SERVICING & STORMWATER MANAGEMENT REPORT

100/108/114 EMMA STREET

TOWN OF GRAND VALLEY
DUFFERIN COUNTY

PREPARED FOR:

GOLDEN CANADIAN HOMES INC.

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
2800 HIGH POINT DRIVE, SUITE 100
MILTON, ON L9T 6P4

SEPTEMBER 2019

CFCA FILE NO. 1476-4787

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CROZIER
CONSULTING ENGINEERS

Revision Number	Date	Comments
Rev.0	January 14, 2019	Issued for First Submission
Rev.1	September 27, 2019	Issued for Second Submission

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1.0 Introduction

C.F. Crozier & Associates Inc. (Crozier) was retained by Golden Canadian Homes Inc. to prepare a Servicing & Stormwater Management Report to support the site plan approvals to permit the development at 100/108/114 Emma Street in the Town of Grand Valley in Dufferin County.

Crozier has previously submitted a servicing and stormwater management design for the subject property. This report has been updated to address Development Engineering comments from the following:

- R.J. Burnside (Town of Grand Valley), dated March 13, 2019
- Dufferin-Peel Catholic District School Board, dated March 19, 2019
- Upper Grand District School Board, dated February 28, 2019
- Dufferin County, dated February 22, 2019
- WSP (Dufferin County), dated March 6, 2019
- Enbridge, dated February 25, 2019
- Grand Valley & District Fire Department, dated March 20, 2019
- Grand River Conservation Authority (GRCA), dated March 27, 2019
- Orangeville Hydro, dated March 11, 2019

The purpose of this report is to demonstrate that the proposed Site can be developed in accordance with the Town of Grand Valley, Dufferin County, and Grand River Conservation Authority (GRCA) guidelines from a servicing & stormwater management perspective.

The following reports and design standards were referenced during the preparation of this report:

- Grand River Conservation Authority: Policies for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulations, effective October 23, 2015
- Grand Valley Master Servicing Plan (MSP) Update, RJ Burnside, May 30, 2014
- Grand Valley Water and Wastewater Master Plan 2019 Class Environmental Assessment, RJ Burnside, March 2019
- Geotechnical Investigation & Report 100, 108 and 114 Emma Street, Central Earth Engineering, January 26, 2018
- Engineering Standards, Town of Grand Valley, November 2013, Consolidated May 2016
- Design Requirements for Drinking-Water Systems, MECP, 2008
- Technical Guide: River & Stream Systems: Flooding Hazard Limit, Ministry of Natural Resources and Forestry, 2002
- Technical Memo: Floodplain Analysis: 100/108/114 Emma Street, Crozier Consulting Engineers, June 8, 2018

2.0 Site Description

The subject property is approximately 0.3 ha and is currently undeveloped vegetated land in the Town of Grand Valley. The property is located in a mixed residential area, bounded by Emma Street to the east, William Street Right of Way (ROW) to the north, residential properties to the west, and a carwash facility to the south.

The project will consist of:

- Three (3) storey residential and commercial building (GFA = 1,827 m^2). The 1st floor consists of commercial space (240 m^2) and common area (295 m^2), and the 2nd and 3rd storey consist of 18 residential units (1,292 m^2)
- Above ground parking lot with 35 stalls

The Grand River is situated approximately 75 m to the east of the Site and the eastern third of the Site is contained within the Regulatory Floodplain of the Grand River. The GRCA regulates this reach of the Grand River as a Two-Zone floodplain and the Site is partially contained within the flood fringe of the floodplain. Crozier completed a Floodplain Analysis for the Site dated June 8, 2018 (**Appendix E**).

3.0 Water Servicing

3.1 Existing Water Servicing

A review of the Town of Grand Valley as-constructed drawing M-796-10/P6 dated October 1993 Issued July 1996 indicates that:

- An existing 150 mm watermain is located along Emma Street, east of the proposed development
- An existing fire hydrant is located at the west side of Emma Street, directly north of the proposed development

3.2 Design Water Demand

The Town of Grand Valley Watermain Design Criteria were referenced to calculate water demands for the proposed development. An average daily water demand of 339 L/capita/day was used with an occupancy density of 2.7 persons/unit for the 18 units in the proposed development. **Table 1** summarizes the water demands. **Appendix A** contains detailed water demand calculations.

Table 1: Estimated Design Water Demand

Standard	Average Daily Demand (L/s)	Maximum Daily Demand (L/s)	Peak Hourly Demand (L/s)
Town of Grand Valley	0.19	0.48	0.72

Using the Town of Grand Valley Design Criteria for domestic water demand, the estimated daily demand and peak flows for the additional units will be 0.19 L/s and 0.48 L/s, respectively.

3.3 Fire Flow Demand

The Fire Underwriters Survey method was used to estimate the fire flow requirements for the proposed development. This calculation estimates the preliminary watermain size required to service the development and is based on basic building construction, automatic sprinklers, and a gross floor area (GFA) of 1,827 m^2 per (Site Plan, September 23, 2019). **Table 2** summarizes the required fire flow and duration to meet fire protection for the proposed development.

Table 2: Estimated Fire Demand Flows

Method	Demand Flow (L/s)	Duration (h)
Fire Underwriters Survey	83	1.75

The proposed fire service is required to accommodate a fire flow of 83 L/s for a duration of 1.75 hours. **Appendix A** contains the Fire Underwriters Survey calculations. The building architect and the mechanical engineer will confirm the estimated fire flow demand.

Please note that the Fire Underwriters Survey value is a conservative estimate for comparison purposes only. The mechanical engineer for this development will complete the required analyses for fire protection and the architect will design fire separation methods per the determined fire flow rate, in order to meet municipally available flows and pressures.

3.4 Proposed Water Servicing

The development is proposed to be serviced by a 50 mm diameter PVC water service and a 150 mm fire line. The proposed 50 mm diameter water service and 150 mm fire line will connect to the existing 150 mm diameter watermain on Emma Street.

The proposed Site Servicing Plan shown on Drawing C103 illustrates the location of the existing watermain connection point on Emma Street, the internal water servicing pipe, and existing hydrant.

Based on the water demand calculations for the proposed development, we conclude that the existing municipal infrastructure has sufficient capacity to support the proposed development without any required external improvements.

4.0 Sanitary Servicing

4.1 Existing Sanitary Servicing

A Waste Water Treatment pumping station is located approximately 150 m west (downstream) of the proposed development. The Master Servicing Plan indicates that the sanitary sewer along Emma Street is proposed to be replaced with a larger sewer.

A review of the Town of Grand Valley as-constructed drawings 111047-PP1 and 111047-PP2 (Gamsby and Mannerow Engineers, July 28, 2014) and M-796-10/P6 dated October 1993 Issued July 1996, in addition to the Master Servicing Plan, indicate that:

- A 250 mm PVC sanitary sewer runs from west to east along the William Street ROW
- Existing SAN MH 2, located at the intersection of Emma Street and William Street, receives sanitary flow from the sewers west, north and east. Sanitary flow is directed south along Emma Street

- EX SAN MH 3 is located 13 m south of EX SAN MH 2, the diameter of the sewer between EX SAN MH 2 and EX SAN MH 3 is 450 mm. The outgoing sanitary sewer from EX SAN MH 3 has a decreased diameter (375 mm) than the input sewer (450 mm).
- The Master Servicing Plan indicates that the 375 mm sewer cannot convey the sanitary flows of projected future conditions and is to be replaced with a sanitary sewer of increased capacity

4.2 Design Sanitary Flow

The Town of Grand Valley Design Criteria were referenced to calculate sanitary design flows for the proposed development. A unit sewage flow of 450 L/capita/day was used with an occupancy density of 2.7 persons/unit for the 18 units in the proposed development. Infiltration flow and a peaking factor were applied to the unit sewage flow to obtain the total estimated design sewage flow. A summary of the results is presented in **Table 3** and detailed calculations are provided in **Appendix B**.

Table 3: Estimated Sanitary Design Flows

Standard	Average Flow (L/s)	Peaking Factor	Peak Flow (L/s)	Infiltration Flow (L/s)	Total Flow (L/s)	Standard
Town of Grand Valley	0.25	4.0	1.01	0.06	1.07	Town of Grand Valley Engineering Standards, 2016

The proposed sanitary sewer was sized to convey a peak sanitary flow of 1.07 L/s for the development, as determined by the Town of Grand Valley Design Criteria.

4.3 Proposed Sanitary Servicing

The Town of Grand Valley has approved sanitary allocation to the proposed development. The development is proposed to be serviced by a 150 mm diameter service with a slope of 5 % to a property line sanitary maintenance hole (MH S1). The proposed sanitary service will be designed per the Town standards.

The Preliminary Site Servicing Plan (**Drawing C103**) illustrates the location of the sanitary sewer and all connections. The internal sanitary system of the building will be designed by a mechanical engineer.

Based on the sanitary demand calculations for the proposed development, we conclude that the existing municipal infrastructure has capacity to support the proposed development without any required external improvements.

5.0 Drainage Conditions

The Site is located within GRCA regulated area; therefore, we will adhere to GRCA guidelines.

5.1 Existing Drainage

The subject property currently consists of vegetated cover with no existing development.

The Grand River is situated approximately 75 m to the east of the Site and the eastern third of the Site is contained within the Regulatory Floodplain of the Grand River. The GRCA regulates this reach of the Grand River as a Two-Zone floodplain and the Site is contained within the flood fringe of the floodplain. Please see the Floodplain Analysis (Crozier, 2017) located in **Appendix E** for more details.

The topographic survey provided by Cullen & Associates (November 2017) indicates that the property has west to east vertical drop of between 5.8 m and 8.8 m, and a north to south vertical drop of approximately 1 m. To be conservative, it has been assumed that the residential area west of the development, fronting Leeson Street, will sheet drain east into the Site (EXT).

The Site drains west to east via sheet flow to the roadside ditch along Emma Street. Figure 1 shows the pre-development drainage of the Site. An existing 500 mm culvert is located under a gravel entrance to the Site allowing conveyance flow of the Emma Street roadside ditch. The Emma Street road side ditch drains south where runoff outlets into the Grand River approximately 250 m south of the Site.

A review of Town of Grand Valley as-constructed drawing 111047-PP1 and 111047-PP2 (Gamsby and Mannerow Engineers, July 28, 2014) indicates that:

- An existing 1500 mm storm sewer within the William Street ROW runs from west to east, transitioning to a 1220 mm x 1920 mm storm sewer before crossing Emma Street at EX STM MH2
- The 1500 mm storm sewer conveys flow from a stormwater management facility located approximately 130 m west of the Site as well as collects surface drainage within the William Street ROW
- Runoff from the William Street ROW is collected by three Drop Inlet Catchbasins (DICB#1, DICB#2, and DICB#3)
- Two existing storm sewer maintenance holes are located within the William Street ROW directly north of the Site (EX STM MH1, EX STM MH2)
- The 1220 mmx1920 mm stewer outlets directly into the Grand River approximately 100m east of the Site

5.2 Proposed Drainage

As previously noted, the proposed development consists of a retirement condominium and above ground parking lot. The proposed grading and stormwater management system for the Site has been designed to meet the drainage criteria established with the Town of Grand Valley set out in the pre-consultation minutes dated November 7, 2018 and through email correspondence with the GRCA (**Appendix D**).

The Site has been graded so that the buildings FFE is above the regional flood level (455.33 m), as discussed in the Floodplain Analysis (June 8, 2018) located in **Appendix E**.

The proposed development will consist of two outlets from the Site.

Table 4: Post-Development Drainage Catchments

Catchment	Impervious Area (m^2)	Pervious Area (m^2)	Total Area (m^2)	Runoff Coefficient
200	0	900	900	0.25
201	700	0	700	0.95
202	300	0	300	0.95
203	400	0	400	0.95
204	0	100	100	0.25
205	500	0	500	0.95
206	0	100	100	0.25
Site Total	**1,900**	**1,100**	**3,000**	**0.69**
EXT	800	2,400	3,200	0.43
Site Total + EXT	**2,700**	**3,500**	**6,200**	**0.56**

The Site's "dirty" runoff (Catchment's 201 and 205) from the developed area of the Site will be collected by catchbasins (CBMH A3 and CBMH A4) located in the above ground parking lot and will be conveyed through an internal storm sewer system to the existing 1220 mm x 1920 mm storm sewer in the William Street ROW. The storm sewers and catchbasins are designed to capture and convey runoff events up to and including the 100-year design storm.

"Clean" runoff from the landscaped area north of the building (Catchment 204) and runoff from the northern section of the roof (Catchment 203) will be conveyed via an internal storm sewer and connect the internal storm system that connects to the 1220 mm x 1920 mm storm sewer located in the William Street ROW.

"Clean" runoff from the landscaped area (Catchment 200) and external drainage (EXT) located west of the building will be collected by a drainage swale running north to south. The drainage swale will outlet into a catchbasin at the southern edge of the property (CBM A1). The clean runoff, including runoff from the southern section of the roof (Catchment 202), will be conveyed via an internal storm sewer and outlet into the Emma Street roadside ditch, via the culvert at the southern entrance. The post-development drainage pattern matches the pre-development drainage for the west side of the Site, as under pre-development conditions, the entire Site drained into the Emma Street roadside ditch.

A small landscaped strip (0.01 ha) of the Site (Catchment 206) east of the parking lot will drain via overland flow directly into the Emma Street Roadside ditch, upstream of the proposed culvert at the Site's proposed southern entrance.

The northern Site entrance in the William Street ROW is graded so that runoff from the area is collected in the existing DICB#2. A small section of the south of the driveway, will now be conveyed to the Emma Street roadside ditch. EX DICB#3 which previously collected drainage for this area will be removed.

A 450 mm culvert has been proposed below the southern Site entrance to allow conveyance of the Emma Street roadside ditch. The culvert maintains the open drainage system and has been sized to convey the 1:50 year storm.

Major overland flow routes have been provided based on the grading of the Site. In emergency situations flow will be directed south in the parking lot and exit the Site through the southern Site entrance onto Emma Street and into the Emma Street road side ditch.

The Preliminary Site Servicing and Site Grading Plans (**Drawing C102** and **C103**) illustrate the proposed drainage of the Site, the location and design of the storm sewer and all connections. Please refer to **Figure 1** and **2** which highlights the pre- and post-development pervious and impervious areas for the Site. **Table 5** provides a comparison of land area between pre- and post-development conditions.

Table 5: Land Area Comparison

Conditions	Impervious Area (m^2)	Pervious Area (m^2)	Total Area (m^2)	Runoff Coefficient
Pre-Development	0	3,000	3,000	0.25
Post-Development	1,900	1,100	3,000	0.68

6.0 Stormwater Management

Stormwater management design criteria were established with the Town of Grand Valley through the pre-consultation meeting minutes dated November 7, 2018 and a review of GRCA regulations. The stormwater management criteria include:

Quantity Control

Runoff will not cause and/or increase flooding on any neighbouring properties between the development and final outlet to the Grand River

Demonstrate existing Emma Street roadside ditch has the capacity to receive the increased post-development flows

Quality Control

An enhanced level of water quality control is required (80% Total Suspended Solids removal)

6.1 Stormwater Quantity Control

The Town of Grand Valley's quantity control requirement is to maintain conveyance. Conveyance of runoff from the Site will be maintained through the internal storm sewer system (sized to contain the 100-year storm event) and the emergency overland flow routes.

