S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

925 MAIN STREET WEST

PROPOSED MIXED-USE BUILDING

CITY OF HAMILTON

Revised: June 2026

July 2023

SLA File: 20009

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Effort Trust to provide Consulting Engineering services for the proposed development at 925 Main Street West in the City of Hamilton (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of constructing a 26-storey and 29-storey mixed-use condominium towers with a 6-storey podium. The proposed development will contain 4 commercial units, 635 residential units and an underground parking structure. The proposed site will also include concrete curbing/sidewalk, an asphalt parking lot and landscaped areas.

This Function Servicing and Stormwater Management Report will provide detailed information of the proposed stormwater management scheme for this development. Please refer to the site engineering plans prepared by S. Llewellyn & Associates Limited and the site plan provided by KNYMH Inc. for additional information.

1.2 BACKGROUND INFORMATION

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

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

Ref. 2: Engineering Guidelines for Servicing Land under Development Applications (City of Hamilton, December 2012)

Ref. 3: City of Hamilton Criteria and Guidelines for Stormwater Management Infrastructure (September 2007)

Ref. 4: City of Hamilton Storm Drainage Policy (2004)

Ref. 5: Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 (CVC and TRCA, 2010)

Ref. 6: 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 City of Hamilton requirements:

Quantity Control

The stormwater discharge rate from the proposed site shall be controlled to the pre-development condition discharge rates for all storm events up to and including the 100-year event to the existing storm sewer along Main Street West and Longwood Drive.

Quality Control

The stormwater runoff from the proposed site must meet the Level 1 (Enhanced) stormwater quality control (80% TSS removal, 90% average annual runoff treatment).

Erosion Control

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

2.1 EXISTING CONDITIONS

In the existing condition, there are two commercial buildings with associated asphalt parking lots, asphalt tennis courts and landscaped areas. The site is bound by Main Street West to the north, Longwood Road South to the east, Highway 403 to the south and existing residential lands to the west.

Drainage from the existing parking lots is captured within existing catchbasins throughout the site which outlet to the existing 900mmø and 975mmø storm sewer along Main Street West and Longwood Road, ultimately discharging to Cootes Paradise. The south portion of the site sheet drains south to the existing ditch which also discharges to Cootes Paradise.

Two catchment areas, Catchment 101 and 102, have been identified in the existing condition. Catchment 101 represents the drainage area for the existing building and asphalt parking lot which is captured by the existing private storm sewer system, which drains to the existing storm sewer along Main Street West and Longwood Drive, ultimately discharging to Cootes Paradise. Catchment 102 represents the drainage area for the remainder of the site which sheet drains south to the existing ditch which leads to Cootes Paradise. See Table 2.1 below and the Pre-Development Drainage Area Plan in Appendix A for details.

Table 2.1 – Existing Conditions Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient (C)
101	To Existing Storm Sewer	0.43	100	0.90
102	To Existing Ditch	1.50	12	0.33

An analysis was performed on the above-mentioned catchment areas using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Hamilton Mount Hope Design Storms. A summery of the results can be found in Table 2.2 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.2 – Existing Conditions Stormwater Discharge Rate

Storm Event	Catchment 101 Discharge (m^3/s)	Catchment 102 Discharge (m^3/s)
2-Yr Event	0.088	0.046
5-Yr Event	0.122	0.095
10-Yr Event	0.145	0.134
25-Yr Event	0.173	0.186
50-Yr Event	0.195	0.226
100-Yr Event	0.216	0.269

2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a 26-storey and 29-storey mixed-use condominium towers with a 6-storey podium. The proposed development will contain 4 commercial units, 635 residential units and an underground parking structure. The proposed site will also include concrete curbing/sidewalk, an asphalt parking lot and landscaped areas. It is proposed to service the site with a private storm sewer system designed and constructed in accordance with the standards and specifications of the City of Hamilton.

Three catchment areas, Catchment 201, 202 and 203, have been identified in the proposed condition. Catchment 201 represent the drainage area for the portion of the site which will be captured and controlled by the private storm sewer system, which will ultimately discharge to the existing storm sewer along Main Street West and Longwood Drive. Catchment 202 represents the portion of the site which will sheet drain to the right-of-way, which will be captured by the existing catch basins along Main Street West and Longwood Drive. Catchment 203 represents the drainage area for the portion of the site which sheet drains south to the existing ditch which ultimately drains to Cootes Paradise. Refer to Table 2.3 below and the Proposed Condition Drainage Area Plan in Appendix A for details.

Table 2.3 – Proposed Condition Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
201	Controlled to Existing Storm Sewer	0.46	100	0.90
202	Uncontrolled to Existing Storm Sewer	0.16	43	0.53
203	To Existing Ditch	1.31	11	0.32

An analysis was performed on the above-mentioned catchment areas using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Hamilton Mount Hope Design Storms. A summery of the results can be found in Table 2.4 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.4 – Proposed Conditions Site Discharge (Uncontrolled)

Storm Event	Catchment 201 Discharge (m^3/s)	Catchment 202 Discharge (m^3/s)	Catchment 203 Discharge (m^3/s)
2-Yr Event	0.094	0.017	0.040
5-Yr Event	0.131	0.028	0.083
10-Yr Event	0.155	0.035	0.117
25-Yr Event	0.186	0.045	0.163
50-Yr Event	0.209	0.053	0.197
100-Yr Event	0.231	0.061	0.235

2.2.1 Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 205mmø orifice plate on the outlet of the stormwater management tank, to restrict discharge from the site to the pre-development discharge rates.

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 concrete tank within the underground parking structure. Details of the proposed tank can be found on the Site Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.5 below and Appendix A for details.

Table 2.5 – Proposed Condition Stage-Storage-Discharge

Elevation (m)	Storage (m^3)	Discharge (m^3/s)
95.90 (Bottom of Tank)	0	0.0000
96.40 (0.50m Depth)	23	0.0553
96.90 (1.00m Depth)	46	0.0831
97.40 (1.50m Depth)	69	0.1037
97.90 (2.00m Depth)	92	0.1208
98.40 (Top of Tank)	115	0.1358

An analysis was performed on the proposed conditions catchment areas using the SWMHYMO hydrologic modelling program to determine the required volume of stormwater storage required during the 2-year to 100-year City of Hamilton Mount Hope Design Storms. A summery of the results can be found in Table 2.6 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.6 – Proposed Conditions Stormwater Discharge and Storage Volumes

Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
2-year	0.066	0.017	0.083	0.088	32.6
5-year	0.086	0.028	0.113	0.122	49.3
10-year	0.096	0.035	0.130	0.145	61.4
25-year	0.109	0.045	0.153	0.173	77.0
50-year	0.118	0.053	0.170	0.195	89.2
100-year	0.127	0.061	0.186	0.216	101.3

The analysis determined the following:

- The proposed condition discharge rates will not exceed the existing conditions discharge rates during the 2-year to 100-year design storms with the installation of an orifice plate within the stormwater storage tank.

- Catchment 201 will require 101.3m^3 of stormwater storage during the 100-year event, which can be accommodated by the proposed storage tank, having a volume of 115m^3.

2.2.2 Water Quality Control

The proposed development is required to achieve an "Enhanced" (80% TSS removal) level of water quality protection. To achieve this criteria, discharge from catchment 201 will be subject to treatment from a Hydro International Up-Flo Filter before ultimately discharging to the existing 900mmø storm sewer along Main Street West. The Up-Flo Filter will be sized by the manufacturer to achieve a minimum of 80% TSS removal. The Up-Flo Filter has been certified under the ETV for 81.2% removal efficiency.

Up-Flow Filters require regular inspection and maintenance as per the manufacture's specifications to ensure the units operate properly. See Up-Flo Filter Operation and Maintenance Manual in Appendix C for details.

2.2.3 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 a mud mat at the construction entrance of the site to reduce mud tracking and sediment leaving the site via construction traffic;
- 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;

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 at the intersection of Main Street West and Longwood Road. There is an existing 375mmø combined sewers along Main Street West.

3.2 SANITARY DEMAND

The proposed development consists of constructing a 26-storey and 29-storey mixed-use condominium towers with a 6-storey podium. The proposed development will contain 4 commercial units, 635 residential units and an underground parking structure. Refer to the Site Plan prepared by KNYMH Inc. for details.

Wastewater generation for the site was calculated based on Table 8.2.1.3.B – Other Occupancies of the 2020 Ontario Plumbing Code. See Table 3.1 below for calculations.

Table 3.1 – Wastewater Generation Calculation	
Occupancy Type:	
One-Bedroom Units (2 Persons)	275 l/person/unit/day x 2 persons x 393 units **= 216,150 l/day.**
Two-Bedroom Units (4 Persons)	275 l/person/unit/day x 4 persons x 179 units **= 196,900 l/day.**
Three-Bedroom Units (6 Persons)	275 l/person/unit/day x 6 persons x 63 units **= 103,950 l/day.**
Commercial Space	5 l/m^2 of floor area/day x 321.7m^2 **= 1,609 l/day.**
Waste Generated (l/day):	**518,609**
Total Wastewater Estimate (l/s):	**6.00**

Based on the above, the estimate of sanitary demand for the development is:

6.00 l/s

3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed residential building will be serviced by a 200mmø sanitary sewer, designed and constructed in accordance with the City of Hamilton standards. Drainage from this sewer will discharge to the existing 375mmø combined sewer located along Main Street West.

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

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of an existing 300mmø watermain located along Main Street West, and an existing 500mmø watermain located along Longwood Road.

An existing municipal fire hydrant is located at the intersection of Main Street West and Bond Street South at 158 Bond Street South.

4.2 DOMESTIC WATER DEMAND

The following is an estimate of the water usage for the proposed and existing buildings. Water usage for the site was calculated based on the “Fixture Unit Method” as per Table 7.6.3.2.A. forming part of sentences 7.6.3.1(1) to (3) and 7.6.3.4.(2), (3) and (5) of the 2024 Ontario Building Code. See Table 4.1 and 4.2 for fixture unit (FU) calculations.

Table 4.1 – Proposed Domestic Water Demand (Residential)			
Component	FU/ Fixture	No. of Fixtures*	Total FU
Lavatory (8.3L/min or less) (Private)	0.7	924	646.8
Water Closet (6 LPF or less with flush tank) (Private)	2.2	924	2032.8
Sink, kitchen, domestic, 8.3L/min or less (Private)	1.4	635	889
Bathtub with or without showerhead (Private)	1.4	924	1293.6
Clothes washer, 3.5 kg	1.4	635	889
Dish Washer, domestic	1.4	635	889
		Total FU:	**6640.2**
* The number of fixtures have been assumed based on the following: - 1 kitchen per unit - 346 units with 1 bathroom - 289 units with 2 bathrooms			

Table 4.2 – Proposed Domestic Water Demand (Commercial)			
Component	FU/ Fixture	No. of Fixtures*	Total FU
Lavatory (8.3L/min or less) (Public)	2	8	16
Water Closet (6 LPF or less with flush tank) (Private)	2.2	8	17.6
Sink, kitchen, commercial (Public)	4	4	16
Dish Washer, commercial	4	4	16
		Total FU:	**65.6**
* The number of fixtures have been assumed based on 1 kitchen and 2 washrooms per commercial unit			

Total peak water usage for the complete site was derived below from the fixture unit count as per Table 7.4.10.5 of the Ontario Building Code.

Total Fixture Unit Count = 6640.2 + 65.6 = 6705.8 FU

Water Usage: 648 IGPM (49.1 L/s)

4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Ontario Building Code (OBC), various codes and standards published by the National Fire Protection Association (NFPA) and most recently, the Target Available Fire Flows provided by the City of Hamilton.

The proposed development consists of constructing a 26-storey and 29-storey mixed-use condominium towers with a 6-storey podium. The proposed development will contain 4 commercial units, 635 residential units and an underground parking structure. Refer to the Site Plan prepared by KNYMH Inc. for details.

Existing municipal fire hydrant is located at the intersection of Main Street West and Bond Street South at 158 Bond Street South. The hydrant does not meet the required 45m separation from the fire department connections at the proposed buildings. (As per Sentence 3.2.5.16 in the

Ontario Building Code 2024). Therefore, a private hydrant is proposed within the boulevard fronting the proposed development on Main Street West to meet the fire protection requirements.

The fire flow for this building was determined to be the greater of the OBC fire flow calculation (OBC section A-3.2.5.7) or the City of Hamilton Target Available Fire Flow. The result of the OBC fire flow calculation was a flow rate of 9,000 l/min (150 l/sec), which is equal to the City of Hamilton target available fire flow 150 l/sec for a Residential Multi (greater than 3 units). Therefore, the minimum required fire flow for this site is **150 l/sec**. Refer to Appendix D for fire flow calculations.

The following hydrant flow test data for the public fire hydrant in closest proximity to the proposed development has been analysed to determine if the municipal system adjacent to the subject site is adequate to provide the required fire flow, with a minimum pressure of 20 psi. Table 4.3 summarizes the hydrant flow data for the public fire hydrants in closest proximity to the proposed development.

Table 4.3 – Hydrant Flow Test Data (City of Hamilton)	
Hydrant ID	HA47H010
Location	158 Bond Street South
Static Pressure	66 psi
Residual Pressure During Test Flow	65 psi
Test Flow Rate	750 IGPM (56.8 l/s)
Theoretical Flow @ 20 psi	**5,929 IGPM (449 l/s)**

Based on the above, the theoretical maximum available flow rate from the hydrant flow data is **449 l/s**, while the maximum required fire flow for the proposed development is only **150 l/s**. Therefore, based on the above analysis, the proposed water distribution system will have the capacity and pressure required to adequately service the subject land.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of connecting two 200mmø water services off of the existing 300mmø watermain fronting the site on Main Street West. The proposed 200mmø water services will provide domestic and fire water servicing for the proposed development. Water services are to be designed and constructed in accordance with City of Hamilton standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development of 925 Main Street West can be constructed to meet the requirements of the City of Hamilton. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Grading & Erosion Control Plan and the Site Servicing Plan prepared by S. Llewellyn & Associates Limited;
- A 205mmø orifice plate be installed at the outlet of the stormwater storage tank as per the Site Servicing Plan and this report to provide adequate quantity control;
- A concrete storage tank be installed within the underground parking structure as per the Site Servicing Plan and this report to provide effective stormwater storage;

- A Up-Flo Filter be installed as per the Site Servicing Plan and this report to provide efficient stormwater quality control;

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

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

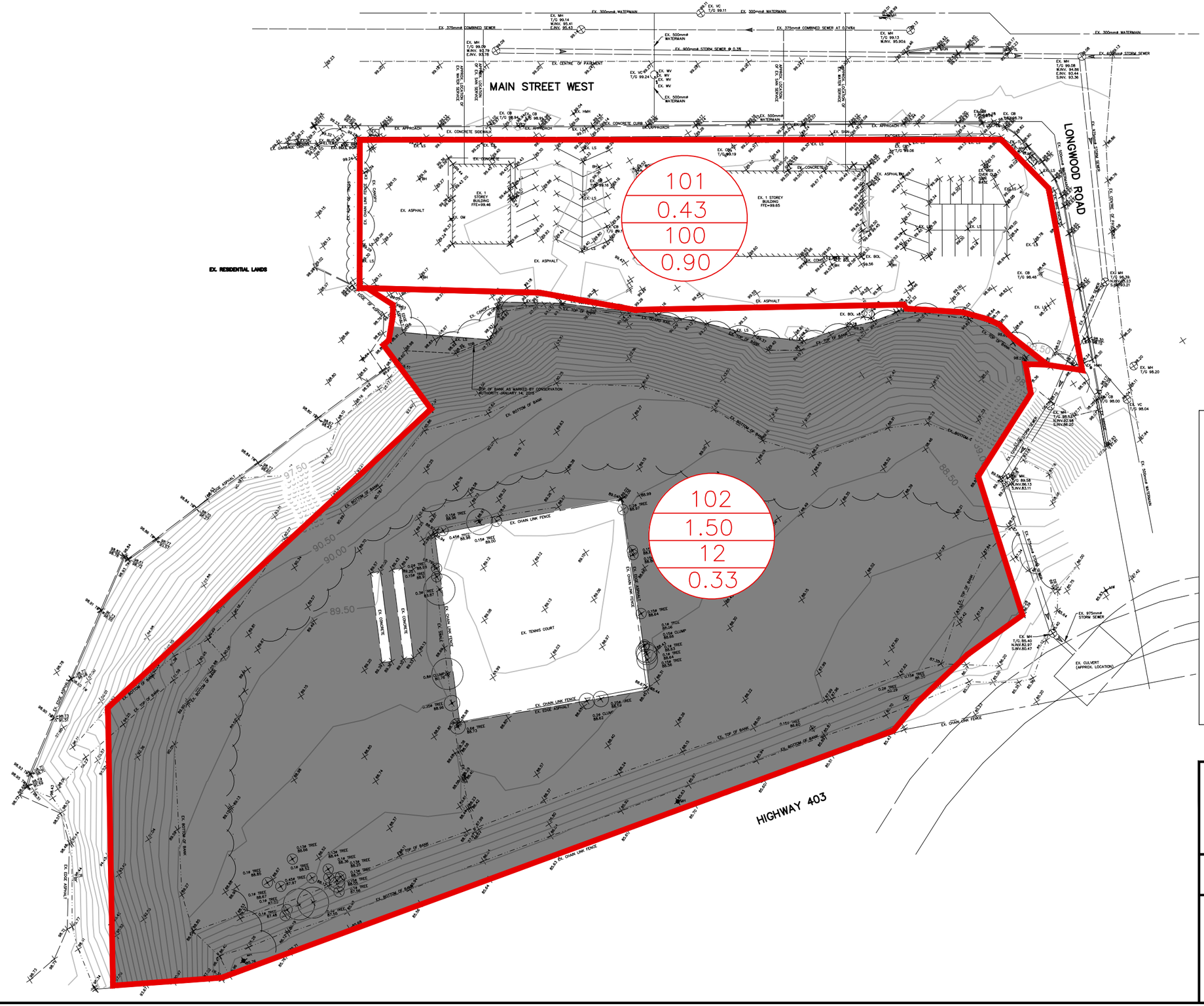
M. Colosimo, Dipl. T.

