URBANTECH®

BLOCK SERVICING STRATEGY (BSS) REPORT

LYNDEN GARDEN
BLOCK PLAN BP-01-2023

CITY OF BRANTFORD

PREPARED FOR
WELTON & INNES GP INC.

Urbantech File No.: 19-617

1ST SUBMISSION – JANUARY 2024

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1 INTRODUCTION

The Lynden Garden Block is located within the "*Expansion Lands*", as identified in the City of Brantford Official Plan (OP), Schedule 2 – Designated Greenfield Area Density and Block Plan Boundaries (August 2021). Refer to **Drawing SLP-1** in **Appendix A**. The Block Plan submission is a non-statutory document which the City will use as a basis for approvals of Draft Plan of Subdivision and/or implementing Zoning By-law amendment applications. The OP sets out specific policies that govern the development of the Block areas. These include:

- Formal Pre-Consultation with the proponent and relevant approval agencies. Pre-Consultation for the Lynden Garden Block was held on October 6, 2021.
- Submission and approval of specific Terms of Reference (TOR) for the preparation of the Block Plan. The TOR for the Lynden Garden Block was submitted on February 1, 2022, to the City of Brantford.
- Draft Block Plan Preparation, including the Block Servicing Strategy Report (this report).
- Final Consultation and Approval.

Urbantech Consulting has been retained by Welton & Innes GP Inc. to prepare the Block Servicing Strategy (BSS) for the Lynden Garden Block. The BSS provides a consolidated summary of servicing plans (stormwater management, municipal services, etc.) for the Block Plan development concept. The BSS is supported by a consortium of technical consultants, as follows, who each provide technical studies in accordance with the City's Block Plan policies. The technical reports prepared by each consultant are included in **Appendix C**.

- GEO Morphix Ltd. (Fluvial Geomorphology)
- WSP Canada Inc. (Environmental)
- BA Group (Traffic)
- Terrapex Environmental Ltd. (Hydrogeology, Geotechnical)
- Gradient Wind (Noise)
- This Land Archaeology Inc. (Archaeological and Cultural Heritage Assessments)
- RVA (Wastewater Pump Station and Forcemain Design Concept)
- C3 Water (Water Hydraulic Analysis)

1.1. BSS Vision and Purpose

According to the Block Plan Terms of Reference from the City "The Block Plan is intended to communicate the vision for the community and promote comprehensive planning within specific sections of the City's Designated Greenfield Areas." The purpose of the Block Servicing Strategy is to:

- Provide comprehensive community planning and design.
- Provide a comprehensive servicing strategy.
- Identify servicing constraints and alternatives.
- Provide consultation opportunities for all landowners in the Lynden Garden community.
- Provide a servicing framework and streamline future development applications and

proposals.

The BSS report will demonstrate how the specific character of the Lynden Garden Block Plan meets the Vision and requirements of the City of Brantford's Official Plan for development in the Designated Greenfield Areas.

1.2. Reference Reports

In preparation of the BSS, the following reports and documents were referenced:

- The City of Brantford Official Plan
- The City of Brantford Master Servicing Plan
- The City of Brantford Transportation Master Plan with Complete Street Network
- The City of Brantford North Brantford and Tutela Heights Subwatershed Study
- The City of Brantford Linear Design and Construction Manual
- GRCA Policies and Guidelines
- Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alteration Authorized Under Environmental Compliance Approval
- Environmental Compliance Approval for a Municipal Sewage Collection System
- Environmental Compliance Approval for a Municipal Stormwater Management System
- Lynden Garden Block Plan Urban Transportation Considerations (BA Group, December 2022)
- Lynden Garden Block Plan (BP-01-2023) Traffic Study Addendum (BA Group, October 2023)
- Scoped Environmental Impact Study (WSP Canada Inc., January 2024)
- Watermain Hydraulic Assessment of the Lynden Garden Development (C3 Water, October 2023)
- Hydrogeological Investigation Report (Terrapex Environmental Ltd., December 2023)
- Supplemental Geotechnical Investigation (Terrapex Environmental Ltd., October 2022)
- Lynden Garden MESP Erosion Hazard and Mitigation Assessment (GEO Morphix, December 2023)
- Phase One Environmental Site Assessment (Terrapex Environmental Ltd., May 2022)
- Transportation Noise & Vibration Feasibility Assessment (Gradient Wind, October 2023)
- Archaeological Assessment (This Land Archaeology Inc., January 2020)
- Lynden Garden Block Pumping Station and Forcemain Design Development Conceptual Design Report (RVA, November 2023)

1.3. Development Concept

The proposed Block Plan is approximately 77 hectares in size. The **Detailed Concept Plan** is available in **Appendix A**. The Welton & Innes GP Inc. lands are 76.4 ha and a non-participating landowner is the remaining 1.3 ha. The proposed land use for the Welton & Innes GP Inc. lands is as follows:

- 28.8 ha Neighbourhood Residential
- 3.6 ha Neighbourhood Corridor

- 0.4 ha Neighbourhood Centre
- 2.7 ha Neighbourhood Park
- 22.1 ha Natural Heritage System (NHS)
- 5.7 ha Stormwater Management (SWM) Facilities, comprised of two (2) SWM Ponds
- 0.1 ha SWM Facility Access Block
- 0.2 ha Pumping Station
- 12.7 ha Public Roads comprised of 18.5 m, 20.0 m, and 24.5 m right-of-ways (ROWs).

The proposed Residential Unit Types are:

- 35% 6.1 m Town Houses
- 30% 9.75 m Single Detached
- 35% 10.97 m Single Detached

The proposed development includes two connections to the existing Lynden Road ROW.

2 BACKGROUND AND EXISTING CONDITIONS

2.1. Existing Conditions

The Lynden Garden Block Plan is currently vacant and used for agricultural purposes. There are residential / farmstead buildings associated with an occupied farmstead and a former farmstead fronting on Lynden Road (253 Lynden Road). The Block is bounded by urban residential development to the west, Silver Creek (a tributary of Fairchild Creek) to the north, Canadian National Railway (CN Rail) to the east and the Garden Avenue / Lynden Road intersection to the south.

The southern portion of the site is primarily agricultural fields. The northern portion of the site consists of features associated with the valleylands of Silver Creek (Fairchild Creek tributary), in addition to isolated wetlands, hedgerows and intermittent drainage features. The Creek is contained within a well-defined valley feature.

Elevations on site vary from approximately 222 m to 216 m (lower in the NHS and along the rail corridor). The site generally undulates with flatter areas to the south and west and steeper slopes to the north and east, primarily within the wooded areas.

Refer to **Drawing EXC-1** in **Appendix A** for additional details.

2.2. Limits of Development

The Block Plan has been prepared to respect the various natural environmental constraints including:

- Natural Heritage System (NHS)
    - Woodlands and Vegetation
    - Hazardous Lands and Hazardous Sites
    - Significant Wetlands
- Regulated Features:
    - Regulated Watercourse and Floodplain (Silver Creek (Fairchild Creek Tributary) / valleyland)
    - Slope valley / steep slopes

Refer to **Section 10** and the WSP Scoped Environmental Impact Assessment Study (**Appendix C2**) for additional details.

3 GEOTECHNICAL INVESTIGATION

An initial geotechnical investigation was carried out by Terraprobe in May 2020 for the Lynden Garden site. At that time, a total of 30 boreholes were completed, ranging in depths from 8.1 to 11.2 mbg (meters below ground). Results from the 2020 investigation indicate that the soil profile at the site consists predominantly of stiff to soft clayey silt to silty clay soil. The majority of the boreholes were terminated in soft soil. As such, there were concerns that raising the site grade to accommodate development would result in long term consolidation and settlement of the soft clay.

Terrapex was retained in 2022 to supplement the Terraprobe findings, specifically to determine the full depth and deformation properties of the soft clay layer on the site. Terrapex also completed boreholes at the proposed SWM Pond site and at the proposed location for the future wastewater pump station. Terrapex's full report, including detailed borehole logs and full recommendations for construction activities, is attached as **Appendix C5**.

Key findings from the 2022 investigation are as follows:

- Topsoil is present at the ground surface in all areas, ranging in thickness from 150 mm to 250 mm.
- Native soils below the topsoil consist predominantly of clayey silt with trace of sand and occasional silty clay layers.
- Test results indicate that the clayey silt possesses a stiff to very stiff consistency, low to medium plasticity and very low relative permeability.
- Bedrock is located approximately 30 mbg.
- Settlement analysis carried out for various heights of grade raise (based on findings from boreholes and soil properties) indicated that a grade raise that exceeds 1 m above existing site grades could result in settlement which exceeds the conventional limit of 25 mm for total settlement of structures.

Given the depth of clay overburden soils and the significant re-grading proposed for this development site, the following should be considered during construction to avoid excessive settlement post-development:

- Areas of the site that will be raised by more than 1 m above existing grade be preloaded in order to effect consolidation of the native soils, prior to the installation of site services and construction of roads and buildings.
- The preloaded areas should be monitored weekly.

The report also provides general guidance for construction activities in this type of soil, related to excavation, groundwater control, re-use of excavated soils, service trenches, foundation design, basement slab and engineered fill.

Refer to the full report in **Appendix C5** as well as **Drawing STM-5** in **Appendix A** for additional information.

4 SITE GRADING AND DRAINAGE

4.1. Existing Conditions

The Lynden Garden site is currently vacant. It varies in elevation from approximately 222 m to 216 m, with lower elevations as the topography slopes downwards towards Silver Creek (Fairchild Creek Tributary) in the north area and towards the rail line in the west. The site topography rises and falls, with steeper slopes to the north and east (generally within the NHS).

4.2. Proposed Conditions

4.2.1 Design Standards

The proposed grading design for the site considers the following requirements:

- Conforms to the City of Brantford design criteria.
- Optimizes cut and fill operations to minimize import/export situations.
- Matches existing boundary conditions.
- Provides overland flow conveyance for major storm conditions.
- Minimizes/eliminates the need for retaining walls.
- Provides appropriate ground cover over top of underground servicing infrastructure.
- Ensures compatibility with extensions of roads into surrounding lands.
- Addresses interim drainage conditions where surrounding lands are not developing at the same time.

4.2.2 Grading Design

The proposed grading plan for the subject property is shown in **Drawing GRD-1** in **Appendix A**. The grading is designed to ensure that major system flows are conveyed to the proposed SWM ponds.

Road centreline grades range from 0.5% to 4.0%. At the draft plan approval stage, the grading will be further refined to include transition details at boundary limits.

4.2.3 Road Right of Way (ROW) Design

The subject development proposes three (3) ROW cross sections:

a. 24.5 m ROW for Street A and Street C
b. 20.0 m ROW for Street I
c. 18.5 m ROW for all remaining Streets

Cross section details are shown on **Drawing RD-1** in **Appendix A**.

5 STORM DRAINAGE AND STORM SEWER DESIGN

5.1. Existing Conditions

There are currently no existing storm sewers within the proposed Block Plan area. There is an existing subdivision to the west which discharges into a culvert at the southwest corner of the site, but this flow does not impact the stormwater management for the Block Plan.

Drawing STM-1 in **Appendix A** illustrates the existing (pre-development) drainage pattern of the Block Plan area, as well as the external drainage that flows through the site. There are four existing sub-catchment areas associated with the Block Plan (identified as Area 1, Area 2, Area 2, Area 4). The outlet of each sub-catchment is identified as a Point of Interest (POI). **Table 5-1** summarizes the drainage areas associated with each Area, as calculated at the four POIs.

Table 5-1: Existing Conditions Drainage Areas

Description	Area (ha)	Outlet
Area 1	33.9	POI - 1
Area 2	7.3	POI - 2
Area 3	72.4	POI - 3
Area 4	11.8	POI - 4

Area 1 is a 33.9 ha drainage area which flows generally from north to south to the intersection of Welton Road and Lynden Road (POI -1). The average slope of the drainage area is 0.81% and the longest flow path is approximately 970 m. There is an existing 900 mm Corrugated Steel Pipe (CSP) underneath the CN Railway line that conveys flow from this area to the south of the CN Railway line.

Area 2 is a 7.3 ha drainage area which flows to the east (towards POI -2) through a 1200 mm steel culvert underneath the CN Railway line. The average slope of the drainage area is 0.73% and longest flow path is approximately 535 m.

Area 3 is a 72.4 ha drainage area which terminates at the CN Railway line culvert. This drainage area is part of the larger Silver Creek drainage system. According to the draft SWSS model file provided by the City of Brantford, the overall drainage area of Silver Creek at this location is estimated to be 607 ha, mainly consisting of existing residential areas. Silver Creek is one of the tributaries of Fairchild Creek.

Area 4, located on the west side of the Lynden Garden block plan, primarily consists of existing development. Its impact on the proposed development is minimal.

5.2. Existing Conditions - Flow Rates

The hydrologic event simulation model Visual OTTHYMO (VO6) was used to calculate runoff flow rates for the Lynden Garden Block Plan under both existing and post-development conditions. VO6 is an event-based hydrologic model widely used to determine runoff

characteristics in both rural and urban watersheds. The model uses the Soil Conservation Service curve number (CN) method of estimating runoff characteristics, in combination with instantaneous unit hydrograph routines to produce storm hydrographs.

A hydrological model simulation was generated for existing conditions to determine peak flow runoff rates that would occur during the 25 mm rainfall event, the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year rainfall events, and during the regional storm event (Hurricane Hazel).

The NASHHYD routine in VO6 was used to generate existing conditions runoff hydrographs for the pre-development conditions. The NASHHYD routine is used to simulate the runoff from a rural area and requires the drainage area, composite curve number (CN), time to peak and available initial storage as inputs. The hydrological input parameters to the VO6 model for existing conditions are summarized in **Table 5-1**.

Table 5-2 summarizes the existing conditions VO6 input parameters for the subject property and relevant external areas. Modelling scenarios were simulated to compare the runoff flows between pre-development and post-development conditions.

The composite curve number (CN), available storage and time to peak was determined through consideration of the soils, topography, and land-use conditions.

Table 5-2: Existing Conditions VO6 Model Input Parameters

Area Description	Area (ha)	Unit Hydrograph	Time to Peak (Tp) hr	% Impervious	Curve Number (CN)
Area 1	33.9	NASHYD	1	N/A	80
Area 2	7.3	NASHYD	0.54	N/A	80
Area 3 *	72.4	NASHYD	1	N/A	80
Area 4	11.8	STANHYD	N/A	65%	80

* *Area 3 only includes about 8.83 ha drainage from the proposed development. According to North Brantford and Tutela Height Subwatershed Study model file Fairchild Creek Trib (F4) drainage is 607 ha.*

Table 5-3 and **Table 5-4** provide flows leaving the subject property under existing conditions for each pre-development drainage area as shown in **Drawing STM-1** in **Appendix A**.

Table 5-3: Existing Conditions – Flow Rates (Peak Discharge)

Storm Event	Area 1	Area 2	Area 3	Area 4
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
25 mm	0.15	0.05	0.33	0.48
2-year	0.47	0.16	1.01	1.25
5-year	0.82	0.28	1.76	1.78
10-year	1.10	0.38	2.35	2.67
25-year	1.49	0.51	3.19	3.29
50-year	1.82	0.63	3.89	3.86
100-year	2.16	0.75	4.62	4.37

Table 5-4: Existing Conditions – Flow Rates (Peak Unit Discharge)

Storm Event	Area 1	Area 2	Area 3	Area 4
	(m^3/s/ha)	(m^3/s/ha)	(m^3/s/ha)	(m^3/s/ha)
25 mm	0.004	0.007	0.005	0.041
2-year	0.014	0.022	0.014	0.106
5-year	0.024	0.038	0.024	0.151
10-year	0.032	0.052	0.032	0.226
25-year	0.044	0.070	0.044	0.279
50-year	0.054	0.086	0.054	0.327
100-year	0.064	0.103	0.064	0.370

Pre-development flows from Area 1 are most conservative and representative for the site. Therefore, SWM Ponds and storage facilities have been designed based on the Area 1 predevelopment flow target rates (i.e., 0.064 m^3/s/ha).

Refer to **Appendix B4** for the VO6 schematic and result outputs.

5.3. Design Criteria

Based on the City of Brantford's '*Storm Sewer, Design and Construction Manual, Linear Municipal Infrastructure Standards (V5 – January 2022)',* design criteria for storm servicing are as follows:

- Storm sewers are designed to convey the 5-year storm event.
- Storm sewers are designed to flow at a maximum of 80% full.
- The time of concentration (tc) at the upstream end of the system shall be a minimum of 10 minutes.
- Overland flow conveyance is safely provided for the 100-year event.

As recommended in the City's standards, storm sewer design has been carried out using the Rational Method.

The Rational Method Equation is written as follows:

Q= CiA/360

where,

Q = Peak rate of runoff (m^3/s)
C = Runoff coefficient
i = rainfall intensity (mm/hr)
A = Drainage Area (ha)

The rainfall intensity used for sewer design is based on the 5-year historical Intensity-Duration-Frequency (IDF) relationship established by the Mount Hope rainfall gauge. The rainfall intensity was determined using the following equations:

$$\mathbf{i} = \frac{\mathbf{A}}{(\mathbf{t_c} + \mathbf{B})^{\mathbf{c}}}$$

where,

A, B, C = constant (provided in the City's guidelines)
t_c = time of concentration in minutes
i = rainfall intensity (mm/hr)

5.4. Proposed Conditions and Storm Sewer System Design

The storm sewer system for the Lynden Garden Block is designed such that flow is directed towards the proposed SWM Ponds / storage facilities before being discharged into the downstream receiving water bodies.

The post development stormwater system design concept is shown on **Drawing STM-2** in **Appendix A**.

5.4.1 Minor System

Storm sewers within the subdivision are sized to convey the 5-year storm in accordance with the City of Brantford standards. Local storm sewer pipes generally range in size from 300 mm to 1200 mm diameter. Box culverts are proposed in the vicinity of the pond inlets. Refer to **Drawing STM-2** in **Appendix A** for additional detail.

Two SWM Ponds and one underground box culvert superpipes storage have been proposed for the site. SWM Pond 1 is located at the south end of the site near Lynden Road and SWM Pond 2 is located on the table land on the northeast corner of the site.

For storm sewer sizing refer to design sheets in **Appendix B1**.

5.4.2 Major System

Flows that exceed the capture capacity of on-site catchbasins and the minor system will be conveyed overland on road surfaces. The anticipated overland flow routes are shown on **Drawing STM-2** and **Drawing STM-3** in **Appendix A.** Three SWM storage facilities have been proposed for this site which will collect both minor and major overland flows from storm runoff.

In case where superpipes are used for SWM storage, catchbasins are designed such that runoff generated from up to 100-year events are captured in the superpipe storage.

Major System to SWM Pond 1 (Area A)

As shown **Drawing STM-2** and **Drawing STM-3** in **Appendix A,** the overland flow drainage is the same as the minor flow drainage for SWM Pond 1. The total drainage area associated with the overland flow to SWM Pond 1 is about 29.61 ha.

Major System to SWM Pond 2

As shown **in Drawing STM-2** and **Drawing STM-3** in **Appendix A,** the overland flow drainage is generally similar to the minor flow drainage for SWM Pond 2. Only the backyard of lots on Street N will flow uncontrolled. The total drainage of the overland flow to SWM Pond 2 is about 7.29 ha.

Major System in Area C

Runoff generated from up to the 100-year storm event will be captured in proposed underground superpipes for Area C. For events larger than the 100-yr storm, the overall flow path will be directed to the outlet of the superpipes as shown in **Drawing STM-2** and **Drawing STM-3** in **Appendix A.** The total drainage of Area C is 2.80 ha.

5.4.3 Hydraulic Grade Line

The Hydraulic Grade Line (HGL) for the site will be finalized during the detailed design stage. HGL data will be utilized to identify any lots that might necessitate the use of sump pumps.

6 WATER RESOURCES and STORMWATER MANAGEMENT

In October 2021, the City of Brantford commenced the North Brantford and Tutela Heights Subwatershed Study Update – Phase Two, which covers the Lynden Garden Block. Phase 1 of the Subwatershed Study was completed in November 2020 and updated in May 2023. Phase 2 of the Subwatershed Study will further refine the findings of Phase 1 and be based on field studies and detailed modeling. Phase 2 is expected to be completed in 2024.

6.1. Stormwater Design Criteria

Stormwater management for the site will be primarily based on the City of Brantford and MECP Stormwater Management Guidelines. Findings of the Phase 1 SWSS and Grand River Conservation Authority (GRCA) guidelines will also be followed where applicable.

- Post development flows from the SWM structures will be the lesser of pre-development flow or critical discharge considering erosion threshold.
- 48-72 hr extended detention for up to the first 25 mm of rainfall.
- A minimum of 80% TSS removal (MECP Enhanced Removal).
- Maintain pre-development water balance through the use of Low impact Development measures (LID).

6.2. Stormwater Management Design Concept

6.2.1 Water Quantity Control

The runoff volume generated from the proposed development will be managed using End-of-Pipe Wet Storm Water Management (SWM) Ponds. In order to control the quantity of runoff, two (2) SWM Ponds and one (1) underground superpipe have been proposed. The existing flow rates for different storm events ranging from 2 to 100 years have been determined. In the post development conditions, the runoff will be regulated by the two SWM Ponds and an underground superpipe. The flow rates from these storage facilities will be maintained at the target rates established from the existing conditions modeling.

SWM Pond and superpipe storage was originally designed using an excel model and then verified in Visual OTTHYMO. The SWM Pond design tables and VO model output has been included in **Appendix B3** and **Appendix B4**, respectively.

The SWM Pond and underground superpipes storage were designed using 24 hours Intensity-Duration-Frequency (IDF) parameters from the City of Brantford *'Linear Municipal Infrastructure Standards, Storm Sewers, January 2022'*. **Table 6-1** lists the IDF parameters used in the VO model.

Table 6-1: City of Brantford IDF Parameters

Parameter	IDF Parameters					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A	743	1593	2221	3158	3886	4688
B	6.0	11.0	12.0	15.0	16.0	17.0
C	0.7989	0.8789	0.9080	0.9355	0.9495	0.9624

Source: County of Brant, Development and Engineering Standards, May 2014

Post development drainage areas used for modelling are shown on **Drawing STM-2** and **Drawing STM-3** in **Appendix A**.

Table 6-2 summarizes the VO6 input parameters of the proposed condition for the subject property and relevant external areas.

Table 6-2: Proposed Conditions VO6 Model Input Parameters

Area Description	Area (ha)	Unit Hydrograph	Percent Impervious	Curve Number (CN[1])
Pond 1	29.61	STANDHYD	77%	-
Pond 2	7.29	STANDHYD	79%	-
Superpipe 1	2.80	STANDHYD	70%	80

6.2.2 Pond 1 Quantity Control

Pond 1 has a catchment area of 29.61 ha. The required storage to achieve the target flows for the storm events is shown in **Table 6-4**. Pond 1 design information is shown in **Drawing SWM-1** and **Drawing SWM-2** in **Appendix A**.

Table 6-3: Pond 1 Flows and Required Storage Volume for Various Storm Events

Storm Event	Post Development Drainage	Target Flow Rate	Pre-Development or Target Flow	Post Development Flows	Required Active Storage
	ha	$m^3/s/ha$	m^3/s	m^3/s	m^3
25 mm	29.61	0.004	0.118	0.14	4,878
2-Year	29.61	0.014	0.415	0.504	7,444

[1] In STANDHYD, the CN value is for the pervious surfaces only while for the NASHYD the CN value is representative of the entire sub-catchment.

Storm Event	Post Development Drainage	Target Flow Rate	Pre-Development or Target Flow	Post Development Flows	Required Active Storage
	ha	$m^3/s/ha$	m^3/s	m^3/s	m^3
5-Year	29.61	0.024	0.711	0.672	10,060
10-Year	29.61	0.032	0.948	0.766	12,037
25-Year	29.61	0.044	1.303	0.875	14,723
50-Year	29.61	0.054	1.599	0.986	16,912
100-Year	29.61	0.064	1.895	1.068	19,090

The proposed pond was designed to achieve the required storage for up to the 100-year storm. **Table 6-4** shows that the provided storage for Pond 1 is greater than the required storage to achieve quantity control. **Figure 6-1** shows the stage storage area curve for the proposed pond.