The Emma Street roadside ditch was determined to have sufficient capacity to convey post-development flows entering the ditch. The area draining to the Emma Street roadside ditch decreased from pre to post-development conditions decreased, however the runoff coefficient of the Site increased as shown in **Table 6**.

Table 6: Pre- and Post Development Land Area Draining to Emma Street Roadside Ditch

Conditions	Impervious Area (m^2)	Pervious Area (m^2)	Total Area (m^2)	Runoff Coefficient
Pre-Development	800	5,400	6,200	0.34
Post-Development	1,200	3,300	4,500	0.43

Note: Catchment Includes external drainage area (EXT) for pre- and post-development conditions

The Rational Method was used to determine the pre- and post-development peak flow of runoff entering the Emma Street roadside ditch. Under post-development conditions there is decreased peak flow entering the Emma Street roadside ditch as shown in **Table 7**.

Table 7: Pre- and Post-Development Peak Flow to Emma Street Roadside Ditch

Return Period	Q_{pre} (L/s)	Q_{post} (L/s)
2 Yr	49	43
5 Yr	64	57
10 Yr	74	66
25 Yr	87	78
50 Yr	97	86
100 Yr	106	94

Note: Includes external drainage area (EXT) for pre- and post-development conditions

The conveyance of the Emma Street roadside ditch was determined in FlowMaster using a cross section of the ditch and the peak flows generated by the rational method for pre-and post-development conditions. It was determined that for the extent of the surveyed area that the ditch has the capacity to convey the increased runoff associated with post-development conditions. Peak flow calculations and channel conveyance calculations can be found in **Appendix C**.

6.2 Stormwater Quality Control

A Jellyfish Filter is proposed to provide water quality control since infiltration at the Site is not possible due to the high ground water level and the proximity to a Source Water Protection Zone. In discussion with GRCA (**Appendix D**), it was established that an Environmental Technology Verification (ETV) certified OGS unit could be used if water quality requirements could not be achieved through other means.

The Jellyfish Filter model JF4-1-1 is proposed to meet water quality objectives and will treat a flow of 7.6 L/s which meets or exceeds 90% of the annual rainfall runoff events based on 33 years of Waterloo, Wellington A rainfall data. See **Appendix C** for the Jellyfish Filter Sizing Report. The Jellyfish filter will provide 89% Total Suspended Solids (TSS) removal from the developed area of the Site, exceeding water quality requirements.

The Jellyfish Filter is designed in an offline configuration and will provide water quality treatment for the water from the parking area (Catchments 201 and 205). The Jellyfish Filter will be installed at the north side of the parking lot, upstream of the storm sewer connection to the William Street ROW sewer.

We acknowledge that runoff generated from the landscaped area (Catchment 200, 204, and 206) and the roof (Catchment 202 and 203)) will not be treated for water quality; however, this runoff is considered "clean" runoff.

7.0 Operation and Maintenance of Stormwater Facilities

It is understood that the Developer will be responsible for the operation and maintenance of the treatment system post-construction and for a two-year warranty period. Following the end of the Developer's warranty, the condominium corporation will assume ownership of and responsibility for the operation and maintenance of the oil/grit separator Jellyfish Filter JF4-1-1 unit.

Post-construction maintenance of the Jellyfish unit is performed using vacuum truck cleaning service providers with experience in the maintenance of sewers and catchbasins at regular intervals. Routine inspections are recommended during the first year of operation to accurately access the sediment accumulation. Inspections should also be performed immediately after oil, fuel, or other chemical spills. Access to the Jellyfish unit is provided through removal of the manhole access cover. An Operation and Maintenance manual is located in the Jellyfish Owner's Manual, provided in Appendix C.

8.0 Erosion and Sediment Controls During Construction

Erosion and sediment controls will be installed prior to the beginning of any construction activities. They will be maintained until the Site is stabilized or as directed by the Site Engineer and/or Town of Grand Valley. The Preliminary Erosion & Sediment Control Plan (**Drawing C101**) identifies the location of the recommended controls. Controls will be inspected after each significant rainfall event and maintained in proper working condition.

The following erosion and sediment controls will be included during construction on the Site:

Heavy Duty Silt Fencing

Silt fencing will be installed on the perimeter of the Site to intercept sheet flow. Additional silt fence may be added based on field decisions by the Site Engineer and Owner, prior to, during and following construction.

Rock Mud Mat

A rock mud mat will be installed at the entrance to the construction zone to prevent mud tracking from the Site onto surrounding lands and the perimeter roadway network. All construction traffic will be restricted to this access only.

9.0 Conclusions

Based on the information offered in this report, we offer the following conclusions:

- The proposed development of the vacant lands includes an 18-unit retirement condominium with main floor commercial space, an above ground parking lot, and landscaped area
- Domestic peak water demand for the proposed condominium is 0.72 L/s. A design fire flow of 83 L/s for 1.75 hours is required
- Water demand for the proposed development will be provided through an internal water main that connects to the existing 150 mm diameter watermain on Emma Street
- Peak sanitary flow from the proposed condominium is 1.01 L/s
- Sanitary flows from the proposed development will be conveyed using an internal sanitary sewer that connects to the existing 375 mm diameter sanitary sewer on Emma Street
- Existing storm drainage infrastructure (Emma Street roadside ditch and William Street ROW storm sewer) have enough capacity to convey the uncontrolled runoff from the Site
- Stormwater quality controls for the Site will be provided through a Jellyfish Filter
- One major overland flow has been outlined to safely convey runoff through the subject property onto Emma Street and the roadside ditch

Based on the above conclusions, we recommend the approval of the Site plan approvals from the perspective of functional servicing and preliminary stormwater management.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

Jordan Atherton, M.Sc.
Water Resources

C.F. CROZIER & ASSOCIATES INC.

K.J. Firth, P.Eng.
Partner

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APPENDIX A

Water Demand Calculations

CROZIER & ASSOCIATES Consulting Engineers

Project: Emma Street | **Created By:** JA | **Date:** 9/9/2019
Project No.: 1476-4787 | **Checked By:** JA | **Updated:** 9/9/2019

Domestic Water Demand

			Notes & References
Site Area:	0.2958	ha	
Population Density:	2.7	persons/unit	ESTIMATED
Number of units:	18		
Population:	49		

Design Parameters

Average Demand (L/capita/d)
339

Grand Valley Engineering Standards, May 2016
Grand Valley Master Servicing Plan Update, RJ Burnside, May 2014

Water Demand:

Average Daily Demand = 16,475 L/day
0.19 L/s

Peaking Factors
Max Day = 2.5
Peak Hour = 3.8

MOECP Design Requirements for Drinking-Water Systems, 2008

Average Day =	0.19	L/s	
Max Day =	**0.48**	L/s	Max Day = Average Day Demand * Max Day
Peak Hour =	**0.72**	L/s	Peak Hour = Average Day Demand * Peak Hour

Municipality	Average Daily Water Demand (L/s)	Max Day Demand (L/s)	Peak Hourly Demand (L/s)
Town of Grand Valley	0.19	0.48	0.72

Project:	Emma Street	**Created By:**	JA	**Date:**	9/26/2019
Project No.:	1476-4787	**Checked By:**	JA	**Updated:**	9/26/2019

Fire Flow Calculations - Fire Underwriters Survey Method

Notes:

1. The development will use ordinary construction (C-value = 1.0).
2. Total gross-floor-area (GFA) is 1,827 sq. m. per Site Plan (September 23, 2019).
3. The building is assumed to have sprinkler protection.
4. The building is classified as a _Low_ hazard occupancy per the appendix of the Water Supply for Public Fire Protection (1999) by FUS.

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

F = 220 * C * sqrt A

where:

F = the required fire flow in litres per minute

C = coefficient related to the type of construction

= 1.5 for wood frame construction (structure essentially all combustible)

= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)

= 0.8 for non-combustible construction (unprotected metal structural components)

= 0.6 for fire-resistive construction (fully protected frame, floors, roof)

A = the total floor area in square metres (including all storeys, but excluding basements at least 50% below grade) in the building considered

Proposed Development: Basic Building Construction

A = 1827.0 sq. m footprint

C = 1.0

Therefore, F= 9,000 L/ min (rounded to nearest 1000 L/min)

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No.1 may be reduced by as much as 25% for occupancies having low contents fire hazard, or be increased by up to 25% surcharge for occupanies having a high fire hazard.

Non-Combustible	-25%	Free Burning	+15%
Limited Combustible	-15%	Rapid Burning	+25%
Combustible	No Charge		

Limited Combustible	-15%	Reduction

-1350 L/min reduction

Note: Flow determined shall not be less than 2,000 L/min

APPENDIX B

Sanitary Flow Calculations

Project: Emma Street | **Created By:** JA | **Date:** 9/19/2019
Project No.: 1476-4787 | **Checked By:** JA | **Updated:** 9/19/2019

Domestic Sanitary Design Flow

			Notes & References
Site Area:	0.2958	ha	
Population Density:	2.7	persons/unit	Assumed
Number of units:	18		
Population:	49		

Design Parameters

Average Flow (L/capita/d)	
450	Town of Grand Valley Engineering Standards, 2016

Sanitary Design Flow:

	Average Daily Flow =	450.0	L/capita/d	Average Daily Flow = Average Daily Flow (L/cap./day) * population / 86400
	Average Daily Flow =	**0.25**	L/s	
Harmon Peak Factor:	M =	**4.00**		M = 1 + 14 / (4 + (p/1000)^.5)
	Peak Flow =	**1.01**	L/s	Peak Flow = Average Daily Flow * M
Infiltration Flow:	Infiltration =	0.20	L/ha/s	Town of Grand Valley Engineering Standards, 2016
	Total Infiltration =	**0.06**	L/s	
	Total Peak Flow =	**1.07**	L/s	Total Peak Flow = Peak Flow + Total Infiltration

Summary Table

Average Daily Flow (L/s)	Peaking Factor	Peak Flow (L/s)	Infiltration Flow (L/s)	Total Peak Flow (L/s)
0.25	4.00	1.01	0.06	1.07

Sewer Design

Length	29.10	m
Diameter	125	mm
Slope	5.00	%
Full Flow Capacity (n = 0.013)	20.92	L/Sec
Velocity	1.71	m/s
Percent Full	**5.12**	%

APPENDIX C

Stormwater Management Calculations

CROZIER & ASSOCIATES
Consulting Engineers

100, 108, & 114 Emma Street
STORM SEWER DESIGN SHEET

100 YEAR DESIGN STORM - Town of Grand Valley (Fergus Shand Dam)

A	50.9	B	-0.6999

PROJECT: 100, 108, 114 Emma Street
PROJECT No.: 1476-4787
FILE: Storm Sewer Design
DATE: September 26, 2019
Revised: September 26, 2019
Design: PS
Check: JA

INITIAL TIME OF CONCENTRATION (min) 10.00 MANNINGS "n" 0.013

Drainage Area ID	FR MH NO	TO MH NO	AREA (A) Ha	RUN-OFF COEFF	A x C	Cummul. A x C	TIME OF CONC. min	I mm/hr	Q l/sec	SLOPE %	PIPE DIA. mm	Area m2	VEL. m/sec	Q/A m/s	Hv m	LENGTH m	TIME OF FLOW min	CAPACITY l/sec	% capacity
202	South Roof	CBMH A1	0.03	0.95	0.03	0.03	10.00	178.38	**14.13**	1.00	300	0.07	1.37	0.20	0.00	2.7	0.03	**96.70**	15
200+ EXT	CBMH A1	MH A2	0.41	0.39	0.16	0.19	10.03	177.97	**93.21**	1.00	375	0.11	1.59	0.84	0.04	22.0	0.23	**175.33**	53
	MH A2	Outlet	0.00	0.00	0.00	0.19	10.26	175.16	**91.74**	1.00	375	0.11	1.59	0.83	0.04	15.6	0.16	**175.33**	52
201	CBMH A3	CBMH A4	0.07	0.95	0.07	0.07	10.00	178.38	**32.98**	0.50	300	0.07	0.97	0.47	0.01	48.2	0.83	**68.38**	48
205	CBMH A4	MH A5	0.05	0.95	0.05	0.11	10.83	168.69	**53.46**	1.00	300	0.07	1.37	0.76	0.03	4.5	0.05	**96.70**	55
	MH A5	MH A7	0.00	0.00	0.00	0.11	10.89	168.10	**53.27**	1.00	300	0.07	1.37	0.75	0.03	2.6	0.03	**96.70**	55
203	North Roof	CBMH A8	0.04	0.95	0.04	0.04	10.00	178.38	**19.83**	1.00	300	0.07	1.37	0.28	0.00	1.1	0.01	**96.70**	21
204	CBMH A8	MH A7	0.01	0.25	0.00	0.04	10.01	178.21	**20.48**	1.00	300	0.07	1.37	0.29	0.00	20.4	0.25	**96.70**	21
	MH A7	Existing Sewer	0.00	0.00	0.00	0.16	10.92	167.76	**72.45**	1.00	300	0.07	1.37	1.02	0.05	12.7	0.15	**96.70**	75

CROZIER & ASSOCIATES Consulting Engineers

Project: 105-108 Emma St.
Project No.: 1476-4787

Created By: JA
Checked By: JA

Date: 9/26/2019
Updated: 9/26/2019

Rational Method Calculations - Input Parameters

Storm Data: Fergus Shand Dam, 43.734427, -80.337112

Time of Concentration: T_c = **10** **min** (per Town of Grand Valley standards)

Return Period	A	B	I (mm/hr)
2 yr	23.3	-0.70	81.52
5 yr	30.7	-0.70	107.42
10 yr	35.6	-0.70	124.56
25 yr	41.8	-0.70	146.25
50 yr	46.4	-0.70	162.35
100 yr	50.9	-0.70	178.09

Pre - Development Conditions (Drainage to Emma Street Roadside Ditch)				
Land Use	**Area** (ha)	**Area** (m^2)	**C**	**Weighted Average C**[1]
EXT	0.32	3200	**0.43**	**0.22**
100	0.30	3000	**0.25**	**0.12**
Total Site	**0.62**	**6200**	**-**	**0.34**

Post - Development Condition (Drainage to Emma Street Roadside Ditch)				
Land Use	**Area** (ha)	**Area** (m^2)	**C**	**Weighted Average C**
EXT	0.32	3200	**0.43**	**0.30**
200	0.09	900	**0.25**	**0.05**
202	0.03	300	**0.95**	**0.06**
206	0.01	100	**0.25**	**0.01**
Total Site	**0.45**	**4500**	**-**	**0.42**

Equations:

Peak Flow
$$Q_{post} = 0.0028 \bullet C_{post} \bullet i(T_d) \bullet A$$

Intensity
$$i(T_d) = A * (T/60)^{B}$$

Where T is in hours

Peak Flows to Emma Street Ditch (L/s)		
Return Period	**Q_{pre}**	**Q_{post}**
2 yr	49	43
5 yr	64	57
10 yr	74	66
25 yr	87	78
50 yr	97	86
100 yr	106	94

CROZIER & ASSOCIATES Consulting Engineers

Project: 105-108 Emma St.
Project No.: 1476-4787

Created By: JA
Checked By: JA

Date: 9/26/2019
Updated: 9/26/2019

Rational Method Calculations - Input Parameters

Storm Data: Fergus Shand Dam, 43.734427, -80.337112

Time of Concentration: T_c = **10** **min** (per Town of Grand Valley standards)

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2 yr	23.3	-0.70	81.52
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10 yr	35.6	-0.70	124.56
25 yr	41.8	-0.70	146.25
50 yr	46.4	-0.70	162.35
100 yr	50.9	-0.70	178.09

Post Development Conditions				
Land Use	**Area** (ha)	**Area** (m^2)	**C**	**Weighted Average C**
204	0.01	100	**0.25**	**0.25**
Total Site	**0.01**	**100**	**-**	**0.25**

Equations:

Peak Flow
$Q_{post} = 0.0028 \bullet C_{post} \bullet i(T_d) \bullet A$

Intensity
$i(T_d) = A * (T/60)^B$

Where T is in hours

Peak Flows RipRap Channel (L/s)	
Return Period	**Q_{post}**
2 yr	1
5 yr	1
10 yr	1
25 yr	1
50 yr	1
100 yr	1

CROZIER & ASSOCIATES Consulting Engineers

Project: 105-108 Emma St. **Created By:** JA **Date:** 9/26/2019
Project No.: 1476-4787 **Checked By:** JA **Updated:** 9/26/2019

Rational Method Calculations - Input Parameters

Storm Data: Fergus Shand Dam, 43.734427, -80.337112

Time of Concentration: T_c = **10** **min** (per Town of Grand Valley standards)

Return Period	A	B	I (mm/hr)
2 yr	23.3	-0.70	81.52
5 yr	30.7	-0.70	107.42
10 yr	35.6	-0.70	124.56
25 yr	41.8	-0.70	146.25
50 yr	46.4	-0.70	162.35
100 yr	50.9	-0.70	178.09

Post - Development Condition (Drainage to William Street ROW Storm Sewer)				
Land Use	**Area** (ha)	**Area** (m^2)	**C**	**Weighted Average C**
201	0.07	700	**0.95**	**0.39**
203	0.04	400	**0.95**	**0.22**
204	0.01	100	**0.25**	**0.01**
205	0.05	500	**0.95**	**0.28**
Total Area	**0.17**	**1700**	**-**	**0.91**

Equations:

Peak Flow
$$Q_{post} = 0.0028 \bullet C_{post} \bullet i(T_d) \bullet A$$

Intensity
$$i(T_d) = A * (T/60)^B$$

Where T is in hours

Peak Flows to William Street Storm Sewer (L/s)	
Return Period	**Q_{post}**
2 yr	35
5 yr	46
10 yr	54
25 yr	63
50 yr	70
100 yr	77

Pre-Development - Emma Street Roadside Ditch Capacity

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.024	
Channel Slope	1.80000	%
Left Side Slope	21.00	%
Right Side Slope	21.00	%
Discharge	106.00	L/s

Results

Normal Depth	0.15	m
Flow Area	0.11	m²
Wetted Perimeter	1.47	m
Hydraulic Radius	0.07	m
Top Width	1.43	m
Critical Depth	0.16	m
Critical Slope	0.01352	m/m
Velocity	0.98	m/s
Velocity Head	0.05	m
Specific Energy	0.20	m
Froude Number	1.14	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.15	m
Critical Depth	0.16	m
Channel Slope	1.80000	%
Critical Slope	0.01352	m/m

Post-Development - Emma Street Roadside Ditch Capacity

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.024	
Channel Slope	1.80000	%
Left Side Slope	21.00	%
Right Side Slope	21.00	%
Discharge	99.00	L/s

Results

Normal Depth	0.15	m
Flow Area	0.10	m²
Wetted Perimeter	1.43	m
Hydraulic Radius	0.07	m
Top Width	1.40	m
Critical Depth	0.15	m
Critical Slope	0.01365	m/m
Velocity	0.97	m/s
Velocity Head	0.05	m
Specific Energy	0.19	m
Froude Number	1.14	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.15	m
Critical Depth	0.15	m
Channel Slope	1.80000	%
Critical Slope	0.01365	m/m

Emma Street Culvert Sizing

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.024	
Channel Slope	1.30000	%
Normal Depth	0.45	m
Diameter	0.45	m
Discharge	176.08	L/s

Results

Discharge	176.08	L/s
Normal Depth	0.45	m
Flow Area	0.16	m²
Wetted Perimeter	1.41	m
Hydraulic Radius	0.11	m
Top Width	0.00	m
Critical Depth	0.30	m
Percent Full	100.0	%
Critical Slope	0.02214	m/m
Velocity	1.11	m/s
Velocity Head	0.06	m
Specific Energy	0.51	m
Froude Number	0.00	
Maximum Discharge	0.19	m³/s
Discharge Full	0.18	m³/s
Slope Full	0.01300	m/m
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Average End Depth Over Rise	0.00	%

Emma Street Culvert Sizing

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.45	m
Critical Depth	0.30	m
Channel Slope	1.30000	%
Critical Slope	0.02214	m/m

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Wednesday, December 12, 2018
Project Name	Grand Valley site
Project Number	
Location	Grand Valley

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 33 years of WATERLOO WELLINGTON A rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	7.6	85

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

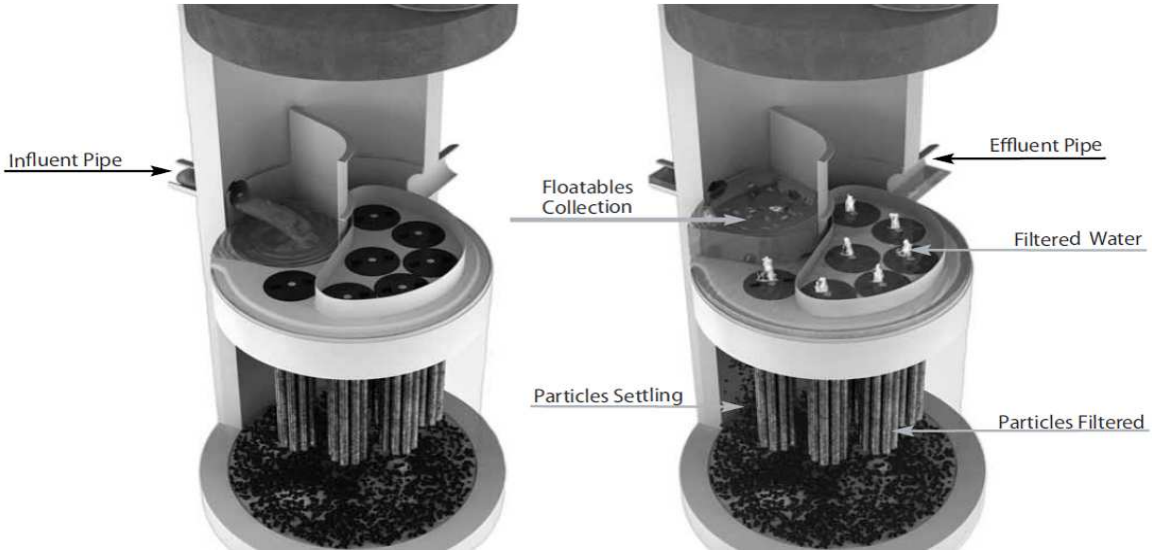
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Wednesday, December 12, 2018
Project Name:	Grand Valley site
Project Number:	
Location:	Grand Valley

Designer Information

Company:	CF Crozier
Contact:	Christopher Kwan
Phone #:	

Notes

Rainfall

Name:	WATERLOO WELLINGTON A
State:	ON
ID:	9387
Record:	1970 to 2003
Co-ords:	43°27'N, 80°23'W

Drainage Area

Total Area:	0.117 ha
Imperviousness:	100%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 33 years of WATERLOO WELLINGTON A rainfall data:	**3.8 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 474 m^3, with a suspended sediment concentration of 60 mg/L.	**28 kg**

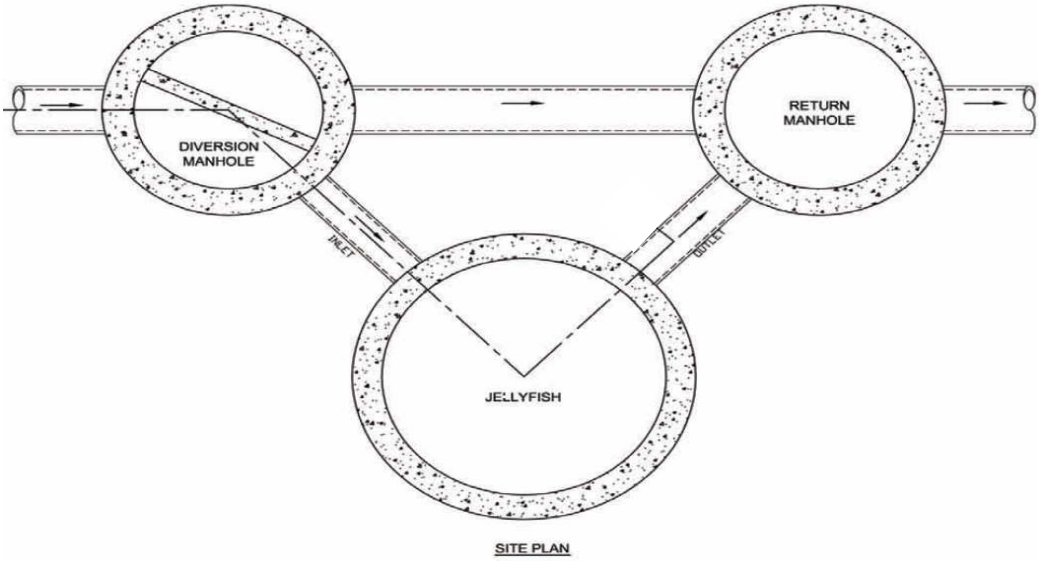
Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 33 years of WATERLOO WELLINGTON A rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m^3)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	**1**	**1**	**1.2**	**2313**	**0.34**	**379**	**7.6**	**85**
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	**62º**	**150**	**200**
1.8	59º	200	250
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

Jordan Atherton

From: Christopher Kwan
Sent: Friday, January 11, 2019 4:33 PM
To: Jordan Atherton
Subject: FW: Jellyfish Sizing

Hi,

Please find below information on the Jellyfish ETV certification for Emma St.

Best,

Christopher Kwan | Engineering Assistant
C.F. Crozier & Associates Consulting Engineers
2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
cfcrozier.ca | ckwan@cfcrozier.ca
tel: 905.875.0026 ext: 362

From: Kent S Campbell [mailto:Kent.Campbell@forterrabp.com]
Sent: Friday, January 11, 2019 3:15 PM
To: Christopher Kwan <ckwan@cfcrozier.ca>
Subject: RE: Jellyfish Sizing

Hi Chris,

Yes, the ETV verification for the JF4-2-1 is accepted for all Jellyfish units.

Regards,

FORTERRA

For the newest version of PCSWMM please visit the Imbrium website at
www.imbriumsystems.com

Kent Campbell
Stormwater Specialist
Cambridge Plant
Phone 888-888-3222
Cell 519 588-7473
kent.campbell@forterrabp.com
Stormceptor
Protecting the water for future generations

From: Christopher Kwan <ckwan@cfcrozier.ca>
Sent: Friday, January 11, 2019 2:17 PM
To: Kent S Campbell <Kent.Campbell@forterrabp.com>
Subject: RE: Jellyfish Sizing

WARNING: External Email. Please use CAUTION when opening attachments or clicking links

Hi,

That makes sense. Does the Town of Grand Valley and GRCA accept the ETV statement from JF4-2-1 as an equivalent statement for other Jellyfish models including JF4-1-1?

Thanks,

Christopher Kwan | Engineering Assistant
C.F. Crozier & Associates Consulting Engineers
2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
cfcrozier.ca | ckwan@cfcrozier.ca
tel: 905.875.0026 ext: 362

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From: Kent S Campbell [mailto:Kent.Campbell@forterrabp.com]
Sent: Friday, January 11, 2019 1:47 PM
To: Christopher Kwan <ckwan@cfcrozier.ca>
Subject: RE: Jellyfish Sizing

Hi Chris,

There is only the one model that was tested and ISO 14034 verified. All other models are sized by scaling using the verified data from the JF4-2-1.

Regards,

For the newest version of PCSWMM please visit the Imbrium website at
www.imbriumsystems.com

Kent Campbell
Stormwater Specialist
Cambridge Plant
Phone 888-888-3222
Cell 519 588-7473
kent.campbell@forterrabp.com
Stormceptor
Protecting the water for future generations

From: Christopher Kwan <ckwan@cfcrozier.ca>
Sent: Thursday, January 10, 2019 11:04 AM
To: Kent S Campbell <Kent.Campbell@forterrabp.com>
Cc: Davidson, Reagan <rdavidson@imbriumsystems.com>
Subject: RE: Jellyfish Sizing

****WARNING: External Email. Please use CAUTION when opening attachments or clicking links****

Hi Kent,

Hope all is well. I was just wondering if there is an ETV statement for the sized unit from the report you sent (Model: JF4-1-1). Currently the only ETV statement I can find on the website is for JF4-2-1 (see attached).

Thanks,

Christopher Kwan | Engineering Assistant
C.F. Crozier & Associates Consulting Engineers
2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
cfcrozier.ca | ckwan@cfcrozier.ca
tel: 905.875.0026 ext: 362

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From: Kent S Campbell [mailto:Kent.Campbell@forterrabp.com]
Sent: Wednesday, December 12, 2018 12:08 PM
To: Christopher Kwan <ckwan@cfcrozier.ca>
Cc: Davidson, Reagan <rdavidson@imbriumsystems.com>
Subject: RE: Jellyfish Sizing

Hello Chris,

The size remains the same, please see the attached updated report.

Regards,

For the newest version of PCSWMM please visit the Imbrium website at
www.imbriumsystems.com

Kent Campbell
Stormwater Specialist
Cambridge Plant
Phone 888-888-3222
Cell 519 588-7473
kent.campbell@forterrabp.com
Stormceptor
Protecting the water for future generations

From: Christopher Kwan <ckwan@cfcrozier.ca>
Sent: Wednesday, December 12, 2018 9:38 AM
To: Kent S Campbell <Kent.Campbell@forterrabp.com>
Cc: Davidson, Reagan <rdavidson@imbriumsystems.com>
Subject: RE: Jellyfish Sizing

****WARNING: External Email. Please use CAUTION when opening attachments or clicking links****

Hi Kent,

Thanks for your help and quick turnaround. There has been a slight change in the catchment area and I was wondering if it would be possible to update the report for a contributing area of 0.117ha.

