



J+B ENGINEERING INC.
WWW.JANDB-INC.COM

STORMWATER MANAGEMENT REPORT

FOR THE PROPERTY LOCATED AT
623 YONGE STREET & 515 BIG BAY POINT RD,
BARRIE, ONTARIO



PETRO-CANADA

Prepared By:

J+B Engineering Inc.
25 Centurian Drive, Suite 201
Markham, Ontario
L3R 5N8

January 22, 2024



Stormwater Management Study

Table of Contents

1. INTRODUCTION	1
1.1 Study Area.....	1
1.2 Background.....	1
1.3 Objectives of Drainage and Stormwater Management Study	1
2. SITE DRAINAGE CONDITIONS.....	2
2.1 Existing Drainage Conditions.....	2
2.2 Target Release Rate.....	2
2.3 Proposed Drainage Conditions	2
3. PROPOSED STORMWATER MANAGEMENT PLAN.....	4
3.1 Quantity Control.....	4
3.2 SWM Summary	6
3.3 Quality Control	7
3.4 Phosphorus Budget.....	7
3.5 Water Balance.....	7
4. EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION	9
5. SUMMARY AND CONCLUSIONS	10
Appendix.....	11
Table 2-1 Existing Runoff Coefficients Sub-catchment A	3
Table 2-2 Proposed Runoff Coefficients Sub-catchment A.....	3
Table 2-3 Adjusted Runoff Coefficients for 5-100 years events (controlled sub-catchment)	3
Table 3-1 Peak Flows 5 - 100 Year Events for Controlled Sub-Catchment A	4
Table 3-2 Required storage Volume 100-year Storm Event (Controlled Sub-catchment A)	5
Table 3-3 Storage provided by stormwater structures.	5
Table 3-4 Storage provided by dry ponding.	5
Table 3-5 Storage provided by underground stormwater conduits.....	6
Table 3-6 Summary of actual Storage provided for controlled sub-catchment A.	6
Table 3-7 Peak Flows 5 - 100 Year Events for Uncontrolled Sub-Catchment B.....	6
Table 3-8 Water Balance volume requirement.	8
Table 3-9 Water Balance – Initial abstraction.....	8
Figure 1 Study Area	2

Stormwater Management Study

1. INTRODUCTION

1.1 Study Area

The study area is located on the southeast quadrant of Big Bay Point Road and Yonge Street intersection in Barrie, Ontario. The civic address for this property is 623 Yonge Street, Barrie, ON and is shown in Figure 1.

The study area is an existing gas station with a proposed redevelopment scope which includes replacement of the underground tanks, associated pumps, canopy and A&W restaurant. The existing c-wash will remain.

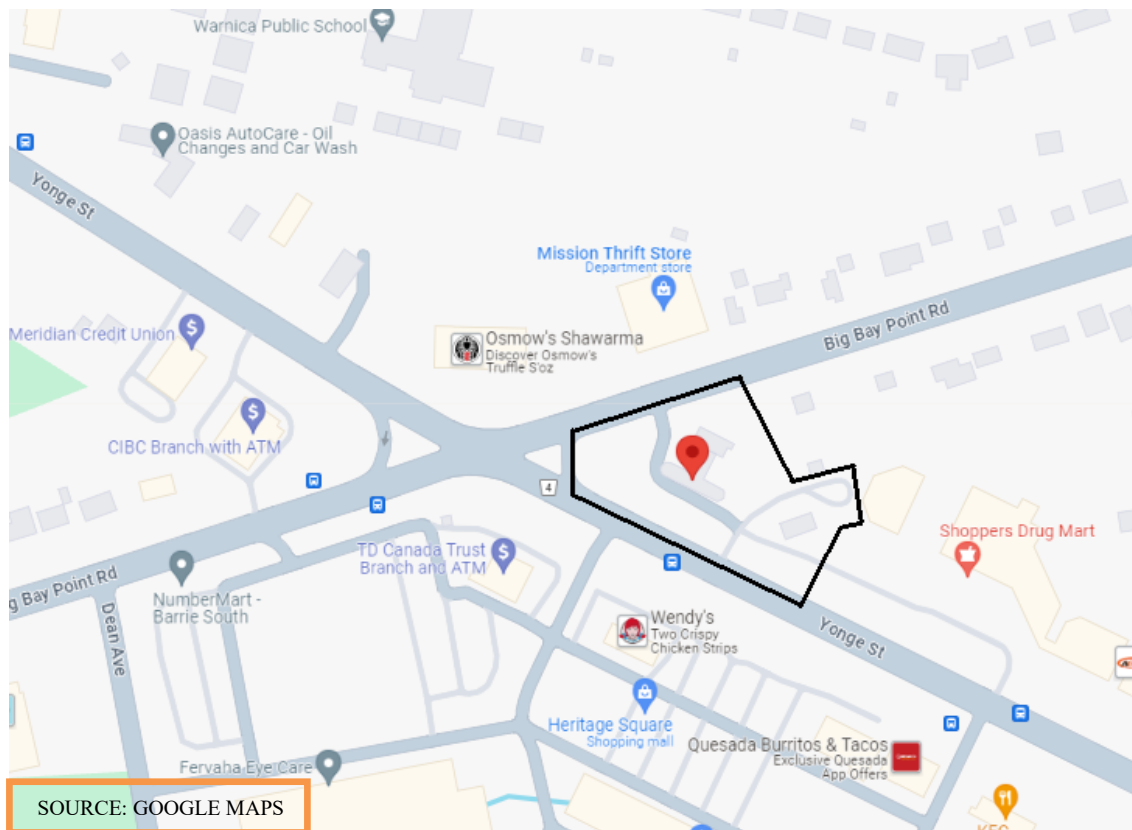


Figure 1 Study Area

1.2 Background

This study addresses the Stormwater Management (SWM) requirements for the proposed redevelopment and provides details for stormwater quantity and quality control to ensure that the proposed development will not have any adverse effects on the existing drainage system.

1.3 Objectives of Drainage and Stormwater Management Study

The objectives of the stormwater management study are to develop a strategy for the project that will:

- Identify potential stormwater runoff (quality) impacts to the receiving watercourses from the proposed development area.



Stormwater Management Study

- Address concerns from the review agencies including the City of Barrie, the Ministry of Environment, Conservation and Parks (MECP) and Lake Simcoe Regional Conservation Authority (LSRCA) for the preparation of a Stormwater Management study for quantity and quality purposes.
- Provide an appropriate site drainage system for safe operational use.

2. SITE DRAINAGE CONDITIONS

General Stormwater Management guidelines and information were obtained from the City of Barrie – Stormwater Infrastructure design Standard June 2023, and Standard Drawings.

2.1 Existing Drainage Conditions

The existing study area is a fully developed site with approx. 0.30ha of landscape and a total of 0.64ha in size. The site drainage is capture by five (5) catch-basins (CBs) that capture and convey the site's runoff to an STC stormceptor for quality control and subsequently discharge at the north property limits into a municipal 675mm dia. storm sewer along Big Bay Point Road. The site currently does not have any storm water quantity control in place.

2.2 Target Release Rate

Considering the subject property area is relatively small (less than 5.0ha as per City of Barrie's Standard), the "Modified Rational Method" was used to generate the 5-year target release rate using the weighted runoff coefficient for the existing conditions (Refer to Pre- and Post-development Plan P-304 in the Appendix for details), and the Intensity was calculated as per section 3.2 of the City of Barrie Infrastructure Design Standard. The calculated allowable release rate for the project site is as follows:

$$Q = 0.00278 \ C \ I \ A \quad \leftarrow \text{Equation (1)}$$

Where Q := Maximum Runoff Rate (m^3/sec)

C := Runoff Coefficient

I := Rainfall Intensity (mm/hr) (5-year storm event)

A := Drainage Area (ha)

$$Q_{\text{target}} = 0.00278 * 0.60 * 109.11 * 0.658$$

$$Q_{\text{target}} = 0.1192 \text{ m}^3/\text{sec} = \text{Allowable Release Rate}$$

2.3 Proposed Drainage Conditions

The post-development hydrologic conditions for the site were established utilizing the current City of Barrie standards, including the current 5-Year to 100-Year IDF data (located in appendix). A conservative surface run-off coefficient of 0.95 was used for impervious surfaces (ie. Roof drainage and parking area), and 0.20 was used for pervious surfaces (ie. landscape).

