Appendix H Stormwater Management Report

Bramalea Road Municipal Class Environmental Assessment Stormwater Management Report

April 11, 2023

Prepared for:

City of Brampton
41 George Street South
Brampton, N L6Y 2E1

Prepared by:

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4

Project No.: 165010590

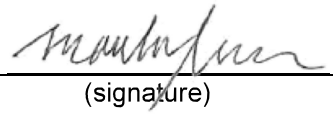
BRAMALEA ROAD MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STORMWATER MANAGEMENT REPORT

This document entitled Bramalea Road Municipal Class Environmental Assessment Stormwater Management Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of the City of Brampton (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes.

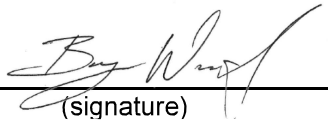
Stantec has assumed all information received by the Client and third parties in the preparation of this Report to be correct. While Stantec has exercised a customary level of judgement or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by 
(signature)

Maximilian Ornat, B.Eng

Prepared by 
(signature)

Marlee Sauder, P.Eng.

Reviewed by 
(signature)

Bryan Weersink, P.Eng.

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

The City of Brampton is undertaking a Schedule 'C' Municipal Class Environmental Assessment (Class EA) Study for improvements to Bramalea Road, between Queen Street East and to the southern City limits (approximately 790 m south of the Highway 407). The project limits are provided in Figure 1 (Appendix A).

This Stormwater Management (SWM) Report has been prepared in support of the Class EA. It provides a summary of the existing drainage conditions and the proposed storm sewer design calculations and SWM plan to mitigate potential impacts associated with the proposed improvements to Bramalea Road to receiving stormwater systems.

2.0 EXISTING SITE CONDITIONS

Within the project limits, Bramalea Road is primarily a four-lane urban arterial road. The existing right-of-way (ROW) varies between 15 to 25m wide. Sidewalks are available on both sides of Bramalea Road, between Steeles Avenue and Avondale Boulevard/Dearbourne Boulevard, and between Balmoral Drive and Queen Street East. A Multi-Use Path (MUP) is located along the east side, while sidewalk is located on the west of Bramalea between Avondale Boulevard/Dearbourne Boulevard and Darras Court.

Existing land uses adjacent to the project area include a mix of residential, agricultural, commercial, and industrial/employment areas. Since the lands adjacent to the project area are primarily urbanized, natural heritage features are limited to ornamental plantings, grassed lawns and parks and roadside ditches. Spring Creek and a tributary of Mimco creek are within the vicinity of Bramalea Road. However, there are no watercourse crossings of Bramalea Road within the project limits. There are no areas designated as Areas of Natural and Scientific Interest (ANSI), Environmentally Sensitive Areas (ESA), or Provincially Significant Wetlands (PSW), within the project limits.

3.0 EXISTING DRAINAGE CONDITIONS

The existing drainage pattern of the project area was determined through analysis of the City of Brampton's online GIS data and as-built drawings where available. Where storm sewer information was unavailable, the topography of the land was used to determine the approximate external drainage areas.

Drainage is mainly influenced by the drainage infrastructure within Bramalea Road ROW and surrounding subdivisions and grade changes along Bramalea Road. Drainage infrastructure within the project area includes roadside curbs, stormwater drains, and municipal storm sewers. Near the southern extent of the project area, some roadside ditches and culverts are present.

There are no watercourses documented within the project limits. Therefore, no watercourse crossings are included within the drainage work for the Bramalea Road improvements. The project area is within Toronto and Region Conservation Authority's (TRCA) jurisdiction. The project area is split between two

watersheds. The Spring Creek Subwatershed (a subwatershed of Etobicoke Creek Watershed) is to the west, and the Mimico Creek Watershed to the east of Bramalea Road.

Figure 2 provides the existing conditions catchment areas, delineated for storm sewer calculations. Figure 4 provides the existing conditions catchments, delineated for the SWM modeling. Each catchment in Figure 4 has an associated SWM outlet for the project area. Table 1 provides a summary of the existing stormwater management catchments and the various outlets.

Table 1: Existing Catchment Conditions

Catchment ID	Total Area	% Impervious	Runoff Coefficient	Outlet Number	Outlet Description
300	1.26	38	0.47	Outlet 1	Tributary of Mimico Creek
301	143.10	42	0.49	Outlet 2	Steeles Ave. Storm Sewer
302	0.68	99	0.89	Outlet 3	Parking Lot Storm Sewer
303	4.44	100	0.90	Outlet 4	CN Railway
304	1.24	99	0.89	Outlet 5	407 N Roadside Ditch
305	1.71	51	0.56	Outlet 6	407 S Roadside Ditch
306	9.17	58	0.61	Outlet 7	City of Mississauga Storm Sewer
Total	161.60	45	0.52	-	-

Catchments were delineated using 2015 LiDAR data downloaded from Ontario GeoHub and the City of Brampton's online storm sewer information and provided as built drawings. Where adjacent site's storm sewer information was missing, LiDAR data was used.

3.1 SOIL AND GROUNDWATER CONDITIONS

In accordance with Chapman and Putnam's "The Physiography of Southern Ontario" (1984), the project area is located within an area indicated as Till Plain. According to the "Surficial Geology of Southern Ontario" (Ontario Geological Survey, 2010), clay to silt-textured till and fine textured glaciolacustrine deposits containing silt, clay and minor sand and gravel are present within the project area. A detailed geotechnical investigation of the project area was not available at the time of preparing this report.

3.2 SIGNIFICANT NATURAL FEATURES

Within the project limits there are no significant natural features documented as present. There are no aquatic features within the project limits. Directly south of the project limits, Spring Creek crosses Bramalea Road.

4.0 STORMWATER MANAGEMENT OBJECTIVES

The project area is within the TRCA's jurisdiction, however, traverses the boundary between the Spring Creek Subwatershed (Etobicoke Creek Watershed) and the Mimico Creek Watershed. Both watersheds flow southerly toward Lake Ontario.

The SWM Plan for the Bramalea Road improvements has been completed in accordance with the following guidelines:

- Ministry of the Environment, Conservation and Parks (MECP), Stormwater Management Planning and Design Manual (2003).
- Ministry of Transportation Ontario (MTO), Highway Drainage Design Standards (2008).
- Toronto and Region Conservation Authority (TRCA), Stormwater Management Criteria (2012).
- Region of Peel, Public Works Stormwater Design Criteria and Procedures Manual (2019).
- The City of Brampton, Subdivision Design Manual (2008).

Based on the above noted documents, the following design criteria have been applied in the development of the drainage and stormwater management strategies for this project.

Storm Sewer System

- Based on the City of Brampton's Subdivision Design Manual, the minor drainage system is to be sized to convey runoff from a 5-year design storm event and the major drainage system is to be sized to convey the 100-year design storm event within the ROW with a maximum depth of 0.15m.

Water Quality Control

- Based on the TRCA's Stormwater Management Criteria, Level 1 Enhanced treatment through removal of 80% Total Suspended Solids (TSS) is required.

Water Quantity Control

- Etobicoke Creek Watershed (Spring Creek Subwatershed):
    - Post-development peak flow rate controlled to the unit runoff rates (URR).
    - Project area is located within Catchment 223:

    - URR are 12.7, 20.9, 26.7, 36.8, 47.2, 55.3 l/s/ha for the 2-, 5-, 10-, 25-, 50- and 100-year design storms, respectively.

- Mimico Creek Watershed:
    - Post-development peak flow rate controlled to the pre-development rates, for the 2-, 5-, 10-, 25-, 50- and 100-year design storms.

Water Balance

- Best efforts to maintain pre-development recharge rates in post-development conditions.

Erosion Control

- Retain minimum of 5 mm on site.

5.0 PROPOSED DRAINAGE CONDITIONS

The proposed roadway improvements as part of this project include pavement widening between Dearbourne Boulevard and Steeles Avenue, MUP and localized intersection improvements along the entire length of the project. Existing catchbasins will require minor adjustment or relocation where curb lines are proposed to be adjusted as part of the proposed works. The proposed works generally have minor increases in total pavement surface area and are not expected to have significant impact on the drainage of Bramalea Road within the project area. The proposed roadway will drain similar to existing conditions, collected by catchbasins and conveyed through the storm sewer system. Major storm events will drain by overland flow along the roadway.

Figures 3 and 5 provide the proposed conditions storm sewer drainage areas and SWM drainage areas, respectively. Minor adjustments to the catchment areas and runoff coefficients are present in the proposed conditions to accommodate the proposed works.

A comparison of the existing versus proposed pavement surface areas was completed, for each catchment area. Hydrologic calculations, using the Rational method, were completed for each catchment to compare the proposed peak flow rates to the existing rates and determine storage requirements. The City of Brampton's Intensity-Duration-Frequency (IDF) curves were used to determine rainfall intensity.

Table 2: Proposed Catchment Conditions

Catchment ID	Total Area (m^2)	% Impervious (%)	Runoff Coefficient	Outlet Number	100-year Peak Flow Rate (m^3/s)
400	1.31	44	0.51	Outlet 1	0.33
401	143.21	43	0.50	Outlet 2	35.38
402	0.77	88	0.82	Outlet 3	0.31
403	4.50	89	0.82	Outlet 4	1.96
404	1.25	97	0.88	Outlet 5	0.54
405	1.73	54	0.58	Outlet 6	0.49
406	9.30	60	0.62	Outlet 7	2.74
Total	162.08	46	0.52	-	-

As described in Table 2, the peak flow rate in the proposed conditions shall increase due to the increase in impervious surface. Stormwater control measures are required within all catchments, prior to discharging to the receiving municipal sewer system. Stormwater calculations are included in Appendix B, while the required storage volumes to control the post development flows to the existing conditions are summarized in Table 3 below. The catchments draining to Etobicoke Creek Watershed have been analyzed for both meeting the URR's specified for the development area and meeting proposed condition peak flow rates to existing conditions.

Table 3: Required Storage

Catchment ID	Outlet Number	Watershed Outlet	Required Storage to meet Existing Flow Rates (m^3)	Required Storage to meet URR's (m^3)
400	Outlet 1	Mimco Creek	28	-
401	Outlet 2	Mimco Creek	418	-
402	Outlet 3	Mimco Creek	7	-
403	Outlet 4	Mimco Creek	Not Required	-
404	Outlet 5	Etobicoke Creek	Not Required	414
405	Outlet 6	Etobicoke Creek	Not Required	125
406	Outlet 7	Etobicoke Creek	Not Required	252

To control proposed peak flows, it is anticipated storage volume in the form of underground storage tanks and orifice plates will be provided at the outlet location of each subcatchment. Detailed storage chamber and orifice sizing calculations will be completed at the detailed design stage.

5.1 STORM SEWERS

A storm sewer assessment was conducted to determine the existing capacity of the Bramalea storm sewers within the project limits. The City of Brampton's online storm sewer mapping was used to provide

information on the existing storm sewer sizing, approximate the existing drainage network and delineate catchment areas.

The City of Brampton IDF curves for the 5-year design storm event was used with a 10-minute inlet time for the flow calculations. The Manning's Equation was used to calculate the capacity within the storm sewers. The City of Brampton's online GIS information for storm sewers was used for the existing location, length, slope, and diameter. There was missing information for some storm sewer legs to Outlet 2, 3, 4, 5, 6 and 7. Where information on the slope was missing, a value of 0.5% was allocated. The slope of these storm sewer legs is to be confirmed in detailed design.

The results indicate that twelve sewer legs are deficient in capacity. It is recommended the storm sewer network be further analyzed to determine proposed sewer sizing at detailed design and a CCTV inspection is completed to assess the existing pipe condition. The storm sewer design sheets are included in Appendix C.

5.2 WATER QUALITY

Under the existing conditions, based on the currently available information, it is assumed the ROW drains to the storm sewers without specific water quality treatment measures. Water quality control measures are required for impervious areas within the ROW. Based on the limited space within the roadway, Oil/Grit Separators (OGS) are proposed to be used to meet an Enhanced Level 1 of treatment. Based on the Fine particle distribution, an OGS unit has been sized for each stormwater outlet to treat >90% volume from each catchment. In addition to the OGS units, the use of infiltration chambers and a swale to meet storage, water balance and erosion control requirements, will enhance water quality through the study area. Preliminary sizing using First Defense OGS units provided by Advanced Drainage Systems (ADS™) was completed and the specifications of each unit can be found in Table 4, below.

Table 4: OGS Unit Specifications

Catchment ID	Label	ADS™ OGS Unit	TSS Removal (%)
400	OGS Unit #1	FD - 4HC	90
401	OGS Unit #2	FD - 8HC	82
402	OGS Unit #3	FD - 4HC	89
403	OGS Unit #4	FD - 4HC	93
404	OGS Unit #5	FD - 4HC	84
405	OGS Unit #6	FD - 4HC	88
406	OGS Unit #7	FD - 4HC	84

5.3 EROSION CONTROL

In accordance with the erosion control criteria outlined in this report, the proposed design must provide an onsite capacity to infiltrate 5mm of runoff from the ROW. The required infiltration volumes per outlet are listed in Table 5, below.

Table 5: 5 mm Infiltration Volumes

Catchment ID	Total Road Area (ha)	5 mm Infiltration Volume (m^3)
400	0.53	26.7
401	5.75	287.6
402	0.62	31.2
403	0.37	18.6
404	1.20	59.9
405	0.67	33.5
406	1.23	61.4

The erosion control volumes will be provided by using infiltration based Low Impact Development (LID) measures within the ROW where soil conditions are suitable. For the majority of catchment areas, Etobicoke style infiltration galleries, including a perforated pipe within a clearstone gallery, are proposed to be located below the traditional storm sewer. A plug located at the end of the perforated pipe allows higher flows to back up into the existing conventional storm sewer system. Erosion control volumes for catchment 401 are proposed to be met using an infiltration bioswale within the retrofitted Durham Park. The proposed LID locations are provided on Figure 5-1, 5-2, and 5-3 in Appendix A. Locations have been designated based on currently available information and space constraints. Where possible, infiltration galleries have been placed below storm sewers designated for upsizing. The locations should be reviewed when detailed geotechnical, hydrogeological and further existing infrastructure information is made available.

Furthermore, the proposed OGS arrangements were placed in such a manner to treat the largest volume of water from each catchment before entering the associated LID feature. There were, however, catchments with multiple outlets in which a single OGS could not effectively treat water entering multiple LID features. Therefore, once the project progresses to the detailed design stage, additional treatment methods shall be implemented to ensure each LID feature receives water quality treatment before infiltration.

Each of these have been preliminarily sized to store 5mm of volume from each catchment, and details regarding each LID can be found in Table 6. These measures will provide storage and allow water to infiltrate, while also enhancing water quality treatment. The erosion control calculations are provided in Appendix B.

Table 6: LID Specifications

Catchment ID	LID	Dimensions (m)	Footprint (m^2)	Water Storage Volume (m^3)
400	Exfiltration Gallery #1	Width = 1 Depth = 1 Length = 66.8	66.8	26.7
401	Bio Swale	Top width = 4.5 Bottom Width = 0.5 Surface Depth = 0.5 Length = 115.1	518.0	143.8
401	Exfiltration Gallery #2	Width = 2.5 Depth = 1 Length = 143.8	359.5	143.8
402	Exfiltration Gallery #3	Width = 1.75 Depth = 1 Length = 44.6	78.1	31.2
403	Exfiltration Gallery #4	Width = 2.5 Depth = 1 Length = 18.6	46.5	18.6
404	Exfiltration Gallery #5 to #8	Width = 2 Depth = 1 Lengths = 18.8, 18.8, 18.8, 18.8	37.6, 37.6, 37.6, 37.6	15, 15, 15, 15
405	Exfiltration Gallery #9 to #10	Width = 2.5 Depth = 1 Lengths = 18.5, 15	46.3, 37.5	18.5, 15
406	Exfiltration Gallery #11 to #12	Width = 2 Depth = 1 Lengths = 32, 45	64, 90	25.6, 36

5.4 WATER BALANCE

In accordance with the water balance criteria outlined in this report, the proposed design must make best efforts to maintain existing recharge rates in proposed conditions. Table 7 below provides the annual runoff increase, and groundwater recharge deficit from existing to proposed conditions. Water balance calculations are provided in Appendix B.

Table 7: Water Balance Criteria

Annual Runoff Increase (m^3)	Groundwater Recharge Deficit (m^3)
1,954	2,499

The LID measures proposed to meet the erosion control targets were analyzed to determine the annual ground water recharge they provide. The results can be found in Table 8, showing a calculated infiltration

surplus of 15,822 m^3/year. This is due to the minimal increase in imperviousness from existing to proposed conditions. Therefore, the LID's sized for the erosion control target can adequately meet the required groundwater recharge.

Table 8: Water Balance

Parameter	Value
Total LID infiltration volume (m^3)	519
Number of days >= 5 mm event (excluding Dec-Mar)	35.3
Total infiltration from LIDs (m^3/yr.)	18320.7
Groundwater Recharge Deficit from Existing to Proposed (m^3)	2499.1
Infiltration Surplus (m^3/yr.)	15822

6.0 EROSION AND SEDIMENT CONTROL

The Erosion and sediment control plan for the project must adhere to the Erosion and Sediment Control Guide for Urban Construction, Toronto Region Conservation Authority, 2019.

To minimize the potential environmental impacts, the following erosion and sedimentation control practices will serve to guide the of the Erosion and Sedimentation Control Plan:

- Limit size of disturbed area.
- Limit duration of soil exposure.
- Retain existing vegetation where feasible.
- Limit slope length and gradient of disturbed areas.
- Preserve overland sheet flow and micro-drainage (avoid concentrated channel flows).
- Break and redirect flows to lower gradients.
- Design and implement staged stripping.
- Prevent disturbance of previously stripped and stabilized areas.
- Stabilize stripped areas with temporary vegetative controls.

Appropriate permanent/temporary erosion control measures to be considered in the design and implementation of the Erosion and Sedimentation Control Plan are:

- Hydroseeding - One step application of seed and hydraulic slurry with adhesive binder (provides permanent stabilization for moderate to steep slopes).

- Seed and Straw Mulch - Alternative two step application that will be applied to provide permanent/temporary vegetative stabilization of disturbed areas.
- Mulch (straw, wood etc.) - Used to provide temporary erosion protection of exposed slopes during over-wintering and for disturbed areas inactive for greater than 45 days.
- Sod - Utilized to provide quick permanent stabilization of disturbed areas. Applications include lateral ditches with gradients < 5% and slopes with steep to moderate grades (i.e., 3% to 5%).
- Erosion Control Blanket - Applied as temporary/permanent erosion protection for slopes greater than 2:1 or as a ditch liner. For permanent applications, seed will be applied prior to installation.
- Aggregate Stone - Appropriate material, such as rip rap will be used to provide immediate permanent erosion protection of lateral ditches > 5% gradient; and along chute/spillways.

For the intended construction on the site described in this report, the following erosion measures should be implemented:

- Install a siltation barrier ring along the site perimeter using heavy-duty silt fence. Keep a provision of temporary.
- Stabilize all disturbed areas where work will not take place for a period of 30 days or more according to OPSS 572.
- Perform street sweeping as necessary to remove soil accumulation caused by construction traffic.
- Use filter socks, where necessary, to further filter the discharge.
- Install and maintain silt sacks at all catchbasins to prevent sediment from entering the proposed storm sewer.

7.0 CONCLUSIONS AND RECOMMENDATIONS

This report documents the preliminary stormwater management aspects associated with the improvements to Bramalea Road within the project limits.

Based on the preceding report, the following conclusions can be drawn:

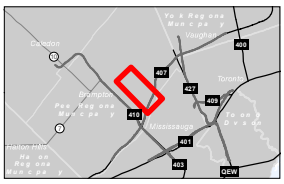
- Based on the currently available information, it is calculated that there are twelve sewer legs deficient in capacity.
- Water quality measures in the form of OGS devices have been preliminarily sized for each stormwater catchment, and will provide Enhanced level 1 water quality treatment for the ROW.
- Storage is required prior to all existing outlets to match proposed conditions flows to existing conditions, proposed to be achieved through underground storage units.

- An annual groundwater deficit of 2,499 m^3 is associated with proposed conditions. However, with the proposed LID measures, an annual infiltration surplus of 15,822 m^3 is achieved.
- To meet Erosion Control requirements, a retention volume is required to retain the first 5 mm of rainfall on-site. This can be achieved through the use of LIDs if site conditions are conducive.

Based on the preceding report and associated analysis, the following recommendations have been determined:

- A detailed survey and CCTV inspection is recommended to determine any deficiencies or missing information in the existing storm sewer. Based on these findings, a detailed design of proposed sewers including sizing and placement should be prepared.
- Detailed geotechnical and/or hydrogeological investigations are required at the to be completed at detailed design to review feasibility and design of the infiltration and low impact development features within the project limits.
- Preliminary design of stormwater management systems, infiltration and water quality devices has been completed, with further refinement to occur during the detailed design stage.