Thanks again.

Best,
Chris

Christopher Kwan | Engineering Assistant
2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
cfcrozier.ca | ckwan@cfcrozier.ca
tel: 905.875.0026 ext: 362

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From: Kent S Campbell [mailto:Kent.Campbell@forterrabp.com]
Sent: Tuesday, December 11, 2018 4:24 PM
To: Christopher Kwan <ckwan@cfcrozier.ca>
Cc: Davidson, Reagan <rdavidson@imbriumsystems.com>
Subject: RE: Jellyfish Sizing

Hi Chris,

It was good meeting you on the phone this afternoon. Please see the attached Jellyfish sizing report attached. The JF4-1-1 is $33,162. Please note that the Jellyfish filter is an offline unit and requires the flow splitting arrangement shown in the sizing report.

Regards,

For the newest version of PCSWMM please visit the Imbrium website at
www.imbriumsystems.com

Kent Campbell
Stormwater Specialist
Cambridge Plant
Phone 888-888-3222
Cell 519 588-7473
kent.campbell@forterrabp.com
Stormceptor
Protecting the water for future generations

From: Christopher Kwan <ckwan@cfcrozier.ca>
Sent: Tuesday, December 11, 2018 4:11 PM
To: Kent S Campbell <Kent.Campbell@forterrabp.com>
Subject: Jellyfish Sizing

****WARNING: External Email. Please use CAUTION when opening attachments or clicking links****

Hi Kent,

Following up from our conversation, our site is located in Grand Valley and is regulated by the Grand Valley Conservation Authority. The area we are looking to treat is 0.108ha and is 100% impervious; in terms of TSS removal the required is 80%. Please don't hesitate to let me know if there is any additional information you need, I will be happy to provide it.

Thanks again for your help.

Best,
Chris

Christopher Kwan | Engineering Assistant
2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
cfcrozier.ca | ckwan@cfcrozier.ca
tel: 905.875.0026 ext: 362

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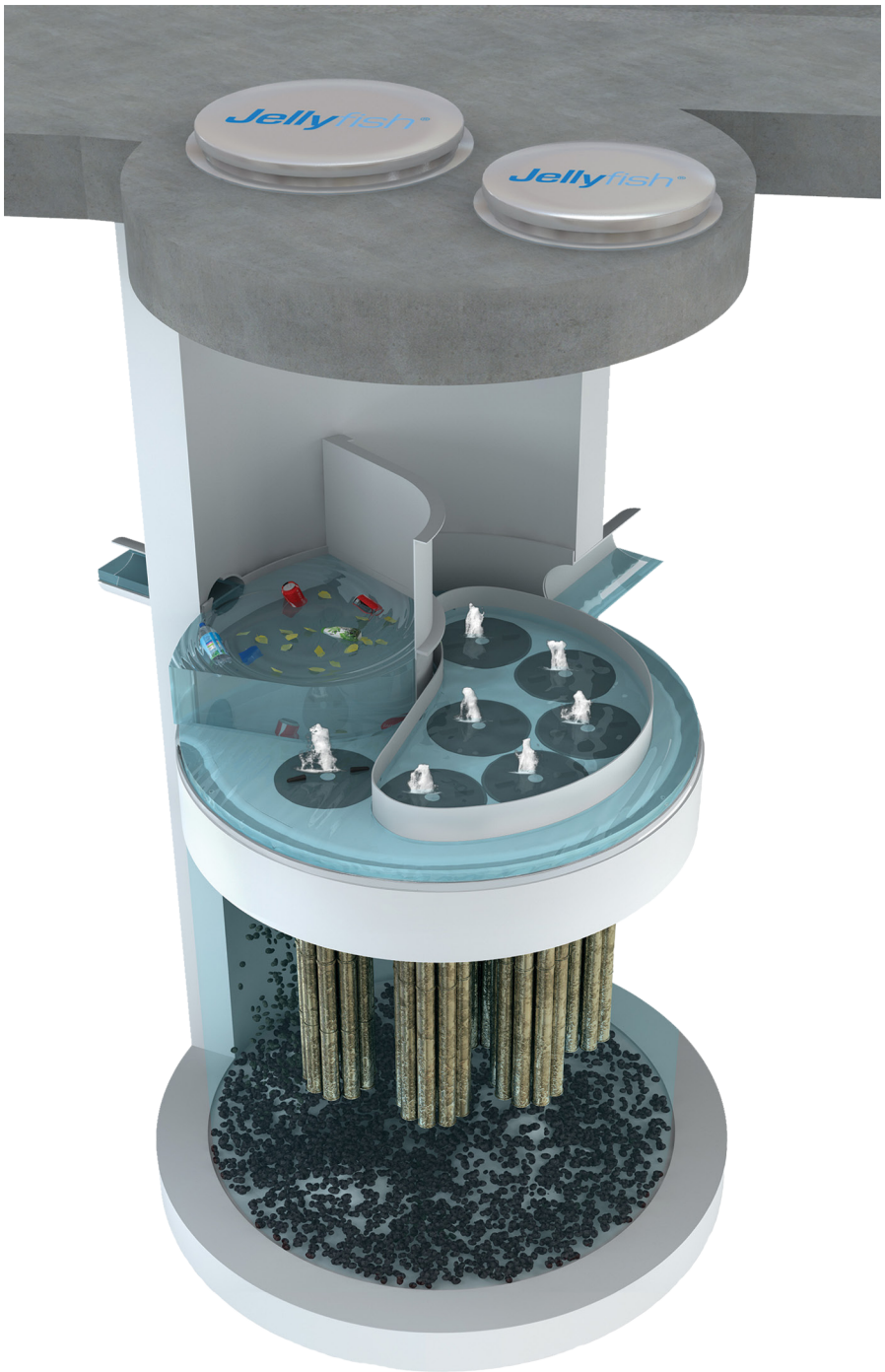
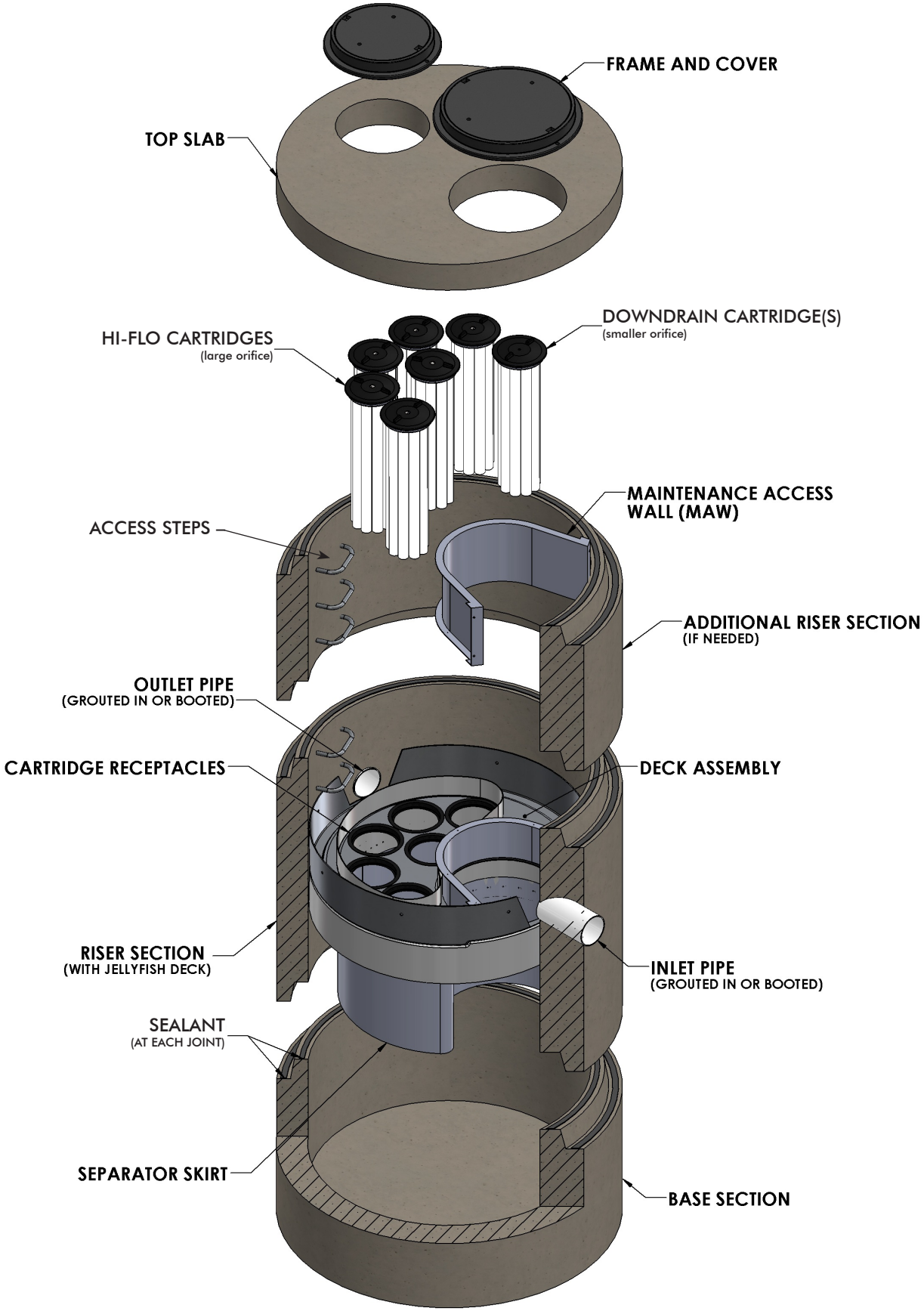
Jellyfish® Filter
Owner's Manual



imbrium®


FRAME AND COVER
TOP SLAB
DOWNDRAIN CARTRIDGE(S)
(smaller orifice)
HI-FLO CARTRIDGES
(large orifice)
MAINTENANCE ACCESS
WALL (MAW)
ACCESS STEPS
ADDITIONAL RISER SECTION
(IF NEEDED)
OUTLET PIPE
(GROUTED IN OR BOOTED)
CARTRIDGE RECEPTACLES
DECK ASSEMBLY
RISER SECTION
(WITH JELLYFISH DECK)
INLET PIPE
(GROUTED IN OR BOOTED)
SEALANT
(AT EACH JOINT)
SEPARATOR SKIRT
BASE SECTION

WARNINGS / CAUTION

1. FALL PROTECTION may be required.
2. WATCH YOUR STEP if standing on the Jellyfish Filter Deck at any time; Great care and safety must be taken while walking or maneuvering on the Jellyfish Filter Deck. Attentive care must be taken while standing on the Jellyfish Filter Deck at all times to prevent stepping onto a lid, into or through a cartridge hole or slipping on the deck.
3. The Jellyfish Filter Deck can be SLIPPERY WHEN WET.
4. If the Top Slab, Covers or Hatches have not yet been installed, or are removed for any reason, great care must be taken to NOT DROP ANYTHING ONTO THE JELLYFISH FILTER DECK. The Jellyfish Filter Deck and Cartridge Receptacle Rings can be damaged under high impact loads. *This type of activity voids all warranties. All damaged items to be replaced at owner's expense*.
5. Maximum deck load 2 persons, total weight 250 lbs. per person.

Safety Notice

Jobsite safety is a topic and practice addressed comprehensively by others. The inclusions here are intended to be reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply on any given site or project. The knowledge and applicability of those responsibilities is the Contractor's responsibility and outside the scope of Imbrium® Systems.

Confined Space Entry

Secure all equipment and perform all training to meet applicable local and OSHA regulations regarding confined space entry. It is the Contractor's or entry personnel's responsibility to proceed safely at all times.

Personal Safety Equipment

Contractor is responsible to provide and wear appropriate personal protection equipment as needed including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment as necessary. Make sure all equipment is **staffed with trained and/or certified personnel**, and all equipment is checked for proper operation and safety features prior to use.

- Fall protection equipment
- Eye protection
- Safety boots
- Ear protection
- Gloves
- Ventilation and respiratory protection
- Hard hat
- Maintenance and protection of traffic plan

Thank You for purchasing the Jellyfish® Filter!

Imbrium® Systems would like to thank you for selecting the Jellyfish Filter to meet your project's stormwater treatment needs. With proper inspection and maintenance, the Jellyfish Filter is designed to deliver ongoing, high levels of stormwater pollutant removal.

If you have any questions, please feel free to call us or e-mail us at info@imbriumsystems.com.

Imbrium Systems
USA: 301.279.8827 | 888.279.8826
CAD: 416.960.9900 | 800.565.4801
INT'L: +1.416.960.9900

Jellyfish Filter Patents

The Jellyfish Filter is protected by one or more of the following patents:

U.S. Patent No. 8,123,935; U.S. Patent No. 8,287,726; U.S. Patent No. 8,221,618
Australia Patent No. 2008,286,748
Canadian Patent No. 2,696,482
Korean Patent No. 10-1287539
New Zealand Patent No. 583,461; New Zealand Patent No. 604,227
South African Patent No. 2010,01068
**other patents pending*

Table of Contents

Chapter 1

1.0 – Owner Specific Jellyfish Filter Product Information

Below you will find your specific Jellyfish Filter unit information to help you easily inspect, maintain and order parts for your system.

Owner Name:	
Phone Number:	
Site Address:	
Site GPS Coordinates/unit location:	
Unit Location Description:	
Jellyfish Filter Model No.:	
Cartridge Installation Date:	
No. of Hi-Flo Cartridges	
Length of Hi-Flo Cartridges:	
Lid Orifice Diameter on Hi-Flo Cartridge:	
No. of Draindown Cartridges:	
Length of Draindown Cartridges:	
Lid Orifice Diameter on Draindown Cartridge:	
No. of Blank Cartridge Lids:	
Online System (Yes/No):	
Offline System (Yes/No):	

Notes:

Chapter 2

2.0 – Jellyfish Filter System Operations and Functions

The Jellyfish Filter is an engineered stormwater quality treatment technology that removes a high level and wide variety of stormwater pollutants. Each Jellyfish Filter cartridge consists of multiple membrane - encased filter elements ("filtration tentacles") attached to a cartridge head plate. The filtration tentacles provide a large filtration surface area, resulting in high flow and high pollutant removal capacity.