S. Nelson, P.Eng.

APPENDIX A

STORMWATER MANAGEMENT INFORMATION

S:\20009\WORKING\CURRENT\20009 - DAPS.dwg



N

LEGEND

PERVIOUS AREA

101
0.39
11
0.32

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

DIRECTION OF SHEET FLOW

FIGURE 1.0
PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN
SCALE: 1:750

PROJECT: 925 MAIN STREET WEST
PROJECT No.: 20009

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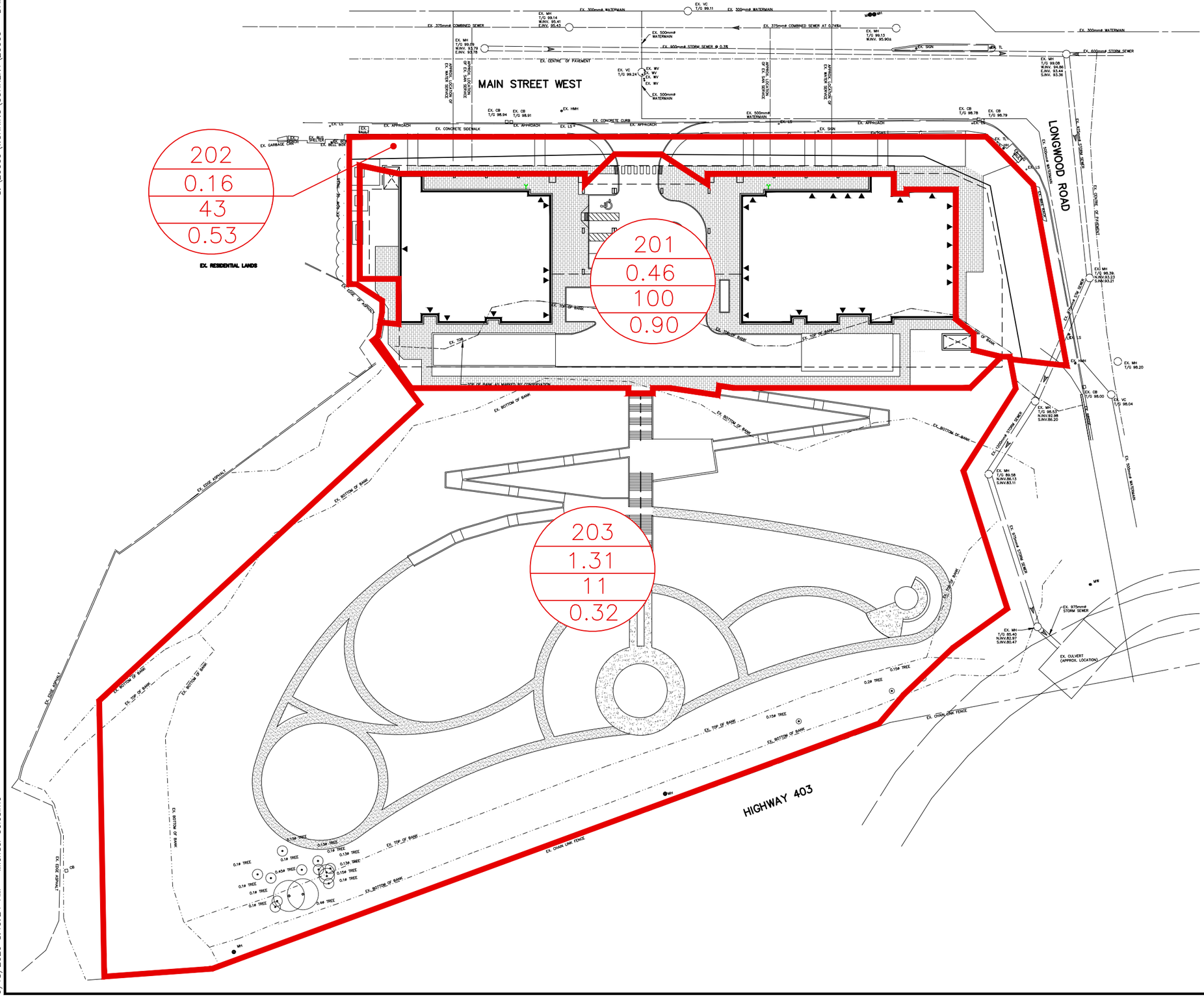
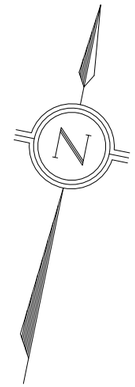
2/10/2026 8:11:11 PM - Michael Colosimo





LEGEND

PERVIOUS AREA

201
0.39
11
0.32

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

DIRECTION OF SHEET FLOW

FIGURE 2.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:750

PROJECT: 925 MAIN STREET WEST
PROJECT No.: 20009

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STAGE-STORAGE-DISCHARGE CALCULATIONS

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	**205**
Area (m^2)	0.03301
Invert Elev. (m)	95.90
C/L Elev. (m)	96.00
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		Tank Volumes				Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Cumulative Volume m^3	Active Storage Volume m^3	H m	Discharge m^3/s
Bottom of Tank	95.90	46	0	0	0	0.000	0.0000
	96.40	46	23	23	23	0.397	0.0553
	96.90	46	23	46	46	0.897	0.0831
	97.40	46	23	69	69	1.397	0.1037
	97.90	46	23	92	92	1.897	0.1208
Top of Tank	98.40	46	23	115	115	2.397	0.1358

APPENDIX B

SWMHYMO INPUT/OUTPUT INFORMATION

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*#                HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
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*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
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                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[3.0](%),
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*#************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
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*#************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
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                                    0.0831 , 0.0046
                                    0.1037 , 0.0069
                                    0.1208 , 0.0092
                                    0.1358 , 0.0115
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                    SCS curve number CN=[82],
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*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
                    MTH4025.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
                    MTH4050.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                    MTH4100.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   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO            9      9   =========
                                                          9   9  9   9   # 3902680
        StormWater Management HYdrologic Model            999    999    =========

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

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

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


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2026-06-18     TIME: 08:38:53     RUN COUNTER: 000050          *
 ********************************************************************************
 * Input   filename: T:\projects\20009\FSR\SWMHYMO\20009.dat                     *
 * Output  filename: T:\projects\20009\FSR\SWMHYMO\20009.out                     *
 * Summary filename: T:\projects\20009\FSR\SWMHYMO\20009.sum                     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________________*
 * 2:_____________________________________________________________________________*
 * 3:_____________________________________________________________________________*
 ********************************************************************************


--------------------------------------------------------------------------------
001:0001----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 925 MAIN ST. W.
*#           HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#*****************************************************************************|
*
  ** END OF RUN :   1

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
            #  1=MTH4002.stm
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 925 MAIN ST. W.
*#           HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 2-YR MT. HOPE (A=646 B=6 C=0.781)
| Ptotal=  35.06 mm|    Comments: 2-YR MT. HOPE (A=646 B=6 C=0.781)
--------------------
            TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
             hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
             .17   2.368 |   1.17  18.525 |   2.17   5.648 |   3.17   2.846
             .33   2.712 |   1.33  74.099 |   2.33   4.806 |   3.33   2.644
             .50   3.193 |   1.50  24.316 |   2.50   4.199 |   3.50   2.472
             .67   3.921 |   1.67  12.980 |   2.67   3.739 |   3.67   2.323
             .83   5.164 |   1.83   8.954 |   2.83   3.378 |   3.83   2.193
            1.00   7.836 |   2.00   6.898 |   3.00   3.087 |   4.00   2.078

--------------------------------------------------------------------------------
002:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#                                                                             |
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING                       |
*#        ==============================================                       |
*#                                                                             |
*#*****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .43          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       3.00         3.00
     Length            (m)=      20.00        25.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=      74.10        16.32
               over (min)        1.00        11.00
     Storage Coeff.  (min)=        .86 (ii)   10.59 (ii)
     Unit Hyd. Tpeak (min)=       1.00        11.00
     Unit Hyd. peak  (cms)=       1.17          .11
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .09          .00          .088 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.50         1.333
     RUNOFF VOLUME    (mm)=      34.06        10.20        33.824
     TOTAL RAINFALL   (mm)=      35.06        35.06        35.063
     RUNOFF COEFFICIENT   =        .97          .29          .965

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0004----------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .046 (i)
     TIME TO PEAK    (hrs)=    1.533
     RUNOFF VOLUME    (mm)=   10.198
     TOTAL RAINFALL   (mm)=   35.063
     RUNOFF COEFFICIENT   =     .291

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

--------------------------------------------------------------------------------
002:0005----------------------------------------------------------------------
*#*****************************************************************************|
*#                                                                             |
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING                      |
*#        ===============================================                      |
*#                                                                             |
*#*****************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .46          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      15.00        15.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=      74.10        17.92
               over (min)        1.00         9.00
     Storage Coeff.  (min)=        .89 (ii)    9.39 (ii)
     Unit Hyd. Tpeak (min)=       1.00         9.00
     Unit Hyd. peak  (cms)=       1.15          .12
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .09          .00          .094 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.47         1.333
     RUNOFF VOLUME    (mm)=      34.06        10.20        33.824
     TOTAL RAINFALL   (mm)=      35.06        35.06        35.063
     RUNOFF COEFFICIENT   =        .97          .29          .965

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
----------------------
| 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    |     .104  .6900E-02
                          .055  .2300E-02    |     .121  .9200E-02
                          .083  .4600E-02    |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .46      .094     1.333     33.824
     OUTFLOW<02: (201   )        .46      .066     1.350     33.824
    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](%)=   70.759
                  TIME SHIFT OF PEAK FLOW         (min)=     1.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.3262E-02

--------------------------------------------------------------------------------
002:0007----------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=        .07          .09
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       2.50         2.50
     Length            (m)=      10.00        10.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=      74.10        21.22
               over (min)        1.00         6.00
     Storage Coeff.  (min)=        .60 (ii)    5.94 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.38          .19
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .017 (iii)
     TIME TO PEAK    (hrs)=       1.30         1.40         1.333
     RUNOFF VOLUME    (mm)=      34.06        10.20        20.460
     TOTAL RAINFALL   (mm)=      35.06        35.06        35.063
     RUNOFF COEFFICIENT   =        .97          .29          .584

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
002:0008----------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201          .46      .066    1.35  33.82    .000
                       +ID2 03:OVF          .00      .000     .00    .00    .000
                       +ID3 04:202          .16      .017    1.33  20.46    .000
                        ==========================================================
                        SUM 05:TOTAL        .62      .083    1.33  30.38    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
002:0009----------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .040 (i)
     TIME TO PEAK    (hrs)=    1.533
     RUNOFF VOLUME    (mm)=   10.198
     TOTAL RAINFALL   (mm)=   35.063
     RUNOFF COEFFICIENT   =     .291

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

------------------------------------------------------------------------------
002:0010----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 5 TO 100-YR)
*
  ** END OF RUN :   4

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
            #  1=MTH4005.stm
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*#############################################################################|
*#  Project Name: 925 MAIN ST. W.
*#           HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#############################################################################|
*
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 5-YR MT. HOPE (A=1049.5 B=8 C=0.803)
| Ptotal=  50.14 mm|    Comments: 5-YR MT. HOPE (A=1049.5 B=8 C=0.803)
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   3.196 |   1.17  28.027 |   2.17   8.084 |   3.17   3.885
              .33   3.691 |   1.33 103.038 |   2.33   6.801 |   3.33   3.593
              .50   4.393 |   1.50  36.919 |   2.50   5.885 |   3.50   3.344
              .67   5.470 |   1.67  19.516 |   2.67   5.198 |   3.67   3.130
              .83   7.347 |   1.83  13.211 |   2.83   4.664 |   3.83   2.945
             1.00  11.470 |   2.00  10.009 |   3.00   4.236 |   4.00   2.782

------------------------------------------------------------------------------
005:0003----------------------------------------------------------------------
*
*#############################################################################|
*#                                                                           |
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#                                                                           |
*#############################################################################|
*# CATCHMENT 101 - EXISTING CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .43          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       3.00         3.00
     Length            (m)=      20.00        25.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=     103.04        39.04
               over (min)        1.00         8.00
     Storage Coeff.  (min)=        .75 (ii)    7.62 (ii)
     Unit Hyd. Tpeak (min)=       1.00         8.00
     Unit Hyd. peak  (cms)=       1.25          .15
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .12          .00          .122 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.43         1.333
     RUNOFF VOLUME    (mm)=      49.14        19.79        48.846
     TOTAL RAINFALL   (mm)=      50.14        50.14        50.139
     RUNOFF COEFFICIENT   =        .98          .39          .974

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
005:0004----------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .095 (i)
     TIME TO PEAK    (hrs)=    1.517
     RUNOFF VOLUME    (mm)=   19.793
     TOTAL RAINFALL   (mm)=   50.139
     RUNOFF COEFFICIENT   =     .395

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

------------------------------------------------------------------------------
005:0005----------------------------------------------------------------------
*#############################################################################|
*#                                                                           |
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#                                                                           |
*#############################################################################|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .46          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      15.00        15.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=     103.04        40.71
               over (min)        1.00         7.00
     Storage Coeff.  (min)=        .78 (ii)    6.90 (ii)
     Unit Hyd. Tpeak (min)=       1.00         7.00
     Unit Hyd. peak  (cms)=       1.23          .16
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .13          .00          .131 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42         1.333
     RUNOFF VOLUME    (mm)=      49.14        19.79        48.846
     TOTAL RAINFALL   (mm)=      50.14        50.14        50.139
     RUNOFF COEFFICIENT   =        .98          .39          .974

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
005:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
----------------------
| 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    |     .104  .6900E-02
                           .055  .2300E-02    |     .121  .9200E-02
                           .083  .4600E-02    |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .46      .131     1.333     48.846
     OUTFLOW<02: (201   )        .46      .086     1.350     48.846
    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](%)=   65.598
                   TIME SHIFT OF PEAK FLOW         (min)=    1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4934E-02

------------------------------------------------------------------------------
005:0007----------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
----------------------
                         IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=        .07          .09
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       2.50         2.50
     Length            (m)=      10.00        10.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=     103.04        45.22
               over (min)        1.00         4.00
     Storage Coeff.  (min)=       .52 (ii)    4.47 (ii)
     Unit Hyd. Tpeak (min)=      1.00         4.00
     Unit Hyd. peak  (cms)=      1.45          .26
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .02          .01          .028 (iii)
     TIME TO PEAK    (hrs)=      1.28         1.37         1.333
     RUNOFF VOLUME    (mm)=     49.14        19.79        32.412
     TOTAL RAINFALL   (mm)=     50.14        50.14        50.139
     RUNOFF COEFFICIENT   =       .98          .39          .646

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
005:0008---------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .46      .086    1.35  48.85    .000
                     +ID2 03:OVF            .00      .000     .00    .00    .000
                     +ID3 04:202            .16      .028    1.33  32.41    .000
                      ========================================================
                      SUM 05:TOTAL          .62      .113    1.33  44.60    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
005:0009---------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
---------------------
| CALIB NASHYD      |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .083 (i)
     TIME TO PEAK    (hrs)=    1.517
     RUNOFF VOLUME    (mm)=   19.793
     TOTAL RAINFALL   (mm)=   50.139
     RUNOFF COEFFICIENT   =     .395

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

-------------------------------------------------------------------------------
005:0010---------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 5 TO 100-YR)
*
-------------------------------------------------------------------------------
005:0002---------------------------------------------------------------------
*
  ** END OF RUN :   9

