S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

3604 INNES ROAD

CITY OF OTTAWA

MARCH 2019

SLA File: 18058

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Bicorp Design Group Inc. to provide consulting engineering services for the proposed development at 3604 Innes Road in the City of Ottawa (see Figure 1.0 for location plan). This report will outline the functional servicing and the stormwater management strategy for the proposed development.

The proposed development consists of constructing an automatic carwash with associated asphalt parking, concrete curbing/sidewalk and landscaped areas.

This report will provide detailed information of the proposed servicing scheme for this development. Please refer to the site engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by Bicorp Design Group 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: Design Guidelines for Water Distribution (City of Ottawa, July 2010)

Ref. 3: Sewer Design Guidelines (City of Ottawa, October 2012)

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 criteria stated in the City of Ottawa's Pre-Application Consultation memorandum dated October 6, 2017:

Quantity Control

The stormwater discharge rate from the proposed site shall be control to the 5-year pre-development condition discharge rate for all storm events up to and including the 100-year event.

Quality Control

The stormwater runoff from the proposed condition 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 Ottawa.

2.1 EXISTING CONDITIONS

In the existing condition, the site consists mostly of impervious areas. The site is bound by Innes Road to the north, existing vacant commercial buildings and land to the east and south, and existing residential lands to the west. In the existing condition, approximately half of the site sheet drains toward Innes Road where is it capture by an existing ditch inlet which discharges to the existing 1475mm x 2310mm storm sewer along Innes Road. The remainder of the site sheet drains towards the south end of the property where it is capture by an existing ditch at the southwest corner of the property.

One catchment area, Catchment 101, has been identified in the existing condition. Catchment 101 represents the existing condition drainage area for the entire site, as the requirements indicate modeling the site as a whole. See Table 2.1 below and the Pre-Development Storm Drainage Area Plan (Figure 1.0) in Appendix A for details.

Table 2.1 – Existing Condition Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	Entire Site	0.65	58%	0.50*

*Existing conditions runoff coefficient shall not exceed 0.50.

The existing conditions discharge from the development was calculated using the Rational Method based on the above runoff coefficient (C) and the City of Ottawa storm intensities at a time of concentration of 10 minutes (Tc=10min). An example of the 5-year calculation for Catchment 101 is shown below.

$$
\begin{aligned}
Q_{\text{5-yr (Catchment 101)}} &= 2.78\ C\ i\ A \\
&= 2.78\ (0.50)\ (104.2\ \text{mm/hr})\ (0.65\ \text{ha}) \\
&= \boldsymbol{94.1\ l/s\ (0.0941\ m^3/s)}
\end{aligned}
$$

Table 2.2 – Existing Condition Site Discharge

Storm Event	Catchment 101 Discharge (m^3/s)
5-Yr Event	0.0094
100-Yr Event	0.0161

2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing an automatic carwash with associated asphalt parking, concrete curbing/sidewalk 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 Ottawa.

Three catchment areas, Catchment 201, 202 and 203, have been identified in the proposed condition. Catchment 201 represents the drainage area for the portion of the site that will be controlled before ultimately discharging to the existing 1475mm x 2310mm storm sewer along Innes Road. Catchment 202 represents the portion of the site that will sheet drain uncontrolled to Innes Road, where it will be captured by existing catchbasins within the right-of-way which discharge to the existing storm sewer along

Innes Road. Catchment 203 represents the portion of the site that will sheet drain uncontrolled to the existing ditch at the southwest corner of the property which drains south towards Frank Bender Street. See Table 2.3 below and the Post-Development Drainage Area Plan (Figure 2.0) 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 Innes Road	0.56	67%	0.69
202	Uncontrolled to Innes Road	0.01	3%	0.27
203	Uncontrolled to South Ditch	0.08	10%	0.32

The proposed conditions stormwater runoff discharge from the development was calculated using the Rational Method based on the above runoff coefficients (C) and the City of Ottawa storm intensities at a time of concentration of 10 minutes (Tc=10min). A summary of Catchment 203 can be found in Table 2.4 below.

Table 2.4 – Proposed Condition Site Discharge (Uncontrolled)	
Storm Event	Catchment 203 Discharge (m^3/s)
5-Yr Event	0.0074
100-Yr Event	0.0127

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201by means of a 195mmø orifice plate at the north invert of MH6 to restrict discharge from the site to the 5-year pre-development discharge rate. Refer to the Site Servicing Plan for orifice location.

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, the proposed asphalt parking lot has been graded to provide sufficient surface ponding to accommodate the required stormwater storage. Details of the proposed surface ponding can be found in the Grading & Erosion Control Plan. The stage-storage-discharge characteristics can be seen in Table 2.5 below and Appendix A for details.

Table 2.5 – Proposed Condition Stage-Storage-Discharge (Catchment 201)		
Storm Event	Total Storage (m^3)	Discharge (m^3/s)
90.75 (Top of Grate)	0	0.0822
90.80 (0.05m of Ponding)	3	0.0841
90.85 (0.10m of Ponding)	19	0.0859
90.90 (0.15m of Ponding)	58	0.0878
90.95 (0.20m of Ponding)	128	0.0895
91.00 (Top of Ponding)	235	0.0913

The maximum discharged rates for Catchments 201 and 202 were calculated using the Rational Method based on the post-development condition runoff coefficients for the 5-year and 100-year storm events. Additionally, the 5-year and 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 2.6 below and in Appendix A for details.

Table 2.6 – Proposed Condition Stormwater Discharge					
Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge* (m^3/s)	Required Storage (m^3)
5-Yr	0.0851	0.0009	0.0860	0.0941	12.3
100-Yr	0.0881	0.0013	0.0894	0.0941	72.3

*Allowable discharge is based on the 5-year pre-development condition discharge.

This analysis determined the following:

- The proposed condition discharge rates will not exceed the allowable discharge rate during the 5-year and 100-year storm events with the installation of an orifice plate.