APPENDIX A:
Figures



Legend

- Study Area
- Municipal Boundary, Lower
- Railway
- Watercourse (Permanent)
- Waterbody

Project Limits

1. North Limit - Queen Street East
2. South Limit - City Limit

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date Spring 2019

0 250 500 metres

1:15,000 (At original document size of 11x17)

Stantec

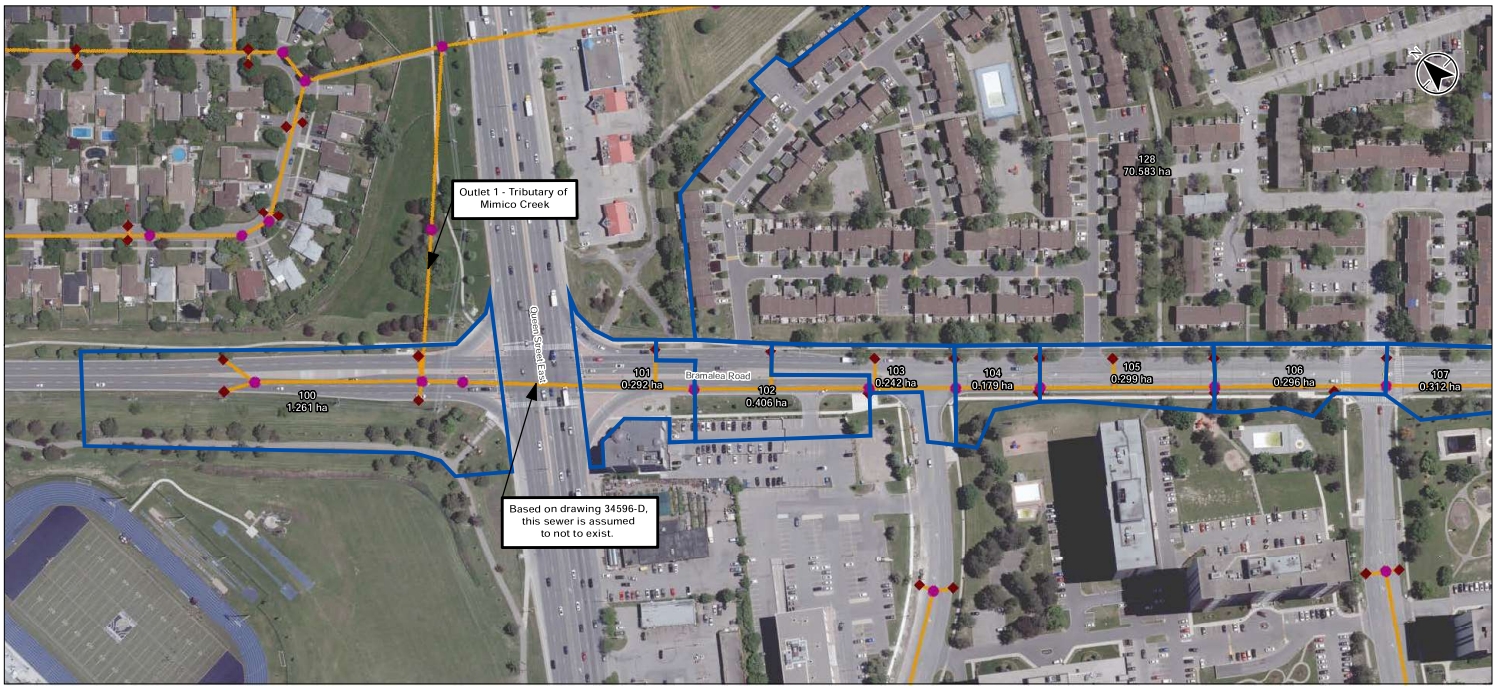
Project Location
City of Brampton

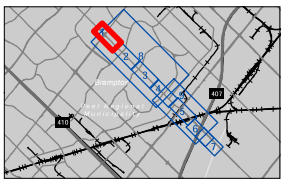
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
1

Title
Location





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

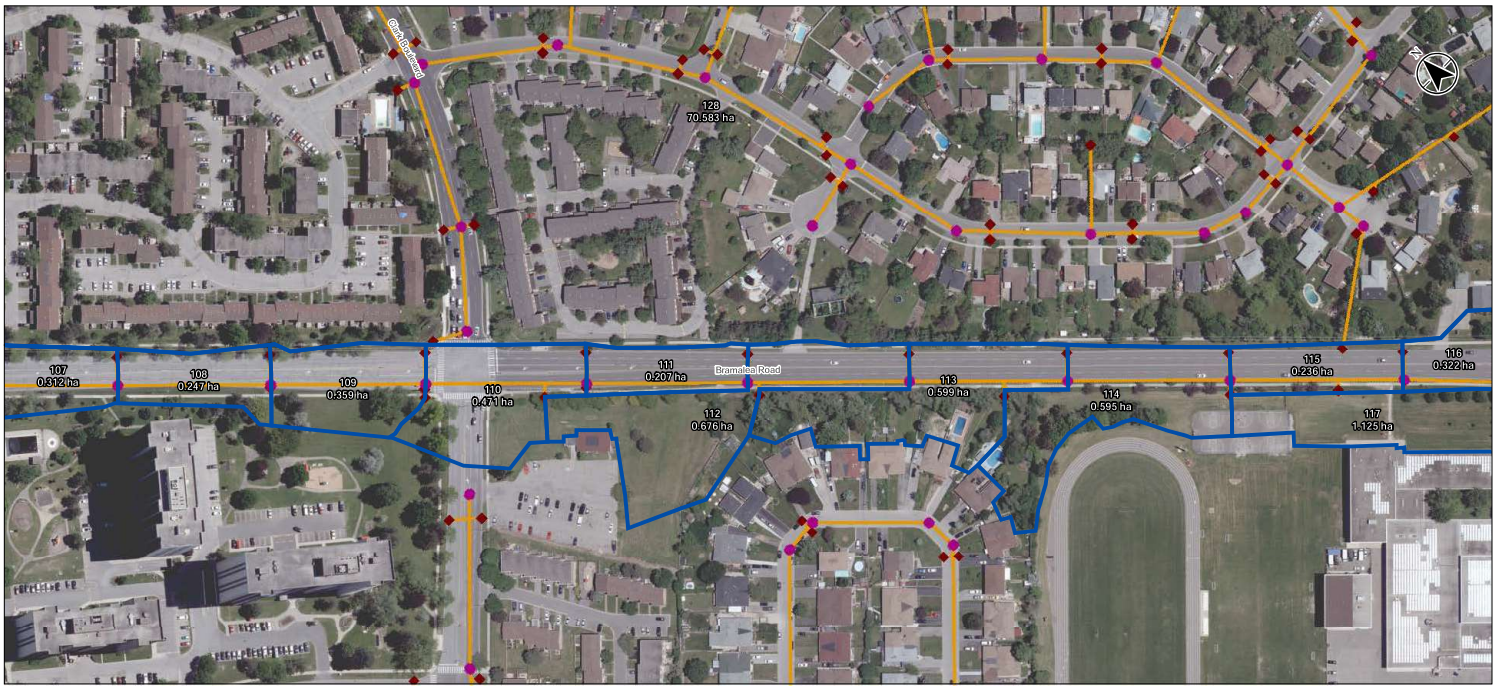
Project Location
City of Brampton

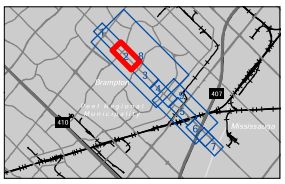
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-1

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

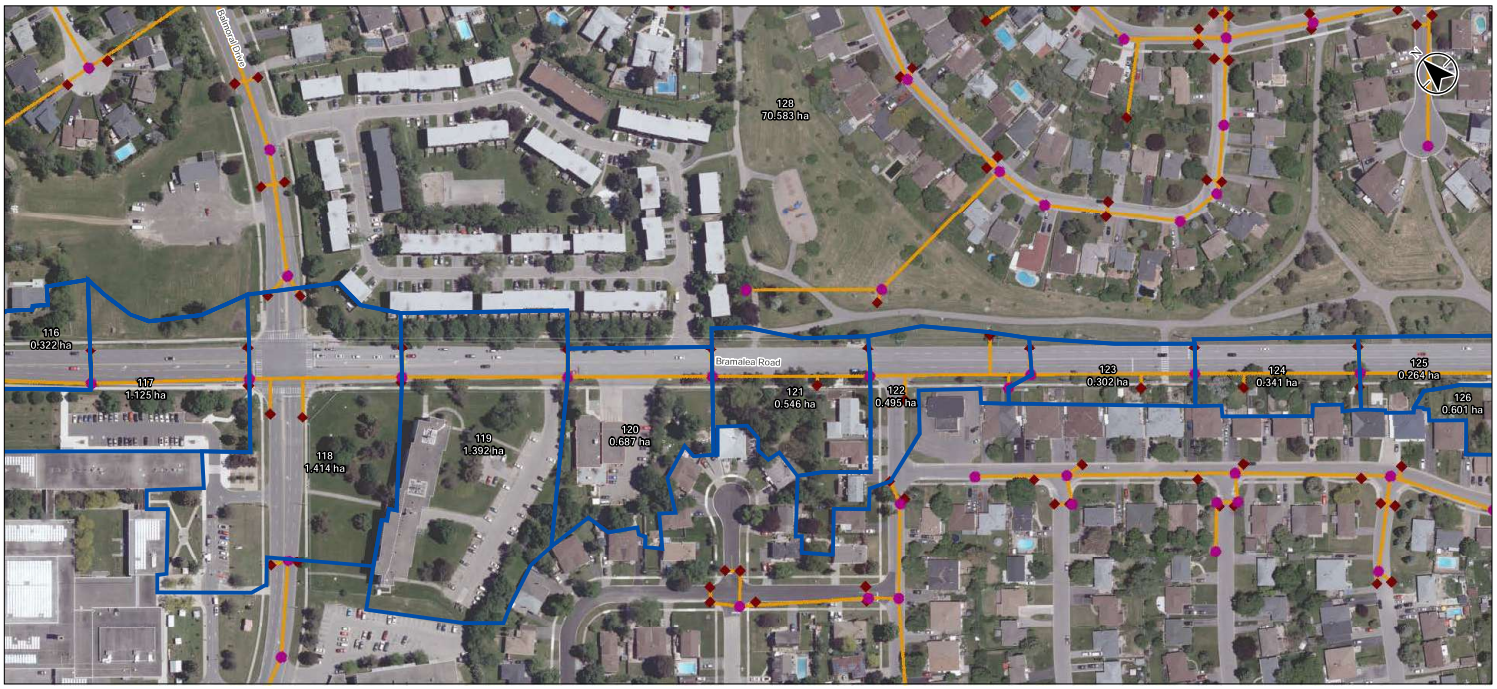
Project Location
City of Brampton

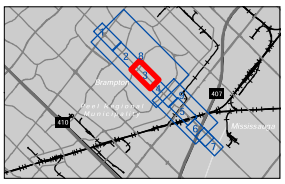
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-2

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

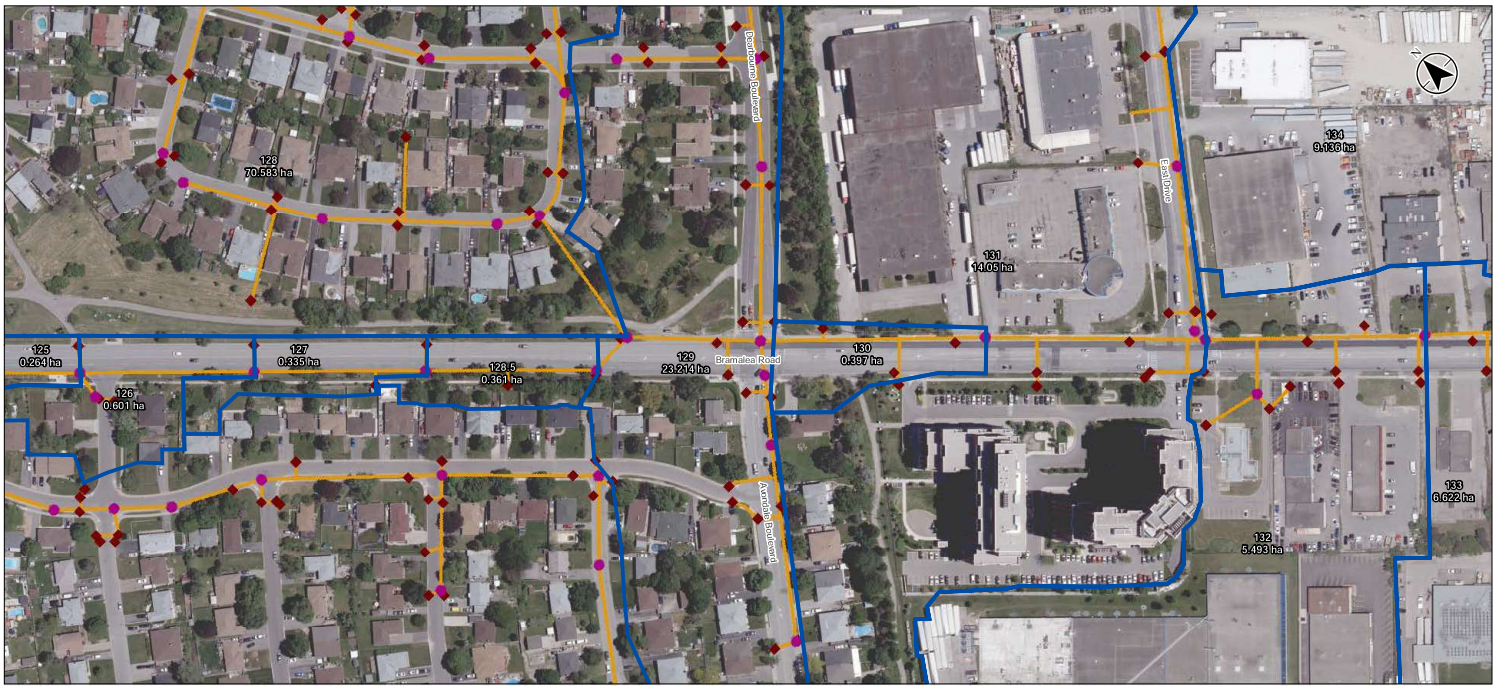
Project Location
City of Brampton

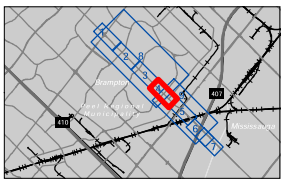
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-3

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

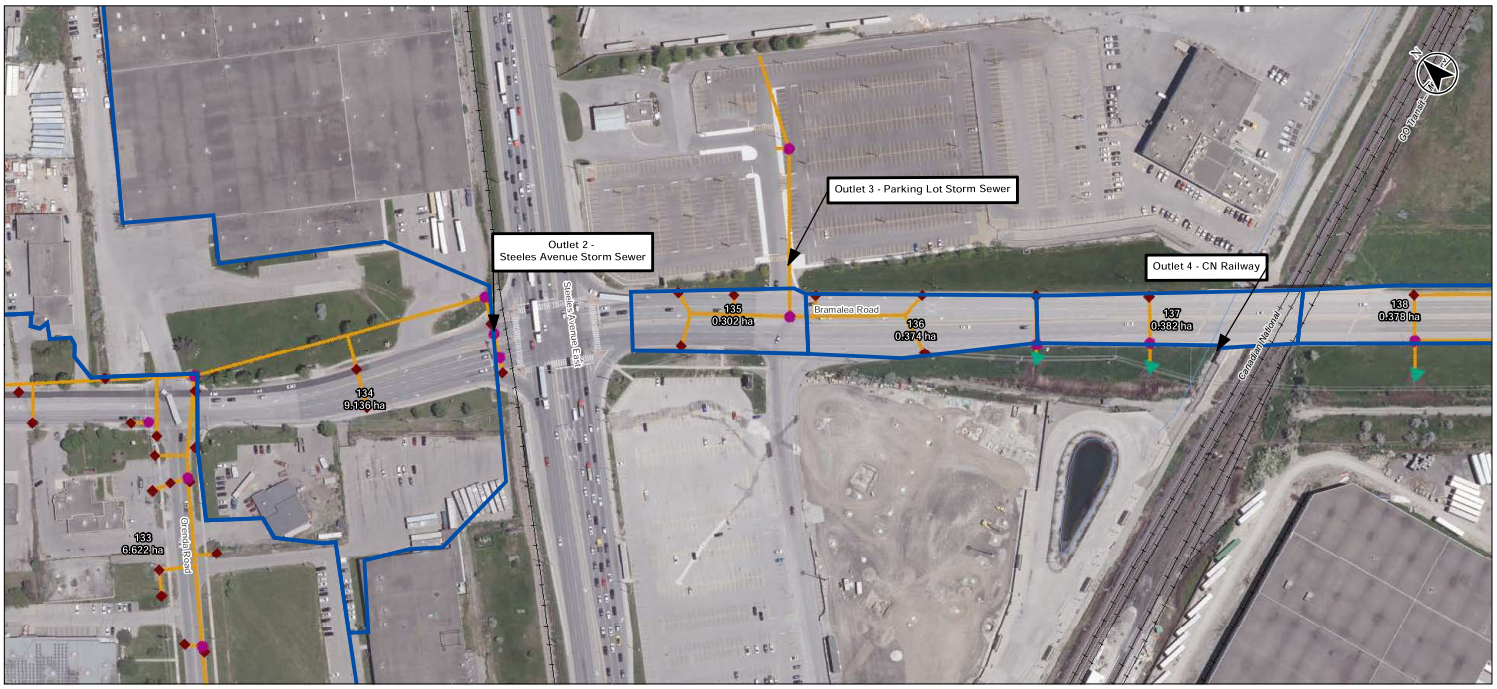
Project Location
City of Brampton

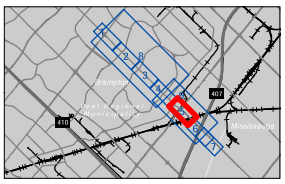
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2 - 4

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Railway
- Watercourse (Permanent)
- Waterbody
- Municipal Boundary, Lower
- Existing Catchments

Outlet 2 - Based on drawing 67469-D received by the City of Brampton, outlet drains to Steeles Avenue storm sewer.

Outlet 3 - Based on drawing J5-11-1 received by the City of Brampton, outlet drains to parking lot storm sewer.

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

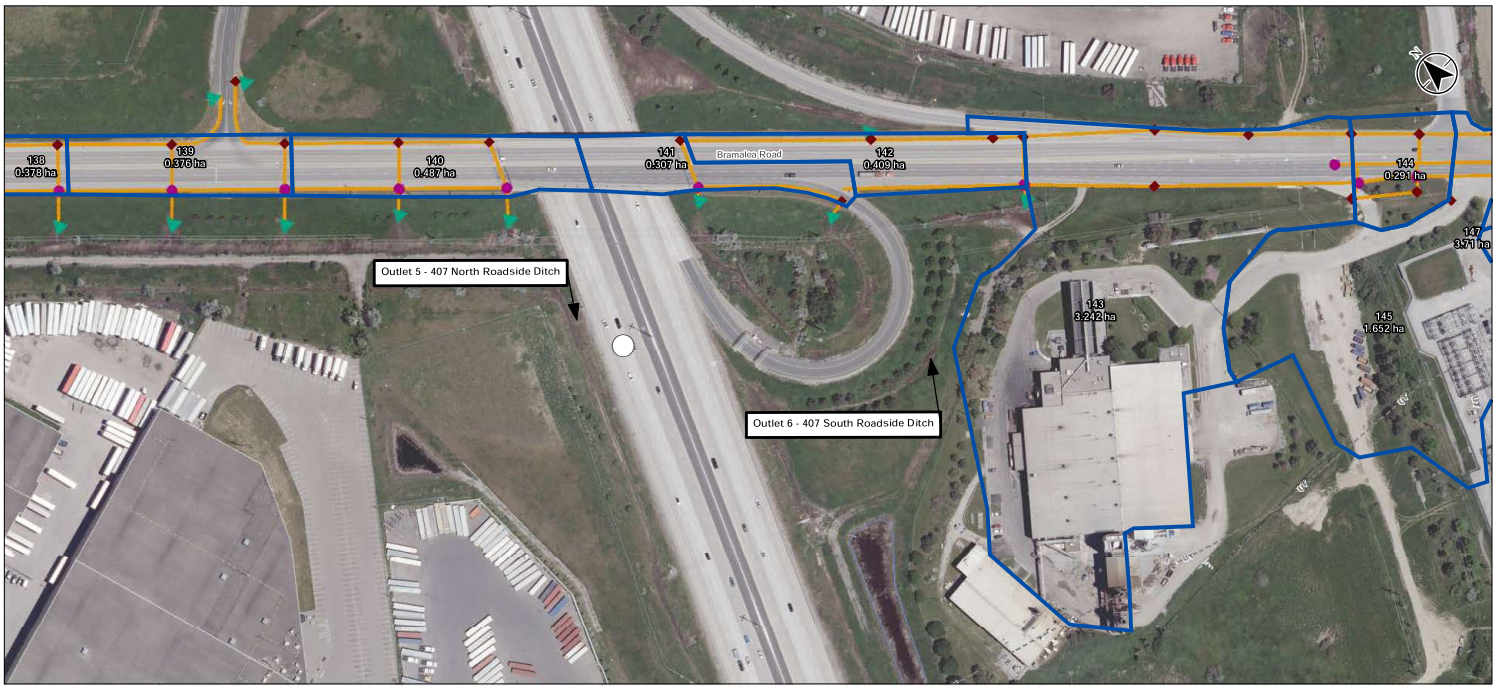
Project Location
City of Brampton

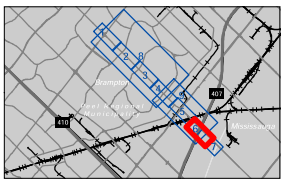
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-5

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Unknown Transmission Line
- Watercourse (Permanent)
- Waterbody
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