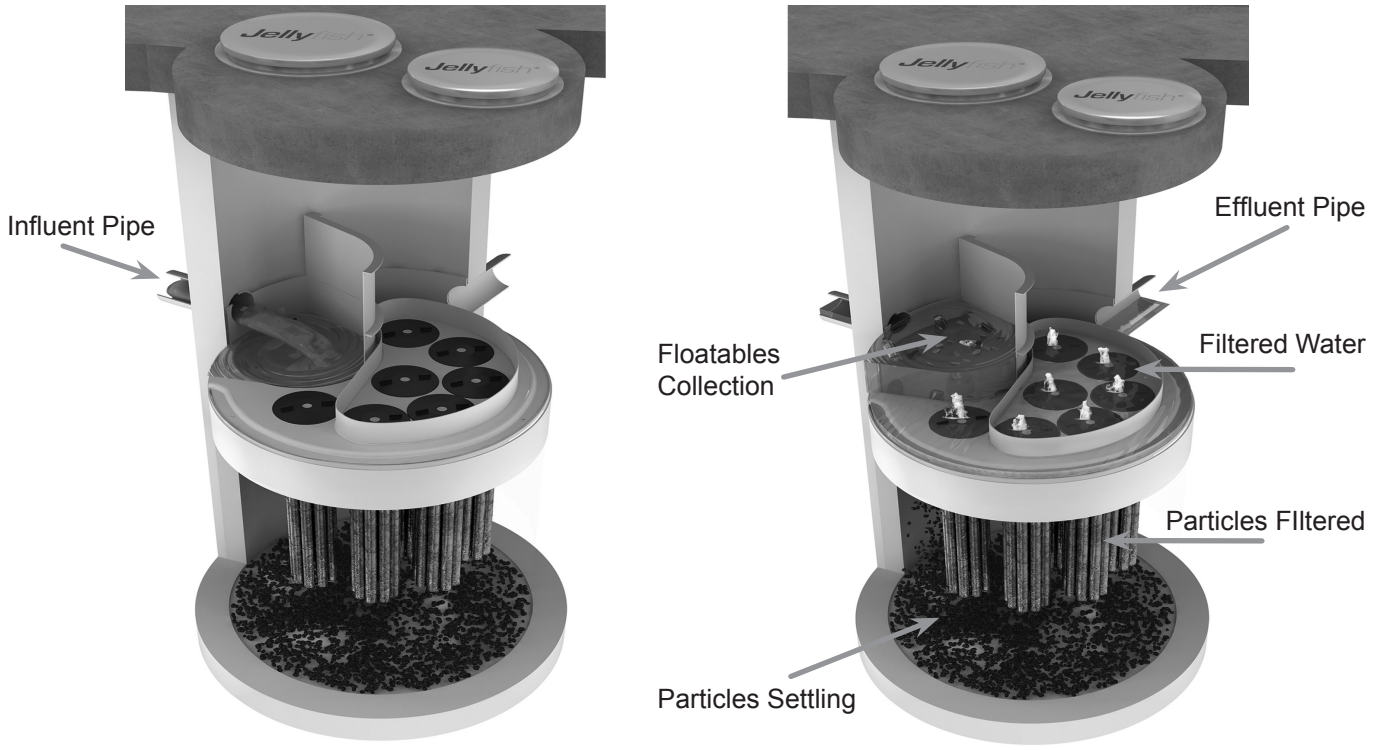
The Jellyfish Filter functions are depicted in **Figure 1** below.

FIGURE 1

Jellyfish Filter Treatment Functions

Membrane Filtration

Section View with Maintenance Access Wall (MAW) Cutaway



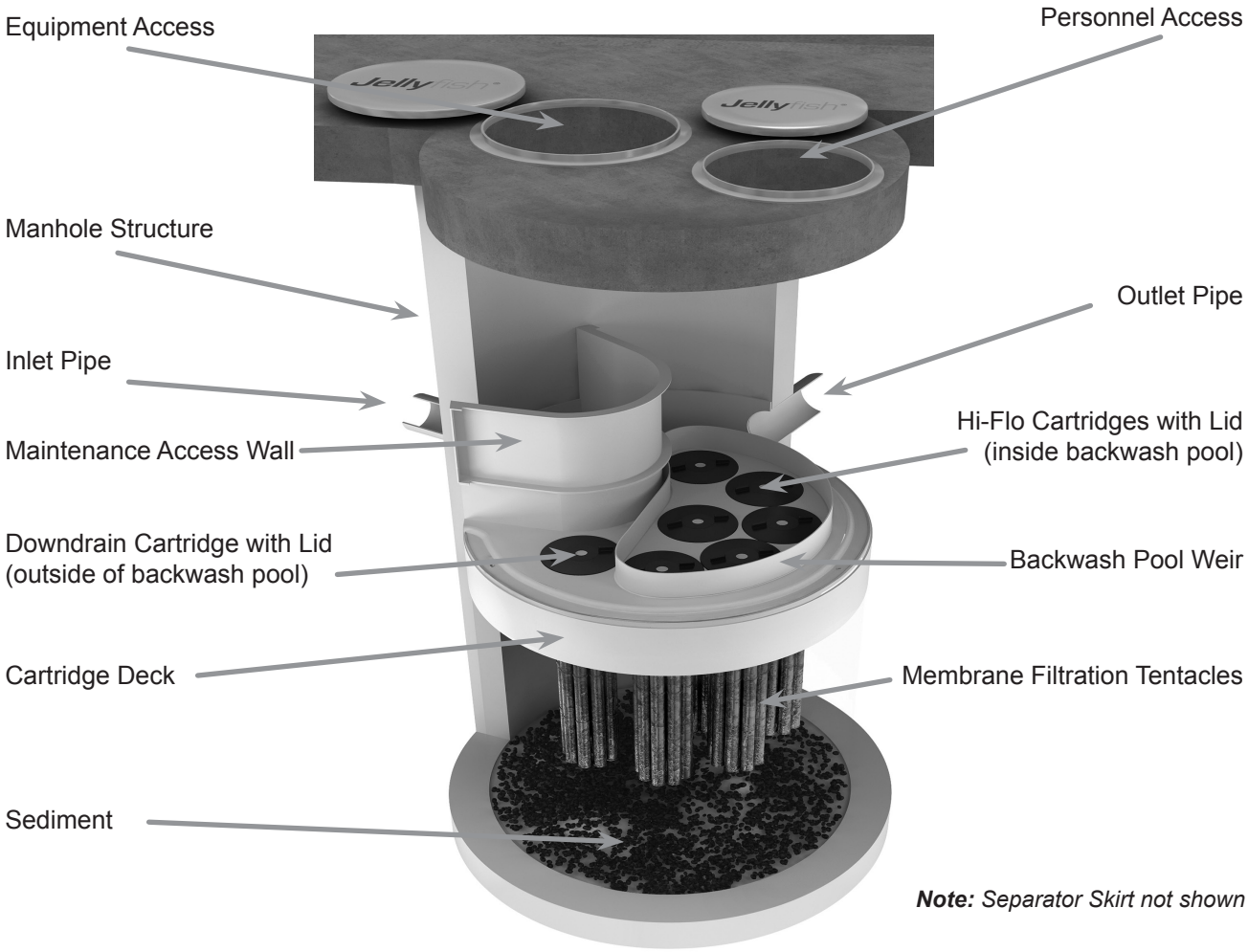
Jellyfish Filter cartridges are backwashed after each peak storm event, which removes accumulated sediment from the membranes. This backwash process extends the service life of the cartridges and increases the time between maintenance events.

For additional details on the operation and pollutant capabilities of the Jellyfish Filter please refer to additional details on our website at www.imbriumsystems.com.

2.1 – Components and Cartridges

The Jellyfish Filter and components are depicted in Figure 2 below.

FIGURE 2 **Jellyfish Filter Components**



Note: *Separator Skirt not shown*

Tentacles are available in various lengths as depicted in Table 1 below.

Table 1 – Cartridge Lengths / Weights and Cartridge Lid Orifice Diameters

Cartridge Lengths	Dry Weight	Hi-Flo Orifice Diameter	Draindown Orifice Diameter
15 inches (381 mm)	10 lbs (4.5 kg)	35 mm	20 mm
27 inches (686 mm)	14.5 lbs (6.6 kg)	45 mm	25 mm
40 inches (1,016 mm)	19.5 lbs (8.9 kg)	55 mm	30 mm
54 inches (1,372 mm)	25 lbs (11.4 kg)	70 mm	35 mm

A Jellyfish membrane filtration cartridge is depicted in Figure 3 below.

FIGURE 3

Jellyfish Membrane Filtration Cartridge

2.2 – Jellyfish Membrane Filtration Cartridge Assembly

The Jellyfish Filter utilizes multiple membrane filtration cartridges. Each cartridge consists of removable cylindrical filtration "tentacles" attached to a cartridge head plate. Each filtration tentacle has a threaded pipe nipple and o-ring. To attach, insert the top pipe nipples with the o-ring through the head plate holes and secure with locking nuts. Locking nuts to be hand tighten and checked with a wrench as shown below.

2.3 – Jellyfish Membrane Filtration Cartridge Installation

- After the upstream catchment and site have stabilized, remove any accumulated sediment and debris from the Jellyfish Filter structure and upstream diversion structure (if applicable). Failure to address this step completely will reduce the time between required maintenance.
- Descend to the cartridge deck (see Safety Notice and page 3).
- Lower the Jellyfish membrane filtration cartridges into the cartridge receptacles within the cartridge deck. A filter cartridge should be placed into each of the draindown cartridge receptacles outside the backwash pool weir. It is possible dependent on the Jellyfish Filter model purchased that not all cartridge receptacles will be filled with a filter cartridge. In that case, a blank headplate and blank cartridge lid (has no orfice) would be installed.

Cartridge Assembly

Avoid snagging the cartridge membranes on the recpticle lip when inserting the Jellyfish membrane filtration cartridges into the cartridge receptacles. Use a gentle twisting or sideways motion to clear any potential snag. Do not force the tentacles down into the cartridge receptacle, as this may damage the membranes. Apply downward pressure on the cartridge head plate to seat the rim gasket (thick circular gasket surrounding the circumference of the head plate) into the cartridge receptacle.

- Examine the cartridge lids to differentiate lids with a small orifice, a large orifice, and no orifice.
  - Lids with a small orifice are to be inserted into the draindown cartridge receptacles, outside of the backwash pool weir.
  - Lids with a large orifice are to be inserted into the hi-flo cartridge receptacles within the backwash pool weir.
  - Lids with no orifice (blank cartridge lids) and a blank headplate are to be inserted into unoccupied cartridge receptacles.
- **To install a cartridge lid, align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal.**

Chapter 3

3.0 – Inspection and Maintenance Overview

The primary purpose of the Jellyfish Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, captured pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Maintenance activities may be required in the event of an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW)

Maintenance activities typically include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments from manhole sump
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed.

It is recommended that Jellyfish Filter inspection and maintenance be performed by professionally trained individuals, with experience in stormwater maintenance and disposal services. Maintenance procedures may require manned entry into the Jellyfish structure. Only professional maintenance service providers trained in confined space entry procedures should enter the vessel. Procedures, safety and damage prevention precautions, and other information, included in these guidelines, should be reviewed and observed prior to all inspection and maintenance activities.

3.1 – Inspection

3.1.1 – Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; *or per the approved project stormwater quality documents (if applicable), whichever is more frequent.*

- Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired.
- A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.

- Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year.
- Inspection is recommended after each major storm event.
- Immediately after an upstream oil, fuel or other chemical spill.

3.1.2 – Inspection Tools and Equipment

The following equipment and tools are typically required when performing a Jellyfish Filter inspection:

- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

3.1.3 – Inspection Procedure

The following procedure is recommended when performing inspections:

- Provide traffic control measures as necessary.
- Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.
- Measure oil and sediment depth by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Retrieve the probe, record sediment depth, and presences of any oil layers and repeat in multiple locations within the MAW opening. **Sediment depth of 12 inches or greater indicates maintenance is required**.
- Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
- Inspect the MAW, cartridge deck, and backwash pool weir for cracks or broken components. If damaged, repair is required.
- **Dry weather inspections:** inspect the cartridge deck for standing water.
  - No standing water under normal operating condition.
  - Standing water **inside** the backwash pool, but not outside the backwash pool, this condition indicates that the filter cartridges need to be rinsed.
  - Standing water **outside** the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- **Wet weather inspections:** observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW.
  - **Less than 6 inches**, flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
  - **Greater than 6 inches**, flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
  - **18 inches or greater** and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges are occluded with sediment and need to be rinsed.

The depth of sediment and oil can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the Jellyfish Filter's maintenance access wall opening. The large opening provides convenient access for inspection and vacuum removal of water and pollutants.

3.2 – Maintenance

3.2.1 – Maintenance Requirements

Required maintenance for Jellyfish Filter units is based upon results of the most recent inspection, historical maintenance records, or the site specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

- **Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.**
- Floatable trash, debris, and oil must be removed.
- Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs first.
- Replace filter cartridge if rinsing does not remove accumulated sediment from the tentacles, or if tentacles are damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
- Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
- The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged by the spill.

3.2.2 – Maintenance Tools and Equipment

The following equipment and tools are typically required when performing Jellyfish Filter maintenance:

- Vacuum truck
- Ladder
- Garden hose and low pressure sprayer
- Rope or cord to lift filter cartridges from the cartridge deck to the surface
- Adjustable pliers for removing filter cartridge tentacles from cartridge head plate
- Plastic tub or garbage can for collecting effluent from rinsed filter cartridge tentacles
- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Proper safety equipment for confined space entry
- Replacement filter cartridge tentacles if required

3.2.3 – Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

- Provide traffic control measures as necessary.
- Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures.
- **Caution:** Dropping objects onto the cartridge deck may cause damage.
- Perform **Inspection Procedure** prior to maintenance activity.
- To access the cartridge deck for filter cartridge service, descend the ladder and step directly onto the deck. **Caution:** Do not step onto the maintenance access wall (MAW) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.

3.2.4 – Filter Cartridge Rinsing Procedure

- Remove a cartridge lid.
- Remove the cartridge from the receptacle using the lifting loops in the cartridge head plate. **Caution:** Should

a snag occur, do not force the cartridge upward as damage to the tentacles may result. Rotate the cartridge with a slight sideways motion to clear the snag and continue removing the cartridge.

- Thread a rope or cord through the lifting loops and lift the filter cartridge from the cartridge deck to the top surface outside the structure.
- **Caution:** Immediately replace and secure the lid on the exposed empty receptacle as a safety precaution. Never expose more than one empty cartridge receptacle.
- Repeat the filter cartridge removal procedure until all of the cartridges are located at the top surface outside the structure.
- Disassemble the tentacles from each filter cartridge by rotating counter-clockwise. Remove the tentacles from the cartridge head plate.
- Position a receptacle in a plastic tub or garbage can such that the rinse water is captured. Using a low-pressure garden hose sprayer, direct a wide-angle water spray at a downward 45° angle onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane. **Caution:** Do not use a high pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane. Turn membran upside down and pour out any residual rinsewater to ensure center of tentacle is clear of any sediment.

Rinsing of dirty filter cartridge tentacles with a low-pressure garden hose sprayer, and using a plastic garbage container to capture rinse water.

