2705460 ONTARIO INC.

1131-1151 Teron Road

Stormwater Management Report

October 14, 2021

1131-1151 Teron Road

Stormwater Management Report

2705460 ONTARIO INC.

Confidential
Issue for City Review
Project No.: 20M-01534-00
Date: October 14, 2021

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Revision History

FIRST ISSUE

April 16, 2021	First Submission			
Prepared by	Reviewed by	Approved By		
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REVISION 1				
October 14, 2021	Second Submission			
Prepared by	Reviewed by	Approved By		
Kathryn Kerker Water Resources E.I.T.	Michelle Hughes, P.Eng., MSc. Manager, Water Resources	Michelle Hughes, P.Eng., MSc. Manager, Water Resources		

Signatures

Prepared by

October 14, 2021

Kathryn Kerker
Water Resources E.I.T.

Date

APPROVED BY

October 14, 2021

Michelle Hughes, P.Eng. MSc.
Manager, Water Resources

Date

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1 INTRODUCTION

1.1 Scope

WSP Canada Inc. was retained by 2705460 Ontario inc. to conduct a stormwater management study in support of proposals to develop nine-storey and three-storey residential buildings with a connecting underground parking garage.

1.2 Site Location

The site is located at 1131-1151 Teron Road, Ottawa, Ontario. The location of the proposed development is illustrated in **Figure 1**.

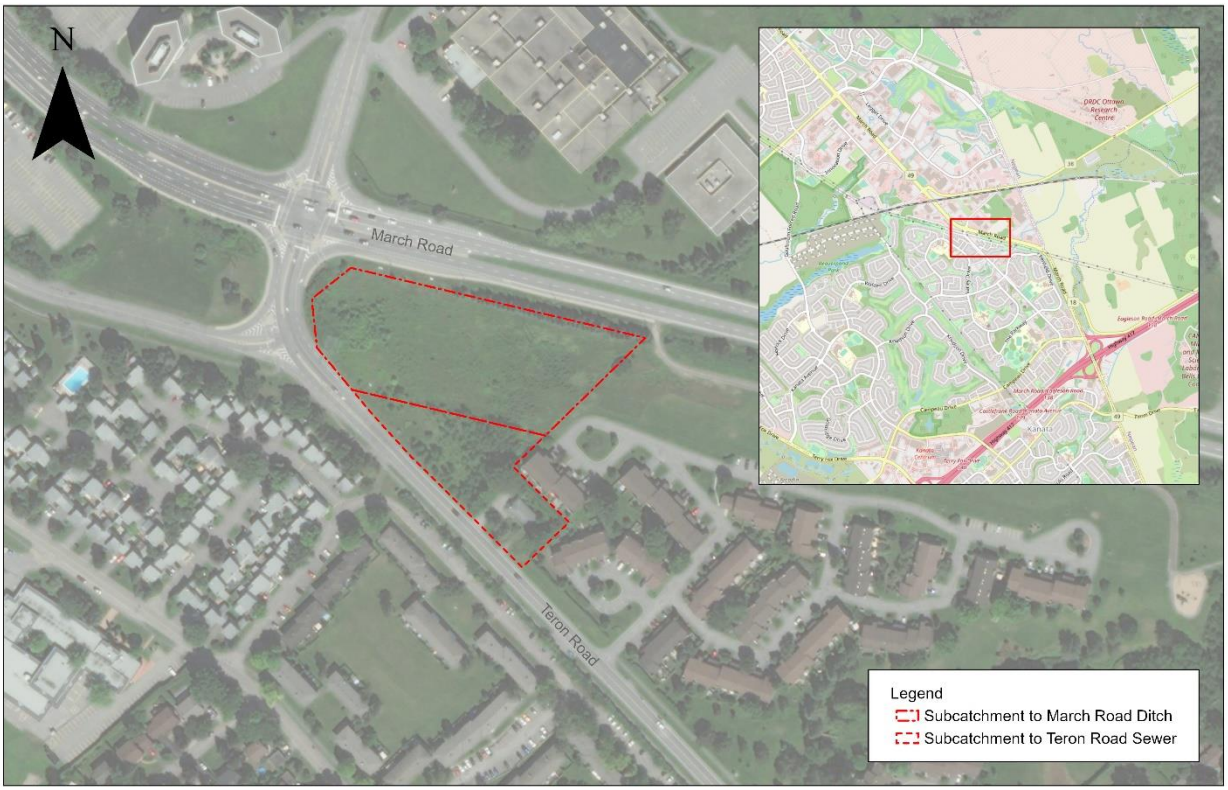

Figure 1: Site Location

1.3 Stormwater Management Plan Objectives

The objectives of the stormwater management (SWM) study are as follows:

- Collect and review background information.
- Confirm applicable SWM design criteria with City of Ottawa staff.
- Evaluate various SWM practices that meet the stormwater management requirements and recommend a preferred strategy—specifically related to the applicable quantity and quality control criteria.

1.4 Design Criteria

Design criteria were confirmed through pre-consultation with the City of Ottawa held on January 14, 2021 (Meeting minutes included in **Appendix A**). Criteria for 1131-1151 Teron Road are as follows:

Water Quantity Control and Discharge to Municipal Infrastructure

- Stormwater directed to March Road ditch must be controlled to pre-development conditions up to the 100-year event.
- Stormwater directed to Teron Road storm sewer must be controlled to the pre-development 5-year event.
- Allowable Runoff coefficient (C): C = the lesser of the existing pre-development conditions to a maximum of 0.5
- Time of concentration (Tc): Tc = pre-development (Calculated); maximum Tc = 10 min

Water Quality

- MVCA requires enhanced water quality protection (80% TSS removal) be provided on-site

2 PRE-DEVELOPMENT CONDITIONS

2.1 General

Currently the land proposed for the new development is a greenfield site (1151 Teron Road) and contains a single-family home (1131 Teron Road). The site is primarily covered in grasses and small trees/bushes. The total site area is 1.48 ha. A large part of the site along March Road remains untouched in proposed conditions and has been excluded from the analysis, making the total study area 0.88 ha.

2.2 Rainfall Information

The rainfall intensity is calculated in accordance with Section 5.4.2 of the Ottawa Sewer Design Guidelines (October 2012):

$$i = \left[\frac{A}{(T_d + C)^B}\right]$$

Where;

- A, B, C = regression constants for each return period (defined in section 5.4.2)
- i = rainfall intensity (mm/hour)
- T_d = storm duration (minutes)
- The IDF parameters/regression constants are included in **Appendix B**.

2.3 Allowable Flow Rates

As noted in **Section 1.4**, for the developed area draining to the March Road ditch (0.50 ha), post-development stormwater runoff must not exceed the pre-development runoff up to the 100-year event, calculated using a runoff coefficient being the lesser of 0.50 or existing conditions. In this instance existing conditions are represented by a runoff coefficient of 0.20, therefore this value has been used to calculate the allowable release rate.

For the area draining to the Teron Road sewer (0.38 ha), post-development stormwater runoff up to the 100-year event must not exceed the pre-development 5-year runoff, calculated using a runoff coefficient being the lesser of 0.50 or existing conditions. In this instance existing conditions are represented by a runoff coefficient of 0.27, therefore this value has been used to calculate the allowable release rate.

The calculated peak flow rates for the site in the pre-development condition are summarized below in Table 2-1.

Table 2-1: Pre-Development Peak Flow Rate Calculations (T_c=10 min)

Return Period	Rainfall Intensity	March Rd Ditch Peak Flow Rate (S1_EX)	Target Release Rate	Teron Rd Sewer Peak Flow Rate (S2_EX)	Target Release Rate
years	mm/hour	C = 0.20, T_c = 10min, l/s		C = 0.27, T_c = 10min, l/s	
2	76.8	21	21	22	**29**
5	104.2	29	29	**29**	
10	122.1	34	34	35	
25	144.7	44	44	45	
50	161.5	54	54	55	
100	178.6	**62**	**62**	63	

3 POST-DEVELOPMENT CONDITIONS

3.1 General

The site will be developed with a nine-storey residential building with a rear surface parking lot, as well as a three-storey residential building connected by an underground parking garage. A bioswale will be used to control the flow to the March Road ditch, and roof storage plus an underground cistern will be used to control flow to the Teron Road storm sewer.

Note that this report should be read in conjunction with the proposed site servicing drawing package—specifically drawings C02 (Grading Plan), C03 (Servicing Plan), and C04 (Drainage Area Plan).

3.2 Water Quantity

3.2.1 March Road Ditch

As noted in **Section 2.3**, the target allowable discharge rate discharging to the March Road ditch 62 L/s. This is equivalent to the peak runoff rate under pre-development conditions during a 100-year design storm event with a runoff coefficient of 0.20. Compliance with the 100-yr target offsite discharge rate will be achieved through use of bioswales in the central parking lot island, with inlet control prior to discharge into the proposed sewer to the March Road ditch. Areas draining to the March Rd ditch include A-101, A-102, A-103 and U-1. Storage calculations are included in Appendix F.

It is noted that a small portion of the developed area (gravel walkway, within U-1) will not drain to the proposed bioswale due to grading constraints. Post-development runoff calculations have accounted for uncontrolled runoff from this area, and the following results report on the cumulative release rates from the study area (controlled plus uncontrolled). The pervious area along March Road remains untouched in proposed conditions, so is not included in the analysis. There are no external areas draining to the site.

A HydroCAD model of the project was created and includes:

- Three bioswales (total storage volume 91 m^3, 50 m^3, 60 m^3), with outlet controlled using HYDROVEX vortex valves to detain 0.49 ha of the new development (C = 0.75, 0.78, 0.74 +25% for 100-year as per OSDG 5.4.5)
- Uncontrolled runoff from 0.01 ha gravel path area (C = 0.70, +25% for 100-year as per OSDG 5.4.5)

The Modified Rational Method (an inherent subroutine of the HydroCAD software) has been used for the modelling exercise, and the model has informed the maximum storage volume used in each bioswale based on the proposed flow. The peak flow rate generated from the uncontrolled drainage area within the project site and controlled flow from the bioswales is 40 L/s which meets the allowable 100-year release rate of 62 L/s. Modelling results are summarized below in **Table 3-1** and shown in **Appendix D**.

Note that results provided below describe performance of the proposed system at several different storm durations, which have been solved iteratively within HydroCAD to represent critical conditions (i.e. maximum storage utilized within storage features, and peak release rate at the system discharge point). The results demonstrate that the target allowable 100-year release rate is satisfied at all durations.

Table 3-1: Summary of Modelling Results

Return Period (Years)	Time of Conc. (min)	Bioswale ID	Utilized Storage (m^3)	Peak Water Elevation in storage (m)	Peak Flow Rate at control (L/s)	Total Flow Leaving Site* (L/s)	Allowable 100-yr Flow Rate (L/s)
2-Year Peak Discharge	165	B1	41	89.637	3	**10**	**21**
		B2	27	89.634	3		
		B3	37	89.640	4		
100-Year Peak Discharge	36	B1	74	89.878	9	**40**	**61**
		B2	45	89.921	10		
		B3	57	89.952	19		
100-Year Peak Storage Bioswale 1	72	**B1**	**79**	**89.916**	**9**	38	
		B2	44	89.902	10		
		B3	50	89.849	18		
100-Year Peak Storage Bioswale 2	48	B1	78	89.902	9	39	
		B2	**46**	**89.931**	**10**		
		B3	56	89.937	19		
100-Year Peak Storage Bioswale 3	36	B1	74	89.878	9	40	
		B2	45	89.921	10		
		B3	**57**	**89.952**	**19**		

*'Total Flow Leaving Site' includes all developed area draining to the March road ditch from the study area.

3.2.2 Teron Road Storm Sewer

As noted in **Section 2.3**, the target allowable discharge rate discharging to the Teron Road storm sewer 29 L/s. This is equivalent to the peak runoff rate under pre-development conditions during a 5-year design storm event with a runoff coefficient of 0.27. Compliance with the 100-yr target offsite discharge rate will be achieved through roof storage and underground storage with outlet control prior to discharge into the

Teron Road storm sewer. Areas draining to the Teron Rd sewer include B-BLDG1, B-BLDG2, B-101, and B-102 (Drainage Area Plan, C04).

A HydroCAD model of the project was created and includes:

- Rooftop flow control drains (WATTS Adjustable Accutrol Weir; See drawing C04A for details) to utilize roof storage on both buildings, to control 0.20 ha of new development. Roof drains on BLDG-1 ½ open, roof drains on BLDG-2 ¼ open.
- Underground storage (active storage volume 68.5m^3), with outlet controlled using vortex valve (HYDROVEX 100-VHV-1) to detain 0.17 ha of the new development

The Modified Rational Method (an inherent subroutine of the HydroCAD software) has been used for the modelling exercise, and the model has informed the maximum storage volume used on each roof and within the cistern based on the proposed flow. The peak flow rate generated from the controlled roof drainage and controlled flow from the cistern is 29 L/s which meets the allowable 100-year release rate of 29 L/s. Modelling results are summarized below in **Table 3-1** and shown in **Appendix C**.

Note that results provided below describe performance of the proposed system at several different storm durations, which have been solved iteratively within HydroCAD to represent critical conditions (i.e. maximum storage utilized within storage features, and peak release rate at the system discharge point). The results demonstrate that the target allowable 100-year release rate is satisfied at all durations.

Table 3-2: Summary of Modelling Results

Return Period (Years)	Time of Conc. (min)	Storage Unit	Utilized Storage (m^3)	Peak Water Elevation in storage (m)	Peak Flow Rate at control (L/s)	Total Flow Leaving Site (L/s)	Allowable 100-yr Flow Rate (L/s)
100 (Peak Discharge)	39	Cistern	58	89.175	9	**29**	**29**
		Bldg1	41	0.150^	15		
		Bldg2	14	0.136^	5		
100 (Peak Cistern Storage)	63	**Cistern**	**60**	**89.199**	**9**	29	
		Bldg1	35	0.144^	15		
		Bldg2	12	0.129^	5		
100 (Peak Bldg 1 Roof Storage)	30	Cistern	56	89.145	8	29	
		Bldg1	**42**	**0.151^**	**15**		
		Bldg2	14	0.137^	5		
100 (Peak Bldg 2 Roof Storage)	30	Cistern	56	89.145	8	29	
		Bldg1	42	0.151^	15		
		Bldg2	**14**	**0.137^**	**5**		

^Depth of rooftop storage.

3.3 Water Quality

As noted in section 1.4, quality control is required to provide enhanced water quality treatment of the site (80% TSS removal).

For the area draining to March Road ditch, quality treatment is provided within the bioswale. The bioswale outlet catch basins are offset by 100 mm to promote flow through the bioswale media and enhance water quality. Due to high groundwater and low permeability soils, the bioswales are not designed to promote infiltration (see Geotechnical Investigation Report, April 1, 2020). However, as indicated in the City of Ottawa Low Impact Development Technical Guidance Report (February 2021), treatment can still be provided through evapotranspiration, LID filtration, and sedimentation. A subdrain wrapped in geotextile drains the bioswale once water has filtered through the media. The design guidance for filters has been used from section 4.6.7 of the MOE SWM Planning and Design Manual. The following equation calculates the required filter surface area. The surface area provided is 149 m^2, which meets the requirement.

$$A = \frac{1000Vd}{k(h+d)t} = \frac{1000(19m^3)(0.15m)}{0.45mm/hr(0.88m+0.15m)48hr} = 128\ m^2$$

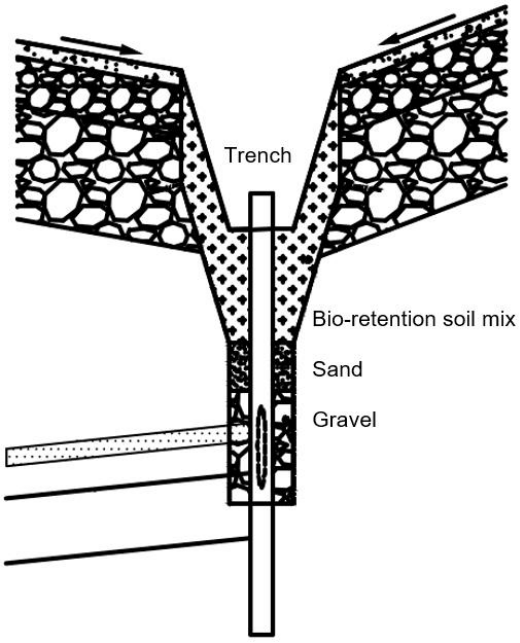

Figure 2: Bioswale cross-section

For the area draining to the Teron Road sewer, treatment is required for the areas with vehicular traffic. An OGS unit of appropriate size will be provided downstream of the cistern which will treat areas B-101 and B-102. Roof drainage, which discharges to the Teron Road sewer at a separate connection, is considered adequate quality for discharge without further treatment. OGS sizing is provided in **Appendix E**.

4 CONCLUSIONS

A stormwater management plan has been prepared to support the site plan application for the 1131 – 1151 Teron Road development in the City of Ottawa. The key points are summarized below.

WATER QUANTITY

March Road Ditch

Runoff from the catchment will be directed to a bioswale in the median of the parking area and will provide a storage volume of 200 m^3 to control the post-development flows to the pre-development flows. The peak 100-year discharge from the site is 40 L/s, which meets the allowable release rate of 62 L/s

Teron Road Storm Sewer

Roof runoff will be detained using rooftop flow control drains before discharging to the Teron Road sewer. The remaining area flows to the cistern, which has a minimum volume of 61 m^3 to control the 100-year event to the 5-year pre-development release rate. The peak 100-year discharge from the site is 29 L/s, which meets the allowable release rate of 29 L/s.

WATER QUALITY

March Road Ditch

Water treatment is provided by bioswales in the parking lot median.

Teron Road Storm Sewer

Water treatment is provided by an OGS unit placed just upstream of the city storm sewer connection.

This report demonstrates that the proposed SWM strategy will address stormwater management related impacts from this project and meet the requirements of the City of Ottawa.

APPENDIX

A

Pre-consultation meeting minutes
(January 14, 2021)

Kerker, Kathryn

From: Worth, Ben
Sent: January 14, 2021 4:28 PM
To: Kerker, Kathryn
Subject: FW: 1131 - 1151 Teron Road SPC Discussion

FYI

Ben Worth, P.Eng. C.Eng. MICE
Manager, Water Resources
T+ 1 613-690-3928
M+ 1 613-986-8997

From: Armstrong, Justin [mailto:justin.armstrong@ottawa.ca]
Sent: January 14, 2021 3:59 PM
To: Yang, Winston <Winston.Yang@wsp.com>; Worth, Ben <Ben.Worth@wsp.com>
Subject: 1131 - 1151 Teron Road SPC Discussion

Hi Winston and Ben,

See the following bullet-point summary of our discussion from earlier today.

- SWM quantity criteria to reflect previous requirements:
    - Areas discharging to March Road ditch - post-development flows up to the 100-yr controlled to corresponding pre-development flows.
    - Areas discharging to Teron Road storm sewer - post-development flows up to the 100-yr controlled to the pre-development 5-yr with a C-value of existing or 0.5, whichever is less, and a calculated time of concentration no less than 10 min).
- SWM quality criteria to be confirmed by the MVCA, however 80% TSS removal was previously required and should be assumed for the site unless MVCA indicates otherwise. MVCA to confirm if treatment is required for rooftop portion of site discharging to the Teron Road storm sewer. Matt Craig mcraig@mvc.on.ca was included as an MVCA contact in previous comments letter.
- There is no sanitary sewer fronting the site in Teron Road or March Road. A connection to the private sanitary sewer within Weeping Willow Lane was previously proposed. A letter of agreement must be provided from the owner of the private sanitary sewer to allow for the connection / easement / works on private property. An easement & or a Joint Use & Maintenance Agreement with the owner of the sewer will be needed. An assessment of available capacity will also need to be performed.
- Water service connections to the 610mm feedermain within Teron Road are not permitted. As such, a local watermain extension must be made from Steacie Drive and extended along Teron Road to the development site in order to service the development. A **second** connection to the existing hydrant lateral (fed by the 610mm feedermain) would be accepted, assuming a **first** connection to the local watermain off Steacie Drive is provided. If the 610mm feedermain is taken offline, there must be another watermain feed to service the development.

Feel free to contact me should you have any more questions.

Justin

During this period of uncertainty surrounding COVID-19, we are following best practices recommended to minimize the risk of exposure, while ensuring that service to our clients remains as uninterrupted as possible. I am working from home and will respond to emails at my earliest opportunity. Should there be delays due to internet connectivity, I thank your understanding and patience.

Justin Armstrong, E.I.T.
Project Manager
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - West Branch
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APPENDIX

B

Pre-Development Stormwater Management Calculations

Project:	1151 Teron Road	No.:	20M-01534-00	
By:	KK	Date:	2021-09-09	Page:
Checked:	MH	Checked:	2021-09-09	1

Subject: **SWM CALCULATIONS- Pre-Development Peak Flow March Rd Ditch**

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78CiA$

Where: Q = peak flow rate (litres/second)
C = runoff coefficient
i = rainfall intensity (mm/hour)
A = catchment area (hectares)

Site Area, A	4,996	m^2
Site Area, A	0.50	hectares
Runoff Coefficient, C	0.20	

Rainfall intensity calculated in accordance with City of Ottawa Sewer Design Guidelines (section 5.4.2):

$$i = \left[\frac{A}{(Td + C)^B}\right]$$

Where: A, B, C = regression constants for each return period (defined in section 5.4.2)
i = rainfall intensity (mm/hour)
Td = storm duration (minutes) 10 minutes

Return Period (Years)	2	5	10	25	50	100*
A	733.0	998.1	1,174.2	1,402.9	1,569.6	1,735.7
B	0.810	0.814	0.816	0.819	0.820	0.820
C	6.199	6.053	6.014	6.018	6.014	6.014
T (mins)	10	10	10	10	10	10
I (mm/hr)	76.8	104.2	122.1	144.7	161.5	178.6
Runoff Coefficient C	0.20	0.20	0.20	0.20	0.20	0.20
C Multiplier (OSDG Table 5.7)	1.00	1.00	1.00	1.10	1.20	1.25
Revised Runoff Coefficient C	0.20	0.20	0.20	0.22	0.24	0.25
Q (litres/sec)	21	29	34	44	54	62
Q (m3/sec)	0.02	0.03	0.03	0.04	0.05	0.06

Project:	1151 Teron Road	No.:	20M-01534-00	
By:	KK	Date:	2021-09-09	Page:
Checked:	MH	Checked:	2021-09-09	1

Subject: **SWM CALCULATIONS- Pre-Development Peak Flow Teron Rd**

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78CiA$

Where: Q = peak flow rate (litres/second)
C = runoff coefficient
i = rainfall intensity (mm/hour)
A = catchment area (hectares)

Site Area, A	3,770	m^2
Site Area, A	0.38	hectares
Runoff Coefficient, C	0.27	

Rainfall intensity calculated in accordance with City of Ottawa Sewer Design Guidelines (section 5.4.2):

$$i = \left[\frac{A}{(Td + C)^B}\right]$$

Where: A, B, C = regression constants for each return period (defined in section 5.4.2)
i = rainfall intensity (mm/hour)
Td = storm duration (minutes) 10 minutes

Return Period (Years)	2	5	10	25	50	100*
A	733.0	998.1	1,174.2	1,402.9	1,569.6	1,735.7
B	0.810	0.814	0.816	0.819	0.820	0.820
C	6.199	6.053	6.014	6.018	6.014	6.014
T (mins)	10	10	10	10	10	10
I (mm/hr)	76.8	104.2	122.1	144.7	161.5	178.6
Runoff Coefficient C	0.27	0.27	0.27	0.27	0.27	0.27
C Multiplier (OSDG Table 5.7)	1.00	1.00	1.00	1.10	1.20	1.25
Revised Runoff Coefficient C	0.27	0.27	0.27	0.30	0.32	0.34
Q (litres/sec)	22	29	35	45	55	63
Q (m3/sec)	0.02	0.03	0.03	0.05	0.05	0.06

APPENDIX

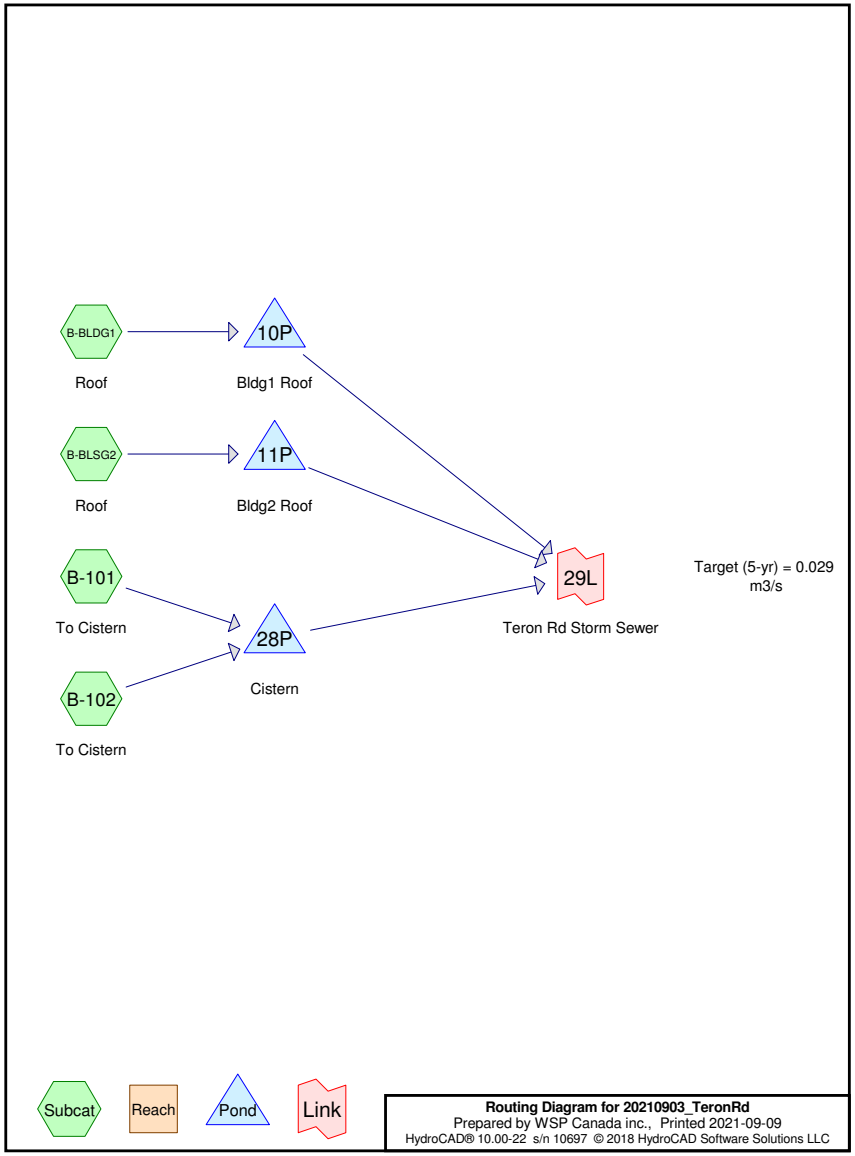
C

HydroCAD Model Output – Teron Road Sewer

APPENDIX

C-1 100-Year Analysis (Peak Discharge, T_c = 39 min)

The storm system for the site is governed by the 100-year storm. Peak storage in each storage unit and peak discharge may occur at separate times of concentration and are therefore reported separately.



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,610.0	0.81	(B-101)
2,160.0	1.00	(B-102, B-BLDG1, B-BLSG2)
3,770.0	**0.92**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-101: To Cistern Runoff Area=1,610.0 m² 0.00% Impervious Runoff Depth=40 mm
Tc=10.0 min C=0.81 Runoff=0.02772 m³/s 64.9 m³

Subcatchment B-102: To Cistern Runoff Area=130.0 m² 100.00% Impervious Runoff Depth=50 mm
Tc=10.0 min C=1.00 Runoff=0.00276 m³/s 6.5 m³

Subcatchment B-BLDG1: Roof Runoff Area=1,490.0 m² 100.00% Impervious Runoff Depth=50 mm
Tc=10.0 min C=1.00 Runoff=0.03167 m³/s 74.1 m³

Subcatchment B-BLSG2: Roof Runoff Area=540.0 m² 100.00% Impervious Runoff Depth=50 mm
Tc=10.0 min C=1.00 Runoff=0.01148 m³/s 26.9 m³

Pond 10P: Bldg1 Roof Peak Elev=100.150 m Storage=41.0 m³ Inflow=0.03167 m³/s 74.1 m³
Outflow=0.01500 m³/s 74.1 m³

Pond 11P: Bldg2 Roof Peak Elev=100.136 m Storage=14.0 m³ Inflow=0.01148 m³/s 26.9 m³
Outflow=0.00539 m³/s 26.9 m³

Pond 28P: Cistern Peak Elev=89.175 m Storage=58.4 m³ Inflow=0.03048 m³/s 71.3 m³
Outflow=0.00868 m³/s 55.8 m³

Link 29L: Teron Rd Storm Sewer Inflow=0.02905 m³/s 156.8 m³
Primary=0.02905 m³/s 156.8 m³

Total Runoff Area = 3,770.0 m² Runoff Volume = 172.3 m³ Average Runoff Depth = 46 mm
42.71% Pervious = 1,610.0 m² 57.29% Impervious = 2,160.0 m²

Summary for Subcatchment B-101: To Cistern

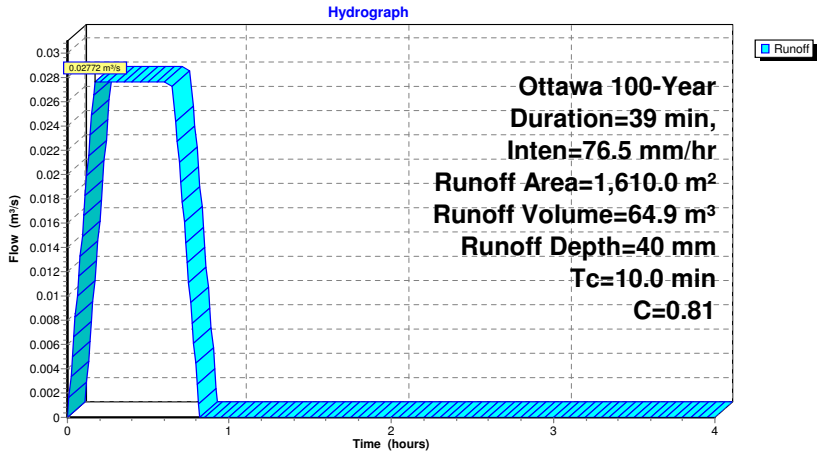
Runoff = 0.02772 m³/s @ 0.17 hrs, Volume= 64.9 m³, Depth= 40 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=39 min, Inten=76.5 mm/hr

Area (m²)	C	Description
1,610.0	0.81	
1,610.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-101: To Cistern



Summary for Subcatchment B-102: To Cistern

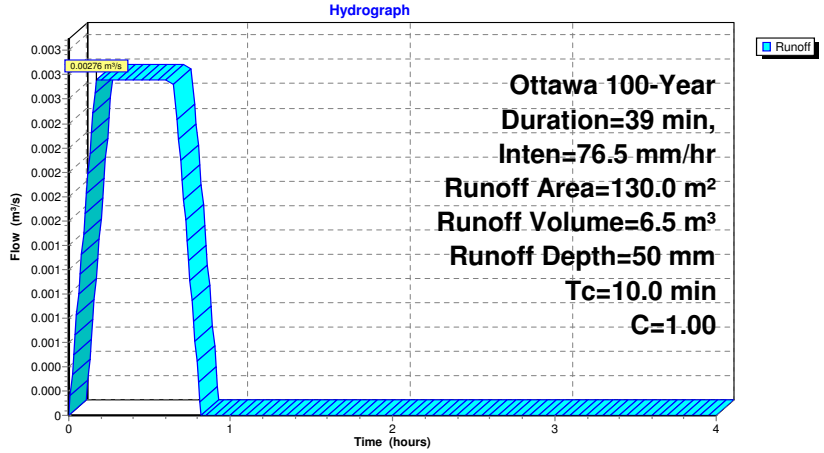
Runoff = 0.00276 m³/s @ 0.17 hrs, Volume= 6.5 m³, Depth= 50 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=39 min, Inten=76.5 mm/hr

Area (m²)	C	Description
130.0	1.00	
130.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-102: To Cistern



Summary for Subcatchment B-BLDG1: Roof

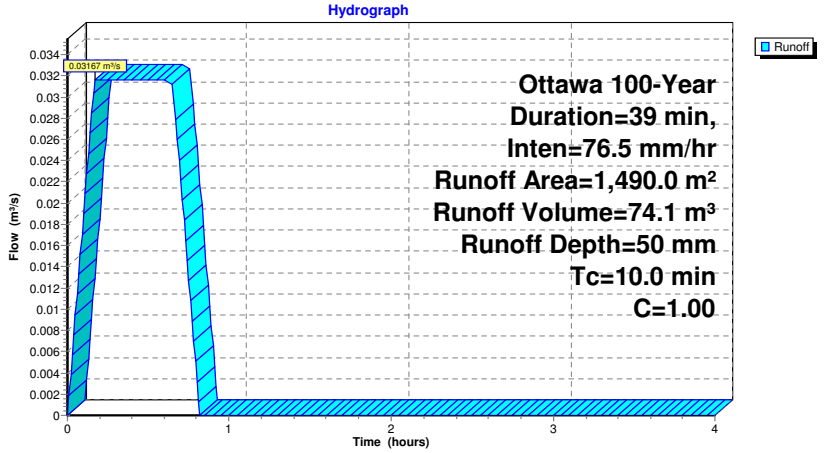
Runoff = 0.03167 m³/s @ 0.17 hrs, Volume= 74.1 m³, Depth= 50 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=39 min, Inten=76.5 mm/hr

Area (m²)	C	Description
1,490.0	1.00	
1,490.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLDG1: Roof