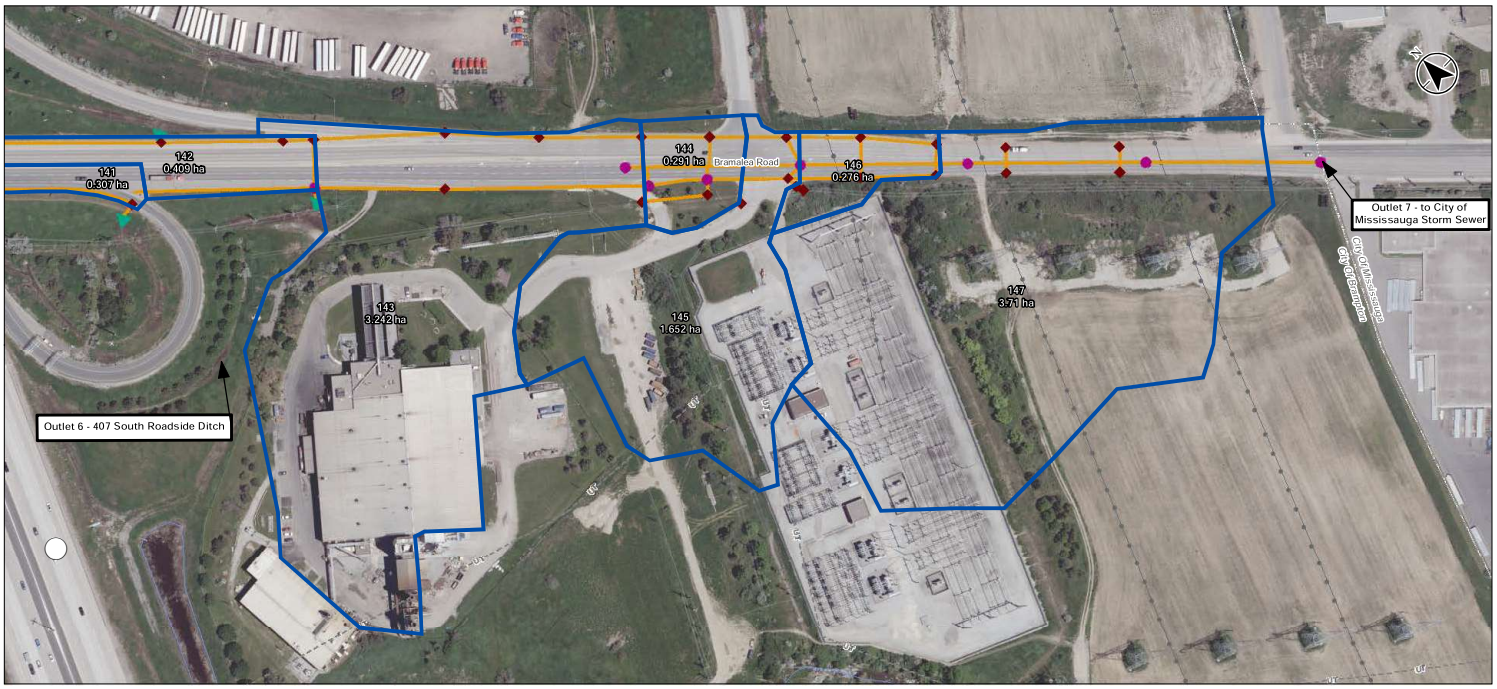
Project Location
City of Brampton

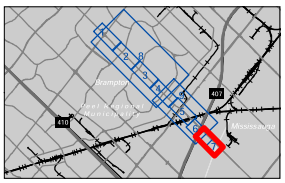
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-6

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Waterbody
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

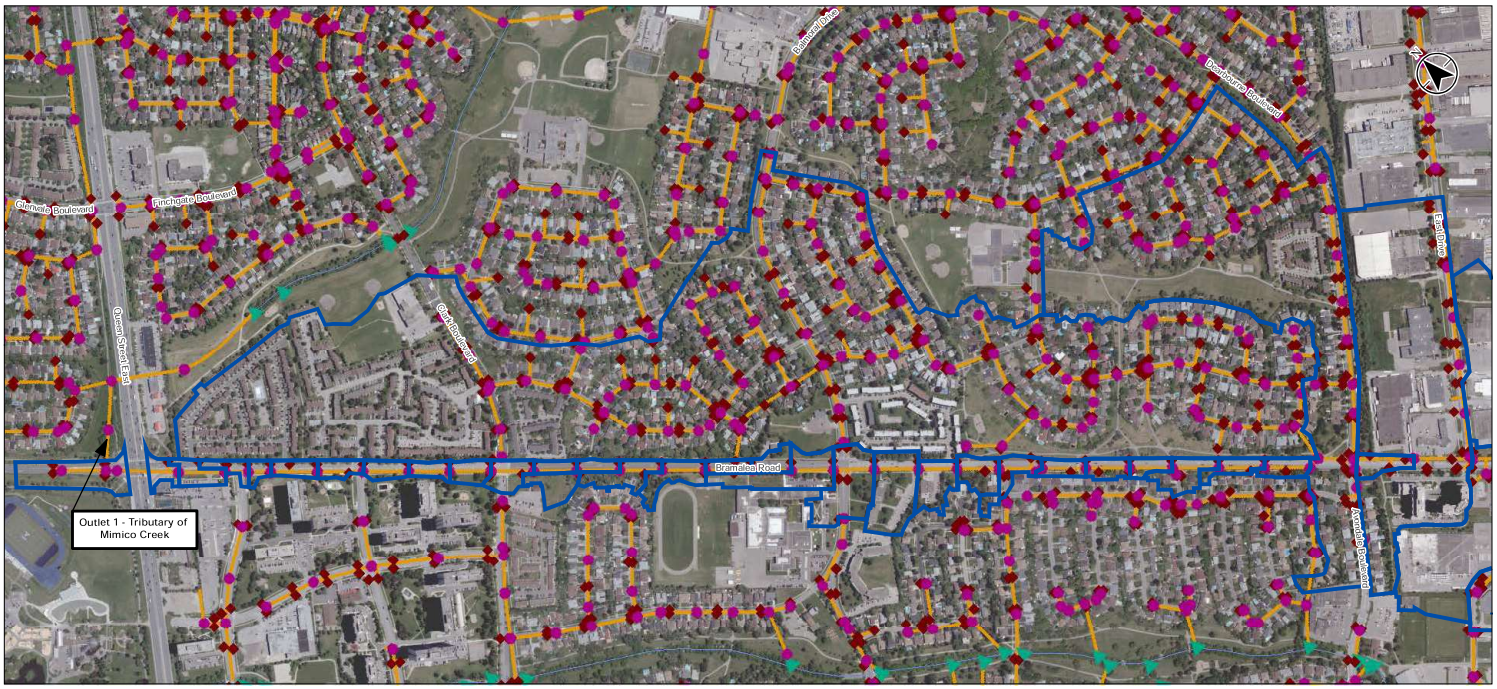
Project Location
City of Brampton

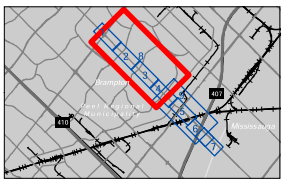
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2 - 7

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Watercourse (Permanent)
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:7,500 (At original document size of 11x17)

Stantec

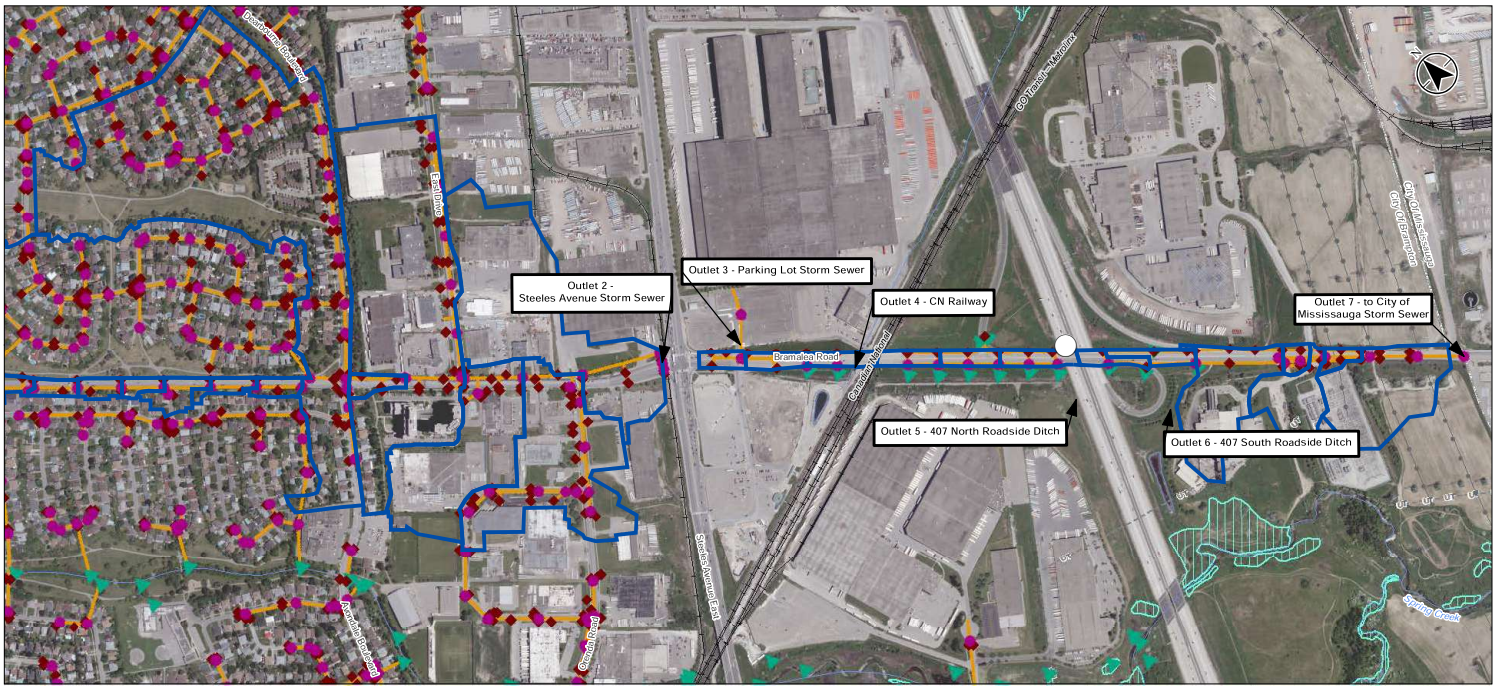
Project Location
City of Brampton

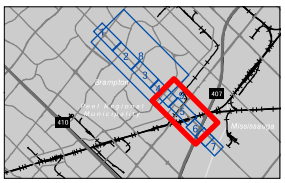
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-8

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Railway
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Wetland, Not evaluated per OWES
- Waterbody
- Municipal Boundary, Lower
- Existing Catchments

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:7,500 (At original document size of 11x17)

Stantec

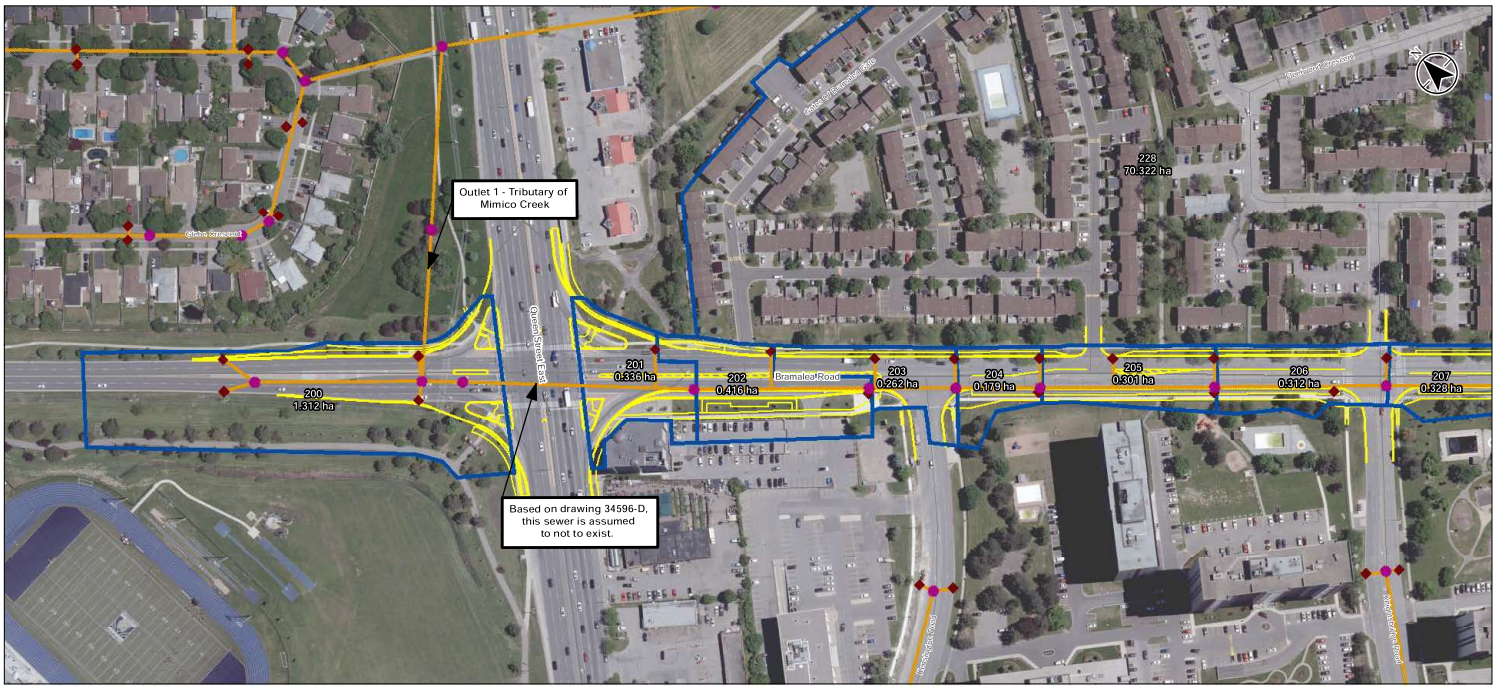
Project Location
City of Brampton

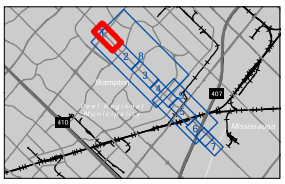
165010590 REVA
Prepared by AMW on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
2-9

Title
Existing Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

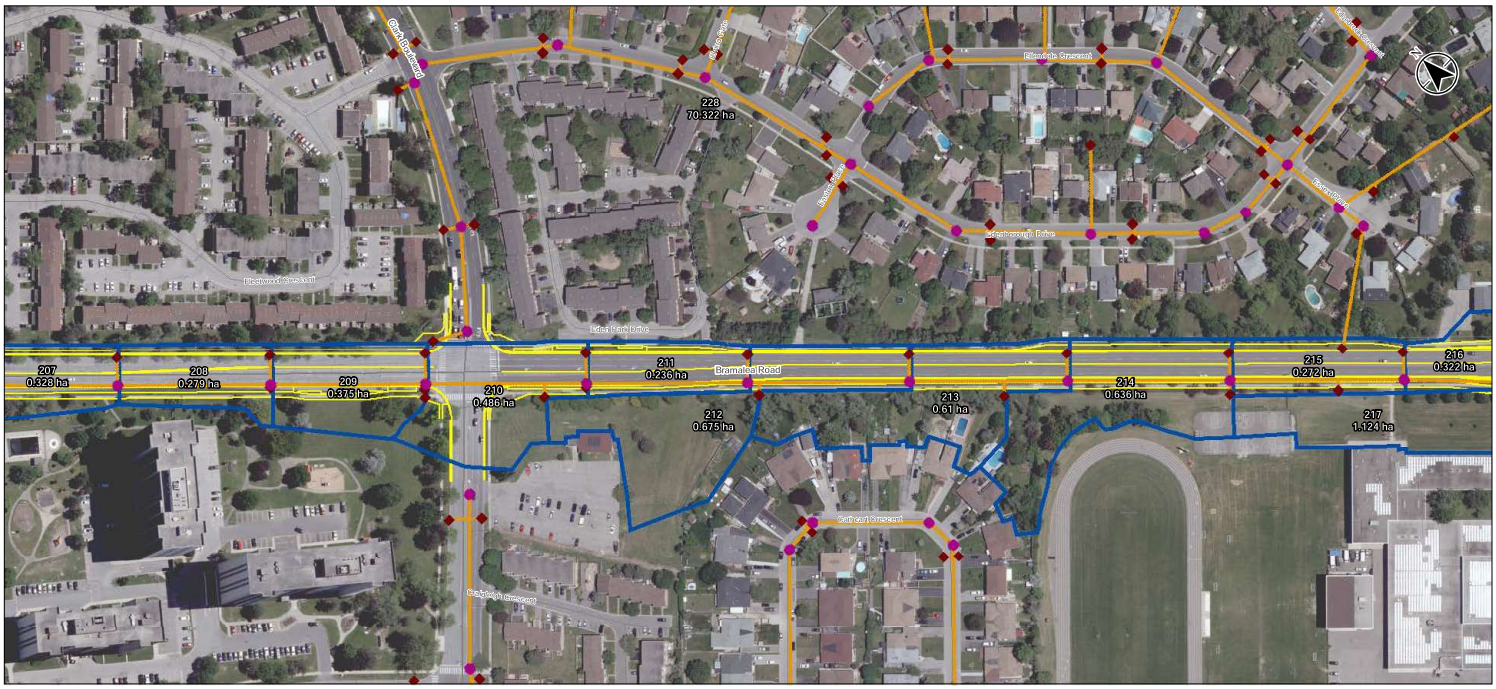
Project Location
City of Brampton

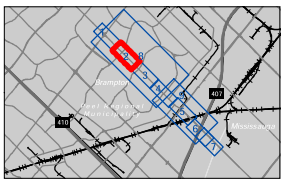
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-1

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

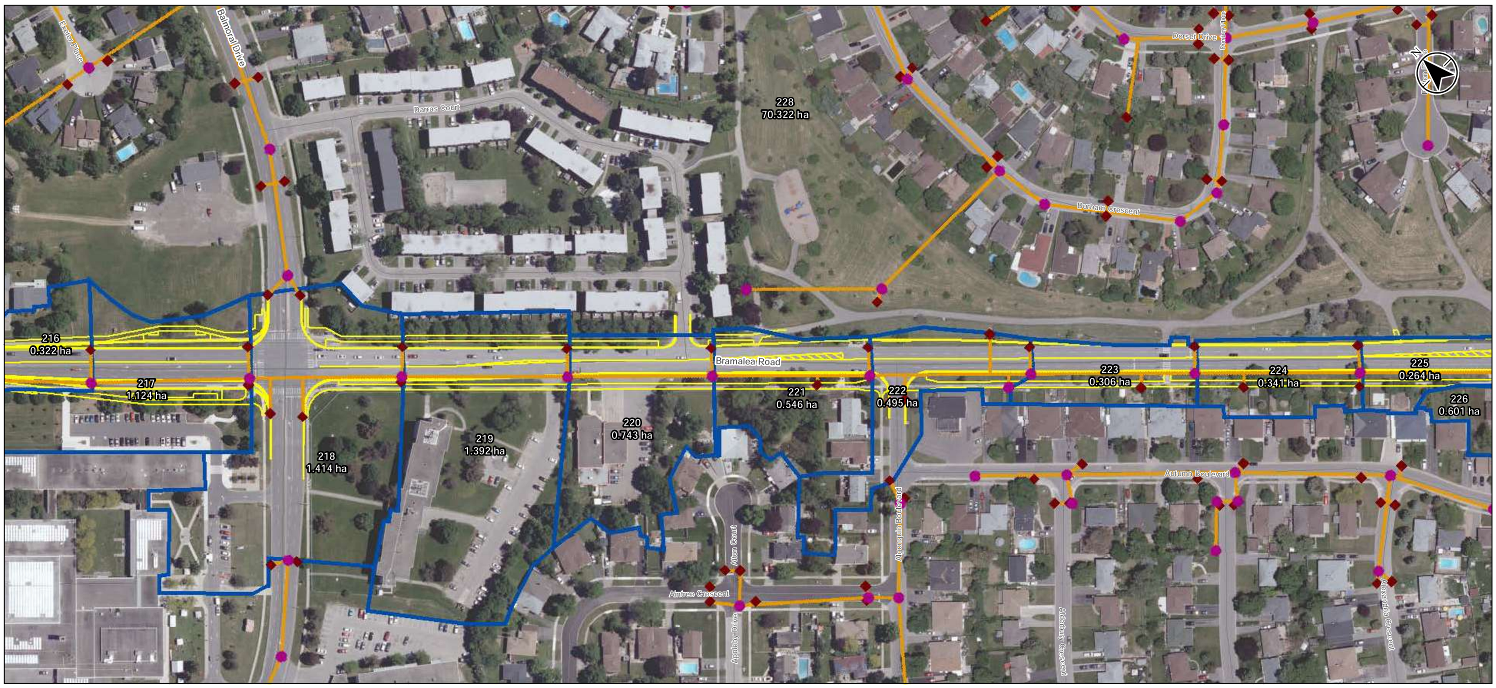
Project Location
City of Brampton

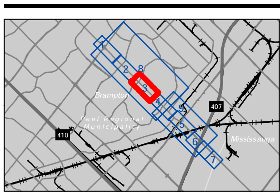
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-2