- 72.3m^3 of stormwater storage is required for Catchment 201 during the 100-year event, which can be accommodated by the proposed surface ponding, having a volume of 235m^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 Hydroguard oil/grit separator before ultimately discharging to the existing 1475mm x 2310mm storm sewer along Innes Road. The Hydroguard sizing software was used to determine the required size of oil/grit separator unit for the site. It was determined that a Hydroguard HG4 will provide 85% TSS removal and 97% average annual runoff treatment, which satisfies the requirements for an “Enhanced” level for quality control. See Hydroguard unit sizing procedures in Appendix B for details.

Hydroguard units require regular inspection and maintenance as per the manufacture's specifications to ensure the unit operates properly. See Hydroguard Maintenance Manual 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.

Details of the proposed erosion & sediment control measures can be seen on the Grading & Erosion Control Plan.

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

The site is located on the south side of Innes Road, east of Page Road, with an existing 150mmø sanitary service off of the existing 250mmø sanitary sewer along Innes Road.

3.2 SANITARY DEMAND

The proposed development consists of an automatic carwash with associated asphalt parking, concrete curbing/sidewalk and landscaped areas. Wastewater generation for the site was calculated based on the Ministry of Environment and the City of Ottawa guidelines. Table 3.1 summarizes the sanitary sewer discharge rates from the proposed site.

Table 3.1- Proposed Sanitary Sewer Discharge			
Site Area (ha)	Avg. Demand [A] (l/s)	Infiltration [B] (l/s)	**Peak Flow [C] (l/s)***
0.65	0.376	0.182	**0.558**
[A] Commercial average flows = 50,000l/ha/day [B] Infiltration flow based on 0.28 l/ha/sec infiltration rate [C] Peak Flow = Average Flow + Infiltration * Peak flows are estimates based on the MOE and City of Ottawa guidelines, actual wastewater discharge from the site may be significantly lower based on manufacturer's information.			

3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed carwash will be serviced by a 150mmø sanitary sewer, designed and constructed in accordance with the City of Ottawa standards. Drainage from this sewer will discharge to the existing 250mmø sanitary sewer along Innes Road.

The minimum grade of the proposed 150mmø sanitary sewer will be 1.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.015 m^3/s (15 l/s). Therefore, the proposed 150mmø sanitary sewer at 1.0% 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 406mmø watermain located along Innes Road with an existing 100mmø water service to the subject property. The nearest existing fire hydrant is located at the northeast corner of the property.

4.2 DOMESTIC WATER DEMAND

The following is an estimate of the water usage for the proposed carwash. Water usage for the site was calculated in accordance with the City of Ottawa Design Criteria. Table 4.1 summarizes the domestic water demand requirements for the Average Daily, Maximum Daily and Peaking Hourly demand scenarios for the subject land.

Table 4.1 – Water Usage Demand Calculations Automatic Car Wash	
Occupancy Type:	Automatic Car Wash
Flow (L/Vehicle):	284[A]
Total No. of Vehicles/Day:	275[B]
Water Usage (L/Day):	78,100
Waste Usage (L/s):	0.903
[A] Water usage of the automatic car wash is based on an estimate and is to be verified by manufacturer's [B] Total number of vehicles are assumed and are to be verified	

4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA).

The proposed carwash will be constructed of non-combustible construction (C=0.8) and with limited combustible occupancy (-15% correction). The exposure corrections for the building are based on the following:

North face: 0% correction (>45m)
South face: 0% correction (>45m)
East face: 0% correction (>45m)
West face: 5% correction (30.1m to 45m)
Total: 5%

The resulting required flow rate as determined in accordance with the Fire Underwriters Survey – 1999 Water Supply for Public Fire Protection, as specified by the City of Ottawa is **8,000 l/min (133 l/s**). Refer to the Fire Flow Demand Requirements in Appendix C for calculations and details.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of extending to the existing 100mmø water service at the property line along Innes Road. The 100mmø water service will provide domestic service for the proposed carwash. The water service for the site are to be designed and constructed in accordance with the City of Ottawa standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development at 3604 Innes Road can be constructed to meet the requirements of the City of Ottawa. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Grading & Erosion Control Plan and the Site Servicing Plan prepared by S.Llewellyn & Associates Limited;
- A 295mmø orifice plate be installed as per the Site Servicing Plan and this report to provide adequate quantity control;
- The asphalt parking lot be graded as per the Grading & Erosion Control Plan to provide sufficient stormwater surface storage;
- A Hydroguard oil/grit separator be installed as per the Site Servicing Plan and this report to provide effective stormwater quality control;
- Erosion and sediment controls be installed as described in this report to meet the City of Ottawa requirements;

- The proposed sanitary and water servicing system be installed as per 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

