S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing Report

117 FOREST AVENUE &
175 CATHARINE STREET SOUTH

PROPOSED 24-STOREY RESIDENTIAL BUILDING

CITY OF HAMILTON

NOVEMBER 2023

SLA File: 16092A

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Representative Holdings Inc. to provide Consulting Engineering services for the proposed development at 117 Forest Avenue & 175 Catharine Street South in the City of Hamilton (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of constructing a 24-storey residential building containing a total of 248 residential units and three levels of underground parking. The proposed site will also include concrete curbing/sidewalk, an asphalt parking lot and landscaped areas.

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

1.2 BACKGROUND INFORMATION

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

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

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

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

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

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

Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

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

Quantity Control

The stormwater discharge rate from the proposed site shall be controlled to the existing 2-year discharge rate with a run-off co-efficient of 0.63 for all storm events up to and including 100-year event.

Quality Control

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

Erosion Control

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

2.1 EXISTING CONDITIONS

In the existing conditions, the approximate 0.45ha land consists of an existing 11-storey residential building with an underground parking structure, asphalt parking lot and a vacant land of 0.21ha which consists of landscaped and gravel areas. The site is bounded by Forest Avenue to the south, Catharine Street South to the west and existing residential lands to the north and east.

Under the existing condition, 0.21ha of the site generally slopes towards Forest Avenue with a portion of the site ponding near the north part of the site. The entire site sheet drains south to the existing 375mmø storm sewer on Forest Avenue.

One catchment area, Catchment 101 has been identified in the existing condition. Catchment 101 represents the drainage area provided by the City of Hamilton, which demonstrates an allocation of 0.24ha with a runoff coefficient of 0.63 to the existing storm sewer along Forest Avenue. See Table 2.1 below and Appendix A for the Allowable Catchment areas to Forest Avenue.

Table 2.1 – Allowable Catchment Areas to Forest Avenue

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	To Forest Avenue	0.24	60%	0.63

The allowable discharge from the development was calculated using the Rational Method based on the above runoff coefficient (C) and the City of Hamilton storm intensities at a time of concentration of 10 minutes (Tc=10min). See below for the allowable discharge calculation for Catchment 101 and Table 2.2 for the summary.

$Q_{(Allowable)}$ = 2.78 C i A
= 2.78 (0.63) (74.10 mm/hr) (0.24 ha)
= ***31.1 l/s (0.0311 m^3/s)***

Table 2.2 – Existing Conditions Stormwater Discharge

Storm Event	Catchment 101 (m^3/s)
2-Yr Event	**0.0311**
5-Yr Event	0.0433
10-Yr Event	0.0514
25-Yr Event	0.0614
50-Yr Event	0.0691
100-Yr Event	0.0764

2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a 24-storey residential building containing a total of 248 residential units and three levels of underground parking. The proposed site will also include concrete curbing/sidewalk, an asphalt parking lot and landscaped areas. It is proposed to service the site with a private storm sewer system designed and constructed in accordance with the standards and specifications of the City of Hamilton.

Two catchment areas, Catchment 201 and 202 have been identified in the proposed condition. Catchment 201 represents the drainage area for the majority of the site which will be captured and controlled by the private storm sewer system, and will ultimately discharge to the existing 375mmø storm sewer along Forest Avenue. Catchment 202

represents the remainder of the site which will sheet drain uncontrolled to Forest Avenue. Refer to Table 2.3 below and the Proposed Condition Drainage Area Plan in Appendix A for details.

Table 2.3 – Proposed Condition Catchment Areas				
Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
201	Controlled to Forest Avenue	0.30	100%	0.90
202	Uncontrolled to Forest Avenue	0.03	10%	0.32

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 75mmø orifice located at the outlet on the proposed cast-in-place concrete storage tank to restrict discharge from the site to the allowable discharge rate of 31.1 l/s.

With the installation of on-site quantity control measures for Catchment 201, it will be required to provide stormwater storage during storm events up to and including the 100-year event. To provide the required storage, it is proposed to install a cast-in-place concrete storage tank within the underground parking Level 1. Details of the proposed tank can be found on the Preliminary Site Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.4 below and Appendix A for details.

Table 2.4 – Proposed Condition Stage-Storage-Discharge		
Elevation (m)	Storage (m^3)	Discharge (m^3/s)
98.48 (Orifice Invert)	0	0.0000
98.48 (Bottom of Tank)	0	0.0000
98.98 (0.50m Deep)	43	0.0080
99.48 (1.00m Deep)	86	0.0115
99.98 (1.50m Deep)	129	0.0142
100.30 (Top of Tank)	157	0.0157

The maximum discharge rates for Catchments 201 and 202 were calculated using the Rational Method based on the post-development condition runoff coefficients for the 2-year to 100-year storm events. Additionally, the 2-year to 100-year storage volumes for Catchment 201 were calculated using the Modified Rational Method (MRM). The proposed discharge rates and storage volumes are summarized in Table 2.5 below and in Appendix A for details.

Table 2.5 – Proposed Condition Stormwater Discharge						
Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Sanitary Sewer Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
2-Yr	0.0065	0.0020	0.0151	0.0236	0.0311	34.9
5-Yr	0.0096	0.0027	0.0151	0.0274	0.0311	62.7
10-Yr	0.0113	0.0033	0.0151	0.0297	0.0311	83.1
25-Yr	0.0130	0.0039	0.0151	0.0320	0.0311	110.3
50-Yr	0.0142	0.0044	0.0151	0.0337	0.0311	129.4
100-Yr	0.0154	0.0048	0.0151	0.0353	0.0311	151.7

This analysis determined the following:

- The proposed condition discharge rates will not exceed the allowable discharge of 0.0311 m^3/s to the existing 375mmø storm sewer during the 2-year to 10-year storm event.

- The proposed condition discharge rates will exceed the allowable discharge of 0.0311 m^3/s during the 25-year to 100-year storm event by a maximum of 0.004 m^3/s, with the installation of a minimum size orifice plate.

- Catchment 201 will require 151.7m^3 of stormwater storage during the 100-year event, which can be accommodated within the proposed cast-in-place storage tank, having a minimum volume of 157m^3.

Water Quality Control

The proposed development is required to achieve an “Enhanced” (80% TSS removal) level of water quality protection. To achieve this criteria, discharge from catchment 201 will be subject to treatment from a HydroStorm oil/grit separator before ultimately discharging to the existing storm sewer along Forest Avenue. The Hydrostorm sizing software was used to determine the required size of oil/grit separator unit for the site. It was determined that a Hydrostrorm HS6 will provide 80% TSS removal and 97% average annual runoff treatment. The Hydrostorm unit (HS6) has been certified under the ETV for a 53% removal credit. As such, the HydroStorm units have been designed to achieve an ‘Enhanced’ (80% TSS Removal) level of stormwater quality control, but only credited for 53% TSS removal within the treatment train. See HydroStorm unit sizing procedures in Appendix B for details.

As part of a treatment train approach, area drains within the proposed asphalt parking lot will be fitted with FlexStrom inlet filters. The installation of the inlet filters will contribute to the removal of TSS and the capture of floatable within the area drains. The units also provide scour protection and reduce the resuspension of solids during heavy rain events which would otherwise enter the storm system.

Table 2.6 – Proposed Condition Stormwater Treatment Train				
Surface Type	Drainage Area (ha)	Treatment Train Mechanism #1 (% TSS Removal)	Treatment Train Mechanism #2 (% TSS Removal)	Total TSS Removal (%) [3]
Asphalt Parking Lot	0.14	HydroStorm O/G Units (53%) [1]	FlexStorm Inlet Filters (52%) [2]	77%

[1] The HydroStorm units have been designed to achieve a minimum of 80% but credited with only 53% TSS Removal.
[2] The FlexStorm Inlet Filters have been assigned a TSS removal rate of 52% based on similar products.
[3] Total TSS removal calculated using the following formula: R=A+B-[(AxB)/100] where R=total TSS removal rate, A=TSS removal rate for first mechanism, B=TSS removal rate for second mechanism.

As such, the weighted TSS removal from the proposed asphalt parking lot reveals that the best management treatment train approach will provide 77% TSS removal rates.

HydroStorm units and FlexStorm inlet filters require regular inspection and maintenance as per the manufacture's specifications to ensure the units operate properly. See HydroStorm and FlexStorm maintenance manuals in Appendix B for details.

2.3 SEDIMENT AND EROSION CONTROL

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

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

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

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

For details on the proposed erosion and sediment control for the proposed site, see the Preliminary Grading & Erosion Control Plan included in the engineering drawings.

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

The site is located on the north east corner of Forest Avenue and Catharine Street. There is an existing 300mmø Combined sewer which flows east along Forest Avenue and 1350mmø Combined sewer which flows north along Catharine Street.

3.2 SANITARY DEMAND

The proposed development consists of constructing a 24-storey residential building containing a total of 248 residential units.

Table 3.1 summarizes the sanitary sewer discharge rates for the residential portion of the proposed development in accordance with the City of Hamilton comprehensive development guidelines.

Table 3.1 – Proposed Sanitary Sewer Discharge

Population [A]	Avg. Dry weather flows (l/s) [B]	Peaking Factor [c]	Infiltration [D] (l/s)	**Peak Flow [F] (l/s)**
720 persons	3.00	5.0	0.12	**15.1**

[A] Population = 1 bedroom = 2 persons/bed x 142 units = 284 persons
= 2 bedroom = 2 persons/bed x 100 units = 400 persons
= 3 bedroom = 2 persons/bed x 6 units = 36 persons

[B] Average Dry Weather Flows = 360 L/Day/cap x 720 persons = 259,200 L/day

[C] Peak Factor (2<Peak Factor<5) = $(5/(\text{Population in thousands})^{0.2})=(5/(0.720)^{0.2})=5.3$

[E] Infiltration flow based on city of Hamilton Standard 0.4 l/sec/ha = 0.4 l/sec x 0.30 ha=0.12

[F] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

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

15.1 L/s

3.3 PROPOSED SANITARY SERVICING

The proposed residential building will be serviced by a 200mmø sanitary sewer, designed and constructed in accordance with the City of Hamilton standards. Drainage from this sewer will discharge to the existing 300mmø combined sewer along Forest Avenue.

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

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 300mmø watermain located along Forest Avenue and 600mmø watermain along Catharine Street. An existing fire hydrant is located fronting the proposed development on Forest Avenue.

4.2 DOMESTIC WATER DEMAND

The following is an estimate of the water usage for the proposed building. Water usage for the site was calculated based on the "Fixture Unit Method" as per Table 7.6.3.2.A. forming part of sentences 7.6.3.1(1) to (3) and 7.6.3.4.(2), (3) and (5) of the 2012 Ontario Building Code. See Table 4.1 for fixture unit (FU) calculations. Fixture unit calculations will be confirmed upon completion of the Water Usage Assessment, which will be prepared as part of the Site Plan Approval process.

Table 4.1 – Proposed Domestic Water Demand

Component	No. of Fixtures*	FU/ Fixture	Total FU
Lavatory (8.3L/min or less per head) (Private)	354	0.7	247.8
Shower Head (9.5L/min or less per head) (Private)	354	1.4	495.6
Water Closet (6 LPF or less with flush tank) (Private)	354	2.2	778.8
Sink (kitchen, domestic, 8.3 L/min or less) (Private)	248	1.4	347.2
Dishwasher, domestic (Private)	248	1.4	347.2
Clothes Washer (3.5 kg) (Private)	248	1.4	347.2
		Total FU:	**2563.8**

* Number of Fixtures per unit have estimated and will be confirmed during detailed design

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

Total Fixture Unit Count = 2563.8 FU

Water Usage: 313 IGPM (23.7 L/s)

4.3 FIRE FLOW DEMAND

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

The proposed development consists of constructing a 24-storey residential building containing a total of 248 residential units. An existing hydrant is located fronting the proposed site on Forest Avenue, within the required 90m separation to the building face of the proposed building (as per Sentence 3.2.5.7 of the Ontario Building Code).

The fire flow for this building was determined to be the greater of the OBC fire flow calculation (OBC section A-3.2.5.7) or the City of Hamilton Target Available Fire Flow. The result of the OBC fire flow calculation was a minimum flow rate of 9000 l/min (150 l/sec). This is equal to the City of Hamilton target available fire flow for a Residential Multi (greater than 3 units), which is 150 l/sec. Therefore, the minimum required fire flow for this site is **150 l/sec**. Refer to Appendix C for fire flow calculations.

The following hydrant flow test data for the public fire hydrants in closest proximity to the proposed development has been analyzed to determine if the municipal system adjacent to the subject site is adequate to provide the required fire flow, with a minimum pressure of 20 psi. Table 4.2 below summarizes the hydrant flow data completed by SCG Flowmetrix. Refer to the attached flow data prepared by SCG Flowmetrix for more information.

Table 4.2 – Hydrant Flow Test Data	
Hydrant ID	HA15H026
Location	146 Forest Avenue
Static Pressure	63.1 psi
Residual Pressure During Test Flow	60.0 psi
Test Flow Rate	972 IGPM (61 l/s)
Theoretical Flow @ 20 psi	**4,025 IGPM (254 l/s)**

Based on the above hydrant flow test data, the theoretical maximum available flow rate from the hydrant is **254 l/s**, while the maximum required fire flow for the proposed development is only **150 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of connecting a 150mmø water service off of the existing 300mmø watermain adjacent to the site on Forest Avenue. The proposed 150mmø water service will provide domestic and fire water service for the proposed condominium building. Water services for the site are to be designed and constructed in accordance with City of Hamilton standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development of 117 Forest Avenue & 175 Catharine Street South can be constructed to meet the requirements of the City of Hamilton. Therefore, it is recommended that:

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

- A 75mmø orifice plate be installed at the outlet on the cast-in-place storage tank as per the Preliminary Site Servicing Plan and this report to provide adequate quantity control;

- A cast-in-place concrete storage tank be installed as per the Preliminary Site Servicing Plan and this report to provide effective stormwater storage;

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

- HydroStorm HS6 oil/grit separator be installed as per the Preliminary Site Servicing Plan and this report to provide efficient stormwater quality control;

- Area drains within the parking lot are to be fitted with FlexStorm inlet filters as illustrated on the Preliminary Site Servicing Plan and this report;

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

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

Prepared by:
S. LLEWELLYN & ASSOCIATES LIMITED

M. Colosimo, Dipl. T.

S. Frankovich, P.Eng.

APPENDIX A

STORMWATER MANAGEMENT INFORMATION

175 Catharine Street South, Ha

Show search results for 175...

