STORMWATER MANAGEMENT REPORT

FOR

GAS STATION

12544 Highway 50

CALEDON, ONTARIO

September 03, 2020

Prepared by:

n Architecture Inc

9120 Leslie Street, Suite-208
Richmond Hill, Ontario
L4B3J9
T: 416-303-4821
https://www.narchitecture.com

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1.0 BACKGROUND

The proposed development is for a new gas station, which includes a car wash, body shop, two buildings and associated pavement area.

The purpose of this report is to present the connection for water distribution, storm drainage and appropriate measures to mitigate the impact of runoff with the proposed development.

Total Area: 0.57 Ha (1.4 Acres)

Proposed development site is located at 12544 Highway 50, Caledon, ON. (Refer: Figure 1) A legal survey was conducted by Greater Toronto Acres Surveying Inc. on January 20, 2018 described the land as Part of Lot 3 Concession 6 (Geographic Township of Albion), Town of Caledon, Regional Municipality of Peel.

The site has a falling gradient from middle to South-East and North-West with an elevation difference of approximately 2m from the North side to the South side.

Figure 1 - Site Location Plan

The proposed lowest building's ground floor level at 241.20m. The existing grades around the site will be matched at the boundary limits. Site servicing, grading and storm drainage plans are submitted separately as full size drawings with this report.

2.0 EXSTING DRAINAGE

The site is located within East Robinson Creek watershed. The creek is running through the west part of the site. The site is bounded by commercial developments to the north and south, and Highway 50 to the east. At present the site is occupied by a building and gravel surface parking area for trucks and cars. Under the existing condition, the east portion of the subject site (Catchment 101 - 0.28ha) drains to the Highway 50 roadside ditch and the balance of the site land (Catchment 100 - 0.30ha) drains to the creek (Refer to DR 101 – Appendix A).

3.0 POST-DEVELOPMENT DRAINAGE

Under the proposed development, a new gas station is to be constructed. The gas station includes a car wash, body shop, two buildings and associated pavement area. A storm sewer system also would be constructed and the outflow will be controlled and directed to the creek. Proposed sub-catchment area presented in Figure DR102 (Appendix A).Most of stormwater will drain to the creek and the balance portion of the property will continue to drain to the Highway 50 roadside ditch (Refer: Drawing C1).

The site is located in a regulated area. The regional flood line has been obtained from the TRCA mapping sheet HUM_169 and is shown in Figure DR-101 and Figure DR-102. The drip line as staked out by TRCA on May 7, 2015 is also shown in both figures. The site is located in the head area of Robinson Creek in a fairly flat terrain and therefore it can be treated as an unconfined river valley system. The regional flood line encroaches into the drip line in a small stretch as shown in the figures. The development limits have been determined by providing a 10.0 m buffer to the outer envelope of the regional flood line and TRCA drip line.

Potential stormwater management (SWM) strategies to mitigate any potential impacts as per Town of Caledon design guidelines and TRCA Stormwater Management guidelines are presented in the report. New site servicing requirements for water supply will also be discussed in the following sections.

4.0 STORM WATER MANAGEMENT CRITERIA

The proposed development shall follow the respective criteria/guidelines of the Town of Celadon (Town of Caledon - Development Standards, Policies & Guidelines, and January 2009) and Toronto Regional Conservation Authority (TRCA) Stormwater Management Criteria. The criteria for small new developments are summarized below:

- **Water Quantity Control** – Required control post-development peak flows to pre-development levels for all storms up to and including the 100 year storm (i.e. 2, 5, 10, 25, 50, and 100 year storms) for Robinson Creek;
- **Water Quality Control** - Water quality treatment will be required for all new development within the Town of Caledon to ensure a long-term average removal of 80%

of total suspended solids (TSS) on an annual loading basis from a minimum 90% of the runoff volume leaving the site;

- **Water Balance** –As per TRCA Stormwater Management Criteria, the site characterized as LGRA (Low Volume Groundwater Recharge Area) and Table 6-1 described the criteria of water balance as *"Best efforts to maintain recharge are expected, provided the site does not impact an ecological feature*". Water balance criteria will be achieved by proposing post-development retention amount of storm water equal to pre-development retention amount.
- **Erosion and Sediment Control During Construction -** The erosion potential of the study area to assessed using methods described in the Development Standards, Policies & Guidelines prepared by the town of Caledon public works & engineering department version 4 – January 2009.

4.1 Storm Drainage Runoff Coefficients

Pre and post development drainage catchment and runoff coefficient is shown in Figure DR01 & DR102 (Appendix A). Calculations for pre-and post-development imperviousness are given in Appendix B and are summarized below:

Table 1 – Weighted Runoff Coefficients

Drainage Area (Hectare)	Runoff coefficient 'C' (Pre-development)	Runoff coefficient 'C' (Post-development)
0.57	0.49	0.71

4.2 Pre and Post Development Flow

Peak flow rates under the pre and post development conditions are computed using IDF curves and Rational Method (Refer: Appendix B) and summarized below:

Table 2 – Pre and Post Development Flows

Return Period	Pre-development Flow (L/sec)	Post-development Flow (L/sec)	Uncontrolled Flow towards Robinson Creek (L/sec)
2	67.73	97.71	5.43
5	86.67	125.02	6.95
10	106.01	152.93	8.50
25	123.64	178.37	9.91
50	139.22	200.85	11.16
100	155.30	224.04	12.45

4.3 Water Quantity Control

4.3.1 Allowable Discharge

Allowable discharge rates are calculated by deducting 2 year through 100 year flow of uncontrolled area from flow of the pre development for entire proposed development site as follows:

2 year = 62.30 L/sec
5 year = 79.72 L/sec
10 year = 97.52 L/sec
25 year = 113.73 L/sec
50 year = 128.07 L/sec
100 year = 142.85 L/sec

4.3.1 Orifice Control

Discharge from site is to be controlled at 2 years rainfall event (allowable discharge 62.30L/sec) up to 100 years (142.85 L/sec**)** rainfall event flow. To ensure that only the flows under allowable limit is released from the site, a 140mm diameter orifice reducer pipe is proposed to be installed upstream of storm manhole MH2. The orifice pipe will control the site flows to 58.47 L/sec to 63.35 L/sec for 2 and 100 years storm respectively. The orifice sizing calculations are attached as Table 1 in Appendix D.

4.3.2. On-site Storage Requirements

The mass rational method was used to calculate the 2 year through 100-year storage requirements for the site area. Design rainfall intensity provided by the IDF formula and required storage calculations presented in Table 2, Appendix D.

Due to flow control at allowable discharge rate up to 100 years rainfall event, 122.89 m^3 of on-site detention storage will be required. Combination of storage in pipes/MH and surface ponding on asphalt pavement proposed to provide total of 180.19m^3 capacities (Ref: Drawing C-1). Details of proposed storage capacity are presented in Table 3 in Appendix D.

4.4 Water Quality Control

Water Quality control will be achieved with the help of a treatment train approach using landscaped areas and oil & grit separator. An overall TSS removal of 80% is
Achieved as shown in Table 3 below. Oil and grit separator's (Storm Filter SFPD0811) overall TSS removal from runoff leaving the site is calculated at 80%.

A Storm Filter (Model: SFPD0811) proposed to treat storm water flow from controlled area. Storm Filter attached in Appendix E.

The following Table 4 summarizes the predicted treatment efficiencies for the site:

Table 3– LID and OGS summary

Surface Type	Treatment Method	Area (m^2)	Effective TSS Removal	% Area of Site	Overall TSS Removal (%)
Uncontrolled (A5)	Inherent	1350.0	100	0.24	23.6
controlled Area	*Storm Filter*	4359.7	80	0.76	61.1
Total		*5709.69*		*1.00*	*84.73*

4.8 Water Balance

To meet the criteria of water balance recharge post development stormwater quantity will have to be same as pre-development retention quantity. The calculation of retaliation conducted based on first 5mm of every rainfall.

5709.69 m x 5 mm = 28.55 m^3

4.8.1 Infiltration Chamber

A Storm chamber (Triton, Model M-6) is recommended to install with a capacity of 30.0m^3. Bed size of the chamber will be 73.0 m^2 (11.15 m x 6.49 m). Location of the chamber is shown in Drawing C2. Chamber Sizing and O&M Manual attached in Appendix

Detail profile with elevation provided in Drawing C2 and design details attached in Appendix F. Table 4 shows water balance control required and proposed quantity.

Table 4: Stormwater Chamber Volume Break Down

Description	Volume (m^3)
Required Volume for Retention (m^3)	28.55
Total Tank Volume Provided (m^3)	30.0

4.8.2 Infiltration Chamber Bed Sizing

The soil investigation for the site carried out for the project by A & A Environmental Consultants Inc. dated January 12, 2019 provides the following data regarding water table and permeability of underlying soils.

The calculated infiltration rate presented in the report is 15.879 for the location of proposed storm tank (Refer: Appendix G) 15.879 mm/hr.

The required water balance volume to be infiltrated is 28.55m^3. The Ministry of Environment's Stormwater Management and Planning Manual, March 2003 method of infiltration will be implemented. The infiltration of this remainder volume of runoff will be through a pervious bottom of an underground device.

Based on Stormwater Management Criteria 2012 Ver.1 of TRCA Table C 3 (Safety Correction factors for calculating design infiltration rates)

Ratio of Mean Measured Infiltration = (60mm/hr) / (15.879mm/hr) = 3.77
Safety Correction Factor = 3.5 From TRCA C 3 table
Design Infiltration Rate = (60mm/hr) / 3.5 = 17.14 mm/hr

This Manual sizes the bottom area of the infiltration device by applying the following equation:

$$A = \frac{1000V}{Pn\Delta t}$$

Where A = Bottom area of the infiltration trench (m^2)
V = Runoff volume to be infiltrated (m^3)
P = Percolation rate of surrounding native soil (mm / hr.)
n = Porosity of the storage media (0.40 for storm chambers)
ΔT = Retention time (24 to 48 hrs)

The above equation assumes that all of the infiltration occurs through the bottom of the device.

The retention time in the underground device is calculated on the conservative side, namely 48hours.

Substituting the known values in the above equation:

A = (1000 x 28.55m^3) / (17.14 mm per hour x 0.40 x 48hours) = **86.75 m^2**

It is proposed to provide an open bottom storm chamber with an available bottom surface area of **95.0 m^2**. The draw down time for the provided storm chamber will be **43.83 hrs**.

5.0 MINOR SYSTEM DRAINAGE

Site storm sewer network proposed development of the site designed for 2 years storm event, Drawing C2 shows connection location, existing storm sewers and proposed site storm sewers network. (Design Sheet attached in Appendix B).

The storm outfall invert has been proposed at the 25 Year WSEL of the creek and 6.0 m Long and 2.0 m wide 300 mm deep Rip-Rap has been proposed for the outfall (Refer: Calculation Sheet H1, Appendix H).

6.0 CULVERT CAPACITY

Under the proposed condition, the existing driveway is proposed to be shifted from the north-east corner to the south-east corner of the site. The size of the existing driveway culvert for the Highway 50 road-side ditch is 600mm CSP. A same size culvert has been proposed for the proposed driveway and the culvert capacity has been assessed (Refer to Appendix H for calculations). As per the calculations, the existing culvert capacity (0.3m free board for design flow) is 0.349 m^3/sec and the proposed culvert capacity is 0.285 m^3/sec. The decrease in capacity is 0.064 m^3/sec. Under the proposed condition, there will be no storm discharged to the road side upto 100 year storm and the site graded to be self-confined (Refer to Calculation Sheet 3 and Calculation Sheet 5, Appendix B) and the reduction would be more for storm event above the 100 year storm. Therefore, the proposed culvert will not create any negative impact on water surface elevations.