Table 6-4: SWM Pond 1 Stage - Storage - Area

Elevation (m)	Location	Area (m^2)	Total Volume (m^3)	Active Volume (m^3)
217.71	Top of Pond	15,106	47,490	28,886
217.40		14,968	47,490	28,886
217.10		14,872	47,490	28,886
216.80		14,673	45,986	27,383
216.50	Emergency Spillway Invert – 100Year	14,478	43,017	24,414
216.30		14,285	40,121	21,518
216.20	50-year	14,093	38,703	20,099
216.00		13,713	35,922	17,318
215.80	25-year	13,526	34,560	15,956
215.70	10-Year	13,340	33,217	14,613
215.60		13,155	31,892	13,288
215.42	5-Year	12,790	29,298	10,694
215.30	2-Year	12,610	28,028	9,424
215.20		12,432	26,775	8,172
215.10		12,254	25,541	6,938
215.0	25 mm	12,079	24,324	5,721
214.90		11,904	23,125	4,522
214.80		11,731	21,944	3,340
214.70		11,320	20,791	2,187
214.60		10,932	19,678	1,075
214.50	Permanent Pool	10,564	18,604	-
214.40		10,192	17,566	
214.30		9,844	16,564	

Elevation (m)	Location	Area (m^2)	Total Volume (m^3)	Active Volume (m^3)
214.10		9,517	15,588	
213.90		9,197	13,685	
213.70		8,883	11,845	
213.50		8,573	10,068	
213.30		8,266	8,354	
213.10		7,963	6,701	
212.90		7,663	5,108	
212.70		7,368	3,575	
212.50		7,076	2,102	
212.40		6,932	1,387	
212.29	Bottom of Pond		-	

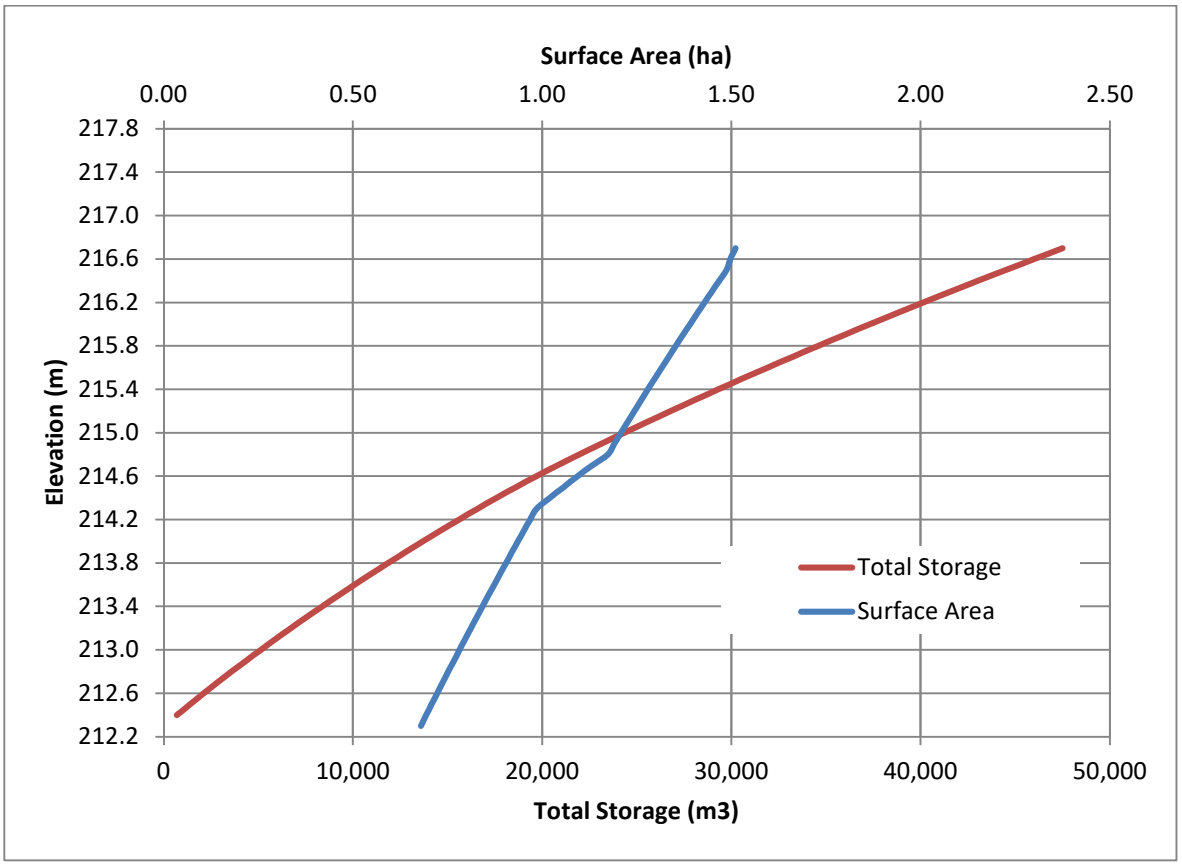

Figure 6-1: Stage Storage Area Curve – Pond 1

6.2.3 Pond 2 Quantity Control

Pond 2 has a catchment area of 7.29 ha. The required storage to achieve the target flows for the storm events is shown in **Table 6-5**. Pond 2 design information is shown in **Drawing SWM-3** and **Drawing SWM-4** in **Appendix A**.

Table 6-5: Pond 2 Flows and Required Storage Volume for Various Storm Events

Storm Event	Post Development Drainage	Target Flow Rate	Pre-Development or Target Flow	Post Development Flows	Required Active Storage
	ha	$m^3/s/ha$	m^3/s	m^3/s	m^3
25 mm	7.29	0.005	0.036	0.005	1,365
2-Year	7.29	0.014	0.102	0.052	2,269
5-Year	7.29	0.024	0.175	0.152	2,680
10-Year	7.29	0.032	0.233	0.22	3,067
25-Year	7.29	0.044	0.321	0.323	3,586
50-Year	7.29	0.054	0.394	0.362	4,050
100-Year	7.29	0.064	0.467	0.373	4,570

The pond was designed to achieve the required storage for up to the 100-year storm. **Table 6-6** shows that the provided storage for the SWM Pond 2 is greater than the required storage to achieve quantity control. Figure 6-2: Stage Storage Area Curve – Pond 2**Figure 6-2** shows the stage storage area curve for the proposed pond.

Table 6-6: SWM Pond 2 Stage - Storage - Area

Elevation (m)	Location	Area (m^2)	Total Volume (m^3)	Active Volume (m^3)
208.61	Top of Pond	6,345	13,735	10,407
208.50		6,239	13,106	9,778
208.40		6,133	12,488	9,160
208.20		5,919	11,282	7,954
208.00		5,704	10,120	6,792
207.90		5,596	9,555	6,227
207.80	Emergency Spillway Crest	5,488	9,001	5,673
207.72	100-year	5,383	8,457	5,129
207.62	50-Year	5,264	7,925	4,597
207.60	25-Year	5,145	7,405	4,076
207.50	10-Year	5,025	6,896	3,568
207.30	5-year	4,905	6,399	3,071
207.20	2-Year	4,784	5,915	2,587
207.10	25 mm	4,662	5,443	2,115

Elevation (m)	Location	Area (m^2)	Total Volume (m^3)	Active Volume (m^3)
207.00		4,540	4,983	1,654
206.80		4,149	4,114	786
206.68	Permanent Pool	3,720	3,328	-
206.50		3,551	2,965	-
206.40		3,420	2,616	-
206.30		3,302	2,280	-
206.20		3,185	2,280	-
206.10		3,070	1,956	-
206.00		2,957	1,643	-
205.90		2,845	1,341	-
205.80		2,735	1,051	-
205.70		2,627	772	-
205.60		2,521	504	-
205.50		2,416	247	-
205.47	Bottom of Pond		-	-

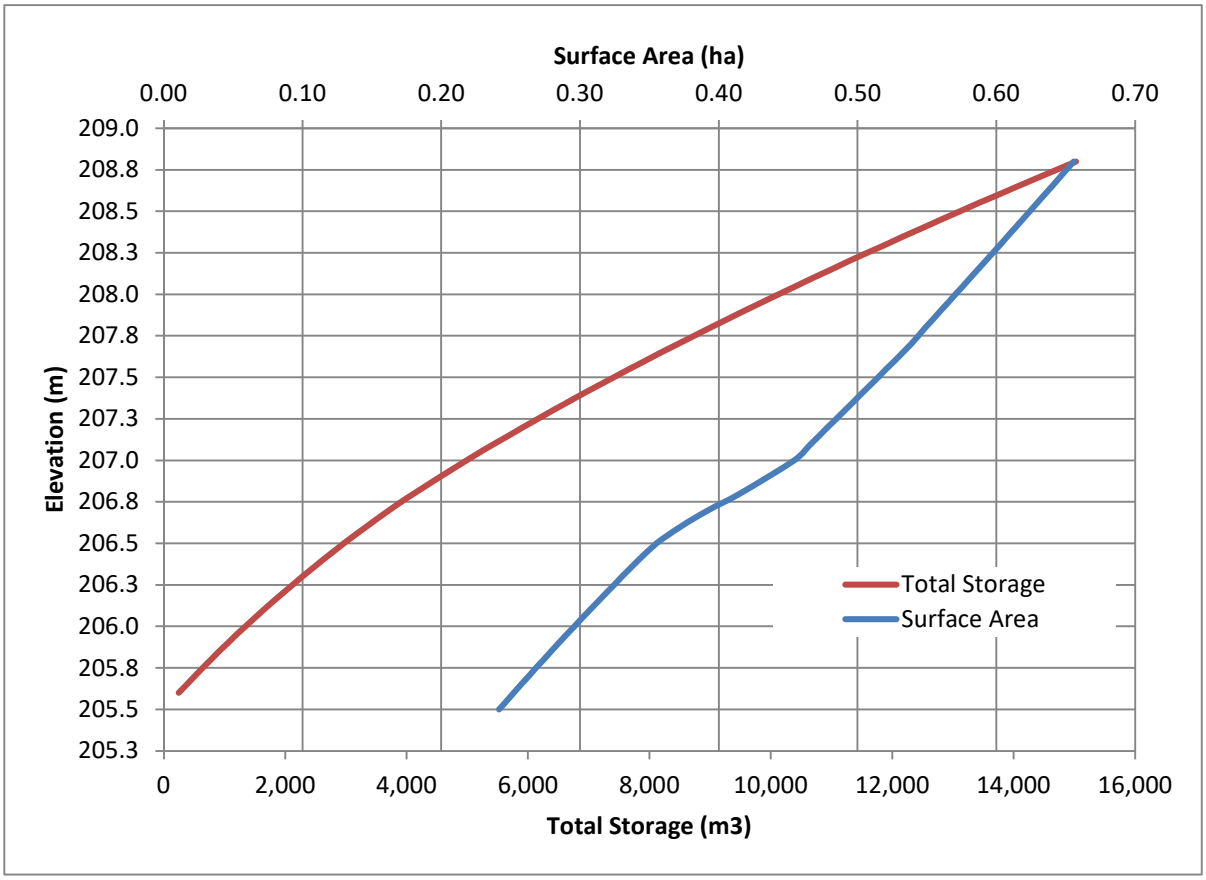

Figure 6-2: Stage Storage Area Curve – Pond 2

6.2.4 Superpipes Quantity Control

The underground superpipes storage have a catchment area of 2.80 ha. The required storage to achieve the target flows for the various storm events is shown in **Table** 6-7.

Table 6-7: Superpipes Flows and Required Storage Volume for Various Storm Events

Storm Event	Post Development Drainage	Target Flow Rate	Pre-Development or Target Flow	Post Development Flows	Required Active Storage
	ha	$m^3/s/ha$	m^3/s	m^3/s	m^3
25 mm	2.80	0.005	0.013	0.038	230
2-Year	2.80	0.014	0.039	0.065	480
5-Year	2.80	0.024	0.066	0.084	730
10-Year	2.80	0.032	0.088	0.095	910
25-Year	2.80	0.044	0.121	0.108	1,150
50-Year	2.80	0.054	0.149	0.117	1,350
100-Year	2.80	0.064	0.177	0.127	1,550

The superpipes were designed to achieve the required storage for up to the 100-year storm. The total length and cross-section dimensions of the proposed superpipes is 300 m of 3000 mm x 1800 mm concrete box culverts. **Table 6-8** shows that the provided storage of the superpipes is greater than the required storage to achieve quantity control.

Table 6-8: Superpipes Stage - Storage - Area

Elevation (m)	Location	Area (m^2)	Total Volume (m^3)	Active Volume (m^3)
1.800	Top of Pipe	900	1620	1620
1.710		900	1539	1539
1.620		900	1458	1458
1.530		900	1377	1377
1.440		900	1296	1296
1.350		900	1215	1215
1.260		900	1134	1134
1.170		900	1053	1053
1.080		900	972	972
0.900		900	810	810
0.810		900	729	729
0.720		900	648	648
0.630		900	567	567

Elevation (m)	Location	Area (m^2)	Total Volume (m^3)	Active Volume (m^3)
0.540		900	486	486
0.450		900	405	405
0.360		900	324	324
0.270		900	243	243
0.216		900	194	194
0.160		900	144	144
0.0	Bottom of Pipe	900	-	-

6.2.5 Water Quality Control

In wet SWM ponds the permanent pool helps to enhance the quality of the post development runoff. As outlined in the MOE (2003) guidelines, some of the merits of the permanent pool are as follow:

- The permanent pool minimizes re-suspension;
- The permanent pool minimizes blockage of the outlet; and
- The permanent pool provides extended settling.

The required permanent pool volumes are based on the area and imperviousness of the contributing lands. As per MOE guidelines, water quality storage requirements based on receiving waters is summarized in **Table 6-9.**

Table 6-9: Water Quality Volume Requirements - SWM Pond 1

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level				
		55%	70%	77%	79%	85%
Enhanced 80% long-term S.S. removal	Wet Pond	190	225	237	240	250

In SWM Pond 1, the required permanent pool storage volume based on a catchment area of 29.61 ha and an imperviousness of 77% is 7,018 m^3 (237 m^3/ha x 29.61 ha). Provided permanent pool volume of Pond 1 is 18,604.

In SWM Pond 2, the required permanent pool storage volume based on a catchment area of 7.29 ha and an imperviousness of 79% is 1,750 m^3 (240 m^3/ha X 7.29 ha). Provided permanent pool volume of Pond 2 is 3,328.

In both SWM Ponds the provided permanent pool volume is more than the required volume.

For the area where a superpipes storage has been proposed, an OGS (Oil and Grit Separator) unit will be provided at the outlet of the storage for the water quality treatment. The sizing and design of OGS unit will be provided in detail design.

6.2.6 Extended Detention Storage

Extended detention storage is the first level of active (fluctuating) storage within the pond. Storage in this range is released slowly to provide increased detention time and reduce downstream erosion effects caused by frequent rainfall events as well as providing additional settling time for suspended sediments. Additionally, this will help maintain base flows in the downstream watercourse for a longer time period following storm events.

The North Brantford and Tutela Heights Subwatershed Study recommends 48-72 hr extended detention up to the first 25 mm of rainfall is required to protect the receiving water bodies from erosion.

In both SWM ponds extended detention up to the first 25 mm of rainfall is more than 72 hours.

6.2.7 Emergency Spillways

Both SWM Ponds (Pond 1 and Pond 2) have been designed to accommodate the 100-year storm event without overtopping the spillways. However, in the event that a storm exceeds the magnitude of a 100-year event, emergency spillways will be utilized. The spillway for Pond 1 is designed to divert excess water towards Lynden Road, while the spillway for Pond 2 will discharge water into Silver Creek. These spillways are specifically designed to handle flood events up to the regional flood level, ensuring that the SWM pond dykes will not be overtopped.

6.3. Continuous Hydrological Modelling

A continuous hydrological model was developed in PCSWMM for both existing and post-development conditions. As detailed in previous sections of the report, the hydrology for existing and proposed conditions was modeled using Visual OTTHYMO.

Continuous modeling was primarily carried out to generate continuous hydrographs for GEO Morphix as input to the erosion threshold analysis (see **Section 6.4**). A complete set of 56 years' worth of continuous hydrographs (1950 to 2006) for both existing and proposed conditions was furnished to GEO Morphix for erosion threshold analysis.

The continuous modeling was not utilized in the Storm Water Management and SWM Pond sizing.

6.4. Erosion Control and Fluvial Geomorphology

The report by GEO Morphix Ltd. (December 2023) provides a fluvial geomorphological characterization and erosion mitigation assessment for the subject lands. The full report is available in **Appendix C6**.

To inform the assessment, various activities were undertaken, including review of topographic and geologic maps, desktop, and field analyses. The North Brantford and Tutela Heights Subwatershed Study also provides important data regarding drainage patterns and stream

reaches. Silver Creek, a significant watercourse, is identified as having a steep valley with wetland cover on the valley floor.

The physiography and geology of the subject lands indicate well-draining sand deposits in the Sand Plains of the Norfolk Sand region. The Silver Creek valley contains modern alluvial deposits, while the tableland area comprises fine textured glaciolacustrine deposits. As outlined in **Section 3**, the geotechnical investigation revealed predominantly clayey silt soils with traces of sand.

The site's history was analyzed using historical aerial photographs from 1945 to 2019. The imagery shows changes in land use and riparian vegetation over time. Notable developments were built upstream of Silver Creek, with increased industrial and housing activities, between 1982 and 2003. However, little significant alteration to the channel's planform was observed from 1964 to 2019.

6.4.1 Watercourse Characteristics

The watercourse characteristics assessment focuses on delineating reaches, defined as homogeneous channel segments studied semi-independently for meaningful characterization. Reaches are delineated based on factors like channel planform, gradient, physiography, land cover, confluences, soil type, and historical modifications. Seven reaches were delineated for Silver Creek, employing scientifically defensible methodology. Details are available in the full report attached as **Appendix C6**.

General observations and measurements, including habitat sketch maps, riparian conditions, bank dimensions, substrate composition, erosion, and photographs, were conducted for each reach. Specific details for Reach SC-A-1 highlight an entrenched channel with a low-sinuosity planform, while Reach SC-A-5 exhibits moderate sensitivity with widening and aggradation, presenting highly unstable banks.

Rapid field assessments utilized the Ontario Ministry of the Environment's Rapid Geomorphic Assessment and the Rapid Stream Assessment Technique. Reach classifications indicated that most of Silver Creek is in adjustment with widening processes. Detailed geomorphological assessments focused on the most erosion-susceptible reach, SC-A-5, providing values for bankfull channel width, depth, gradient, and discharge. The downstream extent of Silver Creek exhibits moderate sensitivity with widening processes and aggradation.

Reach SC-A-5:

- Average width of 6.02 m and a depth of 1.01 m.
- Characterized by a mix of find sediment and organic matter, on top of clayey-till substrate.
- Bankfull gradient of 0.34%.
- Bed gradient of 0.34%

6.4.2 Erosion Threshold Analysis

The erosion threshold is the flow rate required to potentially move bed and bank materials in a channel. For the Lynden Garden site, the erosion thresholds for each impacted watercourse are

determined based on field observations of reaches SC-5-A (most susceptible to erosion). Erosion thresholds are expressed as a critical discharge or shear stress, representing the point at which sediment entrainment would occur based on the bed and bank materials. Due to variations in composition and structure, thresholds are determined separately for both bed and bank materials, and the more conservative estimate (lower of the two thresholds) is adopted.

The critical discharge rates for reach SC-5-A are as follows:

- Reach SC-5-A: 0.497 m^3/s

6.4.3 Post- to Pre-development Erosion Exceedance Analysis.

The Post- to Pre-Development Erosion Exceedance Analysis evaluates the impact of Stormwater Management (SWM) controls on watercourse erosion. Four key indices are employed, with emphasis on cumulative effective stream power. Due to hydrological modeling constraints, a site-level assessment is conducted, determining scaled site-level critical discharges. Results show a reduction in erosion potential for the receiving swale-type channel (POI2) and a maintenance of the long-term rate of erosion for Reach TFC4-1. Notably, Reach SC-A-5 exhibits a significant reduction in long-term erosion rates. The analysis suggests that proposed SWM measures, including extended detention and Low Impact Development, should sufficiently mitigate erosion within the watercourses, with the potential for further refinement during detailed design stages.

6.4.4 Erosion Hazard Assessment

The Erosion Hazard Assessment focuses on estimating meander belt width, crucial for determining potential hazards near watercourses. Southern Ontario watercourses tend to meander naturally, and assessment protocols differ for confined and unconfined systems. Confined systems consider valley toe erosion and stable slope allowances, while unconfined systems rely on meander belt width, often set at 20 times the bankfull channel width. Reaches SC-A-1 to SC-A-4 along Silver Creek are classified as confined. The meander belt width for the subject reaches is determined by measuring natural meanders in aerial images, resulting in a final width of 40 meters. The assessment includes a map of the delineated meander belt width, with adjustments made where it extends beyond the toe of the slope, associated with geotechnical stability considerations detailed in a 2020 investigation by Terraprobe.

6.5. Erosion and Sediment Control Measures

Erosion and sediment control (ESC) will be implemented during all site construction works including topsoil stripping, bulk earthworks, site servicing, foundation excavation and stockpiling of materials, and will conform to the ESC Guide for Urban Construction. These measures will include:

- Sediment fencing/construction (snow) fencing will be placed along the perimeter of the site prior to construction to delineate the limit of disturbance and protect natural features;
- Sediment ponds and/or traps will be provided at each outlet;

- Cut-off swales/diversions to direct runoff to control devices and to keep construction areas dry. Swales to include check dams at regular intervals to reduce erosive velocities;
- Construction traffic access mud mats will be provided at construction vehicle access point(s) to minimize off-site tracking of sediments;
- All erosion and sediment control measures will be routinely inspected and repaired during construction. Temporary controls will not be removed until the areas they serve are restored and stable.

A detailed Erosion & Sediment Control Brief and Soil Management Plan, including Site Alteration Plans will be provided at detailed design stage.

6.6. Floodline Mapping

6.6.1 Existing Conditions

Silver Creek (Fairchild Creek Tributary) bisects the lands from west to east at the northern limits of the Block. Fairchild Creek is described as a major tributary to the Grand River by the GRCA. The creek system exists in a well-defined valley that contains the regulatory floodplain. The proposed development is completely outside of the regulated area, and floodplain elevations are well below grades within the proposed development. The floodplain limit is based on the draft HEC RAS model files associated with the Subwatershed Study provided by the City.

6.6.2 Proposed Refinement

No modifications to the existing floodplain are proposed.

7 HYDROGEOLOGICAL INVESTIGATION AND WATER BALANCE

Terraprobe originally completed a hydrogeological report and water balance analysis in 2008. Terrapex has incorporated Terraprobe's 2008 report and updated the hydrogeological report with additional field investigations and monitoring in December 2022. The full Terrapex report is available in **Appendix C4**.

Terrapex performed drilling operations from June 13 to July 21, 2022, advancing boreholes to depths ranging from 12.7 to 33.5 mbg (meters below grade). Four of these new boreholes were equipped with monitoring wells for long-term monitoring of the groundwater table. Additionally, two shallow minipiezometers were installed using a post hammer technique, reaching depths of 1.1 to 1.3 mbg.

For the purpose of determining subsurface conditions, two boreholes were located at potential sites for the proposed wastewater pumping station, and another two boreholes were positioned within the footprint of the planned stormwater management (SWM) ponds. Standard Penetration Testing (SPT N-values) and sampling were performed at regular depth intervals using conventional split spoon sampling equipment with a nominal 35 mm internal diameter. The findings reported that the encountered native soils were predominantly classified as stiff to soft.

The groundwater monitoring wells in this study were screened at depths ranging from 3.1 to 6.1 mbg, typically adjacent to clayey silt deposits. The minipiezometers were screened from 0.9 to 1.4 mbg.

7.1. Existing Conditions Water Level

Based on visual examination of the soil samples collected during the drilling operations, it was observed that the native soil had a grey appearance starting at depths approximately ranging from 3.1 to 6.0 mbg. This indicates the presence of groundwater for extended periods throughout the year. The native grey soil primarily consisted of clayey silt.

In terms of the static groundwater levels, historical measurements conducted in 2007 by Terraprobe provided the highest and lowest recorded groundwater levels. These levels were reported to range from 5.9 mbg to 0.9 mbg. Correspondingly, the groundwater elevations ranged from 208.1 meters above sea level (masl) to 220.1 masl. The groundwater levels measured during the current investigation in 2022 were found to vary from 1.38 mbg to 5.27 mbg, with groundwater elevations ranging from the equivalent of 214.33 masl to 217.62 masl.

It is important to note that groundwater levels are subject to seasonal fluctuations. It is likely that a higher groundwater level condition will develop later in the spring freshet period or after significant rainfall events.

The proposed final grading of the site varies approximately from 216 masl to 222 masl.

7.2. Site Water Balance

Precipitation that falls onto the ground either flows over land as surface runoff, making its way directly to a watercourse, or it infiltrates into the ground through the process of infiltration. It can also be retained on vegetation and other surface materials as interception storage. However, rainfall that is retained as interception storage is returned to the atmosphere through evaporation and does not contribute to runoff.

When water infiltrates into the soil, a portion of it recharges groundwater reserves, while the rest is stored near the ground surface. This stored water is then used and depleted through transpiration by plants. Additionally, some groundwater moves laterally and is intercepted by valleys, ravines, or the banks of watercourses. This interception causes the groundwater to emerge and contribute to surface flow. This shallow groundwater discharge, known as baseflow, plays a vital role in maintaining flow in channels during dry periods between precipitation events. Consequently, it is a significant factor in determining habitat value and maintaining ecological flows.

These processes and pathways are all part of the hydrologic cycle for both undeveloped and developed lands. The proportion of precipitation that results in surface runoff versus infiltration, as well as the speed at which surface runoff reaches the receiving body, determines the impacts on the natural environment, habitats, and people. The basic components of a water balance include precipitation, evaporation, transpiration, infiltration, overland flow, streamflow, and groundwater flow. These can be represented by the following equation:

Precipitation (P)= Runoff (R) + Infiltration (I) + Evapotranspiration (ET)

Once water enters the ground, local conditions determine whether it percolates through the soil and rock, recharging deep groundwater resources, or moves laterally, re-emerging in local surface water features like wetlands and watercourses.

As the site is developed from its current state as farmland into residential areas, the infiltration and evapotranspiration from the site decrease, while the runoff volume increases due to the conversion of pervious lands to roads, sidewalks, driveways, and buildings.

Terrapex Environmental has completed a water balance analysis for the Lynden Garden site. The analysis indicates that in the post-development conditions, there will be a reduction of 57,149 m^3/year in infiltration compared to existing conditions. Methodology to reduce the infiltration deficit will be explored through the draft plan and detailed design stages of the project.

For a detailed water balance analysis, please refer to the Hydrogeological Investigation Report by Terrapex Environmental, included as **Appendix C4**. **Drawing STM-6** and **Drawing STM-7** in **Appendix A** provide information on drainage areas for the water balance analysis.

7.3. Low Impact Development Measures

A number of Low Impact Development (LID) measures can be implemented on the project site to improve infiltration and reduce runoff. Some of the possible LID measures include:

Infiltration Trench: These are rectangular trenches lined with geotextile fabric, filled with clean granular stone or void-forming materials. They are suitable for sites with limited space for infiltration, such as narrow strips of land between buildings or properties, or along road rights-of-way. They primarily handle roof and walkway runoff.

Bioretention: This infiltration practice utilizes the natural properties of soil and vegetation to treat runoff from paved areas and remove contaminants. Variations can include the inclusion or exclusion of an underdrain and impermeable liner. Bioretention can help achieve Stormwater Management (SWM) objectives related to water quality, water balance, and erosion control.

Rain Barrel: Water collected in rain barrels can serve as a non-potable source for various purposes like toilet flushing, urinals, and irrigation. Rain barrels can contribute to meeting SWM objectives related to water quality, water balance, and erosion control.