Measurement

Hectares

Measurement Result

0.24 Hectares

Clear

Press CTRL to enable snapping

78651
HH10E071
Round: 900mm 0.35%
62439
Irregular: 900mm
Round: 1050mm 1.1%
62440
Round: 975mm 1.1%
65795
HH10B039
HH10E040
HH10E196
HH10B038
66253
65797
65796
Round: 300mm 4.0%
67256
Round: 375mm 1.3%
66846
Round: 300mm 0.5%
62441
HH10B037
HH10E001
78669
80640
Round: 450mm 0.6%
80639
Round: 450mm 0.6%
Round: 300mm 0.5%
78667
78668
Round: 600mm 1.0%
Round: 600mm 0.5%
25CDM-79003
DA-22-014
FC-16-055
ZAC-17-008
108
116
124
132
134
136
138
140
142
144
176
117
125
135
172
174
178
180
188
190
192
100
81
82
86

FIGURE 1.0


78651
HH10E071
Round: 900mm 0.35%
62439
Irregular: 900mm x 1134mm 0.74%
Round: 1050mm 1.4%
176
108
116
124
132
134
136
138
140
142
144
139
141
166
168
172
174
178
180
135
125
117
100
25CDM-79003
DA-22-014
FC-16-055
ZAC-17-008
62440
Round: 375mm 1.1%
HH10E040
HH10B039
HH10E196
HH10B038
65797
65796
6253
Round: 300mm 4.0%
(2 of 2)
Storm Combined Sewer Catchment Areas
Catchment Name: HH10E035.2
Type:
Sub Name:
Year Sketched: 2002
Direction From: HH10E040
Actual C Runoff: 0.63
Ultimate C Runoff: 0.63
Comments:
Zoom to
62441
Round: 300mm 0.5%
HH10B037
HH10E001
78669
80640
Round: 450mm 0.6%
80639
Round: 450mm 0.6%
Round: 300mm 0.5%
78667
78668
Round: 600mm 4.0%
Round: 600mm 0.5%
Round: 375mm 0.42%
76269
HH
FIGURE 2.0

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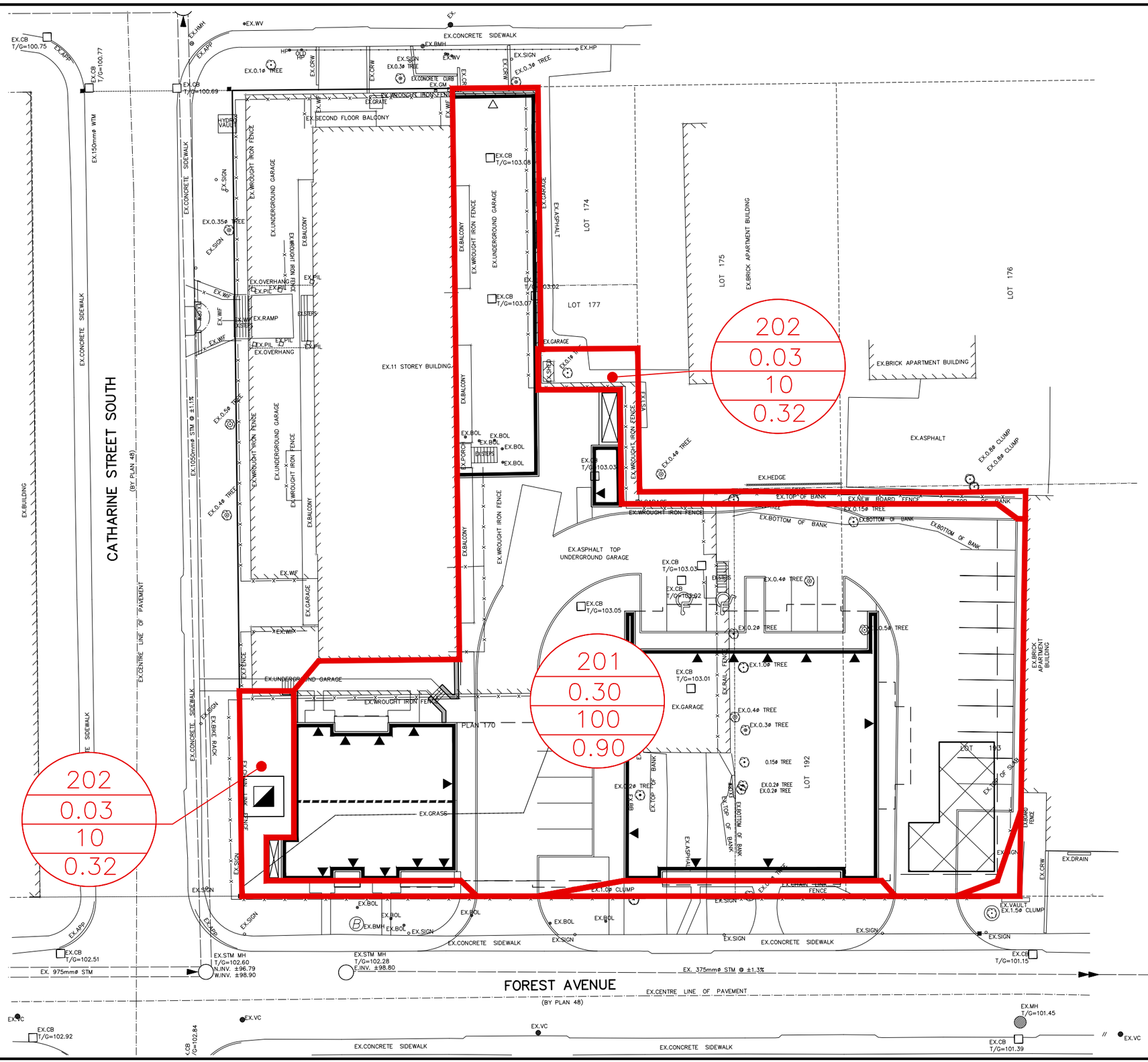

LEGEND

DRAINAGE BOUNDARY

201
0.39
11
0.32

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

FIGURE 3.0
POST–DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 117 FOREST AVE & 175 CATHARINE ST. S.
PROJECT No.: 16092A

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Hamilton, Ontario

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Tank Outlet
Diameter (mm)	**75**
Area (m^2)	0.00442
Invert Elev. (m)	98.48
C/L Elev. (m)	98.52
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes			Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	98.48	86.0	0.0	0	0.000	0.0000
Bottom of Tank	98.48	86.0	0.0	0	0.000	0.0000
0.5m Deep	98.98	86.0	43.0	43	0.463	0.0080
1.0m Deep	99.48	86.0	43.0	86	0.963	0.0115
1.5m Deep	99.98	86.0	43.0	129	1.463	0.0142
Top of Tank	100.30	86.0	27.5	157	1.783	0.0157

2-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information	
City/Town/Region:	**Hamilton**
Return Period:	**2** Years
A =	**646.000**
B =	**6.000**
C=	**0.781**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.30**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0157**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	99.290	0.0000276	0.074	0.0	0.0745	22.34	7.07	15.28
10	600	74.099	0.0000206	0.056	0.0	0.0556	33.34	9.42	23.92
15	900	59.921	0.0000166	0.045	0.0	0.0449	40.45	11.78	28.67
20	1200	50.715	0.0000141	0.038	0.0	0.0380	45.64	14.13	31.51
25	1500	44.206	0.0000123	0.033	0.0	0.0332	49.73	16.49	33.25
30	1800	39.333	0.0000109	0.029	0.0	0.0295	53.10	18.84	34.26
35	2100	35.534	0.0000099	0.027	0.0	0.0267	55.97	21.20	34.77
40	2400	32.480	0.0000090	0.024	0.0	0.0244	58.46	23.55	34.91
45	2700	29.965	0.0000083	0.022	0.0	0.0225	60.68	25.91	34.77
50	3000	27.855	0.0000077	0.021	0.0	0.0209	62.67	28.26	34.41
55	3300	26.055	0.0000072	0.020	0.0	0.0195	64.49	30.62	33.87
60	3600	24.500	0.0000068	0.018	0.0	0.0184	66.15	32.97	33.18

Max. required storage volume = 34.91 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

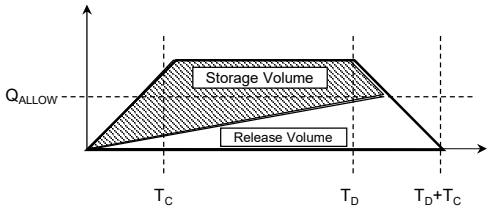
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



5-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information	
City/Town/Region:	**Hamilton**
Return Period:	**5** Years
A =	**1049.500**
B =	**8.000**
C=	**0.803**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.30**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0157**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	133.809	0.0000372	0.100	0.0	0.1004	30.11	7.07	23.04
10	600	103.038	0.0000286	0.077	0.0	0.0773	46.37	9.42	36.95
15	900	84.628	0.0000235	0.063	0.0	0.0635	57.12	11.78	45.35
20	1200	72.263	0.0000201	0.054	0.0	0.0542	65.04	14.13	50.91
25	1500	63.331	0.0000176	0.047	0.0	0.0475	71.25	16.49	54.76
30	1800	56.548	0.0000157	0.042	0.0	0.0424	76.34	18.84	57.50
35	2100	51.204	0.0000142	0.038	0.0	0.0384	80.65	21.20	59.45
40	2400	46.875	0.0000130	0.035	0.0	0.0352	84.38	23.55	60.83
45	2700	43.290	0.0000120	0.032	0.0	0.0325	87.66	25.91	61.76
50	3000	40.267	0.0000112	0.030	0.0	0.0302	90.60	28.26	62.34
55	3300	37.680	0.0000105	0.028	0.0	0.0283	93.26	30.62	62.64
60	3600	35.439	0.0000098	0.027	0.0	0.0266	95.68	32.97	62.71
65	3900	33.476	0.0000093	0.025	0.0	0.0251	97.92	35.33	62.59
70	4200	31.742	0.0000088	0.024	0.0	0.0238	99.99	37.68	62.31
75	4500	30.197	0.0000084	0.023	0.0	0.0226	101.91	40.04	61.88
80	4800	28.811	0.0000080	0.022	0.0	0.0216	103.72	42.39	61.33

Max. required storage volume = 62.71 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

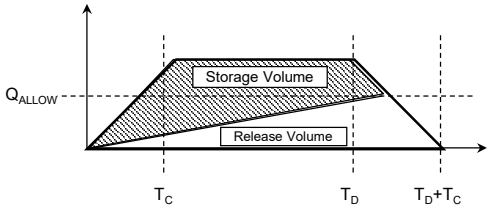
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



10-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information	
City/Town/Region:	**Hamilton**
Return Period:	**10** Years
A =	**1343.700**
B =	**9.000**
C=	**0.814**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.30**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0157**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	156.803	0.0000436	0.118	0.0	0.1176	35.28	7.07	28.22
10	600	122.292	0.0000340	0.092	0.0	0.0917	55.03	9.42	45.61
15	900	101.114	0.0000281	0.076	0.0	0.0758	68.25	11.78	56.48
20	1200	86.678	0.0000241	0.065	0.0	0.0650	78.01	14.13	63.88
25	1500	76.152	0.0000212	0.057	0.0	0.0571	85.67	16.49	69.19
30	1800	68.104	0.0000189	0.051	0.0	0.0511	91.94	18.84	73.10
35	2100	61.735	0.0000171	0.046	0.0	0.0463	97.23	21.20	76.04
40	2400	56.557	0.0000157	0.042	0.0	0.0424	101.80	23.55	78.25
45	2700	52.256	0.0000145	0.039	0.0	0.0392	105.82	25.91	79.91
50	3000	48.622	0.0000135	0.036	0.0	0.0365	109.40	28.26	81.14
55	3300	45.506	0.0000126	0.034	0.0	0.0341	112.63	30.62	82.01
60	3600	42.803	0.0000119	0.032	0.0	0.0321	115.57	32.97	82.60
65	3900	40.434	0.0000112	0.030	0.0	0.0303	118.27	35.33	82.94
70	4200	38.338	0.0000106	0.029	0.0	0.0288	120.77	37.68	83.09
75	4500	36.470	0.0000101	0.027	0.0	0.0274	123.09	40.04	83.05
80	4800	34.794	0.0000097	0.026	0.0	0.0261	125.26	42.39	82.87
85	5100	33.279	0.0000092	0.025	0.0	0.0250	127.29	44.75	82.55
90	5400	31.905	0.0000089	0.024	0.0	0.0239	129.21	47.10	82.11
95	5700	30.650	0.0000085	0.023	0.0	0.0230	131.03	49.46	81.58
100	6000	29.501	0.0000082	0.022	0.0	0.0221	132.75	51.81	80.94
105	6300	28.443	0.0000079	0.021	0.0	0.0213	134.40	54.17	80.23

Max. required storage volume = 83.09 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

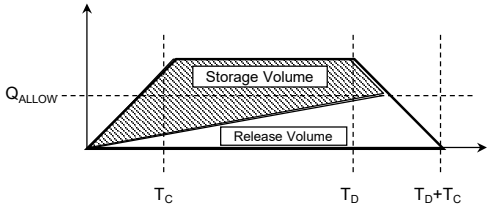
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



