# STORMWATER MANAGEMENT REPORT

## SOLMAR DEVELOPMENTS
## PROPOSED HIGH RISE DEVELOPMENT
## ELM DRIVE WEST (PHASE III – BLDG.C)
## CITY OF MISSISSAUGA

**PROJECT 2020-4904** AUGUST 2020

| DATE | DESCRIPTION | PREPARED | APPROVED |
|---|---|---|---|
| August 2020 | Issued for Submission | D.T. | H.S. |

SCHAEFFERS
CONSULTING ENGINEERS

6 Ronrose Dr
Concord, Ontario L4K 4R3

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# 1.0 INTRODUCTION

## *1.1 Objective*

This stormwater management report is provided in support of the proposed high rise development located at 16 Elm Drive West, within the City of Mississauga. The third phase of this project consists of a high rise building (Tower C). This building is the third and final Phase in the larger development stretching from Kariya Drive to Hurontario Street, on the south side of Elm Drive West.

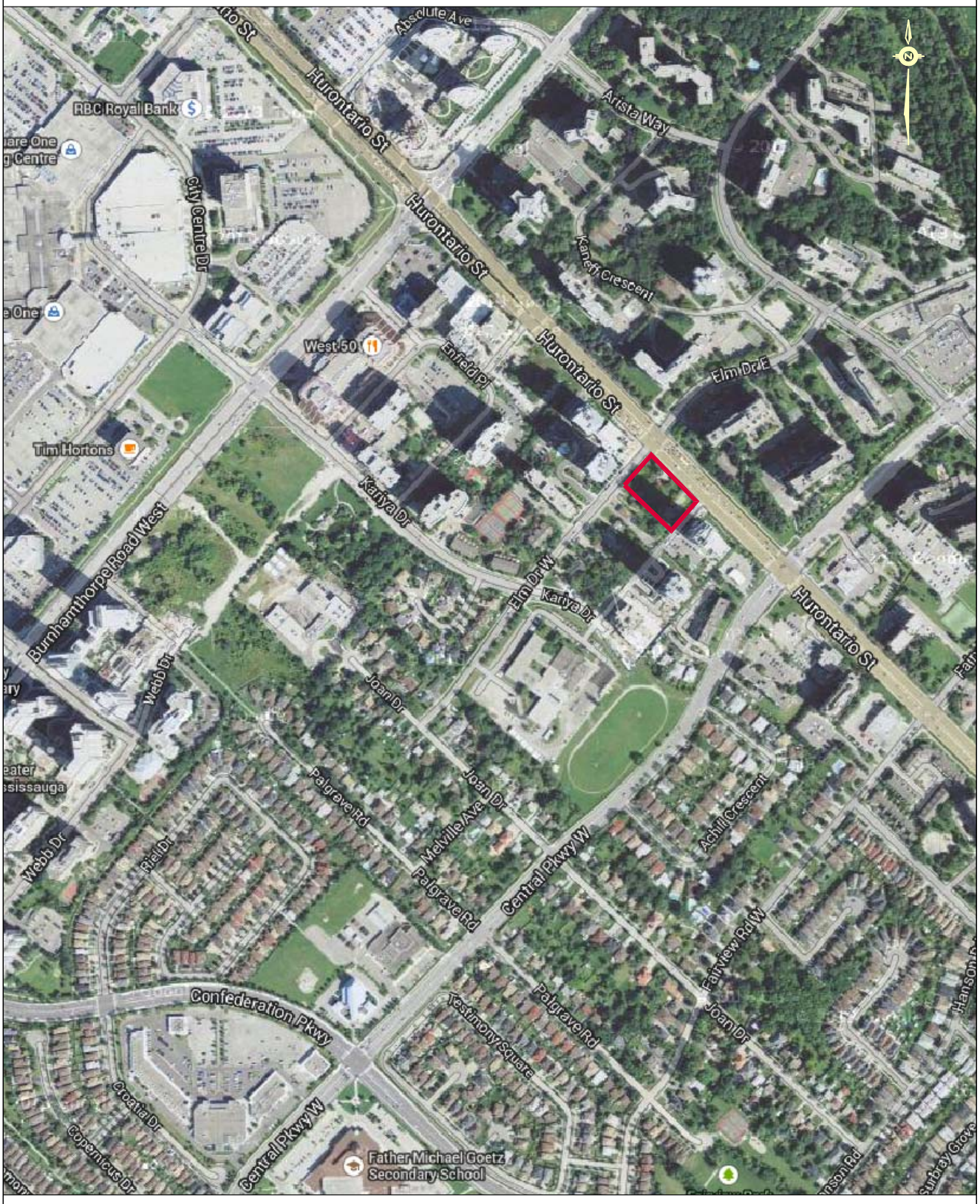
The 0.39 hectare property is located within the boundaries of Burnhamthorpe Road to the north, Confederation Parkway to the west, Hurontario Street to the east, and Central Parkway to the south, as shown in **Figure 1-1**.

This report evaluates existing and proposed stormwater management services within and surrounding the subject property, thereby demonstrating the viability of the proposed development.

## *1.2 Existing Conditions/Site Constraints*

Presently, the site is vacant. Available topography indicates a variance in elevation of more than a few meters across the larger development area of which Tower C is a part of. The peak elevation is just above 141m at the northwest portion of the site. The lowest point has an elevation of approximately 138m at the southeast portion of the site. This suggests that the site drains to the southeast.

The surrounding properties are well developed. Mid-to high-density residential buildings are located north, south, and east of the property. To the west of the site is an existing school. Utility services (i.e. gas, hydro, telecom and cable) exist on Elm Drive, Hurontario Street, and Kariya Drive.




SCHAEFFERS
CONSULTING ENGINEERS
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
design@schaeffers.com

LEGEND

SUBJECT SITE

PROPOSED HIGH-DENSITY RESIDENTIAL DEVELOPMENT
ELM DRIVE WEST
CITY OF MISSISSAUGA

FIGURE 1-1
LOCATION PLAN

| 2020-4904 | JULY 2020 | SCALE: N.T.S. |
|---|---|---|

# 2.0 STORMWATER MANAGEMENT

## *2.1 Existing Infrastructure*

There is an existing storm sewer along Elm Drive West, ranging in diameter from 450mm to 750mm, that conveys drainage easterly towards Hurontario Street. There is also an existing 900mm diameter storm sewer along Hurontario Street that conveys flow from Elm Drive West in a northerly direction.

The site was used for residential purposes. Based on available topographic information, these residential lots generally have split drainage with the front and rear yards draining to the north and south respectively.

**Figure 2-1** illustrates the existing drainage conditions. Estimated existing peak flows are as summarized in **Table 2-1**.