Silva Cell: The Silva Cell is a modular suspended pavement system designed to support the growth of large trees and provide effective stormwater management through processes like absorption, evapotranspiration, and interception.

Clean Water Collector/Exfiltration System (Perforated Pipe System): This system involves using storm sewers or manholes with perforations and stone trenches to promote infiltration of stormwater.

During the draft plan and detail design stage, the SWM Best Management Practices (BMPs) mentioned above will be further evaluated. The evaluation will consider technical feasibility, cost, maintenance requirements, and operational feasibility. While some LID approaches may be technically feasible, they may ultimately be cost-prohibitive or pose challenges in terms of maintenance and operation, particularly on a scale of this magnitude.

LID features recommended in the Subwatershed Study Report will also be evaluated in the draft plan and detail design stage.

8 WATER DISTRIBUTION SYSTEM

8.1. Existing Conditions

There are no existing watermains in close proximity to the subject lands at this time.

Development of the Lynden Garden Block will require construction of new Capital Infrastructure. As identified in the City of Brantford's Master Servicing Plan, new water transmission mains are required within both Lynden Road and the proposed Block Plan. These are identified as Capital Projects W-M-018 and W-M-020 respectively.

The Lynden Garden Block Plan is located within Pressure District (PD) 2/3, which is supplied by the Tollgate, Wayne Gretzky, and Albion Pump Stations. Floating storage is provided by the King George Elevated Tank (ET).

8.2. Design Criteria

The City of Branford's 2023 Linear Municipal Infrastructure Standards provides the following design criteria for the Lynden Garden Block Plan.

Water Use:

- Average Per Capita Daily Demand = 270 L/capita/day
- Max Day Peaking Factor = 1.8
- Peak Hour Peaking Factor = 3.0

Hydraulic Level of Service:

- Distribution System Pressure Requirements:
    - Max Day Demand = 40 psi to 100 psi
    - Max Hour (Peak) Demand = 40 psi minimum
    - Max Day and Fire (Emergency) = 20 psi
- Fire Flow in accordance with the Fire Underwriters Survey (FUS) guidelines and the Ontario Building Code
- Watermain velocities:
    - Maximum velocity not to exceed 1.5 m/s during peak hour conditions.
    - All proposed watermains achieve a minimum flushing velocity of 0.8 m/s
    - Transmission mains and distribution mains will be flagged for review if velocities are over 2.0 m/s.

8.3. Proposed Conditions and System Design

Water servicing will be provided to the Lynden Garden development through a network of new local watermains connected to the proposed Capital Projects described above. All local watermains within the Block are 250 mm in diameter.

The proposed water servicing plan is shown on **Drawing WM-1** in **Appendix A**.

C3 Water was engaged for this study to conduct a hydraulic assessment of the proposed Lynden Garden Block Plan, including the impact of development on the existing water system. C3 Water used the City's InfoWater Pro hydraulic model for the analysis. The C3 Water report is available in **Appendix C3**.

Design flows associated with the Lynden Garden Block Plan (calculated from the design criteria outlined above) were added to the City's hydraulic model. Demand was split evenly across nodes within the development. The ground elevations were assigned per the grading concept provided by Urbantech for the site. The model was run under both existing conditions and future (2051) conditions.

The key findings/recommendations from the hydraulic modeling analysis are as follows:

- Water delivery pressure for the Lynden Garden site is estimated to be between 77-95 psi under existing conditions and 79 – 106 psi under future conditions. The future pressure range slightly exceeds the City's standards (40 – 100 psi). Pressure reducing valves may be required to ensure adequate delivery pressure under future conditions.
- Fire flow targets are met at all locations on the site under existing and future conditions (using a watermain size of 250 mm).
- Pipe flow velocity is maintained below the 1.5 m/s threshold for all scenarios.
- The development does not trigger expansion requirements at the downstream pump stations or storage reservoir.
- Fire flow analysis and watermain sizing should be reviewed when more detailed development concepts are available (i.e., Draft Plan Approval stage).

The proposed water servicing concept is found to meet all required criteria and level of service.

9 SANITARY SERVICING

9.1. Existing Conditions

There is no existing wastewater infrastructure directly adjacent to the site. Development of the Lynden Garden Block will require upgrades to the existing wastewater system and construction of new Capital Infrastructure. These projects will provide wastewater servicing to both the Lynden Garden Block and the employment lands (Bella Gardens) to the east.

Ultimately these lands will drain to the existing Empey WWPS via the Coulbeck Road trunk sewer. Capacity upgrades to the Empey WWPS are required to support projected 2041 growth. This project is currently underway (capital projects WW-PS-007 and WW-PS-008) and expected to be completed by 2025.

A portion of the Lynden Road sanitary sewer will have to be removed and replaced with a larger sanitary trunk sewer to provide sufficient capacity for growth. This upgrade project is identified as WW-SS-013 in the City's Master Servicing Plan.

Due to the shallow depth of the Coulbeck Trunk and site grading constraints, a wastewater pumping station and forcemain are required to service both the Lynden Garden Block and the employment lands to the east. These projects are identified as WW-PS-005 and WW-FM-005 in the City's Master Plan. This Block Plan is proposing an alternative location for the proposed pumping station. Further details are provided in subsequent sections of this report. Also refer to **Drawing SAN-1**, **Drawing SAN-2, Drawing SAN-3,** and **Drawing SAN-EXT** in **Appendix A** for details.

9.2. Design Criteria

The City of Branford's 2023 Linear Municipal Infrastructure Standards provides the following design criteria for the Lynden Garden Block Plan.

The following criteria were used when calculating the design sanitary flow rate:

Wastewater Generation:

- Unit sewage flow = 245 L/person/day for residential
- Unit sewage flow = 270 L/person/day for employment
- Extraneous Flow Allowance = 0.3 L/s/ha
- Peaking Factor = Harmon Formula (min 2, max 4)

Design Flow = (Unit Sewage Flow * Peaking Factor) + Extraneous Flow

Population Equivalents Based on Land Use:

- Low Density Residential = 3.05 ppu (people per unit)
- Medium Density Residential = 2.47 ppu
- High Density (Apartment) = 1.60 ppu

- Commercial = 90 ppha (people per hectare)
- Institutional = 90 ppha
- Industrial = 125 ppha

The City's standard '*Sanitary Sewer Design Computation Sheet'* is used for sizing of all sanitary sewers. The completed sewer design sheet for the Lynden Garden Block can be found in **Appendix B**.

Hydraulic Level of Service

- Flow velocity for sanitary sewers must meet the following requirements, as outlined by the MECP:
    - Minimum flow velocity equal to 0.6 m/s.
    - Maximum pipe capacity equals 80% full.
    - Maximum flow velocity equal to 3.0 m/s.

9.3. Proposed Conditions and System Design

The Lynden Garden Block Plan will be serviced by the construction of a network of local 250mm sanitary sewers which will drain to the proposed Pumping Station. In areas where the depth of the sanitary sewer precludes the installation of servicing laterals to houses, a local sanitary system will be installed at a nominal depth to permit servicing of houses. The local sanitary sewers generally flow in a southerly direction to the proposed pumping station located along Lynden Road. This pump station will ultimately connect to the Coulbeck trunk sewer by the construction of a forcemain and the replacement of a portion of the existing gravity sewer within Lynden Road.

Table 9-1 outlines the proposed sanitary flows from the development. Refer to **Drawing SAN-1** and **Drawing SAN-2** in **Appendix A** for details related to the sanitary drainage areas, locations of the proposed on-site sanitary sewers and connections to public sewers. Sanitary design sheets and sanitary demand calculations are included in **Appendix B**.

Table 9-1: Proposed Sanitary Flows

Outlet Street	Drainage Area (ha)	Population	Infiltration (L/s)	Design Sanitary Flow (L/s) Note 1
Street A	47.01	2612	13.5	25.9

Note 1: Based on City of Brantford Standards (2023)

Table 9-2 below outlines the proposed external sanitary flows from the future employment lands.

Table 9-2: Proposed External Sanitary Flows

Outlet Street	Drainage Area (ha)	Population	Infiltration (L/s)	Design Sanitary Flow (L/s) Note 1
Lynden Road	68.08	7466	20.4	85.6

Note 1: Based on City of Brantford Standards (2023)

As described above, these lands will ultimately drain to the existing Empey WWPS via the Coulbeck Road trunk sewer. Capacity upgrades to the station are required to support projected 2041 growth and are currently underway.

A local pumping station is required to provide wastewater servicing for the Lynden Garden Block Plan and the Garden Street employment lands. This report proposes to locate this pumping station along Lynden Road (refer to **Drawing SAN-EXT, Drawing SAN-EP-1** and **Drawing SAN-EP-2** in **Appendix A**). This location is proposed in lieu of the location in the City's Master Servicing Plan for the following reasons:

- Reduced Capital Works required to bring the pumping station on-line.
- Significant reduction in required forcemain resulting in reduced capital and long-term operation and maintenance costs.
- Reduced wet well depth and resultant cost savings.
- Fewer drain and release valves required due to reduction in forcemain.

RVA was engaged for this study to provide a preliminary design concept for the local pumping station and forcemains required for the Lynden Garden Block Plan. The full report is available in **Appendix C10**. Key design considerations are as follows:

- The pump station is designed to service the Lynden Garden Block and future East Expansion Lands (Employment Area) located north of Hwy 403 & east of Garden Ave. This includes an estimated tributary area of 203.4 ha a service population of approximately 18,600 people.
- Peak flow to the station is estimated at 203.4 L/s.
- The pump station is classified as Type III facility according to City Standards, to include three installed pumps (two duty operating in lead-lag sequence & one standby) and two (2) 350 mm twin discharge forcemains (duty/standby). The station will be designed as a split-cell with both wet well and dry well.
- Overflow is directed to the adjacent SWM Pond.
- Above ground structures will include a single-story building over the wet well and dry well. Electrical equipment, HVAC and odour control equipment will be housed in the building.
- Outdoor diesel generator equipped with sub-base fuel tank is recommended as a backup to support the facility upon loss of Hydro supply.

10 ENVIRONMENTAL IMPACT STUDY

WSP Canada Inc. (WSP) was retained to complete the Scoped Environmental Impact Study (EIS) in support of the Lynden Garden Block Plan. The full report is available in **Appendix C2**.

The Scoped EIS is done to satisfy the Natural Heritage System (NHS) requirements of the City of Brantford's Official Plan and is intended to:

- Document existing natural heritage features and functions.
- Provide recommended measures for impact mitigation, stewardship, and restoration.

The study approach integrates background information and field surveys to assess natural environment features on and around the Lynden Garden Block. The report also considers Species of Conservation Concern (SCC), encompassing provincially and federally listed species, provincially rare species, and regionally significant plants and birds.

10.1. Preliminary Impact Assessment and Mitigation Recommendations

The EIS report concludes that any potential impacts on the natural environment within the Lynden Garden Block Plan due to the proposed development are considered manageable with the proper mitigation plan:

- The proposed development will not intrude into any natural heritage features that make up the Core Natural Areas Designation in the City of Brantford Official Plan. The limits of these areas can be retained in full, and their ecological functions will be protected with development setbacks, permanent fencing, buffer enhancement and other mitigation measures to be identified / confirmed through future submissions.
- The conceptual development design measures, as well as the recommended mitigation measures conform to relevant natural heritage system policies outlined in the City of Brantford Official Plan.

The following work is recommended to confirm or refine conclusions and recommendations. Note that these items are recommended to be completed as part of a future Draft Plan application submission / through the detailed design of the proposed development.

- Prepare a feature water balance to ensure natural features can be sustained post-development.
- Refine the ESC plan and SWM strategy, including details regarding outlet locations and design, as well as LID measures as needed to demonstrate the water balance.
- Refine and confirm feature limits (using detailed surveys and site walks).
- Complete additional fieldwork to assess the presence of potential Monarch and White-tailed Deer habitats across the site based on discussions with SNGR representatives.
- In the bat active season immediately prior to the planned demolition of the shed structure located near Vegetation Unit 11, complete two rounds of bat exit surveys. This will assess potential use of the structure by SAR bats. Appropriate ESA compliance activities are to be completed pending the results of targeted SAR bat surveys.

- Prepare detailed landscape planting plans, including naturalized buffers to environmental features.
- Undertake registration and appropriate compensation measures related to removal / harm of Butternut trees.
- Prepare a Biological Monitoring program to assess the potential impacts and efficacy of the recommended mitigation and enhancement measures.

11 TRAFFIC IMPACT STUDY

BA Group was retained by Welton & Innes GP Inc. to provide transportation consulting services for the Lynden Garden Block Plan. BA Group provided the Urban Transportation Considerations Report in December 2022, and an Addendum Report in October 2023. Both reports are available in **Appendix C1A** and **Appendix C1B**, respectively.

11.1. Existing Site and Planning Context

The Lynden Garden Block Plan site is bordered by existing residential areas and Lynden Hills Park to the west, while the east side is adjacent to County of Brant agricultural and natural heritage areas. Lynden Road forms the southern boundary, and a CN rail corridor delineates the southeast side.

The City of Brantford Official Plan designates the land primarily as a core natural area and residential area, with the land along Lyndon Road designated as "Neighbourhood Centre" and "Neighbourhood Corridor". The City's Official Plan (OP) and Transportation Master Plan (TMP) propose various transportation-related projects within the Site boundaries and vicinity, including road widening of Lynden Road, introduction of minor collector roads within the site boundaries with on-street cycling infrastructure, and on-road and off-road bikeways and trails.

11.2. Transportation Context

The Site has connectivity to various existing roadway connections across the city, County of Brant, and Greater Toronto and Hamilton Area (GTHA), facilitated by adjacent arterial roads and Highway 403. Besides industrial uses, there are several amenities and services within walking distance of the Site, including Lynden Hills Park, retail plazas, a grocery store, and medical facilities. However, there is a noted lack of designated cycling facilities in the area, which the City plans to address. The Site is also well-served by several existing bus transit routes operated by Brantford Transit. There are four bus routes that are accessible within an 800-metre radius of the Site.

11.3. Proposed Block Plan

The Lynden Garden Block Plan introduces a comprehensive development plan for the area, including a mix of residential units, parks, and a network of roads designed to align with the City's Official Plan and Transportation Master Plan. Noteworthy elements of the plan include a new Minor Collector Road (24.5-metre cross-section) that creates a loop through the Site, providing two connections to the existing area road network at Lynden Road/Garden Ave; a signalized intersection at the west intersection of the proposed road and Lynden Road, widening along Lynden Road to permit an overall future right-of-way of 40 metres, a fine grain network of local roads (18.5-metre cross-section); and on-road bike infrastructure within the proposed Minor Collector Road consistent with the City OP and TMP.

11.4. Traffic Volume Forecasting and Analysis

The Site is expected to generate approximately 590 and 765 two-way vehicle trips during the weekday morning and afternoon peak hours, respectively. A signalized access is proposed at

the intersection of the Minor Collector Road and Lynden Road, enhancing pedestrian safety, and providing controlled access for vehicles. All study area intersections within site development, including the proposed Minor Collector Road intersections, will operate under capacity and at acceptable levels-of-service in the weekday peak hours. The report evaluated the feasibility of implementing roundabout, traffic signal or dual roundabout option at the intersections of Lynden Road and Garden Avenue to support the assessment.

Collision data from 2018 to 2023 at intersections along Lynden Road were also reviewed. Out of 25 collisions documented, 10 were related to turning movements (8 involving left turns), 8 were rear-end collisions, 4 were angled, and 2 were sideswipes. Additionally, 2 collisions involved speeding vehicles. Based on these characteristics, if the site access intersections along the Lynden Road were signalized, a roundabout option could potentially reduce 12 out of 25 collisions over a span of 6 years.

Ultimately, the BA Group Traffic Study suggests that the proposed Lynden Garden Block Plan development can be effectively accommodated within the existing transportation network. The proposed road plan aligns well with the City's existing plans for roads and active transportation. Additional road network improvements beyond what is proposed within the Site limits and the City's existing plans in the vicinity are deemed unnecessary.

12 TRANSPORTATION NOISE & VIBRATION FEASIBILITY ASSESSMENT

GradientWind prepared the Transportation Noise & Vibration Feasibility Assessment report, dated October, 2023, in support of the Lynden Garden Block Plan. This section provides a brief summary of the report, with the full report available in **Appendix C8**.

12.1. Transportation Noise Assessment Results and Recommendations

The transportation noise study was undertaken to determine the effect of post-development transportation noise on residents' indoor and outdoor living spaces. The report is prepared in accordance with the MECP's NPC-300 guidelines, and includes recommended mitigation measures for noise attenuation, where applicable.

Modeling completed as part of the analysis suggests that noise levels over the site will range from between 54 and 73 dBA during the daytime, and between 51 and 71 dBA at night. The highest noise levels are anticipated to be in the southeast corner of the site. These results include the combined noise associated with post-development roadway traffic plus the CN rail corridor. Noise calculations include sound level projections from future roadway expansions. It is noted that the major source of transportation noise for the Lynden Garden Block Plan site is associated with the CN rail line.

The MECP guidelines recommend a noise range for indoor living spaces between 35 and 45 dBA. In order to account for potential deficiencies in building construction, the target indoor noise range is between 32 and 35 dBA. To achieve the target range, the following is recommended:

- Upgraded building components with a higher Sound Transmission Class (STC) will be required for areas where outdoor noise levels exceed 60 dBA due to the railway source and 65 dBA due to roadway source.
- Closed windows reduce dBA by 10, therefore lots that experience noise levels above 60 dBA will require air conditioning, or a similar mechanical system, to ensure the comfort of occupants.
- Lots that experience outdoor noise levels between 55-60 dBA will require forced air heating with provision for air conditioning.
- No outdoor noise mitigation is required for lots that fall under 55 dBA.
- Rear yards backing onto the rail line and Lynden Road may require noise control measures such as noise barriers to reduce to under 55 dBA.

A detailed transportation noise study will be undertaken at the time of subdivision registration to determine the specific noise control measures for the development.

12.2. Vibration Study Results and Recommendations

A vibration study was undertaken to determine the potential impact of the CN rail line on foundations in the vicinity of the rail corridor. The analysis was completed using the United States Federal Authority's (FTA's) criteria to identify potential areas of concern.
Potential vibration impacts of the rail line were predicted using the FTA's *Transit Noise and Vibration Impact Assessment* protocol. Estimated vibration levels at foundations nearest to the rail corridor are anticipated to be 0.14 mm/s RMS (75 dBV), based on the FTA's protocol.

In accordance with FTA's *Guidelines for New Development in Proximity to Railway Operations*, no mitigation is required for vibration levels up to 0.14 mm/s RMS. As vibration levels for the Lynden Garden Block Plan site are anticipated to be within this range, no specific mitigation measures are required. Further, regenerated noise levels are also anticipated to be acceptable.

13 ARCHAEOLOGICAL ASSESSMENT

This Land Archaeology (TLA) was contracted in 2019 to conduct a peer review of archaeological work (Stage 1 and Stage 2) done at the Lynden Garden Block Plan site in 2006 by Amick Consultants Ltd.).

At the conclusion of the peer review, and after discussion with MHSTCI:

- A decision was made to proceed with an updated Stage 2 assessment for Field 2 (a portion of the site, along the west boundary). In the 2006 study, the Stage 2 assessment identified four (4) areas in Field 2 requiring further work (i.e., Stage 3). Since the Standards and Guidelines associated with Archaeological Assessments were updated in 2011, it was determined that a new Stage 2 Assessment would be required for Field 2.
- No further work would be required for the remainder of the property. The registered results from 2006 were sufficient for the assessment to be considered complete.

Therefore, a Stage 2 assessment was conducted for Field 2 in June 2019. The Stage 2 assessment resulted in the recovery of 67 Indigenous artifacts from 59 findspots. It was found that three of the sites previously registered and recommended for Stage 3 in the 2006 study did not, under the 2011 Standards and Guidelines, meet the criteria to require further archaeological work. One site (known as Innes-Welton Site D (AhHb-146)) did meet the criteria for a Stage 3 Assessment.

The Stage 3 assessment for the AhHb-146 site was carried out on July 10th and July 11th, 2019. The Stage 3 excavations yielded a total of 8 artifacts. Five of the artifacts were of Indigenous origin, two were of Euro-Canadian origin. None of the artifacts hold further Cultural Heritage Value of Interest (CHVI). The final recommendation was that no further work would be needed.

Appendix C9 includes the full TLA report, as well as the Ministry's clearance letter confirming that the work was done in conformance with the 2011 Standards and Guidelines and no further investigation is required. The study has been entered into the Ontario Public Register of Archaeological Reports.

It is noted that a portion of the site, previously defined as Environmental Protection Area (EPA) and now defined as woodlot was outside of the 2006 and 2019 study area. The Ministry has recommended (as outlined in their clearance letter) that further assessment through test pit survey for this area should be undertaken.

14 PHASING AND IMPLEMENTATION

14.1. Site Servicing

Table 14-1 provides details on the core infrastructure requirements for the Lynden Garden Block Plan.

Table 14-1: Lynden Garden Block – Infrastructure Requirements

Infrastructure	Number	Location	Size
Watermains	Multiple	Throughout Site	250 mm WMs
Sanitary Mains	Multiple	Throughout Site	250 mm to 525 mm WWMs
Sanitary Pumping Station	1	Southwest corner of Site	203.4 L/s (three pumps)
Forcemains	2	Southwest corner of Site	2 x 350 mm twin Forcemains
Storm Sewers	Multiple	Throughout Site	300 mm – 1200 mm STM sewers
SWM Pond 1	1	South side of Site, adjacent to Lynden Road	28,886 m^3 Active Volume
SWM Pond 2	1	Northeast corner of Site	10,407 m^3 Active Volume
Superpipe Storage System	1	Northwest corner of Site	1,620 m^3 Active Volume

14.2. Works External to the Block Plan

Table 14-2 provides details on the infrastructure requirements that support the Lynden Garden Block Plan but are external to the property boundary.

Table 14-2: External Infrastructure Requirements

Infrastructure	Number	Location	Size
Watermains	1	Lynden Road, new external WM, connecting to existing 300 mm WWM.	300 mm WM (new)
Sanitary Mains	1	Lynden Road, connection to future planned 375 mm WWM (by others).	250 mm WWM (new)
Sanitary Pumping Station	-	N/A	N/A
Forcemains	2	Lynden Road, connecting into existing 525 mm WWM	2 x 350 mm twin Forcemains
Storm Sewers	2	Lynden Road:	300 mm STM sewer (Outlet A)

Infrastructure	Number	Location	Size
		1) Connection to existing 600 mm culvert on Lynden Road (Outlet A) 2) Connection to existing watercourse (Outlet B)	675 mm STM sewer (Outlet B)
SWM Pond 1	-	N/A	N/A
SWM Pond 2	-	N/A	N/A
Superpipe Storage System	-	N/A	N/A

15 PUBLIC AND AGENCY CONSULTATION

15.1. Municipal Class Environmental Assessments (MCEA)

The development of the Lynden Garden Block Plan will require construction of new roads, water, wastewater, and stormwater infrastructure. As such, the requirements of the Municipal Class Environmental Assessment (MCEA) 2023 will apply. The MCEA requirements and associated process were recently updated in March 2023. Since the Lynden Garden Block Plan has not commenced an MCEA Study for any infrastructure component, it is understood that the updated 2023 MCEA requirements will guide the process.

The MCEA process provides a decision-making framework that meets the requirements of the Environmental Assessment Act in an efficient and effective manner. It provides:

- A framework for proponents to fulfill their responsibilities regarding public consultation.
- A streamlined and consistent process for planning and implementing infrastructure projects that could have an impact on the environment.

The Landowner group will be the proponent for any required MCEAs for the Lynden Garden Block and, therefore, would be subject to Ontario Regulation 345/93 – Designation and Exemption – Private Sector Developers. This Regulation provides that:

- Proposed infrastructure works that are categorized as a Schedule C in Appendix I of the MCEA Project Schedules would be subject to the MCEA Process.

The 2023 MCEA process also provides opportunities for project exemption or Schedule reduction based on specific screening processes.

15.2. Lynden Garden Infrastructure Covered Under the MCEA Process

The BSS covers Phase 1 (Problem Statement) and Phase 2 (Alternative Solutions) of the MCEA process for the following infrastructure:

- Sanitary Pump Station
- Forcemains and Sanitary Trunk Sewers
- Water Transmission Mains
- Storm Trunks, SWM Ponds and Outfalls
- Internal Collector Roads

Any additional work to satisfy the requirements of the MCEA process will depend on the type and size of infrastructure and will be further advanced through detailed design. As noted above, some projects may be eligible for exemption based on the results of a screening process. Additional details are outlined below.

15.2.1 Collector Roads

The Lynden Garden Block Plan includes a proposed north-south oriented collector road. The construction of a new collector road requires the completion of a Schedule C MCEA Study if the construction cost is greater than $3 million.

It is anticipated that collector road costs for the Lynden Garden Block Plan will be in this range and must be further reviewed for MCEA requirements through detailed design.

Collector roads are eligible for screening. There are two types of screening. Both must be passed before the project can be considered for exemption:

- Archaeological Screening Process (ASP)
- Collector Road Screening Process (CR)

Coordination with the City and communication with the MECP will be required regardless of the path forward.

15.2.2 Water and Wastewater Infrastructure

The Lynden Garden Block Plan includes water distribution and wastewater collection infrastructure. Linear infrastructure (pipes) that are required as a condition of approval of a site plan, plan of subdivision or plan of condominium which will come into effect under the Planning Act prior to the construction of the infrastructure are exempt from the MCEA requirements. This applies to the Lynden Garden Block Plan. No further MCEA work is required for water and wastewater linear infrastructure.

Per the Lynden Garden Block Pumping Station and Forcemain Design Development Report by RVA (full report in **Appendix C10**), the proposed local wastewater pumping station is also exempt from further MCEA requirements. Similar to the linear infrastructure, the pump station will be required as a condition of approval for the site, through the Planning Act. No further MCEA work is required for the pump station and associated forcemains.

15.2.3 Stormwater Management Facilities

The Lynden Garden Block Plan includes two (2) stormwater management ponds and one (1) superpipe storage system. Similar to water and wastewater infrastructure, SWM facilities are considered exempt from the MCEA process if their construction is required as a condition of approval on a site plan, plan of subdivision or condominium which will come into effect under the Planning Act. No further MCEA work is required for stormwater management infrastructure. Note that this also encompasses LID features.

