S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

# Functional Servicing & Stormwater Management Report

**INARIA**
**2030 CAROLINE STREET**

CITY OF BURLINGTON

INARIA BURLINGTON INC.

June 2024

SLA File: 23092

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# 1.0 INTRODUCTION AND BACKGROUND

## 1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Inaria Burlington Incorporated to provide Consulting Engineering services for the proposed development at 2030 Caroline Street in the City of Burlington (see Figure 1.0 for location plan). This report will outline the functional servicing and stormwater management strategy for the proposed development.

The subject land was included in a previous planning approval for the entire block bounded by John Street, Maria Street, Caroline Street and Elizabeth Street which was approved by the City of Burlington in 2010. The approval included the redevelopment of the entire city block in two phases. The southerly portion of the block has been redeveloped with a 17-storey mixed-use building.

For the re-development of the north portion of the block (the subject lands), it is proposed to re-zone the subject lands to allow a 28-storey mixed-use building and an above-grade parking structure. The 28-storey mixed-use condominium building will contain approximately 302 residential units and 382m$^2$ of commercial space. The proposed building will also include underground parking and rooftop amenity areas.

This Functional Servicing & Stormwater Management Report provides 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 Chamberlain Architect Services Limited 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 Stormwater Management Design Guidelines (City of Burlington, May 21, 2020)

Ref. 3: City of Burlington Standard Drawings (City of Burlington, March 2004)

Ref. 4: Halton Region Water and Wastewater Linear Design Manual (Halton Region, May 2014)

Ref. 5: Erosion & Sediment Control Guidelines for Urban Construction (December 2006)




**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 Pre-Consultation Meeting Notes dated August 23, 2023, prepared by the City of Burlington:

**Quantity Control**

The stormwater discharge rates in the post-development condition will be controlled to the 5-year pre-development discharge rate for all storm events up to and including the 100-year event.

**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 which is considered “clean” water runoff.

**Regional Floodplain Spill Hazard**

To analyse the existing impacts of the the existing spill with the proposed development.

**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 0.278 ha site consists of existing asphalt parking lot. The site is bound by Caroline Street to the north, Elizabeth Street to the east, John Street to the west and a existing condominium building to the south.

There is an existing 375mmø storm sewer along John Street, a 900mmø storm sewer along Caroline Street and a 3.6m x 1.8m culvert along Elizabeth Street which all ultimately discharge to Rambo Creek. Stormwater runoff from the subject lands is captured by existing catchbasins within the parking lot and right-of-way ultimately discharging to Rambo Creek.

One catchment area, Catchment 101, has been identified in the pre-development condition. Catchment 101 represents the drainage area for the entire site which ultimately drains to Rambo Creek. See Table 2.1 below and the Pre-Development Storm Drainage Area Plan in Appendix A for details.

**Table 2.1- Pre-Development Condition Catchment Areas**

| Catchment ID | Description | Area (ha) | % Imp.[1] | Runoff Coefficient [2] |
|---|---|---|---|---|
| 101 | To Rambo Creek | 0.25 | 36 | 0.50 |

[1] Existing conditions to have a maximum % imperviousness of 36% per City standards
[2] Existing conditions to have a maximum runoff coefficient of 0.50 per City standards

An analysis was performed on Catchment 101 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**

| Storm Event | Catchment 101 Discharge ($m^3/s$) |
|---|---|
| 2-Yr Event | 0.040 |
| 5-Yr Event | 0.050 |
| 10-Yr Event | 0.066 |
| 25-Yr Event | 0.079 |
| 50-Yr Event | 0.089 |
| 100-Yr Event | 0.099 |

## 2.2 POST-DEVELOPMENT CONDITIONS

It is proposed to develop the site by constructing a 28-storey mixed-use condominium building which will contain approximately 302 residential units and 382$m^2$ 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 majority of the site which will be captured and controlled before ultimately discharging to the existing

3.6m x 1.8m culvert along Elizabth Street, which leads to Rambo Creek. Catchment 202 represents the drainage area for the remainder of the site which sheet drains uncontrolled to the existing right-of-way. Refer to Table 2.3 below and the Post-Development Storm Drainage Area Plan in Appendix A for details.

**Table 2.3- Post-Development Condition Catchment Area**

| Catchment ID | Description | Area (ha) | % Imp. | Runoff Coefficient |
|---|---|---|---|---|
| 201 | Controlled to Rambo Creek | 0.23 | 100 | 0.95 |
| 202 | Uncontrolled to Rambo Creek | 0.02 | 100 | 0.95 |

An analysis was performed on the proposed condition site using the SWMHYMO hydrologic modeling 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 the Table 2.4 and detailed SWMHYMO input/output information can be found in Appendix B.

**Table 2.4 – Post-Development Condition Stormwater Discharge (Uncontrolled)**

| Storm Event | Catchment 201 Discharge ($m^3/s$) | Catchment 202 Discharge ($m^3/s$) |
|---|---|---|
| 2-year | 0.050 | 0.004 |
| 5-year | 0.065 | 0.006 |
| 10-year | 0.074 | 0.006 |
| 25-year | 0.086 | 0.008 |
| 50-year | 0.095 | 0.008 |
| 100-year | 0.104 | 0.009 |

**Water Quantity Control**

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 145mmø cored hole orifice plate located at the outlet of the proposed stormwater detention vault. The orifice plate will restrict discharge from the site to the 5-year pre-development discharge rate for all storm events up to and including the 100-year event.

With the installation of on-site quantity control measures for Catchment 201, 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 detention vault within the level 1 underground parking garage. This detention vault will be cast into the foundation of the mixed-use building and will accommodate the required stormwater storage.

Details of the proposed detention vault and orifice plate can be found on the Preliminary Site Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.5 and Appendix A for details.

| **Table 2.5 – Post-Development Condition Stage-Storage-Discharge (Catchment 201)** | | |
|---|---|---|
| Elevation (m) | Total Storage ($m^3$) | Discharge ($m^3/s$) |
| 84.15 (Orifice Invert/Bottom of Tank) | 0 | 0.0000 |
| 84.35 (0.20m Depth) | 13 | 0.0157 |
| 84.55 (0.40m Depth) | 25 | 0.0251 |
| 84.75 (0.60m Depth) | 38 | 0.0319 |
| 84.95 (0.80m Depth) | 51 | 0.0374 |
| 85.15 (Top of Tank) | 63 | 0.0423 |

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 2.6 below and the detailed SWMHYMO input/output information in Appendix B.

| **Table 2.6 – Post-Development Condition Stormwater Discharge (Controlled)** | | | | | |
|---|---|---|---|---|---|
| Storm Event | Catchment 201 Controlled Discharge ($m^3/s$) | Catchment 202 Uncontrolled Discharge[1] ($m^3/s$) | Total Discharge[2] ($m^3/s$) | Allowable Discharge[3] ($m^3/s$) | Required Storage ($m^3$) |
| 2-Yr | 0.025 | 0.004 | 0.029 | 0.050 | 25.2 |
| 5-Yr | 0.030 | 0.006 | 0.035 | 0.050 | 33.4 |
| 10-Yr | 0.032 | 0.006 | 0.038 | 0.050 | 39.2 |
| 25-Yr | 0.036 | 0.008 | 0.042 | 0.050 | 46.6 |
| 50-Yr | 0.038 | 0.008 | 0.045 | 0.050 | 52.2 |
| 100-Yr | 0.040 | 0.009 | 0.048 | 0.050 | 57.8 |

[1] Catchment 202 discharge from Table 2.4.
[2] Total discharge = ADD HYD from SWMHYMO
[3] Allowable discharge = 5-year pre-development discharge rate (see Table 2.2).

This analysis determined the following:

- The post-development discharge rates will not exceed the 5-year pre-development discharge rate to Rambo Creek during all storm events up to and including the 100-year storm, with the installation of a cored hole orifice plate at the outlet of the stormwater detention vault; and

- 57.8$m^3$ of stormwater storage is required during the 100-year event, which can be accommodated by the proposed detention vault, having a volume of 63$m^3$.

**Water Quality Control**

Stormwater quality control measures will not be required for the proposed development as all stormwater from the development will be captured by roof area, which is considered “clean” runoff.

**Regional Floodplain Spill Hazard**

An update to the floodplain and associated spill hazard hydraulic analysis prepared for the MTSA Phase 2 study for Downtown Burlington was completed to confirm the existing flooding elevation adjacent to the site and how the proposed development effects the floodplain. The existing floodplain spill hazard has an elevation of 96.53m (CGVD1982) adjacent to the site, while the proposed floodplain spill hazard was calculated to be 96.54m (CGVD1982). Due to grading constraints, the door sill elevations and parking garage entrance are within the proposed regional floodplain spill hazard. To flood proof the building, it is proposed to set the finished floor elevation 0.3m above the proposed floodplain spill hazard elevation (96.85m, CGVD1982) and a watertight overhead garage door be installed at the top of the parking ramp to prevent floodwaters from spilling into the underground garage. Refer to the Spill Hazard Assessment Technical Memorandum in Appendix C for details.

### 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; and
- 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.

## 3.0 SANITARY SEWER SERVICING

### 3.1 EXISTING CONDITIONS

The site is located south of Caroline Street, between John Street and Elizabeth Street with an existing 200mmø sanitary sewer along Caroline Street and Elizabeth Street and a 250mmø sanitary sewer along John Street. As part of the development of Phase 1, a

sanitary service was left stubbed from the existing 250mmø sanitary sewer along John 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 summarize 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)** |
|---|---|---|---|---|
| 840 persons | 2.67 | 3.85 | 0.072 | **10.35** |

[A] Population = (189 x 1 bdr units x 2 cap/bdr) + (108 x 2 bdr units x 2 cap/bdr) + (5 x 3 bdr units x 2 cad/bdr) = 840 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 (0.25 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)** |
|---|---|---|---|---|---|
| 0.0383 | 4 persons | 0.011 | 4.45 | 0.072 | **0.12** |

[A] Total Floor Area = 383m$^2$ 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 (0.25 hectares)
[F] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

Total Sanitary Sewer Discharge = 10.35 l/s + 0.12 l/s
**Total Sanitary Sewer Discharge = 10.47 l/s**

### 3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed mixed-use building will be serviced by the existing private 200mmø sanitary sewer, designed and constructed as part of the development at 501 John Street which discharges to the existing 250mmø sanitary sewer along John Street.

The minimum grade of the existing 200mmø sanitary service is 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 existing 200mmø sanitary service 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 300mmø watermain located along Caroline Street and John Street and a 200mmø watermain located along Elizabeth Street. The nearest existing municipal fire hydrants are located at the southwest corner of John Street and Caroline Street and at 497 Elizabeth 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. Tables 4.1 and 4.2 summarize the domestic water demand requirements for the Average Daily, Maximum Daily and Maximum 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)** |
|---|---|---|---|---|---|
| 840 persons | 2.67 | 2.25 | 4.00 | **6.01** | **10.68** |

[A] Population = (189 x 1 bdr units x 2 cap/bdr) + (108 x 2 bdr units x 2 cap/bdr) + (5 x 3 bdr units x cad/bdr) = 840 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.4)
[D] Max. Hourly Peaking Factor = 4.00 (refer to Table 2-2 in Ref. 4)
[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)** |
|---|---|---|---|---|---|
| 0.0383 | 0.011 | 2.25 | 2.25 | **0.025** | **0.025** |

[A] Total Floor Area = 383m$^2$ 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.4)
[D] Max. Hourly Peaking Factor = 2.25 (refer to Table 2-2 in Ref. 4)
[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 = 6.01 l/s + 0.025 l/s
**Total Max. Daily Demand = 6.04 l/s**

Total Max. Hourly Demand = 10.68 l/s + 0.025 l/s
**Total Max. Hourly Demand = 10.71l/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, 2020), 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 will be constructed of non-combustible construction (C=0.8), with limited combustible occupancy (-15% correction) and sprinkler system (-50% correction). Exposure corrections are based on the following:

North Face: 0% correction (45m+)
South Face: 0% correction (Fully protected with an automatic sprinkler system)
East Face: 10% correction (20.1m to 30m)
West Face: 10% correction (20.1m to 30m)

It is estimated that the required fire flow for the proposed development will be **133 l/s**. See Fire Flow Demand Requirements in Appendix D for calculations and details.

### 4.4 PROPOSED WATER SERVICING AND ANALYSIS

The proposed water servicing for the subject site consists of installing a 200mmø watermain which will be split at property line to provide a 100mmø service for residential domestic usage, a 100mmø service for commercial domestic usage and a 200mmø service for fire usage. The proposed 200mmø water service is to connect to the existing 300mmø watermain along Caroline 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 at 2030 Caroline 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 Site Grading Plan and the Preliminary Site Servicing Plan prepared by S.Llewellyn & Associates Limited;

- A 145mmø cored hole orifice plate be installed at the outlet of the proposed detention vault as per the Preliminary Site Servicing Plan and this report to provide adequate quantity control;

- An underground detention 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; and

- 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.