25-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information	
City/Town/Region:	**Hamilton**
Return Period:	**25** Years
A =	**1719.500**
B =	**10.000**
C=	**0.823**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.30**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0157**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	185.131	0.0000514	0.139	0.0	0.1388	41.65	7.07	34.59
10	600	146.101	0.0000406	0.110	0.0	0.1096	65.75	9.42	56.33
15	900	121.590	0.0000338	0.091	0.0	0.0912	82.07	11.78	70.30
20	1200	104.648	0.0000291	0.078	0.0	0.0785	94.18	14.13	80.05
25	1500	92.179	0.0000256	0.069	0.0	0.0691	103.70	16.49	87.22
30	1800	82.586	0.0000229	0.062	0.0	0.0619	111.49	18.84	92.65
35	2100	74.956	0.0000208	0.056	0.0	0.0562	118.06	21.20	96.86
40	2400	68.731	0.0000191	0.052	0.0	0.0515	123.72	23.55	100.17
45	2700	63.545	0.0000177	0.048	0.0	0.0477	128.68	25.91	102.77
50	3000	59.154	0.0000164	0.044	0.0	0.0444	133.10	28.26	104.84
55	3300	55.383	0.0000154	0.042	0.0	0.0415	137.07	30.62	106.46
60	3600	52.106	0.0000145	0.039	0.0	0.0391	140.69	32.97	107.72
65	3900	49.230	0.0000137	0.037	0.0	0.0369	144.00	35.33	108.67
70	4200	46.683	0.0000130	0.035	0.0	0.0350	147.05	37.68	109.37
75	4500	44.411	0.0000123	0.033	0.0	0.0333	149.89	40.04	109.85
80	4800	42.370	0.0000118	0.032	0.0	0.0318	152.53	42.39	110.14
85	5100	40.526	0.0000113	0.030	0.0	0.0304	155.01	44.75	110.27
90	5400	38.851	0.0000108	0.029	0.0	0.0291	157.35	47.10	110.25
95	5700	37.322	0.0000104	0.028	0.0	0.0280	159.55	49.46	110.10
100	6000	35.920	0.0000100	0.027	0.0	0.0269	161.64	51.81	109.83
105	6300	34.630	0.0000096	0.026	0.0	0.0260	163.63	54.17	109.46
110	6600	33.438	0.0000093	0.025	0.0	0.0251	165.52	56.52	109.00
115	6900	32.333	0.0000090	0.024	0.0	0.0242	167.32	58.88	108.45
120	7200	31.306	0.0000087	0.023	0.0	0.0235	169.05	61.23	107.82

Max. required storage volume = 110.27 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

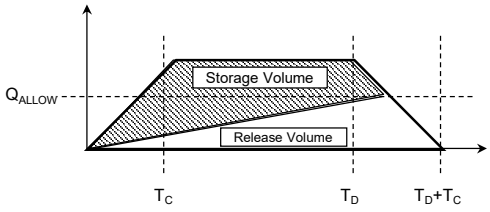
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C\ Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\ Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



50-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information	
City/Town/Region:	**Hamilton**
Return Period:	**50** Years
A =	**1954.800**
B =	**10.000**
C=	**0.826**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.30**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0157**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	208.762	0.0000580	0.157	0.0	0.1566	46.97	7.07	39.91
10	600	164.608	0.0000457	0.123	0.0	0.1235	74.07	9.42	64.65
15	900	136.900	0.0000380	0.103	0.0	0.1027	92.41	11.78	80.63
20	1200	117.761	0.0000327	0.088	0.0	0.0883	105.98	14.13	91.85
25	1500	103.682	0.0000288	0.078	0.0	0.0778	116.64	16.49	100.16
30	1800	92.854	0.0000258	0.070	0.0	0.0696	125.35	18.84	106.51
35	2100	84.246	0.0000234	0.063	0.0	0.0632	132.69	21.20	111.49
40	2400	77.224	0.0000215	0.058	0.0	0.0579	139.00	23.55	115.45
45	2700	71.378	0.0000198	0.054	0.0	0.0535	144.54	25.91	118.63
50	3000	66.428	0.0000185	0.050	0.0	0.0498	149.46	28.26	121.20
55	3300	62.178	0.0000173	0.047	0.0	0.0466	153.89	30.62	123.28
60	3600	58.486	0.0000162	0.044	0.0	0.0439	157.91	32.97	124.94
65	3900	55.246	0.0000153	0.041	0.0	0.0414	161.59	35.33	126.27
70	4200	52.378	0.0000145	0.039	0.0	0.0393	164.99	37.68	127.31
75	4500	49.820	0.0000138	0.037	0.0	0.0374	168.14	40.04	128.11
80	4800	47.522	0.0000132	0.036	0.0	0.0356	171.08	42.39	128.69
85	5100	45.447	0.0000126	0.034	0.0	0.0341	173.83	44.75	129.09
90	5400	43.561	0.0000121	0.033	0.0	0.0327	176.42	47.10	129.32
95	5700	41.841	0.0000116	0.031	0.0	0.0314	178.87	49.46	129.41
100	6000	40.264	0.0000112	0.030	0.0	0.0302	181.19	51.81	129.38
105	6300	38.812	0.0000108	0.029	0.0	0.0291	183.39	54.17	129.22
110	6600	37.471	0.0000104	0.028	0.0	0.0281	185.48	56.52	128.96
115	6900	36.229	0.0000101	0.027	0.0	0.0272	187.48	58.88	128.61
120	7200	35.074	0.0000097	0.026	0.0	0.0263	189.40	61.23	128.17

Max. required storage volume = 129.41 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

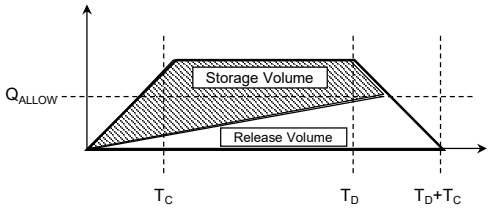
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C\ Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\ Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



100-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information	
City/Town/Region:	**Hamilton**
Return Period:	**100** Years
A =	**2317.400**
B =	**11.000**
C=	**0.836**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.30**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0157**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	228.222	0.0000634	0.171	0.0	0.1712	51.35	7.07	44.28
10	600	181.813	0.0000505	0.136	0.0	0.1364	81.82	9.42	72.40
15	900	152.084	0.0000422	0.114	0.0	0.1141	102.66	11.78	90.88
20	1200	131.287	0.0000365	0.098	0.0	0.0985	118.16	14.13	104.03
25	1500	115.860	0.0000322	0.087	0.0	0.0869	130.34	16.49	113.86
30	1800	103.923	0.0000289	0.078	0.0	0.0779	140.30	18.84	121.46
35	2100	94.392	0.0000262	0.071	0.0	0.0708	148.67	21.20	127.47
40	2400	86.591	0.0000241	0.065	0.0	0.0649	155.86	23.55	132.31
45	2700	80.078	0.0000222	0.060	0.0	0.0601	162.16	25.91	136.25
50	3000	74.553	0.0000207	0.056	0.0	0.0559	167.74	28.26	139.48
55	3300	69.801	0.0000194	0.052	0.0	0.0524	172.76	30.62	142.14
60	3600	65.667	0.0000182	0.049	0.0	0.0493	177.30	32.97	144.33
65	3900	62.036	0.0000172	0.047	0.0	0.0465	181.45	35.33	146.13
70	4200	58.818	0.0000163	0.044	0.0	0.0441	185.28	37.68	147.60
75	4500	55.945	0.0000155	0.042	0.0	0.0420	188.81	40.04	148.78
80	4800	53.363	0.0000148	0.040	0.0	0.0400	192.11	42.39	149.72
85	5100	51.030	0.0000142	0.038	0.0	0.0383	195.19	44.75	150.44
90	5400	48.909	0.0000136	0.037	0.0	0.0367	198.08	47.10	150.98
95	5700	46.973	0.0000130	0.035	0.0	0.0352	200.81	49.46	151.35
100	6000	45.197	0.0000126	0.034	0.0	0.0339	203.39	51.81	151.58
105	6300	43.563	0.0000121	0.033	0.0	0.0327	205.83	54.17	151.67
110	6600	42.053	0.0000117	0.032	0.0	0.0315	208.16	56.52	151.64
115	6900	40.653	0.0000113	0.030	0.0	0.0305	210.38	58.88	151.50
120	7200	39.352	0.0000109	0.030	0.0	0.0295	212.50	61.23	151.27

Max. required storage volume = 151.67 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

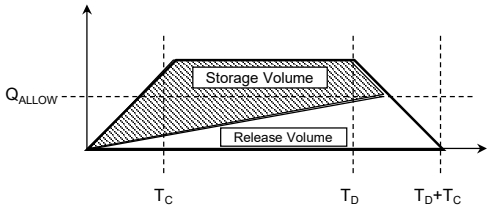
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C\ Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\ Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



APPENDIX B

QUALITY CONTROL INFORMATION

Hydroworks Sizing Summary

Forest Avenue & Catharine Street South

11-15-2023

Recommended Size: HydroStorm HS 6

A HydroStorm HS 6 is recommended to provide 80 % annual TSS removal based on a drainage area of 0.30 (ha) with an imperviousness of 100 % and Hamilton RBG, Ontario rainfall for the ETV/NJDEP particle size distribution.

The recommended HydroStorm HS 6 treats 97 % of the annual runoff and provides 80 % annual TSS removal for the Hamilton RBG rainfall records and ETV/NJDEP particle size distribution.

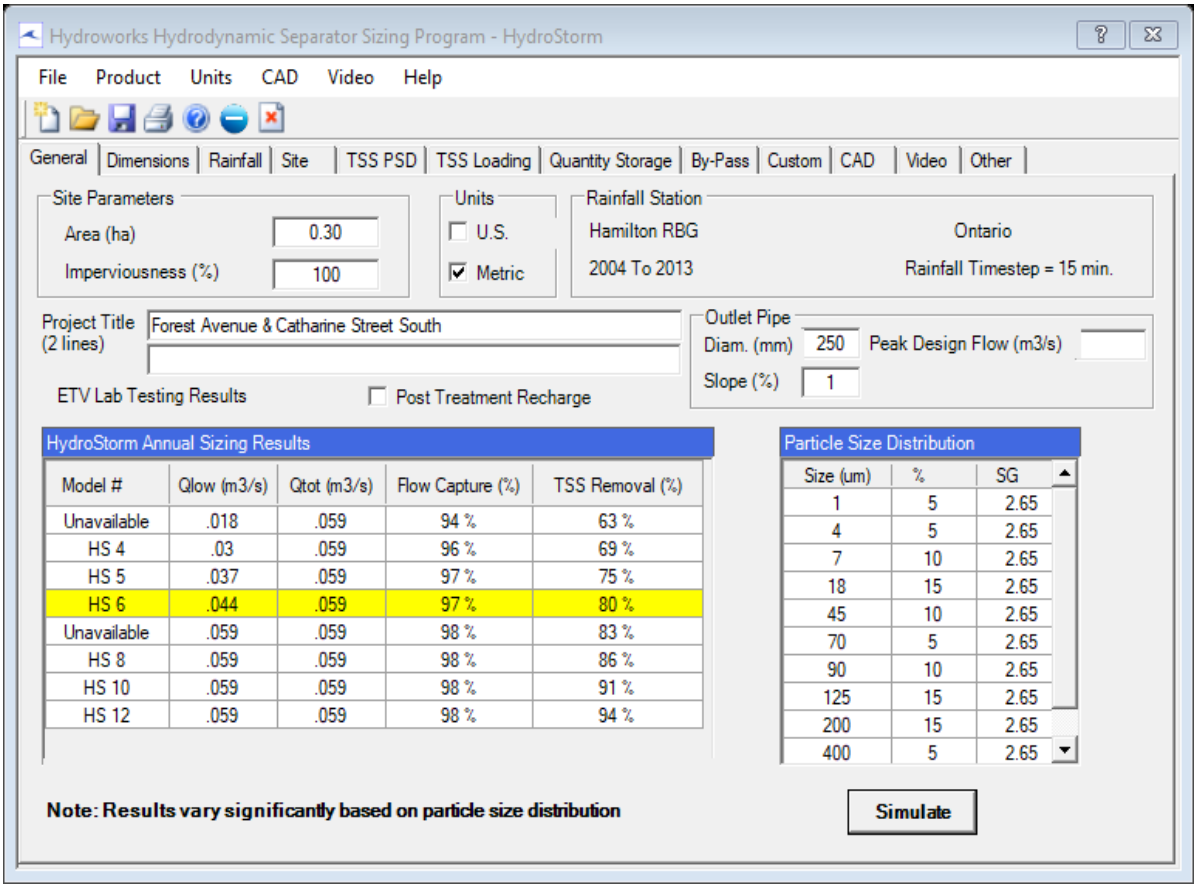
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .06 (m3/s) for the given 250 (mm) pipe diameter at 1% slope. The headloss was calculated to be 78 (mm) based on a flow depth of 250 (mm) (full pipe flow).

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

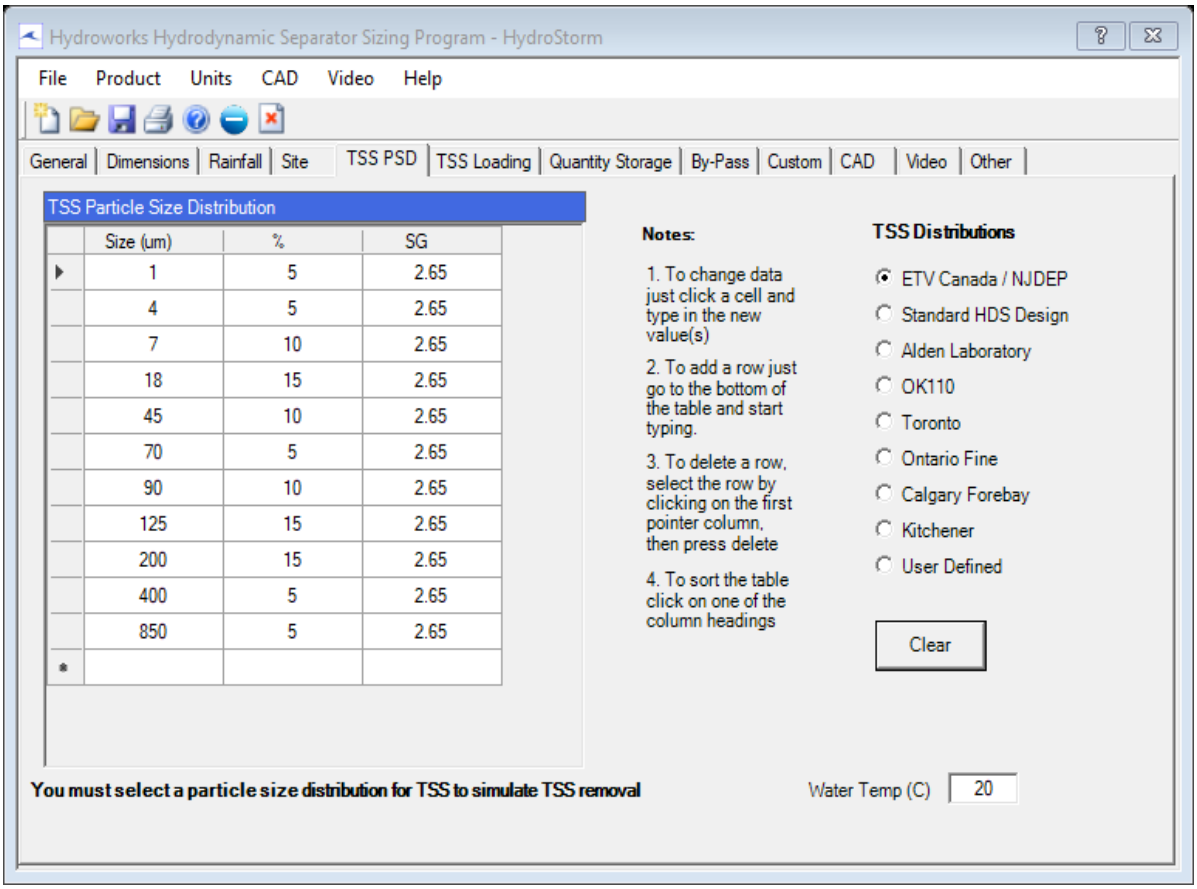
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroStorm .

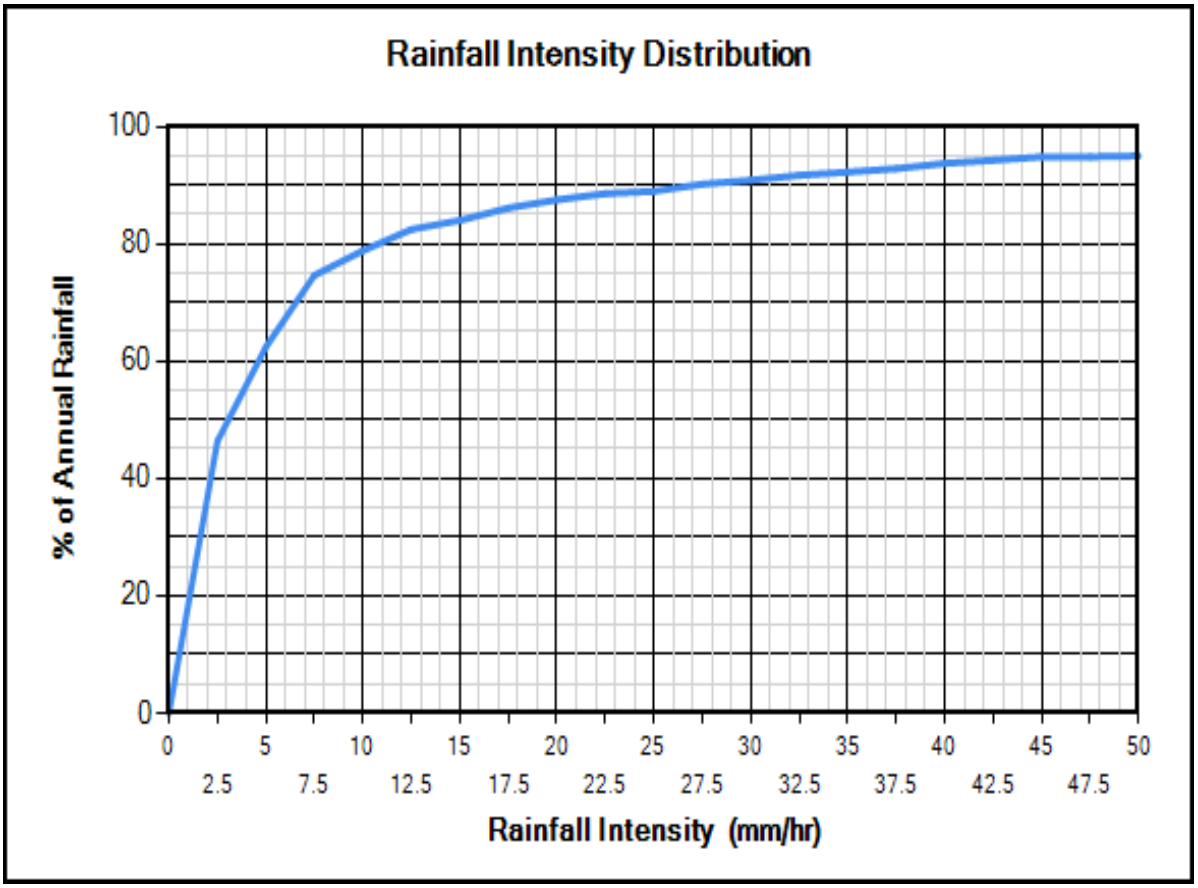
TSS Removal Sizing Summary



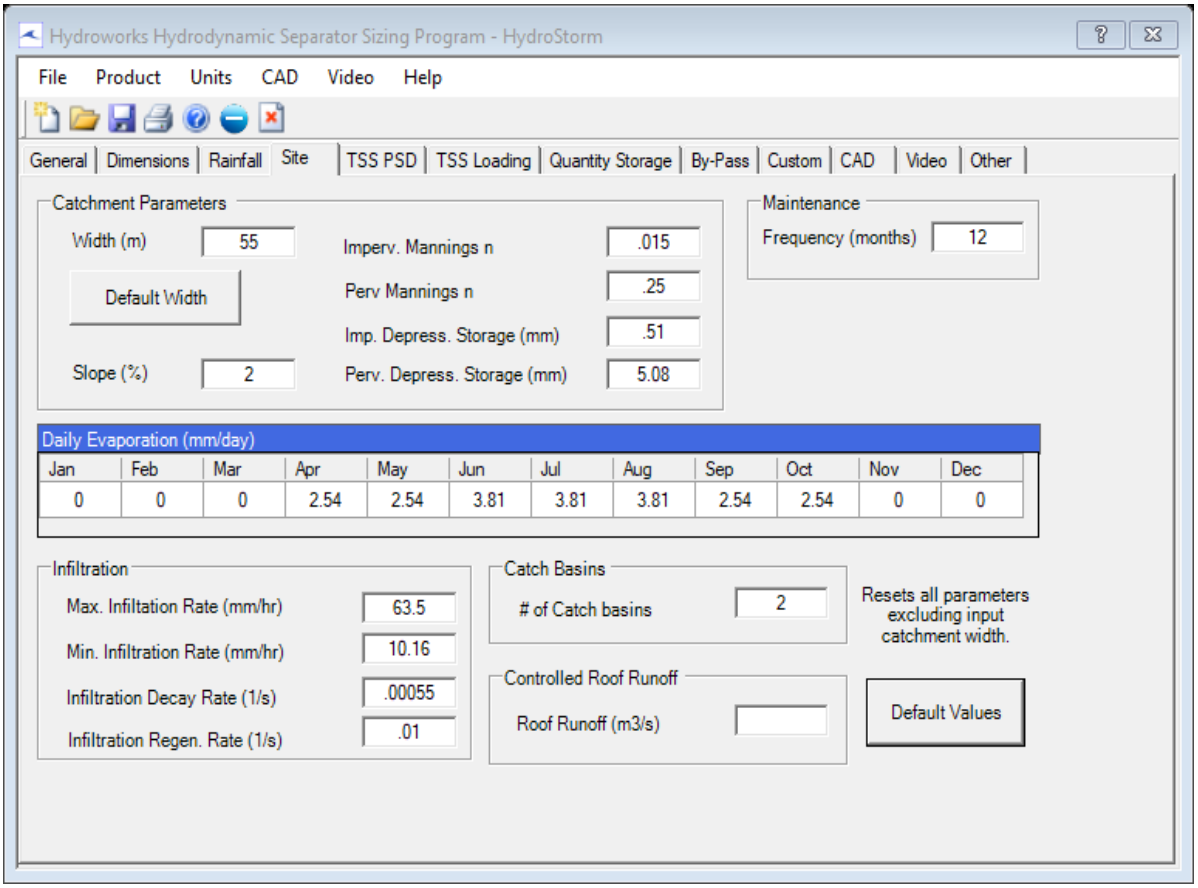
TSS Particle Size Distribution



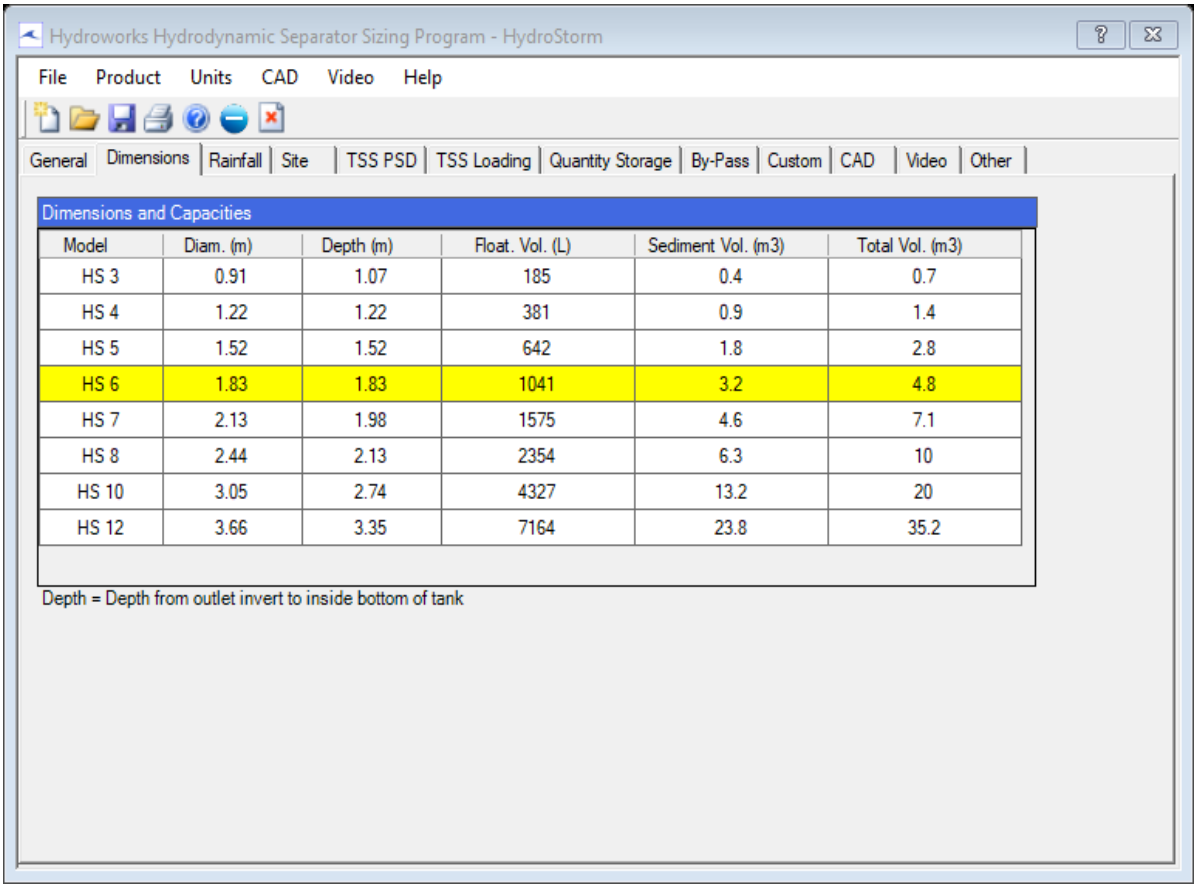
Rainfall Station - Hamilton RBG, Ontario(2004 To 2013)