16 CONCLUSION

This BSS report demonstrates that the Lynden Garden Block has been planned and designed in a comprehensive manner that takes into account:

- The vision and requirements of the City of Brantford's Official Plan for new development.
- MECP, City of Brantford and GRCA requirements / guidelines.
- Protection of natural features and native species.
- Consideration for the Archaeological history of the site.
- Consideration of neighbouring developments with respect to traffic, noise, and servicing capacity.
- Stormwater management practices that limit the impact of development on existing watercourses and groundwater recharge.
- Site servicing that is consistent with the City's Master Servicing Plans and local servicing network.

This report will provide the framework for future development applications and proposals for the Lynden Garden Block.

Report Prepared by:

Rob Merwin, P. Eng.
Senior Associate, Land Development

APPENDIX A

DRAWINGS & FIGURES

LEGEND

LIMIT OF DEVELOPMENT

BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR
BENCHMARK No. 1196U861
ELEVATION = 208.33

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299 LYNDEN ROAD
CITY OF BRANTFORD

SITE LOCATION PLAN

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	1:10000	**SLP-1**

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIG\PRELIMINARY SITE LOCATION PLAN.DWG

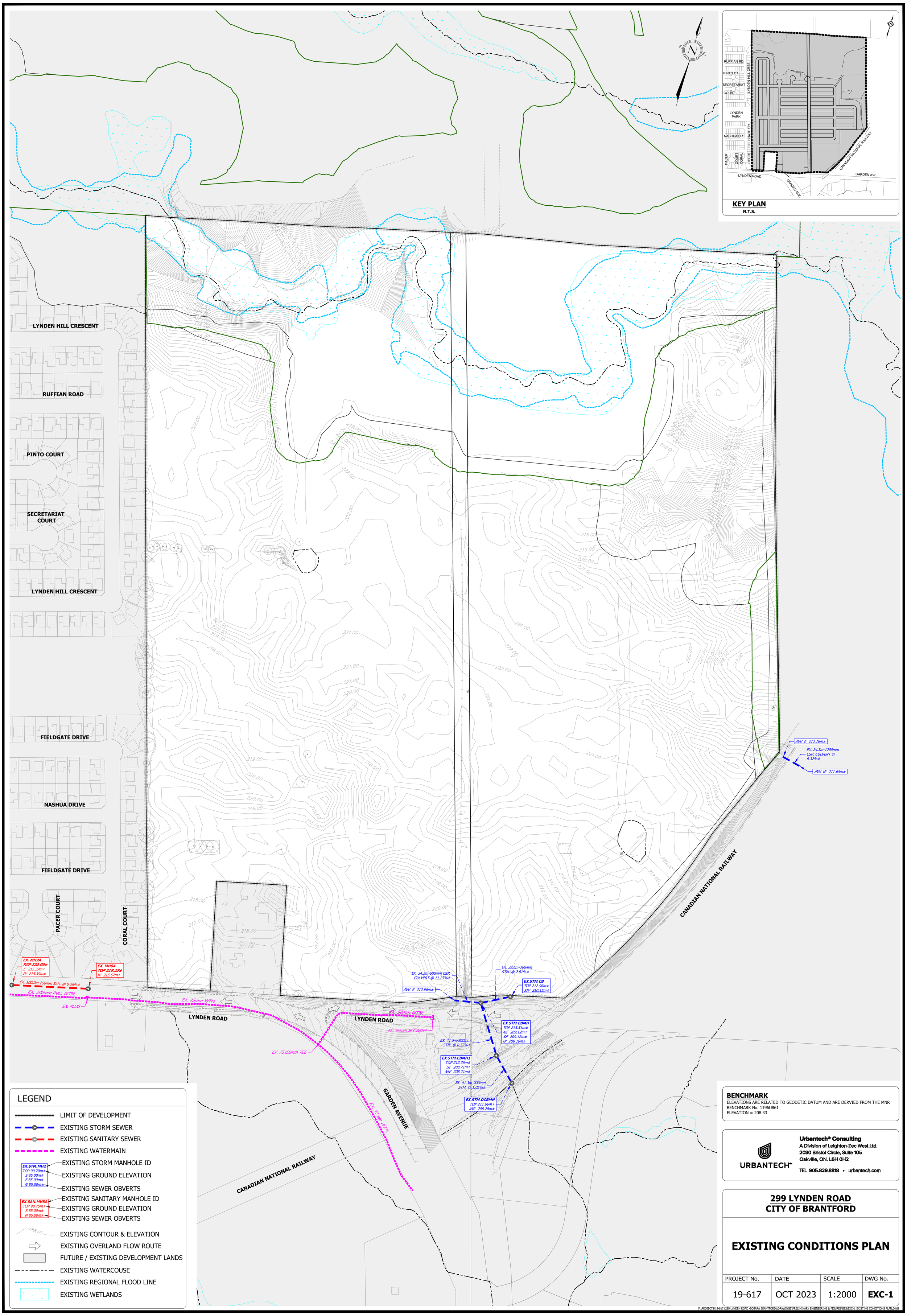
PROPOSED LAND USE	Area	% of Area
1) Neighbourhood Residential	28.8ha	37.1%
2) Neighbourhood Corridor	3.6ha	4.6%
3) Neighbourhood Centre	1.7ha	2.2%
4) Neighbourhood Park	2.7ha	3.5%
5) Natural Heritage System	22.1ha	28.4%
6) Stormwater Management Facility and Access Block	5.8ha	7.5%
7) Pumping Station	0.2ha	0.3%
8) Lynden Road Widening (10m)	0.1ha	0.1%
9) Road Right-of-Ways	12.7ha	16.3%
TOTAL	77.7ha	

Notes:
1. The proposed Neighbourhood Park land use represents 5% of total developable lands.
2. The total proposed area for Neighbourhood Centre includes a 1.2ha parcel owned by a non-participating landowner.

SCHEDULE 1
LYNDEN GARDEN BLOCK PLAN
CONCEPTUAL MASTER PLAN

- Landmark / Focal Point
- Trail
- Block Plan Boundary
- City-Owned Right-of-Way

PREPARED FOR:	SCALE	PROJECT No.
WELTON & INNES GP INC	1:4,000	L19-1708
	DATE	
	January 26, 2024	


KEY PLAN
N.T.S.
RUFFIAN RD.
PINTO CT.
SECRETARIAT COURT
LYNDEN HILL CRES.
LYNDEN PARK
NASHUA DR.
FIELDGATE DR.
PACER COURT
CORAL COURT
LYNDEN ROAD
GARDEN AVE.
CANADIAN NATIONAL RAILWAY
LYNDEN HILL CRESCENT
RUFFIAN ROAD
PINTO COURT
SECRETARIAT COURT
LYNDEN HILL CRESCENT
FIELDGATE DRIVE
NASHUA DRIVE
FIELDGATE DRIVE
PACER COURT
CORAL COURT
CANADIAN NATIONAL RAILWAY
INV. E 213.18m±
EX. 24.3m-1200mm CSP. CULVERT @ 6.32%±
INV. W 211.65m±
EX. MH9A TOP 220.09± E 215.39m± W 215.39m±
EX. MH8A TOP 218.23± W 215.67m±
EX. 100.0m-250mm SAN. @ 0.28%±
EX. 300mm PVC. WTM.
EX. PLUG
EX. 75mm WTM.
LYNDEN ROAD
EX. 50mm WTM.
LYNDEN ROAD
EX. 50mm BLOWOFF
EX. 75x50mm TEE
EX. 34.5m-600mm CSP. CULVERT @ 11.25%±
INV. E 212.96m±
EX. 39.6m-300mm STM. @ 2.61%±
EX.STM.CB TOP 212.96m± SW 210.15m±
EX.STM.CBMH TOP 215.51m± NE 209.12m± SE 209.12m± W 209.10m±
EX. 71.5m-900mm STM. @ 0.57%±
EX.STM.CBMH1 TOP 212.36m± SE 208.71m± NW 208.71m±
EX. 41.3m-900mm STM. @ 1.05%±
EX.STM.DCBMH TOP 211.96m± NW 208.28m±
EX. 75mm WTM.
GARDEN AVENUE
CANADIAN NATIONAL RAILWAY
LEGEND
LIMIT OF DEVELOPMENT
EXISTING STORM SEWER
EXISTING SANITARY SEWER
EXISTING WATERMAIN
EX.STM.MH2 TOP 90.70m± S 85.00m± E 85.00m± W 85.00m±
EXISTING STORM MANHOLE ID
EXISTING GROUND ELEVATION
EXISTING SEWER OBVERTS
EX.SAN.MH5A TOP 90.75m± S 85.00m± N 85.00m±
EXISTING SANITARY MANHOLE ID
EXISTING GROUND ELEVATION
EXISTING SEWER OBVERTS
188.00
EXISTING CONTOUR & ELEVATION
EXISTING OVERLAND FLOW ROUTE
FUTURE / EXISTING DEVELOPMENT LANDS
EXISTING WATERCOUSE
EXISTING REGIONAL FLOOD LINE
EXISTING WETLANDS
BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR BENCHMARK No. 1196U861
ELEVATION = 208.33
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299 LYNDEN ROAD
CITY OF BRANTFORD
EXISTING CONDITIONS PLAN
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:2000
DWG No. EXC-1
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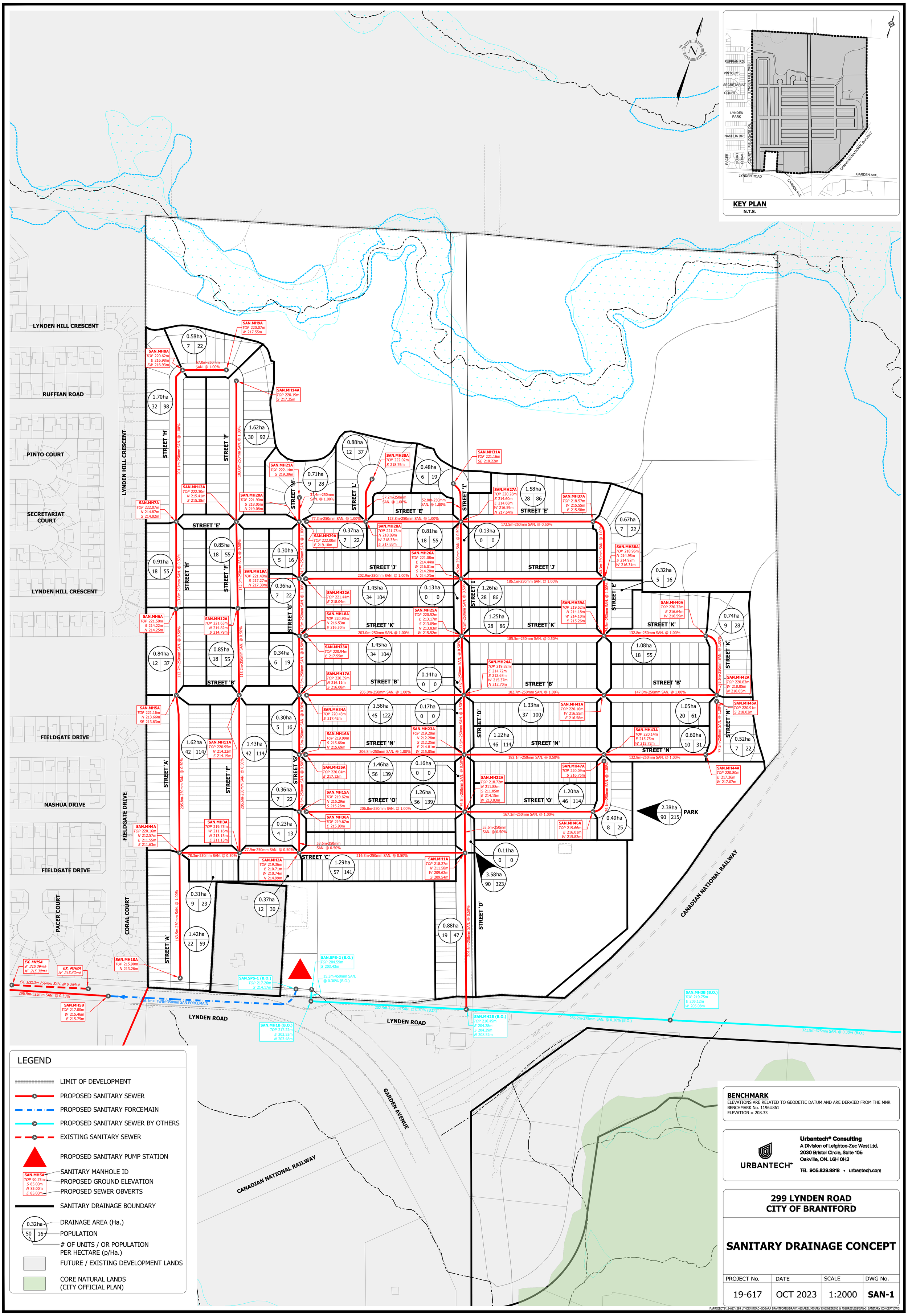
KEY PLAN
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LYNDEN HILL CRESCENT
RUFFIAN ROAD
PINTO COURT
SECRETARIAT COURT
NASHUA DRIVE
FIELDGATE DRIVE
PACER COURT
CORAL COURT
LYNDEN ROAD
GARDEN AVENUE
CANADIAN NATIONAL RAILWAY
PARK
STREET 'A'
STREET 'B'
STREET 'C'
STREET 'D'
STREET 'E'
STREET 'F'
STREET 'G'
STREET 'H'
STREET 'I'
STREET 'J'
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STREET 'L'
STREET 'M'
STREET 'N'
STREET 'O'
LEGEND
LIMIT OF DEVELOPMENT
PROPOSED SANITARY SEWER
PROPOSED SANITARY FORCEMAIN
PROPOSED SANITARY SEWER BY OTHERS
EXISTING SANITARY SEWER
PROPOSED SANITARY PUMP STATION
SANITARY MANHOLE ID
PROPOSED GROUND ELEVATION
PROPOSED SEWER OBVERTS
SANITARY DRAINAGE BOUNDARY
DRAINAGE AREA (Ha.)
POPULATION
OF UNITS / OR POPULATION PER HECTARE (p/Ha.)
FUTURE / EXISTING DEVELOPMENT LANDS
CORE NATURAL LANDS (CITY OFFICIAL PLAN)
BENCHMARK
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ELEVATION = 208.33
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SANITARY DRAINAGE CONCEPT
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:2000
DWG No. SAN-1
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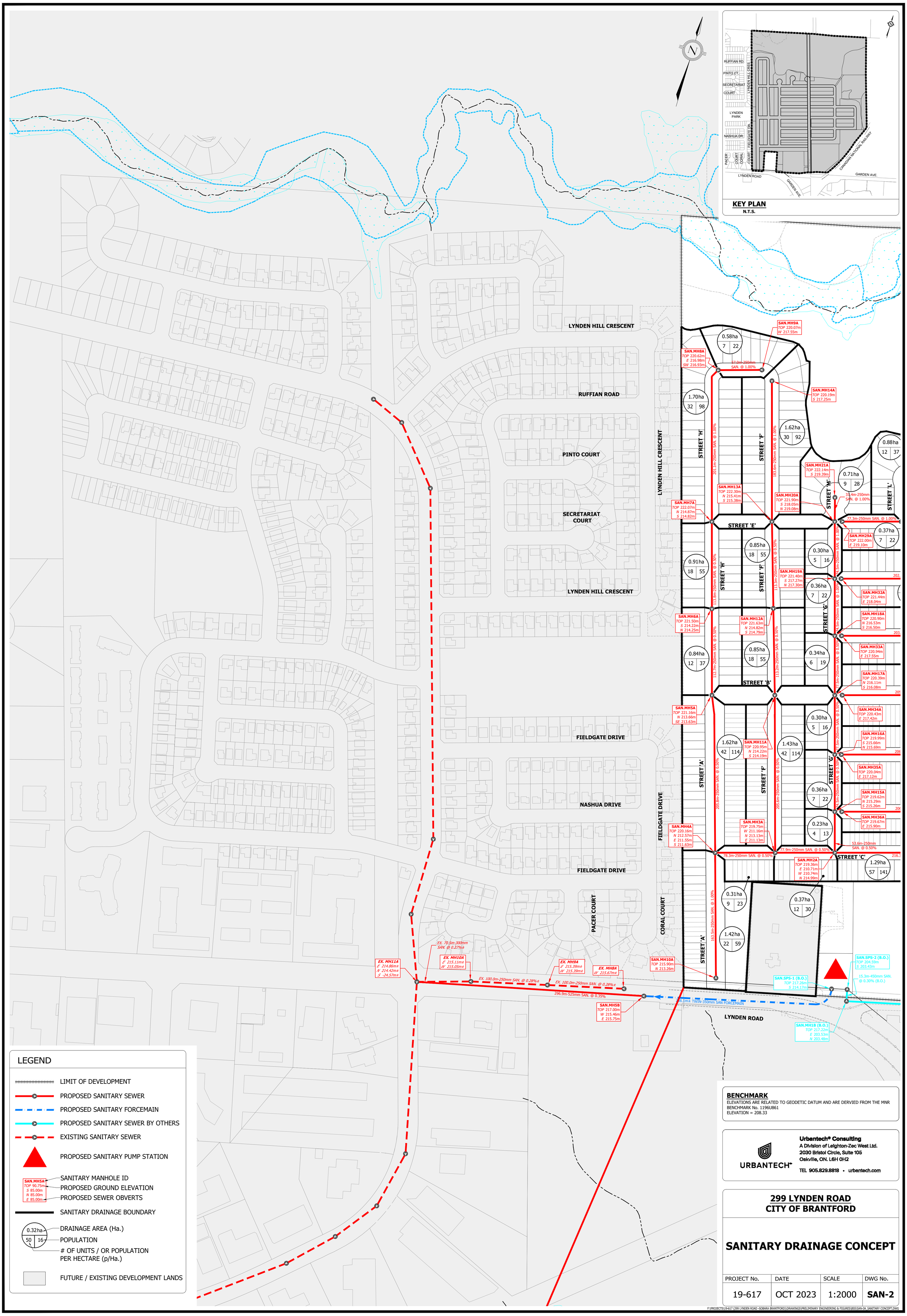

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SANITARY DRAINAGE CONCEPT

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:2000	SAN-2

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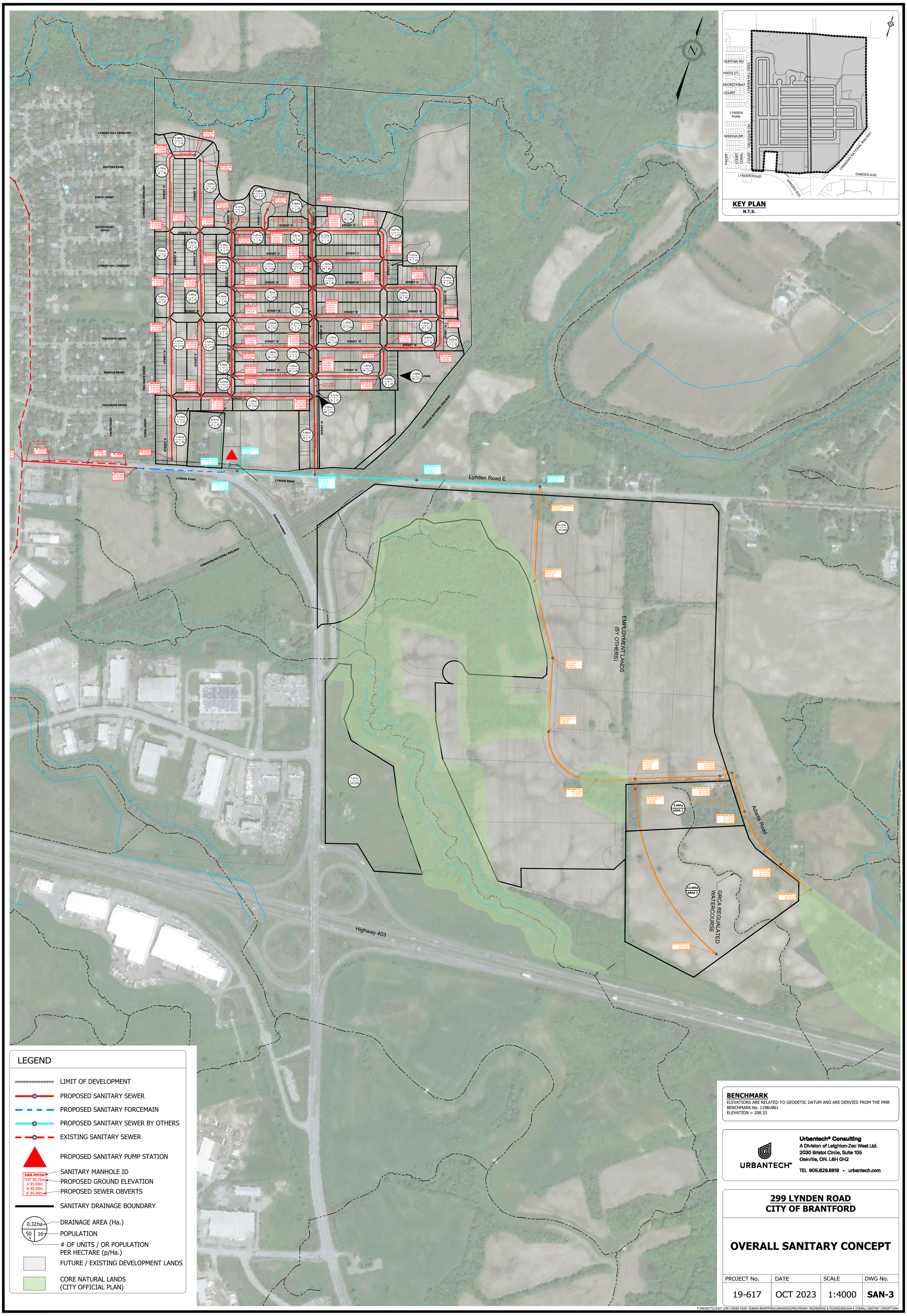

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299 LYNDEN ROAD
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OVERALL SANITARY CONCEPT

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:4000	SAN-3

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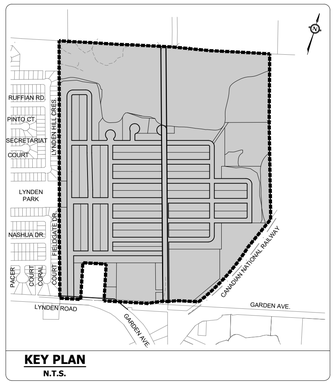
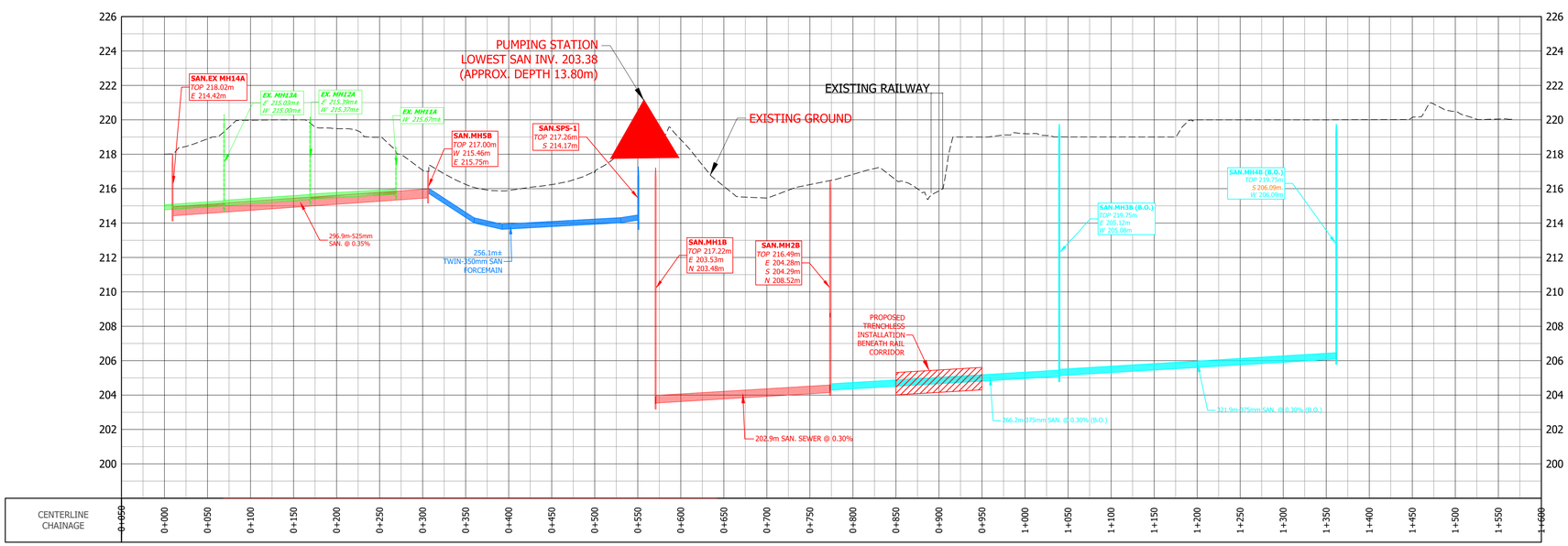


KEY PLAN
N.T.S.