Summary for Subcatchment B-BLSG2: Roof

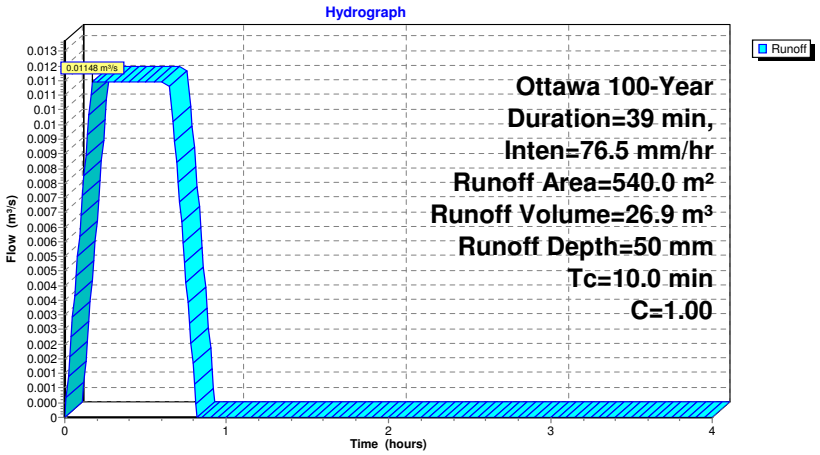
Runoff = 0.01148 m³/s @ 0.17 hrs, Volume= 26.9 m³, Depth= 50 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=39 min, Inten=76.5 mm/hr

Area (m²)	C	Description
540.0	1.00	
540.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLSG2: Roof



Summary for Pond 10P: Bldg1 Roof

Inflow Area = 1,490.0 m², 100.00% Impervious, Inflow Depth = 50 mm for 100-Year event
Inflow = 0.03167 m³/s @ 0.17 hrs, Volume= 74.1 m³
Outflow = 0.01500 m³/s @ 0.74 hrs, Volume= 74.1 m³, Atten= 53%, Lag= 34.1 min
Primary = 0.01500 m³/s @ 0.74 hrs, Volume= 74.1 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.150 m @ 0.74 hrs Surf.Area= 901.5 m² Storage= 41.0 m³

Plug-Flow detention time= 27.3 min calculated for 73.9 m³ (100% of inflow)
Center-of-Mass det. time= 27.4 min (51.9 - 24.5)

Volume	Invert	Avail.Storage	Storage Description
#1	100.060 m	13.3 m³	**Roof drain 1 (Pyramidal)** Listed below (Recalc)
#2	100.000 m	24.2 m³	**Roof drain 2 (Pyramidal)** Listed below (Recalc)
#3	100.080 m	8.3 m³	**Roof drain 3 (Pyramidal)** Listed below (Recalc)
#4	100.000 m	25.2 m³	**Roof drain 4 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	24.4 m³	**Roof drain 5 (Pyramidal)** Listed below (Recalc)
#6	100.000 m	23.2 m³	**Roof drain 6 (Pyramidal)** Listed below (Recalc)
#7	100.000 m	23.3 m³	**Roof drain 7 (Pyramidal)** Listed below (Recalc)
#8	100.000 m	22.8 m³	**Roof drain 8 (Pyramidal)** Listed below (Recalc)
#9	100.080 m	4.5 m³	**Roof drain 9 (Pyramidal)** Listed below (Recalc)
#10	100.080 m	6.6 m³	**Roof drain 10 (Pyramidal)** Listed below (Recalc)
		175.8 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	74.0	2.2	2.2	74.0
100.300	74.0	11.1	13.3	79.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	121.0	6.1	6.1	121.0
100.300	121.0	18.1	24.2	127.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	48.0	1.1	1.1	48.0
100.300	48.0	7.2	8.3	52.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	126.0	6.3	6.3	126.0
100.300	126.0	18.9	25.2	132.8

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	122.0	6.1	6.1	122.0
100.300	122.0	18.3	24.4	128.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.0	5.8	5.8	116.0
100.300	116.0	17.4	23.2	122.5

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.5	5.8	5.8	116.5
100.300	116.5	17.5	23.3	123.0

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	114.0	5.7	5.7	114.0
100.300	114.0	17.1	22.8	120.5

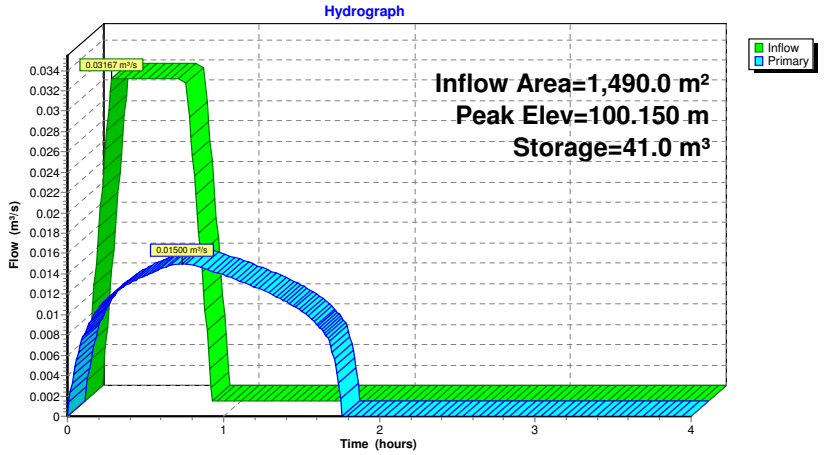
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	26.0	0.6	0.6	26.0
100.300	26.0	3.9	4.5	29.1

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	38.0	0.9	0.9	38.0
100.300	38.0	5.7	6.6	41.7

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.5 X 12.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000790 0.000950 0.001100 0.001260

Primary OutFlow Max=0.01500 m³/s @ 0.74 hrs HW=100.150 m (Free Discharge)
↳**1=WATTS Accutrol_5-0.5** (Custom Controls 0.01500 m³/s)

Pond 10P: Bldg1 Roof



Summary for Pond 11P: Bldg2 Roof

Inflow Area = 540.0 m²,100.00% Impervious, Inflow Depth = 50 mm for 100-Year event
Inflow = 0.01148 m³/s @ 0.17 hrs, Volume= 26.9 m³
Outflow = 0.00539 m³/s @ 0.74 hrs, Volume= 26.9 m³, Atten= 53%, Lag= 34.1 min
Primary = 0.00539 m³/s @ 0.74 hrs, Volume= 26.9 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.136 m @ 0.74 hrs Surf.Area= 392.4 m² Storage= 14.0 m³

Plug-Flow detention time= 24.3 min calculated for 26.8 m³ (100% of inflow)
Center-of-Mass det. time= 24.4 min (48.9 - 24.5)

Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	24.0 m³	**Roof drain 13 (Pyramidal)** Listed below (Recalc)
#2	100.060 m	11.0 m³	**Roof drain 14 (Pyramidal)** Listed below (Recalc)
#3	100.060 m	11.7 m³	**Roof drain 15 (Pyramidal)** Listed below (Recalc)
#4	100.060 m	11.5 m³	**Roof drain 16 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	26.2 m³	**Roof drain 17 (Pyramidal)** Listed below (Recalc)
#6	100.060 m	13.0 m³	**Roof drain 18 (Pyramidal)** Listed below (Recalc)
		97.4 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	120.0	6.0	6.0	120.0
100.300	120.0	18.0	24.0	126.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	61.0	1.8	1.8	61.0
100.300	61.0	9.1	11.0	65.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	65.0	2.0	2.0	65.0
100.300	65.0	9.7	11.7	69.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	64.0	1.9	1.9	64.0
100.300	64.0	9.6	11.5	68.8

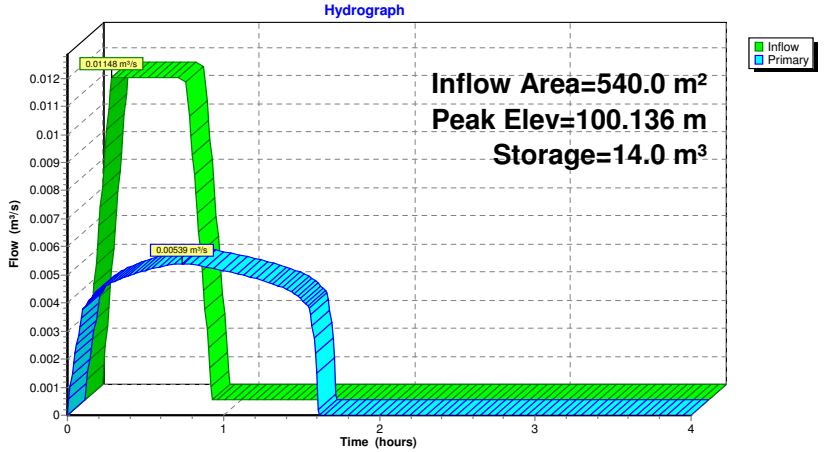
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	131.0	6.6	6.6	131.0
100.300	131.0	19.6	26.2	137.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	72.0	2.2	2.2	72.0
100.300	72.0	10.8	13.0	77.1

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.25 X 6.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000710 0.000790 0.000870 0.000950

Primary OutFlow Max=0.00539 m³/s @ 0.74 hrs HW=100.136 m (Free Discharge)
└**1=WATTS Accutrol_5-0.25** (Custom Controls 0.00539 m³/s)

Pond 11P: Bldg2 Roof



Summary for Pond 28P: Cistern

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 1,740.0 m², 7.47% Impervious, Inflow Depth = 41 mm for 100-Year event
Inflow = 0.03048 m³/s @ 0.17 hrs, Volume= 71.3 m³
Outflow = 0.00868 m³/s @ 0.77 hrs, Volume= 55.8 m³, Atten= 72%, Lag= 36.0 min
Primary = 0.00868 m³/s @ 0.77 hrs, Volume= 55.8 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.175 m @ 0.77 hrs Surf.Area= 0.0 m² Storage= 58.4 m³

Plug-Flow detention time= 68.0 min calculated for 55.6 m³ (78% of inflow)
Center-of-Mass det. time= 63.9 min (88.4 - 24.5)

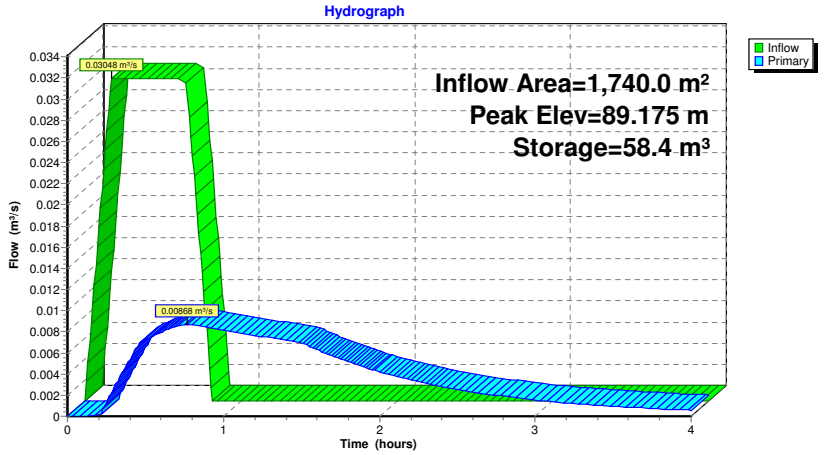
Volume	Invert	Avail.Storage	Storage Description
#1	88.467 m	68.5 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.467	0.0
89.297	68.5

Device	Routing	Invert	Outlet Devices
#1	Primary	88.435 m	**HYDROVEX 100-VHV-1** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00868 m³/s @ 0.77 hrs HW=89.175 m (Free Discharge)
↑—**1=HYDROVEX 100-VHV-1** (Custom Controls 0.00868 m³/s)

Pond 28P: Cistern

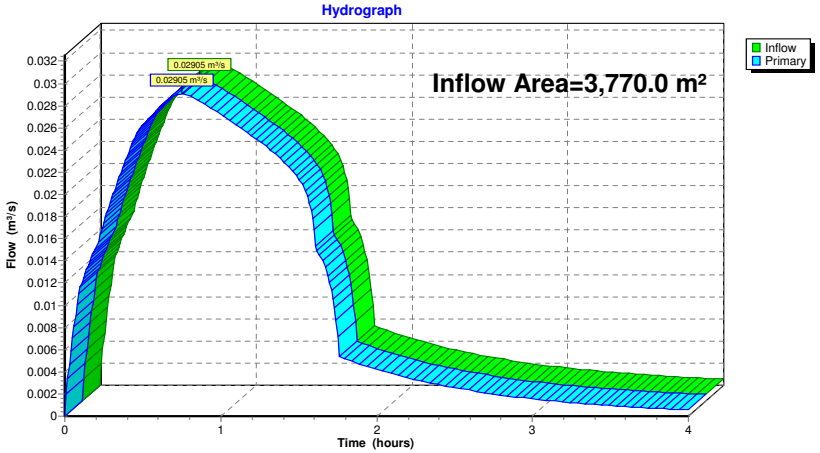


Summary for Link 29L: Teron Rd Storm Sewer

Inflow Area = 3,770.0 m², 57.29% Impervious, Inflow Depth > 42 mm for 100-Year event
Inflow = 0.02905 m³/s @ 0.75 hrs, Volume= 156.8 m³
Primary = 0.02905 m³/s @ 0.75 hrs, Volume= 156.8 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 29L: Teron Rd Storm Sewer

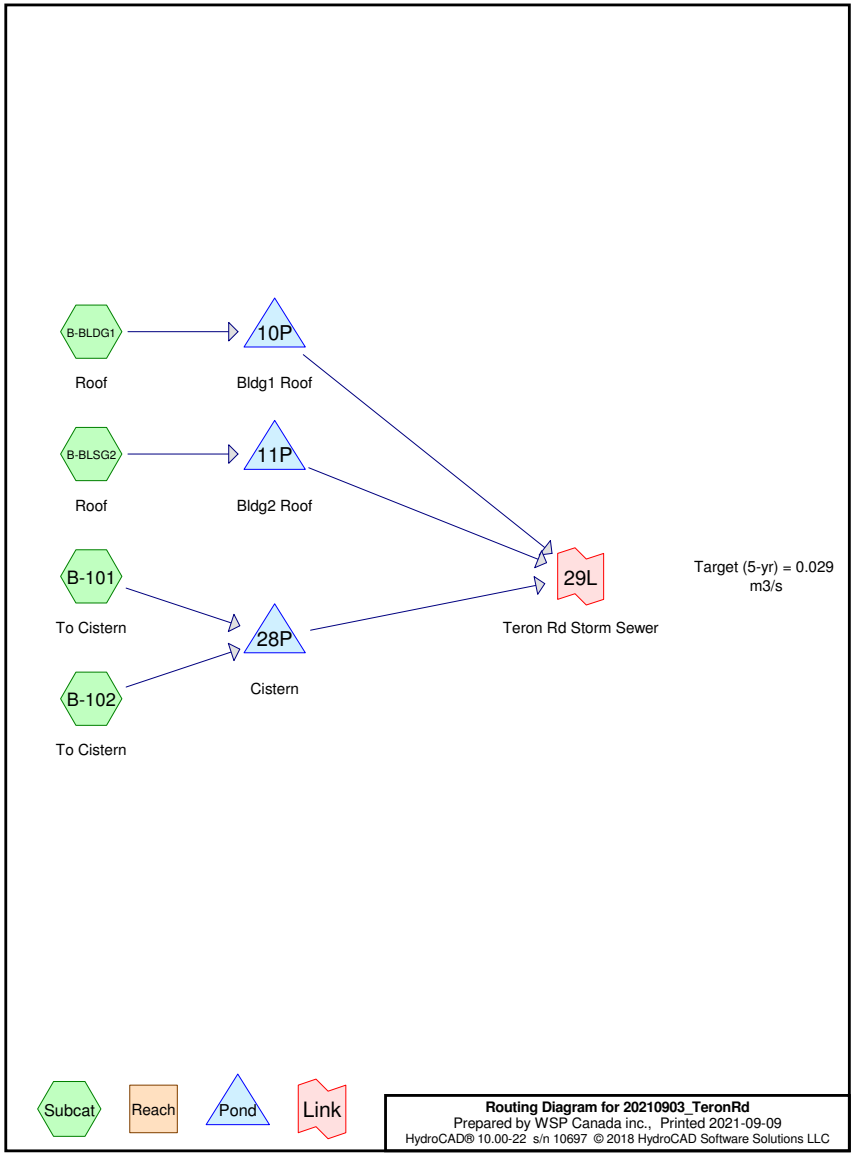


APPENDIX

C-2

100-Year Analysis (Peak Cistern Storage, T_c = 63 min)

The storm system for the site is governed by the 100-year storm. Peak storage in each storage unit and peak discharge may occur at separate times of concentration and are therefore reported separately



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,610.0	0.81	(B-101)
2,160.0	1.00	(B-102, B-BLDG1, B-BLSG2)
3,770.0	**0.92**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-101: To Cistern Runoff Area=1,610.0 m² 0.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=0.81 Runoff=0.01952 m³/s 73.8 m³

Subcatchment B-102: To Cistern Runoff Area=130.0 m² 100.00% Impervious Runoff Depth=57 mm
Tc=10.0 min C=1.00 Runoff=0.00195 m³/s 7.4 m³

Subcatchment B-BLDG1: Roof Runoff Area=1,490.0 m² 100.00% Impervious Runoff Depth=57 mm
Tc=10.0 min C=1.00 Runoff=0.02231 m³/s 84.3 m³

Subcatchment B-BLSG2: Roof Runoff Area=540.0 m² 100.00% Impervious Runoff Depth=57 mm
Tc=10.0 min C=1.00 Runoff=0.00808 m³/s 30.6 m³

Pond 10P: Bldg1 Roof Peak Elev=100.144 m Storage=35.2 m³ Inflow=0.02231 m³/s 84.3 m³
Outflow=0.01448 m³/s 84.3 m³

Pond 11P: Bldg2 Roof Peak Elev=100.129 m Storage=11.5 m³ Inflow=0.00808 m³/s 30.6 m³
Outflow=0.00526 m³/s 30.6 m³

Pond 28P: Cistern Peak Elev=89.199 m Storage=60.4 m³ Inflow=0.02147 m³/s 81.2 m³
Outflow=0.00885 m³/s 64.5 m³

Link 29L: Teron Rd Storm Sewer Inflow=0.02857 m³/s 179.4 m³
Primary=0.02857 m³/s 179.4 m³

Total Runoff Area = 3,770.0 m² Runoff Volume = 196.0 m³ Average Runoff Depth = 52 mm
42.71% Pervious = 1,610.0 m² 57.29% Impervious = 2,160.0 m²

Summary for Subcatchment B-101: To Cistern

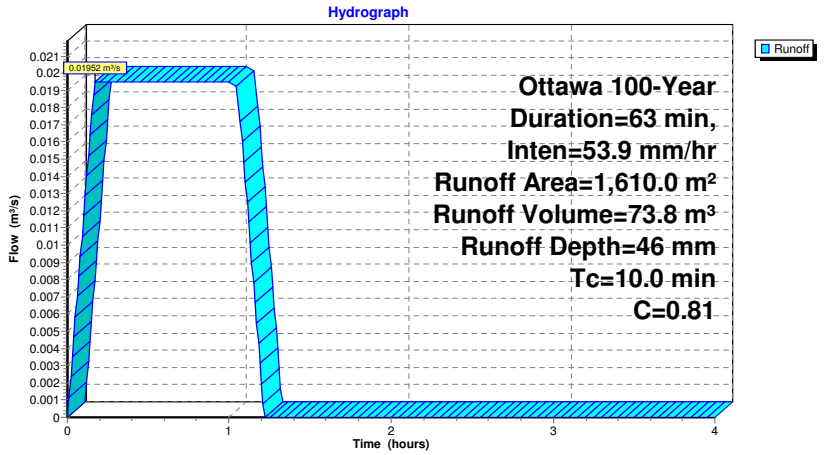
Runoff = 0.01952 m³/s @ 0.17 hrs, Volume= 73.8 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=63 min, Inten=53.9 mm/hr

Area (m²)	C	Description
1,610.0	0.81	
1,610.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-101: To Cistern



Summary for Subcatchment B-102: To Cistern

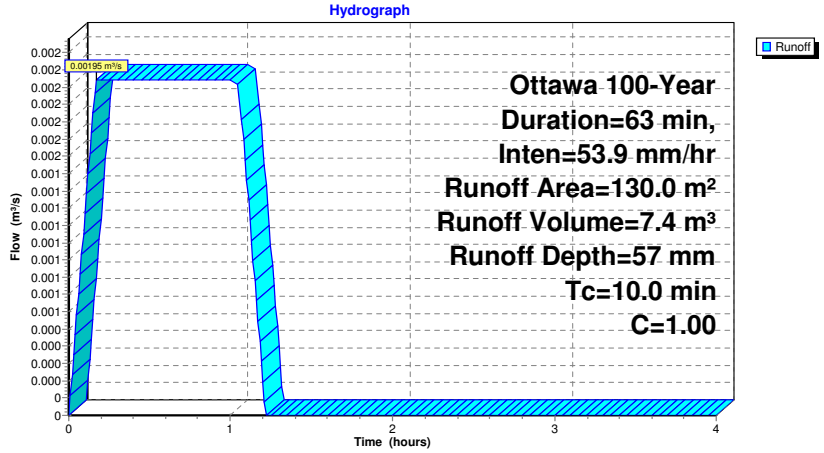
Runoff = 0.00195 m³/s @ 0.17 hrs, Volume= 7.4 m³, Depth= 57 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=63 min, Inten=53.9 mm/hr

Area (m²)	C	Description
130.0	1.00	
130.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-102: To Cistern



Summary for Subcatchment B-BLDG1: Roof

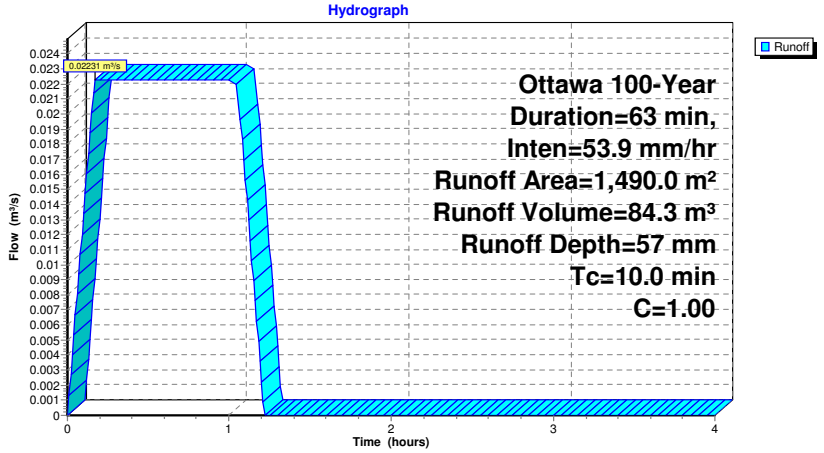
Runoff = 0.02231 m³/s @ 0.17 hrs, Volume= 84.3 m³, Depth= 57 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=63 min, Inten=53.9 mm/hr

Area (m²)	C	Description
1,490.0	1.00	
1,490.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLDG1: Roof



Summary for Subcatchment B-BLSG2: Roof

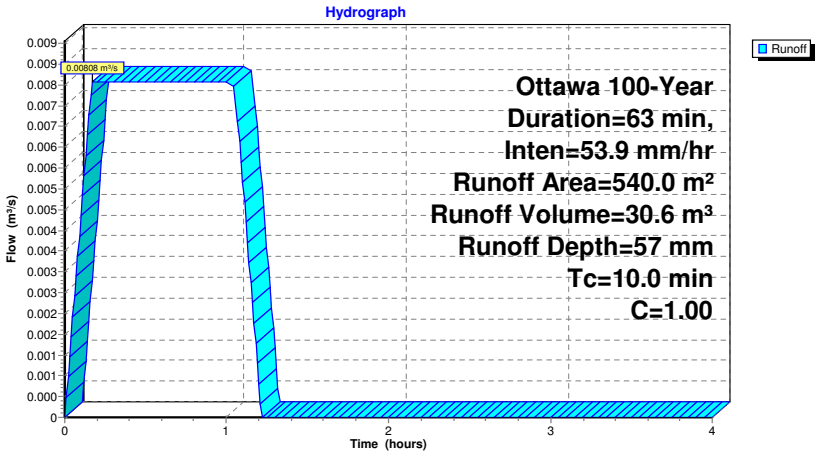
Runoff = 0.00808 m³/s @ 0.17 hrs, Volume= 30.6 m³, Depth= 57 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=63 min, Inten=53.9 mm/hr

Area (m²)	C	Description
540.0	1.00	
540.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLSG2: Roof



Summary for Pond 10P: Bldg1 Roof

Inflow Area = 1,490.0 m²,100.00% Impervious, Inflow Depth = 57 mm for 100-Year event
Inflow = 0.02231 m³/s @ 0.17 hrs, Volume= 84.3 m³
Outflow = 0.01448 m³/s @ 1.11 hrs, Volume= 84.3 m³, Atten= 35%, Lag= 56.3 min
Primary = 0.01448 m³/s @ 1.11 hrs, Volume= 84.3 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.144 m @ 1.11 hrs Surf.Area= 813.7 m² Storage= 35.2 m³

Plug-Flow detention time= 25.0 min calculated for 84.1 m³ (100% of inflow)
Center-of-Mass det. time= 25.1 min (61.6 - 36.5)

Volume	Invert	Avail.Storage	Storage Description
#1	100.060 m	13.3 m³	**Roof drain 1 (Pyramidal)** Listed below (Recalc)
#2	100.000 m	24.2 m³	**Roof drain 2 (Pyramidal)** Listed below (Recalc)
#3	100.080 m	8.3 m³	**Roof drain 3 (Pyramidal)** Listed below (Recalc)
#4	100.000 m	25.2 m³	**Roof drain 4 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	24.4 m³	**Roof drain 5 (Pyramidal)** Listed below (Recalc)
#6	100.000 m	23.2 m³	**Roof drain 6 (Pyramidal)** Listed below (Recalc)
#7	100.000 m	23.3 m³	**Roof drain 7 (Pyramidal)** Listed below (Recalc)
#8	100.000 m	22.8 m³	**Roof drain 8 (Pyramidal)** Listed below (Recalc)
#9	100.080 m	4.5 m³	**Roof drain 9 (Pyramidal)** Listed below (Recalc)
#10	100.080 m	6.6 m³	**Roof drain 10 (Pyramidal)** Listed below (Recalc)
		175.8 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	74.0	2.2	2.2	74.0
100.300	74.0	11.1	13.3	79.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	121.0	6.1	6.1	121.0
100.300	121.0	18.1	24.2	127.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	48.0	1.1	1.1	48.0
100.300	48.0	7.2	8.3	52.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	126.0	6.3	6.3	126.0
100.300	126.0	18.9	25.2	132.8

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	122.0	6.1	6.1	122.0
100.300	122.0	18.3	24.4	128.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.0	5.8	5.8	116.0
100.300	116.0	17.4	23.2	122.5

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.5	5.8	5.8	116.5
100.300	116.5	17.5	23.3	123.0

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	114.0	5.7	5.7	114.0
100.300	114.0	17.1	22.8	120.5

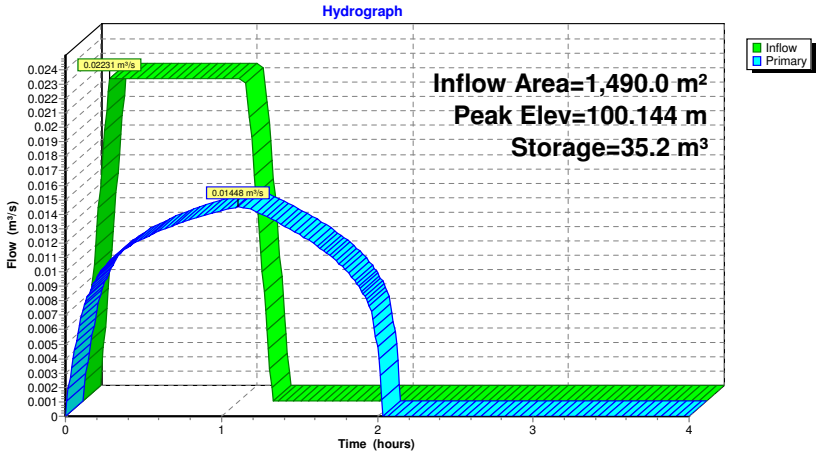
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	26.0	0.6	0.6	26.0
100.300	26.0	3.9	4.5	29.1

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	38.0	0.9	0.9	38.0
100.300	38.0	5.7	6.6	41.7

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.5 X 12.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000790 0.000950 0.001100 0.001260

Primary OutFlow Max=0.01448 m³/s @ 1.11 hrs HW=100.144 m (Free Discharge)
↳**1=WATTS Accutrol_5-0.5** (Custom Controls 0.01448 m³/s)

Pond 10P: Bldg1 Roof



Summary for Pond 11P: Bldg2 Roof

Inflow Area = 540.0 m²,100.00% Impervious, Inflow Depth = 57 mm for 100-Year event
Inflow = 0.00808 m³/s @ 0.17 hrs, Volume= 30.6 m³
Outflow = 0.00526 m³/s @ 1.11 hrs, Volume= 30.6 m³, Atten= 35%, Lag= 56.3 min
Primary = 0.00526 m³/s @ 1.11 hrs, Volume= 30.6 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.129 m @ 1.11 hrs Surf.Area= 340.1 m² Storage= 11.5 m³

Plug-Flow detention time= 20.9 min calculated for 30.5 m³ (100% of inflow)
Center-of-Mass det. time= 21.0 min (57.5 - 36.5)

Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	24.0 m³	**Roof drain 13 (Pyramidal)** Listed below (Recalc)
#2	100.060 m	11.0 m³	**Roof drain 14 (Pyramidal)** Listed below (Recalc)
#3	100.060 m	11.7 m³	**Roof drain 15 (Pyramidal)** Listed below (Recalc)
#4	100.060 m	11.5 m³	**Roof drain 16 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	26.2 m³	**Roof drain 17 (Pyramidal)** Listed below (Recalc)
#6	100.060 m	13.0 m³	**Roof drain 18 (Pyramidal)** Listed below (Recalc)
		97.4 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	120.0	6.0	6.0	120.0
100.300	120.0	18.0	24.0	126.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	61.0	1.8	1.8	61.0
100.300	61.0	9.1	11.0	65.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	65.0	2.0	2.0	65.0
100.300	65.0	9.7	11.7	69.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	64.0	1.9	1.9	64.0
100.300	64.0	9.6	11.5	68.8

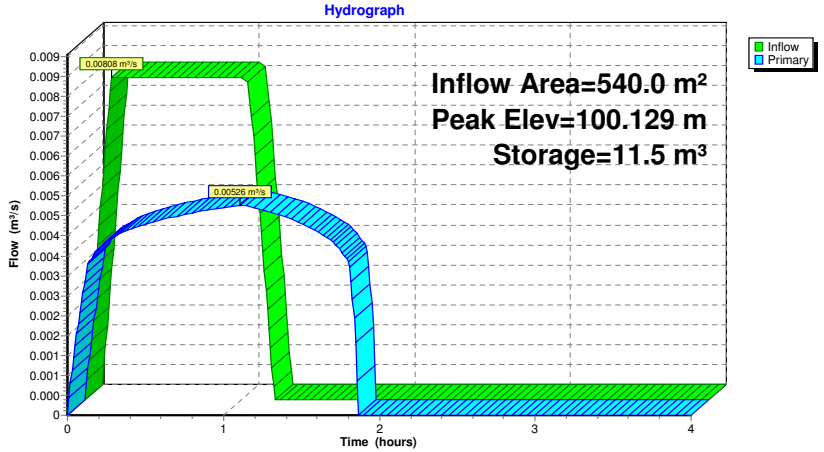
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	131.0	6.6	6.6	131.0
100.300	131.0	19.6	26.2	137.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	72.0	2.2	2.2	72.0
100.300	72.0	10.8	13.0	77.1

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.25 X 6.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000710 0.000790 0.000870 0.000950

Primary OutFlow Max=0.00526 m³/s @ 1.11 hrs HW=100.129 m (Free Discharge)
└**1=WATTS Accutrol_5-0.25** (Custom Controls 0.00526 m³/s)

Pond 11P: Bldg2 Roof



Summary for Pond 28P: Cistern

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 1,740.0 m², 7.47% Impervious, Inflow Depth = 47 mm for 100-Year event
Inflow = 0.02147 m³/s @ 0.17 hrs, Volume= 81.2 m³
Outflow = 0.00885 m³/s @ 1.15 hrs, Volume= 64.5 m³, Atten= 59%, Lag= 58.7 min
Primary = 0.00885 m³/s @ 1.15 hrs, Volume= 64.5 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.199 m @ 1.15 hrs Surf.Area= 0.0 m² Storage= 60.4 m³

Plug-Flow detention time= 71.1 min calculated for 64.3 m³ (79% of inflow)
Center-of-Mass det. time= 64.8 min (101.3 - 36.5)

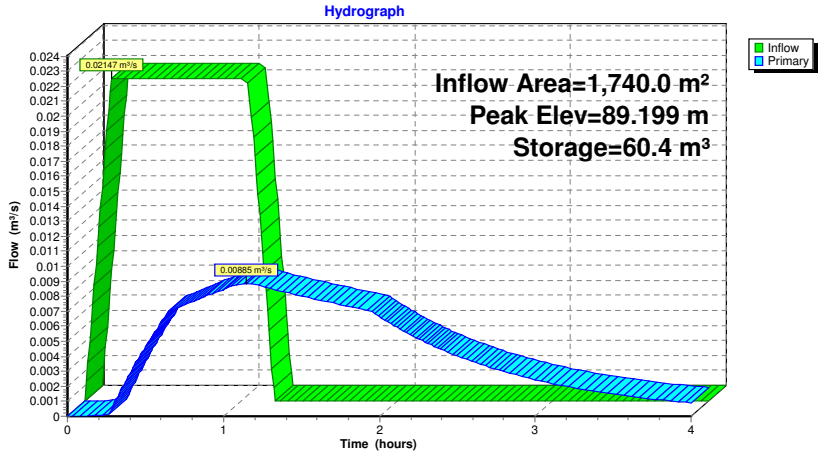
Volume	Invert	Avail.Storage	Storage Description
#1	88.467 m	68.5 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.467	0.0
89.297	68.5