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 010
    NSTORM=   1
           #  1=MTH4010.stm
-------------------------------------------------------------------------------
010:0002---------------------------------------------------------------------
*#############################################################################|
*#  Project Name: 925 MAIN ST. W.
*#           HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#############################################################################|
*
-------------------------------------------------------------------------------
010:0002---------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 10-YR MT. HOPE (A=1343.7 B=9 C=0.814)
| Ptotal=  60.22 mm|    Comments: 10-YR MT. HOPE (A=1343.7 B=9 C=0.814)
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.725 |   1.17  34.487 |   2.17   9.714 |   3.17   4.557
               .33   4.322 |   1.33 122.292 |   2.33   8.126 |   3.33   4.203
               .50   5.173 |   1.50  45.465 |   2.50   6.998 |   3.50   3.903
               .67   6.489 |   1.67  23.981 |   2.67   6.156 |   3.67   3.646
               .83   8.802 |   1.83  16.104 |   2.83   5.503 |   3.83   3.423
              1.00  13.931 |   2.00  12.108 |   3.00   4.982 |   4.00   3.228

-------------------------------------------------------------------------------
010:0003---------------------------------------------------------------------
*
*#############################################################################|
*#                                                                           |
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING                     |
*#        ==============================================                     |
*#                                                                           |
*#############################################################################|
*# CATCHMENT 101 - EXISTING CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .43          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       3.00         3.00
     Length            (m)=      20.00        25.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=     122.29        56.32
               over (min)        1.00         7.00
     Storage Coeff.  (min)=       .70 (ii)    6.63 (ii)
     Unit Hyd. Tpeak (min)=      1.00         7.00
     Unit Hyd. peak  (cms)=      1.29          .17
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .14          .00          .145 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.42         1.333
     RUNOFF VOLUME    (mm)=     59.22        27.04        58.897
     TOTAL RAINFALL   (mm)=     60.22        60.22        60.219
     RUNOFF COEFFICIENT   =       .98          .45          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
010:0004---------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
---------------------
| CALIB NASHYD      |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .134 (i)
     TIME TO PEAK    (hrs)=    1.517
     RUNOFF VOLUME    (mm)=   27.043
     TOTAL RAINFALL   (mm)=   60.219
     RUNOFF COEFFICIENT   =     .449

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

-------------------------------------------------------------------------------
010:0005---------------------------------------------------------------------
*#############################################################################|
*#                                                                           |
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING                    |
*#        ==============================================                     |
*#                                                                           |
*#############################################################################|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .46          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      15.00        15.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=     122.29        58.21
               over (min)        1.00         6.00
     Storage Coeff.  (min)=       .73 (ii)    6.03 (ii)
     Unit Hyd. Tpeak (min)=      1.00         6.00
     Unit Hyd. peak  (cms)=      1.27          .19
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .15          .00          .155 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.40         1.333
     RUNOFF VOLUME    (mm)=     59.22        27.04        58.898
     TOTAL RAINFALL   (mm)=     60.22        60.22        60.219
     RUNOFF COEFFICIENT   =       .98          .45          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
010:0006---------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
---------------------
| 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   |     .104  .6900E-02
                            .055  .2300E-02   |     .121  .9200E-02
                            .083  .4600E-02   |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .46      .155     1.333     58.898
     OUTFLOW<02: (201   )        .46      .096     1.350     58.898
    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](%)=   62.188
                    TIME SHIFT OF PEAK FLOW         (min)=    1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.6135E-02

-------------------------------------------------------------------------------
010:0007---------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
```

```
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .07         .09
     Dep. Storage     (mm)=      1.00        5.58
     Average Slope     (%)=      2.50        2.50
     Length            (m)=     10.00       10.00
     Mannings n            =      .015        .250

     Max.eff.Inten.(mm/hr)=    122.29       61.68
               over (min)        1.00        4.00
     Storage Coeff.  (min)=       .49 (ii)    3.98 (ii)
     Unit Hyd. Tpeak (min)=      1.00        4.00
     Unit Hyd. peak  (cms)=      1.48         .28
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .02         .01          .035 (iii)
     TIME TO PEAK    (hrs)=      1.30        1.35         1.333
     RUNOFF VOLUME    (mm)=     59.22       27.04        40.879
     TOTAL RAINFALL   (mm)=     60.22       60.22        60.219
     RUNOFF COEFFICIENT   =       .98         .45          .679

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.


------------------------------------------------------------------------------
010:0008----------------------------------------------------------------------
-----------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:201             .46     .096    1.35  58.90    .000
                    +ID2 03:OVF             .00     .000     .00    .00    .000
                    +ID3 04:202             .16     .035    1.33  40.88    .000
                     ==========================================================
                     SUM 05:TOTAL           .62     .130    1.33  54.25    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
010:0009----------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD      |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .117 (i)
     TIME TO PEAK    (hrs)=    1.517
     RUNOFF VOLUME    (mm)=   27.043
     TOTAL RAINFALL   (mm)=   60.219
     RUNOFF COEFFICIENT   =     .449

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

------------------------------------------------------------------------------
010:0010----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 5 TO 100-YR)
*
------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
  ** END OF RUN :  24

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
           #  1=MTH4025.stm
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*#****************************************************************************|
*#  Project Name: 925 MAIN ST. W.
*#            HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#****************************************************************************|
*
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
| Ptotal=  73.09 mm|    Comments: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   4.422 |   1.17  42.745 |   2.17  11.847 |   3.17   5.440
              .33   5.152 |   1.33 146.101 |   2.33   9.863 |   3.33   5.006
              .50   6.198 |   1.50  56.322 |   2.50   8.458 |   3.50   4.639
              .67   7.827 |   1.67  29.752 |   2.67   7.413 |   3.67   4.326
              .83  10.708 |   1.83  19.870 |   2.83   6.605 |   3.83   4.055
             1.00  17.140 |   2.00  14.849 |   3.00   5.963 |   4.00   3.818

------------------------------------------------------------------------------
025:0003----------------------------------------------------------------------
*
*#****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .43         .00
     Dep. Storage     (mm)=      1.00        5.58
     Average Slope     (%)=      3.00        3.00
     Length            (m)=     20.00       25.00
     Mannings n            =      .015        .250

     Max.eff.Inten.(mm/hr)=    146.10       79.53
               over (min)        1.00        6.00
     Storage Coeff.  (min)=       .66 (ii)    5.82 (ii)
     Unit Hyd. Tpeak (min)=      1.00        6.00
     Unit Hyd. peak  (cms)=      1.33         .19
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .17         .00          .173 (iii)
     TIME TO PEAK    (hrs)=      1.33        1.38         1.333
     RUNOFF VOLUME    (mm)=     72.09       36.97        71.735
     TOTAL RAINFALL   (mm)=     73.09       73.09        73.086
     RUNOFF COEFFICIENT   =       .99         .51          .982

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0004----------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .186 (i)
     TIME TO PEAK    (hrs)=    1.517
     RUNOFF VOLUME    (mm)=   36.971
     TOTAL RAINFALL   (mm)=   73.086
     RUNOFF COEFFICIENT   =     .506

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

------------------------------------------------------------------------------
025:0005----------------------------------------------------------------------
*#****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#****************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .46         .00
     Dep. Storage     (mm)=      1.00        5.58
     Average Slope     (%)=      1.50        1.50
     Length            (m)=     15.00       15.00
     Mannings n            =      .015        .250

     Max.eff.Inten.(mm/hr)=    146.10       81.60
               over (min)        1.00        5.00
     Storage Coeff.  (min)=       .68 (ii)    5.31 (ii)
     Unit Hyd. Tpeak (min)=      1.00        5.00
     Unit Hyd. peak  (cms)=      1.31         .22
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .18         .00          .186 (iii)
     TIME TO PEAK    (hrs)=      1.33        1.37         1.333
     RUNOFF VOLUME    (mm)=     72.09       36.97        71.735
     TOTAL RAINFALL   (mm)=     73.09       73.09        73.086
     RUNOFF COEFFICIENT   =       .99         .51          .982

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
--------------------
| 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   |     .104  .6900E-02
                           .055  .2300E-02   |     .121  .9200E-02
                           .083  .4600E-02   |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .46      .186     1.333     71.735
     OUTFLOW<02: (201   )        .46      .109     1.350     71.735
    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](%)=   58.948
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.7695E-02
```

```
--------------------------------------------------------------------------------
025:0007--------------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .07          .09
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      2.50         2.50
     Length            (m)=     10.00        10.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    146.10        83.56
               over (min)        1.00         4.00
     Storage Coeff.  (min)=       .46 (ii)    3.54 (ii)
     Unit Hyd. Tpeak (min)=      1.00         4.00
     Unit Hyd. peak  (cms)=      1.51          .31
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .03          .02          .045 (iii)
     TIME TO PEAK    (hrs)=      1.28         1.35         1.333
     RUNOFF VOLUME    (mm)=     72.09        36.97        52.071
     TOTAL RAINFALL   (mm)=     73.09        73.09        73.086
     RUNOFF COEFFICIENT   =       .99          .51          .712

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0008--------------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                         ID1 02:201          .46      .109    1.35  71.74    .000
                        +ID2 03:OVF          .00      .000     .00    .00    .000
                        +ID3 04:202          .16      .045    1.33  52.07    .000
                         ========================================================
                         SUM 05:TOTAL        .62      .153    1.33  66.66    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
025:0009--------------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .163 (i)
     TIME TO PEAK    (hrs)=    1.517
     RUNOFF VOLUME    (mm)=   36.971
     TOTAL RAINFALL   (mm)=   73.086
     RUNOFF COEFFICIENT   =     .506

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

--------------------------------------------------------------------------------
025:0010--------------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 5 TO 100-YR)
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
  ** END OF RUN :  49

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
          #  1=MTH4050.stm
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 925 MAIN ST. W.
*#            HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 50-YR MT. HOPE (A=1954.8 B=10 C=0.826)
| Ptotal=  81.72 mm|    Comments: 50-YR MT. HOPE (A=1954.8 B=10 C=0.826)
--------------------
            TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
             hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
             .17   4.881 |   1.17  47.876 |   2.17  13.160 |   3.17   6.012
             .33   5.692 |   1.33 164.608 |   2.33  10.942 |   3.33   5.529
             .50   6.856 |   1.50  63.166 |   2.50   9.374 |   3.50   5.122
             .67   8.670 |   1.67  33.244 |   2.67   8.209 |   3.67   4.774
             .83  11.887 |   1.83  22.146 |   2.83   7.309 |   3.83   4.473
            1.00  19.086 |   2.00  16.518 |   3.00   6.594 |   4.00   4.210

--------------------------------------------------------------------------------
050:0003--------------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .43          .00
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      3.00         3.00
     Length            (m)=     20.00        25.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    164.61        98.49
               over (min)        1.00         5.00
     Storage Coeff.  (min)=       .62 (ii)    5.37 (ii)
     Unit Hyd. Tpeak (min)=      1.00         5.00
     Unit Hyd. peak  (cms)=      1.36          .22
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .19          .00          .195 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.37         1.333
     RUNOFF VOLUME    (mm)=     80.72        43.96        80.355
     TOTAL RAINFALL   (mm)=     81.72        81.72        81.723
     RUNOFF COEFFICIENT   =       .99          .54          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0004--------------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .226 (i)
     TIME TO PEAK    (hrs)=    1.500
     RUNOFF VOLUME    (mm)=   43.956
     TOTAL RAINFALL   (mm)=   81.723
     RUNOFF COEFFICIENT   =     .538

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

--------------------------------------------------------------------------------
050:0005--------------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .46          .00
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      1.50         1.50
     Length            (m)=     15.00        15.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    164.61        98.49
               over (min)        1.00         5.00
     Storage Coeff.  (min)=       .65 (ii)    4.94 (ii)
     Unit Hyd. Tpeak (min)=      1.00         5.00
     Unit Hyd. peak  (cms)=      1.34          .23
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .21          .00          .209 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.37         1.333
     RUNOFF VOLUME    (mm)=     80.72        43.96        80.355
     TOTAL RAINFALL   (mm)=     81.72        81.72        81.723
     RUNOFF COEFFICIENT   =       .99          .54          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0006--------------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
----------------------
| 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    |     .104  .6900E-02
                             .055  .2300E-02    |     .121  .9200E-02
                             .083  .4600E-02    |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .46      .209     1.333     80.355
     OUTFLOW<02: (201   )        .46      .118     1.350     80.355
    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](%)=   56.654
                TIME SHIFT OF PEAK FLOW         (min)=    1.00
                MAXIMUM  STORAGE   USED       (ha.m.)=.8918E-02

--------------------------------------------------------------------------------
050:0007----------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .07          .09
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      2.50         2.50
     Length            (m)=     10.00        10.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    164.61       102.67
               over (min)       1.00         3.00
     Storage Coeff.  (min)=      .44 (ii)    3.28 (ii)
     Unit Hyd. Tpeak (min)=      1.00         3.00
     Unit Hyd. peak  (cms)=      1.53          .35
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .03          .02          .053 (iii)
     TIME TO PEAK    (hrs)=      1.27         1.35         1.333
     RUNOFF VOLUME    (mm)=     80.72        43.96        59.766
     TOTAL RAINFALL   (mm)=     81.72        81.72        81.723
     RUNOFF COEFFICIENT   =       .99          .54          .731

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0008----------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201           .46     .118    1.35  80.36    .000
                       +ID2 03:OVF           .00     .000     .00    .00    .000
                       +ID3 04:202           .16     .053    1.33  59.77    .000
                        ========================================================
                        SUM 05:TOTAL         .62     .170    1.33  75.04    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
050:0009----------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
---------------------
| CALIB NASHYD       |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .197 (i)
     TIME TO PEAK    (hrs)=    1.500
     RUNOFF VOLUME    (mm)=   43.956
     TOTAL RAINFALL   (mm)=   81.723
     RUNOFF COEFFICIENT   =     .538

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

--------------------------------------------------------------------------------
050:0010----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 5 TO 100-YR)
*
--------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
  ** END OF RUN :  99

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
            #  1=MTH4100.stm
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 925 MAIN ST. W.
*#               HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 100-YR MT. HOPE (A=2317.4 B=11 C=0.836)
| Ptotal=  91.37 mm|    Comments: 100-YR MT. HOPE (A=2317.4 B=11 C=0.836)
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   5.311 |   1.17  54.599 |   2.17  14.754 |   3.17   6.584
              .33   6.222 |   1.33 181.813 |   2.33  12.204 |   3.33   6.040
              .50   7.538 |   1.50  72.007 |   2.50  10.407 |   3.50   5.582
              .67   9.603 |   1.67  37.943 |   2.67   9.076 |   3.67   5.191
              .83  13.290 |   1.83  25.134 |   2.83   8.053 |   3.83   4.855
             1.00  21.597 |   2.00  18.629 |   3.00   7.242 |   4.00   4.561

--------------------------------------------------------------------------------
100:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .43          .00
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      3.00         3.00
     Length            (m)=     20.00        25.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    181.81       115.45
               over (min)       1.00         5.00
     Storage Coeff.  (min)=       .60 (ii)    5.05 (ii)
     Unit Hyd. Tpeak (min)=      1.00         5.00
     Unit Hyd. peak  (cms)=      1.38          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .21          .00          .216 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.37         1.333
     RUNOFF VOLUME    (mm)=     90.37        52.00        89.989
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .57          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
100:0004----------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
---------------------
| CALIB NASHYD       |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .269 (i)
     TIME TO PEAK    (hrs)=    1.500
     RUNOFF VOLUME    (mm)=   51.999
     TOTAL RAINFALL   (mm)=   91.372
     RUNOFF COEFFICIENT   =     .569

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

--------------------------------------------------------------------------------
100:0005----------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .46          .00
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      1.50         1.50
     Length            (m)=     15.00        15.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    181.81       115.45
               over (min)       1.00         5.00
     Storage Coeff.  (min)=       .62 (ii)    4.65 (ii)
     Unit Hyd. Tpeak (min)=      1.00         5.00
     Unit Hyd. peak  (cms)=      1.36          .24
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .23          .00          .231 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.37         1.333
     RUNOFF VOLUME    (mm)=     90.37        52.00        89.989
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .57          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
100:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
---------------------
| 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   |     .104  .6900E-02
                         .055  .2300E-02   |     .121  .9200E-02
                         .083  .4600E-02   |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )         .46      .231     1.333     89.989
     OUTFLOW<02: (201   )         .46      .127     1.350     89.989
    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](%)=   54.856
                  TIME SHIFT OF PEAK FLOW         (min)=     1.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.1013E-01

--------------------------------------------------------------------------------
100:0007----------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .07          .09
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       2.50         2.50
     Length            (m)=      10.00        10.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     181.81       119.86
               over (min)        1.00         3.00
     Storage Coeff.  (min)=       .42 (ii)    3.09 (ii)
     Unit Hyd. Tpeak (min)=      1.00         3.00
     Unit Hyd. peak  (cms)=      1.54          .37
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .03          .03          .061 (iii)
     TIME TO PEAK    (hrs)=      1.27         1.33         1.333
     RUNOFF VOLUME    (mm)=     90.37        52.00        68.499
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .57          .750

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
100:0008----------------------------------------------------------------------
-----------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 02:201            .46     .127    1.35  89.99    .000
                      +ID2 03:OVF            .00     .000     .00    .00    .000
                      +ID3 04:202            .16     .061    1.33  68.50    .000
                       ==========================================================
                       SUM 05:TOTAL          .62     .186    1.33  84.44    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
100:0009----------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
---------------------
| CALIB NASHYD       |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .235 (i)
     TIME TO PEAK    (hrs)=    1.500
     RUNOFF VOLUME    (mm)=   51.999
     TOTAL RAINFALL   (mm)=   91.372
     RUNOFF COEFFICIENT   =     .569

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

--------------------------------------------------------------------------------
100:0010----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 5 TO 100-YR)
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
  ** END OF RUN : 124

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




--------------------
| START            |  Project  dir.: T:\projects\20009\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\20009\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 125
    NSTORM=   1
```

```
          #  1=MTHP25MM.stm
--------------------------------------------------------------------------------
125:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 925 MAIN ST. W.
*#                HAMILTON, ONTARIO
*#  JOB NUMBER  : 20009
*#       Date   : MAY 2023
*#    Revised   : JUN 2026
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 20009.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 CONDITIONS (TO MAIN STREET/LONGWOOD ROAD)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .43
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .43          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       3.00         3.00
     Length            (m)=      20.00        25.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=      58.58         7.70
               over (min)        1.00        14.00
     Storage Coeff.  (min)=        .94 (ii)   14.09 (ii)
     Unit Hyd. Tpeak (min)=      1.00        14.00
     Unit Hyd. peak  (cms)=      1.11          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .07          .00          .069 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.58         1.333
     RUNOFF VOLUME    (mm)=     24.27         5.14        24.077
     TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
     RUNOFF COEFFICIENT   =       .96          .20          .953

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    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----------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
---------------------
| CALIB NASHYD       |   Area    (ha)=    1.50   Curve Number   (CN)=82.00
| 02:102    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .337

     PEAK FLOW       (cms)=     .023 (i)
     TIME TO PEAK    (hrs)=    1.550
     RUNOFF VOLUME    (mm)=    5.138
     TOTAL RAINFALL   (mm)=   25.268
     RUNOFF COEFFICIENT   =     .203

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

--------------------------------------------------------------------------------
125:0005----------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (CONTROLLED TO STORM SEWER)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .46          .00
     Dep. Storage     (mm)=       1.00         5.58
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      15.00        15.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=      58.58         7.87
               over (min)        1.00        13.00
     Storage Coeff.  (min)=        .98 (ii)   12.79 (ii)
     Unit Hyd. Tpeak (min)=      1.00        13.00
     Unit Hyd. peak  (cms)=      1.09          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .07          .00          .074 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.53         1.333
     RUNOFF VOLUME    (mm)=     24.27         5.14        24.077
     TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
     RUNOFF COEFFICIENT   =       .96          .20          .953
```

```
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    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.