LEGEND

- EXISTING SANITARY SEWER
- GRAVITY SANITARY SEWER
- GRAVITY SANITARY SEWER BY OTHERS
- GRAVITY SANITARY SEWER BY OTHERS
- PUMPING STATION
- TWIN FORCEMAIN LAYOUT



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BENCHMARK No. 1196U861
ELEVATION = 208.33

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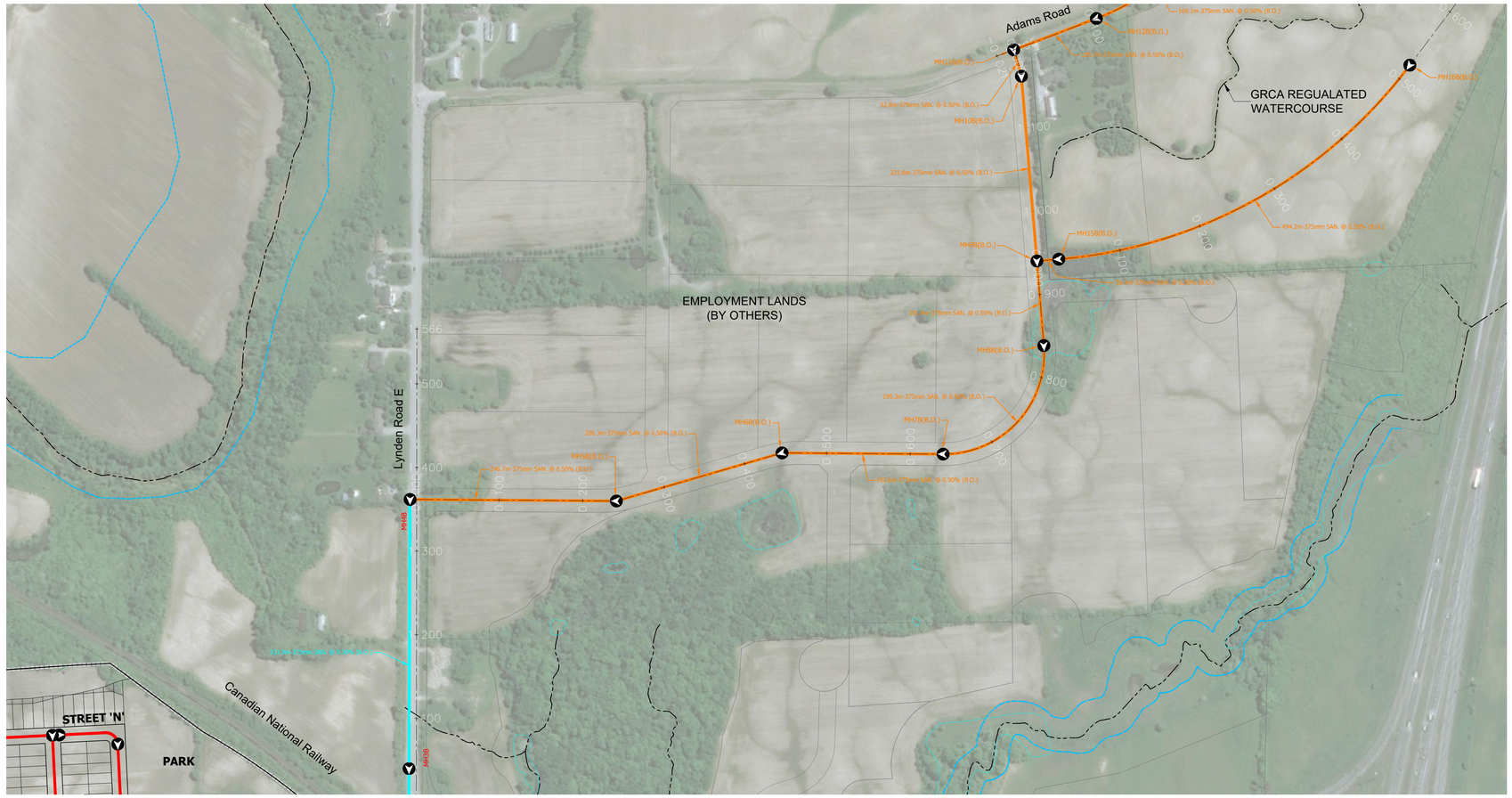
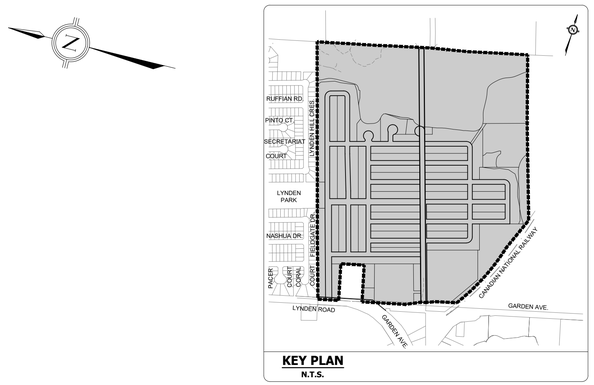
299 LYNDEN ROAD
CITY OF BRANTFORD

EAST EXPANSION LANDS
PUMPING STATION

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	H: 1:3,000 V: 1:150	SAN-EXT

F:\PROJECTS\19-617 (299 LYNDEN ROAD -GOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SAN-EXT_OPTION 2.DWG

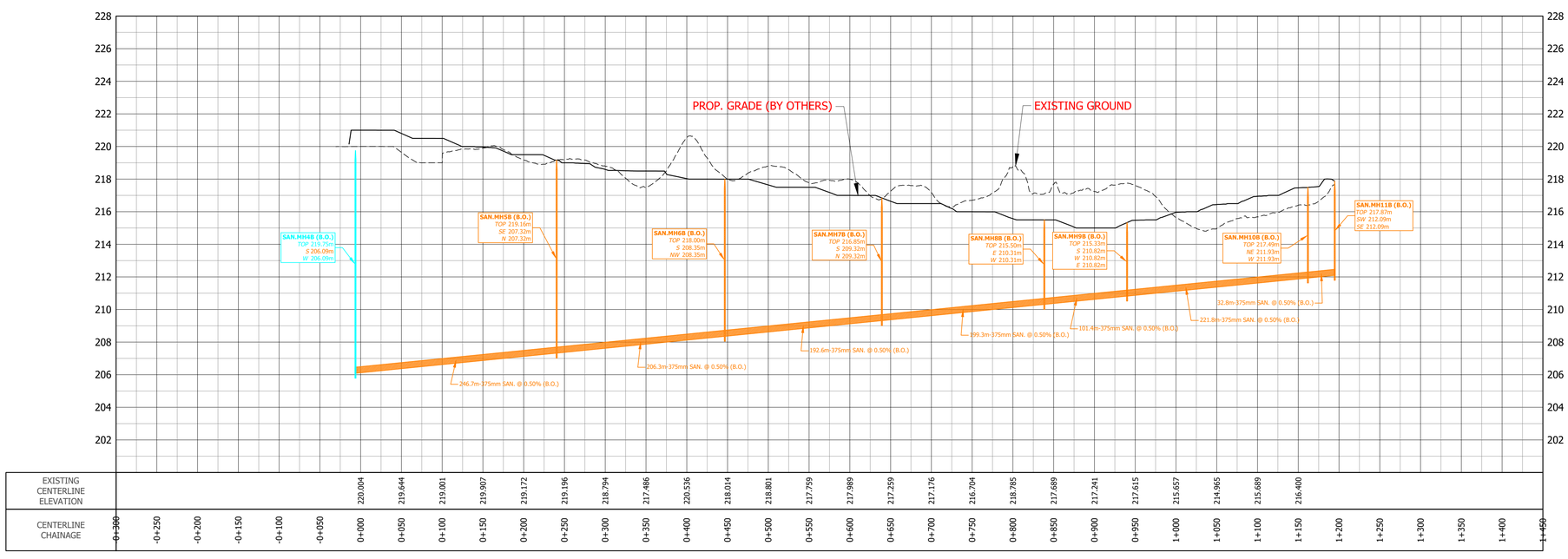




KEY PLAN
N.T.S.

LEGEND

- EXISTING SANITARY SEWER
- GRAVITY SANITARY SEWER
- GRAVITY SANITARY SEWER BY OTHERS
- GRAVITY SANITARY SEWER BY OTHERS
- PUMPING STATION
- TWIN FORCEMAIN LAYOUT



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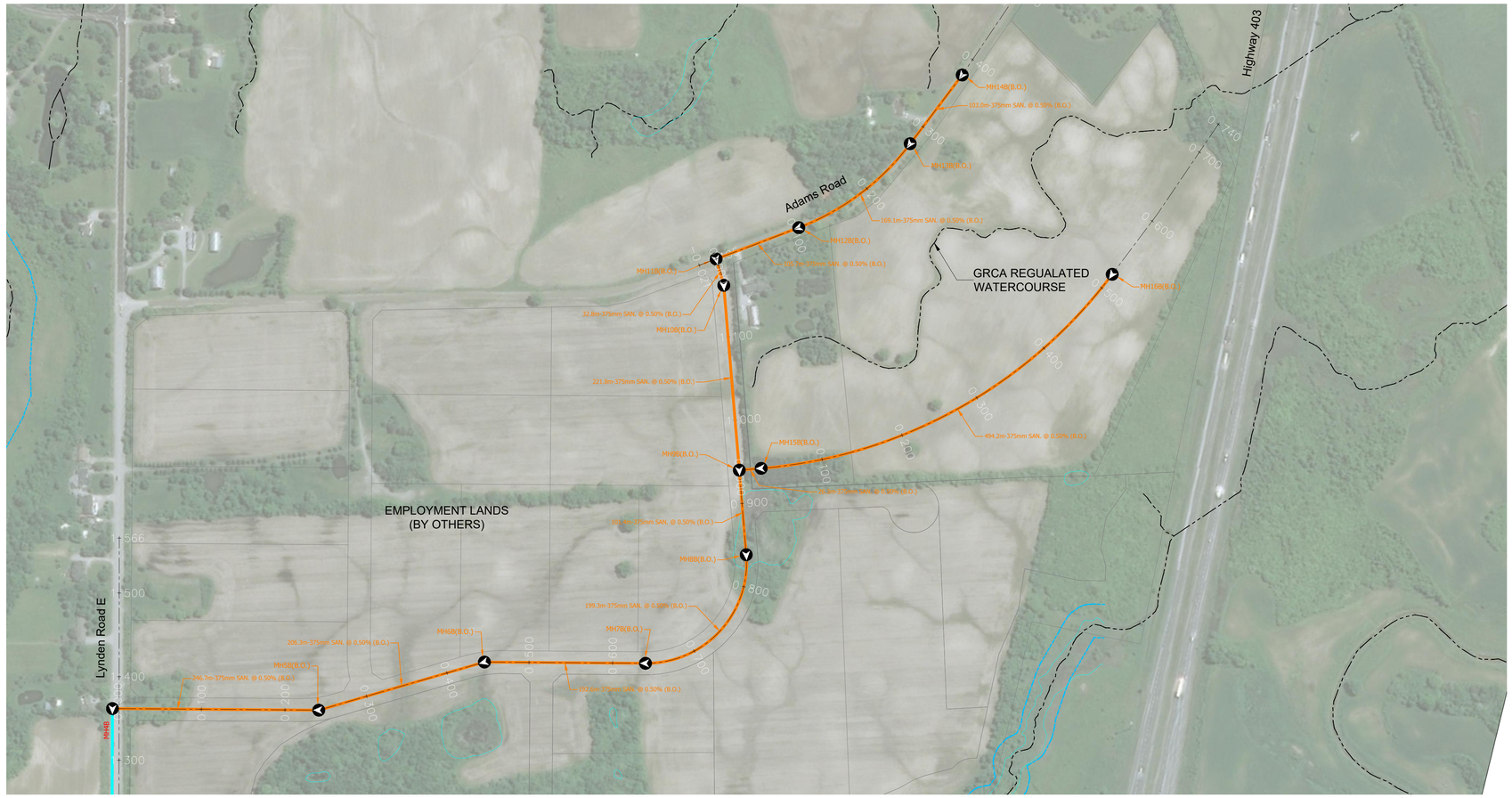
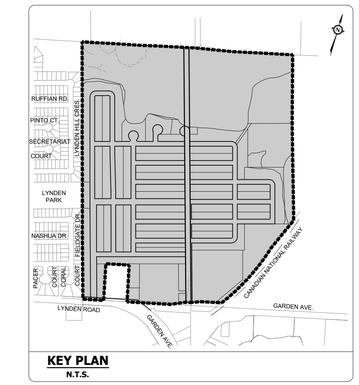
EMPLOYMENT LANDS

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	H: 1:3,000 V: 1:150	SAN-EP-1

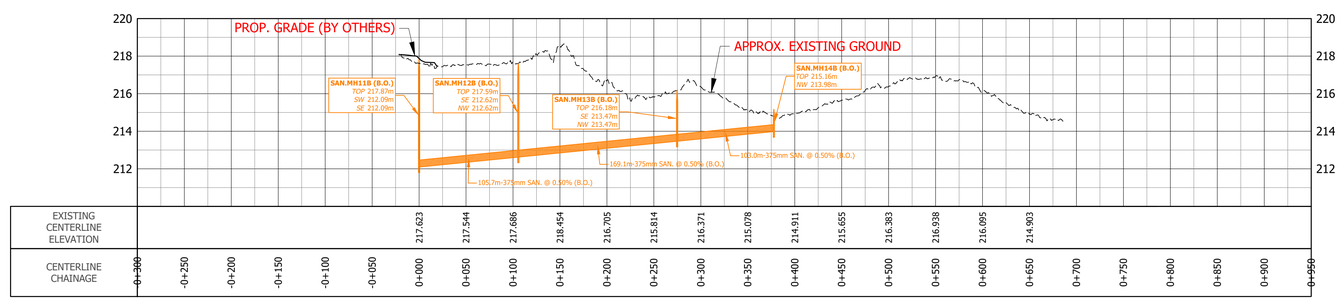
F:\PROJECTS\19-617 (299 LYNDEN ROAD -GOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SAN-EXT_OPTION 2A.DWG

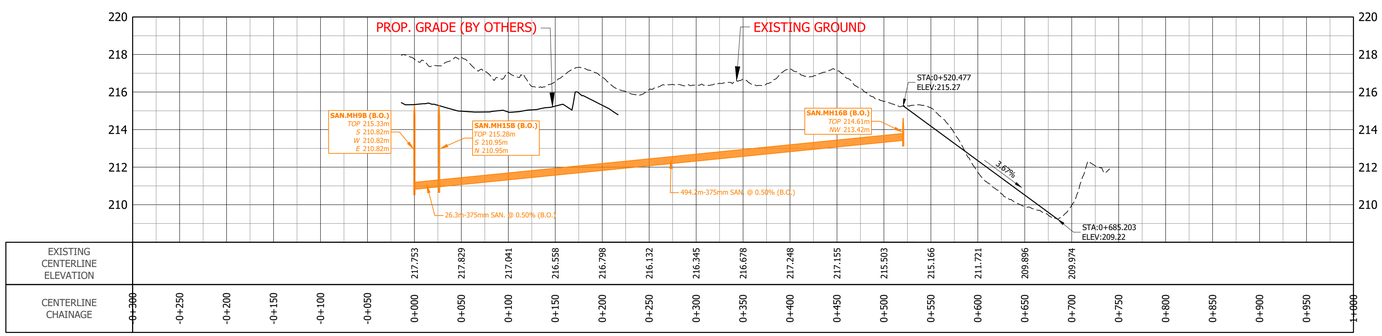




LEGEND

- EXISTING SANITARY SEWER
- GRAVITY SANITARY SEWER
- GRAVITY SANITARY SEWER BY OTHERS
- GRAVITY SANITARY SEWER BY OTHERS
- PUMPING STATION
- TWIN FORCEMAIN LAYOUT





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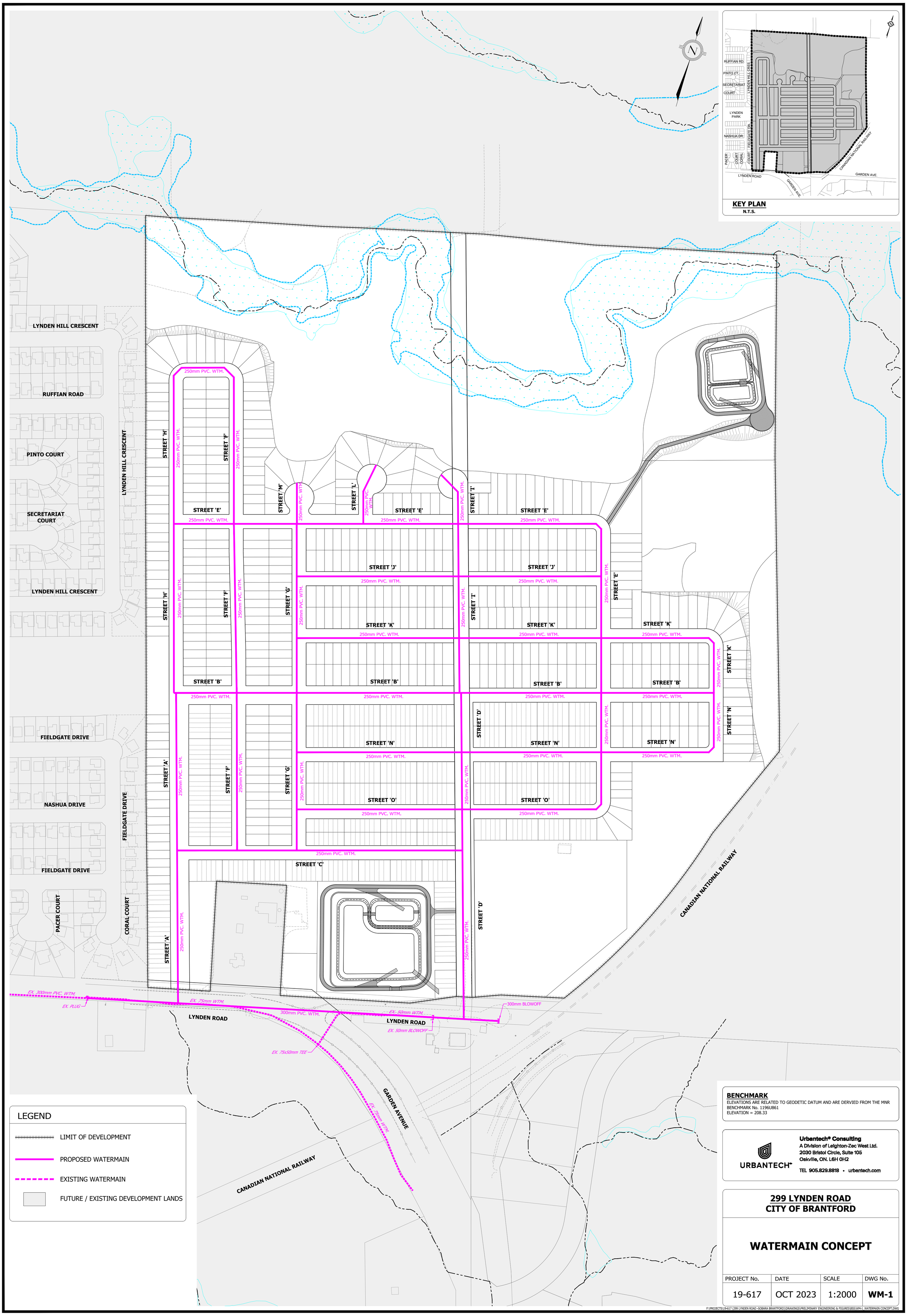
EMPLOYMENT LANDS

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	H: 1:3,000 V: 1:150	SAN-EP-2

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SAN-EXT_OPTION 2B.DWG



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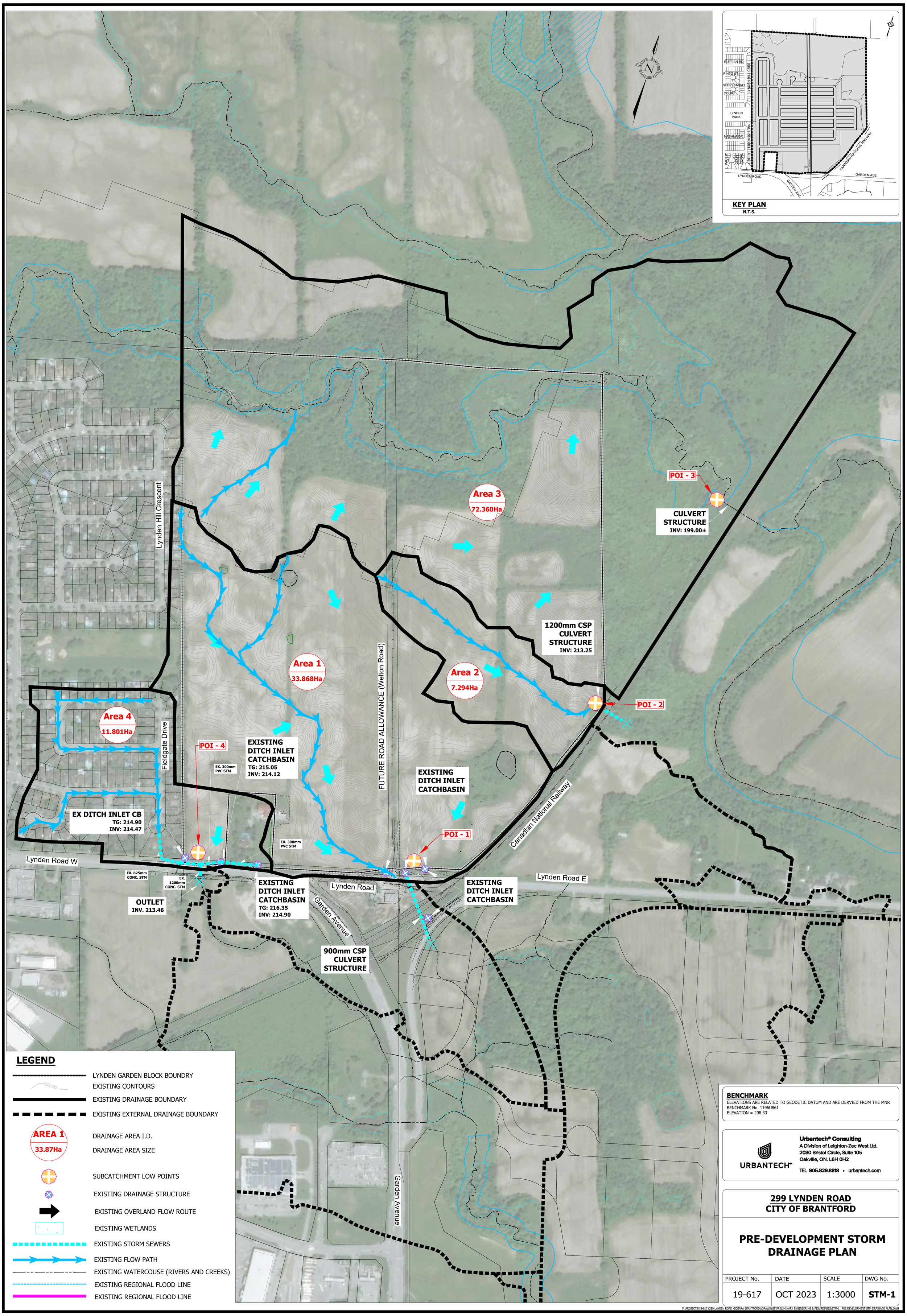
WATERMAIN CONCEPT

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:2000	**WM-1**

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\WM-1_WATERMAIN CONCEPT.DWG


KEY PLAN
N.T.S.
RUFFIAN RD.
PINTO CT.
SECRETARIAT COURT
LYNDEN HILL CRES.
LYNDEN PARK
NASHUA DR.
FIELDGATE DR.
PACER COURT
GALLANT COURT
LYNDEN ROAD
GARDEN AVE.
CANADIAN NATIONAL RAILWAY
Lynden Hill Crescent
Fieldgate Drive
Area 1
33.868Ha
Area 2
7.294Ha
Area 3
72.360Ha
Area 4
11.801Ha
POI - 1
POI - 2
POI - 3
POI - 4
CULVERT STRUCTURE
INV: 199.00±
1200mm CSP CULVERT STRUCTURE
INV: 213.25
FUTURE ROAD ALLOWANCE (Welton Road)
EXISTING DITCH INLET CATCHBASIN
TG: 215.05
INV: 214.12
EXISTING DITCH INLET CATCHBASIN
EX DITCH INLET CB
TG: 214.90
INV: 214.47
EX. 300mm PVC STM
EX. 300mm PVC STM
Canadian National Railway
Lynden Road W
EX. 825mm CONC. STM
EX. 1200mm CONC. STM
OUTLET
INV. 213.46
EXISTING DITCH INLET CATCHBASIN
TG: 216.35
INV: 214.90
Lynden Road
Garden Avenue
EXISTING DITCH INLET CATCHBASIN
Lynden Road E
900mm CSP CULVERT STRUCTURE
Garden Avenue
LEGEND
LYNDEN GARDEN BLOCK BOUNDRY
EXISTING CONTOURS
EXISTING DRAINAGE BOUNDARY
EXISTING EXTERNAL DRAINAGE BOUNDARY
AREA 1
33.87Ha
DRAINAGE AREA I.D.
DRAINAGE AREA SIZE
SUBCATCHMENT LOW POINTS
EXISTING DRAINAGE STRUCTURE
EXISTING OVERLAND FLOW ROUTE
EXISTING WETLANDS
EXISTING STORM SEWERS
EXISTING FLOW PATH
EXISTING WATERCOUSE (RIVERS AND CREEKS)
EXISTING REGIONAL FLOOD LINE
EXISTING REGIONAL FLOOD LINE
BENCHMARK
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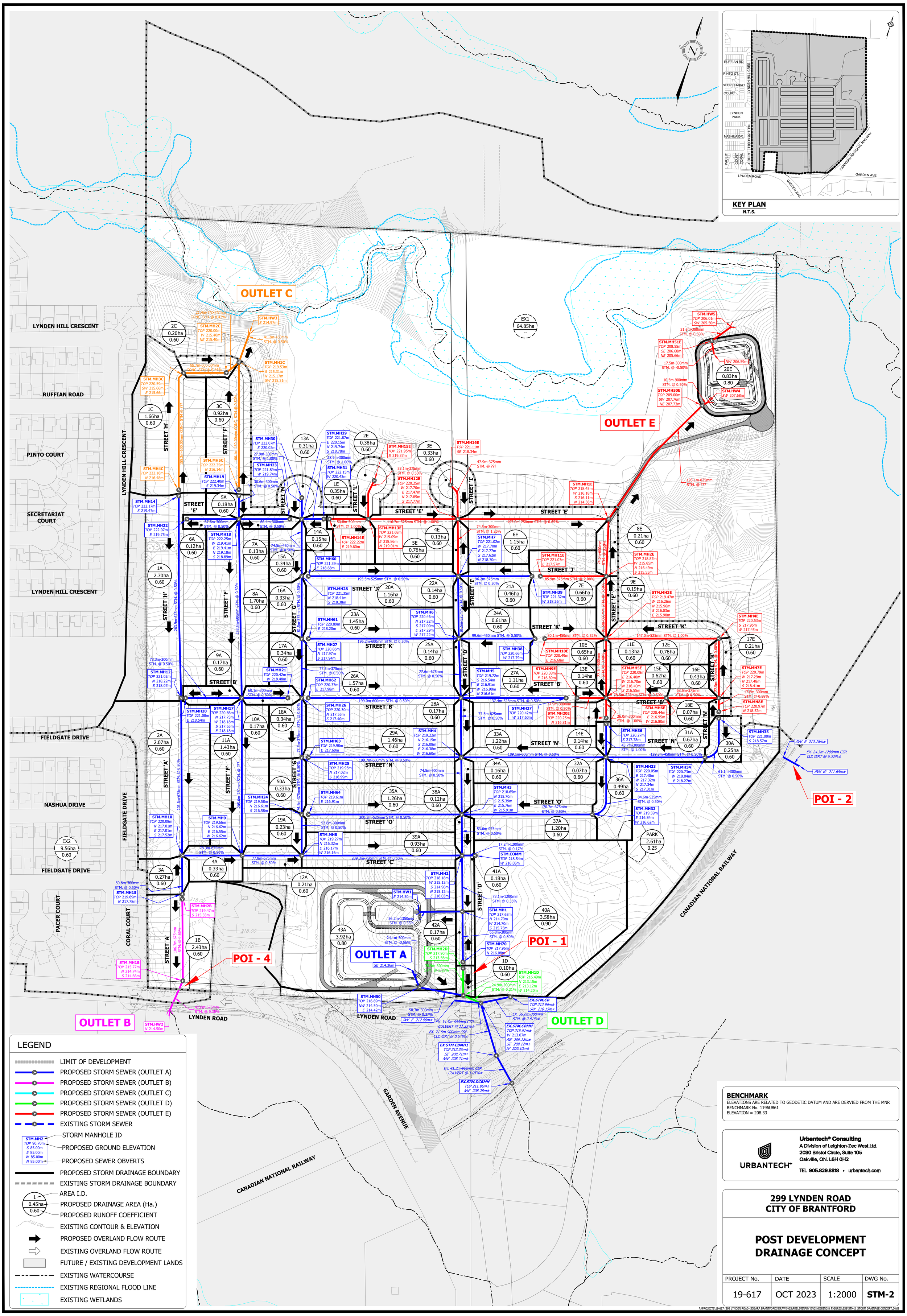
299 LYNDEN ROAD
CITY OF BRANTFORD
PRE-DEVELOPMENT STORM DRAINAGE PLAN
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:3000
DWG No. STM-1
F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\STM-1 PRE DEVELOPMENT STM DRAINAGE PLAN.DWG