Device	Routing	Invert	Outlet Devices
#1	Primary	88.435 m	**HYDROVEX 100-VHV-1** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00885 m³/s @ 1.15 hrs HW=89.199 m (Free Discharge)
↑**1=HYDROVEX 100-VHV-1** (Custom Controls 0.00885 m³/s)

Pond 28P: Cistern

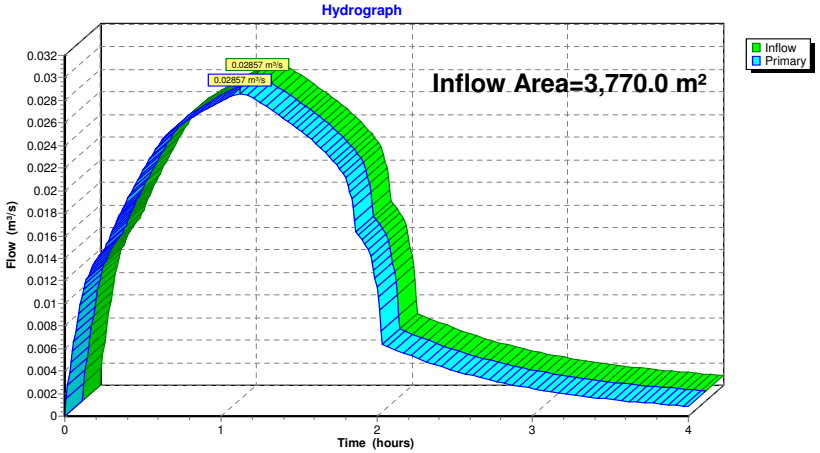


Summary for Link 29L: Teron Rd Storm Sewer

Inflow Area = 3,770.0 m², 57.29% Impervious, Inflow Depth > 48 mm for 100-Year event
Inflow = 0.02857 m³/s @ 1.12 hrs, Volume= 179.4 m³
Primary = 0.02857 m³/s @ 1.12 hrs, Volume= 179.4 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 29L: Teron Rd Storm Sewer

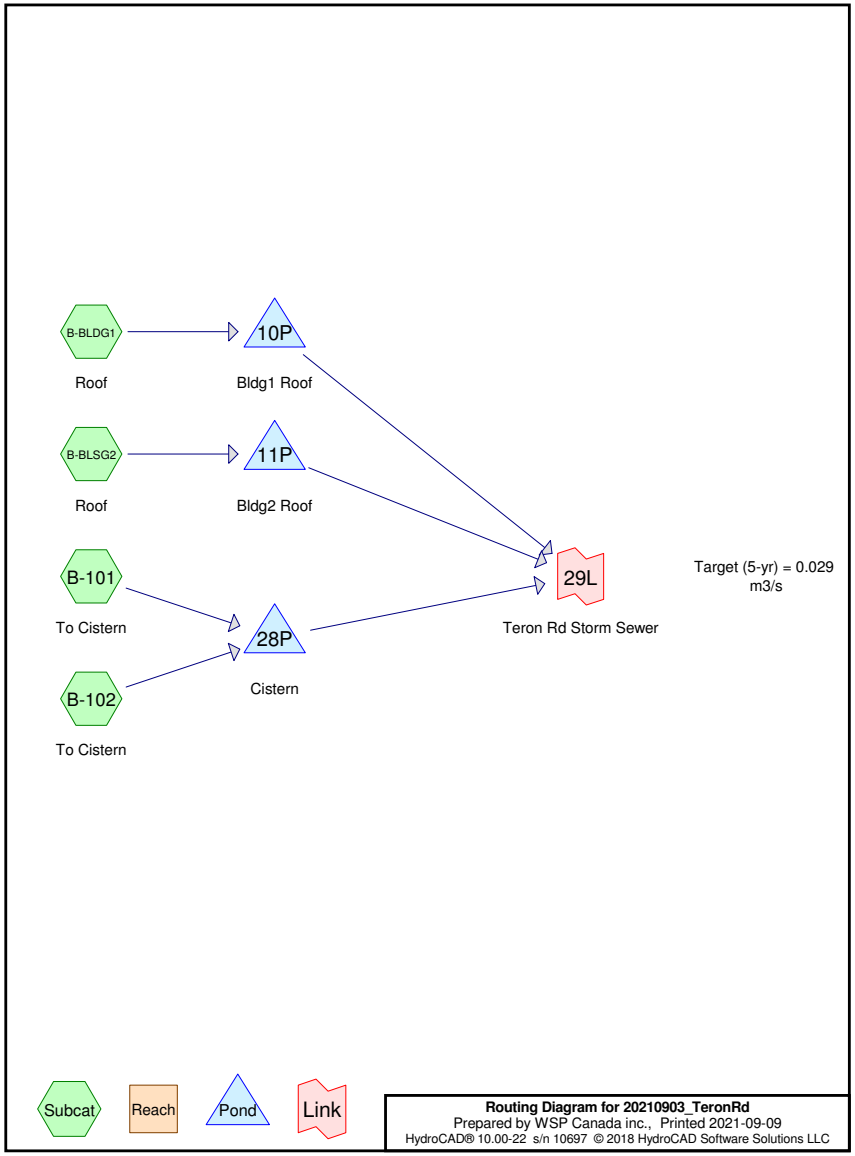


APPENDIX

C-3

100-Year Analysis (Peak Building 1 Rooftop Storage, T_C = 30 Min)

The storm system for the site is governed by the 100-year storm. Peak storage in each storage unit and peak discharge may occur at separate times of concentration and are therefore reported separately.



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,610.0	0.81	(B-101)
2,160.0	1.00	(B-102, B-BLDG1, B-BLSG2)
3,770.0	**0.92**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-101: To Cistern Runoff Area=1,610.0 m² 0.00% Impervious Runoff Depth=37 mm
Tc=10.0 min C=0.81 Runoff=0.03328 m³/s 59.9 m³

Subcatchment B-102: To Cistern Runoff Area=130.0 m² 100.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=1.00 Runoff=0.00332 m³/s 6.0 m³

Subcatchment B-BLDG1: Roof Runoff Area=1,490.0 m² 100.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=1.00 Runoff=0.03802 m³/s 68.4 m³

Subcatchment B-BLSG2: Roof Runoff Area=540.0 m² 100.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=1.00 Runoff=0.01378 m³/s 24.8 m³

Pond 10P: Bldg1 Roof Peak Elev=100.151 m Storage=41.6 m³ Inflow=0.03802 m³/s 68.4 m³
Outflow=0.01505 m³/s 68.5 m³

Pond 11P: Bldg2 Roof Peak Elev=100.137 m Storage=14.4 m³ Inflow=0.01378 m³/s 24.8 m³
Outflow=0.00541 m³/s 24.8 m³

Pond 28P: Cistern Peak Elev=89.145 m Storage=55.9 m³ Inflow=0.03660 m³/s 65.9 m³
Outflow=0.00847 m³/s 50.8 m³

Link 29L: Teron Rd Storm Sewer Inflow=0.02891 m³/s 144.0 m³
Primary=0.02891 m³/s 144.0 m³

Total Runoff Area = 3,770.0 m² Runoff Volume = 159.1 m³ Average Runoff Depth = 42 mm
42.71% Pervious = 1,610.0 m² 57.29% Impervious = 2,160.0 m²

Summary for Subcatchment B-101: To Cistern

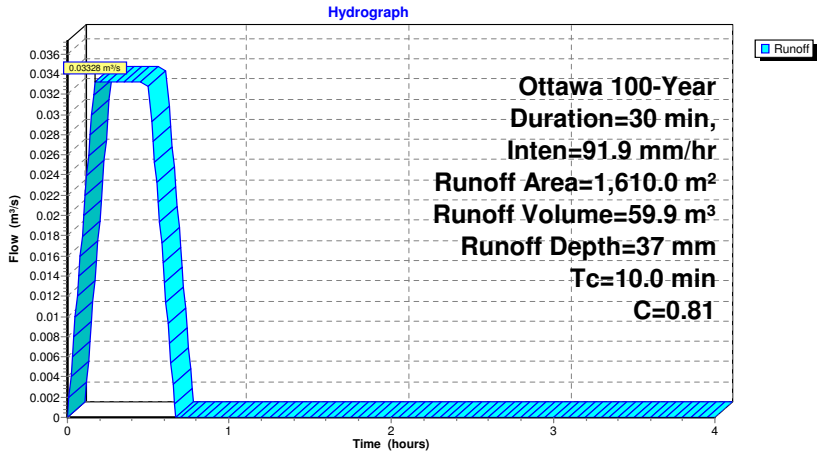
Runoff = 0.03328 m³/s @ 0.17 hrs, Volume= 59.9 m³, Depth= 37 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
1,610.0	0.81	
1,610.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-101: To Cistern



Summary for Subcatchment B-102: To Cistern

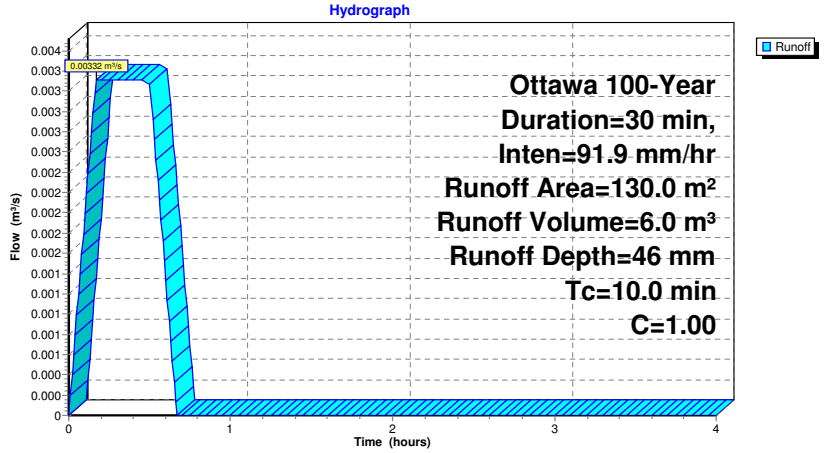
Runoff = 0.00332 m³/s @ 0.17 hrs, Volume= 6.0 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
130.0	1.00	
130.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-102: To Cistern



Summary for Subcatchment B-BLDG1: Roof

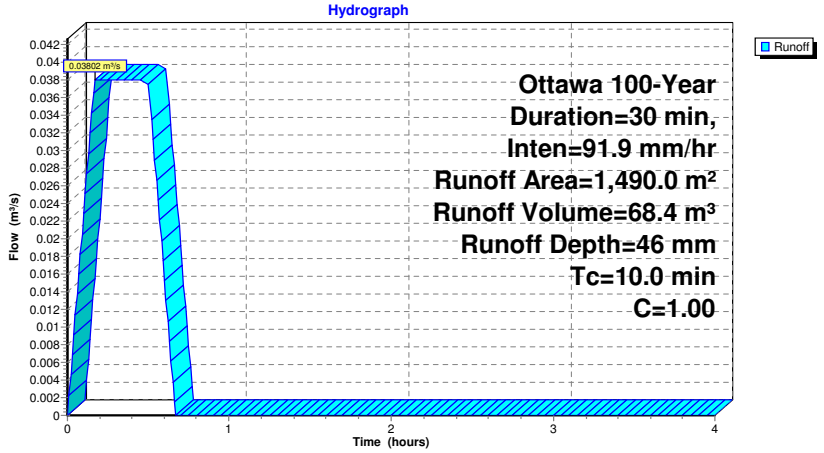
Runoff = 0.03802 m³/s @ 0.17 hrs, Volume= 68.4 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
1,490.0	1.00	
1,490.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLDG1: Roof



Summary for Subcatchment B-BLSG2: Roof

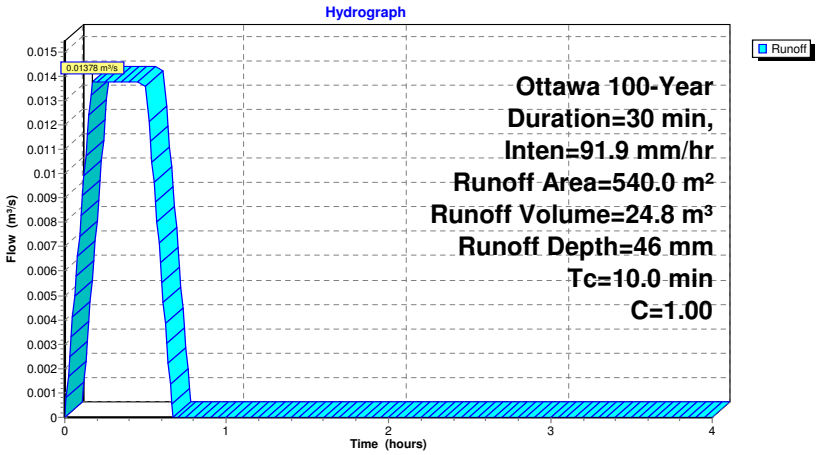
Runoff = 0.01378 m³/s @ 0.17 hrs, Volume= 24.8 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
540.0	1.00	
540.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLSG2: Roof



Summary for Pond 10P: Bldg1 Roof

Inflow Area = 1,490.0 m²,100.00% Impervious, Inflow Depth = 46 mm for 100-Year event
Inflow = 0.03802 m³/s @ 0.17 hrs, Volume= 68.4 m³
Outflow = 0.01505 m³/s @ 0.60 hrs, Volume= 68.5 m³, Atten= 60%, Lag= 25.8 min
Primary = 0.01505 m³/s @ 0.60 hrs, Volume= 68.5 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.151 m @ 0.60 hrs Surf.Area= 901.5 m² Storage= 41.6 m³

Plug-Flow detention time= 27.4 min calculated for 68.3 m³ (100% of inflow)
Center-of-Mass det. time= 27.5 min (47.5 - 20.0)

Volume	Invert	Avail.Storage	Storage Description
#1	100.060 m	13.3 m³	**Roof drain 1 (Pyramidal)** Listed below (Recalc)
#2	100.000 m	24.2 m³	**Roof drain 2 (Pyramidal)** Listed below (Recalc)
#3	100.080 m	8.3 m³	**Roof drain 3 (Pyramidal)** Listed below (Recalc)
#4	100.000 m	25.2 m³	**Roof drain 4 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	24.4 m³	**Roof drain 5 (Pyramidal)** Listed below (Recalc)
#6	100.000 m	23.2 m³	**Roof drain 6 (Pyramidal)** Listed below (Recalc)
#7	100.000 m	23.3 m³	**Roof drain 7 (Pyramidal)** Listed below (Recalc)
#8	100.000 m	22.8 m³	**Roof drain 8 (Pyramidal)** Listed below (Recalc)
#9	100.080 m	4.5 m³	**Roof drain 9 (Pyramidal)** Listed below (Recalc)
#10	100.080 m	6.6 m³	**Roof drain 10 (Pyramidal)** Listed below (Recalc)
		175.8 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	74.0	2.2	2.2	74.0
100.300	74.0	11.1	13.3	79.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	121.0	6.1	6.1	121.0
100.300	121.0	18.1	24.2	127.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	48.0	1.1	1.1	48.0
100.300	48.0	7.2	8.3	52.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	126.0	6.3	6.3	126.0
100.300	126.0	18.9	25.2	132.8

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	122.0	6.1	6.1	122.0
100.300	122.0	18.3	24.4	128.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.0	5.8	5.8	116.0
100.300	116.0	17.4	23.2	122.5

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.5	5.8	5.8	116.5
100.300	116.5	17.5	23.3	123.0

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	114.0	5.7	5.7	114.0
100.300	114.0	17.1	22.8	120.5

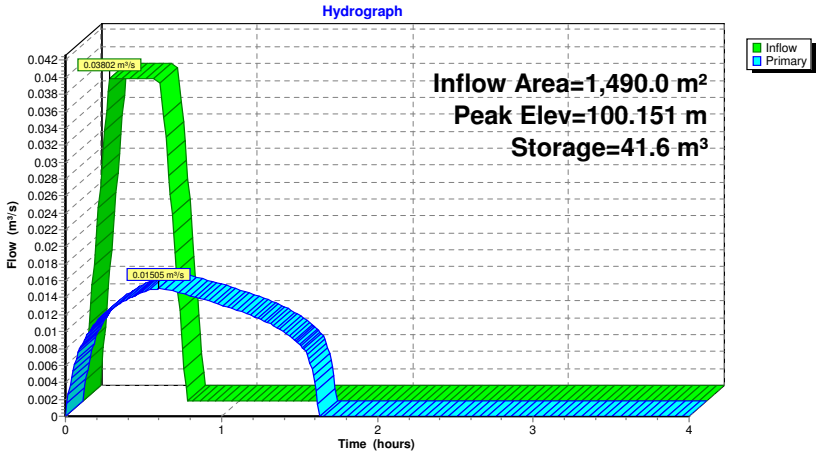
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	26.0	0.6	0.6	26.0
100.300	26.0	3.9	4.5	29.1

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	38.0	0.9	0.9	38.0
100.300	38.0	5.7	6.6	41.7

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.5 X 12.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000790 0.000950 0.001100 0.001260

Primary OutFlow Max=0.01505 m³/s @ 0.60 hrs HW=100.151 m (Free Discharge)
↳**1=WATTS Accutrol_5-0.5** (Custom Controls 0.01505 m³/s)

Pond 10P: Bldg1 Roof



Summary for Pond 11P: Bldg2 Roof

Inflow Area = 540.0 m²,100.00% Impervious, Inflow Depth = 46 mm for 100-Year event
Inflow = 0.01378 m³/s @ 0.17 hrs, Volume= 24.8 m³
Outflow = 0.00541 m³/s @ 0.60 hrs, Volume= 24.8 m³, Atten= 61%, Lag= 25.9 min
Primary = 0.00541 m³/s @ 0.60 hrs, Volume= 24.8 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.137 m @ 0.60 hrs Surf.Area= 399.6 m² Storage= 14.4 m³

Plug-Flow detention time= 24.7 min calculated for 24.8 m³ (100% of inflow)
Center-of-Mass det. time= 24.7 min (44.8 - 20.0)

Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	24.0 m³	**Roof drain 13 (Pyramidal)** Listed below (Recalc)
#2	100.060 m	11.0 m³	**Roof drain 14 (Pyramidal)** Listed below (Recalc)
#3	100.060 m	11.7 m³	**Roof drain 15 (Pyramidal)** Listed below (Recalc)
#4	100.060 m	11.5 m³	**Roof drain 16 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	26.2 m³	**Roof drain 17 (Pyramidal)** Listed below (Recalc)
#6	100.060 m	13.0 m³	**Roof drain 18 (Pyramidal)** Listed below (Recalc)
		97.4 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	120.0	6.0	6.0	120.0
100.300	120.0	18.0	24.0	126.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	61.0	1.8	1.8	61.0
100.300	61.0	9.1	11.0	65.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	65.0	2.0	2.0	65.0
100.300	65.0	9.7	11.7	69.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	64.0	1.9	1.9	64.0
100.300	64.0	9.6	11.5	68.8

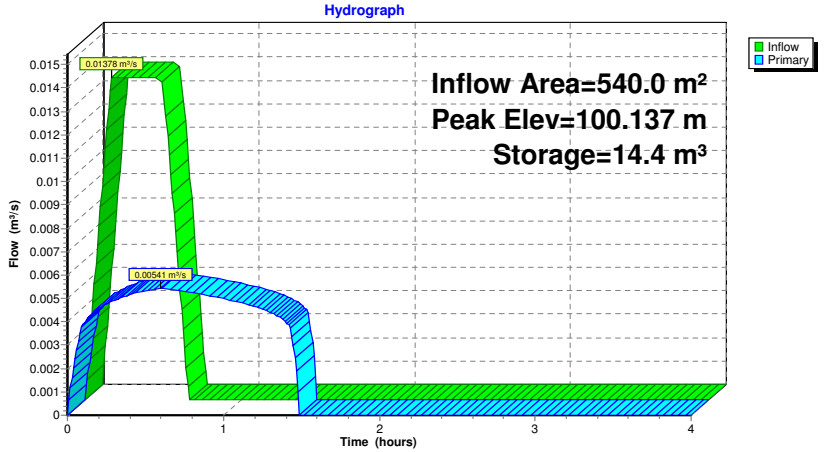
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	131.0	6.6	6.6	131.0
100.300	131.0	19.6	26.2	137.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	72.0	2.2	2.2	72.0
100.300	72.0	10.8	13.0	77.1

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.25 X 6.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000710 0.000790 0.000870 0.000950

Primary OutFlow Max=0.00541 m³/s @ 0.60 hrs HW=100.137 m (Free Discharge)
↑**1=WATTS Accutrol_5-0.25** (Custom Controls 0.00541 m³/s)

Pond 11P: Bldg2 Roof



Summary for Pond 28P: Cistern

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 1,740.0 m², 7.47% Impervious, Inflow Depth = 38 mm for 100-Year event
Inflow = 0.03660 m³/s @ 0.17 hrs, Volume= 65.9 m³
Outflow = 0.00847 m³/s @ 0.63 hrs, Volume= 50.8 m³, Atten= 77%, Lag= 27.5 min
Primary = 0.00847 m³/s @ 0.63 hrs, Volume= 50.8 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.145 m @ 0.63 hrs Surf.Area= 0.0 m² Storage= 55.9 m³

Plug-Flow detention time= 66.0 min calculated for 50.6 m³ (77% of inflow)
Center-of-Mass det. time= 62.7 min (82.7 - 20.0)

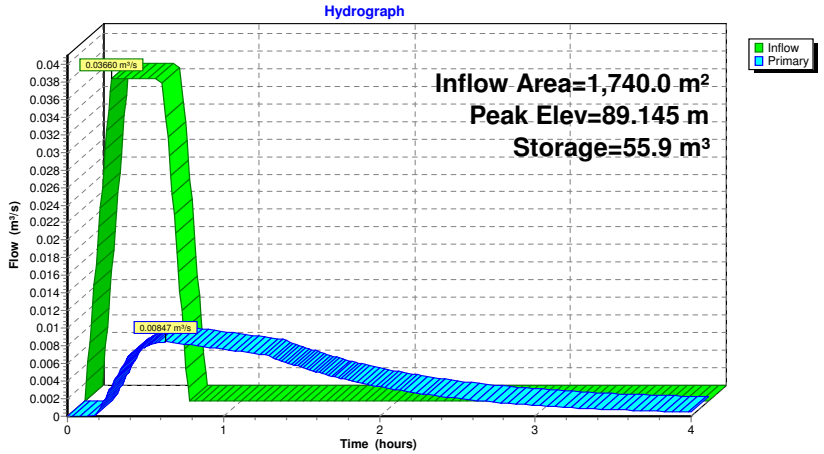
Volume	Invert	Avail.Storage	Storage Description
#1	88.467 m	68.5 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.467	0.0
89.297	68.5

Device	Routing	Invert	Outlet Devices
#1	Primary	88.435 m	**HYDROVEX 100-VHV-1** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00847 m³/s @ 0.63 hrs HW=89.145 m (Free Discharge)
↑—**1=HYDROVEX 100-VHV-1** (Custom Controls 0.00847 m³/s)

Pond 28P: Cistern

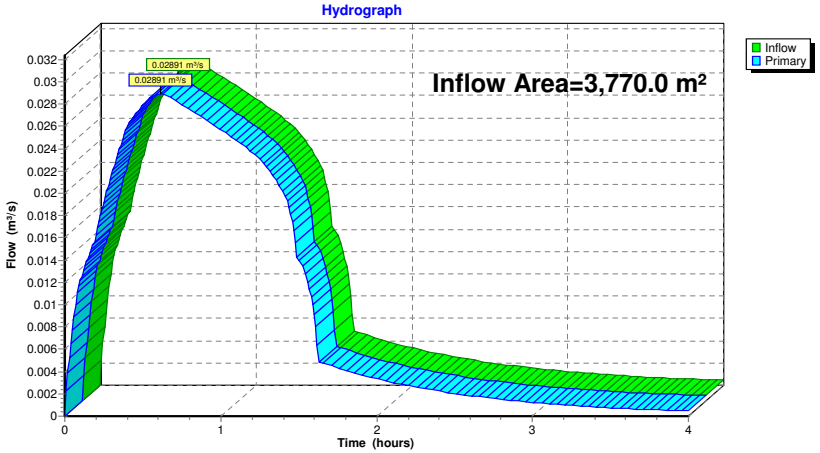


Summary for Link 29L: Teron Rd Storm Sewer

Inflow Area = 3,770.0 m², 57.29% Impervious, Inflow Depth > 38 mm for 100-Year event
Inflow = 0.02891 m³/s @ 0.61 hrs, Volume= 144.0 m³
Primary = 0.02891 m³/s @ 0.61 hrs, Volume= 144.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

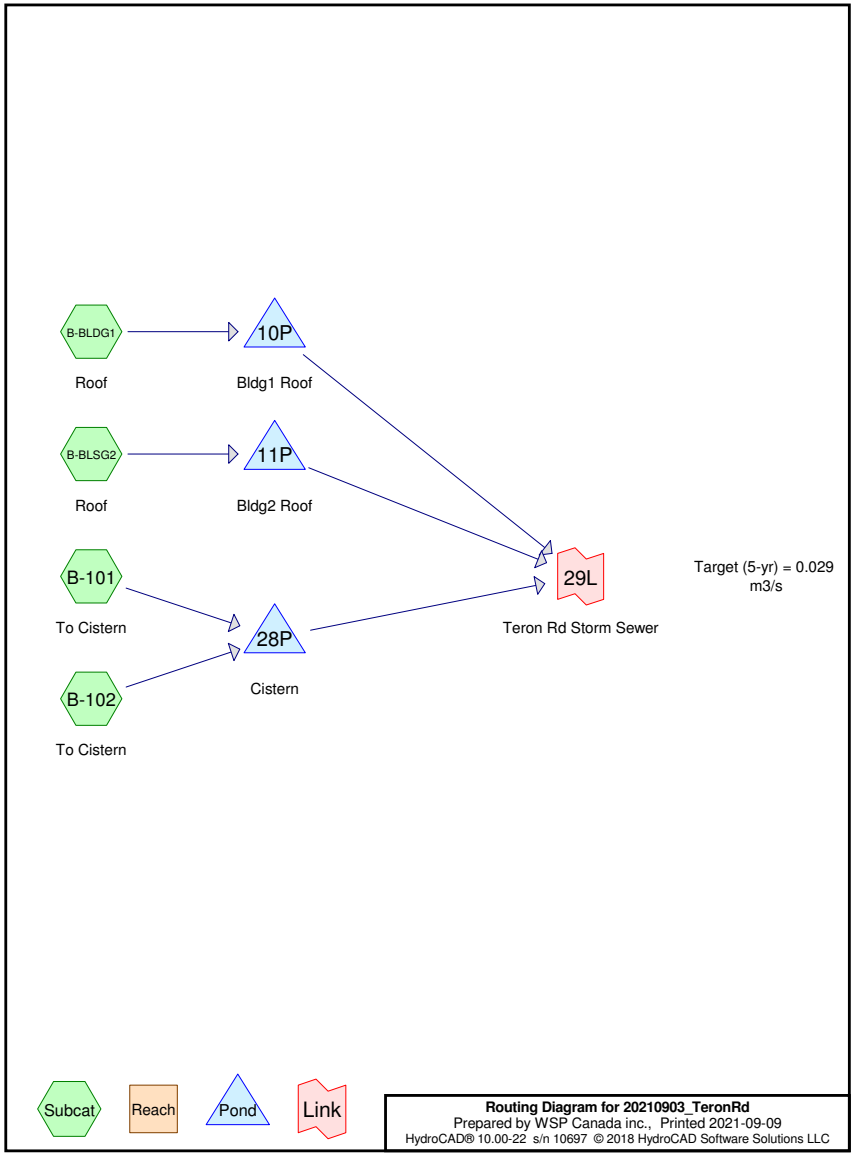
Link 29L: Teron Rd Storm Sewer



APPENDIX

C-4 100-Year Analysis (Peak Building 2 Rooftop Storage, T_C = 30 Min)

The storm system for the site is governed by the 100-year storm. Peak storage in each storage unit and peak discharge may occur at separate times of concentration and are therefore reported separately.



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,610.0	0.81	(B-101)
2,160.0	1.00	(B-102, B-BLDG1, B-BLSG2)
3,770.0	**0.92**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-101: To Cistern Runoff Area=1,610.0 m² 0.00% Impervious Runoff Depth=37 mm
Tc=10.0 min C=0.81 Runoff=0.03328 m³/s 59.9 m³

Subcatchment B-102: To Cistern Runoff Area=130.0 m² 100.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=1.00 Runoff=0.00332 m³/s 6.0 m³

Subcatchment B-BLDG1: Roof Runoff Area=1,490.0 m² 100.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=1.00 Runoff=0.03802 m³/s 68.4 m³

Subcatchment B-BLSG2: Roof Runoff Area=540.0 m² 100.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=1.00 Runoff=0.01378 m³/s 24.8 m³

Pond 10P: Bldg1 Roof Peak Elev=100.151 m Storage=41.6 m³ Inflow=0.03802 m³/s 68.4 m³
Outflow=0.01505 m³/s 68.5 m³

Pond 11P: Bldg2 Roof Peak Elev=100.137 m Storage=14.4 m³ Inflow=0.01378 m³/s 24.8 m³
Outflow=0.00541 m³/s 24.8 m³

Pond 28P: Cistern Peak Elev=89.145 m Storage=55.9 m³ Inflow=0.03660 m³/s 65.9 m³
Outflow=0.00847 m³/s 50.8 m³

Link 29L: Teron Rd Storm Sewer Inflow=0.02891 m³/s 144.0 m³
Primary=0.02891 m³/s 144.0 m³

Total Runoff Area = 3,770.0 m² Runoff Volume = 159.1 m³ Average Runoff Depth = 42 mm
42.71% Pervious = 1,610.0 m² 57.29% Impervious = 2,160.0 m²

Summary for Subcatchment B-101: To Cistern

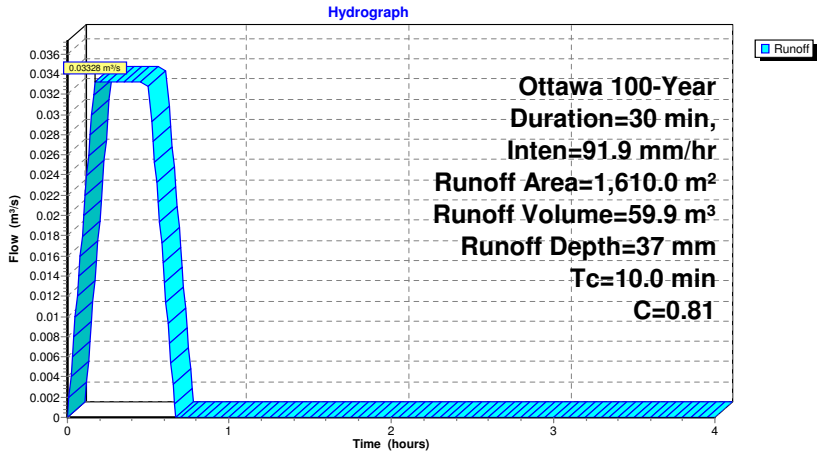
Runoff = 0.03328 m³/s @ 0.17 hrs, Volume= 59.9 m³, Depth= 37 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
1,610.0	0.81	
1,610.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-101: To Cistern



Summary for Subcatchment B-102: To Cistern

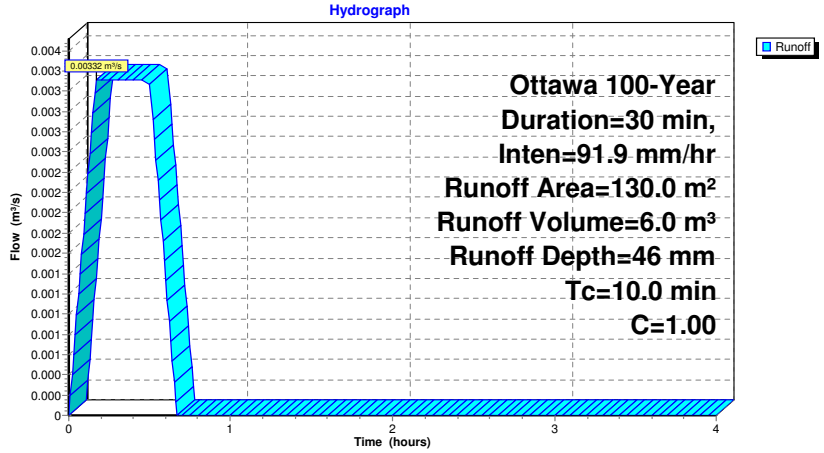
Runoff = 0.00332 m³/s @ 0.17 hrs, Volume= 6.0 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
130.0	1.00	
130.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-102: To Cistern



Summary for Subcatchment B-BLDG1: Roof

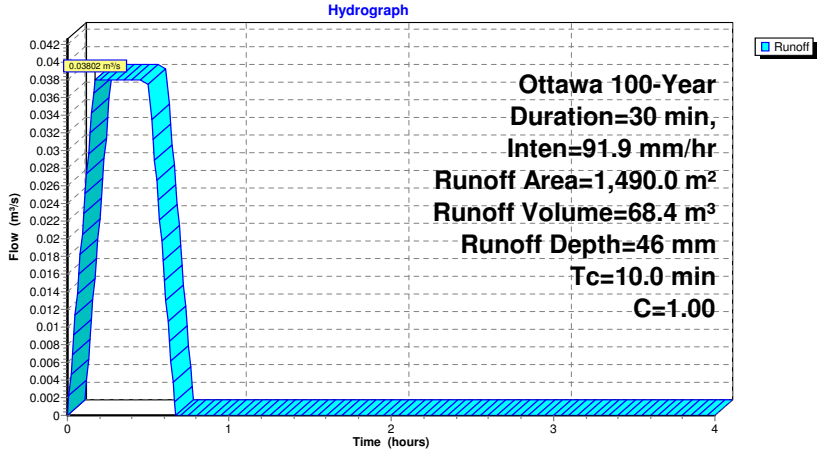
Runoff = 0.03802 m³/s @ 0.17 hrs, Volume= 68.4 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
1,490.0	1.00	
1,490.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLDG1: Roof



