Functional Servicing and Stormwater Management Report

141–153 Plains Road West Burlington, Ontario

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22-45

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Proposed Mixed-Use Development

141 – 153 Plains Road West
Burlington, Ontario

Functional Servicing

and

Stormwater Management Report

(in Support of Official Plan and Zoning By-law Amendment (OPA and ZBA) Application)

Summary of Issues/Revisions

No.	Date	Description
1	April 28th, 2023	1st Submission to City of Burlington
2	January 19th, 2024	2nd Submission to City of Burlington

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Project No. 22-45

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1.0 INTRODUCTION

1.1 Objectives

This report has been prepared as supporting documentation for an Official Plan and Zoning By-law Amendment (OPA and ZBA) Application for the property situated on the north side of Plains Road West between Howard Road and Daryl Drive in the City of Burlington. It is to be noted that the Site Plan Application (SPA) will be applied for at a later date. The development is designated as a mixed-use development consisting of one (1) building with 11 stories and two (2) subgrade parking levels. The development is to take place between 141 Plains Road West and 153 Plains Road West, where three (3) existing lots are to be rezoned in support of the development of the mixed-use structure.

1.2 Scope of Report

The servicing of the development is addressed with respect to storm and sanitary drainage. Water demand for domestic and fire flow requirements are also presented. Stormwater management requirements are based on the Stormwater Management Design Guidelines prepared for the City of Burlington (dated May 21st, 2020).

In more detail the Functional Servicing sections of this report will address:

- Anticipated domestic water consumption based on City criteria.
- Anticipated fire flow demand based on the nature of the development and the requirements of the Fire Underwriter's Survey, 2020 (FUS).
- Review of existing watermains servicing the area.
- Determine if upgrades are required to the existing watermain infrastructure.
- Anticipated sanitary discharge from the development.
- Current capacity of existing sanitary sewer to which the development will connect.
- Impact on the existing sanitary sewer as a result of the new demand will be assessed.
- Determine if upgrades are required to the existing sanitary sewer infrastructure.

- Storm drainage from the development will be controlled to the 5-year predevelopment run-off levels as per the Stormwater Management Design Guidelines prepared for the City of Burlington (dated May 21st, 2020).
- The existing storm sewer capacity will be determined.
- Impact to the existing storm sewer as a result of the new controlled flow from the development will be assessed.
- Determine if upgrades are required to the existing storm sewer infrastructure.

With regards to stormwater management the following are addressed:

- The Grading Plan and Servicing Plan enclosed with the report indicate direction of surface drainage.
- Emergency overland flow route is indicated on the Grading Plan.
- Storage volumes are provided for detention and retention storage for events up to and including the 100-year storm.
- Water quality calculation indicating 80% TSS removal.
- Water balance for the site.

1.3 Study Area

The subject site is located between 141 Plains Road West and 153 Plains Road West within the City of Burlington. This property is situated on the north side of Plains Road West between Howard Road and Daryl Drive. Additionally, the site is abutting a commercial plaza to the east and a commercial building to the west. To the south, the site is bound by Plains Road West and to the north the site is bordered by an industrial building. The development site presently consists of three (3) separate properties, where 141 Plains Road West is a commercial building, and 147 Plains Road West and 153 Plains Road West are single-family residential dwellings. In the post-development condition, the subject site will be rezoned where 141, 147, and 153 Plains Road West is combined into a 0.2418-hectare parcel of land. Additionally, in the post-development condition, the proposed site will consist of one (1) building with 11 stories consisting of a majority of residential units. A non-residential space will be situated on the ground floor and two (2) subgrade levels will be constructed, where access to the parking levels will be by

a series of ramps. All existing infrastructure and landscaping features at 141, 147, and 153 Plains Road West are to be decommissioned and demolished to facilitate the development of the mixed-used building.



Figure 1 – Site Location: Aerial

2.0 DEVELOPMENT CONCEPT

2.1 Development

The site plan proposes one (1) mixed-use building that will consist primarily of residential units and is to have accessible non-residential space on the ground floor in the post-development condition. The development will consist of an 11-storey building where 131 residential units are to be proposed, along with an area designated for non-residential use on the ground floor (please see **Table 1** for site statistics). The development will also consist of two (2) sub-surface levels for parking. The aforementioned parking levels will be accessed by a series of ramps. The proposed building will possess 10,126 m^2 of GFA.

Table 1 – Site Statistics

Site Area (ha)	Total Residential GFA (m^2)	Total Non-Residential GFA (m^2)	Total GFA (m^2)	1-BR	2-BR	3-BR	Total Number of Units
0.2418	9,950	176	10,126	38	83	10	131

3.0 SANITARY SEWERS

3.1 Existing Sanitary Sewers

There is an existing 375mm diameter sanitary sewer that is located within City of Burlington's right-of-way situated on the north side of Plains Road West, fronting the subject property and slopes from west to east at approximately 0.4%. To determine the pipe's full flow capacity, Manning's Formula was used (see **Equation 1.0**).

$$Q = \frac{1}{n} * R^{2/3} * S^{1/2} * A \qquad \textbf{[Equation 1.0]}$$

Where,

$Q = Design\ Flow\ \left(m^3/_{sec}\right)$

$n = Manning's\ Coefficient\ of\ Roughness$

$n = 0.013$

$R = Hydraulic\ Radius\ (m)$

$S = Slope\ (m/_m)$

$A = Section\ Area\ of\ Flow\ (m^2)$

Based on the existing conditions of the sanitary sewer that fronts the subject site (375mm sewer sloping at 0.4%), the full flow capacity of this sewer was calculated, using **Equation 1.0**, to be 115.68 L/sec.

As per the drawing called "Plains Road West (from Howard Road to 20 meters East of Daryl Road) – Drawing No. B-12159" issued by Halton Region (dated May 2002), it is assumed that the existing subject sites at 141, 147, and 153 Plains Road West connect directly to this sanitary sewer through 150mm sanitary service connections.

3.2 Proposed Sanitary Sewer Design

The site will be serviced through a sanitary service connection that ultimately connects from the south face of the proposed underground parking structure to the existing 375mm sanitary sewer main located within the City of Burlington's right-of-way along Plains Road West (see the *Servicing Plan*, ***S-1,*** and ***Section 3.1*** for details). The proposed development's sanitary sewer system was designed as a 200mm PVC DR-35 sanitary pipe in accordance with the minimum pipe size criteria.

The post-development sanitary design flow was analyzed based on the Regional Municipality of Halton Water and Wastewater Linear Design Manual criteria (Section 3.2 of the design manual). The design manual states that the sanitary flows can be estimated based on **Equation 2.0** below:

Sanitary Design Flow	=	Average Dry Weather Flow	*	Average Peak Wastewater Flow Factor	+	Inflow / Infiltration Allowance	**[Equation 2.0]**

The average dry weather flow can be calculated using Table 3-1 and Table 3-2 of the design manual (Section 3.2.2). The average peak wastewater flow factor (M) can be calculated using the modified Harmon Formula equation (using **Equation 2.1** and **Equation 2.2**) for all tributary area land use mixes. The design manual also states that for all drainage areas that do not include existing developed areas, the inflow/infiltration allowance shall be 0.286 x 10^{-3} m^3/ha/s.

$$M = K_{av} * \left(1 + \frac{14}{4+\sqrt{P_e}}\right) \qquad \textbf{[Equation 2.1]}$$

Where,

$$K_{av} = \left(\frac{A_R+(0.8*(A_I+A_C)}{A_R+A_I+A_C}\right) \qquad \textbf{[Equation 2.2]}$$

And:

$M = ratio\ of\ peak\ flow\ to\ average\ flow$

$P_e = equivalent\ tributary\ population\ in\ thousands$

$A_R = residential\ land\ use\ area\ (ha)$

$$A_I = industrial\ land\ use\ area\ (ha)$$
$$A_C = commercial\ land\ use\ (ha)$$

Note, the minimum permissible peaking factor (M) is to be used as 2.0. Additionally, land use determinations that were used were based on the planned land use designation. Tributary populations are the product of land use area (in hectares) and equivalent population density (persons per hectare) as described in Table 3-1 and Table 3-2 in Section 3.2.2 of the design manual. Table 3-1 and Table 3-2 provide a general guideline on population densities and wastewater flows. As noted in Table 3-1, apartments over six (6) storeys can be assigned an equivalent population density of 285 persons per hectare. The residential population for the proposed development is then determined to be 284 persons (0.9950 ha x 285 persons/ha). As noted in Table 3-2, light commercial areas can be assigned an equivalent population density of 90 persons per hectare. The non-residential population for the proposed development is then determined to be 2 persons (0.0176 ha x 90 persons/ha). Therefore, these were the populations used in the sanitary design flow calculations.

Based on the aforementioned criteria, post-development sanitary design flow was determined using **Equation 2.0**, **Equation 2.1**, and **Equation 2.2**. As per Table 3-1 in the design manual, the non-residential area of the proposed development (141 – 153 Plains Road West) was classified light commercial and thus the unit sewage flow of 24.75 m^3/ha/day (cubic meters per hectare per day). The average dry weather flow is then calculated as 0.005 L/sec by multiplying the unit sewage flow by the non-residential site area designation (0.0176 ha x 24.75 m^3/ha/day x 1000L / 86400s/day). The unit sewage flow for the residential areas of the development (as per Table 3-1 in the design manual) was taken as 0.275 m^3pcd (cubic meters per capita per day). This means that the average dry weather flow for the residential areas of the development is 0.904 L/sec (284 persons x 0.275 m^3pcd x 1000 L / 86400 s/day). From these values, the total sanitary design flow can be determined, see **Table 2** below.

Table 2 – Post-Development Sanitary Average Dry Weather Flow Table

Area (ha)	P, (Population – persons)	Unit Sewage Flow	Average Dry Weather Flow (L/sec)	Average Peak Wastewater Flow Factor (M)	Inflow / Infiltration Allowance (L/sec)	Sanitary Design Flow (L/sec)
Non-Residential (0.0176ha)	2	24.75[1]	0.005			
Residential (0.9643ha)	284	0.275[2]	0.904			
Total	**286**		**0.909**	**4.07**	**0.069**	**3.77**

[1] *m^3/ha/day = cubic meters per hectare per day.*

[2] *m^3pcd = cubic meters per capita per day.*

Table 2 summarizes the post-development average dry weather flow and peak sanitary design flow. Additionally, using the data from **Table 2**, the average peak wastewater flow factor (*M*) was calculated to be 4.07 using **Equation 2.1** and **Equation 2.2**. The inflow/infiltration allowance was also calculated based on the developable site area to be 0.069 L/sec (0.286×10^{-3} m^3/ha/s x 0.2418 ha x 1,000 L/m^3). Therefore, the sanitary wastewater demand for the subject site in the post-development condition is 3.77 L/sec.

The connection to the existing sanitary sewer within Plains Road West is to be made by a proposed 200mm diameter sanitary pipe connected to the subject site's proposed sanitary control manhole flowing at approximately 1% full at an expected actual velocity of 1.00m/s. The aforementioned sanitary control manhole is proposed within the entrance driveway to the site. The receiving existing sanitary sewer is a 92.9-meter-long, 375mm diameter sanitary pipe which slopes at approximately 0.40%, from west to east. The existing sanitary connection servicing the property may be seen on the *Servicing Plan*, drawing ***S-1***, enclosed at the back of this report.

4.0 WATER DISTRIBUTION

4.1 Existing Watermains

There is an existing 300 mm watermain along Plains Road West that will act as the supply line for the development. Presently, the existing sites at 141, 147, and 153 Plains Road West are being serviced by the aforementioned watermain within Plains Road West through the use of three (3) existing 25mm service connection(s). These service connections will be decommissioned and removed prior to the building construction.