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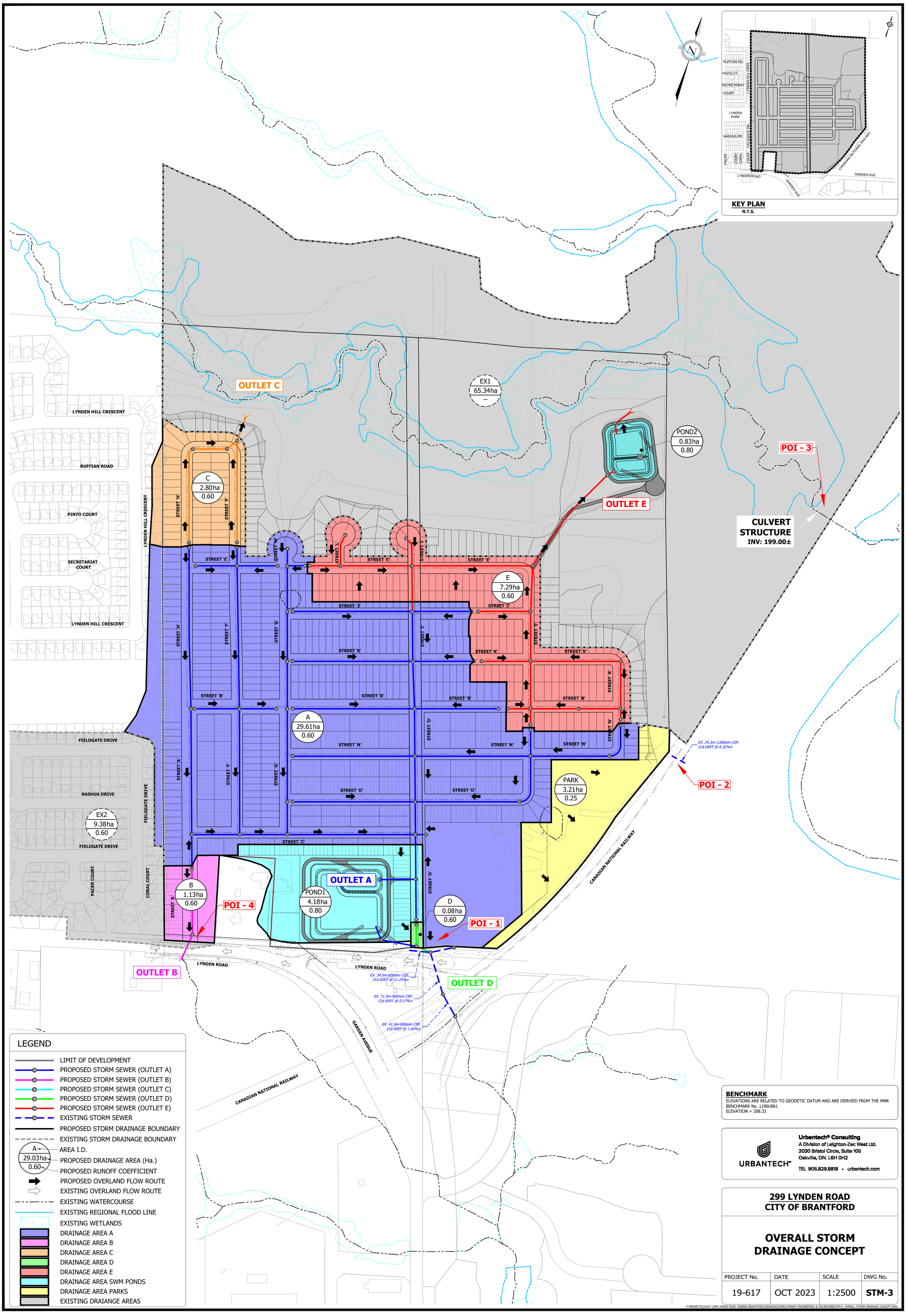
POST DEVELOPMENT DRAINAGE CONCEPT

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:2000	STM-2

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\STM-2_STORM DRAINAGE CONCEPT.DWG



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ELEVATION = 208.33

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CITY OF BRANTFORD

OVERALL STORM DRAINAGE CONCEPT

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:2500	STM-3

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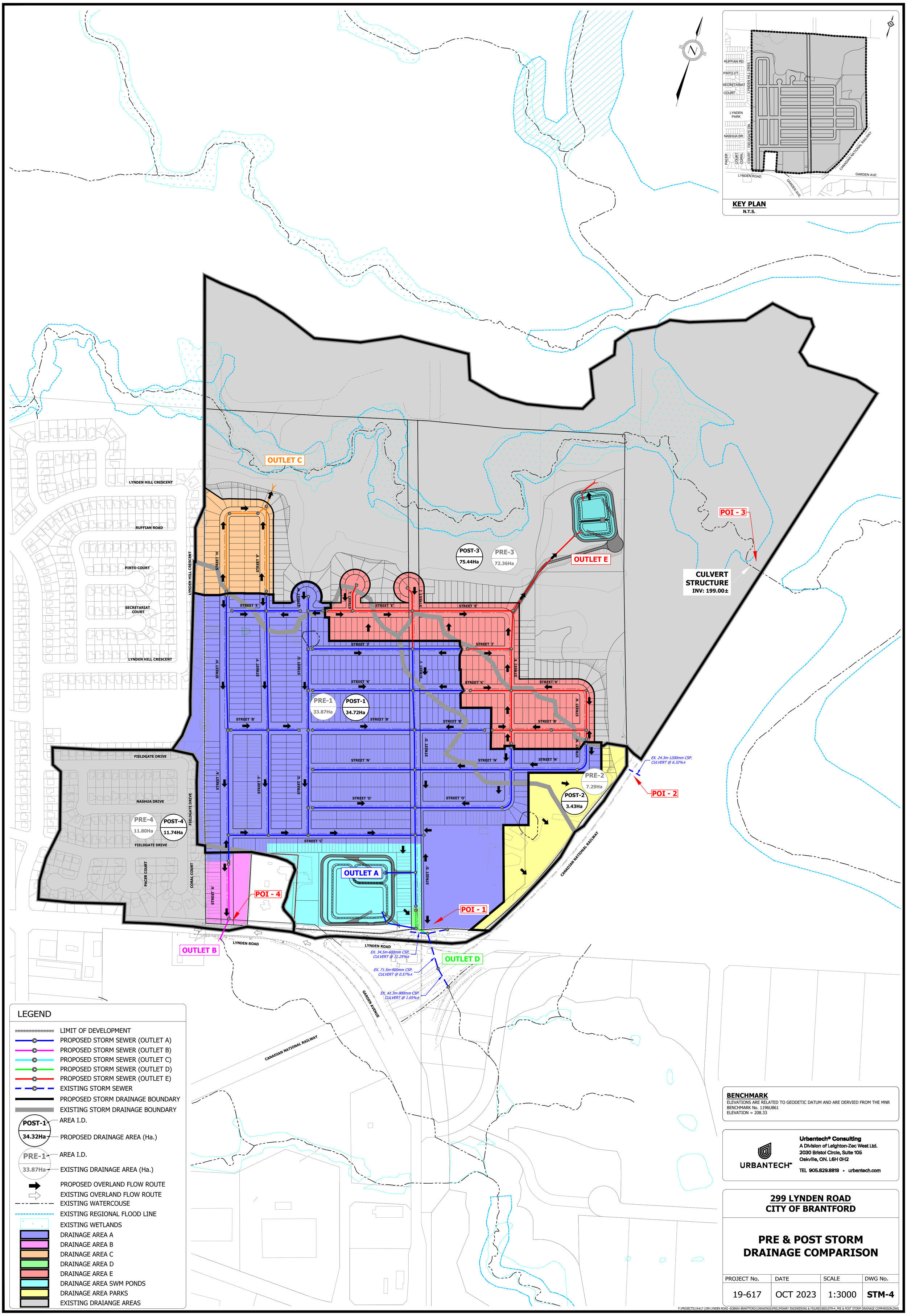
KEY PLAN
N.T.S.
RUFFIAN RD.
PINTO CT.
SECRETARIAT COURT
LYNDEN HILL CRES.
LYNDEN PARK
NASHUA DR.
FIELDGATE DR.
PACER COURT
CORAL COURT
LYNDEN ROAD
GARDEN AVE.
CANADIAN NATIONAL RAILWAY
OUTLET C
OUTLET E
OUTLET A
OUTLET B
OUTLET D
POI - 1
POI - 2
POI - 3
POI - 4
CULVERT STRUCTURE
INV: 199.00±
POST-3
75.44Ha
PRE-3
72.36Ha
PRE-1
33.87Ha
POST-1
34.72Ha
PRE-2
7.29Ha
POST-2
3.43Ha
PRE-4
11.80Ha
POST-4
11.74Ha
EX. 24.3m-1200mm CSP. CULVERT @ 6.32%±
EX. 34.5m-600mm CSP. CULVERT @ 11.25%±
EX. 71.5m-900mm CSP. CULVERT @ 0.57%±
EX. 41.3m-900mm CSP. CULVERT @ 1.05%±
LEGEND
LIMIT OF DEVELOPMENT
PROPOSED STORM SEWER (OUTLET A)
PROPOSED STORM SEWER (OUTLET B)
PROPOSED STORM SEWER (OUTLET C)
PROPOSED STORM SEWER (OUTLET D)
PROPOSED STORM SEWER (OUTLET E)
EXISTING STORM SEWER
PROPOSED STORM DRAINAGE BOUNDARY
EXISTING STORM DRAINAGE BOUNDARY
AREA I.D.
PROPOSED DRAINAGE AREA (Ha.)
AREA I.D.
EXISTING DRAINAGE AREA (Ha.)
PROPOSED OVERLAND FLOW ROUTE
EXISTING OVERLAND FLOW ROUTE
EXISTING WATERCOUSE
EXISTING REGIONAL FLOOD LINE
EXISTING WETLANDS
DRAINAGE AREA A
DRAINAGE AREA B
DRAINAGE AREA C
DRAINAGE AREA D
DRAINAGE AREA E
DRAINAGE AREA SWM PONDS
DRAINAGE AREA PARKS
EXISTING DRAIANGE AREAS
BENCHMARK
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ELEVATION = 208.33
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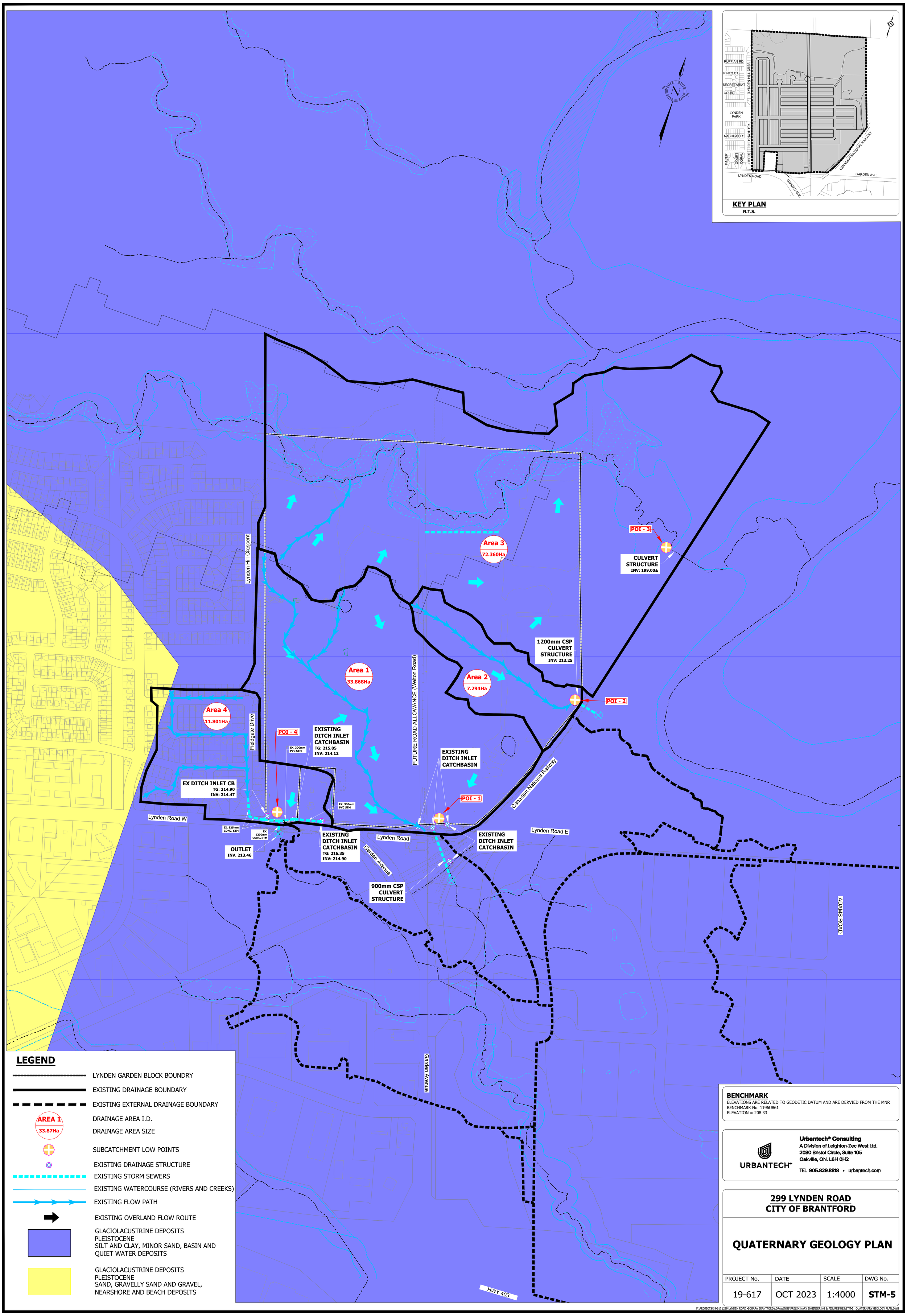
299 LYNDEN ROAD
CITY OF BRANTFORD
PRE & POST STORM DRAINAGE COMPARISON
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:3000
DWG No. STM-4
F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\STM-4 PRE & POST STORM DRAINAGE COMPARISON.DWG


KEY PLAN
N.T.S.
RUFFIAN RD.
PINTO CT.
SECRETARIAT COURT
LYNDEN HILL CRES.
LYNDEN PARK
NASHUA DR.
FIELDGATE DR.
PACER COURT
CORAL COURT
LYNDEN ROAD
GARDEN AVE.
CANADIAN NATIONAL RAILWAY
Area 3
72.360Ha
Area 1
33.868Ha
Area 2
7.294Ha
Area 4
11.801Ha
POI - 3
CULVERT STRUCTURE
INV: 199.00±
1200mm CSP CULVERT STRUCTURE
INV: 213.25
POI - 2
POI - 4
EXISTING DITCH INLET CATCHBASIN
TG: 215.05
INV: 214.12
EX. 300mm PVC STM
EXISTING DITCH INLET CATCHBASIN
POI - 1
EX DITCH INLET CB
TG: 214.90
INV: 214.47
EX. 300mm PVC STM
EX. 825mm CONC. STM
EX. 1200mm CONC. STM
OUTLET
INV. 213.46
EXISTING DITCH INLET CATCHBASIN
TG: 216.35
INV: 214.90
EXISTING DITCH INLET CATCHBASIN
900mm CSP CULVERT STRUCTURE
Lynden Hill Crescent
Fieldgate Drive
FUTURE ROAD ALLOWANCE (Welton Road)
Canadian National Railway
Lynden Road W
Lynden Road
Lynden Road E
Garden Avenue
ADAMS ROAD
HWY 403
LEGEND
LYNDEN GARDEN BLOCK BOUNDRY
EXISTING DRAINAGE BOUNDARY
EXISTING EXTERNAL DRAINAGE BOUNDARY
AREA 1
33.87Ha
DRAINAGE AREA I.D.
DRAINAGE AREA SIZE
SUBCATCHMENT LOW POINTS
EXISTING DRAINAGE STRUCTURE
EXISTING STORM SEWERS
EXISTING WATERCOURSE (RIVERS AND CREEKS)
EXISTING FLOW PATH
EXISTING OVERLAND FLOW ROUTE
GLACIOLACUSTRINE DEPOSITS
PLEISTOCENE
SILT AND CLAY, MINOR SAND, BASIN AND QUIET WATER DEPOSITS
GLACIOLACUSTRINE DEPOSITS
PLEISTOCENE
SAND, GRAVELLY SAND AND GRAVEL, NEARSHORE AND BEACH DEPOSITS
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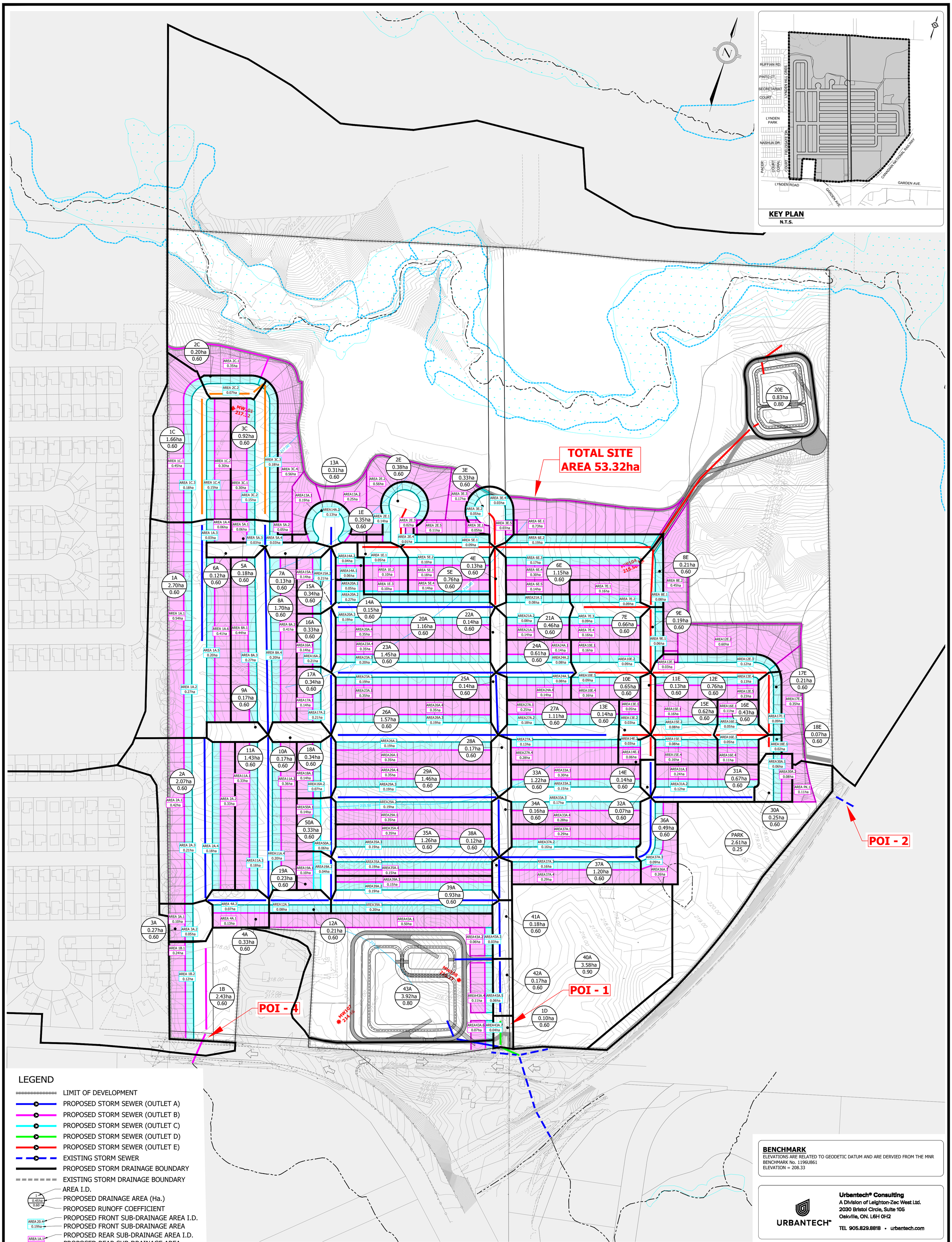
QUATERNARY GEOLOGY PLAN
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:4000
DWG No. STM-5
F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\STM-5_QUATERNARY GEOLOGY PLAN.DWG



LEGEND

- LIMIT OF DEVELOPMENT
- PROPOSED STORM SEWER (OUTLET A)
- PROPOSED STORM SEWER (OUTLET B)
- PROPOSED STORM SEWER (OUTLET C)
- PROPOSED STORM SEWER (OUTLET D)
- PROPOSED STORM SEWER (OUTLET E)
- EXISTING STORM SEWER
- PROPOSED STORM DRAINAGE BOUNDARY
- EXISTING STORM DRAINAGE BOUNDARY
- AREA I.D.
- PROPOSED DRAINAGE AREA (Ha.)
- PROPOSED RUNOFF COEFFICIENT
- PROPOSED FRONT SUB-DRAINAGE AREA I.D.
- PROPOSED FRONT SUB-DRAINAGE AREA
- PROPOSED REAR SUB-DRAINAGE AREA I.D.
- PROPOSED REAR SUB-DRAINAGE AREA
- DRAINAGE AREA TO FRONT YARDS *SEE NOTES
- DRAINAGE AREA TO REAR YARDS *SEE NOTES
- EXISTING GROUND WATER CONTOUR (SEASONAL HIGH)
- EXISTING CONTOUR & ELEVATION
- PROPOSED OVERLAND FLOW ROUTE
- EXISTING OVERLAND FLOW ROUTE
- FUTURE / EXISTING DEVELOPMENT LANDS
- EXISTING WATERCOURSE
- EXISTING REGIONAL FLOOD LINE
- EXISTING WETLANDS

FRONT YARD AND ROAD DRAINAGE		REAR YARD DRAINAGE	
TOTAL AREA	19.31 ha	TOTAL AREA	9.47 ha
IMPERVIOUS AREA	13.32 ha	IMPERVIOUS AREA	4.17 ha
% IMPERVIOUS	69%	% IMPERVIOUS	44%