Stormwater Management Study

The study area is delineated into two sub-catchments, (Controlled and Uncontrolled) for stormwater management purposes and are described below.

Sub Catchment A (Controlled)

The controlled sub-catchment consists of majority of the site area (0.64ha) and the stormwater will be collected by various drains located around the proposed development and an underground storm storage chamber. The flow will be treated by an Oil/Water Separator (OWS) filter and controlled by an orifice pipe installed at the inlet of STM.MH#1 prior to discharging onto the City's storm network along Big Bay Point Road. The existing and proposed runoff coefficients for the controlled sub-catchment are shown in Tables 2-1 and 2-2 below.

Surface Composition		Impervious	Pervious	Combined
Existing Condition	(m ²)	3379.91	2996.49	6376.40
	(ha)	0.338	0.300	0.638
Runoff Coefficient		0.95	0.20	0.60

Table 2-1 Existing Runoff Coefficients Sub-catchment A

Surface Composition		Impervious	Pervious	Combined
Proposed Condition	(m ²)	4592.09	1784.31	6376.40
	(ha)	0.459	0.178	0.638
Runoff Coefficient		0.95	0.20	0.74

Table 2-2 Proposed Runoff Coefficients Sub-catchment A

For estimating flows using the Rational Method for storms greater than the 10-year return storm, runoff coefficients are increased 10%, 20% and 25% for the 25-year, 50-year and 100-year storms respectively to account for additional runoff due to soil saturation and the reduced accuracy associated with larger storms. C value of 0.50 has been used for existing developed site conditions. (Refer to Table 2-3).

St. Event	Existing	Proposed
5-Year	0.60	0.73
10-Year	0.60	0.73
25-Year	0.66	0.81
50-Year	0.72	0.89
100-Year	0.75	0.93

Table 2-3 Adjusted Runoff Coefficients for 5-100 years events (controlled sub-catchment)

Sub Catchment B (Uncontrolled)

The uncontrolled runoff from a small portion of the landscape and sidewalk areas at the north and southeast property limits identified as sub catchment B = 0.02ha will flow uncontrolled onto the adjacent right-of-way due to grading constraints and discharge onto the city's sewer network on Big Bay Point Road and Yonge Street, respectively.

Stormwater Management Study

3. PROPOSED STORMWATER MANAGEMENT PLAN

3.1 Quantity Control

With the proposed development, the drainage pattern is expected to change. In order to satisfy the City's requirements, quantity control must be provided to ensure post-development peak run-off is being controlled to pre-development levels for the 5 – 100-year storm events.

Sub-catchment A (Controlled)

The results of peak flow rates (m^3) generated by the "Modified Rational Method" for existing and proposed conditions for the North sub-catchment is shown in Table 3-1 below,

Storm Event	Rainfall Intensity (mm/hr)				<Equation 1> Flow Rate (m^3/sec)		
	a	b	c	I	Existing	Proposed	Excess Flow
5-Year	843.019	4.582	0.763	109.11	0.1156	0.1431	0.0276
10-Year	976.898	4.745	0.760	126.38	0.1339	0.1658	0.0319
25-Year	1133.123	4.734	0.756	148.26	0.1570	0.2140	0.0569
50-Year	1251.473	4.847	0.753	164.13	0.1738	0.2584	0.0845
100-Year	1383.628	4.905	0.754	180.44	0.1911	0.2959	0.1048

Table 3-1 Peak Flows 5 - 100 Year Events for Controlled Sub-Catchment A

As per Table 3-1 the release rate for the Control sub-catchment is based on the 5-year existing storm event which has a flow rate $Q = 0.1156 m^3/s$. The target release rate will be achieved using an orifice pipe restrictor at the inlet of the proposed storm outlet STM.MH#01 at the northwest limits of the property line adjacent to Big Bay Point Road.

Sizing of the orifice is given by the formula:

$$Q = C A \sqrt{2 g h} \leftarrow \text{Equation (2)}$$

Where Q = Flow Rate Through Orifice (m^3/sec) = $Q_{Allowable}$

C = Contraction Coefficient = 0.80 (For Orifice Pipe)

A = Area of Orifice Plate (m^2)

g = Acceleration Due To Gravity (m/sec^2) = $9.81 (m/sec^2)$

h = Pressure Head To Be Dissipated (m)

By trial-and-error calculations, a 165mm orifice pipe is required to control the flow to the allowable release rate.

$$Q = (0.80)\pi \left(\frac{0.165}{2}\right)^2 \sqrt{2 * 9.81 * \left(249.98 - 247.88 - \left(\frac{0.165}{2}\right)\right)}$$

$$Q = 0.1076 m^3/sec$$

Stormwater Management Study

The required onsite storage based on the orifice release rate is calculated using modified rational method and is shown below in Table 3-2.

Stm Event	Td	Id	Qpost	Qorifice	Excess Flow	Volume(cum)
100 Year	5	245.55	0.4027	0.1076	0.295	88.523
	10	180.44	0.2959	0.1076	0.188	112.974
	11	171.82	0.2818	0.1076	0.174	114.939
	12	164.10	0.2691	0.1076	0.161	116.272
	13	157.14	0.2577	0.1076	0.150	117.060
	14	150.83	0.2474	0.1076	0.140	117.374
	15	145.08	0.2379	0.1076	0.130	117.271
	20	122.52	0.2009	0.1076	0.093	111.975
	25	106.74	0.1750	0.1076	0.067	101.131
	30	94.99	0.1558	0.1076	0.048	86.688
	40	78.56	0.1288	0.1076	0.021	50.904
	50	67.51	0.1107	0.1076	0.003	9.263
	Max Volume Required cum					117.37

Table 3-2 Required storage Volume 100-year Storm Event (Controlled Sub-catchment A)

The 165mm orifice pipe, upstream of inlet STM.MH#1 will generate a required storage of 119.64m³. The storage is met by a combination of underground piping, storm drainage structures (CB's and MH's), dry ponding, and an underground storm storage concrete chamber system. The generated storage is illustrated in Tables 3-3, 3-4, 3-5, and 3-6 respectively.

Structure	Diameter (mm)	Area (m ²)	Maximum. Water level	Invert	Volume (m ³)
CB#01	600x600	0.36	249.98	248.86	0.40
CB#02	600x600	0.36	249.98	248.80	0.42
CBMH#01	1200.00	1.13	249.55	248.00	1.75
CBMH#02	1200.00	1.13	249.98	248.37	1.82
CBMH#03	1200.00	1.13	249.98	248.66	1.49
CBMH#04	1200.00	1.13	249.98	248.64	1.52
STM MH#02	1200.00	1.13	249.98	248.12	2.10
STM MH#03	1200.00	1.13	249.98	248.49	1.69
Sum					11.20

Table 3-3 Storage provided by stormwater structures.

	Surface Area (m ²)	Ponding Elevation (m)	Structure surface elevation (m)	Depth (m)	Volume (m ³)
Pond1 (dry)	83.78	249.98	249.55	0.43	12.01

Table 3-4 Storage provided by dry ponding.

Stormwater Management Study

U/G Conduit	Diameter (m)	Area (m ²)	Length (m)	Volume (m ³)
1	250	0.05	59.00	2.90
2	300	0.07	21.50	1.52
3	375	0.11	75.50	8.34
Sum				12.75

Table 3-5 Storage provided by underground stormwater conduits.

Storage Volume For 100-Year Event (m³)	
Catch Basins & Manholes	11.20
Underground Conduits	12.75
Ponds	12.01
Underground chamber	82.00
Total Provided	117.96
Total Required	117.37

Table 3-6 Summary of actual Storage provided for controlled sub-catchment A.

The total storage provided on site for stormwater runoff is 117.96m³ which is more than the required volume of 117.37m³. Refer to Site Servicing Plan P-301 in the Appendix for details.

Sub-catchment B (Uncontrolled)

The results for the peak flow rates (m³/s) generated by the “Rational Method” for existing and proposed conditions for the uncontrolled landscape area are shown below on Table 3-7:

Storm Event	Rainfall Intensity (mm/hr)				<Equation 1> Flow Rate (m ³ /sec)		
	a	b	c	I	Existing	Proposed	Excess Flow
5-Year	843.019	4.582	0.763	109.11	0.0036	0.0032	-0.0005
10-Year	976.898	4.745	0.760	126.38	0.0042	0.0037	-0.0005
25-Year	1133.123	4.734	0.756	148.26	0.0049	0.0047	-0.0002
50-Year	1251.473	4.847	0.753	164.13	0.0055	0.0057	0.0003
100-Year	1383.628	4.905	0.754	180.44	0.0060	0.0066	0.0005

Table 3-7 Peak Flows 5 - 100 Year Events for Uncontrolled Sub-Catchment B

3.2 SWM Summary

For The overall release rate for the site is the sum of the flows from both controlled and uncontrolled sub-catchments. See below for overall release rate.