4.2 Proposed Watermains

The proposed building will contain a fire pump system with an automatic sprinkler system (see Architectural Site Plan drawing A101 for details). This system will be supplied by a 150mm watermain that will be drawing from the 300mm watermain within Plains Road West. This service connection will be located at the south side of the proposed building (exiting from the P1 level) and will travel south to the existing municipal watermain. The 11.1m long service connection (PVC DR-18 Class 235) branches to a 100mm domestic line and a 150mm fire line, respectively. Each line will be constructed with a 100mm and a 150mm valve and box as well as the appropriate fixtures (detector check valve, backflow preventer and water meter) to be installed as per Halton Region Standards RH-504.010, RH-504.011, and RH-601.010. The service connection will be installed as per Halton Region Standard RH-409.010.

4.2.1 Domestic Demand

The watermain design must accommodate the demand under the greater of the two (2) conditions, the maximum daily demand plus fire flow and the maximum hourly demand. As discussed in **Section 3.2** there are designated non-residential and residential areas of the proposed development. The Region of Halton Water and Wastewater Linear Design Manual (Table 2-1 [Section 2.3.2] of the design manual) states equivalent population densities and water services demands. Based on the equivalent population densities in Table 2-1 of the design manual, the population for

the non-residential and residential uses for the proposed development are 2 persons and 284 persons, respectively (see **Section 3.2** for details). Therefore, the total population estimate is 286 persons was used to calculate the average day services demands for the proposed development.

The domestic demand is summarized for average daily demand, maximum daily demand, and maximum hourly demand, based on peaking factors stated in the design manual (Section 2.4.2), in **Table 2** as follows. The development demand for the average day is calculated by multiplying 0.275 m^3/capita by the estimated population. The average daily domestic service demand for the designated non-residential and residential portions of the proposed development is then calculated as 0.38 L/min (0.275 m^3/capita * 2 persons) and 54.24 L/min (0.275 m^3/capita * 284 persons), respectively. The remaining parameters are calculated by multiplying the peaking factor by the average daily domestic demand as stated in Section 2.4.2 (see Table 2-2) of the design manual.

Table 3 – Domestic Demand

Development Block	Population	Average Daily Demand (L/min)	Maximum Daily Demand (L/min)	Maximum Hourly Demand (L/min)
		Peaking Factors		
		1.0	2.25	4.00 [2.25][1]
Non-Residential	2	0.38	0.86	0.86
Residential	284	54.24	122.03	216.94
Total	**286**	**54.62**	**122.89**	**217.80**

[1] *As stated in Section 2.4.2 (Table 2-2), the residential maximum hourly demand peaking factor is 4.00, where the industrial, commercial, and community services maximum hourly demand peaking factor is 2.25.*

4.2.2 Fire Demand

Based on the Fire Underwriters Survey, Water Supply for Fire Protection, 2020, an estimate of the fire flow required is given by **Equation 3.0**:

$$RFF = 220C\sqrt{A} \qquad \textbf{[Equation 3.0]}$$

where: $RRF = required\ fire\ flow\ in\ litres/minute$

$C = coefficient\ relating\ to\ type\ of\ construction$

$A = floor\ area\ in\ square\ metres$

The required fire flow was found to be 11,000 L/min (See Fire Demand Calculations in ***Appendix 'B'***).

4.2.3 Total Demand

The total demand is the greater of the two conditions, the maximum daily demand plus fire flow and the maximum hourly demand. Thus:

$$Total\ Demand = 122.89 + 11{,}000$$

$$Total\ Demand = 11{,}123\ {}^{L}/_{min}$$

Hydrant flow tests were completed by IQ Environmental at the hydrants located along Plains Road West, adjacent to the site (please see ***Appendix 'B'*** to see the hydrant flow test results from IQ Environmental as well as the test results plotted on N-1.85 graph paper). Based on the results of the hydrant flow test, the available flow within the existing 300mm watermain within Plains Road West is 12,108 L/min. Therefore, the existing watermain within Plains Road West has adequate flow to service the proposed mixed-use development at 141, 147, and 153 Plains Road West.

5.0 STORM SEWERS

5.1 Existing Site Drainage and Storm Sewer System

Currently the existing properties at 141, 147, and 153 Plains Road West slopes from the north-west (153 Plains Road West) and from the north-east (141 Plains Road West) towards the southern limits of the properties (towards Plains Road West). The subject site currently contains no stormwater collection infrastructure, and all excess stormwater runoff is being sheet drained to Plains Road West. Presently there are no stormwater management techniques implemented on the

site and the storm runoff is being discharged at an uncontrolled rate. The stormwater runoff is being released towards a double catch basin located on Plains Road West. The double catch basin located on Plains Road West discharges stormwater runoff to the existing storm sewer located within the City of Burlington's right-of-way, which traverses along the southern portion of the subject property and slopes from west to east. The aforementioned existing sewer is an 825mm pipe and is approximately 92.9 meters in length, sloping at 0.44%. To determine the pipe's full flow capacity, Manning's Formula was used (see ***Section 3.1*** and **Equation 1.0**). Based on the existing conditions of the storm sewer fronts the subject site (825mm sewer sloping at 0.44%), the full flow capacity of this sewer was calculated, using **Equation 1.0**, to be 952.16 L/sec.

5.2 Proposed Storm Drainage and Storm Sewer Design

It is proposed to discharge storm flows from the development to the existing storm sewer located on the north side of Plains Road West in a similar fashion to the pre-existing condition, albeit at a controlled rate (See **Section 5.2.1** for additional details). The overland flow route will continue to be directed towards Plains Road West in the post-development condition.

5.2.1 Proposed Storm Flows

Based on the Stormwater Management Design Guidelines for the City of Burlington (2020), the allowable outflow from the site will be limited to the 5-year pre-development Rational Method peak flow. Based on a time of concentration of 10 minutes, a pre-development runoff coefficient of 0.5 and a site area of 0.2418 ha, it is determined that the allowable outflow from the site will be 34.03 L/sec (see detailed calculations in ***Appendix 'C'*** and **Section 6.5** for details).

5.2.2 Storm Connection

In order to service the proposed development, a service connection will be required to discharge the captured stormwater runoff from the site. As per **Section 5.1**, the site is presently sheet draining at an uncontrolled rate towards an existing double catch basin on Plains Road West, which is

connecting to the existing storm sewer main located just north of Plains Road West. In order to improve the pre-existing drainage pattern, the site will continue to discharge to the storm sewer main located within Plains Road West in the post-development condition at a controlled rate (see **Section 6.5** for additional details).

In the post-development condition, a new service connection will be installed, and the stormwater runoff will continue to be discharged to the existing storm sewer main. Based on the characteristics of the proposed storm sewer, the 100-year storm event will be limited to discharging stormwater runoff to the 5-year pre-development flow rate of a maximum of 33.21 L/s (see **Section 6.5** for additional details).

The receiving sewer will have adequate capacity to service the proposed development based on two clear indications. The first of which is that the site will now control the 100-year storm event to the 5-year pre-development condition, as opposed to the pre-construction condition, where the site did not implement any stormwater management techniques. Lastly, the design of the receiving system would have allowed for flows from the subject site based on a runoff coefficient greater than 0.50.

6.0 STORM DRAINAGE AND STORMWATER MANAGEMENT

6.1 Drainage Parameters

The general requirements for drainage and stormwater management are specified in the Stormwater Management Design Guidelines for the City of Burlington (2020):

i. Water Quality:
Long term average removal of 80% of total suspended solids (T.S.S.).

ii. Water Balance:
The City of Burlington's Stormwater Management Design Guidelines specifies that the site is to retain the first 5mm of a storm event by infiltration.

iii. Allowable Site Discharge Rate Criteria:

The peak allowable outflow from the site must be limited to the peak runoff rate generated in the pre-development condition by a 5-year design rate using a Time of Concentration of 10 minutes and a maximum runoff coefficient equal to 0.50, or the existing capacity of the receiving storm sewer, whichever is less.

6.2 External Drainage

There are external drainage areas contributing storm runoff to the subject property. These external drainage areas are considered in the stormwater management calculations in the post-development condition. The limits of the external drainage lands have been illustrated on **STM-1** (see ***Appendix 'C'***). Approximately 105 m^2 of land area adjacent to the subject site (approximately 31 m^2 to the west and 74 m^2 to the east of the site – see **STM-1** for details) will convey surface runoff to the subject site. These external drainage areas are considered controlled tributary areas.

6.3 Water Quality Control

Water quality for the site must satisfy 80% Total Suspended Solids (TSS) removal. It is assumed that the removal ratio for an impervious roof and soft landscaping surfaces is 80%. No removal rate was assigned to the hard-landscaped areas, including the unit paver area. Based on the types of surface areas on the site, the following water quality table was prepared to summarize the Total Suspended Solids (T.S.S.) removal:

Table 4 – Stormwater Quality from Site

Surface	Fractional Area (ha)[1]	Percentage of Total Area	TSS Removal for Site Area	TSS Removal Over Total Site
Hard Landscape	0.0589	24.36%	0%	0%
Soft Landscape	0.0421	17.41%	80%	13.9%
Impervious Roof	0.1155	47.77%	80%	38.2%
Green Roof	0.0253	10.46%	80%	8.4%
TOTAL	**0.2418**	**100%**		**60.5%**

[1] **See *Figure 3* enclosed in *Appendix 'C'* for details.**

Table 4 indicates that 60.5% of T.S.S. is removed from the site during the initial T.S.S. Treatment (see ***Figure 3*** enclosed in ***Appendix 'C'*** for details). This means there is 39.5% of T.S.S. remaining. In order to achieve the minimum 80% removal rate of T.S.S. in accordance with the City of Burlington Stormwater Management Design Guidelines, a Jellyfish Filter Unit (JF 4-1-1) will be installed in an offline configuration (see ***Appendix 'C'*** for sizing report and performance specifications).

Table 5 – T.S.S. Removal Summary

T.S.S. Removal	Percentage of T.S.S. Removed (%)
Initial T.S.S. Removal Over Total Site	60.5%
T.S.S. Removal from JF 4-1-1	31.6%
TOTAL T.S.S. TREATMENT	**92.1%**

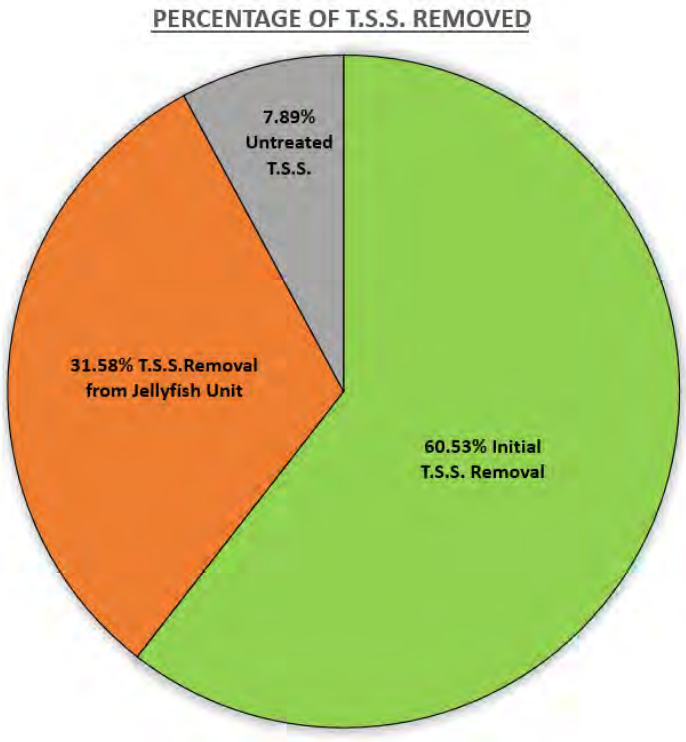


Figure 2 – T.S.S. Removal Efficacy

A Jellyfish Filter is preferred compared to an oil/grit separator because it is a stormwater quality treatment technology featuring pre-treatment and membrane filtration in a compact stand-alone system that outperforms an OGS Unit. A

Jellyfish Filter removes floatables, trash, oil, debris, T.S.S., fine silt-sized particles, and a high percentage of particulate-bound pollutants, including phosphorus and nitrogen, metals and hydrocarbons. The Jellyfish Filter has been verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol and also has a NJDEP certification.