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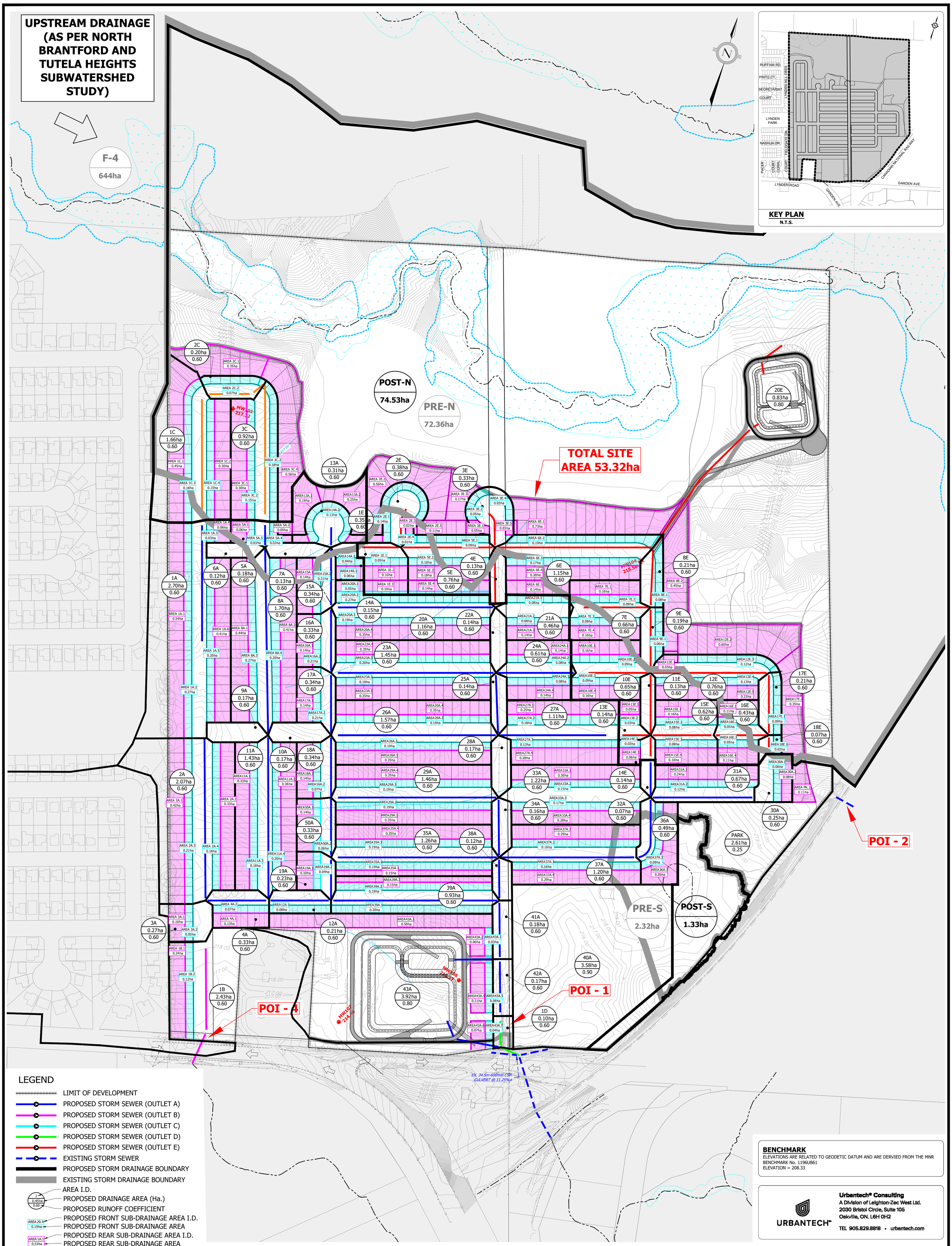
299 LYNDEN ROAD
CITY OF BRANTFORD

PROPOSED DRAINAGE FOR WATER BALANCE ANALYSIS

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:2000	STM-6

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\STM-6 WATER BALANCE ANALYSIS.DWG



LEGEND

- LIMIT OF DEVELOPMENT
- PROPOSED STORM SEWER (OUTLET A)
- PROPOSED STORM SEWER (OUTLET B)
- PROPOSED STORM SEWER (OUTLET C)
- PROPOSED STORM SEWER (OUTLET D)
- PROPOSED STORM SEWER (OUTLET E)
- EXISTING STORM SEWER
- PROPOSED STORM DRAINAGE BOUNDARY
- EXISTING STORM DRAINAGE BOUNDARY
- AREA I.D.
- PROPOSED DRAINAGE AREA (Ha.)
- PROPOSED RUNOFF COEFFICIENT
- PROPOSED FRONT SUB-DRAINAGE AREA I.D.
- PROPOSED FRONT SUB-DRAINAGE AREA
- PROPOSED REAR SUB-DRAINAGE AREA I.D.
- PROPOSED REAR SUB-DRAINAGE AREA
- DRAINAGE AREA TO FRONT YARDS *SEE NOTES
- DRAINAGE AREA TO REAR YARDS *SEE NOTES
- EXISTING GROUND WATER CONTOUR (SEASONAL HIGH)
- EXISTING CONTOUR & ELEVATION
- PROPOSED OVERLAND FLOW ROUTE
- EXISTING OVERLAND FLOW ROUTE
- FUTURE / EXISTING DEVELOPMENT LANDS
- EXISTING WATERCOURSE
- EXISTING REGIONAL FLOOD LINE
- EXISTING WETLANDS

WETLAND NORTH

LOCATION	TOTAL AREA	% IMPERVIOUS
FRONT YARD & ROAD DRAINAGE	7.60 ha	69%
REAR YARD DRAINAGE	2.75 ha	44%

WETLAND SOUTH

LOCATION	TOTAL AREA	% IMPERVIOUS
PARK	1.33 ha	0%

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CITY OF BRANTFORD

PRE & POST DEVELOPMENT DRAINAGE FOR WETLAND FEATURES

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:2000	STM-7

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\STM-7_PRE & POST STORM DRAINAGE WETLANDS.DWG


KEY PLAN
N.T.S.
RUFFIAN RD.
PINTO CT.
SECRETARIAT COURT
LYNDEN HILL CRES.
LYNDEN PARK
NASHUA DR.
FIELDGATE DR.
PACER COURT
CORAL COURT
LYNDEN ROAD
GARDEN AVE.
CANADIAN NATIONAL RAILWAY
LYNDEN HILL CRESCENT
RUFFIAN ROAD
PINTO COURT
SECRETARIAT COURT
FIELDGATE DRIVE
NASHUA DRIVE
PACER COURT
STREET 'A'
STREET 'B'
STREET 'C'
STREET 'D'
STREET 'E'
STREET 'F'
STREET 'G'
STREET 'H'
STREET 'I'
STREET 'J'
STREET 'K'
STREET 'L'
STREET 'M'
STREET 'N'
STREET 'O'
3:1 SLOPE (MAX)
LEGEND
LIMIT OF DEVELOPMENT
188.50 PROPOSED ELEVATION
188.00SW PROPOSED SWALE ELEVATION
(188.50) PROPOSED ELEVATION (BY OTHERS)
188.50 EXISTING ELEVATION
MAXIMUM 3:1 (UNLESS OTHERWISE NOTED)
PROPOSED OVERLAND FLOW ROUTE
EXISTING OVERLAND FLOW ROUTE
215.00 EXISTING CONTOUR & ELEVATION
FUTURE / EXISTING DEVELOPMENT LANDS
BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR BENCHMARK No. 1196U861
ELEVATION = 208.33
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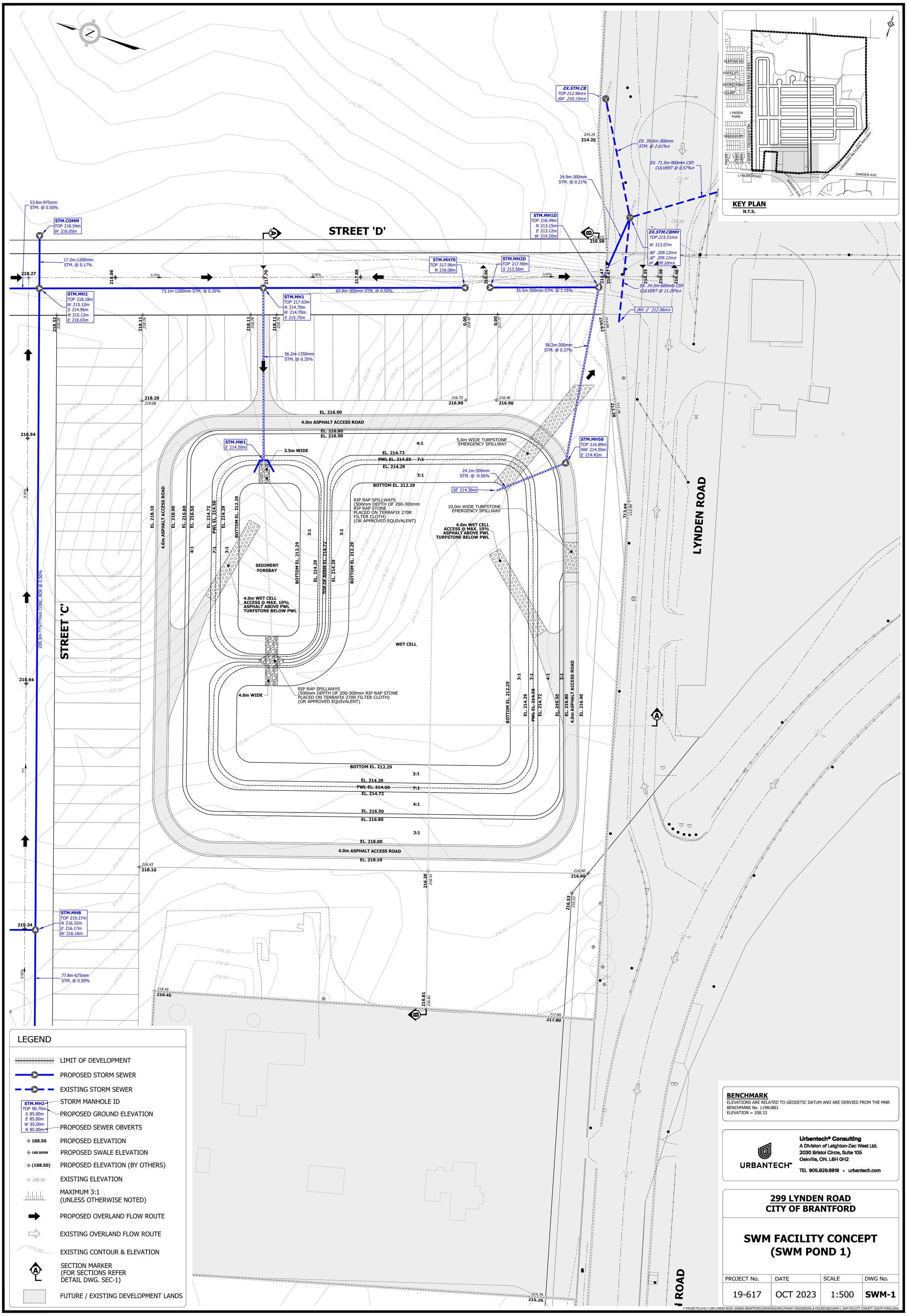
299 LYNDEN ROAD
CITY OF BRANTFORD
GRADING CONCEPT
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:2000
DWG No. GRD-1
F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\GRD-1_GRADING CONCEPT.DWG



LEGEND

- LIMIT OF DEVELOPMENT
- PROPOSED STORM SEWER
- EXISTING STORM SEWER
- STORM MANHOLE ID (STM.MH2)
- PROPOSED GROUND ELEVATION (TOP 90.70m)
- PROPOSED SEWER OBVERTS (S 85.00m, E 85.00m, W 85.00m, N 85.00m)
- 188.50 PROPOSED ELEVATION
- 188.00SW PROPOSED SWALE ELEVATION
- (188.50) PROPOSED ELEVATION (BY OTHERS)
- 188.50 EXISTING ELEVATION
- MAXIMUM 3:1 (UNLESS OTHERWISE NOTED)
- PROPOSED OVERLAND FLOW ROUTE
- EXISTING OVERLAND FLOW ROUTE
- 215.00 EXISTING CONTOUR & ELEVATION
- SECTION MARKER (FOR SECTIONS REFER DETAIL DWG. SEC-1)
- FUTURE / EXISTING DEVELOPMENT LANDS

BENCHMARK
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ELEVATION = 208.33

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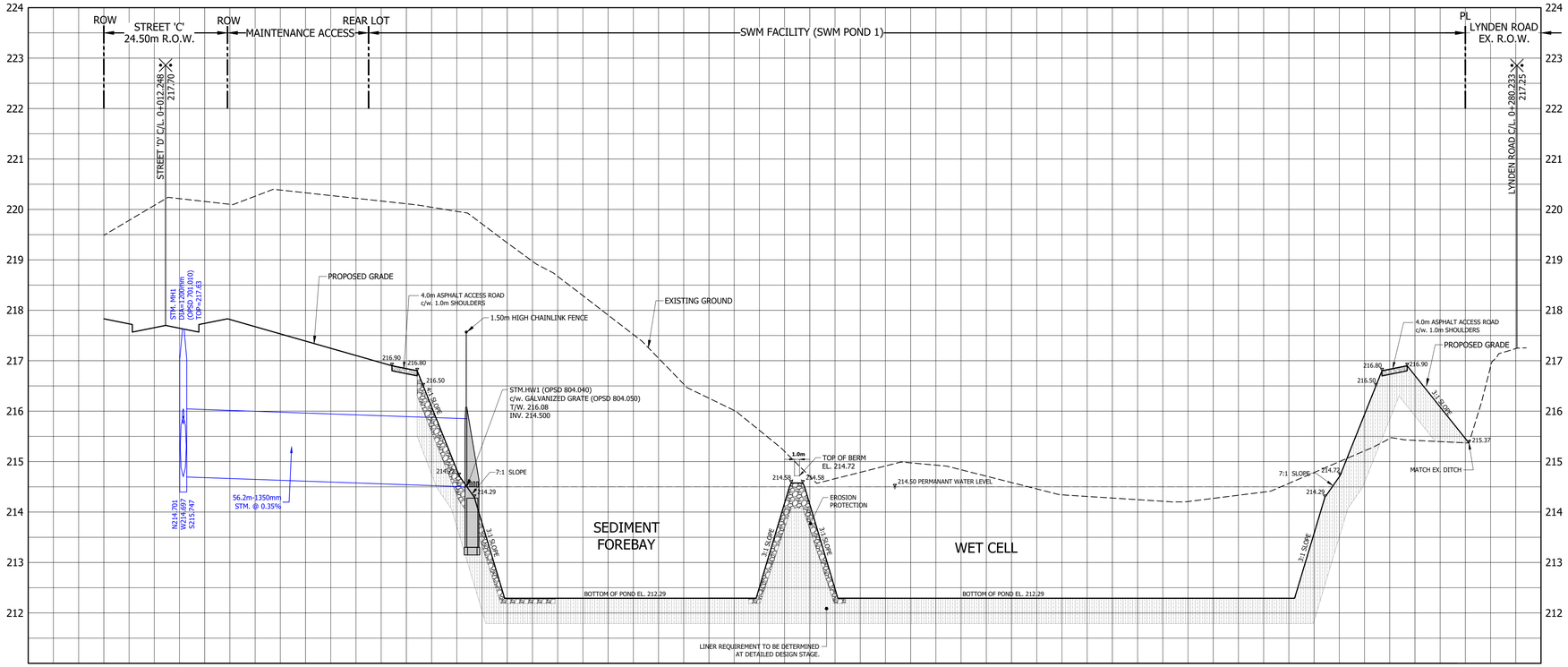
299 LYNDEN ROAD
CITY OF BRANTFORD

SWM FACILITY CONCEPT (SWM POND 1)

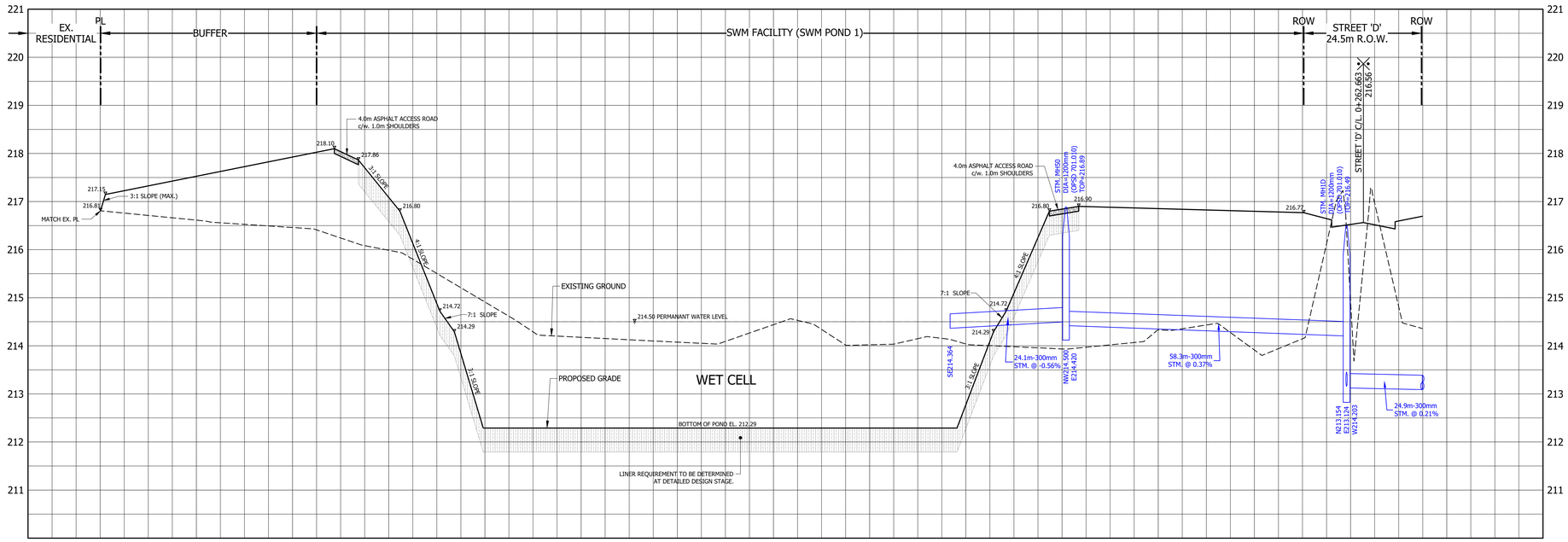
PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2023	1:500	SWM-1

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SWM-1_SWM FACILITY CONCEPT (SOUTH POND).DWG



SECTION A-A

SCALE HOR. 1:500
VER. 1:50



SECTION B-B

SCALE HOR. 1:500
VER. 1:50

BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR BENCHMARK No. 11960.B61
ELEVATION = 208.33

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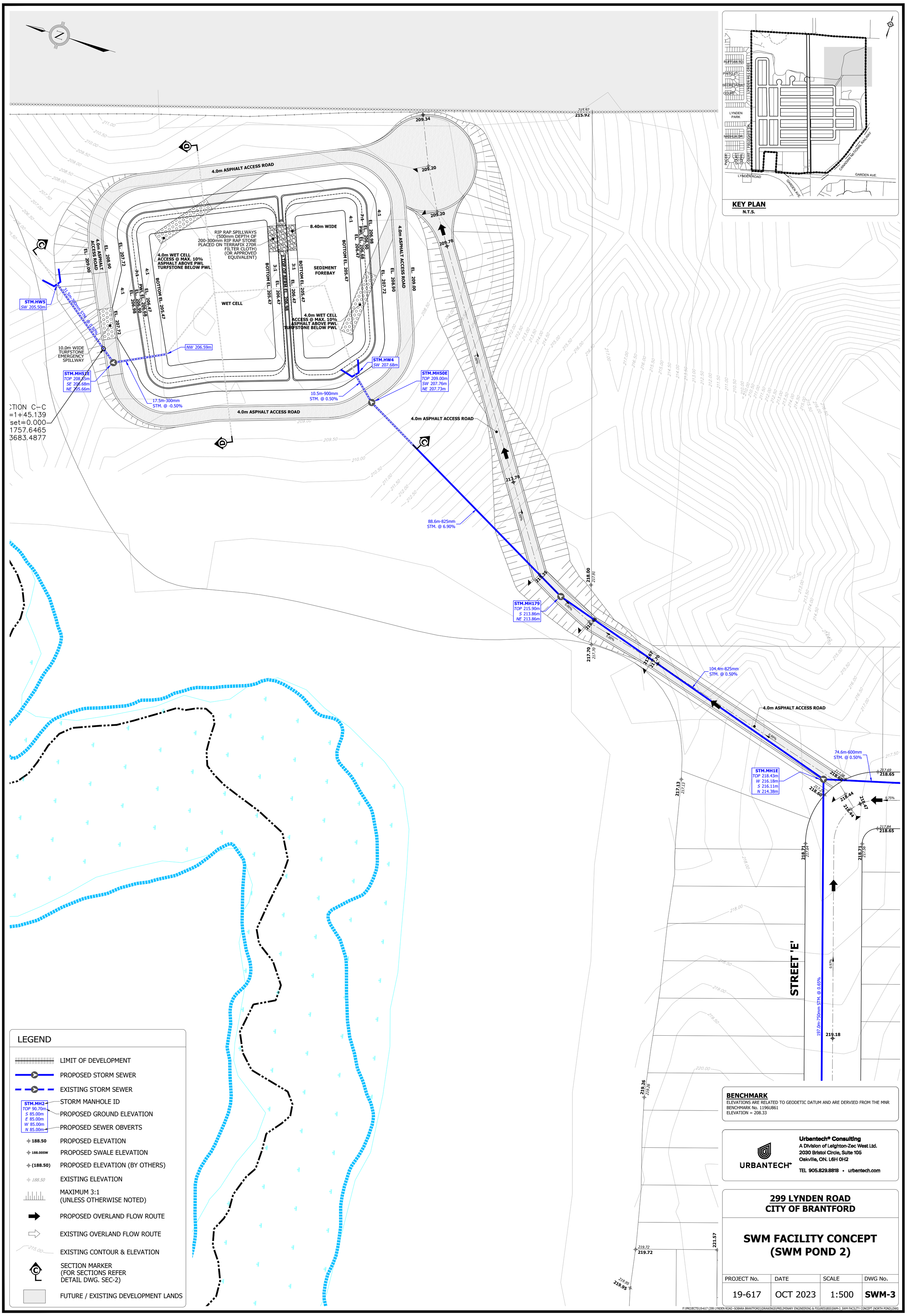
299 LYNDEN ROAD
CITY OF BRANTFORD

SWM FACILITY SECTIONS (SWM POND 1)

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	1:500	**SWM-2**

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SWM-2_SWM SECTIONS (SOUTH POND).DWG


4.0m ASPHALT ACCESS ROAD
RIP RAP SPILLWAYS (500mm DEPTH OF 200-300mm RIP RAP STONE PLACED ON TERRAFIX 270R FILTER CLOTH) (OR APPROVED EQUIVALENT)
8.40m WIDE
4.0m WET CELL ACCESS @ MAX. 10% ASPHALT ABOVE PWL TURFSTONE BELOW PWL
SEDIMENT FOREBAY
WET CELL
TOP OF BERM EL. 206.98
BOTTOM EL. 205.47
STM.HW5
SW 205.50m
31.5m-300mm STM. @ 0.50%
10.0m WIDE TURFSTONE EMERGENCY SPILLWAY
NW 206.59m
STM.MH52E
TOP 208.55m
SE 206.68m
NE 205.66m
17.5m-300mm STM. @ -0.50%
STM.HW4
SW 207.68m
10.5m-900mm STM. @ 0.50%
STM.MH50E
TOP 209.00m
SW 207.76m
NE 207.73m
88.6m-825mm STM. @ 6.90%
STM.MH179
TOP 215.90m
S 213.86m
NE 213.86m
104.4m-825mm STM. @ 0.50%
74.6m-600mm STM. @ 0.50%
STM.MH1E
TOP 218.43m
W 216.18m
S 216.11m
N 214.38m
197.0m-750mm STM. @ 0.65%
STREET 'E'
LYNDEN ROAD
GARDEN AVE.
CANADIAN NATIONAL RAILWAY
KEY PLAN
N.T.S.
LEGEND
LIMIT OF DEVELOPMENT
PROPOSED STORM SEWER
EXISTING STORM SEWER
STORM MANHOLE ID
PROPOSED GROUND ELEVATION
PROPOSED SEWER OBVERTS
PROPOSED ELEVATION
PROPOSED SWALE ELEVATION
PROPOSED ELEVATION (BY OTHERS)
EXISTING ELEVATION
MAXIMUM 3:1 (UNLESS OTHERWISE NOTED)
PROPOSED OVERLAND FLOW ROUTE
EXISTING OVERLAND FLOW ROUTE
EXISTING CONTOUR & ELEVATION
SECTION MARKER (FOR SECTIONS REFER DETAIL DWG. SEC-2)
FUTURE / EXISTING DEVELOPMENT LANDS
BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR BENCHMARK No. 1196U861
ELEVATION = 208.33
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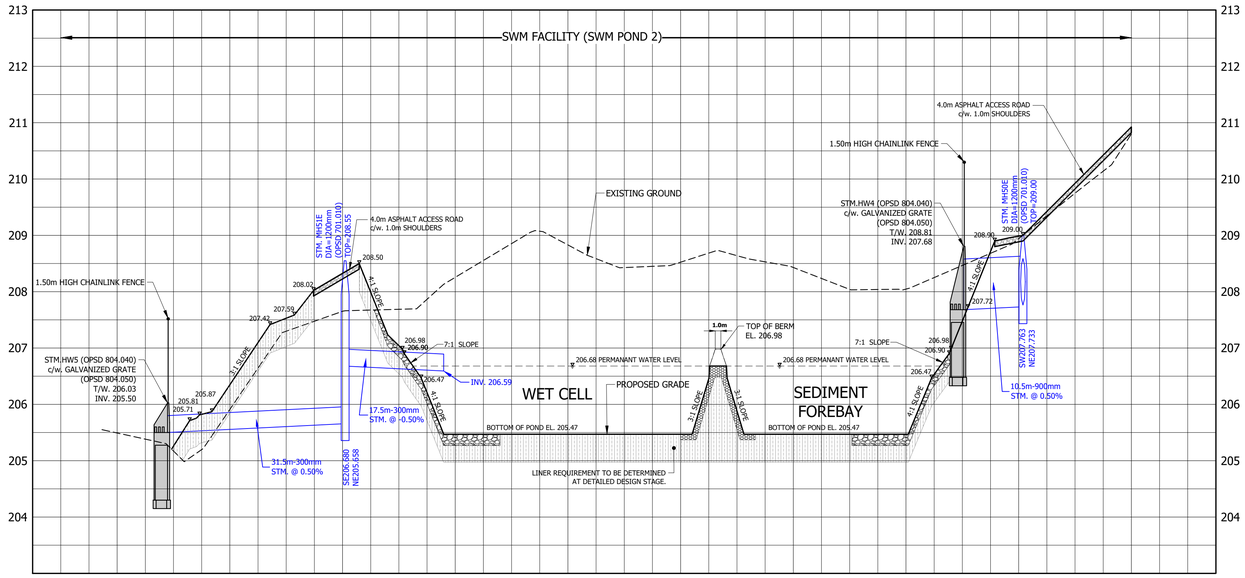
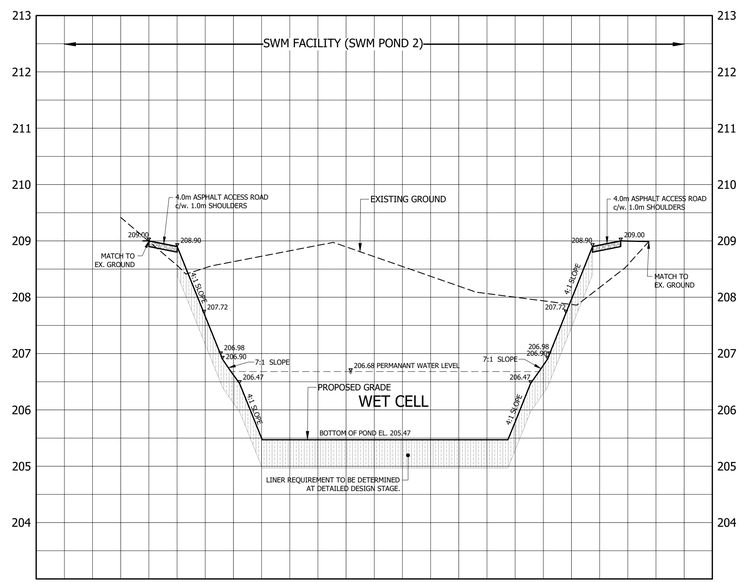
299 LYNDEN ROAD
CITY OF BRANTFORD
SWM FACILITY CONCEPT (SWM POND 2)
PROJECT No. 19-617
DATE OCT 2023
SCALE 1:500
DWG No. SWM-3
F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SWM-3_SWM FACILITY CONCEPT (NORTH POND).DWG