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date Spring 2019

Stantec

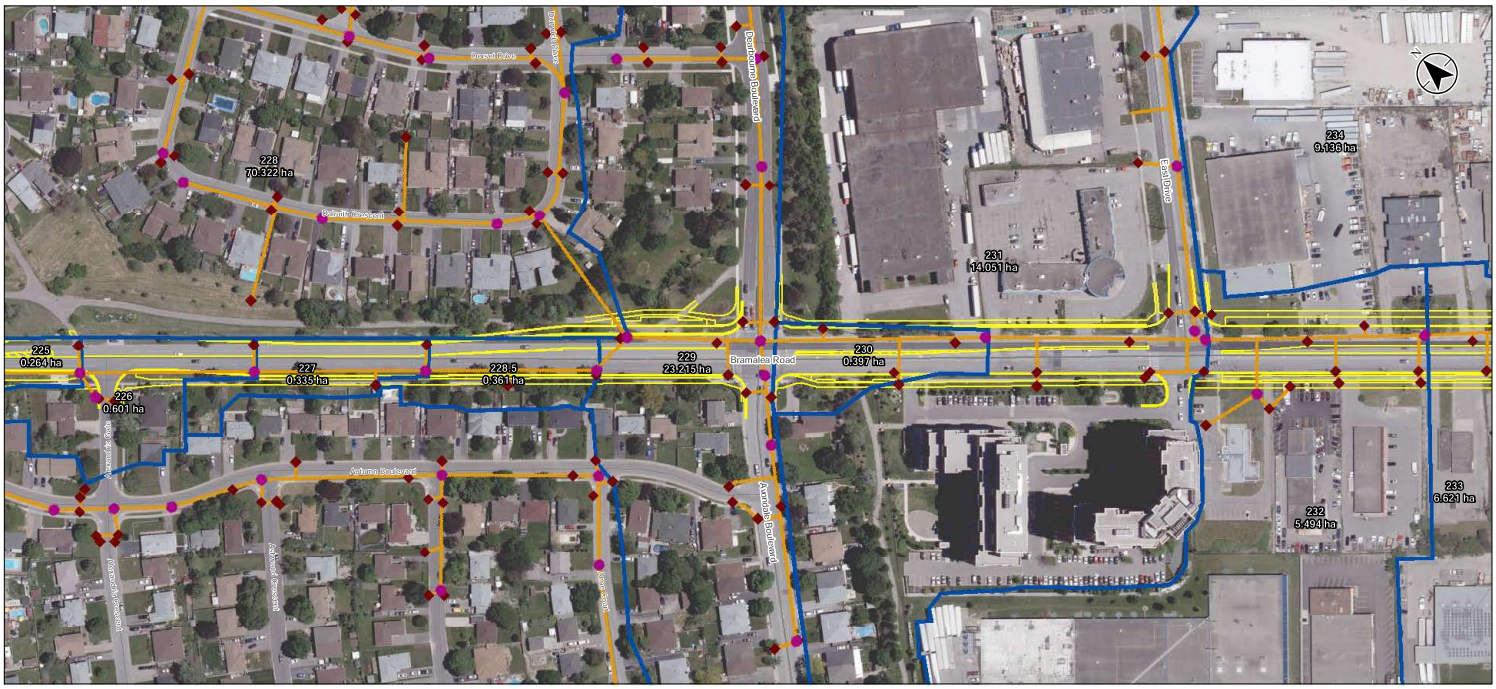
Project Location
City of Brampton

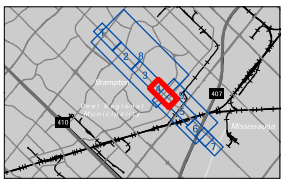
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-3

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

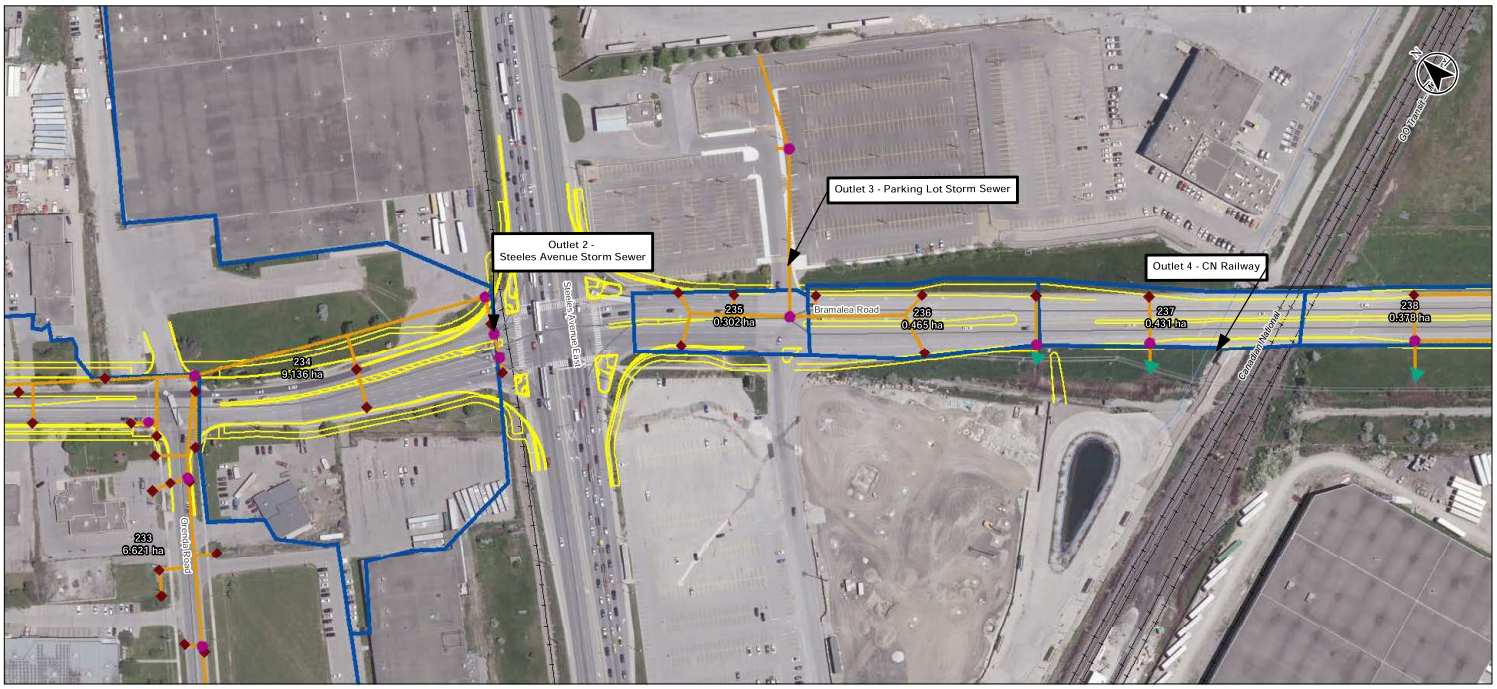
Project Location
City of Brampton

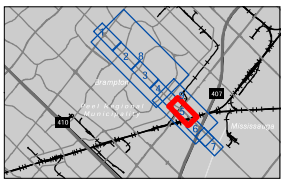
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-4

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Railway
- Watercourse (Permanent)
- Waterbody
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Outlet 2 - Based on drawing 67469-D received by the City of Brampton, outlet drains to Steeles Avenue storm sewer.

Outlet 3 - Based on drawing J5-11-1 received by the City of Brampton, outlet drains to parking lot storm sewer.

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

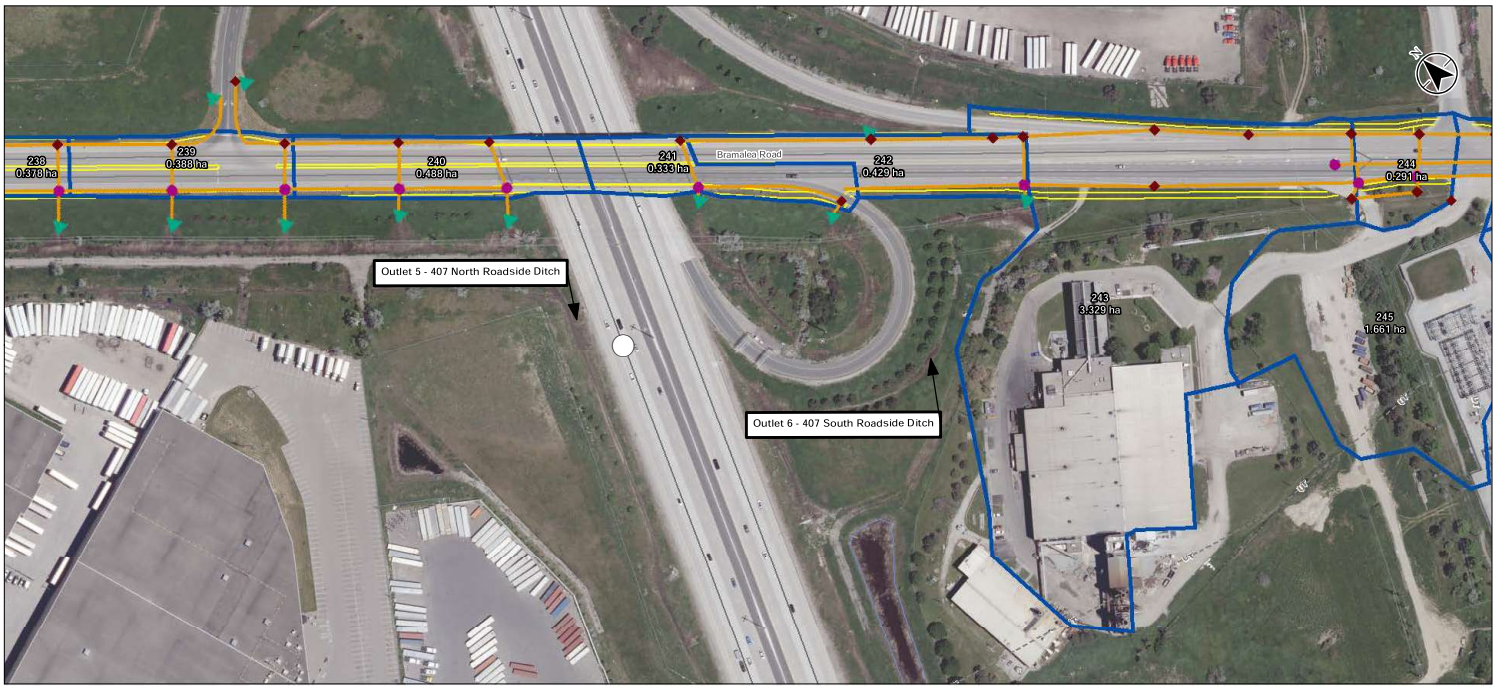
Project Location
City of Brampton

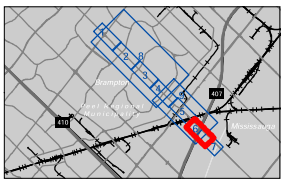
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-5

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Unknown Transmission Line
- Watercourse (Permanent)
- Waterbody
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:2,000 (At original document size of 11x17)

Stantec

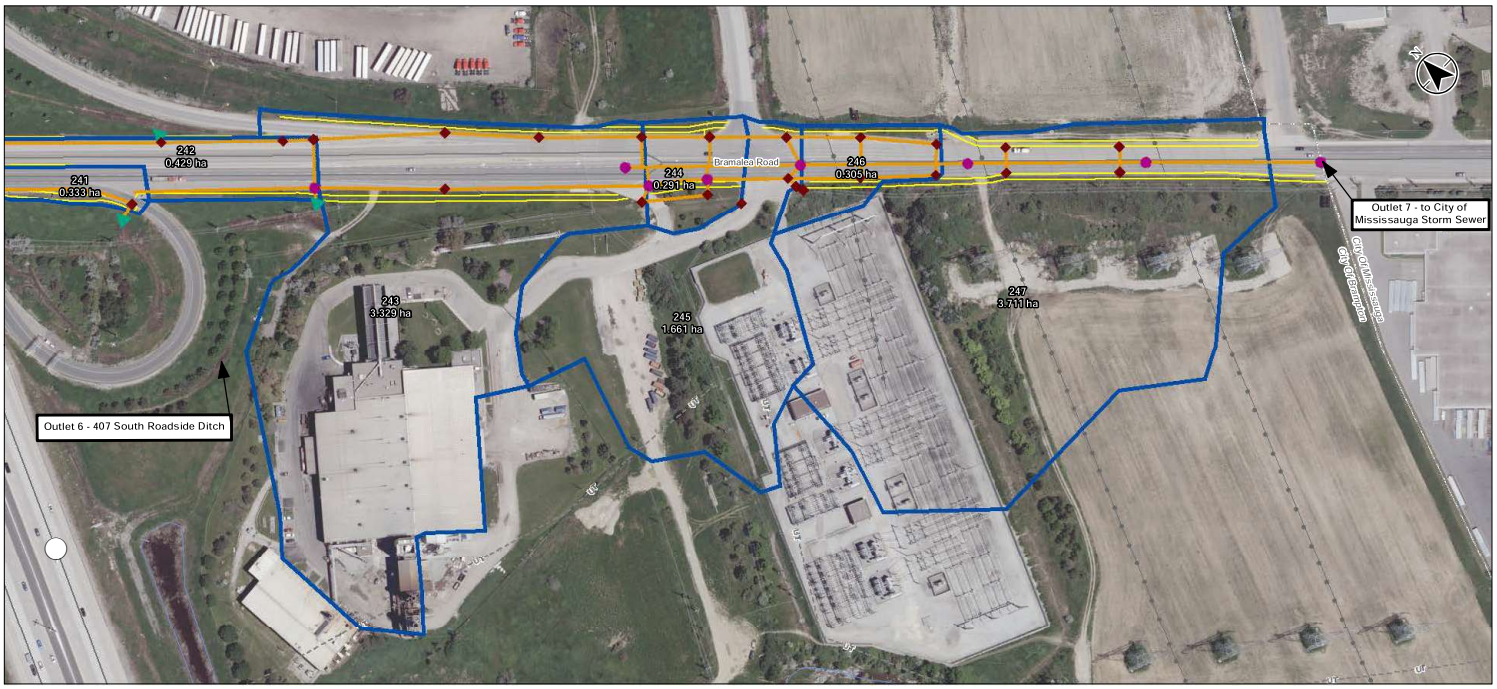
Project Location
City of Brampton

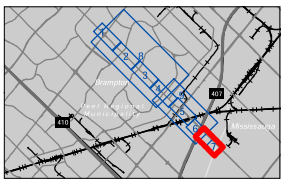
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-6

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Waterbody
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

Stantec

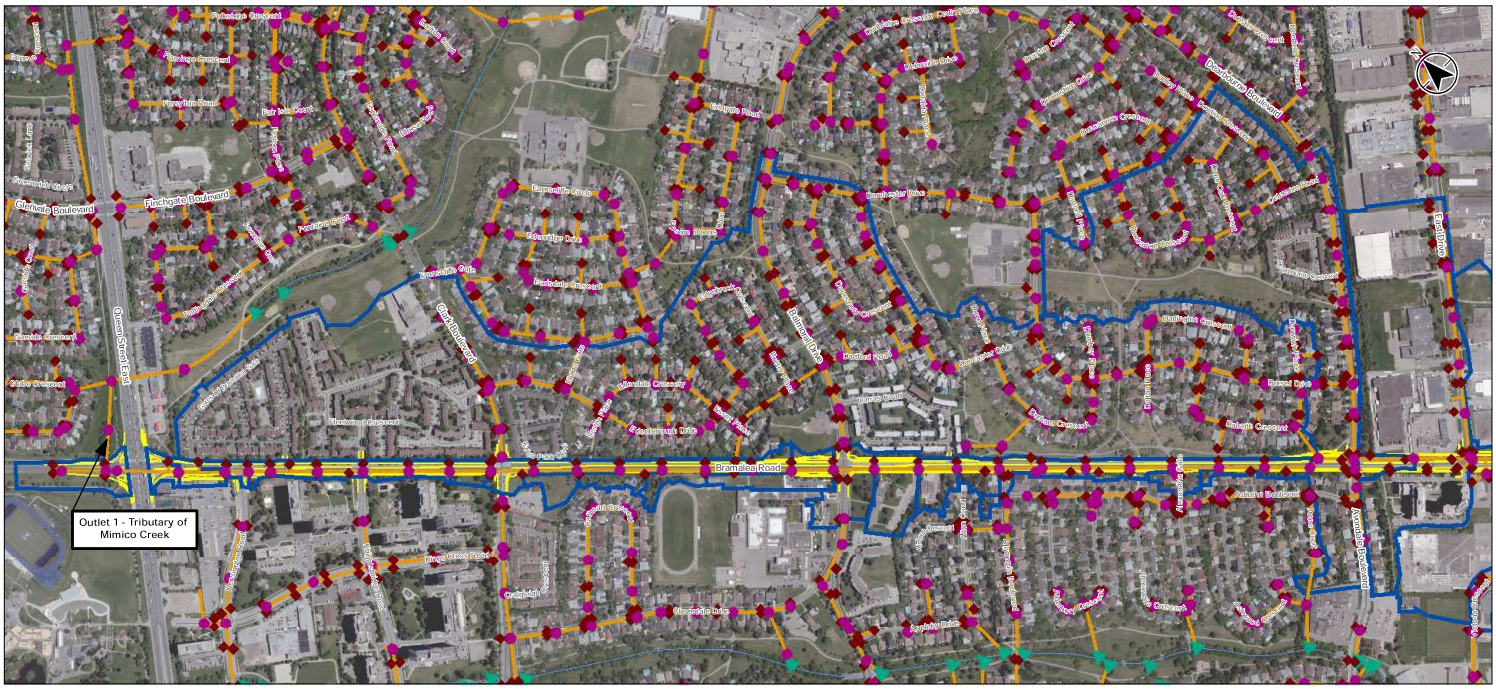
Project Location
City of Brampton

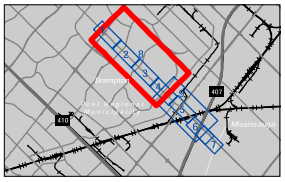
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-7

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Watercourse (Permanent)
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:7,500 (At original document size of 11x17)

Stantec

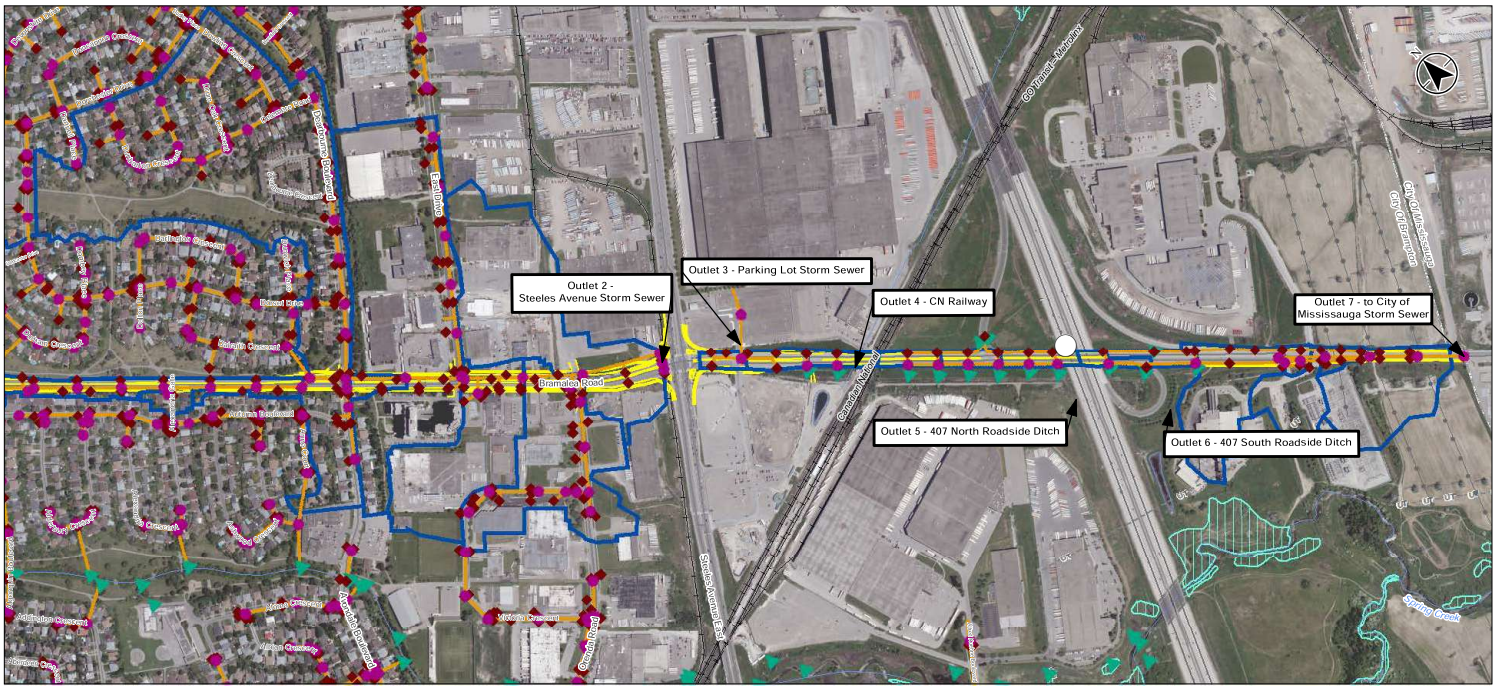
Project Location
City of Brampton

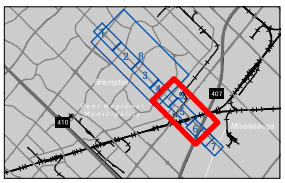
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-8

Title
Proposed Storm Sewer Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Railway
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Wetland, Not evaluated per OWES
- Waterbody
- Municipal Boundary, Lower
- New Construction
- Proposed Catchments

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 50 100 metres

1:7,500 (At original document size of 11x17)

Stantec

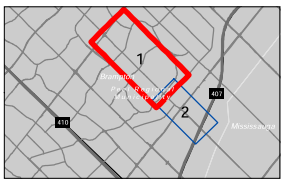
Project Location
City of Brampton

165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
3-9

Title
Proposed Storm Sewer Drainage Area Plan



Legend

- Watercourse (Permanent)
- Municipal Boundary, Lower
- Existing Stormwater Management Drainage Area Plan

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 100 200 metres

1:7,500 (At original document size of 11x17)