6.4 Water Balance

The Stormwater Management Design Guidelines for the City of Burlington (2020) requires that a "water budget" for the amount of rainfall input which becomes runoff is infiltrated or is lost through evapotranspiration for a subject area. The City of Burlington required that the infiltration volumes in the pre-development condition are maintained under post-development conditions. At a minimum, the City of Burlington recommends that the first 5mm of rainfall which lands on the site is retained and infiltrated on site. Therefore, the surface treatments in the post-development condition were analyzed to affect a water balance on the site.

All impervious (hard) surfaces for the site are accredited for 1mm of initial abstraction, where all proposed pervious (soft) surfaces will be accredited for 5mm of initial abstraction. Based on the proposed development plans for the site, more than 80% of the total site area is proposed as a combination of impervious (hard) surfaces and/or the proposed building's (impervious) roof. Due to these constraints, adhering to the aforementioned water balance criteria would not be possible without proposing low-impact development infrastructure.

The MECP Stormwater Management Guidelines states that the location of any infiltration trench must be setback at least four (4) meters from any building foundations to prevent excessive foundation drainage. Otherwise, the stormwater infiltration will just be collected by the sub-foundation groundwater collection system (weeping tiles) and will be discharged through the municipal sewers. Currently, the proposed structure's underground levels are setback 3.0 meters from the southern property line and is also proposed to abut the property lines along the west, north, and east limits. In the post-development condition, due to these site constraints, it is *not permissible* to utilize infiltration on this site to adhere to water balance criteria.

In order to provide water balance to the site's greatest potential, a green roof is to be implemented. The Landscape Architect of record (Henry Kortekaas & Associates Inc. [HKLA]) has specified a green roof product called ZinCo Sedum Green Roof and is to be installed on the roof of the 11th storey of the building and to cover approximately 253m^2 of roof area in total (the landscape architecture submission package was submitted as a stand-alone design, please see the landscape architect drawings by HKLA). As discussed above, the green roof will be accredited for 5mm of initial abstraction.

Table 6 – Water Balance of Site

Developable Area	Area (ha)[1]	Fraction of Area	Initial Abstraction (mm)	Initial Abstraction over Area (mm)
Hard Landscape	0.0589	24.36%	1	0.25
Soft Landscape	0.0421	17.41%	5	0.88
Impervious Roof	0.1155	47.77%	1	0.48
Green Roof	0.0253	10.46%	5	0.53
TOTAL	**0.2418**	**100%**		**2.14**

[1] **See *Figure 3* enclosed in *Appendix 'C'* for details**

As per **Table 5**, the site will abstract 2.14 mm of water through evapotranspiration and infiltration, for every rainfall event; this generates a shortfall of 2.86 mm from every storm event to adhere to the water balance criteria.

The assembly of the Sedum Green Roof consists of a layer of plant material, growing medium, ZinCo Fixodrain (XD20), diffusion membrane (ZinCo TGV21), XPS insulation, root barrier membrane (ZinCo WSF40), and a waterproofing membrane to be installed on top of the roof construction. One of the benefits to implementing the ZinCo Sedum Green Roof is that this product was designed to provide retention storage capacity, where the retention storage will provide additional abstraction by allowing evapotranspiration and/or absorption by the planting roots and/or the growing medium. The retention volume is stored within the green roof and the vegetation will undergo osmosis through absorbing the retained stormwater, as opposed to needing consistent irrigation. The ZinCo Sedum Green Roof assembly as described above has been accredited for a retention capacity of 37 L/m^2 (please see landscape architect drawings by HKLA for additional details). Any overflow from the retention storage capacity will be

collected by the ZinCo Fixodrain (XD20) and drained towards the roof area drains, where the stormwater will be discharged to the stormwater detention tank on the P1 level.

Based on the total retention capacity of the proposed green roof, the total retention storage on the green roof is approximately 9.36 m^3 [(37 L/m^2 x 253 m^2) / 1000 L/m^3]. This means the retention storage capacity can be accredited for an additional 3.87 mm of abstraction to water balance [(9.36 m^3/ 2,418m^2) x 1000 mm/m)], resulting in a total abstraction of 6.01 mm (2.14 mm + 3.87mm). Therefore, the water balance requirement has been achieved for this development.

6.5 Quantity Control

The quantity control of the site was established by approximately controlling the 100-year post-development flow rate to the 5-year pre-development flow rate. This volume was determined by using the Modified Rational Method (see ***Appendix 'C'*** for details).

The site in the pre-development condition consisted mostly of impervious landscaping, ultimately generating a pre-development runoff coefficient of 0.69. Since the maximum allowable pre-development runoff coefficient is 0.50 (as per Stormwater Management Design Guidelines for the City of Burlington), this was the value that was used. Considering the total area of the subject site is 0.2418 ha, and based on the pre-development runoff coefficient of 0.50, the peak 5-year allowable runoff rate for the site is 34.03 L/sec (without accounting for uncontrolled flow).

However, in the post-development condition, there is a total uncontrolled area of 0.0030 ha and an uncontrolled post-development runoff coefficient of 0.60. As discussed in **Section 6.2**, there is a controlled external area of approximately 0.0105 ha and a controlled external area post-development runoff coefficient of 0.74. Based on the aforementioned, the proposed controlled post-development area is 0.2493 ha (including the proposed controlled external area of 105 m^2). Based on the controlled area, the post-development-controlled runoff coefficient is 0.76. Therefore, in the post-development condition, the allowable controlled flow rate was calculated as 33.21 L/sec.

In accordance with the orifice sizing calculations (see *Appendix 'C'* for details), an orifice tube will be required on this site to attenuate the storm discharge. The orifice tube diameter was determined using **Equation 4.0**, below.

$$A = \frac{Q}{C\sqrt{2gh}} \qquad \textbf{[Equation 4.0]}$$

where:

$Q = Peak\ Allowable\ Controlled\ Discharge\ Rate$

$C = 0.82\ (Orifice\ Tube\ Coefficient)$

$g = 9.81\ ^{m}/_{s^2}\ (gravitational\ constant)$

$h = depth\ of\ 1{:}100\ year\ stom\ event$

$A = Area\ of\ orifice,\ m^2$

Based on the stormwater management calculations (see ***Appendix 'C'*** for details), the depth of the 100-year storm event was determined at an elevation of 101.78m assuming a 54m^3 storage capacity (see **Section 6.5.1** for additional details of the storage tank). Based the aforementioned factors and using **Equation 4.0**, the maximum permissible orifice diameter was calculated as 109mm. Since orifice tubes come in nominal sizes, the orifice tube diameter was rounded down to the nearest PVC DR-35 pipe size, which was determined to be a 100mm orifice pipe. Thus, the stormwater discharge flow rate was adjusted to 28.53 L/sec for a 100mm orifice tube and will require a minimum of 37 m^3 of detention volume storage.

The detention storage volume requirement of 37 m^3 is to be achieved by implementing cast-in-place stormwater detention storage tank. For a storm event greater than the 100-year storm event, the stormwater management tank will be equipped with an overflow grate which will be situated along the southern property line with a top of grate elevation of 102.71m. The overflow grate is also specified as a maintenance access grate as well. If overflow were ever to occur, the stormwater would spill over the top of the overflow grade and drain south towards Plains Road West.

Lastly, since the site is not presently utilizing a stormwater management system and is discharging at an uncontrolled rate, it is anticipated that the receiving system (within Plains Road West) will not be subjected to any adverse affects from the

aforementioned discharge rate. This is because the post-development condition is an improvement to the discharge rate, in relation to the pre-development condition.

6.5.1 Site Storage

In the post-development condition, the site will release the captured stormwater runoff at a controlled rate of a maximum of 28.53 L/sec (see **Section 6.5** for details). Based on the flow attenuation, the development will require a stormwater management tank to provide temporary detention storage prior to the release of the runoff.

The proposed stormwater management tank will be located along the southern property line and is proposed as a cast-in-place concrete tank. The internal tank dimensions are to be 14.5 m long x 2.5 m wide x 1.49 m deep (100.68 m internal bottom of tank elevation) for a maximum capacity of 54 m^3. The stormwater management tank will be equipped with an overflow grate with a top of grate elevation at 102.71 m. This means the capacity of the detention tank before any overflow of stormwater runoff to the existing storm sewer service is 54 m^3. The stormwater management tank will be considered a closed system and will not be utilizing any infiltration due to site constraints.

Lastly, the quantity control of the site is satisfied based on a provided detention storage within the stormwater management tank of 54 m^3 of storage. The required amount of detention storage for the site is 37 m^3 (see **Section 6.5** for additional required volume storage details).

7.0 EROSION AND SEDIMENT CONTROL

An effective Erosion and Sediment Control (ESC) Plan is essential for minimizing the potentially adverse environmental effects originating from a construction site. A multi-barrier approach is to be considered to limit the adverse effects, such as to prevent erosion during the construction process to deal with the suspended sediment at the source and to minimize sediment transport from leaving the construction site. The following measures will be implemented onsite during construction to minimize sediment transport downstream of the site, in accordance with the Greater Golden Horseshoe Area

Conservation Authorities Erosion & Sediment Control Guidelines for Urban Construction in addition to Halton Region and the City of Burlington requirements:

- Temporary silt fencing will be installed along site boundary prior to any construction / grading activities (as illustrated on CMESC-1 as per Halton Region Standard Drawing RH-200.040).
- Construction access mud mats will be installed (as illustrated on CMESC-1 as per as per Halton Region Standard Drawing RH-200.040).
- All future grassed areas will be seeded as soon as possible.
- All erosion and sediment control measures shall be installed prior to commencement of site construction works and will remain in place through the duration of construction.
- Conduct inspections of all erosion and sediment control measures after significant rainfall and snowmelt events.

The contractor is to ensure that all involved parties on site are familiar with ESC practices and are trained in the ECS Plan, implementation, inspections, maintenance, and repairs. During construction, the site inspector shall monitor the ECS measures and shall be maintained by the contractor.

8.0 CONCLUSIONS AND SUMMARY

a) Peak sanitary flows from the proposed development are expected to be 3.77 L/sec.

b) The required fire flow for the proposed development is 11,000 L/min.

c) The required domestic flow for the proposed development is 54.62 L/min.

d) The required total demand was determined to be 11,123 L/min. A hydrant flow test was completed, and the available flow was determined as 12,108 L/min. This confirms that the available flow within the existing 300mm watermain is adequate to service the proposed mixed-use building.

e) The receiving stormwater system (within Plains Road West) has adequate capacity under the 100-year storm event to accommodate peak storm outflows from the proposed development.

f) Quantity control requirements must limit peak site outflows from the 100-year storm event to less than 28.53 L/sec and store a total of 37 m^3 of runoff. This is achieved by implementing a stormwater management tank, providing 54 m^3 of storage, equipped with a 100mm orifice tube.

g) The internal stormwater management tank dimensions are 14.5 m (L) x 2.5 m (W) x 1.49 m (D).

h) Water quality target of 80% T.S.S. removal will be met by implementing a Jellyfish JF 4-1-1.

i) Water balance for this site has been achieved by providing an abstraction of 6.01 mm, exceeding the 5.00 mm requirement. This was achieved by implementing a ZinCo Sedum Green Roof which is accredited for a retention volume capacity of 37 L/m^2.

