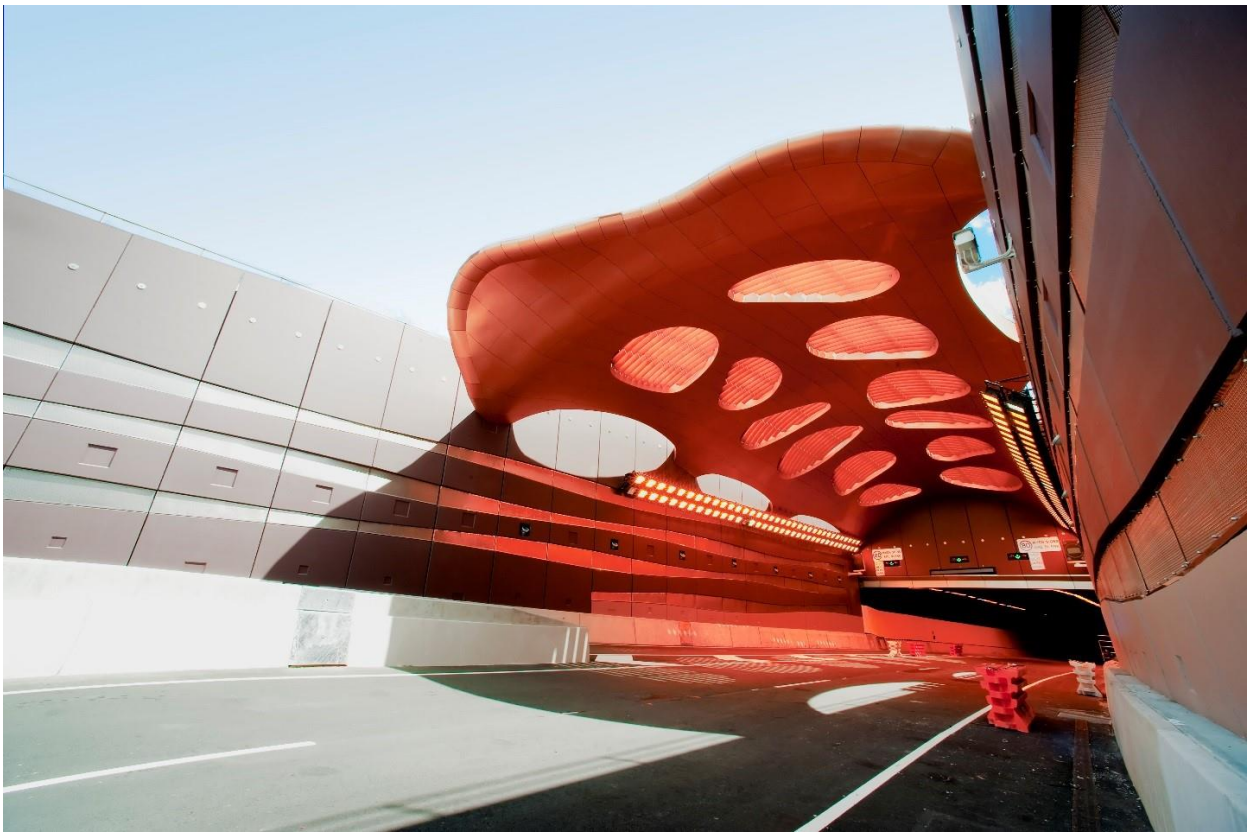
Edenshaw Queen Developments Limited
Project Number: 211-12423-00

30 Queen Street East

Stormwater Management Report

January 28, 2022

Confidential



30 Queen Street East

Stormwater Management Report

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Project No.: 211-12423-00
Date: January 28, 2022

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Revision History

FIRST ISSUE

January 28, 2022	Rezoning Application			
Prepared by	Reviewed by			
Mike Nanos, EIT	Iain Smith, P.Eng.			
REVISION 1				
REVISION 2				
FINAL				

Signatures

Prepared by

January 28, 2022

Mike Nanos, EIT
Designer, Water Resources

Date

Approved[1] by

January 28, 2022

Iain Smith, P.Eng.
Project Engineer, Water Resources

Date

[1] Approval of this document is an administrative function indicating readiness for release and does not impart legal liability on to the Approver for any technical content contained herein. Technical accuracy and fit-for-purpose of this content is obtained through the review process. The Approver shall ensure the applicable review process has occurred prior to signing the document.

Contributors

Client

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WSP

Designer	Mike Nanos, EIT
Project Engineer	Iain Smith, P.Eng.

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1 INTRODUCTION

1.1 Scope

WSP has been retained by Edenshaw Queen Developments Limited to prepare a Stormwater Management (SWM) Report to support the Rezoning Application (RZA) and Site Plan Approval (SPA) for the proposed re-development at 30 Queen Street East, in the City of Mississauga. This SWM report examines the potential water balance, water quality, and water quantity impacts of the proposed development and summarizes how each will be addressed in accordance with the City of Mississauga's Development Requirements (2016) and the Credit Valley Conservation Authority (CVC) Stormwater Management Criteria (2012).

1.2 Site Location

The subject site is located at the northeast corner of Park Street East and Ann Street within the City of Mississauga and the Region of Peel. The site is bounded by the following:

- Queen Street East: A municipal asphalt pavement road with concrete curbs, gutters and concrete sidewalks located at the north west boundary of the site.
- Park Street East: A municipal asphalt pavement road with concrete curbs, gutters and concrete sidewalks located at the south boundary of the site.
- Port Credit GO Station: Light rail transit station located at the east boundary of the site.
- Ann Street: A municipal asphalt pavement road with concrete curbs, gutters and concrete sidewalks located at the west boundary of the site.

The site is approximately 0.59 hectares and it currently contains a surface parking lot for Port Credit GO Station commuters. The location of the proposed development is presented in Figure 1.

1.3 Stormwater Management Plan Objectives

The objectives of the stormwater management plan area as follows:

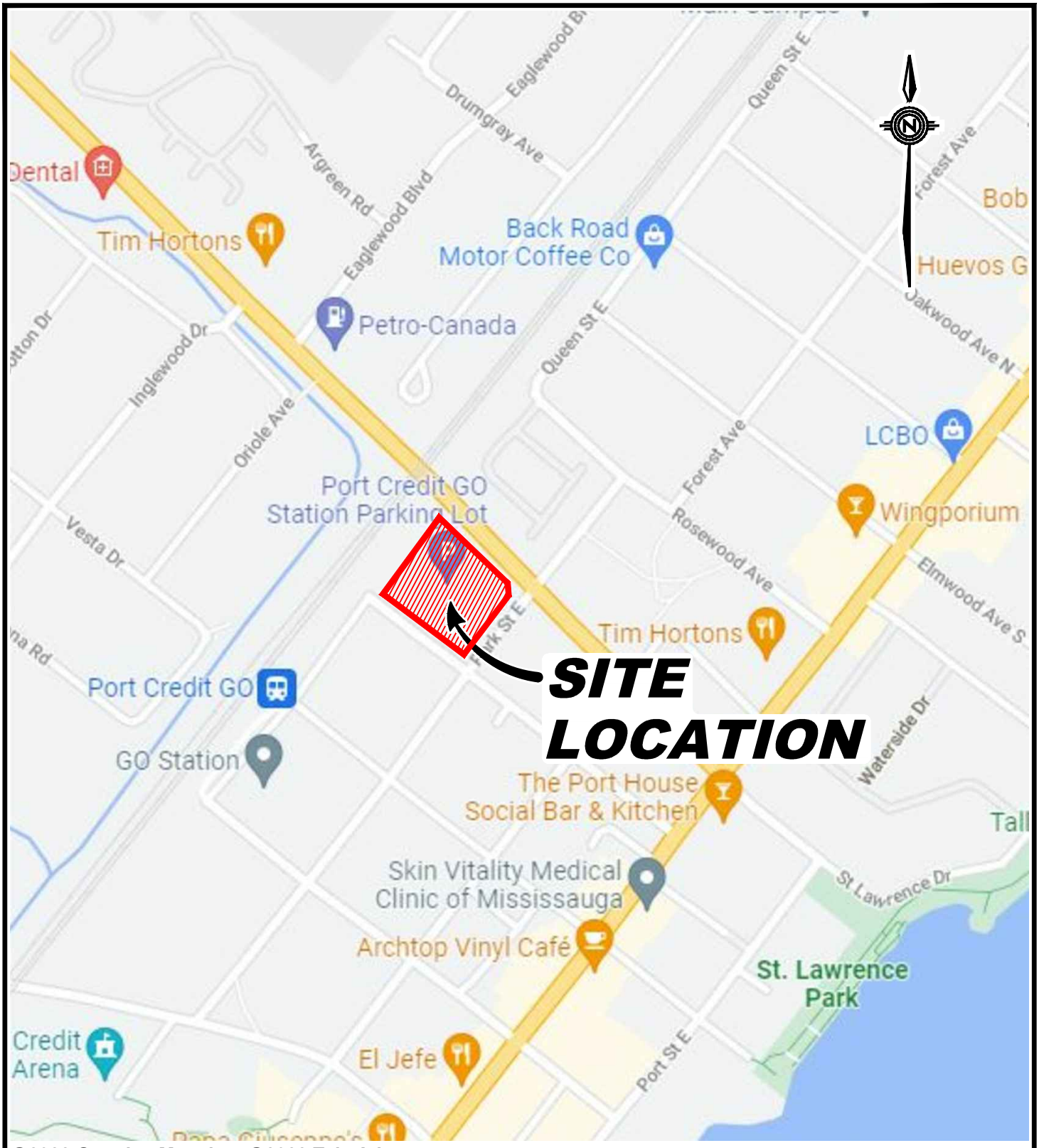
- Determine site specific stormwater management requirements to ensure that the proposals are in conformance with the City of Mississauga and CVC SWM criteria;
- Evaluate various stormwater management practices that meet the requirements of the City and conservation authority and recommend a preferred strategy; and,
- Prepare a stormwater management report documenting the strategy along with the technical information necessary for the justification and preliminary sizing of the proposed stormwater management facilities.

1.4 Design Criteria

The City of Mississauga has issued Development Requirements (2016) to provide directions on the management of rainfall and runoff inside the City's jurisdiction. A summary of the relevant stormwater management criteria applicable to this project is as follows:

- **Runoff Volume Reduction:** The City's Design Manual requires the first 5 mm of runoff shall be retained on-site and managed by way of infiltration, evapotranspiration, or reuse. There are no applicable subwatershed studies or master drainage plans for the subject site area published that indicates any higher minimum requirement.
- **Water Quality:** The City's Design Requirements specify that water quality control is to be implemented in accordance with the applicable Master Drainage Plan or Subwatershed Plan, the City's Stormwater Quality Control Strategy (January 1996) and the MECP (formerly MOECC) Stormwater Management Practices Planning and Design Manual. Based on the MECP 's Manual, the long-term removal of 80% of the TSS loading is required for this site.
- **Water Quantity Control and Discharge to Municipal Infrastructure:** Through use of Table 2.01.03.03a of The City of Mississauga's Development Requirements (2016), correspondence with City and previous projects in the area, it has been determined that water quantity control for this site will be limited by the existing storm sewer capacity. The downstream analysis indicates that existing system is surcharged and has no capacity; therefore, the site's post development release rate will be limited to the 2-year pre-development release rate with a runoff coefficient of 0.5 to provide relief to the system.