Summary for Subcatchment B-BLSG2: Roof

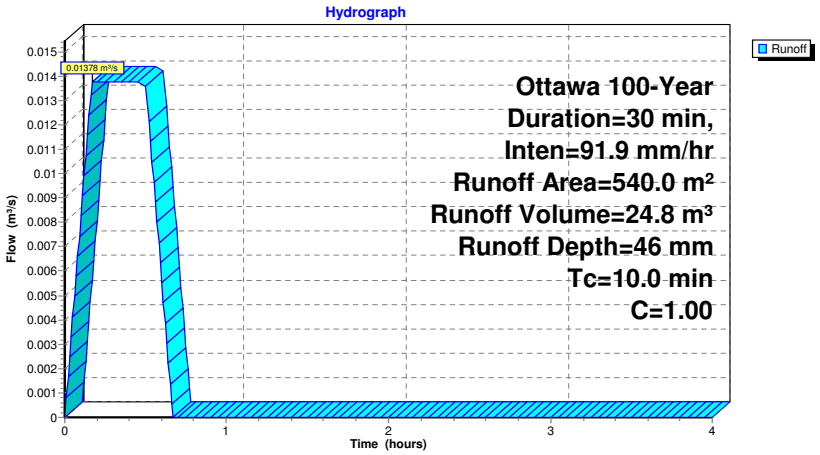
Runoff = 0.01378 m³/s @ 0.17 hrs, Volume= 24.8 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=30 min, Inten=91.9 mm/hr

Area (m²)	C	Description
540.0	1.00	
540.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment B-BLSG2: Roof



Summary for Pond 10P: Bldg1 Roof

Inflow Area = 1,490.0 m²,100.00% Impervious, Inflow Depth = 46 mm for 100-Year event
Inflow = 0.03802 m³/s @ 0.17 hrs, Volume= 68.4 m³
Outflow = 0.01505 m³/s @ 0.60 hrs, Volume= 68.5 m³, Atten= 60%, Lag= 25.8 min
Primary = 0.01505 m³/s @ 0.60 hrs, Volume= 68.5 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.151 m @ 0.60 hrs Surf.Area= 901.5 m² Storage= 41.6 m³

Plug-Flow detention time= 27.4 min calculated for 68.3 m³ (100% of inflow)
Center-of-Mass det. time= 27.5 min (47.5 - 20.0)

Volume	Invert	Avail.Storage	Storage Description
#1	100.060 m	13.3 m³	**Roof drain 1 (Pyramidal)** Listed below (Recalc)
#2	100.000 m	24.2 m³	**Roof drain 2 (Pyramidal)** Listed below (Recalc)
#3	100.080 m	8.3 m³	**Roof drain 3 (Pyramidal)** Listed below (Recalc)
#4	100.000 m	25.2 m³	**Roof drain 4 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	24.4 m³	**Roof drain 5 (Pyramidal)** Listed below (Recalc)
#6	100.000 m	23.2 m³	**Roof drain 6 (Pyramidal)** Listed below (Recalc)
#7	100.000 m	23.3 m³	**Roof drain 7 (Pyramidal)** Listed below (Recalc)
#8	100.000 m	22.8 m³	**Roof drain 8 (Pyramidal)** Listed below (Recalc)
#9	100.080 m	4.5 m³	**Roof drain 9 (Pyramidal)** Listed below (Recalc)
#10	100.080 m	6.6 m³	**Roof drain 10 (Pyramidal)** Listed below (Recalc)
		175.8 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	74.0	2.2	2.2	74.0
100.300	74.0	11.1	13.3	79.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	121.0	6.1	6.1	121.0
100.300	121.0	18.1	24.2	127.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	48.0	1.1	1.1	48.0
100.300	48.0	7.2	8.3	52.2

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	126.0	6.3	6.3	126.0
100.300	126.0	18.9	25.2	132.8

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	122.0	6.1	6.1	122.0
100.300	122.0	18.3	24.4	128.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.0	5.8	5.8	116.0
100.300	116.0	17.4	23.2	122.5

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	116.5	5.8	5.8	116.5
100.300	116.5	17.5	23.3	123.0

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	114.0	5.7	5.7	114.0
100.300	114.0	17.1	22.8	120.5

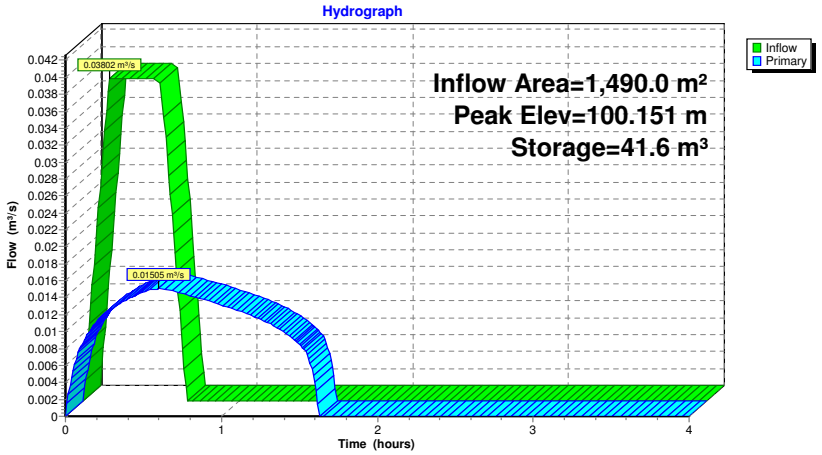
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	26.0	0.6	0.6	26.0
100.300	26.0	3.9	4.5	29.1

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.080	0.0	0.0	0.0	0.0
100.150	38.0	0.9	0.9	38.0
100.300	38.0	5.7	6.6	41.7

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.5 X 12.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000790 0.000950 0.001100 0.001260

Primary OutFlow Max=0.01505 m³/s @ 0.60 hrs HW=100.151 m (Free Discharge)
↳**1=WATTS Accutrol_5-0.5** (Custom Controls 0.01505 m³/s)

Pond 10P: Bldg1 Roof



Summary for Pond 11P: Bldg2 Roof

Inflow Area = 540.0 m²,100.00% Impervious, Inflow Depth = 46 mm for 100-Year event
Inflow = 0.01378 m³/s @ 0.17 hrs, Volume= 24.8 m³
Outflow = 0.00541 m³/s @ 0.60 hrs, Volume= 24.8 m³, Atten= 61%, Lag= 25.9 min
Primary = 0.00541 m³/s @ 0.60 hrs, Volume= 24.8 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 100.137 m @ 0.60 hrs Surf.Area= 399.6 m² Storage= 14.4 m³

Plug-Flow detention time= 24.7 min calculated for 24.8 m³ (100% of inflow)
Center-of-Mass det. time= 24.7 min (44.8 - 20.0)

Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	24.0 m³	**Roof drain 13 (Pyramidal)** Listed below (Recalc)
#2	100.060 m	11.0 m³	**Roof drain 14 (Pyramidal)** Listed below (Recalc)
#3	100.060 m	11.7 m³	**Roof drain 15 (Pyramidal)** Listed below (Recalc)
#4	100.060 m	11.5 m³	**Roof drain 16 (Pyramidal)** Listed below (Recalc)
#5	100.000 m	26.2 m³	**Roof drain 17 (Pyramidal)** Listed below (Recalc)
#6	100.060 m	13.0 m³	**Roof drain 18 (Pyramidal)** Listed below (Recalc)
		97.4 m³	Total Available Storage

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	120.0	6.0	6.0	120.0
100.300	120.0	18.0	24.0	126.6

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	61.0	1.8	1.8	61.0
100.300	61.0	9.1	11.0	65.7

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	65.0	2.0	2.0	65.0
100.300	65.0	9.7	11.7	69.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	64.0	1.9	1.9	64.0
100.300	64.0	9.6	11.5	68.8

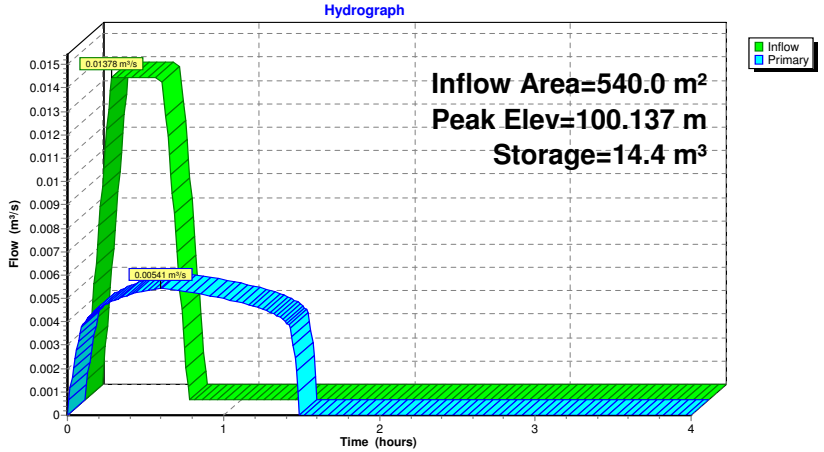
Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	131.0	6.6	6.6	131.0
100.300	131.0	19.6	26.2	137.9

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.060	0.0	0.0	0.0	0.0
100.150	72.0	2.2	2.2	72.0
100.300	72.0	10.8	13.0	77.1

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-0.25 X 6.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000310 0.000630 0.000710 0.000790 0.000870 0.000950

Primary OutFlow Max=0.00541 m³/s @ 0.60 hrs HW=100.137 m (Free Discharge)
↑**1=WATTS Accutrol_5-0.25** (Custom Controls 0.00541 m³/s)

Pond 11P: Bldg2 Roof



Summary for Pond 28P: Cistern

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 1,740.0 m², 7.47% Impervious, Inflow Depth = 38 mm for 100-Year event
Inflow = 0.03660 m³/s @ 0.17 hrs, Volume= 65.9 m³
Outflow = 0.00847 m³/s @ 0.63 hrs, Volume= 50.8 m³, Atten= 77%, Lag= 27.5 min
Primary = 0.00847 m³/s @ 0.63 hrs, Volume= 50.8 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.145 m @ 0.63 hrs Surf.Area= 0.0 m² Storage= 55.9 m³

Plug-Flow detention time= 66.0 min calculated for 50.6 m³ (77% of inflow)
Center-of-Mass det. time= 62.7 min (82.7 - 20.0)

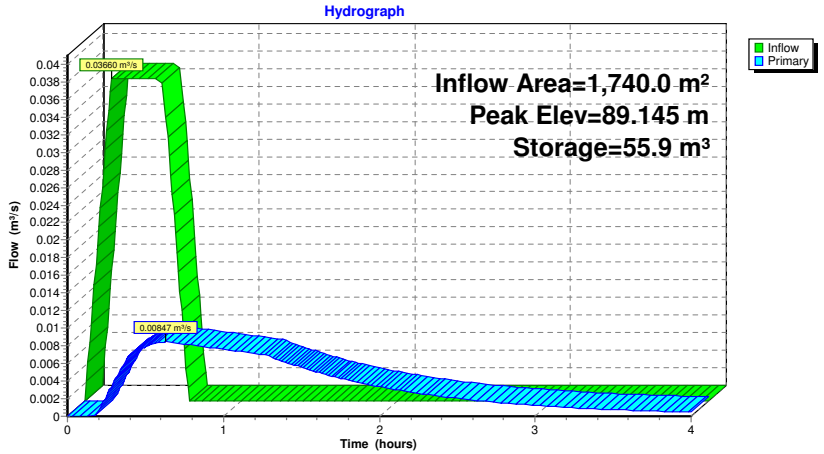
Volume	Invert	Avail.Storage	Storage Description
#1	88.467 m	68.5 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.467	0.0
89.297	68.5

Device	Routing	Invert	Outlet Devices
#1	Primary	88.435 m	**HYDROVEX 100-VHV-1** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00847 m³/s @ 0.63 hrs HW=89.145 m (Free Discharge)
↑—**1=HYDROVEX 100-VHV-1** (Custom Controls 0.00847 m³/s)

Pond 28P: Cistern

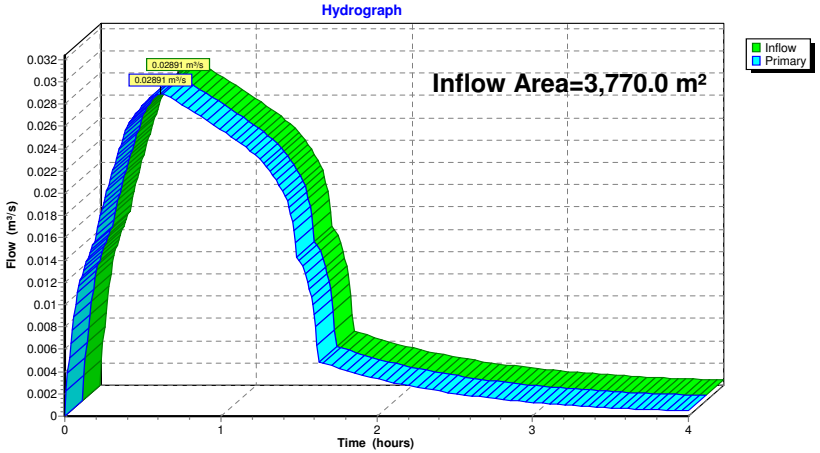


Summary for Link 29L: Teron Rd Storm Sewer

Inflow Area = 3,770.0 m², 57.29% Impervious, Inflow Depth > 38 mm for 100-Year event
Inflow = 0.02891 m³/s @ 0.61 hrs, Volume= 144.0 m³
Primary = 0.02891 m³/s @ 0.61 hrs, Volume= 144.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 29L: Teron Rd Storm Sewer



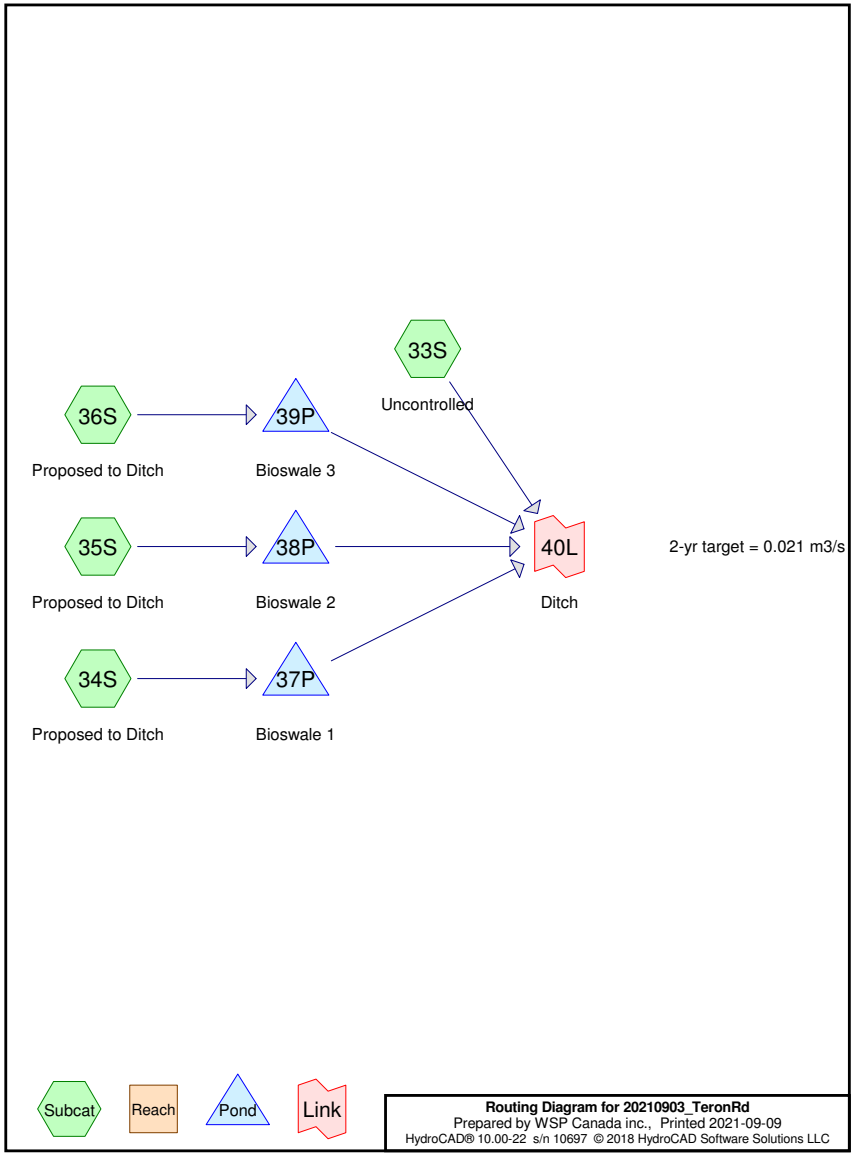
APPENDIX

D

HydroCAD Model Output – March Road Ditch

APPENDIX

D-1 2-Year Analysis (Peak Outflow, T_c = 165 Min)



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
135.5	0.87	(33S)
1,880.0	0.75	(34S)
1,220.0	0.78	(35S)
1,760.0	0.74	(36S)
4,995.5	**0.76**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 33S: Uncontrolled Runoff Area=135.5 m² 0.00% Impervious Runoff Depth=27 mm
Tc=10.0 min C=0.87 Runoff=0.00037 m³/s 3.7 m³

Subcatchment 34S: Proposed to Ditch Runoff Area=1,880.0 m² 0.00% Impervious Runoff Depth=23 mm
Tc=10.0 min C=0.75 Runoff=0.00446 m³/s 44.1 m³

Subcatchment 35S: Proposed to Ditch Runoff Area=1,220.0 m² 0.00% Impervious Runoff Depth=24 mm
Tc=10.0 min C=0.78 Runoff=0.00301 m³/s 29.8 m³

Subcatchment 36S: Proposed to Ditch Runoff Area=1,760.0 m² 0.00% Impervious Runoff Depth=23 mm
Tc=10.0 min C=0.74 Runoff=0.00412 m³/s 40.7 m³

Pond 37P: Bioswale 1 Peak Elev=89.637 m Storage=41.0 m³ Inflow=0.00446 m³/s 44.1 m³
Outflow=0.00341 m³/s 5.5 m³

Pond 38P: Bioswale 2 Peak Elev=89.634 m Storage=27.0 m³ Inflow=0.00301 m³/s 29.8 m³
Outflow=0.00285 m³/s 3.6 m³

Pond 39P: Bioswale 3 Peak Elev=89.640 m Storage=36.8 m³ Inflow=0.00412 m³/s 40.7 m³
Outflow=0.00392 m³/s 5.2 m³

Link 40L: Ditch Inflow=0.01046 m³/s 18.0 m³
Primary=0.01046 m³/s 18.0 m³

Total Runoff Area = 4,995.5 m² Runoff Volume = 118.3 m³ Average Runoff Depth = 24 mm
100.00% Pervious = 4,995.5 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 33S: Uncontrolled

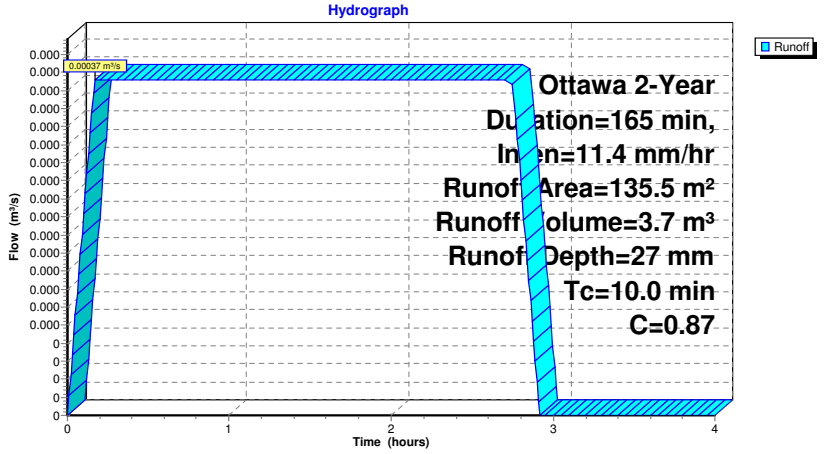
Runoff = 0.00037 m³/s @ 0.17 hrs, Volume= 3.7 m³, Depth= 27 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 2-Year Duration=165 min, Inten=11.4 mm/hr

Area (m²)	C	Description
135.5	0.87	
135.5		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 33S: Uncontrolled



Summary for Subcatchment 34S: Proposed to Ditch

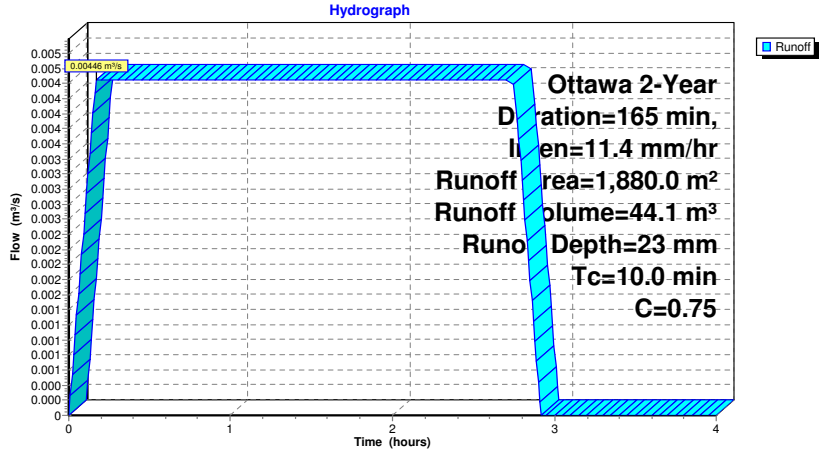
Runoff = 0.00446 m³/s @ 0.17 hrs, Volume= 44.1 m³, Depth= 23 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 2-Year Duration=165 min, Inten=11.4 mm/hr

Area (m²)	C	Description
1,880.0	0.75	
1,880.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 34S: Proposed to Ditch



Summary for Subcatchment 35S: Proposed to Ditch

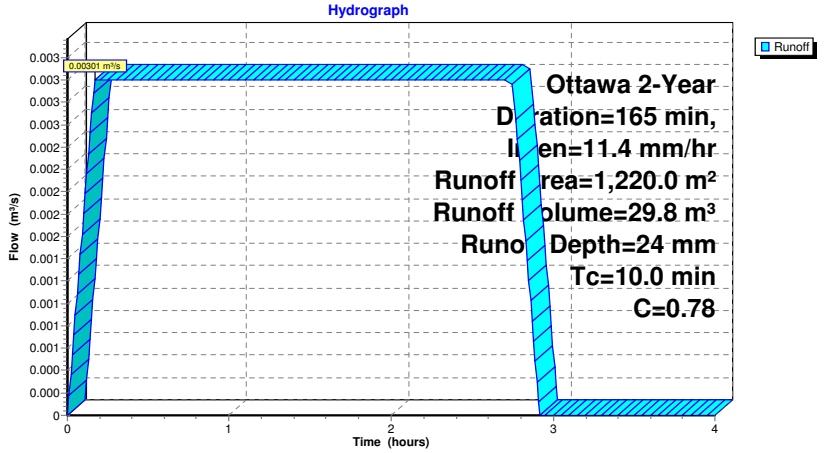
Runoff = 0.00301 m³/s @ 0.17 hrs, Volume= 29.8 m³, Depth= 24 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 2-Year Duration=165 min, Inten=11.4 mm/hr

Area (m²)	C	Description
1,220.0	0.78	
1,220.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 35S: Proposed to Ditch



Summary for Subcatchment 36S: Proposed to Ditch

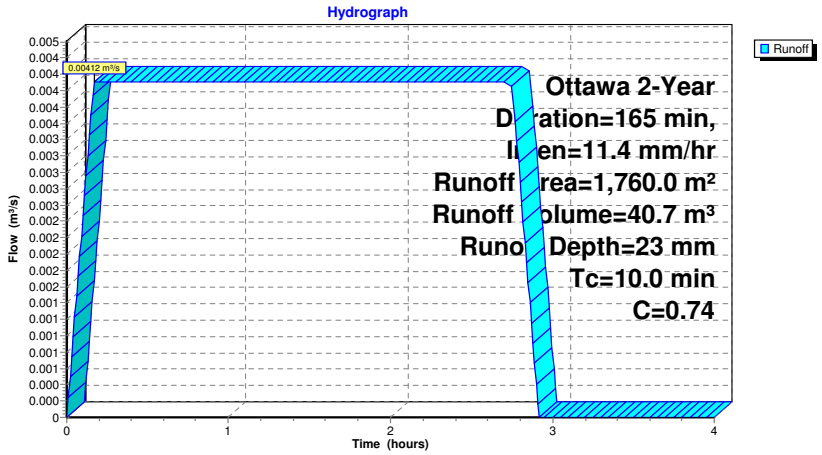
Runoff = 0.00412 m³/s @ 0.17 hrs, Volume= 40.7 m³, Depth= 23 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 2-Year Duration=165 min, Inten=11.4 mm/hr

Area (m²)	C	Description
1,760.0	0.74	
1,760.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 36S: Proposed to Ditch



Summary for Pond 37P: Bioswale 1

Inflow Area = 1,880.0 m², 0.00% Impervious, Inflow Depth = 23 mm for 2-Year event
Inflow = 0.00446 m³/s @ 0.17 hrs, Volume= 44.1 m³
Outflow = 0.00341 m³/s @ 2.79 hrs, Volume= 5.5 m³, Atten= 24%, Lag= 157.2 min
Primary = 0.00341 m³/s @ 2.79 hrs, Volume= 5.5 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.637 m @ 2.79 hrs Surf.Area= 0.0 m² Storage= 41.0 m³

Plug-Flow detention time= 156.1 min calculated for 5.4 m³ (12% of inflow)
Center-of-Mass det. time= 83.9 min (171.4 - 87.5)

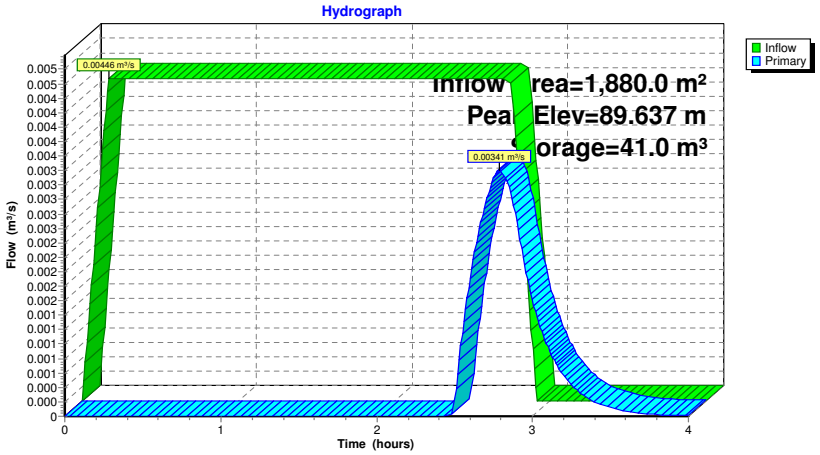
Volume	Invert	Avail.Storage	Storage Description
#1	88.700 m	182.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.700	0.0
89.050	8.0
89.200	12.0
89.550	29.0
90.000	91.0
91.000	182.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.700 m	**HYDROVEX 100-VHV-1 X 0.80** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00341 m³/s @ 2.79 hrs HW=89.637 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Passes 0.00341 m³/s of 0.00805 m³/s potential flow)
└**1=Single OPSD 400.01** (Custom Controls 0.00341 m³/s)

Pond 37P: Bioswale 1



Summary for Pond 38P: Bioswale 2

Inflow Area = 1,220.0 m², 0.00% Impervious, Inflow Depth = 24 mm for 2-Year event
Inflow = 0.00301 m³/s @ 0.17 hrs, Volume= 29.8 m³
Outflow = 0.00285 m³/s @ 2.76 hrs, Volume= 3.6 m³, Atten= 5%, Lag= 155.4 min
Primary = 0.00285 m³/s @ 2.76 hrs, Volume= 3.6 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.634 m @ 2.76 hrs Surf.Area= 0.0 m² Storage= 27.0 m³

Plug-Flow detention time= 150.5 min calculated for 3.6 m³ (12% of inflow)
Center-of-Mass det. time= 77.9 min (165.4 - 87.5)

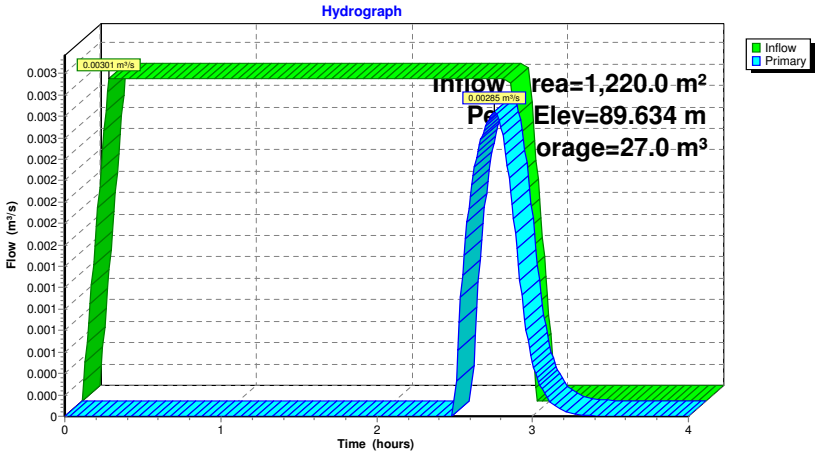
Volume	Invert	Avail.Storage	Storage Description
#1	88.641 m	100.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.641	0.0
88.990	6.0
89.140	8.0
89.490	18.0
90.000	50.0
91.000	100.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.400 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000 0.200000
#2	Primary	88.641 m	**HYDROVEX 100-VHV-1 X 0.85** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00284 m³/s @ 2.76 hrs HW=89.634 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Passes 0.00284 m³/s of 0.00888 m³/s potential flow)
└**1=Single OPSD 400.01** (Custom Controls 0.00284 m³/s)

Pond 38P: Bioswale 2



Summary for Pond 39P: Bioswale 3

Inflow Area = 1,760.0 m², 0.00% Impervious, Inflow Depth = 23 mm for 2-Year event
Inflow = 0.00412 m³/s @ 0.17 hrs, Volume= 40.7 m³
Outflow = 0.00392 m³/s @ 2.76 hrs, Volume= 5.2 m³, Atten= 5%, Lag= 155.3 min
Primary = 0.00392 m³/s @ 2.76 hrs, Volume= 5.2 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.640 m @ 2.76 hrs Surf.Area= 0.0 m² Storage= 36.8 m³

Plug-Flow detention time= 149.4 min calculated for 5.2 m³ (13% of inflow)
Center-of-Mass det. time= 77.5 min (165.0 - 87.5)

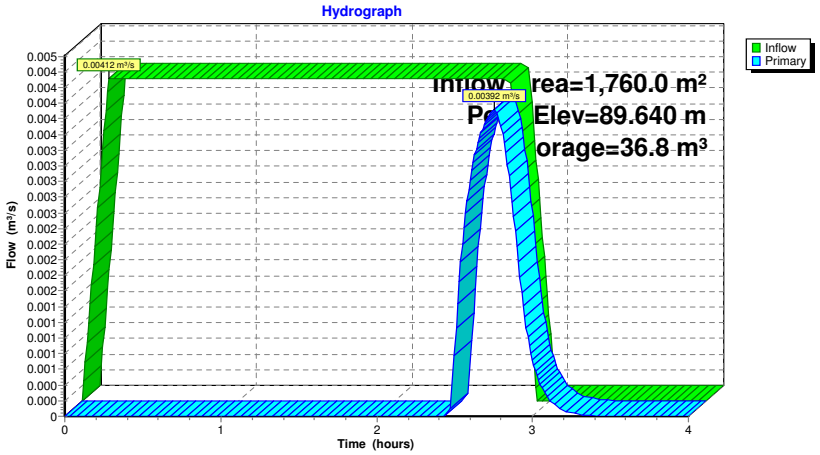
Volume	Invert	Avail.Storage	Storage Description
#1	88.555 m	120.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.555	0.0
88.910	7.0
89.060	10.0
89.410	22.0
90.000	60.0
91.000	120.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.555 m	**HYDROVEX 125-VHV-2 X 0.85** Head (meters) 0.000 0.200 0.600 1.000 1.500 2.000 2.500 3.500 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.014000 0.018500 0.023000 0.027000 0.030000 0.035500 0.040000 0.046000

Primary OutFlow Max=0.00392 m³/s @ 2.76 hrs HW=89.640 m (Free Discharge)
↑└**2=HYDROVEX 125-VHV-2** (Passes 0.00392 m³/s of 0.01637 m³/s potential flow)
↑└**1=Single OPSD 400.01** (Custom Controls 0.00392 m³/s)

Pond 39P: Bioswale 3

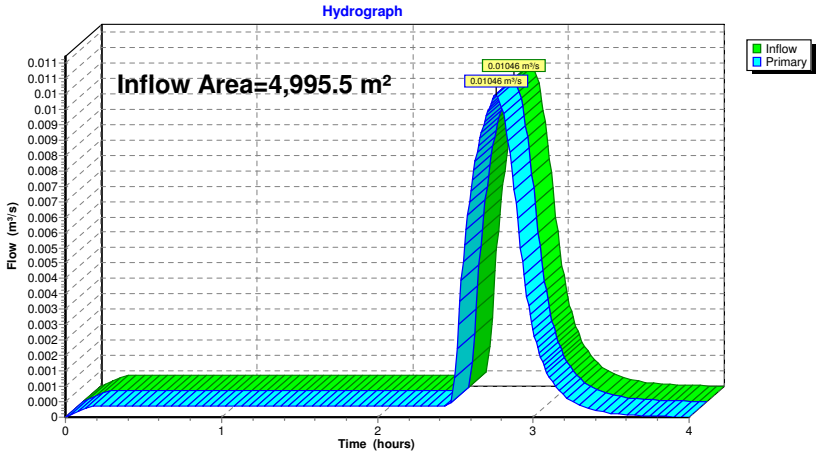


Summary for Link 40L: Ditch

Inflow Area = 4,995.5 m², 0.00% Impervious, Inflow Depth > 4 mm for 2-Year event
Inflow = 0.01046 m³/s @ 2.76 hrs, Volume= 18.0 m³
Primary = 0.01046 m³/s @ 2.76 hrs, Volume= 18.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

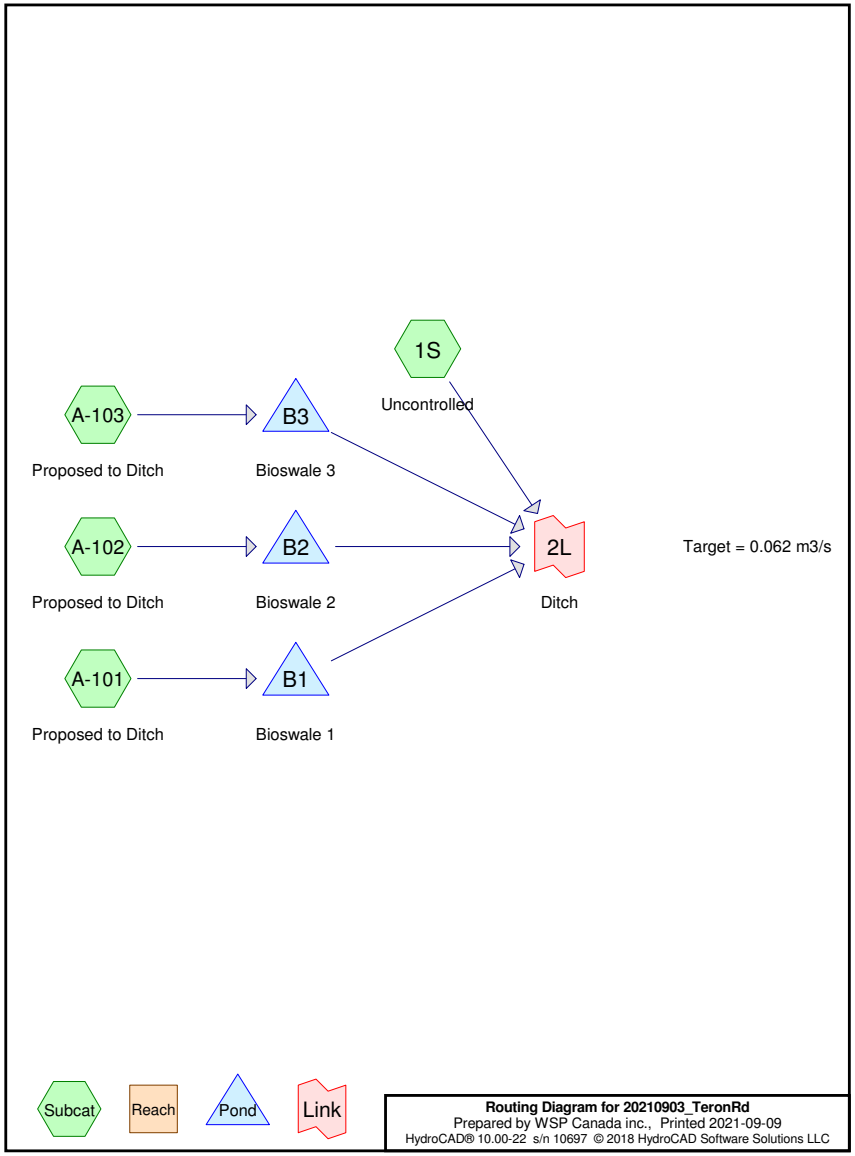
Link 40L: Ditch



APPENDIX

D-2 100-Year Analysis (Peak Outflow, T_C = 36 Min)

The storm system for the site is governed by the 100-year storm. Peak storage for each storage unit and peak discharge occur at separate times of concentration and are therefore reported separately.



