STORMWATER MANAGEMENT REPORT

GAS STATION REDEVELOPMENT

6175 ROCKDALE ROAD, VARS

Project Nº 171-14602-00

Prepared for:
Mr. Abdu El-Arab

Date: March 25, 2019

REV.2

–
WSP Canada Inc.
1345 Rosemount Ave.
Cornwall, Ontario K6J 3E5

Phone: 613-933-5602
Fax: 613-936-0335
www.wspgroup.com

TABLE OF CONTENTS

TABLES

APPENDICES

1 INTRODUCTION

1.1 BACKGROUND

WSP Canada Inc. has been retained by Mr. Abdu El-Arab to complete a detailed stormwater management design for a mixed use catchment area, which includes a gas station redevelopment and car sales lot in Vars, Ontario. This Stormwater Management report addresses the stormwater collection system and stormwater management for the proposed 0.912Ha development.

2 GENERAL DESCRIPTION

2.1 GENERAL DESCRIPTION

The proposed development is located on the property known as 6175 Rockdale Road, of the Municipality of Ottawa located within ward 19. The property is located on the East Side of Rockdale road, immediately North of highway 417, approximately 2km south of the Village of Vars.

The General Site Plan, C1.2, shows a key plan which illustrates the subject property and the proposed future development of the surrounding lands.

3 STORMWATER COLLECTION

Stormwater is generally of concern for two main reasons: the quantity of flow generated from an event and the potential contaminants that water is carrying. The City of Ottawa and MOE have determined that quantity control will not be required for this site, however enhanced quality control is mandatory.

3.1 EXISTING AND PROPOSED DRAINAGE PATTERNS

The existing drainage patterns were established based on the topographical survey completed by WSP Canada Inc; the site was observed to be relatively flat, open paved land. As shown in FIG.1 – “Pre-Development Stormwater Catchment Areas”, catchment A-1 currently crowns, draining into the surrounding open ditches which run Southwards along both sides of the property. These open ditches convey the water to the north side of Highway 417, going Eastward. The approximate distance from the most norther tip of the site to the South-East corner approximately 190m comprising a mix of asphalt, average grass and dense grass.

FIG.2 – “Post-Development Stormwater Catchment Areas” illustrates the proposed overall post-development stormwater catchment areas for the site. Area A-2 of the proposed development (including the pump area and vehicle parking areas) will sheet drain a maximum 76m to a surface inlet collection point near the South-East corner of the proposed redevelopment area, to be treated

and released to the ditch on the east side of the development. The roof (area A-1) is proposed to be controlled at the roof level, with a controlled release to a surface outlet along the Northern edge of the site. This outlet is proposed to be directed through approximately 130m of ditch along the east side of the development before meeting up with the released flow from Area A-2. The remaining areas (A-3) around the perimeter of the property will sheet drain, uncontrolled to the nearest ditch. The furthest distance any part of area A-3 will flow is approximately 120m.

FIG.1 and FIG.2 may be found in Appendix B.

3.2 STORMWATER MANAGEMENT DESIGN CRITERIA

The City of Ottawa and MOE require 80% total suspended solids (TSS) removal. Water quantity control has not been made a criteria, however it is proposed for the proposed building roof.

3.3 MODIFIED RATIONAL METHOD

The modified rational method was used to compare the pre-development and post-development runoff for storm events with return periods of 5 years and 100 years. The modified rational method is a valid approximation of the peak flow generated by a storm event, provided it is used for drainage areas smaller than 100 hectares.[1]

3.4 RUNOFF COEFFICIENT

The pre-development runoff coefficients were based on infill conditions as per the City of Ottawa Sewer Design Guidelines (2012), therefore a pre-development runoff coefficient of 0.50 was used for A-1.

The post-development runoff coefficients were calculated based on runoff coefficients of 0.30 for vegetation and 0.90 for asphalt, concrete, and roof areas. A post development weighted runoff coefficient of 0.56 for the entire site was calculated using the above noted runoff coefficients and their respective areas. The post-development runoff coefficient calculations can be found in Appendix C.

3.5 TIME OF CONCENTRATION

The time of concentration (Tc) represents the longest time that will take for a water droplet to run off the watershed to its discharge point, and at which time the peak flow will occur. The time of concentration for the predevelopment condition was taken from Appendix 5-D of the City of Ottawa Sewer Design Guidelines, using low slope asphalt. A Tc of 20 minutes was used.

The time of concentration for the post development conditions were calculated using the Bransby-Williams equation as it was found to generate conservatively shorter times than the city of Ottawa method. As a result, the post developments Tc’s were determined to be 25 minutes, 10 minutes and 20 minutes for areas A-1, A-2 and A-3 respectively. A copy of the Tc calculation sheet has been included in Appendix C.

---

[1] Singh, V. (1992). *Elementary Hydrology*. Prentice-Hall, Upper Saddle River, New Jersey. p. 599

3.6 RAINFALL INTENSITY

The rainfall intensity was derived from the intensity duration frequency (IDF) curves provided in the City of Ottawa Sewer Design Guidelines (2012).

3.7 STORM SEWER DESIGN

The storm sewers were sized based on the peak flow event with a 100 year return period, the above design criteria and a Mannings roughness coefficient of 0.013. The storm sewer design sheets may be found in “Appendix C”.

4 STORMWATER QUANTITY

As previously mentioned, storm water quantity control is being proposed for the proposed building roof area.

Table 4-1 and Table 4-2 below summarize the pre and post-development uncontrolled scenarios for the entire site for storm events with return periods of 5 years and 100 years respectively.