Table 7 – Stormwater Management Summary Table

Item	Value
Maximum Allowable Release Rate	34.03 L/sec
Actual Release Rate (Uncontrolled Rate + Controlled Rate)	29.34 L/sec
Required Detention Storage	37 m^3
Proposed Detention Storage	54 m^3
Proposed Retention Storage	9.36 m^3
Total Provided Storage	63.36 m^3
Orifice Tube Diameter	100mm
High Water Level at 100 Year Storm Event	101.78m
Water Balance Required	5.00 mm
Water Balance Provided	6.01 mm
Jellyfish Unit Size	JF-4-1-1
TSS % Removal	> 80%
Annual Runoff Treated	7.6 L/sec

Johnson Sustronk Weinstein + Associates

Prepared by:



Stephan Starcevic, P.Eng.

Checked by:



Michael Mikhail, P.Eng.

APPENDIX ‘A’:

SANITARY DESIGN SHEET

JSW+ associates

Sanitary Drainage Design Sheet

Internal Sanitary Flows

Population Equivalents:

1. Apartment (> 6 storeys), Pe = 285 persons/ha @ 0.275 m^3pcd
2. Light Commercial, Pe = 90 persons/ha @ 24.75 m^3/ha/day

Street	Up Stream		Down Stream		Increment			Cumulative		M	q_{dry}	A Road	A Gross	INF	Q Total	Pipe								Cross-Sectional Area of Pipe [A]	Hydraulic Mean Depth [h_m]	Froude Number [Fr]	Type of Flow	NOTE
	MH	Invert	MH	Invert	GFA (m^2)	A Site (ha)	P	p	Areas Ha.		L/s	(ha)	(ha)	L/s	L/s	L (m)	Actual Size [T] (mm)	Nominal Size (mm)	Grade (%)	Cap. Flow (l/s)	Cap. Vel. (m/s)	Act. Vel. (m/s)	% Full	m^2	m			
Non-Residential Flow	Building	99.58	MH2A	99.54	176	0.2418	2	2	0.2418		0.005																	
Residential Flow	Building	99.58	MH2A	99.54	9,950	0.2418	284	284	0.2418		0.904																	
Total Sanitary Flow	Building	99.58	MH2A	99.54	10,126	0.0000		286	0.2418	4.07	0.909	-	0.2418	0.069	3.77	2.0	203	200	2.0	48.26	1.49	0.59	7.81	0.0324	0.1594	0.47	Sub-critical	1,2
	MH2A	99.49	MH1A	99.43		0.0000		286	0.2418	4.07	0.909	-	0.2418	0.069	3.77	3.2	203	200	2.0	47.88	1.48	0.60	7.88	0.0324	0.1594	0.48	Sub-critical	1,2

A_{site} = Site Area (ha)

P = 407 persons (From Architect Site Plan A101)

Q Total = (q_{dry} * M) + INF (L/s)

INF = (0.286 L/ha/s)* A_{Site} (L/s)

INF = Inflow/Infiltration Allowance

$q_{DRY,NON-RESIDENTIAL}$ = (24.75 m^3/ha/day) * $A_{NON-RESIDENTIAL}$

$q_{DRY,RESIDENTIAL}$ = (0.003183 L/capita (residential) /sec) * P

$q_{DRY,TOTAL}$ = $q_{DRY,RESIDENTIAL}$ + $q_{DRY,NON-RESIDENTIAL}$

M = K_{av} * (1 + (14 /(4 + (P^0.5)))) = Ratio of Peak Flow to Ave. Flow

The minimum permissible peaking factor is M = 2.0

K_{av} = (A_R+ (0.8 * (A_I + A_C)))/(A_R + A_I + A_C) = 0.997

A_R = Residential Land Use Area (ha) = 0.9950ha; A_I = Industrial Land Use Area (ha) = 0ha; A_C = Commercial Land Use Area (ha) = 0.0176ha

h_m = A/T = hydraulic mean depth (m)

A = cross-section area (m^2)

T = diameter of conduit (m)

Fr = v/(g h_m)$^{1/2}$

Fr = Froude's number

v = flow velocity (m/s)

g = acceleration of gravity (9.81 m/s^2)

NOTE: 1) The site area is 0.2418ha and the GFA of proposed building is 10,126 m^2

NOTE: 2) When Fr =1 flow is critical, Fr < 1 flow is subcritical, Fr > 1 flow is supercritical

141 - 153 Plains Road West

Mixed-Use Development

Designed:	**S.S.**	Job No:	22-45
Checked:	**M.M.**	Date:	1/18/2024
		Sheet :	1 of 1

APPENDIX ‘B’:

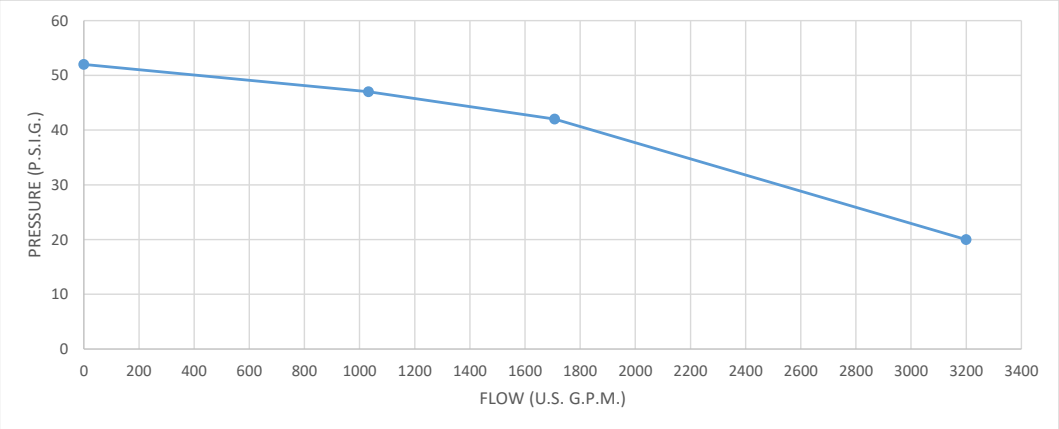
FIRE DEMAND CALCULATIONS

PO Box 199
Millgrove, ON
L0R 1V0

FLOW TEST REPORT

Date	October 13, 2023
Customer	2381798 Ontario Inc
Job Location	153 Plains Rd, W, Burlington
Time of Test	9:30 AM
Location of test (flow)	153 Plains rd west
Location of test (residual)	127 Plains rd w
Main Size (mm)	300
Static Pressure (psi)	52

	Number of Outlets & Orifice Size	PITOT Pressure (psi)	Flow (U.S. G.P.M.)	Residual Pressure (psi)
#1	1 x 2 1/2	38	1032	47
#2	2 x 2 1/2	26	1707	42
#3	USGPM @ 20psi		3199	20
Colour code	Blue			



Comments	Performed a NFPA 291 Fire Flow Test
Crew Member	Tyler Burns

MAIN SIZE: 300 mm

STATIC / BASELINE PRESSURE: 52 P.S.I. / 20 P.S.I.

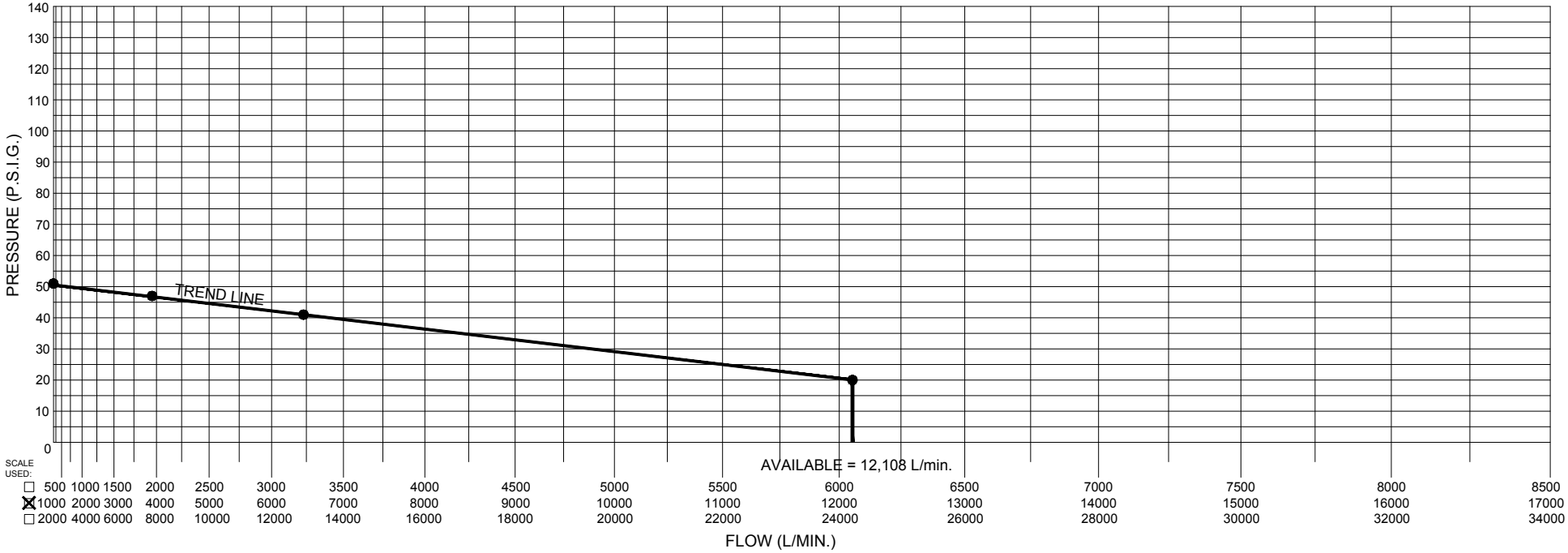
Hr (STATIC - BASELINE): (52 - 20) = 32 P.S.I.

Hf (STATIC - RESIDUAL): (52 - 42) = 10 P.S.I.

	NUMBER OF OUTLETS & ORIFICE SIZE	PITOT PRESSURE (P.S.I.)	Q_F (FLOW [U.S. G.P.M.])	Q_F (FLOW [L/MIN.])[2]	RESIDUAL PRESSURE (P.S.I.)
#1	1 x 2 ½	38	1,032	3,906	47
#2	2 x 2 ½	26	1,707	6,461	42
#3			Q_R = 3,199 [1]	*Q_R = 12,108 [1]	20
#4					
#5					

[1] Q_R = RATED FLOW CAPACITY AT 20 P.S.I. = Q_F x (Hr / Hf)^0.54

[2] 1 U.S.G.P.M. = 3.785 L/MIN.



NOTE: THE TREND LINE IS A LINE OF BEST FIT BASED ON THE DATA FROM THE HYDRANT FLOW TEST.