**Table 2-1: Summary of Estimated Existing Peak Flows**

| Location | Area (ha) | Weighted Run-off Coefficient | Intensity* (mm/hr) | | Flow Rate ($m^3/s$) | |
|---|---|---|---|---|---|---|
| | | | 2-year | 100-year | 2-year | 100-year |
| North Area draining to Elm Drive | 0.20 | 0.28 | 59.9 | 140.7 | 0.0095 | 0.022 |
| South Area draining to Private lane | 0.19 | 0.42 | 59.9 | 140.7 | 0.014 | 0.032 |
| Total | 0.39 | - | - | - | - | - |

* Based on a Tc of 15 minutes

## 2.2 Design Criteria

The stormwater flow calculations are based on the following the City of Mississauga design criteria:

- Storm sewers shall be designed using Rational Formula; Q = 0.0028 CIA, where Q is the flow rate in $m^3/s$, C is the runoff coefficient (dimensionless), I is rainfall intensity in mm/hr and A is area in ha;
- Storm sewer design should be based on City of Mississauga Rainfall Intensity Curves and a minimum time of concentration of 15 min. I = A/ (T + B)C, where I is rainfall intensity in mm/hr, T is time of Concentration in hours, A = 1010, B = 4.6, C = 0.78 for the 10-year storm event;
- Runoff Coefficient:
    - Paved and House Areas 0.90
    - Parks and Open Space 0.25

## 2.3 Proposed Stormwater Management

The proposed stormwater management scheme for the subject development will be designed in accordance with the City of Mississauga's stormwater servicing criteria. Furthermore, the proposed development consists of a high rise building (Tower C), and it is proposed to capture all flows from storms up to 100-yr storm events within the site and control runoff from this area, to allowable release rates (2-yr pre-development flows). This can be accomplished by using a combination of underground storage and a flow restrictor. The following describes the proposed plan for stormwater management.

Flows from the building (Tower C) will be conveyed via underground plumbing system to proposed STM.CTL.MH1, and ultimately to the existing 750mm storm sewer on Elm Drive. On-site controls will limit the peak flows to the allowable release rate via a flow restrictor (100mm dia. orifice tube), and on-site storage. It is recommended that all drains and plumbing be designed watertight under surcharge conditions. Please refer to **Section 2.3.1**. The internal plumbing system shall be designed by the Mechanical Engineer.

Due to site limitations and the shallow municipal storm sewer on Elm Drive West, the storm discharge for the site is proposed to be pumped from the SWM Tank, to allow for gravity drainage to the municipal sewers on Elm Drive West through the control manhole. This concept of using a SWM Tank with a pump system was chosen as the gravity solution would have resulted in a very shallow tank which would prove difficult to waterproof & maintain. As will be noted below, the pump systems will be designed by the mechanical engineer with sufficient redundancies to safely convey the flow to the municipal sewer.

Runoff exceeding the capacity of the on-site controls (i.e. in excess of the 100-year storm or in the event of a system blockage) will be conveyed overland to Elm Drive West and Hurontario Street.

Further details of the proposed SWM plan are provided below.

### 2.3.1 QUANTITY CONTROL

***ALLOWABLE RELEASE RATE***

The allowable release rates for the building (Tower C) have been determined using the existing condition under the 2-year storm event. In order to estimate the appropriate allowable release rates, a 15 minute time of concentration has been used. The run-off coefficient has been provided based on the existing conditions on site. The allowable release is as summarized in **Table 2-2**. Please refer to **Appendix A** for detailed calculations.

**Table 2-2: Allowable Release Rate Summary**

| Block | Area (ha) | Runoff Coeff. 'C' | External area (ha) | External Runoff Coeff. 'C' | Time of Concentration (min.) | Intensity* (mm/hr) | Peak Flow (l/s) |
|---|---|---|---|---|---|---|---|
| Phase III | 0.20 | 0.28 | n/a | n/a | 15.0 | 59.9 | 9.5 |

PROPOSED HIGH-DENSITY
RESIDENTIAL DEVELOPMENT
ELM DRIVE WEST
CITY OF MISSISSAUGA

LEGEND

- EXISTING STORM SEWER
- MAINTENANCE HOLE
- FLOW DIRECTION
- AREA DRAINING TO ELM DRIVE WEST – PH.3
- AREA DRAINING TO PRIVATE LANE
- PAVED AREA
- 0.69ha / C=0.50 — DRAINAGE AREA RUNOFF COEFFICIENT
- FLOW DIRECTION


SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
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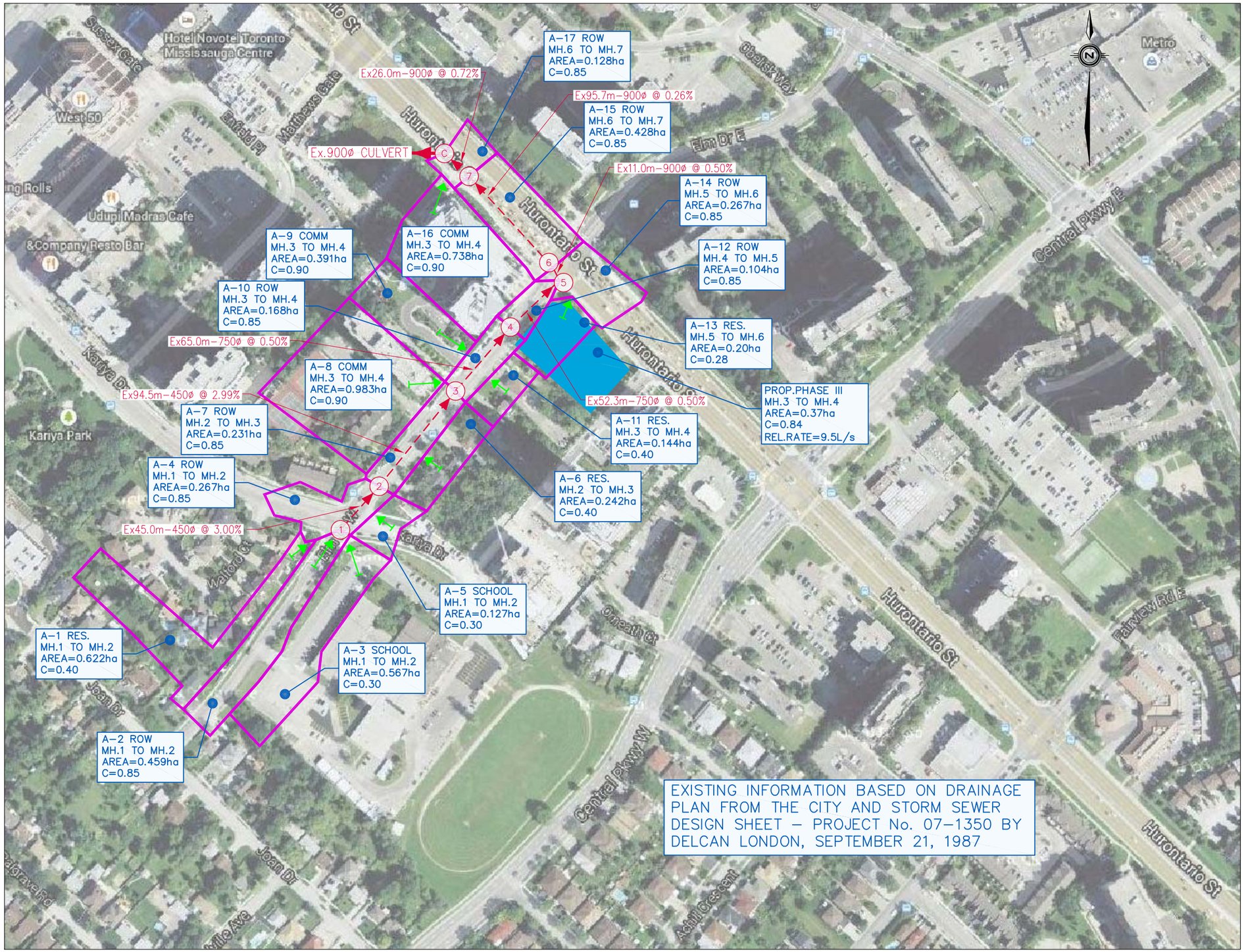
FIGURE 2-1
EXISTING DRAINAGE CONDITIONS