- **Erosion Control:** As indicated in the City of Mississauga's Development Requirements (2016), sites under one hectare are not required to provide long term erosion control measures.



CLIENT

EDENSHAW DEVELOPMENTS

TITLE

30 QUEEN STREET EAST

SITE LOCATION

wsp

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Date JANUARY 2021	Proj. No. 211-12423-00
Scale AS SHOWN	Figure No. 1

FIGURE 1.dwg 30 Queen St E - Site Location C:\Users\CAFA072844\ACCDocs\WSP Canada projects (AMER)\Land Development Ontario\Project Files\211-12423 30 Queen\SWM\CAD\FIGURES\ Jan 14, 2022 - 11:48am

2 PRE-DEVELOPMENT CONDITIONS

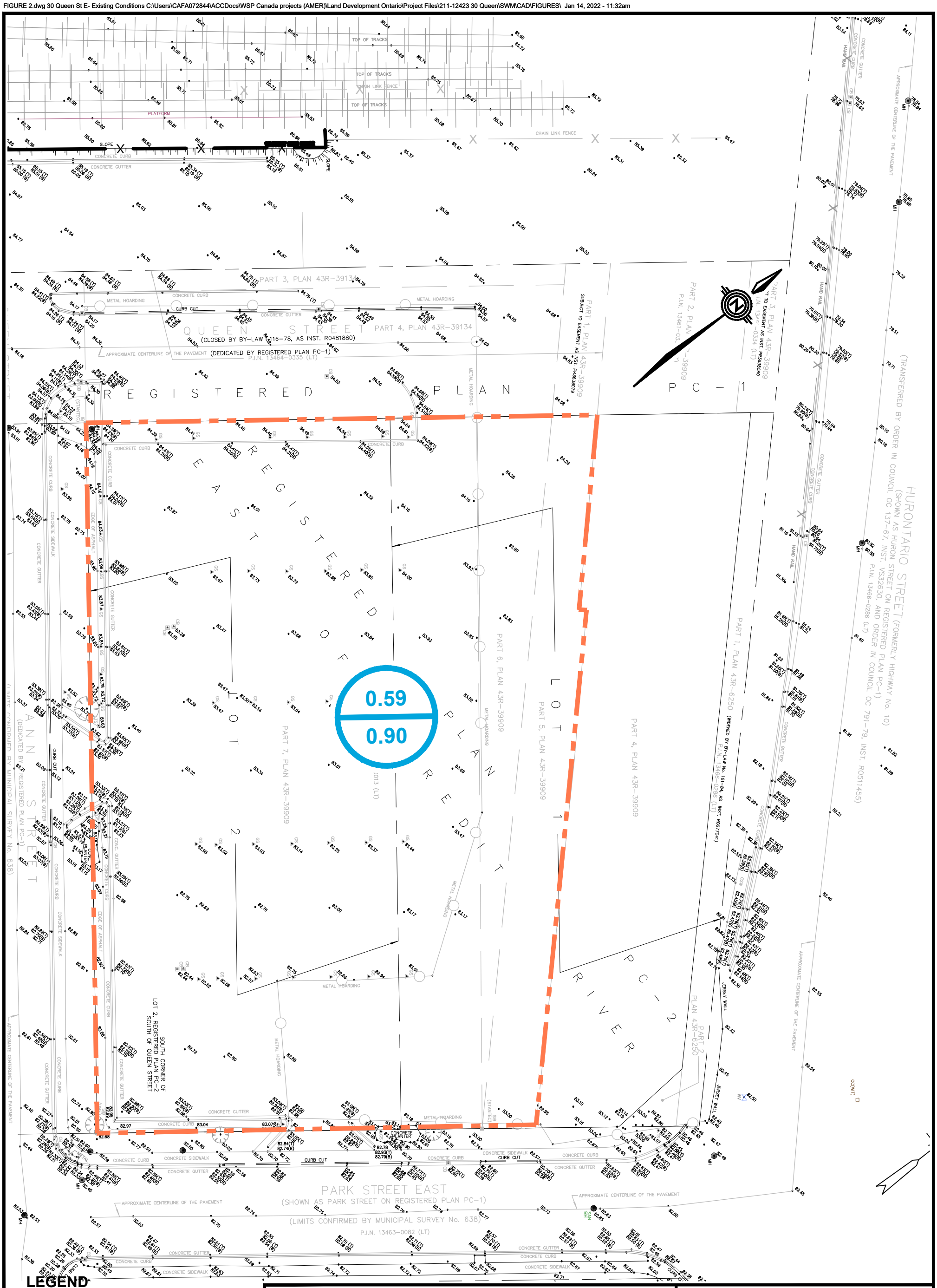
2.1 General

The subject site encompasses 0.59 ha of mostly impervious surfaces comprised of an at-grade asphalt parking lot. As such, a single impervious catchment is used to represent existing conditions with a runoff coefficient of 0.9. Generally, site runoff flows are captured via on-site catch basins and routed south-east to 300 mm diameter storm sewers underneath Ann Street. The existing local storm sewer network servicing the site flows south along Ann Street and west along Park Street, south along Helene Street, then west along Lakeshore Road Street and outlets to the Credit River at the Port Credit Harbour. The Queen Street storm sewer drains west, then south along Helene Street. A summary of the pre-development land use conditions and runoff coefficients are provided in Table 2.1. Existing site conditions are shown in Figure 2.

Table 2.1 Pre-Development Land Use Summary

Land Use	Area (m^2)	Runoff C	Coverage (%)
Impervious Surfaces	5,948	0.90	100
Total Area	**5,948**	**0.90**	**100**

FIGURE 2.dwg 30 Queen St E- Existing Conditions C:\Users\CAFA072844\ACCDocs\WSP Canada projects (AMER)\Land Development Ontario\Project Files\211-12423 30 Queen\SWM\CAD\FIGURES\ Jan 14, 2022 - 11:32am



LEGEND

- PROPERTY BOUNDARY
- 0.10 — DRAINAGE AREA (ha)
- 0.90 — RUNOFF COEFFICIENT

0 5 10 15 20 25m

CLIENT
EDENSHAW DEVELOPMENTS

TITLE
30 QUEEN STREET EAST

EXISTING CONDITIONS

wsp

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Date JANUARY 2022	Proj. No. 211-12423
Scale AS SHOWN	Figure No. 2

2.2 Rainfall Information

According to the City of Mississauga Development Requirements (2016), the rainfall intensity for the site was calculated using the following equation:

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

Where:

i = rainfall intensity in mm/hour.

T = time of concentration in minutes.

A, B, and *C* = constant parameters (see below).

The parameters (A, B and C), recommended for use by the City of Mississauga, are summarized in Table 2.2.

Table 2.2: Rainfall Parameters

Return Period (Years)	2	5	10	25	50	100
A	610	820	1,010	1,160	1,300	1,450
B	4.6	4.6	4.6	4.6	4.7	4.9
C	0.78	0.78	0.78	0.78	0.78	0.78
T (mins)*	15	15	15	15	15	15
T (hours)*	0.25	0.25	0.25	0.25	0.25	0.25
i (mm/hr)	59.9	80.5	99.2	113.9	127.1	140.7

An initial time of concentration, *T*, of 15 minutes (or 0.25 hours) is recommended in the City of Mississauga Development Requirements (2016).

2.3 Allowable Flow Rates

As noted in Section 1.4, relevant policies from the City of Mississauga and the CVC are as follows. The site is located within the CVC Credit River – Norval to Port Credit subwatershed. However, the CVC does not regulate the area in which the site is located and defers to the City of Mississauga quantity control requirements. According to the City of Mississauga Development Requirements (2016), Sections 2.01.01.02 and 2.01.03.03, storm sewers shall be designed to accommodate a 10-year storm and, the target discharge rate to the municipal storm sewer system from the proposed development is based on the 2-year pre-development flow rate calculated with a

maximum runoff coefficient value of 0.50. This yields an allowable release rate to the municipal sewer of 49.5 L/s. The calculated peak flow rates for the site under pre-development conditions are summarized below in Table 2.3. Detailed calculations are contained within Appendix A.

Table 2.3: Peak Flow and Allowable Site Discharge Rate

Return Period (Years)	Rainfall Intensity (mm/hr)	Existing Peak Flow Rate[1] (L/s)	WWFMG Allowable Release Rate[2] (L/s)
2	59.9	89.1	49.5
5	80.5	119.8	
10	99.2	147.6	
25	113.9	169.5	
50	127.1	189.2	
100	140.7	209.4	

[1] C =0.90, drainage area of 0.59 ha and a time of concentration of 15 minutes

[2] C=0.50, drainage area of 0.59 ha and a time of concentration of 15 minutes

3 POST-DEVELOPMENT CONDITIONS

3.1 General

The proposed development consists of two residential high-rise buildings with retail space and five underground parking levels. The high-rise buildings are as follows:

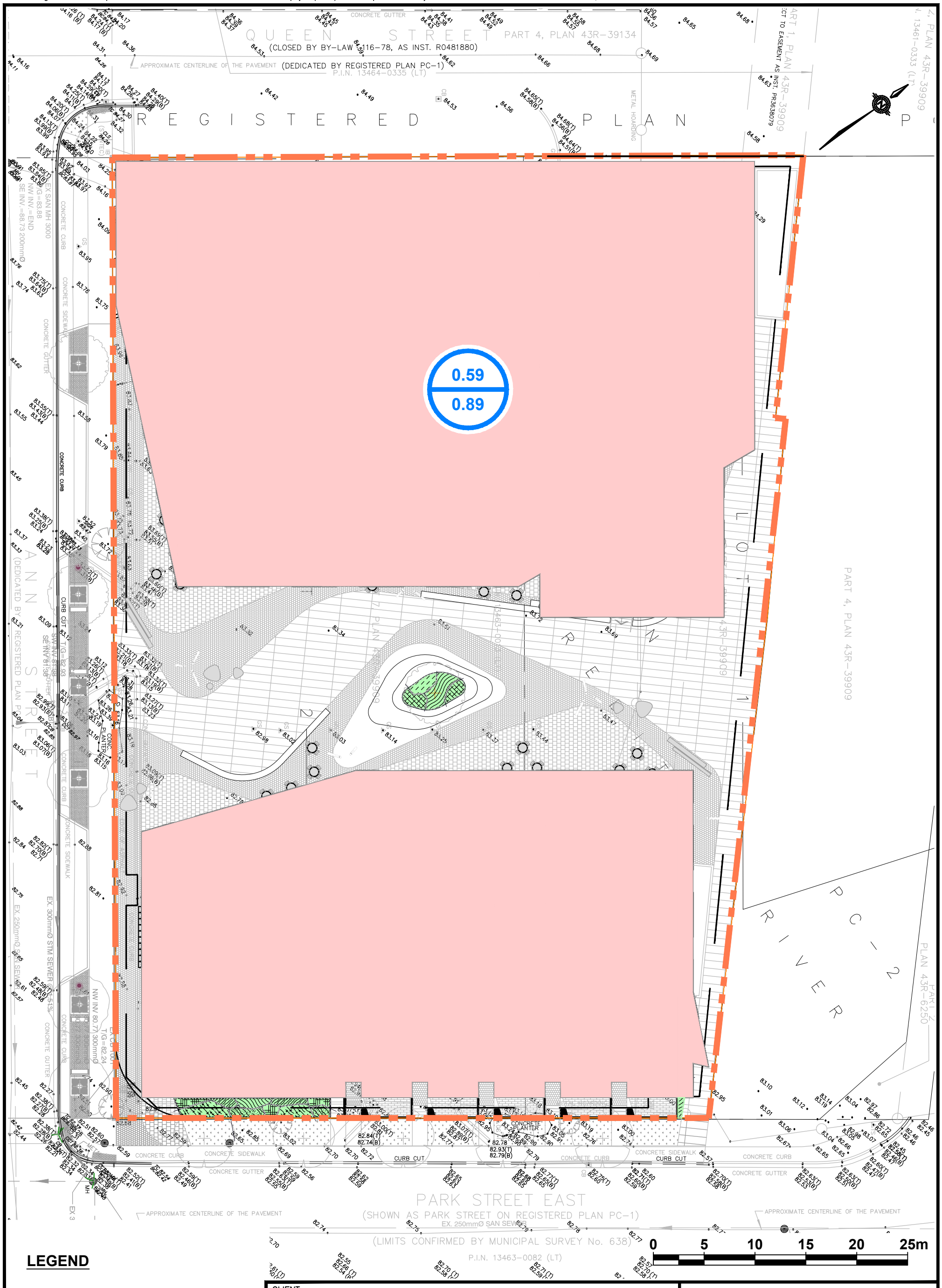
- Tower A: 40 storey building on eastern portion of the site.
- Tower B: 42 storey building on western portion of the site.

The development Vehicular access to the underground parking garage is accessed via the entrance off Ann Street. A land use summary for the proposed site is provided below in Table 3.1. Please refer to Figure 3 for details of the post-development conditions land-uses and stormwater catchments.

Table 3.1: Proposed Conditions Land Use Summary

Land Use	Area (m^2)	Runoff C	Coverage (%)
Impervious			
At-Grade	1,710	0.90	29
Roof			
- *Tower A*	1,659	0.90	28
- *Tower B*	2,532	0.90	43
Pervious			
Landscaped	47	0.25	1
Total Area	**5,948**	**0.89**	**100**

FIGURE 3-.dwg 30 Queen St E - Proposed Conditions C:\Users\CAFA072844\ACCDocs\WSP Canada projects (AMER)\Land Development Ontario\Project Files\211-12423 30 Queen\SWM\CAD\FIGURES\ Jan 14, 2022 - 11:22am



LEGEND

- PROPERTY BOUNDARY
- 0.20 / 0.73 — DRAINAGE AREA (ha) / RUNOFF COEFFICIENT
- IMPERVIOUS ROOF
- PERVIOUS LANDSCAPE

CLIENT
EDENSHAW DEVELOPMENTS

TITLE
30 QUEEN STREET EAST

PROPOSED CONDITIONS

wsp

Checked I.S.	Drawn AutoCAD/F.A.
Date JANUARY 2022	Proj. No. 211-12423
Scale AS SHOWN	Figure No. 3

3.2 Erosion Control

CVC and the City of Mississauga require a minimum on-site detention of 5 mm. The City of Mississauga Design Guidelines do not specify long term in-stream erosion control requirements for sites under 1.0 ha. Since the site area for this application is 0.59 ha, no additional long-term site-specific erosion controls are recommended. However, measures for erosion and sediment control during construction should be installed. The details for control during construction will be outlined in the Erosion and Sediment Control Plan and should conform to the City and CVC Requirements. Therefore, erosion control is satisfied for this site as a result of the 5 mm on-site detention achieved in the runoff volume reduction section of this report.

3.3 Water Quality Control

The City of Mississauga and the CVC require that water quality of the runoff discharging from the development site should be treated to enhanced level as defined by the MOECC SWM Planning and Design Manual, such that a minimum of 80% Total Suspended Solids (TSS) removal is provided. Impervious roofs, walkways, and soft/pervious landscaping within the site are not prone to sediment generation and therefore, considered clean for the purpose of water quality control. Stormwater runoff from the at-grade impervious areas will require water quality treatment.

An Imbrium Jellyfish Filter JF6-3-1 is recommended to meet TSS removal requirements. This oil-grit separator has 40-inch-high cartridges and a removal rate of over 80%. The treatment unit will be installed in an offline configuration immediately upstream of the SWM storage system. The unit will treat the site's controlled, at-grade vehicular surfaces. The remainder of the site will be captured and sent to the stormwater tank directly. Treatment unit specifications as provided by Forterra are in Appendix C of this report.

3.4 Water Balance

As noted in Section 1.4, the City of Mississauga's Development Requirements (2016), Section 2.01.03.02, states that the proponent should target the retention of 5 mm of stormwater runoff from all surfaces.

For the proposed development, an underground parking garage underlies the majority of the site's footprint, thus infiltration is not a feasible option to satisfy the water balance requirement. A stormwater cistern with a sump volume for reuse purposes will be the

primary mechanism to capture rainwater for reuse. Discharge from the impervious roof areas, and at-grade areas will be directed to the underground cistern.

Allowing for an initial abstraction of 1 mm from impervious surfaces and 5 mm from pervious surfaces (soft landscaping, green roof, and permeable pavement), a water balance volume of 23.6 m^3 after abstractions is required to be captured for reuse. The storm tank will provide a sump volume of 23.6 m^3 to meet the water balance requirement. Details of the sump and storm tank are further discussed in Section 3.5.

The reuse methods for the captured stormwater are still being assessed in conjunction with the mechanical design of the building's water supply systems. The methods being considered include greywater toilet/urinal flushing and other non-potable water demand in the non-residential areas of the building. It is assumed that opportunities exist within the development to reuse the full volume of retained stormwater.

The mechanical design of the rainwater reuse pump system from the cistern will ensure that the cistern is empty prior to switching to the City's water supply. Table 3.2 outlines the water balance requirement for the site. Detailed water balance calculations can be found in Appendix A of this report.

Table 3.2 Water Balance Calculations

Land Use	Area (m^2)	Initial Abstraction (m)	Volume Abstracted (m^3)	5 mm Volume (m^3)	Water Balance (m^3)
Impervious					
At-Grade	1,710	0.001	1.7	8.6	6.8
Roof	4,191	0.001	4.2	20.9	16.8
Pervious					
Landscaped	74	0.005	0.2	0.2	0.0
Total Area	**5,948**	**-**	**6.1**	**29.7**	**23.6**

3.5 Water Quantity Control

As noted in Section 2.3, the allowable release rate to the municipal sewer system for the proposed development is 49.5 L/s. This is equivalent to the peak runoff rate under pre-development conditions during a 2-year design storm event with a runoff coefficient of 0.50.

Runoff from the site will be collected by the proposed stormwater tank prior to discharge via a mechanical pump. The proposed tank provides 300 m^3 of storage based on a footprint of 150 m^2 and 2 m height. Outflow from the tank will be controlled via mechanical pump with a discharge rate of 49.5 L/s (post-development flow target) set 0.16 m above the internal base to provide sufficient re-use volume required to satisfy the water balance requirement. The tank will also be fitted with an emergency overflow to grade. This will prevent flow back-up into the building when the primary outlet is blocked or in a storm event is excess of the 100-year return period.

A HydroCAD model of the project was constructed and utilized to determine the required storage volume in the stormwater tank, and to calculate the discharge rates achieved by the proposed flow controls under all storm events. The Modified Rational Method (an inherent subroutine of the HydroCAD software) has been used for the modelling exercise to determine the critical duration of the storm (t_d). Detailed modeling output is presented in Appendix B. Table 3.3 summarizes the generated peak flow rates for proposed conditions and storage volumes required.

Table 3.3 Summary of Modeling Results

Return Period (Years)	Peak Elevation in Cistern (m)	Used Cistern Storage (m^3)	Cistern Discharge[1] (L/s)	Allowable Release Rate (L/s)
2	0.28	42.2	49.4	49.5
5	0.43	64.2	49.4	
10	0.59	87.9	49.4	
25	0.76	114.0	49.4	
50	0.90	134.8	49.4	
100	1.05	157.7	49.5	

[1]For peak stormwater tank volumes an event duration of 31 minutes is used.

The modelling results demonstrate that the post-development peak flow rates for all events up to the 100-year storm are lower than the target release rate established in accordance with the City of Mississauga's Development Requirements (2016). The maximum required storage volume to control the 100-year post-development runoff is 158 m^3. A critical storm duration, t_d, of 31 minutes was used to determine storage volume requirements while peak flows were obtained based on a time of concentration, t_c, of 15 minutes.

4 CONCLUSIONS

A stormwater management plan has been prepared to support the Rezoning Application (RZA) and Site Plan Approval (SPA) for the proposed re-development of 30 Queen Street East, City of Mississauga. The key points are summarized below:

- **Erosion Control:** The site area for this application is 0.59 ha, which is well below the 2.0 ha guideline, and the 5 mm water balance requirement has been addressed. Therefore, additional measures for erosion control are not recommended.
- **Water Balance:** A minimum water reuse volume of 23.6 m^3 will be provided in a sump volume below the invert of the outlet of the stormwater tank to store the required water balance volume for reuse.
- **Water Quantity:** Site generated runoff will be directed to a 300 m^3 stormwater tank. Post-development flows have been controlled to below 49.5 L/s in accordance with the target release rate by a mechanical pump.
- **Water Quality:** Stormwater runoff from the site will satisfy the intent of the City of Mississauga's Development Requirements (2016) water quality requirements without specific treatment measures being installed.

This report has demonstrated that the proposed SWM strategy will address stormwater management related impacts from this project and meet the intent of the City of Mississauga's Development Requirements (2016) and CVC SWM Criteria (2012).