6.0 MAJOR SYSTEM DRAINAGE

The overland flow will not impact the building since the grading of the site ensures storm flows greater than 100 years will be able to flow overland through the site without any impact to proposed buildings and adjacent site. The maximum 100 yrs flood level on site is 241.15m compared to the proposed lowest building finish floor elevation of 241.20 m.

7.0 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

An erosion and sediment control strategy will be implemented during the construction to mitigate the transportation of silt from the site. Drawing C-3 shows the silt fence and sediment control measures. To prevent construction-generated sediments from entering the storm sewer or leaving the site by overland flow, the following measures should be implemented with regular inspection and maintenance,

- Temporary silt fencing around the perimeter of the grading activities;
- Designated construction vehicle access should be laid with 150mm dia. Quarry Stone rip rap as a vibration pad for mud tracking control;
- Temporary sediment ponds;
- Erosion control measures to be removed only after the site is substantially stabilized with soding, and at the direction of the consultant or Town staff.

8.0 SUMMARY

- To control 100 year post development flows, quantity controls are required which are provided through orifice control and Storm Chamber. The post development flow is controlled from 58.47 L/sec to 63.35 L/sec for the 2 year through 100 year storm event respectively.
- Spills and quality control will be provided by an oil-grit separator device, specified as a storm filter (Model SFPD0811).
- Overland flow route through the site ensures that major overland flows are safely carried through the site.
- Erosion control such as installation of temporary silt fence, mud matt and sediment bag are recommended to minimize off-site sediment transport.

We trust you will find this submission complete and in order. Should you have any questions, please contact the undersigned.

PROFESSIONAL ENGINEER
LICENSED
A.S.ZIAUDDIN
100233432
03.09.2020
PROVINCE OF ONTARIO

Abu. S. Ziauddin P. Eng.
Project Manager

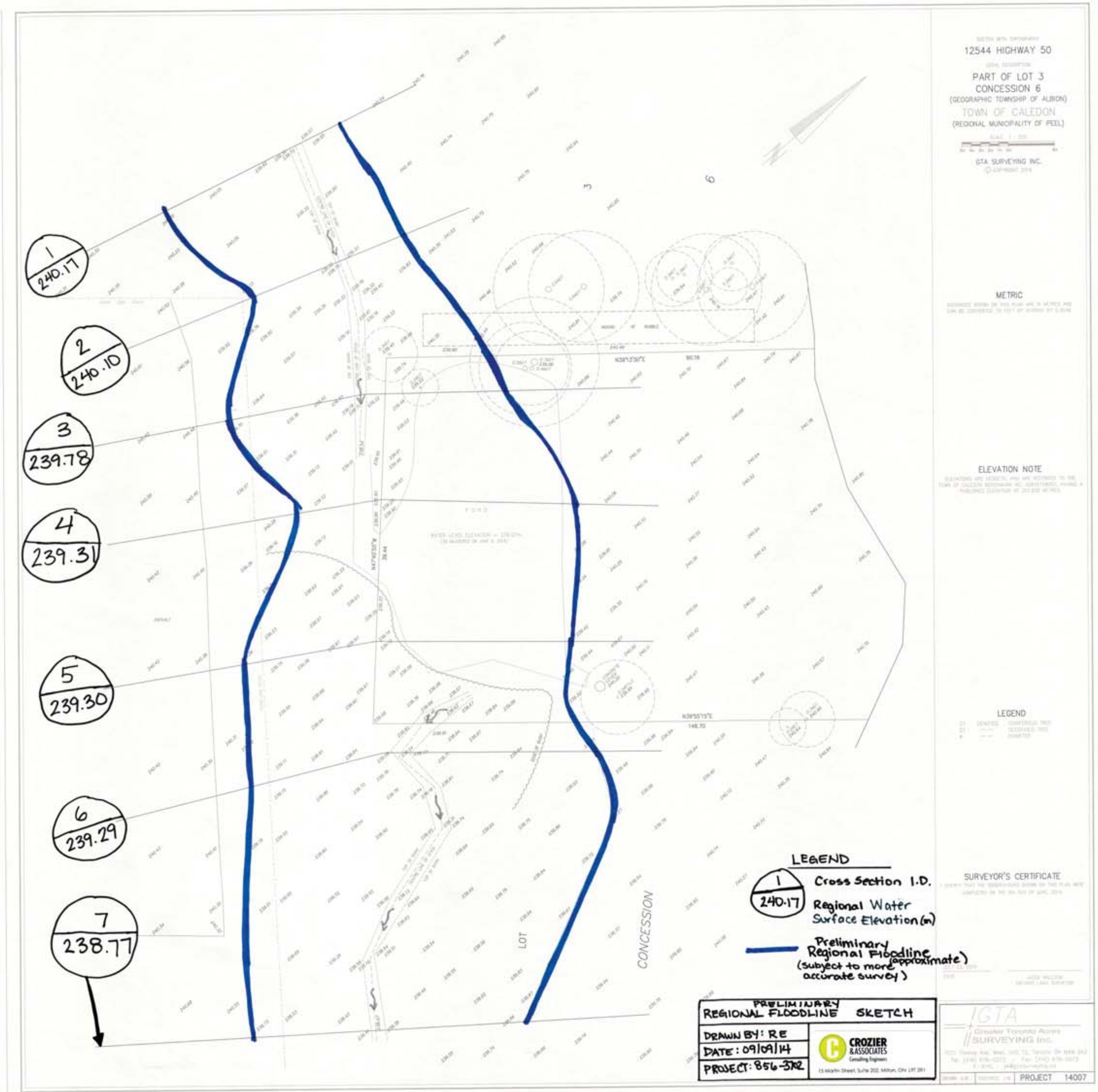
n Architecture Inc.

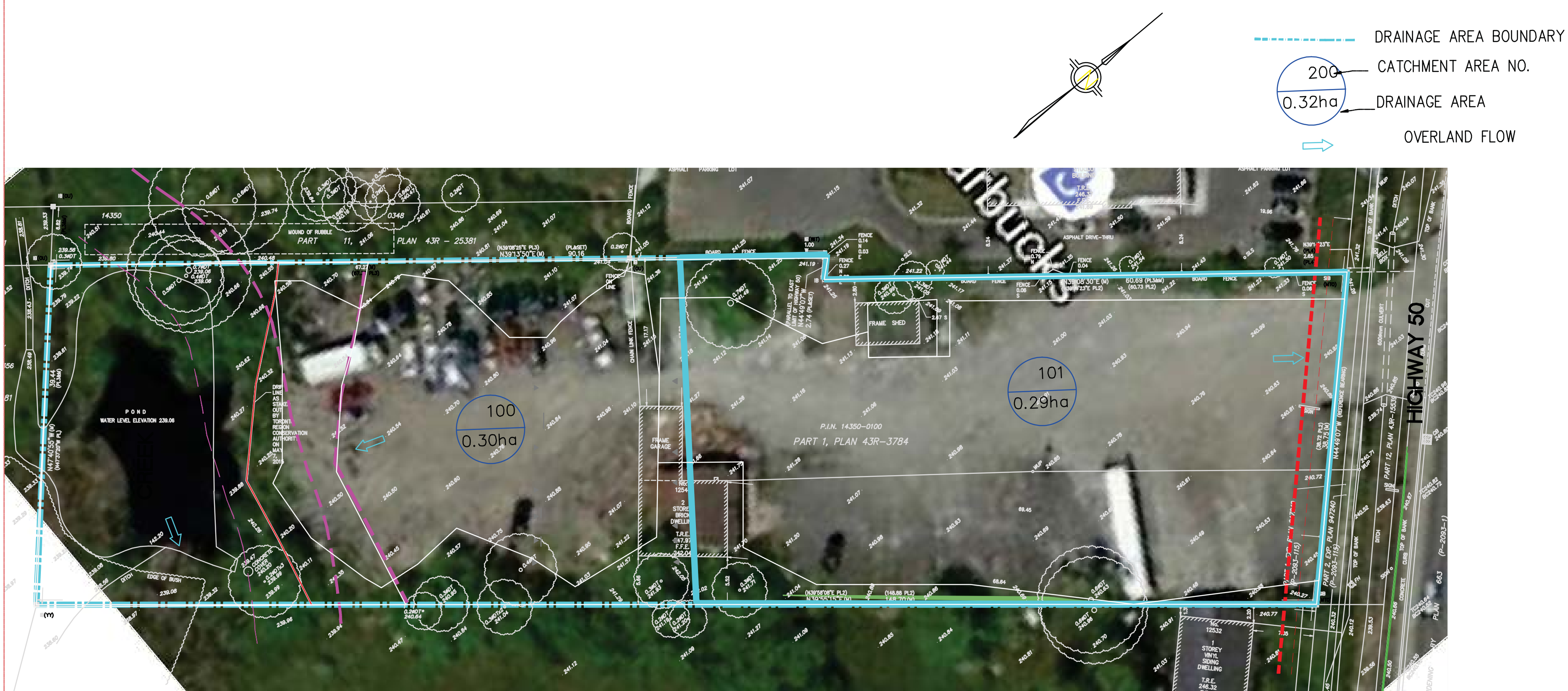
Ramyar Mehraban M. Eng. EIT
Municipal Project Designer

n Architecture Inc.

Appendix A

Figures


12544 HIGHWAY 50
PART OF LOT 3
CONCESSION 6
(GEOGRAPHIC TOWNSHIP OF ALBION)
TOWN OF CALEDON
(REGIONAL MUNICIPALITY OF PEEL)
GTA SURVEYING INC.
METRIC
ELEVATION NOTE
LEGEND
SURVEYOR'S CERTIFICATE
1
240.17
2
240.10
3
239.78
4
239.31
5
239.30
6
239.29
7
238.77
POND
LOT
CONCESSION
LEGEND
Cross Section I.D.
Regional Water Surface Elevation (m)
Preliminary Regional Floodline (approximate)
(subject to more accurate survey)
PRELIMINARY REGIONAL FLOODLINE SKETCH
DRAWN BY: RE
DATE: 09/09/14
PROJECT: 856-3782
CROZIER & ASSOCIATES Consulting Engineers
GTA Greater Toronto Acres SURVEYING Inc.
PROJECT 14007



EXISTING DRAINAGE SYSTEM
BOLTON GAS STATION

Fig. 2

CALEDON HILLS ENGINEERING LTD.