JOB NUMBER: 22-45

FLOW TEST DATE: OCTOBER 13th, 2023

JOB LOCATION: 153 PLAINS ROAD WEST, BURLINGTON, ON

PLOT DATE: JANUARY 8th, 2024

FLOW: 153 PLAINS ROAD WEST

RESIDUAL PRESSURE: 127 PLAINS ROAD WEST

TEST LOCATION: NO. 1

JSW + associates
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
Tel: (905)889-8100 Fax: (905)889-6616

Fire Demand Calculations Based on Fire Underwriters Survey

1. *Fire Flow Estimate for a Given Area*

Table 1 – Fire Flow Estimate for a Given Area

Proposed Development	*Construction Coefficient [C]* [1]	*Total Effective GFA (m²)* [2, 3]	*Fire Flow Estimate (L/min)* [4]	*Fire Flow Estimate Rounded (L/min)* [5]
Mixed Use Development	0.8	5,633.5	13,209.97	**13,000**

Table 2 – Total Effective Floor Area Calculation

Floor	*GFA (m²)* [2, 3]	*GFA Factored* [2]	*Effective Floor Area* [2]
Ground Floor	198	0%	0
Ground Floor Commercial	178	0%	0
2[2]	**1107**	100%	1107
3[2]	**1107**	100%	1107
4[2]	1098	50%	549
5[2]	1098	50%	549
6[2]	1044	50%	522
7[2]	755	50%	377.5
8[2]	755	50%	377.5
9[2]	755	50%	377.5
10[2]	755	50%	377.5
11[2]	579	50%	289.5
Mechanical Penthouse[2]	307	0%	0
		Total Effective GFA	**5,633.5**

Note:

[1] *Since the building is a non-combustible building constructed of non-combustible materials, the 'C' coefficient is to be selected as 0.8 (Fire Underwriters Survey [2020], Page 20).*

[2] *See Table 2 for the calculations for the determination of the total effective floor area. The floor areas illustrated in Table 2 were taken from the architectural site plans supplied by AAA Architects (see drawing A101). For a building classified with the 'C' coefficient of less than 1.0, the total effective area for the fire flow calculations are to consider the two largest adjoining floor areas plus 50% of all floors immediately above them up to a maximum of eight that would be affected by the design fire (in square meters). This is conservatively assuming that any vertical openings in the building (i.e. interconnected floor spaces, atria, elevators, escalators, etc.) are unprotected [Fire Underwriters Survey [2020], Page 22, line 2.a)].*

[3] Total effective floor area is not including the underground basements, since the area is at least 50% below grade and is not considered within the fire flow estimate (Fire Underwriters Survey [2020], Page 23).

[4] $\left[RFF = 220C\sqrt{A}\right]$ *(Fire Underwriters Survey [2020], Page 19)*

[5] The fire flow calculated must be rounded to the nearest 1000 L/min (Fire Underwriters Survey [2020], Page 19)

2. Occupancy Surcharge or Reduction

Table 3 – Fire Flow Occupancy Reduction

Proposed Development Block	*Fire Flow Estimate Rounded* (L/min) [5]	*Occupancy Reduction Factor* [6]	*Occupancy Reduction Flow* (L/min) [6]
Mixed Use Development	13,000	0.85	**11,050**

Note:

[6] Since the mixed-use development building contains a majority of residential units, it was determined that the building contains limited combustible contents, thus a reduction of -15% (0.85) can be applied to the estimated fire flow (Fire Underwriters Survey [2020], Page 24-25).

3. Sprinkler Protection

Table 4 – Sprinkler Protection Reduction

Proposed Development	*Occupancy Reduction Flow (L/min)* [6]	*Sprinkler Protection Reduction Factor* [7]	*Sprinkler Reduction Flow* (L/min) [7]
Mixed-Use Development	11,050	0.40	**4,420**

Note:

[7] The building will contain a sprinkler system conformed to NFPA 13, therefore a reduction is granted to the Fire Flow from Part 2. Occupancy Surcharge or Reduction (Fire Underwriters Survey [2020], Page 27).

4. Separation Exposure

Table 4 – Separation Exposure Summary

Direction	Mixed-Use Development	
	Separation	Charge
West	3.1 to 10m	20%
East	3.1 to 10m	20%
North	>30m	0%
South	>30m	0%
Total		**40%**

Table 5 – Separation Exposure Charge

Proposed Development	*Occupancy Reduction Flow* (L/min) [6]	Separation Exposure Reduction Factor [8]	*Separation Exposure Reduction Flow* (L/min) [8]
Mixed-Use Development	11,050	0.40	**4,420**

Note:

[8] *The separation charge is applied the Fire Flow from Part 2. Occupancy Surcharge or Reduction (Fire Underwriters Survey [2020], Page 30).*

5. Adjusted Fire Flow

Table 6 – Adjusted Fire Flow

Proposed Development	*Fire Flow Estimate Rounded* (L/min) [5]	*Occupancy Reduction Flow* (L/min) [6]	*Sprinkler Reduction Flow* (L/min) [7]	*Separation Exposure Reduction Flow* (L/min) [8]	*Adjusted Fire Flow* (L/min) [9]	*Adjusted Fire Flow Rounded* (L/min) [5]
Mixed-Use Development	13,000	11,050	4,420	4,420	11,050	**11,000**

Note:

[9] $\left[Fire\ Flow_{Adjusted} = Occupancy\ Reduction\ Flow_{6} - Sprinkler\ Reduction\ Flow_{7} + Exposure\ Reduction\ Flow_{8}\right]$ *(Fire Underwriters Survey [2020], Page 19)*

APPENDIX ‘C’:

STORM DESIGN SHEET

FIGURE 2.0 – PRE-DEVELOPMENT HARD AND SOFT PLAN

FIGURE 3.0 – POST-DEVELOPMENT HARD AND SOFT PLAN

STM-1 – POST-DEVELOPMENT STORMWATER MANAGEMENT PLAN

STORMWATER MANAGEMENT CALCULATIONS

5-YR-5-YR STORMWATER MANAGEMENT CALCULATIONS

JELLYFISH UNIT SIZING REPORT AND PERFORMANCE SPECIFICATIONS

JSW+ associates

Storm Drainage Design Sheet

Street	Up Stream		Down Stream		No. of Hectares		Storm Co-efficient						Total A*C		T_c	I-5	I-100	5 yr Flow	100 yr Flow	100 - 5 yr Flow	Cont. Flow	Total Design Flow	Pipe Data							
	MH	Invert	MH	Invert	Contributing Area	Cum. Total	0.25	0.50	0.60	0.70	0.80	0.95	Contributing Area*C	Cum		(mm/hr)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	L (m)	Actual Size (mm)	Nominal Size (mm)	Grade (%)	Cap. (m^3/s)	Vel. at Cap (m/s)	Time (min.)	% Pipe Full	Remarks
	MH3	101.93	SWM Tank	101.82	0.0033	0.0033	0.0006					0.0027	0.003	0.003	10.00	101.31	163.18	0.001	0.001	0.000		0.001	11.3	201	200	1.0	0.033	1.03	0.18	4	
	Building	101.83	SWM Tank	101.82	0.2460	0.2493					0.2460		0.187	0.190	10.00	101.31	163.18	0.053	0.086	0.033		0.086	0.7	299	300	2.0	0.136	1.93	0.01	63	
	Control 100 year Flow to 28.53 L/sec																													
	SWM Tank	100.73	Bypass MH	100.69	0.0000	0.2493							0.000	0.190	10.00	101.31	163.18	0.053	0.086	0.033	0.029	0.029	1.8	101	100	2.0	0.008	0.94	0.03	380	
	Bypass MH	100.64	JF 4-1-1	100.58	0.0000	0.2493							0.000	0.190	10.03	101.15	162.91	0.053	0.086	0.033	0.029	0.029	3.0	150	150	2.0	0.022	1.22	0.04	132	
	JF 4-1-1	100.43	MH2	100.37	0.0000	0.2493							0.000	0.190	10.07	100.94	162.57	0.053	0.086	0.033	0.029	0.029	3.0	201	200	2.0	0.047	1.48	0.03	61	
	Bypass MH	100.74	MH2	100.42	0.0000	0.2493							0.000	0.190	10.00	101.31	163.18	0.053	0.086	0.033	0.029	0.029	5.4	299	300	5.9	0.233	3.32	0.03	12	
	MH2	100.32	MH1	100.27	0.0000	0.2493							0.000	0.190	10.11	100.76	162.30	0.053	0.086	0.032	0.029	0.029	2.6	201	200	2.0	0.047	1.48	0.03	61	
	MH1	100.22	Main STM	100.17	0.0000	0.2493							0.000	0.190	10.14	100.62	162.06	0.053	0.085	0.032	0.029	0.029	2.7	201	200	2.0	0.047	1.47	0.03	61	

Q = 0.00278 x A x C x I
C = Runoff Coefficient
5 Year Rainfall Intensity = 802.04 / ([td + 5] ^ 0.764)

A = Area (Hectares)
n = Pipe Roughness = 0.013
100 Year Rainfall Intensity = 1281.34 / ([td + 5] ^ 0.761) (in mm/hr)
$t_d = T_c$ (in min)

Mixed Use Development
141 - 153 Plains Road West

Designed: **S.S.** Job No: 22-45
Checked: **M.M.** Date: 1/18/2024 Sheet: 1 of 1



LEGEND

DENOTES ROOF AREA	= 0.0509 ha
DENOTES SOFT SURFACE AREA	= 0.0898 ha
DENOTES HARD SURFACE AREA	= 0.1011 ha
PRE–DEVELOPMENT SITE AREA	= 0.2418 ha

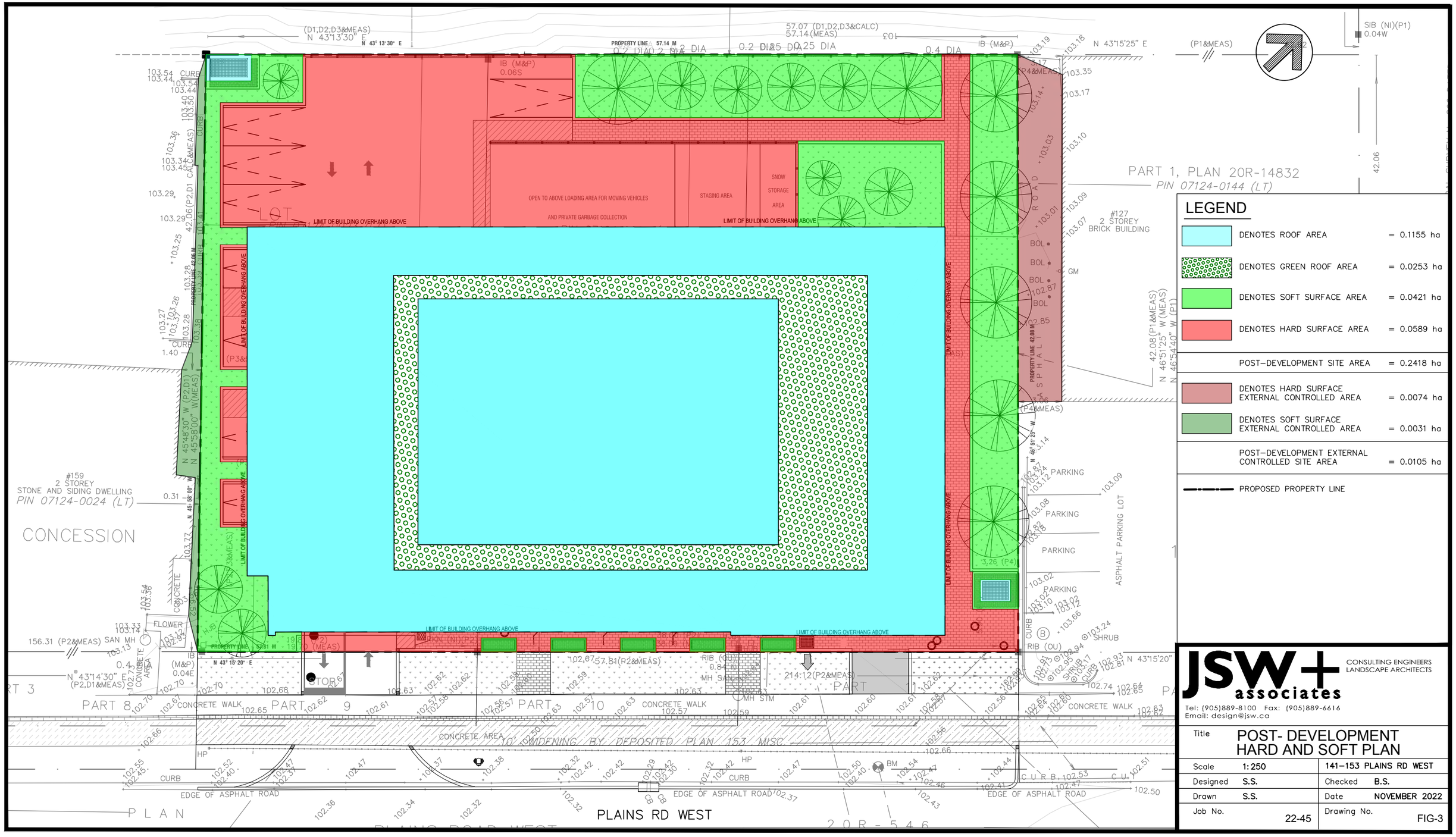
PROPOSED PROPERTY LINE

EXISTING EMERGENCY OVERLAND FLOW ROUTE

JSW+ associates
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
Tel: (905)889-8100 Fax: (905)889-6616
Email: design@jsw.ca