--------------------------------------------------------------------------------
125:0006----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - (ORIFICIE CONTROLS)
*
---------------------
| 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   |     .104  .6900E-02
                            .055  .2300E-02   |     .121  .9200E-02
                            .083  .4600E-02   |     .136  .1150E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .46      .074     1.333     24.077
     OUTFLOW<02: (201   )        .46      .057     1.350     24.077
    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](%)=   76.252
                   TIME SHIFT OF PEAK FLOW          (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2447E-02

--------------------------------------------------------------------------------
125:0007----------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (UNCONTROLLED TO RIGHT-OF-WAY)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .16
| 04:202    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   43.00
----------------------
                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .07          .09
     Dep. Storage     (mm)=      1.00         5.58
     Average Slope     (%)=      2.50         2.50
     Length            (m)=     10.00        10.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     58.58         9.60
                 over (min)       1.00         8.00
     Storage Coeff.  (min)=       .66 (ii)    7.99 (ii)
     Unit Hyd. Tpeak (min)=      1.00         8.00
     Unit Hyd. peak  (cms)=      1.33          .14
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .012 (iii)
     TIME TO PEAK    (hrs)=      1.30         1.45         1.333
     RUNOFF VOLUME    (mm)=     24.27         5.14        13.364
     TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
     RUNOFF COEFFICIENT   =       .96          .20          .529

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    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.

--------------------------------------------------------------------------------
125:0008----------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201             .46      .057    1.35  24.08    .000
                     +ID2 03:OVF             .00      .000     .00    .00    .000
                     +ID3 04:202             .16      .012    1.33  13.36    .000
                      ==========================================================
                      SUM 05:TOTAL           .62      .068    1.33  21.31    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
125:0009----------------------------------------------------------------------
*# CATCHMENT 203 - PROPOSED CONDITION (TO DITCH ALONG SOUTH PROPERTY LINE)
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.31   Curve Number   (CN)=82.00
| 06:203    DT= 1.00 |   Ia      (mm)=   5.580   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .294

     PEAK FLOW       (cms)=     .020 (i)
     TIME TO PEAK    (hrs)=    1.550
     RUNOFF VOLUME    (mm)=    5.138
     TOTAL RAINFALL   (mm)=   25.268
     RUNOFF COEFFICIENT   =     .203