Appendix B

Pre & Post Development Flow Analysis

Calculation Sheet 1

PRE-DEVELOPMENT FLOW

n Architecture Inc

Project:	**Bolton Gas**
Address:	**12544 Highway 50**
Town/Township/City	**Town of Caledon, ON**
Project No.	**n 1340**
Proposed Development Area (m^2)	**5709.69**
Date:	**9/1/2020**

PRE-DEVELOPMENT RUNOFF COFFICENT

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
POND	556.6	0.05	27.83
BUILDING	170.9	0.95	162.39
GRAVEL	3960.9	0.60	2376.55
LANDSCAPED AREA	1021.3	0.25	255.32
		ΣAREA X C	2822.09
		WEIGHTED AVERAGE "C"	**0.49**
		AREA "A" (Hectares)	0.57

Rainfall intensity:

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

Where:

I = Rainfall Intensity (mm/hr)
A = coefficient
B = coefficient
t =Time of concentration(min) 10.00 (Refer: Standard No. 104)

Design Flow:

$$Q = 0.0028\ CIA$$

Where:

Q= Flow (m^3/second)
C = Runoff coefficient
A = Draingae Area (hectares)
I= Average rainfall intensity (milimeters/hour)

Return	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	1070	1593	2221	3158	3886	4688
B	7.85	11.00	12.00	15.00	16.00	17.00
C	0.8759	0.8789	0.9080	0.9335	0.9495	0.9624
t (mins)	10.00	10.00	10.00	10.00	10.00	10.00
I (mm/hr)	85.72	109.68	134.16	156.47	176.19	196.54
C	0.49	0.49	0.49	0.49	0.49	0.49
Q (m^3/sec)	0.07	0.09	0.11	0.12	0.14	0.16
Q (l/sec)	**67.73**	**86.67**	**106.01**	**123.64**	**139.22**	**155.30**

Variables are from Town`s Standard No. 104

Calculation Sheet 2

PRE-DEVELOPMENT FLOW
(Flow towards Highway 50)

n Architecture Inc

Project:	**Bolton Gas**
Address:	**12544 Highway 50**
Town/Township/City	**Town of Caledon, ON**
Project No.	**n 1340**
Proposed Development Area (m^2)	**5709.69**
Date:	**9/1/2020**

PRE-DEVELOPMENT RUNOFF COFFICENT

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
ASPHALT/CONC.	0.0	0.95	0.00
BUILDING	72.4	0.95	68.78
GRAVEL	2355.8	0.60	1413.48
LANDSCAPED AREA	298.0	0.25	74.50
		ΣAREA X C	1556.76
		WEIGHTED AVERAGE "C"	**0.57**
		AREA "A" (Hectares)	0.2726

Rainfall intensity:

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

Where:
I = Rainfall Intensity (mm/hr)
A = coefficient
B = coefficient
t =Time of concentration(min) 10.00 (Refer: Standard No. 104)

Design Flow:

$$Q = 0.0028\ CIA$$

Where:

Q= Flow (m^3/second)
C = Runoff coefficient
A = Draingae Area (hectares)
I= Average rainfall intensity (milimeters/hour)

Return	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	1070	1593	2221	3158	3886	4688
B	7.85	11.00	12.00	15.00	16.00	17.00
C	0.8759	0.8789	0.9080	0.9335	0.9495	0.9624
t (mins)	10.00	10.00	10.00	10.00	10.00	10.00
I (mm/hr)	85.72	109.68	134.16	156.47	176.19	196.54
C	0.57	0.57	0.57	0.57	0.57	0.57
Q (m^3/sec)	0.04	0.05	0.06	0.07	0.08	0.09
Q (l/sec)	**37.36**	**47.81**	**58.48**	**68.20**	**76.80**	**85.67**

Variables are from Town`s Standard No. 104

Calculation Sheet 3

POST DEVELOPMENT FLOW

n Architecture Inc

Project:	**Bolton Gas**
Address:	**12544 Highway 50**
Town/Township/City	**Town of Caledon, ON**
Project No.	**n 1340**
Proposed Development Area (m^2)	**5709.69**
Date:	**9/1/2020**

POST-DEVELOPMENT RUNOFF COFFICENT

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
ASPHALT/CONC.	3211.0	0.95	3050.49
BUILDING	565.7	0.95	537.45
LANDSCAPED AREA	1932.9	0.25	483.23
		ΣAREA X C	4071.17
		WEIGHTED AVERAGE "C"	**0.71**
		AREA "A" (Hectares)	0.57

Rainfall intensity:

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

Where:

I = Rainfall Intensity (mm/hr)

A = coefficient

B = coefficient

t =Time of concentration(min) 10.00 (Refer: Standard No. 104)

Design Flow:

$$Q = 0.0028\ CIA$$

Where:

Q= Flow (m^3/second)

C = Runoff coefficient

A = Draingae Area (hectares)

I= Average rainfall intensity (milimeters/hour)

Return Period (Years)	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	1070	1593	2221	3158	3886	4688
B	7.85	11.00	12.00	15.00	16.00	17.00
C	0.8759	0.8789	0.9080	0.9335	0.9495	0.9624
t (mins)	10.00	10.00	10.00	10.00	10.00	10.00
I (mm/hr)	85.72	109.68	134.16	156.47	176.19	196.54
C	0.71	0.71	0.71	0.71	0.71	0.71
Q (m^3/sec)	0.10	0.13	0.15	0.18	0.20	0.22
Q (l/sec)	**97.71**	**125.02**	**152.93**	**178.37**	**200.85**	**224.04**

Variables are from Town`s Standard No. 104

Calculation Sheet 4

FLOW TOWARDS ROBINSON CREEK
(Uncontrolled)

n Architecture Inc

Project:	**Bolton Gas**
Address:	**12544 Highway 50**
Town/Township/City	**Town of Caledon, ON**
Project No.	**n 1340**
Proposed Development Area (m^2)	**5709.69**
Date:	**9/1/2020**

POST-DEVELOPMENT RUNOFF COFFICENT

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
POND	556.6	0.05	27.83
BUILDING	0.0	0.95	0.00
GRAVEL	0.0	0.60	0.00
LANDSCAPED AREA	793.4	0.25	198.35
		ΣAREA X C	226.18
		WEIGHTED AVERAGE "C"	**0.17**
		AREA "A" (Hectares)	0.1350

Rainfall intensity:

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

Where:
I = Rainfall Intensity (mm/hr)
A = coefficient
B = coefficient
t =Time of concentration(min) 10.00 (Refer: Standard No. 104)

Design Flow:

$$Q = 0.0028\ CIA$$

Where:

Q= Flow (m^3/second)
C = Runoff coefficient
A = Draingae Area (hectares)
I= Average rainfall intensity (milimeters/hour)

Return	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	1070	1593	2221	3158	3886	4688
B	7.85	11.00	12.00	15.00	16.00	17.00
C	0.8759	0.8789	0.9080	0.9335	0.9495	0.9624
t (mins)	10.00	10.00	10.00	10.00	10.00	10.00
I (mm/hr)	85.72	109.68	134.16	156.47	176.19	196.54
C	0.17	0.17	0.17	0.17	0.17	0.17
Q (m^3/sec)	0.01	0.01	0.01	0.01	0.01	0.01
Q (l/sec)	**5.43**	**6.95**	**8.50**	**9.91**	**11.16**	**12.45**

Variables are from Town`s Standard No. 104

Appendix C

Storm Sewer Design Sheet

N Architecture Inc.

PREPARED BY:	A.Z
DATE PREPARED	04-Sep-20
Project	Bolton Gas
Project No.	n 1340
td (start):	10 minutes

Public Works and Engineering Department
Storm Drainage Design Chart
For Circular Drains Flowing Full
12544 Highway 50
Town of Caledon, ON

$$i = \frac{a}{(t_c + b)^c}$$

IDF CURVE						
Town of Caledon, ON						
Constants	**2 -yrs**	**5-yrs**	***10-yrs***	***25-yrs***	***50 yrs***	**100-yrs**
a	1070	1593	2221	3158	3886	4688
b	7.85	11	12	15	16	17
c	0.8759	0.8789	0.908	0.9335	0.9495	0.9624

Catchments								**Hydrology**		**Hyraulics**							
										STORM SEWER DESIGN INFORMATION					**TIME**		
Catchment ID	**Total Area (ha)**	**Captured By**	**Outlet to**	**C** runoff Coeffi.	**A x C**	**ACC.** A x C	**td (min)**	Rainfall Intensity, I (mm/hr) **I_2**	Peak Flow (m^3/sec) **2-yrs**	size (mm)	slope (%)	length (m)	Q full (m^3/s)	V full (m/s)	SECT. (min)	**% Flow (2 yrs)**	**Remarks**
A1 (East Side)	0.106	CB5	MH1	0.84	0.089	0.09	10.00	85.72	0.021	300	0.50	7.50	0.068	0.967	0.13	31%	
B1 (Roof)	0.018	Roof Outlet	MH1	0.95	0.018	0.02	10.00	85.72	0.004	300	0.50	8.00	0.068	0.967	0.14	6%	
A2 (South Side)	0.126	CB2	Pipe	0.85	0.108	0.21	10.00	85.72	0.051	300	0.50	25.50	0.068	0.967	0.44	75%	
A3(North Side)	0.073	CB1	Pipe	0.90	0.066	0.07	10.00	85.72	0.016	300	0.75	2.50	0.084	1.185	0.04	19%	
Pipe Conveyance	0.000	MH1	MH3	0.00	0.000	0.39	10.13	85.18	0.092	375	0.40	65.50	0.111	1.004	1.09	83%	
B2 (Roof)	0.028	Roof Outlet	CBMH3	0.95	0.026	0.03	10.00	85.72	0.006	300	0.50	7.50	0.068	0.967	0.13	9%	
B3(Roof)	0.011	Roof Outlet	CBMH3	0.95	0.010	0.01	10.00	85.72	0.002	300	0.50	10.00	0.068	0.967	0.17	4%	
A4(South Side)	0.058	CBMH3	MH3	0.95	0.055	0.09	10.13	85.18	0.022	300	0.50	18.00	0.068	0.967	0.31	32%	
Pipe Conveyance	0.000	MH3	STM FILTER	0.00	0.000	0.48	11.22	80.91	0.108	375	0.50	5.50	0.124	1.122	0.08	87%	
Pipe Conveyance	0.000	STM FILTER	STM TANK	0.00	0.000	0.48	11.30	80.61	0.108	375	0.50	2.00	0.124	1.122	0.03	87%	
Pipe Conveyance	0.000	STM TANK	MH2	0.00	0.000	0.48	11.33	80.50	0.108	375	0.50	1.50	0.124	1.122	0.02	87%	
Pipe Conveyance	0.000	*MH2*	HW	0.00	0.000	0.48	11.35	80.41	0.108	200	0.50	22.50	0.023	0.738	0.51	464%	

Appendix D

Onsite Storage Calculations
Orifice Sizing Calculations

Table 1

Orifice Sizing Calculations

Project:	**Bolton Gas**
Address:	**12544 Highway 50**
Town/Township/City	**Town of Caledon, ON**
Project No.	**n 1340**
Proposed Development Area (m^2)	**5709.69**
Date:	**9/4/2020**

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Orifice Location	MH2	
Orifice Type	Eccentric Reducer	
Invert Elevation	239.730	m
Min. Ground Elevation	240.850	m
Orifice Center Elevation	239.800	
Diameter of Orifce Pipe	140	mm
Area of Orifice (A)	0.015386	m^2
Coefficient of Discharge (C_d)	0.8	
Gravitational Constant	9.81	

Orifice Flow Equation:

$$Q = C_d A_o \sqrt{(2gH)}$$

Where:

Q = Flow (m3/sec)

A_o = Orifice area (m2)

g = Gravitational Constant

H = Center line head (m)

C_d = coefficient of discharge, dimensionless, typically between 0.6 and 0.85, depending on the orifice geometry