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**



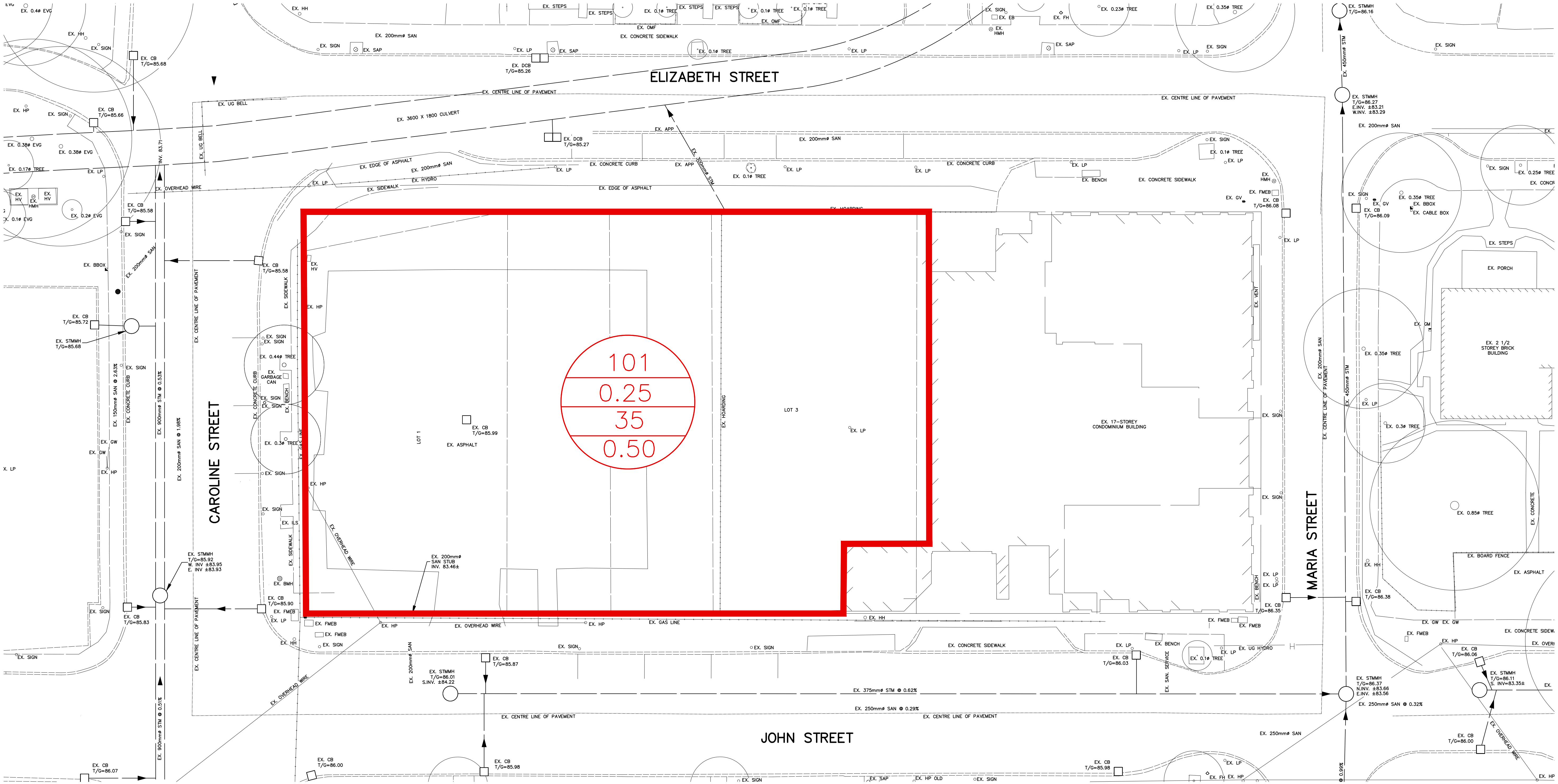

M. Colosimo, Dipl.T

S. Frankovich, P.Eng.

# APPENDIX A

# STORMWATER MANAGEMENT INFORMATION

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## LEGEND

| | |
|---|---|
| 101 | DRAINAGE AREA I.D. |
| 0.25 | DRAINAGE AREA (ha) |
| 100 | PERCENT IMPERVIOUS |
| 0.95 | RUNOFF COEFFICENT |

# FIGURE 1.0
# PRE–DEVELOPMENT STORM DRAINAGE AREA PLAN
SCALE: 1:300

PROJECT: 2030 CAROLINE STREET
PROJECT No.: 23092

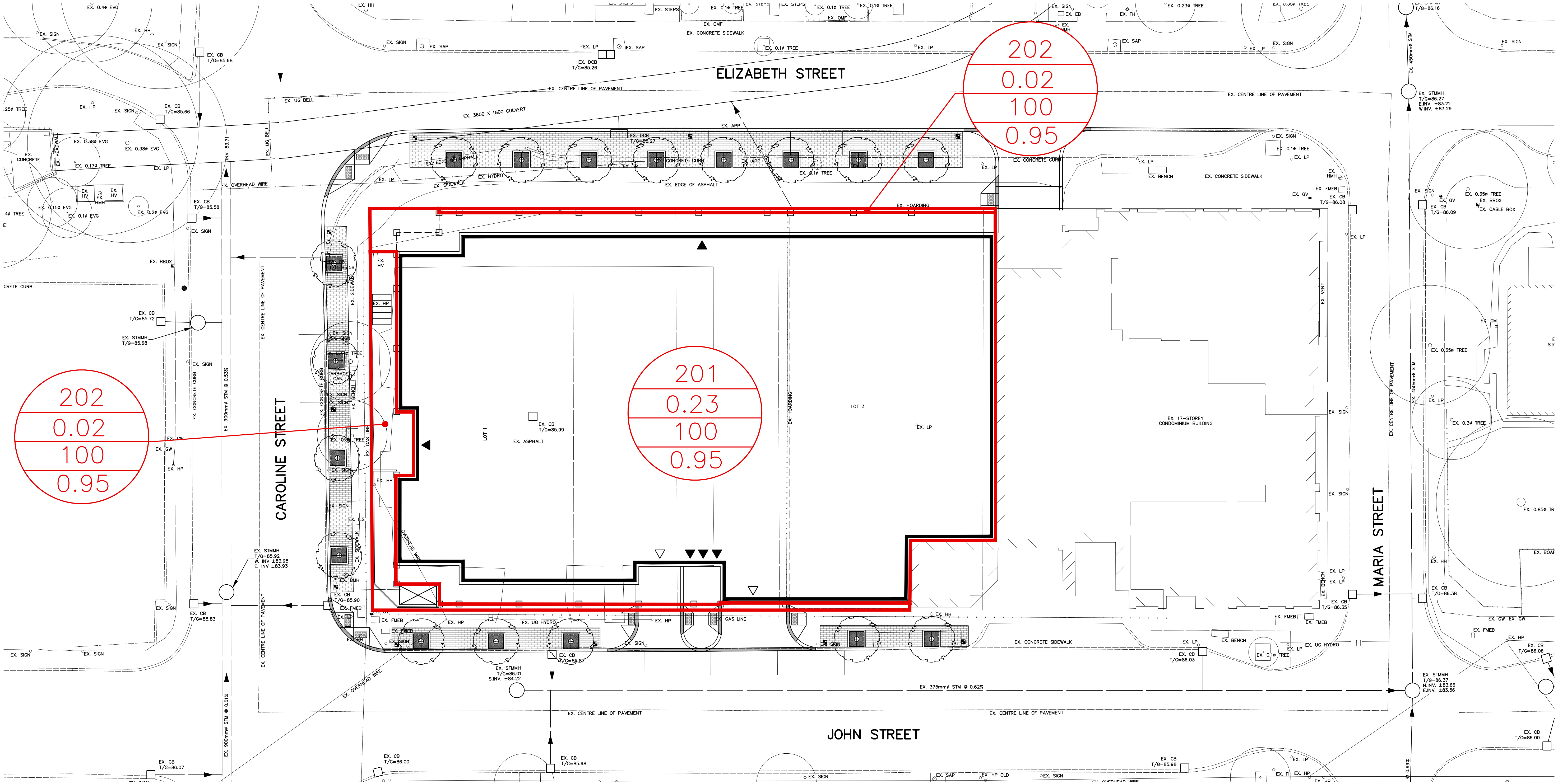
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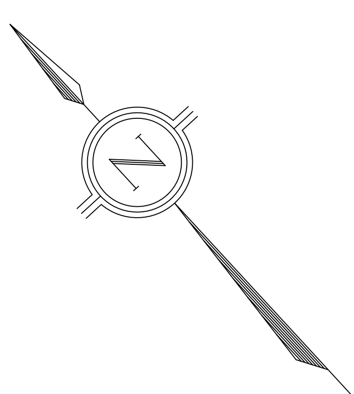
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## LEGEND

| | |
|---|---|
| 201 | DRAINAGE AREA I.D. |
| 0.25 | DRAINAGE AREA (ha) |
| 100 | PERCENT IMPERVIOUS |
| 0.95 | RUNOFF COEFFICENT |

# FIGURE 2.0
# POST–DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:300

PROJECT: 2030 CAROLINE STREET
PROJECT No.: 23092


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2030 Caroline Street
Burlington, Ontario

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

# STAGE-STORAGE-DISCHARGE CALCULATIONS

Outlet Device No. 1 (Quantity)

| | |
|---|---|
| Type: | Cored Hole |
| Diameter (mm) | 145 |
| Area ($m^2$) | 0.01651 |
| Invert Elev. (m) | 84.15 |
| C/L Elev. (m) | 84.22 |
| Disch. Coeff. ($C_d$) | 0.6 |
| 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 | 84.15 | | | | **0** | 0.000 | 0.0000 | **0.0000** |
| 0.20m Depth | 84.35 | 63 | 13 | 13 | **13** | 0.127 | 0.0157 | **0.0157** |
| 0.40m Deoth | 84.55 | 63 | 13 | 25 | **25** | 0.327 | 0.0251 | **0.0251** |
| 0.60m Depth | 84.75 | 63 | 13 | 38 | **38** | 0.527 | 0.0319 | **0.0319** |
| 0.80m Depth | 84.95 | 63 | 13 | 51 | **51** | 0.727 | 0.0374 | **0.0374** |
| 1.00m Depth/Top of Tank | 85.15 | 63 | 13 | 63 | **63** | 0.927 | 0.0423 | **0.0423** |