Overall release rate for the site = Controlled Sub-catchment + Uncontrolled Sub-catchment

$$Q = 0.1076 + 0.0066$$

$$Q = 0.1142 \text{ m}^3/\text{s}$$

Therefore, the overall release rate is less than allowable release rate of 0.1192m³/s (refer to section 2.2 for details).

Stormwater Management Study

3.3 Quality Control

For quality control purposes and to comply with regulatory guidelines, the OWS JF6-3-1 is placed upstream of the stormwater storage chamber. The JF6-3-1 is sized for the runoff captured by all the catchbasins located throughout the impervious (asphalt) pavement and their associated landscape areas, which has a total contribution area of 0.572ha, for a projected TSS removal rate of 80% and Total Phosphorus Removal of 77% (Refer to the Jellyfish sizing report in the Appendix for details).

3.4 Phosphorus Budget

As required by the City of Barrie, a phosphorus budget report must be provided for all redevelopments. A phosphorus budget report was prepared to calculate pre- and post-phosphorus loading for this development. The following criteria was taken into consideration for the phosphorus budget. Refer to Phosphorous Budget in the Appendix for details.

- Post / Predevelopment Area: 0.66ha (Area within the property line)
- Sub watershed: Lake Simcoe and Couchiching/Black River
- Predevelopment land use: Commercial / Industrial
- Post development land used: Commercial / Industrial
- Soil type: Sandy Loam.
- Duration of construction activity: 8 months

The following measures listed below are proposed to control the amount of phosphorus leaving the site.

- Erosion and Sediment Protection during construction: Silt fence, non-woven geotextile fabric over CB's
- Oil Water Separator model - Jellyfish JF6-3-1 - estimated 77% TSS removal based on manufacturer specs. See Appendix for supporting documentation from manufacturer.

Therefore, the proposed control measures will limit the amount of phosphorus leaving the site to an acceptable amount.

3.5 Water Balance

The primary objective of the Water Balance Targets/Criteria is to capture and manage annual rainfall on the development site itself to preserve the pre-development hydrology through a combination of infiltration, evapotranspiration, landscaping, rainwater reuse and/or other low impact development practices. The water balance target for this site is to retain as minimum the first 5mm rainfall volume from the subject development as per section 7.4.2 of the Stormwater Infrastructure Design Standard of the City of Barrie.

Table 3-8 below shows the water balance requirement for the subject site,



Stormwater Management Study

Total Site Area =	6577.30	m²
Rainfall Depth to be retained =	5.00	mm
Volume at 5mm =	32.89	m³

Table 3-8 Water Balance volume requirement.

The initial abstraction value for sod/landscaping is between **12 – 17 mm**, a 15mm value will be selected for this development. Impervious surfaces will be considered to have a 0mm initial abstraction.

Below is a table summarizing the initial abstraction (IA) for this site.

Initial Abstraction:				
Surface	Area (m²)	IA (mm)	Volume	Units
Landscape/ Evapotranspiration	1899.69	15.0	28.49	m ³
Total	1899.69		28.49	m³

Table 3-9 Water Balance – Initial abstraction.

The specified landscaping for this project will promote evapotranspiration and is therefore assigned an IA value = 15mm. Refer to the landscape drawings for the specified landscape species.

Other methods investigated that were not able to be implemented due site conditions and restrictions included:

- Green roofs – cannot be implemented due to additional loading to structure and conflicts with mechanical equipment.
- Infiltration trench – cannot be implemented due to infiltration limitations.
- Bio-retention – cannot be implemented with the limited amount of space.

Due to the shortfall of 2.32mm in water balance, a minimum depth of 300mm absorbent soil for the landscaped area will be provided.

Stormwater Management Study

4. EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

The erosion potential of the study area was assessed using methods described in the “*MTO Drainage Management Manual*” of temporary erosion and sediment control measures suitable for construction sites close to highways.

During Site construction, various temporary measures will be implemented to prevent the discharge of sediment laden Stormwater from the Site. These measures include silt fencing, catchbasin buffers and mud-mats.

In addition to the above, the following “good housekeeping” measures are recommended:

- All exposed soil shall be stabilized as soon as possible with a seed and mulch application as directed by the Engineer.
- No construction activity or machinery shall intrude beyond the silt/snow fence or limit of construction area. All construction vehicles shall leave the site at designated locations as shown on the plans.
- Stockpiles of soil shall be set back from any watercourse and stabilized against erosion as soon as possible. A set back of at least 15m from any top-of-bank, watercourse or pond is required.
- Cleaning and repairs of mud-mats and any other temporary sediment control measures shall be completed as deemed necessary through regular inspection.
- Sediment/silt shall be removed from the sediment control devices after storm events and deposited in areas as approved by the engineer.
- All re-graded areas within the development which are not occupied by buildings, roadways, sidewalks, or driveways shall be top-soiled and sodded/seeded immediately after completion of final grading operations as directed by the engineer.



Stormwater Management Study

5. SUMMARY AND CONCLUSIONS

In summary, all required conditions for the City of Barrie have been satisfied as follows:

- There is no increase in Stormwater flow from the Site.
- The SWM facilities provide ENHANCED LEVEL of protection.
- The Sediment and Erosion Control Plan demonstrates how erosion and sedimentation will be minimized during construction.

This SWM Report satisfies all requirements for stormwater quantity, quality and erosion & sedimentation control.

James Sam, P.Eng
Tel (416) 229-2636 ext 205
Fax (416) 226-6965
j.sam@jandb-inc.com



623 Yonge Street
Barrie, ON

Stormwater Management Study

Appendix

IDF RECORDS

SITE SERVICING PLAN

PRE/POST DRAINAGE PLAN

JELLYFISH SIZING REPORT

JELLYFISH ISO 14034/ETV CERTIFICATE

QUALITY CONTROL, PHOSPHORUS BUDGET

where,

- Q = the design flow in (m³/s)
 C = the site specific runoff coefficient
 A = the drainage area (ha)
 i = rainfall intensity (mm/hr)

The rainfall intensity shall be calculated in accordance with the following table and equation:

Table 3.1: Barrie WPCC IDF Curve Parameters - Adjusted to Account for Climate Change

Parameter	Return Period					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
A	675.586	843.019	976.898	1133.123	1251.473	1383.628
B	4.681	4.582	4.745	4.734	4.847	4.905
C	0.780	0.763	0.760	0.756	0.753	0.754

Rainfall Intensity, I (mm/hr) = A/(t+B)^C, where t is time duration in minutes

Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557

Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a, b, c values to account for climate change.

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

where,

- i = the rainfall intensity (mm/hr)
 t_d = the storm duration (minutes)

A, B, C = a function of the local intensity-duration data.

The storm duration is set to the time of concentration (i.e. the sewer inlet time plus the time of travel in the pipe or channel) for the total cumulative drainage area to the node of interest. The maximum inlet time for the first pipe of a storm sewer system is 10 minutes.