	2 years	5 years	10 years	25 years	50 years	100 years
Ponding Depth (m)	0.100	0.130	0.150	0.230	0.250	0.300
Water Elevation	240.95	240.98	241.00	241.08	241.10	241.15
Upstearm Head (m)	1.150	1.180	1.200	1.280	1.300	1.350
Total Discharge (L/sec)	**58.47**	**59.23**	**59.72**	**61.68**	**62.16**	**63.35**
Discharge Velocity (m/sec)	3.80	3.85	3.88	4.01	4.04	4.12
Allowable Peak Flow (l/sec)	**62.30**	**79.72**	**97.52**	**113.73**	**128.07**	**142.85**
Detention Storage Required (m^3)	**23.08**	**39.84**	**59.67**	**81.08**	**101.38**	**122.89**
Storage Used in Pipe (m^3)	12.74	12.74	12.74	12.74	12.74	12.74
Storage Used in MH (m^3)	5.46	5.46	5.46	5.46	5.46	5.46
Storage Used in Ponding (m^3)	4.88	21.64	41.47	62.88	83.18	104.69
Max Stoarge Available	**179.84**	**179.84**	**179.84**	**179.84**	**179.84**	**179.84**

On-Site Avaiable Storage Calculator

Town of Caledon, ON

Table 3

n Architecture Inc

Project:	Bolton Gas
Address:	12544 Highway 50
Project No.:	n 1340
Date:	4-Sep-20

MH/CATCH BASIN HWL 241.15

Description	Length/Dia. (m)	Width (m)	Elevation	Height(m)	Volume (m^3)
MH1	1.2		240.07	1.08	1.22
CB5	0.6	0.6	240.11	1.04	0.37
CB2	0.6	0.6	240.01	1.14	0.41
MH3	1.2		239.79	1.36	1.54
CBMH3	1.2	1.2	239.86	1.29	1.46
CB1	0.6	0.6	239.88	1.27	0.46
TOTAL					5.46

PIPES

FROM MH	TO MH	Length (m)		DIA (mm)	Volume (m^3)
Bldg	MH1	8		300	0.56
CB5	MH1	7.5		300	0.53
MH1	MH3	65.5		375	6.90
CB2	PIPE	25.5		300	1.79
Bldg-B	MHCH3	7.5		300	0.53
Carwash	MHCH3	10.0		300	0.70
CBMH3	MH3	22.0		300	1.55
CB1	PIPE	2.5		300	0.18
TOTAL					12.74

LOT PONDING

Ponding Location/Area	Top Elevation	Ponding Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)
CBMH3(Area 3)	240.85	0.3	512.3	51.2
CB1(Area 1)	240.85	0.3	545.8	54.6
CB2 (Area 2)	240.85	0.3	558.3	55.8
TOTAL				161.6

TOTAL VOLUME	179.84

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Table 2

On-Site Storage Calculator

Town of Caledon, ON

2 Years Detention Storage

Required Flood Storage Volume:

Equation of IDF:

$$i = \frac{a}{(t_c + b)^c}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min)
A= 1070
B= 7.85
C= 0.8759

Composite Runoff Coefficient: R =	0.71	
Site Area, A =	0.57	ha
Maximum Allowable Discharge Rate $Q_{release}$ =	0.058	m^3/s
	58.47	L/s

Max Storage 23.08

t_c (min)	i2 (mm/hr)	Q2 (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
10	85.718	0.097	0.038	23.082	Max Storage
11	81.722	0.092	0.034	22.407	
12	78.104	0.088	0.030	21.499	
13	74.813	0.085	0.026	20.387	
14	71.806	0.081	0.023	19.098	
15	69.045	0.078	0.020	17.653	
16	66.503	0.075	0.017	16.070	
17	64.153	0.073	0.014	14.364	
18	61.974	0.070	0.012	12.547	
19	59.948	0.068	0.009	10.632	
20	58.058	0.066	0.007	8.627	
21	56.291	0.064	0.005	6.541	
22	54.636	0.062	0.003	4.382	

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Table 2

On-Site Storage Calculator

Town of Caledon, ON

5 Years Detention Storage

Required Flood Storage Volume:

Equation of IDF:

$$i = \frac{a}{(t_c + b)^c}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min)
A= 1593
B= 11
C= 0.8789

Composite Runoff Coefficient: R =	0.71	
Site Area, A =	0.57	ha
Maximum Allowable Discharge Rate $Q_{release}$ =	0.059	m^3/s
	59.23	L/s

Max Storage 39.84

t_c (min)	i5 (mm/hr)	Q5 (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
10	109.677	0.124	0.065	38.884	
11	105.284	0.119	0.060	39.493	
12	101.250	0.115	0.055	39.799	
13	97.532	0.110	0.051	39.836	Max Storage
14	94.095	0.106	0.047	39.635	
15	90.907	0.103	0.044	39.221	
16	87.941	0.099	0.040	38.616	
17	85.174	0.096	0.037	37.839	
18	82.587	0.093	0.034	36.905	
19	80.163	0.091	0.031	35.830	
20	77.886	0.088	0.029	34.625	
21	75.742	0.086	0.026	33.302	
22	73.721	0.083	0.024	31.871	
23	71.812	0.081	0.022	30.341	
24	70.006	0.079	0.020	28.718	
25	68.294	0.077	0.018	27.010	
26	66.669	0.075	0.016	25.224	
27	65.124	0.074	0.014	23.365	
28	63.654	0.072	0.013	21.438	
29	62.254	0.070	0.011	19.447	
30	60.917	0.069	0.010	17.397	
31	59.641	0.067	0.008	15.291	
32	58.420	0.066	0.007	13.134	
33	57.251	0.065	0.006	10.928	
34	56.132	0.063	0.004	8.676	

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Table 2

On-Site Storage Calculator

Town of Caledon, ON

10 Years Detention Storage

Required Flood Storage Volume:

Equation of IDF:

$$i = \frac{a}{(t_c + b)^c}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min)
A= 2221
B= 12
C= 0.908

Composite Runoff Coefficient: R =	0.71	
Site Area, A =	0.57	ha
Maximum Allowable Discharge Rate $Q_{release}$ =	0.060	m^3/s
	59.72	L/s

Max Storage 59.67

t_c (min)	i10 (mm/hr)	Q10 (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
10	134.162	0.152	0.092	55.198	
11	128.855	0.146	0.086	56.756	
12	123.970	0.140	0.080	57.939	
13	119.459	0.135	0.075	58.788	
14	115.280	0.130	0.071	59.340	
15	111.396	0.126	0.066	59.626	
16	107.778	0.122	0.062	59.672	Max Storage
17	104.398	0.118	0.058	59.503	
18	101.233	0.114	0.055	59.138	
19	98.263	0.111	0.051	58.595	
20	95.471	0.108	0.048	57.890	
21	92.841	0.105	0.045	57.036	
22	90.358	0.102	0.042	56.046	
23	88.011	0.100	0.040	54.930	
24	85.788	0.097	0.037	53.699	
25	83.680	0.095	0.035	52.361	
26	81.678	0.092	0.033	50.923	
27	79.774	0.090	0.030	49.394	
28	77.961	0.088	0.028	47.779	
29	76.233	0.086	0.026	46.084	
30	74.583	0.084	0.025	44.314	
31	73.006	0.083	0.023	42.475	
32	71.498	0.081	0.021	40.571	
33	70.054	0.079	0.019	38.605	
34	68.670	0.078	0.018	36.582	
35	67.342	0.076	0.016	34.504	
36	66.067	0.075	0.015	32.375	
37	64.841	0.073	0.014	30.198	
38	63.663	0.072	0.012	27.975	
39	62.528	0.071	0.011	25.709	
40	61.435	0.069	0.010	23.402	
41	60.382	0.068	0.009	21.057	
42	59.366	0.067	0.007	18.674	
43	58.385	0.066	0.006	16.257	
44	57.437	0.065	0.005	13.806	
45	56.522	0.064	0.004	11.324	

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Table 2

On-Site Storage Calculator

Town of Caledon, ON

25 Years Detention Storage

Required Flood Storage Volume:

Equation of IDF:

$$i = \frac{a}{(t_c + b)^c}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min)
A= 3158
B= 15
C= 0.9335

Composite Runoff Coefficient: R =	0.71	
Site Area, A =	0.57	ha
Maximum Allowable Discharge Rate $Q_{release}$ =	0.062	m^3/s
	61.68	L/s

t_c (min)	i25 (mm/hr)	Q25 (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Max Storage 81.08
10	156.471	0.177	0.115	69.160	
11	150.846	0.171	0.109	71.878	
12	145.624	0.165	0.103	74.160	
13	140.764	0.159	0.098	76.052	
14	136.227	0.154	0.092	77.593	
15	131.983	0.149	0.088	78.816	
16	128.005	0.145	0.083	79.751	
17	124.267	0.141	0.079	80.424	
18	120.748	0.137	0.075	80.857	
19	117.429	0.133	0.071	81.071	
20	114.294	0.129	0.068	81.083	Max Storage
21	111.328	0.126	0.064	80.911	
22	108.517	0.123	0.061	80.567	
23	105.848	0.120	0.058	80.065	
24	103.313	0.117	0.055	79.417	
25	100.900	0.114	0.052	78.632	
26	98.600	0.112	0.050	77.722	
27	96.407	0.109	0.047	76.693	
28	94.313	0.107	0.045	75.554	
29	92.310	0.104	0.043	74.312	
30	90.394	0.102	0.041	72.973	
31	88.558	0.100	0.038	71.545	
32	86.798	0.098	0.036	70.031	
33	85.109	0.096	0.035	68.437	
34	83.486	0.094	0.033	66.767	
35	81.926	0.093	0.031	65.027	
36	80.426	0.091	0.029	63.219	
37	78.981	0.089	0.028	61.348	
38	77.589	0.088	0.026	59.417	
39	76.247	0.086	0.025	57.429	
40	74.952	0.085	0.023	55.387	
41	73.702	0.083	0.022	53.294	
42	72.494	0.082	0.020	51.152	
43	71.327	0.081	0.019	48.964	
44	70.198	0.079	0.018	46.731	
45	69.105	0.078	0.016	44.457	
46	68.047	0.077	0.015	42.142	
47	67.022	0.076	0.014	39.789	
48	66.028	0.075	0.013	37.400	
49	65.064	0.074	0.012	34.975	
50	64.129	0.073	0.011	32.517	
51	63.222	0.071	0.010	30.027	
52	62.341	0.070	0.009	27.506	
53	61.484	0.070	0.008	24.956	
54	60.652	0.069	0.007	22.378	
55	59.843	0.068	0.006	19.772	
56	59.056	0.067	0.005	17.141	
57	58.290	0.066	0.004	14.484	

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Table 2

On-Site Storage Calculator

Town of Caledon, ON

50 Years Detention Storage

Required Flood Storage Volume:	Equation of IDF:	
	$i = \frac{a}{(t_c + b)^c}$	I = Rainfall Intensity (mm/hr) T = Time of Concentration (min) A= 3886 B= 16 C= 0.9495