# APPENDIX B

# SWMHYMO INPUT/OUTPUT INFORMATION

```
2     Metric units
*#*************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.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 (ENTIRE SITE)
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.25](ha),
                    XIMP=[0.36], TIMP=[0.36], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[89],
                    Pervious   surfaces: IAper=[3.14](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
**#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
CALIB STANDHYD      ID=[1], NHYD=["201"], DT=[1](min), AREA=[0.23](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[89],
                    Pervious   surfaces: IAper=[3.14](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
                                    0.0157 , 0.0013
                                    0.0251 , 0.0025
                                    0.0319 , 0.0038
                                    0.0374 , 0.0051
                                    0.0423 , 0.0063
                                    -1  ,  -1    (max twenty pts)
```

```
                          IDovf=[3], NHYDovf=["OVF"]
*%-----------------|-------------------------------------------------------|
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
CALIB STANDHYD      ID=[4], NHYD=["202"], DT=[1](min), AREA=[0.02](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[89],
                    Pervious   surfaces: IAper=[3.14](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
*%-----------------|-------------------------------------------------------|
ADD HYD             IDsum=[5], NHYD=["BRANT"], IDs to add=[2, 3, 4]
*%-----------------|-------------------------------------------------------|
* 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
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[125]
                    MTHP25MM.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 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                +++++++++
 +++++++++                in any City           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: 2024-01-24     TIME: 15:37:39     RUN COUNTER: 000930          *
 ********************************************************************************
 * Input   filename: T:\PROJECTS\23092\FSR\SWMHYMO\23092.dat                     *
 * Output  filename: T:\PROJECTS\23092\FSR\SWMHYMO\23092.out                     *
 * Summary filename: T:\PROJECTS\23092\FSR\SWMHYMO\23092.sum                     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________________*
 * 2:_____________________________________________________________________________*
 * 3:_____________________________________________________________________________*
 ********************************************************************************


--------------------------------------------------------------------------------
001:0001----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#*****************************************************************************|
*
  ** END OF RUN :   1

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




--------------------
| START            |  Project  dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
          #  1=BURL_002.stm
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 2-yr 6hr CHICAGO  (A=681.52,
| Ptotal=  40.93 mm|    Comments: Burlington 2-yr 6hr CHICAGO  (A=681.52,
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   1.715 |   1.67   8.325 |   3.17   4.467 |   4.67   2.213
              .33   1.858 |   1.83  19.646 |   3.33   3.978 |   4.83   2.105
              .50   2.032 |   2.00  78.391 |   3.50   3.595 |   5.00   2.008
              .67   2.247 |   2.17  25.776 |   3.67   3.286 |   5.17   1.920
              .83   2.522 |   2.33  13.777 |   3.83   3.030 |   5.33   1.841
             1.00   2.888 |   2.50   9.511 |   4.00   2.815 |   5.50   1.769
             1.17   3.399 |   2.67   7.331 |   4.17   2.632 |   5.67   1.703
             1.33   4.172 |   2.83   6.005 |   4.33   2.474 |   5.83   1.642
             1.50   5.492 |   3.00   5.111 |   4.50   2.335 |   6.00   1.586

--------------------------------------------------------------------------------
002:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#****************************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .16
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.50          .10
     Length            (m)=      15.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=      78.39        47.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .80 (ii)    1.44 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.21          .85
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .02          .02          .040 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00         2.000
     RUNOFF VOLUME    (mm)=      39.93        20.64        27.588
     TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
     RUNOFF COEFFICIENT   =        .98          .50          .674

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
**#****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=      78.39        47.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .71 (ii)    1.35 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.29          .89
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .05          .00          .050 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00         2.000
     RUNOFF VOLUME    (mm)=      39.93        20.64        39.740
     TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
     RUNOFF COEFFICIENT   =        .98          .50          .971

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
*# 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    |     .032  .3800E-02
                            .016  .1300E-02    |     .037  .5100E-02
                            .025  .2500E-02    |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .050     2.000     39.740
     OUTFLOW<02: (201   )        .23      .025     2.017     39.740
    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](%)=   50.517
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2520E-02

--------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=      78.39        47.13
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .57 (ii)    1.22 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.40          .95
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .00          .00          .004 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.00         2.000
     RUNOFF VOLUME    (mm)=      39.93        20.64        39.740
     TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
```

```
     RUNOFF COEFFICIENT   =        .98          .50          .971

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

-------------------------------------------------------------------------------
002:0007---------------------------------------------------------------------
-----------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201           .23     .025    2.02  39.74    .000
                       +ID2 03:OVF           .00     .000     .00    .00    .000
                       +ID3 04:202           .02     .004    2.00  39.74    .000
                        ============================================================
                        SUM 05:BRANT         .25     .029    2.00  39.74    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

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




--------------------
| START            |  Project  dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
           #  1=BURL_005.stm
-------------------------------------------------------------------------------
005:0002---------------------------------------------------------------------
*******************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#******************************************************************************|
*
-------------------------------------------------------------------------------
005:0002---------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 5-yr 6hr CHICAGO    (A=802.04
| Ptotal=  53.05 mm|    Comments: Burlington 5-yr 6hr CHICAGO    (A=802.04
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   2.348 |   1.67  10.690 |   3.17   5.897 |   4.67   3.004
              .33   2.537 |   1.83  24.479 |   3.33   5.279 |   4.83   2.862
              .50   2.766 |   2.00 101.312 |   3.50   4.790 |   5.00   2.734
              .67   3.048 |   2.17  31.941 |   3.67   4.394 |   5.17   2.619
              .83   3.407 |   2.33  17.333 |   3.83   4.065 |   5.33   2.514
             1.00   3.881 |   2.50  12.145 |   4.00   3.788 |   5.50   2.419
             1.17   4.539 |   2.67   9.469 |   4.17   3.550 |   5.67   2.331
             1.33   5.523 |   2.83   7.826 |   4.33   3.344 |   5.83   2.251
             1.50   7.185 |   3.00   6.709 |   4.50   3.164 |   6.00   2.176

-------------------------------------------------------------------------------
005:0003---------------------------------------------------------------------
*
*#******************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*****************************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .16
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.50          .10
     Length            (m)=      15.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.31        69.50
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .72 (ii)    1.27 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.27          .93
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .03          .055 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=      52.05        30.64        38.349
     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
     RUNOFF COEFFICIENT   =        .98          .58          .723

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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---------------------------------------------------------------------
**#****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.31        69.50
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .64 (ii)    1.19 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.34          .97
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .065 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=      52.05        30.64        51.839
     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
     RUNOFF COEFFICIENT   =        .98          .58          .977

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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---------------------------------------------------------------------
*# 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     |     .032  .3800E-02
                            .016  .1300E-02     |     .037  .5100E-02
                            .025  .2500E-02     |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .065     2.000     51.839
     OUTFLOW<02: (201   )        .23      .030     2.017     51.839
    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](%)=   45.746
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3344E-02

-------------------------------------------------------------------------------
005:0006---------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.31        69.50
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .52 (ii)    1.07 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.45         1.03
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .006 (iii)
     TIME TO PEAK    (hrs)=       1.93         2.00         2.000
     RUNOFF VOLUME    (mm)=      52.05        30.64        51.838
     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
     RUNOFF COEFFICIENT   =        .98          .58          .977

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

-------------------------------------------------------------------------------
005:0007---------------------------------------------------------------------
-----------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201           .23     .030    2.02  51.84    .000
                       +ID2 03:OVF           .00     .000     .00    .00    .000
                       +ID3 04:202           .02     .006    2.00  51.84    .000
                        ============================================================
                        SUM 05:BRANT         .25     .035    2.00  51.84    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS 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\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 010
    NSTORM=   1
           #  1=BURL_010.stm
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#*************************************************************************|
*
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 10-yr 6hr CHICAGO     (A=918.
| Ptotal=  61.10 mm|    Comments: Burlington 10-yr 6hr CHICAGO     (A=918.
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   2.714 |   1.67  12.326 |   3.17   6.808 |   4.67   3.472
              .33   2.933 |   1.83  28.176 |   3.33   6.095 |   4.83   3.308
              .50   3.197 |   2.00 116.310 |   3.50   5.532 |   5.00   3.161
              .67   3.523 |   2.17  36.748 |   3.67   5.075 |   5.17   3.027
              .83   3.937 |   2.33  19.967 |   3.83   4.696 |   5.33   2.907
             1.00   4.483 |   2.50  14.001 |   4.00   4.376 |   5.50   2.796
             1.17   5.242 |   2.67  10.921 |   4.17   4.102 |   5.67   2.695
             1.33   6.377 |   2.83   9.030 |   4.33   3.864 |   5.83   2.602
             1.50   8.291 |   3.00   7.743 |   4.50   3.656 |   6.00   2.516


--------------------------------------------------------------------------------
010:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#************************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .16
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.50          .10
     Length            (m)=      15.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     116.31        84.67
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .68 (ii)    1.19 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.31          .97
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .03          .04          .066 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=      60.10        37.60        45.699
     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
     RUNOFF COEFFICIENT   =        .98          .62          .748

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
**#************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#************************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     116.31        84.67
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .60 (ii)    1.11 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.37         1.01
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .07          .00          .074 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=      60.10        37.59        59.876
     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
     RUNOFF COEFFICIENT   =        .98          .62          .980

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
*# 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   |     .032  .3800E-02
                           .016  .1300E-02   |     .037  .5100E-02
                           .025  .2500E-02   |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .074     2.000     59.876
     OUTFLOW<02: (201   )        .23      .032     2.017     59.876
    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](%)=   43.698
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3916E-02

--------------------------------------------------------------------------------
010:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     116.31        84.67
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .49 (ii)    1.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.48         1.08
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .006 (iii)
     TIME TO PEAK    (hrs)=       1.93         2.00         2.000
     RUNOFF VOLUME    (mm)=      60.10        37.60        59.876
     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
     RUNOFF COEFFICIENT   =        .98          .62          .980

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

--------------------------------------------------------------------------------
010:0007----------------------------------------------------------------------
------------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201          .23     .032    2.02  59.88    .000
                       +ID2 03:OVF          .00     .000     .00    .00    .000
                       +ID3 04:202          .02     .006    2.00  59.88    .000
                        ==========================================================
                        SUM 05:BRANT        .25     .038    2.00  59.88    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS 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\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
           #  1=BURL_025.stm
--------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#*************************************************************************|
*
--------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 25-yr 6hr CHICAGO      (A=106
| Ptotal=  71.35 mm|    Comments: Burlington 25-yr 6hr CHICAGO      (A=106
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
```

| hrs | mm/hr | hrs | mm/hr | hrs | mm/hr | hrs | mm/hr |
|---|---|---|---|---|---|---|---|
| .17 | 3.182 | 1.67 | 14.410 | 3.17 | 7.968 | 4.67 | 4.068 |
| .33 | 3.437 | 1.83 | 32.881 | 3.33 | 7.135 | 4.83 | 3.876 |
| .50 | 3.746 | 2.00 | 135.380 | 3.50 | 6.477 | 5.00 | 3.704 |
| .67 | 4.128 | 2.17 | 42.866 | 3.67 | 5.943 | 5.17 | 3.548 |
| .83 | 4.612 | 2.33 | 23.321 | 3.83 | 5.499 | 5.33 | 3.407 |
| 1.00 | 5.251 | 2.50 | 16.365 | 4.00 | 5.125 | 5.50 | 3.278 |
| 1.17 | 6.138 | 2.67 | 12.771 | 4.17 | 4.805 | 5.67 | 3.160 |
| 1.33 | 7.465 | 2.83 | 10.563 | 4.33 | 4.527 | 5.83 | 3.051 |
| 1.50 | 9.700 | 3.00 | 9.061 | 4.50 | 4.284 | 6.00 | 2.950 |

```
------------------------------------------------------------------------------
025:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#************************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
---------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .16
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.50          .10
     Length            (m)=      15.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38       104.28
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .64 (ii)    1.11 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.34         1.01
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .03          .05          .079 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=      70.35        46.71        55.218
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .65          .774

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
**#************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#************************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       1.00          .10
     Length            (m)=      10.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38       104.28
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .57 (ii)    1.04 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.41         1.05
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .09          .00          .086 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=      70.35        46.71        70.110
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .65          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
*# 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    |     .032  .3800E-02
                           .016  .1300E-02    |     .037  .5100E-02
                           .025  .2500E-02    |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .086     2.000     70.110
     OUTFLOW<02: (201   )        .23      .036     2.017     70.110
    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](%)=   41.165
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4662E-02

------------------------------------------------------------------------------
025:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02          .00
     Dep. Storage     (mm)=       1.00         3.14
     Average Slope     (%)=       2.00          .10
     Length            (m)=      10.00          .10
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38       104.28
               over (min)        1.00         1.00
     Storage Coeff.  (min)=        .46 (ii)     .93 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.50         1.12
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .008 (iii)
     TIME TO PEAK    (hrs)=       1.93         2.00         2.000
     RUNOFF VOLUME    (mm)=      70.35        46.71        70.110
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .65          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

------------------------------------------------------------------------------
025:0007----------------------------------------------------------------------
------------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------ (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .23     .036    2.02  70.11    .000
                     +ID2 03:OVF            .00     .000     .00    .00    .000
                     +ID3 04:202            .02     .008    2.00  70.11    .000
                      ========================================================
                      SUM 05:BRANT          .25     .042    2.00  70.11    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS 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\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
             #  1=BURL_050.stm
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#*************************************************************************|
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 50-yr 6hr CHICAGO     (A=1172
| Ptotal=  78.93 mm|    Comments: Burlington 50-yr 6hr CHICAGO     (A=1172
--------------------
```