| 2020-4904 | JULY 2020 | SCALE: NTS |
|---|---|---|




PROPOSED HIGH-DENSITY
RESIDENTIAL DEVELOPMENT
ELM DRIVE WEST
CITY OF MISSISSAUGA

LEGEND

- EXISTING STORM SEWER
- EXISTING TRIBUTARY BOUNDARY
- DRAINAGE DIRECTION
- (3) MAINTENANCE HOLE
- PROPOSED PHASE III

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6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
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FIGURE 2-2
EXISTING AND PROPOSED
STORM TRIBUTARY PLAN

| 2020-4904 | JULY 2020 | SCALE: NTS |
|---|---|---|

***POST-DEVELOPMENT RUN-OFF COEFFICIENT***

The existing drainage pattern on adjacent properties has not been altered and no stormwater runoff from the subject development will be directed to drain onto the adjacent properties (up to the 100-year flows). The following table presents the composition of drainage areas for the subject site.

**Table 2-3: Allowable Release Rate Summary**

| Block | Description | Area (ha) | Runoff Coefficient |
|---|---|---|---|
| Phase III | Roof & Impervious areas | 0.34 | 0.90 |
| Phase III | Pervious Areas | 0.03 | 0.25 |

Based on the existing information from the City of Mississauga – Drainage plans and storm sewer design sheets from Project 07-1350 by Delcan London, September 21, 1987, the proposed development was included in the existing storm drainage analysis.

Therefore, these storm sewer design sheets and tributary plans have been used to estimate the proposed development conditions for the subject area. **Figure 2-2** shows the post development conditions and revised design sheets are included in **Appendix A**. Based on these calculations, the flows from the proposed development will be less than pre-development and no issues downstream are expected for the system.

***STORAGE REQUIREMENTS***

In order to reduce the post-development 100-year peak flow to the allowable release rate, on-site controls are proposed (i.e. flow reducer and on-site storage). The rational method was used to estimate the total volume of storage required. **Table 2-4** summarizes the storage requirements. Storage volume calculations are provided in **Appendix A**.

Storage will be provided in an underground storage tank located in the building's P1 level and will be pumped to the existing storm sewer on Elm Drive West as will be noted below. Based on the information provided below, the provided storage is sufficient to ensure flows do not exceed the allowable release rate noted in **Section 2.3.1**.

**Table 2-4: Storage Requirement Summary**

| Block | Area (ha) | Actual Release Rate (l/s) | Required Storage Volume ($m^3$) | Provided Storage Volume ($m^3$) |
|---|---|---|---|---|
| Phase III | 0.37 | 9.5 | 143 | 160 |

***ORIFICE CONTROL***

The building (Tower C) will be serviced via a 100mm diameter orifice tube. The orifice tube is located downstream of the tank and upstream of the quality control unit and control manhole. The 100mm diameter orifice tube will release 9.5 l/sec (effective head of 0.12m acting on it). The actual release rate is generated by the orifice and note the pump system. The sizing of the orifice tube has been presented in **Appendix A**.

***ROOF AND AREA DRAIN CONTROL***

No roof area control has been provided, and as it will be noted below and in **Section 2.3.3**, rain water is to drain to the Irrigation Tank located in the P1 level (immediately adjacent to the SWM Tank) for water-reuse purposes.

All area drains should capture the 100-year storm event, with the internal storm plumbing designed to be watertight by the mechanical engineer.

***WATER RETENTION***

At 0.39ha, to total 5mm retention would equal 19.5 cu.m. (0.39ha x 5mm = 19.5 cu.m.). As the site layout does not permit infiltration due to the large underground parking structure required in this urban area, the clean roof rainwater will be stored within the proposed Rain Water Harvesting (RWH) Tank located in the P1 level.

***PUMPING***

In order to provide an extra level of safety, multiple submersible pumps are recommended to be provided within the SWM Tank.

The pump system is recommended to be provided with switches installed for different situations: Pump off, Pump on, Both Pumps on and Alarm level. For each situation, the related switch will send a signal to the control panel to control the operation of the pumps.

In the extremely unlikely event that both pumps fail, the water will spill towards Elm Drive West from the Tank's overflow grate. If both pumps fail and/or the water is rising towards the

top of the SWM tank, the system will send a high-water alarm signal to the control panel which is provided with a buzzer and connection to the concierge/maintenance team as a warning.

The pump system should also be provided with an emergency back-up generator to ensure that the system can operate during power outages.

It is recommended that the SWM tank be inspected every 4 months to ensure there is no debris or sand build up that could prevent the pumps from working properly or in any way damage the pumps. It is strongly recommended that the building management establish a maintenance schedule for the pump and electronic systems based on the suppliers' manual.

The pump system design and maintenance shall be detailed by the mechanical engineer.

# PROPOSED HIGH-DENSITY RESIDENTIAL DEVELOPMENT
# ELM DRIVE WEST
# CITY OF MISSISSAUGA

ELM DRIVE WEST

KARIYA DRIVE

HURONTARIO STREET

PHASE 1 AREA

PHASE 2 AREA

LOT 23

LOT 24

LOT 1

LOT 2

0.37ha
C=0.84

LIMIT OF PHASE 2

LIMIT OF PHASE 3

31 STOREY RESIDENTIAL BUILDING

32 STOREY RESIDENTIAL BUILDING

## LEGEND

- EXSITING STORM SEWER
- PROPOSED STORM SEWER
- MAINTENANCE HOLE
- OVERALL SITE BOUNDARY
- PHASE III

| | | |
|---|---|---|
| FUTURE R.O.W. – WIDENING | A=0.061ha | |
| IMPERVIOUS AREA | A=0.34ha | C=0.90 |
| PERVIOUS AREAS | A=0.03ha | C=0.25 |
| TOTAL PROPERTY: | A=0.37ha | C=0.84 |

EMERGENCY OVERLAND FLOW ROUTE


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6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
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FIGURE 2-3
PROPOSED STORMWATER MANAGEMENT INFRASTRUCTURE

| 2020-4904 | JULY 2020 | SCALE: NTS |
|---|---|---|

### 2.3.2 WATER QUALITY CONTROL

The water quality target for the building (Tower C) area is the system that can provide an "enhanced" level of water quality control, as defined by the MOE SWMP Manual. An "enhanced" level of water quality implies 80% long-term removal of suspended solids.