STANDARD OFFLINE Jellyfish Filter Sizing Report

Project Information

Date	Friday, January 19, 2024
Project Name	623 Yonge St.
Project Number	230278
Location	Barrie

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 JF6-3-1 is recommended to meet the water quality objective by treating a flow of 17.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 36 years of BARRIE WPCC rainfall data for this site. This model has a sediment capacity of 199 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)
JF6-3-1	3	1	1.8	17.7	199

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:

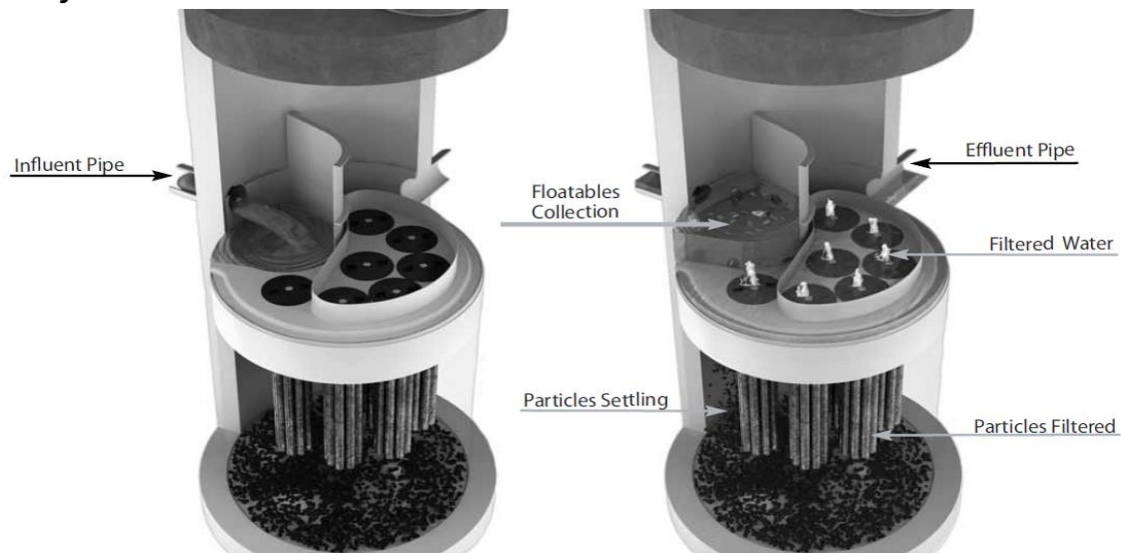
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Performance

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

- A median TSS removal efficiency of 90%, 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 monitored storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 77%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Project Information

Date:	Friday, January 19, 2024
Project Name:	623 Yonge St.
Project Number:	230278
Location:	Barrie

Designer Information

Company:	J+B Engineering Inc.
Contact:	Jesus Guerra
Phone #:	

Notes

--

Rainfall

Name:	BARRIE WPCC
State:	ON
ID:	557
Record:	1968 to 2003
Co-ords:	44°23'N, 79°41'W

Drainage Area

Total Area:	0.64 ha
Runoff Coefficient:	0.74

Upstream Detention

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

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 36 years of BARRIE WPCC rainfall data:	13.9 L/s
Sediment Loading	Treating 90% of the average annual runoff volume, 1448 m³, with a suspended sediment concentration of 60 mg/L.	87 kg

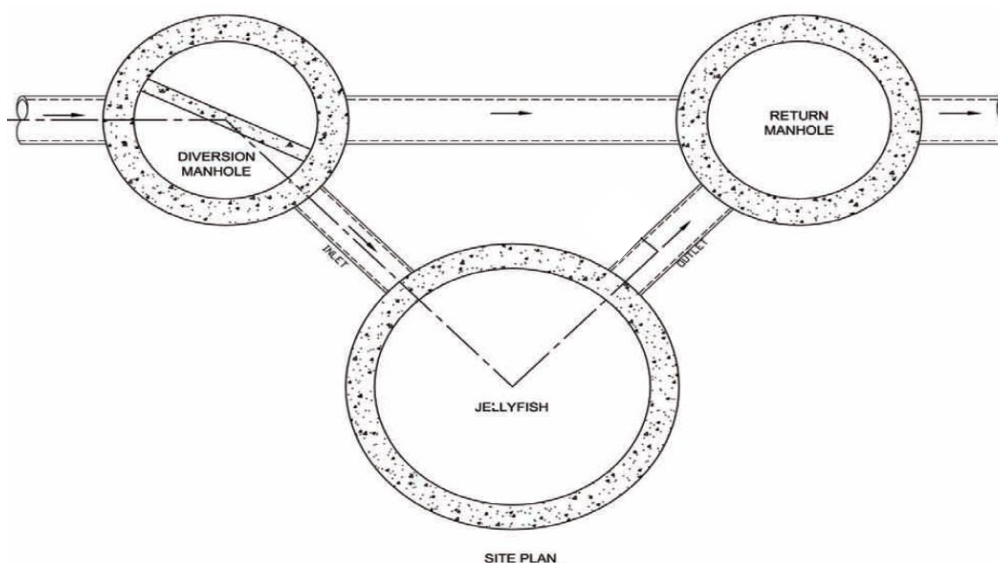
Recommendation

The Jellyfish Filter model JF6-3-1 is recommended to meet the water quality objective by treating a flow of 17.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 36 years of BARRIE WPCC rainfall data for this site. This model has a sediment capacity of 199 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 (m³)	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	62°	150	200
1.8	59°	200	250
2.4	52°	250	300
3.0	48°	300	450
3.6	40°	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 calculations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged conditions.
- 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

Imbrium Systems
www.imbriumsystems.com

Ph 888-279-8826
Ph 416-960-9900

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 (ft ² / m ²)	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 Con Seal 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 it 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

I:\IMBRIUM\PRODUCTS\JELLYFISH FILTER\40 DRAWINGS & DETAILS\STANDARD DETAILS\JELLYFISH FILTER - OFFLINE\JELLYFISH FILTER JF6 - OFFLINE\DIVERSION MANHOLE.DWG 9/17/2017 1:49 PM

GENERAL NOTES:

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. JELLYFISH STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE JELLYFISH SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECTS BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

JELLYFISH STRUCTURE & DESIGN NOTES:

1. 762 MM Ø (30") MAINTENANCE ACCESS WALL TO BE USED FOR CLEANOUT AND ACCESS BELOW CARTRIDGE DECK.
2. CASTINGS OR DOORS OF THE JELLYFISH MANHOLE STRUCTURE TO EXTEND TO DESIGN FINISH GRADE. DEPTHS IN EXCESS OF 3.65 M (12') MAY REQUIRE THE DESIGN AND INSTALLATION OF INTERMEDIATE SAFETY GRATES OR OTHER STRUCTURAL ELEMENTS.
3. CASTINGS AND GRADE RINGS, OR DOORS AND DOOR RISERS, OR BOTH, SHALL BE GROUTED FOR WATERTIGHTNESS. STRUCTURE SHALL MEET AASHTO HS-20, ASSUMING EARTH COVER OF 0' - 3', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE IMBRIUM LOGO.
4. ALL STRUCTURAL SECTIONS AND PARTS TO MEET OR EXCEED ASTM C-478, ASTM C-443, AND ASTM D-4097 CORRESPONDING TO AASHTO SPECIFICATIONS, AND ANY OTHER SITE OR LOCAL STANDARDS.
5. CONCRETE RISER SECTIONS FROM BOTTOM TO TOP WILL BE ADDED AS REQUIRED INCLUDING TRANSITION PIECES TO SMALLER DIAMETER RISERS FOR SURFACE ACCESSES WHERE WARRANTED BY SERVICING DEPTH.
6. IF MINIMUM DEPTH FROM TOP OF CARTRIDGE DECK TO BOTTOM OF STRUCTURAL TOP SLAB CANNOT BE ACHIEVED DUE TO PIPING INVERT ELEVATIONS OR OTHER SITE CONSTRAINTS. ALTERNATIVE HATCH CONFIGURATIONS MAY BE AVAILABLE. HATCH DOORS SHOULD BE SIZED TO PROVIDE FULL ACCESS ABOVE THE CARTRIDGES TO ACCOMMODATE MAINTENANCE.
7. STEPS TO BE APPROXIMATELY 330 MM (13") APART AND DIMENSIONS MUST MEET LOCAL STANDARDS. STEPS MUST BE INSTALLED AFTER CARTRIDGE DECK IS IN PLACE.
8. CONFIGURATION OF INLET AND OUTLET PIPE CAN VARY TO MEET SITE'S NEEDS.
9. IT IS THE RESPONSIBILITY OF OTHERS TO PROPERLY PROTECT THE TREATMENT DEVICE, AND KEEP THE DEVICE OFFLINE DURING CONSTRUCTION. FILTER CARTRIDGES SHALL NOT BE INSTALLED UNTIL THE PROJECT SITE IS CLEAN AND FREE OF DEBRIS, BY OTHERS. THE PROJECT SITE INCLUDES ANY SURFACE THAT CONTRIBUTES STORM DRAINAGE TO THE TREATMENT DEVICE. CARTRIDGES SHALL BE FURNISHED NEW, AT THE TIME OF FINAL ACCEPTANCE.
10. THIS DRAWING MUST BE VIEWED IN CONJUNCTION WITH THE STANDARD JELLYFISH SPECIFICATION, AND STORMWATER QUALITY FILTER TREATMENT JELLYFISH DOCUMENTS.