Respectfully submitted,

WSP Canada Inc

APPENDIX

A

Stormwater Management Calculations

	Stormwater Management Calculations	**Project:** 30 Queen Street East	**No.:** 211-12423-00	
	Existing Offsite Discharge Rate	**By:** MN **Checked:** IS	**Date:** 1/26/2022	**Page:** 1

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78\,CiA$

Where: Q = Peak flow rate (litres/second)
C = Runoff coefficient
i = Rainfall intensity (mm/hour)
A = Catchment area (hectares)

Area, A 0.59 hectares
Runoff Coef, C* 0.90

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

Where: A, B and C = Parameters defined in Mississauga Development Requirements (2016).
i = Rainfall intensity (mm/hour)
T = Time of concentration (minutes)

Return Period (Years)	2	5	10	25	50	100
A	610	820	1,010	1,160	1,300	1,450
B	4.6	4.6	4.6	4.6	4.7	4.9
C	0.78	0.78	0.78	0.78	0.78	0.78
T (mins) **	15	15	15	15	15	15
T (hrs)	0.250	0.250	0.250	0.250	0.250	0.250
i (mm/hr)	59.9	80.5	99.2	113.9	127.1	140.7
Q (litres/sec)	89.1	119.8	147.6	169.5	189.2	209.4
Q (m^3/sec)	0.09	0.12	0.15	0.17	0.19	0.21

** Note recommended minimum value for time of concentration for small sites (<2.0 ha) is 15 minutes.

	Stormwater Management Calculations	Project: 30 Queen Street East	No.: 211-12423-00	
	Allowable Offsite Discharge Rate	By: MN Checked: IS	Date: 1/26/2022	Page: 2

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78\,CiA$

Where: Q = Peak flow rate (litres/second)
C = Runoff coefficient
i = Rainfall intensity (mm/hour)
A = Catchment area (hectares)

Total Project Area, A 0.59 hectares
Runoff Coef, C* 0.50

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

Where: A, B and C = Parameters defined in Mississauga Development Requirements (2016).
i = Rainfall intensity (mm/hour)
T = Time of concentration (minutes)

Return Period (Years)	2
A	610
B	4.6
C	0.78
T (mins) **	15
T (hrs)	0.25
i (mm/hr)	59.9
Q (litres/sec)	**49.5**
Q (m^3/sec)	0.05

** Note recommended minimum value for time of concentration for small sites (<2.0 ha) is 15 minutes.

Allowable release rate to municipal storm sewer system is 49.5 L/s.

The current area measurements and land use types for the site are as follows:

Land Use	Area (m^2)	Runoff C	Impervious
Impervious Roof Area	4,191	0.90	100%
Green Roof	0	0.45	0%
Soft Landscaping	47	0.25	0%
Vehicular Surfaces	0	0.90	100%
At-Grade Impervious	1,710	0.90	100%
Total Site Area:	5,948	0.89	99%

Surface Type	Area (m^2)	Initial Abstraction (m)	Volume Abstracted (m^3)	5 mm Volume (m^3)	Water Balance (m^3)
Impervious Roof Area	4,191	0.001	4.19	20.96	16.77
Green Roof	0	0.005	0.00	0.00	0.00
Soft Landscaping	47	0.005	0.23	0.23	0.00
Vehicular Surfaces	0	0.001	0.00	0.00	0.00
At-Grade Impervious	1,710	0.001	1.71	8.55	6.84
Total Site Area:	**5,948**	-	**6.14**	**29.74**	**23.61**

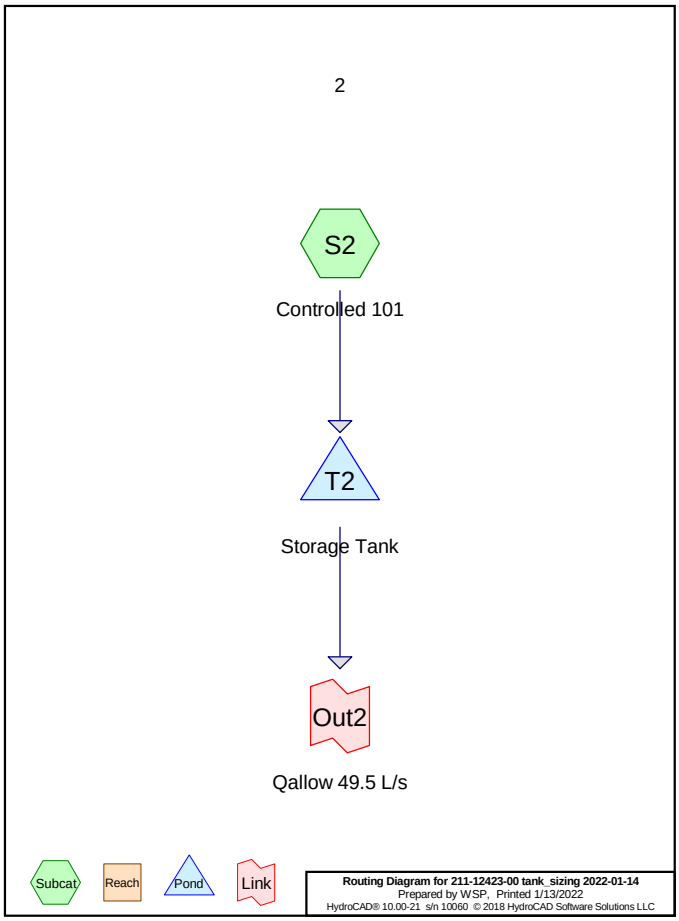
For the purposes of the water balance calculation it is assumed that green roofs can accept 5 mm of rainfall without producing any runoff. It is assumed that the remaining hard surfaces on the site can abstract 1 mm of rainfall, and that all soft landscaped areas can absorb 5 mm.

Therefore, volume of runoff during a 5 mm storm event: 23.6 m^3

APPENDIX

B

Hydrologic Model Output (HydroCAD)



Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,710.0	0.90	At-Grade Impervious (S2)
4,191.4	0.90	Impervious Roof Area (S2)
46.9	0.25	Soft Landscaping (S2)
5,948.3	**0.89**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S2: Controlled 101 Runoff Area=5,948.3 m² 0.00% Impervious Runoff Depth=14 mm
Tc=15.0 min C=0.89 Runoff=0.0851 m³/s 81.3 m³

Pond T2: Storage Tank Peak Elev=0.281 m Storage=42.2 m³ Inflow=0.0851 m³/s 81.3 m³
Outflow=0.0494 m³/s 89.0 m³

Link Out2: Qallow 49.5 L/s Inflow=0.0494 m³/s 89.0 m³
Primary=0.0494 m³/s 89.0 m³

Total Runoff Area = 5,948.3 m² Runoff Volume = 81.3 m³ Average Runoff Depth = 14 mm
100.00% Pervious = 5,948.3 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment S2: Controlled 101

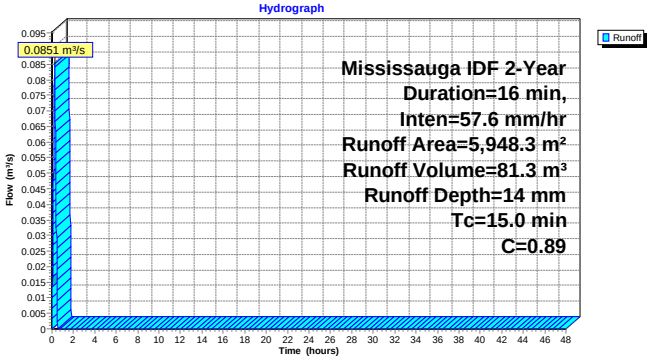
Runoff = 0.0851 m³/s @ 0.26 hrs, Volume= 81.3 m³, Depth= 14 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Mississauga IDF 2-Year Duration=16 min, Inten=57.6 mm/hr

Area (m²)	C	Description
4,191.4	0.90	Impervious Roof Area
0.0	0.45	Green Roof
46.9	0.25	Soft Landscaping
1,710.0	0.90	At-Grade Impervious
5,948.3	0.89	Weighted Average
5,948.3		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
15.0					**Direct Entry,**

Subcatchment S2: Controlled 101



Summary for Pond T2: Storage Tank

Inflow Area = 5,948.3 m², 0.00% Impervious, Inflow Depth = 14 mm for 2-Year event
Inflow = 0.0851 m³/s @ 0.26 hrs, Volume= 81.3 m³
Outflow = 0.0494 m³/s @ 0.37 hrs, Volume= 89.0 m³, Atten= 42%, Lag= 7.0 min
Primary = 0.0494 m³/s @ 0.37 hrs, Volume= 89.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 0.205 m Surf.Area= 150.0 m² Storage= 30.7 m³
Peak Elev= 0.281 m @ 0.37 hrs Surf.Area= 150.0 m² Storage= 42.2 m³ (11.4 m³ above start)

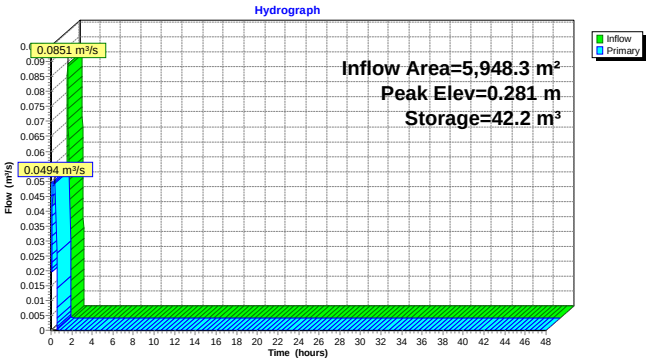
Plug-Flow detention time= 10.5 min calculated for 58.2 m³ (72% of inflow)
Center-of-Mass det. time= 1.9 min (17.4 - 15.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	300.0 m³	**15.00 mW x 10.00 mL x 2.00 mH Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.160 m	**Pump** Discharges@2.000 m Flow (l/min)= 2,964.0 2,970.0 Head (meters)= 2.000 0.000

Primary OutFlow Max=0.0494 m³/s @ 0.37 hrs HW=0.281 m (Free Discharge)
1=Pump (Pump Controls 0.0494 m³/s)