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| .17 | 3.533 | 1.67 | 15.961 | 3.17 | 8.836 | 4.67 | 4.516 |
| .33 | 3.817 | 1.83 | 36.356 | 3.33 | 7.913 | 4.83 | 4.304 |
| .50 | 4.160 | 2.00 | 149.296 | 3.50 | 7.185 | 5.00 | 4.113 |
| .67 | 4.582 | 2.17 | 47.374 | 3.67 | 6.593 | 5.17 | 3.940 |
| .83 | 5.119 | 2.33 | 25.806 | 3.83 | 6.102 | 5.33 | 3.783 |
| 1.00 | 5.827 | 2.50 | 18.121 | 4.00 | 5.688 | 5.50 | 3.640 |
| 1.17 | 6.809 | 2.67 | 14.149 | 4.17 | 5.333 | 5.67 | 3.509 |
| 1.33 | 8.278 | 2.83 | 11.707 | 4.33 | 5.025 | 5.83 | 3.388 |
| 1.50 | 10.753 | 3.00 | 10.045 | 4.50 | 4.755 | 6.00 | 3.277 |

```
------------------------------------------------------------------------------
050:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#************************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
---------------------
```

```
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .09          .16
     Dep. Storage     (mm)=         1.00         3.14
     Average Slope     (%)=         1.50          .10
     Length            (m)=        15.00          .10
     Mannings n           =         .013         .250

     Max.eff.Inten.(mm/hr)=       149.30       118.76
               over (min)          1.00         1.00
     Storage Coeff.  (min)=          .62 (ii)     1.06 (ii)
     Unit Hyd. Tpeak (min)=         1.00         1.00
     Unit Hyd. peak  (cms)=         1.36         1.04
                                                    *TOTALS*
     PEAK FLOW       (cms)=          .04          .05          .089 (iii)
     TIME TO PEAK    (hrs)=         1.98         2.00         2.000
     RUNOFF VOLUME    (mm)=        77.93        53.59        62.355
     TOTAL RAINFALL   (mm)=        78.93        78.93        78.932
     RUNOFF COEFFICIENT   =          .99          .68          .790

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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---------------------------------------------------------------------
**#*********************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*********************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .23          .00
     Dep. Storage     (mm)=         1.00         3.14
     Average Slope     (%)=         1.00          .10
     Length            (m)=        10.00          .10
     Mannings n           =         .013         .250

     Max.eff.Inten.(mm/hr)=       149.30       118.76
               over (min)          1.00         1.00
     Storage Coeff.  (min)=          .55 (ii)     .99 (ii)
     Unit Hyd. Tpeak (min)=         1.00         1.00
     Unit Hyd. peak  (cms)=         1.43         1.08
                                                    *TOTALS*
     PEAK FLOW       (cms)=          .09          .00          .095 (iii)
     TIME TO PEAK    (hrs)=         1.97         2.00         2.000
     RUNOFF VOLUME    (mm)=        77.93        53.59        77.689
     TOTAL RAINFALL   (mm)=        78.93        78.93        78.932
     RUNOFF COEFFICIENT   =          .99          .68          .984

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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---------------------------------------------------------------------
*# 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    |     .032  .3800E-02
                          .016  .1300E-02    |     .037  .5100E-02
                          .025  .2500E-02    |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .095     2.000     77.689
     OUTFLOW<02: (201   )        .23      .038     2.017     77.689
    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](%)=   39.762
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.5218E-02

-------------------------------------------------------------------------------
050:0006---------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .02          .00
     Dep. Storage     (mm)=         1.00         3.14
     Average Slope     (%)=         2.00          .10
     Length            (m)=        10.00          .10
     Mannings n           =         .013         .250

     Max.eff.Inten.(mm/hr)=       149.30       118.76
               over (min)          1.00         1.00
     Storage Coeff.  (min)=          .44 (ii)     .89 (ii)
     Unit Hyd. Tpeak (min)=         1.00         1.00
     Unit Hyd. peak  (cms)=         1.52         1.15
                                                    *TOTALS*
     PEAK FLOW       (cms)=          .01          .00          .008 (iii)
     TIME TO PEAK    (hrs)=         1.93         2.00         2.000
     RUNOFF VOLUME    (mm)=        77.93        53.59        77.689
     TOTAL RAINFALL   (mm)=        78.93        78.93        78.932
     RUNOFF COEFFICIENT   =          .99          .68          .984

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

-------------------------------------------------------------------------------
050:0007---------------------------------------------------------------------
-----------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                          ID1 02:201          .23     .038    2.02  77.69    .000
                         +ID2 03:OVF          .00     .000     .00    .00    .000
                         +ID3 04:202          .02     .008    2.00  77.69    .000
                          ===========================================================
                          SUM 05:BRANT        .25     .045    2.00  77.69    .000

   NOTE:  PEAK FLOWS DO 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\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=BURL_100.stm
-------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------
*#*********************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#*********************************************************************|
*
-------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 100-yr 6hr CHICAGO        (A=
| Ptotal=  86.27 mm|    Comments: Burlington 100-yr 6hr CHICAGO        (A=
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.862 |   1.67  17.445 |   3.17   9.657 |   4.67   4.936
               .33   4.172 |   1.83  39.736 |   3.33   8.649 |   4.83   4.704
               .50   4.546 |   2.00 163.177 |   3.50   7.853 |   5.00   4.495
               .67   5.008 |   2.17  51.779 |   3.67   7.206 |   5.17   4.306
               .83   5.595 |   2.33  28.205 |   3.83   6.670 |   5.33   4.135
              1.00   6.369 |   2.50  19.806 |   4.00   6.217 |   5.50   3.979
              1.17   7.443 |   2.67  15.465 |   4.17   5.829 |   5.67   3.835
              1.33   9.048 |   2.83  12.795 |   4.33   5.492 |   5.83   3.703
              1.50  11.752 |   3.00  10.979 |   4.50   5.197 |   6.00   3.581

-------------------------------------------------------------------------------
100:0003---------------------------------------------------------------------
*
*#*********************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*********************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .09          .16
     Dep. Storage     (mm)=         1.00         3.14
     Average Slope     (%)=         1.50          .10
     Length            (m)=        15.00          .10
     Mannings n           =         .013         .250

     Max.eff.Inten.(mm/hr)=       163.18       133.20
               over (min)          1.00         1.00
     Storage Coeff.  (min)=          .60 (ii)     1.02 (ii)
     Unit Hyd. Tpeak (min)=         1.00         1.00
     Unit Hyd. peak  (cms)=         1.38         1.06
                                                    *TOTALS*
     PEAK FLOW       (cms)=          .04          .06          .099 (iii)
     TIME TO PEAK    (hrs)=         1.97         2.00         2.000
     RUNOFF VOLUME    (mm)=        85.27        60.34        69.317
     TOTAL RAINFALL   (mm)=        86.27        86.27        86.271
     RUNOFF COEFFICIENT   =          .99          .70          .803

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
**#**********************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#**********************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .23          .00
     Dep. Storage     (mm)=      1.00         3.14
     Average Slope     (%)=      1.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    163.18       133.20
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .53 (ii)     .95 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.44         1.10
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .10          .00          .104 (iii)
     TIME TO PEAK    (hrs)=      1.97         2.00         2.000
     RUNOFF VOLUME    (mm)=     85.27        60.34        85.022
     TOTAL RAINFALL   (mm)=     86.27        86.27        86.271
     RUNOFF COEFFICIENT   =       .99          .70          .986

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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----------------------------------------------------------------------
*# 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   |     .032  .3800E-02
                           .016  .1300E-02   |     .037  .5100E-02
                           .025  .2500E-02   |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .104     2.000     85.022
     OUTFLOW<02: (201   )        .23      .040     2.017     85.022
    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](%)=   38.552
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.5776E-02

--------------------------------------------------------------------------------
100:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .02          .00
     Dep. Storage     (mm)=      1.00         3.14
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    163.18       133.20
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .43 (ii)     .85 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.53         1.17
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .009 (iii)
     TIME TO PEAK    (hrs)=      1.93         2.00         2.000
     RUNOFF VOLUME    (mm)=     85.27        60.34        85.022
     TOTAL RAINFALL   (mm)=     86.27        86.27        86.271
     RUNOFF COEFFICIENT   =       .99          .70          .986

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

--------------------------------------------------------------------------------
100:0007----------------------------------------------------------------------
------------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)    (cms)
                    ID1 02:201             .23      .040    2.02  85.02    .000
                   +ID2 03:OVF             .00      .000     .00    .00    .000
                   +ID3 04:202             .02      .009    2.00  85.02    .000
                    ========================================================
                    SUM 05:BRANT           .25      .048    2.00  85.02    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS 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----------------------------------------------------------------------
*
  ** END OF RUN : 124

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




--------------------
| START            |  Project  dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23092\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 125
    NSTORM=   1
           #  1=MTHP25MM.stm
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*#**********************************************************************|
*#  Project Name: 2030 CAROLINE STREET
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23092
*#       Date   : JANUARY 2024
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23092.DAT
*#**********************************************************************|
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 25mm 4-HOUR (A=555 B=5.89 C=0.813)
| Ptotal=  25.27 mm|    Comments: 25mm 4-HOUR (A=555 B=5.89 C=0.813)
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   1.491 |   1.17  13.390 |   2.17   3.748 |   3.17   1.810
              .33   1.720 |   1.33  58.584 |   2.33   3.156 |   3.33   1.675
              .50   2.045 |   1.50  17.849 |   2.50   2.734 |   3.50   1.560
              .67   2.542 |   1.67   9.118 |   2.67   2.417 |   3.67   1.460
              .83   3.408 |   1.83   6.129 |   2.83   2.170 |   3.83   1.374
             1.00   5.319 |   2.00   4.638 |   3.00   1.973 |   4.00   1.299

--------------------------------------------------------------------------------
125:0003----------------------------------------------------------------------
*
*#**********************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#**********************************************************************|
*# CATCHMENT 101 - Existing Condition (ENTIRE SITE)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .09          .16
     Dep. Storage     (mm)=      1.00         3.14
     Average Slope     (%)=      1.50          .10
     Length            (m)=     15.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     58.58        25.88
               over (min)        1.00         2.00
     Storage Coeff.  (min)=       .90 (ii)    1.72 (ii)
     Unit Hyd. Tpeak (min)=      1.00         2.00
     Unit Hyd. peak  (cms)=      1.14          .61
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .01          .01          .025 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     24.27         9.15        14.592
     TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
     RUNOFF COEFFICIENT   =       .96          .36          .577

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

--------------------------------------------------------------------------------
125:0004----------------------------------------------------------------------
**#**********************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#**********************************************************************|
*# CATCHMENT 201 - Proposed Condition (CONROLLED TO CAROLINE STREET)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .23          .00
     Dep. Storage     (mm)=      1.00         3.14
     Average Slope     (%)=      1.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250
```

```
     Max.eff.Inten.(mm/hr)=      58.58        25.88
               over (min)         1.00         2.00
     Storage Coeff.  (min)=        .79 (ii)    1.61 (ii)
     Unit Hyd. Tpeak (min)=       1.00         2.00
     Unit Hyd. peak  (cms)=       1.22          .64
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .037 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=      24.27         9.15        24.117
     TOTAL RAINFALL   (mm)=      25.27        25.27        25.268
     RUNOFF COEFFICIENT   =        .96          .36          .954

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

--------------------------------------------------------------------------------
125:0005----------------------------------------------------------------------
*# 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   |     .032  .3800E-02
                           .016  .1300E-02   |     .037  .5100E-02
                           .025  .2500E-02   |     .042  .6300E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .23      .037     1.333     24.117
     OUTFLOW<02: (201   )        .23      .020     1.350     24.117
    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](%)=   52.556
                    TIME SHIFT OF PEAK FLOW         (min)=    1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1794E-02

--------------------------------------------------------------------------------
125:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (UNCONTROLLED TO RIGHT OF WAY)
*
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .02
| 04:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .02          .00
     Dep. Storage     (mm)=      1.00         3.14
     Average Slope     (%)=      2.00          .10
     Length            (m)=     10.00          .10
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=      58.58        26.64
               over (min)         1.00         1.00
     Storage Coeff.  (min)=        .65 (ii)    1.45 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.34          .85
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .00          .00          .003 (iii)
     TIME TO PEAK    (hrs)=       1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=      24.27         9.15        24.116
     TOTAL RAINFALL   (mm)=      25.27        25.27        25.268
     RUNOFF COEFFICIENT   =        .96          .36          .954

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  89.0    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.

--------------------------------------------------------------------------------
125:0007----------------------------------------------------------------------
-----------------------
| ADD HYD (BRANT     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 02:201            .23     .020    1.35  24.12    .000
                      +ID2 03:OVF            .00     .000     .00    .00    .000
                      +ID3 04:202            .02     .003    1.33  24.12    .000
                       ==========================================================
                       SUM 05:BRANT          .25     .022    1.33  24.12    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
125:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------

   Simulation ended on 2024-01-24     at 15:37:40
================================================================================
```

# APPENDIX C

# SPILL HAZARD ASSESSMENT TECHNICAL MEMORADNUM

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

# TECHNICAL MEMORANDUM

| | | | |
|---|---|---|---|
| **To:** | Laura Schreiner<br>Environmental Planner | **From:** | Steven DeGrow<br>Steven Frankovich |
| | | **Date:** | June 24, 2024 |
| **Project:** | 2030 Caroline Street<br>Burlington, ON | **Pages:** | 8 + Appendices A & B |
| | | **Job #:** | 23092 |
| **Re:** | Floodplain Spill Hazard Analysis for 2030 Caroline Street | | |

## 1. Introduction

S. Llewellyn and Associates Limited has been engaged by Inaria Burlington Inc. to assess the existing floodplain spill elevations adjacent to and within the site limits. This evaluation supports the development of Phase 2, a 27-storey mixed-use condominium building that will be constructed adjacent to the existing Phase 1 building, which currently exists on the site. The 0.278 ha site is located east of Caroline Street, south of Elizabeth Street, West of Maria Street and north of John Street in the City of Burlington. The construction of the project builds on the existing planning framework for the entire block that was issued in 2010.

Rambo Creek inlets into an existing 3600mm x 1800mm box culvert situated approximately 25 meters north of the property line on the north side of Caroline Street. The constrained capacity of the 3600mm x 1800mm box culvert creates a flood spill scenario during both the 100-year and Regional Storm Events. The resulting overflow from Rambo Creek flows southward from the existing culvert inlet, inundating the adjacent municipal streets and the proposed development area. Refer to Figure 1 for the location plan.

For background information, a 100-year storm is used to describe a rainfall event that has a 1% statistical probability of occurring in any given year. Despite the term “100-year” it is possible for the event to occur more or less frequently than once every 100 years. A 100-year storm is often used in engineering and planning to design infrastructure, such as stormwater management facilities, channels and culvert crossings. The Regional Storm event in Burlington is defined by the measured rainfall data that was collected during Hurricane Hazel, which occurred in October 1954. A storm of this magnitude is a rare event for the region, however, it caused significant damage and loss of life in Ontario. The Regional Storm event is not often used to size infrastructure such as stormwater management facilities, channels and culvert crossings unless specifically required by the reviewing agencies due to area specific flood concerns. While both the 100-year and Regional Storm refer to weather events, a 100-year storm is a specific rainfall event with a defined return period, while the Regional Storm is based on weather phenomena that would impact a large region of Ontario with an unknown return period.

The purpose of this memorandum is to document the methodology and results from the spill flood hazard analysis and demonstrate how the grading of the proposed development can satisfy the criteria established by the Conservation Halton (CH). This criterion was provided to S. Llewellyn and Associates by CH staff via email on November 9, 2021.

## 2. Background

The following information was used in the preparation of this memo:

Ref. 1: Major Transit Station Area (MTSA) Phase 2 Flood Hazard Assessment Burlington GO and Downtown (WSP, March 06, 2023).

Ref. 2: River & Stream Systems: Flood Hazard Limit Technical Guide (Ontario Ministry of Natural Resources, 2002)

Ref. 3: Burlington-Downtown Hazard Mapping HEC-RAS modelling provided by Conservation Halton.

Ref. 4: Topographic survey prepared by A.T. McLaren Limited, dated December, 2023.

## 3. Methodology

The subject area is located within a spill hazard recently identified by Conservation Halton. Proposed redevelopment within this area must demonstrate that: there is no increased risk to “existing development”, the proposed development is not exposed to greater risk than the existing development, neighbouring properties are not negatively impacted by the proposed development, access and egress will be provided, and there are no feasible alternatives to developing outside of the hazard or within a lower risk area of the site.

The spill flood hazard analysis assessment included the following tasks:

- Review of the existing site topography within the 2D Downtown HEC-RAS model
- Update the hydraulic (HEC-RAS) model provided by the CH to incorporate the existing information captured by the topographic survey of the development area.
- Run the updated existing conditions model to confirm the spill hazard and flood elevations.
- Update the terrain to model the proposed site conditions.
- Run a proposed model with the updated terrain to determine changes to the floodplain and spill flood hazard areas.
- Review the proposed conditions results against the existing conditions results.




**Figure 1 – Location Plan**

## 4. Hydraulic Modeling Information

### 4.1. Flow Rates

Flows in the model are based on the Major Transit Station Area (MTSA) Phase 2 Flood Hazard Assessment (Ref. 1) and were included within the existing model provided by Conservation Halton. The *Regional Storm with FCF and Spills* unsteady flow file was used for both existing and proposed models.