Composite Runoff Coefficient: R =	0.71	
Site Area, A =	0.57	ha
Maximum Allowable Discharge Rate $Q_{release}$ =	0.062	m^3/s
	62.16	L/s

t_c (min)	i50 (mm/hr)	Q50 (m^3/s)	Q_{stored} (m^3/s)	Max Storage Peak Volume (m^3)	101.38
10	176.192	0.199	0.137	82.253	
11	169.990	0.192	0.130	85.849	
12	164.220	0.186	0.124	88.956	
13	158.839	0.180	0.117	91.622	
14	153.807	0.174	0.112	93.890	
15	149.092	0.169	0.106	95.798	
16	144.665	0.164	0.101	97.377	
17	140.499	0.159	0.097	98.659	
18	136.573	0.154	0.092	99.666	
19	132.865	0.150	0.088	100.423	
20	129.358	0.146	0.084	100.950	
21	126.036	0.143	0.080	101.264	
22	122.885	0.139	0.077	101.382	Max Storage
23	119.891	0.136	0.073	101.318	
24	117.043	0.132	0.070	101.086	
25	114.331	0.129	0.067	100.697	
26	111.745	0.126	0.064	100.162	
27	109.276	0.124	0.061	99.491	
28	106.916	0.121	0.059	98.693	
29	104.659	0.118	0.056	97.776	
30	102.498	0.116	0.054	96.748	
31	100.426	0.114	0.051	95.615	
32	98.438	0.111	0.049	94.384	
33	96.530	0.109	0.047	93.060	
34	94.696	0.107	0.045	91.649	
35	92.932	0.105	0.043	90.155	
36	91.234	0.103	0.041	88.584	
37	89.599	0.101	0.039	86.940	
38	88.023	0.100	0.037	85.225	
39	86.502	0.098	0.036	83.445	
40	85.035	0.096	0.034	81.602	
41	83.618	0.095	0.032	79.700	
42	82.248	0.093	0.031	77.741	
43	80.924	0.092	0.029	75.728	
44	79.643	0.090	0.028	73.664	
45	78.403	0.089	0.027	71.552	
46	77.202	0.087	0.025	69.392	
47	76.038	0.086	0.024	67.189	
48	74.909	0.085	0.023	64.943	
49	73.814	0.083	0.021	62.656	
50	72.752	0.082	0.020	60.331	
51	71.721	0.081	0.019	57.968	
52	70.719	0.080	0.018	55.570	
53	69.745	0.079	0.017	53.138	
54	68.799	0.078	0.016	50.673	
55	67.879	0.077	0.015	48.176	
56	66.983	0.076	0.014	45.650	
57	66.112	0.075	0.013	43.094	
58	65.263	0.074	0.012	40.511	
59	64.437	0.073	0.011	37.900	
60	63.631	0.072	0.010	35.264	
61	62.846	0.071	0.009	32.603	
62	62.081	0.070	0.008	29.918	
63	61.335	0.069	0.007	27.210	
64	60.606	0.069	0.006	24.480	

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Table 2
On-Site Storage Calculator
Town of Caledon, ON
100 Years Detention Storage

Required Flood Storage Volume:

Equation of IDF:

$$i = \frac{a}{(t_c + b)^c}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min)
A= 4688
B= 17
C= 0.9624

Composite Runoff Coefficient: R =	0.71	
Site Area, A =	0.57	ha
Maximum Allowable Discharge Rate $Q_{release}$ =	0.063	m^3/s
	63.35	L/s

Max Storage 122.89

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
10	196.536	0.222	0.159	95.347	
11	189.777	0.215	0.151	99.836	
12	183.475	0.207	0.144	103.781	
13	177.585	0.201	0.137	107.234	
14	172.068	0.195	0.131	110.242	
15	166.890	0.189	0.125	112.847	
16	162.020	0.183	0.120	115.083	
17	157.432	0.178	0.115	116.982	
18	153.100	0.173	0.110	118.574	
19	149.005	0.169	0.105	119.882	
20	145.128	0.164	0.101	120.929	
21	141.450	0.160	0.097	121.735	
22	137.958	0.156	0.093	122.319	
23	134.637	0.152	0.089	122.697	
24	131.475	0.149	0.085	122.882	
25	128.461	0.145	0.082	122.890	Max Storage
26	125.585	0.142	0.079	122.731	
27	122.837	0.139	0.076	122.417	
28	120.209	0.136	0.073	121.957	
29	117.693	0.133	0.070	121.362	
30	115.282	0.130	0.067	120.640	
31	112.969	0.128	0.064	119.797	
32	110.750	0.125	0.062	118.842	
33	108.617	0.123	0.059	117.781	
34	106.567	0.121	0.057	116.620	
35	104.594	0.118	0.055	115.364	
36	102.694	0.116	0.053	114.019	
37	100.863	0.114	0.051	112.590	
38	99.097	0.112	0.049	111.080	
39	97.394	0.110	0.047	109.495	
40	95.749	0.108	0.045	107.838	
41	94.160	0.106	0.043	106.113	
42	92.623	0.105	0.041	104.323	
43	91.137	0.103	0.040	102.470	
44	89.699	0.101	0.038	100.559	
45	88.306	0.100	0.037	98.592	
46	86.957	0.098	0.035	96.571	
47	85.649	0.097	0.034	94.499	
48	84.380	0.095	0.032	92.378	
49	83.149	0.094	0.031	90.211	
50	81.955	0.093	0.029	87.999	
51	80.794	0.091	0.028	85.744	
52	79.667	0.090	0.027	83.448	
53	78.572	0.089	0.026	81.113	
54	77.506	0.088	0.024	78.740	
55	76.470	0.086	0.023	76.331	
56	75.462	0.085	0.022	73.887	
57	74.480	0.084	0.021	71.409	
58	73.524	0.083	0.020	68.900	
59	72.593	0.082	0.019	66.360	
60	71.685	0.081	0.018	63.790	
61	70.800	0.080	0.017	61.191	
62	69.938	0.079	0.016	58.565	
63	69.096	0.078	0.015	55.912	
64	68.275	0.077	0.014	53.234	
65	67.473	0.076	0.013	50.531	
66	66.691	0.075	0.012	47.803	

Appendix E

Storm Filter (OGS)

Determining Number of Cartridges for Flow Based Systems

Date	**8/31/2020**	**Black Cells =**	**Calculation**
Site Information			
Project Name	**12544 Highway 50**		
Project Location	**Bolton, ON**		
OGS ID	**Stormfilter**		
Drainage Area, Ad	**1.08** ac	(0.436 ha)	
Impervious Area, Ai	**0.93** ac		
Pervious Area, Ap	**0.15**		
% Impervious	**86%**		
Runoff Coefficient, Rc	**0.81**		
Treatment storm flow rate, Q_{treat}	**0.45** cfs	(12.74 L/s)	
Peak storm flow rate, Q_{peak}	**2.47** cfs	(70 L/s)	
Filter System			
Filtration brand	**StormFilter**		
Cartridge height	**18** in		
Specific Flow Rate	**2.00** gpm/ft^2		
Flow rate per cartridge	**15.00** gpm		

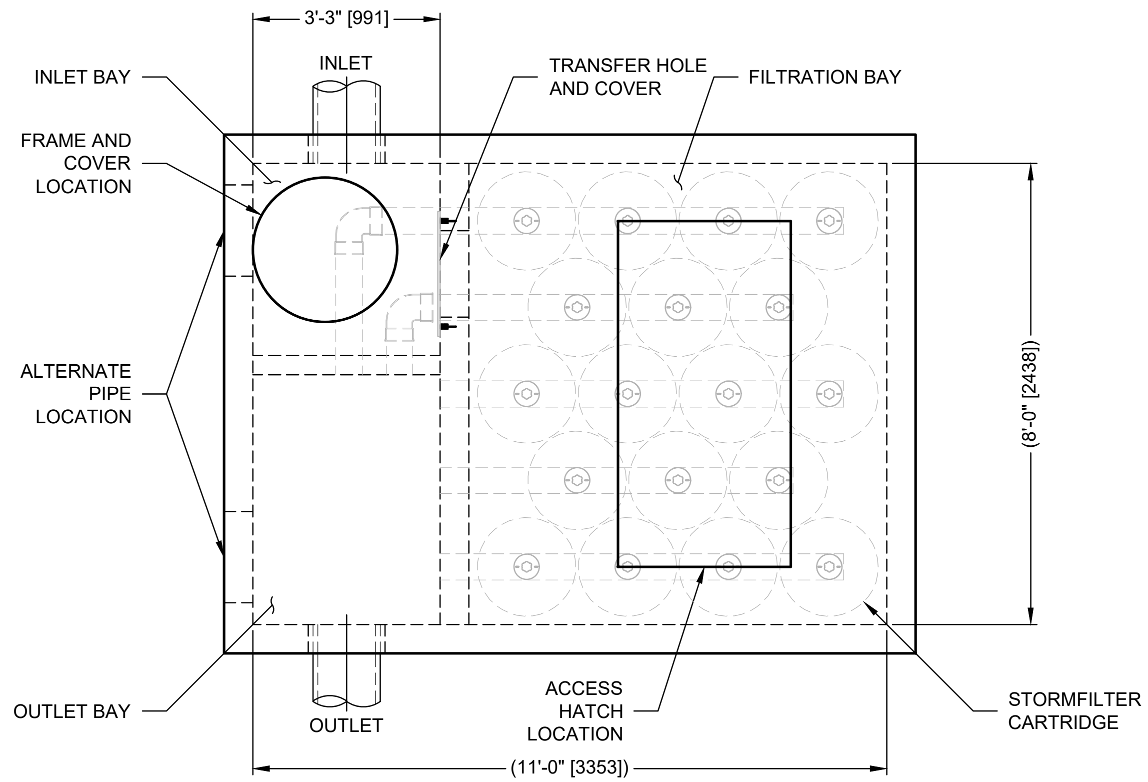
SUMMARY

Number of Cartridges	14
Media Type	Perlite

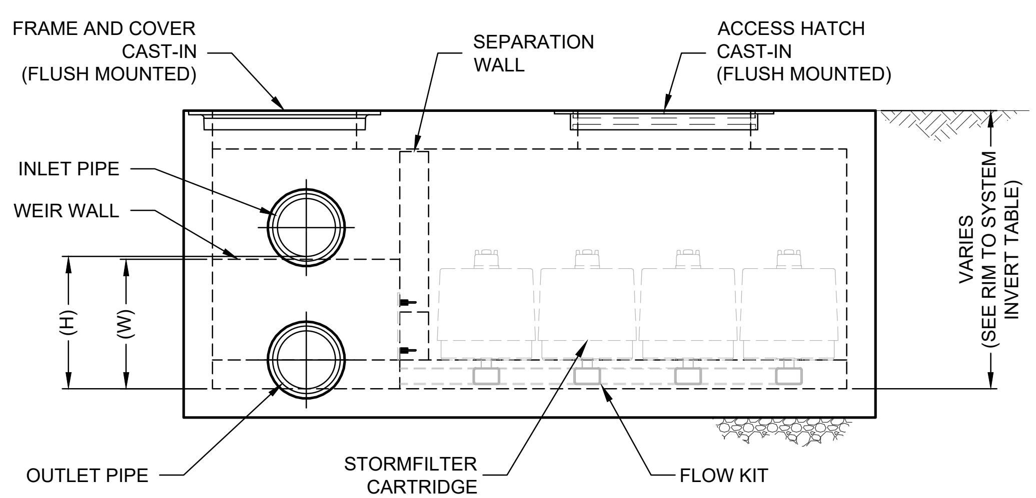
Event Mean Concentration (EMC)	**120** mg/L
Annual TSS Removal	**80%**
Percent Runoff Capture	**90%**

Recommend SFPD0811

200 Enterprise Drive
Scarborough, ME 04074
Phone 877-907-8676
Fax 207-885-9825



PLAN



ELEVATION

The Stormwater Management StormFilter®

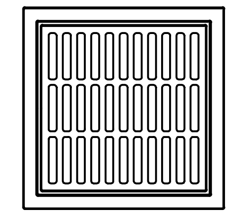
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,524,576; 5,707,527; 5,985,157; 6,027,639; 6,649,048; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