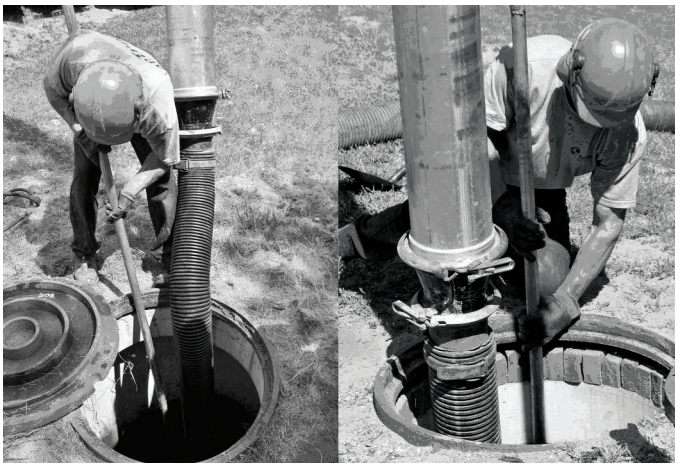
- Remove rinse water from rinse tub or garbage can using a vacuum hose as needed.
- Slip the o-ring over the tentacle nipple and reassemble onto the cartridge head plate; hand-tighten.
- If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Imbrium Systems to order replacement tentacles.
- Lower a rinsed filter cartridge to the cartridge deck. Remove the cartridge lid on a receptacle and carefully lower the filter cartridge into the receptacle until the head plate gasket is seated squarely on the lip of the receptacle. **Caution:** Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur. Rotate the cartridge with a slight sideways motion to clear the snag and complete the installation.
- Replace the cartridge lid on the exposed receptacle. Rinse away any accumulated grit from the receptacle threads if needed to get a proper fit. **Align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal**.
- Repeat cartridge installation until all cartridges are installed.

3.2.5 – Vacuum Cleaning Procedure

- **Caution:** Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning **only through the maintenance access wall (MAW) opening**, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone, and could be torn if contacted by the wand. **Do not lower the vacuum wand through a cartridge receptacle**, as damage to the receptacle will result.
  - To remove floatable trash, debris, and oil, lower the vacuum hose into the MAW opening and vacuum floatable pollutants off the surface of the water. Alternatively, floatable solids may be removed by a net or skimmer.
  - Using a vacuum hose, remove the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.
  - Remove the sediment from the bottom of the unit through the MAW opening.
  - For larger diameter Jellyfish Filter manholes (8-ft, 10-ft, 12-ft diameter), complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle..
  - After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.
  - Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

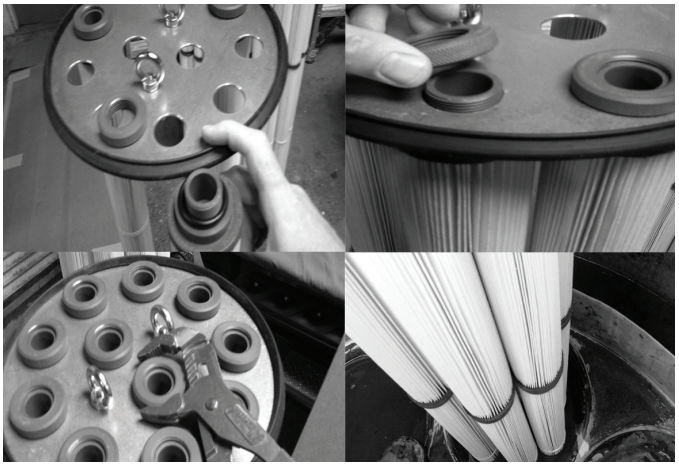
3.2.6 – Chemical Spills

- **Caution**: If a chemical spill has been captured by the Jellyfish Filter, do not attempt maintenance. Immediately contact the local hazard response agency.



A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and floatables from the Jellyfish Filter by inserting the vacuum wand through the maintenance access wall opening.

A view of a Jellyfish Filter cartridge deck from the surface showing all the cartridge lids intact and no standing water on the deck (left image), and inspection of the flexible separator skirt from inside the maintenance access wall opening (right image).



Assembly of a Jellyfish Filter cartridge (left) and installation of a filter cartridge into a cartridge receptacle in the deck (right).

3.3 – Disposal Procedures

Disposal requirements for recovered pollutants and spent filtration tentacles may vary depending on local guidelines. In most areas the sediment and spent filtration tentacles, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

Petroleum-based pollutants captured by the Jellyfish Filter, such as oil and fuels, should be removed and disposed of by a licensed waste management company.

Although the Jellyfish Filter captures virtually all free oil, a sheen may still be present at the MAW. A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

Chapter 4

4.0 – Recommended Safety Procedures

Jobsite safety is a topic and a practice addressed comprehensively by others. The inclusions here are merely reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply.

4.1 – Confined Space/Personal Safety Equipment/Warning and Cautions

Please see reference on Page 3.

Chapter 5

5.0 – Jellyfish Filter Replacement Parts

Jellyfish membrane filtration cartridges, cartridge components, cartridge lids, other replacement parts can be ordered by contacting Imbrium Systems at:

United States: 888-279-8826 or 301-279-8827

Canada/International: 800-565-4801 or +1-416-960-9900

info@imbriumsystems.com

5.1 – Jellyfish Filter Replacement Parts List

Note: Jellyfish Cartridges and/or Filtration tentacles are available in the following lengths:

• 15 Inch (381 mm) • 27 Inch (686 mm) • 40 Inch (1,016 mm) • 54 Inch (1,372 mm)

- Jellyfish Cartridge (specify length). Includes head plate with lifting loops, rim gasket, eleven (11) filtration tentacles, eleven (11) o-rings, and eleven (11) locking nuts
- Standard Head plate
- Blank head plate
- Rim gasket (for head plate)
- Locking nuts (for tentacles)
- O-rings (for tentacles)
- Cartridge lids are available with the following orifice sizes: 70mm, 55mm, 45mm, 35mm, 30mm, 25mm, 30mm, blank lid (no orifice)
- Maintenance Access Wall (MAW) extension (18-inch segment)

** Nothing in this catalog should be construed as an expressed warranty or implied warranties, including the warranties of merchantability and of fitness for any particular purpose.*

Jellyfish Filter Inspection and Maintenance Log

Owner: _____ Jellyfish Model No.:_____

Location: _____ GPS Coordinates: _____

Land Use: Commercial:_____ Industrial: _____ Service Station:_____

Road/Highway:____ Airport: _____ Residential: _____ Parking Lot:_____

Date/Time:						
Inspector:						
Maintenance Contractor:						
Visible Oil Present: (Y/N)						
Oil Quantity Removed						
Floatable Debris Present: (Y/N)						
Floatable Debris removed: (Y/N)						
Water Depth in Backwash Pool						
Draindown Cartridges externally rinsed and re-commissioned: (Y/N)						
New tentacles put on Cartridges: (Y/N)						
Hi-Flo cartridges externally rinsed and recommissioned (Y/N):						
New tentacles put on Hi-Flo Cartridges: (Y/N)						
Sediment Depth Measured: (Y/N)						
Sediment Depth (inches or mm):						
Sediment Removed: (Y/N)						
Cartridge Lids intact: (Y/N)						
Observed Damage:						
Comments:						

APPENDIX D

Terms of Reference

CROZIER
CONSULTING ENGINEERS

2800 High Point Drive | T. 905.875.0026
Suite 100, Milton, ON | F. 905.875.4915
L9T 6P4 | cfcrozier.ca

MINUTES

NAME OF MEETING: Pre-Consultation Meeting
DATE OF MINUTES: November 8, 2018
DATE OF MEETING: November 7, 2018
PROJECT NAME: 100, 108, & 114 Emma St. South (Emma Grand)
PROJECT NO.: 1476-4787
LOCATION: Town of Grand Valley

ATTENDEES

NAME	COMPANY	EMAIL ADDRESS
Mark Kluge	Town of Grand Valley	mkluge@townofgrandvalley.ca
Carley Dixon	R.J. Burnside	Carley.Dixon@rjburnside.com
Mohsin Samdany	Golden Canadian Homes	mohsinsam1971@yahoo.ca
Loghman Azar	Line Architecture	loghman@linearchitect.com
Abraham Barrios	Crozier Consulting Engineers	abarrios@cfcrozier.ca
Jordan Atherton	Crozier Consulting Engineers	jatherton@cfcrozier.ca

ITEMS

ACTION / DISCUSSION

1.0	**William Street Easement Entrance**
1.1	The Town prefers that the norther access to the site be via a private driveway through the William Street ROW. The Town does not want the northern site access to be directly to Emma Street, as originally planned, due to the nearby William Street intersection.
1.2	An agreement would need to be established between the property owner and the Town to use part of the William Street ROW as the northern site access.
1.3	Neighboring property owner already using the William Street ROW likely has an agreement in place with the Town for its use of the ROW.
1.4	A private driveway through the William Street ROW would be the property owner's responsibility.
2.0	**William Street Sidewalk Connectivity**
2.1	The Town wants connectivity of a sidewalk along William Street from the site at Emma Street to the existing sidewalk at Water Street.
2.2	The design of the sidewalk would be submitted with the current application.
3.0	**Emma Street Upgrades**
3.1	Town states there are no planned upgrades to Emma Street in the vicinity of the site.

4.0	**Stormwater Management**
4.1	The Town outlined their stormwater management requirements for the site. The Town will defer to GRCA requirements when more stringent.
4.2	Quantity Control: Town does not require quantity control measures, only adequate conveyance to ultimate outlet.
4.3	Quality Control: Town requires MOECP Enhanced Level of Protection (80% TSS removal).
4.4	Town has no hydrological modelling preferences.
4.5	Crozier to contact Laura Warner or Jenn Simons for GRCA stormwater requirements.
4.6	Town will require an explanation of how foundation draining will be addressed.
4.7	The Town wants to see that all gravity sewer options have been explored before a sump pump is proposed.
5.0	**Groundwater Protection Zone**
5.1	The Town recommends Crozier check if the site is located within a GRCA Groundwater Protection Zone.
6.0	**Sanitary Services**
6.1	The current sanitary sewer along Emma Street has reached its capacity. There are planned upgrades to the Emma Street sanitary sewer. Crozier to state in report that sanitary sewer is to be upgraded as outlined in the Master Servicing Plan.
6.2	Crozier not required to complete a downstream analysis of the sanitary sewer.
6.3	Crozier only required to submit sanitary demand for the site and RJ Burnside will update their sanitary model as part of the review of the application.
7.0	**Water Servicing**
7.1	A hydrant flow test is not required for the submission. Water pressures can be obtained from RJ Burnside through their water distribution model.
7.2	Crozier will need to provide water demand and fire flow demands as part of the FSR. RJ Burnside will look at the demands in their water model as part of the review.
8.0	**Retaining Wall**
8.1	The Town states that retaining walls shown on drawings require a structural engineer approval or note clearly stating that the retaining walls are to be designed by a structural engineer. Drawings stamped by a structural engineer will be required.

These minutes are a record of the above noted meeting and are considered final.

Yours truly,

C.F. CROZIER & ASSOCIATES INC.

Jordan Atherton, M.Sc. EIT
Water Resources

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Jordan Atherton

From: Laura Warner <lwarner@grandriver.ca>
Sent: Monday, December 10, 2018 11:45 AM
To: Jordan Atherton
Cc: Christopher Kwan
Subject: RE: Emma Street Grand Valley - SWM Requirements (1476-4787)1

Hi Jordan,

Please see the answers to your questions below in blue:

1. Can we use an OGS (with 83% TSS removal efficiency) as the sole source of water quality treatment. We can not infiltrate on the site due to a high water table and the site being located partially within a Well Protection Zone.
   If OGS is the only source of water quality treatment GRCA requires the OGS unit to be ETV certified, such as the Jellyfish Filter.

2. Can we have two stormwater outlets for the site.
   a. The clean runoff from the roof and landscape areas would outlet to the Emma Street roadside ditch. This is where existing runoff drains.
      GRCA requires that the runoff will not cause and/or increase flooding on any neighbouring properties between the proposed development and the final outlet to the Grand River. Please demonstrate that the existing Emma Street roadside ditch has the capacity of receive the increased post-development flows from roofs/landscaped areas if they are not being retained to meet pre-development flow rates.
   b. The runoff treated by the OGS would outlet to the storm sewer located along the William Street ROW.

Please let me know if you have additional questions.

Kind regards,
Laura

Laura Warner | Resource Planner
Grand River Conservation Authority
400 Clyde Road, Cambridge ON N1R 5W6
P: (519) 621-2763 x 2231 | F: (519) 621-4844
lwarner@grandriver.ca | www.grandriver.ca

From: Jordan Atherton [mailto:jatherton@cfcrozier.ca]
Sent: Thursday, December 6, 2018 10:53 AM
To: Laura Warner
Subject: RE: Emma Street Grand Valley - SWM Requirements (1476-4787)1

Hi Laura,

I am working on a project in the Town of Grand Valley and had some questions regarding GRCA stormwater management criteria. I was previously speaking with Jason Wagler, see below emails. This site is located in the flood fringe at the intersection of Emma Street and William Street, google map.

1. Can we use an OGS (with 83% TSS removal efficiency) as the sole source of water quality treatment. We can not infiltrate on the site due to a high water table and the site being located partially within a Well Protection Zone.
2. Can we have two stormwater outlets for the site.
    a. The clean runoff from the roof and landscape areas would outlet to the Emma Street roadside ditch. This is where existing runoff drains.
    b. The runoff treated by the OGS would outlet to the storm sewer located along the William Street ROW.

Thanks,

Jordan

| **JORDAN ATHERTON** MSc., EIT | ENGINEERING INTERN | C.F. CROZIER & ASSOCIATES
| 2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
| cfcrozier.ca | jatherton@cfcrozier.ca | tel 905 875 0026

CROZIER & ASSOCIATES Consulting Engineers
Land development engineering, from the ground up.
Water Resources · Transportation · Structural · Mechanical · Electrical · Building Science

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From: Jason Wagler <jwagler@grandriver.ca>
Sent: Tuesday, November 20, 2018 11:00 AM
To: Jordan Atherton <jatherton@cfcrozier.ca>
Subject: RE: Emma Street Grand Valley - SWM Requirements (1476-4787)

Hi Jordan,

Here are GRCA's SWM requirements for the site:

In terms of SWM quantity control requirements, GRCA requires that the proposed development will not cause and/or increase flooding on any neighbouring properties between the proposed development and the final outlet to the Grand River.

GRCA will require the proponent to demonstrate that the storm sewer system and existing ditches can convey the post development storms up to and including the 100 year, and that there are no impacts to flooding and erosion control on neighbouring "downstream" properties for overland flow.

Regards,

Jason Wagler, MCIP, RPP
Resource Planner
Grand River Conservation Authority

400 Clyde Rd, Cambridge ON N1R 5W6
(519) 621-2763 x2320
www.grandriver.ca

From: Jordan Atherton [mailto:jatherton@cfcrozier.ca]
Sent: Monday, November 19, 2018 8:57 AM
To: Jason Wagler
Subject: RE: Emma Street Grand Valley - SWM Requirements (1476-4787)

Hi Jason,

Runoff will be conveyed off site via internal storm sewer to the existing 1500 mm storm sewer in the William Street ROW. Overland flow will be conveyed to the roadside ditch along Emma Street, matching the existing drainage patterns. Both of the storm sewer and roadside ditch eventually outlet into the Grand River.