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

--------------------------------------------------------------------------------
125:0010----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (MOUNT HOPE 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 2026-06-18     at 08:38:54
================================================================================
```

APPENDIX C

QUALITY CONTROL INFORMATION

February 11, 2026

ADS UFF Sizing Summary

Project Name: 925 Main Street West
Consulting Engineer: S. Llewellyn & Associates Ltd.
Location: Hamilton, ON
Sizing Completed By: Steve Buckley **Email:** steve.buckley@adspipe.com

Recommended Unit	
Recommended Model:	UFF-7
TSS Removal Percentage:	82.4%
Total Site Volume Treated:	91.3%

Site Details	
Site Area:	0.49 ha
Rational C:	0.90
Rainfall Station:	Hamilton, ONT
Particle Size Distribution:	ETV
Peak Storm Flowrate:	L/s

Unit Specifications:	
Number of Filter Modules:	7
Maximum Treatment Flowrate:	11.2 L/s
Inlet - Outlet Drop:	240 mm*
Max. Pipe Diameter:	600 mm
Operating Head:	760 mm

* Drop across unit can be reduced when required.

Site Elevations:	
Rim Elevation:	99.30
Inlet Pipe Elevation:	95.76
Outlet Pipe Elevation:	95.52

Consult approved shop drawings for final elevations. Riser sections (and/or grade rings) may be required to reach final grade on site.

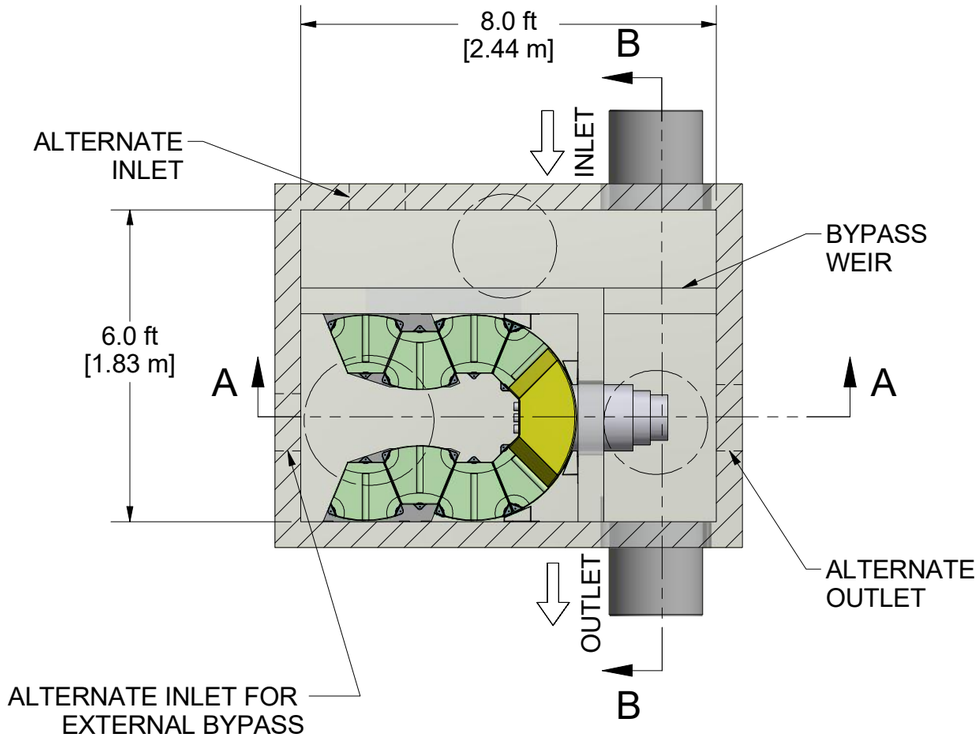
Rainfall Intensity[1]	Fraction of Rainfall[1]	Removal Efficiency[2]	Weighted Net-Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.4%	92.4%	0.3%
1.00	18.8%	91.5%	17.2%
1.50	10.9%	90.7%	9.9%
2.00	13.9%	89.8%	12.4%
2.50	4.5%	89.0%	4.0%
3.00	2.7%	88.1%	2.4%
3.50	7.8%	87.3%	6.8%
4.00	4.2%	86.4%	3.6%
4.50	2.2%	85.6%	1.9%
5.00	4.7%	84.8%	4.0%
6.00	4.2%	83.1%	3.5%
7.00	4.2%	81.4%	3.5%
8.00	3.2%	79.7%	2.6%
9.00	1.9%	78.0%	1.5%
10.00	2.6%	76.3%	2.0%
20.00	9.2%	59.4%	5.5%
30.00	2.3%	42.5%	1.0%
40.00	1.1%	25.7%	0.3%
50.00	0.5%	8.8%	0.0%
100.00	0.6%	0.0%	0.0%
150.00	0.1%	0.0%	0.0%
Net Annual Treatment			**82.4%**
Total Runoff Volume Treated:			**91.3%**

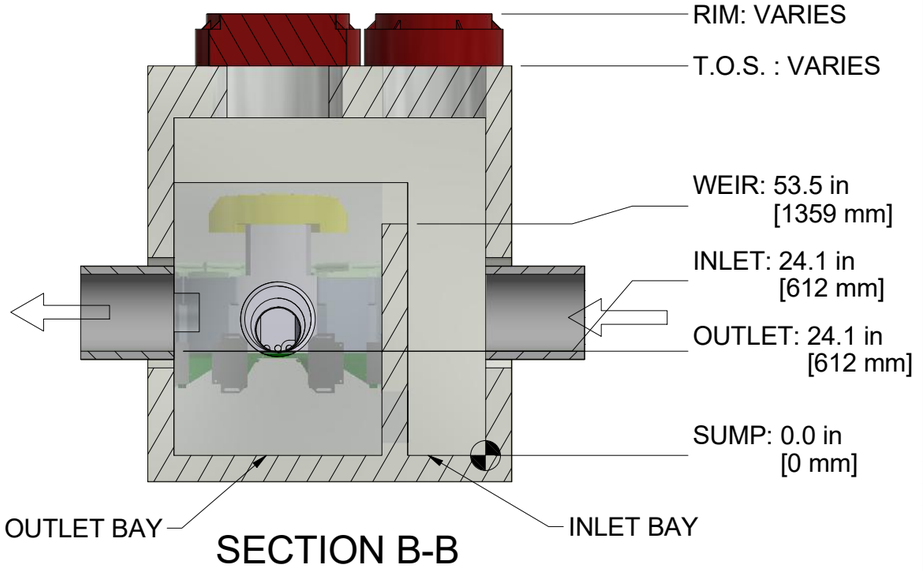
Rainfall Data: 1970:2007, HLY03, Hamilton, ON, 6153194.

Notes:

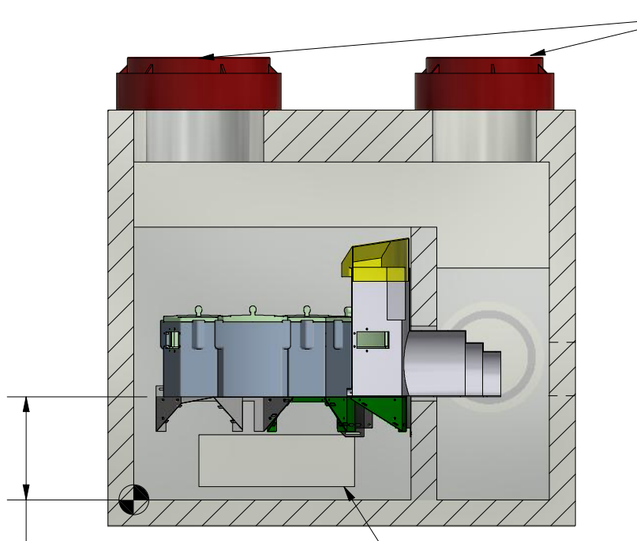
Removal efficiencies are based on NJDEP Test Protocols and independent

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.





SECTION B-B



SECTION A-A

CAPACITIES:

- Minimum performance: 80% removal. Washington DOE/NJCAT verified at the peak treatment flow.
- Peak treatment flow:
  .033 CFS (0.9 LPS) (15 GPM) per module (Ribbons)
  .022 CFS (0.6 LPS) (10 GPM) per module (Long Ribbons)
  .056 CFS (1.6 LPS) (25 GPM) per module (CPZ)
- Maximum number of ribbon modules per outlet module: 36
- Maximum number of CPZ modules per outlet module: 18 (contract Hydro if more are required)

ADDITIONAL DESIGN INFORMATION:

- Normal operating W.S.E. is 26-30" (660-762mm) above the outlet invert
- Media Types Available: Ribbons, CPZ

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

TOLERENCES ARE:
FRACTIONS ± 1/16
DECIMALS:
X.X ± .06
X.XX ± .03
X.XXX ± .015
ANGLES: ± .5°

PROJECTION

COMMENTS:
1. STRUCTURE WALL AND SLAB THICKNESSES ARE NOT TO SCALE
2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING THE STRUCTURE
3. NOT FOR CONSTURCION CONTACT HYDRO FOR SITE SPECIFIC DRAWING
4. NOT ALL SIZES AVAILABLE IN ALL AREAS
5. SUMP DEPTH AVAILABLE IN 24" (610mm) CPZ, RIBBONS AND 36" (914mm) LONG RIBBONS DEPTH

REVISION HISTORY

REV	BY	DESCRIPTION	DATE
-	ER	FIRST RELEASE	3/8/2019

DATE: 3/8/2019
SCALE: 1:35
DRAWN BY: ER
CHECKED BY:
APPROVED BY

Title
UP-FLO FILTER
6ft (1829mm) X 8ft (2438mm)

8 MODULES MAX

Hydro International

94 Hutchins Drive
Portland, ME 04102
Tel: +1 (207) 756-6200
Fax: +1 (207) 756-6212
hydro-int.com

WEIGHT: N/A
MATERIAL:
NEXT ASSEMBLY: 6x8-1
DRAWING NO.: 6x8-UFF-1
SHEET SIZE: B
SHEET: 1 OF 1
Rev: -

Verification Statement

Hydro International Up-Flo® Filter with CPZ™ Media

Registration number: (V-2019-06-01)
Date of issue: (2019-November-27)

Technology type	Stormwater Filtration Device		
Application	Technology to remove sediment, nutrients and metals from stormwater runoff		
Company	Hydro International	**Website**	https://www.hydro-int.com
Address	94 Hutchins Drive, Portland, Maine USA 04102		
E-mail	TechSupport@hydro-int.com	**Phone**	+1 (207) 756 6200

This Verification Statement was prepared by VerifiGlobal to summarize the results reported in the Verification Report for the Hydro International Up-Flo® Filter with CPZ™ Media, dated November 26, 2019. The Verification Report was prepared by Good Harbour Laboratories Inc. (GHL) for VerifiGlobal in accordance with the requirements of the International Organization for Standardization (ISO) 14034 Environmental Technology Verification (ETV) standard and the VerifiGlobal Performance Verification Protocol. All the information provided in this Statement are based on the independent, third-party review and verification of technical information, performance test reports, performance data and specific performance claims documented in the Verification Report.

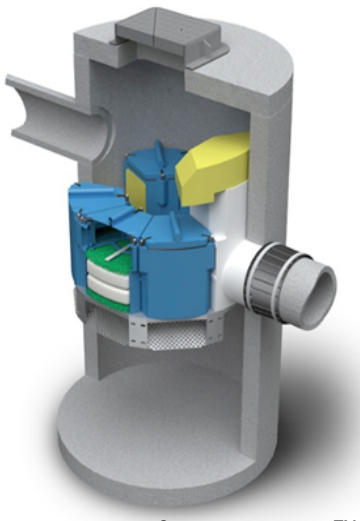


Figure 1: Up-Flo® Filter with CPZ™ Media

Technology Description

The Up-Flo® Filter with CPZ™ Media is a stormwater remedial device that incorporates gravitational separation of floating and settling materials, screening, and filtration of polluted stormwater to offer treatment train capabilities in a standalone device. Each Up-Flo® Filter consists of a highly configurable array of modules that are typically supplied as a complete system housed in a 4-ft (1.2 m) diameter manhole or precast vault. Manhole configurations consist of a single ring assembly containing one to six modules. Vaulted systems are highly configurable and may contain single or multiple arrays each consisting of one to 18 Filter Modules depending on availability of vault sizes.

Verified Performance Claims

Verification of the Hydro International Up-Flo® Filter with CPZ™ Media is based on existing performance test data from two different locations with different rainfall characteristics, catchment areas and pollutant loadings. Supporting data were obtained from three independent perfomance monitoring studies. One was conducted by Engineering School of Sustainable Infrastructure and Environment (ESSIE) at the University of Florida (UF) under the supervision of Dr. John Sansalone and two were conducted by Department of Civil, Construction, and Environmental Engineering (CCEE) at the University of Alabama (UA) under the supervision of Dr. Bob Pitt.

All three studies performance monitoring studies were conducted following the requirements of the New Jersey Department of Environmental Protection (NJDEP) Technology Acceptance Reciprocity Partnership (TARP) Tier II Protocol for Stormwater Best Management Practice Demonstrations (2003) and its 2006 and 2009 amendments. In total, there were 66[1] storms assessed to verify that an Up-Flo® Filter with CPZ™ Media achieves the performance listed in Tables 1 and 2, when designed to the following parameters:

- System hydraulic loading rate of 25 gpm (1.58 L/s) per filter module, with bypass of higher flows.
- Filter flux rate of 22.7 gpm/ft2 (15.4 L/s/m2)
- Operating head of ≤30 in. (76.2 cm)
- Effective Sedimentation/ Filtration Treatment Area (ESA/EFTA) –12.6/6.6 (1.91)
- Maximum sediment storage volume of 16.8 ft3 (0.476 m3) at a sediment depth of 16 inches (0.41m).

Table 1. Up-Flo® Filter with CPZ™ Media – Verified Concentration Removal Efficiency

Constituent	Lower 95% Confidence Interval	Median	Upper 95% Confidence Interval
SSC *	85.9%	92.8%	94.7%
SSC **	73.9%	82.8%	86.3%
TSS *	79.0%	89.2%	91.0%
TSS **	72.0%	78.3%	85.2%
TN *	90.0%	43.9%	50.9%
TP *	33.8%	28.5%	64.7%
Zn **	39.4%	50.0%	62.1%
Cu **	72.6%	80.7%	85.2%
* Based on ESSIE (UF) Performance monitoring results ** Based on CCEE (UA) Performance monitoring results			

Table 2. Up-Flo® Filter with CPZ™ Media – Verified Flow Weighted Mass Removal Efficiency

Constituent	ESSIE (UF) Performance monitoring results		CCEE (UA) Performance monitoring results
	6-month	12-month	12-month
SSC	93%	92%	86%
TSS*	89%	87%	87%
TN **	68%	39%	***
TP **	48%	48%	***
Zn	***	***	59%
Cu	***	***	70%
* TSS results for UF are a function of SSC. ** TN and TP load data was time dependent after 6-months *** No data submitted			

[1]Of the total 66 storms (16 storms from UF and 50 storms from UA), 62 were identified as qualifying events having quality data for TSS, and 59 for SSC. Fewer events with metals detected in the runoff limited the metals data sets. There were a total of 28 and 17 storms for Zn and Cu, respectively, solely from the UA data. Total Nitrogen and Total Phosphorous claims were based on the 16 storms recorded solely from the UF data.

Description of Test Procedure

Table 3 shows the target criteria as outlined by the TARP and TAPE programs as well as the results achieved at the two locations. Table 4 provides a more detailed description of the observed operating conditions over the testing period. At the time of testing, the TARP and TAPE programs both allowed for field testing data to be used to obtain certification in participating states. They were the most widely used protocols and were generally accepted as industry standards. The TARP program has since stopped accepting field data, but the TAPE program remains in effect and is currently referenced to benchmark the quality of data obtained from stormwater monitoring programs.

Table 3. Up-Flo® Filter with CPZ™ Media Performance Testing - Specified TARP & TAPE criteria, and achieved results, for storm selection and sampling

Description	TARP Criteria	TAPE Criteria	Achieved value	
			ESSIE - UF	CCEE - UA
Total rainfall/storm	≥2.5 mm (0.1”)	≥3.81 mm (0.15”)	>2.5 mm (0.1")	≥4.6 mm (0.18”)
Minimum inter-event period	6 h	6 h	≥ 6 h	≥ 6 h
Minimum flow-weighted composite sample storm coverage	70% including as much of the first 20% of the storm	75% including as much of the first 20% of the storm	100%	87.6%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	12, but a minimum of 10 subsamples for composite samples	5, whole manual samples	11
Total sampled rainfall	≥ 381 mm (15”)	NA	195 mm (7.66”)	765 mm (30.07”)
Total sampled storms	≥ 20	≥ 12	16	29

Table 4. Up-Flo® Filter with CPZ™ Media Performance Testing - Observed operational conditions for events monitored over each performance test period

Operating parameter	Observed range	
	ESSIE - UF	CCEE - UA Total*
Storm duration	0.35-5.78 h	0.67-64.7 h
Previous dry hours**	6-213	> 6 hrs for the 20 storms in 1st study and 12-632 hrs for 30 storms in second study
Rainfall depth	0.10-1.64 in	0.18-2.44 in
Runoff volume	223-4095 gal (0.84-15.5 m^3)	2,065-61,131 gal(7.82-231 m^3)
Peak rainfall intensity (5 min)	1.2-5.4 in/h (3.0-13.7 cm)	0.24-4.68 in/h (0.61-11.9 cm)
Peak runoff flow rate	27.7-233 gpm (1.75-14.7 L/s)	68-1023 gpm (4.29-64.5 L/s)
Event median flow rate	2.4-21.4 gpm (0.15-1.35 L/s)	28-175 gpm (1.75-11.0 L/s)

* The UA data ranges cover the storms for both studies; ranges for individual studies might be narrower.
** This is the same as the time period between events, or time since it last rained a qualifying event.

For the UF study, performance monitoring was conducted at the Reitz Union surface parking lot, which had a drainage area of 0.12-0.20 acres (0.049-0.081 ha),which was 76% impervious, depending on storm intensity and wind direction. The area generated a flow rate in excess of the 150 gpm (9.55 L/s) maximum treatment flow rate (MTFR) in 3 of the 16 storms. The 4-ft diameter (1.2 m) test unit was installed above ground in a temporary installation at the bottom of a hill sloping down from the lot. An inlet catch basin conveyed runoff from the parking lot through a Pashall flume into the filter. Monitoring occurred over a period of 12 months and the UF team recovered the captured mass at the end of the perfomance monitoring study. No maintenance was required or conducted during the year long monitoring period from 12 September 2015 through 1 September 2016.

The UA perfomance monitoring studies covered a total of 50 storms, but not all of them yielded useful data for all parameters. The site used in both cases was the Riverwalk parking lot near the Bama Belle in Tuscaloosa, Alabama. The drainage area was about 0.9 acres (0.36 ha), 68% impervious. The unit was installed in a 4 ft. (1.2 m) diameter below-grade catch basin inlet manhole on the site. Monitoring occurred in two stages of approximately 12 months each over a total of 32 months. The first round of testing occurred from July 16, 2010 to April 11, 2011 and the second from May 31st, 2012 to March 30th, 2013.

The UA perfomance monitoring study used autosamplers to generate the flow-weighted composite samples and the event mean concentration data. This data was used to calculate removal efficiencies. However, in the UF performance monitoring study, sediment removal performance was assessed by taking full cross section samples of the influent and effluent streams at regular intervals for the duration of the storm and combining the samples into flow-weighted composites. The data was converted into event mean concentrations for the purposes of calculating removals.

The following approved analytical methods were used:

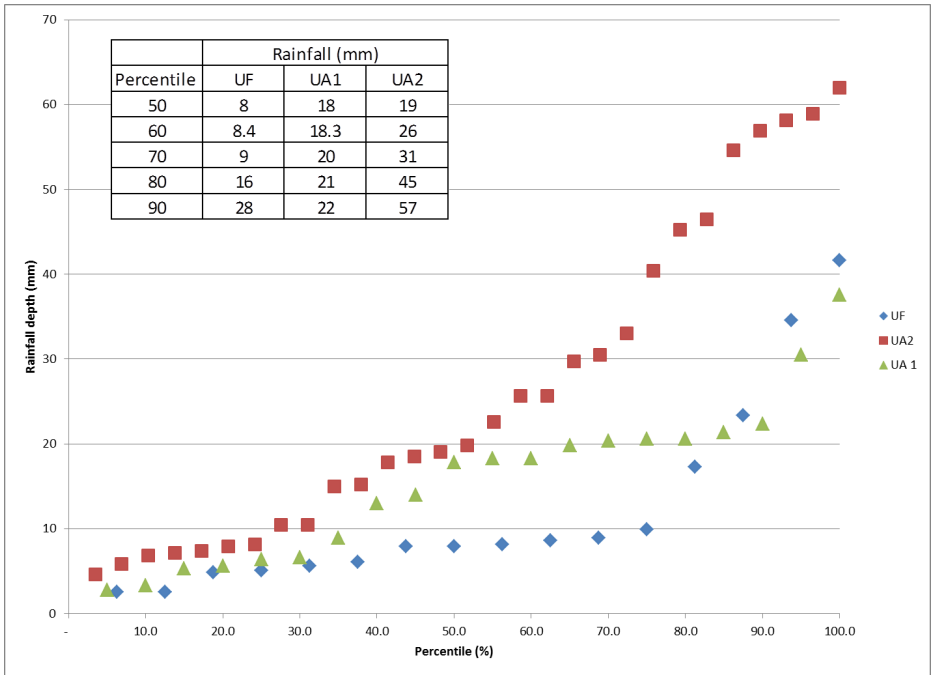
- TSS – ASTM D2540
- SSC – ASTM D3977-97(2013) Standard Test Methods for Determining Sediment Concentration in Water Samples
- PSD – ASTM D422 – 63 Standard Test Method for Particle-Size Analysis of Soils and ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- PSD – ASTM 2560- C, D (UF used 2560D laser diffraction or light-scattering method and UA used 2560C Coulter Counter or light-blocking method)
- TP – S.M.4500-P-B Acid Hydrolysis
- TN – Persulfate Digestion Method
- Cu – EPA 200.8 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry
- Zn - EPA 200.8 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry

As part of the mass balance measurements, the UF team allowed all samples to sit for an hour and reported concentrations of suspended solids, measured using ASTM 2540D, as TSS, in addition to the usual SSC measurement using SM3977. In order to be able to report a TSS comparable to other perfomance monitoring studies, Dr. Sansalone developed a correlation equation for TSS* = f(SSC) as well as equations for the 95% confidence limits of TSS*.

Summary of Verification Results

The cumulative frequency of rainfall depths monitored during the three perfomance monitoring studies is presented in Figure 2. The median rainfall depths in the three perfomance monitoring studies were 0.31, 0.71, and 0.75 inches (8, 18 & 19 mm) while the 90th percentile rainfall depths were 1.1, 0.9 and 2.2 inches (28, 22 and 57 mm). Thus the data presented covers a comparatively wide range of rain events.

Figure 2. Rainfall depth frequency curves



	Rainfall (mm)		
Percentile	UF	UA1	UA2
50	8	18	19
60	8.4	18.3	26
70	9	20	31
80	16	21	45
90	28	22	57

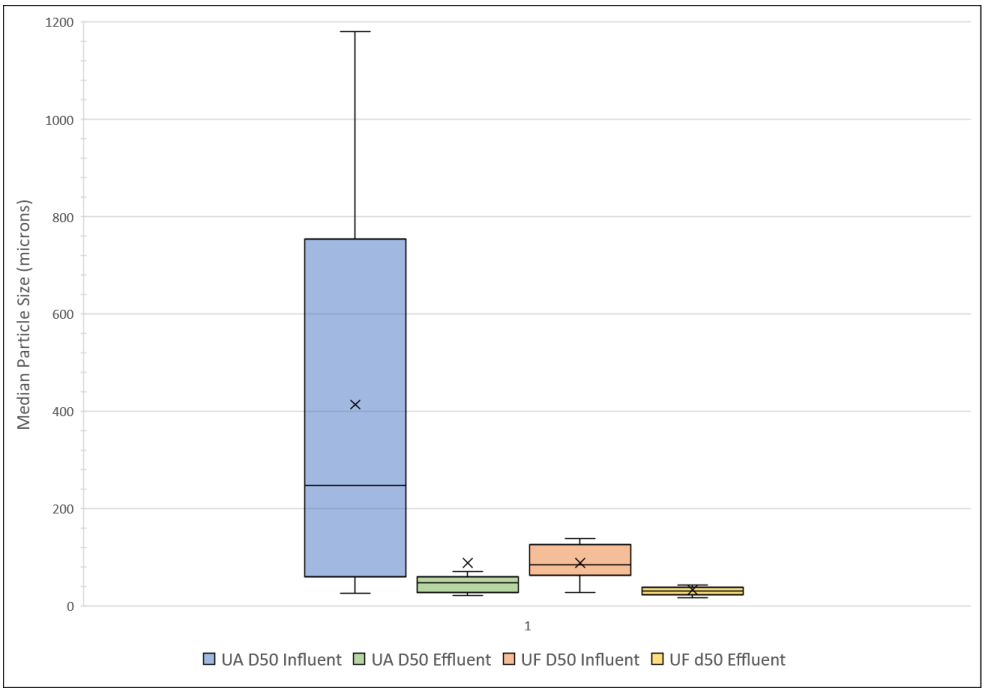
For UF monitoring, a total of 16 storm events, with varying rainfall intensity and runoff volume from event to event, were monitored. The cumulative rainfall depth was 7.66 inches (195 mm) and the cumulative influent runoff volume was 20,022 gallons (7.65 m^3). The entire volume was treated by the Up-Flo® Filter system. Of the 16 storms treated, three storms generated flow rates exceeding the MTFR of 150 gpm (9.55 L/s) but there was no bypass, because the excess was not sufficient to top the overflow weir, and all sampled flows passed through the filtration media. Median driving head difference for an event never exceeded 13.1 inches (33.3 cm) and peak driving head difference never exceeded 27.1 inches (68.8 cm), which indicates the media was not occluded.

For the UA site, all of the storm events from May 31st, 2012 to March 30th, 2013 were monitored for flow but only 30 events were sampled. The total rainfall depth for this period was 49 inches (124.5 cm) or 982,192 gal. (3,718 m^3) of runoff volume that was routed through the filter. Actual storm data from the monitoring period showed about 624,503 gal. (2,364 m^3) of runoff (from about 30 inches or 76.2 cm of rainfall) was treated by the media filter system. This included about 28.5 % of bypass flow volume, which was sampled and included in the performance results. Given that the total bypassed volume was almost three times the expected bypass volume at the UA site, the UA results are considered conservative.

Influent particle sizes varied considerably between the two monitored locations and between storm events. Catchment characteristics and available sources, sampling methods (auto sampling vs. grab sampling), storm intensities, duration and volumes all influence the particle size range. The particle size analyses were completed for just the median particle size for each storm. A comparison of statistical descriptive values for influent and effluent median particle sizes for the two monitored sites is illustrated with the Whisker-Box-Plot shown in Figure 3.

Due to larger storm events and curbside erosion, the median UA influent particle size range and d_{50} were substantially the larger of the two monitored sites. The interquartile range for the influent median particles sizes was 659 µm for UA compared to 59 µm for UF and the UA d50 was 247 µm compared to 85 µm for UF. However, despite the influent particle size differences between locations, the median UA and UF effluent particle size range and d50 were similar. The interquartile range for the effluent median particles sizes was 33 µm for UA compared to 13 µm for UF and the UA d50 was 48 µm compared to 30 µm for UF.

Figure 3. UF and UA Summary of Influent and Effluent Median Particle Sizes



Summary statistics for the influent and effluent concentration removal efficiencies as well as the overall mass load reductions are shown in Table 4 and Table 5 for UF and UA, respectively.

While the flow weighted removal efficiency for TP and TN were 48% and 39%, respectively, TP and TN reduction tended to decrease with the overall volume treated. Results showed that if the filter maintnenance cycle is limited to 6-8 months, the long-term load reduction for TP and TN would have been 50% and 70%, respectively.

Table 4: Up-Flo® Filter with CPZ™ Media Performance Testing - Summary statistics for influent and effluent event mean concentrations (EMCs) and the overall mass load reductions for selected constituents (UF Test)

Parameter	Sample Location	Min	Max	Median	SD	Mass Load Reduction
SSC	Influent	146	1584	487	360	92%
	Effluent	19.9	96.5	43.25	20.2	
TSS*	Influent	93.3	870	277	194	87%
	Effluent	25.0	66.4	37.6	10.9	
TP	Influent	0.79	6.05	1.9	1.70	48%
	Effluent	.56	2.19	1.1	0.56	
TN	Influent	.41	7.89	2.1	2.18	39%
	Effluent	.52	3.84	1.2	1.21	

Table 5. Up-Flo® Filter with CPZ™ Media Performance Testing - Summary statistics for influent and effluent event mean concentrations (EMCs) and the overall mass load reductions for selected constituents (UA Tests)

Parameter	Sample Location	Min	Max	Median	SD	Mass Load Reduction
SSC (mg/L)	Influent	23	879	88	166	86%
	Effluent	3	69	17	18	
TSS (mg/L)	Influent	11	571	89	128	87%
	Effluent	3	64	19	22	
Total Zn (µg/L)	Influent	7.0	157	22.0	0.71	59%
	Effluent	2.5*	72	14.0	0.68	
Total Cu (µg/L)	Influent	6	181	9	42	70%
	Effluent	1.3**	42	1.3	20.9	

* There was a single effluent value that was non-detect (ND). Since it was only 1 value ½ the detection limit 1.3 µg/L, was substituted when calculating statistics.
**The Cu data was highly censored (many non-detect, ND, effluents). Statistics were calculated by substituting ½ the detection limit, 1.3 µg/L, for all ND data then bootstrapping as usual.

As the independent third-party verifier, following the requirements of ISO 14034, GHL has confirmed that:

- The Hydro International Up-Flo® Filter with CPZ™ Media is based on sound scientific and engineering principles, providing a net environmental benefit.
- Performance testing of the Hydro International Up-Flo® Filter with CPZ™ Media was based on defined parameters and was conducted following the requirements of the NJDEP TARP Tier II Protocol for Stormwater Best Management Practice Demonstrations (2003) and its 2006 and 2009 amendments.
- Performance testing of the Hydro International Up-Flo® Filter with CPZ™ Media was performed by a qualified testing organization.
- Sample analyses were carried out as part of the test plan by a third-party analytical laboratory in a manner that meets the quality requirements of ISO 17025. Operating conditions and performance during each testing run were documented.
- Frequency of sampling and duration of each performance test were determined based on the specifications in a credible test plan and the requirements to produce sufficient data to support the performance claim at a 95% confidence level.
- Performance measurements and calculations were based on the technology application and relevant performance parameters as outlined in the Verification Plan.
- Performance calculations were done according to generally accepted test methods described in the test design, including the applicable mathematical and statistical principles and procedures.
- Data storage, transfer and control were adequate, carried out in accordance with the intent of ISO 9001 enabling control and retrieval of documents and records.
- Quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This confirmation included reviewing all data sheets and data downloads, as well as overall management of test system quality.

Quality Assurance

Performance testing and verification of the Hydro International Up-Flo® Filter with CPZ™ Media were performed in accordance with the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The verifier, Good Harbour Laboratories, has confirmed that quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This includes reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity.

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Particulate Matter Fraction Analyses. (Sansalone & Kim: Transport of Particulate Matter Fractions in Runoff, Journal of Environmental Quality • Volume 37 • September–October 2008)

New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, January 2013

2009 Urban Stormwater BMP Performance Monitoring Guidelines
http://www.bmpdatabase.org/contacts.html

Description of Up-Flo® Filter

Up-Flo® Filter Design Manual https://www.hydroint.com/sites/default/files/uff_dg_nashville_f1504.pdf

Up-Flo® Filter Verification Brochure

ISO/IEC 14034, Environmental management – Environmental technology verification

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

ISO/IEC 9001, Quality Management Systems.

VerifiGlobal Performance Verification Protocol (Applying ISO 14034:2016)

VerifiGlobal Test Body Assessment – Guidance (2018)

What is ISO 14034?

The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively. The International Organization for Standardization (ISO) standard for environmental technology verification (ETV) is ISO 14034, which was published in November 2016.

Benefits of ETV

ETV contributes to protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. Through the provision of objective evidence, ETV provides an independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

For more information on the Hydro International Up-Flo® Filter, contact:	For more information on VerifiGlobal, contact:
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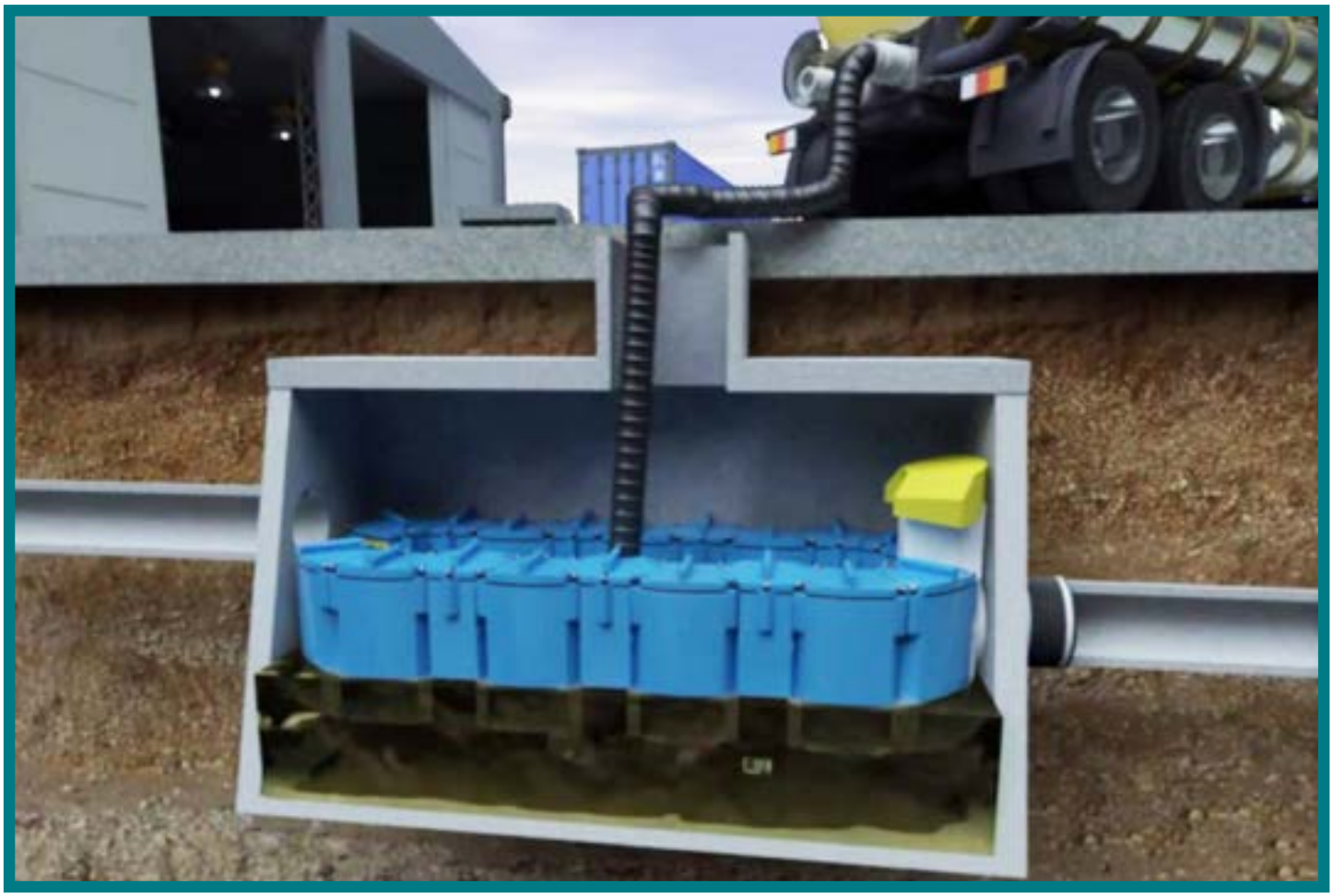
Signed for Hydro International: *Original signed by:* Phillip Taylor Technical Product Manager, Americas Stormwater	Signed for VerifiGlobal: *Original signed by:* Thomas Bruun, Managing Director *Original signed by:* John Neate, Managing Director

Hydro International®



Operation and Maintenance Manual

Stormwater Solutions

Up-Flo® Filter

Filtration System for Stormwater Treatment

94 Hutchins Drive
Portland, ME 04102

Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

www.hydro-int.com

Table of Contents

IMPORTANT - ORDER REPLACEMENT PARTS FOR MAINTENANCE - IMPORTANT

Annual maintenance requires replacement of the Media Packs and the Drain Down Filter. Contact Hydro International to order replacements. Allow 2-4 weeks for delivery.

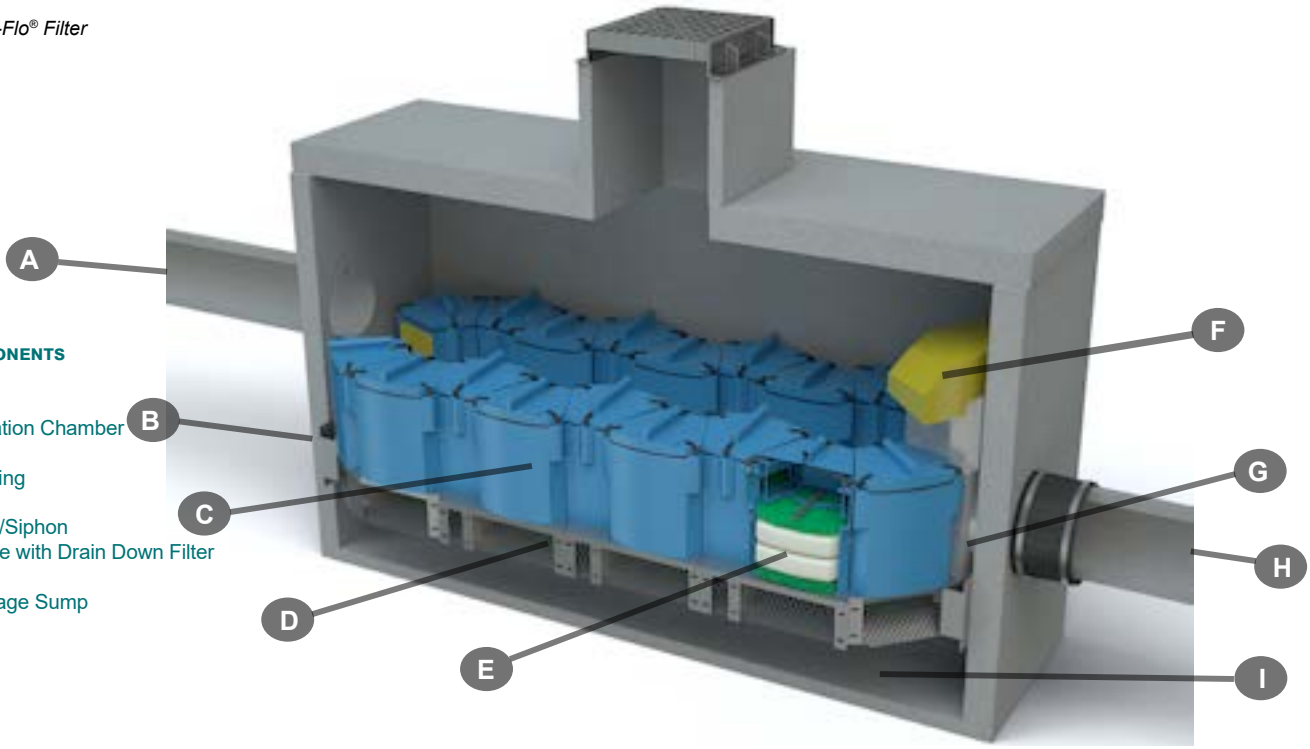
Office hours Monday thru Friday 8:00 A.M. to 5:00 P.M. EST
Toll free: 1-888-382-7808
Phone: 207-756-6200
Fax: 207-756-6212
Email: services@hydro-int.com

Overview & Product Description

The Up-Flo® Filter is a modular high-rate stormwater filtration device designed to capture trash, oil, sediment and remove fine pollutants such as dissolved and particulate metals and nutrients from stormwater runoff. Designed with efficiency, longevity and upkeep in mind, this high performance, low maintenance filter option that offers higher loading rates and longer media life for higher quality stormwater for longer periods between servicings.

In general, a minimum of two inspections are required per year to monitor sediment and gross pollutant accumulations. In order to achieve an annual TSS removal rate of 80% for the Up-Flo® Filter, the minimum maintenance frequency specified in the maintenance section for replacement of the Media Pack and removal of accumulated sediment from the sump is mandatory.

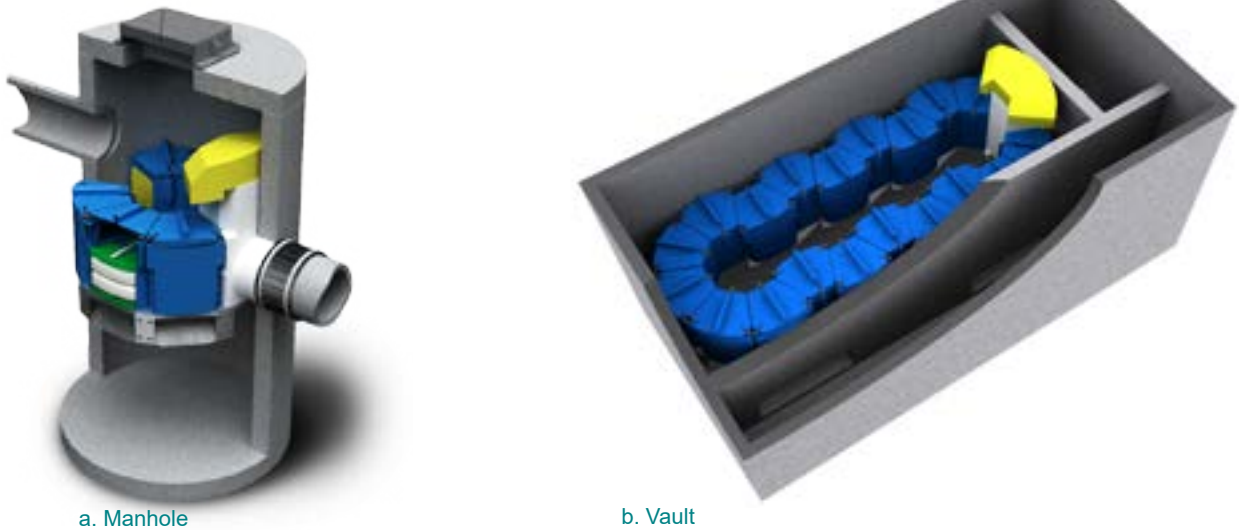
Fig.1 *The Up-Flo® Filter*



System Components

A. Inlet Pipe
B. Precast Filtration Chamber
C. Filter Module
D. 4mm Screening
E Media bag
F. Bypass Hood/Siphon
G. Outlet Module with Drain Down Filter
H. Outlet pipe
I. Pollutant Storage Sump

Product Configurations



a. Manhole

b. Vault

Fig.2 *The Up-Flo® Filter is installed in a) 4-ft (1.2m) round manholes or b) in rectangular precast vaults. Both configurations have a wide central opening in the Up-Flo® Filter.*

Operation

Introduction

The Up-Flo® Filter operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirements and is fabricated with durable non-corrosive components. Personnel are not required to operate the unit and maintenance is limited to periodic inspections, sediment and floatables removal, Media Pack replacement and Drain Down Filter replacement.

Pollutant Capture

The Up-Flo® Filter is designed to operate as a "treatment train" by incorporating multiple treatment technologies into a single device. Trash and gross debris are removed by sedimentation and screening before they are introduced to the filtration media, preventing surface blinding of the filter media. The Up-Flo® Filter is a wet-sump device. Between storm events, oil and floatables are stored on the water surface separate from the sediment storage volume in the sump (see **Fig.1**). The high-capacity bypass siphon acts as a floatables baffle to prevent washout of captured floatable pollutants during high intensity events.

Reduced Clogging

The Up-Flo® Filter has been designed to minimize the occurrence of clogging and blinding and employs a unique Drain Down Filter that allows the water level in the chamber to drop below the filter media between events. The Drain Down Filter mechanism creates a reverse flow that flushes captured pollutants off the surface of the Media Bag, helping to prevent blinding. By allowing the water to drain out, the Drain Down Filter also reduces the weight of the Media Bags. This makes the bags easier and safer to remove during maintenance operations.

Overflow Protection

The Angled Screens are designed to prevent ragging and blinding and are situated below the Filter Modules, sheltering them from the direct path of the influent. Coarse debris settles in the sump before the runoff flows up through the screens, protecting them from blinding. In the unlikely event of a blockage, the high capacity siphonic Bypass Hood is designed to convey high enough flow to minimize the risk of large storm creating upstream flooding.

Best Practices

Good housekeeping upstream of the Up-Flo® Filter can significantly extend Media Bag life. For example, sweeping paved surfaces, collecting leaves and grass trimmings, and protecting bare ground from erosion will reduce loading to the system. Media Packs should not be installed in the Filter Modules until construction activities are complete and site stabilization is effective.

Damage Due to Lack of Maintenance

Delayed maintenance would result in clogged Media Bags and/or blinded Angled Screens. In that situation, the Up-Flo® Filter would go into bypass and there would be no treatment of the incoming stormwater. Because the Bypass Weir can easily convey all of the flow to the Outlet Module, there would be no lasting damage to the system. Replacement of the Media Bags and removal of sediment from the sump would restore the Up-Flo® Filter to its original treatment efficiency. Establishing and adhering to a regular maintenance schedule ensures optimal performance of the system.

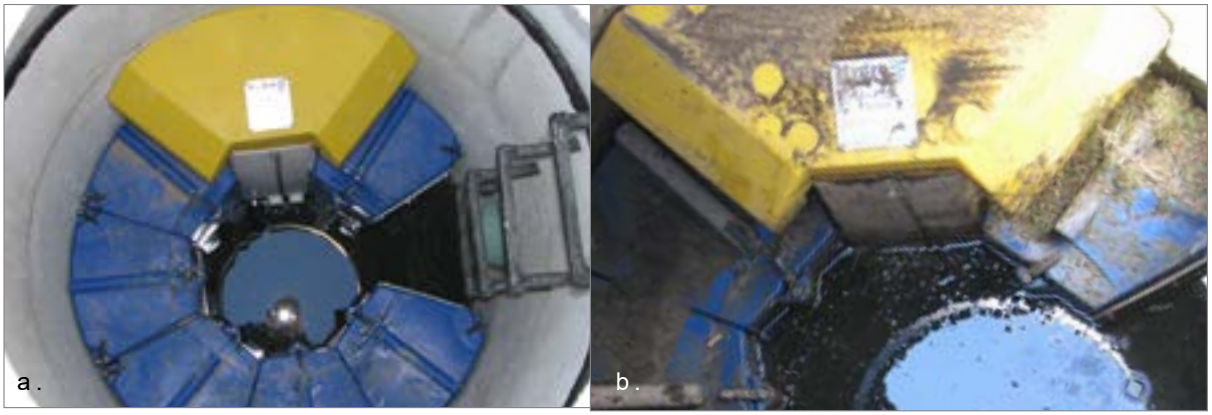


Fig.3 a) The water level in a properly functioning Up-Flo® Filter will drain down to the base of the Filter Modules. b) When the Drain Down Filter becomes clogged, the base of the Filter Modules will be submerged in standing water. Note, above right, that the Drain Down Filter is submerged in standing water.

Inspection & Maintenance

Overview

The Up-Flo® Filter protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the proper functioning of the Up-Flo® Filter.

Maintenance activities can be categorized as those that may be performed from outside the Up-Flo® vessel and those that are performed inside the vessel. Maintenance performed from outside the modules includes removal of floatables and oils that have accumulated on the water surface and removal of sediment from the sump. Maintenance performed inside the vessel includes removal and replacement of Media Bags, Flow Distribution Media and the Drain Down Filter. A vactor truck is required for removal of oils, water, sediment, and to completely pump out the vessel to allow for maintenance inside. If you are not using Hydro Internatioanl or a trained servcie provider you must follow OSHA Confined Space Entry procedures when entering the Up-Flo® vessel.