Site Physical Characteristics



Dimensions And Capacities

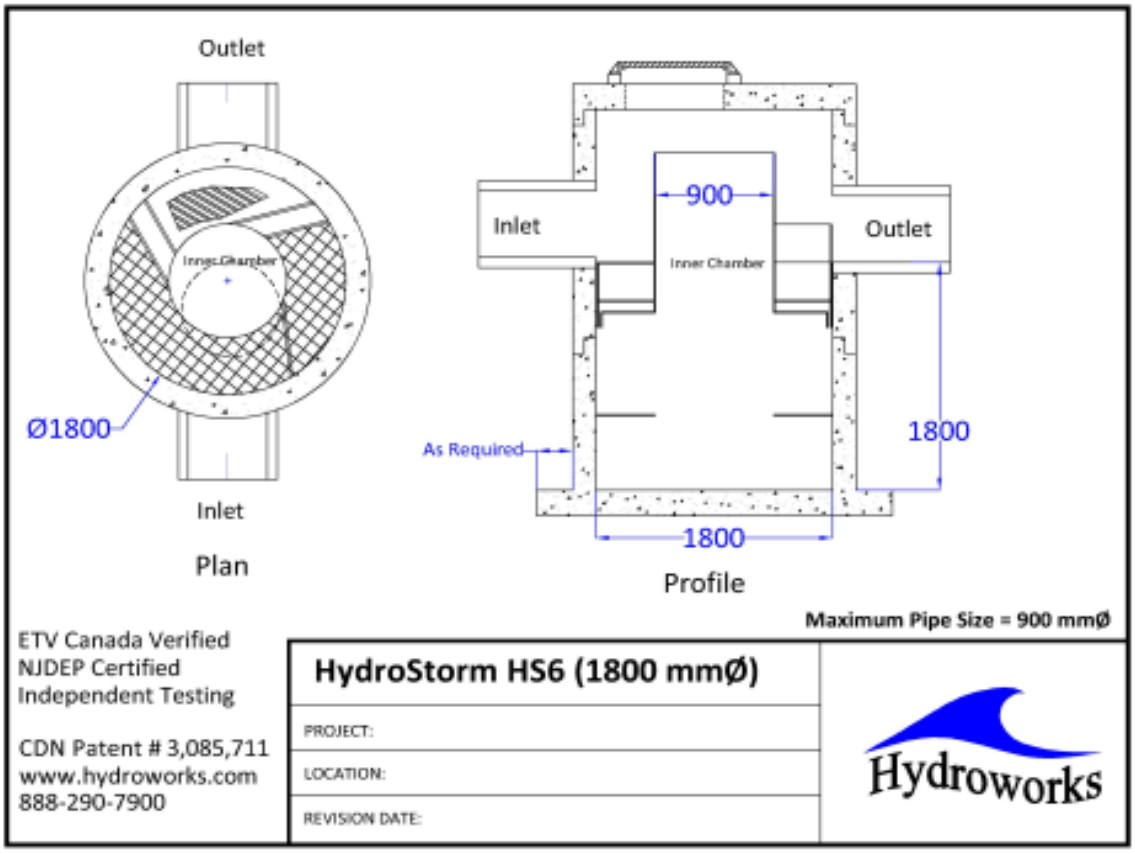


Dimensions and Capacities

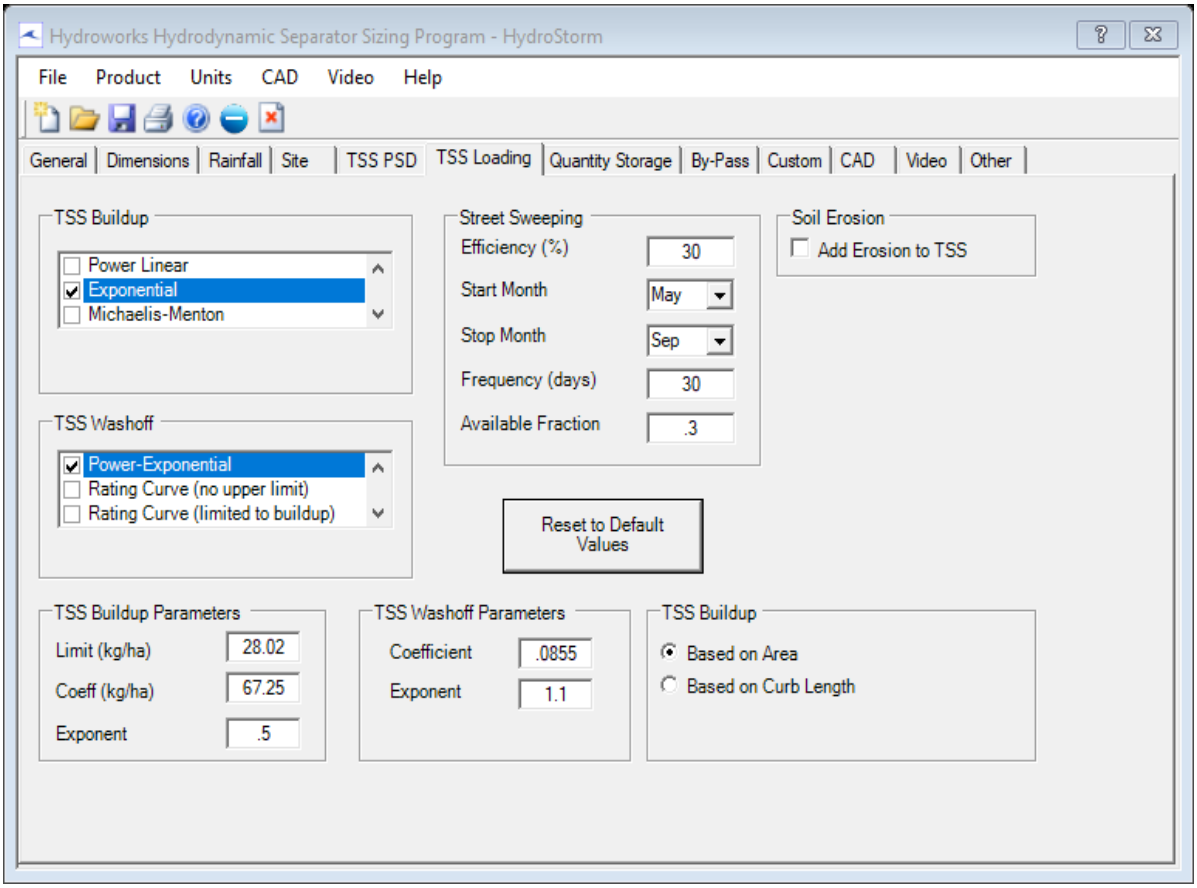
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

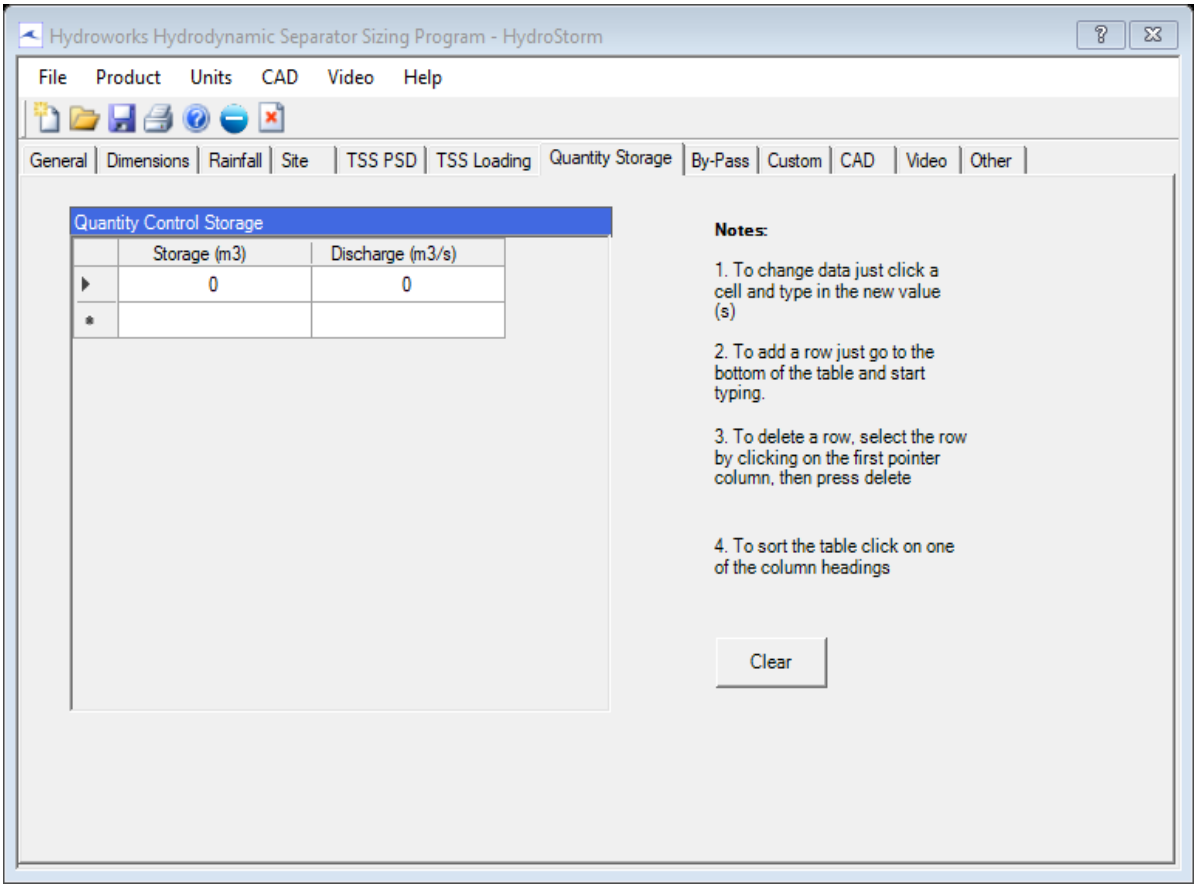
Generic HS 6 CAD Drawing



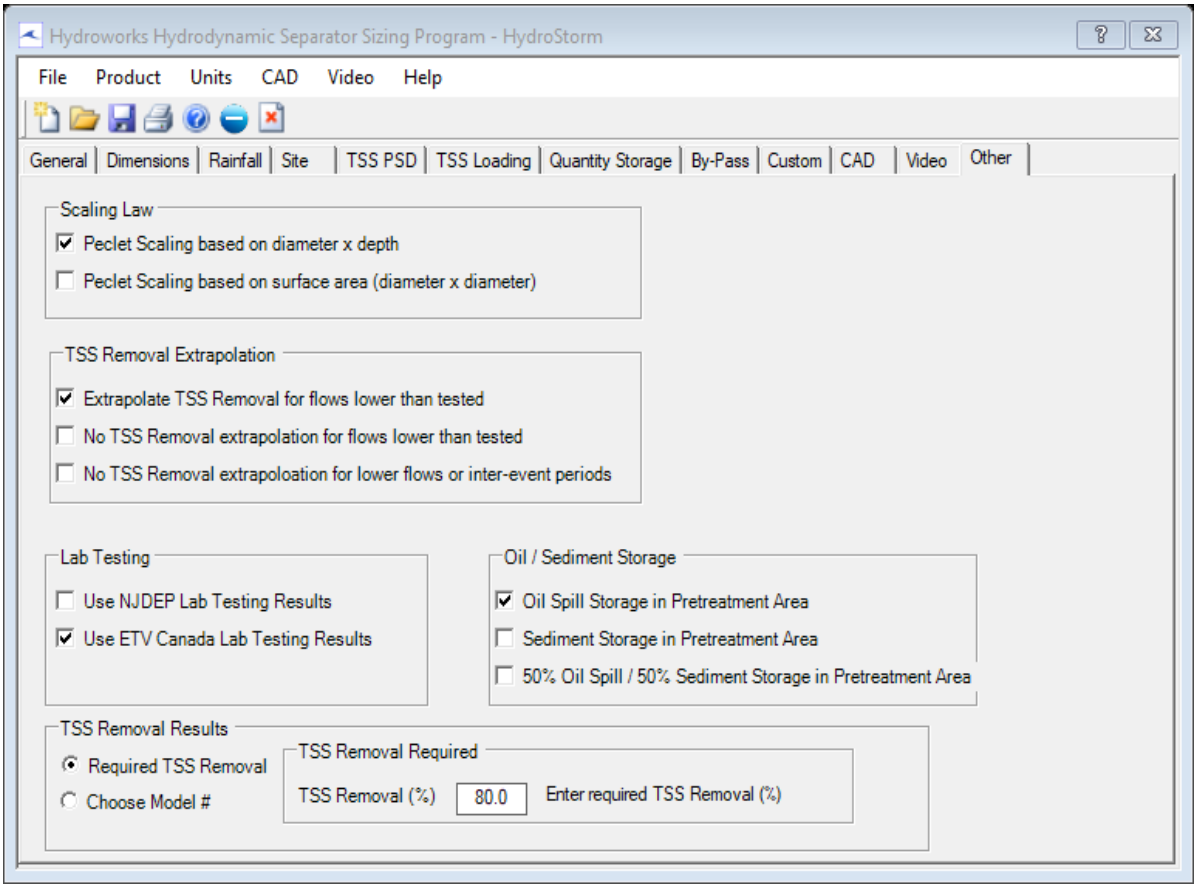
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.7
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1-800-290-7900
www.hydroworks.com

Hydroworks® HydroStorm

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please fax a copy of the completed checklist to Hydroworks at 888-783-7271 for our records.

Introduction

The HydroStorm is a state of the art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroStorm is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroStorm.

Hydroworks® HydroStorm Operation

The Hydroworks HydroStorm (HS) separator is a unique hydrodynamic by-pass separator. It incorporates a protected submerged pretreatment zone to collect larger solids, a treatment tank to remove finer solids, and a dual set of weirs to create a high flow bypass. High flows are conveyed directly to the outlet and do not enter the treatment area, however, the submerged pretreatment area still allows removal of coarse solids during high flows.

Under normal or low flows, water enters an inlet area with a horizontal grate. The area underneath the grate is submerged with openings to the main treatment area of the separator. Coarse solids fall through the grate and are either trapped in the pretreatment area or conveyed into the main treatment area depending on the flow rate. Fines are transported into the main treatment area. Openings and weirs in the pretreatment area allow entry of water and solids into the main treatment area and cause water to rotate in the main treatment area creating a vortex motion. Water in the main treatment area is forced to rise along the walls of the separator to discharge from the treatment area to the downstream pipe.

The vortex motion forces solids and floatables to the middle of the inner chamber. Floatables are trapped since the inlet to the treatment area is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while water must flow up the walls of the separator to discharge into the downstream pipe.

A set of high flow weirs near the outlet pipe create a high flow bypass over both the pretreatment area and main treatment chamber. The rate of flow into the treatment area is regulated by the number and size of openings into the treatment chamber and the height of by-pass weirs. High flows flow over the weirs directly to the outlet pipe preventing the scour and resuspension of any fines collected in the treatment chamber.

A central access tube is located in the structure to provide access for cleaning. The arrangement of the inlet area and bypass weirs near the outlet pipe facilitate the use of multiple inlet pipes.

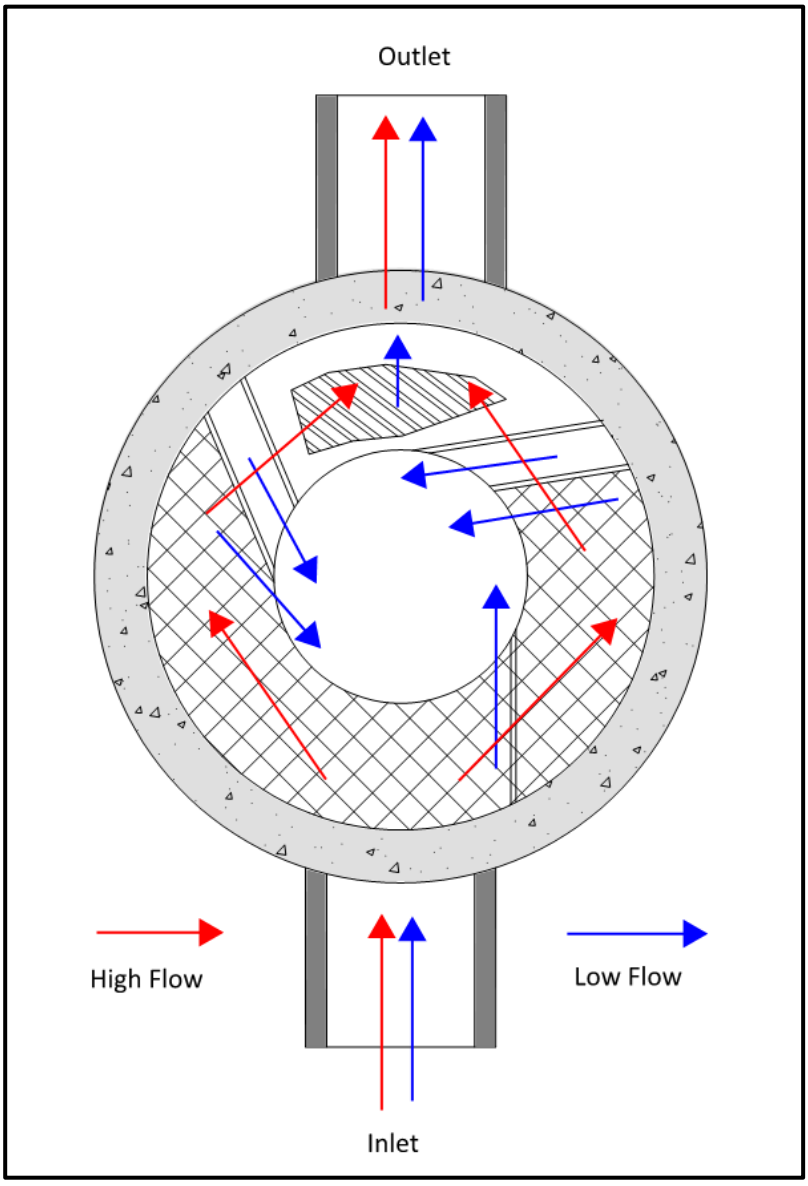


Figure 1. Hydroworks HydroStorm Operation – Plan View

Figure 2 is a profile view of the HydroStorm separator showing the flow patterns for low and high flows.

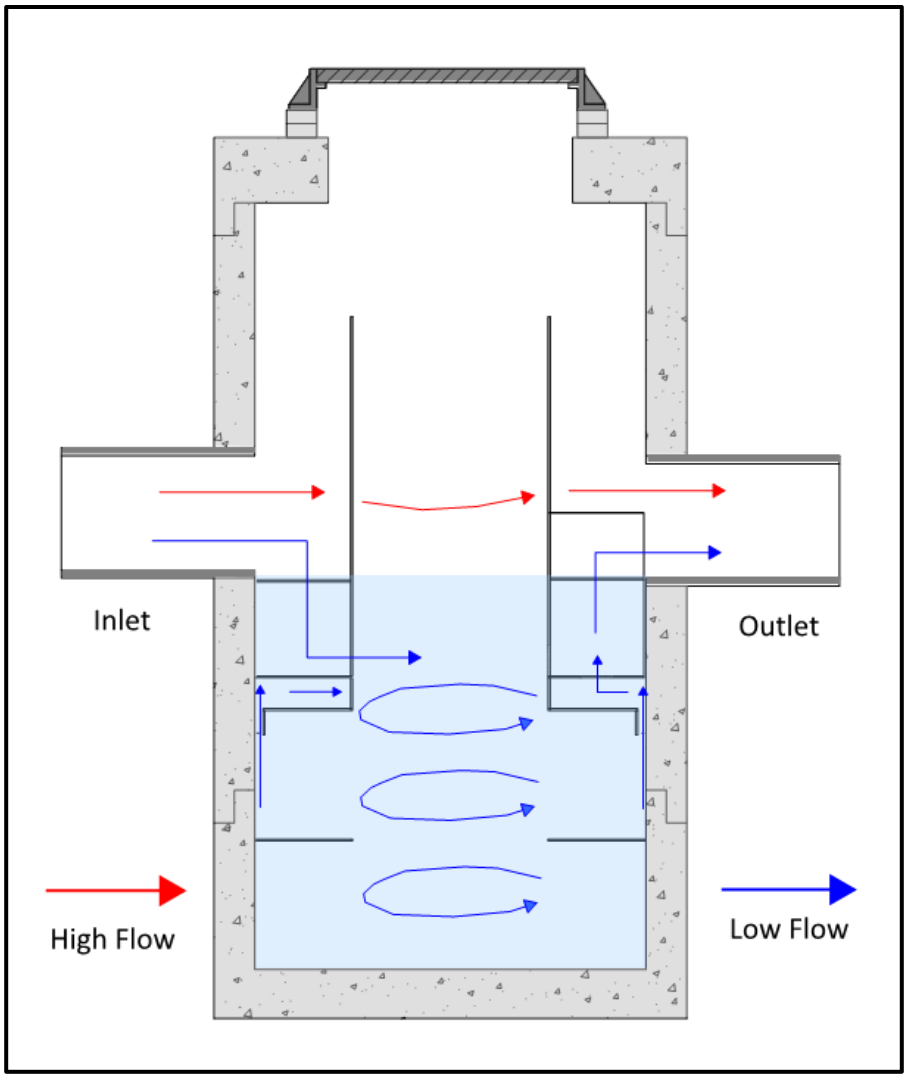


Figure 2. Hydroworks HydroStorm Operation – Profile View

The HS 4i is an inlet version of the HS 4 separator. There is a catch-basin grate on top of the HS 4i. A funnel sits sits underneath the grate on the frame and directs the water to the inlet side of the separator to ensure all lows flows are properly treated. The whole funnel is removed for inspection and cleaning.

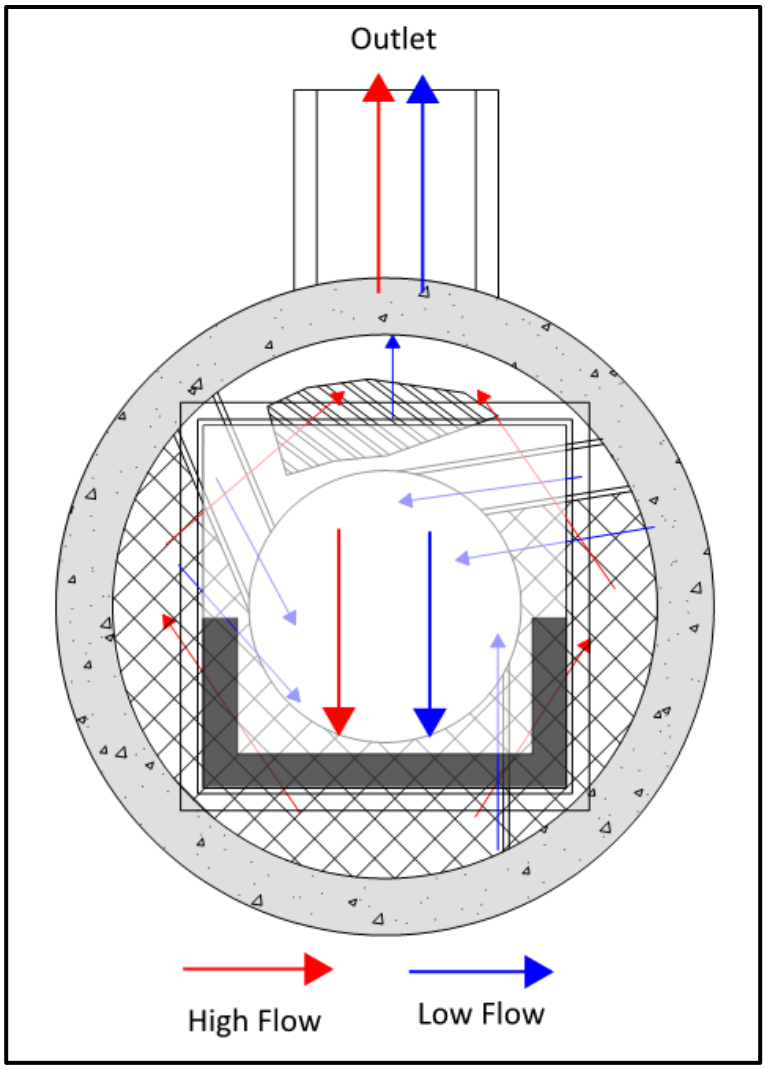


Figure 3. Hydroworks HS 4i Funnel

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the center access tube of the separator. Separators with an inlet grate (HS 4i or custom separator) will have a plastic funnel located under the grate that must be removed from the frame prior to inspection or maintenance. If you are missing a funnel please contact Hydroworks at the numbers provided at the end of this document.

Hydroworks

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HydroStorm separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroStorm separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HydroStorm separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required future frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroStorm unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroStorm separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

A central access opening (24” or greater) is provided to the gain access to the lower treatment tank of the unit. This is the primary location to maintain by vacuum truck. The pretreatment area can also be vacuumed and/or flushed into the lower treatment tank of the separator for cleaning via the central access once the water level is lowered below the pretreatment floor.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature. Disposal of the water will depend on local requirements. Disposal options for the decanted water may include:

1. Discharge into a nearby sanitary sewer manhole
2. Discharge into a nearby LID practice (grassed swale, bioretention)
3. Discharge through a filter bag into a downstream storm drain connection

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HydroStorm unit will typically take 1 to 2 hours based on a vacuum truck and longer for other cleaning methods (i.e. clamshell bucket).

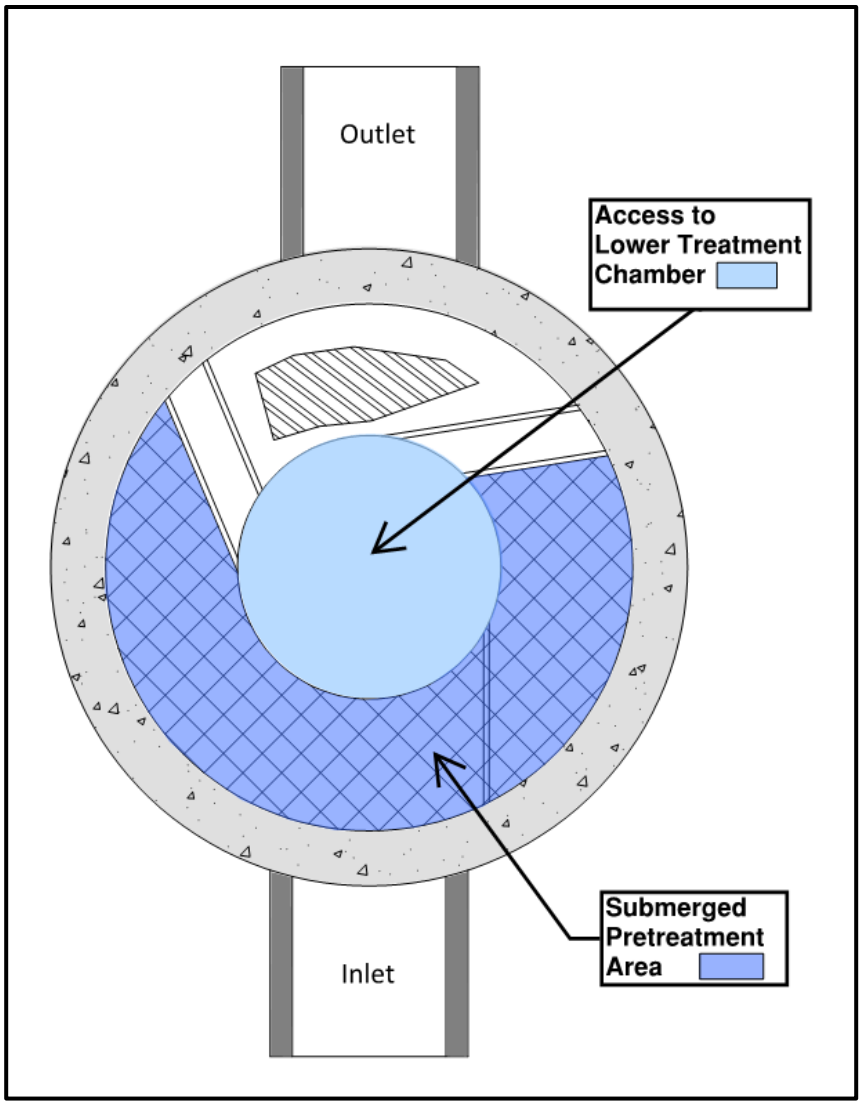


Figure 3. Maintenance Access

Frequency

Construction Period

A HydroStorm separator can fill with construction sediment quickly during the construction period. The HydroStorm must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroStorm separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The HydroStorm was independently tested by Alden Research Laboratory in 2017. A HydroStorm HS 4 was tested for scour with a 50% sediment depth of 0.5 ft. Therefore, maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. A measurement of the total water depth in the separator through the central access tube should be taken and compared to water depth given in Table 1. The standard water depth from Table 1 should be subtracted from the measured water depth and the resulting extra depth should be added to the 1 ft to determine the site-specific sediment maintenance depth for that separator.

For example, if the measured water depth in the HS-7 is 7 feet, then the sediment maintenance depth for that HS-7 is 2 ft (= 1 + 7 – 6) and the separator does not need to be cleaned for sediment accumulation until the measure sediment depth is 2 ft.

The HydroStorm separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroStorm Models

Model	Diameter (ft)	Total Water Depth (ft)	Sediment Maintenance Depth for Table 1 Total Water Depth(ft)
HS-3	3	3	1
HS-4	4	4	1
HS-5	5	4	1
HS-6	6	4	1
HS-7	7	6	1
HS-8	8	7	1
HS-9	9	7.5	1
HS-10	10	8	1
HS-11	11	9	1
HS-12	12	9.5	1

HYDROSTORM INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroStorm	**Yes**	**No**
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____“

Routine Measurements

Floating debris depth	**< 0.5” (13mm)**	☐	**>0.5” 13mm)**	☐ *
Floating debris coverage	**< 50% of surface area**	☐	**> 50% surface area**	☐ *
Sludge depth	**< 12” (300mm)**	☐	**> 12” (300mm)**	☐ ****

* Maintenance required
** Repairs required
*** Further investigation is required

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroStorm

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroStorm to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroStorm are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroStorm, or the cost of other goods or services related to the purchase and installation of the HydroStorm. For this Limited Warranty to apply, the HydroStorm must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroStorm arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroStorm, whether the claim is based upon contract, tort, or other legal basis.

FLEXSTORM™ Inlet Filter Specifications and Work Instructions

Product: **FLEXSTORM Inlet Filters**

Manufacturer: **Inlet & Pipe Protection, Inc** www.inletfilters.com

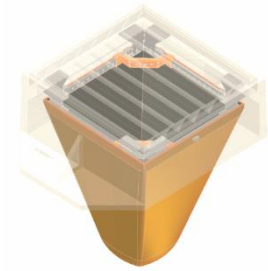
A subsidiary of **Advanced Drainage Systems (ADS)** www.ads-pipe.com

1.0 Description of Work:

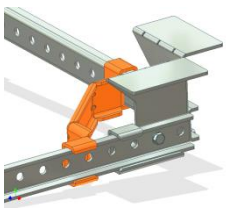
1.1 The work covered shall consist of supplying, installing, and maintaining/cleaning of the FLEXSTORM Inlet Filter assembly. The purpose of the FLEXSTORM Inlet Filter system is to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans or as directed by the Engineer. FLEXSTORM PURE, permanent filters, are capable of removing small particles, hydrocarbons, and other contaminants from drainage "hot spots".