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
135.5	0.87	(1S)
1,880.0	0.94	(A-101)
1,220.0	0.97	(A-102)
1,760.0	0.93	(A-103)
4,995.5	**0.94**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled Runoff Area=135.5 m² 0.00% Impervious Runoff Depth=42 mm
Tc=10.0 min C=0.87 Runoff=0.00265 m³/s 5.7 m³

Subcatchment A-101: Proposed to Ditch Runoff Area=1,880.0 m² 0.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=0.94 Runoff=0.03974 m³/s 85.8 m³

Subcatchment A-102: Proposed to Runoff Area=1,220.0 m² 100.00% Impervious Runoff Depth=47 mm
Tc=10.0 min C=0.97 Runoff=0.02661 m³/s 57.5 m³

Subcatchment A-103: Proposed to Ditch Runoff Area=1,760.0 m² 0.00% Impervious Runoff Depth=45 mm
Tc=10.0 min C=0.93 Runoff=0.03681 m³/s 79.5 m³

Pond B1: Bioswale 1 Peak Elev=89.878 m Storage=74.2 m³ Inflow=0.03974 m³/s 85.8 m³
Outflow=0.00897 m³/s 47.2 m³

Pond B2: Bioswale 2 Peak Elev=89.921 m Storage=45.1 m³ Inflow=0.02661 m³/s 57.5 m³
Outflow=0.00988 m³/s 31.3 m³

Pond B3: Bioswale 3 Peak Elev=89.952 m Storage=56.9 m³ Inflow=0.03681 m³/s 79.5 m³
Outflow=0.01876 m³/s 44.0 m³

Link 2L: Ditch Inflow=0.03961 m³/s 128.2 m³
Primary=0.03961 m³/s 128.2 m³

Total Runoff Area = 4,995.5 m² Runoff Volume = 228.6 m³ Average Runoff Depth = 46 mm
75.58% Pervious = 3,775.5 m² 24.42% Impervious = 1,220.0 m²

Summary for Subcatchment 1S: Uncontrolled

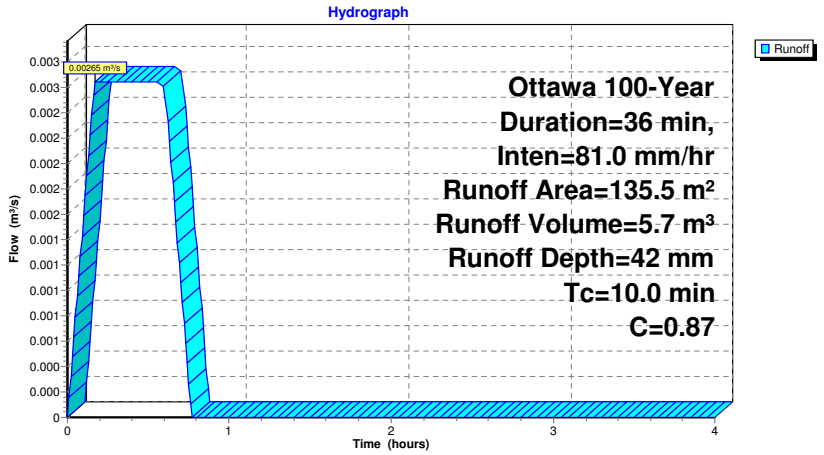
Runoff = 0.00265 m³/s @ 0.17 hrs, Volume= 5.7 m³, Depth= 42 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
135.5	0.87	
135.5		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Uncontrolled



Summary for Subcatchment A-101: Proposed to Ditch

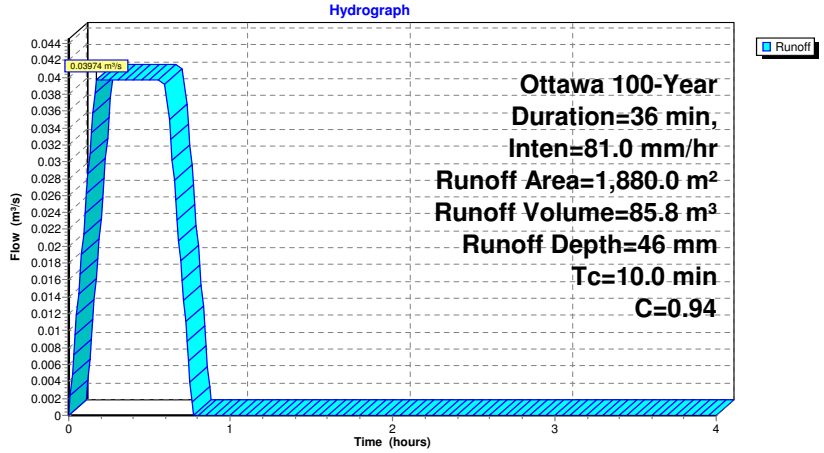
Runoff = 0.03974 m³/s @ 0.17 hrs, Volume= 85.8 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
1,880.0	0.94	
1,880.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-101: Proposed to Ditch



Summary for Subcatchment A-102: Proposed to Ditch

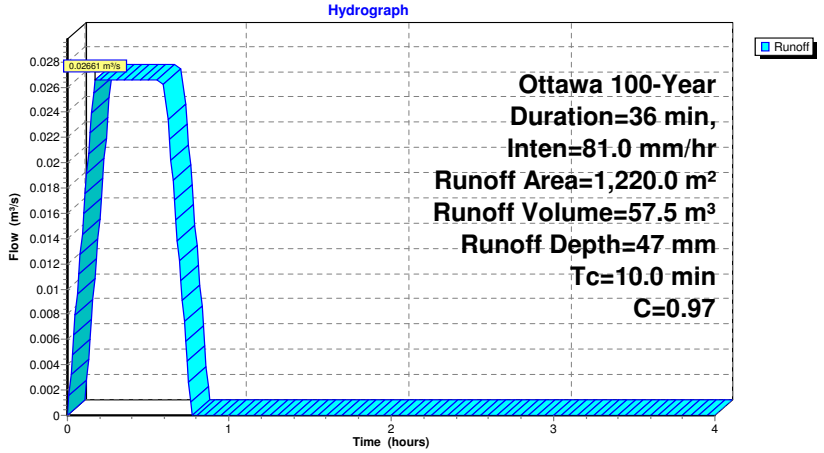
Runoff = 0.02661 m³/s @ 0.17 hrs, Volume= 57.5 m³, Depth= 47 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
1,220.0	0.97	
1,220.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-102: Proposed to Ditch



Summary for Subcatchment A-103: Proposed to Ditch

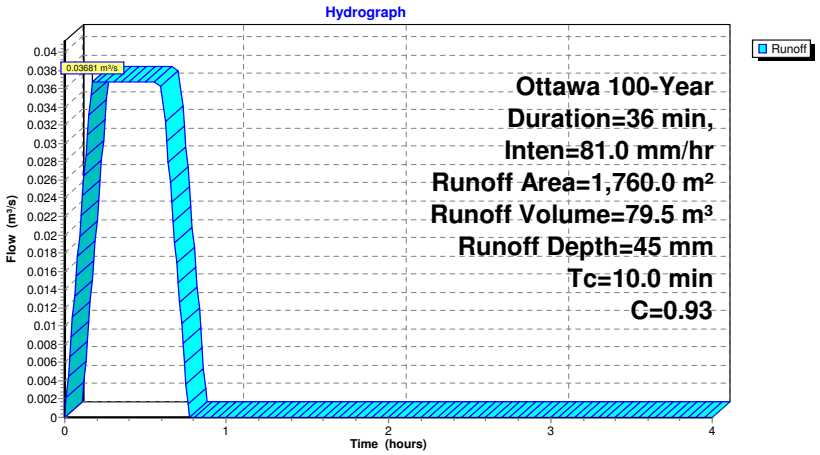
Runoff = 0.03681 m³/s @ 0.17 hrs, Volume= 79.5 m³, Depth= 45 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
1,760.0	0.93	
1,760.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-103: Proposed to Ditch



Summary for Pond B1: Bioswale 1

Inflow Area = 1,880.0 m², 0.00% Impervious, Inflow Depth = 46 mm for 100-Year event
Inflow = 0.03974 m³/s @ 0.17 hrs, Volume= 85.8 m³
Outflow = 0.00897 m³/s @ 0.73 hrs, Volume= 47.2 m³, Atten= 77%, Lag= 33.5 min
Primary = 0.00897 m³/s @ 0.73 hrs, Volume= 47.2 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.878 m @ 0.73 hrs Surf.Area= 0.0 m² Storage= 74.2 m³

Plug-Flow detention time= 53.9 min calculated for 47.2 m³ (55% of inflow)
Center-of-Mass det. time= 45.6 min (68.6 - 23.0)

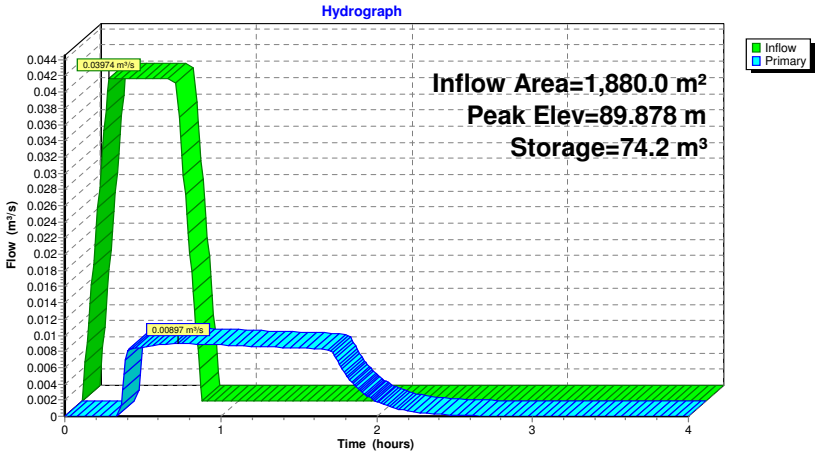
Volume	Invert	Avail.Storage	Storage Description
#1	88.700 m	182.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.700	0.0
89.050	8.0
89.200	12.0
89.550	29.0
90.000	91.0
91.000	182.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.700 m	**HYDROVEX 100-VHV-1 X 0.80** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00897 m³/s @ 0.73 hrs HW=89.878 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00897 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00897 m³/s of 0.18323 m³/s potential flow)

Pond B1: Bioswale 1



Summary for Pond B2: Bioswale 2

Inflow Area = 1,220.0 m², 100.00% Impervious, Inflow Depth = 47 mm for 100-Year event
Inflow = 0.02661 m³/s @ 0.17 hrs, Volume= 57.5 m³
Outflow = 0.00988 m³/s @ 0.70 hrs, Volume= 31.3 m³, Atten= 63%, Lag= 32.1 min
Primary = 0.00988 m³/s @ 0.70 hrs, Volume= 31.3 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.921 m @ 0.70 hrs Surf.Area= 0.0 m² Storage= 45.1 m³

Plug-Flow detention time= 35.4 min calculated for 31.3 m³ (54% of inflow)
Center-of-Mass det. time= 27.1 min (50.1 - 23.0)

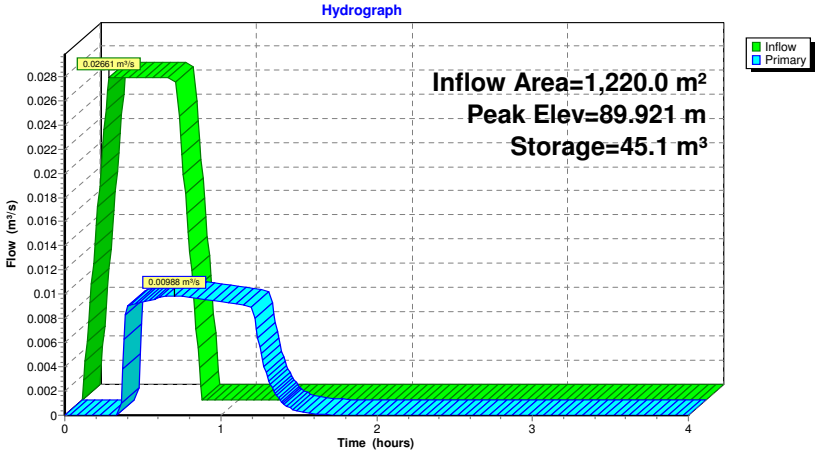
Volume	Invert	Avail.Storage	Storage Description
#1	88.641 m	100.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.641	0.0
88.990	6.0
89.140	8.0
89.490	18.0
90.000	50.0
91.000	100.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.400 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000 0.200000
#2	Primary	88.641 m	**HYDROVEX 100-VHV-1 X 0.85** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00988 m³/s @ 0.70 hrs HW=89.921 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00988 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00988 m³/s of 0.20000 m³/s potential flow)

Pond B2: Bioswale 2



Summary for Pond B3: Bioswale 3

Inflow Area = 1,760.0 m², 0.00% Impervious, Inflow Depth = 45 mm for 100-Year event
Inflow = 0.03681 m³/s @ 0.17 hrs, Volume= 79.5 m³
Outflow = 0.01876 m³/s @ 0.68 hrs, Volume= 44.0 m³, Atten= 49%, Lag= 30.7 min
Primary = 0.01876 m³/s @ 0.68 hrs, Volume= 44.0 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.952 m @ 0.68 hrs Surf.Area= 0.0 m² Storage= 56.9 m³

Plug-Flow detention time= 28.5 min calculated for 43.9 m³ (55% of inflow)
Center-of-Mass det. time= 20.3 min (43.3 - 23.0)

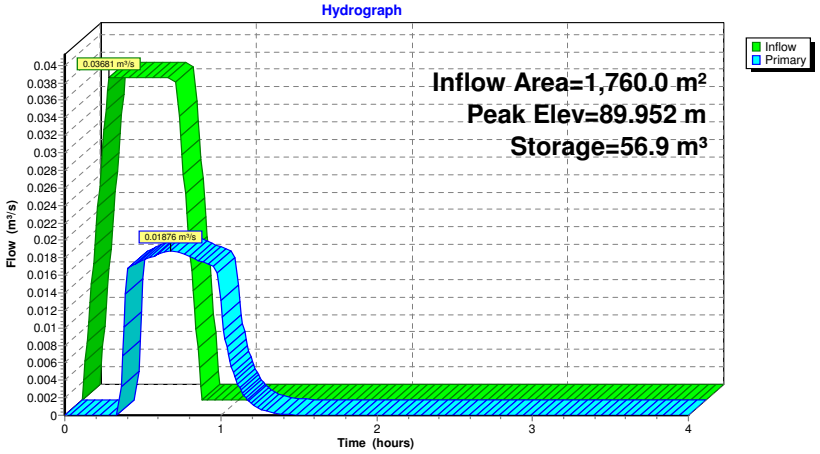
Volume	Invert	Avail.Storage	Storage Description
#1	88.555 m	120.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.555	0.0
88.910	7.0
89.060	10.0
89.410	22.0
90.000	60.0
91.000	120.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.555 m	**HYDROVEX 125-VHV-2 X 0.85** Head (meters) 0.000 0.200 0.600 1.000 1.500 2.000 2.500 3.500 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.014000 0.018500 0.023000 0.027000 0.030000 0.035500 0.040000 0.046000

Primary OutFlow Max=0.01876 m³/s @ 0.68 hrs HW=89.952 m (Free Discharge)
↑└**2=HYDROVEX 125-VHV-2** (Custom Controls 0.01876 m³/s)
↑└**1=Single OPSD 400.01** (Passes 0.01876 m³/s of 0.21283 m³/s potential flow)

Pond B3: Bioswale 3

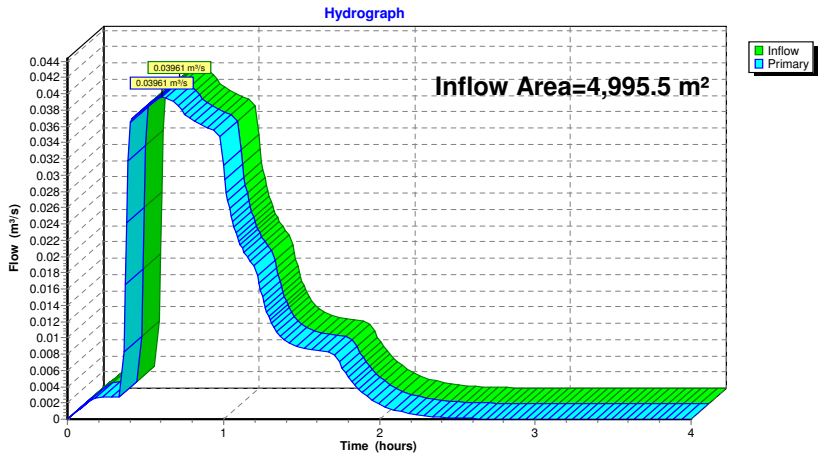


Summary for Link 2L: Ditch

Inflow Area = 4,995.5 m², 24.42% Impervious, Inflow Depth = 26 mm for 100-Year event
Inflow = 0.03961 m³/s @ 0.60 hrs, Volume= 128.2 m³
Primary = 0.03961 m³/s @ 0.60 hrs, Volume= 128.2 m³, Atten= 0%, Lag= 0.0 min

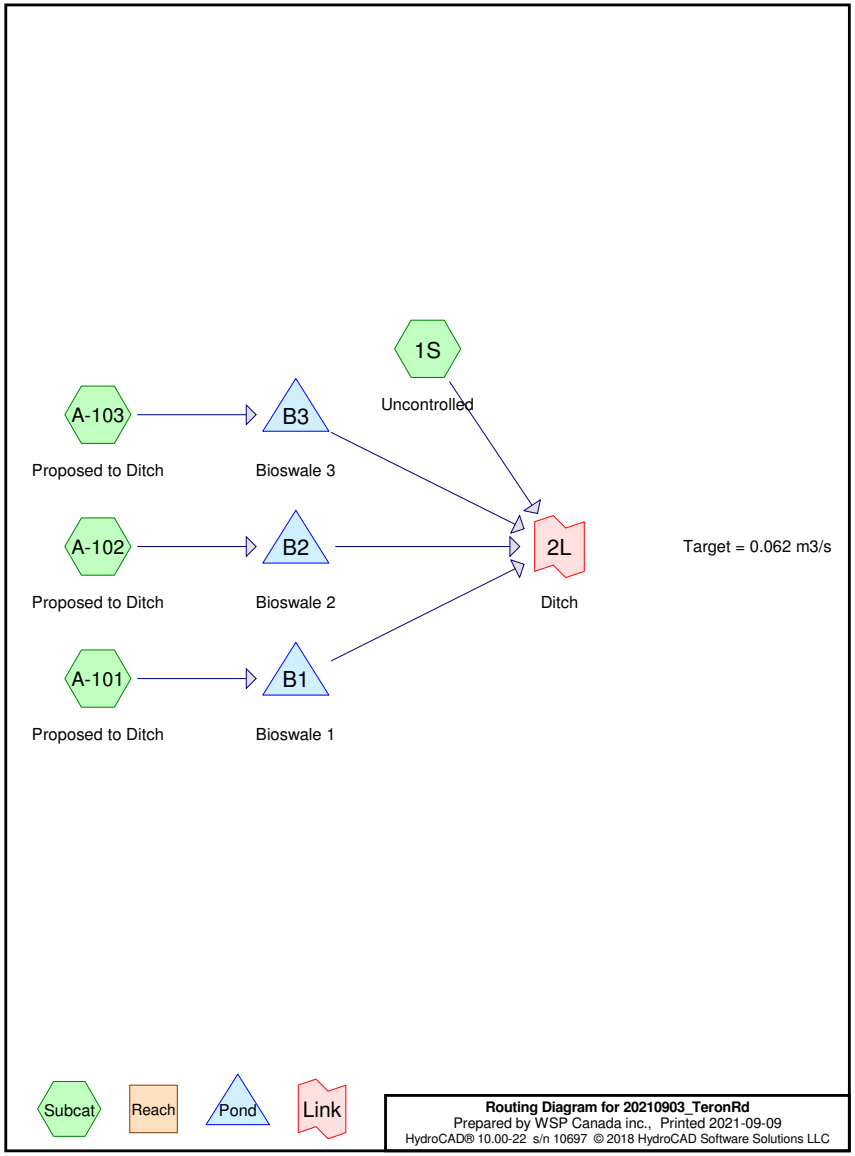
Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 2L: Ditch



APPENDIX

D-3 100-Year Analysis (Peak Storage Bioswale 1, T_C = 72 Min)



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
135.5	0.87	(1S)
1,880.0	0.94	(A-101)
1,220.0	0.97	(A-102)
1,760.0	0.93	(A-103)
4,995.5	**0.94**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled Runoff Area=135.5 m² 0.00% Impervious Runoff Depth=51 mm
Tc=10.0 min C=0.87 Runoff=0.00160 m³/s 6.9 m³

Subcatchment A-101: Proposed to Ditch Runoff Area=1,880.0 m² 0.00% Impervious Runoff Depth=55 mm
Tc=10.0 min C=0.94 Runoff=0.02393 m³/s 103.4 m³

Subcatchment A-102: Proposed to Runoff Area=1,220.0 m² 100.00% Impervious Runoff Depth=57 mm
Tc=10.0 min C=0.97 Runoff=0.01602 m³/s 69.2 m³

Subcatchment A-103: Proposed to Ditch Runoff Area=1,760.0 m² 0.00% Impervious Runoff Depth=54 mm
Tc=10.0 min C=0.93 Runoff=0.02216 m³/s 95.7 m³

Pond B1: Bioswale 1 Peak Elev=89.916 m Storage=79.4 m³ Inflow=0.02393 m³/s 103.4 m³
Outflow=0.00909 m³/s 64.7 m³

Pond B2: Bioswale 2 Peak Elev=89.902 m Storage=43.8 m³ Inflow=0.01602 m³/s 69.2 m³
Outflow=0.00981 m³/s 43.1 m³

Pond B3: Bioswale 3 Peak Elev=89.849 m Storage=50.3 m³ Inflow=0.02216 m³/s 95.7 m³
Outflow=0.01797 m³/s 60.2 m³

Link 2L: Ditch Inflow=0.03834 m³/s 174.9 m³
Primary=0.03834 m³/s 174.9 m³

Total Runoff Area = 4,995.5 m² Runoff Volume = 275.2 m³ Average Runoff Depth = 55 mm
75.58% Pervious = 3,775.5 m² 24.42% Impervious = 1,220.0 m²

Summary for Subcatchment 1S: Uncontrolled

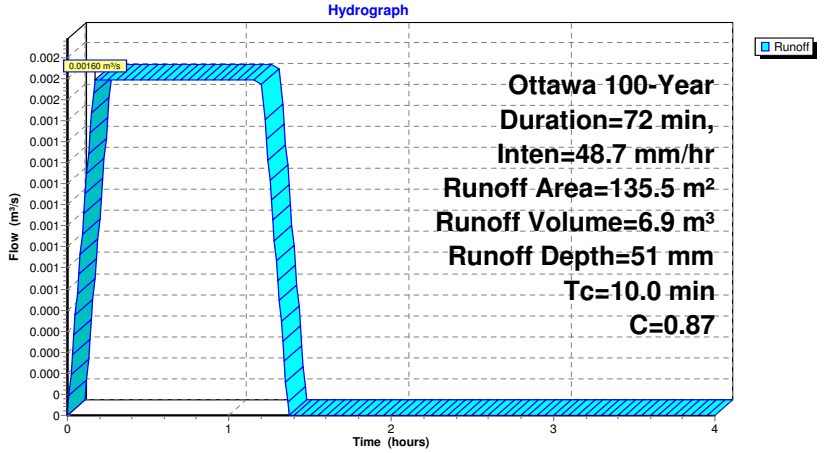
Runoff = 0.00160 m³/s @ 0.17 hrs, Volume= 6.9 m³, Depth= 51 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=72 min, Inten=48.7 mm/hr

Area (m²)	C	Description
135.5	0.87	
135.5		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Uncontrolled



Summary for Subcatchment A-101: Proposed to Ditch

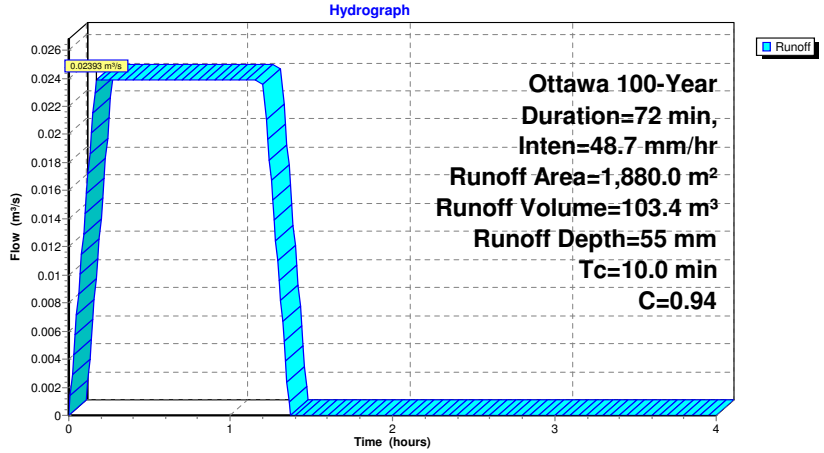
Runoff = 0.02393 m³/s @ 0.17 hrs, Volume= 103.4 m³, Depth= 55 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=72 min, Inten=48.7 mm/hr

Area (m²)	C	Description
1,880.0	0.94	
1,880.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-101: Proposed to Ditch



Summary for Subcatchment A-102: Proposed to Ditch

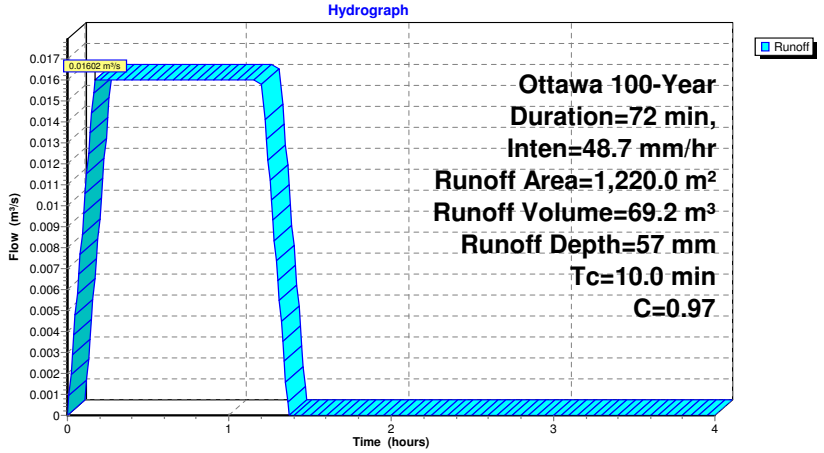
Runoff = 0.01602 m³/s @ 0.17 hrs, Volume= 69.2 m³, Depth= 57 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=72 min, Inten=48.7 mm/hr

Area (m²)	C	Description
1,220.0	0.97	
1,220.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-102: Proposed to Ditch



Summary for Subcatchment A-103: Proposed to Ditch

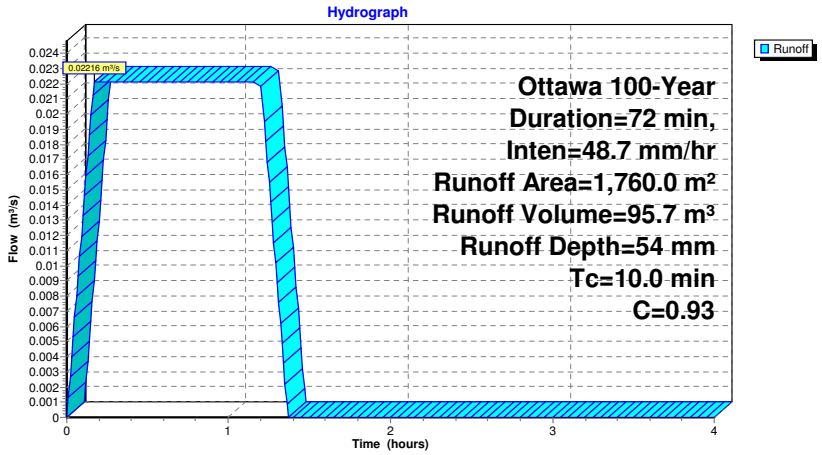
Runoff = 0.02216 m³/s @ 0.17 hrs, Volume= 95.7 m³, Depth= 54 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=72 min, Inten=48.7 mm/hr

Area (m²)	C	Description
1,760.0	0.93	
1,760.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-103: Proposed to Ditch



Summary for Pond B1: Bioswale 1

Inflow Area = 1,880.0 m², 0.00% Impervious, Inflow Depth = 55 mm for 100-Year event
Inflow = 0.02393 m³/s @ 0.17 hrs, Volume= 103.4 m³
Outflow = 0.00909 m³/s @ 1.30 hrs, Volume= 64.7 m³, Atten= 62%, Lag= 68.0 min
Primary = 0.00909 m³/s @ 1.30 hrs, Volume= 64.7 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.916 m @ 1.30 hrs Surf.Area= 0.0 m² Storage= 79.4 m³

Plug-Flow detention time= 69.2 min calculated for 64.7 m³ (63% of inflow)
Center-of-Mass det. time= 55.6 min (96.6 - 41.0)

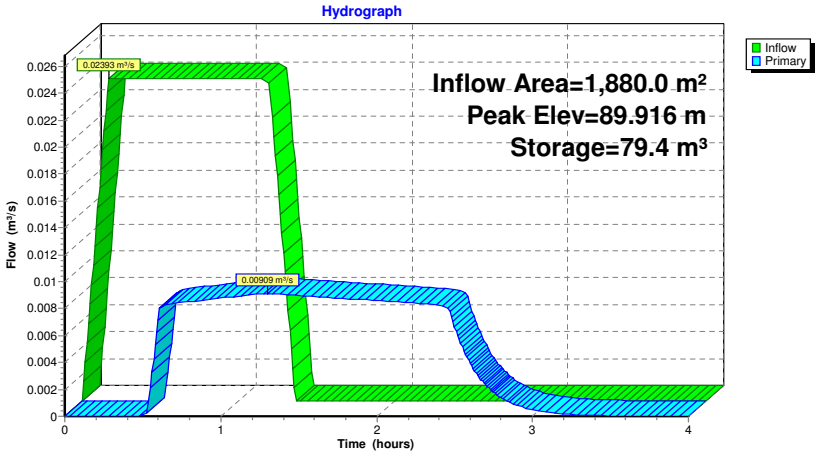
Volume	Invert	Avail.Storage	Storage Description
#1	88.700 m	182.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.700	0.0
89.050	8.0
89.200	12.0
89.550	29.0
90.000	91.0
91.000	182.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.700 m	**HYDROVEX 100-VHV-1 X 0.80** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00909 m³/s @ 1.30 hrs HW=89.916 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00909 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00909 m³/s of 0.19828 m³/s potential flow)