LICENSED PROFESSIONAL ENGINEER
S.V. FRANKOVICH
MARCH 6/19
PROVINCE OF ONTARIO

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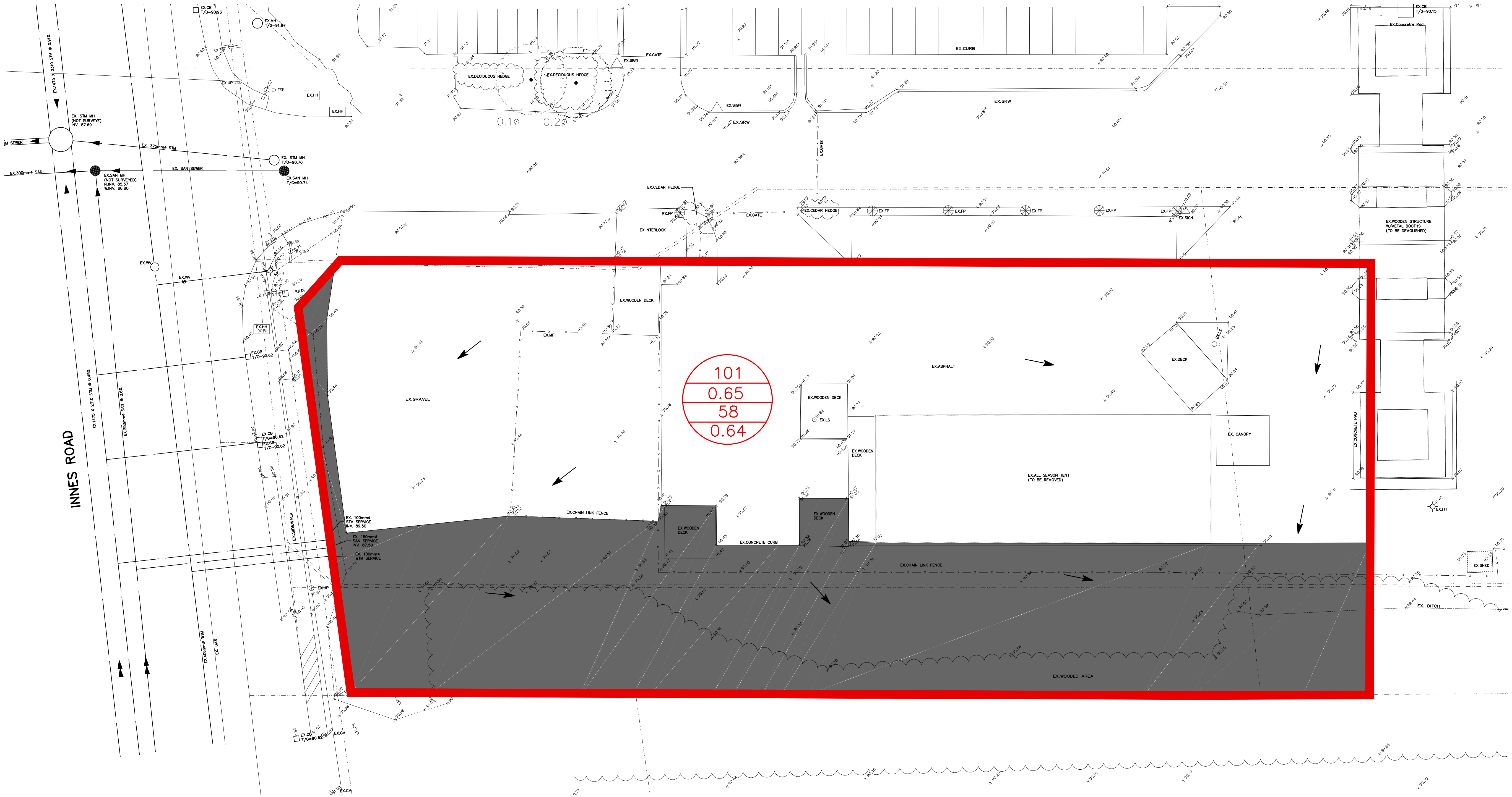
S. Frankovich, P.Eng.

APPENDIX A

STORMWATER MANAGEMENT INFORMATION



LEGEND

PERVIOUS AREA

→ DIRECTION OF SHEET FLOW

101
0.39
11
0.32

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

FIGURE 1.0
PRE–DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 3604 INNES ROAD, OTTAWA, ONTARIO
PROJECT No.: 18058

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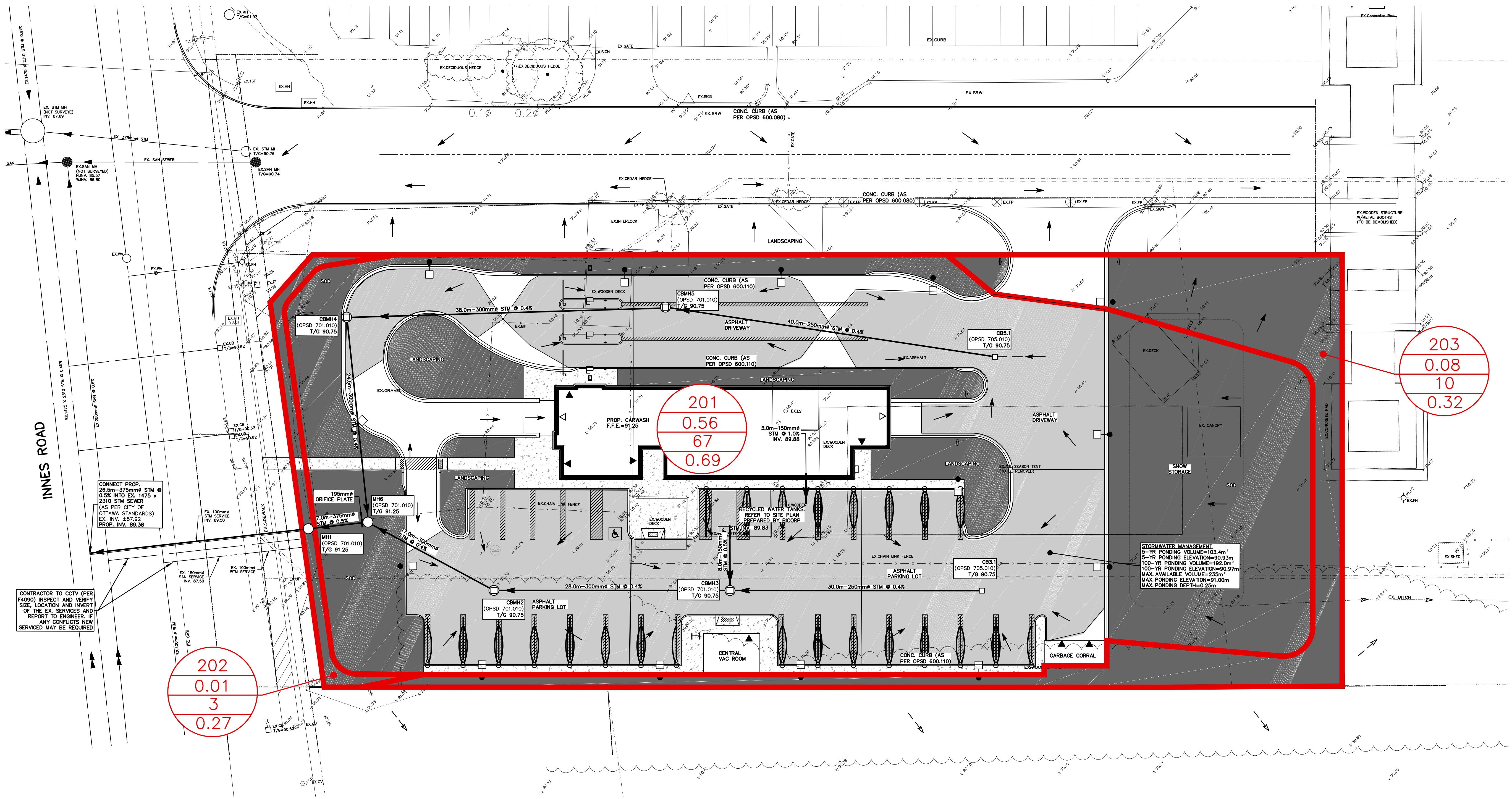