Jordan

From: Jason Wagler <jwagler@grandriver.ca>
Sent: Friday, November 16, 2018 11:17 AM
To: Jordan Atherton <jatherton@cfcrozier.ca>
Subject: FW: Emma Street Grand Valley - SWM Requirements (1476-4787)

Hi Jordan,

Our engineer has a couple questions before providing SWM requirements:

- How will runoff be conveyed off site? Overland flow, storm sewers?
- Provide overland flow route of major system.

Regards,

Jason

From: Jordan Atherton [mailto:jatherton@cfcrozier.ca]
Sent: Friday, November 9, 2018 9:09 AM
To: Jason Wagler
Subject: Emma Street Grand Valley - SWM Requirements (1476-4787)

Hi Jason,

We are working on a development in the Town of Grand Valley. The site is partially located within the flood fringe and we are wondering what the GRCA SWM requirements are for such sites. The site is located at 100, 108 & 114 Emma Street, Grand Valley. We are proposing connecting to the storm sewer along the William Street RoW.

We have had discussion with the Town and they have no quantity control requirements, only quality control.

Thanks,

Jordan

| **JORDAN ATHERTON** MSc., EIT | ENGINEERING INTERN | C.F. CROZIER & ASSOCIATES
| 2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4

| cfcrozier.ca | jatherton@cfcrozier.ca | tel 905 875 0026

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APPENDIX E

Floodplain Analysis

CROZIER
CONSULTING ENGINEERS

2800 High Point Drive | T. 905.875.0026
Suite 100, Milton, ON | F. 905.875.4915
L9T 6P4 | cfcrozier.ca

TECHNICAL MEMO

DATE	June 8, 2018	**PROJECT NO.**	1476-4787
RE	Floodplain Analysis 100/108/114 Emma Street, Town of Grand Valley, Dufferin County		

TO	Nathan Garland, Resources Officer (Grand River Conservation Authority)
FROM	Abraham Barrios, P.Eng.
CC	Mohsin Samdany (Golden Canadian Homes Inc.) Loghman Azar (Line Architect)

Introduction

C.F. Crozier and Associates Inc. (Crozier) was retained by Golden Canadian Homes Inc. (the Owner) to complete a floodplain analysis to support the Site Plan Application for a proposed development at 100/108/114 Emma Street in the Town of Grand Valley. The purpose of this memo is to document the methodology and results of the floodplain analysis and demonstrate that the proposed site grading design meets the criteria of the Grand River Conservation Authority (GRCA) for the lands in the vicinity of the Site.

Background

The subject property is approximately 0.3 ha and is currently vegetated undeveloped land. The property is located in a mixed residential area, bounded by Emma Street to the east and William Street to the north, residential properties to the west, and a carwash facility to the south. It is understood that the proposed development includes the construction of a 22 to 24-unit apartment building and associated parking area.

The Grand River is located approximately 75 m to the east of the property and the eastern third of the property is contained within the Regulatory Floodplain of Grand River. As a result of this, a floodplain analysis is required to satisfy GRCA requirements prior to proceeding with a Site Plan Application. The GRCA regulates this reach of the Grand River as a two-zone floodplain and the site is contained within the flood fringe of the floodplain.

The material in this memo reflects best judgment in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. C.F. Crozier & Associates Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Terms of Reference

Terms of Reference were developed for the location of the proposed development with respect to the floodplain were developed development through correspondence with GRCA.

The following terms were agreed upon through pre-consultation with GRCA in December 2007 and February 2018:

- The Regional flood level at the site is 455.33 m and the 100-Year flood level at the site is 453.74 m.
- A cut and fill balance analysis is not required for developments located within the flood fringe of a two-zone floodplain.
- The fixed floor elevation (FFE) of a building located within the flood fringe of a two-zone floodplain should be situated at least 1 cm above the Regional floodplain.

Methodology

The floodplain assessment included the following tasks:

- Reviewing the Grand River hydraulic (HEC-RAS) model provided by the GRCA.
- Confirming that the Regional and 100-Year flood levels provided by the GRCA model were 455.33 masl and 453.74 masl, respectively, by interpolating the water level of HEC-RAS stations 442.3 (upstream of the site) and 437.3 (downstream of the site).
- Interpolating the existing Regional and 100-Year floodplains onto the topographic survey (Cullen & Associates, November 2013) of the site.
- Completing conceptual grading of the site based on raising the fixed floor elevation of the proposed building above the Regional floodplain (to 455.34 m). The site was raised above the Regional floodplain through the addition of fill, no cut and fill balance is required because the site is located within the flood fringe of the two-zone floodplain.

Existing Conditions

As discussed in the Terms of Reference, the high-water elevation corresponding to the Regional and 100-year event for the subject reach of the Grand River is 455.33 m and 453.74 m, respectively. The topographic survey provided by Cullen & Associates indicates that the property is sloping downwards from west to east. The Regional floodplain extends onto approximately one third of the property, including part of the proposed construction area. The section of the property located within the Regional floodplain is situated between the Regional food level and the 100-Year flood level, an area classified as the flood fringe of the two-zone floodplain.

The 100-Year flood line is mostly confined to the western edge of Emma Street, apart from a small area at the south east corner of the property that is located within the 100-Year flood line. The area that is located below the 100-Year flood level is classified as the flood way of the two-zone floodplain.

Proposed Conditions

A conceptual grading plan of the site was completed to show that the proposed building can be elevated above the Regional floodplain elevation, as shown in Figure 1. Under proposed conditions, the area of the proposed building will be earth filled to bring the fixed floor elevation of the proposed building to 455.34m. As can be seen in Figure 1, the proposed Regional floodplain is pushed east of existing Regional floodplain location approximately 6 m. The proposed parking area is to be located within the flood fringe of the floodplain.

The Ontario Ministry of Natural Resources and Forestry (MNRF) Technical Guide: River and Stream Systems: Flooding Hazard Limit (2002) provides recommendations relating to the safe ingress/egress of the site. In Appendix 6 of the MNRF Technical Guide, the MNRF presents guidelines for the velocity and flooding depth to allow for safe ingress/egress. The MNRF's "3x3" rule indicates that vehicles are stable with velocity x depth product of approximately 3 m^2/s and advises a maximum flooding depth of 0.9 m -1.2 m for diesel fire trucks before the vehicle would have issues with ingress/egress from the site. In conversation with the GRCA, it was stated that "by virtue of locating in the two zone it has safe access".

The northern site entrance at the property line has a low point elevation of 454.42 m at the property line. This corresponds to a Regional flood depth of 0.91 m. The bank velocity (0.82 m/s) of the Regional storm at the property is determined by taking the average of the HEC-RAS overbank velocities of River Stations 442.3 and 437.3 on the right bank, see Table 1. With a flood depth of 0.91 m and a velocity of 0.82 m/s, the velocity x depth in this specific location is 0.75 m^2/s. The Regional depth of flooding and depth x velocity product at the property line of the northern property access ramp satisfy the MNRF requirements for diesel fire truck ingress/egress to the site. The northern entrance to the site is located within the flood fringe and would thereby provide safe access under the GRCA two-zone policy. It should be noted that the elevation of Emma Street at the southern site access is located within the floodway.

Table 1: HEC-RAS Overbank Velocity and Water Surface Elevation for the Regional Storm Event

HEC-RAS River Station	Right Overbank Velocity (m/s)	Regional Water Surface Elevation (m)
442.3	0.61	455.39
437.3	1.03	455.27
Average	0.82	455.33

A conceptual Site Grading and Drainage Plan (Figure 1) illustrates that drainage from the site will not be impeded by the proposed development. During frequent precipitation events, stormwater from the site will continue to drain to the roadside ditch along Emma Street. Two culverts will be required within the Emma Street roadside ditch to convey flow under the site entrance ramps at the east and west side of the site.

Conclusions and Recommendations

We conclude that the floodplain analysis for this property is in general conformance with the GRCA standards for a two-zone floodplain. The proposed building is situated at a fixed floor elevation 455.34 m, which is above the Regional floodplain elevation of 455.33m as required by the GRCA for developments within the flood fringe. The Regional flood depth and velocity at the northern site entrance ramp allow for safe ingress/egress of emergency vehicles.

We trust that this analysis meets the GRCA requirements to support the proposed development of the site and recommend that the floodplain analysis contained in this memo is accepted such that the owner can proceed with the Site Plan Application for the proposed works.

Please contact the undersigned if you have any questions.

Sincerely,

C.F. CROZIER & ASSOCIATES INC.

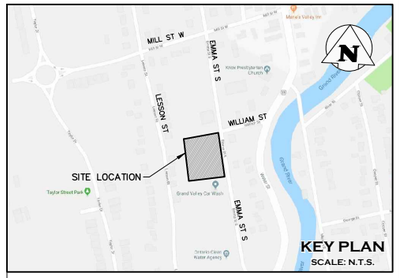
Jordan Atherton, M.Sc., E.I.T.
Water Resources E.I.T.
/ko

C.F. CROZIER & ASSOCIATES INC.

Abraham Barrios, P.Eng.
Senior Water Resources Engineer

Encl. Figure 1: Conceptual Grading and Drainage Figure
Correspondence with GRCA
HEC-RAS Output for River Stations 442.3 and 437.3

I:\1400\1476-Mohsin Samdany\4787-105-108-114 Emma St\Memos\Phase 2\2018.06.08 - Floodplain Analysis.docx



LEGEND

- PROPERTY LINE
- EX. CONTOUR (0.5m)
- EX. CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING FENCE
- x215.00 EXISTING GRADE
- x215.00 PROPOSED GRADE
- x215.00 PROPOSED GRADE (TO MATCH EXISTING)
- 2.0% PROPOSED MINOR FLOW DIRECTION
- 2.0% PROPOSED GRASSED SWALE
- PROPOSED SLOPE (3:1 MAX.)
- PROPOSED MAJOR OVERLAND FLOW DIRECTION
- PROPOSED BUILDING EXIT
- PROPOSED TREES
- PROPOSED CURB
- PROPOSED RETAINING WALL
- PROPOSED STORM SEWER
- PROPOSED CATCHBASIN
- PROPOSED CATCHBASIN MANHOLE
- PROPOSED RIPRAP LINED CHANEL
- EXISTING REGIONAL FLOODPLAIN; ELEV = 455.33
- PROPOSED REGIONAL FLOODPLAIN

No.	ISSUE / REVISION	YYYY/MMM/DD
A	ISSUED WITH FLOODPLAIN ANALYSIS	2018/JUN/07

ELEVATION NOTE:

ALL ELEVATIONS SHOWN HERON ARE DERIVED FROM VERTICAL CONTROL MONUMENT No. 00819798442

ELEVATION = 472.478m

SURVEY NOTES:

SURVEY COMPLETED BY CULLEN & ASSOCIATES (2017/NOV/13)
REFERENCE No.: 17-186

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON SITE PLAN BY LINE ARCHITECT
DRAWING No.: A101, REV.1 (2017/APR/11)
PROJECT No.: 1731

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Project

MOHSIN SAMDANY
100,108 & 114 EMMA ST SOUTH
GRAND VALLEY

Drawing

CONCEPTUAL
SITE GRADING AND DRAINAGE PLAN

NOT FOR CONSTRUCTION

Stamp

PRELIMINARY

CROZIER & ASSOCIATES Consulting Engineers
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905 875-0026 T
905 875-4915 F
WWW.CFCROZIER.CA

Drawn	Design	Project No.
I.K.A.	J.A.	1476-4787
Check	Check	Scale / Dwg.
S.C.S.	A.J.B.	1:200 / FIG1

5 0m 5 10 15
SCALE: 1:200

HEC-RAS Plan: 2015 Locations: User Defined

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vel Left	Vel Right	Vel Total
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(m/s)	(m/s)	(m/s)
Grand	Upper	442.3	Regional	780.00	449.88	455.39		455.58	0.000700	2.25	576.62	235.02	0.33	0.70	0.61	1.35
Grand	Upper	442.3	100-yr	296.00	449.88	453.81		453.92	0.000600	1.59	250.94	171.59	0.28	0.35	0.29	1.18
Grand	Upper	442.3	50-yr	279.00	449.88	453.73		453.84	0.000591	1.55	238.02	166.54	0.28	0.33	0.27	1.17
Grand	Upper	442.3	20-yr	250.00	449.88	453.59		453.70	0.000576	1.49	215.19	161.69	0.28	0.28	0.24	1.16
Grand	Upper	442.3	10-yr	222.00	449.88	453.44		453.54	0.000562	1.42	191.53	155.13	0.27	0.23	0.20	1.16
Grand	Upper	442.3	5-yr	192.00	449.88	453.26		453.35	0.000546	1.34	164.76	136.38	0.26	0.17	0.18	1.17
Grand	Upper	442.3	2-yr	132.00	449.88	452.81		452.87	0.000493	1.13	116.93	58.38	0.24		0.10	1.13
Grand	Upper	437.3	Regional	780.00	449.76	455.27		455.46	0.000867	2.34	495.46	171.28	0.36		1.03	1.57
Grand	Upper	437.3	100-yr	296.00	449.76	453.68		453.82	0.000809	1.77	234.34	142.51	0.33		0.58	1.26
Grand	Upper	437.3	50-yr	279.00	449.76	453.61		453.74	0.000806	1.74	223.43	141.33	0.32		0.56	1.25
Grand	Upper	437.3	20-yr	250.00	449.76	453.47		453.59	0.000802	1.69	203.75	139.18	0.32		0.50	1.23
Grand	Upper	437.3	10-yr	222.00	449.76	453.32		453.44	0.000807	1.64	182.78	137.34	0.32		0.44	1.21
Grand	Upper	437.3	5-yr	192.00	449.76	453.13		453.25	0.000799	1.57	158.43	123.44	0.31		0.41	1.21
Grand	Upper	437.3	2-yr	132.00	449.76	452.68		452.77	0.000805	1.40	105.90	84.77	0.31		0.37	1.25

Jordan Atherton

From: Nathan Garland <ngarland@grandriver.ca>
Sent: Wednesday, February 14, 2018 10:25 AM
To: Jordan Atherton
Subject: RE: 105/108/114 Emma Street Grand River (1476-4787)

Response below in red.

I'm going to stress this pretty strongly and you can relay this along to your client, but we have not been in touch with any geotechnical engineer or seen any geotechnical consideration and this is going to be a major consideration for the site. Right now this is looking like it is going to be near the end of the project and we are going to red flag the geotechnical if it comes back as a concern.

Regards,

Nathan Garland
Resource Planner
Grand River Conservation Authority

ngarland@grandriver.ca
Direct Line: 519.621.2763 x 2236
Office: 1.866.900.4722
Fax: 519.621.4945

From: Jordan Atherton [mailto:jatherton@cfcrozier.ca]
Sent: February 14, 2018 9:48 AM
To: Nathan Garland
Subject: RE: 105/108/114 Emma Street Grand River (1476-4787)

Hi Nathan,

I have some questions regarding the requirements for developing within the flood fringe for the Emma Street property.