The Up-Flo® Filter design has a wide central opening between the Filter Modules for easy access to all of the components (see **Fig.3**). In the case of inspection and floatables removal, a vactor truck is not required. Otherwise, a vactor truck is normally required for oil removal, removal of sediment from the sump, and replacement of the Media Packs and Drain Down Filter. In most cases, entry into the Up-Flo® Filter vessel is required for replacement of the Media Packs and Drain Down Filter.

The minimum required frequency for replacement of the Media Pack is annually, whereas the minimum required frequency for removal of accumulated sediment from the sump is dependent on the Up-Flo® Filter configuration. Configurations with a larger sediment storage volume per module will require less frequent removal of accumulated sediment. Regardless, whenever sediment depth in the sump is found to be greater than 16 inches, sediment removal is required.

Fig.4 a) A new Media Bag of Hydro Filter Sand. b) A spent media bag of Hydro Filter Sand.

At a minimum, media bags must be replaced at least once a year.

Make Sure your System was Installed Correctly

First Year Inspection and Maintenance

The frequency of inspection and maintenance can be determined in the field after installation. The frequency of ongoing maintenance needs is based on site characteristics such as contributing area, types of surfaces (e.g., paved and/or landscaped), site activities (e.g., short-term or long-term parking), and other site maintenance (e.g., sanding and sweeping). At a minimum, inspection and maintenance should be conducted at intervals of no more than six months during the first year of operation. Maintenance personnel should observe and record pollutant accumulations during the first year of service in order to benchmark the maintenance intervals that will later be established for the site. Pollutant accumulations should be measured or monitored using the following procedures:

- Measurement of sediment depth in the sump: A minimum of 8 inches (20 cm) should separate the Drain Down Filter inlet from stored sediment in the sump in order to minimize sediment migration into the Drain Down Filter. A simple probe, such as the Sludge-Judge®, can be used to determine the depth of the solids in the sump. In a typical 4-ft (1.2m) diameter manhole installation, the sediment depth should be no more than 16 inches (41 cm).

- Maintenance personnel should then enter the structure, remove the Media Pack from one of the Filter Modules, and weigh the Media Bags. Media Bags with a wet weight of approximately 40 lbs (18 kg) or more are an indication that the filter media has become full and that the Media Packs in all of the Filter Modules will require replacement (Fig.4). Minimum filtration rate is generally reached when the Media Bags have accumulated approximately 20 lbs (9 kg) of sediment. Determining the amount of accumulated sediment will be accomplished by removing both of the Media Bags from one of the Media Packs and weighing the bags separately. Since a new Media Bag weighs approximately 30 lbs (14 kg) wet, the difference in weight will approximately equal the weight of solids that have accumulated in the bag. A spent Media Bag weighs approximately 50 lbs (23 kg) wet.

- Measurement of oil layer on water surface: Since water in the Up-Flo® vessel drains down to an elevation below the bottom of the Filter Modules when the system is idle, the amount of accumulated oil must be minimized so that oil is not entrained in the Media Pack when stormwater begins to fill the vessel at the start of a storm event. Oil accumulation should be limited to 1.5 inches (4 cm) or less. Probes can be used to measure oil thickness.

- Monitoring for Drain Down Filter clogging: The water level in the Up-Flo® Filter should be monitored to ensure that the Drain Down Filter is operating properly. The Drain Down Filter is designed to lower the water level in the Up-Flo® vessel to an elevation below the bottom of the Filter Modules between storm events. Periodically conduct an inspection one to two days after a storm event during the first year of operation. Approximately 36 hours after a 1-in (2.5-cm) rainfall, the water level inside the vessel should have dropped to a point where it is equal with the base of the Filter Modules. If the water level has not reached that point, then the Drain Down Filter has either become clogged or blinded by trash or debris (Fig.5 a and b). If there is no evidence of trash or debris around the Drain Down Filter inlet, then it has likely become clogged with particles.

- Monitoring for slime and debris covering the Flow Distribution Media or Angled Screens: After removal of the Media Bags, the bottom Flow Distribution Media should be removed and inspected to determine if it is coated with slime or debris. Similarly, the Angled Screen should be inspected for blockages and ragging.

Find out how Frequently your System Needs Maintenance

Monitoring for floatables on the water surface: Similar to oil, the amount of accumulated floatables must be minimized to prevent trash and loose debris from becoming trapped on the Angled Screens when stormwater begins to fill the Up-Flo® vessel at the start of a storm event. Visual inspection is adequate to determine the amount of floatables. Floatables should be removed before they form a mat on the surface of the water.

The solids loading rate in the sump will be calculated by measuring the sediment depth in the sump and dividing the depth by the correlating interval of time since the sump was last cleaned. Similarly, starting with fresh Media Bags, the solids loading rate in the Media Packs will be calculated by weighing the Media Bags and dividing the weights by the correlating interval of time since they were installed. The wet weight of the heaviest bag will be used to determine the loading rate. As previously mentioned, a spent Media Bag weighs approximately 50 lbs (23 kg) wet. The spent Media Bag weight estimate was based on calculations of sediment loading in an Up-Flo® Filter that was run to exhaustion during laboratory testing.

The rate of oil accumulation will be calculated by measuring the thickness of the oil layer and dividing the thickness by the correlating interval of time since the sump was last cleaned. Ordinarily, oil thickness will not be measurable unless a spill has occurred. Consequently, any oil will typically be removed along with water when cleaning the sump.

Monitoring the Drain Down Filter for clogging, monitoring the Flow Distribution Media and Angled Screens for slime and debris, and monitoring the accumulation of floatables will provide an estimate of how long the Up-Flo® Filter can operate before its performance can become impaired by one of these factors.

Routine Inspection and Maintenance

After completion of the first year of operation, determining and then following the established inspection and maintenance intervals will keep pollutant loadings within their respective limits. Removal of oils and floatables, replacement of the Drain Down Filter, replacement of Flow Distribution Media (see Fig.9, pg 11), and cleaning of Angled Screens will occur at the same frequency as cleaning of the sump and replacement of Media Bags unless the first year of operation indicates otherwise. Keeping to the established maintenance intervals will keep treatment flow rates at, or above, the design flow rate. Typically, annual maintenance is adequate.

In addition to scheduled maintenance, occasional checks for Up-Flo® Filter clogging can be performed by removing the manhole cover during a storm, monitoring the water level in the manhole or vault, and determining whether the filter is in bypass. A properly-sized filter (on-line or off-line) that is in bypass during a storm that is producing runoff at, or below, the filter's design filtration rate needs maintenance.

Inspection & Maintenance

Routine Inspection

Inspection is a simple process that requires monitoring pollutant accumulations. Maintenance crews should be familiar with the Up-Flo® Filter and its components prior to inspection.

The following instructions are intended for non-Hydro maintenance service providers and/or those intending to maintain thier own Up-Flo® Filter:

Scheduling

- Inspection may be conducted during any season of the year but should occur shortly after a predicted rainfall to ensure components are operating properly.

Necessary Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Scale to measure the weight of the Media Bags
- Crow bar to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge-Judge®)
- Hydro International Up-Flo® Filter Maintenance Log
- Trash bags for removed floatables

Routine Inspection Procedures

1. Set up any necessary safety equipment (such as traffic cones) to provide access to the Up-Flo® Filter. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the grate or lid to the manhole or vault.
3. Without entering the vessel, look down into the chamber to inspect the inside and to determine whether the high-water level indicator has been activated. Make note of any irregularities. See Fig.6 for a typical Inspection View.
4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the chamber.
5. Using a sediment probe such as a Sludge-Judge®, measure the depth of sediment that has collected in the sump of the vessel.
   Maximum sediment depth is 16 inches (41 cm).
6. If the high-water level indicator has been activated after two consecutive storms, remove the Filter Module lid by turning the cam latch and remove the Filter Media Pack (*refer to page 11 Replacement Procedures*). Weigh the Media Bags from one or two modules. Media Bags should be replaced if the wet weight exceeds 40 lbs (18 kg).
7. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or a high standing water level (see Fig.6 for the standard standing water level).
8. Securely replace the grate or lid.
9. Remove safety equipment.
10. Contact Hydro International at (800) 848-2706 to discuss any irregularities noted during inspection.

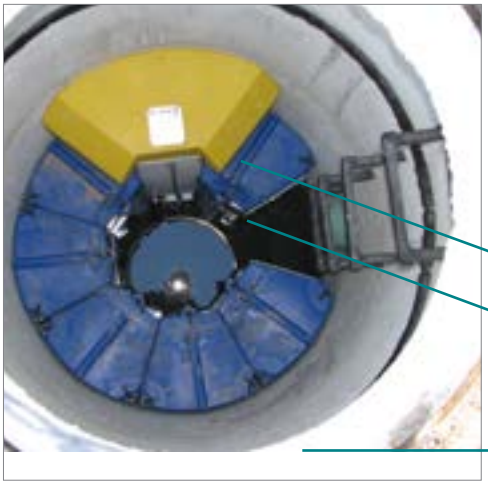


Fig.6 Inspection view of the Up-Flo® Filter.

Routine Maintenance

Maintenance activities are grouped into two categories:

- *Activities **Not Requiring** Man Entry Into the Up-Flo® Filter*
  These activities include floatables removal, oil removal and removal of sediment from the sump.
- *Activities **Requiring** Man Entry Into the Up-Flo® Filter*
  Media Pack replacement and Drain Down Filter replacement.

Maintenance intervals are determined from monitoring the Up-Flo® Filter during its first year of operation. Depending on the site, some maintenance activities may have to be performed on a more frequent basis than others. In the case of floatables removal, a vactor truck is not required. Floatables and loose debris can be netted with a skimmer and pole.

A vactor truck is normally required for oil removal, removal of sediment from the sump, and to dewater the vessel for replacement of the Media Packs and Drain Down Filter (Fig.7). All inspection and maintenance activities would be recorded in an Inspection and Maintenance Log.

Completion of all the maintenance activities for a typical 4-ft (1.2m) diameter manhole installation takes less than one hour. Approximately 360 gallons of water and up to 0.6 yd^3 (0.5 m^3) of sediment may be removed in the process. In an installation equipped with six Filter Modules, 12 Media Bags (2 bags per module) would be removed and replaced. Assuming a spent Media Bag weight of 50 lbs (23 kg), up to 600 lbs (272 kg) of spent Media Bags would be removed. All consumables, including Media Bags, Flow Distribution Media, and replacement Drain Down Filters are supplied by Hydro International.

The access port located at the top of the manhole provides unobstructed access for a vactor hose and/or skimmer pole to be lowered to the base of the sump.

Maintenance Activities Not Requiring Man Entry

These activities include floatables removal, oil removal and removal of sediment from the sump.

Scheduling

- Floatables and sump cleanout may typically be done during any season of the year - before and after rainy season
- Floatables and sump cleanout should occur as soon as possible following a contaminated spill in the contributing drainage area

Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge-Judge®)
- Vactor truck (flexible hose preferred)
- Pressure nozzle attachment or other screen-cleaning device

Fig.7 Sediment is removed from the sump with a vactor hose. Man entry is not required for this step.

No Man Entry Required: Floatables, Oil and Sediment:

1. Set up any necessary safety equipment (such as traffic cones) around the access of the Up-Flo® Filter. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole or vault.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. If the standing water level in the sump is above the base of the Filter Modules (see Fig.8), tug the Pull Chain(s) to release the Drain Down Filter plug(s). Allow the excess water to drain out of the chamber.

5. Use the skimmer pole to fit the Drain Down Filter plug back into the open port.

6. Once all floatables and oil have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris from the sump floor. Up to 0.3 yd^3 (0.2 m^3) of sediment and 360 gallons (1,363 L) of water will be removed from a typical manhole Up-Flo® Filter during this process.

7. Retract the vactor hose from the vessel.

8. Inspect the Angled Screens for blockages and ragging. If present, remove the obstruction or ragging materials from the surface using a hose or other screen-cleaning device.

9. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables, oils, and gross debris removed, and the depth of sediment measured. Note any apparent irregularities such as damaged components or blockages.

10. Securely replace the grate or lid. Remove safety equipment.

11. Dispose of sediment and gross debris following local regulations.

12. Dispose of oil and sump water at a licensed water treatment facility or following local regulations.

13. Contact Hydro International at (800) 848-2706 to discuss any irregularities noted during cleanout.

Maintenance Activities Requiring Man Entry

These activities include replacement of the Media Packs and Drain Down Filter.

Unless the Up-Flo® Filter has been installed as a very shallow unit, it is necessary to have an OSHA-confined space entry trained person enter the vessel to replace Media Packs.

The access port located at the top of the manhole or vault provides access to the Up-Flo® vessel for maintenance personnel to enter the vessel and remove and replace Media Packs. The same access would be used for maintenance personnel working from the surface to net or skim debris and floatables or to vactor out sediment, oil, and water. Unless the Up-Flo® Filter has been installed in a very shallow configuration, it is necessary to have personnel with OSHA Confined Space Entry training performing the maintenance that occurs inside the vessel.