Table 4-1 Pre Development Flows - 5 & 100 Year Period

CATCHMENT AREA	AREA (HA)	C FACTOR	5 YEAR FLOW (L/S)	100 YEAR FLOW (L/S)
A-101	0.91	0.50	89.73	153.21
Total	**0.91**		**89.73**	**153.21**

Table 4-2 Post Development Uncontrolled Flows - 5 & 100 Year Return Period

CATCHMENT AREA	AREA (HA)	C FACTOR	5 YEAR FLOW (L/S)	100 YEAR FLOW (L/S)
A-1	0.03	0.90	13.69	23.58
A-2	0.33	0.86	68.29	116.81
A-3	0.55	0.36	35.93	61.31
Total	**0.91**	**0.56**	**117.92**	**201.70**

As can be seen, the total post-development flows exceed the corresponding pre-development values for both the 5 and 100 year storms, respectively. Given that storm water management is proposed for the building roof area, total post-development flows will be reduced for area A-1, but cannot be reduced to less than pre-development levels as detailed in Table 4-3 below.

Table 4-3 Post Development controlled Flows - 5 & 100 Year Return Period

CATCHMENT AREA	AREA (HA)	C FACTOR	5 YEAR FLOW (L/S)	100 YEAR FLOW (L/S)
A-1	0.03	0.90	0.63	0.63
A-2	0.33	0.86	(see Appendix D)	(see Appendix D)
A-3	0.55	0.36		
Total	**0.91**	**0.56**	**104.86**	**178.75**

Storage will therefore be required for this area in order to attenuate post-development flows to specified levels. This will be achieved using a maximum of 150mm of rooftop ponding.

Drawing C1.3 – Services Plan, illustrates the proposed building area, the roof of which is proposed to be used as a stormwater management facility for both the 5 and 100 year post development storm events. The provided storage calculations were based on a maximum water depth of 150mm.

Table 4-4 and
Table 4-5 below summarize the pre-development and post development controlled scenarios for the roof area for the 5 year and 100 year storm events respectively. Detailed required storage, provided storage and resulting out flow calculations may be found in Appendix "D".

Table 4-4 Controlled Stormwater Runoff for Pre/Post – 5 Year Return Period

	PRE DEVELOPMENT			POST DEVELOPMENT			
CATCHMENT AREA	**Area (Ha)**	**C Factor**	**Allowable Peak Runoff (L/s)**	**C Factor**	**Controlled Peak Runoff (L/s)**	**Required Storage (M^3)**	**Provided Storage (M^3)**
A-2	0.03	0.50	3.28	**0.90**	**0.63**	**7.63**	**15.51**
Total	**0.03**		**3.28**		**0.63**	**7.63**	**15.51**

Table 4-5 Controlled Stormwater Runoff for Pre/Post –100 Year Return Period

	PRE DEVELOPMENT			POST DEVELOPMENT			
CATCHMENT AREA	**Area (Ha)**	**C Factor**	**Allowable Peak Runoff (L/s)**	**C Factor**	**Controlled Peak Runoff (L/s)**	**Required Storage (M^3)**	**Provided Storage (M^3)**
A-2	0.03	0.50	5.59	0.90	0.63	15.20	15.51
Total	**0.03**		**5.59**		**0.63**	**15.20**	**15.51**

As shown above, the provided storage is greater than the required storage values. The post development peak run-off rates are greater than would be typical for a development on this size in the City of Ottawa, however given that quantity control is not a design criteria, this is irrelevant.

5 STORMWATER QUALITY

As previously mentioned, the MOE also requires 80% TSS removal, which will be achieved with a Stormceptor water treatment unit. The manufacturer's model sizing tool was employed in the selection of the STC750 complete with extended oil storage (EOS) capacity. Additional details and calculations may be found in Appendix "D".

The areas at risk of introducing contaminants to the surface runoff include the pump station apron and car sales parking area. These areas are proposed to be graded such that they drain exclusively into the proposed stormceptor. It is recommended that the stormceptor be equipped with the "Smartpro" remote monitoring system. This monitor triggers an alarm when the Sotrmceptor unit has reached 85% of its oil storage capacity, thus ensuring that spills do not go unnoticed.

6 SEDIMENT CONTROL DURING CONSTRUCTION

Straw bale flow check (as per O.P.S.D. 219.180) and light duty silt fence (as per O.P.S.D. 219.110) will be installed and maintained throughout the duration of construction, to be removed only once seeding is completed and grass in the ditches has reached a height of 150 mm.

The straw bale flow checks will be installed in the outlet ditch, while the silt fence will be installed along the perimeter of the development. This will serve to minimize sediment transport and erosion during construction of the proposed subdivision.

The straw bale flow checks and silt fence are to be monitored on a weekly basis and after significant rainfall events throughout construction and repaired or replaced as necessary to maintain functionality.

7 PROCESS AND SCHEDULE

This Stormwater Management Report is prepared in support of the application to MOE. The owner intends on proceeding with the construction of the stormwater collection and management systems as soon as Environment Compliance Approval (ECA) is finalized.

Please do not hesitate to contact the undersigned should you have any questions or comments.

Sincerely,

WSP

chael Jans, P.Eng.
unicipal Engineer

M:\2017\171-14602-00 - Vars Gas Station\3.0 Technical\3.7 Reports\171-14602-00-ServicingRpt-mj.docx

Appendix A

CORRESPONDANCE WITH AUTHORITIES

Jans, Michael

From: McCormick, Sarah <sarah.mccormick@ottawa.ca>
Sent: Wednesday, November 01, 2017 3:10 PM
To: Jans, Michael
Cc: Morgan, Brian
Subject: RE: 6175 Rockdale Road, Vars

Good afternoon Michael,

While a full stormwater management report is not required in this circumstance, a brief will need to be submitted. The stormwater brief will need to address water quality and will need to include an oil/grit separator. Given the location of the property, water quantity does not need to be controlled.

If there are any additional questions regarding the engineering requirement, you can contact Brian Morgan directly. Please copy me on all correspondence so I remain up to date on the discussions.