- What are the cut/fill requirements, is a balance required? No cut and fill requirement because it is two zone.
- Do we require a freeboard above the regional flood level? Just higher than the regulatory line. 1 cm if you wanted a number.

Thanks,

| **JORDAN ATHERTON** | E.I.T. | C.F. CROZIER & ASSOCIATES
| 2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
| cfcrozier.ca | jatherton@cfcrozier.ca | tel 905 875 0026

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From: Nathan Garland [mailto:ngarland@grandriver.ca]
Sent: Tuesday, December 05, 2017 2:03 PM
To: Jordan Atherton <jatherton@cfcrozier.ca>
Subject: RE: 105/108/114 Emma Street Grand River (1476-4787)

Hi Jordan,

The criteria for two zone is safe access therefore by virtue of locating in the two zone it has safe access. However, one of the reasons we have been so firm on the requirement that it not be assisted living or institutional is that the access will may be safe, but not dry and therefore would not support the use. So if we review a zone change application and there is reference to assisted living, seniors, home care or any type of supported living we will likely raise a concern. Once again I have not seen any plans or proposals so I can give you generals and reference policy, but there are details and facts left out we will raise a concern.

Regards,

Nathan Garland
Resource Planner
Grand River Conservation Authority

ngarland@grandriver.ca
Direct Line: 519.621.2763 x 2236
Office: 1.866.900.4722
Fax: 519.621.4945

From: Jordan Atherton [mailto:jatherton@cfcrozier.ca]
Sent: December 5, 2017 1:57 PM
To: Nathan Garland
Subject: RE: 105/108/114 Emma Street Grand River (1476-4787)

Hi Nathan,

I have a question about ingress/egress within the flood fringe for the Emma Street property.

Section 8.1.31 of the GRCA Policies state that building may be permitted within the flood fringe provided that “e) ingress and egress to the building or structure is ‘dry’ where this standard can be practically achieved, or floodproofed to an elevation which is practical and feasible, but no less than ‘safe’.”

Are there any more specific GRCA guidelines or requirements on ingress/egress for properties within the flood fringe area? Is this an issue with this property. I have not seen this topic raised in previous correspondence with Mohsin.

Thanks,

Jordan

From: Nathan Garland [mailto:ngarland@grandriver.ca]
Sent: Monday, December 04, 2017 11:48 AM
To: Jordan Atherton <jatherton@cfcrozier.ca>

Cc: Gabriela Skibinski <gskibinski@cfcrozier.ca>
Subject: RE: 105/108/114 Emma Street Grand River (1476-4787)

Hi Jordan,

Probably sometime after 3pm would be fine.

Nathan Garland
Resource Planner
Grand River Conservation Authority

ngarland@grandriver.ca
Direct Line: 519.621.2763 x 2236
Office: 1.866.900.4722
Fax: 519.621.4945

From: Jordan Atherton [mailto:jatherton@cfcrozier.ca]
Sent: December 4, 2017 11:46 AM
To: Nathan Garland
Cc: Gabriela Skibinski
Subject: 105/108/114 Emma Street Grand River (1476-4787)

Hi Nathan,
We would like to have a quick chat with you regarding our clients proposed development at 105/108/114 Emma Street in Grand Valley. Would we be able to give you a call sometime this afternoon?
Thanks,
Jordan

| **JORDAN ATHERTON** | E.I.T. | C.F. CROZIER & ASSOCIATES
| 2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
| cfcrozier.ca | jatherton@cfcrozier.ca | tel 905 875 0026

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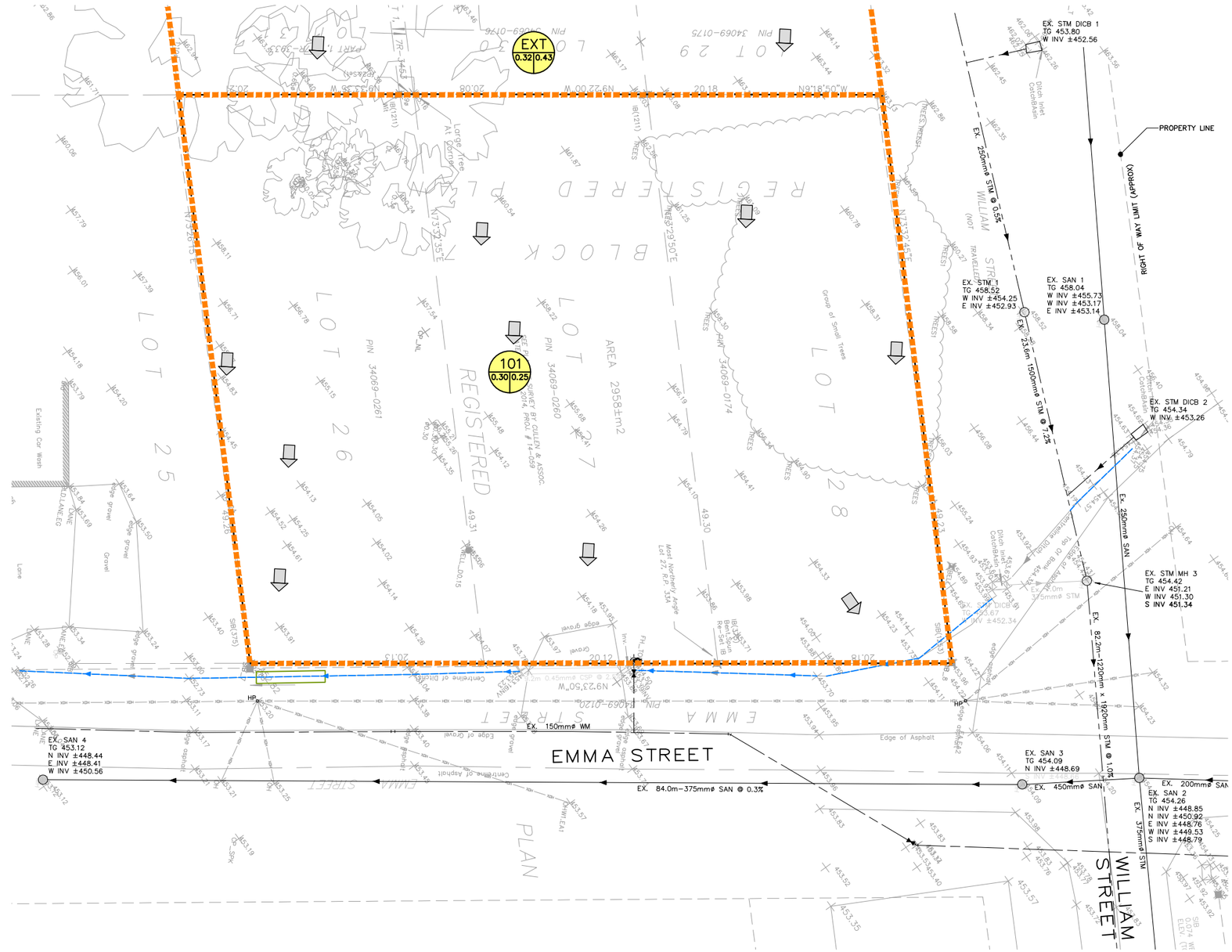
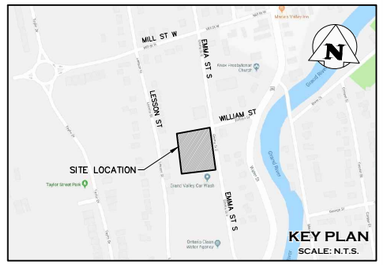
FIGURES





LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING GRADE
- EXISTING OVERLAND FLOW DIRECTION
- STORM DRAINAGE CATCHMENT
- ID — CATCHMENT I.D.
- A | RC — AREA (ha) | RUNOFF COEFFICIENT

No.	ISSUE / REVISION	YYYY/MMM/DD
1	ISSUED FOR 2ND SUBMISSION SPA	2019/SEPT/27
0	ISSUED FOR 1ST SUBMISSION SPA	2019/JAN/14

ELEVATION NOTE:

ELEVATIONS ARE RELATED TO THE CANADIAN GEODETIC VERTICAL DATUM: 1978, AND ARE REFERRED TO STATION #008197988442 (VERTICAL ORDER: 1) LOCATED AT LATITUDE 43°53'18" NORTH, LONGITUDE 80°18'48" WEST. TABLET IN SOUTH FACE OF STONE FOUNDATION OF BRICK HOUSE (MUN. #173146). ELEVATION = 472.478 m.
LOCAL BENCHMARKS WERE ESTABLISHED ON THE TOP OF TWO FIRE HYDRANTS AS SHOWN ON THE PLAN.

SURVEY NOTES:

SURVEY COMPLETED BY P.J. WILLIAMS (2018/DEC/18)

SURVEY COMPLETED BY CULLEN & ASSOCIATES (2017/NOV/13)
REFERENCE No.: 17-186

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON SITE PLAN BY LINE ARCHITECT
DRAWING No.: A101, REV.1 (2019/SEPT/24)
PROJECT No.: 1731

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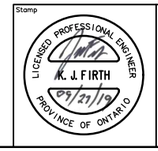
Project

GOLDEN CANADIAN HOMES INC.
100,108 & 114 EMMA ST SOUTH
GRAND VALLEY

Drawing

PRE DEVELOPMENT DRAINAGE PLAN

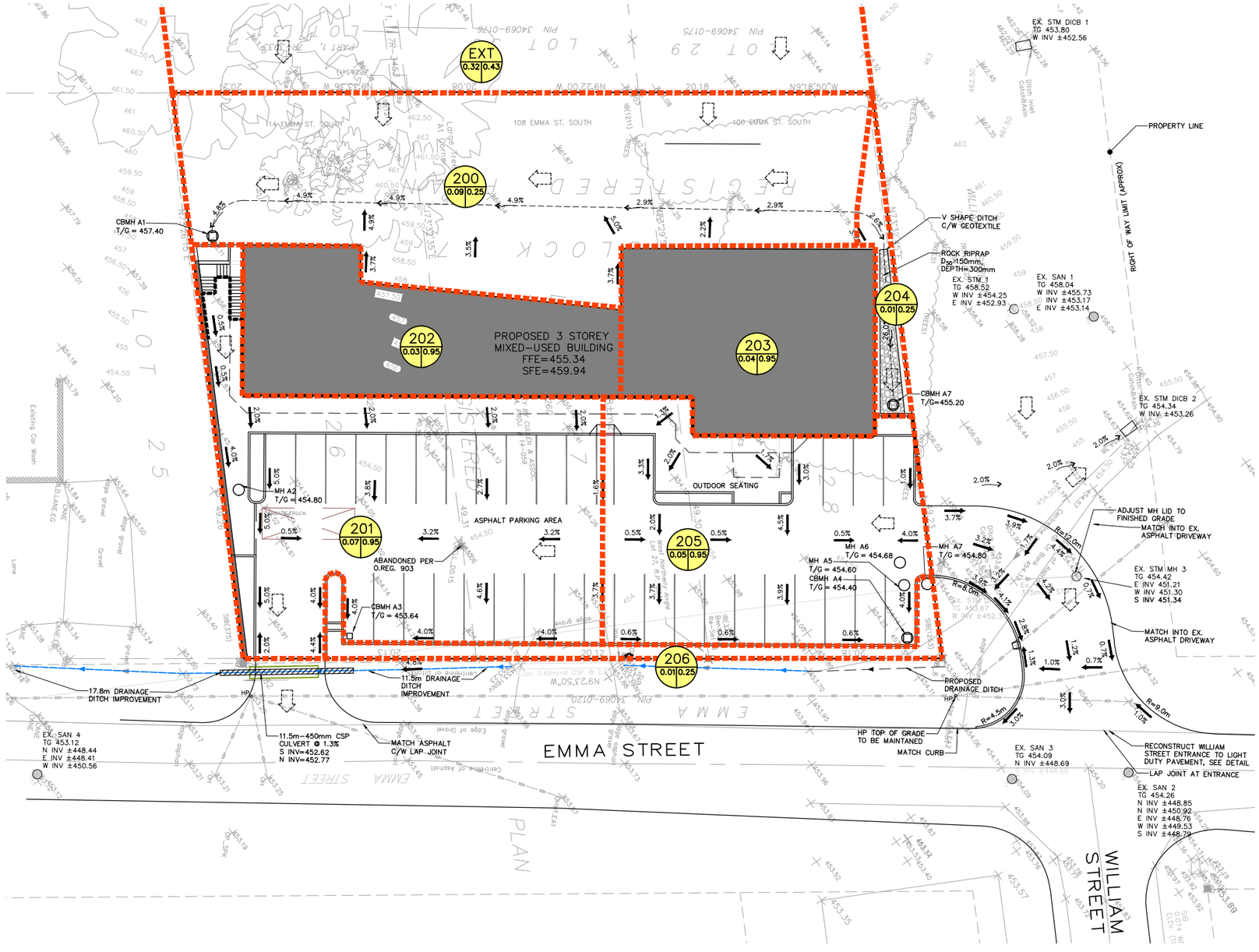
Stamp

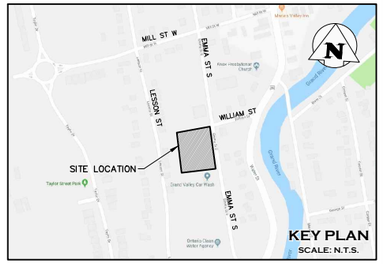


Stamp

CROZIER & ASSOCIATES Consulting Engineers
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905 875-0026 T
905 875-4915 F
WWW.CFCROZIER.CA

Drawn	Design	Project No.	
P.S.	P.S.	1476-4787	
Check	Check	Scale	Dwg.
S.C.S.	J.A.	1:200	FIG 1





LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING GRADE
- PROPOSED MAJOR OVERLAND FLOW DIRECTION
- STORM DRAINAGE CATCHMENT
- ID / A | RC — CATCHMENT I.D. / AREA (ha) | RUNOFF COEFFICIENT

No.	ISSUE / REVISION	YYYY/MMM/DD
1	ISSUED FOR 2ND SUBMISSION SPA	2019/SEPT/27
0	ISSUED FOR 1ST SUBMISSION SPA	2019/JAN/14

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Project

GOLDEN CANADIAN HOMES INC.
100,108 & 114 EMMA ST SOUTH
GRAND VALLEY

Drawing

PROPOSED DRAINAGE CONDITIONS

Stamp

LICENSED PROFESSIONAL ENGINEER
K. J. FIRTH
09/27/19
PROVINCE OF ONTARIO

Stamp

CROZIER & ASSOCIATES
Consulting Engineers
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905 8750026 T
905 875 4915 F
WWW.CFCROZIER.CA

Drawn	P.S.	Design	P.S.	Project No.	1476-4787
Check	S.C.S.	Check	J.A.	Scale	1:200
				Dwg.	FIG 2