Stantec

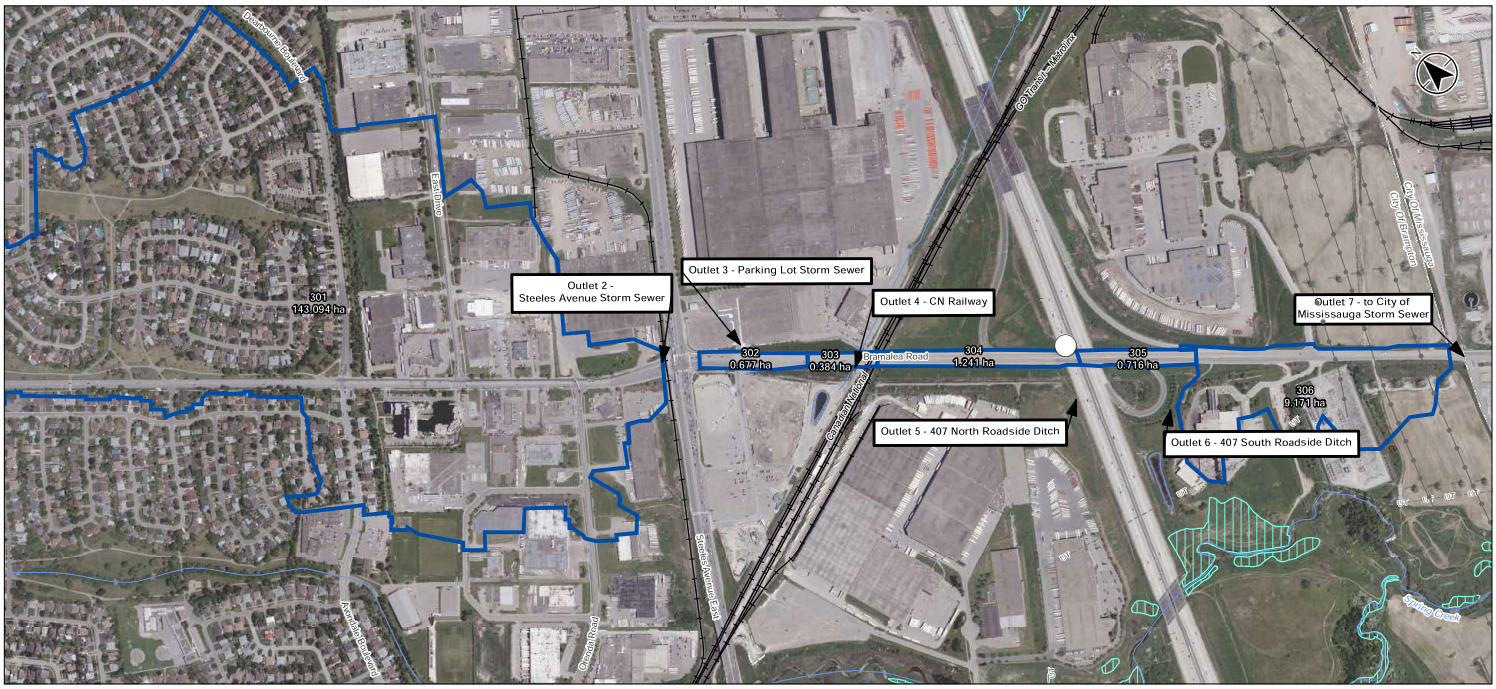
Project Location
City of Brampton

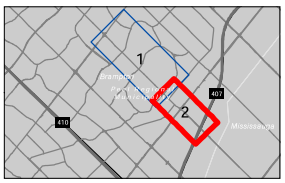
165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
4-1

Title
Existing Stormwater Management Drainage Area Plan





Legend

- Railway
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Wetland, Not evaluated per OWES
- Waterbody
- Municipal Boundary, Lower
- Existing Stormwater Management Drainage Area Plan

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date: Spring 2019

0 100 200 metres

1:7,500 (At original document size of 11x17)

Stantec

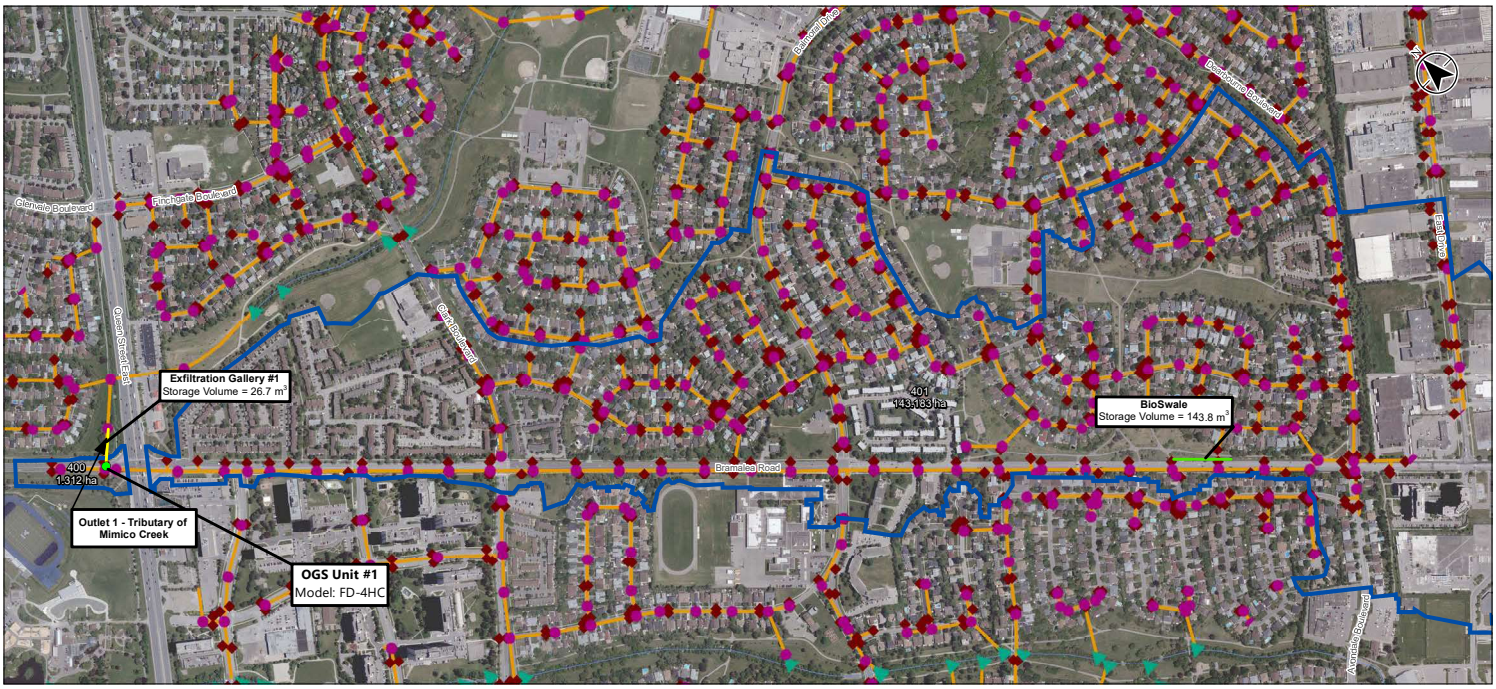
Project Location
City of Brampton

165010590 REVA
Prepared by JSa on 2022-11-17
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
4-2

Title
Existing Stormwater Management Drainage Area Plan



Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Watercourse (Permanent)
- Municipal Boundary, Lower
- Proposed Stormwater Management Drainage Area Plan
- Oil Grit Separator
- Exfiltration Gallery
- Bioswale

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date Spring 2019

0 100 200 metres

1:7,500 (At original document size of 11x17)

Stantec

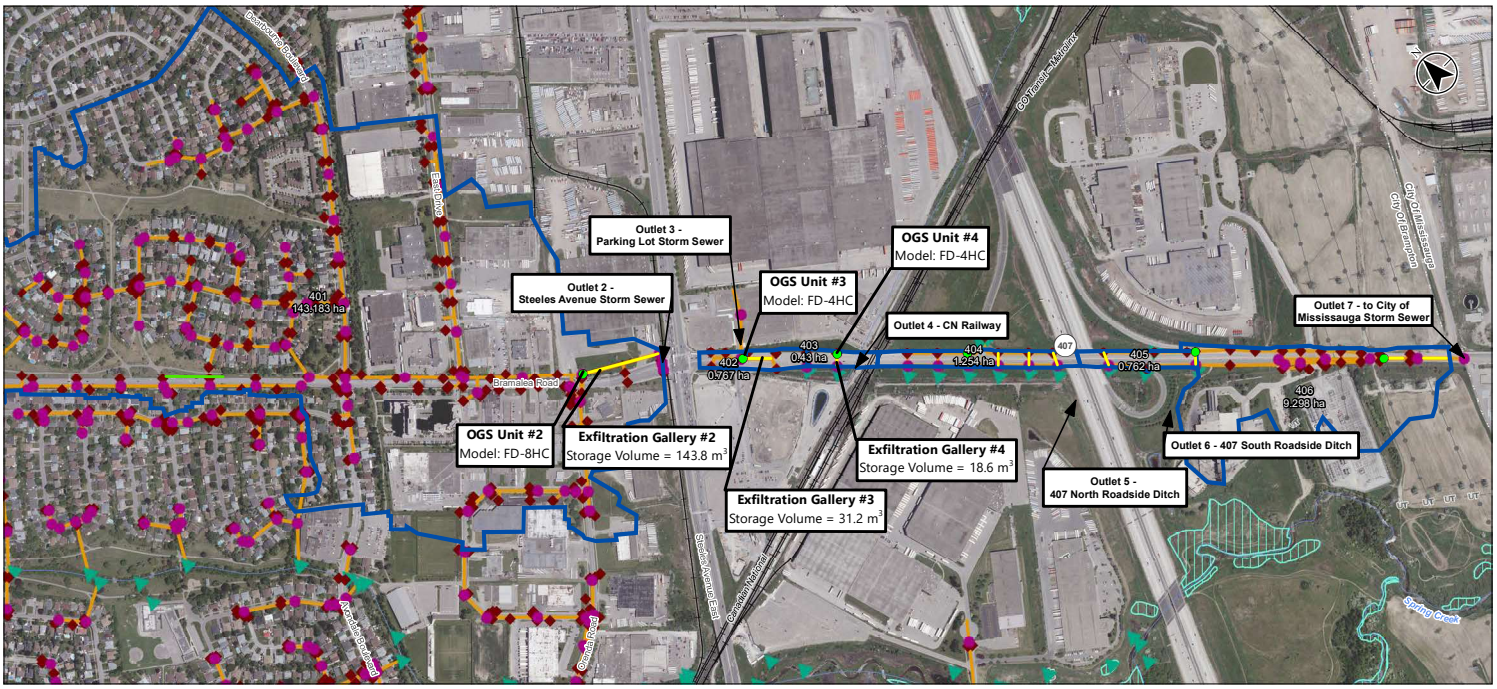
Project Location
City of Brampton

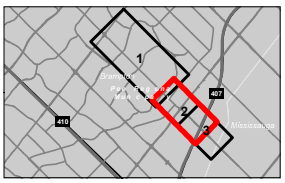
165010590 REVA
Prepared by JSa on 2023-03-31
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
5-1

Title
Proposed Stormwater Management Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Railway
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Wetland, Not evaluated per OWES
- Waterbody
- Municipal Boundary, Lower
- Proposed Stormwater Management Drainage Area Plan
- Oil Grit Separator
- Exfiltration Gallery
- Bioswale

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date Spring 2019

0 100 200 metres

1:7,500 (At original document size of 11x17)

Stantec

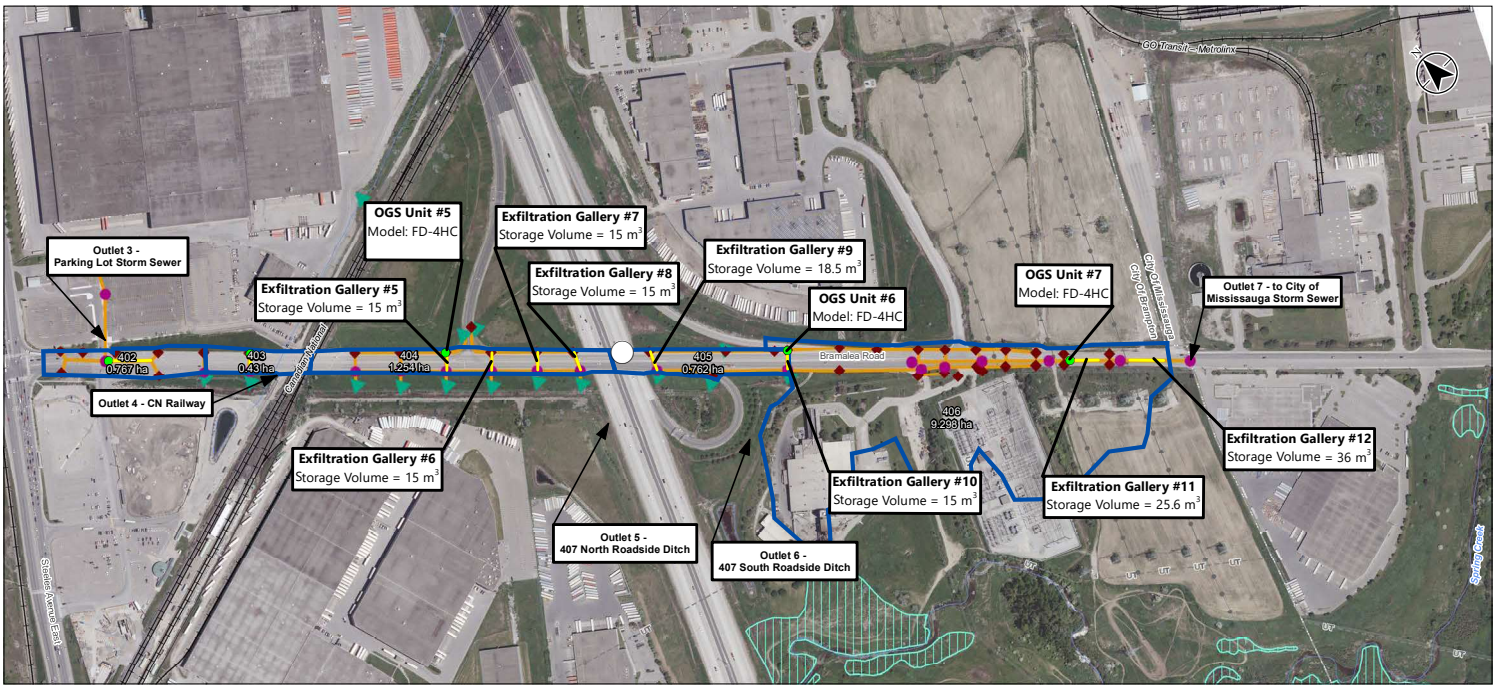
Project Location
City of Brampton

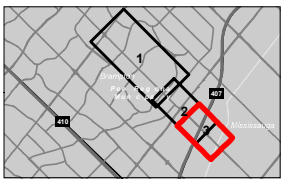
165010590 REVA
Prepared by JSa on 2023-03-31
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
5-2

Title
Proposed Stormwater Management Drainage Area Plan





Legend

- Storm Sewer Outfalls
- Manholes
- Catchbasins
- Lines
- Railway
- Hydro Line
- Unknown Transmission Line
- Watercourse (Permanent)
- Wetland, Not evaluated per OWES
- Waterbody
- Municipal Boundary, Lower
- Proposed Stormwater Management Drainage Area Plan
- Oil Grit Separator
- Exfiltration Gallery

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Aerial Imagery Date Spring 2019

0 100 200 metres

1:5,000 (At original document size of 11x17)

Stantec

Project Location
City of Brampton

165010590 REVA
Prepared by JSa on 2023-03-31
Technical Review by MS on 2022-09-16

Client/Project
CITY OF BRAMPTON
BRAMALEA ROAD CLASS EA

Figure No.
5-3

Title
Proposed Stormwater Management Drainage Area Plan

APPENDIX B:
Stormwater Management Calculations

Subject: Catchment Summary
Project: Bramalea Road
Project No.: 165010590
Client: City of Brampton
Date: 8-Nov-22

Existing Conditions

Catchment ID	Impermeable Area	Permeable Area	Total Area	% Impervious	C
300	0.48	0.78	1.26	38.36	0.47
301	59.75	83.35	143.10	41.75	0.49
302	0.67	0.01	0.68	98.74	0.89
303	4.44	0.00	4.44	100.00	0.90
304	1.23	0.01	1.24	98.87	0.89
305	0.87	0.84	1.71	50.74	0.56
306	5.35	3.82	9.17	58.32	0.61
Total	72.78	88.82	161.60	45.04	0.52

Proposed Conditions

Catchment ID	Impermeable Area	Permeable Area	Total Area	% Impervious	C
400	0.58	0.73	1.31	44.24	0.51
401	62.01	81.20	143.21	43.30	0.50
402	0.68	0.09	0.77	88.11	0.82
403	4.01	0.49	4.50	89.08	0.82
404	1.22	0.03	1.25	97.34	0.88
405	0.93	0.80	1.73	53.81	0.58
406	5.54	3.77	9.30	59.53	0.62
Total	74.96	87.12	162.08	46.25	0.52

Total Area of the Road

Catchment ID	Total Area (ha)
400	0.53
401	5.75
402	0.62
403	0.37
404	1.20
405	0.67
406	1.23
Total	10.38

Subject: Rainfall Intensity and Peak Flows - Outlet 1
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 8-Nov-22

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 1.26 ha
Runoff Coefficient : 0.47 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.13
5-Year	104.99	0.17
10-Year	121.93	0.20
25-Year	143.48	0.24
50-Year	159.52	0.26
100-Year	175.36	0.29

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 1.31 ha
Runoff Coefficient : 0.51 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.15
5-Year	104.99	0.20
10-Year	121.93	0.23
25-Year	143.48	0.27
50-Year	159.52	0.30
100-Year	175.36	0.33

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: **Storage Requirements - Outlet 1**
Project: **Bramalea Road**
Project No.: **165010590**
Client: **The City of Brampton**
Date: **8-Nov-22**

Storage Requirements

100-Year Allowable Flow : 0.29 cu. m

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.326	195.67	174.09	21.58	28.05
15	132.78	0.247	222.24	261.14	-38.90	-50.57
20	109.00	0.203	243.25	348.18	-104.93	-136.41
25	93.53	0.174	260.90	435.23	-174.33	-226.62
30	82.53	0.153	276.28	522.28	-246.00	-319.80
35	74.25	0.138	289.98	609.32	-319.34	-415.15
40	67.75	0.126	302.39	696.37	-393.97	-512.16
45	62.49	0.116	313.79	783.41	-469.63	-610.51
50	58.13	0.108	324.34	870.46	-546.12	-709.95
55	54.46	0.101	334.20	957.50	-623.31	-810.30
60	51.30	0.095	343.45	1044.55	-701.10	-911.43

Required Storage : **28 cu. m**

Subject: Rainfall Intensity and Peak Flows - Outlet 2
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 8-Nov-22

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 143.10 ha
Runoff Coefficient : 0.49 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	15.67
5-Year	104.99	20.71
10-Year	121.93	24.05
25-Year	143.48	28.30
50-Year	159.52	31.46
100-Year	175.36	34.59

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 143.21 ha
Runoff Coefficient : 0.50 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	16.02
5-Year	104.99	21.18
10-Year	121.93	24.60
25-Year	143.48	28.94
50-Year	159.52	32.18
100-Year	175.36	35.38

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: **Storage Requirements - Outlet 2**
Project: **Bramalea Road**
Project No.: **165010590**
Client: **The City of Brampton**
Date: **8-Nov-22**

Storage Requirements

100-Year Allowable Flow : 34.59 cu. m

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	35.123	21073.64	20752.48	321.17	417.52
15	132.78	26.594	23934.93	31128.71	-7193.78	-9351.91
20	109.00	21.831	26197.69	41504.95	-15307.26	-19899.44
25	93.53	18.733	28099.12	51881.19	-23782.07	-30916.69
30	82.53	16.530	29754.71	62257.43	-32502.72	-42253.54
35	74.25	14.872	31230.36	72633.66	-41403.31	-53824.30
40	67.75	13.570	32567.65	83009.90	-50442.25	-65574.93
45	62.49	12.517	33794.68	93386.14	-59591.46	-77468.90
50	58.13	11.644	34931.41	103762.38	-68830.96	-89480.25
55	54.46	10.907	35992.62	114138.61	-78145.99	-101589.79
60	51.30	10.275	36989.55	124514.85	-87525.30	-113782.89

Required Storage : **418 cu. m**

Subject: Rainfall Intensity and Peak Flows - Outlet 3
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 8-Nov-22

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 0.68 ha
Runoff Coefficient : 0.89 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.13
5-Year	104.99	0.18
10-Year	121.93	0.21
25-Year	143.48	0.24
50-Year	159.52	0.27
100-Year	175.36	0.30

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 0.77 ha
Runoff Coefficient : 0.82 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.14
5-Year	104.99	0.18
10-Year	121.93	0.21
25-Year	143.48	0.25
50-Year	159.52	0.28
100-Year	175.36	0.31

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: **Storage Requirements - Outlet 3**
Project: **Bramalea Road**
Project No.: **165010590**
Client: **The City of Brampton**
Date: **8-Nov-22**

Storage Requirements

100-Year Allowable Flow : 0.30 cu. m

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.305	183.27	177.69	5.57	7.25
15	132.78	0.231	208.15	266.54	-58.39	-75.91
20	109.00	0.190	227.83	355.39	-127.56	-165.83
25	93.53	0.163	244.37	444.23	-199.87	-259.83
30	82.53	0.144	258.76	533.08	-274.32	-356.61
35	74.25	0.129	271.60	621.93	-350.33	-455.43
40	67.75	0.118	283.23	710.78	-427.55	-555.81
45	62.49	0.109	293.90	799.62	-505.72	-657.44
50	58.13	0.101	303.78	888.47	-584.69	-760.09
55	54.46	0.095	313.01	977.32	-664.30	-863.60
60	51.30	0.089	321.68	1066.16	-744.48	-967.83