In this regard, the Jellyfish Filter product from Imbrium System is selected. Based on the calculation provided by Imbrium Systems (**Appendix A**), a Jellyfish model JF6-4-1-L0 contained in a 1800mm DIA. pre-cast concrete MH by Imbrium Systems Corporation has been selected and it will provide a TSS removal rate of 89%.

According to the sizing report presented in **Appendix A**, the design treatment flow rate is 10.6 l/s, which meets or exceeds 90% of the average annual runoff based on 18 years of Toronto Central rainfall data. The required sediment capacity is determined to be 221 kg, which meets or exceeds the estimated average annual sediment load. Based on the Jellyfish filter datasheet, a JF6-4-1-L0 unit with 4 cartridges can handle a maximum design flow rate of 22.7 l/s and has a sediment capacity of 256 kg, which are both greater than the required amounts.

### 2.3.3 SUSTAINABLE STORMWATER MANAGEMENT

The underground parking level of the proposed development occupies the majority of the subject site. The rainwater from the roofs is to drain to the Irrigation Tank located immediately adjacent to the SWM Tank in the building's P1 level. There it will be stored for re-use by the irrigation system.

Based on the architect's experience, high building green roofs do not have the intended function and are usually affected by the wind. As such, green roofs have not been considered for this development.

# 3.0 EROSION AND SEDIMENT CONTROL

Although the area of the subject site is less than 2ha, the sediment and erosion control measures are suggested to minimize the effects of erosion and siltation from the construction site. Control measures can include a combination of the following:

- Topsoil stockpiles;
- Rock check dams; and
- Environmental fencing.

The following is an overview of the methodologies and practices considered for the proposed development in order to prevent the release of sediment into the existing storm sewer system. The following describes temporary measures that can potentially be included in the sediment and erosion control plan.

### 3.1.1 TOPSOIL STOCKPILES

Grading for construction requires the top layer of soil (topsoil), which contains nutrients and organic matter necessary for plant growth, to be removed. The topsoil is put into piles and conserved for later use on the site. Measures will be taken to prevent erosion of stockpiles, keeping sediment, nutrients and organic matter from entering the waterways.

To ensure the stockpile is effective, the slopes should be stabilized immediately. Seeding or mulching can be used to stabilize the stockpile. Another option is to place plastic sheeting on the stockpile to protect it from rainfall.

### 3.1.2 ROCK CHECK DAMS

Rock check dams (RCDs) act to slow the velocity of runoff and consequentially promote settling. Some storage capacity is created on the upstream side of the RCD. During construction activities, RCDs are anticipated to be used within stormwater drainage ditches as part of the sediment and erosion control plan.

### 3.1.3 ENVIRONMENTAL FENCING

Environmental fencing is a type of barrier used to physically separated construction areas from the environment. Other physical barriers include vegetative strips, plastic sheeting, and buffers. In general, environmental fencing will be placed around the limits of construction and topsoil stockpiles. Fencing should be used adjacent areas of environmental significance. It is important to inspect all physical barriers on a weekly basis and after significant rainfall events.

# 4.0 SUMMARY

This Stormwater Management Report provides an overview of the proposed servicing plan for the high-density residential development, located at Elm Drive West, in the City of Mississauga. This report demonstrates that adequate stormwater servicing will be available for the proposed development. In summary, the storm servicing analysis established the following:

- The Water Quality criteria will be met by providing a Jellyfish filtration unit by Imbrium Systems Corporation, which will provide a TSS removal rate of 80%.

- The storm water will be released to the municipal storm sewer system on Elm Drive West, with a release rate not exceeding the allowable release rate of 9.5 l/s.

- On-site water quantity control storage will be provided through underground storage and an orifice tube.

-No roof area control has been provided.

We trust the above information is suitable for your needs at this time. Should you have any questions or comments, please do not hesitate to contact the undersigned.

Sincerely,

**SCHAEFFER & ASSOCIATES LTD.**


**Hagop Sarkissian, P.Eng.**
Partner

**Diana Tabuas, EIT**
Project Manager

# APPENDIX A: STORMWATER MANAGEMENT CALCULATIONS & BACKUP

# City of Mississauga
# Runoff Coefficient - Pre-Development Condition

Project: Residential Development - Elm Drive West
TOWER C (Phase III)

Criteria:

The Runoff Coefficients were taken from City's Design Criteria.

Calculations for Internal Drainage Area - Draining to System on Elm Drive West

| | Area (ha) | Runoff Coeff. | A x C |
|---|---|---|---|
| Pervious areas | 0.19 | 0.25 | 0.0486 |
| Impervious areas | 0.01 | 0.90 | 0.0083 |
| **Sub Total** | **0.20** | | **0.0569** |

| | |
|---|---|
| Weighted Coefficient - Internal | 0.28 |

Calculations for Internal Drainage Area - Draining to System on Private Drive

| | Area (ha) | Runoff Coeff. | A x C |
|---|---|---|---|
| Pervious areas | 0.14 | 0.25 | 0.0354 |
| Impervious areas | 0.05 | 0.90 | 0.0461 |
| **Sub Total** | **0.19** | | **0.0815** |

| | |
|---|---|
| Weighted Coefficient - Internal | 0.42 |

# City of Mississauga- Design Criteria
# Allowable Release Rate

Project: 4577 - Elm Drive West
Phase III - TOWER C

Criteria:
The Runoff Coefficients were taken from City's Design Criteria.