### 4.2. Review of LiDAR Data

LiDAR is short for Light Detection And Ranging, and is a technique that uses lasers to create detailed 3D terrain models of the Earth's surface. LIDAR is normally completed using airplanes equipped with lasers that scan the earth's surface and record how long it takes for the light to bounce back, creating a 3D terrain of the ground below.

The LiDAR data within the HEC-RAS model was compared with five surveyed data points across varying surface types. It is noted that the LiDAR data has a vertical datum of CVGD2013 and the topographic survey has a vertical datum of CVGD1982. Based on this, it is expected that the LiDAR data points will be approximately 0.42m lower than the surveyed data points. **Table 4.1** shows the comparison of the points, along with the difference in vertical elevation and **Figure A1** in **Appendix A** shows the location from which the points were taken.

**Table 4.1 – Data Point Comparison**

| Point Number | LiDAR Elevation (m) | Topographic Survey Elevation (m) | Difference in Elevation (m) |
|---|---|---|---|
| 1 | 85.73 | 86.15 | 0.42 |
| 2 | 85.38 | 85.79 | 0.41 |
| 3 | 85.87 | 86.30 | 0.43 |
| 4 | 85.96 | 86.39 | 0.43 |
| 5 | 85.72 | 86.13 | 0.41 |

A clear understanding of the difference between topographic data and LiDAR data is crucial. Floodplain elevations must be accurately reflected in both engineering drawings and the 2D HEC-RAS model. Discrepancies between these data sources can lead to construction errors, potentially creating unsafe conditions for future residents or tenants. Through our review of the LiDAR and topographic data, the differences are within acceptable tolerances.

## 4.3. Geometry and Existing Conditions Analysis Results

The existing terrain file, MTSA_Structures_2013CGVD_0.5m, provided with the 2D Downtown HEC-RAS model, was updated to integrate the survey data provided by A.T. McLaren Limited. This survey covered the development area, municipal rights-of-way, sections of Rambo Creek, and the existing 17-storey condominium tower constructed as part of the first phase of this project. The updated terrain combines the MTSA_Structures_2013CGVD_0.5m file with the topographic data, resulting in an accurate representation of the existing conditions. The terrain is titled Original_Terrain_Birkley_Ph_1 in the revised HEC-RAS model. Furthermore, a new terrain file, Original_Terrain_Birkley_Topo_and_Proposed_Site_1, was created for the proposed condition which integrated the Phase 2 building and associated grading with the updated existing terrain file.

The 2D Downtown HEC-RAS model was re-run with the updated existing terrain file in the plan titled Regional-Storm (Phase 1 Birkley). The results of this model reflect the current spill hazard based on current and most accurate topographic information. The RAS Mapper output illustrates that a spill from Rambo Creek occurs at the box culvert inlet, impacting Caroline Street and flowing eastward along Elizabeth and John Street. Subsequently, a portion of the spill reconnects with the Rambo Creek Floodplain, while the remaining portion continues, south ultimately reaching Lake Ontario without reconnecting with Rambo Creek. **Figure B1** in **Appendix B** provides a map displaying the floodplain water surface elevations for the existing conditions in the vicinity of the site.

Under existing conditions, John and Maria Street are categorized as low-risk hazards adjacent to the development area. However, the flood depths on these streets exceed private vehicular access guidelines based on the River & Stream Systems: Flooding Hazard Limit Manual, Ontario Ministry of Natural Resources, 2002. Furthermore, there are portions of Caroline and Elizabeth Street that are characterized as high hazard based on flood depths and the product of depth*velocity. It's important to note that these high-hazard portions would still be accessible by emergency vehicles with top exhausts, such as fire trucks. The high and low hazard risks in the right-of-ways surrounding the site would be present for approximately 4.5 hours, based on the results from the HEC-RAS model. **Figures B2-B4** in **Appendix B** illustrate the existing flood hazard risk for the area surrounding the site and the criteria used for determination.

## 4.4. Proposed Conditions Analysis Results

The proposed condition was modelled in the plan titled Regional-Storm w FCF and Spills (Birkley). Based on the results provided in RAS Mapper, the floodplain will remain at approximately the same elevation in the existing condition, with only a slight increase to the floodplain (0.01m +/-) directly north of the Phase 2 building. A proposed conditions map of the floodplain water surface elevations of the area surrounding the site is shown in **Figure B5** in **Appendix B.** In addition, **Figure B9** in **Appendix B** shows the change in water surface elevations in the vicinity of the development.

**Figure B10** in **Appendix B** shows the change in water surface elevation over the whole downtown area. **Figure B10** shows the water surface elevation is relatively unchanged (less than 0.01m increase) or even decreased slightly over most of the spill hazards under proposed conditions. Additionally, the previously mentioned increase on Caroline Street of 0.01m, is located within the municipal right of way and does not impact any adjacent private lands.

Under proposed conditions, the hazard risks remain unchanged from the existing condition with respect to safe egress and ingress. In addition, the high and low hazard risks in the right-of-ways surrounding the site would be present for approximately 4.5 hours, which is consistent with the existing condition. Conservation Halton staff have also confirmed that an 0.01 m increase in the flood spill elevation is within an acceptable range. **Figures B7-B8** in **Appendix B** illustrate the proposed flood hazard risk for the area surrounding the site as well as the criteria used to determine this.

## 5. Discussion

The results indicate that the proposed building and associated grading will not adversely increase the floodplain over the downtown area. Additionally, the first-floor elevation of the proposed building will be set 0.30m above the highest floodplain elevation against the building (86.12m, CVGD2013) (86.54m, CVGD1982) to prevent inflow during a flood event.

However, setting all door sills located at the building's edge 0.30m above the floodplain is not feasible due to grading constraints. Instead, internal stairs and ramps will be designed to ensure the first-floor elevation is at the required elevation. Similarly, based on the existing grades within the John Street right of way it's also not feasible to set the top of the underground parking ramp 0.30m above the floodplain spill elevation. As a solution, a watertight overhead door is being considered for the underground parking ramp on John Street to prevent floodwaters from entering the building during the Regional or 100-year storm event. Furthermore, the parking ramp on Elizabeth Street is to the above-grade parking structure level, eliminating any potential for flooding within the Elizabeth Street right of way to enter the underground parking structure.

Additionally, a further analysis was completed to assess the impact of incorporating floodplain storage within the municipal parking lot on the north side of Caroline Street. Two iterations of the storage plan were considered. In the first iteration, a depression was added in the proposed terrain within the parking lot area with a total storage volume of around 10,000$m^3$, which was directly connected to Rambo Creek. This plan is titled Regional-Storm Birkley w Storage in the HEC-RAS model. In the second iteration, a similar depression in the terrain within the parking lot was considered, also with a total storage of approximately 10,000$m^3$. However, in this iteration, the depression was separated from Rambo Creek by the existing top of the creek bank. This plan is titled Sto-2 within the HEC-RAS model. Both storage areas had similar bottom elevations, representing the lowest elevation for a gravity-draining storage area.

The results from both models showed a negligible change to the peak flood depths within the spill area. **Figures B11-B12** in Appendix B show the relative change to the water surface elevation based on these two iterations of the model. Consequently, it was concluded that floodplain storage is not a viable solution to reduce these hazards. Therefore, no additional flood storage has been proposed for this development.

## 5.1. Conclusions and Recommendations

Based on the results of the HEC-RAS model, the following conclusions were drawn:

- The development will have a negligible impact on the floodplain and associated spill hazard, increasing it by a maximum of 1cm+/-, from 86.11m CVGD2013 to 86.12m CVGD2013, with the addition of the Phase 2 building.

- The proposed first-floor elevation will be set 0.30m above the highest modelled floodplain spill elevation around the building, determined to be 86.12m CVGD2013, resulting in a proposed first-floor elevation of approximately 86.85m to floodproof the building.

- John and Maria Street remain categorized as low-risk hazards, exceeding private pedestrian-vehicle access guidelines in the post-development condition adjacent to the development area.

- Caroline and Elizabeth Street remain characterized as high-risk hazards; however, they will still be accessible by emergency vehicles with top exhausts, such as fire trucks.

- A watertight overhead door will be installed at the top of the parking ramp to prevent floodwaters from spilling into the underground garage.

- Flood storage within the adjacent municipal parking lot is not deemed a feasible solution to elevate the flood spill in the area.

It should be noted that the City of Burlington and Conservation Halton have initiated work to determine and implement mitigation measures to reduce the impact of these spill hazards on existing residences and future development in the city. This work is complex and is expected to a number of years to be constructed. However, as demonstrated through the modeling provided, the solution to the flood spill issue is not practical or feasible to be implemented on a site-by-site basis. Flood mitigation measures are required to be implemented within the sub-watershed. This will have to be undertaken by the City of Burlington and Conservation Authority.

It is concluded that the proposed development will have minimal impact on the spill hazard in the downtown area and will not negatively affect the surrounding properties. Consequently, the proposed building at 2030 Caroline Street can be constructed to meet the requirements of the Conservation Halton, the City of Burlington and Halton Region.

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

**S. Llewellyn & Associates Limited.**




Steven DeGrow, C.Tech.

Steven Frankovich, P. Eng.