Thank you,

Sarah McCormick **MCIP, RPP**
Planner / Urbaniste
Development Review, Rural Services / Examen des projets d'aménagement, Service ruraux
Planning, Infrastructure and Economic Development Department
Services de planifications, d'infrastructure et de développement économique

City of Ottawa / Ville d'Ottawa
110 av Laurier Avenue West/ouest - 4th Floor/4e étage
Ottawa, ON, K1P 1J1

PLANNING AND GROWTH MANAGEMENT
URBANISME ET GESTION DE LA CROISSANCE

613.580.2424 ext./poste 24487

From: Jans, Michael [mailto:michael.jans@wsp.com]
Sent: Monday, October 30, 2017 8:20 AM
To: McCormick, Sarah <sarah.mccormick@ottawa.ca>
Cc: Morgan, Brian <Brian.Morgan@ottawa.ca>
Subject: RE: 6175 Rockdale Road, Vars

Hi Sarah,

Ok, thanks for the heads up.

Regards,

Regards,

Michael J. Jans, P.Eng.
T +1 613-933-5602 #296

From: McCormick, Sarah [mailto:sarah.mccormick@ottawa.ca]
Sent: Friday, October 27, 2017 10:25 AM
To: Jans, Michael <michael.jans@wsp.com>
Cc: Morgan, Brian <Brian.Morgan@ottawa.ca>
Subject: 6175 Rockdale Road, Vars

Good morning Michael,

Melanie is now working in another area of the City and I have now been assigned to this file. I have reached out to the engineer on the file to clarify the engineering requirements, and we will get back to you as soon as possible.

Regards,

Sarah McCormick **MCIP, RPP**
Planner / Urbaniste
Development Review, Rural Services / Examen des projets d'aménagement, Service ruraux
Planning, Infrastructure and Economic Development Department
Services de planifications, d'infrastructure et de développement économique

City of Ottawa / Ville d'Ottawa
110 av Laurier Avenue West/ouest - 4th Floor/4e étage
Ottawa, ON, K1P 1J1

613.580.2424 ext./poste 24487

From: webform@ottawa.ca [mailto:webform@ottawa.ca]
Sent: Tuesday, October 24, 2017 3:14 PM
To: Gervais, Melanie <Melanie.Gervais@ottawa.ca>
Cc: Morgan, Brian <Brian.Morgan@ottawa.ca>
Subject: 6175 Rockdale Road, Vars

A visitor to ottawa.ca website has sent you this message through the employee directory online contact form.

Sender's Full Name *
Michael Jans

Sender's E-mail *
michael.jans@wsp.com

Daytime phone number
613-935-0539

CC
Brian Morgan

Message *
Hi Melanie, We've been retained by Mr. El-Arab to complete the site works design for his proposed gas station redevelopment at the above captioned address. I met with Mr. El-Arab and his architect, Ewald, yesterday to hold a kickoff meeting. I learned that at least one preconsultation meeting had taken place and recieved a copy of the Applicant's Study and Plan Identification List. The purpose of this email is to confirm the design criteria conveyed to me during yesterday's meeting. According to the owner and his architect, the City has expressed that stormwater management is not required for this site and that sheet drainage to any or all of the surrounding ditches is permissible. Please confirm. Following your response, further questions may arise. Regards, Michael Jans

Mailval

'

'

-LAEmHhHzdJzBITWfa4Hgs7pbKl

'

This e-mail originates from the City of Ottawa e-mail system. Any distribution, use or copying of this e-mail or the information it contains by other than the intended recipient(s) is unauthorized. Thank you.

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.

'

Jans, Michael

From: Leavoy, Jena (MOECC) <Jena.Leavoy@ontario.ca>
Sent: Monday, October 30, 2017 10:05 AM
To: Jans, Michael
Subject: gas station redevelopment - vars
Attachments: ODO - Pre-Submission Consultation Request Fill-in Form-May 2017 v4r.docx

Hello Michael,

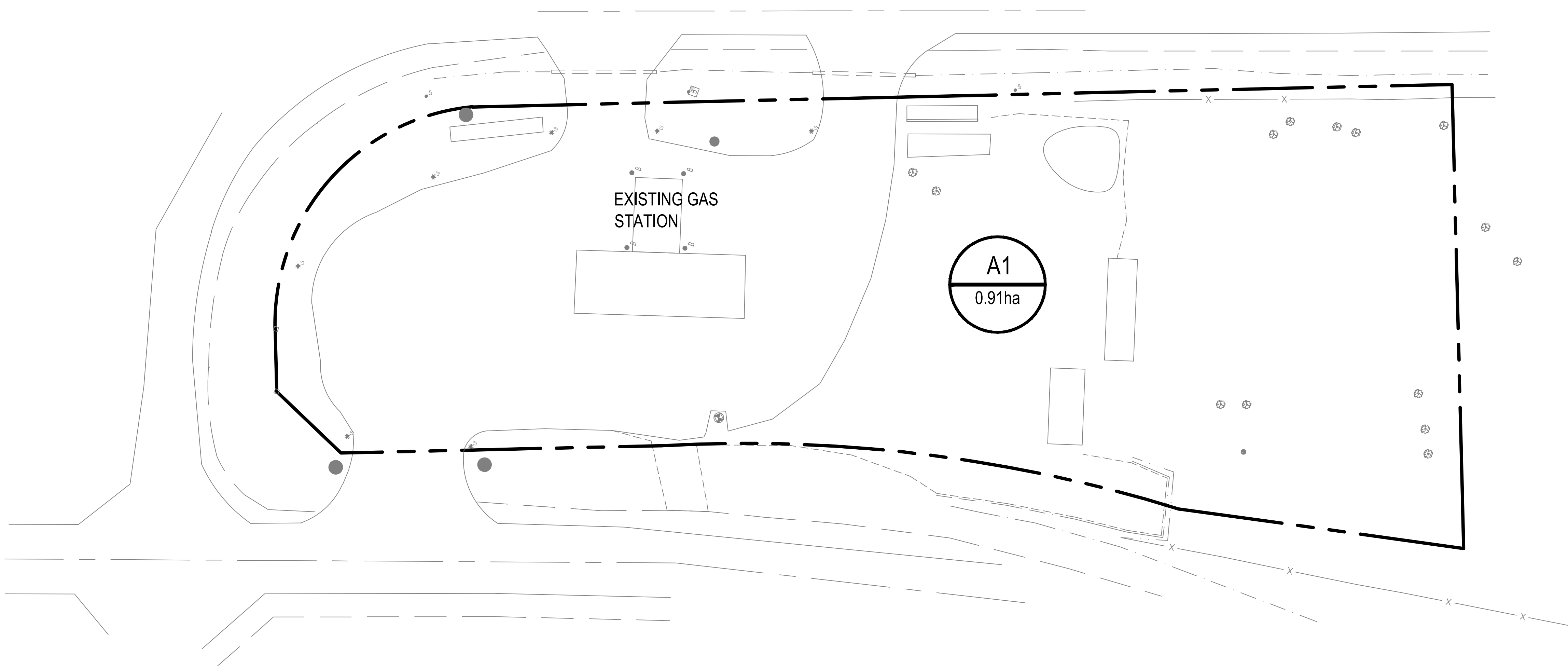
Please fill out the pre-submission application form attached. Once this information been submitted then the Environmental Officer (me) assigned to your file will contact you. As discussed, this gas station redevelopment would require an industrial sewage works ECA for stormwater management.