Rainfall intensity

| Design Storm Event | A | B | C | I (mm/hr) |
|---|---|---|---|---|
| 2-Year | 610 | 4.6 | 0.78 | 59.892 |
| 5-Year | 820 | 4.6 | 0.78 | 80.511 |
| 10-Year | 1010 | 4.6 | 0.78 | 99.166 |
| 25-Year | 1160 | 4.6 | 0.78 | 113.893 |
| 50-Year | 1300 | 4.7 | 0.78 | 127.133 |
| 100-Year | 1450 | 4.9 | 0.78 | 140.690 |

Note:
T=15 minutes
I=A / (T+B)^C

Existing Peak Discharge Rate to Storm Sewer on Elm Drive West

| | | |
|---|---|---|
| Runoff Coefficient, C | **0.28** | |
| Drainage Area | **0.20** | ha |
| 2-Year Peak Flow, Q2 | 9.54 | l/s |
| 5-Year Peak Flow, Q5 | 12.83 | l/s |
| 10-Year Peak Flow, Q10 | 15.80 | l/s |
| 25-Year Peak Flow, Q25 | 18.15 | l/s |
| 50-Year Peak Flow, Q50 | 20.26 | l/s |
| 100-Year Peak Flow, Q100 | 22.42 | l/s |

Total Maximum Allowable Release rate from the site = Qex+Q2= 9.5 l/s

Existing Peak Discharge Rate to Storm Sewer on Private Drive

| | | |
|---|---|---|
| Runoff Coefficient, C | **0.42** | |
| Drainage Area | **0.19** | ha |
| 2-Year Peak Flow, Q2 | 13.66 | l/s |
| 5-Year Peak Flow, Q5 | 18.37 | l/s |
| 10-Year Peak Flow, Q10 | 22.62 | l/s |
| 25-Year Peak Flow, Q25 | 25.98 | l/s |
| 50-Year Peak Flow, Q50 | 29.00 | l/s |
| 100-Year Peak Flow, Q100 | 32.10 | l/s |

# City of Mississauga - Design Criteria

## Runoff Coefficient Based on Current Design

Project: High Density Residential Development
Elm Drive - Phase III TOWER C

Criteria:

The Runoff Coefficients were taken from City's Design Criteria.

| | | | |
|---|---|---|---|
| Future R.O.W. - widening | 0.062 | 0.90 | 0.0554 |

Controlled on the site via SWM Tank:

| | Area (ha) | Runoff Coeff. | A x C |
|---|---|---|---|
| Roof & Impervious Areas | 0.34 | 0.90 | 0.304 |
| Pervious Areas | 0.03 | 0.25 | 0.008 |
| **Sub Total** | 0.37 | | 0.312 |
| Weighted Coefficient (Controlled): | | | **0.84** |

# Elm Street West Development
# City of Mississauga
# Size Control Orifice - Tower C

Allowable Release Rate = 0.0095 $m^3/s$

| | | |
|---|---|---|
| DIA (mm)= | **100** | |
| AREA m^2 | 0.008 | |
| COEFF = | **0.80** | |
| GRAVITY = | 9.81 | |
| K = | 1.0 | |
| D/S HGL= | N/A | m |
| Orifice Inv. | 137.47 | m |
| Spill elev. | | m |

| Effective Head m | Depth Water At CTL MH m | Qp m^3/s | TOTAL FLOW Qp m^3/s | ELEVATION of Water m |
|---|---|---|---|---|
| 0.00 | 0.050 | 0.0000 | 0.0000 | 137.52 |
| 0.100 | 0.150 | 0.0088 | 0.0088 | 137.62 |
| **0.117** | **0.167** | **0.00952** | **0.0095** | **137.64** |
| 0.150 | 0.200 | 0.0108 | 0.0108 | 137.67 |
| 0.200 | 0.250 | 0.0124 | 0.0124 | 137.72 |
| 0.250 | 0.300 | 0.0139 | 0.0139 | 137.77 |
| 0.300 | 0.350 | 0.0152 | 0.0152 | 137.82 |

ORIFICE FLOW Q(m^3/s)= COEF*AREA*(2*GRAVITY*HEAD/K)^0.5

WEIR FLOW Q(m^3/s)= CLH^1.5 C=1.5

## Storage Volume Calculation - Phase III

Project: Elm Drive West Development (City of Mississauga)

**Modified Rational Method**

*Internal Area*

| | |
|---|---|
| Area (ha) = | 0.37 |
| C = | 0.84 |
| Maximum Release Rate (l/s) = | 9.50 |

100 Year Storm

| | |
|---|---|
| Design Storm = | City of Mississauga |
| A = | 1450 |
| B = | 4.9 |
| C = | 0.78 |

| | 100 Year | | | | | Total | Maximum | Required |
|---|---|---|---|---|---|---|---|---|
| Time | Intensity | Total | Rooftop | External | Total | Runoff | Release | Storage |
| (min) | 100 year | Runoff | Runoff | Runoff | Runoff | Volume | Volume | Volume |
| | (mm/hr) | (l/s) | (l/s) | (l/s) | (l/s) | ($m^3$) | ($m^3$) | ($m^3$) |
| 15 | 140.69 | 121.13 | 0.00 | 0.00 | 121.13 | 109.01 | 8.55 | 100.46 |
| 16 | 135.41 | 116.58 | 0.00 | 0.00 | 116.58 | 111.92 | 9.12 | 102.80 |
| 17 | 130.56 | 112.41 | 0.00 | 0.00 | 112.41 | 114.66 | 9.69 | 104.97 |
| 18 | 126.09 | 108.56 | 0.00 | 0.00 | 108.56 | 117.24 | 10.26 | 106.98 |
| 19 | 121.96 | 105.00 | 0.00 | 0.00 | 105.00 | 119.70 | 10.83 | 108.87 |
| 20 | 118.12 | 101.70 | 0.00 | 0.00 | 101.70 | 122.04 | 11.40 | 110.64 |
| 25 | 102.41 | 88.17 | 0.00 | 0.00 | 88.17 | 132.25 | 14.25 | 118.00 |
| 30 | 90.77 | 78.15 | 0.00 | 0.00 | 78.15 | 140.67 | 17.10 | 123.57 |
| 35 | 81.77 | 70.40 | 0.00 | 0.00 | 70.40 | 147.84 | 19.95 | 127.89 |
| 40 | 74.58 | 64.21 | 0.00 | 0.00 | 64.21 | 154.10 | 22.80 | 131.30 |
| 45 | 68.68 | 59.13 | 0.00 | 0.00 | 59.13 | 159.66 | 25.65 | 134.01 |
| 50 | 63.75 | 54.89 | 0.00 | 0.00 | 54.89 | 164.66 | 28.50 | 136.16 |
| 55 | 59.56 | 51.28 | 0.00 | 0.00 | 51.28 | 169.22 | 31.35 | 137.87 |
| 60 | 55.95 | 48.17 | 0.00 | 0.00 | 48.17 | 173.42 | 34.20 | 139.22 |
| 65 | 52.81 | 45.46 | 0.00 | 0.00 | 45.46 | 177.30 | 37.05 | 140.25 |
| 70 | 50.03 | 43.08 | 0.00 | 0.00 | 43.08 | 180.92 | 39.90 | 141.02 |
| 75 | 47.58 | 40.96 | 0.00 | 0.00 | 40.96 | 184.32 | 42.75 | 141.57 |
| 80 | 45.38 | 39.07 | 0.00 | 0.00 | 39.07 | 187.51 | 45.60 | 141.91 |
| 85 | 43.39 | 37.36 | 0.00 | 0.00 | 37.36 | 190.54 | 48.45 | 142.09 |
| 90 | 41.60 | 35.82 | 0.00 | 0.00 | 35.82 | 193.40 | 51.30 | 142.10 |
| 95 | 39.97 | 34.41 | 0.00 | 0.00 | 34.41 | 196.13 | 54.15 | 141.98 |
| 100 | 38.47 | 33.12 | 0.00 | 0.00 | 33.12 | 198.74 | 57.00 | 141.74 |

| | |
|---|---|
| **Required Storage ($m^3$):** | **143** |
| **Provided Storage ($m^3$):** | **160** |