Pond T2: Storage Tank

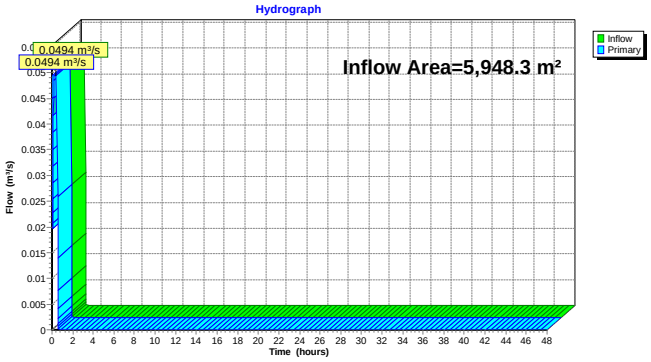


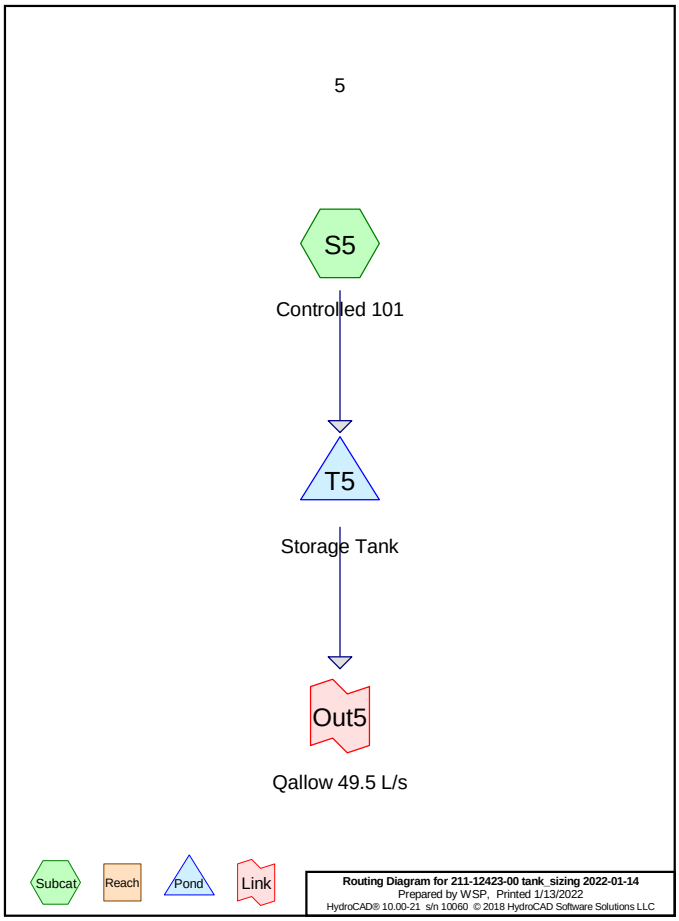
Summary for Link Out2: Qallow 49.5 L/s

Inflow Area = 5,948.3 m², 0.00% Impervious, Inflow Depth = 15 mm for 2-Year event
Inflow = 0.0494 m³/s @ 0.37 hrs, Volume= 89.0 m³
Primary = 0.0494 m³/s @ 0.37 hrs, Volume= 89.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Out2: Qallow 49.5 L/s





Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,710.0	0.90	At-Grade Impervious (S5)
4,191.4	0.90	Impervious Roof Area (S5)
46.9	0.25	Soft Landscaping (S5)
5,948.3	**0.89**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S5: Controlled 101 Runoff Area=5,948.3 m² 0.00% Impervious Runoff Depth=20 mm
Tc=15.0 min C=0.89 Runoff=0.1024 m³/s 116.8 m³

Pond T5: Storage Tank Peak Elev=0.428 m Storage=64.2 m³ Inflow=0.1024 m³/s 116.8 m³
Outflow=0.0494 m³/s 124.4 m³

Link Out5: Qallow 49.5 L/s Inflow=0.0494 m³/s 124.4 m³
Primary=0.0494 m³/s 124.4 m³

Total Runoff Area = 5,948.3 m² Runoff Volume = 116.8 m³ Average Runoff Depth = 20 mm
100.00% Pervious = 5,948.3 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment S5: Controlled 101

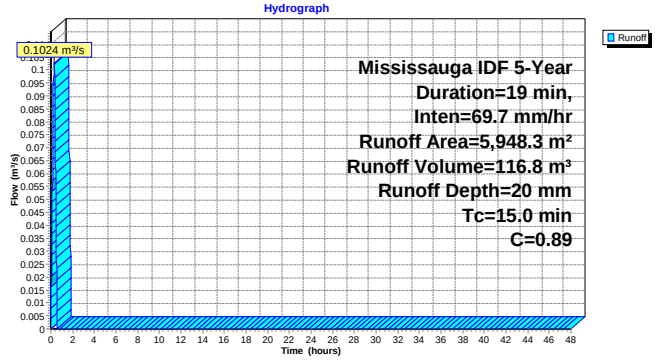
Runoff = 0.1024 m³/s @ 0.25 hrs, Volume= 116.8 m³, Depth= 20 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Mississauga IDF 5-Year Duration=19 min, Inten=69.7 mm/hr

Area (m²)	C	Description
4,191.4	0.90	Impervious Roof Area
0.0	0.45	Green Roof
46.9	0.25	Soft Landscaping
1,710.0	0.90	At-Grade Impervious
5,948.3	0.89	Weighted Average
5,948.3		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
15.0					**Direct Entry,**

Subcatchment S5: Controlled 101



Summary for Pond T5: Storage Tank

Inflow Area = 5,948.3 m², 0.00% Impervious, Inflow Depth = 20 mm for 5-Year event
Inflow = 0.1024 m³/s @ 0.25 hrs, Volume= 116.8 m³
Outflow = 0.0494 m³/s @ 0.45 hrs, Volume= 124.4 m³, Atten= 52%, Lag= 11.8 min
Primary = 0.0494 m³/s @ 0.45 hrs, Volume= 124.4 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 0.205 m Surf.Area= 150.0 m² Storage= 30.7 m³
Peak Elev= 0.428 m @ 0.45 hrs Surf.Area= 150.0 m² Storage= 64.2 m³ (33.5 m³ above start)

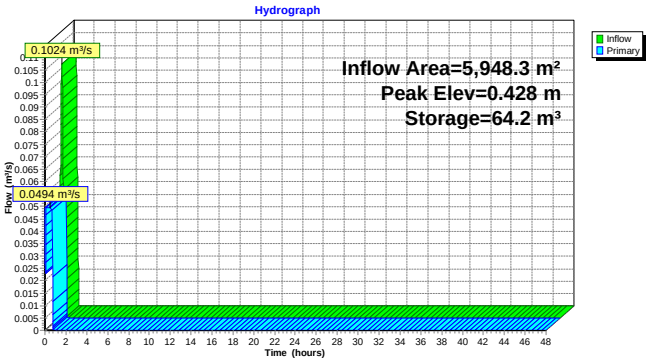
Plug-Flow detention time= 13.7 min calculated for 93.7 m³ (80% of inflow)
Center-of-Mass det. time= 5.8 min (22.8 - 17.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	300.0 m³	**15.00 mW x 10.00 mL x 2.00 mH Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.160 m	**Pump** Discharges@2.000 m Flow (l/min)= 2,964.0 2,970.0 Head (meters)= 2.000 0.000

Primary OutFlow Max=0.0494 m³/s @ 0.45 hrs HW=0.428 m (Free Discharge)
↑**1=Pump** (Pump Controls 0.0494 m³/s)

Pond T5: Storage Tank

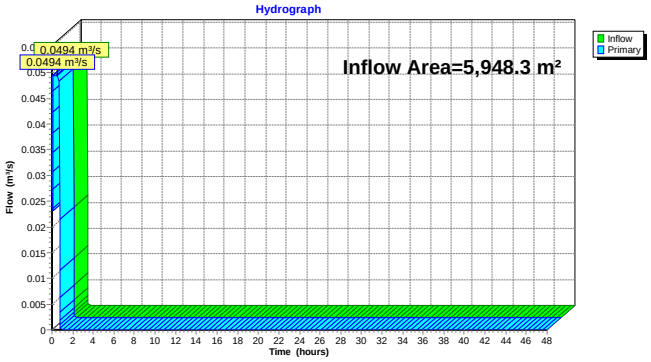


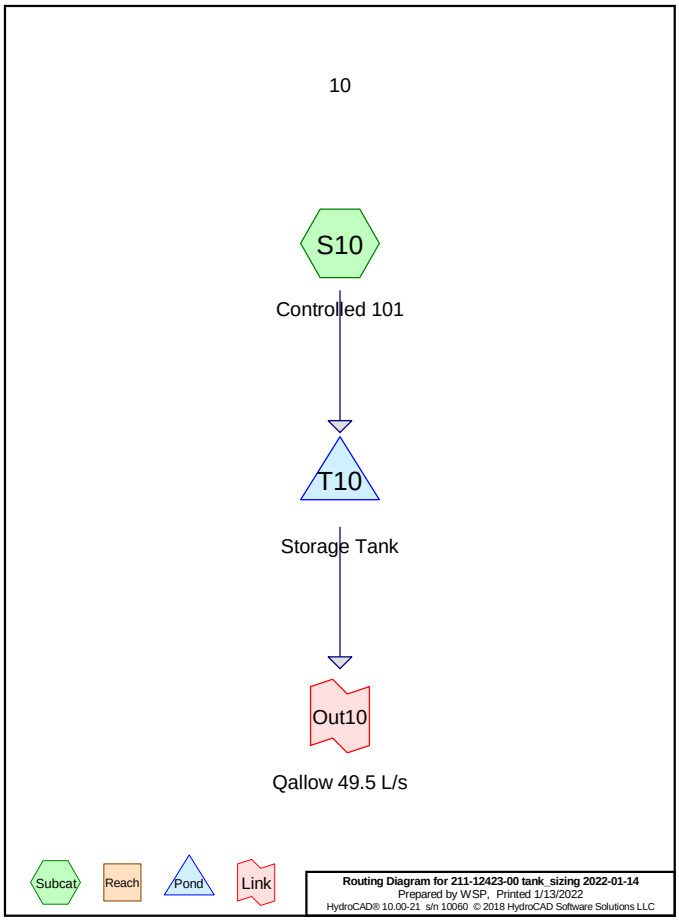
Summary for Link Out5: Qallow 49.5 L/s

Inflow Area = 5,948.3 m², 0.00% Impervious, Inflow Depth = 21 mm for 5-Year event
Inflow = 0.0494 m³/s @ 0.45 hrs, Volume= 124.4 m³
Primary = 0.0494 m³/s @ 0.45 hrs, Volume= 124.4 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Out5: Qallow 49.5 L/s





Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,710.0	0.90	At-Grade Impervious (S10)
4,191.4	0.90	Impervious Roof Area (S10)
46.9	0.25	Soft Landscaping (S10)
5,948.3	**0.89**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S10: Controlled 101 Runoff Area=5,948.3 m² 0.00% Impervious Runoff Depth=26 mm
Tc=15.0 min C=0.89 Runoff=0.1149 m³/s 151.7 m³

Pond T10: Storage Tank Peak Elev=0.586 m Storage=87.9 m³ Inflow=0.1149 m³/s 151.7 m³
Outflow=0.0494 m³/s 159.3 m³

Link Out10: Qallow 49.5 L/s Inflow=0.0494 m³/s 159.3 m³
Primary=0.0494 m³/s 159.3 m³

Total Runoff Area = 5,948.3 m² Runoff Volume = 151.7 m³ Average Runoff Depth = 26 mm
100.00% Pervious = 5,948.3 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment S10: Controlled 101