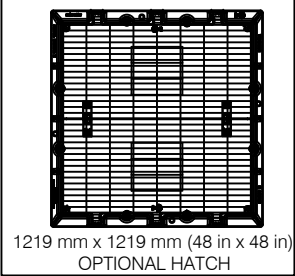
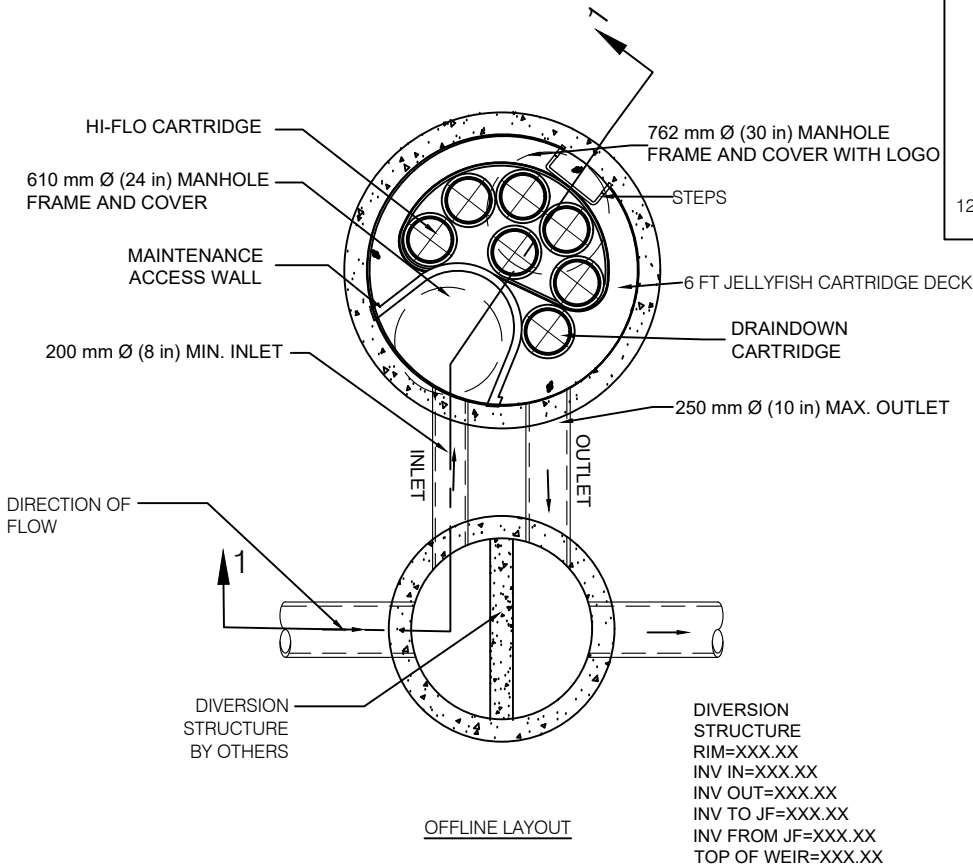
INSTALLATION NOTES

- A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
- C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
- D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
- E. CARTRIDGE INSTALLATION, BY IMBRIUM, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE JELLYFISH UNIT IS CLEAN AND FREE OF DEBRIS. CONTACT IMBRIUM TO COORDINATE CARTRIDGE INSTALLATION WITH SITE STABILIZATION.

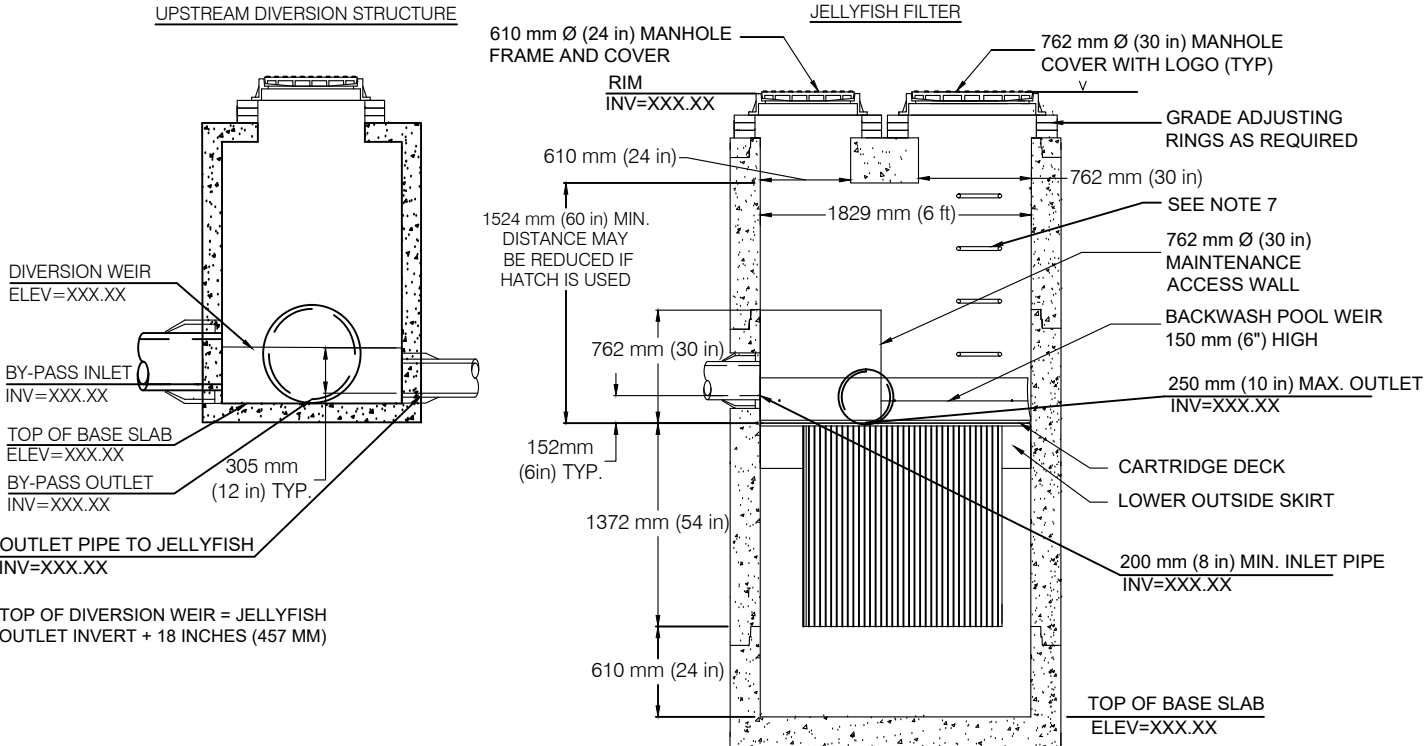
STANDARD OFFLINE JELLYFISH RECOMMENDED PIPE DIAMETERS			
MODEL DIAMETER (m)	MINIMUM ANGLE INLET/OUTLET PIPES	MINIMUM INLET PIPE DIAMETER (mm)	MINIMUM OUTLET PIPE DIAMETER (mm)
1.2	62	150	200
1.8	59	200	250
2.4	52	250	300
3.0	48	300	450
3.6	40	300	450
CONTACT IMBRIUM SYSTEMS FOR ALTERNATE PIPE DIAMETERS			

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL JELLYFISH FILTER REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE.

DRAWING NOT TO BE USED FOR CONSTRUCTION



UPSTREAM DIVERSION STRUCTURE



CROSS SECTION 1-1

JELLYFISH DESIGN NOTES

JELLYFISH TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN. Ø1829 mm (72") MANHOLE JELLYFISH PEAK TREATMENT CAPACITY IS 32.8 L/s (1.16 CFS). TREATMENT FLOW RATE IS BASED ON 457 MM (18") OF HEAD PRESSURE.