# ON-LINE
# Jellyfish Filter Sizing Report

## Project Information

| | |
|---|---|
| Date | Thursday, August 06, 2020 |
| Project Name | Elm Dr. and Hurontario St. |
| Project Number | 4904 |
| Location | Mississauga |

## 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 JF6-4-1-L0 is recommended to meet the water quality objective by treating a flow of 22.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This Jellyfish Model has a Peak Flow Capacity of 22.7 L/s. This model has a sediment capacity of 256 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) | Peak Capacity (L/s) | Bypass MAW | Sediment Capacity (kg) |
|---|---|---|---|---|---|---|---|
| **JF6-4-1-L0** | 4 | 1 | 1.8 | 22.7 | 22.7 | No | 256 |

## 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 maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance inverval is designed to be a minimum of 12 months, but this will vary significantly with on-line desings based on storm event conditions, 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:

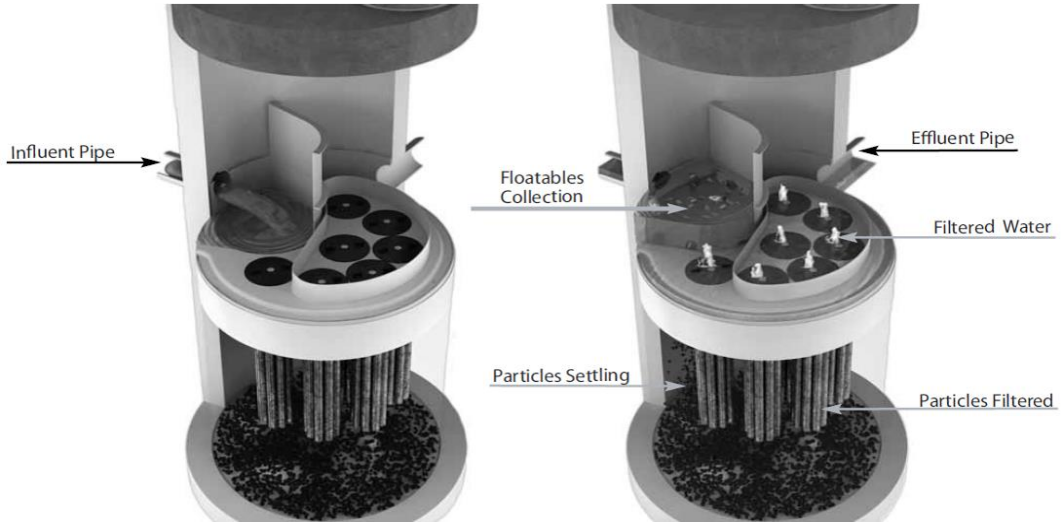
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash 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: | Thursday, August 06, 2020 |
| Project Name: | Elm Dr. and Hurontario St. |
| Project Number: | 4904 |
| Location: | Mississauga |

## Designer Information

| | |
|---|---|
| Company: | Schaeffer & Associates Ltd. |
| Contact: | Diana Tabuas |
| Phone #: | |

## Notes

## Rainfall

| | |
|---|---|
| Name: | TORONTO CENTRAL |
| State: | ON |
| ID: | 100 |
| Record: | 1982 to 1999 |
| Co-ords: | 45°30'N, 90°30'W |

## Drainage Area

| | |
|---|---|
| Total Area: | 0.37 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 18 years of TORONTO CENTRAL rainfall data: | **10.6 L/s** |
| **Sediment Loading** | Treating 90% of the average annual runoff volume, 2214 m³, with a suspended sediment concentration of 100 mg/L. | **221 kg*** |
| **Peak Flow** | The flow which must pass through the unit, includes | **9.5 L/s** |

** Indicates that sediment loading is the limiting parameter in the sizing of this Jellyfish system.*

## Recommendation

The Jellyfish Filter model JF6-4-1-L0 is recommended to meet the water quality objective by treating a flow of 22.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This Jellyfish Model has a Peak Flow Capacity of 22.7 L/s. This model has a sediment capacity of 256 kg, which meets or exceeds the estimated average annual sediment load.