Pond B1: Bioswale 1



Summary for Pond B2: Bioswale 2

Inflow Area = 1,220.0 m², 100.00% Impervious, Inflow Depth = 57 mm for 100-Year event
Inflow = 0.01602 m³/s @ 0.17 hrs, Volume= 69.2 m³
Outflow = 0.00981 m³/s @ 1.26 hrs, Volume= 43.1 m³, Atten= 39%, Lag= 65.7 min
Primary = 0.00981 m³/s @ 1.26 hrs, Volume= 43.1 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.902 m @ 1.26 hrs Surf.Area= 0.0 m² Storage= 43.8 m³

Plug-Flow detention time= 45.3 min calculated for 43.1 m³ (62% of inflow)
Center-of-Mass det. time= 31.5 min (72.5 - 41.0)

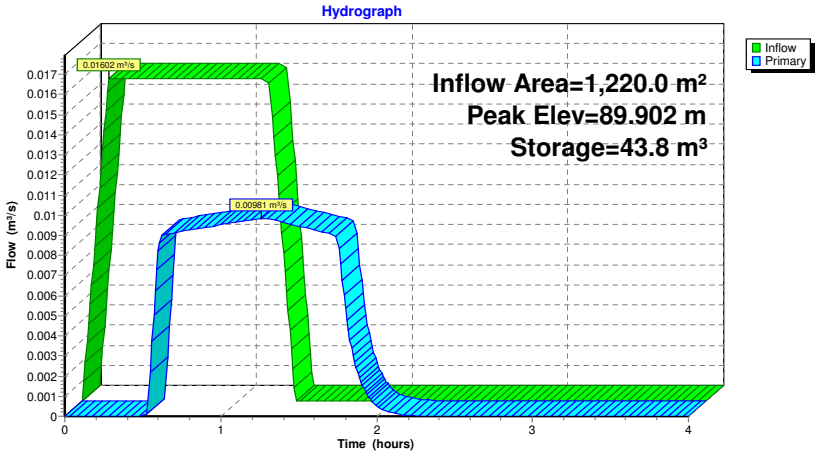
Volume	Invert	Avail.Storage	Storage Description
#1	88.641 m	100.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.641	0.0
88.990	6.0
89.140	8.0
89.490	18.0
90.000	50.0
91.000	100.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.400 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000 0.200000
#2	Primary	88.641 m	**HYDROVEX 100-VHV-1 X 0.85** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00981 m³/s @ 1.26 hrs HW=89.901 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00981 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00981 m³/s of 0.19259 m³/s potential flow)

Pond B2: Bioswale 2



Summary for Pond B3: Bioswale 3

Inflow Area = 1,760.0 m², 0.00% Impervious, Inflow Depth = 54 mm for 100-Year event
Inflow = 0.02216 m³/s @ 0.17 hrs, Volume= 95.7 m³
Outflow = 0.01797 m³/s @ 1.23 hrs, Volume= 60.2 m³, Atten= 19%, Lag= 63.7 min
Primary = 0.01797 m³/s @ 1.23 hrs, Volume= 60.2 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.849 m @ 1.23 hrs Surf.Area= 0.0 m² Storage= 50.3 m³

Plug-Flow detention time= 36.0 min calculated for 60.1 m³ (63% of inflow)
Center-of-Mass det. time= 22.7 min (63.7 - 41.0)

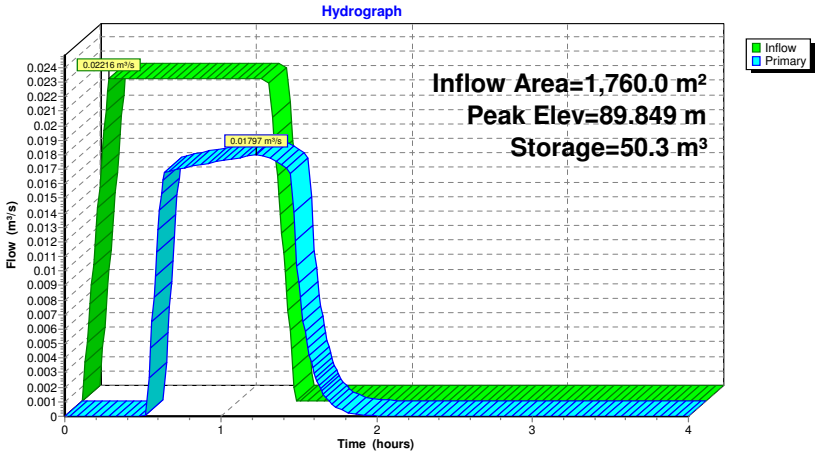
Volume	Invert	Avail.Storage	Storage Description
#1	88.555 m	120.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.555	0.0
88.910	7.0
89.060	10.0
89.410	22.0
90.000	60.0
91.000	120.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.555 m	**HYDROVEX 125-VHV-2 X 0.85** Head (meters) 0.000 0.200 0.600 1.000 1.500 2.000 2.500 3.500 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.014000 0.018500 0.023000 0.027000 0.030000 0.035500 0.040000 0.046000

Primary OutFlow Max=0.01797 m³/s @ 1.23 hrs HW=89.849 m (Free Discharge)
└**2=HYDROVEX 125-VHV-2** (Custom Controls 0.01797 m³/s)
└**1=Single OPSD 400.01** (Passes 0.01797 m³/s of 0.17157 m³/s potential flow)

Pond B3: Bioswale 3

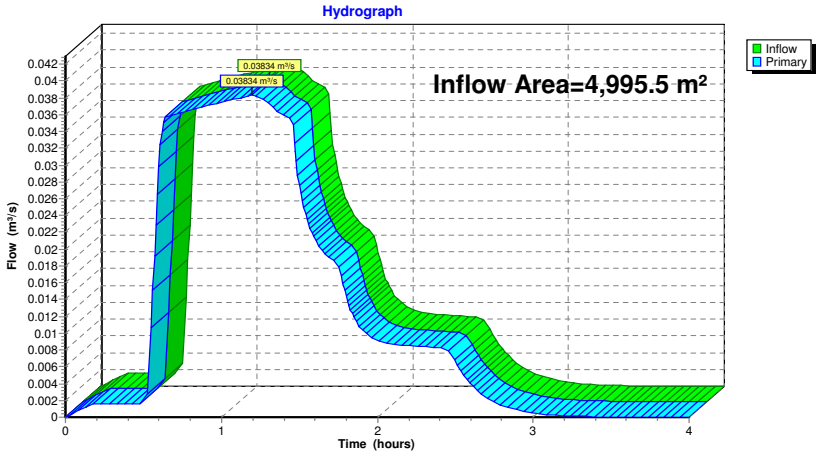


Summary for Link 2L: Ditch

Inflow Area = 4,995.5 m², 24.42% Impervious, Inflow Depth = 35 mm for 100-Year event
Inflow = 0.03834 m³/s @ 1.20 hrs, Volume= 174.9 m³
Primary = 0.03834 m³/s @ 1.20 hrs, Volume= 174.9 m³, Atten= 0%, Lag= 0.0 min

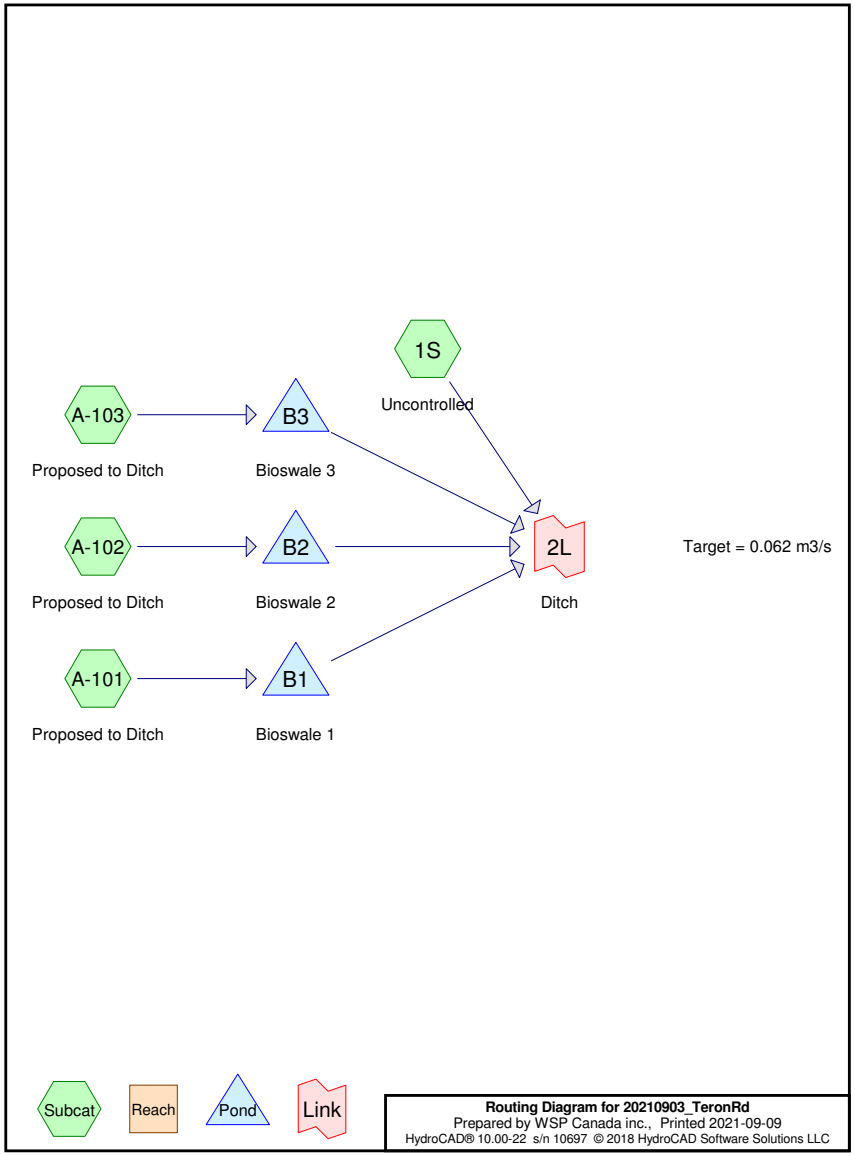
Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 2L: Ditch



APPENDIX

D-4 100-Year Analysis (Peak Storage Bioswale 2, T_C = 48 Min)



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
135.5	0.87	(1S)
1,880.0	0.94	(A-101)
1,220.0	0.97	(A-102)
1,760.0	0.93	(A-103)
4,995.5	**0.94**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled Runoff Area=135.5 m² 0.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=0.87 Runoff=0.00216 m³/s 6.2 m³

Subcatchment A-101: Proposed to Ditch Runoff Area=1,880.0 m² 0.00% Impervious Runoff Depth=50 mm
Tc=10.0 min C=0.94 Runoff=0.03234 m³/s 93.2 m³

Subcatchment A-102: Proposed to Runoff Area=1,220.0 m² 100.00% Impervious Runoff Depth=51 mm
Tc=10.0 min C=0.97 Runoff=0.02166 m³/s 62.4 m³

Subcatchment A-103: Proposed to Ditch Runoff Area=1,760.0 m² 0.00% Impervious Runoff Depth=49 mm
Tc=10.0 min C=0.93 Runoff=0.02996 m³/s 86.3 m³

Pond B1: Bioswale 1 Peak Elev=89.902 m Storage=77.5 m³ Inflow=0.03234 m³/s 93.2 m³
Outflow=0.00905 m³/s 54.5 m³

Pond B2: Bioswale 2 Peak Elev=89.931 m Storage=45.7 m³ Inflow=0.02166 m³/s 62.4 m³
Outflow=0.00991 m³/s 36.2 m³

Pond B3: Bioswale 3 Peak Elev=89.937 m Storage=56.0 m³ Inflow=0.02996 m³/s 86.3 m³
Outflow=0.01865 m³/s 50.8 m³

Link 2L: Ditch Inflow=0.03939 m³/s 147.7 m³
Primary=0.03939 m³/s 147.7 m³

Total Runoff Area = 4,995.5 m² Runoff Volume = 248.0 m³ Average Runoff Depth = 50 mm
75.58% Pervious = 3,775.5 m² 24.42% Impervious = 1,220.0 m²

Summary for Subcatchment 1S: Uncontrolled

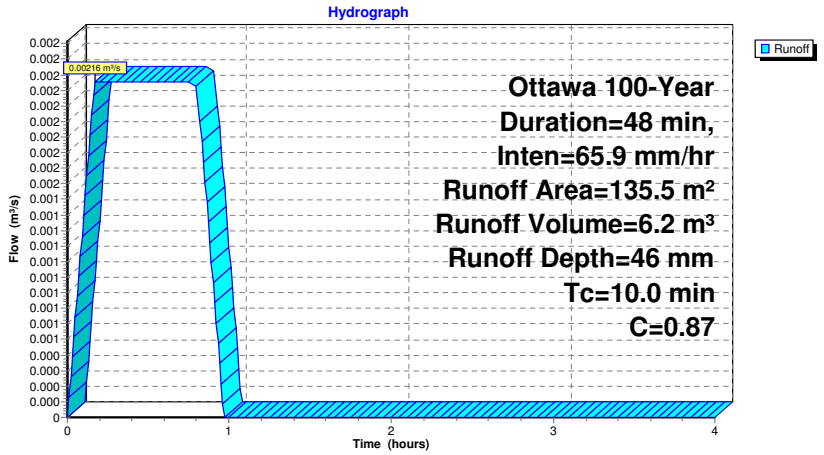
Runoff = 0.00216 m³/s @ 0.17 hrs, Volume= 6.2 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=48 min, Inten=65.9 mm/hr

Area (m²)	C	Description
135.5	0.87	
135.5		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Uncontrolled



Summary for Subcatchment A-101: Proposed to Ditch

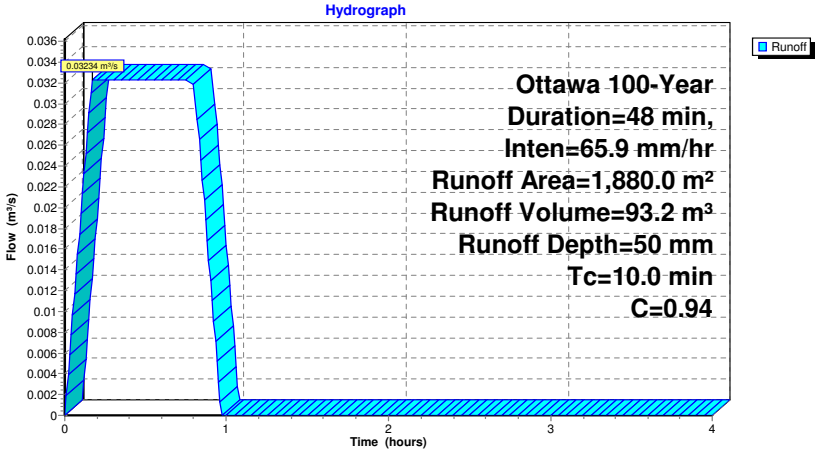
Runoff = 0.03234 m³/s @ 0.17 hrs, Volume= 93.2 m³, Depth= 50 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=48 min, Inten=65.9 mm/hr

Area (m²)	C	Description
1,880.0	0.94	
1,880.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-101: Proposed to Ditch



Summary for Subcatchment A-102: Proposed to Ditch

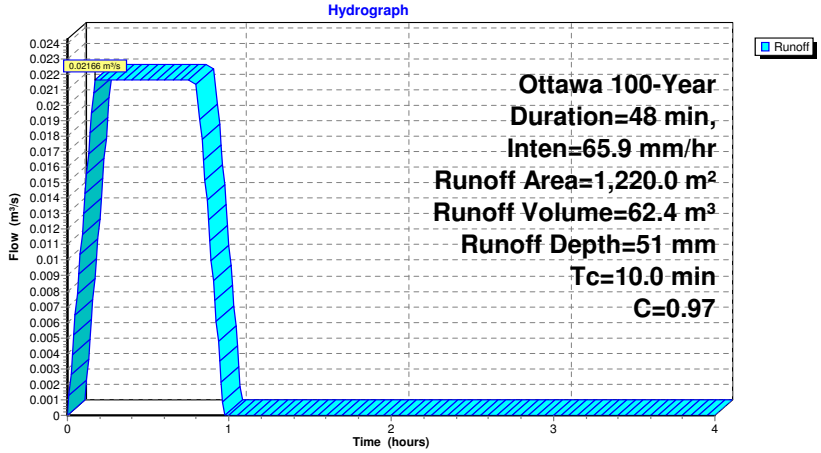
Runoff = 0.02166 m³/s @ 0.17 hrs, Volume= 62.4 m³, Depth= 51 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=48 min, Inten=65.9 mm/hr

Area (m²)	C	Description
1,220.0	0.97	
1,220.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-102: Proposed to Ditch



Summary for Subcatchment A-103: Proposed to Ditch

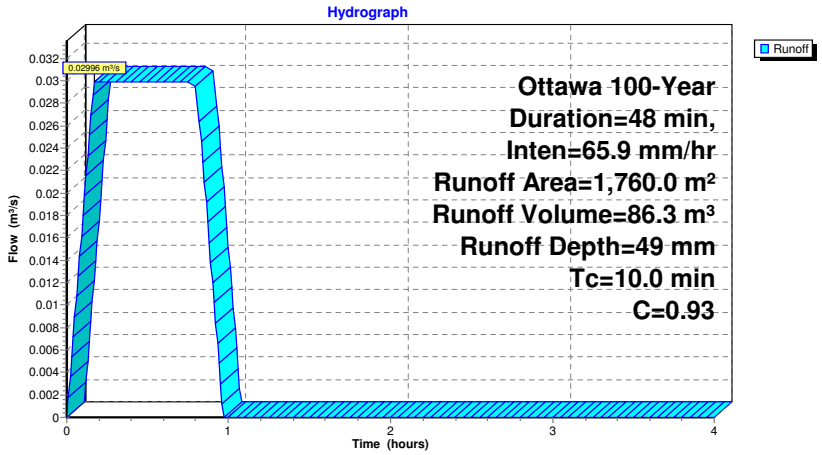
Runoff = 0.02996 m³/s @ 0.17 hrs, Volume= 86.3 m³, Depth= 49 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=48 min, Inten=65.9 mm/hr

Area (m²)	C	Description
1,760.0	0.93	
1,760.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-103: Proposed to Ditch



Summary for Pond B1: Bioswale 1

Inflow Area = 1,880.0 m², 0.00% Impervious, Inflow Depth = 50 mm for 100-Year event
Inflow = 0.03234 m³/s @ 0.17 hrs, Volume= 93.2 m³
Outflow = 0.00905 m³/s @ 0.92 hrs, Volume= 54.5 m³, Atten= 72%, Lag= 45.0 min
Primary = 0.00905 m³/s @ 0.92 hrs, Volume= 54.5 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.902 m @ 0.92 hrs Surf.Area= 0.0 m² Storage= 77.5 m³

Plug-Flow detention time= 60.5 min calculated for 54.5 m³ (59% of inflow)
Center-of-Mass det. time= 50.3 min (79.3 - 29.0)

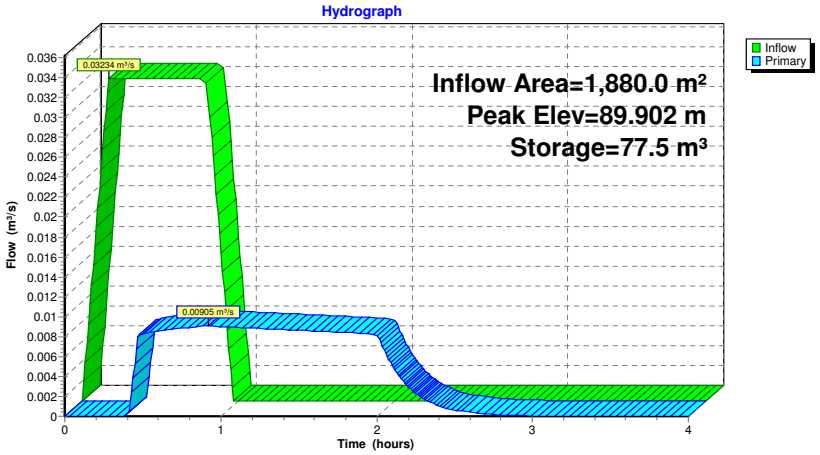
Volume	Invert	Avail.Storage	Storage Description
#1	88.700 m	182.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.700	0.0
89.050	8.0
89.200	12.0
89.550	29.0
90.000	91.0
91.000	182.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.700 m	**HYDROVEX 100-VHV-1 X 0.80** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00905 m³/s @ 0.92 hrs HW=89.902 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00905 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00905 m³/s of 0.19268 m³/s potential flow)

Pond B1: Bioswale 1



Summary for Pond B2: Bioswale 2

Inflow Area = 1,220.0 m², 100.00% Impervious, Inflow Depth = 51 mm for 100-Year event
Inflow = 0.02166 m³/s @ 0.17 hrs, Volume= 62.4 m³
Outflow = 0.00991 m³/s @ 0.89 hrs, Volume= 36.2 m³, Atten= 54%, Lag= 43.2 min
Primary = 0.00991 m³/s @ 0.89 hrs, Volume= 36.2 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.931 m @ 0.89 hrs Surf.Area= 0.0 m² Storage= 45.7 m³

Plug-Flow detention time= 39.5 min calculated for 36.1 m³ (58% of inflow)
Center-of-Mass det. time= 29.4 min (58.4 - 29.0)

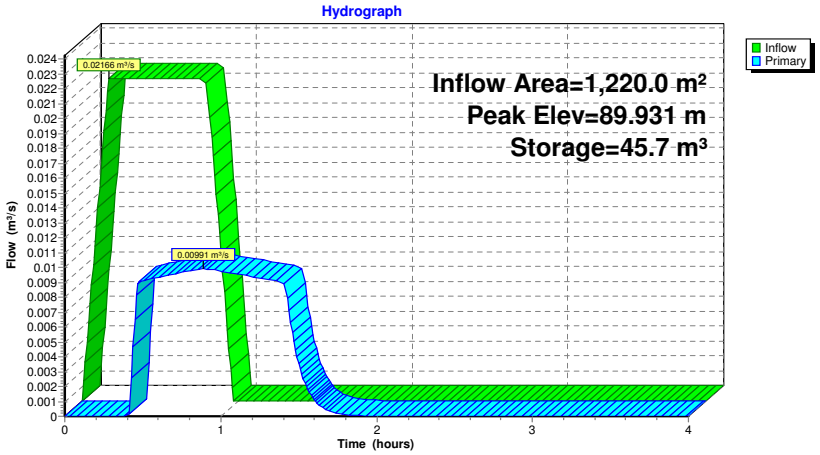
Volume	Invert	Avail.Storage	Storage Description
#1	88.641 m	100.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.641	0.0
88.990	6.0
89.140	8.0
89.490	18.0
90.000	50.0
91.000	100.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.400 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000 0.200000
#2	Primary	88.641 m	**HYDROVEX 100-VHV-1 X 0.85** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00991 m³/s @ 0.89 hrs HW=89.931 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00991 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00991 m³/s of 0.20000 m³/s potential flow)

Pond B2: Bioswale 2



Summary for Pond B3: Bioswale 3

Inflow Area = 1,760.0 m², 0.00% Impervious, Inflow Depth = 49 mm for 100-Year event
Inflow = 0.02996 m³/s @ 0.17 hrs, Volume= 86.3 m³
Outflow = 0.01865 m³/s @ 0.86 hrs, Volume= 50.8 m³, Atten= 38%, Lag= 41.6 min
Primary = 0.01865 m³/s @ 0.86 hrs, Volume= 50.8 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.937 m @ 0.86 hrs Surf.Area= 0.0 m² Storage= 56.0 m³

Plug-Flow detention time= 31.9 min calculated for 50.8 m³ (59% of inflow)
Center-of-Mass det. time= 21.7 min (50.7 - 29.0)

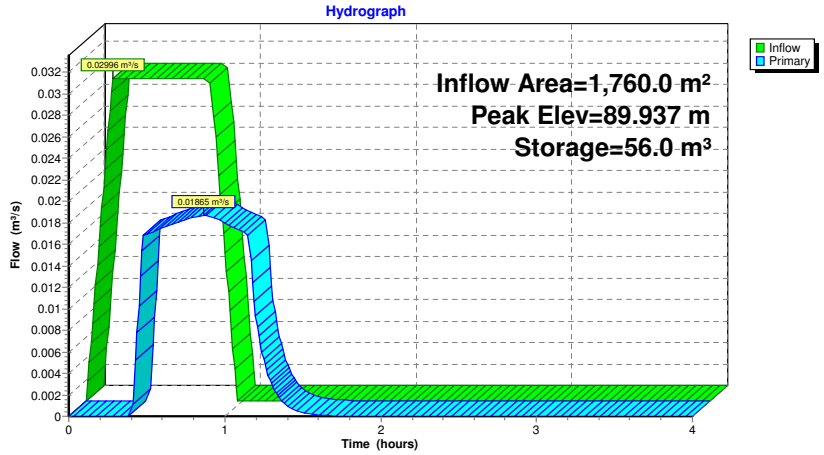
Volume	Invert	Avail.Storage	Storage Description
#1	88.555 m	120.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.555	0.0
88.910	7.0
89.060	10.0
89.410	22.0
90.000	60.0
91.000	120.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.555 m	**HYDROVEX 125-VHV-2 X 0.85** Head (meters) 0.000 0.200 0.600 1.000 1.500 2.000 2.500 3.500 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.014000 0.018500 0.023000 0.027000 0.030000 0.035500 0.040000 0.046000

Primary OutFlow Max=0.01865 m³/s @ 0.86 hrs HW=89.937 m (Free Discharge)
↑└**2=HYDROVEX 125-VHV-2** (Custom Controls 0.01865 m³/s)
↑└**1=Single OPSD 400.01** (Passes 0.01865 m³/s of 0.20691 m³/s potential flow)

Pond B3: Bioswale 3

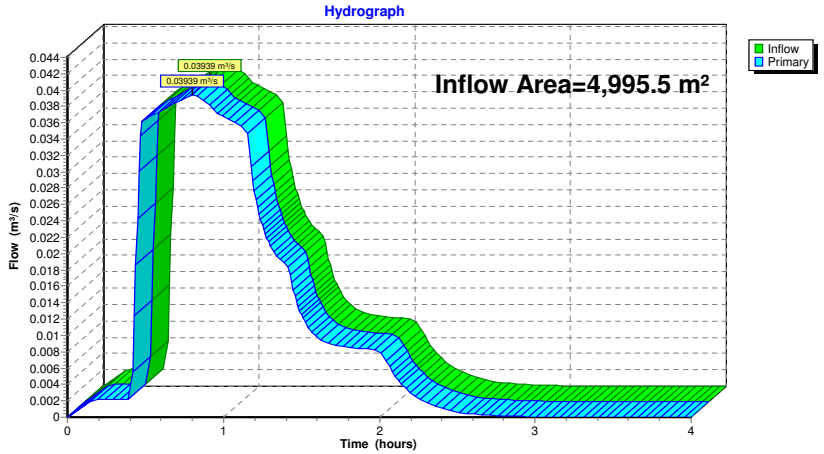


Summary for Link 2L: Ditch

Inflow Area = 4,995.5 m², 24.42% Impervious, Inflow Depth = 30 mm for 100-Year event
Inflow = 0.03939 m³/s @ 0.80 hrs, Volume= 147.7 m³
Primary = 0.03939 m³/s @ 0.80 hrs, Volume= 147.7 m³, Atten= 0%, Lag= 0.0 min

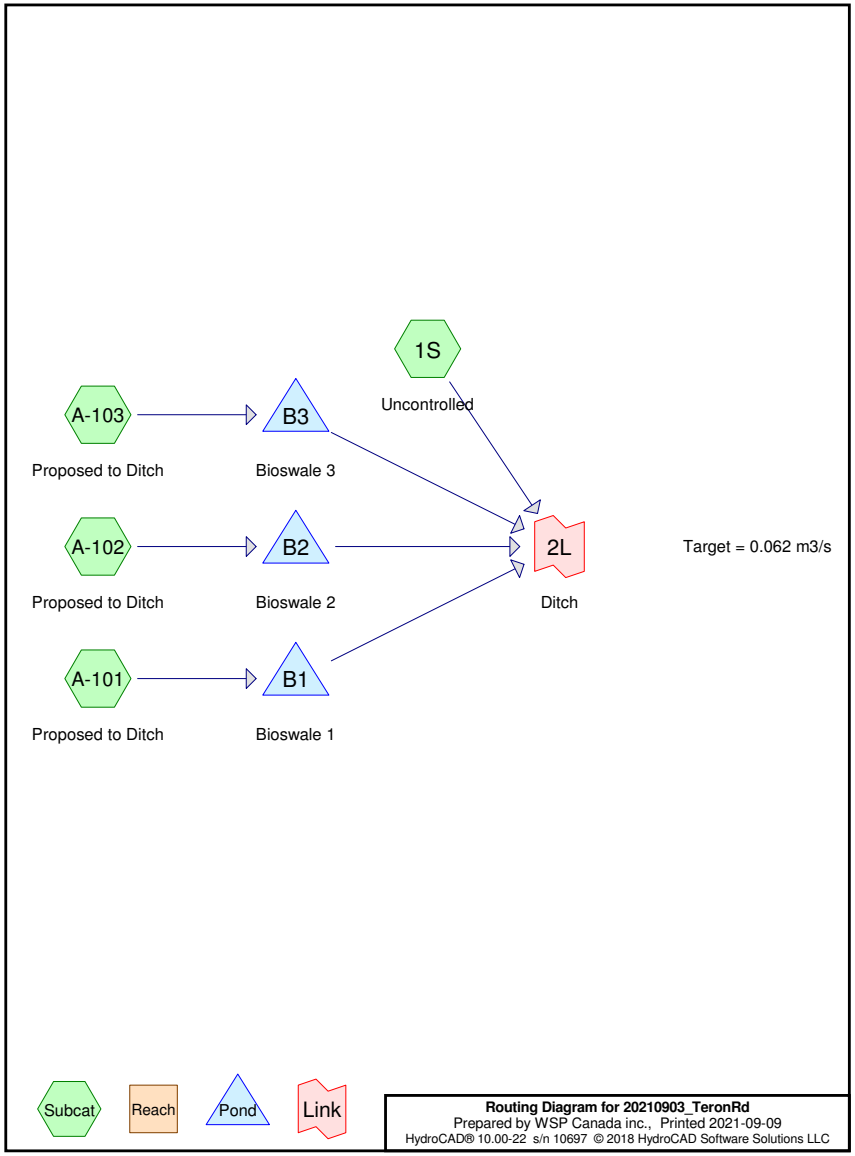
Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 2L: Ditch



APPENDIX

D-5 100-Year Analysis (Peak Storage Bioswale 3, T_C = 36 Min)



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
135.5	0.87	(1S)
1,880.0	0.94	(A-101)
1,220.0	0.97	(A-102)
1,760.0	0.93	(A-103)
4,995.5	**0.94**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled Runoff Area=135.5 m² 0.00% Impervious Runoff Depth=42 mm
Tc=10.0 min C=0.87 Runoff=0.00265 m³/s 5.7 m³

Subcatchment A-101: Proposed to Ditch Runoff Area=1,880.0 m² 0.00% Impervious Runoff Depth=46 mm
Tc=10.0 min C=0.94 Runoff=0.03974 m³/s 85.8 m³

Subcatchment A-102: Proposed to Runoff Area=1,220.0 m² 100.00% Impervious Runoff Depth=47 mm
Tc=10.0 min C=0.97 Runoff=0.02661 m³/s 57.5 m³

Subcatchment A-103: Proposed to Ditch Runoff Area=1,760.0 m² 0.00% Impervious Runoff Depth=45 mm
Tc=10.0 min C=0.93 Runoff=0.03681 m³/s 79.5 m³

Pond B1: Bioswale 1 Peak Elev=89.878 m Storage=74.2 m³ Inflow=0.03974 m³/s 85.8 m³
Outflow=0.00897 m³/s 47.2 m³

Pond B2: Bioswale 2 Peak Elev=89.921 m Storage=45.1 m³ Inflow=0.02661 m³/s 57.5 m³
Outflow=0.00988 m³/s 31.3 m³

Pond B3: Bioswale 3 Peak Elev=89.952 m Storage=56.9 m³ Inflow=0.03681 m³/s 79.5 m³
Outflow=0.01876 m³/s 44.0 m³

Link 2L: Ditch Inflow=0.03961 m³/s 128.2 m³
Primary=0.03961 m³/s 128.2 m³

Total Runoff Area = 4,995.5 m² Runoff Volume = 228.6 m³ Average Runoff Depth = 46 mm
75.58% Pervious = 3,775.5 m² 24.42% Impervious = 1,220.0 m²