STORMFILTER DESIGN NOTES

- STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD
- A 8' x 11' [2438 x 3353] PEAK DIVERSION STYLE STORMFILTER IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (18) AND IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR A RIGHT INLET CONFIGURATION
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS NOTED OTHERWISE

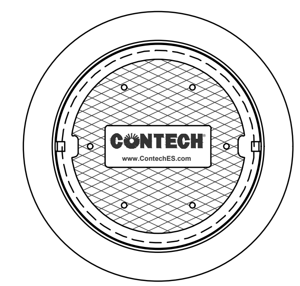
CARTRIDGE SIZE (in. [mm])	27 [686]			18 [457]			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H) (ft. [mm])	3.05 [930]			2.3 [701]			1.8 [549]		
HEIGHT OF WEIR (W) (ft. [mm])	3.00 [914]			2.25 [686]			1.75 [533]		
SPECIFIC FLOW RATE (gpm/sf [L/s/m²])	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]
CARTRIDGE FLOW RATE (gpm [L/s])	22.5 [1.42]	18.79 [1.19]	11.25 [0.71]	15 [0.95]	12.53 [0.79]	7.5 [0.47]	10 [0.63]	8.35 [0.53]	5 [0.32]

* 1.67 gpm/sf [1.13 L/s/m²] SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY



FRAME AND GRATE

(24" SQUARE)
(NOT TO SCALE)



FRAME AND COVER

(30" ROUND)
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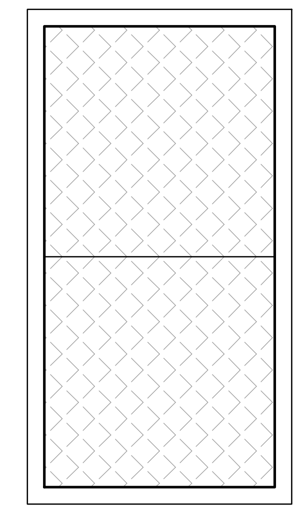


ACCESS HATCH

(36" x 72")
(NOT TO SCALE)

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (cfs [L/s])	
PEAK FLOW RATE (cfs [L/s])	
RETURN PERIOD OF PEAK FLOW (yrs)	
CARTRIDGE FLOW RATE	
CARTRIDGE SIZE (27, 18, LOW DROP (LD))	
MEDIA TYPE (PERLITE, ZPG, PSORB)	
NUMBER OF CARTRIDGES REQUIRED	
FILTER BAY RIM ELEVATION	

PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES/SPECIAL REQUIREMENTS:

RIM TO SYSTEM INVERT

CARTRIDGE SIZE	MIN. HEIGHT	MAX. HEIGHT
LOW DROP / 18"	3'-6"	4'-10"
27"	4'-2"	4'-10"

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **38 SECONDS**.
SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0'-0", AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE.
C. CONTRACTOR TO ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SFPD0811-S
8' x 11' PEAK DIVERSION STORMFILTER
SHALLOW STANDARD DETAIL

CONTECH ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

> **Important**: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

> **Warning**: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

> **Important:** Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Inspection Report

Date: ____________________ Personnel: ____

Location: ____________________ System Size: ____________________ Months in Service: ____________________

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: __________

Sediment Thickness in Forebay: ____ Date: ____________________

Sediment Depth on Vault Floor: ____

Sediment Depth on Cartridge Top(s): ____

Structural Damage: ____

Estimated Flow from Drainage Pipes (if available): ____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: ______________________________

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: ____

☐ Minor Structural Repairs: ____

☐ Drainage Area Report ____

Excessive Oil Loading: Yes ☐ No ☐ Source: ______________________________

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: ______________________________

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: ______________________________

Items Needing Further Work: ____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

____

____

____

____

____

____

____

____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: ______________________ Personnel: ____

Location: ______________________ System Size: ____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: __________

List Safety Procedures and Equipment Used: ____

____

____

System Observations

Months in Service: ____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): ____

Sediment Depth on Vault Floor: ____

Sediment Depth on Cartridge Top(s): ____

Structural Damage: ____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: ______________________

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: ______________________

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: ______________________

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: ______________________

Replace Cartridges: Yes ☐ No ☐ Details: ______________________

Sediment Removed: Yes ☐ No ☐ Details: ______________________

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: ______________________

Residuals (debris, sediment) Disposal Methods: ____

Notes:

____

____

____

____

____

____

____

RECYCLED PAPER

800-338-1122

www.ContechES.com

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other Contech division offerings, visit www.ContechES.com or call 800.338.1122.

Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

Appendix F

Infiltration Chambers

Parameters

Units: Metric

Storage Volume: 29 Cu m

Chamber Selection: M-6

Header Row Position: Right

Fill Over Embedment Stone: 300 mm

Controlled By: width 7.5 m

Embedment Stone mm:

Over: 150 Under: 150 Porosity: 0.4

Min 150mm over and under

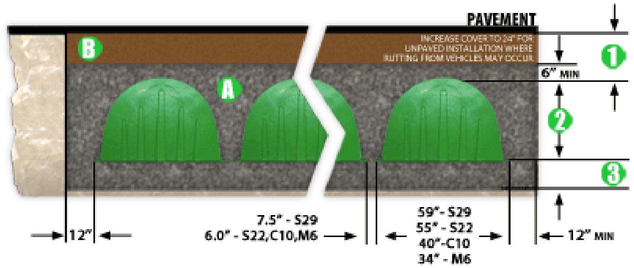
Double Stacked

Double Stacked?: No

Stone Between: 304.80

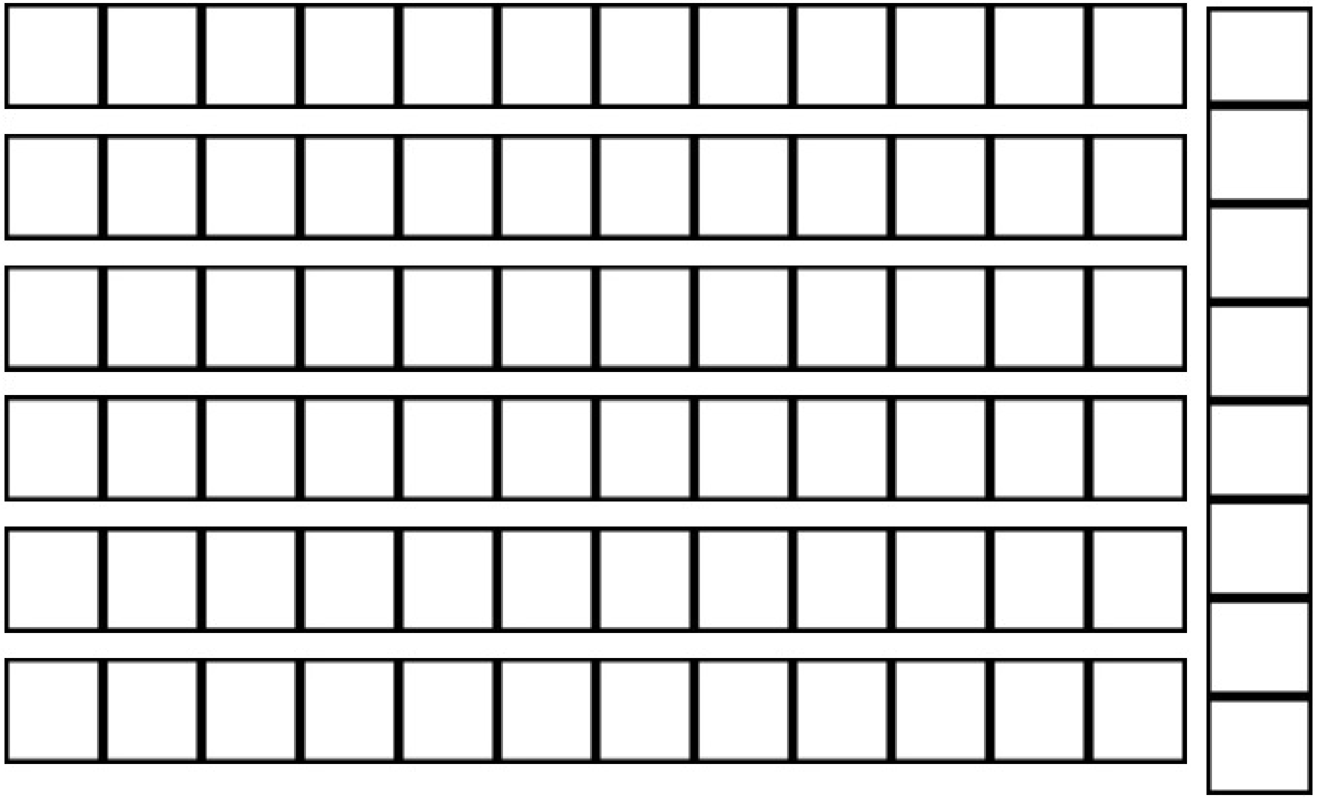
Note: After making an input change you must hit calculate to update the Field Diagram and Project Results.
* The image generation will not save if using MicroSoft Edge

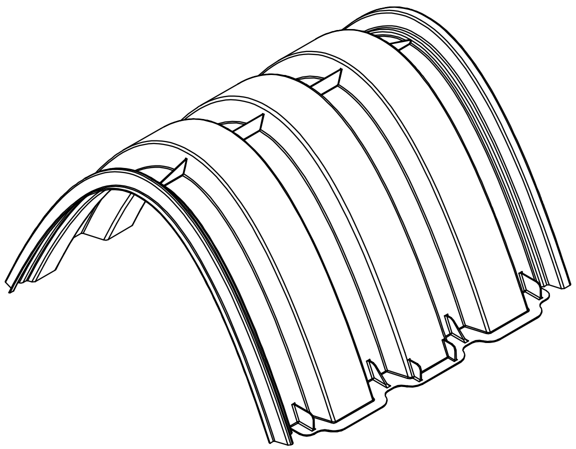
Project Results



1 Total Cover Over Chambers: 451 mm	
2 Height Of Chamber: 445 mm	
3 Embedment Stone Under Chambers: 151 mm	
A Volume of Embedment Stone Required: 41 Cu. m	
B Volume of Fill Material Required: 22 Cu. m	
Total Storage Provided: 30 Cu. m	
Type Of Chambers: M-6	
# Of Chambers Required: 80	
# Of End Caps Required: 14	
Required Bed Size: 73 Sq. m	
Volume of Excavation: 54 Cu. m	
* Area of Filter Fabric: 99 Sq. m	
# of Chambers Long: 12	
# of rows: 6	
Actual Trench Length: 11.15 m	
Actual Trench Width: 6.49 m	

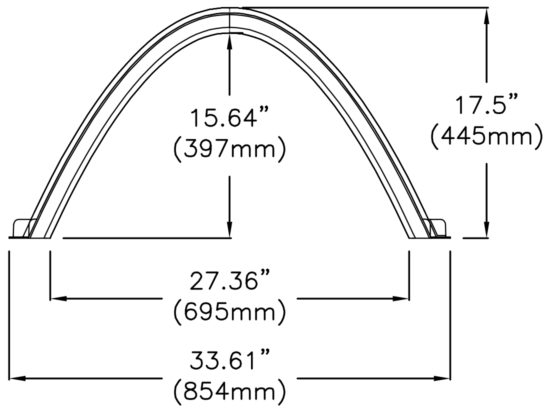
* Filter Fabric quantity for Fabric on Top and Sides of System Only, does not include overlap

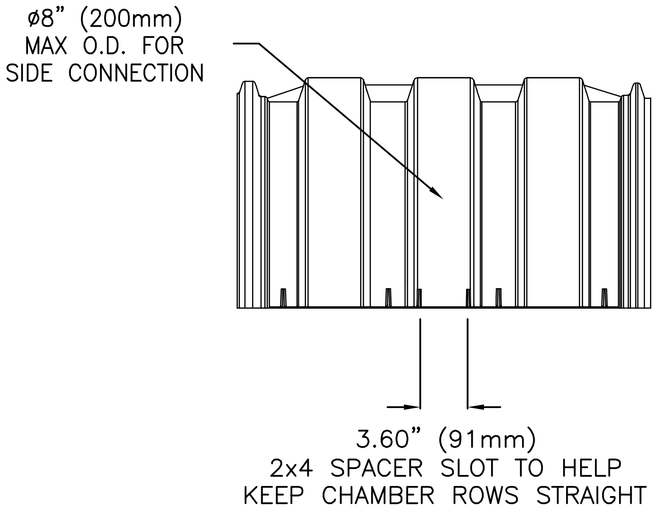


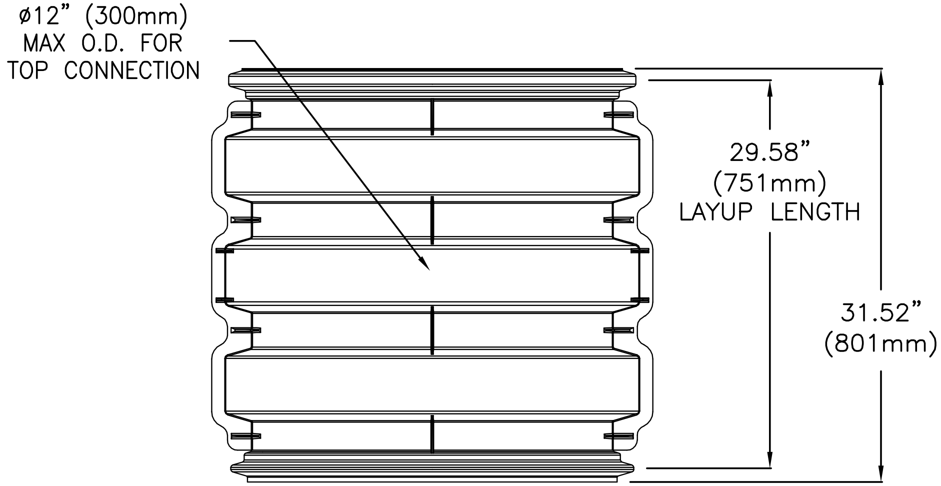


M-6 CHAMBER SPECS	
NOMINAL DIMENSIONS (LAYUP LENGTH X WIDTH X HEIGHT)	29.58" X 33.61" X 17.5" (751mm X 854mm X 445mm)
BARE CHAMBER STORAGE	5.6 CUBIC FEET (0.159 CUBIC METERS)
*MIN INSTALLED STORAGE	11.36 CUBIC FEET (0.322 CUBIC METERS)
CHAMBER WEIGHT	14 lbs (6.35 kg)
STORAGE PER LINEAR FOOT WITHOUT STONE	2.27 CUBIC FEET (0.064 CUBIC METERS)
STORAGE PER LINEAR FOOT WITH STONE	4.61 CUBIC FEET (0.131 CUBIC METERS)
*ASSUMING A MIN OF 6" (152mm) STONE ABOVE AND BELOW AND 6" (152mm) BETWEEN ROWS WITH 40% STONE POROSITY (DOES NOT INCLUDE 12" (305mm) PERIMETER STONE VOLUME)	

NOTE: M-6 CHAMBER DETAILS TESTED AND RATED FOR H-30 LOAD CONDITIONS WITH 18" (457mm) OF COVER AND NO PAVEMENT.





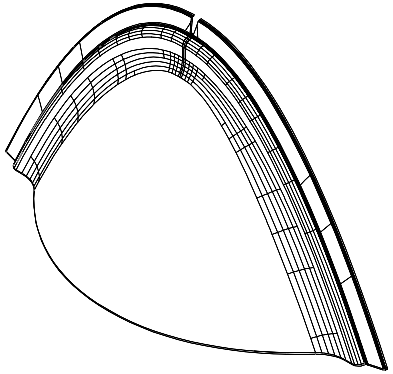


TRITON STORMWATER SOLUTIONS
7600 EAST GRAND RIVER, STE.195
BRIGHTON, MI 48114
PHONE: (810) 222-7652 ● FAX: (810) 222-1769
WWW.TRITONSWS.COM

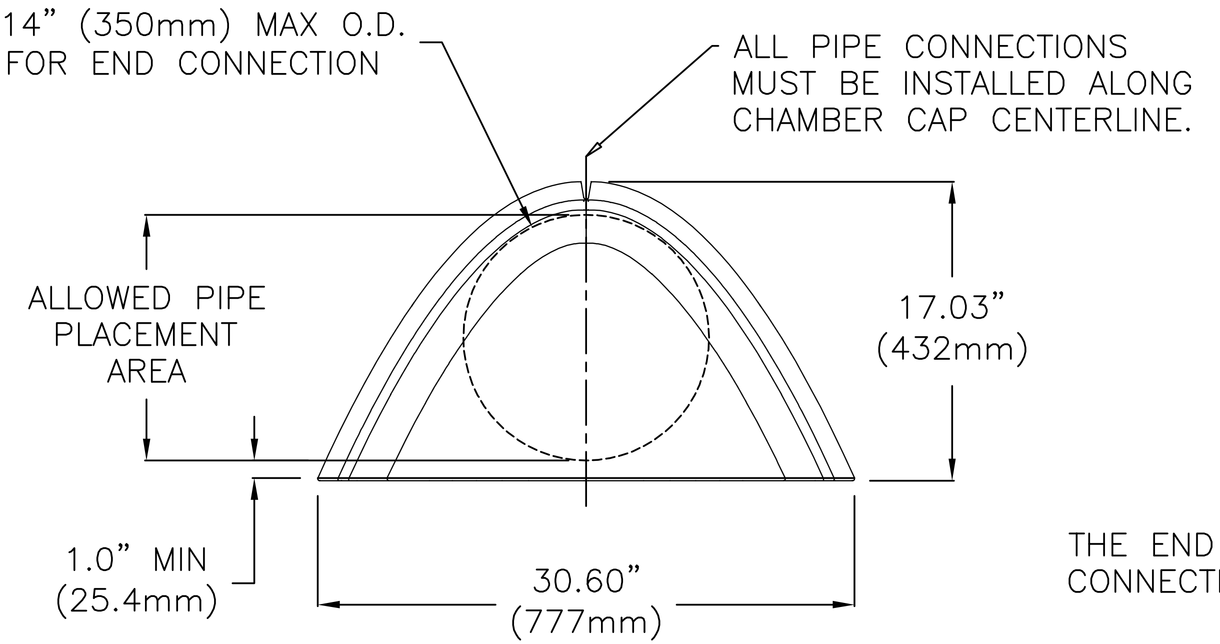
M-6 CHAMBER DETAIL

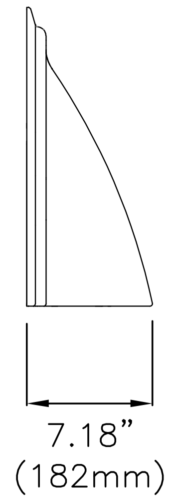
TRITON - STANDARD DETAILS

REVISED:
02-26-16 JWM



M-6 END CAP SPECS	
NOMINAL DIMENSIONS (LAYUP LENGTH X WIDTH X HEIGHT)	7.18" X 30.60" X 17.03" (183mm X 777mm X 432mm)
BARE END CAP STORAGE	0.533 CUBIC FEET (0.015 CUBIC METERS)
*MIN INSTALLED STORAGE	2.26 CUBIC FEET (0.064 CUBIC METERS)
*ASSUMING A MIN OF 6" (152mm) STONE ABOVE AND BELOW AND 6" (152mm) BETWEEN ROWS WITH 40% STONE POROSITY (DOES NOT INCLUDE 12" (305mm) PERIMETER STONE VOLUME)	





THE END CAP FITS UP INSIDE THE LAST CONNECTING RIBS OF THE M–6 CHAMBER

CONCEPTUAL PLAN DISCLAIMER

THIS GENERIC DETAIL DOES NOT ENCOMPASS THE SIZING, FIT, AND APPLICABILITY OF THE TRITON CHAMBER SYSTEM FOR THIS SPECIFIC PROJECT. IT IS THE ULTIMATE RESPONSIBILITY OF THE DESIGN ENGINEER TO ASSURE THAT THE STORMWATER SYSTEM DESIGN IS IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGUALTIONS. TRITON PRODUCTS MUST BE DESIGNED AND INSTALLED IN ACCORDANCE WITH TRITON'S MINIMUM REQUIREMENTS. TRITON STORMWATER SOLUTIONS DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS. THE DESIGN ENGINEER IS RESPONSIBLE FOR ALL DESIGN DECISIONS.

TRITON STORMWATER SOLUTIONS

7600 EAST GRAND RIVER, STE.195
BRIGHTON, MI 48114
PHONE: (810) 222-7652 ● FAX: (810) 222-1769
WWW.TRITONSWS.COM

M-6 CHAMBER END CAP DETAIL

TRITON - STANDARD DETAILS

REVISED:
02-26-16 JWM

TRITON M-6 PRODUCT SPECIFICATIONS

1.0 General

1.1 Triton chambers are designed to control stormwater runoff. As a subsurface retention or detention system, Triton chambers retain and allow effective infiltration of water into the soil. As a subsurface detention system, Triton chambers detain and allow for the metered flow of water to an outfall.

2.0 Chamber Parameters

2.1 The chamber shall be injection compression molded of a structural grade 1010 green soy resin composite to be inherently resistant to environmental stress cracking (ESCR), creep, and to maintain proper stiffness through temperature ranges of -40 degrees Fahrenheit to 180 degrees Fahrenheit (-40 degrees Celsius to 82.2 degrees Celsius).

2.2 The material property for the chamber and end cap must meet or exceed the following:
Tensile Strength- Ultimate: 21,755 PSI (150 Mpa)
Tensile Strength-Yield: 17,404 PSI (120 Mpa)
Tensile Modulus: 1,750-2,240 KSI (12,066 Mpa - 15,444 Mpa)
Flex Modulus: 1,600 KSI (11,032 Mpa)
Flex Yield Strength: 33,100 PSI (228 Mpa)
Compressive Strength: 30,457 PSI (210 Mpa)
Shear Strength: 11,500 PSI (79 Mpa)

2.3 The nominal chamber dimensions of the Triton M-6 shall be 17.5 inches tall (445 millimeters), 33.61 inches wide (854 millimeters) and 31.5 inches long (800 millimeters). Lay-up length is 29.58 inches (751 millimeters).

2.4 The chamber shall have an elliptical curved section profile.

2.5 The chamber shall be open-bottomed.

2.6 The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows to be constructed.

2.7 The nominal storage volume of a Triton M-6 chamber shall be 11.36 cubic feet (0.322 cubic meters) per chamber when installed per Triton's typical details. This equates to 1.40 cubic feet (0.040 cubic meters) of storage per square foot of bed. This does not include perimeter stone.