Thank you,

Jena Leavoy
Senior Environmental Officer
Ontario Ministry of the Environment and Climate Change
Operation Division, Eastern Region
Ottawa District Office
2430 Don Reid Drive
Ottawa, ON K1H 1E1
Phone: (613)521-3450 x236
Fax: (613) 521-5437

Appendix B

STORMWATER CATCHMENT AREAS



wsp
1345 ROSEMOUNT AVENUE
CORNWALL, ONTARIO
CANADA K6J 3E5
PHONE: 613-933-5602 FAX: 613-936-0335
WWW.WSPGROUP.COM

CLIENT: MR. ABDU EL-ARAB

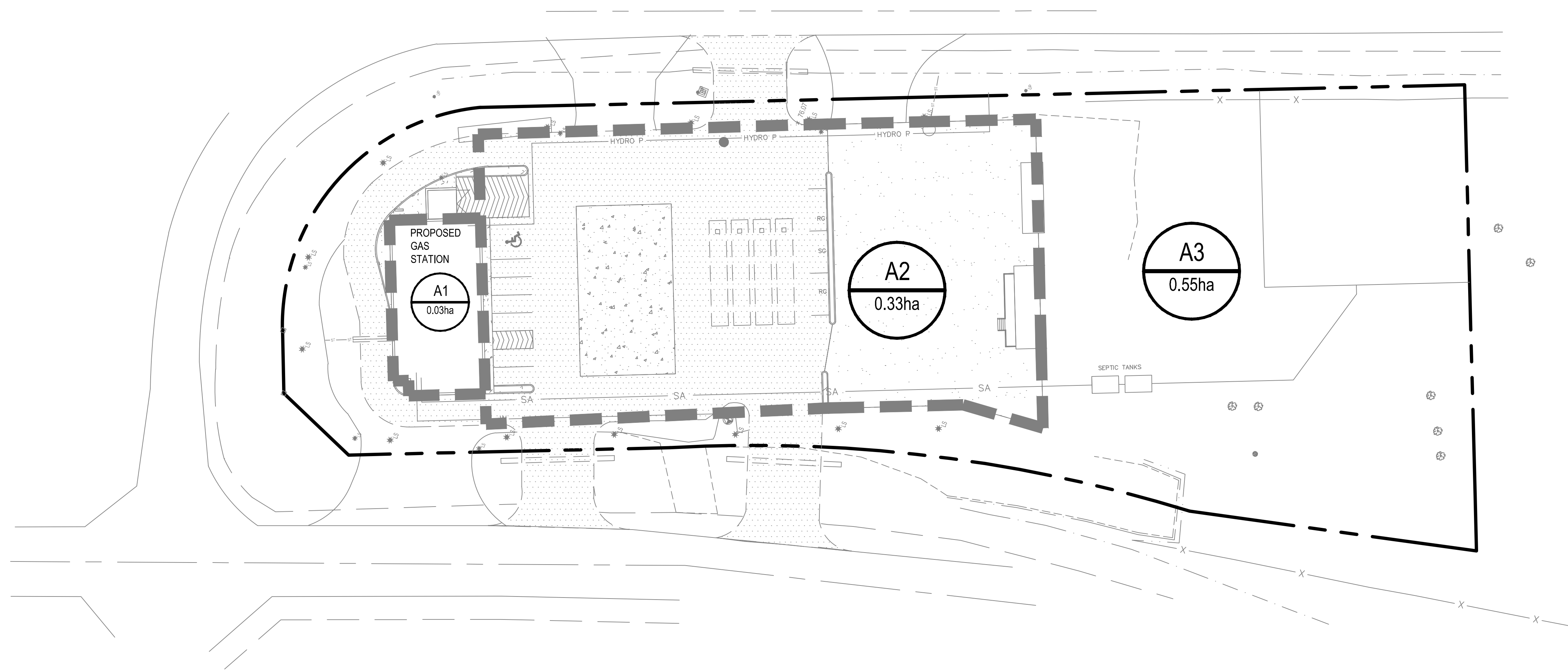
CLIENT REF. #:

PROJECT: GAS STATION REDEVELOPEMENT

PROJECT NO: 171-14602-00	DATE: MARCH 25, 2019
ORIGINAL SCALE: 1:750	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.
DESIGNED BY: MJ	
DRAWN BY: BL	
CHECKED BY: MJ	25mm

TITLE: PREDEVELOPMENT STORM CATCHMENT AREAS

SHEET NUMBER: FIG.1



wsp
1345 ROSEMOUNT AVENUE
CORNWALL, ONTARIO
CANADA K6J 3E5
PHONE: 613-933-5602 FAX: 613-936-0335
WWW.WSPGROUP.COM

CLIENT:

MR. ABDU EL-ARAB

CLIENT REF. #:

PROJECT:

GAS STATION REDEVELOPEMENT

PROJECT NO: 171-14602-00	DATE: 03/25/2019
ORIGINAL SCALE: 1:750	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE. 25mm
DESIGNED BY: MJ	
DRAWN BY: BL	
CHECKED BY: MJ	

TITLE:

POST DEVELOPMENT STORM
CATCHMENT AREAS

SHEET NUMBER:

FIG.2

Appendix C

WEIGHTED RUNOFF COEFFICIENTS
RUN-OFF CALCULATIONS
TIME OF CONCENTRATION CALCULATIONS
STORM SEWER SIZING CALCULATIONS

Vars Gas Station Project # 171-14602-00

Weighted Runoff Coefficient Calculations

Building Roof

Description	C factor	Area (ha)
Asphalt/Concrete/Building	0.90	0.03
Gravel	0.80	0.00
Grass / Woodland	0.30	0.00
Total Area		0.03
Weighted "C" Factor		0.90

Pumps & Parking

Description	C factor	Area (ha)
Asphalt/Concrete/Building	0.90	0.21
Gravel	0.80	0.13
Grass / Woodland	0.30	0.00
Total Area		0.33
Weighted "C" Factor		0.86

Remainder

Description	C factor	Area (ha)
Asphalt/Concrete/Building	0.90	0.05
Gravel	0.80	0.00
Grass / Woodland	0.30	0.49
Total Area		0.55
Weighted "C" Factor		0.36

Site Average

Description	C factor	Area (ha)
Roof	0.90	0.03
Pumps & Parking	0.86	0.33
Remainder	0.36	0.55
Total Area		0.91
Weighted "C" Factor		0.56

Gas Station Redevelopment
RUN-OFF CALCULATIONS

PROJECT No.: 171-14602-00
DESIGNED BY: Mike Jans, P.Eng.
CHECKED BY: Mike Jans, P.Eng.

Allowable Peek Run-off Rates for Entire Site (Pre-Development)

AREA		RUNOFF DATA						
		C	CA	Tc	Intensity (mm/hr)		5yr. Q (L/s)	100yr. Q (L/s)
No	Ha	PRE	PRE	(min.)	5yr.	100yr.	PRE	PRE
A-101	0.91	0.50	0.46	20.00	70.25	119.95	89.73	153.21
Total	0.91	0.50	0.46				89.73	153.21

Post Development Run-off Rates for Entire Site (Uncontrolled)

AREA		RUNOFF DATA						
		C	CA	Tc	Intensity (mm/hr)		5yr. Q (L/s)	100yr. Q (L/s)
No	Ha	POST	POST	(min.)	5yr.	100yr.	POST	POST
A-1	0.03	0.90	0.03	3.2	163.16	280.95	13.69	23.58
A-2	0.33	0.86	0.29	14.5	85.21	145.74	68.29	116.81
A-3	0.55	0.36	0.20	22.3	65.58	111.90	35.93	61.31
Total / Average	0.91	0.56	0.51				117.92	201.70

Time of Concentration Calculation

Project Name: Gas Station, Vars, Ontario
Project #: 171-14602-00

The Kirpich formula was used:

$$t_c = \frac{58L}{A^{0.1}{S_c}^{0.2}}$$

Where:
t_c is the time of concentration in minutes
S_c is the equal area slope of the main stream projected to the catchment divide (m/km)
L is the main stream length measured to the catchment divide (km)
A is the area of the catchment (km2)

Post Development t_c's

Area	L (km)	A (sq km)	S_c (m/km)	t_c (minutes)
A-1	0.014	0.003	0.02	3.2
A-2	0.076	0.033	0.014	14.5
A-3	0.12	0.055	0.0125	14.9

Storm Sewer Calculation Sheet - 5 Year Storm

STREET	MANHOLE		AREA		CONTRIBUTING AREAS	RUNOFF DATA						PIPE DATA								
	From	To	No	Ha		C	AC	Σ AC	Tc (min.)	I (mm/hr)	Q (L/s)	Size (mm)	Slope (%)	Capacity (L/s)	Q/Q_{full}	Velocity (m/s)	Length (m)	FALL (m)	U/S	D/S
	STC	Ditch	1	0.332	Pumps & Parking	0.86	0.286	0.286	15.0	83.6	66.97	300	1.75%	127.9	0.5	1.81	7.00	0.123	74.60	74.46

DESIGN PARAMETER

Mannings n 0.013

Existing

Designed By:
Michael Jans P.Eng.

Checked By:
Michael Jans P.Eng.