LEGEND

PERVIOUS AREA	
——▶	DIRECTION OF SHEET FLOW

201	DRAINAGE AREA I.D.
0.39	DRAINAGE AREA (ha)
11	PERCENT IMPERVIOUS
0.32	RUNOFF COEFFICENT

FIGURE 2.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

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CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Outlet Device No. 1 (Quantity)

Type:	Orifice Pipe
Diameter (mm)	195
Area (m^2)	0.02986
Invert Elev. (m)	89.58
C/L Elev. (m)	89.68
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	$Cd\ A\ (2\ g\ H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes					Outlet No. 1	
	Elevation m	Area m^2	Incremental Volume m^3	Cumulative Volume m^3	**Total Active Storage Volume m^3**	H m	Discharge m^3/s	**Total Discharge m^3/s**
Orifice Invert	89.58				**0**	0.000	**0.0000**	**0.0000**
Top of Grate	90.75	0	0	0	**0**	1.073	**0.0822**	**0.0822**
0.05m Ponding	90.80	127	3	3	**3**	1.123	**0.0841**	**0.0841**
0.10m Ponding	90.85	496	16	19	**19**	1.173	**0.0859**	**0.0859**
0.15m Ponding	90.90	1059	39	58	**58**	1.223	**0.0878**	**0.0878**
0.20m Ponding	90.95	1770	71	128	**128**	1.273	**0.0895**	**0.0895**
0.25m Ponding	91.00	2489	106	235	**235**	1.323	**0.0913**	**0.0913**

5-Year Storm - Modified Rational Method

Stormwater Storage Volume and Orifice Sizing

Determination of required storage volume under proposed conditions. Storage volume calculated using the Modified Rational Method.
Catchment 201

Oshawa Storm Rainfall Information		
City/Town/Region:	**Ottawa**	
Return Period:	**5**	Years
A =	**998.071**	
B =	**6.053**	
C=	**0.814**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.56** (Lot Area)
Composite Runoff Coeff. (C) = **0.69** (Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) = **0.091** (Allowable discharge based on capacity of 100mm dia. orifice)

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	Release	Storage
				Site	Roof	Total "Q_{POST}"	Volume	Volume	Volume
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	141.179	0.0000392	0.152	0.0	0.1515	45.46	41.09	4.37
10	600	104.193	0.0000289	0.112	0.0	0.1118	67.10	54.78	12.32
15	900	83.557	0.0000232	0.090	0.0	0.0897	80.72	68.48	12.24
20	1200	70.251	0.0000195	0.075	0.0	0.0754	90.48	82.17	8.31
25	1500	60.896	0.0000169	0.065	0.0	0.0654	98.04	95.87	2.18
30	1800	53.928	0.0000150	0.058	0.0	0.0579	104.19	109.56	-5.37
35	2100	48.518	0.0000135	0.052	0.0	0.0521	109.36	123.26	-13.90
40	2400	44.184	0.0000123	0.047	0.0	0.0474	113.82	136.95	-23.13
45	2700	40.629	0.0000113	0.044	0.0	0.0436	117.74	150.65	-32.90
50	3000	37.653	0.0000105	0.040	0.0	0.0404	121.24	164.34	-43.10
55	3300	35.123	0.0000098	0.038	0.0	0.0377	124.41	178.04	-53.63
60	3600	32.943	0.0000092	0.035	0.0	0.0354	127.29	191.73	-64.44

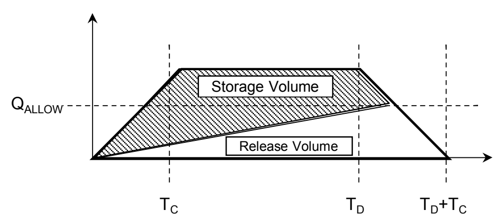
Max. required storage volume = 12.32 m^3

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 and Orifice Sizing

Determination of required storage volume under proposed conditions. Storage volume calculated using the Modified Rational Method.
Catchment 201

Oshawa Storm Rainfall Information		
City/Town/Region:	**Ottawa**	
Return Period:	**100**	Years
A =	**1735.688**	
B =	**6.014**	
C=	**0.820**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.56** (Lot Area)
Composite Runoff Coeff. (C) = **0.69** (Post development "C")
Release Rate - Q_{ALLOW} (m^3/s) = **0.091** (Allowable discharge based on capacity of 100mm dia. orifice)

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	Release	Storage
				Site	Roof	Total "Q_{POST}"	Volume	Volume	Volume
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	242.704	0.0000674	0.261	0.0	0.2605	78.15	41.09	37.07
10	600	178.559	0.0000496	0.192	0.0	0.1917	114.99	54.78	60.21
15	900	142.894	0.0000397	0.153	0.0	0.1534	138.04	68.48	69.56
20	1200	119.950	0.0000333	0.129	0.0	0.1287	154.50	82.17	72.33
25	1500	103.847	0.0000288	0.111	0.0	0.1115	167.19	95.87	71.33
30	1800	91.868	0.0000255	0.099	0.0	0.0986	177.49	109.56	67.93
35	2100	82.579	0.0000229	0.089	0.0	0.0886	186.13	123.26	62.88
40	2400	75.145	0.0000209	0.081	0.0	0.0807	193.57	136.95	56.62
45	2700	69.050	0.0000192	0.074	0.0	0.0741	200.11	150.65	49.46
50	3000	63.954	0.0000178	0.069	0.0	0.0686	205.93	164.34	41.59
55	3300	59.624	0.0000166	0.064	0.0	0.0640	211.19	178.04	33.15
60	3600	55.895	0.0000155	0.060	0.0	0.0600	215.98	191.73	24.25

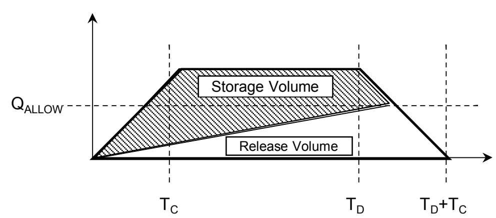
Max. required storage volume = 72.33 m^3

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



Project No. 18058
Sheet No. 1
Checked by:
Computed by: MC
Date: March 4, 2019

CITY OF OTTAWA

STORM SEWER DESIGN - (5 year Ottawa)

Project: 3604 INNES ROAD

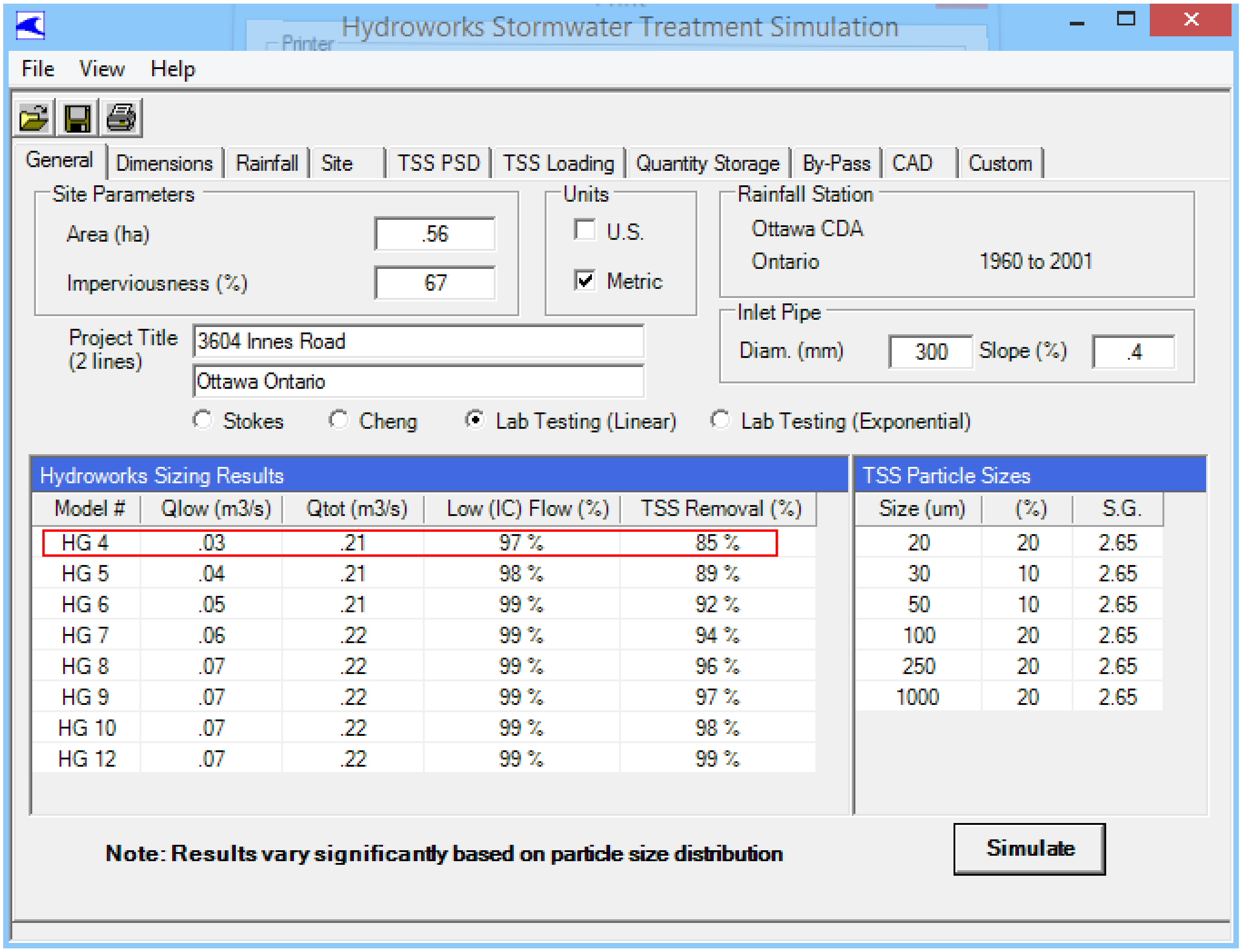
$$i = \frac{A}{(T+B)^C}$$

2317.4	A= 998.07
11	B= 6.05
0.836	C= 0.814
	n= 0.013

Area No.	Street Name	From MH	To MH	Area [ha]	C *	A*C	Cumulative A*C	Time of Conc. [min]	Intensity [mm/hr]	Qpeak [m³/s]	Pipe Characteristcs Diameter [mm]	Slope [%]	Length [m]	Capacity [m³/s]	Velocity [m/s]	Travel Time [min]	Fraction Full [%]	Remarks
		MH6	MH1	0.560	0.69	0.39	0.39	10.00	104.21	0.112	**450**	**0.50%**	**7.0**	0.182	1.11	0.11	61%	
								10.11										

APPENDIX B

OIL/GRIT SEPARATOR INFORMATION



Hydroworks Sizing Results

Model #	Qlow (m3/s)	Qtot (m3/s)	Low (IC) Flow (%)	TSS Removal (%)
HG 4	.03	.21	97 %	85 %
HG 5	.04	.21	98 %	89 %
HG 6	.05	.21	99 %	92 %
HG 7	.06	.22	99 %	94 %
HG 8	.07	.22	99 %	96 %
HG 9	.07	.22	99 %	97 %
HG 10	.07	.22	99 %	98 %
HG 12	.07	.22	99 %	99 %

TSS Particle Sizes

Size (um)	(%)	S.G.
20	20	2.65
30	10	2.65
50	10	2.65
100	20	2.65
250	20	2.65
1000	20	2.65

Note: Results vary significantly based on particle size distribution

Hydroworks® Hydroguard

Maintenance Manual

Version 1.3

Introduction

The Hydroguard 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 Hydroguard 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 Hydroguard.

Hydroworks® HG Operation

The Hydroworks HG separator is unique since it treats both high and low flows in one device, but maintains separate flow paths for low and high flows. Accordingly, high flows do not scour out the fines that are settled in the low flow path since they are treated in a separate area of the device as shown in Figure 1.

The HG separator consists of three chambers:

1. an inner chamber that treats low or normal flows
2. a middle chamber that treats high flows
3. an outlet chamber where water is discharged to the downstream storm system

Under normal or low flows, water enters the middle chamber and is conveyed into the inner chamber by momentum. Since the inner chamber is offset to one side of the structure the water strikes the wall of the inner chamber at a tangent creating a vortex within the inner chamber. The vortex motion forces solids and floatables to the middle of the inner chamber. The water spirals down the inner chamber to the outlet of the inner chamber which is located below the inlet of the inner chamber and adjacent to the wall of the structure but above the floor of the structure. Floatables are trapped since the outlet of the inner chamber 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 the outlet of the inner chamber draws water from the wall of the inner chamber.

The water leaving the inner chamber continues into the middle chamber, again at a tangent to the wall of the structure. The water is then conveyed through an outlet baffle wall (high and low baffle). This enhances the collection of any floatables or solids not removed by the inner chamber. Water flowing through the baffles then enters the outlet chamber and is discharged into the downstream storm drain.

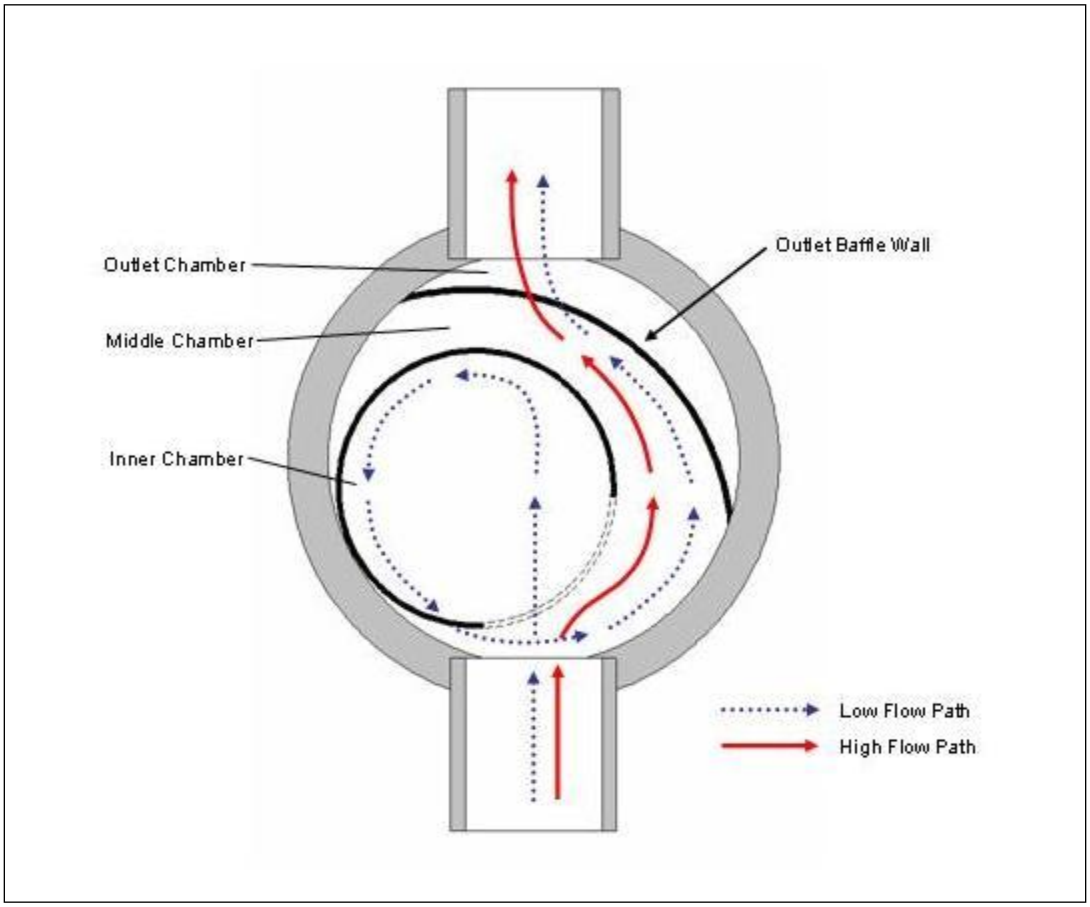


Figure 1. Hydroworks HG Operation – Plan View

During high flows, the flow rate entering the inner chamber is restricted by the size of the inlet opening to the inner chamber. This restriction of flow rate into the inner chamber prevents scour and re-suspension of solids from the inner chamber during periods of high flow. This is important since fines, which are typically considered highly polluted, are conveyed during low/normal flows.

The excess flow is conveyed directly into the middle chamber where it receives treatment for floatables and solids via the baffle system. This treatment of the higher flow rates is important since trash and heavier solids are typically conveyed during periods of higher flow rates. The Hydroworks HG separator is revolutionary since it incorporates low and high flow treatment in one device while maintaining separate low and high flow paths to prevent the scour and re-suspension of fines.

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

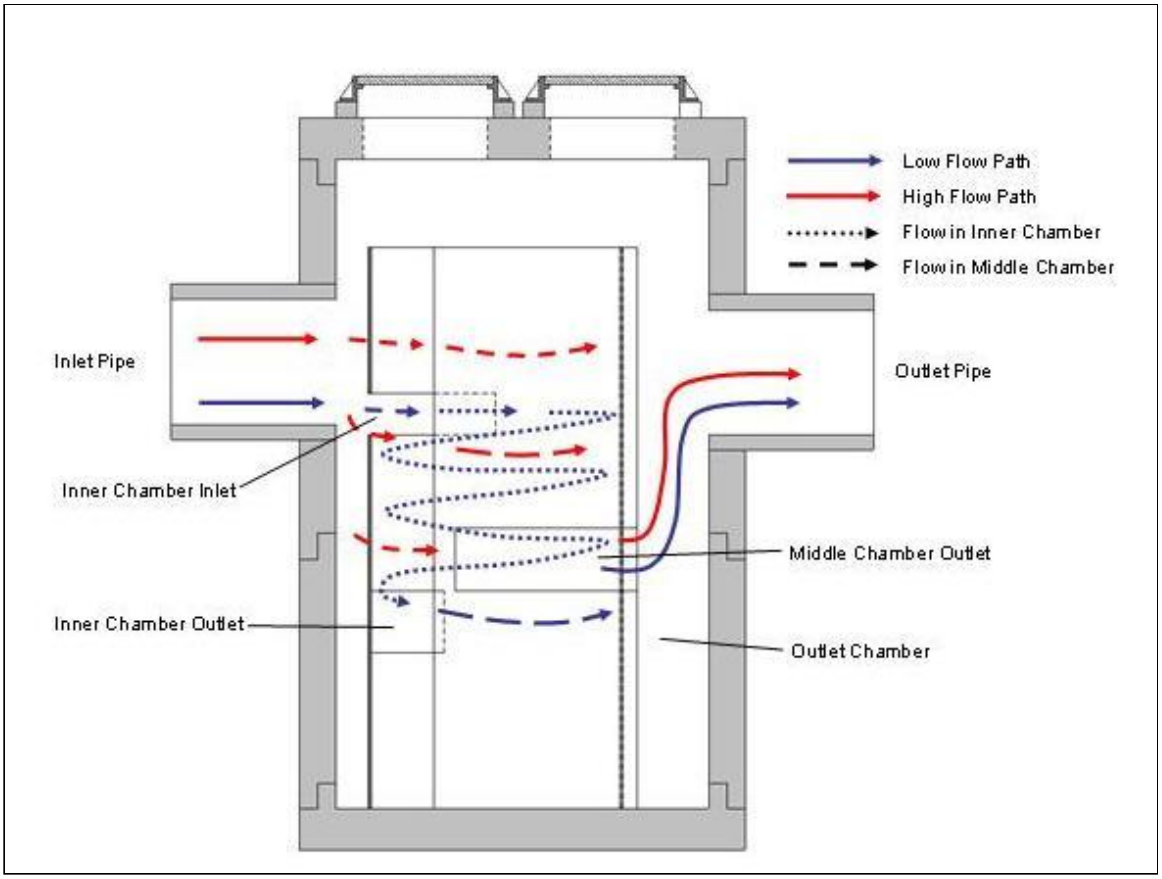
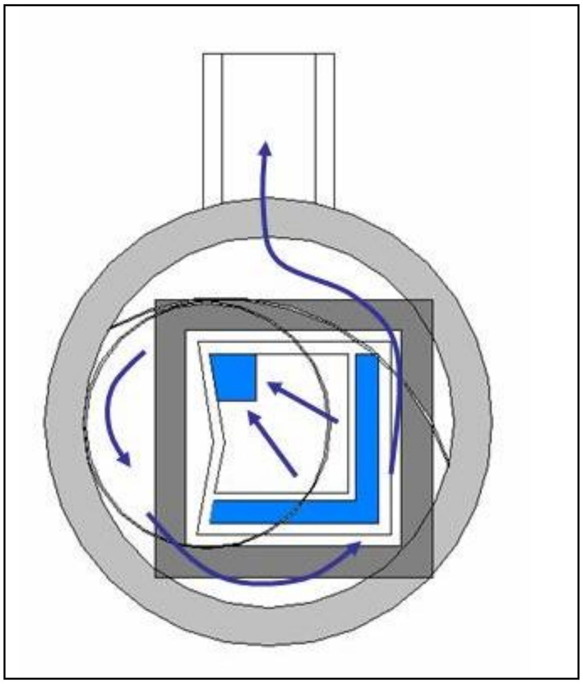


Figure 2. Hydroworks HG Operation – Profile View

The HG 4i is an inlet version of the HG 4 separator. There is a catch-basin grate on top of the HG 4i. Water flows directly into the inner chamber of the HG 4i through the catch-basin grate on top of the structure. The grate is oversized to allow maintenance of the entire structure. A funnel that sits underneath the grate on the top cap of the concrete itself directs the water into the inner chamber during normal flows and the middle chamber during high flows. Figures 3 and 4 show the flow paths for the HG 4i separator.

The inlet funnel is sloped towards the corner inlet and hence the wall of the inner chamber. Water moves in a circular direction in the inner chamber since water enters tangentially along the wall of the inner chamber due to the sloping funnel.

Water continues moving in a circular motion (vortex) through the rest of the structure (through the middle chamber and baffle wall) until it is discharged from the separator.



During periods of peak flow the water will back up from the corner inlet and overflow into two side overflow troughs which discharge directly into the middle chamber. These overflow troughs are covered from the surface such that water cannot directly fall through them (i.e. water must back up to enter the overflow troughs).

Accordingly this funnel provides the same separate flow paths for low and high flow as the other Hydroguard separators.

The whole funnel is removed for inspection and cleaning providing.