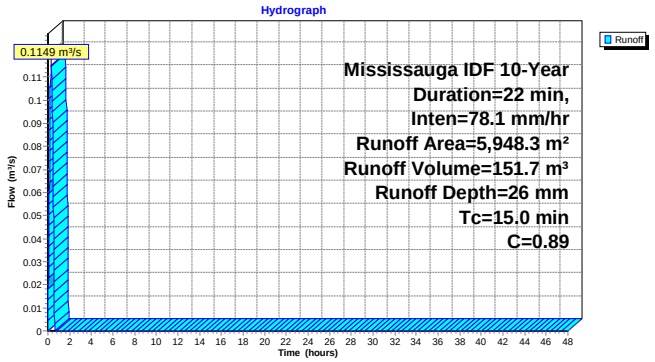
Runoff = 0.1149 m³/s @ 0.25 hrs, Volume= 151.7 m³, Depth= 26 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Mississauga IDF 10-Year Duration=22 min, Inten=78.1 mm/hr

Area (m²)	C	Description
4,191.4	0.90	Impervious Roof Area
0.0	0.45	Green Roof
46.9	0.25	Soft Landscaping
1,710.0	0.90	At-Grade Impervious
5,948.3	0.89	Weighted Average
5,948.3		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
15.0					**Direct Entry,**

Subcatchment S10: Controlled 101



Summary for Pond T10: Storage Tank

Inflow Area = 5,948.3 m², 0.00% Impervious, Inflow Depth = 26 mm for 10-Year event
Inflow = 0.1149 m³/s @ 0.25 hrs, Volume= 151.7 m³
Outflow = 0.0494 m³/s @ 0.51 hrs, Volume= 159.3 m³, Atten= 57%, Lag= 15.5 min
Primary = 0.0494 m³/s @ 0.51 hrs, Volume= 159.3 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 0.205 m Surf.Area= 150.0 m² Storage= 30.7 m³
Peak Elev= 0.586 m @ 0.51 hrs Surf.Area= 150.0 m² Storage= 87.9 m³ (57.1 m³ above start)

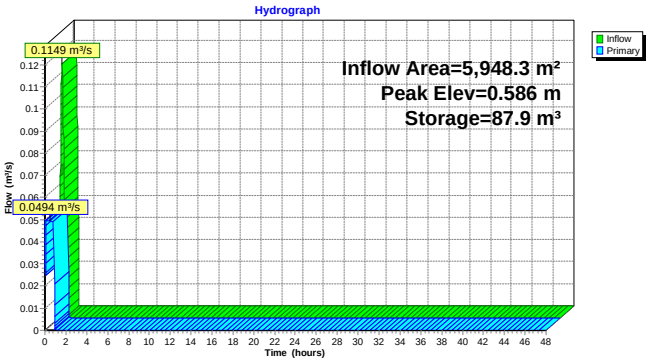
Plug-Flow detention time= 17.3 min calculated for 128.6 m³ (85% of inflow)
Center-of-Mass det. time= 9.8 min (28.4 - 18.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	300.0 m³	**15.00 mW x 10.00 mL x 2.00 mH Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.160 m	**Pump** Discharges@2.000 m Flow (l/min)= 2,964.0 2,970.0 Head (meters)= 2.000 0.000

Primary OutFlow Max=0.0494 m³/s @ 0.51 hrs HW=0.586 m (Free Discharge)
1=Pump (Pump Controls 0.0494 m³/s)

Pond T10: Storage Tank

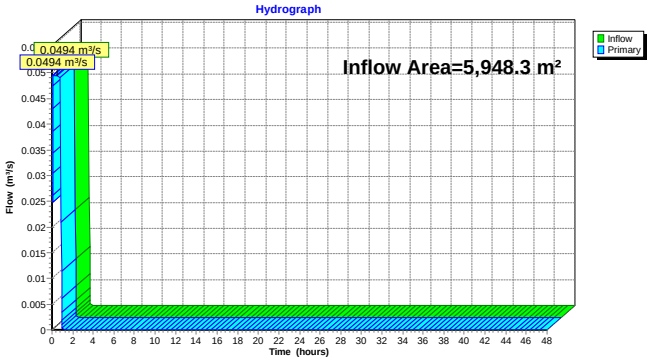


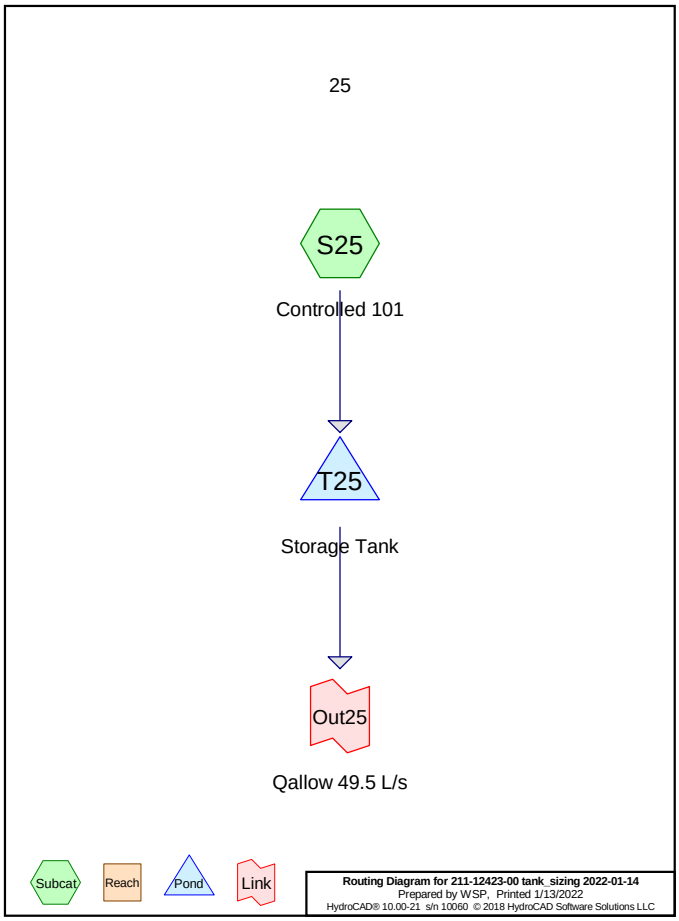
Summary for Link Out10: Qallow 49.5 L/s

Inflow Area = 5,948.3 m², 0.00% Impervious, Inflow Depth = 27 mm for 10-Year event
Inflow = 0.0494 m³/s @ 0.51 hrs, Volume= 159.3 m³
Primary = 0.0494 m³/s @ 0.51 hrs, Volume= 159.3 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Out10: Qallow 49.5 L/s





Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,710.0	0.99	At-Grade Impervious (S25)
4,191.4	0.90	Impervious Roof Area (S25)
46.9	0.25	Soft Landscaping (S25)
5,948.3	**0.92**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S25: Controlled 101 Runoff Area=5,948.3 m² 28.75% Impervious Runoff Depth=32 mm
Tc=15.0 min C=0.92 Runoff=0.1223 m³/s 190.8 m³

Pond T25: Storage Tank Peak Elev=0.760 m Storage=114.0 m³ Inflow=0.1223 m³/s 190.8 m³
Outflow=0.0494 m³/s 198.4 m³

Link Out25: Qallow 49.5 L/s Inflow=0.0494 m³/s 198.4 m³
Primary=0.0494 m³/s 198.4 m³

Total Runoff Area = 5,948.3 m² Runoff Volume = 190.8 m³ Average Runoff Depth = 32 mm
71.25% Pervious = 4,238.3 m² 28.75% Impervious = 1,710.0 m²

Summary for Subcatchment S25: Controlled 101

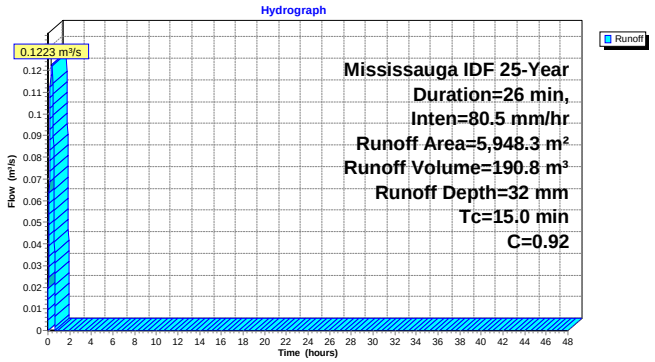
Runoff = 0.1223 m³/s @ 0.25 hrs, Volume= 190.8 m³, Depth= 32 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Mississauga IDF 25-Year Duration=26 min, Inten=80.5 mm/hr

Area (m²)	C	Description
4,191.4	0.90	Impervious Roof Area
0.0	0.45	Green Roof
46.9	0.25	Soft Landscaping
1,710.0	0.99	At-Grade Impervious
5,948.3	0.92	Weighted Average
4,238.3		71.25% Pervious Area
1,710.0		28.75% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
15.0					**Direct Entry,**

Subcatchment S25: Controlled 101



Summary for Pond T25: Storage Tank

Inflow Area = 5,948.3 m², 28.75% Impervious, Inflow Depth = 32 mm for 25-Year event
Inflow = 0.1223 m³/s @ 0.25 hrs, Volume= 190.8 m³
Outflow = 0.0494 m³/s @ 0.58 hrs, Volume= 198.4 m³, Atten= 60%, Lag= 19.9 min
Primary = 0.0494 m³/s @ 0.58 hrs, Volume= 198.4 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 0.205 m Surf.Area= 150.0 m² Storage= 30.7 m³
Peak Elev= 0.760 m @ 0.58 hrs Surf.Area= 150.0 m² Storage= 114.0 m³ (83.2 m³ above start)

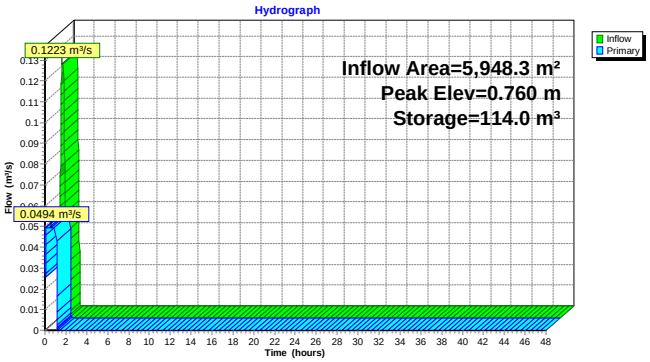
Plug-Flow detention time= 21.5 min calculated for 167.7 m³ (88% of inflow)
Center-of-Mass det. time= 14.3 min (34.8 - 20.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	300.0 m³	**15.00 mW x 10.00 mL x 2.00 mH Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.160 m	**Pump** Discharges@2.000 m Flow (l/min)= 2,964.0 2,970.0 Head (meters)= 2.000 0.000

Primary OutFlow Max=0.0494 m³/s @ 0.58 hrs HW=0.760 m (Free Discharge)
1=Pump (Pump Controls 0.0494 m³/s)