Dwg. Reference:

PROJECT:
Gas Station Redevelopment

LOCATION:
6175 Rockdale Road, Vars, Ontario

Project Number: 171-14602-00

Date: 17-Nov-17

Sheet Number: 1/1

Storm Sewer Calculation Sheet - 100 Year Storm

STREET	MANHOLE		AREA		CONTRIBUTING AREAS	RUNOFF DATA						PIPE DATA								
	From	To	No	Ha		C	AC	Σ AC	Tc (min.)	I (mm/hr)	Q (L/s)	Size (mm)	Slope (%)	Capacity (L/s)	Q/Q_{full}	Velocity (m/s)	Length (m)	FALL (m)	U/S	D/S
	STC	Ditch	1	0.332	Pumps & Parking	0.86	0.286	0.286	15	142.9	114.53	300	1.75%	127.9	0.9	1.81	7.00	0.123	74.60	74.46

DESIGN PARAMETER

Mannings n 0.013

Existing

Designed By: Michael Jans P.Eng.

Checked By: Michael Jans P.Eng.

Dwg. Reference:

PROJECT: Gas Station Redevelopment

LOCATION: 6175 Rockdale Road, Vars, Ontario

Project Number: 171-14602-00

Date: 17-Nov-17

Sheet Number: 1/1

Appendix D

REQUIRED STORAGE CALCULATIONS – 5 & 100 YEAR
PERCENT IMPERVIOUSNESS CALCULATIONS
STORMCEPTOR DESIGN SUMMARY REPORT

VARS GAS STATION
REQUIRED STORMWATER STORAGE CALCULATION

PROJECT No.: 171-14602-00
DESIGNED BY: Mike Jans, P.Eng.
CHECKED BY: Mike Jans, P.Eng.

RATIONAL METHOD STORAGE COMPUTATION

Vars, ONTARIO

Time Step	**10**	**minute**
STORAGE RATE METHOD		
Catchment Area = Building Roof	**0.033**	**ha**
C=	**0.90**	
Total Allowable Release 5yr	**N/A**	**l/s**
Design Release Rate	**0.63**	

5 YEAR

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	104.19	8.68	0.63	8.05	4.83
20	70.25	5.85	0.63	5.22	6.27
30	53.93	4.49	0.63	3.86	6.95
40	44.18	3.68	0.63	3.05	7.32
50	37.65	3.14	0.63	2.51	7.52
60	32.94	2.74	0.63	2.11	7.61
70	29.37	2.45	0.63	1.82	7.63
80	26.56	2.21	0.63	1.58	7.60
90	24.29	2.02	0.63	1.39	7.53
100	22.41	1.87	0.63	1.24	7.42
110	20.82	1.73	0.63	1.10	7.29
120	19.47	1.62	0.63	0.99	7.14
130	18.29	1.52	0.63	0.89	6.98
140	17.27	1.44	0.63	0.81	6.79
150	16.36	1.36	0.63	0.73	6.60

VARS GAS STATION
REQUIRED STORMWATER STORAGE CALCULATION

PROJECT No.: 171-14602-00
DESIGNED BY: Mike Jans, P.Eng.
CHECKED BY: Mike Jans, P.Eng.

RATIONAL METHOD STORAGE COMPUTATION
Vars, ONTARIO

Time Step:	**10**	**minute**
STORAGE RATE METHOD		
Catchment Area = Building Roof	**0.033**	**ha**
C=	**0.90**	
Total Allowable Release 100yr	**N/A**	**l/s**
Design Release Rate	**0.63**	

100 YEAR

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	178.56	14.88	0.63	14.25	8.55
20	119.95	9.99	0.63	9.36	11.24
30	91.87	7.65	0.63	7.02	12.64
40	75.15	6.26	0.63	5.63	13.51
50	63.95	5.33	0.63	4.70	14.10
60	55.89	4.66	0.63	4.03	14.50
70	49.79	4.15	0.63	3.52	14.78
80	44.99	3.75	0.63	3.12	14.97
90	41.11	3.43	0.63	2.80	15.09
100	37.90	3.16	0.63	2.53	15.17
110	35.20	2.93	0.63	2.30	15.20
120	32.89	2.74	0.63	2.11	15.20
130	30.90	2.57	0.63	1.94	15.17
140	29.15	2.43	0.63	1.80	15.11
150	27.61	2.30	0.63	1.67	15.03
160	26.24	2.19	0.63	1.56	14.94
170	25.01	2.08	0.63	1.45	14.83
180	23.90	1.99	0.63	1.36	14.70
190	22.90	1.91	0.63	1.28	14.57

Gas Station Redevelopment
PERCENT IMPERVIOUSNESS CALCULATIONS

PROJECT No.: 171-14602-00
DESIGNED BY: Mike Jans, P.Eng.
CHECKED BY: Mike Jans, P.Eng.

Design C Factor vs. % Imperviousness

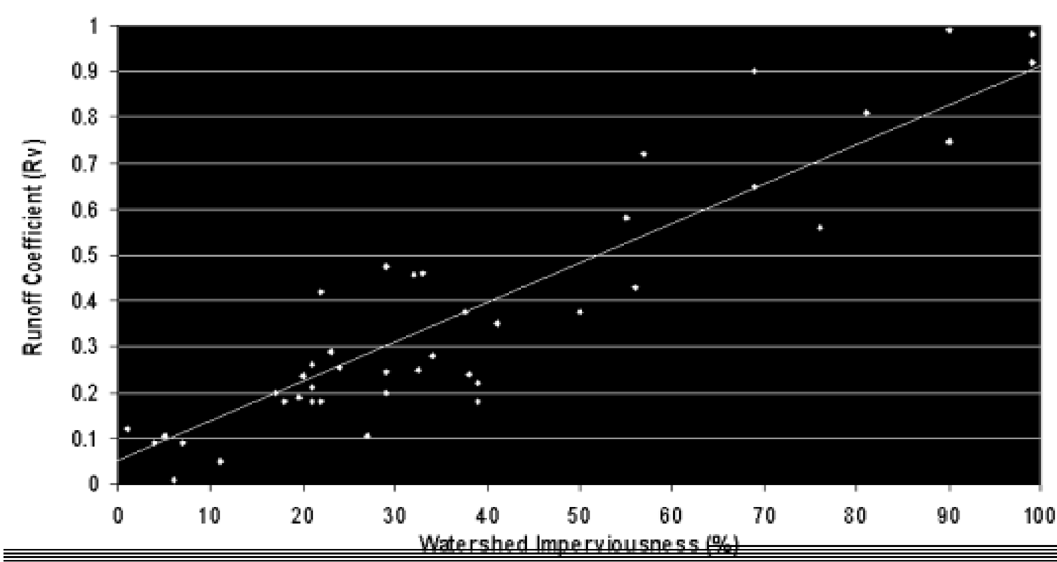
Impervious %	C Factor
18%	0.20
100%	0.90