2.8 The chamber shall have both of its ends open to allow for unimpeded hydraulic flows and visual inspections down a row's entire length.

2.9 The chamber shall have five corrugations to achieve strengths defined above.

2.10 The chamber shall have five circular and elliptical, indented and raised, surfaces on the top to the chamber for a maximum of 12 inch (300 millimeter) diameter optional top feed inlets, inspection ports and/or clean-out access ports.

2.11 The chamber side shall be capable of accepting pipe O.D. up to 8 inches (200 millimeters).

2.12 The chamber shall be analyzed, designed and field tested using AASHTO LRFD bridge design specifications 1. Design live load shall meet or exceed the AASHTO HS30 or a rear axle load of 48,000 pounds (21,772.4 kg). Design shall consider earth and live loads without pavement as appropriate for the minimum 18 inches (457 millimeters) of total cover to a maximum total cover of 50 feet (15.24 meters).

2.13 The chamber shall be manufactured in an ISO/TS16949:2002 and ISO 14001:2004 certified facility

2.14 The service life of the product is over 60 years under a constant sustained load of 10,000 PSI (68.95 Mpa) which is equal to the H-20 loading condition. Under typical loading conditions the Chamber and End Cap has a useful life span of 120 years from date of when manufactured.

3.0 End Cap Parameters

3.1 The end cap shall be Injection Compression molded of 1010 green soy resin to be inherently resistant to environmental stress cracking (ESCR), creep and to maintain proper stiffness through temperature ranges of -40 degrees Fahrenheit to 180 degrees Fahrenheit (-40 degrees Celsius to 82.2 degrees Celsius).

3.2 The end cap shall be designed to fit inside the last corrugation of a chamber, which allows the capping of each end of the chamber row.

3.3 The end cap shall have 7 different diameter connection guides across the front face of the bull nosed surface. The maximum diameter that the end cap can accept is 14 inches (350 millimeters) PS46, ASTM F679 PVC pipe.

3.4 The end cap shall have excess structural adequacies to allow cutting an orifice of any size at any invert elevation.

3.5 The primary face of an end cap shall have five corrugations and be angled outward to resist horizontal loads generated near the edges of beds.

3.6 The end cap shall be manufactured in an ISO/TS16949:2002 and ISO 14001:2004 certified facility.

3.7 The service life of the product to be over 60 years under a sustained load of 10,000 PSI (68.95 Mpa) which is equal to the H-20 loading condition.

3.8 The nominal storage volume of a Triton M-6 end cap shall be 2.26 cubic feet (0.064 cubic meters) per end cap when installed per triton's typical details. This equates to 1.15 cubic feet (0.032 cubic meters) of storage per square foot of bed.

4.0 Installation

4.1 Installation shall be in accordance with the latest Triton Installation manual that can be downloaded from the Triton website: www.tritonsws.com/support/downloads

7600 EAST GRAND RIVER, STE.195
BRIGHTON, MI 48114
PHONE: (810) 222-7652 ● FAX: (810) 222-1769
WWW.TRITONSWS.COM

M-6 PRODUCT SPECIFICATIONS

TRITON - STANDARD DETAILS

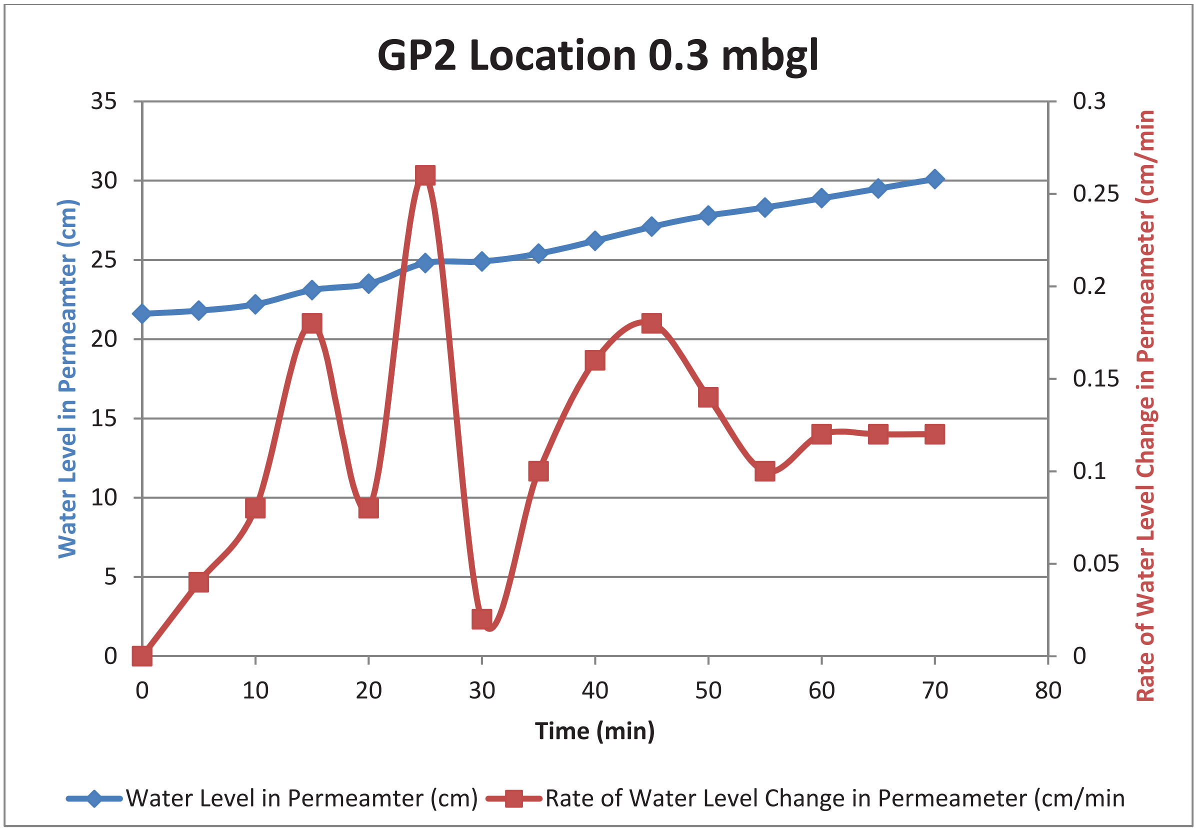
REVISED: 03-02-16 JWM

Appendix G

Percolation Test

Guelph Permeameter Test Analysis

GP2



$$Hydraulic\ Conductivity, Field\ Saturated^{(1)}(K_{FS}) = \ 1.84E - 06\ cm/s$$

$$Approximate\ infiltration\ rate^{(2)} = \left(\frac{K_{FS}}{6 \times 10^{-11}}\right)^{\frac{1}{3.7363}} \quad mm/hr$$

$$= \ 15.879\ mm/hr$$

$$Percolation\ Time\ = \ (infilration\ rate\ )^{-1} \times (60\ min/hr) \times (10\ mm/cm) \quad min/cm$$

$$= \ 37.785\ min/cm$$

Notes: (1) see Next page for calculation of Kfs

(2) Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997.

Supplementary Guidelines to Ontario Building Code 1997.

SG-6 Percolations Times and Soil Descriptions. Toronto, Ontario.

SOILMOISTURE

Guelph Permeameter Calculations

Input (green) | Result (yellow)

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):	2.16
Enter water Head Height ("H" in cm):	15
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.1200

Res Type	2.16
H	15
a	3
H/a	5
a*	0.04
C0.01	1.518
C0.04	1.629
C0.12	1.667
C0.36	1.667
C	1.629
R	0.120
Q	0.004
pi	3.142

$\alpha^*=$	0.04	cm^{-1}
C =	1.629144	
Q =	0.00432	
K_{fs} =	1.84E-06	cm/sec
	1.11E-04	cm/min
	1.84E-08	m/sec
	4.36E-05	inch/min
	7.26E-07	inch/sec
Φ_m =	4.61E-05	cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):	2.16
Enter water Head Height ("H" in cm):	15
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.1200

Res Type	2.16
H	15
a	3
H/a	5
a*	0.04
C0.01	1.51827
C0.04	1.62914
C0.12	1.66689
C0.36	1.66689
C	1.62914
R	0.120
Q	0.00432
pi	3.1415

$\alpha^*=$	0.04	cm^{-1}
C =	1.629144	
Q =	0.00432	
K_{fs} =	1.84E-06	cm/sec
	1.11E-04	cm/min
	1.84E-08	m/ses
	4.36E-05	inch/min
	7.26E-07	inch/sec
Φ_m =	4.61E-05	cm^2/min

A & A ENVIRONMENTAL CONSULTANTS INC.

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	α^*(cm^{-1})	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Appendix H

Culvert Calculations

Uniform Culvert Flow at Given Slope and Depth
Bolton Gas
12544 Highway 50

Existing Culvert

Inputs:

Pipe Diameter, d_o	0.6000	m
Manning Roughness, n	0.0140	
Pressure slope (possibly equal to pipe slope), S_o	0.0150	slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.5000	fraction

Results:

Flow, Q	0.3491	m^3/s
Velocity, v	2.4697	m/s
Velocity head, hv	0.3110	m
Flow Area, A	0.1414	m^2
Wetted Perimeter, P	0.9425	m
Hydraulic Radius	0.1500	m
Top Width, T	0.6000	m
Froude Number, F	1.62	
Shear Stress (tractive force), τ	44.1270	N/m^2

Culvert Flow Capacity
Bolton Gas
12544 Highway 50

Proposed 600m Dia. Culvert

Inputs:

Pipe Diameter, d_o	0.6000	m
Manning Roughness, n	0.0140	
Pressure slope (possibly equal to pipe slope), S_o	0.0100	slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.5000	fraction

Results:

Flow, Q	0.2851	m^3/s
Velocity, v	2.0165	m/s
Velocity head, hv	0.2073	m
Flow Area, A	0.1414	m^2
Wetted Perimeter, P	0.9425	m
Hydraulic Radius	0.1500	m
Top Width, T	0.6000	m
Froude Number, F	1.33	
Shear Stress (tractive force), τ	29.4180	N/m^2

Appendix I

Rip Rap Design

n Architecture Inc

Calculation Sheet H1

RIPRAP DESIGN

Project:	Bolton Gas
Address:	12544 Highway 50
Town/Township/City	Town of Caledon, ON
Project No.	n 1340
Proposed Development Area (m^2)	5709.69
Date:	8/26/2020

Diameter of Outlet Pipe (mm)	300
Length of Appron (m)	6
Width of Appron(m)	2

Median of Riprap Size

$$D_{50} = \frac{00594 V_a^{\ 3}}{d_{avg}^{\ 1/2} K_1^{\ 3/2}}$$

where:

D_{50} =	Median of Riprap Size (mm)	65.5
V_a =	Average velocity in main channel (m/sec)	0.986
K_1 =	Bank Angle Corection term	1
D_{avg} =	Average Depth of channel (m)	0.063
Thickness of the riprap (1.5 x D_{50}) (mm)		98

TRCA Criteria: Minimum diameter of riprap stone should be 300mm.

Therefore D_{100} = 300 mm

Design Thickness (mm) = 300 mm

Gradation of Stone

Size (mm)	Percent Finer
300	100
250	50
150	5-10