Title: **PRE-DEVELOPMENT HARD AND SOFT PLAN**

Scale	1:250	141–153 PLAINS RD WEST	
Designed	S.S.	Checked	B.S.
Drawn	M.S.	Date	NOVEMBER 2022
Job No.	22-45	Drawing No.	FIG-2



LEGEND

DENOTES ROOF AREA	= 0.1155 ha
DENOTES GREEN ROOF AREA	= 0.0253 ha
DENOTES SOFT SURFACE AREA	= 0.0421 ha
DENOTES HARD SURFACE AREA	= 0.0589 ha
POST–DEVELOPMENT SITE AREA	= 0.2418 ha
DENOTES HARD SURFACE EXTERNAL CONTROLLED AREA	= 0.0074 ha
DENOTES SOFT SURFACE EXTERNAL CONTROLLED AREA	= 0.0031 ha
POST–DEVELOPMENT EXTERNAL CONTROLLED SITE AREA	= 0.0105 ha

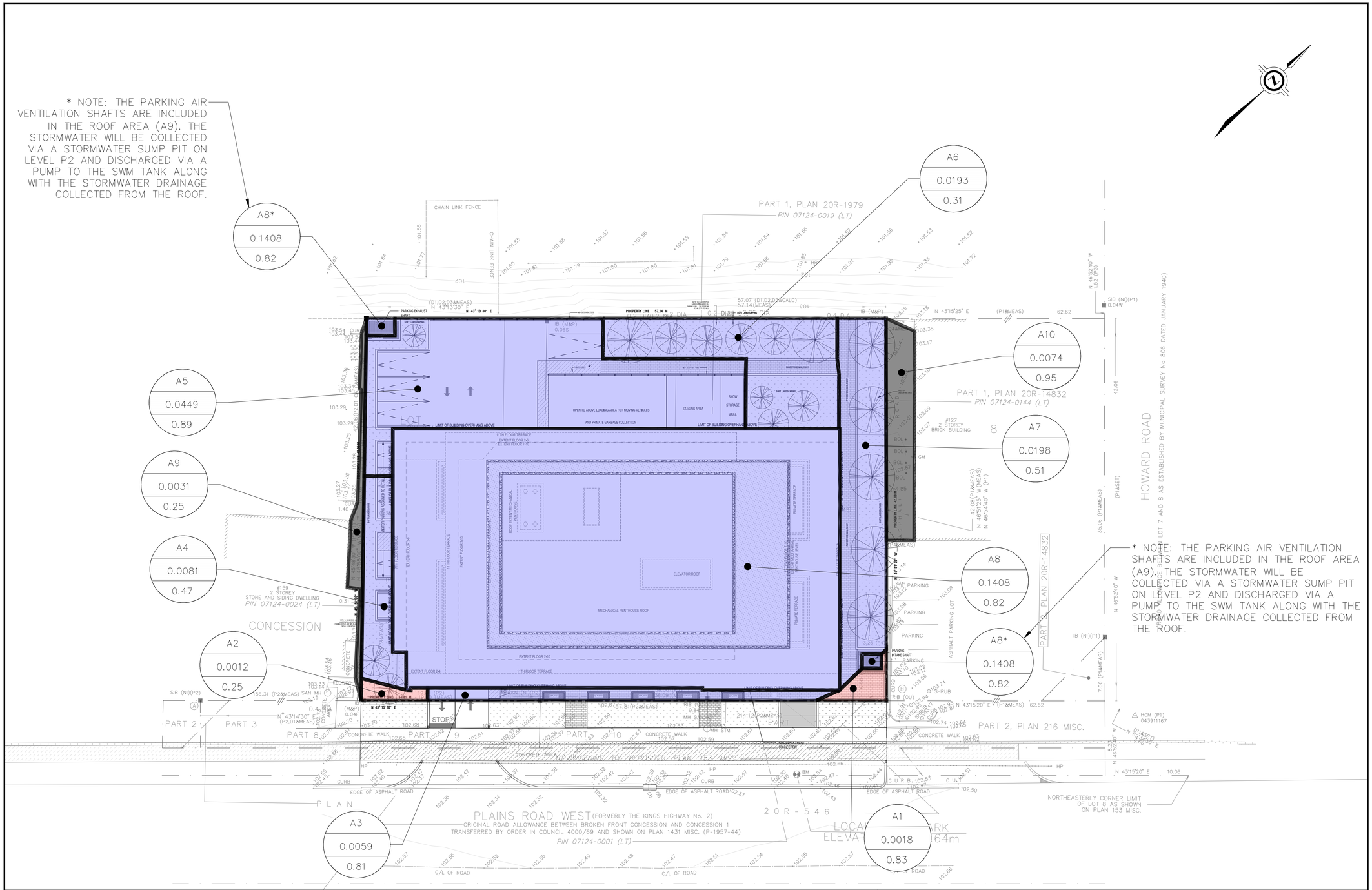
PROPOSED PROPERTY LINE

JSW+ associates
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
Tel: (905)889-8100 Fax: (905)889-6616
Email: design@jsw.ca

Title: POST- DEVELOPMENT HARD AND SOFT PLAN

Scale	1:250	141–153 PLAINS RD WEST	
Designed	S.S.	Checked	B.S.
Drawn	S.S.	Date	NOVEMBER 2022
Job No.	22-45	Drawing No.	FIG-3

* NOTE: THE PARKING AIR VENTILATION SHAFTS ARE INCLUDED IN THE ROOF AREA (A9). THE STORMWATER WILL BE COLLECTED VIA A STORMWATER SUMP PIT ON LEVEL P2 AND DISCHARGED VIA A PUMP TO THE SWM TANK ALONG WITH THE STORMWATER DRAINAGE COLLECTED FROM THE ROOF.



* NOTE: THE PARKING AIR VENTILATION SHAFTS ARE INCLUDED IN THE ROOF AREA (A9). THE STORMWATER WILL BE COLLECTED VIA A STORMWATER SUMP PIT ON LEVEL P2 AND DISCHARGED VIA A PUMP TO THE SWM TANK ALONG WITH THE STORMWATER DRAINAGE COLLECTED FROM THE ROOF.

LEGEND

A3 / 0.00414 / 0.95 — DENOTES AREA NUMBER / DENOTES AREA SIZE (ha.) / DENOTES RUNOFF COEFFICIENT

DENOTES DRAINAGE AREA BOUNDARIES

DENOTES SITE CONTROLLED STORM DRAINAGE AREAS = 0.2388 ha (2,388m²)

DENOTES SITE UNCONTROLLED STORM DRAINAGE AREAS = 0.0030 ha (30m²)

TOTAL SITE AREA = 0.2418 ha (2,418m²)

DENOTES EXTERNAL CONTROLLED STORM DRAINAGE AREAS = 0.0105 ha (105m²)

(+) = TOTAL CONTROLLED AREA = 0.2493 ha (2,493m²)



KEY PLAN N.T.S.

BENCHMARK

A SPIKE SET ON PLAINS ROAD WEST LOCATED APPROXIMATELY 10.2 METERS NORTH FROM THE CENTRELINE OF ROAD, 1.1 METERS NORTH OF THE BACK OF CURB, AS SHOWN ON THE FACE OF PLAN.
ELEVATION=102.64m

ELEVATION

ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BURLINGTON BENCHMARKS:
No. 463 ELEVATION=90.035m
No. 467 ELEVATION=107.625m

LEGEND

- PROPOSED EMERGENCY OVERLAND FLOW ROUTE
- CB DENOTES EXISTING CATCHBASIN
- MH DENOTES EXISTING MANHOLE
- PROPERTY LINE

No.	Date	Description	By	Ck.
2.	JAN. 19/24	2nd SUBMISSION TO HALTON REGION AND CITY OF BURLINGTON	S.S.	M.M.
1.	APR. 28/23	1st SUBMISSION TO HALTON REGION AND CITY OF BURLINGTON	S.S.	B.S.

Revisions

JSW+ associates
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LANDSCAPE ARCHITECTS
Tel: (905)889-8100 Fax: (905)889-6616

MIXED-USE DEVELOPMENT

141-153 PLAINS RD WEST

BURLINGTON, ONTARIO

Title: POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

Scale:	1:200		
Designed:	S.S.	Checked:	B.S.
Drawn:	M.S.	Date:	NOVEMBER 2022
Job No.	22-45	Drawing No.	STM-1

141 - 153 Plains Road West, Burlington, Ontario - Mixed Use Development
Modified Rational Method Analysis

5 Year Pre-Development Condition

[A] Controlled Pre-Development Area	=	0.2418	ha
[C] Pre-Development Site runoff Co-efficient	=	0.50	**Pre. Dev. 'C' = 0.69, however, 'C' can only be a maximum of 0.5**
[t_d]Time of concentration	=	10	min
[i] Average Rainfall Intensity	=	101.31	mm/hr **A = 802.04, B = 5, and C = 0.764 for City of Burlington**
[$Q_{allowable}$] Peak Run-off Rate for 5 yr Storm Event	=	34.03	L/sec ** Q = 2.778CIA **

100 Year Post-Development Condition

[$A_{C,\ TOT.}$] Total Controlled Area	=	0.2388	ha	Excluding Controlled External Area
[$A_{EXT.}$] Controlled External Area	=	0.0105	ha	
[$A_{C,\ SITE.}$] Controlled Site Area	=	0.2493	ha	Including Controlled External Area
[A_{un}] Un-controlled Site Area	=	0.0030	ha	
[C_{un}] Uncontrolled Post-Development Site Runoff Co-efficient	=	0.60		
[C] Controlled Post-Development Site Runoff Co-efficient	=	0.76		Including Controlled External Area
[tc]Time of concentration	=	10	min	
[i] Average Rainfall Intensity	=	163.18	mm/hr	**A = 1281.34, B = 5, and C = 0.761 for City of Burlington**
[$Q_{Un\text{-}controlled}$] Peak Run-off Rate for 100 yr Storm Event	=	0.81	L/sec	** Q = 2.778CIA **

$[Q_{controlled}] = [Q_{allowable}] - [Q_{Un\text{-}controlled}]$

$[Q_{controlled}] =$ 33.21 L/sec

$[Q_{in}] =$ CIA/360

Time [T_c]	Intensity [i]	Inflow [Q_{in}]	Inflow Volumes [V_{in}]	Outflow [$Q_{controlled}$]	Outflow Volume [V_{out}]	Storage
(min)	(mm/hr)	(m^3/sec)	(m^3)	(m^3/sec)	(m^3)	(m^3)
5.0	222.16	0.12	35.08	0.03321	9.96	25.11
10.0	163.18	0.09	51.53	0.03321	19.93	31.60
11.0	155.36	0.08	53.96	0.03321	21.92	32.04
12.0	148.35	0.08	56.22	0.03321	23.91	32.30
13.0	142.04	0.07	58.31	0.03321	25.91	32.40
14.0	136.31	0.07	60.26	0.03321	27.90	32.36
15.0	131.09	0.07	62.09	0.03321	29.89	32.20
16.0	126.32	0.07	63.82	0.03321	31.89	31.94
17.0	121.92	0.06	65.45	0.03321	33.88	31.57
18.0	117.87	0.06	67.00	0.03321	35.87	31.13
19.0	114.11	0.06	68.46	0.03321	37.86	30.60
20.0	110.62	0.06	69.86	0.03321	39.86	30.01
21.0	107.37	0.06	71.20	0.03321	41.85	29.35
22.0	104.33	0.05	72.48	0.03321	43.84	28.64
23.0	101.48	0.05	73.70	0.03321	45.83	27.87
REQUIRED STORAGE = 33 m3						