y=mx+b
m = 117.1429
b = -5.4286

For SWM Facility Sizing

Description	Post-Development Area (ha)	C factor	% Imperv.
Asphalt	0.21	0.90	100.0
Gravel	0.13	0.80	88.3
Grass	0.00	0.30	29.7
Total	**0.33**		
Weighted Average		**0.86**	**95.6**

Relationship Between Watershed Imperviousness (I) and the Storm Runoff Coefficient (Rv)
(Source: Schueler, 1987)



Detailed Stormceptor Sizing Report – Vars Gas Station

Project Information & Location			
Project Name	Vars Gas Station	**Project Number**	171-14602-00
City		**State/ Province**	Ontario
Country	Canada	**Date**	11/29/2017
Designer Information		**EOR Information (optional)**	
Name	Daniel Searle	**Name**	
Company	WSP Group Canada	**Company**	
Phone #	613-933-5602	**Phone #**	
Email	michael.jans@wsp.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	
Recommended Stormceptor Model	EOS 750
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	84
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary

EOS Model	% TSS Removal Provided	Oil Spill Capture Volume Provided (L)
EOS 300	77	662
EOS 750	84	1,380
EOS 1000	85	2,235
EOS 2000	86	5,515
EOS 3000	89	6,710
EOS 4000	91	7,585
EOS 5000	92	9,515
EOS 6000	93	12,940
EOS 9000	95	19,010
EOS 10000	95	22,865
EOS 14000	96	29,715
StormceptorMAX	Custom	Custom

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	4819
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	3449.3
Elevation (ft)	370	**Total Infiltration (mm)**	0.0
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	17528.8

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	0.33
Imperviousness %	100.0

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (L)	40
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	

Site Details

Drainage Area	
Total Area (ha)	0.33
Imperviousness %	100.0
Oil Spill Capture Volume (L)	40

Surface Characteristics	
Width (m)	115.00
Slope %	2
Impervious Depression Storage (mm)	1.57
Pervious Depression Storage (mm)	4.67
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	76.2
Min. Infiltration Rate (mm/hr)	13.2
Decay Rate (1/sec)	0.00115
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

Winter Months	
Winter Infiltration	0

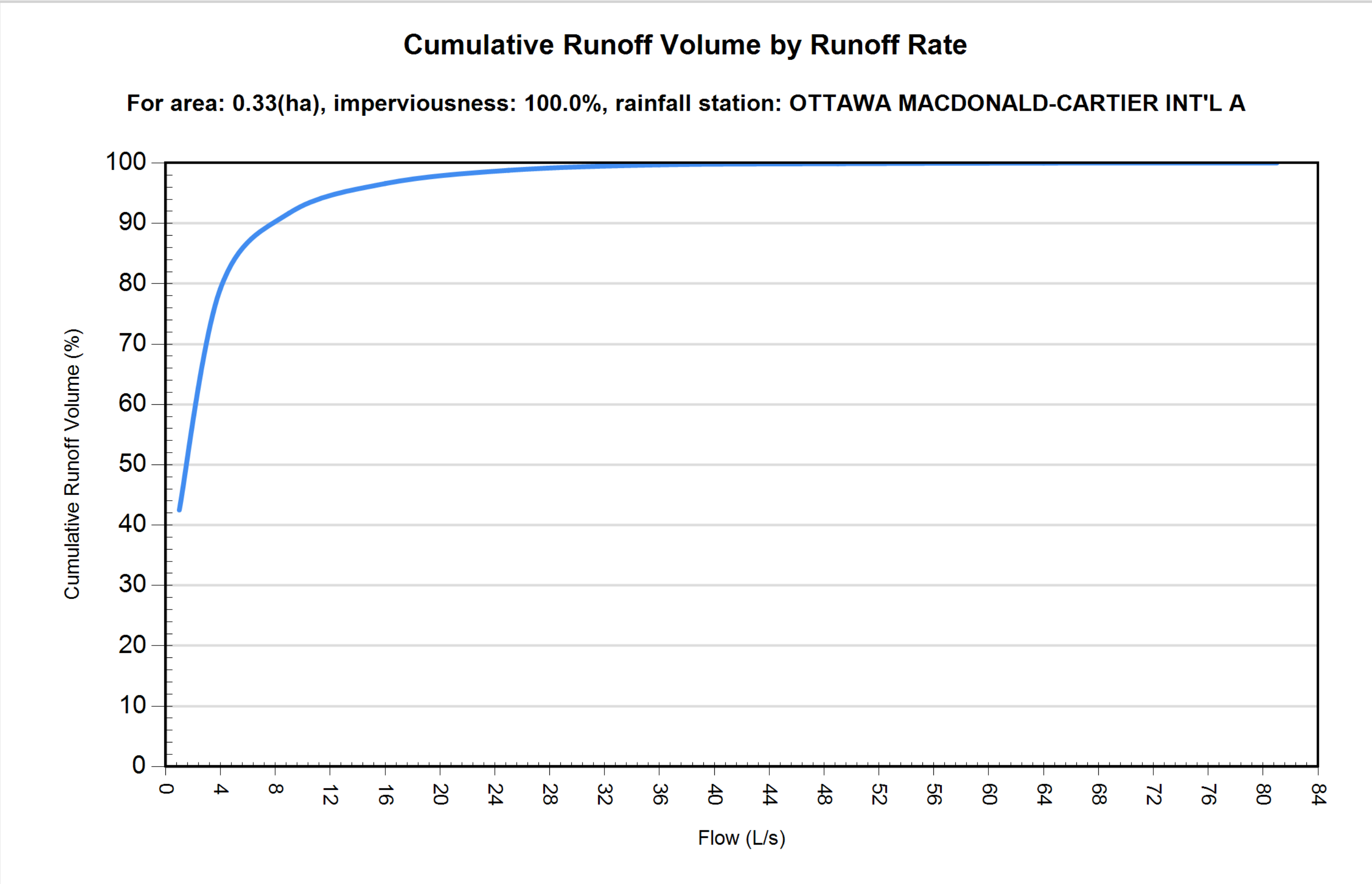
TSS Loading Parameters	
TSS Loading Function	

Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

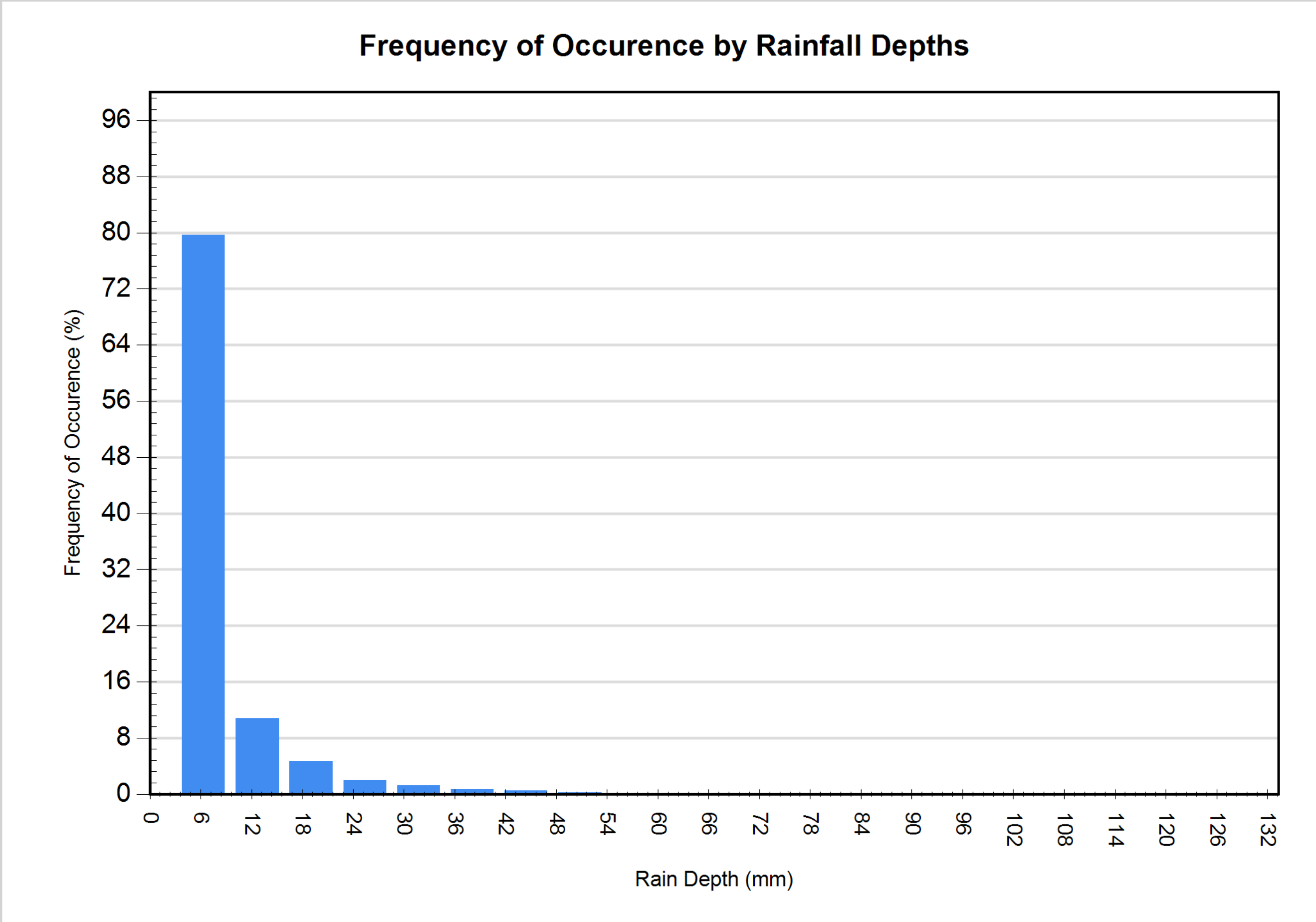
TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate

Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	Cumulative Runoff Volume (%)
1	24772	33478	42.5
4	46155	12094	79.2
9	53390	4857	91.7
16	56286	1960	96.6
25	57528	718	98.8
36	58078	168	99.7
49	58210	36	99.9
64	58242	3	100.0
81	58246	0	100.0



Rainfall Event Analysis				
Rainfall Depth (mm)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (mm)**	**Percentage of Annual Volume (%)**
6.35	3843	79.7	5885	28.1
12.70	520	10.8	4643	22.1
19.05	225	4.7	3470	16.5
25.40	98	2.0	2144	10.2
31.75	58	1.2	1639	7.8
38.10	32	0.7	1118	5.3
44.45	24	0.5	996	4.7
50.80	9	0.2	416	2.0
57.15	5	0.1	272	1.3
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications