Drainage and Stormwater Management Report– Eastern Avenue Transit Oriented Communities

356 Eastern Avenue
Toronto Ontario M4M 1B8

Issued for Rezoning

Contract RFS-2019-NAFC-110

PO 214244

HDR Project 10206938

Ontario Line Technical Advisor

TORONTO, ONTARIO

October 2022

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Abbreviations

BMP	Best Management Practice
DMOG	Digital Map Owners Group Database
DRM	Design Requirements Manual
HGL	Hydraulic Grade Line
HGRA	High Volume Groundwater Recharge Areas
IBC	Initial Business Case
IDF	Intensity-Duration-Frequency
IO	Infrastructure Ontario
mbgs	m below ground surface
MECP	Ministry of the Environment, Conservation and Parks
OLTA	Ontario Line Technical Advisor
OGS	Oil and Grit Separator
RCD	Reference Concept Design
SPA	Site Plan Application
SWM	Stormwater Management
TGS	Toronto Green Standard
TMC681	Toronto Municipal Code Chapter 681
TOC	Transit Oriented Communities
TSS	Total Suspended Solids
TRCA	Toronto and Region Conservation Authority
WWFMG	Wet Weather Flow Management Guidelines

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1 Introduction

1.1 Project Description

The Province of Ontario is planning to build a new 15.5 km rapid transit line serving the City of Toronto. The development of this line is being managed jointly by Metrolinx, the Provincial Transit Agency responsible for the Greater Toronto and Hamilton Area, and Infrastructure Ontario (IO). The work is based on an Initial Business Case (IBC) published in July 2019, including a representative alignment for the Ontario Line.

The Ontario Line Technical Advisory Services team have been organized into the following segments, as shown in **Figure 1-1**.

- Maintenance and Storage Facility (OMSF), and
- Four linear geographical segments:
  - Lakeshore (containing both Lakeshore West and Lakeshore East)
  - Downtown
  - Pape
  - Thorncliffe

The Lakeshore Corridor Segment is predominantly above ground and consists of two sections. The Lakeshore West section begins at the west limit and ends at the Exhibition GO portal. The Lakeshore East section begins at the tunnel portal near Don Yard in the west and ends at the tunnel portal at Gerrard in the east. The Lakeshore East section consists of three stations:

- East Harbour Station
- Leslieville Station
- Gerrard Station

Transit Oriented Communities (TOC) are proposed at the Ontario Line Stations to integrate high density, mixed-used developments with the transit infrastructure. This Drainage and Stormwater Management report summarizes the drainage and stormwater management (SWM) requirements for the proposed Ontario Line TOC at East Harbour Station located at the intersection of Eastern Avenue and Lewis Street in the City of Toronto with respect to drainage conveyance, stormwater quantity control, stormwater quality treatment, and water balance. There is another TOC adjacent to East Harbour Station which is referred to as the East Harbour TOC, done by others.

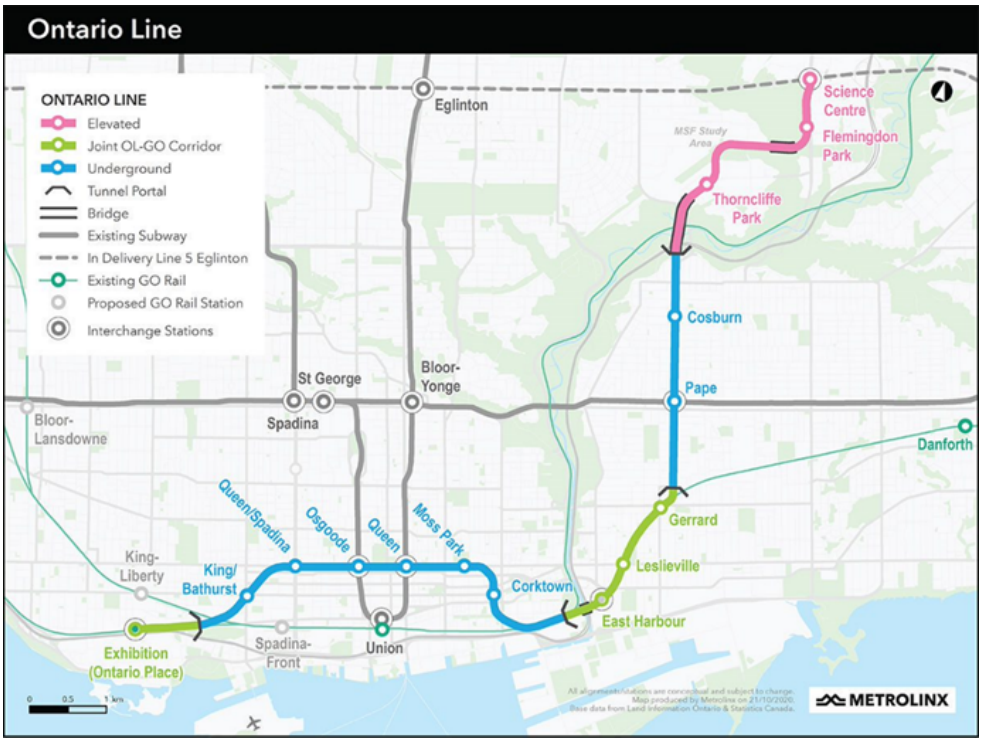


Figure 1-1. Ontario Line Segments

1.2 Eastern Avenue TOC

East Harbour Station is located along the rail corridor between Eastern Avenue and the Lower Don Bridge. The TOC development building is proposed at the northwest intersection of the rail corridor and Eastern Avenue.

1.3 Background Review

In preparation of the 356 Eastern Avenue TOC Drainage and Stormwater Management Report, the following essential documents were obtained and reviewed:

- Digital Map Owners Group Database (DMOG), City of Toronto; and Toronto Water Asset Geodatabase (TWAG) (City of Toronto)
- Drawing 310T001A Draft – Architecture and Landscape Set – Rezoning (SvN)

2 Existing Conditions

The existing site is relatively flat terrain occupied by a five-story storage building and parking lot, and vegetated areas. Refer to **Figure 2-1** for the existing conditions of the proposed development. East Harbour Station is located in the Don River Watershed. East Harbour Station is within Basement Flooding Study Area 32. The study of which was started in 2006, and completed in 2012, according to the City of Toronto.

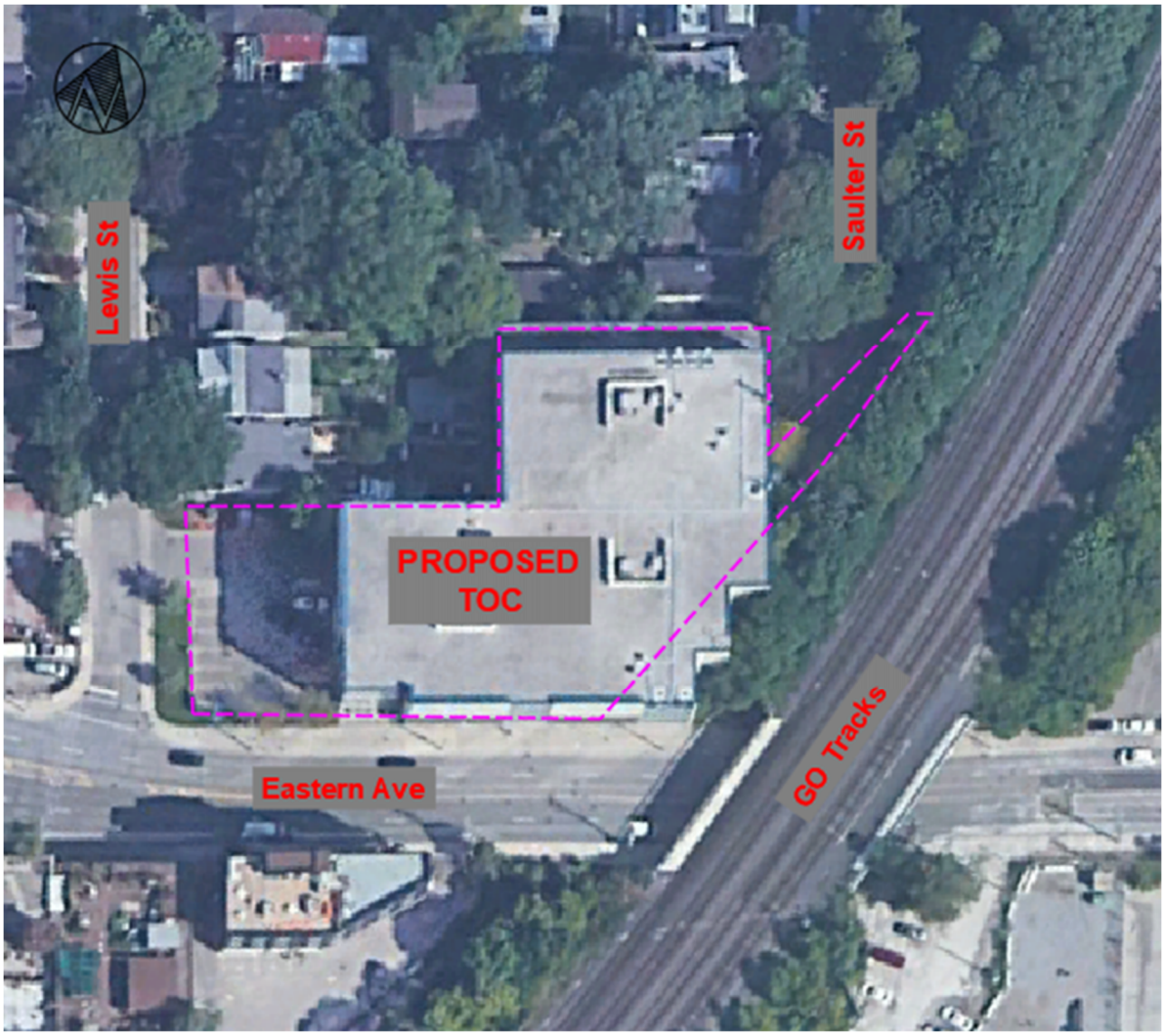


Figure 2-1. Area Plan

2.1 Minor and Major Flows

The existing parking lot component of the commercial site located at 356 Eastern Avenue is graded to contain runoff on site and direct it to catch basins located at low points. It is assumed that roof drains discharge to the on-site storm sewer system as downspouts discharging to grade are evident. The presence of on-site controls could not be established based on the information received at the time of the preparation of this report. Runoff in excess of the capacity of the on-site storm sewer system ponds in the parking lots and then spills to the adjacent municipal roadways.

Existing storm sewers adjacent to the site include a 450 mm combined sewer flowing from north to south along Saulter Street, which connects into the 900mm x 600mm combined sewer on Eastern Avenue. A 450mm storm sewer flows north to south along Lewis Street, which connects to the 900mm x 600mm combined sewer on Eastern Avenue. The 900mm x 600mm combined sewer on Eastern Avenue flows east to west, discharging into the Don River. A 1650 mm combined sewer overflow runs west to east along Eastern Avenue. With the limited information that is currently available, it was assumed that a portion of the existing roof is serviced by the Lewis Street storm sewer and a portion is serviced by the

Saulter Street combined sewer. Refer to the attached existing conditions drainage plan in **Appendix A**.

A portion of major flows on Eastern Avenue collect at a low point at the rail corridor underpass immediately east of the proposed development. Major flows on Eastern Avenue, west of the proposed development flow east to west. Major flows on Saulter Street and Lewis Street travel from north to south. A portion of the major flows from the GO tracks flow west onto Saulter Street and into the 356 Eastern Avenue property.

3 Stormwater Management Criteria

Stormwater management requirements are specified by the authorities having jurisdiction over the Project. These requirements are applicable to all locations where the proposed design will influence or be influenced by surface water runoff. Stormwater management criteria for this Project are set by the following documents:

- Stormwater Management Planning and Design Manual (MECP, 2003)
- Drainage Management Manual (MTO, 1997)
- Municipal Code Chapter 681, Sewers 681-1 (City of Toronto, 2019)
- Design Criteria for Sewers and Watermains (City of Toronto, 2021)
- Wet Weather Flow Management Guidelines (City of Toronto, 2006)
- Stormwater Management Criteria (TRCA, 2012)
- Living City Policies (TRCA, 2014)
- Toronto Green Standard (City of Toronto, 2018)
- Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation and TRCA, 2010)
- Erosion & Sediment Control Guide for Urban Construction (TRCA, 2019)
- GO Design Requirements Manual (Metrolinx, 2019)
- Light Rail Transit Design Criteria Manual (Metrolinx, 2016)

The Wet Weather Flow Management Guidelines (WWFMG) provide requirements and guidance on stormwater management for developments within the City of Toronto. Table 7 in the WWFMG provides a summary of applicable design criteria based on the type and size of proposed development. Storm sewer and inlet design requirements for the City of Toronto are provided in the Design Criteria for Sewers and Watermains. The Toronto Green Standard (TGS) provides additional stormwater standards specifically related to sustainable development. The TRCA Stormwater Management Criteria provides design requirements related to stormwater management for developments within the jurisdiction of the Toronto and Region Conservation Authority (TRCA). Requirements vary depending on the watershed in which a proposed development is located. The GO Design Requirements Manual (DRM) supplements the local guidelines and provides guidance to be adhered to in all Metrolinx developments.

3.1 SWM Criteria Summary

The key criteria applicable to this Project are summarized in the following sections. Additional criteria and general guidance can be found in the guideline documents listed at the beginning of **Section 3**.

3.1.1 Quality Control

- Provide a long-term average removal of 80% of total suspended solids (TSS) from the storm runoff of additional impervious areas (TRCA Guidelines).
- Provide a long-term average removal of 80% of TSS on an annual loading basis from all the storm runoff leaving the site (WWFMG, TGS).
  - Oil/Grit separator units (OGS) are credited with a maximum of 50% TSS removal (WWFMG, TRCA).

3.1.2 Quantity/Flood Control

- Provide protection against surface flooding from ponding on streets during the 100-year event. Consult *Toronto Water – Sewer Asset Planning Section* for developments within the City's chronic basement flooding areas (WWFMG).
- Drainage discharged to the municipal storm sewer must be controlled to the peak release rate from the lower of:
  - The existing conditions peak flow from design event with a 2-year return period assuming a runoff coefficient of 0.5, if the existing imperviousness is greater than 50%; and,
  - The existing capacity of the storm sewer (WWFMG).
- In absence of an approved or adequate overland flow route, all flows from the 2-year up to the 100-year return storm events shall be stored on site and released at the allowable release rate as defined above (WWFMG).
- Peak flows should be calculated using the intensity-duration-frequency (IDF) information in the WWFMG.

3.1.3 Water Balance

- Retain all runoff from the 5 mm rainfall event on site through infiltration, evaporation, and/or rainwater reuse (TGS Version 4 - Tier 1).
- For sites located in high volume groundwater recharge areas (HGRA), pre-development groundwater recharge rates should be maintained (TRCA).

3.1.4 Erosion Control

- For infill/redevelopment sites (<2 ha), where the site does not drain to a sensitive watercourse, erosion control should be provided through the retention of a small design rainfall event (typically 5 mm). This is often achieved by satisfying the water balance retention requirement (WWFMG, TRCA).
- For new large development sites (> 5 ha) discharge directly and/or in proximity (within 100 m) of natural watercourses, it is required to complete an Erosion Analysis Report to determine the erosion control criteria for the sites (WWFMG).
- For sites where it is not feasible (this condition must be reviewed and agreed by City staff) to complete an erosion analysis study report, it is typically required that runoff from a 25 mm design storm shall be detained on-site and released over a minimum of 24 hours (WWFMG).

3.1.5 Private Water Discharge

Within the City of Toronto, the discharge of water from a private site (Private Water) to a municipal sewer system is regulated under Toronto Municipal Code Chapter 681 (TMC681). TMC681 defines Private Water to include both surface and groundwater. In the case of surface water, compliance with these requirements is generally demonstrated by satisfying the quality and quantity control requirements of the City of Toronto's WWFMG.

In the case of groundwater or a mixture of surface water and groundwater, if temporary or permanent discharging is permitted, a "Private Water Discharge Approval Application" must be approved by the City of Toronto (Toronto Water, Environmental Monitoring and Protection Unit). A Private Water Discharge Approval Application is required for all structures that are not waterproofed where the foundation is ≤ 1 m above the seasonally high groundwater elevation.

The following outlines the general requirements that must be satisfied in order to be granted a permit for long-term or short-term discharge of groundwater to a municipal storm, sanitary, or combined sewer.

Storm Sewer

Quality Requirements

- Water quality tests must demonstrate that the water to be discharged meets the quality requirements specified in TMC681 (TMC681, Table 2).
    - If water quality does not meet TMC681 requirements, on-site treatment system may be designed to raise the quality enough to allow the water to be discharged to the storm sewer.
- Design must include provision for water quality testing for the duration of the discharge period through grab sampling.
- Design must include backup plan in case water quality changes and no longer meets TMC681 requirements.

Quantity Requirements

- Design of discharge system must meet quantity control requirements of the WWFMG. As such, the proposed groundwater discharge rate should be removed from the overall allowable site release rate for the site's stormwater management system.
- Design must include provision for water quantity testing for the duration of the discharge period including continuous monitoring of flows.

Sanitary or Combined Sewer

Quality Requirements

- Water quality tests must demonstrate that the water to be discharged meets the quality requirements specified in TMC681 (TMC681, Table 1).

- If water quality does not meet TMC681 requirements, on-site treatment system may be designed to raise the quality enough to allow the water to be discharged to the sanitary or combined sewer.

- Design must include provision for water quality testing for the duration of the discharge period through grab sampling.
- Design must include backup plan in case water quality changes and no longer meets TMC681 requirements.

Quantity Requirements

- Hydraulic analysis of the downstream system up to a trunk sewer must be conducted. The model must be calibrated based on monitoring data and needs to consider:
  - Average wastewater flow with peaking factor
  - Inflow and Infiltration (based on monitoring done by the applicant)
  - Both wet weather and dry weather flows*
- Assessment must compare the downstream Hydraulic Grade Line (HGL) vs the City's basement flooding freeboard requirement which is HGL ≤ 1.8 m below ground surface (mbgs), not a comparison of proposed HGL vs existing HGL (where the 1.8 mbgs criterion is already violated).

  *In some cases, if the HGL criteria are not met during wet weather, it may be possible to provide on-site storage and automated flow monitoring/control to store the Private Water during the wet weather and release it at a controlled rate during dry weather (referred to as a Discharge Management Plan). These plans are evaluated on a case-by-case basis and approved based on an analysis of the modelling sensitivity, risk, and adequacy of contingencies presented.

If the requirements noted above cannot be met, the Private Water must be hauled off site and treated/disposed elsewhere. It should be noted that the process for obtaining approval to discharge Private Water to a municipal sewer is often lengthy as it involves field investigations, coordination between multiple design disciplines, and review by multiple City departments.

3.2 Erosion & Sediment Control Guidelines during Construction

On-site temporary erosion and sediment control should be provided during construction as per the Erosion & Sediment Control Guidelines for Urban Construction (TRCA, 2019).

4 Proposed Conditions

A single multi-story development building is proposed at the northeast corner of Eastern Avenue and Lewis Street as shown on Proposed Drainage Area Plan **(Appendix A)**. The proposed East Harbour Station is located south of Eastern Avenue along the rail path, and will have a separate roof to the proposed TOC development at 356 Eastern Ave. It is assumed that the portion of the GO track draining into 356 Eastern Avenue will be contained on the rail corridor by a retaining wall which will be constructed by others, prior to the development of the Eastern Avenue TOC. For catchment 201A, stormwater runoff

from the at-grade laneway will be captured via a catch basin and released into the Lewis Street storm sewer. Catchment 201B will receive runoff from the western portion of the TOC roof and will be directed to an on-site storage tank prior to discharge to the Lewis Street storm sewer. Catchment 201B will be overcontrolled to achieve pre-development flow rates to the Lewis Street storm sewer. For catchment 202A, stormwater runoff from the at-grade laneway will be captured via a catch basin and released to the Saulter Street combined sewer. Catchment 202B will receive runoff from the eastern portion of the TOC roof and will be directed to an on-site storage tank prior to discharge to the Saulter Street combined sewer. Catchment 202B will be overcontrolled to achieve pre-development flow rates to the Saulter Street combined.

The 356 Eastern Avenue TOC site development is as follows:

- One proposed building at the northeast intersection of Eastern Avenue and Lewis Street with a total area of 0.36 ha.

5 Stormwater Management Plan

As per the applicable SWM criteria summarized in **Section 3.1**, it is required to provide water balance, as well as quantity, quality, and erosion control for the proposed 356 Eastern Avenue TOC site. The stormwater best management practices (BMP) considered for the site include a green roof, an underground detention/retention tank, catch basin sedimentation separation units, and an OGS unit. The Proposed Conditions Drainage Plan is presented in **Appendix A**.

All building openings shall be protected from flooding. During detail design, depth of overland flow at these locations should be calculated using dual drainage models to confirm that all openings to the buildings will have sufficient freeboard above the maximum water elevation during the 100-year storm event.

5.1 Quantity Control

Drainage discharged to a municipal storm sewer must be controlled to the allowable peak release rate as stated in **Section 3.1.2** of this report. In absence of an adequate overland flow route, all site runoff from the 2-year up to the 100-year return storm events will be stored on site and released at the allowable release rate (2-year pre-development rate). The capacity of the receiving sewer systems will need to be calculated during detail design to confirm the allowable release rate. Catchments 201A and 202A will release uncontrolled to Lewis Street and Saulter Street respectively, with catchments 201B and 202B overcontrolling using orifice controls to meet the pre-development flow rates to each respective storm sewer. Storage volumes were calculated to be 35 m^3 and 45 m^3 for catchments 201B and 202B respectively, as shown in **Table 5-1**. Detailed calculations are included in **Appendix B**. In concept, storage tanks with orifice controls can be installed in the first underground level to provide the required storage volumes for both catchments 201B and 202B. Controlled runoff from catchment 201B will discharge to the Lewis Street storm sewer and controlled runoff from catchment 202B will discharge to the Saulter Street combined sewer with ultimate discharge to the 900x600 mm combined sewer on Eastern Avenue.

Table 5-1. Quantity Control Storage

ID	Area (ha)		Runoff Coefficient			Allowable Release Rate[2] (L/s)	Required Storage Volume (m^3)
	Exist.	Prop.	Exist.	Exist.[1] (City Criteria)	Prop.		
201B	0.22	0.10	0.87	0.5	0.80	6	35
202B	0.31	0.16	0.62	0.5	0.78	16	48

Note:
[1] Assuming a runoff coefficient of 0.5 if the existing imperviousness is greater than 50%.
[2] Based on the 2-year pre-development flow rate (overcontrolled).

5.2 Water Balance and Erosion Control

The water balance criterion of TGS Version 4 Tier 1 requires the retention of 5 mm of runoff over the proposed area, which is equivalent to the retention of 17.7 m^3/event. The total proposed green roof for the development is 535 m^2. In concept, the proposed green roof will achieve a retention of 2.7 m^3/event, the landscaping will achieve a retention of 2.2 m^3/event, and the impervious surface will achieve a retention of 2.7 m^3/event through initial abstraction. To meet the TGS Version 4 Tier 1 criterion, the remaining runoff will be stored in the underground storage tanks for reuse. In concept, the required reuse storage is 10.8 m^3 to meet the water balance criterion. A total reuse volume of 20 m^3 is proposed to meet the quality control criterion as discussed in **Section 5.3**, thus exceeding the water balance requirements. By satisfying the water balance retention criterion, the erosion control criterion will be achieved for the sites, since they have a drainage area less than 2 ha. Refer **Table 5-2** for water balance storage summary and **Appendix B** for detailed calculations.

Table 5-2. Water Balance Storage

Land-Cover Type	Area (ha)	Initial Abstraction (mm)		Reuse			Total[2] (m^3)
		Depth (mm)	Volume (m^3)	Depth (mm)	Required Volume (m^3)	Proposed Volume[1] (m^3)	
Impervious Area	0.256	1	2.6	4	10.2	20	29.2
Green Roof - Intensive	0.054	5	2.7	0	0		
Landscape	0.031	7	2.2	0	0		

Notes:
[1] The greater of the required water balance volume or quality control volume
[2] The sum of initial abstraction volume and proposed reuse volume

5.3 Quality Control

Quality control will be required to provide long-term average removal of 80% of TSS from all runoff leaving the site as per WWFMG. In concept, combination of a green roof, landscaping, catch basin shields, water reuse, and an OGS unit will provide the required quality control to the runoff leaving the site. Reuse volumes of 10 m^3 and 10 m^3 for catchments 201 and 202 respectively, are proposed to meet quality control criterion as shown in **Table 5-3** and **Table 5-4**. Detailed calculations are provided in **Appendix B**.

Table 5-3. Catchment 201 Quality Control

Land Use	Area (ha)	TSS Produced[1] (g)	Source TSS Removed (g)	CB S&S Unit TSS Removed (g)	Prop. Reuse Tank Size (m^3)	Water Reuse TSS Removed (g)	OGS TSS Removed (g)	TSS Removal
At-Grade Imperv.	0.027	176	0	88	10	0	44	80%
Imperv. Roadway	0.020	226	0	113		0	56	
Imperv. Roof	0.057	372	0	0		248	62	
Green Roof	0.021	137	109	0		18	5	
Landscape	0.008	52	42	5		0	3	

Notes:
[1] Assumed 0.65g/m^2 TSS produced for High-Density Residential land use, and 2.82kg/curb-km per 5-day build-up (EPA Reference Manual III – Water Quality)

Table 5-4. Catchment 202 Quality Control

Land Use	Area (ha)	TSS Produced[1] (g)	Source TSS Removed (g)	CB S&S Unit TSS Removed (g)	Prop. Reuse Tank Size (m^3)	Water Reuse TSS Removed (g)	OGS TSS Removed (g)	TSS Removal
At-Grade Imperv.	0.038	247	0	124	10	0	62	80%
Imperv. Roadway	0.036	338	0	169		0	85	
Imperv. Roof	0.09	572	0	0		248	162	
Green Roof	0.033	215	172	0		19	12	
Landscape	0.023	150	120	15		0	7	

Notes:
[1] Assumed 0.65g/m^2 TSS produced for High-Density Residential land use, and 2.82kg/curb-km per 5-day build-up (EPA Reference Manual III – Water Quality)

5.4 Dewatering

There will be a need for dewatering during construction. Watertight structures should be specified as much as possible to minimize long-term dewatering requirements. The anticipated quantity and quality of the water will need to be specified at each site to support potential discharge management plan. Water quality will determine if dewatering effluent

requires treatment and be directed toward the municipal storm sewer or sanitary sewer. Please refer to **Subsection 3.1.5** for further details.

6 Conclusions and Recommendations

This Stormwater Management Report is prepared in support of the Rezoning Application and Reference Concept Design (RCD) for the Proposed Eastern Avenue TOC Development Site. The RCD satisfies SWM and drainage requirements for the Proposed Eastern Avenue TOC as follows:

- **Quantity Control:**

  A storage tank with orifice controls is proposed in the first underground level to provide quantity control for catchment 201B. Catchment 201B requires 35 m^3 of storage, with an allowable release rate of 6 L/s. A storage tank unit with orifice control is proposed in the first underground level to provide quantity control for catchment 202B. Catchment 202B requires 48 m^3 of storage, with an allowable release rate of 16 L/s.

- **Quality Control:**

  Quality control for each site will be provided via the proposed green roof, catch basin sediment separation units, the water captured in the storage tanks for reuse and OGS units. For catchment 201, a 10 m^3 reuse volume is required to meet the quality criterion. For catchment 202, a 10 m^3 reuse volume is required to meet the quality criterion.

- **Water Balance:**

  Green roof and water reuse are proposed to satisfy the 5 mm retention requirement. A total reuse tank volume of 20 m^3 is proposed to meet the minimum water balance requirement.

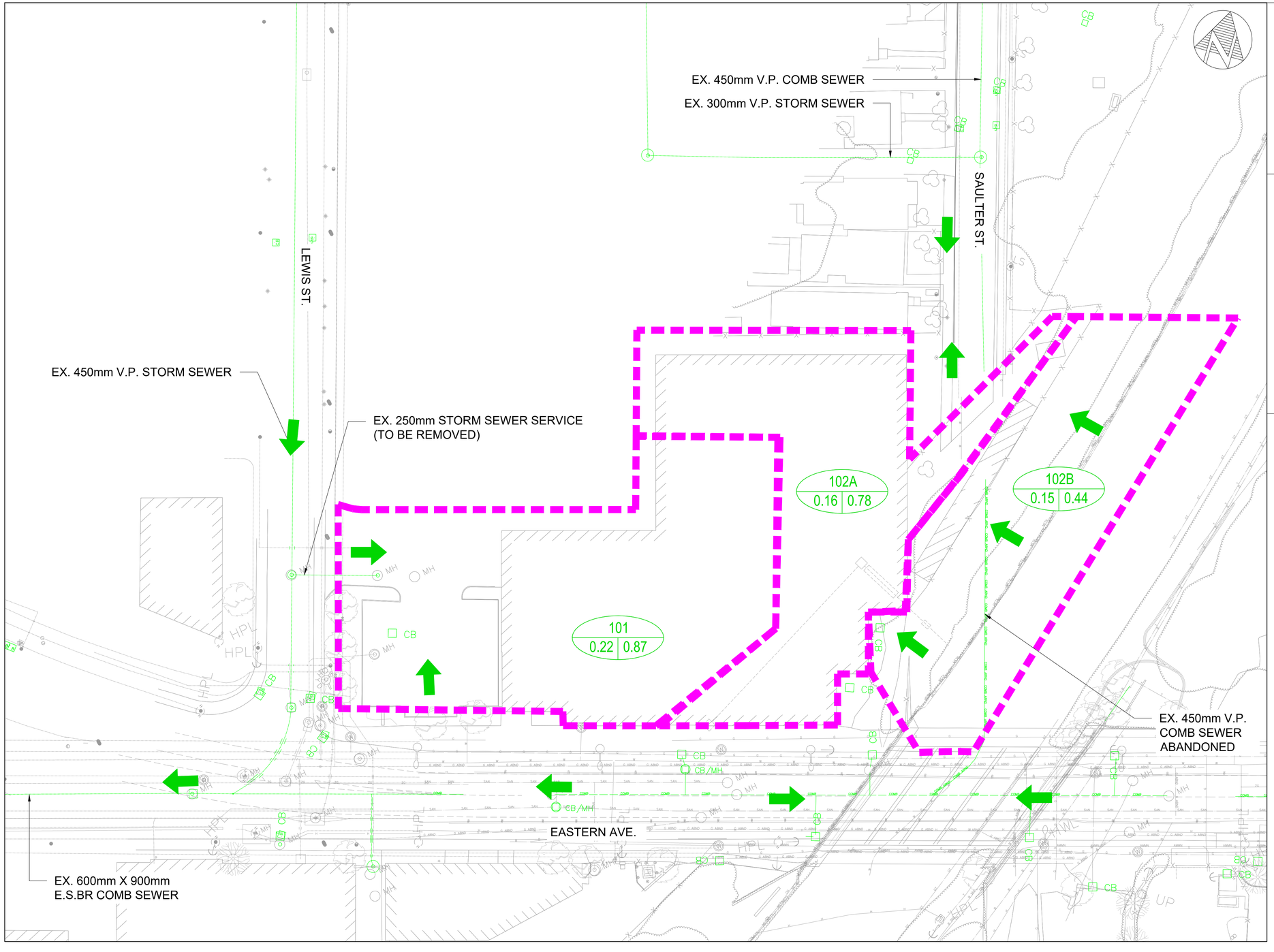
- **Minor Drainage System:**

  Water captured from the roofs of the building will be discharged into the proposed combined sewer system on Saulter Street and Lewis Street storm sewer after receiving quality and quantity treatment.

- **Major Drainage System:**

  Major system drainage patterns will be generally maintained under proposed conditions. For the proposed aboveground structures, major system flows will be captured and controlled using underground storage.

Appendix A. Drainage Area Plans



NOTES:

1. EXISTING UTILITY INFORMATION SHOWN IS BASED ON SUBSURFACE UTILITY ENGINEERING (SUE) QL-B, QL-C AND QL-D. ALL LOCATIONS AND DEPTH ARE TO BE CONFIRMED BY THE CONTRACTOR PRIOR CONSTRUCTION.
2. FOR PROPOSED PUBLIC UTILITY RELOCATION WITHIN ROW, REFER TO CIVIL RELOCATION PLANS. DRY UTILITY RELOCATIONS TO BE CONFIRMED WITH PRIVATE UTILITY COMPANIES.
3. NOT ALL AERIAL UTILITIES HAVE BEEN IDENTIFIED OR SHOWN ON THIS PLAN.
4. EXHIBIT TO BE UPDATED AS NEW INFORMATION IS MADE AVAILABLE.

LEGEND

- EXISTING STORM CATCHMENT
- 101 / 0.98 | 0.9 — DRAINAGE AREA ID; RUNOFF COEFFICIENT; DRAINAGE AREA (ha)
- OVERLAND FLOW DIRECTION
- STM STM — EXISTING STORM SEWER
- COMB COMB — EXISTING COMBINED SEWER

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PLOTTED BY: FEHLINGS, NICHOLAS

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2		5	
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RCD
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SCALE(S) 1:300

STATUS

HDR

ONE TEAM
ONTARIO LINE TECHNICAL ADVISOR

DESIGNED D. NUTTALL
DRAWN N. FEHLINGS
CHECKED D. NUTTALL
APPROVED D. NUTTALL

ONTARIO LINE SUBWAY

TITLE EASTERN AVENUE TOC

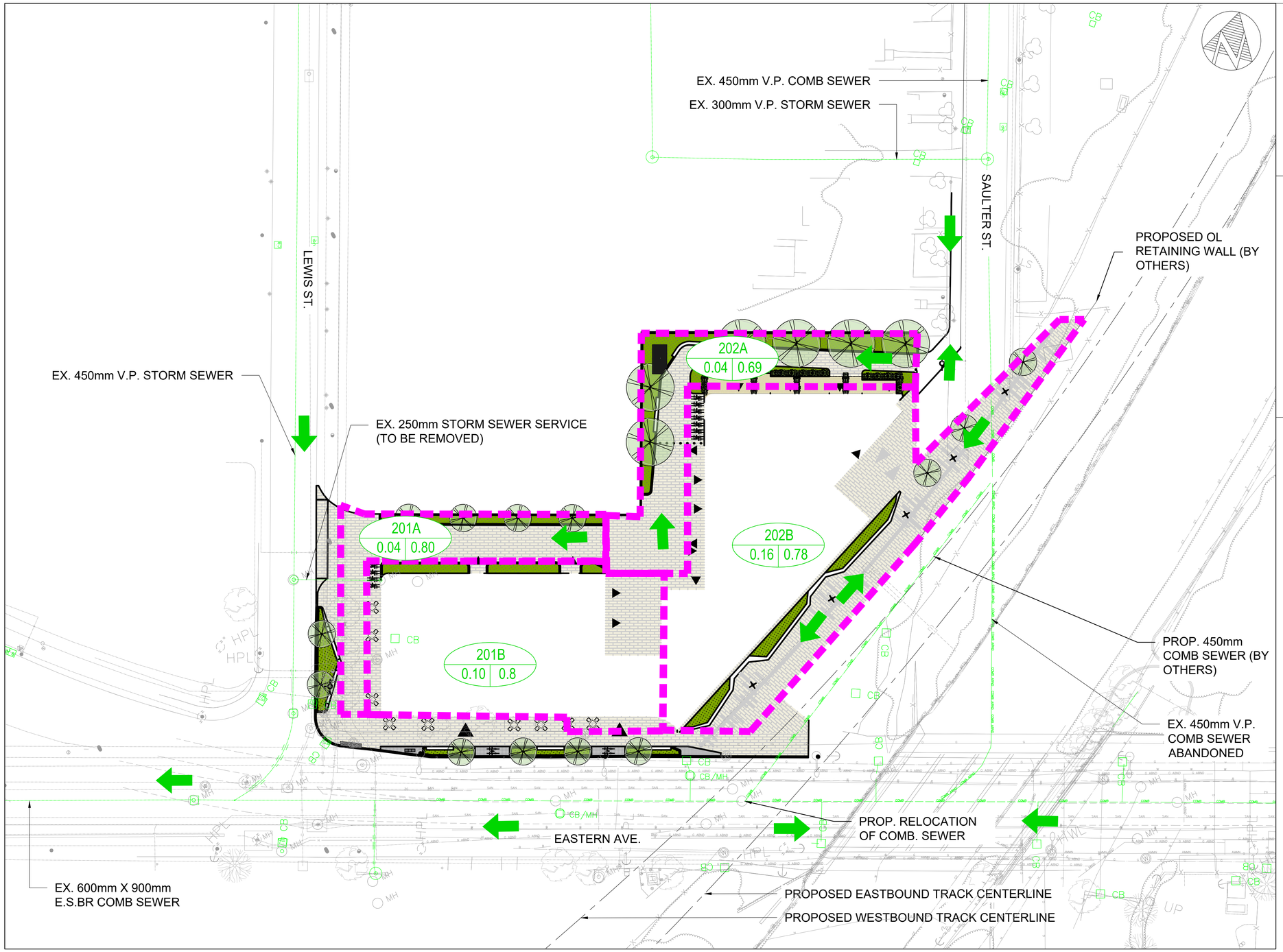
EXISTING DRAINAGE PLAN

Plot Date: 8 November 2022

METROLINX Infrastructure Ontario

Dwg. No.

Sheet No.



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RCD
NOT FOR CONSTRUCTION
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SCALE(S) 1:300

STATUS

HDR

ONE TEAM
ONTARIO LINE TECHNICAL ADVISOR

DESIGNED D. NUTTALL
DRAWN N.FEHLINGS
CHECKED D.NUTTALL
APPROVED D.NUTTALL

ONTARIO LINE SUBWAY

TITLE EASTERN AVENUE TOC

PROPOSED DRAINAGE PLAN

Plot Date: 8 November 2022

METROLINX
Infrastructure Ontario

Dwg. No.

Sheet No.

Appendix B. Stormwater Management Calculations

	Project	OLTA	No.10206938	
	By	N. Fehlings	Date	09-Nov-2022
	Checked	D.Nuttall	Checked	09-Nov-2022

Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 101

Catchment	Area, A	2-10-yr		25-yr			50-yr			100-yr		
		C	A x C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
ID	(ha)											
Impervious	0.21	0.90	0.19	1.10	0.95	0.20	1.20	0.95	0.20	1.25	0.95	0.20
Landscape	0.01	0.25	0.00	1.10	0.28	0.00	1.20	0.30	0.00	1.25	0.31	0.00
	0.22		**0.19**			**0.20**			**0.20**	ms		**0.20**

Total Drainage Area		0.22	ha
Weighted C	2-10-yr	0.87	***Note 3**
	25-yr	0.92	
	50-yr	0.92	
	100-yr	0.92	

NOTE:

1. C_f = Runoff Coefficient Factor
2. Reference of C_f : MTO
3. Use 'C' value as 0.5 if the existing weighted 'C ' value is greater than 0.5 for 2-yr return period

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/ [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : $i = A * T \wedge B$

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

	Rainfall	Peak Flow	
Year	mm/hr	m^3/s	(L/s)
2	88.189	0.027	27
5	131.792	0.070	70
10	162.268	0.086	86
25	189.522	0.106	106
50	224.324	0.126	126
100	250.320	0.141	141

	Project	OLTA	No.10206938	
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	Checked	D.Nuttall	Checked	09-Nov-2022

Stormwater Management Calculations

Post-Development Runoff Coefficients - 201A

Catchment	Area, A	2-10-yr		25-yr			50-yr			100-yr		
		C	A x C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
ID	(ha)											
Impervious	0.030	0.90	0.03	1.10	0.95	0.03	1.20	0.95	0.03	1.25	0.95	0.03
Landscape	0.005	0.20	0.00	1.10	0.22	0.00	1.20	0.24	0.00	1.25	0.25	0.00
Green Roof	0.000	0.50	0.00	1.10	0.55	0.00	1.20	0.60	0.00	1.25	0.63	0.00
	0.035		**0.03**			**0.03**			**0.03**			**0.03**

Total Drainage Area		0.04	ha
Weighted C	2-10-yr	0.80	
	25-yr	0.85	
	50-yr	0.85	
	100-yr	0.85	

NOTE:
1. C_f = Runoff Coefficient Factor
2. Reference of C_f: MTO

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/ [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

	Rainfall	Peak Flow	
Year	mm/hr	m^3/s	(L/s)
2	88.189	0.007	7
5	131.792	0.010	10
10	162.268	0.013	13
25	189.522	0.016	16
50	224.324	0.019	19
100	250.320	0.021	21

	Project	OLTA	No.10206938	
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	Checked	D.Nuttall	Checked	09-Nov-2022

Stormwater Management Calculations

Post-Development Runoff Coefficients - 201B

Catchment ID	Area, A (ha)	2-10-yr C	2-10-yr A x C	25-yr C_f	25-yr C	25-yr A x C	50-yr C_f	50-yr C	50-yr A x C	100-yr C_f	100-yr C	100-yr A x C
Impervious	0.079	0.90	0.07	1.10	0.95	0.08	1.20	0.95	0.08	1.25	0.95	0.08
Landscape	0.003	0.20	0.00	1.10	0.22	0.00	1.20	0.24	0.00	1.25	0.25	0.00
Green Roof	0.021	0.50	0.01	1.10	0.55	0.01	1.20	0.60	0.01	1.25	0.63	0.01
	0.103		**0.08**			**0.09**			**0.09**			**0.09**

Total Drainage Area		0.10	ha
Weighted C	2-10-yr	0.80	
	25-yr	0.85	
	50-yr	0.86	
	100-yr	0.86	

NOTE:
1. C_f = Runoff Coefficient Factor
2. Reference of C_f: MTO

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/l [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

Year	Rainfall mm/hr	Peak Flow m^3/s	Peak Flow (L/s)
2	88.189	0.020	20
5	131.792	0.030	30
10	162.268	0.037	37
25	189.522	0.046	46
50	224.324	0.055	55
100	250.320	0.062	62

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Stormwater Management Calculations

REQUIRED STORAGE (POST - PRE) 100 yr

201B

Watershed Area, A	0.10	ha
Weighted Post Development Runoff Coefficient, C	0.86	

Using Modified Rational Method

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall intensity (mm/hr) [From IDF Curve]

A = Watershed Area (ha)

Allowable Release rate [2 yr Pre-development Flow]	0.006	m^3/s

Storm Duration (min)	Storm Runoff Rate (cms)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)	Rainfall 100 Yr mm/hr
0	0	0	0	0	**0**
10	0.062	37.10	3.76	33.34	250.3199
20	**0.036**	**42.62**	**7.51**	**35.10**	143.771
30	0.026	46.22	11.27	34.95	103.9437
40	0.020	48.95	15.03	33.93	82.57476
50	0.017	51.19	18.78	32.41	69.07475
60	0.015	53.09	22.54	30.55	59.7

Maximum Storage (Post - Pre)	35	m^3

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	Project	OLTA	No.10206938	
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Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 102A

Catchment ID	Area, A (ha)	2-10-yr		25-yr			50-yr			100-yr		
		C	A x C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
Impervious	0.13	0.90	0.12	1.10	0.95	0.12	1.20	0.95	0.12	1.25	0.95	0.12
Landscape	0.03	0.25	0.01	1.10	0.28	0.01	1.20	0.30	0.01	1.25	0.31	0.01
	0.16		**0.12**			**0.13**			**0.13**			**0.13**

Total Drainage Area		0.16	ha
Weighted C	2-10-yr	0.78	***Note 3**
	25-yr	0.82	
	50-yr	0.83	
	100-yr	0.83	

NOTE:

1. C_f = Runoff Coefficient Factor
2. Reference of C_f : MTO
3. Use 'C' value as 0.5 if the existing weighted 'C ' value is greater than 0.5 for 2-yr return period

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/ [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

Year	Rainfall mm/hr	Peak Flow m^3/s	Peak Flow (L/s)
2	88.189	0.020	20
5	131.792	0.046	46
10	162.268	0.056	56
25	189.522	0.069	69
50	224.324	0.083	83
100	250.320	0.092	92

	Project	OLTA	No.10206938	
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Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 102B

Catchment	Area, A	2-10-yr		25-yr			50-yr			100-yr		
		C	A x C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
ID	(ha)											
Impervious	0.02	0.90	0.01	1.10	0.95	0.01	1.20	0.95	0.01	1.25	0.95	0.01
Landscape	0.07	0.25	0.02	1.10	0.28	0.02	1.20	0.30	0.02	1.25	0.31	0.02
Ballast	0.07	0.55	0.04	1.10	0.61	0.04	1.20	0.66	0.05	1.25	0.69	0.05
	0.153		**0.07**			**0.08**			**0.08**			**0.08**

Total Drainage Area		0.15	ha
Weighted C	2-10-yr	0.45	***Note 3**
	25-yr	0.50	
	50-yr	0.53	
	100-yr	0.55	

NOTE:

1. C_f = Runoff Coefficient Factor
2. Reference of C_f : MTO
3. Use 'C' value as 0.5 if the existing weighted 'C ' value is greater than 0.5 for 2-yr return period

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/ [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : $i = A * T \wedge B$

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

Year	Rainfall	Peak Flow	
	mm/hr	m^3/s	(L/s)
2	88.189	0.017	17
5	131.792	0.025	25
10	162.268	0.031	31
25	189.522	0.040	40
50	224.324	0.051	51
100	250.320	0.059	59

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Stormwater Management Calculations

Post-Development Runoff Coefficients - 202A

Catchment	Area, A	2-10-yr		25-yr			50-yr			100-yr		
ID	(ha)	C	A x C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
Impervious	0.027	0.90	0.02	1.10	0.95	0.03	1.20	0.95	0.03	1.25	0.95	0.03
Landscape	0.013	0.25	0.00	1.10	0.28	0.00	1.20	0.30	0.00	1.25	0.31	0.00
	0.040		**0.03**			**0.03**			**0.03**			**0.03**

Total Drainage Area		0.04	ha
Weighted C	2-10-yr	0.69	
	25-yr	0.73	
	50-yr	0.74	
	100-yr	0.74	

NOTE:
1. C_f = Runoff Coefficient Factor
2. Reference of C_f: MTO

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/h [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : $i = A * T \wedge B$

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

	Rainfall	Peak Flow	
Year	mm/hr	m^3/s	(L/s)
2	88.189	0.007	7
5	131.792	0.010	10
10	162.268	0.012	12
25	189.522	0.015	15
50	224.324	0.018	18
100	250.320	0.021	21

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Stormwater Management Calculations

Post-Development Runoff Coefficients - 202B

Catchment ID	Area, A (ha)	2-10-yr C	2-10-yr A x C	25-yr C_f	25-yr C	25-yr A x C	50-yr C_f	50-yr C	50-yr A x C	100-yr C_f	100-yr C	100-yr A x C
Impervious	0.120	0.90	0.11	1.10	0.95	0.11	1.20	0.95	0.11	1.25	0.95	0.11
Landscape	0.010	0.25	0.00	1.10	0.28	0.00	1.20	0.30	0.00	1.25	0.31	0.00
Green Roof	0.033	0.50	0.02	1.10	0.55	0.02	1.20	0.60	0.02	1.25	0.63	0.02
	0.163		**0.13**			**0.13**			**0.14**			**0.14**

Total Drainage Area		0.16	ha
Weighted C	2-10-yr	0.78	
	25-yr	0.83	
	50-yr	0.84	
	100-yr	0.85	

NOTE:
1. C_f = Runoff Coefficient Factor
2. Reference of C_f: MTO

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/l [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : $i = A * T \wedge B$

A & B parameter for IDF Curve

Year	A =	B =
2	21.800	-0.780
5	32.000	-0.790
10	38.700	-0.800
25	45.200	-0.800
50	53.500	-0.800
100	59.700	-0.800

T_c (min)	10

Peak Flows

Year	Rainfall mm/hr	Peak Flow m^3/s	Peak Flow (L/s)
2	88.189	0.031	31
5	131.792	0.046	46
10	162.268	0.057	57
25	189.522	0.071	71
50	224.324	0.085	85
100	250.320	0.096	96

	Project	OLTA		No.10206938
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Stormwater Management Calculations

REQUIRED STORAGE (POST - PRE) 100 yr

202B

Watershed Area, A	0.16	ha
Weighted Post Development Runoff Coefficient, C	0.85	

Using Modified Rational Method

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall intensity (mm/hr) [From IDF Curve]

A = Watershed Area (ha)

Allowable Release rate [2 yr Pre-development Flow]	0.016	m^3/s

Storm Duration (min)	Storm Runoff Rate (cms)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)	Rainfall 100 Yr mm/hr
0	0	0	0	0	0
10	**0.096**	**57.47**	**9.59**	**47.88**	250.3199
20	0.055	66.01	19.17	46.84	143.771
30	0.040	71.59	28.76	42.83	103.944
40	0.032	75.83	38.35	37.49	82.575
50	0.026	79.29	47.93	31.36	69.075
60	0.023	82.24	57.52	24.72	59.700

Maximum Storage (Post - Pre)	48	m^3

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Stormwater Management Calculations

Water Balance Calculations - 356 Eastern Ave

Site Chracteristics		
Site Area	0.34	ha

Retention Requirements		
Per Event Retain depth of	5	mm
Site requirement	17.1	m^3/event

Catchment Area characteristics		**Capture Event Characteristics**			**Water Reuse Characteristics**			
Runoff Source	**Area (ha)**	**Capture Event (mm)**	**Initial Abstraction (mm)**	**Volume Initially Abstracted (m^3)**	**Runoff Depth (mm)**	**Water Reuse Volume Captured (m^3)**	**Total Volume Retained (m^3)**	**% of Target**
Impervious	0.256	5	1	2.6	4	10.2	12.8	75%
Landscape	0.031		7	2.2	0	0.0	2.2	13%
Green Roof	0.054		5	2.7	0	0.0	2.7	16%
					Totals	**10.2**	**17.7**	**104%**

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HDR

Project		OLTA	No.10206938						
By		N. Fehlings	Date	09-Nov-2022					
Checked		D.Nuttall	Checked	09-Nov-2022					

Stormwater Management Calculations

Water Quality Treatment Train Calculations - 356 Eastern Ave

Catchment 201					Step 1 - Source						Step 2 - Catchbasin Shields			Step 3 - Water Reuse				Step 4 - OGS		
Area (ha)	Curb Length (km)	Land Use	Runoff Coefficient	Quality Event (mm)	Relative Sediment Loading[1] (g/m^2)	Roadway Sediment Loading[2] (g/curb-km)	Relative TSS Produced (g)	Source Removal Efficiency	Source TSS Removal (g)	Step 1 Remaining TSS (g)	CB Sediment Separator Removal Effeciency	CB Shield TSS Removal (g)	Step 2 Remaining TSS (g)	Runoff to Storage Tank (m^3)	Fraction of Runoff Intercepted by Water Re-Use	Reuse TSS Removal (g)	Step 2 - Remaining TSS (g)	OGS Removal Efficiency	OGS TSS Removal (g)	Step 3 - Remaining TSS (g)
0.0200	0.08	Impervious Roadway	0.9	25	N/A	2819	226	0%	0	226	50%	113	113	0.0		0	113		56	56
0.0270	N/A	At-Grade Impervious	0.9	25	0.65	N/A	176	0%	0	176	50%	88	88	0.0		0	88		44	44
0.0572	N/A	Impermeable Roof	0.9	25	0.65	N/A	372	0%	0	372	N/A	0	372	12.9	0.67	248	123	50%	62	62
0.021	N/A	Green Roof	0.4	25	0.65	N/A	137	80%	109	27	N/A	0	27	2.1		18	9		5	5
0.0080	N/A	Landscape	0.2	25	0.65	N/A	52	80%	42	10	50%	5	5	0.0		0	5		3	3
TOTALS							**961**			**811**			**605**				**338**			**169**

Catchment 202					Step 1 - Source						Step 2 - Catchbasin Shields			Step 3 - Water Reuse				Step 4 - Water Reuse		
Area (ha)	Curb Length (km)	Land Use	Runoff Coefficient	Quality Event (mm)	Relative Sediment Loading[1] (g/m^2)	Roadway Sediment Loading[2] (g/curb-km)	Relative TSS Produced (g)	Source Removal Efficiency	Source TSS Removal (g)	Step 1 Remaining TSS (g)	CB Sediment Separator Removal Effeciency	CB Shield TSS Removal (g)	Step 2 Remaining TSS (g)	Runoff to Storage Tank (m^3)	Fraction of Runoff Intercepted by Water Re-Use	Reuse TSS Removal (g)	Step 2 - Remaining TSS (g)	OGS Removal Efficiency	OGS TSS Removal (g)	Step 3 - Remaining TSS (g)
0.0360	0.12	Impervious Roadway	0.9	25	N/A	2819	338	0%	0	338	50%	169	169	0.0		0	169		85	85
0.0380	N/A	At-Grade Impervious	0.9	25	0.65	N/A	247	0%	0	247	50%	124	124	0.0		0	124		62	62
0.088	N/A	Impermeable Roof	0.9	25	0.65	N/A	572	0%	0	572	N/A	0	572	19.8	0.43	248	324	50%	162	162
0.033	N/A	Green Roof	0.4	25	0.65	N/A	215	80%	172	43	N/A	0	43	3.3		19	24		12	12
0.0230	N/A	Landscape	0.2	25	0.65	N/A	150	80%	120	30	50%	15	15	0.0		0	15		7	7
TOTALS							**1521**			**1230**			**922**				**656**			**328**

Total Site TSS Reduction		
201 Proposed Reuse Tank Size (m^3)		**10**
202 Proposed Reuse Tank Size (m^3)		**10**
TOTAL TSS Produced (g)		**2483**
TOTAL TSS Remaining (g)		**497**
TSS Removal Efficiency (%)		**80%**

Notes

[1] Sediment loading for high density residential land use (EPA Reference Manual III - Water Quality)

[2] Sediment loading for roadway with winter mainenance (EPA Reference Manual III - Water Quality)