  41.194 |   2.50   7.683 |   3.50   4.637
               .67   7.198 |   1.67  22.439 |   2.67   6.881 |   3.67   4.369
               .83   9.350 |   1.83  15.757 |   2.83   6.247 |   3.83   4.135
              1.00  13.879 |   2.00  12.303 |   3.00   5.733 |   4.00   3.927

-------------------------------------------------------------------------------
050:0003----------------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#****************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .15          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       1.50          .10
     Length            (m)=      15.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     129.82       127.42
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .65 (ii)    1.09 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.33         1.02
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .05          .00          .054 (iii)
     TIME TO PEAK    (hrs)=       1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=      60.96        56.66        60.919
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
050:0004----------------------------------------------------------------------------
**#****************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     129.82       127.42
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .47 (ii)    .90 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.50         1.14
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .02          .00          .018 (iii)
     TIME TO PEAK    (hrs)=       1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=      60.96        56.66        60.919
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
050:0005----------------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       1.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     129.82       127.42
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .58 (ii)    1.01 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.40         1.07
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .061 (iii)
     TIME TO PEAK    (hrs)=       1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=      60.96        56.65        60.919
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
050:0006----------------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
--------------------
| ROUTE RESERVOIR  |    Requested routing time step =  1.0 min.
|  IN>01:(201   )  |
| OUT<02:(201   )  |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .027  .3200E-02
                           .019  .1600E-02   |     .031  .4200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .17      .061     1.333     60.919
     OUTFLOW<02: (201   )        .17      .027     1.350     60.919
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   44.410
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3231E-02

-------------------------------------------------------------------------------
050:0007----------------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .03          .00
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     129.82       127.42
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .47 (ii)    .90 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.50         1.14
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .011 (iii)
     TIME TO PEAK    (hrs)=       1.27         1.33         1.333
     RUNOFF VOLUME    (mm)=      60.96        56.66        60.919
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

-------------------------------------------------------------------------------
050:0008----------------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------------
*
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------------
*
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------------
*
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------------
*
  ** END OF RUN :  99

*******************************************************************************
```

```
--------------------
| START            |  Project  dir.: T:\projects\17135\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17135\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=BURL_100.stm
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 409 BRANT STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17135
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17135.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 100-YR BURLINGTON CHICAGO STORM (4-HR DU
| Ptotal=  67.72 mm|    Comments: 100-YR BURLINGTON CHICAGO STORM (4-HR DU
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.865 |   1.17  34.553 |   2.17  11.126 |   3.17   5.800
               .33   5.538 |   1.33 141.892 |   2.33   9.547 |   3.33   5.406
               .50   6.472 |   1.50  45.024 |   2.50   8.397 |   3.50   5.068
               .67   7.868 |   1.67  24.526 |   2.67   7.521 |   3.67   4.776
               .83  10.219 |   1.83  17.223 |   2.83   6.828 |   3.83   4.519
              1.00  15.170 |   2.00  13.447 |   3.00   6.266 |   4.00   4.292

--------------------------------------------------------------------------------
100:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#****************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Brant Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .15           .00
     Dep. Storage     (mm)=       1.00           .52
     Average Slope     (%)=       1.50           .10
     Length            (m)=      15.00           .10
     Mannings n             =       .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.65
               over (min)        1.00          1.00
     Storage Coeff.  (min)=        .63 (ii)     1.05 (ii)
     Unit Hyd. Tpeak (min)=       1.00          1.00
     Unit Hyd. peak  (cms)=       1.35          1.05
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .06           .00          .059 (iii)
     TIME TO PEAK    (hrs)=       1.32          1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72         62.39        66.681
     TOTAL RAINFALL   (mm)=      67.72         67.72        67.724
     RUNOFF COEFFICIENT   =        .99           .92          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
100:0004----------------------------------------------------------------------
**#****************************************************************************|
*# CATCHMENT 102 - Existing Condition (to John Street)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05           .00
     Dep. Storage     (mm)=       1.00           .52
     Average Slope     (%)=       2.00           .10
     Length            (m)=      10.00           .10
     Mannings n             =       .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.65
               over (min)        1.00          1.00
     Storage Coeff.  (min)=        .45 (ii)     .87 (ii)
     Unit Hyd. Tpeak (min)=       1.00          1.00
     Unit Hyd. peak  (cms)=       1.51          1.16
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .02           .00          .020 (iii)
     TIME TO PEAK    (hrs)=       1.27          1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72         62.39        66.681
     TOTAL RAINFALL   (mm)=      67.72         67.72        67.724
     RUNOFF COEFFICIENT   =        .99           .92          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
100:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Brant Street
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17           .00
     Dep. Storage     (mm)=       1.00           .52
     Average Slope     (%)=       1.00           .10
     Length            (m)=      10.00           .10
     Mannings n             =       .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.65
               over (min)        1.00          1.00
     Storage Coeff.  (min)=        .56 (ii)     .97 (ii)
     Unit Hyd. Tpeak (min)=       1.00          1.00
     Unit Hyd. peak  (cms)=       1.42          1.09
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .07           .00          .067 (iii)
     TIME TO PEAK    (hrs)=       1.30          1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72         62.39        66.681
     TOTAL RAINFALL   (mm)=      67.72         67.72        67.724
     RUNOFF COEFFICIENT   =        .99           .92          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
100:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
----------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .027  .3200E-02
                            .019  .1600E-02    |     .031  .4200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .17      .067     1.333     66.681
     OUTFLOW<02: (201   )        .17      .029     1.350     66.681
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   42.697
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3577E-02

--------------------------------------------------------------------------------
100:0007----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to ROW)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .03           .00
     Dep. Storage     (mm)=       1.00           .52
     Average Slope     (%)=       2.00           .10
     Length            (m)=      10.00           .10
     Mannings n             =       .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.65
               over (min)        1.00          1.00
     Storage Coeff.  (min)=        .45 (ii)     .87 (ii)
     Unit Hyd. Tpeak (min)=       1.00          1.00
     Unit Hyd. peak  (cms)=       1.51          1.16
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .01           .00          .012 (iii)
     TIME TO PEAK    (hrs)=       1.27          1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72         62.39        66.681
     TOTAL RAINFALL   (mm)=      67.72         67.72        67.724
     RUNOFF COEFFICIENT   =        .99           .92          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    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.

--------------------------------------------------------------------------------
100:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
*******************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2017-12-07     at 17:54:18
===============================================================================
```

APPENDIX C
WATER ANALYSIS INFORMATION

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Project Number: 17135
Project Name: 409 Brant Street
Date: 08-Dec-17

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A} \qquad (1)$$

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

	Building Area				(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
Building / Location	Footprint Area (m^2)	# of Storeys	**Total GFA (m^2)**	Type of Construction	***Fire Flow "F"*** (l/min)	(l/s)	***Occupancy*** %	Adjustment (l/min)	**Adjusted Fire Flow (l/min)**	***Sprinkler*** %	Adjustment (l/min)	***Exposure*** %	Adjustment (l/min)	**(l/min)**	**(l/s)**
409 Brant Street	**20101**	**1**	**20101**	**0.8**	25000	416.7	**-15**	-3750.0	**21250.0**	**-50**	-10625.0	45	9562.5	**20000**	**333**

Floor	Area	Tot. Area	Cumm. Area
1	1642	1642	1642.0
2	1479	1479	3121.0
3-4	1365	2730	5851.0
5-23	750	14250	20101.0

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

Minimum credit for systems designed to NFPA 13 is 30%.

If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

(4) Exposure

0 to 3m	25%	
3.1 to 10m	20%	Calculate for all
10.1 to 20m	15%	sides. Maximum
20.1 to 30m	10%	charge shall not
30.1 to 45m	5%	exceed 75%

Side	Exposure (m)	Charge (%)
North =	**10.1 to 20m**	**15**
South =	**30.1 to 45**	**5**
East =	**20.1 to 30**	**10**
West =	**10.1 to 20m**	**15**
Total Expoure =		***45***