CARTRIDGE SELECTION	54"	40"	27"	15"
CARTRIDGE DEPTH	90"	76"	63"	51"
OUTLET INVERT TO STRUCTURE BASE SLAB				
FLOW RATE HIGH-FLO / DRAINDOWN (L/s) (per cart)	5.09 / 2.55	3.68 / 1.84	2.55 / 1.27	1.41 / 0.71
SEDIMENT CAPACITY HIGH-FLO / DRAINDOWN (kg) (per cart)	57 / 28	42 / 21	28 / 14	16 / 8
MAX. CARTS HIGH-FLO/DRAINDOWN		6 / 1		
MAX. SEDIMENT CAPACITY (kg)	370	273	182	104
MAX. TREATMENT (L/s)	32.8	24.6	16.4	9.06

SITE SPECIFIC DATA REQUIREMENTS

JELLYFISH MODEL	*				
STRUCTURE ID	*				
WATER QUALITY FLOW RATE (L/s)	*				
PEAK FLOW RATE (L/s)	*				
RETURN PERIOD OF PEAK FLOW (yrs)	*				
# OF CARTRIDGES REQUIRED (HF / DD)	*				
CARTRIDGE SIZE (inches)	*				
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*
* PER ENGINEER OF RECORD					

Jellyfish®
JF6 STANDARD
Scale = 1:50

imbrium®
7037 Ridge Road, Suite 350, Hanover, MD 21076
USA 888-279-5826 CA 800-955-4801 INTL +1-410-960-9900
Jellyfish® Filter
IMBRIUM SYSTEMS, A U.S. AND CANADIAN COMPANY
IMBRIUM SYSTEMS, A U.S. AND CANADIAN COMPANY
IMBRIUM SYSTEMS, A U.S. AND CANADIAN COMPANY

DATE: #####	
DESIGNED: BSF	DRAWN: BSF
CHECKED: BSF	APPROVED: SP
PROJECT #: #####	PROJECT NAME: #####
SHEET: 1 OF 2	

JELLYFISH® FILTER - SPECIFICATIONS

GENERAL

- A. WORK INCLUDED: SPECIFIES REQUIREMENTS FOR CONSTRUCTION AND PERFORMANCE OF AN UNDERGROUND STORMWATER QUALITY, MEMBRANE FILTRATION, AND TREATMENT DEVICE THAT REMOVES POLLUTANTS FROM STORMWATER RUNOFF THROUGH THE UNIT OPERATIONS OF SEDIMENTATION, FLOATATION, AND MEMBRANE FILTRATION.
- B. 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 990: SPECIFICATION FOR JOINTS FOR CONCRETE MANHOLES USING PREFORMED FLEXIBLE JOINT SEALANTS
 - ASTM D 4101: SPECIFICATION FOR COPOLYMER STEPS CONSTRUCTION
- C. 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 PRECAST CONCRETE AND CALL OUT OR NOTE THE FIBERGLASS (FRP) INTERNALS/COMPONENTS.
- D. 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.
- E. HANDLING AND STORAGE: PREVENT DAMAGE TO MATERIALS DURING STORAGE AND HANDLING.

PRODUCTS

- 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.
- B. THE CYLINDRICAL CONCRETE DEVICE SHALL INCLUDE A FIBERGLASS CARTRIDGE DECK INSERT. THE RECTANGULAR CONCRETE DEVICE SHALL INCLUDE A COATED ALUMINUM INSERT. IN EITHER INSTANCE, THE INSERT SHALL BE BOLTED AND SEALED WATERTIGHT INSIDE THE PRECAST CONCRETE CHAMBER. THE INSERT 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); (D) A CONDUIT FOR CONVEYANCE OF TREATED WATER TO THE EFFLUENT PIPE.
- C. MEMBRANE 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) OR GREATER 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 FLUX RATE SHALL BE 0.21 GPM/FT² (0.142 LPS/M²). EACH MEMBRANE FILTER CARTRIDGE SHALL ALLOW FOR MANUAL INSTALLATION AND REMOVAL.
- D. 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.
- E. ACCESS SHALL HAVE A MINIMUM CLEAR HEIGHT OF 60" OVER ALL OF THE FILTER CARTRIDGES, OR BE ACCESSIBLE BY A HATCH OR OTHER MECHANISM THAT PROVIDES MINIMUM 60" 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.
- F. 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" MAY HAVE AN IMPACT ON THE TOTAL PERFORMANCE AND/OR LONGEVITY BETWEEN CARTRIDGE MAINTENANCE/REPLACEMENT OF THE DEVICE.
- G. 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.
- H. GASKETS AND/OR SEALANTS TO PROVIDE WATER TIGHT SEAL BETWEEN CONCRETE JOINTS. JOINTS SHALL BE SEALED WITH PREFORMED JOINT SEALING COMPOUND CONFORMING TO ASTM C 990.
- I. 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.
- J. DOOR AND HATCHES, IF PROVIDED SHALL MEET DESIGNATED LOADING REQUIREMENTS OR AT A MINIMUM FOR INCIDENTAL VEHICULAR TRAFFIC.
- K. ALL CONCRETE COMPONENTS SHALL BE MANUFACTURED ACCORDING TO LOCAL SPECIFICATIONS AND SHALL MEET THE REQUIREMENTS OF ASTM C 478.
- L. 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.
- M. 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.
- N. 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.

PERFORMANCE

- A. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL FUNCTION TO REMOVE POLLUTANTS BY THE FOLLOWING UNIT TREATMENT PROCESSES: SEDIMENTATION, FLOATATION, AND MEMBRANE FILTRATION.
- B. 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.
- C. 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 PASS WATER OVER THE CARTRIDGE DECK, AND AVOID PASSAGE THROUGH THE SUMP AND/OR CARTRIDGE FILTRATION ZONE.
- D. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL TREAT 100% OF THE REQUIRED WATER QUALITY TREATMENT FLOW BASED ON A MAXIMUM TREATMENT FLUX RATE (SURFACE LOADING RATE) ACROSS THE MEMBRANE FILTER CARTRIDGES NOT TO EXCEED 0.21 GPM/FT² (0.142 LPS/M²).
- E. AT A MINIMUM, THE STORMWATER QUALITY FILTER DEVICE SHALL HAVE BEEN FIELD TESTED AND VERIFIED WITH A MINIMUM 25 QUALIFYING STORM EVENTS AND FIELD MONITORING CONDUCTED ACCORDING TO THE TARP TIER II OR TAPE FIELD TEST PROTOCOL, AND HAVE RECEIVED NJCAT VERIFICATION.
- F. 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%.
- G. 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 D50 OF 15 MICRONS OR LOWER FOR ALL MONITORED STORM EVENTS, AND AN EFFLUENT TURBIDITY OF 15 NTUS OR LOWER.
- H. 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%.
- I. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL HAVE DEMONSTRATED A MINIMUM MEDIAN TOTAL ZINC REMOVAL OF 50%, AND A MINIMUM MEDIAN TOTAL COPPER REMOVAL OF 75%.

INSPECTION AND MAINTENANCE

- A. 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.
- B. 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).
- C. 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.
- D. 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.
- E. MAINTENANCE ACCESS SHALL HAVE A MINIMUM CLEAR HEIGHT OF 60" OVER ALL OF THE FILTER CARTRIDGES, OR BE ACCESSIBLE BY A HATCH OR OTHER MECHANISM THAT PROVIDES MINIMUM 60" 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.
- F. FILTER CARTRIDGES SHALL BE ABLE TO BE MAINTAINED WITHOUT THE USE OF ADDITIONAL LIFTING EQUIPMENT.

EXECUTION

- 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.
- B. 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
- C. 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.
- D. ADJUSTMENT UNITS (E.G. GRADE RINGS) SHOULD BE INSTALLED TO SET THE FRAME AND COVER AT THE REQUIRED ELEVATION. THE ADJUSTMENT 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.
- E. 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.
- F. FILTER CARTRIDGES SHALL BE INSTALLED IN THE CARTRIDGE DECK 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.
- G. 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 IT 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.
- H. THE MANUFACTURER SHALL PROVIDE AN OWNER'S MANUAL UPON REQUEST.
- I. 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.
- J. 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

 7037 Ridge Road, Suite 350, Hanover, MD 21076 USA 888-279-8826 CA 900-655-4801 INTL +1-416-960-9900 Jellyfish® Filter IMBRIUM SYSTEMS, INC. IS AN ISO 9001:2015 CERTIFIED COMPANY ADDRESS: 7037 RIDGE ROAD, SUITE 350, HANOVER, MD 21076, USA J. HANCOCK & SONS, INC. IS AN ISO 9001:2015 CERTIFIED COMPANY ADDRESS: 2500 STEELES CIRCLE, INTERLAKEN, ONTARIO, CANADA		JELLYFISH FILTER SPECIFICATIONS  JF6 STANDARD Scale = 1:50 www.imbrium.com info@imbrium.com			
DATE:	#####				
DESIGNED:			DRAWN: BSF		
CHECKED: BSF			APPROVED: SP		
PROJECT #:	#####		PROJECT NAME: #####		
SHEET:	2		OF		2

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

Registration: GPS-ETV_V2022-03-01

In accordance with

ISO 14034:2016

**Environmental Management —
Environmental Technology Verification (ETV)**



John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 1, 2022
Vancouver, BC, Canada



Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada | V6C 3E2

Technology description and application

The Jellyfish® Filter is an engineered stormwater quality treatment technology designed to remove a variety of stormwater pollutants including floatable trash and debris, oil, coarse and fine suspended sediments, and particulate-bound pollutants such as nutrients, heavy metals, and hydrocarbons. The Jellyfish Filter combines gravitational pre-treatment (sedimentation and floatation) and membrane filtration in a single compact structure. The system utilizes membrane filtration cartridges comprised of multiple detachable pleated filter elements (“filtration tentacles”) that provide high filtration surface area with the associated advantages of high flow rate, high sediment capacity, and low filtration flux rate.