ORIFICE TUBE SIZING

Q = CA √2gh or A = Q / (C*√2gh)

[Q] Allowable Discharge	=	33.21	L/s
[C] Orifice Entrance Co-efficient	=	0.82	Constant (0.63 for plate, 0.82 for tube)
[g] Acceleration due to Gravity	=	9.81	m/s^2
[h] (1:100 Year Storage Elevation - Center of Outlet)	=	0.97	m (1:100 year water level based on 33m^3 of required storage = 101.78m)
[A] Area of Orifice	=	0.00926	m^2
[r] Radius of Orifice	=	0.054	m

ORIFICE DIAMETER = 109 mm

****Since orifice tubes come in nominal sizes, use 100mm orifice tube and recalcuate required storage and outflow based on this revised size****

ORIFICE TUBE SIZING

Q = CA √2gh or A = Q / (C*√2gh)

[C] Orifice Entrance Co-efficient	=	0.82	Constant (0.63 for plate, 0.82 for tube)
[g] Acceleration due to Gravity	=	9.81	m/s^2
[h] (1:100 Year Storage Elevation - Center of Outlet)	=	1.00	m (1:100 year water level based on 33m^3 of required storage = 101.78m)
[r] Radius of Orifice	=	0.050	m
[A] Area of Orifice	=	0.00785	m^2

[Q] Revised Allowable Discharge = 28.53 L/s

Time [T_c]	Intensity [i]	Inflow [Q_{in}]	Inflow Volumes [V_{in}]	Outflow [$Q_{controlled}$]	Outflow Volume [V_{out}]	Storage
(min)	(mm/hr)	(m^3/sec)	(m^3)	(m^3/sec)	(m^3)	(m^3)
5.0	222.16	0.12	35.08	0.02853	8.56	26.52
10.0	163.18	0.09	51.53	0.02853	17.12	34.41
11.0	155.36	0.08	53.96	0.02853	18.83	35.14
12.0	148.35	0.08	56.22	0.02853	20.54	35.68
13.0	142.04	0.07	58.31	0.02853	22.25	36.06
14.0	136.31	0.07	60.26	0.02853	23.96	36.30
15.0	131.09	0.07	62.09	0.02853	25.67	36.42
16.0	126.32	0.07	63.82	0.02853	27.39	36.43
17.0	121.92	0.06	65.45	0.02853	29.10	36.35
18.0	117.87	0.06	67.00	0.02853	30.81	36.19
19.0	114.11	0.06	68.46	0.02853	32.52	35.94
20.0	110.62	0.06	69.86	0.02853	34.23	35.63
21.0	107.37	0.06	71.20	0.02853	35.94	35.26
22.0	104.33	0.05	72.48	0.02853	37.66	34.82
23.0	101.48	0.05	73.70	0.02853	39.37	34.34
REVISED REQUIRED STORAGE = 37 m3						

Pre-Development Site Area 'C' (Areas From Figure 2)				
Type	**Area (ha)**	**C**	**Weighted Area (ha)**	**Weighted C**
Soft Landscape	0.0898	0.25	0.371	0.090
Hard Landscape	0.1011	0.95	0.418	0.400
Roof	0.0509	0.95	0.211	0.200
Permeable Pavers	0.0000	0.80	0.000	0.000
	0.2418			**0.69**

Area A1 (From STM-1) - Uncontrolled				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0003	0.25	0.1667	0.04
Hard Landscape	0.0015	0.95	0.8333	0.79
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0018			**0.83**

Area A2 (From STM-1) - Uncontrolled				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0012	0.25	1.0000	0.25
Hard Landscape	0.0000	0.95	0.0000	0.00
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0012			**0.25**

Area A3 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0012	0.25	0.2034	0.05
Hard Landscape	0.0047	0.95	0.7966	0.76
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0059			**0.81**

Area A4 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0055	0.25	0.6790	0.17
Hard Landscape	0.0026	0.95	0.3210	0.30
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0081			**0.47**

Area A5 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0036	0.25	0.0802	0.02
Hard Landscape	0.0413	0.95	0.9198	0.87
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0449			**0.89**

Area A6 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0177	0.25	0.9171	0.23
Hard Landscape	0.0016	0.95	0.0829	0.08
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0193			**0.31**

Area A7 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0126	0.25	0.6364	0.16
Hard Landscape	0.0072	0.95	0.3636	0.35
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0198			**0.51**

Area A8 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0000	0.95	0.0000	0.00
Roof	0.1155	0.95	0.8203	0.78
Green Roof	0.0253	0.25	0.1797	0.04
	0.1408			**0.82**

Area A9 (From STM-1) - External Controlled Area				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0031	0.25	1.0000	0.25
Hard Landscape	0.0000	0.95	0.0000	0.00
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0031			**0.25**

Area A10 (From STM-1) - External Controlled Area				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0074	0.95	1.0000	0.95
Roof	0.0000	0.95	0.0000	0.00
Green Roof	0.0000	0.25	0.0000	0.00
	0.0074			**0.95**

Total Controlled External Areas Runoff Coefficient (See STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
A9	0.0031	0.25	0.2952	0.07
A10	0.0074	0.95	0.7048	0.67
	0.0105			**0.74**

Total Uncontrolled Developed Site Areas Runoff Coefficient (See STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
A1	0.0018	0.83	0.6000	0.50
A2	0.0012	0.25	0.4000	0.10
	0.0030			**0.60**

Total Controlled Developed Site Runoff Coefficient (See STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0406	0.25	0.1700	0.04
Hard Landscape	0.0574	0.95	0.2404	0.23
Roof	0.1155	0.95	0.4837	0.46
Green Roof	0.0253	0.25	0.1059	0.03
	0.2388			**0.76**

Total Controlled Runoff Coefficient Including External Areas (See STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0437	0.25	0.1753	0.04
Hard Landscape	0.0648	0.95	0.2599	0.25
Roof	0.1155	0.95	0.4633	0.44
Green Roof	0.0253	0.25	0.1015	0.03
	0.2493			**0.76**

141 - 153 Plains Road West, Burlington, Ontario - Mixed Use Development
5-year Pre-development - 5 year Post-development Modified Rational Method Analysis

5-Year Pre-Development Condition

[A] Controlled Pre-Development Area	=	0.2523	ha	
[C] Pre-Development Site runoff Co-efficient	=	0.50		**Pre. Dev. 'C' = 0.69, however, 'C' can only be a maximum of 0.5**
[t_d]Time of concentration	=	10	min	
[i] Average Rainfall Intensity	=	101.31	mm/hr	**A = 802.04, B = 5, and C = 0.764 for City of Burlington**
[$Q_{allowable}$] Peak Run-off Rate for 5 yr Storm Event	=	35.50	L/sec	** Q = 2.778CIA **

5-Year Post-Development Condition

[$A_{C,\ SITE}$] Controlled Site Area (Excluding External Area)	=	0.2325	ha	
[$A_{EXT.}$] Controlled External Area	=	0.0106	ha	
[$A_{C,\ TOT.}$] Total Controlled Area	=	0.2431	ha	Including Controlled External Area
[A_{un}] Un-controlled Site Area	=	0.0092	ha	
[C_{un}] Uncontrolled Post-Development Site Runoff Co-efficient	=	0.69		
[C] Controlled Post-Development Site Runoff Co-efficient	=	0.80		Including Controlled External Area
[tc]Time of concentration	=	10	min	
[i] Average Rainfall Intensity	=	101.31	mm/hr	**A = 802.04, B = 5, and C = 0.764 for City of Burlington**
[$Q_{Un\text{-}controlled}$] Peak Run-off Rate for 5 yr Storm Event	=	1.79	L/sec	** Q = 2.778CIA **

$[Q_{controlled}] = [Q_{allowable}] - [Q_{Un\text{-}controlled}]$

$[Q_{controlled}] =$ 33.71 L/sec

$[Q_{in}] =$ CIA/360

Time [T_c]	Intensity [i]	Inflow [Q_{in}]	Inflow Volumes [V_{in}]	Outflow [$Q_{controlled}$]	Outflow Volume [V_{out}]	Storage
(min)	(mm/hr)	(m^3/sec)	(m^3)	(m^3/sec)	(m^3)	(m^3)
1.0	204.03	0.11	6.61	0.03371	2.02	4.59
2.0	181.36	0.10	11.76	0.03371	4.05	7.71
3.0	163.77	0.09	15.93	0.03371	6.07	9.86
4.0	149.68	0.08	19.41	0.03371	8.09	11.31
5.0	138.10	0.07	22.38	0.03371	10.11	12.27
6.0	128.40	0.07	24.97	0.03371	12.14	12.83
7.0	120.14	0.06	27.26	0.03371	14.16	13.10
8.0	113.02	0.06	29.31	0.03371	16.18	13.12
9.0	106.80	0.06	31.15	0.03371	18.21	12.95
10.0	101.31	0.05	32.84	0.03371	20.23	12.61
11.0	96.44	0.05	34.38	0.03371	22.25	12.13
12.0	92.07	0.05	35.81	0.03371	24.27	11.54
13.0	88.14	0.05	37.14	0.03371	26.30	10.84
14.0	84.57	0.05	38.38	0.03371	28.32	10.06
15.0	81.32	0.04	39.54	0.03371	30.34	9.20
REQUIRED STORAGE = 14 m3						

DRAWING NOT TO BE USED FOR CONSTRUCTION

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 PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

JELLYFISH STRUCTURE & DESIGN NOTES:

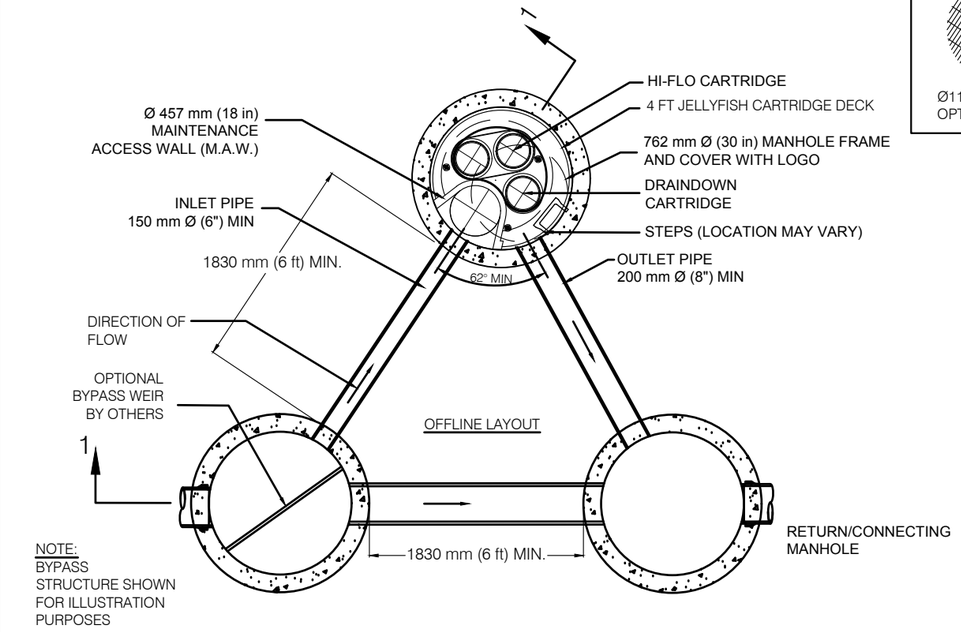
1. 457 MM Ø (18") MAINTENANCE ACCESS WALL TO BE USED FOR CLEANOUT AND ACCESS BELOW CARTRIDGE DECK.
2. CASTINGS OR DOORS OF THE JELLYFISH MANHOLE STRUCTURE TO EXTEND TO DESIGN FINISH GRADE. DEPTHS IN EXCESS OF 3.65 M (12') MAY REQUIRE THE DESIGN AND INSTALLATION OF INTERMEDIATE SAFETY GRATES OR OTHER 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