# APPENDIX A

# DATA POINT COMPARISON INFORMATION

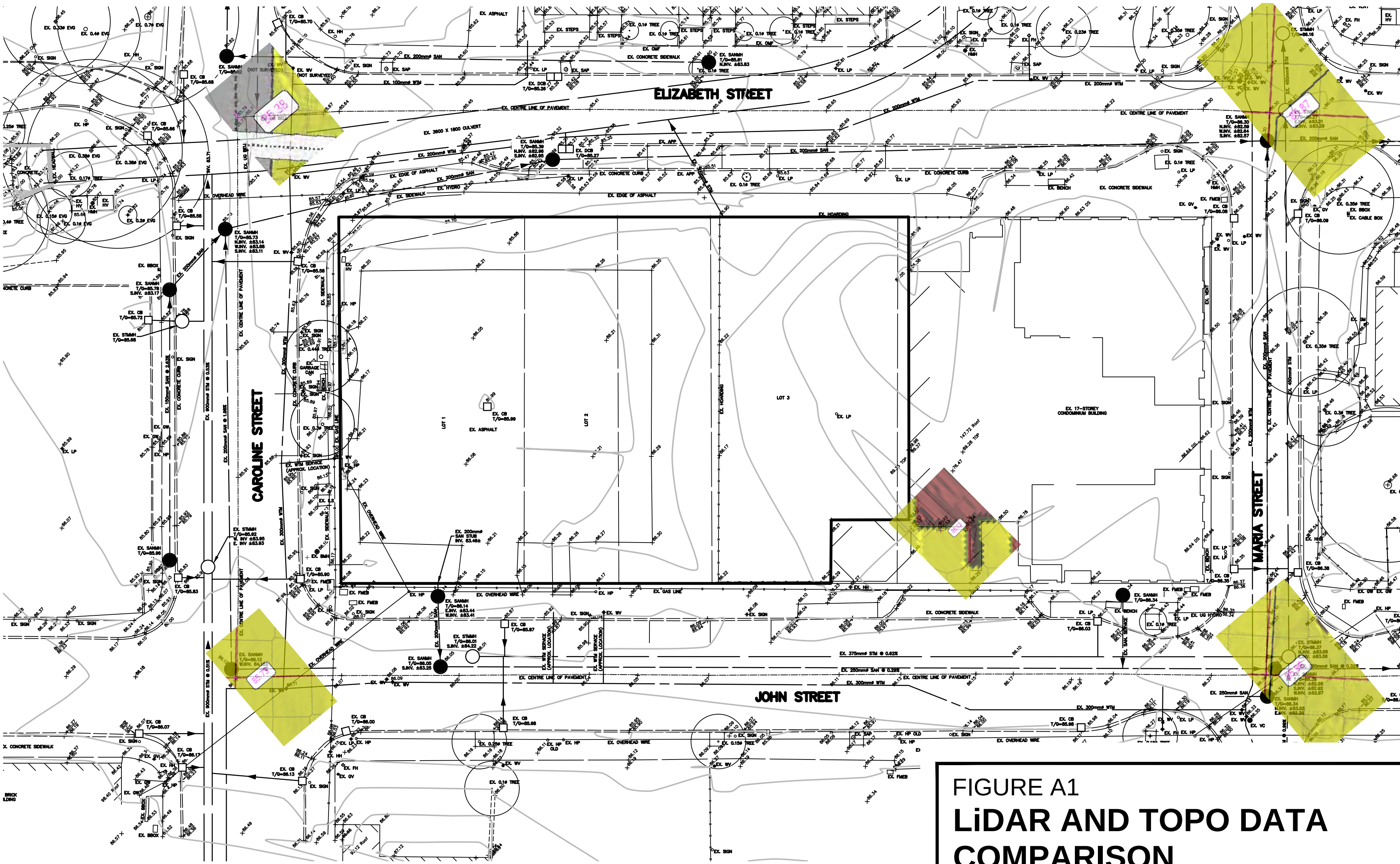



FIGURE A1

# LiDAR AND TOPO DATA COMPARISON

SCALE: NTS

PROJECT: 2030 Caroline Street

PROJECT No.: 23092

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# APPENDIX B

# RAS MAPPER OUTPUTS



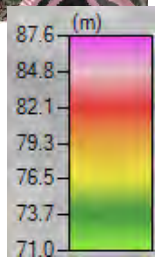




FIGURE B1

# EXISTING WATER SURFACE ELEVATIONS

SCALE: NTS

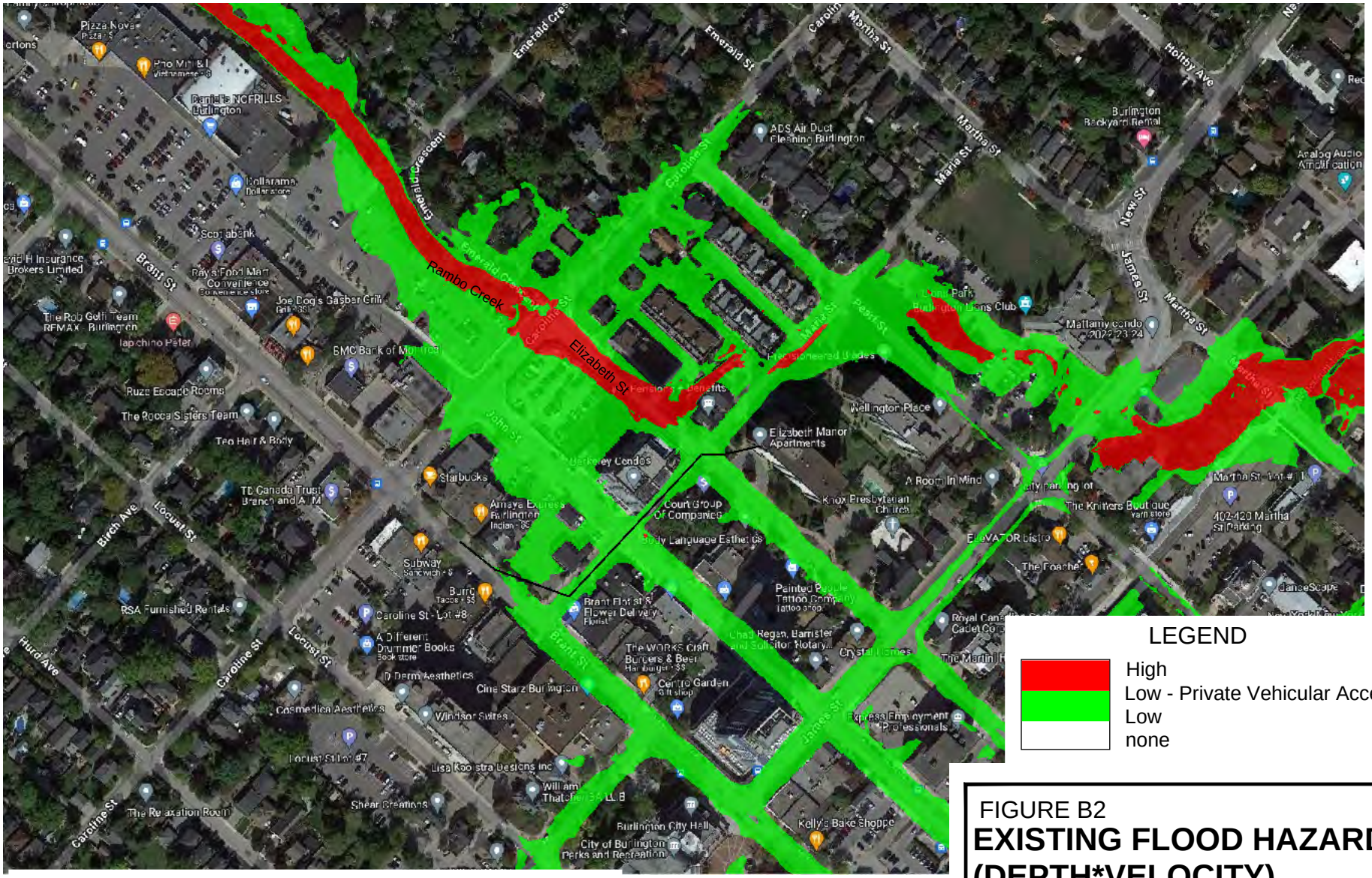
PROJECT: 2030 Caroline Street

PROJECT No.: 23092

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## Risk Level Criteria

| Criterion | Low | Low: Exceeds Private Vehicular Access Guideline | High |
|---|---|---|---|
| Depth | < 0.30 m | > 0.30 and < 0.80m | > 0.80 m |
| Velocity | < 1.7 m/s | < 1.7 m/s | > 1.7 m/s |
| Depth x Velocity | < 0.37 $m^2/s$ | < 0.37 $m^2/s$ | > 0.37 $m^2/s$ |

FIGURE B2

# EXISTING FLOOD HAZARD RISK (DEPTH*VELOCITY)

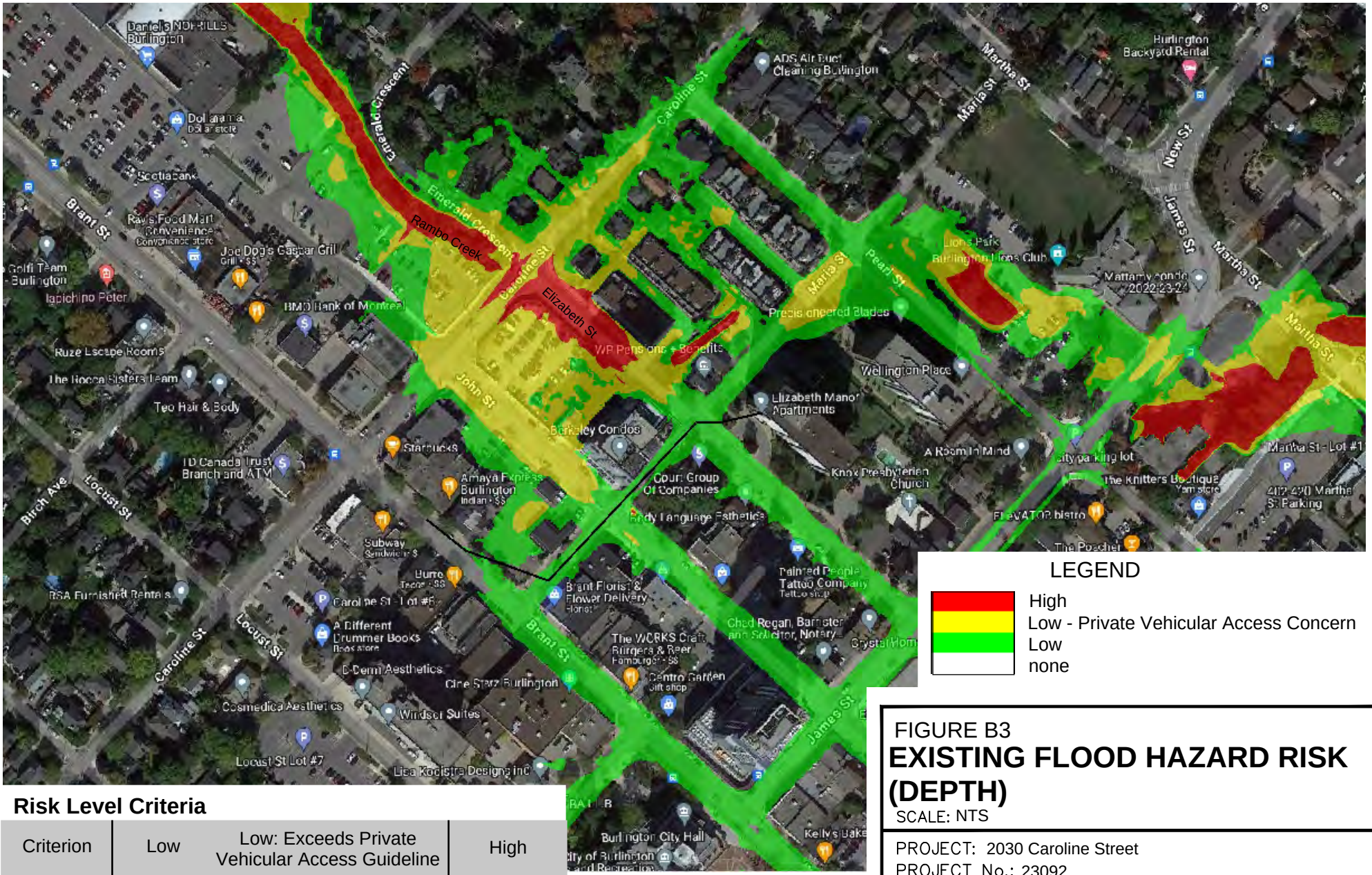
SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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LEGEND

- High
- Low - Private Vehicular Access Concern
- Low
- none

## Risk Level Criteria

| Criterion | Low | Low: Exceeds Private Vehicular Access Guideline | High |
|---|---|---|---|
| Depth | < 0.30 m | > 0.30 and < 0.80m | > 0.80 m |
| Velocity | < 1.7 m/s | < 1.7 m/s | > 1.7 m/s |
| Depth x Velocity | < 0.37 $m^2/s$ | < 0.37 $m^2/s$ | > 0.37 $m^2/s$ |

FIGURE B3

# EXISTING FLOOD HAZARD RISK (DEPTH)

SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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LEGEND

- High
- Low - Private Vehicular Access Concern
- Low
- none

## Risk Level Criteria

| Criterion | Low | Low: Exceeds Private Vehicular Access Guideline | High |
|---|---|---|---|
| Depth | < 0.30 m | > 0.30 and < 0.80m | > 0.80 m |
| Velocity | < 1.7 m/s | < 1.7 m/s | > 1.7 m/s |
| Depth x Velocity | < 0.37 $m^2/s$ | < 0.37 $m^2/s$ | > 0.37 $m^2/s$ |

FIGURE B4

# EXISTING FLOOD HAZARD RISK (VELOCITY)

SCALE: NTS

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PROJECT No.: 23092

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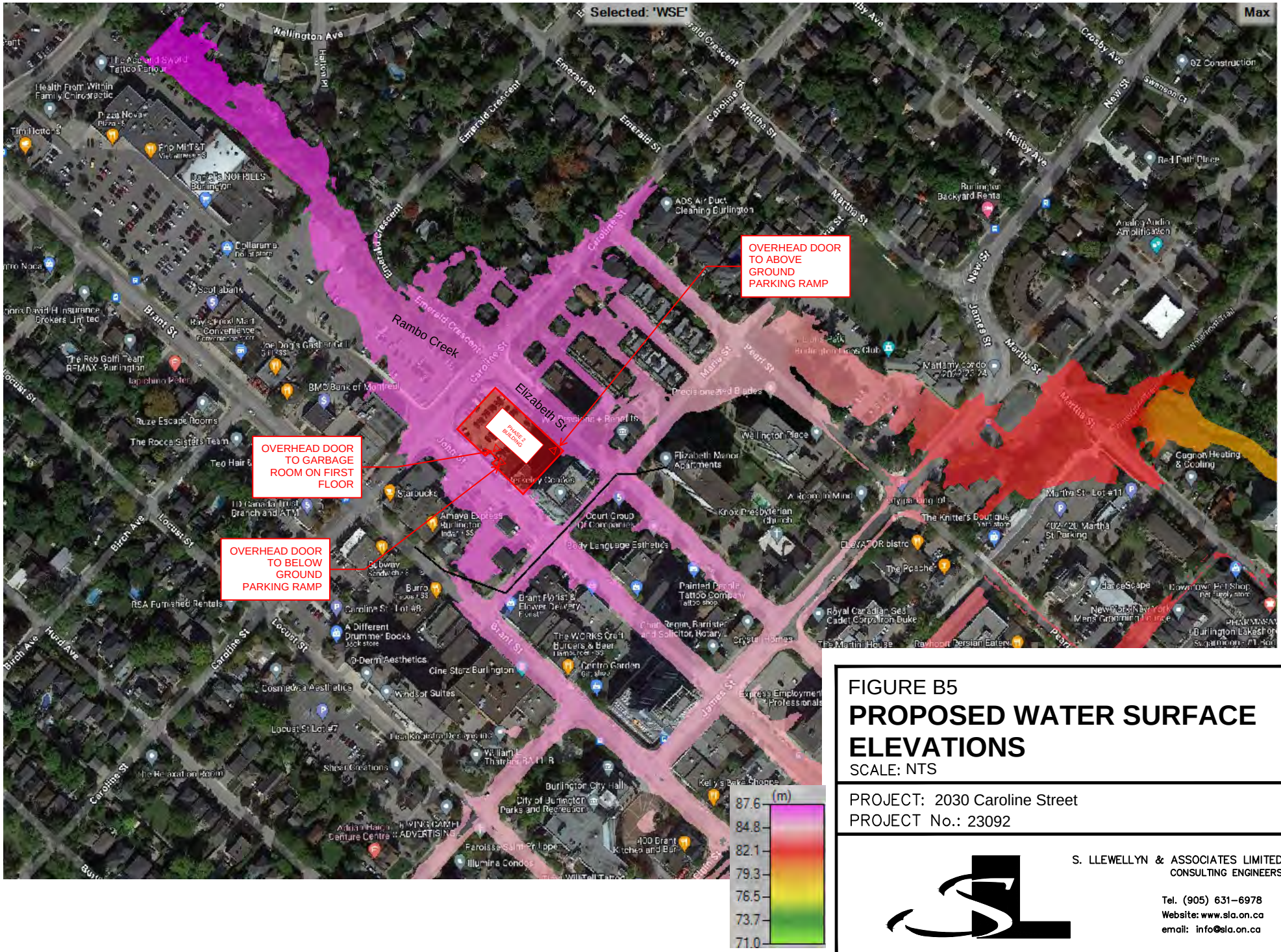