Scheduling

- Call Hydro International to order replacement Media Packs and Drain Down Filter prior to scheduling maintenance.

- Because Media Pack replacement requires entry into the Up-Flo® chamber, maintenance events should be scheduled during dry weather.

- Media Pack replacement should occur immediately after a contaminated spill in the contributing drainage area.

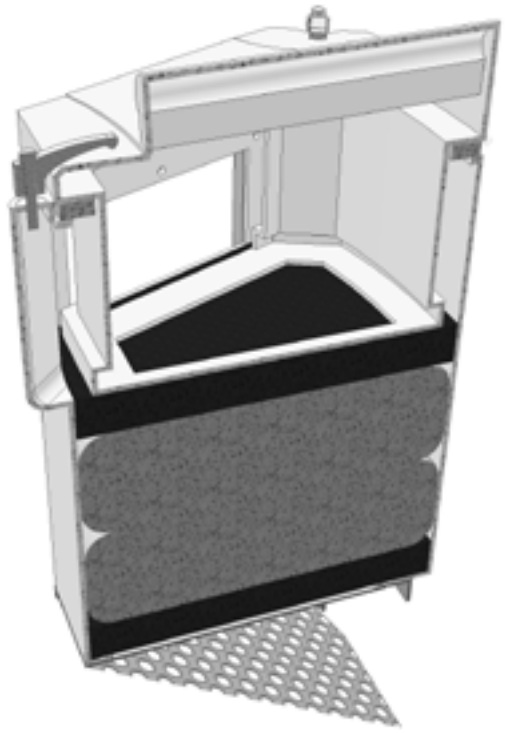


Fig.8 Cutaway view of the Filter Module

Recommended Equipment

- Safety Equipment (traffic cones, etc.)
- Crow bar to remove grate or lid
- Pole with skimmer or net (if floatables removal is not to be done with vactor hose)
- Sediment probe (such as a Sludge-Judge®)
- Vactor truck (flexible hose preferred)
- OSHA Confined Space Entry Equipment
- Up-Flo® Filter Replacement Media Packs (available from Hydro International)
- Hydro International Up-Flo® Filter Maintenance Log
- Screwdriver (flat head)
- Replacement Drain Down Filter components supplied by Hydro International

Man Entry Required: Media Pack and Drain Down Filter

1. Follow Floatables and Sump Cleanout Procedures, 1 – 13.
2. Following OSHA Confined Space Entry procedures, enter the Up-Flo® Filter Chamber.
3. Open the Filter Module by turning the three cam latches on the front and sides of the module. Remove the lid (1) to gain access to the Media Pack (Fig.9).
4. Remove and discard the spent Media Pack. The Media Pack contents include:
    - A top layer of (A) Flow Distributing Sheets
    - Two (2) Media Bags (B) equipped with nylon handles.
    - A bottom layer of (A) Flow Distributing Media.
5. Insert a new Media Pack, supplied by Hydro International.
    - First, insert a bottom layer of green Flow Distributing Media. Be sure that the media sits snugly and level at the bottom of the Filter Module.
    - Next, insert the first of two (2) replacement Media Bags. Smooth the bag out with your hands to make sure that the bag extends snugly to the walls and corners of the Filter Module.
    - Insert the second Media Bag, following the same procedure.
    - Insert the top layer of green Flow Distributing Media.

1. Filter Module Cover and Media Restraint

2. Replaceable Media Pack:
    a) Flow distribution sheets
    b) Filter Media Bags

3. Cam Latch

4. Conveyance Channel

5. Filter Module

6. Support Bracket / Angled Screen

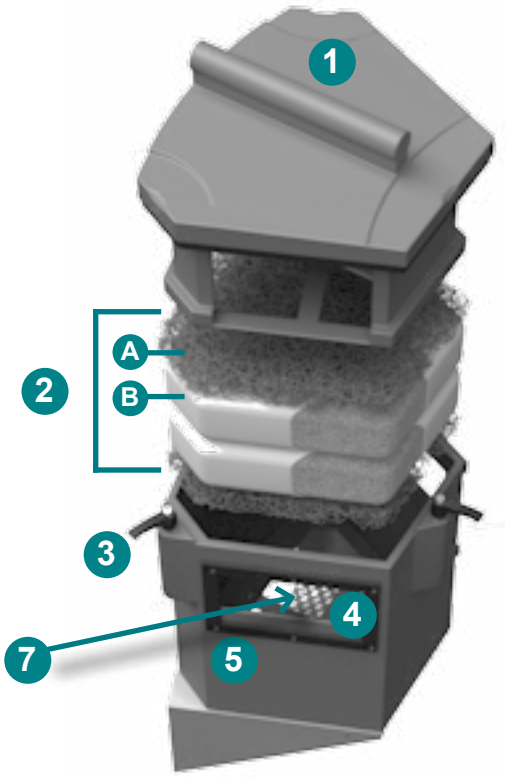


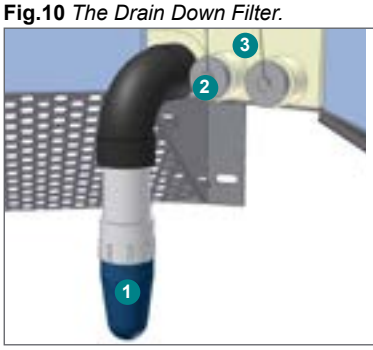
Fig.9 The Filter Module houses the Media Restraint and the Media Pack.

Be sure that the piece fits snugly against the walls and corners of the Filter Module.

- Put the lid on and secure the three latches. Check to make sure that the latches are closed properly.

6. Use a screwdriver to unscrew the Drain Down Filter from the face of the Outlet Module (see Fig.10). DO NOT DISCARD THIS PIECE.
7. Install new Drain Down Filter supplied by Hydro International.
8. Exit the Up-Flo® Filter chamber and securely replace the grate __or lid.
9. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables, oil and gross debris removed, and the depth of sediment measured. Note the number of Media Packs replaced. Note any irregularities such as damaged components or blockages.

Fig.10 *The Drain Down Filter.*



1. Drain Down Filter
2. Drain Down Plug
3. Pull Chain for Drain Down

10. Remove safety equipment.
11. Dispose of spent media packs at your local landfill, following local regulations.
12. Return the spent Drain Down Filter to Hydro International.
13. Contact Hydro International to discuss any irregularities noted during annual maintenance.

Solids Disposal

Sediment, floatables, gross debris, and spent Media Bags can generally be disposed of at the local landfill in accordance with local regulations. The toxicity of the residues captured will depend on the activities in the contributing drainage area, and testing of the residues may be required if they are considered potentially hazardous.

Sump water can generally be disposed of at a licensed water treatment facility but the local sewer authority should be contacted for permission prior to discharging the liquid. Significant accumulations of oil removed separately from sump water should be transported to a licensed hazardous waste treatment facility for treatment or disposal. **In all cases, local regulators should be contacted about disposal requirements.**

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Floatables/Oils Removal	- Twice per year or as needed - Following a contaminated spill in the drainage area
Sediment Removal	- Every six to 12 months, depending on the Up-Flo® Filter Configuration - The maximum allowable sediment depth in any Up-Flo Filter configuration is 16 inches (41 cm) - Following a contaminated spill in the drainage area
Media Pack Replacement	- Once per year - Replacement is required anytime inspection reveals that the high-water level indicator has been activated after two consecutive storms and the subsequent weighing of the Media Bags shows a wet weight greater than 40 lbs - Following a contaminated spill in the drainage area
Drain Down Filter Replacement	- Once per year with Media Pack replacement - Replacement is required anytime inspection reveals that the water level inside the vessel has not reached a level equal with the base of the Filter Modules approximately 36 hours after a 1-inch (2.5 cm) rainfall - As needed, in the event of continuous base flow conditions

Up-Flo® Filter Installation Log

SITE REFERENCE NAME OR NUMBER FOR THIS UP-FLO® FILTER LOCATION:	
SITE NAME:	
SITE LOCATION:	
OWNER:	**SITE CONTRACTOR:**
CONTACT NAME:	**CONTACT NAME:**
COMPANY NAME:	**COMPANY NAME:**
ADDRESS:	**ADDRESS:**
TELEPHONE:	**TELEPHONE:**
FAX:	**FAX:**

INSTALLATION DATE: / /

CONFIGURATION (CIRCLE ONE): **MANHOLE** **VAULT SYSTEM**

TOTAL NUMBER OF UP-FLO® FILTER MODULES: _____

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Up-Flo® Filter Inspection Log

Site Name: _____ Owner Change since last inspection? Y N

Location: _____

Owner Name: _____

Address: _____ Phone Number: _____

Site Status: _____

Date: _____ Time: _____ Site conditions*: _____

(Stable, Under Construction, Needing Maintenance, etc.)

Inspection Frequency Key: A=annual; M=monthly; S=after major storms

Inspection Items	Inspection Frequency	Inspected? (Yes/No)	Maintenance Needed? (Yes/No)	Comments/Description
Debris Removal				
Adjacent area free of debris?	M			
Inlets and Outlets free of debris?	M			
Facility (internally) free of debris?	M			
Vegetation				
Surrounding area fully stabilized? (no evidence of eroding material into Up-Flo® Filter)	A			
Grass mowed?	M			
Water retention where required				
Water holding chamber(s) at normal pool?	A			
Evidence of erosion?	A			
Sediment Deposition				
Filtration Chamber free of sediments?	A			
Sedimentation sump not more than 50% full?	A			
Structural Components				
Any evidence of structural deterioration?	A			
Grates in good condition?	A			
Spalling or cracking of structural parts?	A			
Outlet/Overflow Spillway	A			
Other				
Noticeable odors?	A			
Any evidence of filter(s) clogging?	M			
Evidence of flow bypassing facility?	A			

Inspector Comments: _____

_____

_____

_____

Overall Condition of Up-Flo® Filter**: ☐ Acceptable ☐ Unacceptable

***"Acceptable" would mean properly functioning; "unacceptable" would mean damaged or required further maintenance.*

If any of the above Inspection Items are checked "Yes" for "Maintenance Needed", list Maintenance actions and their completion dates below or on the Maintenance Log provided on page 15 of the Up-Flo® Filter Operation & Maintenance Manual:

Maintenance Action Needed	Due Date

The next routine inspection is schedule for approximately: (date) _____

Inspected by: (signature) _____

Inspected by: (printed) _____

Up-Flo® Filter Maintenance Log

Site Name: _____ Owner Change since last inspection? Y N

Location: _____

Owner Name: _____

Address: _____ Phone Number: _____

Site Status: _____

Date: _____ Time: _____ Site conditions: _____
**(Stable, Under Construction, Needing Maintenance, etc.)*

Estimated volume of oil/floatable trash removed: _____

Sediment depth measured in sump prior to removal: _____

Number of Filter Modules fitted with new media packs: _____

Inspector Comments: _____

_____

_____

_____

Overall Condition of Up-Flo® Filter: ☐ Acceptable ☐ Unacceptable
***"Acceptable" would mean properly functioning; "unacceptable" would mean damaged or required further maintenance.*

Maintained by: (signature) _____

Maintained by: (printed) _____

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Stormwater Solutions

94 Hutchins Drive
Portland, ME 04102

Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

www.hydro-int.com

Turning Water Around...®

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APPENDIX D

WATER ANALYSIS INFORMATION

OBC FIRE FLOW WATER SUPPLY

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Project: **925 Main Street West**
Project Number: 20009
Date: June 2026

Type of Development: **Mixed-Use Building**

Required Fire Water Supply (Q) per OBC: **$Q = K\ V\ S_{tot}$** *(OBC Tables and Figures attached)*

Where: Q = Minimim supply of water in litres
K = Water suppy coefficient from Table 1
V = total building volume in cubic meters
S_{tot} = total of spatial coefficient values from property line exposures on all sides
$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + ...]$ from Figure 1. Max. 2.0

Water Supply Coefficient (K)

Building Group/Division Classification: **C (Residential Occupancies)**

From Table 1, **K =** **23**

Building Volume (V)

Building Footprint Area: **1598** m^2 (Average GFA)

Building Height: **92.55** m (Assumption of 3m to floor)

Building Volume (V): ***147894.9*** **m^3** (conservatively assume attic has same footprint)

Spatial Coefficient (S)

See Figure 1 for Spatial Coefficients

Side	Dist (m)	S_{coeff}
North	**22**	**0**
South	**80+**	**0**
East	**27**	**0**
West	**8**	**0.2**
	Total	0.2

Therefore, S_{tot} = **1.2**

Required Water Supply

$Q = K\ V\ S_{tot}$ = 4081899 m^3

From Table 2, the minimum required water supply flow rate = ***9000*** ***l/s*** ***or*** 150 l/s

City of Hamilton Target flow for residential multi (greater than 3 units) = **150** **l/s <-- governs**

OBC Tables and Figures

Table 1

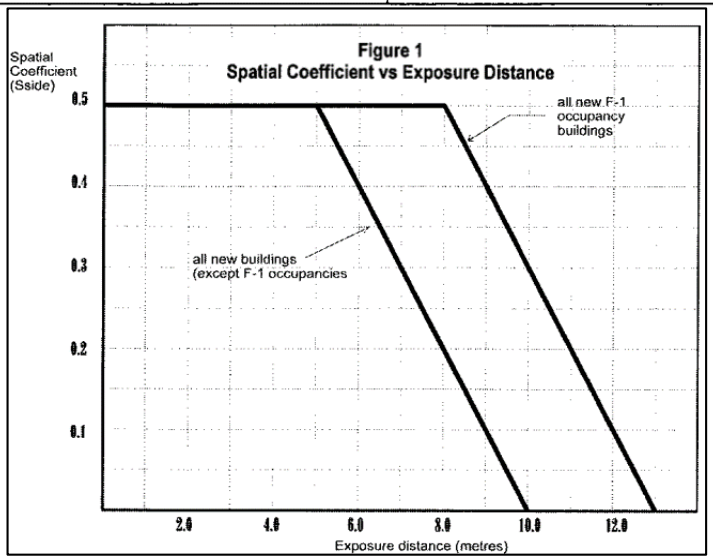
Water Supply Coefficient - K

Type of Construction	Classification by Group or Division in Accordance with Table 3.1.2.1. of the Building Code				
	A-2 B-1 B-2 B-3 C D	A-4 F-3	A-1 A-3	E F-2	F-1
Building is of noncombustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches.	10	12	14	17	23
Building is of noncombustible construction or of heavy timber construction conforming to Article 3.1.4.6. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	16	19	22	27	37
Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2.	18	22	25	31	41
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	23	28	32	39	53
Column 1	2	3	4	5	6

Table 2

Part 3 Buildings under the Building Code	Required Minimum Water Supply Flow Rate, L/min
One-storey building with building area not exceeding 600 m²	1 800
All other buildings	2 700 (if Q ≤ 108 000 L)(1) 3 600 (if Q > 108 000 L and ≤ 135 000 L)(1) 4 500 (if Q > 135 000 L and ≤ 162 000 L)(1) 5 400 (if Q > 162 000 L and ≤ 190 000 L)(1) 6 300 (if Q > 190 000 L and ≤ 270 000 L)(1) 9 000 (if Q > 270 000 L)(1)

Figure 1
Spatial Coefficient vs Exposure Distance



City of Hamilton Target Flows (Policy PW19096)

Table 1: Target Available Fire Flow

Land Use	Target AFF (L/s)
Commercial	150
Small ICI (<1,800 m²)	100
Industrial	250
Institutional	150
Residential Multi (greater than 3 units)	150
Residential Medium (3 or less units)	125
Residential Single	75
Residential Single (Dead End)	50

Adequate Water Services - Required Fire Flow-RFF and Available Fire Flow-AFF – (PILOT VERSION-01)

Application Number :	
Municipal Address :	925 Main Street West

Through staff report PW19096 - City of Hamilton Watermain Fire Flow Requirement Design Guidelines Policy on November 27th, 2019 Council adopted the new fire flow policy. This form is intended to guide applicants through the documentation requirements of this change. FUS calculations are no longer required for new submissions. This form is supplemental to related and supporting documentation/calculations.

1 - REQUIRED FIRE FLOW – RFF

1 a) Required Fire Flow-RFF a)

$Q = KVS_{Tot}$

Please provide required fire flow-RFF using the water supply flow rate method (OBC section A-3.2.5.7 ; OFM-TG-03-1999 FIRE PROTECTION WATER SUPPLY GUIDELINE FOR PART 3 IN THE ONTARIO BUILDING CODE - 6.3 Buildings Requiring On-Site Fire Protection Water Supply ; **$Q = KVS_{Tot}$**). This methodology shall be applied to all buildings falling under Part 3 and Part 9 of the Building Code (OBC sections 1.1.2.2 and 1.1.2.4). Detailed calculations shall be submitted as an appended memo.

Enter calculated value here (highest if multiple buildings)

150 Litres / second

Comments :

1 b) Required Fire Flow-RFF b)

Target Table

Please select from **Table 1 : Target Available Fire Flow**

Table 1: Target Available Fire Flow

Land Use	Target AFF (L/s)
Commercial	150
Small ICI (<1,800 m^3)[1]	100
Industrial	250
Institutional	150
Residential Multi (greater than 3 units)	150
Residential Medium (3 or less units)	125
Residential Single	75
Residential Single (Dead End)	50

[1] 1800m^3 represents a maximum building volume that qualifies as "Small ICI"

Enter applicable value for Target Available Fire Flow (highest value if multiple Land Uses) here:

150 Litres / second

Comments :

Residential Multi (greater than 3 units)

1 c) Required Fire Flow-RFF c)

Enter higher of a) or b) from above

Enter value here :

150 Litres / second

Comments :

Adequate Water Services - Required Fire Flow-RFF and Available Fire Flow-AFF – (PILOT VERSION-01)

Application Number :	
Municipal Address :	925 Main Street West

2 - AVAILABLE FIRE FLOW - AFF

2 a) Available Fire Flow-AFF a)

Field Hydrant Test calculated at 20 psi
Please provide available fire flow-AFF as determined through developer hydrant fire flow test or City Hydrant test database.
Enter value here : 449 Litres / second Please check : ☐ Developer hydrant fire flow test, or *(as directed in FC or thereafter)* ☑ City Hydrant test database
Comments :

OR (as directed in FC or thereafter)

2 b) Available Fire Flow-AFF b)

Computer Modelling
Please provide available fire flow-AFF as determined through computer modelling. ☐ Modelling criteria and boundary conditions were approved by Hamilton Water
Enter value here : Litres / second
Comments :

DECLARATION OF ADEQUATE SERVICES

☑ RFF c) is less than or equal to AFF, or

☐ RFF c) is greater than AFF.

Prepared by : M. Colosimo

Date : June 18, 2026