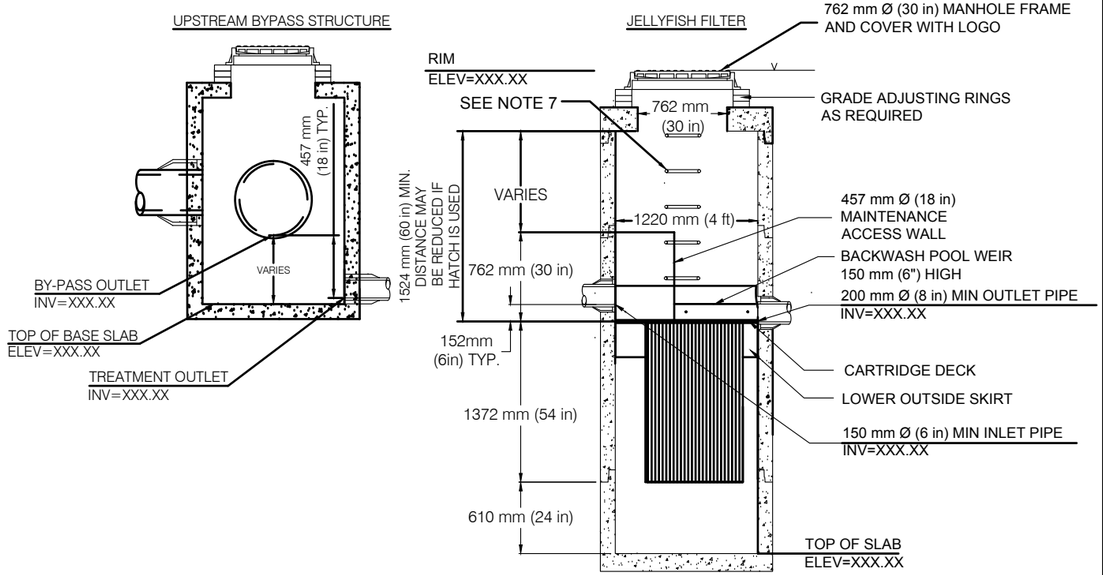
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR 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 OULTET 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.



XXX.XX INFORMATION TO BE SUPPLIED BY ENGINEER OF RECORD



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. Ø1220 mm (48") MANHOLE JELLYFISH PEAK TREATMENT CAPACITY IS 12.7 L/s (0.54 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		5.09 / 2.55	3.68 / 1.84		2.55 / 1.27		1.41 / 0.71				
FLOW RATE HIGH-FLO / DRAINDOWN (L/s) (per cart)		57 / 28	42 / 21		28 / 14		16 / 8				
SEDIMENT CAPACITY HIGH-FLO / DRAINDOWN (kg) (per cart)				2 / 1							
MAX. CARTS HIGH-FLO/DRAINDOWN								142	105	70	40
MAX. SEDIMENT CAPACITY (kg)								12.7	9.3	6.2	3.4
MAX. TREATMENT (L/s)											

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

MARK	DATE	REVISION DESCRIPTION	BY
1	08/01/2015	NOTES	BSF
0	10/01/2014	INTIAL RELEASE	BSF

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Jellyfish
JF4 STANDARD
Scale = 1:50
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THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS: U.S. 6,641,720 B2; 7,425,262 B2; 7,470,366 B2; 7,905,367 B2; CA 2,366,482; CA 2,634,542; CA 2,466,480; KR 10-1307519; NZ 583481; NZ 604427; ZL 200580050866; OTHER INTERNATIONAL PATENTS PENDING

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CHECKED: BSF | APPROVED: SP
PROJECT #: ##### | PROJECT NAME: #####
SHEET: 1 OF 2

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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

A. 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

A. 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 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.

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 MANUFACTURERS 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 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.

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

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JELLYFISH FILTER SPECIFICATIONS

Jellyfish

JF4 STANDARD

Scale = 1:50

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Jellyfish Filter

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS: US 6,511,595 B1, US 7,425,262 B2, US 7,470,366 B2, US 8,431,011 B2, CA 2, 399,462, CA 2,634,842,CA 2,856,466, KR 10-1287578, NZ 593461, NZ 606427, AU 2001281084, OTHER PATENTS PENDING.

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STANDARD PERFORMANCE SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing 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 & PROCEDURES

ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV)

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: filtration surface area, treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, filtration treatment device product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 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 internal components. 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 their installed placement for the entire length of the cartridge.

2.1.2 Pollutant Storage: The Filter device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter treatment device shall have been field tested in accordance with either TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements – Amendments to TARP Tier II Protocol (NJDEP, 2009) or Washington State Technology Assessment Protocol – Ecology (TAPE), 2011 or later version. The field test shall have been verified in accordance with ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV). See Section 3.2 of this specification for field test performance requirements.

3.2 FIELD TEST PERFORMANCE

The field test (as specified in section 3.1.1)shall have monitored a minimum of twenty (20) TARP or TAPE qualifying storm events, and report at **minimum** the following results:

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median TSS removal efficiency of at least 85% and load based median SSC removal efficiency of at least 98%.

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, and 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 turbidity such that effluent turbidity is 15 NTU or lower.

3.2.5 Nutrients & Metals – The stormwater quality filter treatment device shall have ISO 14034 ETV Verified minimum load based removal efficiencies for the following:

3.2.5.1 Total Phosphorus (TP) Removal - Median TP removal efficiency of at least 49%.

3.2.5.2 Total Nitrogen (TN) Removal - Median TN removal efficiency of at least 39%.

3.2.5.3 Total Zinc (Zn) Removal - Median Zn removal efficiency of at least 69%.

3.2.5.4 Total Copper (Cu) Removal - Median Cu removal efficiency of at least 91%.

END OF SECTION

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Sunday, January 29, 2023
Project Name	141-153 Plains Rd. W
Project Number	
Location	Burlington

Jellyfish Filter Design Overview

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

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

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 34 years of HAMILTON A rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

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

The Jellyfish Filter System

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

Maintenance

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

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

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

Performance

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

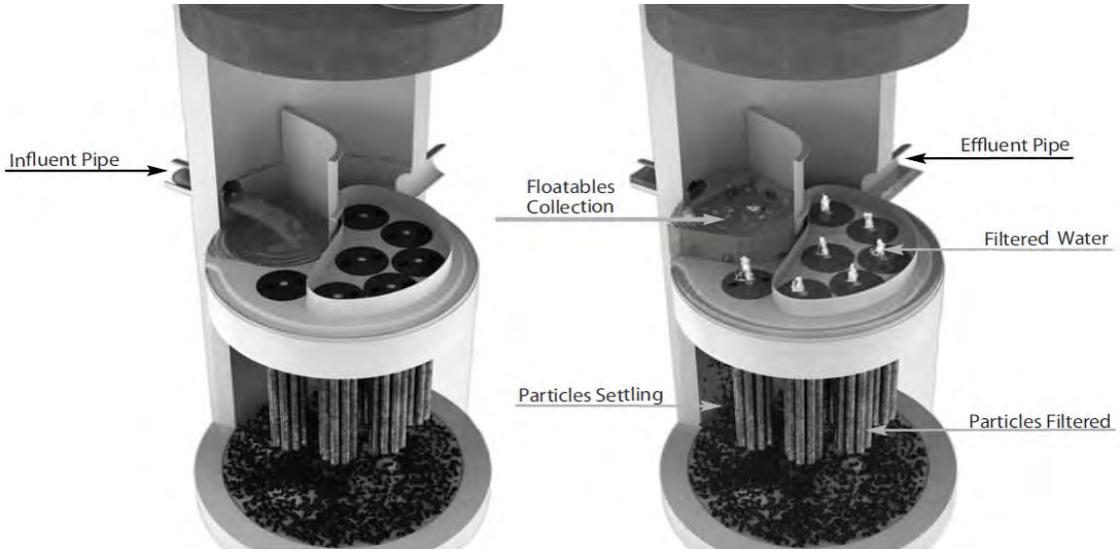
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash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

Field Proven 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 77%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Sunday, January 29, 2023
Project Name:	141-153 Plains Rd. W
Project Number:	
Location:	Burlington

Designer Information

Company:	JSW+ Associates
Contact:	Steve Starcevic
Phone #:	

Notes

Rainfall

Name:	HAMILTON A
State:	ON
ID:	3194
Record:	1970 to 2003
Co-ords:	43°10.N'N, 79°56.W'N

Drainage Area

Total Area:	0.2417 ha
Imperviousness:	85.93%

Upstream Detention

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

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 34 years of HAMILTON A rainfall data:	**5.8 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 1059 m³, with a suspended sediment concentration of 60 mg/L.	**64 kg**

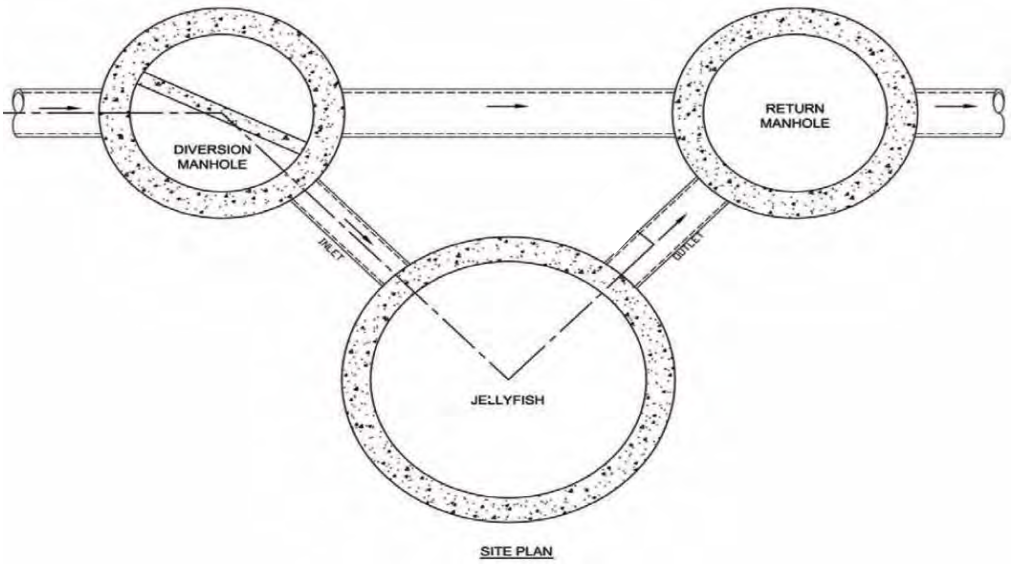
Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 34 years of HAMILTON A rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (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	**62º**	**150**	**200**
1.8	59º	200	250
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

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

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS

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

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

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

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

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

1.4 PRODUCT SUBSTITUTIONS

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

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

2.2 PRECAST CONCRETE SECTIONS

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

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

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

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

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

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

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

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

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

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

PART 3 – PERFORMANCE

3.1 GENERAL

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

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

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

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

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

3.2 FIELD TEST PERFORMANCE

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

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

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

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

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

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

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

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

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

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

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

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

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

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

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

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

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

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

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

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

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

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

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

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

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

PART 5 – QUALITY ASSURANCE

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

5.2 INSPECTION AND MAINTENANCE

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

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

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

END OF SECTION