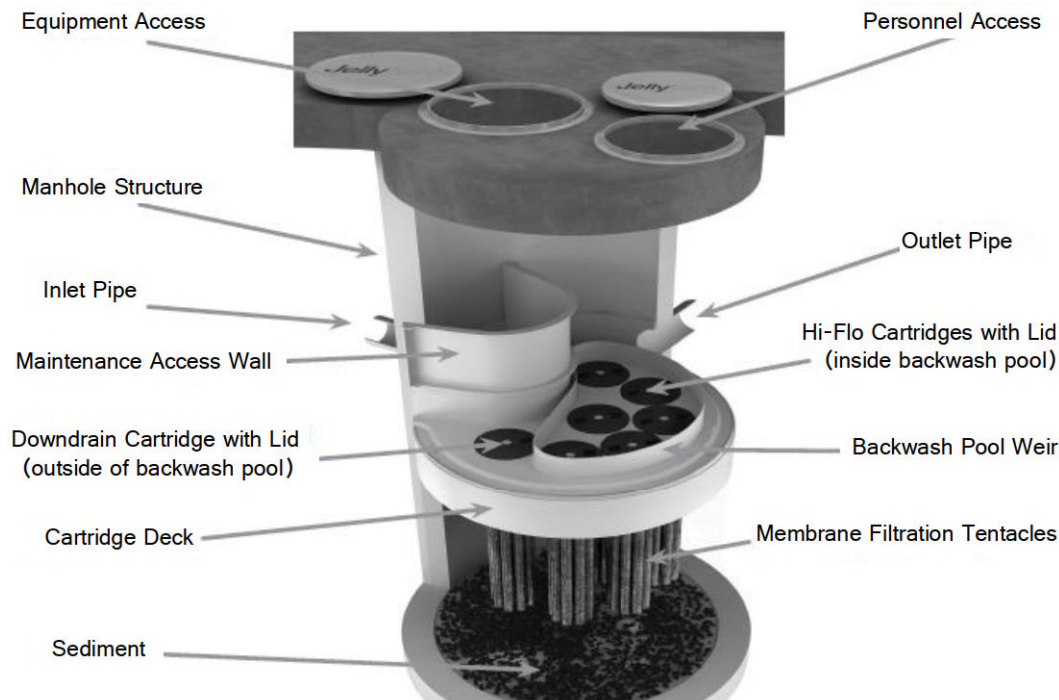


Figure 1. Cut-away graphic of a Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge

Figure 1 depicts a cut-away graphic of a typical 6-ft diameter Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge (JF6-6-1). Stormwater influent enters the system through the inlet pipe and builds a pond behind the maintenance access wall, with the pond elevation providing driving head. Flow is channeled downward into the lower chamber beneath the cartridge deck. A flexible separator skirt surrounds the filtration zone where the filtration tentacles of each cartridge are suspended, and the volume between the vessel wall and the outside surface of the separator skirt comprises a pre-treatment channel. As flow spreads throughout the pre-treatment channel, floatable pollutants accumulate at the surface of the pond behind the maintenance access wall and also beneath the cartridge deck in the pre-treatment channel, while coarse sediments settle to the sump. Flow proceeds under the separator skirt and upward into the filtration zone, entering each filtration tentacle and depositing fine suspended sediment and associated particulate-bound pollutants on the outside surface of the membranes. Filtered water proceeds up the center tube of each tentacle, with the flow from each tentacle combining under the cartridge lid, and discharging to the top of the cartridge deck through the cartridge lid orifice. Filtered effluent from the hi-flo cartridges enters a pool enclosed by a 15-cm high weir, and if storm intensity and resultant driving head is sufficient, filtered water overflows the weir and proceeds across the cartridge deck to the outlet pipe. Filtered effluent discharging from the draindown cartridge(s) passes directly to the outlet pipe, and requires only a minimal amount of driving head (2.5 cm) to provide forward flow. As

storm intensity subsides and driving head drops below 15 cm, filtered water within the backwash pool reverses direction and passes backward through the hi-flo cartridges, and thereby dislodges sediment from the membrane which subsequently settles to the sump below the filtration zone. During this passive backwashing process, water in the lower chamber is displaced only through the draindown cartridge(s). Additional self-cleaning processes include gravity, as well as vibrational pulses emitted when flow exits the orifice of each cartridge lid, and these combined processes significantly extend the cartridge service life and maintenance cleaning interval. Sediment removal from the sump by vacuum is required when sediment depths reach 30 cm, and cartridges are typically removed, externally rinsed, and recommissioned on an annual basis, or as site-specific maintenance conditions require. Filtration tentacle replacement is typically required every 3 – 5 years.

Performance conditions

The data and results published in this Verification Statement were obtained from the field testing conducted on a Jellyfish Filter JF6-6-I (6-ft diameter manhole with 6 hi-flo cartridges and 1 draindown cartridge), in accordance with the requirements outlined by the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology, (WADOE, 2011). The drainage area providing stormwater runoff to the test unit was 86 acres and was 32% impervious. Throughout the monitoring period (March 2017 – April 2020), a total of 25 individual storm events were sampled. The Basic Treatment standard outlined in the TAPE requires $\geq 80\%$ total suspended solids (TSS) removal at influent TSS concentrations ranging from 100 to 200 mg/L. In addition, the Phosphorus Treatment standard outlined in the TAPE requires $\geq 50\%$ removal of total phosphorus (TP) at influent concentrations ranging from 0.10 to 0.5 mg/L. For this verification, the performance claim for TSS removal is for influent TSS concentration ≥ 100 mg/L, and the performance claim for TP removal is for influent TP concentration ≥ 0.1 mg/L. Based on these requirements, 15 and 18 sample pairs deemed qualified for evaluating the removal performance of TSS and TP, respectively. Prior to starting the performance testing program, a quality assurance project plan (QAPP) was submitted to and approved by the State of Washington Department of Ecology.

Table I shows the specified and achieved TAPE criteria for storm selection and sampling.

Table I. Specified and achieved TAPE criteria for storm selection and sampling

Description	TAPE criteria value	Achieved value
Total rainfall	> 3.8 mm (0.15 in)	> 3.8 mm (0.15 in) ¹
Minimum inter-event period	6 hours	6 hours
Minimum flow-weighted composite sample storm coverage	Minimum 70% including as much of the first 20% of the storm	> 70%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	10, except for two events that had 9 aliquots
Total sampled rainfall	N/A	8.29 in
Number of storms	Minimum 15 (preferably 20)	25

¹N.B. Storm event depth was greater than the TAPE rainfall depth guideline of 0.15 inches for all events sampled, except for the 3/21/2017, 3/22/2019, 3/26/2019, and 04/13/2019 events. Given the size of the drainage basin, storm events below this threshold produced adequate runoff volume for sampling. Only two of these events were used to evaluate performance, and all had rainfall depths of 0.11 inches or greater. These events were included as their runoff volumes, precipitation durations, and influent TSS concentrations were all within range of the total data set.

The 6-ft diameter test unit has sedimentation surface area of 2.62 m² (28.26 ft²). Each of the seven filter cartridges employed in the test unit uses filtration tentacles of 137 cm (54 in) length, with filter surface area of 35.4 m² (381 ft²) per cartridge, and total filter surface area of 247.8 m² (2667 ft²) for the seven cartridges combined. The design treatment flow rate is 5 L/s (80 gal/min) for each of the six hi-flo

cartridges and 2.5 L/s (40 gal/min) for the single draindown cartridge, for a total design treatment flow rate of 32.5 L/s (520 gal/min) at design driving head of 457 mm (18 in). This translates to a filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m² (0.21 gal/min/ft²) for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) for the draindown cartridge. The design flow rate for each cartridge is controlled by the sizing of the orifice in the cartridge lid. The distance from the bottom of the filtration tentacles to the sump is 61 cm (24 in).