Pond T25: Storage Tank

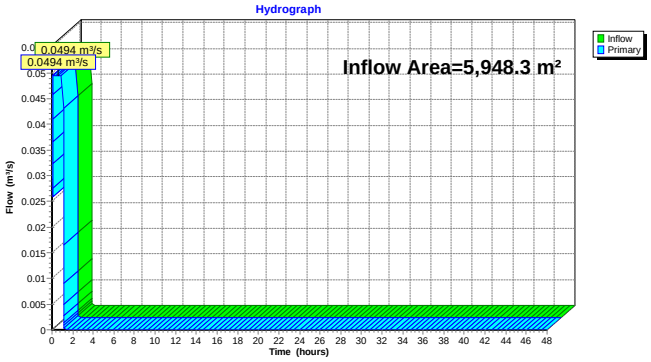


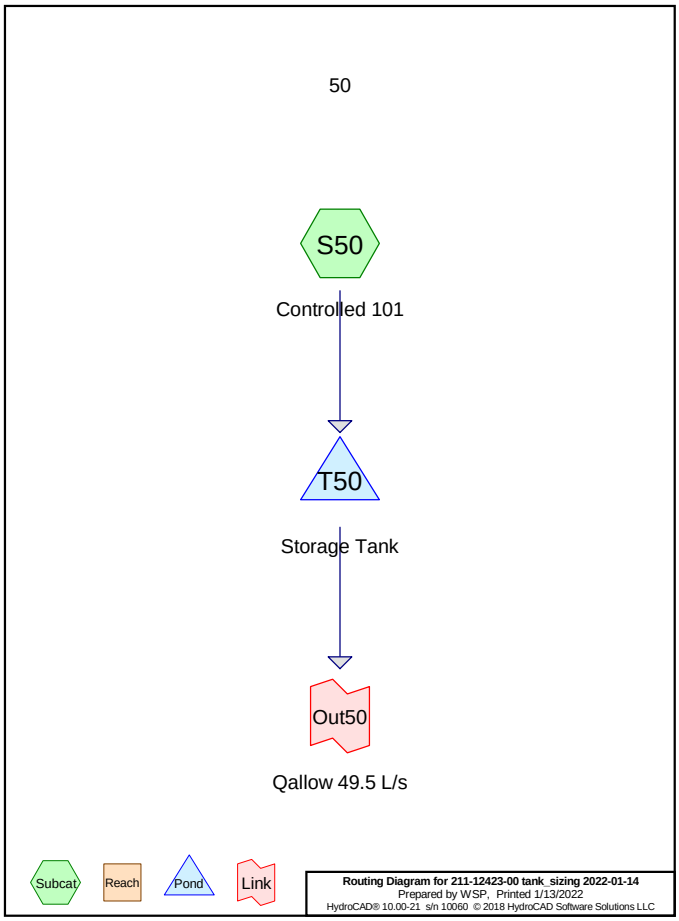
Summary for Link Out25: Qallow 49.5 L/s

Inflow Area = 5,948.3 m², 28.75% Impervious, Inflow Depth = 33 mm for 25-Year event
Inflow = 0.0494 m³/s @ 0.58 hrs, Volume= 198.4 m³
Primary = 0.0494 m³/s @ 0.58 hrs, Volume= 198.4 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Out25: Qallow 49.5 L/s





Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,710.0	1.00	At-Grade Impervious (S50)
4,191.4	0.90	Impervious Roof Area (S50)
46.9	0.25	Soft Landscaping (S50)
5,948.3	**0.92**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S50: Controlled 101 Runoff Area=5,948.3 m² 28.75% Impervious Runoff Depth=37 mm
Tc=15.0 min C=0.92 Runoff=0.1271 m³/s 221.2 m³

Pond T50: Storage Tank Peak Elev=0.899 m Storage=134.8 m³ Inflow=0.1271 m³/s 221.2 m³
Outflow=0.0494 m³/s 228.9 m³

Link Out50: Qallow 49.5 L/s Inflow=0.0494 m³/s 228.9 m³
Primary=0.0494 m³/s 228.9 m³

Total Runoff Area = 5,948.3 m² Runoff Volume = 221.2 m³ Average Runoff Depth = 37 mm
71.25% Pervious = 4,238.3 m² 28.75% Impervious = 1,710.0 m²

Summary for Subcatchment S50: Controlled 101

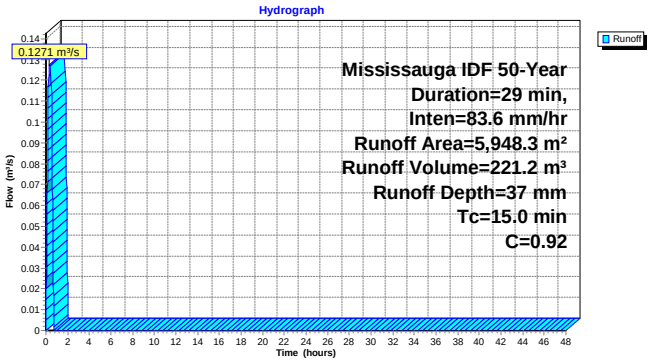
Runoff = 0.1271 m³/s @ 0.25 hrs, Volume= 221.2 m³, Depth= 37 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Mississauga IDF 50-Year Duration=29 min, Inten=83.6 mm/hr

Area (m²)	C	Description
4,191.4	0.90	Impervious Roof Area
0.0	0.45	Green Roof
46.9	0.25	Soft Landscaping
1,710.0	1.00	At-Grade Impervious
5,948.3	0.92	Weighted Average
4,238.3		71.25% Pervious Area
1,710.0		28.75% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
15.0					**Direct Entry,**

Subcatchment S50: Controlled 101



Summary for Pond T50: Storage Tank

Inflow Area = 5,948.3 m², 28.75% Impervious, Inflow Depth = 37 mm for 50-Year event
Inflow = 0.1271 m³/s @ 0.25 hrs, Volume= 221.2 m³
Outflow = 0.0494 m³/s @ 0.64 hrs, Volume= 228.9 m³, Atten= 61%, Lag= 23.2 min
Primary = 0.0494 m³/s @ 0.64 hrs, Volume= 228.9 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 0.205 m Surf.Area= 150.0 m² Storage= 30.7 m³
Peak Elev= 0.899 m @ 0.64 hrs Surf.Area= 150.0 m² Storage= 134.8 m³ (104.0 m³ above start)

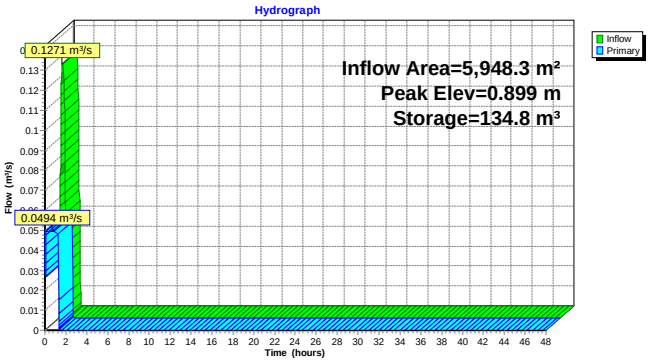
Plug-Flow detention time= 25.1 min calculated for 198.1 m³ (90% of inflow)
Center-of-Mass det. time= 17.8 min (39.8 - 22.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	300.0 m³	**15.00 mW x 10.00 mL x 2.00 mH Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.160 m	**Pump** Discharges@2.000 m Flow (l/min)= 2,964.0 2,970.0 Head (meters)= 2.000 0.000

Primary OutFlow Max=0.0494 m³/s @ 0.64 hrs HW=0.898 m (Free Discharge)
1=Pump (Pump Controls 0.0494 m³/s)

Pond T50: Storage Tank

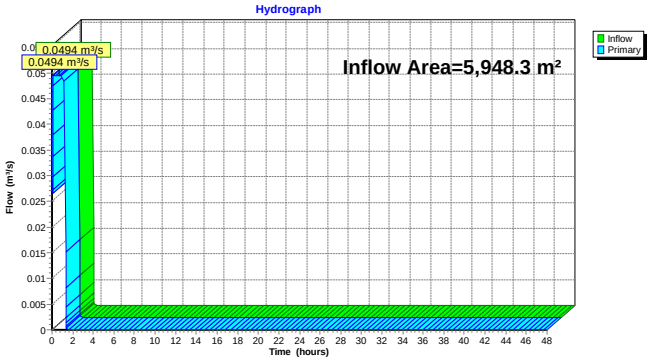


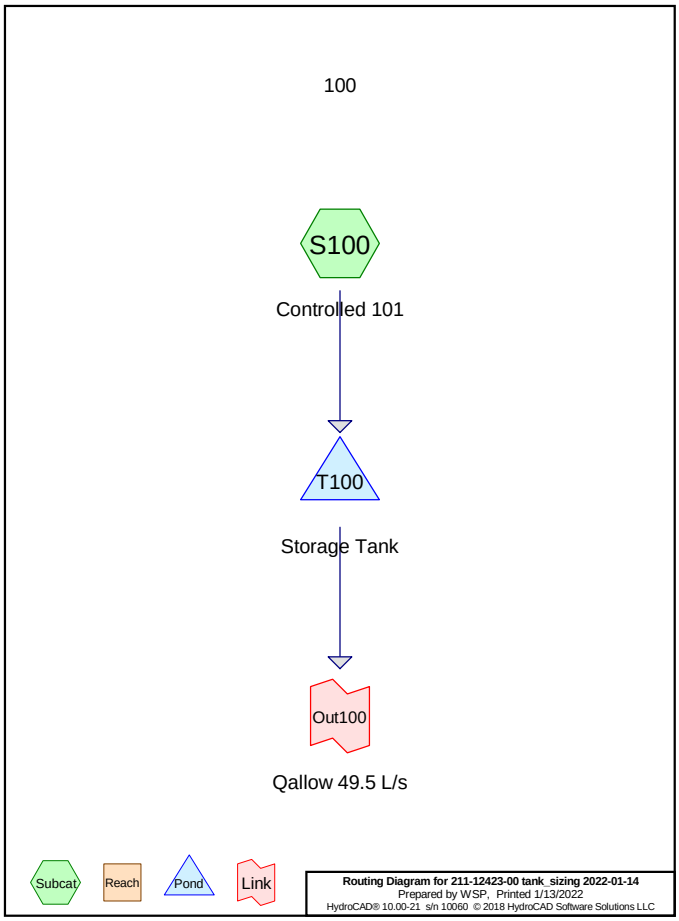
Summary for Link Out50: Qallow 49.5 L/s

Inflow Area = 5,948.3 m², 28.75% Impervious, Inflow Depth = 38 mm for 50-Year event
Inflow = 0.0494 m³/s @ 0.64 hrs, Volume= 228.9 m³
Primary = 0.0494 m³/s @ 0.64 hrs, Volume= 228.9 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Out50: Qallow 49.5 L/s