2.0 Material:

2.1 The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile sediment bag attached to the frame with a stainless steel locking band. The sediment bag hangs suspended from the rigid frame at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment.

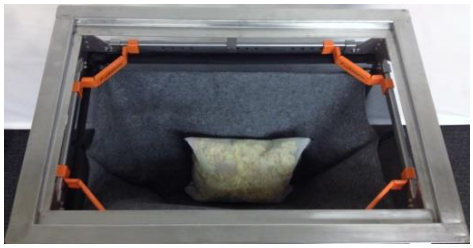



2.2 The FLEXSTORM Inlet Filter frame includes lifting handles in addition to the standard overflow feature. A FLEXSTORM Removal Tool engages the lifting bars or handles to allow manual removal of the assembly without machine assistance. The frame suspension system on most rectangular designs is adjustable in ½" increments up to 5" per side should the casting or drainage structure have imperfections.


2.3 **FLEXSTORM CATCH-IT** Inlet Filters for temporary inlet protection: The FLEXSTORM CATCH-IT framing is galvanized or zinc plated for corrosion resistance. The **"FX"** Woven Polypropylene filter bag is the design standard, although the **"IL"** Nonwoven geotextile is also available if preferred by the engineer. These products are typically used for temporary inlet protection lasting 3 months (short term road work) to 5 years (residential developments).

2.4 **FLEXSTORM PURE** Inlet Filters for permanent inlet protection: The FLEXSTORM PURE framing is comprised of 304 stainless steel with a 25 year life rating. Multiple filter bags are available: **FX, FX+, PC, PC+, LL** and others. The Post Construction **"PC+"** is the design standard consisting of the **"FX"** Woven Polypropylene sediment bag lined with Adsorb-it filter fabric, which is made from recycled polyester fibers. The **"PC+"** includes a replaceable hydrocarbon skimmer pouch strapped to the bottom of the bag for advanced TPH removal.



3.0 Filter Bag Specifications and Capabilities:

3.1 Material Properties (taken from manufacturers average roll value):

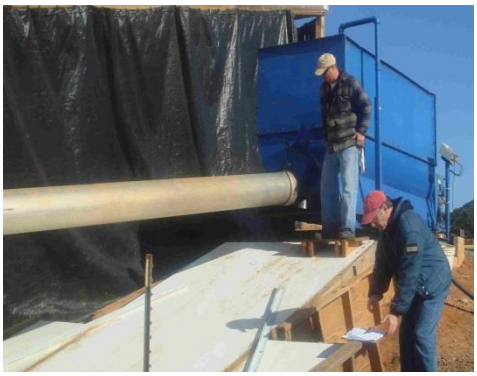
FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ Oil Skimmer	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC w/ Oil Skimmer	PCP	PCP-S	137	140
LL: Litter and Leaf Bag	LL	LL-S	High	3.5
IL: IDOT Non-Woven Bag	IL	IL-S	145	70

3.2 Standard Bag Sizes and Capabilities: Bag Sizes are determined by clear opening dimensions of the drainage structure. Once frame design size is confirmed, Small - XL bag ratings can be confirmed to meet design criteria. Ratings below are for standard 22" deep bags.

Standard Bag Size§	Solids Storage Capacity (CuFt)	Filtered Flow Rate at 50% Max (CFS)			Oil Retention (Oz)	
		FX	PC	IL	PC*	PCP**
Small	1.6	1.2	0.8	0.9	66	155
Medium	2.1	1.8	1.2	1.3	96	185
Large	3.8	2.2	1.5	1.6	120	209
XL	4.2	3.6	2.4	2.6	192	370

4.0 Tested Filtration Efficiency and Removal Rates: Filtration Efficiency, TSS, and TPH testing performed under large scale, real world conditions at accredited third party erosion and sediment control testing laboratory. (See Full Test Reports at www.inletfilters.com)

Inside View of Hopper Agitator



Hopper With Outlet Pipe Leading To Area Inlet

Area Inlet Simulated Showing Influent Discharge From Pipe

4.1 **FLEXSTORM "FX" Filtration Efficiency Test Results:** All testing performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination of Sediment Retention Device Effectiveness in Sheet Flow Application,* with flow diverted into an area inlet. Test Soil used as sediment had the following characteristics with a nominal 7% sediment to water concentration mix. This is representative of a heavy sediment load running off of a construction site.

Soil Characteristics	Test Method	Value		Filtration Efficiency of "FX" FLEXSTORM Bag
% Gravel	ASTM D 422	2		**82%**
% Sand		60		
% Silt		24		
% Clay		14		
Liquid Limit, %	ASTM D 4318	34		
Plasticity Index, %		9		
Soil Classification	USDA	Sandy Loam		
Soil Classification	USCS	Silty Sand (SM)		

4.2 **FLEXSTORM "PC" and "PC+" Test Results:** TSS measured on effluent samples in accordance with SM 2540D and TPH in accordance with EPA 1664A.

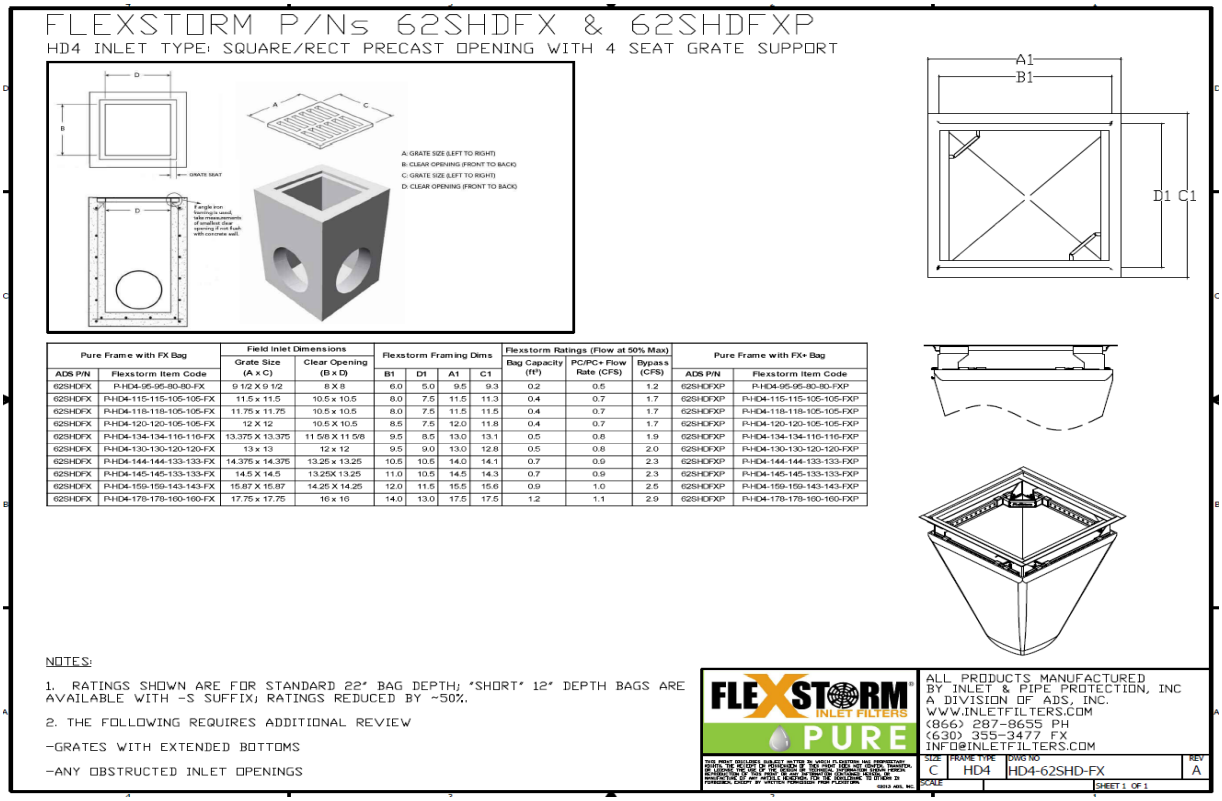
Product Tested	110 micron Sediment Load	Ave Flow Rate GPM	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	1750 mg/L using OK-110 Silica Sand and Clean Water	23	**99.28%**	98.96%
		48	**99.32%**	99.25%
		70	**98.89%**	98.80%

Product Tested	Street Sweep Sediment Load	Particle Size of Sediment Load	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	2.5% = 100 lbs Sed / 4000 lbs water	.001 mm – 10.0 mm (median 200 micron)	**99.68%**	95.61%

Product Tested	Hydrocarbon Load	Ave Flow Rate GPM	% TPH Removal	Oil Retention Efficiency
FLEXSTORM PC+	243 mg/L using 750 mL (1.45 lb) used motor oil + lube oil and clean water	19	**99.04%**	97.22%
FLEXSTORM PC		20	**97.67%**	91.61%
FLEXSTORM PC+		92	**96.88%**	99.11%

5.0 Identification of Drainage Structures to Determine FLEXSTORM Item Codes:

5.1 The Installer (Contactor) shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number or the exact grate size and clear opening size will provide the information necessary to identify the required FLEXSTORM Inlet Filter part number. Inlet Filters are supplied to the field pre-configured to fit the specified drainage structure. Item Codes can be built using the FLEXSTORM Product Configurator at www.inletfilters.com. Detailed Submittal / Specification drawings are linked to each Item Code and available for download by engineers and contractors to include on plans and/or verify field inlet requirements. An example of a typical drawing is shown below.



Pure Frame with FX Bag		Field Inlet Dimensions		Flexstorm Framing Dims				Flexstorm Ratings (Flow at 50% Max)			Pure Frame with FX+ Bag	
		Grate Size (A x C)	Clear Opening (B x D)					Bag Capacity (ft³)	PC/PC+ Flow Rate (CFS)	Bypass (CFS)		
ADS P/N	Flexstorm Item Code			B1	D1	A1	C1				ADS P/N	Flexstorm Item Code
62SHDFX	P-HD4-95-95-80-80-FX	9 1/2 X 9 1/2	8 X 8	6.0	5.0	9.5	9.3	0.2	0.5	1.2	62SHDFXP	P-HD4-95-95-80-80-FXP
62SHDFX	P-HD4-115-115-105-105-FX	11.5 x 11.5	10.5 x 10.5	8.0	7.5	11.5	11.3	0.4	0.7	1.7	62SHDFXP	P-HD4-115-115-105-105-FXP
62SHDFX	P-HD4-118-118-105-105-FX	11.75 x 11.75	10.5 x 10.5	8.0	7.5	11.5	11.5	0.4	0.7	1.7	62SHDFXP	P-HD4-118-118-105-105-FXP
62SHDFX	P-HD4-120-120-105-105-FX	12 X 12	10.5 X 10.5	8.5	7.5	12.0	11.8	0.4	0.7	1.7	62SHDFXP	P-HD4-120-120-105-105-FXP
62SHDFX	P-HD4-134-134-116-116-FX	13.375 X 13.375	11 5/8 X 11 5/8	9.5	8.5	13.0	13.1	0.5	0.8	1.9	62SHDFXP	P-HD4-134-134-116-116-FXP
62SHDFX	P-HD4-130-130-120-120-FX	13 x 13	12 x 12	9.5	9.0	13.0	12.8	0.5	0.8	2.0	62SHDFXP	P-HD4-130-130-120-120-FXP
62SHDFX	P-HD4-144-144-133-133-FX	14.375 x 14.375	13.25 x 13.25	10.5	10.5	14.0	14.1	0.7	0.9	2.3	62SHDFXP	P-HD4-144-144-133-133-FXP
62SHDFX	P-HD4-145-145-133-133-FX	14.5 X 14.5	13.25X 13.25	11.0	10.5	14.5	14.3	0.7	0.9	2.3	62SHDFXP	P-HD4-145-145-133-133-FXP
62SHDFX	P-HD4-159-159-143-143-FX	15.87 X 15.87	14.25 X 14.25	12.0	11.5	15.5	15.6	0.9	1.0	2.5	62SHDFXP	P-HD4-159-159-143-143-FXP
62SHDFX	P-HD4-178-178-160-160-FX	17.75 x 17.75	16 x 16	14.0	13.0	17.5	17.5	1.2	1.1	2.9	62SHDFXP	P-HD4-178-178-160-160-FXP

6.0 Installation Into Standard Grated Drainage Structures:

6.1 Remove the grate from the casting or concrete drainage structure. Clean the ledge (lip) of the casting frame or drainage structure to ensure it is free of stone and dirt. Drop in the FLEXSTORM Inlet Filter through the clear opening and be sure the suspension hangers rest firmly on the inside ledge (lip) of the casting. Replace the grate and confirm it is elevated no more than 1/8", which is the thickness of the steel hangers. For Curb Box Inlet Filters: Insert FLEXSTORM CATCH IT Inlet Filter as described above, pull the rear curb guard flap up and over the open curb box until tight, align magnets to ensure firm attachment to the top portion of the curb box casting. If the curb back opening is not magnetic, slide a typical rock sack or 2 x 4 through the 2-ply rear curb box flap to create a dam which will direct runoff into the sediment bag.




7.0 Maintenance Guidelines: The frequency of maintenance will vary depending on the application (during construction, post construction, or industrial use), the area of installation (relative to grade and runoff exposure), and the time of year relative to the geographic location (infrequent rain, year round rain, rain and snow conditions). The FLEXSTORM Operation & Maintenance Plan (as shown in 7.5) or other maintenance log should be kept on file.

7.1 Frequency of Inspections: Construction site inspection should occur following each ½" or more rain event. Post Construction inspections should occur three times per year (every four months) in areas with year round rainfall and three times per year (every three months) in areas with rainy seasons before and after snowfall season. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than three times per year.

7.2 General Maintenance for standard sediment bags: Upon inspection, the FLEXSTORM Inlet Filter should be emptied if the sediment bag is more than half filled with sediment and debris, or as directed by the Engineer. Remove the grate, engage the lifting bars or handles with the FLEXSTORM Removal Tool, and lift the FLEXSTORM Inlet Filter from the drainage structure. Machine assistance is not required. Dispose of the sediment or debris as directed by the Engineer. As an alternative, an industrial vacuum may be used to collect the accumulated sediment if available. Remove any caked on silt from the sediment bag and reverse flush the bag for optimal filtration. Replace the bag if the geotextile is torn or punctured to ½" diameter or greater on the lower half of the bag. If properly maintained, the Woven sediment bag will last a minimum of 4 years in the field.