Summary for Subcatchment 1S: Uncontrolled

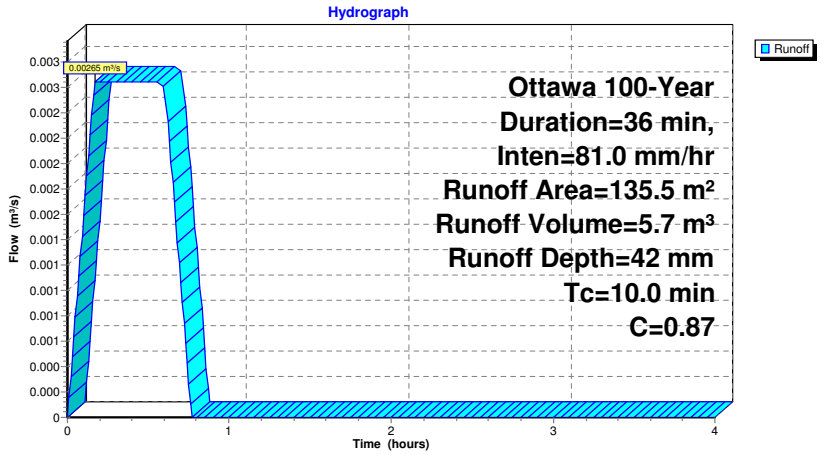
Runoff = 0.00265 m³/s @ 0.17 hrs, Volume= 5.7 m³, Depth= 42 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
135.5	0.87	
135.5		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Uncontrolled



Summary for Subcatchment A-101: Proposed to Ditch

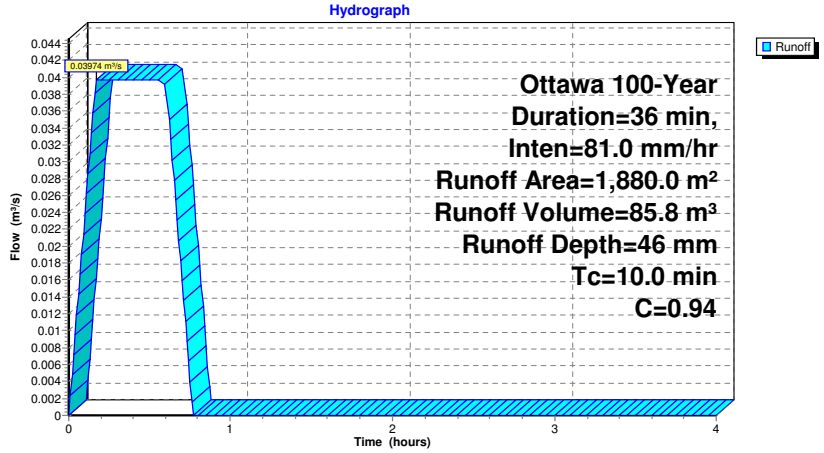
Runoff = 0.03974 m³/s @ 0.17 hrs, Volume= 85.8 m³, Depth= 46 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
1,880.0	0.94	
1,880.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-101: Proposed to Ditch



Summary for Subcatchment A-102: Proposed to Ditch

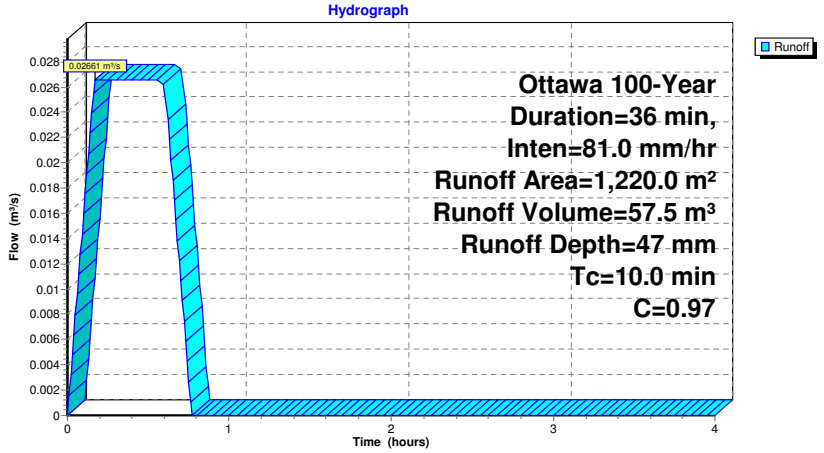
Runoff = 0.02661 m³/s @ 0.17 hrs, Volume= 57.5 m³, Depth= 47 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
1,220.0	0.97	
1,220.0		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-102: Proposed to Ditch



Summary for Subcatchment A-103: Proposed to Ditch

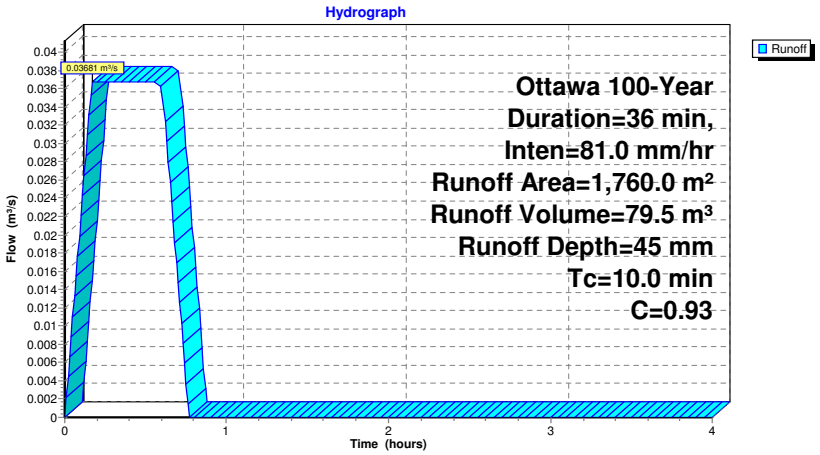
Runoff = 0.03681 m³/s @ 0.17 hrs, Volume= 79.5 m³, Depth= 45 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Ottawa 100-Year Duration=36 min, Inten=81.0 mm/hr

Area (m²)	C	Description
1,760.0	0.93	
1,760.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-103: Proposed to Ditch



Summary for Pond B1: Bioswale 1

Inflow Area = 1,880.0 m², 0.00% Impervious, Inflow Depth = 46 mm for 100-Year event
Inflow = 0.03974 m³/s @ 0.17 hrs, Volume= 85.8 m³
Outflow = 0.00897 m³/s @ 0.73 hrs, Volume= 47.2 m³, Atten= 77%, Lag= 33.5 min
Primary = 0.00897 m³/s @ 0.73 hrs, Volume= 47.2 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.878 m @ 0.73 hrs Surf.Area= 0.0 m² Storage= 74.2 m³

Plug-Flow detention time= 53.9 min calculated for 47.2 m³ (55% of inflow)
Center-of-Mass det. time= 45.6 min (68.6 - 23.0)

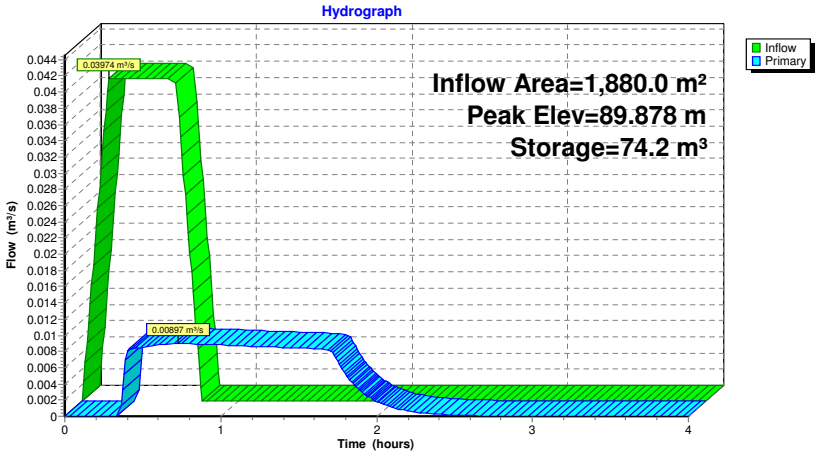
Volume	Invert	Avail.Storage	Storage Description
#1	88.700 m	182.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.700	0.0
89.050	8.0
89.200	12.0
89.550	29.0
90.000	91.0
91.000	182.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.700 m	**HYDROVEX 100-VHV-1 X 0.80** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00897 m³/s @ 0.73 hrs HW=89.878 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00897 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00897 m³/s of 0.18323 m³/s potential flow)

Pond B1: Bioswale 1



Summary for Pond B2: Bioswale 2

Inflow Area = 1,220.0 m², 100.00% Impervious, Inflow Depth = 47 mm for 100-Year event
Inflow = 0.02661 m³/s @ 0.17 hrs, Volume= 57.5 m³
Outflow = 0.00988 m³/s @ 0.70 hrs, Volume= 31.3 m³, Atten= 63%, Lag= 32.1 min
Primary = 0.00988 m³/s @ 0.70 hrs, Volume= 31.3 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.921 m @ 0.70 hrs Surf.Area= 0.0 m² Storage= 45.1 m³

Plug-Flow detention time= 35.4 min calculated for 31.3 m³ (54% of inflow)
Center-of-Mass det. time= 27.1 min (50.1 - 23.0)

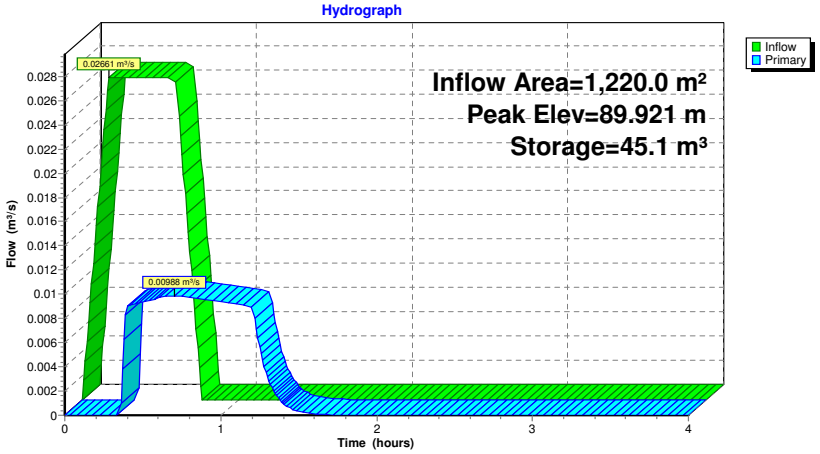
Volume	Invert	Avail.Storage	Storage Description
#1	88.641 m	100.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.641	0.0
88.990	6.0
89.140	8.0
89.490	18.0
90.000	50.0
91.000	100.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.400 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000 0.200000
#2	Primary	88.641 m	**HYDROVEX 100-VHV-1 X 0.85** Head (meters) 0.000 0.200 0.500 1.000 1.500 2.000 3.000 4.000 6.000 Disch. (m³/s) 0.000000 0.000100 0.007000 0.010500 0.012500 0.014000 0.018000 0.021000 0.026000

Primary OutFlow Max=0.00988 m³/s @ 0.70 hrs HW=89.921 m (Free Discharge)
└**2=HYDROVEX 100-VHV-1** (Custom Controls 0.00988 m³/s)
└**1=Single OPSD 400.01** (Passes 0.00988 m³/s of 0.20000 m³/s potential flow)

Pond B2: Bioswale 2



Summary for Pond B3: Bioswale 3

Inflow Area = 1,760.0 m², 0.00% Impervious, Inflow Depth = 45 mm for 100-Year event
Inflow = 0.03681 m³/s @ 0.17 hrs, Volume= 79.5 m³
Outflow = 0.01876 m³/s @ 0.68 hrs, Volume= 44.0 m³, Atten= 49%, Lag= 30.7 min
Primary = 0.01876 m³/s @ 0.68 hrs, Volume= 44.0 m³

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 89.952 m @ 0.68 hrs Surf.Area= 0.0 m² Storage= 56.9 m³

Plug-Flow detention time= 28.5 min calculated for 43.9 m³ (55% of inflow)
Center-of-Mass det. time= 20.3 min (43.3 - 23.0)

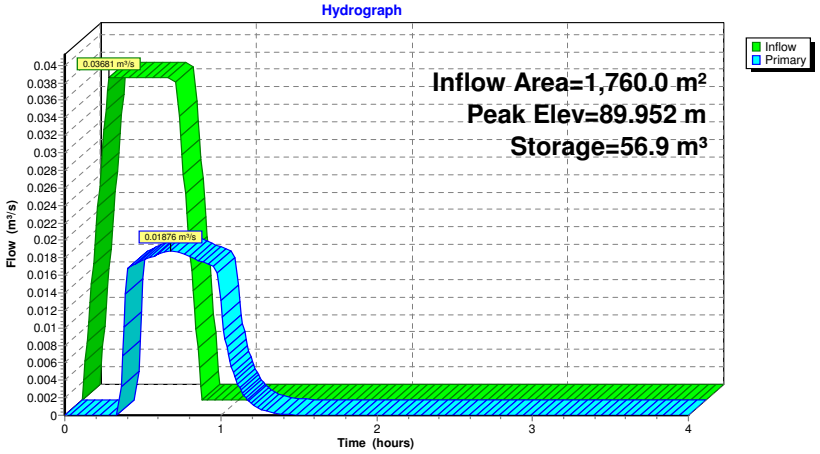
Volume	Invert	Avail.Storage	Storage Description
#1	88.555 m	120.0 m³	**Custom Stage Data** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
88.555	0.0
88.910	7.0
89.060	10.0
89.410	22.0
90.000	60.0
91.000	120.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.620 m	**Single OPSD 400.01** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.160000 0.180000 0.200000
#2	Primary	88.555 m	**HYDROVEX 125-VHV-2 X 0.85** Head (meters) 0.000 0.200 0.600 1.000 1.500 2.000 2.500 3.500 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.014000 0.018500 0.023000 0.027000 0.030000 0.035500 0.040000 0.046000

Primary OutFlow Max=0.01876 m³/s @ 0.68 hrs HW=89.952 m (Free Discharge)
↑└**2=HYDROVEX 125-VHV-2** (Custom Controls 0.01876 m³/s)
↑└**1=Single OPSD 400.01** (Passes 0.01876 m³/s of 0.21283 m³/s potential flow)

Pond B3: Bioswale 3

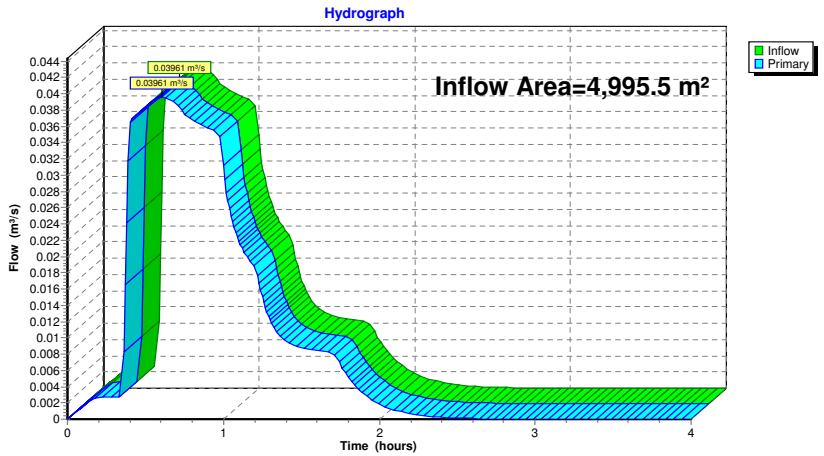


Summary for Link 2L: Ditch

Inflow Area = 4,995.5 m², 24.42% Impervious, Inflow Depth = 26 mm for 100-Year event
Inflow = 0.03961 m³/s @ 0.60 hrs, Volume= 128.2 m³
Primary = 0.03961 m³/s @ 0.60 hrs, Volume= 128.2 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs

Link 2L: Ditch



APPENDIX

E OGS Sizing

Stormceptor®

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

04/12/2021

Province:	Ontario - Sault Ste Marie
City:	Ottawa
Nearest Rainfall Station:	OTTAWA MACDONALD-CARTIER INT'L AP
NCDC Rainfall Station Id:	6000
Years of Rainfall Data:	37

Site Name:	1151 - 1131 Teron Road
Drainage Area (ha):	0.17
Runoff Coefficient 'c':	0.67
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Project Name:	1151 - 1131 Teron Road Res Project
Project Number:	20M-01534-00
Designer Name:	Ding Bang Yang
Designer Company:	WSP Canada Inc
Designer Email:	winston.yang@wsp.com
Designer Phone:	613-690-0538
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	4.12
Oil / Fuel Spill Risk Site?	No
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	18.00
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EF4	89
EF6	91
EF8	92
EF10	93
EF12	93

Recommended Stormceptor EF Model: EF4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 89

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

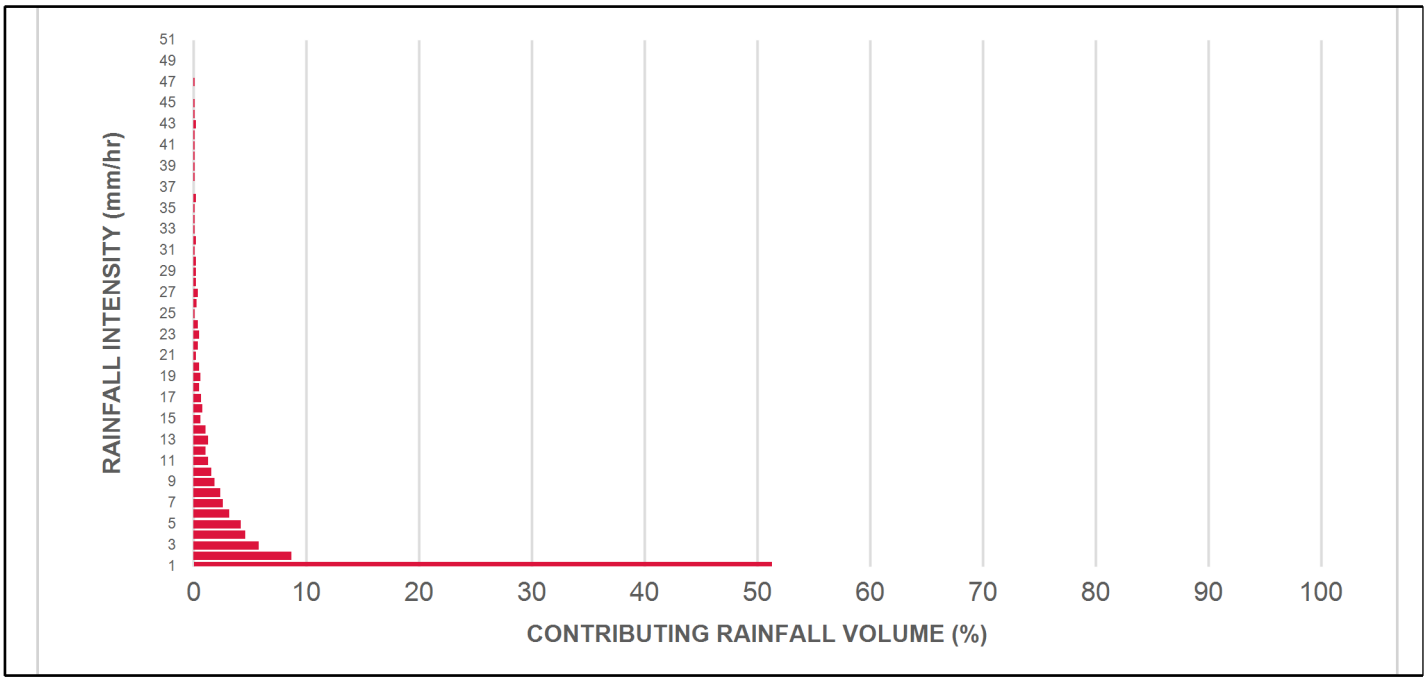
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

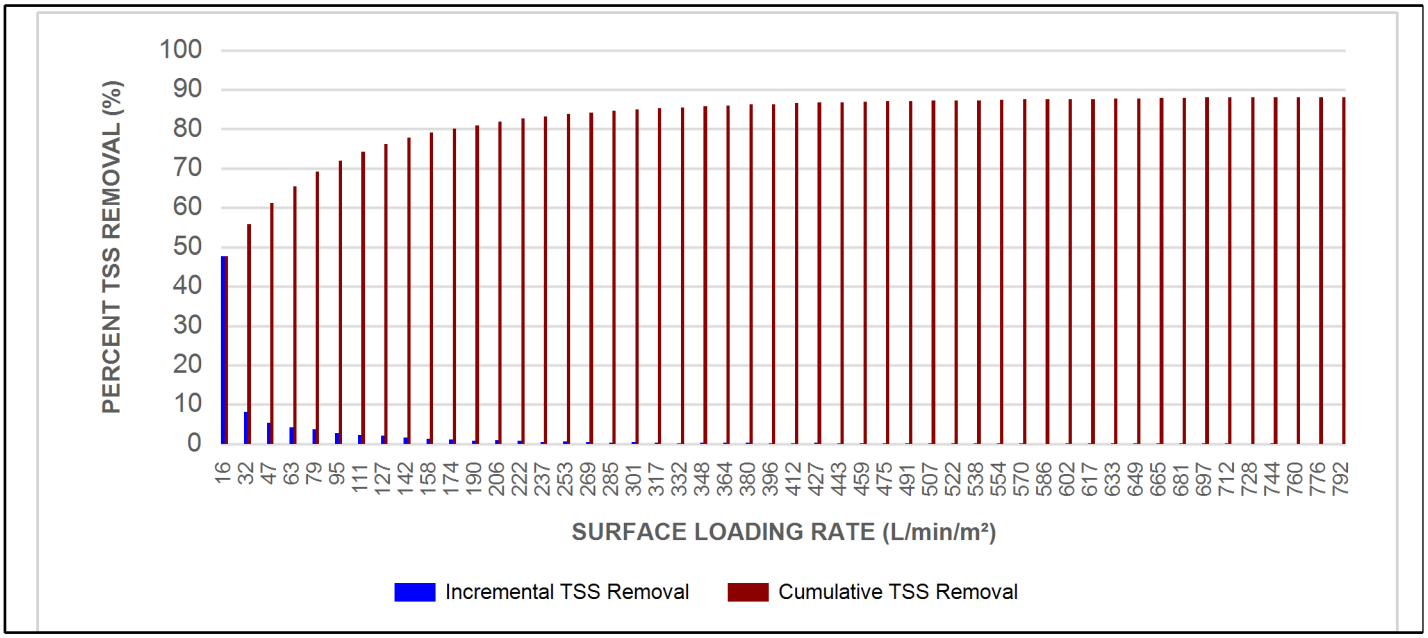
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	51.3	51.3	0.32	19.0	16.0	93	47.7	47.7
2	8.7	60.0	0.63	38.0	32.0	93	8.1	55.8
3	5.8	65.8	0.95	57.0	47.0	93	5.4	61.2
4	4.6	70.4	1.27	76.0	63.0	91	4.2	65.4
5	4.2	74.6	1.58	95.0	79.0	89	3.7	69.1
6	3.2	77.8	1.90	114.0	95.0	88	2.8	71.9
7	2.6	80.4	2.22	133.0	111.0	86	2.2	74.2
8	2.4	82.8	2.53	152.0	127.0	85	2.0	76.2
9	1.9	84.7	2.85	171.0	142.0	83	1.6	77.8
10	1.6	86.3	3.17	190.0	158.0	81	1.3	79.1
11	1.3	87.6	3.48	209.0	174.0	79	1.0	80.1
12	1.1	88.7	3.80	228.0	190.0	77	0.8	80.9
13	1.3	90.0	4.12	247.0	206.0	76	1.0	81.9
14	1.1	91.1	4.43	266.0	222.0	74	0.8	82.7
15	0.6	91.7	4.75	285.0	237.0	73	0.4	83.2
16	0.8	92.5	5.07	304.0	253.0	72	0.6	83.8
17	0.7	93.2	5.38	323.0	269.0	70	0.5	84.2
18	0.5	93.7	5.70	342.0	285.0	69	0.3	84.6
19	0.6	94.3	6.02	361.0	301.0	67	0.4	85.0
20	0.5	94.8	6.33	380.0	317.0	66	0.3	85.3
21	0.2	95.0	6.65	399.0	332.0	64	0.1	85.5
22	0.4	95.4	6.97	418.0	348.0	63	0.3	85.7
23	0.5	95.9	7.28	437.0	364.0	62	0.3	86.0
24	0.4	96.3	7.60	456.0	380.0	60	0.2	86.3
25	0.1	96.4	7.92	475.0	396.0	59	0.1	86.3

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
26	0.3	96.7	8.23	494.0	412.0	58	0.2	86.5
27	0.4	97.1	8.55	513.0	427.0	58	0.2	86.7
28	0.2	97.3	8.87	532.0	443.0	58	0.1	86.8
29	0.2	97.5	9.18	551.0	459.0	57	0.1	86.9
30	0.2	97.7	9.50	570.0	475.0	57	0.1	87.1
31	0.1	97.8	9.82	589.0	491.0	57	0.1	87.1
32	0.2	98.0	10.13	608.0	507.0	57	0.1	87.2
33	0.1	98.1	10.45	627.0	522.0	57	0.1	87.3
34	0.1	98.2	10.77	646.0	538.0	57	0.1	87.3
35	0.1	98.3	11.08	665.0	554.0	57	0.1	87.4
36	0.2	98.5	11.40	684.0	570.0	56	0.1	87.5
37	1.5	100.0	11.72	703.0	586.0	56	0.8	88.4
38	0.1	100.1	12.03	722.0	602.0	56	0.1	88.4
39	0.1	100.2	12.35	741.0	617.0	56	0.1	88.5
40	0.1	100.3	12.67	760.0	633.0	56	0.1	88.5
41	0.1	100.4	12.98	779.0	649.0	56	0.1	88.6
42	0.1	100.5	13.30	798.0	665.0	56	0.1	88.6
43	0.2	100.7	13.62	817.0	681.0	56	0.1	88.7
44	0.1	100.8	13.93	836.0	697.0	56	0.1	88.8
45	0.1	100.9	14.25	855.0	712.0	55	0.1	88.9
46	-0.9	100.0	14.57	874.0	728.0	55	N/A	88.4
47	0.1	100.1	14.88	893.0	744.0	55	0.1	88.4
48	-0.1	100.0	15.20	912.0	760.0	55	N/A	88.4
49	0.0	100.0	15.52	931.0	776.0	55	0.0	88.4
50	0.0	100.0	15.83	950.0	792.0	55	0.0	88.4
Estimated Net Annual Sediment (TSS) Load Reduction =								**88 %**

RAINFALL DATA FROM OTTAWA MACDONALD-CARTIER INT'L AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

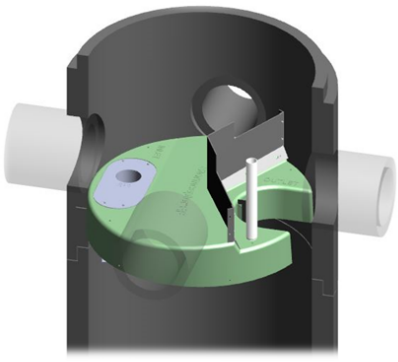
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

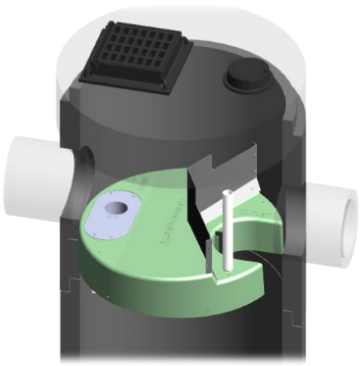
DESIGN FLEXIBILITY

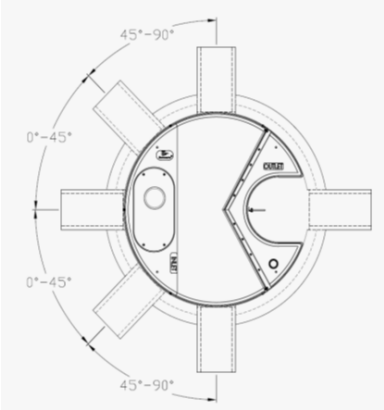
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The **minimum** sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1

4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

APPENDIX

F

Storage Calculations

Project:	1131-1151 Teron Road	No.:	20M 01534-00	
By:	KK	Date:	2021-09-09	Page:
Checked:	MH	Checked:	2021-09-09	1

Subject: **STORAGE CALCULATIONS**

Building Roofs

Building 1

Roof Drain #	Drainage Area (m2)	Total Volume (m3)
1	74	2.2
2	121	6.1
3	48	1.1
4	126	6.3
5	122	6.1
6	116	5.8
7	137	5.8
8	114	5.7
9	26	0.6
10	38	0.9
11	12	N/A
12	12	N/A

Building 2

Roof Drain #	Drainage Area (m2)	Total Volume (m3)
13	120	6.0
14	61	1.8
15	65	2.0
16	64	1.9
17	131	6.6
18	72	2.2

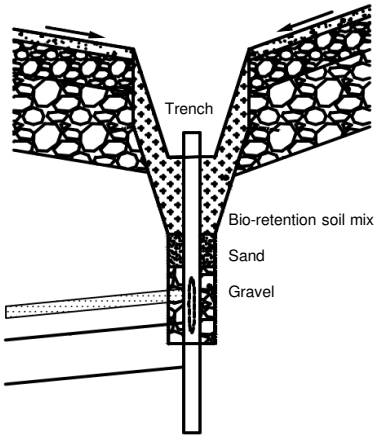
Cistern

	Elevation (m)	Volume (m3)
Bottom of Cistern	88.467	0.0
Top of Cisterm	89.297	68.5

Project:	1131-1151 Teron Road	No.:	20M 01534-00	
By:	KK	Date:	2021-09-09	Page:
Checked:	MH	Checked:	2021-09-09	1

Subject: **STORAGE CALCULATIONS**

Bioswale Storage
Cross section



Bioretention soil mix (m) 0.35
Sand (m) 0.15
Gravel (m) 0.35
Void ratio 0.4

	Bioswale 1	Bioswale 2	Bioswale 3
Top Width (m)	7.33	5.00	5.02
Bottom Width (m)	2.02	2.01	2.04
Top elevation (m)	90.00	90.00	90.00
Bottom elevation (m)	89.62	89.62	89.62
Trench depth (m)	0.38	0.38	0.38
Surface Area (m2)	57.6	41.0	50.2
Gravel area (m2)	0.3	0.3	0.3
Sand area (m2)	0.1	0.1	0.1
Bioretention soil mix area (m2)	1.0	0.7	0.7
Trench area (m2)	1.8	1.3	1.3
Cross-sectional area (m2)	3.2	2.4	2.5
Trench length (m)	28.5	20.4	24.6
Volume (m3)	**91**	**50**	**60**

Stage	Storage (m3)		
(m)	Bioswale 1	Bioswale 2	Bioswale 3
0	0	0	0
0.35	8	6	7
0.50	12	8	10
0.85	29	18	22
1.23	91	50	60

APPENDIX

G

Product Specifications

WATTS®	Adjustable Accutrol Weir Tag: _____	Adjustable Flow Control for Roof Drains

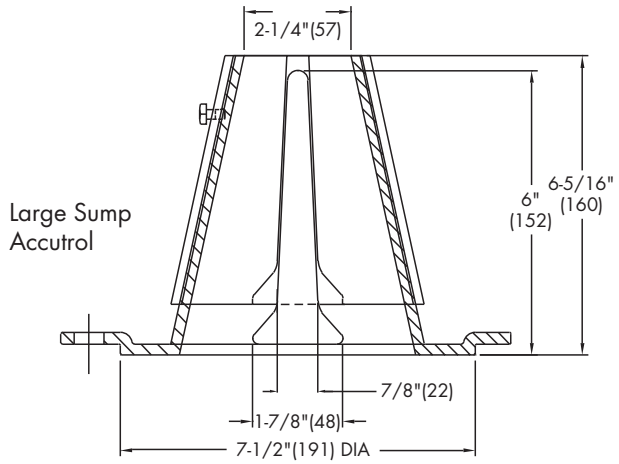
ADJUSTABLE ACCUTROL (for Large Sump Roof Drains only)

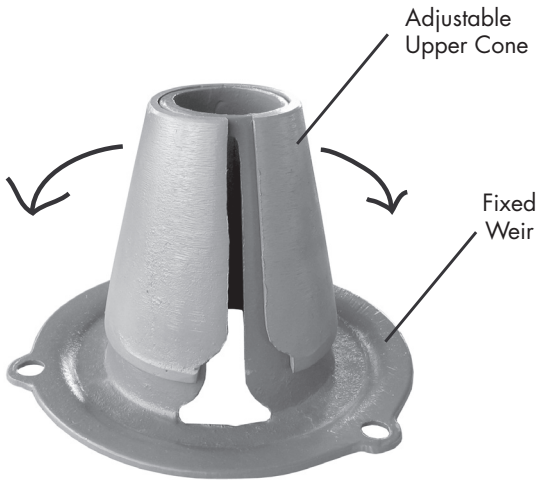
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the flow rate for depths over 2" of head, set the slot in the adjustable upper cone according to the flow rate required. Refer to Table 1 below.
Note: Flow rates are directly proportional to the amount of weir opening that is exposed.

EXAMPLE:

For example, if the adjustable upper cone is set to cover 1/2 of the weir opening, flow rates above 2"of head will be restricted to 2-1/2 gpm per inch of head.

Therefore, at 3"of head, the flow rate through the Accutrol Weir that has 1/2 the slot exposed will be:
[5 gpm (per inch of head) x 2 inches of head] + 2-1/2 gpm (for the third inch of head) = 12-1/2 gpm.