Performance claim(s)

The Jellyfish® Filter demonstrated the removal efficiencies indicated in **Table 2** for TSS and TP during field monitoring conducted in accordance with the Washington State Department of Ecology's Technology Assessment Protocol – Ecology (TAPE), and using the following design parameters:

- System hydraulic loading rate (system treatment flow rate per unit of sedimentation surface area) of 12.5 L/s/m² (18.4 gal/min/ft²) or lower
- Filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m² (0.21 gal/min/ft²) or lower for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) or lower for each draindown cartridge
- Distance from the bottom of the filtration tentacles to the sump of 61 cm (24 in) or greater
- Driving head of 457 mm (18 in) or greater

Table 2. Bootstrapped mean, median, and 95% confidence interval (median) for removal efficiencies of Total Suspended Solids (TSS) and Total Phosphorus (TP)

Parameter	Mean (%)	Median (%)	Median – 95% Lower Limit	Median – 95% Upper Limit
TSS ¹	87.6	90.1	85.1	91.6
TP ²	77.3	77.5	70.8	85.6

¹ TSS influent concentration ≥ 100 mg/L

² TP influent concentration ≥ 0.1 mg/L

N.B. As with any field test of stormwater treatment devices, removal efficiencies will vary based on pollutant influent concentrations and other site-specific conditions.

The performance claims can be applied to other Jellyfish® Filter models smaller or larger than the tested model as long as the untested models are designed in accordance with the design parameters specified in the performance claims.

Performance results

Performance Claims – Removal Efficiency for Total Suspended Solids

Raw data summarizing the percent removal of total suspended solids (TSS) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m² (18.4 gal/min/ft²) for 15 sample pairs deemed qualified are presented in **Table 3**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

Table 3. Raw data summarizing the percent removal of total suspended solids (TSS)

Event ID	TSS Influent (mg/L)	TSS Effluent (mg/L)	TSS Removal (%) (Inf ≥ 100 mg/L)
3/21/2017	102.0	22.0	78.4
4/7/2017	201.0	30.8	84.7
4/12/2017	108.0	24.4	77.4
4/19/2017	452.0	44.6	90.1
4/26/2017	257.0	10.0	96.1

6/15/2017	134.0	10.4	92.2
3/8/2018	755.0	47.2	93.8
3/14/2018	181.0	27.0	85.1
3/22/2018	224.0	20.0	91.1
4/5/2019	171.0	23.0	86.6
4/13/2019	117.0	25.0	78.6
5/18/2019	254.0	20.0	92.1
12/7/2019	200.0	17.0	91.5
3/30/2020	605.0	51.0	91.6
4/20/2020	210.0	29.0	86.2
n	15	15	15
Min	102.0	10.0	77.4
Max	755.0	51.0	96.1
Median	201.0	24.4	90.1
Mean	264.7	26.8	87.7
SD	190.9	12.3	5.9

Performance Claims – Removal Efficiency for Total Phosphorus

Raw data summarizing the percent removal of total phosphorus (TP) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m² (18.4 gal/min/ft²) for 18 sample pairs deemed qualified are presented in **Table 4**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

Table 4. Raw data summarizing the percent removal of total phosphorus (TP)

Event ID	TP Influent (mg/L)	TP Effluent (mg/L)	TP Removal (%) (Inf ≥ 0.1 mg/L)
4/7/2017	0.706	0.092	87.0
4/12/2017	0.338	0.076	77.5
4/19/2017	0.500	0.036	92.8
4/26/2017	0.504	0.042	91.7
5/13/2017	0.256	0.110	57.0
6/8/2017	0.256	0.104	59.4
6/15/2017	0.362	0.052	85.6
3/8/2018	1.75	0.130	92.6
3/14/2018	0.652	0.094	85.6
3/22/2018	0.364	0.072	80.2
3/27/2019	0.226	0.070	69.1
4/5/2019	0.337	0.092	72.9
4/13/2019	0.249	0.087	65.1
5/18/2019	1.09	0.173	84.1
12/7/2019	0.335	0.105	68.7
12/19/2019	0.211	0.093	56.2
3/30/2020	1.05	0.092	91.2
4/20/2020	0.451	0.112	75.2
n	18	18	18
Min	0.211	0.036	56.2
Max	1.75	0.173	92.8
Median	0.363	0.092	78.9
Mean	0.535	0.091	77.3
SD	0.400	0.032	12.5

Verification

The verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies (“CAWT”), contracted by GLOBE Performance Solutions, using the International Standard **ISO 14034:2016 Environmental management – Environmental technology verification (ETV)**. Data and information provided by Imbrium Systems to support the performance claim included the performance monitoring report “General Use Level Designation Technical Evaluation Report” prepared by CONTECH Engineered Solutions, Portland, OR, USA, and dated December 28, 2020. This report is based on a field testing completed by CONTECH personnel at a site in Dundee, Oregon between March 2017 and April 2020 in accordance with the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology (WADOE, 2011).

What is ISO 14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV) and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Jellyfish® Filter please contact:

Imbrium Systems Inc.,
407 Fairview Drive
Whitby, Ontario
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
V6C 3E2, Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globepformance.com
www.globepformance.com

Limitation of verification - Registration: GPS-ETV_V2022-03-01

GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.



MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: 623 Yonge Street, Barrie, ON

Subwatershed: Black River

Total Pre-Development Area (ha):	0.6577	Total Pre-Development Phosphorus Load (kg/yr):	1.20
----------------------------------	--------	--	------

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industrial	0.6577	1.82	1.20

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Comm/Industrial	0.02	1.82	NONE	0.04

Uncontrolled runoff

High Intensity - Comm/Industrial	0.065	1.82	Dry Detention Ponds	10%	0.11
----------------------------------	-------	------	---------------------	-----	------

Dry pond for mainly landscape, internal sidewalks and restaurant roof area

High Intensity - Comm/Industrial	0.5722	1.82	Flow Balancing Systems	77%	0.24
----------------------------------	--------	------	------------------------	-----	------

Jellifish filter with up to 77% Phosphorous removal. Refer to SWM report Appendix

Post-Development Area Altered:	0.66	P Load (kg/yr)
--------------------------------	------	----------------

Total Pre-Development Area: 0.66

Unaffected Area: 0

Pre-Development: 1.20
Post-Development: 1.20
Change (Pre - Post): 0.00

0% Net Reduction in Load

Post-Development (with BMPs): 0.38
Change (Pre - Post): 0.81

68% Net Reduction in Load

DEVELOPMENT: 623 Yonge Street, Barrie, ON

Subwatershed: Black River

CONSTRUCTION PHASE LOAD

Site-Specific Input:

Constant / Lookup:

Calculation:

Sub Area: Entire site

Duration of Construction (months):	8	R (rainfall / runoff for Lake Simcoe)	90
Duration of Exposed Soil (months):	4	K (soil erodability factor):	0.2
Surface Slope Gradient (%):	2	NN (determined by slope):	0.3
Length of Slope (m):	90	BMP prevention Efficiency:	0%
Slope Area (ha):	0.66	BMP capture Efficiency:	70%
% slope erosion prevention applied to:	0	LS (slope length gradient factor):	0.78
% slope runoff capture applied to:	1	C (portion of year of exposed soil):	0.50
Subwatershed Soil [P] (kg/kg):	0.0004	P (prevention + capture):	0.30
		Soil Loss (kg/year):	3120.153
		Phosphorus Load (kg):	0.83

Developed AREA (ha): 0.66000002623

Total

Construction Phase Phosphorus Load with BMPs (kg):	0.83
Construction Phase Phosphorus Load no BMPs (kg):	2.77

SUMMARY WITH IMPLEMENTATION OF BMPs

**P Load
(kg/yr)**

Pre-Development:	1.20
Construction Phase Amortized Over 8 Years :	0.10
Post-Development:	0.38
Post-Development + Amortized Construction:	0.49

Pre-Development Load - Post-Development Load:	0.81
Conclusion:	68% Reduction in Load

Pre-Development Load - (Post-Development + Amortized Construction Load):	0.71
Conclusion:	59% Reduction in Load

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Approve development as site specific appropriate.