Required Storage : **7 cu. m**

Subject: Rainfall Intensity and Peak Flows - Outlet 4
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 8-Nov-22

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 4.44 ha
Runoff Coefficient : 0.90 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.89
5-Year	104.99	1.17
10-Year	121.93	1.36
25-Year	143.48	1.61
50-Year	159.52	1.78
100-Year	175.36	1.96

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 4.50 ha
Runoff Coefficient : 0.82 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.82
5-Year	104.99	1.09
10-Year	121.93	1.26
25-Year	143.48	1.49
50-Year	159.52	1.65
100-Year	175.36	1.82

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: **Storage Requirements - Outlet 4**
Project: **Bramalea Road**
Project No.: **165010590**
Client: **The City of Brampton**
Date: **8-Nov-22**

Storage Requirements

100-Year Allowable Flow : 1.96 cu. m

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	1.806	1083.56	1177.24	-93.68	-121.78
15	132.78	1.367	1230.68	1765.86	-535.18	-695.73
20	109.00	1.123	1347.03	2354.48	-1007.45	-1309.69
25	93.53	0.963	1444.79	2943.10	-1498.31	-1947.80
30	82.53	0.850	1529.92	3531.72	-2001.80	-2602.34
35	74.25	0.765	1605.79	4120.34	-2514.54	-3268.91
40	67.75	0.698	1674.56	4708.96	-3034.40	-3944.73
45	62.49	0.644	1737.65	5297.58	-3559.93	-4627.91
50	58.13	0.599	1796.09	5886.20	-4090.10	-5317.14
55	54.46	0.561	1850.66	6474.82	-4624.16	-6011.41
60	51.30	0.528	1901.92	7063.44	-5161.52	-6709.98

Required Storage : **-122 cu. m**

ie: Not Required

Subject: Rainfall Intensity and Peak Flows - Outlet 5
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 10-Apr-23

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 1.24 ha
Runoff Coefficient : 0.89 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.25
5-Year	104.99	0.33
10-Year	121.93	0.38
25-Year	143.48	0.44
50-Year	159.52	0.49
100-Year	175.36	0.54

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 1.25 ha
Runoff Coefficient : 0.88 -
Total Road Area: 1.20
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge	Etobicoke Drain
-	mm/hr	cms	cms
2-Year	79.43	0.25	0.0152
5-Year	104.99	0.32	0.0250
10-Year	121.93	0.38	0.0320
25-Year	143.48	0.44	0.0441
50-Year	159.52	0.49	0.0565
100-Year	175.36	0.54	0.0662

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: Storage Requirements - Outlet 5
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 10-Apr-23

Storage Requirements

100-Year Allowable Flow (Post to Pre) : **0.54 cu. m**

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.539	323.19	325.51	-2.33	-3.02
15	132.78	0.408	367.07	488.27	-121.20	-157.56
20	109.00	0.335	401.77	651.03	-249.25	-324.03
25	93.53	0.287	430.93	813.78	-382.85	-497.71
30	82.53	0.254	456.32	976.54	-520.22	-676.28

Required Storage : **-3 cu. m**

ie: No Storage Required

100-Year Allowable Flow (URR) : **0.07 cu. m**

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.515	308.80	39.74	269.06	349.77
15	132.78	0.390	350.73	59.62	291.11	378.44
20	109.00	0.320	383.88	79.49	304.40	395.72
25	93.53	0.274	411.75	99.36	312.39	406.10
30	82.53	0.242	436.01	119.23	316.77	411.81
35	74.25	0.218	457.63	139.10	318.53	414.08
40	67.75	0.199	477.23	158.98	318.25	413.72
45	62.49	0.183	495.21	178.85	316.36	411.26
50	58.13	0.171	511.86	198.72	313.14	407.08

Required Storage : **414 cu. m**

Subject: Rainfall Intensity and Peak Flows - Outlet 6
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 10-Apr-23

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 1.71 ha
Runoff Coefficient : 0.56 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	0.21
5-Year	104.99	0.28
10-Year	121.93	0.33
25-Year	143.48	0.38
50-Year	159.52	0.43
100-Year	175.36	0.47

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 1.73 ha
Runoff Coefficient : 0.58 -
Total Road Area : 0.67 ha
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge	Etobicoke Drain
-	mm/hr	cms	cms
2-Year	79.43	0.22	0.0085
5-Year	104.99	0.29	0.0140
10-Year	121.93	0.34	0.0179
25-Year	143.48	0.40	0.0246
50-Year	159.52	0.45	0.0316
100-Year	175.36	0.49	0.0370

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: Storage Requirements - Outlet 6
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 10-Apr-23

Storage Requirements

100-Year Allowable Flow (Post to Pre) : **0.49 cu. m**

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.487	292.27	294.38	-2.10	-2.73
15	132.78	0.369	331.96	441.57	-109.61	-142.49
20	109.00	0.303	363.34	588.75	-225.41	-293.04
25	93.53	0.260	389.71	735.94	-346.23	-450.10
30	82.53	0.229	412.67	883.13	-470.46	-611.59

Required Storage : **-3 cu. m**

ie: No storage required

100-Year Allowable Flow (URR) : **0.0370 cu.m**

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.188	112.97	22.22	90.75	117.97
15	132.78	0.143	128.30	33.33	94.97	123.47
20	109.00	0.117	140.43	44.44	95.99	124.79
25	93.53	0.100	150.63	55.55	95.08	123.60
30	82.53	0.089	159.50	66.66	92.84	120.69

Required Storage : **125 cu. m**

Subject: Rainfall Intensity and Peak Flows - Outlet 7
Project: Bramalea Road
Project No.: 165010590
Client: The City of Brampton
Date: 10-Apr-23

IDF Curve City of Brampton

Design Storm	A	B
2-Year	22.1	-0.714
5-Year	29.9	-0.701
10-Year	35.1	-0.695
25-Year	41.6	-0.691
50-Year	46.5	-0.688
100-Year	51.3	-0.686

Existing Conditions

Total Drainage Area : 9.17 ha
Runoff Coefficient : 0.61 -
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge
-	mm/hr	cms
2-Year	79.43	1.24
5-Year	104.99	1.64
10-Year	121.93	1.90
25-Year	143.48	2.24
50-Year	159.52	2.49
100-Year	175.36	2.74

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Proposed Conditions

Total Drainage Area : 9.30 ha
Runoff Coefficient : 0.62 -
Total Road Area : 1.23 ha
tc : 10 min
T : 0.167 hr

Design Storm	Rainfall Intensity	Peak Discharge	Etobicoke Drain
-	mm/hr	cms	cms
2-Year	79.43	1.28	0.0156
5-Year	104.99	1.69	0.0257
10-Year	121.93	1.96	0.0328
25-Year	143.48	2.31	0.0452
50-Year	159.52	2.56	0.0580
100-Year	175.36	2.82	0.0679

$I = A * (T)^B$ $Q = 0.0028(C * I * Area)$

Subject: **Storage Requirements - Outlet 7**
Project: **Bramalea Road**
Project No.: **165010590**
Client: **The City of Brampton**
Date: **10-Apr-23**

Storage Requirements

100-Year Allowable Flow (Post to Pre) : **2.82 cu. m**

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	2.797	1678.21	1690.28	-12.07	-15.70
15	132.78	2.118	1906.07	2535.42	-629.35	-818.16
20	109.00	1.739	2086.26	3380.56	-1294.30	-1682.59
25	93.53	1.492	2237.68	4225.70	-1988.02	-2584.42
30	82.53	1.316	2369.53	5070.84	-2701.31	-3511.71

Required Storage : **-16 cu. m**
ie: No storage Required

100-Year Allowable Flow (URR): **0.07 cu. m**

Time (min)	Rainfall Intensity (mm/hr)	Peak Runoff Rate (cms)	Incremental Runoff Volume (cms)	Incremental Outflow Volume (cms)	Storage Volume (cum)	Storage Volume + 30 % Contigency
10	175.36	0.369	221.50	40.74	180.76	234.99
15	132.78	0.280	251.58	61.12	190.46	247.60
20	109.00	0.229	275.36	81.49	193.87	252.03
25	93.53	0.197	295.35	101.86	193.49	251.53
30	82.53	0.174	312.75	122.23	190.52	247.67

Required Storage : **252 cu. m**

Pre Development Catchment Water Balance

Catchment Summary					Infiltration Factor				Average Annual Depth		Output				
Catchment	Land Type	Area (ha)	Soil Type	Soil Group	Topography[1]	Soils[2]	Land Use[3]	Total	Precipitation[4] (mm)	Evapotranspiration[5] (mm)	Average Annual Rainfall (m^3)	Evapotranspiration (m^3)	Precipitation Surplus (m^3)	Groundwater Recharge (m^3)	Annual Runoff Volume (m^3)
300	Pervious	0.78	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	5322.9	3035.2	2287.7	1143.9	1143.9
	Impervious	0.48	Clay	C	0	0	0	0	684.6	480.0	3312.2	2322.3	989.9	0.0	989.9
301	Pervious	83.35	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	570609.1	325368.6	245240.5	122620.2	122620.2
	Impervious	59.75	Clay	C	0	0	0	0	684.6	480.0	409026.6	286784.6	122241.9	0.0	122241.9
302	Pervious	0.01	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	58.3	33.3	25.1	12.5	12.5
	Impervious	0.67	Clay	C	0	0	0	0	684.6	480.0	4575.1	3207.8	1367.3	0.0	1367.3
303	Pervious	0.00	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	0.0	0.0	0.0	0.0	0.0
	Impervious	4.44	Clay	C	0	0	0	0	684.6	480.0	30396.3	21312.1	9084.3	0.0	9084.3
304	Pervious	0.01	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	96.0	54.7	41.3	20.6	20.6
	Impervious	1.23	Clay	C	0	0	0	0	684.6	480.0	8400.4	5889.9	2510.6	0.0	2510.6
305	Pervious	0.84	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	5783.9	3298.1	2485.8	1242.9	1242.9
	Impervious	0.87	Clay	C	0	0	0	0	684.6	480.0	5956.8	4176.6	1780.3	0.0	1780.3
306	Pervious	3.82	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	26170.1	14922.5	11247.6	5623.8	5623.8
	Impervious	5.35	Clay	C	0	0	0	0	684.6	480.0	36613.7	25671.3	10942.4	0.0	10942.4
										Total	**1106321**	**696077**	**410245**	**130664**	**279581**

Post-Development Catchment Water Balance

Catchment Summary					Infiltration Factor				Average Annual Depth		Output				
Catchment	Land Type	Area (ha)	Soil Type	Soil Group	Topography[1]	Soils[2]	Land Use[3]	Total	Precipitation[4] (mm)	Evapotranspiration[5] (mm)	Average Annual Rainfall (m^3)	Evapotranspiration (m^3)	Precipitation Surplus (m^3)	Groundwater Recharge (m^3)	Annual Runoff Volume (m^3)
400	Pervious	0.73	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	5010.3	2857.0	2153.4	1076.7	1076.7
	Impervious	0.58	Clay	C	0	0	0	0	684.6	480.0	3975.2	2787.2	1188.0	0.0	1188.0
401	Pervious	81.20	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	555929.1	316997.8	238931.2	119465.6	119465.6
	Impervious	62.01	Clay	C	0	0	0	0	684.6	480.0	424495.9	297630.7	126865.1	0.0	126865.1
402	Pervious	0.09	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	624.7	356.2	268.5	134.2	134.2
	Impervious	0.68	Clay	C	0	0	0	0	684.6	480.0	4627.2	3244.3	1382.9	0.0	1382.9
403	Pervious	0.49	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	3361.6	1916.9	1444.8	722.4	722.4
	Impervious	4.01	Clay	C	0	0	0	0	684.6	480.0	27431.7	19233.5	8198.3	0.0	8198.3
404	Pervious	0.03	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	228.5	130.3	98.2	49.1	49.1
	Impervious	1.22	Clay	C	0	0	0	0	684.6	480.0	8353.9	5857.3	2496.7	0.0	2496.7
405	Pervious	0.80	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	5478.6	3124.0	2354.6	1177.3	1177.3
	Impervious	0.93	Clay	C	0	0	0	0	684.6	480.0	6383.3	4475.6	1907.7	0.0	1907.7
406	Pervious	3.77	Clay	C	0.2	0.2	0.1	0.5	684.6	390.4	25777.8	14698.8	11079.0	5539.5	5539.5
	Impervious	5.54	Clay	C	0	0	0	0	684.6	480.0	37914.6	26583.4	11331.2	0.0	11331.2
										Total	**1109593**	**699893**	**409700**	**128165**	**281535**

Groundwater Recharge Deficit from Existing to Proposed: 2499.1 m

Annual Runoff Increase from Existing to Proposed: 1954.1 m

Subject: **Infiltration Calculations and LID sizing**
Project: **Bramalea Road**
Project No.: **165010590**
Client: **City of Brampton**
Date: **28-Mar-22**

Catchment ID	Total Area (ha)	5 mm Infiltration Volume (m^3)	Infiltration Gallery Width (m)	Total Infiltration Gallery Length (m)	Total Infiltration Swale Length (m)
400	0.53	26.7	1.0	66.8	-
401	5.75	287.6	2.5	143.8	115.1
402	0.62	31.2	1.75	44.6	-
403	0.37	18.6	2.5	18.6	-
404	1.20	59.9	2.0	74.9	-
405	0.67	33.5	2.5	33.5	-
406	1.23	61.4	2.0	76.7	-

Infiltration Gallery Dimensions	
Height (m)	1
Porosity	0.4

Infiltration Swale Dimensions	
Bottom width (m)	0.5
Height (m)	0.5
Slope (rise:run)	0.25
Top width (m)	4.5
Cross sectional area (m^2)	1.25

APPENDIX C:
Storm Sewer Design Calculations

Existing Storm Sewer Design Sheet

Bramalea Road EA (Queen Street East to Highway 407)

Stantec

Project:	Bramalea Road Class EA	Design Storm Parameters							
File Number:	1850-10590	I = a / ((t_c + b)^c)							
Date:	November 23, 2022	A	527,4	Design Frequency =	5 year	Minimum Cover =	1,5 m	Maximum Permitted Full Flow Velocity =	4,50 m/s
Designed by:	MS	B	0,0	Mannings "n" =	0,013	Time of Entry =	10 min	Minimum Permitted Full Flow Velocity =	0,75 m/s
Checked by:	DRAFT	C	0,781						

Location			Drainage Area				Time		Design Flow		Pipe Flow								
ID in City of Brampton's Online Storm Sewer Data	Comment	Drainage Area ID	Area (ha)	C	A x C	Accum. AC	T of C (min)	Sytem Time (min)	I (mm/h)	Q (m^3/s)	Length (m)	Pipe Size (mm)	Slope	Cap. (Full) (m^3/s)	Vel. (Full) (m/s)	Vel. (ACT) (m/s)	Time of flow (min)	Pipe Capacity	Remarks
To Outlet 1																			
10655	Flow direction assumed - to be confirmed during detailed design	100	1,261	0,47	0,59	0,59	10,00	10,00	104,99	0,172	79,8	300,0	1,0%	0,098	0,35	0,40	3,35	175%	SURCHARGED
To Outlet 2																			
88477		101	0,262	0,92	0,24	0,24	10,00	10,00	104,99	0,070	91,4	375,0	0,5%	0,119	0,27	0,28	5,46	59%	No Surcharge
88473		102	0,406	0,67	0,27	0,51	10,00	15,46	77,36	0,110	45,9	375,0	1,3%	0,201	0,46	0,47	1,84	55%	No Surcharge
88471		103	0,242	0,66	0,16	0,67	10,00	17,10	72,07	0,135	44,8	375,0	1,3%	0,201	0,46	0,49	1,52	67%	No Surcharge
88470		104	0,178	0,62	0,09	0,77	10,00	18,62	67,90	0,144	91,4	375,0	1,6%	0,224	0,51	0,54	2,81	65%	No Surcharge
40342		105	0,288	0,62	0,18	0,95	10,00	21,44	61,32	0,162	90,6	450,0	1,6%	0,363	0,57	0,55	2,74	45%	No Surcharge
36290		106	0,296	0,62	0,18	1,13	10,00	24,17	56,55	0,178	91,4	450,0	0,7%	0,240	0,38	0,42	3,85	74%	No Surcharge
36287		107	0,312	0,57	0,18	1,31	10,00	27,82	51,34	0,186	80,5	525,0	0,4%	0,284	0,33	0,35	3,82	66%	No Surcharge
36284		108	0,247	0,57	0,14	1,45	10,00	31,64	46,82	0,189	80,2	525,0	0,5%	0,319	0,37	0,38	3,49	59%	No Surcharge
36304		109	0,359	0,51	0,18	1,63	10,00	35,13	43,51	0,198	85,2	525,0	0,5%	0,319	0,37	0,39	3,64	62%	No Surcharge
36299		110	0,471	0,59	0,28	1,91	10,00	38,78	40,60	0,218	85,2	525,0	0,5%	0,319	0,37	0,40	3,59	68%	No Surcharge
36282		111	0,207	0,70	0,14	2,05	10,00	42,37	38,16	0,218	85,3	600,0	0,3%	0,339	0,30	0,32	4,44	64%	No Surcharge
36281		112	0,676	0,34	0,23	2,28	10,00	46,80	35,59	0,226	85,3	600,0	0,3%	0,339	0,30	0,32	4,41	67%	No Surcharge
36280		113	0,598	0,36	0,22	2,50	10,00	51,22	33,41	0,232	85,3	600,0	0,6%	0,459	0,41	0,41	3,50	51%	No Surcharge
36255		114	0,566	0,39	0,23	2,73	10,00	54,72	31,89	0,242	92,2	600,0	0,8%	0,554	0,49	0,46	3,30	44%	No Surcharge
36246		115	0,236	0,60	0,14	2,87	10,00	58,02	30,61	0,244	79,2	600,0	0,8%	0,600	0,53	0,50	2,65	41%	No Surcharge
36244		116	0,322	0,48	0,15	3,03	10,00	60,67	29,67	0,250	82,6	600,0	0,7%	0,518	0,46	0,45	3,04	48%	No Surcharge
36213		117	1,125	0,43	0,48	3,51	10,00	63,71	28,87	0,280	82,3	600,0	0,8%	0,536	0,47	0,48	2,87	52%	No Surcharge
36207		118	1,414	0,44	0,63	4,13	10,00	66,57	27,80	0,320	88,4	600,0	0,8%	0,554	0,49	0,50	2,82	58%	No Surcharge
36192		119	1,392	0,48	0,67	4,81	10,00	69,50	26,87	0,360	76,2	600,0	0,8%	0,571	0,50	0,53	2,37	63%	No Surcharge
36191		120	0,687	0,56	0,39	5,19	10,00	71,87	26,35	0,380	82,3	600,0	0,8%	0,564	0,50	0,54	2,56	67%	No Surcharge
36180		121	0,546	0,42	0,23	5,42	10,00	74,43	25,71	0,388	86,3	600,0	0,8%	0,584	0,52	0,55	2,59	66%	No Surcharge
36177		122	0,495	0,47	0,23	5,66	10,00	77,02	25,10	0,395	86,7	600,0	0,8%	0,587	0,52	0,56	2,59	67%	No Surcharge
36174		123	0,302	0,51	0,15	5,81	10,00	79,61	24,52	0,396	86,3	600,0	1,2%	0,693	0,53	0,57	2,52	66%	No Surcharge
36171		124	0,341	0,48	0,16	5,98	10,00	82,13	23,99	0,399	86,0	600,0	1,2%	0,678	0,60	0,62	2,30	59%	No Surcharge
36169		125	0,264	0,54	0,14	6,12	10,00	84,43	23,53	0,400	91,4	600,0	1,3%	0,758	0,67	0,68	2,25	53%	No Surcharge
36167		126	0,601	0,49	0,29	6,41	10,00	86,68	23,10	0,412	91,4	600,0	1,5%	0,758	0,67	0,68	2,23	54%	No Surcharge
36164		127	0,335	0,48	0,16	6,57	10,00	88,91	22,70	0,415	90,4	600,0	1,5%	0,758	0,67	0,68	2,20	55%	No Surcharge
36161		124	0,361	0,48	0,17	6,75	10,00	91,11	22,31	0,419	24,2	600,0	1,5%	0,758	0,67	0,68	0,59	55%	No Surcharge
36156		128	79,583	0,43	30,62	37,37	10,00	91,70	22,21	2,307	69,6	1500,0	0,6%	5,519	0,78	0,73	1,58	42%	No Surcharge
36147		129	23,214	0,39	9,10	46,47	10,00	93,28	21,94	2,835	122,3	1650,0	0,5%	6,496	0,76	0,72	2,83	44%	No Surcharge
36115		130	0,397	0,68	0,27	46,74	10,00	96,11	21,49	2,792	117,0	1800,0	0,5%	8,193	0,80	0,72	2,89	34%	No Surcharge
36098		131	14,050	0,63	8,80	55,54	10,00	98,80	21,08	3,255	119,0	1800,0	0,5%	8,193	0,80	0,74	2,66	40%	No Surcharge
35896		132	5,493	0,73	4,03	59,57	10,00	101,46	20,69	3,426	116,0	1800,0	0,5%	8,193	0,80	0,76	2,56	42%	No Surcharge
		133	6,622	0,63	4,15	4,15	10,00	104,02	20,33	0,235									
35807		134	9,136	0,74	6,72	70,44	10,00	104,02	20,33	3,981	159,0	1800,0	0,5%	8,193	0,80	0,80	3,30	49%	No Surcharge
To Outlet 3																			
122894		135	0,341	0,88	0,30	0,30	10,00	10,00	104,99	0,088	52,5	450,0	0,5%	0,203	0,32	0,30	2,88	43%	No Surcharge
122896		136	0,374	0,90	0,34	0,24	10,00	12,88	87,91	0,082	60,8	300,0	0,5%	0,069	0,24	0,28	3,64	119%	SURCHARGED
To Outlet 4																			
122793		137A	0,191	0,90	0,17	0,17	10,00	10,00	104,99	0,050	25,5	250,0	0,5%	0,042	0,22	0,25	1,73	118%	SURCHARGED
122812						0,17	10,00	11,73	93,91	0,045	6,6	300,0	0,5%	0,069	0,24	0,26	0,42	65%	No Surcharge
122794		137B	0,191	0,90	0,17	0,17	10,00	10,00	104,99	0,050	24,1	250,0	0,5%	0,042	0,22	0,25	1,63	118%	SURCHARGED
122795						0,17	10,00	11,63	94,42	0,045	12,1	300,0	0,5%	0,069	0,24	0,26	0,78	65%	No Surcharge
To Outlet 5																			
122518		138	0,378	0,89	0,34	0,34	10,00	10,00	104,99	0,098	24,2	250,0	0,5%	0,042	0,22	0,25	1,64	232%	SURCHARGED
122409						0,34	10,00	11,64	94,41	0,088	18,9	300,0	0,5%	0,069	0,24	0,26	1,13	128%	SURCHARGED
122891		139A	0,188	0,89	0,17	0,17	10,00	10,00	104,99	0,049	24,2	250,0	0,5%	0,042	0,22	0,25	1,64	115%	SURCHARGED
122517						0,17	10,00	11,64	94,41	0,044	17,6	300,0	0,5%	0,069	0,24	0,26	1,13	64%	No Surcharge
123979		139B	0,188	0,89	0,17	0,17	10,00	10,00	104,99	0,049	24,0	250,0	0,5%	0,042	0,22	0,25	1,62	115%	SURCHARGED
122516						0,17	10,00	11,62	94,49	0,044	18,7	300,0	0,5%	0,069	0,24	0,26	1,21	64%	No Surcharge
122515		140A	0,244	0,89	0,22	0,22	10,00	10,00	104,99	0,063	24,4	250,0	0,5%	0,042	0,22	0,25	1,65	150%	SURCHARGED
122610						0,22	10,00	11,62	94,49	0,057	13,0	300,0	0,5%	0,069	0,24	0,27	0,79	83%	No Surcharge
122336		140B	0,244	0,89	0,22	0,22	10,00	10,00	104,99	0,063	25,7	250,0	0,5%	0,042	0,22	0,25	1,74	150%	SURCHARGED
122337						0,22	10,00	11,74	93,81	0,057	16,8	300,0	0,5%	0,069	0,24	0,27	1,03	82%	No Surcharge
To Outlet 6																			
122338		141A	0,154	0,46	0,07	0,07	10,00	10,00	104,99	0,021	26,4	250,0	0,5%	0,042	0,22	0,21	2,06	49%	No Surcharge
122892						0,07	10,00	12,06	92,09	0,018	6,5	300,0	0,5%	0,069	0,24	0,20	0,54	26%	No Surcharge
122705		141B	0,154	0,46	0,07	0,07	10,00	10,00	104,99	0,021	9,8	300,0	0,5%	0,069	0,24	0,21	0,77	30%	No Surcharge
122893		142	0,341	0,85	0,29	0,29	10,00	10,00	104,99	0,085	25,5	300,0	0,5%	0,069	0,24	0,28	1,53	123%	SURCHARGED
To Outlet 7																			
84140		143	3,242	0,70	2,27	2,27	10,00	10,00	104,99	0,663	91,5	825,0	0,3%	0,792	0,37	0,42	3,88	84%	No Surcharge
		144	0,291	0,57	0,17	0,17	10,00	10,00	104,99	0,049									
84153		145	1,652	0,57	0,94	3,38	10,00	13,66	84,38	0,793	91,5	825,0	0,3%	0,792	0,37	0,43	3,53	100%	No Surcharge
84154		146	0,276	0,67	0,19	3,56	10,00	17,19	71,82	0,712	91,5	900,0	0,3%	0,899	0,39	0,43	3,56	71%	No Surcharge
84124		147	3,710	0,54	2,01	5,58	10,00	20,75	62,64	0,976	89,0	900,0	0,5%	1,290	0,51	0,56	2,65	76%	No Surcharge

Notes:
1. Sewer information in accordance with online storm sewer GIS information, provided by the City of Brampton
2. Where slope was unknown, a slope of 0.5% was assumed. Slope to be confirmed during detailed design
3. Capacity of downstream receivers was not analyzed
4. Storm sewer calculations do not account for any on site stormwater management controls from contributing sites
5. Where storm sewer information was unavailable for contributing site, LiDAR data was used

Proposed Conditions - Existing Sewer Network
Storm Sewer Design Sheet

Bramalea Road EA (Queen Street East to Highway 407)

Stantec

Project:	Bramalea Road Class EA	**Design Storm Parameters**							
File Number:	1650-10590	I = a / ((tc + b) ^c)							
Date:	November 21, 2022	A	527.4	Design Frequency =	5 year	Minimum Cover =	1.5 m	Maximum Permitted Full Flow Velocity =	4.50 m/s
Designed by:	MS	B	0.0	Mannings 'n' =	0.013	Time of Entry =	10 min	Minimum Permitted Full Flow Velocity =	0.75 m/s
Checked by:	DRAFT	C	0.701						

Location			Drainage Area				Time		Design Flow		Pipe Flow								
ID in City of Brampton's Online Storm Sewer Data	Comment	Drainage Area ID	Area (ha)	C	A x C	Accum. AC	T of C (min)	Sytem Time (min)	I (mm/h)	Q (m³/s)	Length (m)	Pipe Size (mm)	Slope	Cap. (Full) (m³/s)	Vel. (Full) (m/s)	Vel. (ACT) (m/s)	Time of Flow (min)	Pipe Capacity	Remarks
To Outlet 1																			
10655	Flow direction assumed - to be confirmed during detailed design	200	1.261	0.51	0.64	0.64	10.00	10.00	104.99	0.188	78.9	300.0	1.0%	0.098	0.35	0.40	3.35	191%	SURCHARGED
To Outlet 2																			
88477		201	0.292	0.84	0.24	0.24	10.00	10.00	104.99	0.071	91.4	375.0	0.5%	0.119	0.27	0.28	5.41	60%	No Surcharge
88473		202	0.406	0.75	0.31	0.55	10.00	15.41	77.54	0.119	45.9	375.0	1.3%	0.201	0.46	0.47	1.61	59%	No Surcharge
88471		203	0.242	0.81	0.19	0.74	10.00	17.02	72.32	0.150	44.6	375.0	1.3%	0.201	0.46	0.50	1.48	74%	No Surcharge
88470		204	0.179	0.83	0.11	0.86	10.00	18.50	68.22	0.163	91.4	375.0	1.6%	0.224	0.51	0.56	2.74	73%	No Surcharge
40342		205	0.269	0.71	0.21	1.07	10.00	21.23	61.93	0.184	90.6	450.0	1.6%	0.363	0.57	0.57	2.64	51%	No Surcharge
36290		206	0.296	0.72	0.21	1.28	10.00	23.88	57.04	0.204	91.4	450.0	0.7%	0.240	0.38	0.43	3.57	85%	No Surcharge
36287		207	0.312	0.67	0.21	1.49	10.00	27.45	51.73	0.215	80.5	525.0	0.4%	0.284	0.33	0.38	3.70	75%	No Surcharge
36284		208	0.247	0.63	0.16	1.65	10.00	31.14	47.35	0.217	80.2	525.0	0.5%	0.319	0.37	0.40	3.35	68%	No Surcharge
36304		209	0.359	0.60	0.21	1.86	10.00	34.49	44.08	0.228	85.2	525.0	0.5%	0.319	0.37	0.40	3.54	72%	No Surcharge
36299		210	0.471	0.64	0.30	2.16	10.00	38.03	41.18	0.247	85.2	525.0	0.5%	0.319	0.37	0.41	3.48	78%	No Surcharge
36262		211	0.207	0.75	0.16	2.32	10.00	41.51	38.71	0.249	85.3	600.0	0.3%	0.339	0.30	0.33	4.31	74%	No Surcharge
36261		212	0.078	0.38	0.03	2.57	10.00	45.82	36.12	0.258	85.3	600.0	0.3%	0.339	0.30	0.33	4.28	76%	No Surcharge
36260		213	0.599	0.41	0.24	2.82	10.00	50.10	33.83	0.266	85.3	600.0	0.6%	0.459	0.41	0.42	3.40	58%	No Surcharge
36255		214	0.595	0.42	0.25	3.08	10.00	53.50	32.40	0.278	92.2	600.0	0.8%	0.554	0.49	0.48	3.17	50%	No Surcharge
36246		215	0.236	0.66	0.16	3.22	10.00	56.67	31.12	0.279	79.2	600.0	0.6%	0.800	0.53	0.52	2.54	35%	No Surcharge
36244		216	0.322	0.59	0.19	3.41	10.00	59.21	30.18	0.286	82.6	600.0	0.7%	0.518	0.46	0.47	2.95	55%	No Surcharge
36213		217	1.125	0.51	0.58	3.99	10.00	62.16	29.17	0.323	82.3	600.0	0.8%	0.536	0.47	0.50	2.78	60%	No Surcharge
36207		218	1.414	0.47	0.67	4.66	10.00	64.92	28.29	0.366	88.4	600.0	0.8%	0.554	0.49	0.53	2.80	66%	No Surcharge
36192		219	1.382	0.51	0.71	5.36	10.00	67.72	27.47	0.410	76.2	600.0	0.6%	0.571	0.50	0.55	2.31	72%	No Surcharge
36191		220	0.887	0.56	0.39	5.75	10.00	70.02	26.83	0.429	82.3	600.0	0.8%	0.564	0.50	0.55	2.48	76%	No Surcharge
36180		221	0.546	0.48	0.26	6.01	10.00	72.50	26.18	0.438	86.3	600.0	0.9%	0.594	0.52	0.57	2.52	75%	No Surcharge
36177		222	0.495	0.55	0.27	6.29	10.00	75.02	25.56	0.447	88.7	600.0	0.9%	0.587	0.52	0.58	2.51	76%	No Surcharge
36174		223	0.302	0.57	0.17	6.46	10.00	77.53	24.98	0.448	86.3	600.0	1.0%	0.603	0.53	0.59	2.44	74%	No Surcharge
36171		224	0.341	0.51	0.18	6.63	10.00	79.97	24.45	0.451	88.0	600.0	1.2%	0.678	0.60	0.64	2.22	66%	No Surcharge
36169		225	0.284	0.63	0.17	6.80	10.00	82.19	23.98	0.453	91.4	600.0	1.5%	0.758	0.67	0.70	2.19	60%	No Surcharge
36167		226	0.601	0.54	0.32	7.12	10.00	84.38	23.54	0.466	91.4	600.0	1.5%	0.758	0.67	0.70	2.17	61%	No Surcharge
36164		227	0.335	0.59	0.20	7.32	10.00	86.55	23.13	0.471	90.4	600.0	1.5%	0.758	0.67	0.71	2.12	62%	No Surcharge
36161		228.5	0.391	0.63	0.23	7.54	10.00	88.67	22.74	0.477	24.2	600.0	1.5%	0.758	0.67	0.71	0.57	63%	No Surcharge
36156		228	70.583	0.44	31.01	38.56	10.00	89.23	22.64	2.427	69.6	1500.0	0.6%	5.519	0.78	0.74	1.58	44%	No Surcharge
36147		229	23.214	0.40	9.22	47.78	10.00	90.80	22.36	2.971	122.3	1650.0	0.5%	6.496	0.76	0.73	2.78	46%	No Surcharge
36115		230	0.397	0.78	0.31	48.09	10.00	93.58	21.80	2.927	117.0	1800.0	0.5%	8.193	0.80	0.72	2.69	36%	No Surcharge
36098		231	14.050	0.62	8.77	56.86	10.00	96.27	21.46	3.393	119.0	1800.0	0.5%	8.193	0.80	0.76	2.62	41%	No Surcharge
35898		232	5.463	0.74	4.05	60.91	10.00	98.89	21.08	3.567	118.0	1800.0	0.5%	8.193	0.80	0.78	2.53	44%	No Surcharge
		233	6.822	0.63	4.18	4.18	10.00	101.42	20.69	0.241									
35807		234	9.136	0.75	6.83	71.92	10.00	101.42	20.69	4.138	158.0	1800.0	0.5%	8.193	0.80	0.80	3.27	51%	No Surcharge
To Outlet 3																			
122694		235	0.341	0.82	0.28	0.28	10.00	10.00	104.99	0.081	52.5	450.0	0.5%	0.203	0.32	0.30	2.98	40%	No Surcharge
122696		236	0.374	0.82	0.31	0.31	10.00	12.98	87.54	0.074	60.8	300.0	0.5%	0.069	0.24	0.28	3.60	108%	SURCHARGED
To Outlet 4																			
122793		237A	0.191	0.82	0.16	0.16	10.00	10.00	104.99	0.046	25.5	250.0	0.5%	0.042	0.22	0.25	1.70	108%	SURCHARGED
122512						0.16	10.00	11.70	94.03	0.041	6.6	300.0	0.5%	0.069	0.24	0.25	0.44	59%	No Surcharge
122794		237B	0.191	0.82	0.16	0.16	10.00	10.00	104.99	0.046	24.1	250.0	0.5%	0.042	0.22	0.25	1.61	108%	SURCHARGED
122795						0.16	10.00	11.61	94.54	0.041	12.1	300.0	0.5%	0.069	0.24	0.25	0.80	60%	No Surcharge
To Outlet 5																			
122518		238	0.378	0.89	0.33	0.33	10.00	10.00	104.99	0.098	24.2	250.0	0.5%	0.042	0.22	0.25	1.64	230%	SURCHARGED
124409						0.33	10.00	11.64	94.41	0.088	18.9	300.0	0.5%	0.069	0.24	0.28	1.13	127%	SURCHARGED
123991		239A	0.188	0.89	0.17	0.17	10.00	10.00	104.99	0.049	24.2	250.0	0.5%	0.042	0.22	0.25	1.64	116%	SURCHARGED
122517						0.17	10.00	11.64	94.41	0.044	17.6	300.0	0.5%	0.069	0.24	0.26	1.12	64%	No Surcharge
122979		239B	0.188	0.89	0.17	0.17	10.00	10.00	104.99	0.049	24.0	250.0	0.5%	0.042	0.22	0.25	1.62	116%	SURCHARGED
122516						0.17	10.00	11.62	94.49	0.044	18.7	300.0	0.5%	0.069	0.24	0.26	1.20	64%	No Surcharge
122515		240A	0.244	0.87	0.21	0.21	10.00	10.00	104.99	0.062	24.4	250.0	0.5%	0.042	0.22	0.25	1.65	146%	SURCHARGED
123610						0.21	10.00	11.62	94.49	0.058	13.0	300.0	0.5%	0.069	0.24	0.27	0.80	81%	No Surcharge
122336		240B	0.244	0.87	0.21	0.21	10.00	10.00	104.99	0.062	25.7	250.0	0.5%	0.042	0.22	0.25	1.74	146%	SURCHARGED
122337						0.21	10.00	11.74	93.81	0.055	16.9	300.0	0.5%	0.069	0.24	0.27	1.04	80%	No Surcharge
To Outlet 6																			
122338		241A	0.154	0.47	0.07	0.07	10.00	10.00	104.99	0.021	28.4	250.0	0.5%	0.042	0.22	0.21	2.08	50%	No Surcharge
122862						0.07	10.00	12.08	92.09	0.019	6.5	300.0	0.5%	0.069	0.24	0.20	0.54	27%	No Surcharge
122705		241B	0.154	0.47	0.07	0.07	10.00	10.00	104.99	0.021	6.8	300.0	0.5%	0.069	0.24	0.21	0.77	31%	No Surcharge
122894		242	0.341	0.90	0.31	0.31	10.00	10.00	104.99	0.089	7.4	300.0	0.5%	0.069	0.24	0.28	0.44	130%	SURCHARGED
To Outlet 7																			
84140		243	3.242	0.71	2.31	2.31	10.00	10.00	104.99	0.675	91.5	825.0	0.3%	0.792	0.37	0.42	3.64	85%	No Surcharge
		244	0.291	0.66	0.19	0.19	10.00	10.00	104.99	0.056									
84153		245	1.852	0.57	0.93	3.44	10.00	13.64	84.45	0.808	91.5	825.0	0.3%	0.792	0.37	0.43	3.53	102%	No Surcharge
84154		246	0.276	0.77	0.21	3.65	10.00	17.17	71.87	0.730	91.5	900.0	0.3%	0.999	0.39	0.43	3.53	73%	No Surcharge
84124		247	3.710	0.54	1.99	5.64	10.00	20.70	63.04	0.989	89.0	900.0	0.5%	1.290	0.51	0.56	2.64	77%	No Surcharge

Notes:
1. Sewer information in accordance with online storm sewer GIS information, provided by the City of Brampton
2. Where slope was unknown, a slope of 0.5% was assumed. Slope to be confirmed during detailed design
3. Capacity of downstream receivers was not analyzed
4. Storm sewer calculations do not account for any on site stormwater management controls from contributing sites
5. Where storm sewer information was unavailable for contributing site, LIDAR data was used

APPENDIX D:
OGS Sizing Reports

ADS OGS Sizing Summary

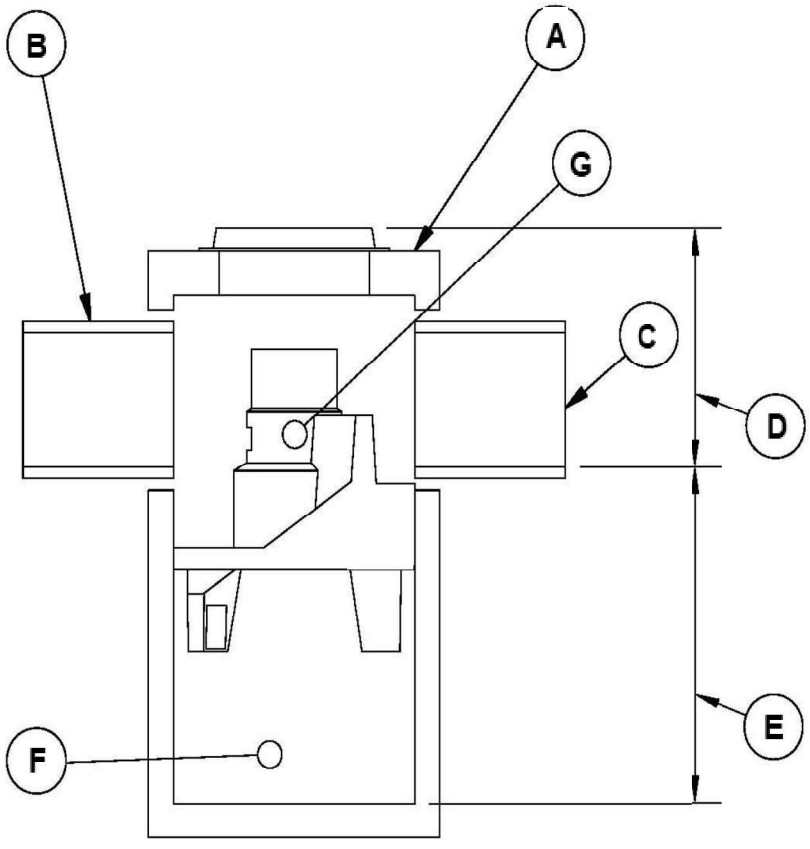
Project Name:	165010590 - Bramalea Road - Catchment 400
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.53 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
FD-4HC	90.0%	>90%
FD-5HC	93.0%	>90%
FD-6HC	95.0%	>90%
FD-8HC	97.0%	>90%
FD-10HC	98.0%	>90%

FD 4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 400
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 4HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.2%	100.0%	0.2%
1.00	16.3%	100.0%	16.3%
1.50	13.1%	97.6%	12.8%
2.00	13.2%	95.0%	12.6%
2.50	4.5%	93.0%	4.2%
3.00	2.2%	91.5%	2.0%
3.50	8.4%	90.2%	7.6%
4.00	4.8%	89.0%	4.2%
4.50	1.5%	88.1%	1.3%
5.00	5.0%	87.2%	4.3%
6.00	4.4%	85.8%	3.8%
7.00	4.8%	84.5%	4.0%
8.00	3.5%	83.5%	3.0%
9.00	2.2%	82.6%	1.8%
10.00	2.4%	81.8%	2.0%
20.00	8.8%	76.7%	6.8%
30.00	2.7%	73.8%	2.0%
40.00	0.9%	71.9%	0.7%
50.00	0.4%	70.4%	0.3%
100.00	0.5%	66.0%	0.3%
150.00	0.1%	63.6%	0.1%
200.00	0.0%	61.9%	0.0%
		Total Net Annual Removal Efficiency:	90.2%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

ADS OGS Sizing Summary

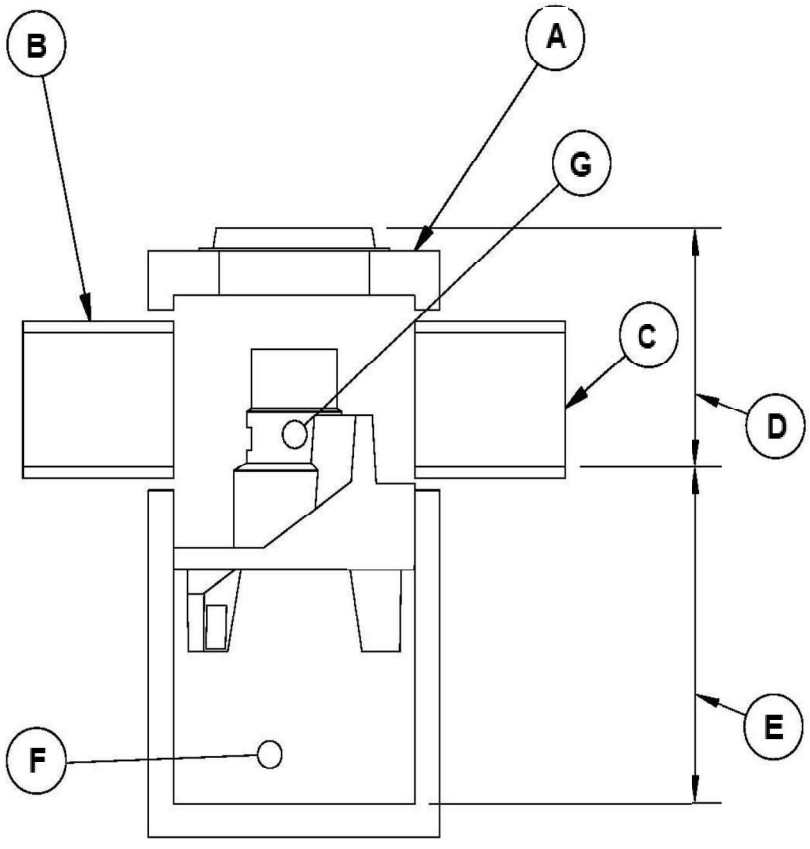
Project Name:	165010590 - Bramalea Road - Catchment 401
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-8HC**	

Site Details	
Site Area:	5.75 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
FD-4HC	72.0%	88.7%
FD-5HC	76.0%	>90%
FD-6HC	78.0%	>90%
FD-8HC	82.0%	>90%
FD-10HC	86.0%	>90%

FD 8HC Specification	
Unit Diameter (A):	2,400 mm
Inlet Pipe Diameter (B):	600 mm
Outlet Pipe Diameter (C):	600 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	2260 mm
Sediment Storage Capacity (F):	3.47 m³
Oil Storage Capacity (G):	4,239 L
Recommended Sediment Depth for Maintenance:	465 mm
Max. Pipe Diameter:	1,200 mm
Peak Flow Capacity:	1,415 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 401
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-8HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 8HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.2%	98.5%	0.2%
1.00	16.3%	92.3%	15.1%
1.50	13.1%	88.9%	11.7%
2.00	13.2%	86.6%	11.5%
2.50	4.5%	84.8%	3.8%
3.00	2.2%	83.4%	1.8%
3.50	8.4%	82.2%	6.9%
4.00	4.8%	81.2%	3.9%
4.50	1.5%	80.3%	1.2%
5.00	5.0%	79.5%	4.0%
6.00	4.4%	78.2%	3.4%
7.00	4.8%	77.1%	3.7%
8.00	3.5%	76.1%	2.7%
9.00	2.2%	75.3%	1.7%
10.00	2.4%	74.5%	1.8%
20.00	8.8%	69.9%	6.2%
30.00	2.7%	67.3%	1.8%
40.00	0.9%	65.5%	0.6%
50.00	0.4%	64.2%	0.3%
100.00	0.5%	60.2%	0.3%
150.00	0.1%	57.9%	0.0%
200.00	0.0%	56.4%	0.0%
		Total Net Annual Removal Efficiency:	82.4%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

ADS OGS Sizing Summary

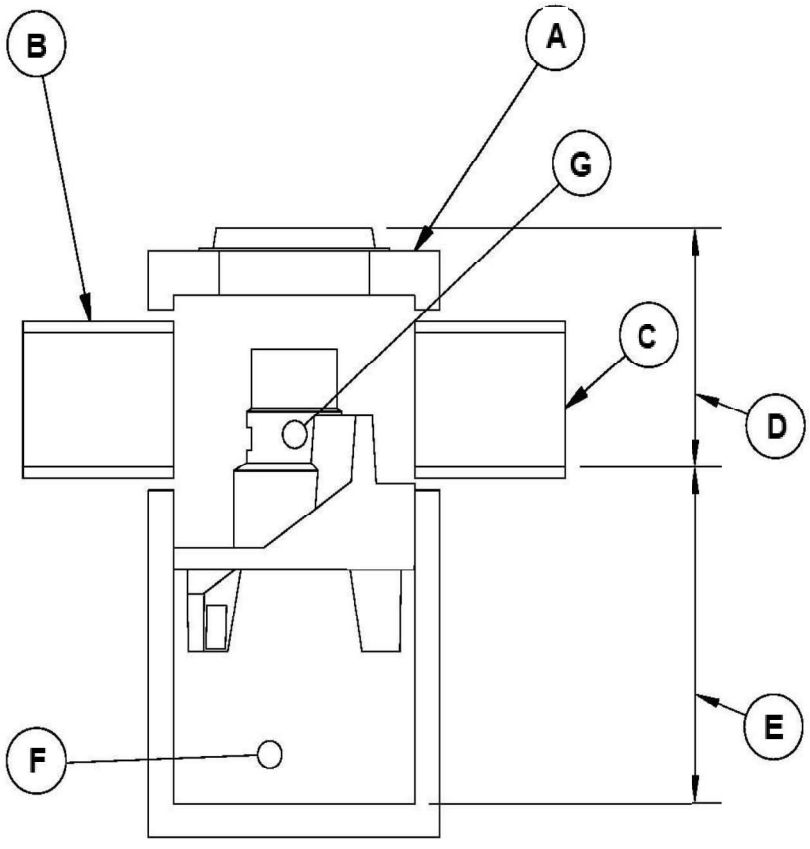
Project Name:	165010590 - Bramalea Road - Catchment 402
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.62 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
Model	**TSS Removal**	**Volume Treated**
FD-4HC	89.0%	>90%
FD-5HC	92.0%	>90%
FD-6HC	94.0%	>90%
FD-8HC	97.0%	>90%
FD-10HC	98.0%	>90%

FD 4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 402
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 4HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
0.50	0.2%	100.0%	0.2%
1.00	16.3%	99.8%	16.3%
1.50	13.1%	96.1%	12.6%
2.00	13.2%	93.6%	12.4%
2.50	4.5%	91.7%	4.1%
3.00	2.2%	90.1%	2.0%
3.50	8.4%	88.9%	7.5%
4.00	4.8%	87.8%	4.2%
4.50	1.5%	86.8%	1.3%
5.00	5.0%	86.0%	4.3%
6.00	4.4%	84.5%	3.7%
7.00	4.8%	83.3%	4.0%
8.00	3.5%	82.3%	2.9%
9.00	2.2%	81.4%	1.8%
10.00	2.4%	80.6%	1.9%
20.00	8.8%	75.6%	6.7%
30.00	2.7%	72.8%	1.9%
40.00	0.9%	70.8%	0.7%
50.00	0.4%	69.4%	0.3%
100.00	0.5%	65.1%	0.3%
150.00	0.1%	62.6%	0.0%
200.00	0.0%	61.0%	0.0%
		Total Net Annual Removal Efficiency:	89.1%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

ADS OGS Sizing Summary

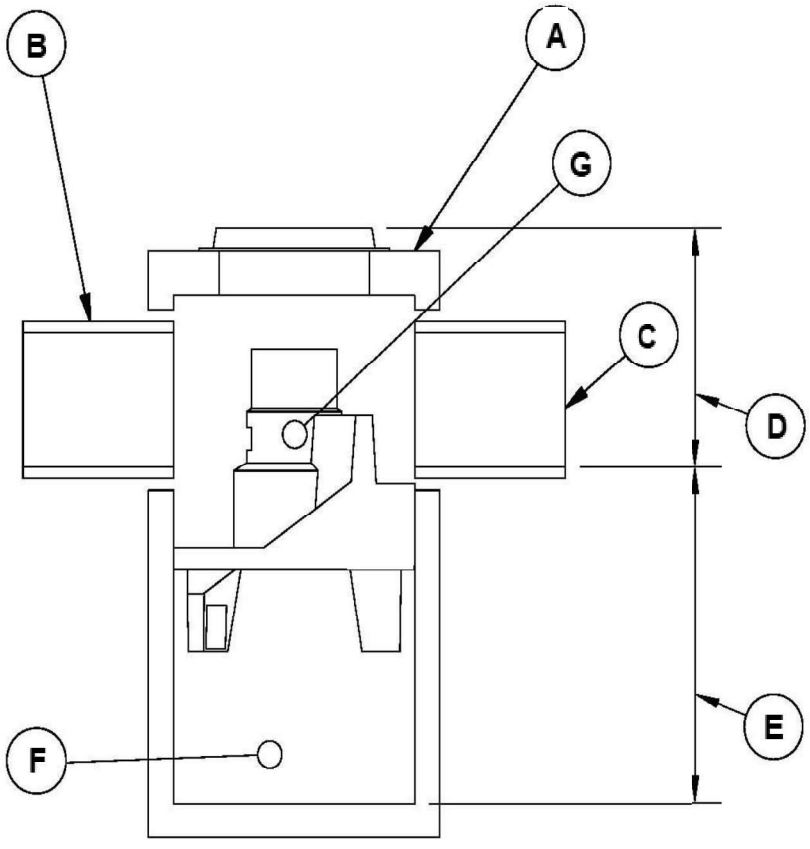
Project Name:	165010590 - Bramalea Road - Catchment 403
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.37 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
FD-4HC	93.0%	>90%
FD-5HC	95.0%	>90%
FD-6HC	97.0%	>90%
FD-8HC	98.0%	>90%
FD-10HC	99.0%	>90%

FD 4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 403
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 4HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.2%	100.0%	0.2%
1.00	16.3%	100.0%	16.3%
1.50	13.1%	100.0%	13.1%
2.00	13.2%	98.2%	13.0%
2.50	4.5%	96.2%	4.3%
3.00	2.2%	94.6%	2.1%
3.50	8.4%	93.2%	7.8%
4.00	4.8%	92.1%	4.4%
4.50	1.5%	91.1%	1.4%
5.00	5.0%	90.2%	4.5%
6.00	4.4%	88.7%	3.9%
7.00	4.8%	87.4%	4.2%
8.00	3.5%	86.3%	3.1%
9.00	2.2%	85.4%	1.9%
10.00	2.4%	84.6%	2.0%
20.00	8.8%	79.3%	7.0%
30.00	2.7%	76.3%	2.0%
40.00	0.9%	74.3%	0.7%
50.00	0.4%	72.8%	0.3%
100.00	0.5%	68.3%	0.4%
150.00	0.1%	65.7%	0.1%
200.00	0.0%	64.0%	0.0%
		Total Net Annual Removal Efficiency:	92.6%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

ADS OGS Sizing Summary

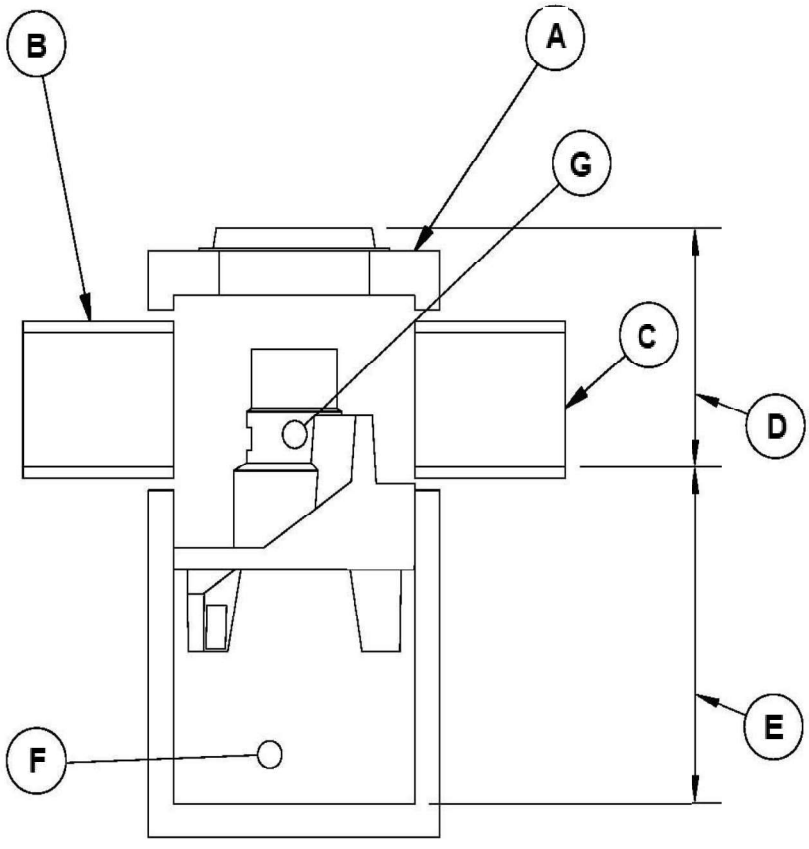
Project Name:	165010590 - Bramalea Road - Catchment 404
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	1.2 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
FD-4HC	84.0%	>90%
FD-5HC	88.0%	>90%
FD-6HC	90.0%	>90%
FD-8HC	94.0%	>90%
FD-10HC	96.0%	>90%

FD 4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 404
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 4HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.2%	100.0%	0.2%
1.00	16.3%	93.9%	15.3%
1.50	13.1%	90.4%	11.9%
2.00	13.2%	88.0%	11.7%
2.50	4.5%	86.2%	3.9%
3.00	2.2%	84.8%	1.9%
3.50	8.4%	83.6%	7.0%
4.00	4.8%	82.5%	3.9%
4.50	1.5%	81.6%	1.2%
5.00	5.0%	80.8%	4.0%
6.00	4.4%	79.5%	3.5%
7.00	4.8%	78.3%	3.8%
8.00	3.5%	77.4%	2.7%
9.00	2.2%	76.5%	1.7%
10.00	2.4%	75.8%	1.8%
20.00	8.8%	71.1%	6.3%
30.00	2.7%	68.4%	1.8%
40.00	0.9%	66.6%	0.6%
50.00	0.4%	65.3%	0.3%
100.00	0.5%	61.2%	0.3%
150.00	0.1%	58.9%	0.0%
200.00	0.0%	57.4%	0.0%
		Total Net Annual Removal Efficiency:	83.8%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

ADS OGS Sizing Summary

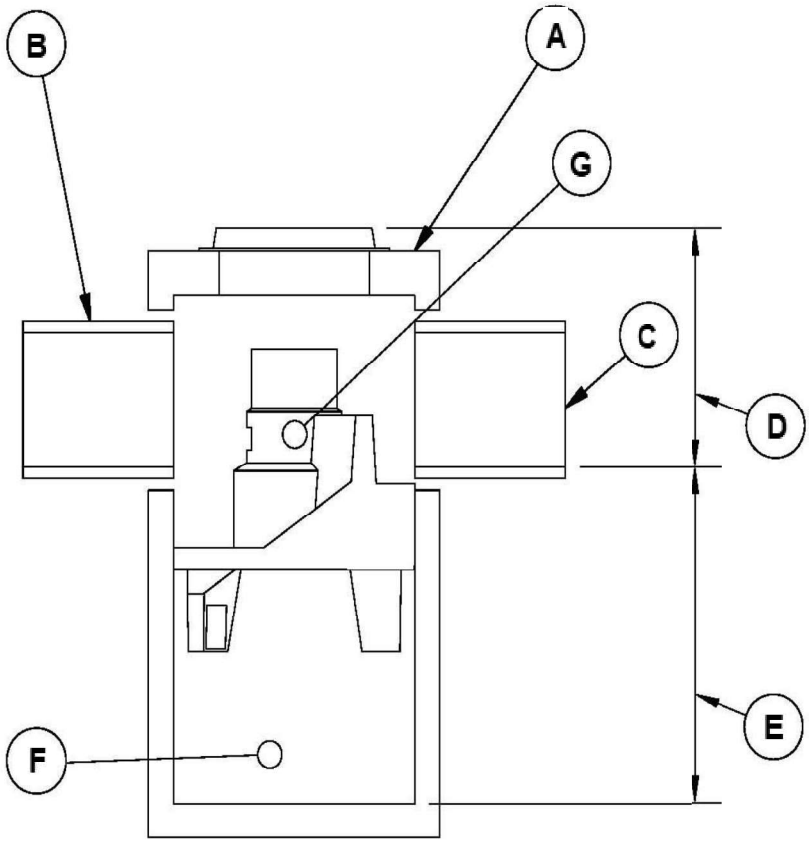
Project Name:	165010590 - Bramalea Road - Catchment 405
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.67 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
FD-4HC	88.0%	>90%
FD-5HC	92.0%	>90%
FD-6HC	94.0%	>90%
FD-8HC	96.0%	>90%
FD-10HC	98.0%	>90%

FD 4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 405
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 4HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.2%	100.0%	0.2%
1.00	16.3%	99.1%	16.2%
1.50	13.1%	95.5%	12.5%
2.00	13.2%	92.9%	12.3%
2.50	4.5%	91.0%	4.1%
3.00	2.2%	89.5%	2.0%
3.50	8.4%	88.2%	7.4%
4.00	4.8%	87.1%	4.1%
4.50	1.5%	86.2%	1.3%
5.00	5.0%	85.3%	4.2%
6.00	4.4%	83.9%	3.7%
7.00	4.8%	82.7%	4.0%
8.00	3.5%	81.7%	2.9%
9.00	2.2%	80.8%	1.8%
10.00	2.4%	80.0%	1.9%
20.00	8.8%	75.0%	6.6%
30.00	2.7%	72.2%	1.9%
40.00	0.9%	70.3%	0.6%
50.00	0.4%	68.9%	0.3%
100.00	0.5%	64.6%	0.3%
150.00	0.1%	62.2%	0.0%
200.00	0.0%	60.6%	0.0%
		Total Net Annual Removal Efficiency:	88.5%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

ADS OGS Sizing Summary

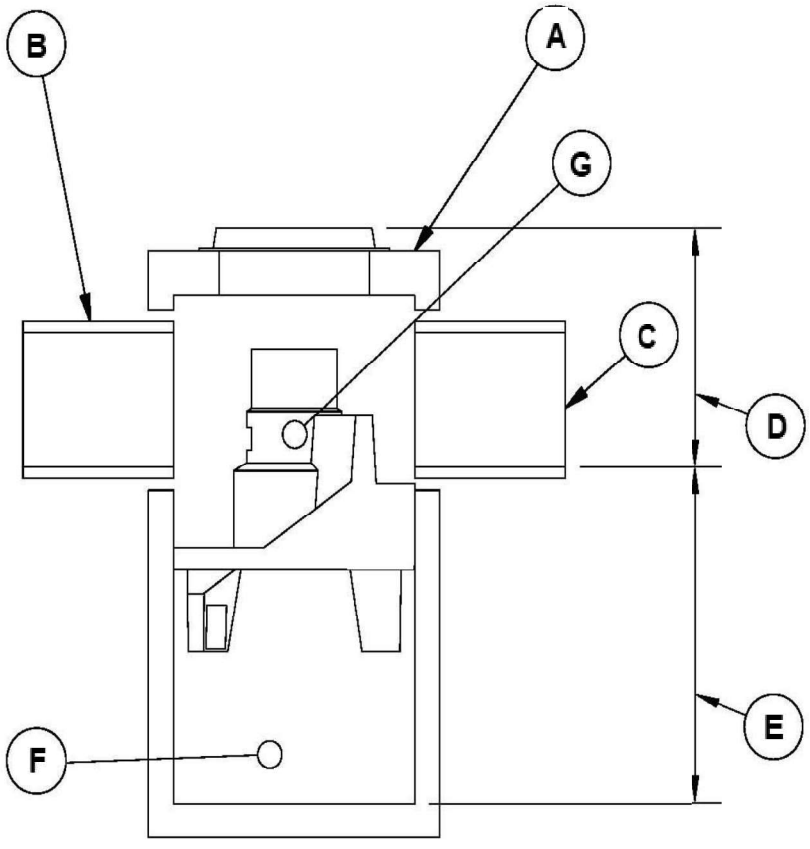
Project Name:	165010590 - Bramalea Road - Catchment 406
Consulting Engineer:	Stantec
Location:	Brampton, ON
Sizing Completed By:	C. Neath
Email:	cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	1.23 ha
% Impervious:	100%
Rational C:	0.90
Rainfall Station:	Toronto Pearson Intl AP, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
FD-4HC	84.0%	>90%
FD-5HC	88.0%	>90%
FD-6HC	90.0%	>90%
FD-8HC	94.0%	>90%
FD-10HC	96.0%	>90%

FD 4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 165010590 - Bramalea Road - Catchment 406
Consulting Engineer: Stantec
Location: Brampton, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD 4HC Removal Efficiency[2]	Weighted Net Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.2%	99.9%	0.2%
1.00	16.3%	93.7%	15.3%
1.50	13.1%	90.2%	11.9%
2.00	13.2%	87.8%	11.6%
2.50	4.5%	86.0%	3.9%
3.00	2.2%	84.6%	1.9%
3.50	8.4%	83.4%	7.0%
4.00	4.8%	82.3%	3.9%
4.50	1.5%	81.4%	1.2%
5.00	5.0%	80.7%	4.0%
6.00	4.4%	79.3%	3.5%
7.00	4.8%	78.2%	3.7%
8.00	3.5%	77.2%	2.7%
9.00	2.2%	76.4%	1.7%
10.00	2.4%	75.6%	1.8%
20.00	8.8%	70.9%	6.3%
30.00	2.7%	68.3%	1.8%
40.00	0.9%	66.5%	0.6%
50.00	0.4%	65.1%	0.3%
100.00	0.5%	61.0%	0.3%
150.00	0.1%	58.8%	0.0%
200.00	0.0%	57.2%	0.0%
		Total Net Annual Removal Efficiency:	83.6%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1960:2013, HLY03, Toronto Pearson Intl AP , ON, 6158733.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.