FIGURE B5

# PROPOSED WATER SURFACE ELEVATIONS

SCALE: NTS

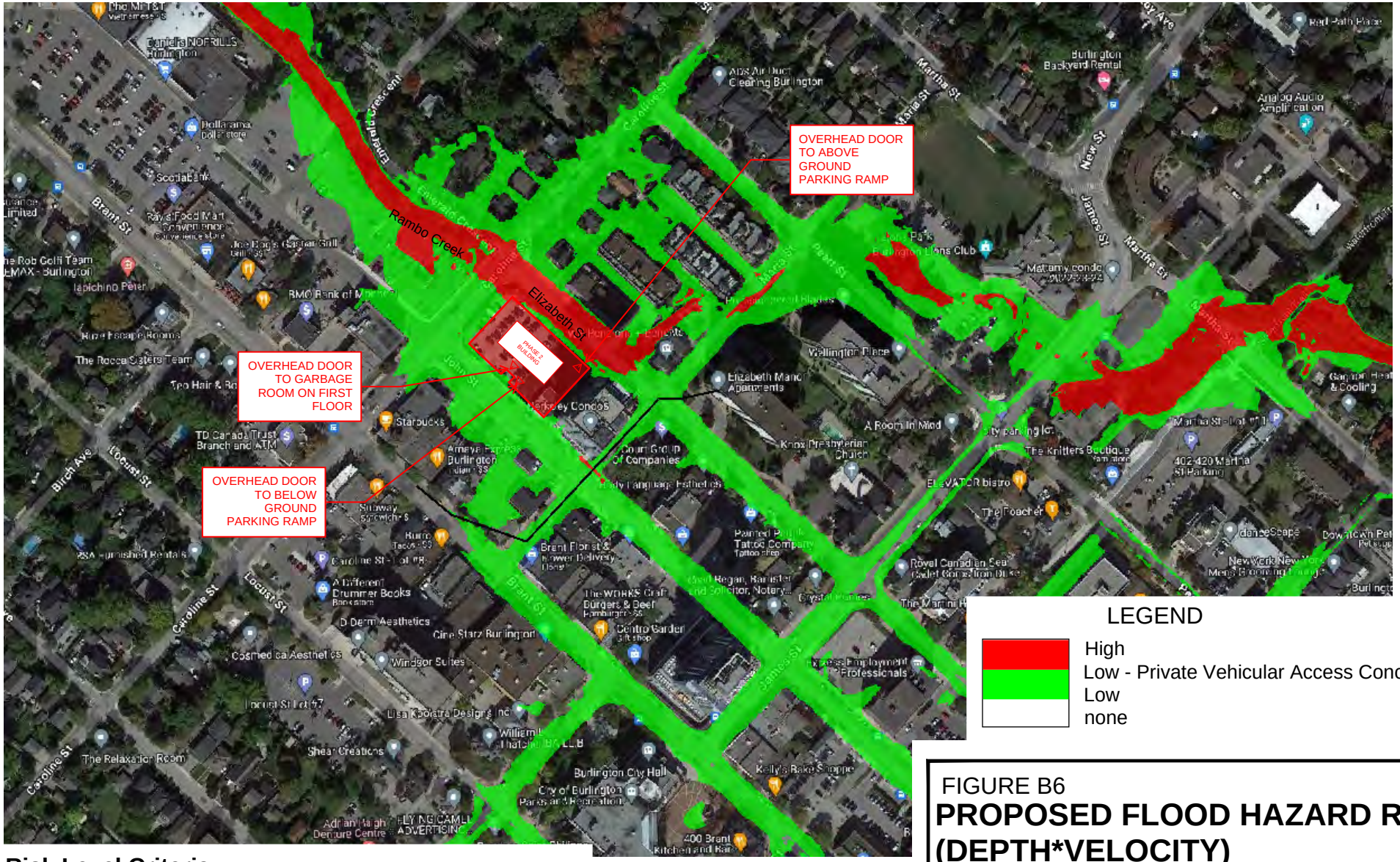
PROJECT: 2030 Caroline Street

PROJECT No.: 23092

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## Risk Level Criteria

| Criterion | Low | Low: Exceeds Private Vehicular Access Guideline | High |
|---|---|---|---|
| Depth | < 0.30 m | > 0.30 and < 0.80m | > 0.80 m |
| Velocity | < 1.7 m/s | < 1.7 m/s | > 1.7 m/s |
| Depth x Velocity | < 0.37 $m^2/s$ | < 0.37 $m^2/s$ | > 0.37 $m^2/s$ |

FIGURE B6

# PROPOSED FLOOD HAZARD RISK (DEPTH*VELOCITY)

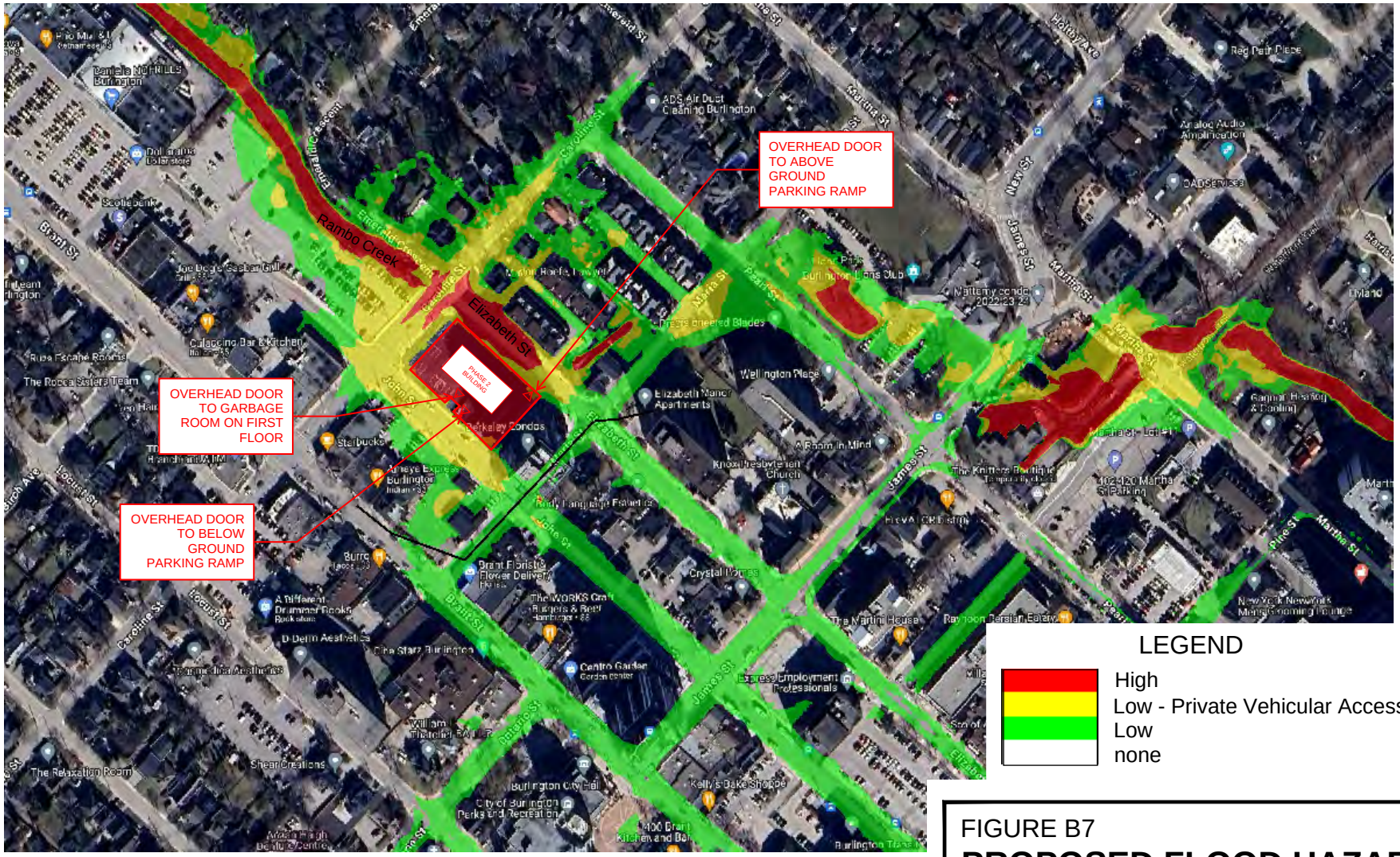
SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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## Risk Level Criteria

| Criterion | Low | Low: Exceeds Private Vehicular Access Guideline | High |
|---|---|---|---|
| Depth | < 0.30 m | > 0.30 and < 0.80m | > 0.80 m |
| Velocity | < 1.7 m/s | < 1.7 m/s | > 1.7 m/s |
| Depth x Velocity | < 0.37 $m^2/s$ | < 0.37 $m^2/s$ | > 0.37 $m^2/s$ |

FIGURE B7

# PROPOSED FLOOD HAZARD RISK (DEPTH)

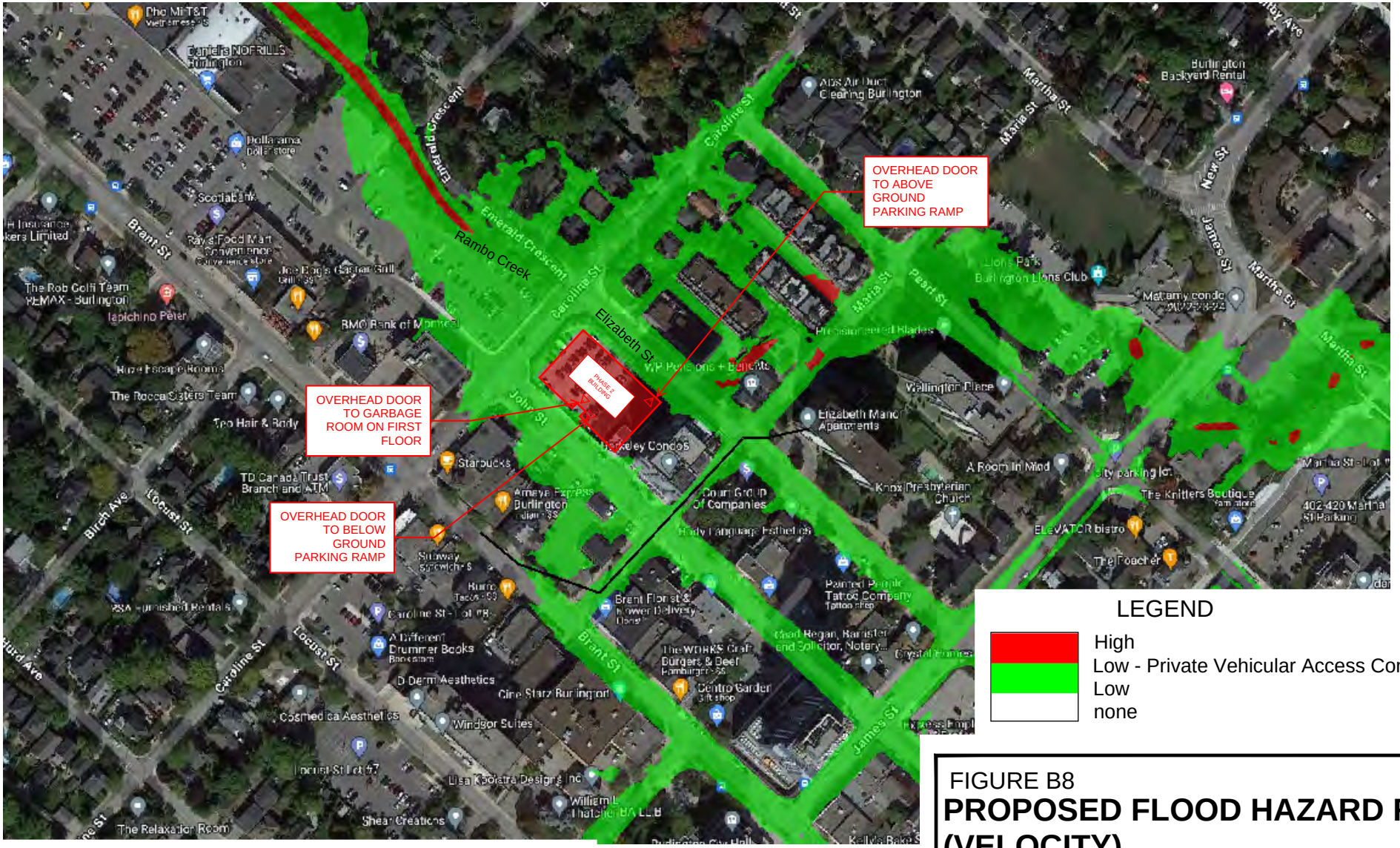
SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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## Risk Level Criteria

| Criterion | Low | Low: Exceeds Private Vehicular Access Guideline | High |
|---|---|---|---|
| Depth | < 0.30 m | > 0.30 and < 0.80m | > 0.80 m |
| Velocity | < 1.7 m/s | < 1.7 m/s | > 1.7 m/s |
| Depth x Velocity | < 0.37 $m^2/s$ | < 0.37 $m^2/s$ | > 0.37 $m^2/s$ |

FIGURE B8

# PROPOSED FLOOD HAZARD RISK (VELOCITY)

SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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FIGURE B9