Figure 3. Hydroworks Hydroguard HG 4i Normal Flow Path

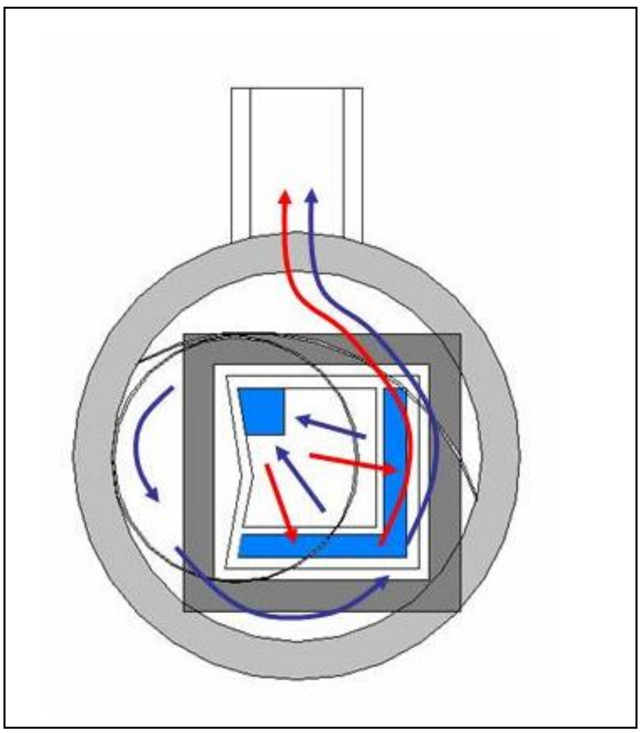


Figure 4. Hydroworks Hydroguard HG 4i Peak Flow Path

Inspection

Procedure

Although all parts of the Hydroguard should be inspected, inspection and maintenance should focus on the inner and middle chambers since this is where the pollutants (floatable and sinking) will accumulate.

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the separator. Multiple covers are provided on Hydroworks HG units to access all areas of the separator (The HG 4 may have a single larger 32” (800mm) cover due to the lack of space for multiple 24” (600mm) covers).

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 HG separator should be inspected every two weeks and after every large storm (over 0.5” (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HG separator should be inspected once per year 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 HG separator should be inspected more frequently (4 times per year). An initial annual inspection will indicate the required future frequency of 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 HG unit is typically maintained using a vactor truck or clam shell bucket. There are numerous companies that can maintain the HG separator. Envirocalm, LLC, an affiliate company of Hydroworks offers inspection and maintenance services and can inspect and maintain the HG separator. (www.envirocalm.com).

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HG unit will typically take 1 to 2 hours.

Frequency

Construction Period

A HG separator can fill with construction sediment quickly during the construction period. The construction sediment will have a much coarser particle size distribution than the suspended solids during the post-development period. Accordingly, scour is not so much of a concern during the construction period compared to the separator filling up with solids. The Hydroguard must be maintained during the construction period when the depth of TSS/sediment reaches 27” (675 mm). This represents 75% of the maximum sediment storage capacity. 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 open water surface on the inlet side of the outlet baffle wall.

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

Post-Construction Period

The Hydroguard was independently tested by Alden Research Laboratory in 2008. A HG6 was tested for scour with initial sediment loads of 4.6 ft^3 and 9.3 ft^3. The results from these tests were almost identical. Therefore, the 9.3 ft^3 sediment load was used as 50% of the maximum sediment depth for maintenance in the calculation of the maintenance interval for the HG6 separator based on the NJDEP maintenance interval equation.

Maintenance Interval (months) = 3.565 x (Sediment Storage) / (MTFR x TSS Removal)

Maintenance Interval (HG6) = 3.565 x 9.3 / (1.67x 0.55) = 36 months

All values (flow, sediment storage) can be scaled by the surface area making the sediment depths and maintenance intervals equal for all separators.

The separator was loaded with the sediment in the inner chamber and middle chamber with the majority of sediment (80%) located in the inner chamber. The inner chamber for area represents approximately 44% of the separator surface area. The inner chamber is 4 ft (1200 mm) in diameter in the HG6. Therefore the 50% sediment depth for the HG6 in the inner chamber would be:

9.3 ft^3 x 0.80 / (3.14 x 4 ft^2) x 12 in/ft = 7.1 inches (175 mm)

Accordingly the 100% sediment volume would represent 14.2” (350 mm) of sediment depth in the inner chamber.

The HG separator must 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 open water surface on the inlet side of the outlet baffle wall. It should also be maintained once the accumulated TSS/sediment depths are greater than 14” (350 mm) in the inner chamber. For typical stabilized post-construction sites (parking lots, streets) it is anticipated that maintenance will be required annually or once every two years. More frequent or less frequent maintenance will be required depending on individual site conditions (traffic use, stabilization, storage piles, etc.). The long term maintenance frequency can be established based on the maintenance requirements during the first several years of operation if site conditions do not change.

HYDROGUARD 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	☐	☐

Hydroguard	**Yes**	**No**
Incorrect access orientation	☐ ***	☐
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed 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	**< 25% of surface area**	☐	**> 25% surface area**	☐ *
Sludge depth	**< 14" (350mm)**	☐	**> 14" (350mm)**	☐ *

Other Comments: ____
____
____

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

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.

APPENDIX C

WATER ANALYSIS INFORMATION

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

Project Number: 18058
Project Name: 3604 Innes Road
Date: 20-Jun-18

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

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

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

where:

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

Building / Location	Building Area: Footprint Area (m^2)	Building Area: # of Storeys	Building Area: **Total GFA (m^2)**	Type of Construction	(1) *Fire Flow "F"* (l/min)	(1) *Fire Flow "F"* (l/s)	(2) *Occupancy* %	(2) *Occupancy* Adjustment (l/min)	(2) *Occupancy* **Adjusted Fire Flow (l/min)**	(3) *Sprinkler* %	(3) *Sprinkler* Adjustment (l/min)	(4) *Exposure* %	(4) *Exposure* Adjustment (l/min)	**Final Adjusted Fire Flow (l/min)**	**Final Adjusted Fire Flow (l/s)**
Proposed Carwash	**2364**	**1**	**2364**	**0.8**	9000	150.0	**-15**	-1350.0	**7650.0**	**0**	0.0	5	382.5	**8000**	**133**

(2) Occupancy

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

(3) Sprinkler

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

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

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

(4) Exposure

0 to 3m	25%
3.1 to 10m	20%
10.1 to 20m	15%
20.1 to 30m	10%
30.1 to 45m	5%

Calculate for all sides. Maximum charge shall not exceed 75%

Side	Exposure (m)	Charge (%)
North =	>45	0
South =	>45	0
East =	>45	0
West =	30.1 to 45	5
Total Expoure =		***5***

APPENDIX D

ENGINEERING DRAWINGS