1/2 Weir Opening Exposed Shown Above

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Job Name _____ Contractor _____

Job Location _____ Contractor's P.O. No. _____

Engineer _____ Representative _____

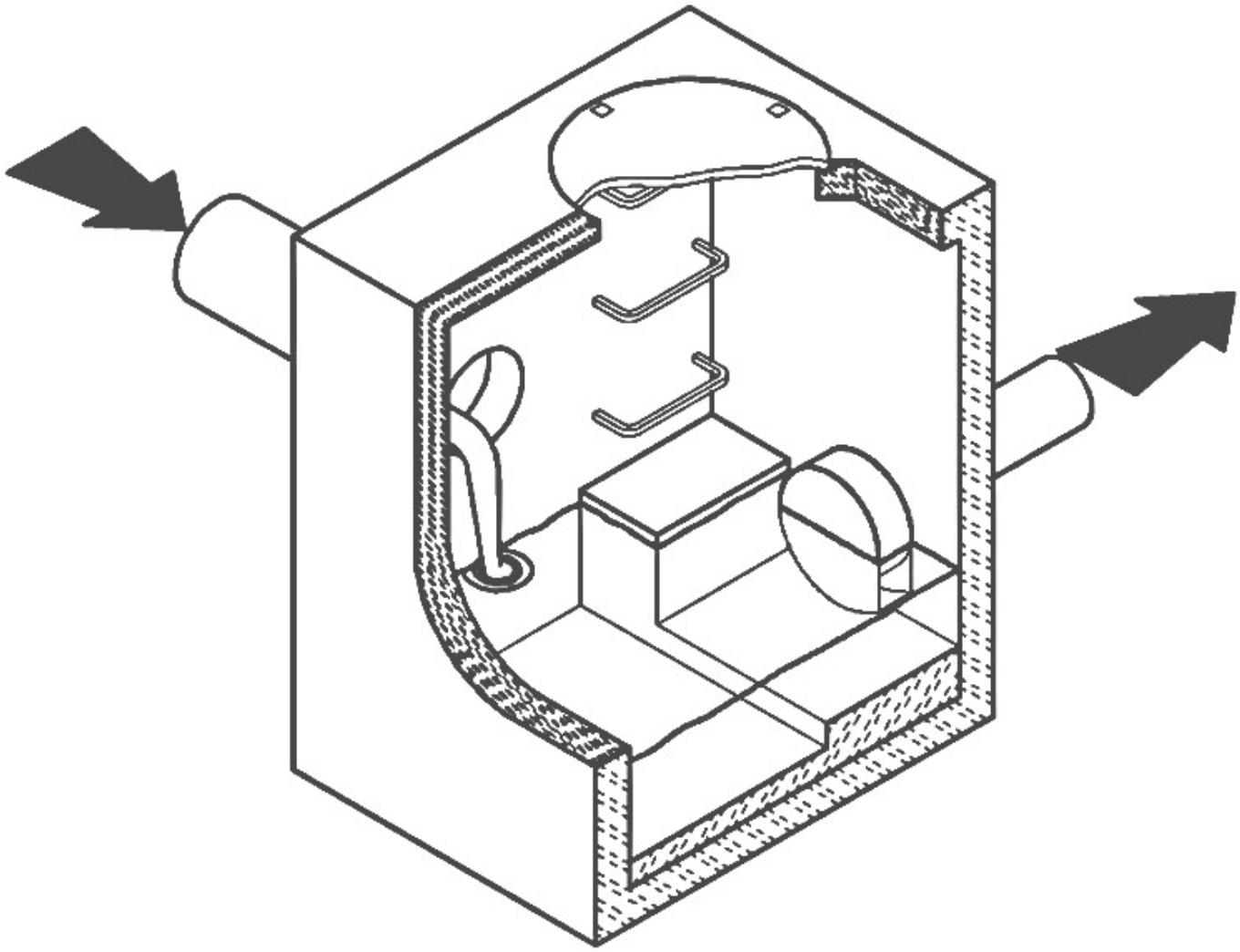
WATTS®
A Watts Water Technologies Company

USA: Tel: (800) 338-2581 • Fax: (828) 248-3929 • Watts.com
Canada: Tel: (905) 332-4090 • Fax: (905) 332-7068 • Watts.ca
Latin America: Tel: (52) 81-1001-8600 • Fax: (52) 81-8000-7091 • Watts.com

CSO/STORMWATER MANAGEMENT

HYDROVEX® VHV / SVHV

Vertical Vortex Flow Regulator



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APPLICATIONS

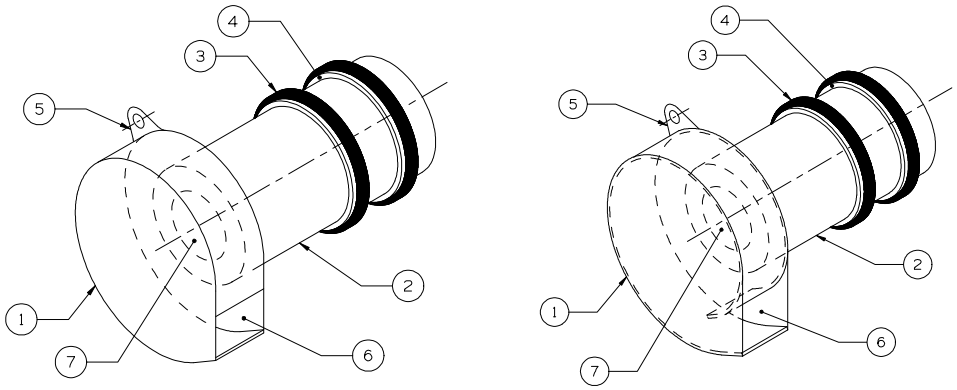
One of the major problems of urban wet weather flow management is the runoff generated after a heavy rainfall. During a storm, uncontrolled flows may overload the drainage system and cause flooding. Due to increased velocities, sewer pipe wear is increased dramatically and results in network deterioration. In a combined sewer system, the wastewater treatment plant may also experience significant increases in flows during storms, thereby losing its treatment efficiency.

A simple means of controlling excessive water runoff is by controlling excessive flows at their origin (manholes). **John Meunier Inc.** manufactures the **HYDROVEX® VHV / SVHV** line of vortex flow regulators to control stormwater flows in sewer networks, as well as manholes.

The vortex flow regulator design is based on the fluid mechanics principle of the forced vortex. This grants flow regulation without any moving parts, thus reducing maintenance. The operation of the regulator, depending on the upstream head and discharge, switches between orifice flow (gravity flow) and vortex flow. Although the concept is quite simple, over 12 years of research have been carried out in order to get a high performance.

The **HYDROVEX® VHV / SVHV** Vertical Vortex Flow Regulators **(refer to Figure 1)** are manufactured entirely of stainless steel, and consist of a hollow body (**1**) (in which flow control takes place) and an outlet orifice (**7**). Two rubber "O" rings (**3**) seal and retain the unit inside the outlet pipe. Two stainless steel retaining rings (**4**) are welded on the outlet sleeve to ensure that there is no shifting of the "O" rings during installation and use.

1. **BODY**
2. **SLEEVE**
3. **O-RING**
4. **RETAINING RINGS (SQUARE BAR)**
5. **ANCHOR PLATE**
6. **INLET**
7. **OUTLET ORIFICE**



VHV ***SVHV***

FIGURE 1: HYDROVEX® VHV-SVHV VERTICAL VORTREX FLOW REGULATORS

ADVANTAGES

- The **HYDROVEX® VHV / SVHV** line of flow regulators are manufactured entirely of stainless steel, making them durable and corrosion resistant.
- Having no moving parts, they require minimal maintenance.
- The geometry of the **HYDROVEX® VHV / SVHV** flow regulators allows a control equal to an orifice plate, having a cross section area 4 to 6 times smaller. This decreases the chance of blockage of the regulator, due to sediments and debris found in stormwater flows. **Figure 2** illustrates the comparison between a regulator model 100 SVHV-2 and an equivalent orifice plate. One can see that for the same height of water, the regulator controls a flow approximately four times smaller than an equivalent orifice plate.
- Installation of the **HYDROVEX® VHV / SVHV** flow regulators is quick and straightforward and is performed after all civil works are completed.
- Installation requires no special tools or equipment and may be carried out by any contractor.
- Installation may be carried out in existing structures.

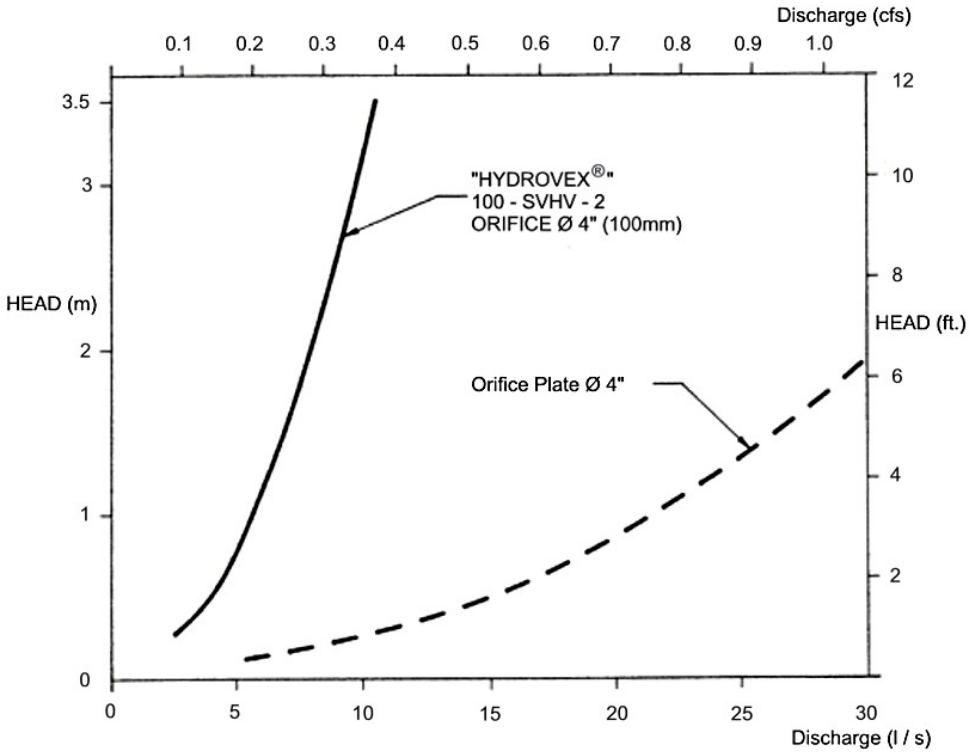


FIGURE 2: DISCHARGE CURVE SHOWING A HYDROVEX® FLOW REGULATOR VS AN ORIFICE PLATE

SELECTION

Selection of a **VHV or SVHV** regulator can be easily made using the selection charts found at the back of this brochure (see **Figure 3)**. These charts are a graphical representation of the maximum upstream water pressure (head) and the maximum discharge at the manhole outlet. The maximum design head is the difference between the maximum upstream water level and the invert of the outlet pipe. All selections should be verified by John Meunier Inc. personnel prior to fabrication.

Example:

✓ Maximum design head	2m (6.56 ft.)
✓ Maximum discharge	6 L/s (0.2 cfs)
✓ Using **Figure 3** - VHV	model required is a **75 VHV-1**

INSTALLATION REQUIREMENTS

All **HYDROVEX® VHV / SVHV** flow regulators can be installed in circular or square manholes. **Figure 4** gives the various minimum dimensions required for a given regulator. ***It is imperative to respect the minimum clearances shown to ensure easy installation and proper functioning of the regulator.***

SPECIFICATIONS

In order to specify a **HYDROVEX®** regulator, the following parameters must be defined:

- The model number (ex: 75-VHV-1)
- The diameter and type of outlet pipe (ex: 6" diam. SDR 35)
- The desired discharge (ex: 6 l/s or 0.21 CFS)
- The upstream head (ex: 2 m or 6.56 ft.) *
- The manhole diameter (ex: 36" diam.)
- The minimum clearance "H" (ex: 10 inches)
- The material type (ex: 304 s/s, 11 Ga. standard)

* ***Upstream head is defined as the difference in elevation between the maximum upstream water level and the invert of the outlet pipe where the HYDROVEX® flow regulator is to be installed.***

PLEASE NOTE THAT WHEN REQUESTING A PROPOSAL, WE SIMPLY REQUIRE THAT YOU PROVIDE US WITH THE FOLLOWING:

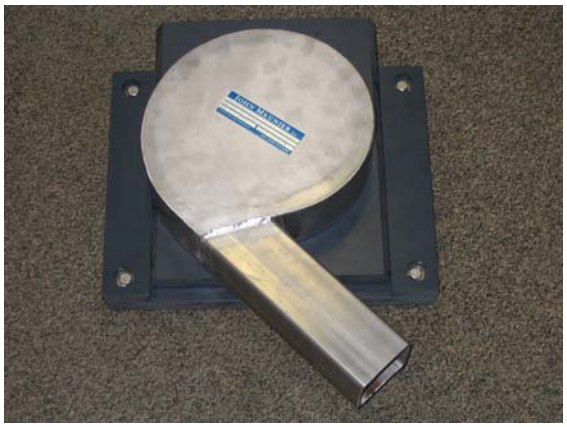
- ***project design flow rate***
- ***pressure head***
- ***chamber's outlet pipe diameter and type***

Typical VHV model in factory

OPTIONS

FV – SVHV (mounted on sliding plate)

VHV-1-O (standard model with odour control inlet)



FV – VHV-O (mounted on sliding plate with odour control inlet)

VHV with Gooseneck assembly in existing chamber without minimum release at the bottom

VHV with air vent for minimal slopes

HYDROVEX®

VHV Vertical Vortex Flow Regulator

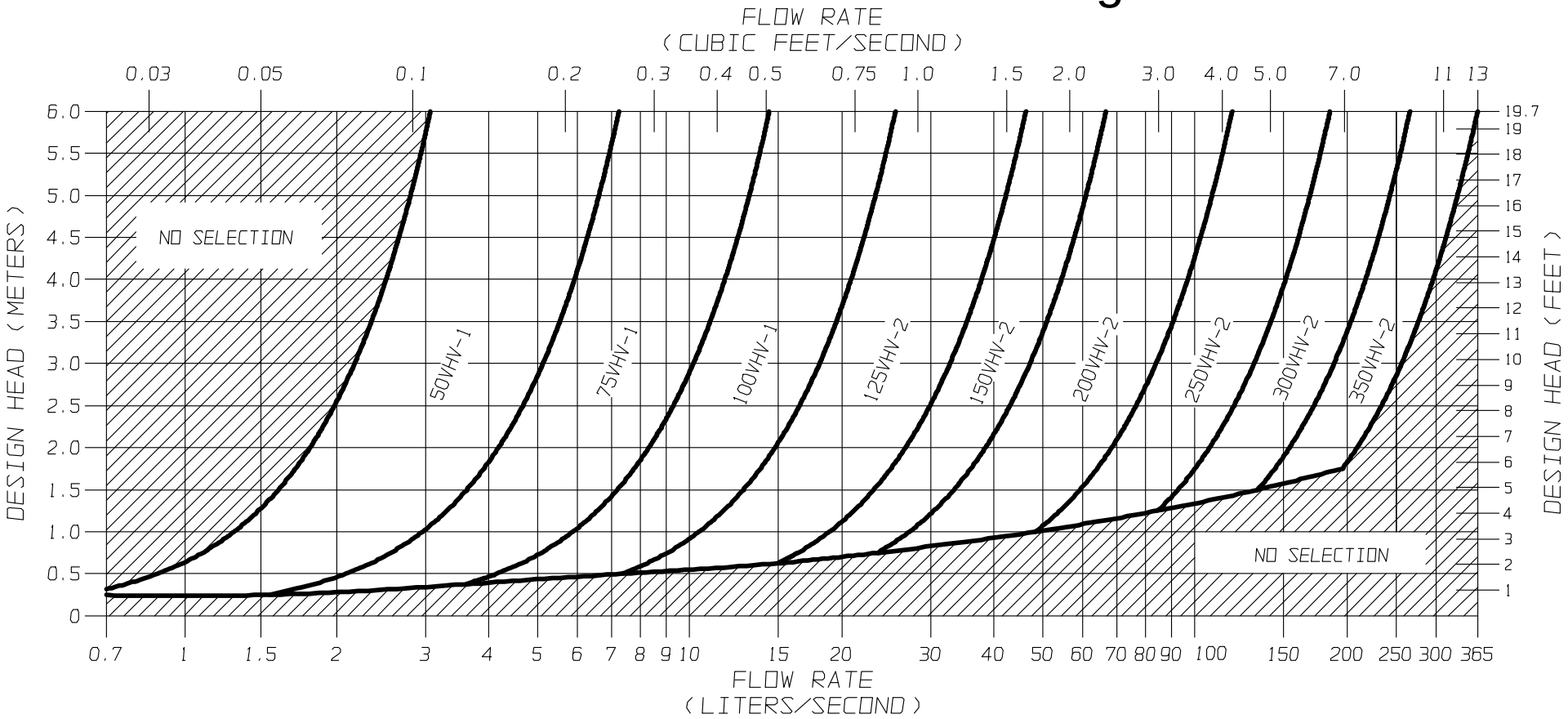


FIGURE 3 - VHV

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HYDROVEX®

SVHV Vertical Vortex Flow Regulator

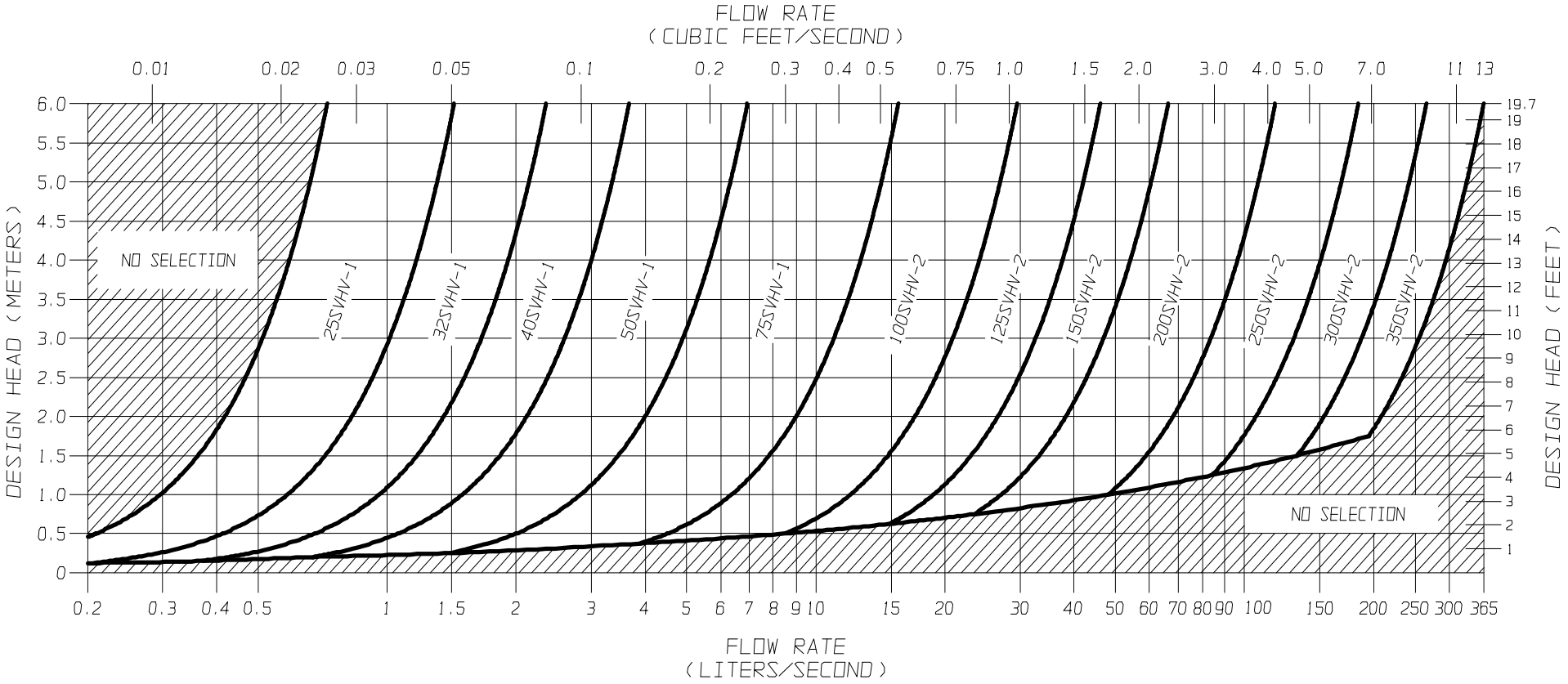

FIGURE 3 - SVHV

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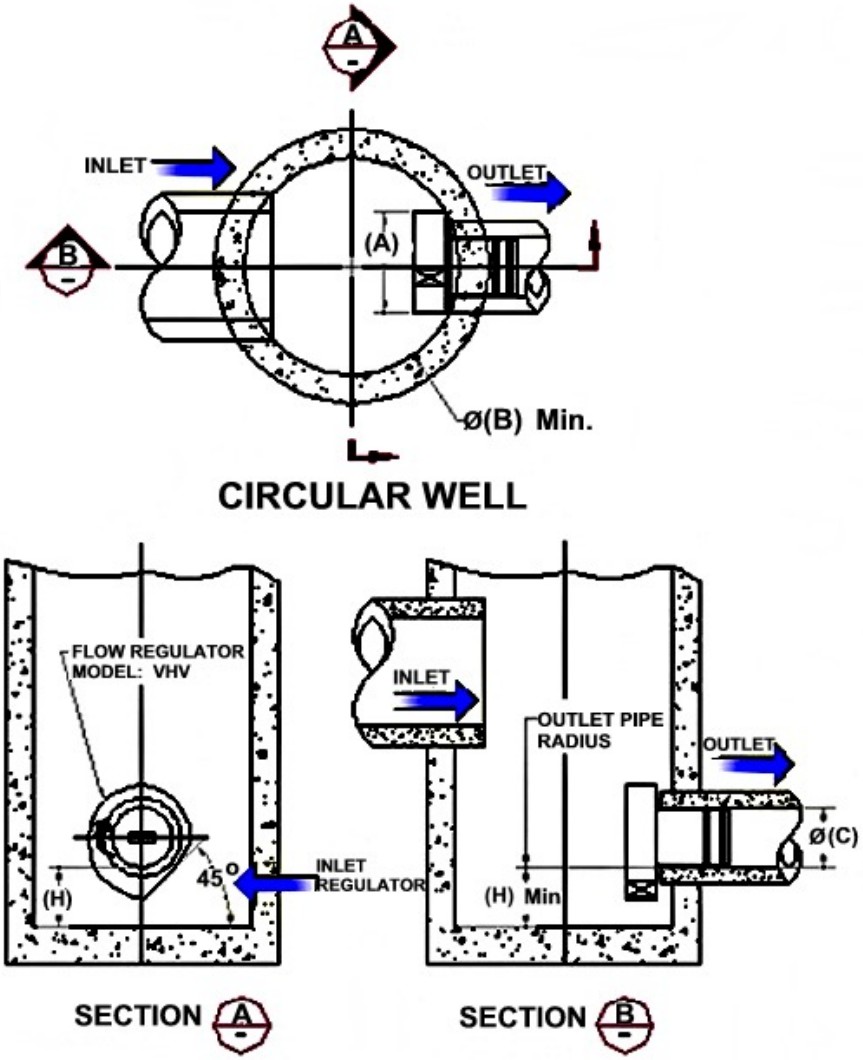
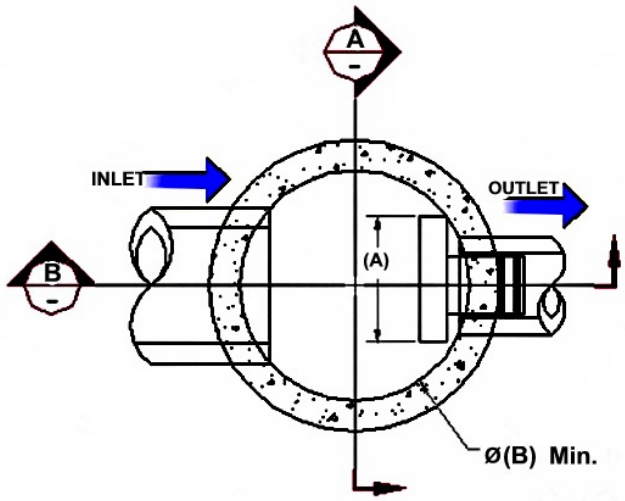
FLOW REGULATOR TYPICAL INSTALLATION IN CIRCULAR MANHOLE
FIGURE 4 (MODEL VHV)

Model Number	Regulator Diameter		Minimum Manhole Diameter		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
50VHV-1	150	6	600	24	150	6	150	6
75VHV-1	250	10	600	24	150	6	150	6
100VHV-1	325	13	900	36	150	6	200	8
125VHV-2	275	11	900	36	150	6	200	8
150VHV-2	350	14	900	36	150	6	225	9
200VHV-2	450	18	1200	48	200	8	300	12
250VHV-2	575	23	1200	48	250	10	350	14
300VHV-2	675	27	1600	64	250	10	400	16
350VHV-2	800	32	1800	72	300	12	500	20

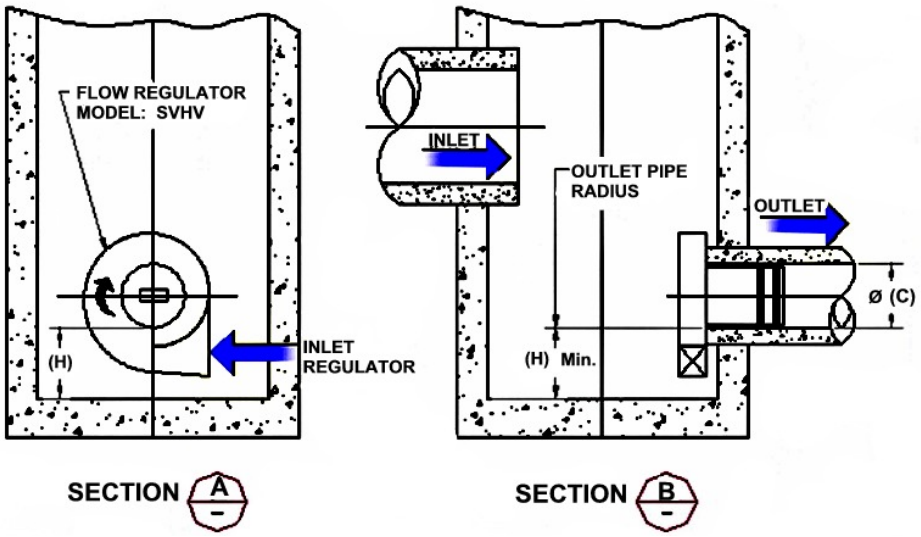


FLOW REGULATOR TYPICAL INSTALLATION IN CIRCULAR MANHOLE
FIGURE 4 (MODEL SVHV)

Model Number	Regulator Diameter		Minimum Manhole Diameter		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
25 SVHV-1	125	5	600	24	150	6	150	6
32 SVHV-1	150	6	600	24	150	6	150	6
40 SVHV-1	200	8	600	24	150	6	150	6
50 SVHV-1	250	10	600	24	150	6	150	6
75 SVHV-1	375	15	900	36	150	6	275	11
100 SVHV-2	275	11	900	36	150	6	250	10
125 SVHV-2	350	14	900	36	150	6	300	12
150 SVHV-2	425	17	1200	48	150	6	350	14
200 SVHV-2	575	23	1600	64	200	8	450	18
250 SVHV-2	700	28	1800	72	250	10	550	22
300 SVHV-2	850	34	2400	96	250	10	650	26
350 SVHV-2	1000	40	2400	96	250	10	700	28



CIRCULAR WELL

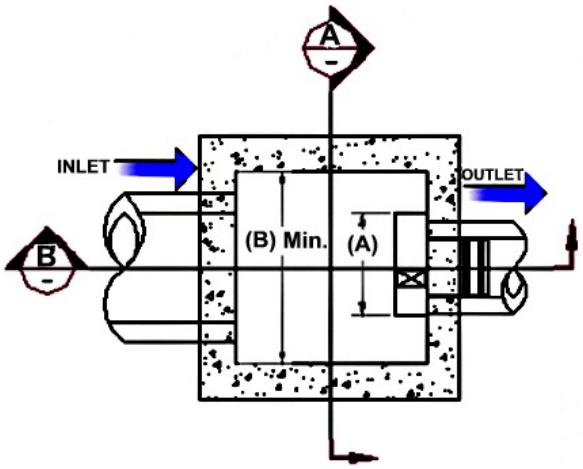


SECTION A **SECTION B**

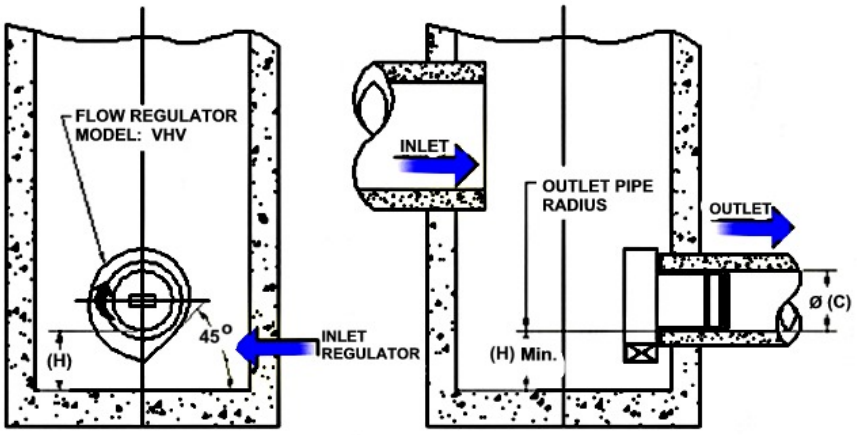
FLOW REGULATOR TYPICAL INSTALLATION IN SQUARE MANHOLE
FIGURE 4 (MODEL VHV)

Model Number	Regulator Diameter		Minimum Chamber Width		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
50VHV-1	150	6	600	24	150	6	150	6
75VHV-1	250	10	600	24	150	6	150	6
100VHV-1	325	13	600	24	150	6	200	8
125VHV-2	275	11	600	24	150	6	200	8
150VHV-2	350	14	600	24	150	6	225	9
200VHV-2	450	18	900	36	200	8	300	12
250VHV-2	575	23	900	36	250	10	350	14
300VHV-2	675	27	1200	48	250	10	400	16
350VHV-2	800	32	1200	48	300	12	500	20

NOTE: ***In the case of a square manhole, the outlet flow pipe must be centered on the wall to ensure enough clearance for the unit.***



SQUARE / RECTANGULAR WELL

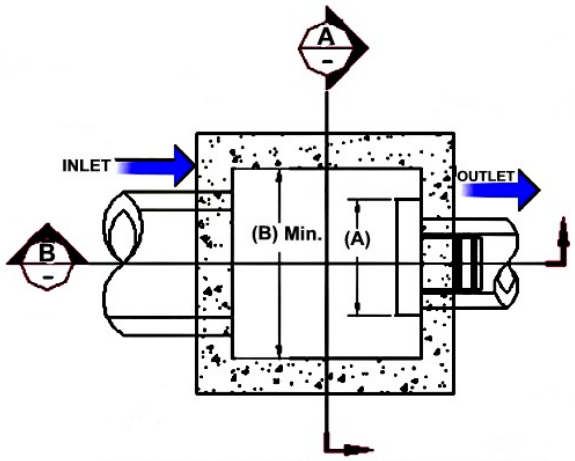


SECTION A **SECTION B**

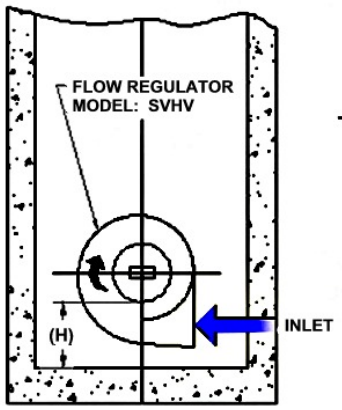
FLOW REGULATOR TYPICAL INSTALLATION IN SQUARE MANHOLE
FIGURE 4 (MODEL SVHV)

Model Number	Regulator Diameter		Minimum Chamber Width		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
25 SVHV-1	125	5	600	24	150	6	150	6
32 SVHV-1	150	6	600	24	150	6	150	6
40 SVHV-1	200	8	600	24	150	6	150	6
50 SVHV-1	250	10	600	24	150	6	150	6
75 SVHV-1	375	15	600	24	150	6	275	11
100 SVHV-2	275	11	600	24	150	6	250	10
125 SVHV-2	350	14	600	24	150	6	300	12
150 SVHV-2	425	17	600	24	150	6	350	14
200 SVHV-2	575	23	900	36	200	8	450	18
250 SVHV-2	700	28	900	36	250	10	550	22
300 SVHV-2	850	34	1200	48	250	10	650	26
350 SVHV-2	1000	40	1200	48	250	10	700	28

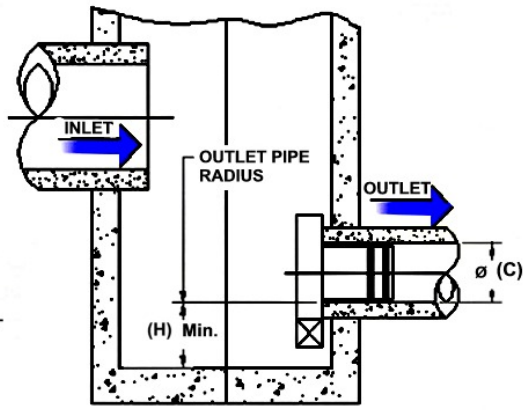
NOTE: ***In the case of a square manhole, the outlet flow pipe must be centered on the wall to ensure enough clearance for the unit.***



SQUARE / RECTANGULAR WELL



SECTION A



SECTION B

INSTALLATION

The installation of a **HYDROVEX®** regulator may be undertaken once the manhole and piping is in place. Installation consists of simply fitting the regulator into the outlet pipe of the manhole. **John Meunier Inc.** recommends the use of a lubricant on the outlet pipe, in order to facilitate the insertion and orientation of the flow controller.

MAINTENANCE

HYDROVEX® regulators are manufactured in such a way as to be maintenance free; however, a periodic inspection (every 3-6 months) is suggested in order to ensure that neither the inlet nor the outlet has become blocked with debris. The manhole should undergo periodically, particularly after major storms, inspection and cleaning as established by the municipality

GUARANTY

The **HYDROVEX®** line of **VHV / SVHV** regulators are guaranteed against both design and manufacturing defects for a period of 5 years. Should a unit be defective, **John Meunier Inc.** is solely responsible for either modification or replacement of the unit.

John Meunier Inc.
ISO 9001 : 2008

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Revised: 2011-05-03