# CHANGE IN WATER SURFACE ELEVATION

SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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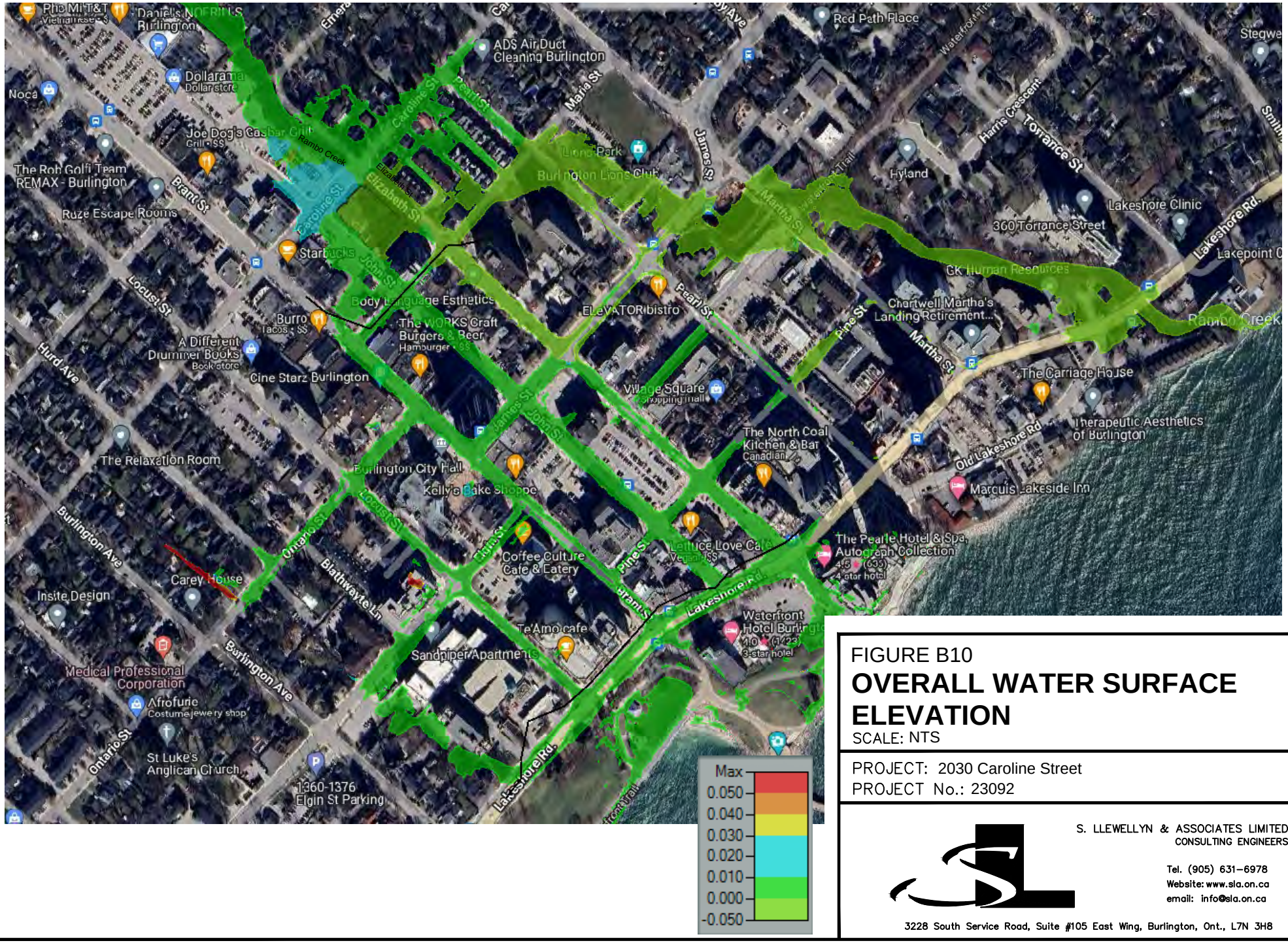



FIGURE B10

# OVERALL WATER SURFACE ELEVATION

SCALE: NTS

PROJECT: 2030 Caroline Street

PROJECT No.: 23092

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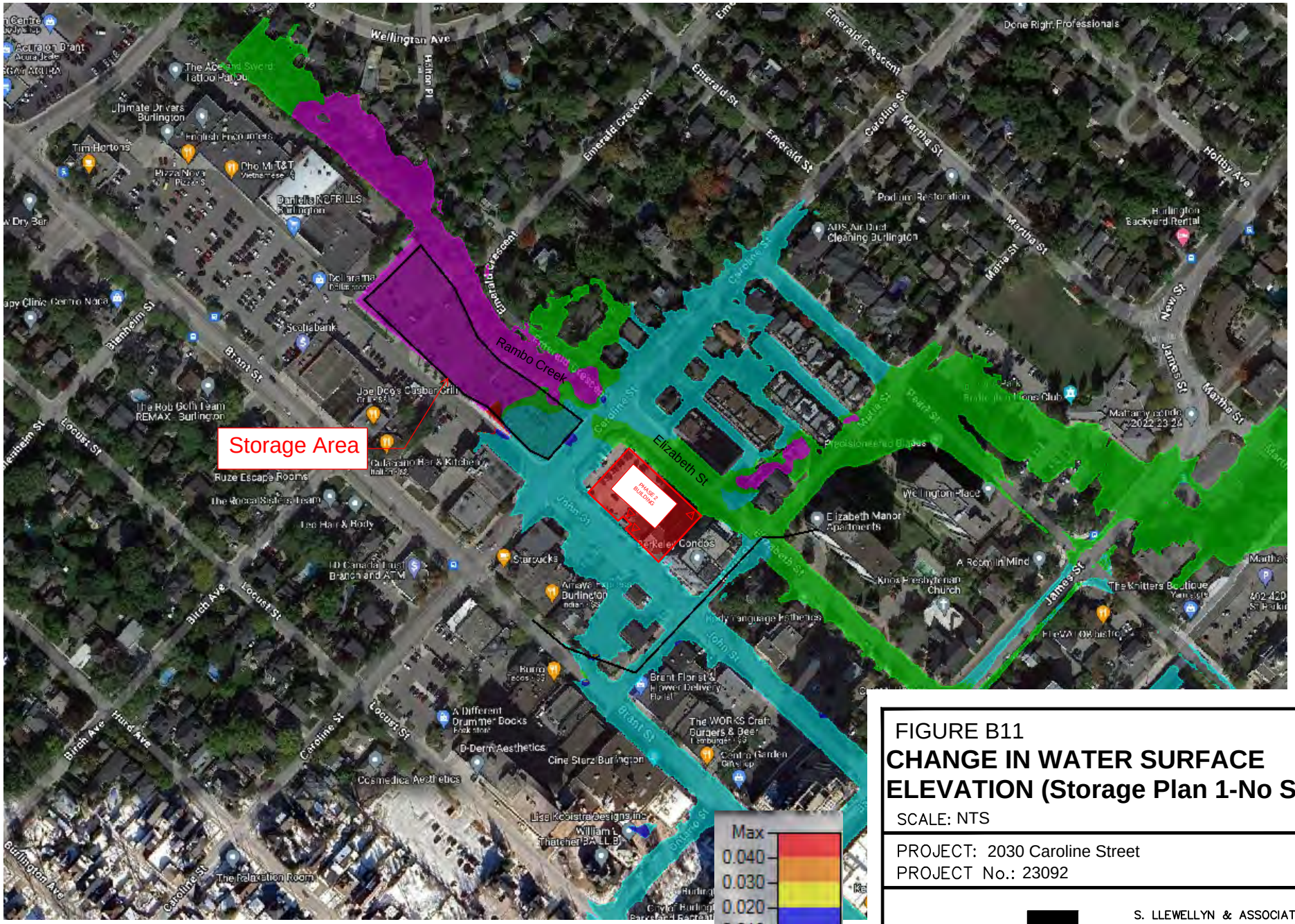



FIGURE B11

## CHANGE IN WATER SURFACE ELEVATION (Storage Plan 1-No Storage)

SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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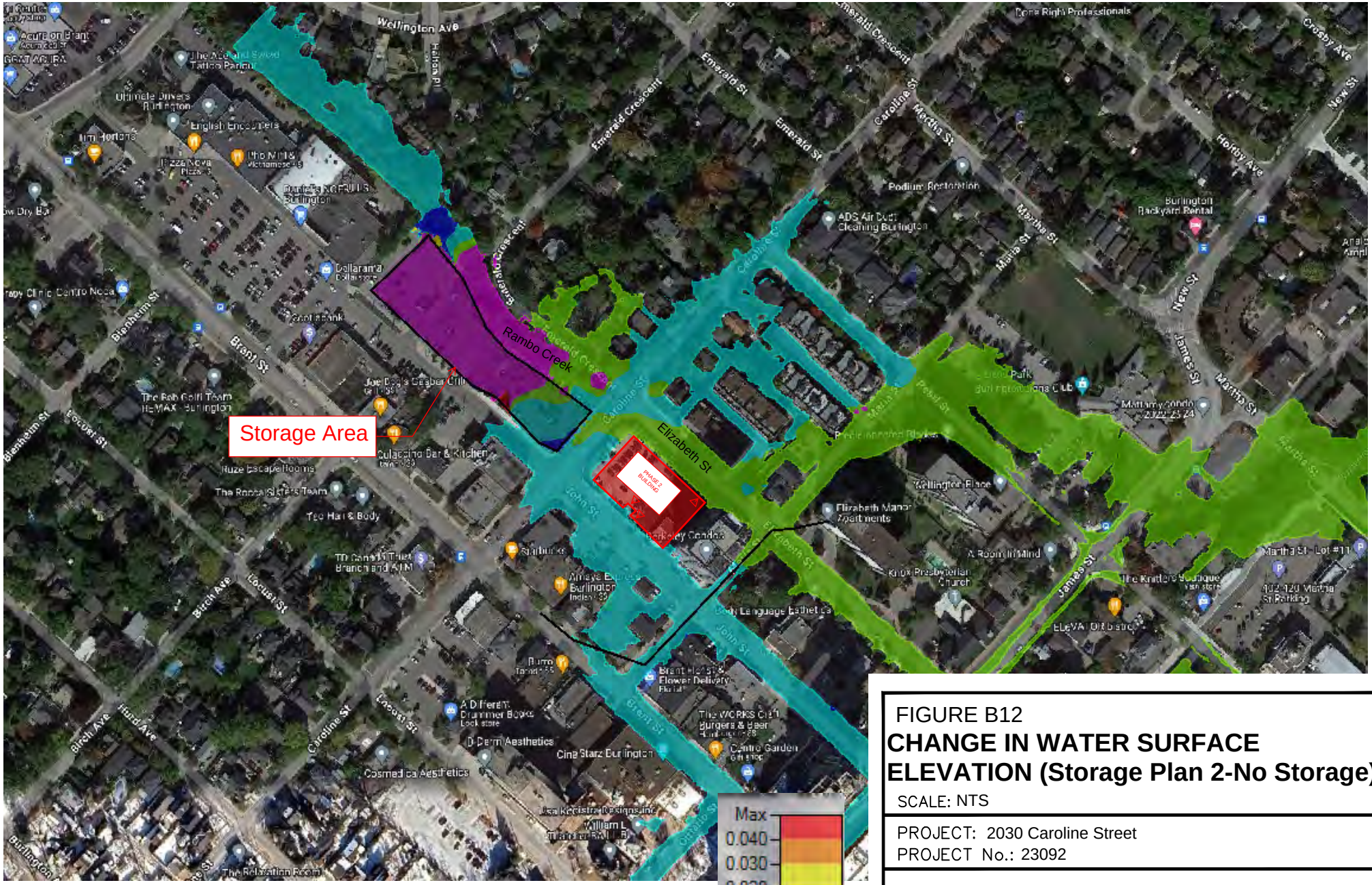



FIGURE B12

# CHANGE IN WATER SURFACE ELEVATION (Storage Plan 2-No Storage)

SCALE: NTS

PROJECT: 2030 Caroline Street
PROJECT No.: 23092

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# APPENDIX D

# WATER ANALYSIS INFORMATION

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

**Project Number:** 23092
**Project Name:** 2030 Caroline Street
**Date:** 20-Jun-24

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 2020).

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 Type V wood frame construction (structure essentially all combustible)
= 0.8 for Type IV-A mass timber construction (encapsulated mass timber)
= 0.9 for Type IV-B mass timber construction (rated mass timber)
= 1.0 for Type IV-C mass timber construction (ordinary mass timber)
= 1.5 for Type IV-D mass timber construction (un-rated mass timber)
= 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)** |
| **2030 Caroline Street** | **6620.7** | **-** | **6620.7** | **0.8** | 14000 | 233.3 | **-15** | -2100.0 | **11900.0** | **-50** | -5950.0 | 20 | 2380.0 | **8000** | **133** |

**Total Area Calculation**

Two largest ajoinding floors plus 50% of any floors immediately above them up to eight floors

| Floor | Area | Tot. Area | Cumm. Area |
|---|---|---|---|
| 1 | 1891.56 | 1891.56 | 1891.6 |
| 2 | 1009.03 | 1009.03 | 2900.6 |
| 3 | 997.58 | 498.79 | 3399.4 |
| 4-6 | 976.07 | 1464.105 | 4863.5 |
| 7 | 1226.09 | 613.045 | 5476.5 |
| 8 | 789.16 | 394.58 | 5871.1 |
| 9-10 | 749.54 | 749.54 | 6620.7 |

**(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 = | **45m+** | **0** |
| South = | ** | **0** |
| East = | **20.1 to 30m** | **10** |
| West = | **20.1 to 30m** | **10** |
| ***Total Exposure =*** | | ***20*** |

*exposed building is fully protected with an automatic sprinkler system = 50% of total exposure
**subject and exposed buildings are fully protected with an automatic sprinkler system = no adjustment
***subject building and the area between the buildings are fully protected with an automatic sprinkler system = no adjustment
****exposed building face of a Type V building has an exterior cladding with min. 1 hour FRR, than the exposure charge may be treated as a Type III/IV building