7.3 Inspection and Handling of the FLEXSTORM PC / PC+ post construction sediment bag: The PC+ sediment bags will collect oil until saturated. Both the Adsorb-it filter liner and the skimmer pouch will retain oil. The volume of oils retained will depend on sediment bag size. Unlike other passive oil sorbent products, Adsorb-it filter fabric has the ability to remove hydrocarbons at high flow rates while retaining 10- 20 times its weight in oil (weight of fabric is 12.8 oz / sq yd). The average 2' x 2' PC Bag contains approx .8 sq yds, or 10 oz of fabric. At 50% saturation, the average Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil. Once the bag has become saturated with oils, it can be centrifuged or passed through a wringer to recover the oils, and the fabric reused with 85% to 90% efficacy. If it is determined, per Maintenance Contracts or Engineering Instructions, that the saturated PC sediment bags will be completely replaced, it is the responsibility of the service technician to place the filter medium and associated debris in an approved container and dispose of in accordance with EPA regulations. Spent Adsorb-it can be recycled for its fuel value through waste to energy incineration with a higher BTU per pound value than coal. The oil skimmers start white in color and will gradually turn brown/black as they become saturated, indicating time for replacement. The average skimmer pouch will absorb approximately 62 oz (4 lbs) of oil before requiring replacement. To remove the pouch simply unclip it from the swivel strap sewn to the bottom of the bag. Dispose of all oil contaminated products in accordance to EPA guidelines. The ClearTec Rubberizer media used in the pouch, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

7.4 Sediment Bag Replacement: When replacing a Sediment Bag, remove the bag by loosening or cutting off the clamping band. Take the new sediment bag, which is equipped with a stainless steel worm drive clamping band, and use a drill or screw driver to tighten the bag around the frame channel. Ensure the bag is secure and that there is no slack around the perimeter of the band. For Oil absorbent boom bags, simply replace the oil boom or pouch when saturated by sliding it through the mesh support sleeve.

7.5 Operation & Maintenance Plan. (Download at www.inletfilters.com or www.ads-pipe.com)

FLEXSTORM OPERATION AND MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Installation Instructions:

1. Remove grate from the drainage structure
2. Clean stone and dirt from ledge (lip) of drainage structure
3. Drop the FLEXSTORM inlet filter through the clear opening such that the hangers rest firmly on the lip of the structure.
4. Replace the grate and confirm it is not elevated more than 1/8", the thickness of the steel hangers.

Frequency of Inspections:

1. Inspection should occur following any rain event >½".
2. Post construction inspections should occur 4 times per year. In snowfall affected regions additional inspections should take place before and after snowfall season.
3. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than 3 times/year.

Maintenance Guidelines:

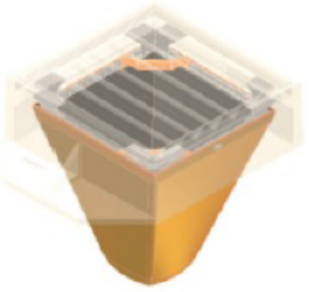
1. Empty the sediment bag if more than half filled with sediment and debris, or as directed.
2. Remove the grate, engage the lifting bars with the FLEXSTORM Removal Tool, and lift from drainage structure.
3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract.
4. An industrial vacuum can be used to collect sediment.
5. Remove caked on silt from sediment bag and flush with Medium spray with optimal filtration.
6. Replace bag if torn or punctured to >½" diameter on lower half of bag.

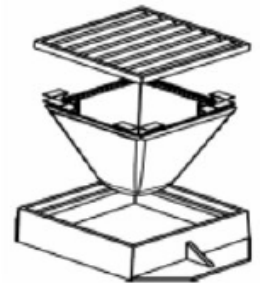
Post Construction PC Bag Maintenance:

1. At 50% saturation the average 2'x2' Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil and should be serviced. To recover the oils the filter can be centrifuged or passed through a wringer.
2. Oil skimmer pouches start to turn black when saturated, indicating time for replacement. Each ClearTec Rubberizer pouch will absorb ~62oz (4 lbs) of oil before needing replacement.
3. Dispose of all oil contaminated products in accordance with EPA guidelines. ClearTec Rubberizer, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

Sediment Bag Replacement:

1. Remove the bag by loosening or cutting off clamping bag.
2. Take new sediment bag and secure worm drive clamping band to the frame channel.
3. Ensure Bag is secure and there is no slack around perimeter.





STRUCTURE ID#/LOCATION:

DATE	TASK PERFORMED	INSPECTOR

APPENDIX C

WATER ANALYSIS INFORMATION

OBC FIRE FLOW WATER SUPPLY

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Project: **117 Forest Avenue & 175 Catharine Street South**
Project Number: 16092A
Date: Aug-22

Type of Development: **Multi-Residential**

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

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

Water Supply Coefficient (K)

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

From Table 1, **K =** **16**

Building Volume (V)

14-Storey Building

Building Footprint Area: **1186** m^2

Building Height: **43.3** m

Building Volume (V): ***51353.8*** **m^3**

Spatial Coefficient (S)

See Figure 1 for Spatial Coefficients

Side	Dist (m)	S_{coeff}
Front	**2.4**	**0.5**
Back	**11.3**	**0**
Left	**11.2**	**0**
Right	**6.5**	**0.3**
	Total	0.8

Therefore, S_{tot} = **1.8**

Required Water Supply

$Q = K\ V\ S_{tot}$ = 1478989 m^3

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

City of Hamilton Target flow for Multi Residential (3 or more units) = **150** **l/s <-- governs**

OBC Tables and Figures

Table 1

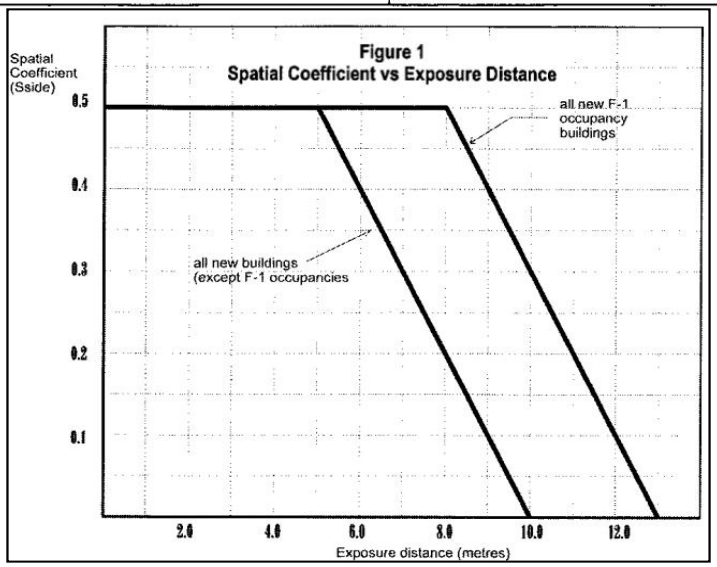
Water Supply Coefficient - K

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

Table 2

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

Figure 1
Spatial Coefficient vs Exposure Distance



City of Hamilton Target Flows (Policy PW19096)

Table 1: Target Available Fire Flow

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

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

Application Number :	ZAC-23-019
Municipal Address :	117 Forest Ave & 175 Catharine St. S.

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

1 - REQUIRED FIRE FLOW – RFF

1 a) Required Fire Flow-RFF a)

$Q = KVS_{Tot}$
Please provide required fire flow-RFF using the water supply flow rate method (OBC section A-3.2.5.7 ; OFM-TG-03-1999 FIRE PROTECTION WATER SUPPLY GUIDELINE FOR PART 3 IN THE ONTARIO BUILDING CODE - 6.3 Buildings Requiring On-Site Fire Protection Water Supply ; **$Q = KVS_{Tot}$**). This methodology shall be applied to all buildings falling under Part 3 and Part 9 of the Building Code (OBC sections 1.1.2.2 and 1.1.2.4). Detailed calculations shall be submitted as an appended memo.
Enter calculated value here (highest if multiple buildings) 150 Litres / second
Comments :

1 b) Required Fire Flow-RFF b)

Target Table

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

Table 1: Target Available Fire Flow

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

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

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

150 Litres / second

Comments :

Residential Multi (greater than 3 units)

1 c) Required Fire Flow-RFF c)

Enter higher of a) or b) from above

Enter value here :

150 Litres / second

Comments :

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

Application Number :	ZAC-23-019
Municipal Address :	117 Forest Ave & 175 Catharine St. S.

2 - AVAILABLE FIRE FLOW - AFF

2 a) Available Fire Flow-AFF a)

Field Hydrant Test calculated at 20 psi
Please provide available fire flow-AFF as determined through developer hydrant fire flow test or City Hydrant test database.
Enter value here : 254 Litres / second Please check : ☑ Developer hydrant fire flow test, or *(as directed in FC or thereafter)* ☐ City Hydrant test database
Comments :

OR (as directed in FC or thereafter)

2 b) Available Fire Flow-AFF b)

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

DECLARATION OF ADEQUATE SERVICES

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

☐ RFF c) is greater than AFF.

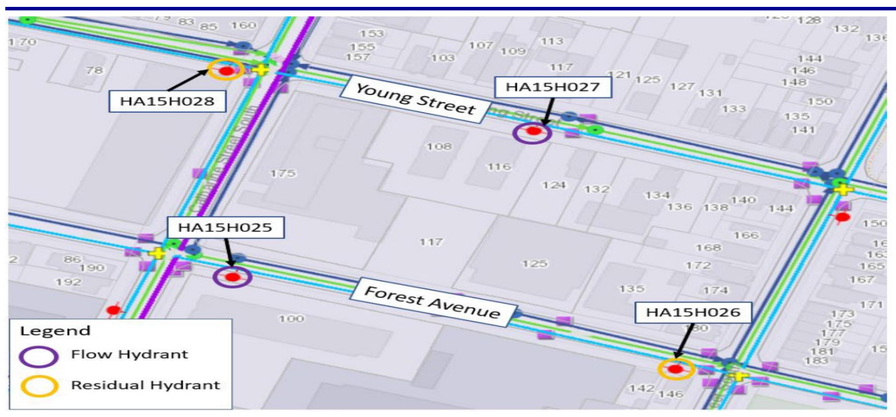
Prepared by : M. Colosimo

Date : Nov 15, 2023

FLOWMETRIX
INDU-TECH
PROCESS

Fire Flow Testing Report

Residual Hydrant #	**HA15H026**
NFPA Colour Code	**BLUE**



DATE	July 21, 2022	
TIME	12:00 PM	
ADDRESS	146 Forest Avenue	
	Hamilton, ON	
	L8N 1X5	
SIZE-inches/mm	8	300
MATERIAL	DI	
CONTACT INFO	Scott Beedie	
	Urban Solutions	
	(905) 546-1087	
	sbeedie@urbansolutions.info	

RESIDUAL HYDRANT INFO.

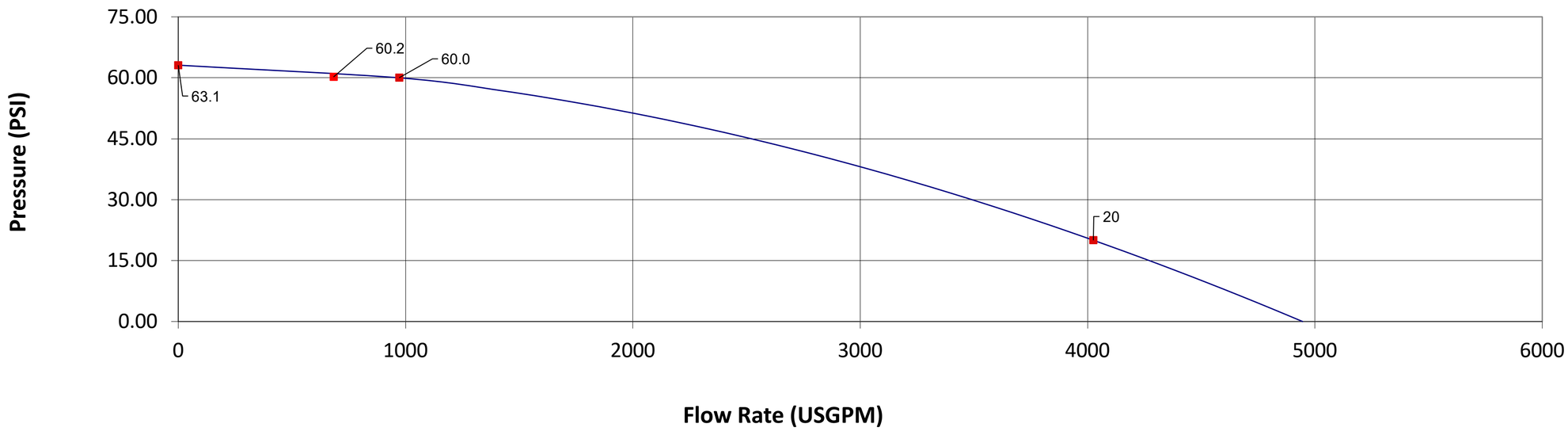
HYDRANT #	HA15H026	
N.F.P.A. COLOUR CODE	BLUE	
STATIC PRESSURE	63.1	psi
RESIDUAL PRESSURE - ONE PORT OPEN	60.2	psi
RESIDUAL PRESSURE - TWO PORTS OPEN	60.0	psi
PRESSURE DROP	3.1	psi
% PRESSURE DROP	4.9	% psi
Flow at Test Hydrant @ 20 psi	4025	USGPM

FLOW HYDRANT(S) INFO.

HYDRANT ASSET ID	HYD. # PORTS	OUTLET DIAMETER (INCHES)	NOZZLE COEFFICIENT	DIFFUSER TYPE	DIFFUSER COEFFICIENT	PITOT READING (psi)	PITOT FLOW (USGPM)	FLOW METER (USGPM)
HA15H025	1	2.5	Round	LPD250	0.90	**20.5**	683	0
								0
HA15H025	2	2.5	Round	LPD250	0.90	**10.4**	972	0
		2.5	Round	LPD250	0.90	**10.4**		0

FIRE FLOW CHART

Pressure - Flow Graph
at Test Hydrant



COMMENTS

OPERATOR	FMX	Jordan Whitlock
OPERATOR		Brendan Howatt
OPERATOR		City of Hamilton