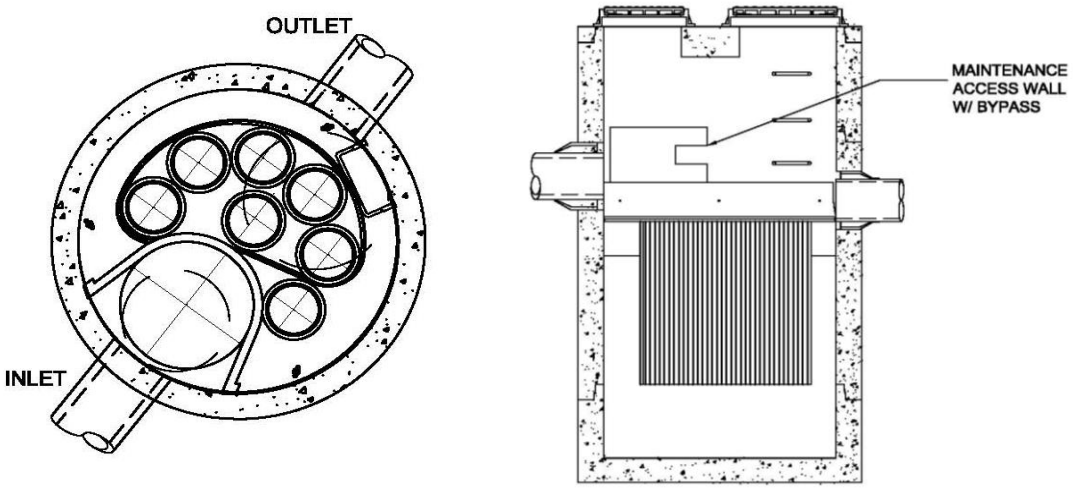
| Jellyfish Model | Number of High-Flo Cartridges | Number of Draindown Cartridges | Bypass MAW | Addt'l Sump (ft) | Manhole Diameter (m) | Wet Vol Below Deck (L) | Sump Storage (m³) | Oil Capacity (L) | Treatment Flow Rate (L/s) | Sediment Capacity (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| JF4-1-1-L0 | 1 | 1 | No | 0 | 1.2 | 2313 | 0.34 | 379 | 7.6 | 85 |
| JF4-1-1-L1 | 1 | 1 | Yes | 1 | 1.2 | 2661 | 0.34 | 379 | 7.6 | 85 |
| JF4-2-1-L0 | 2 | 1 | No | 0 | 1.2 | 2313 | 0.34 | 379 | 12.6 | 142 |
| JF4-2-1-L1 | 2 | 1 | Yes | 1 | 1.2 | 2661 | 0.34 | 379 | 12.6 | 142 |
| JF6-3-1-L0 | 3 | 1 | No | 0 | 1.8 | 5205 | 0.79 | 848 | 17.7 | 199 |
| JF6-3-1-L1 | 3 | 1 | Yes | 1 | 1.8 | 6003 | 0.79 | 848 | 17.7 | 199 |
| **JF6-4-1-L0** | **4** | **1** | **No** | **0** | **1.8** | **5205** | **0.79** | **848** | **22.7** | **256** |
| JF6-4-1-L1 | 4 | 1 | Yes | 1 | 1.8 | 6003 | 0.79 | 848 | 22.7 | 256 |
| JF6-5-1-L0 | 5 | 1 | No | 0 | 1.8 | 5205 | 0.79 | 848 | 27.8 | 313 |
| JF6-5-1-L1 | 5 | 1 | Yes | 1 | 1.8 | 6003 | 0.79 | 848 | 27.8 | 313 |
| JF6-6-1-L0 | 6 | 1 | No | 0 | 1.8 | 5205 | 0.79 | 848 | 28.6 | 370 |
| JF6-6-1-L1 | 6 | 1 | Yes | 1 | 1.8 | 6003 | 0.79 | 848 | 28.6 | 370 |
| JF8-6-2-L0 | 6 | 2 | No | 0 | 2.4 | 9252 | 1.42 | 1469 | 35.3 | 398 |
| JF8-6-2-L1 | 6 | 2 | Yes | 1 | 2.4 | 10675 | 1.42 | 1469 | 35.3 | 398 |
| JF8-7-2-L0 | 7 | 2 | No | 0 | 2.4 | 9252 | 1.42 | 1469 | 40.4 | 455 |
| JF8-7-2-L1 | 7 | 2 | Yes | 1 | 2.4 | 10675 | 1.42 | 1469 | 40.4 | 455 |
| JF8-8-2-L0 | 8 | 2 | No | 0 | 2.4 | 9252 | 1.42 | 1469 | 45.4 | 512 |
| JF8-8-2-L1 | 8 | 2 | Yes | 1 | 2.4 | 10675 | 1.42 | 1469 | 45.4 | 512 |
| JF8-9-2-L0 | 9 | 2 | No | 0 | 2.4 | 9252 | 1.42 | 1469 | 50.5 | 569 |
| JF8-9-2-L1 | 9 | 2 | Yes | 1 | 2.4 | 10675 | 1.42 | 1469 | 50.5 | 569 |
| JF8-10-2-L0 | 10 | 2 | No | 0 | 2.4 | 9252 | 1.42 | 1469 | 50.5 | 626 |
| JF8-10-2-L1 | 10 | 2 | Yes | 1 | 2.4 | 10675 | 1.42 | 1469 | 50.5 | 626 |
| JF10-11-3-L0 | 11 | 3 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 63.1 | 711 |
| JF10-11-3-L1 | 11 | 3 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 63.1 | 711 |
| JF10-12-3-L0 | 12 | 3 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 68.2 | 768 |
| JF10-12-3-L1 | 12 | 3 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 68.2 | 768 |
| JF10-12-4-L0 | 12 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 70.7 | 796 |
| JF10-12-4-L1 | 12 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 70.7 | 796 |
| JF10-13-4-L0 | 13 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 75.7 | 853 |
| JF10-13-4-L1 | 13 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 75.7 | 853 |
| JF10-14-4-L0 | 14 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 78.9 | 910 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| JF10-14-4-L1 | 14 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 78.9 | 910 |
| JF10-15-4-L0 | 15 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 78.9 | 967 |
| JF10-15-4-L1 | 15 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 78.9 | 967 |
| JF10-16-4-L0 | 16 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 78.9 | 1024 |
| JF10-16-4-L1 | 16 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 78.9 | 1024 |
| JF10-17-4-L0 | 17 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 78.9 | 1081 |
| JF10-17-4-L1 | 17 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 78.9 | 1081 |
| JF10-18-4-L0 | 18 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 78.9 | 1138 |
| JF10-18-4-L1 | 18 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 78.9 | 1138 |
| JF10-19-4-L0 | 19 | 4 | No | 0 | 3.0 | 14456 | 2.21 | 2302 | 78.9 | 1195 |
| JF10-19-4-L1 | 19 | 4 | Yes | 1 | 3.0 | 16678 | 2.21 | 2302 | 78.9 | 1195 |
| JF12-20-5-L0 | 20 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.6 | 1280 |
| JF12-20-5-L1 | 20 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.6 | 1280 |
| JF12-21-5-L0 | 21 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1337 |
| JF12-21-5-L1 | 21 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1337 |
| JF12-22-5-L0 | 22 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1394 |
| JF12-22-5-L1 | 22 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1394 |
| JF12-23-5-L0 | 23 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1451 |
| JF12-23-5-L1 | 23 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1451 |
| JF12-24-5-L0 | 24 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1508 |
| JF12-24-5-L1 | 24 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1508 |
| JF12-25-5-L0 | 25 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1565 |
| JF12-25-5-L1 | 25 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1565 |
| JF12-26-5-L0 | 26 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1622 |
| JF12-26-5-L1 | 26 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1622 |
| JF12-27-5-L0 | 27 | 5 | No | 0 | 3.6 | 20820 | 3.2 | 2771 | 113.7 | 1679 |
| JF12-27-5-L1 | 27 | 5 | Yes | 1 | 3.6 | 24012 | 3.2 | 2771 | 113.7 | 1679 |

Jellyfish® Filter

## 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 that 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 Online 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. Alternative driving head values are only possible with off-line configuration.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation.
- The Jellyfish Filter can not accommodate multiple inlet pipes in an on-line configuration.
- Typical systems conform to the following pipe orientations:

| Model Diameter (m) | Minimum Angle Inlet / Outlet Pipes | Minimum Inlet Pipe Diameter (mm) | Maximum Inlet Pipe Diameter (mm) |
|---|---|---|---|
| 1.2 | 62º | 150 | 300 |
| **1.8** | **59º** | **200** | **300** |
| 2.4 | 52º | 250 | 375 |
| 3.0 | 48º | 300 | 450 |
| 3.6 | 40º | 300 | 450 |

- Outlet pipes to be one size larger than inlet pipes on new projects.
- 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

# Jellyfish® Filter Manhole Installations
# Inspection and Maintenance Manual

**Imbrium Systems**
**1-800-565-4801**
**www.imbriumsystems.com**

## 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, these 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 form 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
- 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.

## Inspection 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.

## 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

## 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, backwash pool weir, and pressure relief pipe(s) (on-line units only) 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.

## Maintenance Requirements

Required maintenance for the Jellyfish Filter 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 removal.
- 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 sooner.
- 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.

## 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

### 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.
- **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.
- Remove rinse water from rinse tub or garbage can using a vacuum hose as needed.
- Slip the O-ring over the pipe nipple on the top end of the tentacle 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. Check the fit before completing rotation to a firm hand-tight attachment. Rinse away any accumulated grit from the receptacle threads if needed to get a proper fit.
- Repeat cartridge installation until all cartridges are installed.

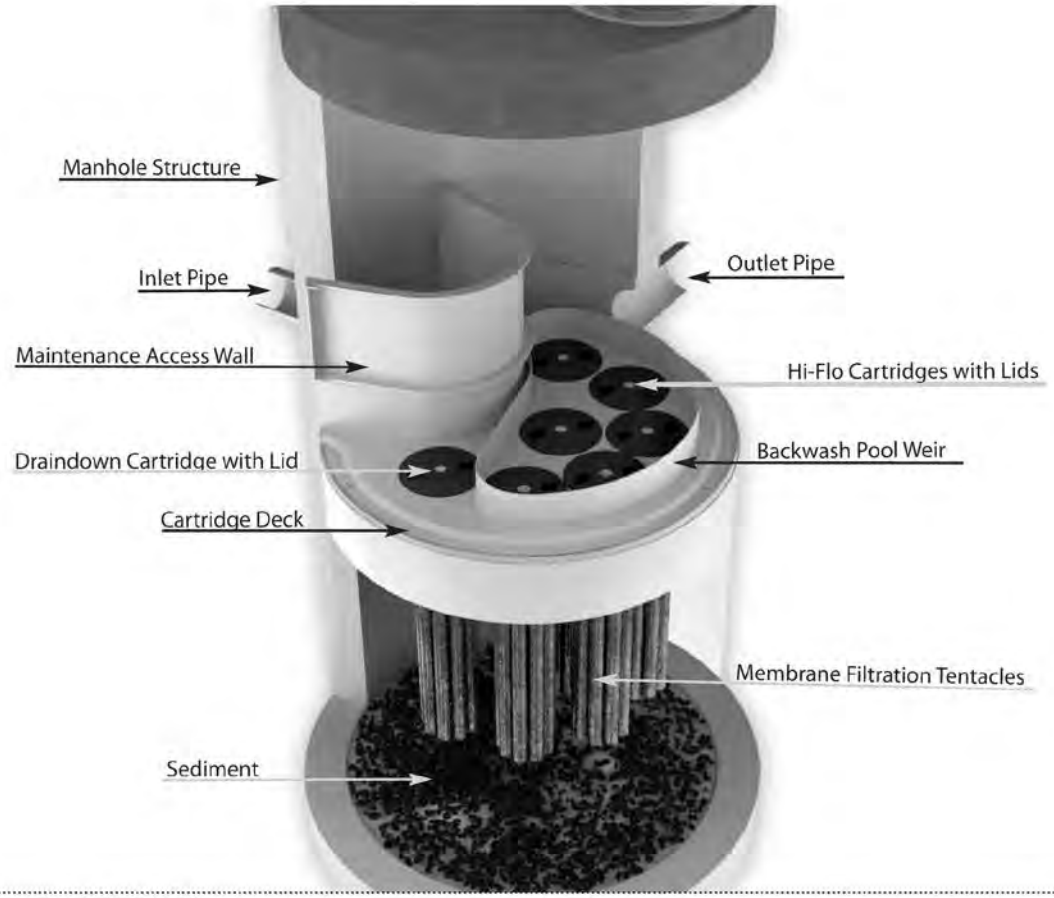
- **Vacuum Cleaning Procedure**
  - **Caution:** Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning **only through the maintenance access wall (MAW) opening**, being careful not to damage the flexible 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.

- **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.

Below is a cut-away schematic of the Jellyfish Filter manhole with key components identified (6-ft diameter manhole is depicted).

**FIGURE 1**

**Jellyfish Filter and Components**

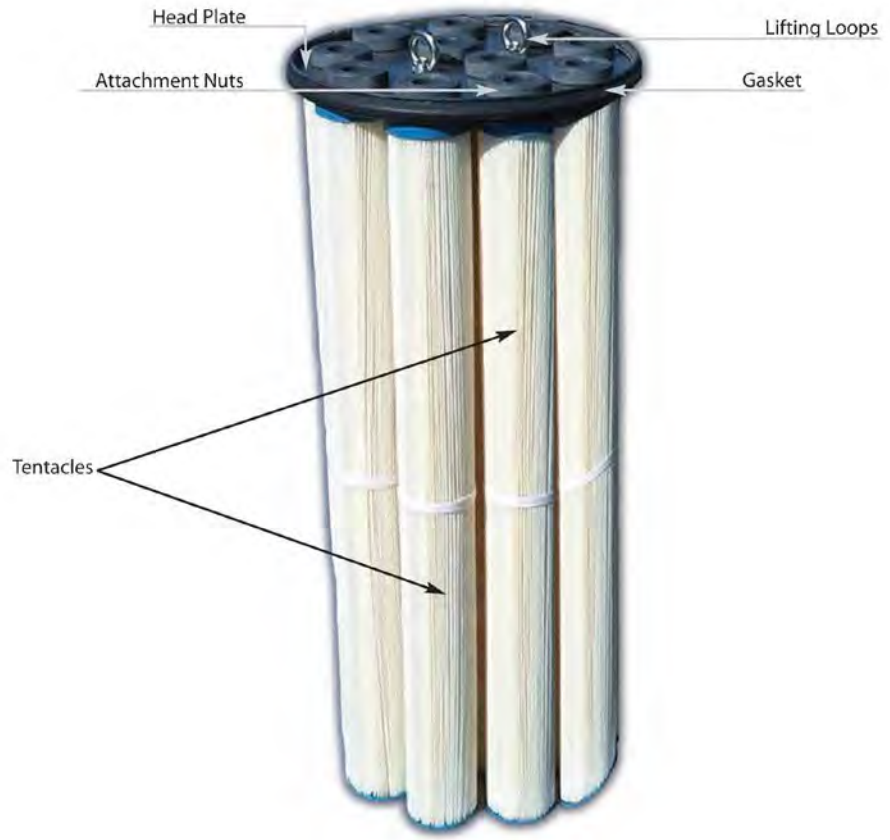



**Note:** Separator Skirt Not Shown

The Jellyfish Filter has no moving parts to wear out and therefore maintenance activities are generally focused on pollutant removal and filter cartridge service.

Below is a schematic of a Jellyfish Filter membrane filtration cartridge. Tentacles can be easily removed from the head plate and rinsed or replaced as needed.

**FIGURE 2**





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.



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).


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

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to the Jellyfish Filter's long and effective service life.

**Ordering Replacement Parts**

Jellyfish Filter cartridges, replacement tentacles, cartridge lids, and other system components can be ordered by contacting: **Imbrium Systems at 1-800-565-4801, or info@imbriumsystems.com**

# APPENDIX B: ENGINEERING DRAWINGS

PLEASE REFER TO ENGINEERING DRAWINGS IN THE SUBMISSION PACKAGE