Area Listing (selected nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
1,710.0	1.00	At-Grade Impervious (S100)
4,191.4	0.90	Impervious Roof Area (S100)
46.9	0.25	Soft Landscaping (S100)
5,948.3	**0.92**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S100: Controlled 101 Runoff Area=5,948.3 m² 28.75% Impervious Runoff Depth=42 mm
Tc=15.0 min C=0.92 Runoff=0.1350 m³/s 251.1 m³

Pond T100: Storage Tank Peak Elev=1.051 m Storage=157.7 m³ Inflow=0.1350 m³/s 251.1 m³
Outflow=0.0495 m³/s 258.7 m³

Link Out100: Qallow 49.5 L/s Inflow=0.0495 m³/s 258.7 m³
Primary=0.0495 m³/s 258.7 m³

Total Runoff Area = 5,948.3 m² Runoff Volume = 251.1 m³ Average Runoff Depth = 42 mm
71.25% Pervious = 4,238.3 m² 28.75% Impervious = 1,710.0 m²

Summary for Subcatchment S100: Controlled 101

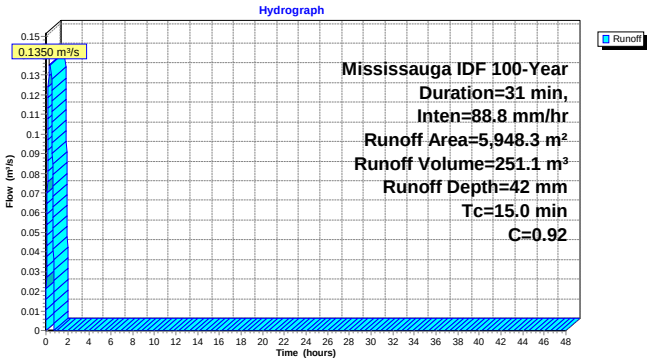
Runoff = 0.1350 m³/s @ 0.25 hrs, Volume= 251.1 m³, Depth= 42 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Mississauga IDF 100-Year Duration=31 min, Inten=88.8 mm/hr

Area (m²)	C	Description
4,191.4	0.90	Impervious Roof Area
0.0	0.45	Green Roof
46.9	0.25	Soft Landscaping
1,710.0	1.00	At-Grade Impervious
5,948.3	0.92	Weighted Average
4,238.3		71.25% Pervious Area
1,710.0		28.75% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
15.0					**Direct Entry,**

Subcatchment S100: Controlled 101



Summary for Pond T100: Storage Tank

Inflow Area = 5,948.3 m², 28.75% Impervious, Inflow Depth = 42 mm for 100-Year event
Inflow = 0.1350 m³/s @ 0.25 hrs, Volume= 251.1 m³
Outflow = 0.0495 m³/s @ 0.68 hrs, Volume= 258.7 m³, Atten= 63%, Lag= 25.5 min
Primary = 0.0495 m³/s @ 0.68 hrs, Volume= 258.7 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 0.205 m Surf.Area= 150.0 m² Storage= 30.8 m³
Peak Elev= 1.051 m @ 0.68 hrs Surf.Area= 150.0 m² Storage= 157.7 m³ (126.9 m³ above start)

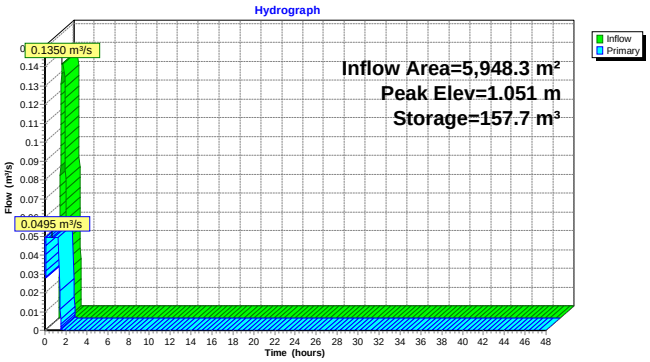
Plug-Flow detention time= 28.7 min calculated for 228.0 m³ (91% of inflow)
Center-of-Mass det. time= 21.7 min (44.7 - 23.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	300.0 m³	**15.00 mW x 10.00 mL x 2.00 mH Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.160 m	**Pump** Discharges@2.000 m Flow (l/min)= 2,964.0 2,970.0 Head (meters)= 2.000 0.000

Primary OutFlow Max=0.0495 m³/s @ 0.68 hrs HW=1.051 m (Free Discharge)
1=Pump (Pump Controls 0.0495 m³/s)

Pond T100: Storage Tank

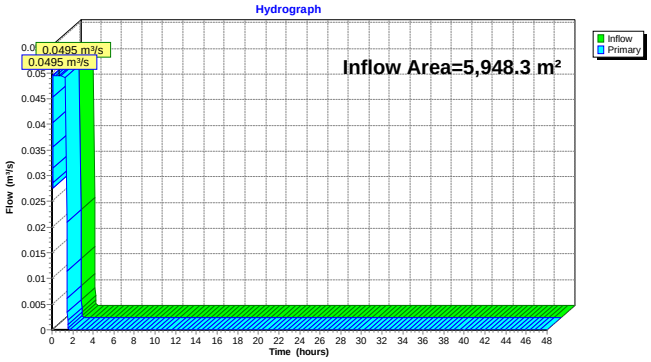


Summary for Link Out100: Qallow 49.5 L/s

Inflow Area = 5,948.3 m², 28.75% Impervious, Inflow Depth = 43 mm for 100-Year event
Inflow = 0.0495 m³/s @ 0.68 hrs, Volume= 258.7 m³
Primary = 0.0495 m³/s @ 0.68 hrs, Volume= 258.7 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link Out100: Qallow 49.5 L/s



APPENDIX

C Jellyfish Filter

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Thursday, January 13, 2022
Project Name	30 Queen St. E
Project Number	
Location	Mississauga

Jellyfish Filter Design Overview

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

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

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF6-3-1 is recommended to meet the water quality objective by treating a flow of 17.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 199 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF6-3-1	3	1	1.8	17.7	199

The Jellyfish Filter System

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

Maintenance

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

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

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

Performance

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

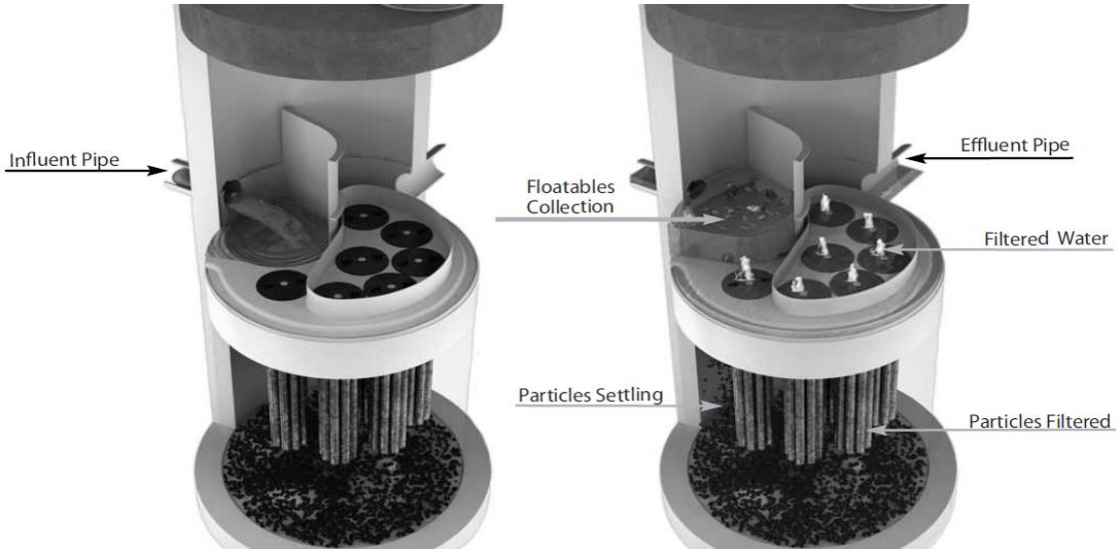
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash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

Field Proven Peformance

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

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

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Thursday, January 13, 2022
Project Name:	30 Queen St. E
Project Number:	
Location:	Mississauga

Designer Information

Company:	WSP Canada Group Ltd.
Contact:	Mike Nanos
Phone #:	

Notes

Rainfall

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

Drainage Area

Total Area:	0.4091 ha
Imperviousness:	100%

Upstream Detention

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

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**11.8 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 2446 m³, with a suspended sediment concentration of 60 mg/L.	**147 kg***

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

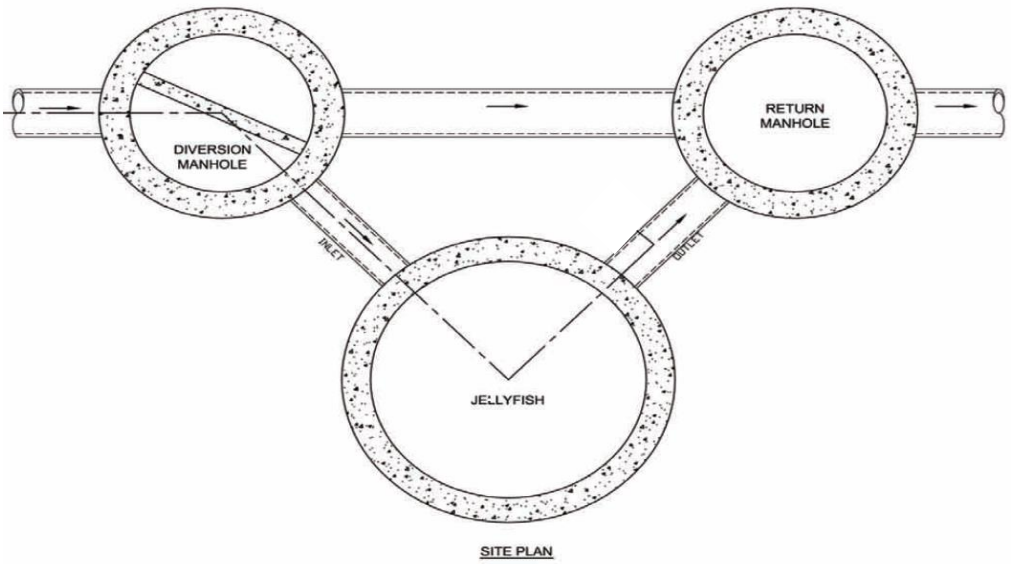
Recommendation

The Jellyfish Filter model JF6-3-1 is recommended to meet the water quality objective by treating a flow of 17.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 199 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	**3**	**1**	**1.8**	**5205**	**0.79**	**848**	**17.7**	**199**
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

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



Jellyfish Filter Typical Layout

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

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	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