SECTION C-C

SCALE HOR. 1:500
VER. 1:50



SECTION D-D

SCALE HOR. 1:500
VER. 1:50

BENCHMARK
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ELEVATION = 208.33

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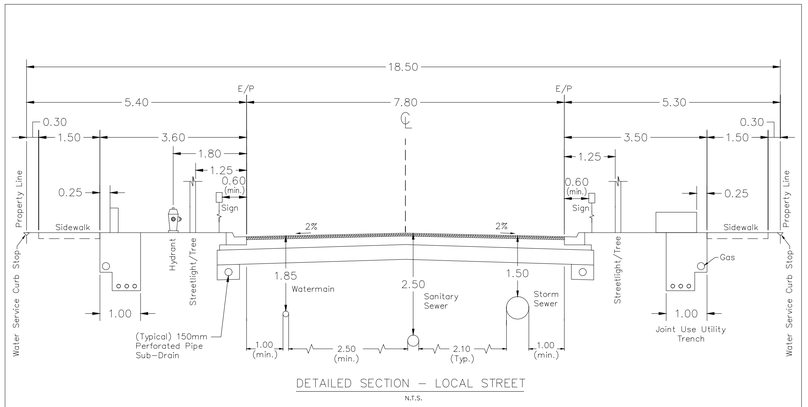
299 LYNDEN ROAD
CITY OF BRANTFORD

SWM FACILITY SECTIONS (SWM POND 2)

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	1:500	**SWM-4**

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\850\SWM-4_SWM SECTIONS (NORTH POND).DWG



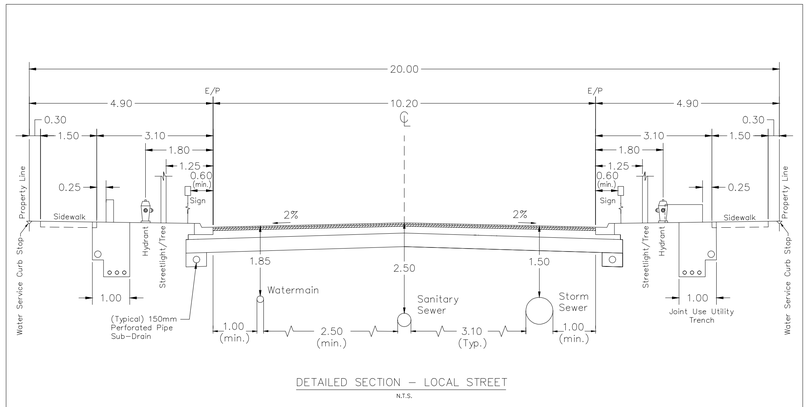
DETAILED SECTION – LOCAL STREET

N.T.S.

NOTE: 1) All dimensions are in metres unless otherwise shown.
2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD–104 for two–stage curb construction in accordance with project drawings
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
5) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
6) Refer to Standard Detail Drawing UT–105 for Joint Use Utility Trench.
7) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
8) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD	
DETAILED SECTION LOCAL STREET (18.5m ROW 7.8m ROAD WIDTH)	
DATE: FEB. 2020 REV: JAN. 2022 DRAWN BY: E.K.	H–101

STREETS 'B', 'C', 'E' TO 'H', 'J' TO 'O'



DETAILED SECTION – LOCAL STREET

N.T.S.

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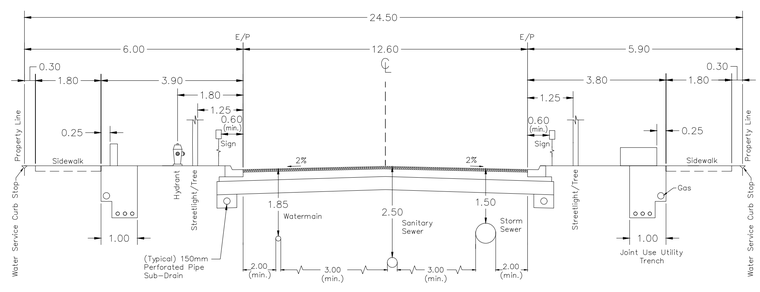
9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD	
DETAILED SECTION LOCAL STREET (20.0m ROW 10.2m ROAD WIDTH)	
DATE: FEB. 2020 REV: JAN. 2022 DRAWN BY: E.K.	H–102B

STREET 'I'



DETAILED SECTION – MINOR COLLECTOR

N.T.S.

NOTE: 1) All dimensions are in metres unless otherwise shown.
2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD–104 for two–stage curb construction in accordance with project drawings
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
5) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
6) Refer to Standard Detail Drawing UT–105 for Joint Use Utility Trench.
7) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
8) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD	
DETAILED SECTION MINOR COLLECTOR (24.5m ROW 12.6m ROAD WIDTH)	
DATE: FEB. 2020 REV: JAN. 2022 DRAWN BY: E.K.	H–103

STREETS 'A', 'B', & 'D'

BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR BENCHMARK No. 11960J861
ELEVATION = 208.33

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299 LYNDEN ROAD
CITY OF BRANTFORD

TYPICAL ROAD CROSS SECTIONS

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT. 2023	N.T.S.	**RD-1**

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWING\PRELIMINARY ENGINEERING & FIGURES\BSD\RD-1_ROAD CROSS SECTIONS.DWG

APPENDIX B

DESIGN CALCULATIONS

B1	Storm Sewer Design Sheets
B2	Landuse Breakdown & Imperviousness Calculations
B3	SWM Design Calculations
B4	VO Model Output (Existing and Proposed Conditions)
B5	Sanitary Sewer Design Sheet

Appendix B1: Storm Sewer Design Sheets

URBANTECH®

STORM SEWER DESIGN SHEET (POND OUTLET A)

5 Year Storm

299 Lynden Road

Brantford

PROJECT DETAILS

Project No: 19-617
Date: 3-Nov-23
Designed by: RM
Checked by: RBTM

DESIGN CRITERIA

Min. Diameter =	300	mm	Rainfall Intensity =	A / (Tc+B)^c
Mannings 'n'=	0.013			
Starting Tc =	10	min	A =	1593
			B =	11
Factor of Safety =	20	%	c =	0.8789

NOMINAL PIPE SIZE USED

ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
1A	STREET H	14	12	2.70	0.60	1.62	1.62	109.7	0.494			0.494	263.9	0.50	675	0.594	1.66	10.00	2.65	12.65	83%
2A	STREET A	12	10	2.07	0.60	1.24	1.24	109.7	0.378			0.378	205.6	0.50	675	0.594	1.66	10.00	2.06	12.06	64%
3A	STREET A	15	10	0.27	0.60	0.16	0.16	109.7	0.049			0.049	50.8	0.50	300	0.068	0.97	10.00	0.88	10.88	72%
4A	STREET C	10	9	0.33	0.60	0.20	1.44	101.0	0.404			0.404	78.3	0.50	675	0.594	1.66	12.06	0.79	12.85	68%
5A	STREET F	19	18	0.18	0.60	0.11	0.11	109.7	0.033			0.033	30.6	0.50	300	0.068	0.97	10.00	0.53	10.53	48%
6A	STREET E	22	18	0.12	0.60	0.07	0.07	109.7	0.022			0.022	67.6	0.50	300	0.068	0.97	10.00	1.16	11.16	32%
7A	STREET E	23	18	0.13	0.60	0.08	0.08	109.7	0.024			0.024	66.4	0.50	300	0.068	0.97	10.00	1.14	11.14	35%
8A	STREET F	18	17	1.70	0.60	1.02	1.20	104.6	0.349			0.349	233.5	0.50	600	0.434	1.54	11.16	2.53	13.70	80%
9A	STREET B	20	17	0.17	0.60	0.10	0.10	109.7	0.031			0.031	73.3	0.50	300	0.068	0.97	10.00	1.26	11.26	45%
10A	STREET B	21	17	0.17	0.60	0.10	0.10	109.7	0.031			0.031	60.1	0.50	300	0.068	0.97	10.00	1.04	11.04	45%
11A	STREET F	17	9	1.43	0.60	0.86	2.16	95.1	0.571			0.571	205.6	0.50	750	0.787	1.78	13.70	1.92	15.62	72%
12A	STREET C	9	8	0.21	0.60	0.13	1.57	98.1	0.427			0.427	77.8	0.50	675	0.594	1.66	12.85	0.78	13.63	72%
13A	STREET M	30	29	0.31	0.60	0.19	0.19	109.7	0.057			0.057	27.9	1.00	300	0.097	1.37	10.00	0.34	10.34	59%
14A	STREET E	31	29	0.15	0.60	0.09	0.09	109.7	0.027			0.027	28.9	1.00	300	0.097	1.37	10.00	0.35	10.35	28%
15A	STREET G	29	28	0.34	0.60	0.20	0.39	108.1	0.117			0.117	74.5	0.50	450	0.202	1.27	10.34	0.98	11.32	58%
16A	STREET G	28	27	0.33	0.60	0.20	0.20	109.7	0.060			0.060	81.5	0.50	375	0.124	1.12	10.00	1.21	11.21	49%
17A	STREET G	27	26	0.34	0.60	0.20	0.20	109.7	0.062			0.062	77.5	0.50	375	0.124	1.12	10.00	1.15	11.15	50%
18A	STREET G	26	25	0.34	0.60	0.20	0.20	109.7	0.062			0.062	77.5	0.50	375	0.124	1.12	10.00	1.15	11.15	50%
50A	STREET G	25	24	0.33	0.60	0.20	0.20	109.7	0.060			0.060	74.5	0.50	375	0.124	1.12	10.00	1.11	11.11	49%
19A	STREET G	24	8	0.23	0.60	0.14	0.14	109.7	0.042			0.042	53.6	0.50	300	0.068	0.97	10.00	0.92	10.92	61%
20A	STREET J	60	7	1.16	0.60	0.70	0.70	109.7	0.212			0.212	195.5	0.50	525	0.304	1.40	10.00	2.32	12.32	70%
21A	STREET J	39	7	0.46	0.60	0.28	0.28	109.7	0.084			0.084	96.2	0.50	375	0.124	1.12	10.00	1.43	11.43	68%
22A	STREET I	7	6	0.14	0.60	0.08	0.78	100.0	0.217			0.217	81.5	0.50	525	0.304	1.40	12.32	0.97	13.29	71%

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23A	STREET K	61	6	1.45	0.60	0.87	0.87	109.7	0.265			0.265	196.2	0.50	600	0.434	1.54	10.00	2.13	12.13	61%
24A	STREET K	38	6	0.61	0.60	0.37	0.37	109.7	0.112			0.112	99.6	0.50	450	0.202	1.27	10.00	1.31	11.31	55%
25A	STREET D	6	5	0.14	0.60	0.08	1.73	96.5	0.465			0.465	77.6	0.50	675	0.594	1.66	13.29	0.78	14.07	78%
26A	STREET B	62	5	1.57	0.60	0.94	0.94	109.7	0.287			0.287	199.0	0.50	600	0.434	1.54	10.00	2.16	12.16	66%
27A	STREET B	37	5	1.13	0.60	0.68	0.68	109.7	0.207			0.207	137.4	0.50	525	0.304	1.40	10.00	1.63	11.63	68%
28A	STREET D	5	4	0.17	0.60	0.10	2.78	93.9	0.724			0.724	77.5	0.50	825	1.015	1.90	14.07	0.68	14.75	71%
29A	STREET N	63	4	1.46	0.60	0.88	0.88	109.7	0.267			0.267	199.7	0.50	600	0.434	1.54	10.00	2.17	12.17	61%
30A	STREET N	35	34	0.25	0.60	0.15	0.15	109.7	0.046			0.046	61.1	0.50	300	0.068	0.97	10.00	1.05	11.05	67%
31A	STREET N	34	33	0.67	0.60	0.40	0.40	109.7	0.122			0.122	129.3	0.50	450	0.202	1.27	10.00	1.70	11.70	61%
32A	STREET N	36	33	0.07	0.60	0.04	0.04	109.7	0.013			0.013	43.7	0.50	300	0.068	0.97	10.00	0.75	10.75	19%
33A	STREET N	33	4	1.22	0.60	0.73	1.13	102.4	0.323			0.323	189.1	0.50	600	0.434	1.54	11.70	2.05	13.75	74%
34A	STREET D	4	3	0.16	0.60	0.10	3.75	91.7	0.955			0.955	74.5	0.50	900	1.280	2.01	14.75	0.62	15.36	75%
35A	STREET O	64	3	1.26	0.60	0.76	0.76	109.7	0.230			0.230	200.3	0.50	525	0.304	1.40	10.00	2.38	12.38	76%
36A	STREET O	33	32	0.49	0.60	0.29	0.74	102.4	0.210			0.210	84.6	0.50	525	0.304	1.40	11.70	1.00	12.70	69%
PARK		PARK	32	2.61	0.25	0.65	0.65	193.6	0.351			0.351									
37A	STREET O	32	3	1.20	0.60	0.72	1.46	98.6	0.399			0.399	170.7	0.50	675	0.594	1.66	12.70	1.71	14.42	67%
38A	STREET D	3	2	0.12	0.60	0.07	4.58	89.8	1.142			1.142	53.6	0.50	975	1.585	2.12	15.36	0.42	15.78	72%
39A	STREET C	8	2	0.93	0.60	0.56	2.26	95.3	0.599			0.599	209.3	0.50	750	0.787	1.78	13.63	1.96	15.59	76%
40A		COMM	2	3.58	0.90	3.22	3.22	109.7	0.982			0.982	17.2	0.17	1200	1.607	1.42	10.00	0.20	10.20	61%
41A	STREET D	2	1	0.18	0.60	0.11	6.95	88.6	1.709			1.709	73.1	0.35	1200	2.307	2.04	15.78	0.60	16.38	74%
42A	STREET D	70	1	0.17	0.60	0.10	0.10	109.7	0.031			0.031	65.8	0.50	300	0.068	0.97	10.00	1.13	11.13	45%
43A	POND	1	HW1	3.92	0.80	3.14	10.08	86.9	2.433			2.433	56.2	0.35	1350	3.158	2.21	16.38	0.42	16.81	77%
	OUTLET A	POND SW	50					109.7					24.1	0.50	300	0.068	0.97	10.00	0.42	10.42	
		50	1D					109.7					58.3	0.37	300	0.059	0.83	10.00	1.17	11.17	

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URBANTECH®

STORM SEWER DESIGN SHEET (SW OUTLET B)

5 Year Storm

299 Lynden Road

Brantford

PROJECT DETAILS

Project No: 19-617
Date: 3-Nov-23
Designed by: RM
Checked by: RBTM

DESIGN CRITERIA

Min. Diameter =	300	mm	Rainfall Intensity =	A / (Tc+B)^c
Mannings 'n'=	0.013			
Starting Tc =	10	min	A =	1593
			B =	11
Factor of Safety =	20	%	c =	0.8789

NOMINAL PIPE SIZE USED

ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
1B	STREET A	2B	1B	2.43	0.60	1.46	1.46	109.7	0.444			0.444	106.7	0.55	675	0.623	1.74	10.00	1.02	11.02	71%
	LYNDEN ROAD	1B	HW2				1.46	105.2	0.426			0.426	42.6	0.38	675	0.518	1.45	11.02	0.49	11.51	82%

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URBANTECH®

STORM SEWER DESIGN SHEET (NW OUTLET C)

5 Year Storm

299 Lynden Road

Brantford

PROJECT DETAILS

Project No: 19-617
Date: 3-Nov-23
Designed by: RM
Checked by: RBTM

DESIGN CRITERIA

Min. Diameter =	300	mm	Rainfall Intensity =	A / (Tc+B)^c
Mannings 'n'=	0.013			
Starting Tc =	10	min	A =	1593
			B =	11
Factor of Safety =	20	%	c =	0.8789

NOMINAL PIPE SIZE USED

ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
1C	STREET H	4C	3C	1.66	0.60	1.00	1.00	109.7	0.303			0.303	155.2	0.50	600	0.434	1.54	10.00	1.68	11.68	70%
2C	STREET H	3C	2C	0.25	0.60	0.15	1.15	102.5	0.326			0.326	55.7	0.46	600	0.416	1.47	11.68	0.63	12.31	78%
	STREET H	2C	1C					109.7					21.4	0.42	300	0.063	0.89	10.00	0.40	10.40	
3C	STREET F	5C	1C	0.90	0.60	0.54	0.54	109.7	0.165			0.165	166.1	0.50	450	0.202	1.27	10.00	2.18	12.18	82%
	OUTLET C	1C	HW3				0.54	100.5	0.151			0.151	41.2	0.50	450	0.202	1.27	12.18	0.54	12.73	75%

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URBANTECH®

STORM SEWER DESIGN SHEET (SE OUTLET D)

5 Year Storm

299 Lynden Road

Brantford

PROJECT DETAILS

Project No: 19-617
Date: 3-Nov-23
Designed by: RM
Checked by: RBTM

DESIGN CRITERIA

Min. Diameter =	300	mm	Rainfall Intensity =	A / (Tc+B)^c
Mannings 'n'=	0.013			
Starting Tc =	10	min	A =	1593
			B =	11
Factor of Safety =	20	%	c =	0.8789

NOMINAL PIPE SIZE USED

ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
1D	STREET D	2D	1D	0.10	0.60	0.06	0.06	109.7	0.018			0.018	35.5	1.15	300	0.104	1.47	10.00	0.40	10.40	18%
	LYNDEN ROAD	1D	EX.STM.CBMH				0.06	107.9	0.018			0.018	24.9	0.21	300	0.044	0.63	10.40	0.66	11.07	41%
	LYNDEN ROAD	EX.STM.CB	EX.STM.CBMH					109.7					39.6	2.61	300	0.156	2.21	10.00	0.30	10.30	
	LYNDEN ROAD	EX.STM.CBMH	EX.STM.CBMH1				0.06	105.0	0.018			0.018	71.5	0.57	300	0.073	1.03	11.07	1.15	12.22	24%
	LYNDEN ROAD	EX.STM.CBMH1	EX.STM.CBMH2				0.06	100.4	0.017			0.017	41.3	1.05	300	0.099	1.40	12.22	0.49	12.71	17%

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URBANTECH®

STORM SEWER DESIGN SHEET (POND OUTLET E)

5 Year Storm

299 Lynden Road

Brantford

PROJECT DETAILS

Project No: 19-617
Date: 3-Nov-23
Designed by: RM
Checked by: RBTM

DESIGN CRITERIA

Min. Diameter =	300	mm	Rainfall Intensity =	A / (Tc+B)^c
Mannings 'n'=	0.013			
Starting Tc =	10	min	A =	1593
			B =	11
Factor of Safety =	20	%	c =	0.8789

NOMINAL PIPE SIZE USED

ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
1E	STREET E	14E	13E	0.35	0.60	0.21	0.21	109.7	0.064			0.064	50.8	1.00	300	0.097	1.37	10.00	0.62	10.62	66%
2E	STREET L	15E	13E	0.38	0.60	0.23	0.23	109.7	0.069			0.069	52.1	0.50	375	0.124	1.12	10.00	0.77	10.77	56%
5E	STREET E	13E	12E	0.76	0.60	0.46	0.89	106.2	0.264			0.264	116.7	1.00	525	0.430	1.99	10.77	0.98	11.75	61%
3E	STREET I	16E	12E	0.33	0.60	0.20	0.20	109.7	0.060			0.060	47.9	0.50	375	0.124	1.12	10.00	0.71	10.71	49%
4E	STREET I	7	12E	0.13	0.60	0.08	0.08	109.7	0.024			0.024	74.5	1.25	300	0.108	1.53	10.00	0.81	10.81	22%
6E	STREET E	12E	1E	1.15	0.60	0.69	1.86	102.2	0.528			0.528	197.0	0.50	750	0.787	1.78	11.75	1.84	13.60	67%
18E	STREET N	8E	7E	0.07	0.60	0.04	0.04	109.7	0.013			0.013	17.8	0.50	300	0.068	0.97	10.00	0.31	10.31	19%
17E	STREET K	7E	4E	0.21	0.60	0.13	0.17	108.3	0.051			0.051	77.5	0.50	300	0.068	0.97	10.31	1.34	11.64	74%
12E	STREET K	4E	3E	0.76	0.60	0.46	0.62	102.7	0.178			0.178	147.0	0.60	450	0.221	1.39	11.64	1.76	13.41	81%
10E	STREET K	10E	3E	0.65	0.60	0.39	0.39	109.7	0.119			0.119	80.1	1.00	375	0.175	1.59	10.00	0.84	10.84	68%
9E	STREET E	3E	2E	0.19	0.60	0.11	1.13	96.1	0.301			0.301	81.5	0.52	600	0.443	1.57	13.41	0.87	14.27	68%
8E	STREET E	2E	1E	0.21	0.60	0.13	1.25	93.2	0.325			0.325	74.6	0.50	600	0.434	1.54	14.27	0.81	15.08	75%
16E	STREET B	7E	6E	0.43	0.60	0.26	0.30	108.3	0.090			0.090	68.5	0.50	375	0.124	1.12	10.31	1.02	11.32	73%
15E	STREET B	6E	5E	0.62	0.60	0.37	0.67	103.9	0.194			0.194	78.5	0.50	525	0.304	1.40	11.32	0.93	12.26	64%
13E	STREET B	9E	5E	0.26	0.60	0.16	0.16	109.7	0.048			0.048	37.9	0.50	300	0.068	0.97	10.00	0.65	10.65	70%
14E	STREET E	20E	5E	0.12	0.60	0.07	0.07	109.7	0.022			0.022	26.0	0.50	300	0.068	0.97	10.00	0.45	10.45	32%
11E	STREET E	5E	3E	0.13	0.60	0.08	0.98	100.3	0.272			0.272	77.5	0.50	600	0.434	1.54	12.26	0.84	13.10	63%
7E	STREET J	11E	2E	0.66	0.60	0.40	0.40	109.7	0.121			0.121	85.9	2.00	375	0.248	2.25	10.00	0.64	10.64	49%
		1E	50E				3.11	90.7	0.784			0.784	193.1	0.50	825	1.015	1.90	15.08	1.69	16.78	77%
20E	POND 2	50E	HW4	0.83	0.80	0.66	3.78	85.8	0.900			0.900	10.5	0.50	900	1.280	2.01	16.78	0.09	16.87	70%
	POND 2		51E										17.5	0.50	300	0.068	0.97	10.00	0.30	10.30	
	POND 2	51E	HW5					108.3					31.5	0.50	300	0.068	0.97	10.30	0.54	10.84	

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Appendix B2: Land Use Breakdown and Imperviousness Calculations

SWM DESIGN CALCULATIONS

Landuse Breakdown & Imperviousness Calculations

URBANTECH

Project Name: Lynden Garden
Municipality: City of Brantford
Project No.: 19-617
Date: 2023-10-30

Prepared by: M.B.
Checked by: N.P.
Submission #: 1

No.	Area (Ha)	Land Use Type	C	IMP (%) =100(C-0.2)/0.7	TIMP	XIMP
1	25.21	Neighborhood residential	0.75	78.6	0.8	
2	2.90	Block Townhouses	0.75	78.6	0.8	
3	0.87	Residential	0.75	78.6	0.8	
4	0.64	Neighborhood park	0.25	7.1	0.1	
Total Drainage Area to Pond 1	29.61			77.0	0.77	0.69

No.	Area (Ha)	Land Use Type	C	IMP (%) =100(C-0.2)/0.7	TIMP	XIMP
Drainage area to Pond 2	7.29	Neighborhood residential	0.75	78.6	0.79	0.71

Appendix B3: SWM Design Calculations

SWM DESIGN CALCULATIONS

SWM Pond 1 Design

URBANTECH

Project Name:	Lynden garden	**Prepared by:**	M.B.
Municipality:		**Checked by:**	N.P
Project No.:	19-617	**Submission #:**	1
Date:	2023-10-30		

Drainage Areas	**29.61**	ha
% Impervious	**77%**	
100-Year Allowable Flow Rate	**0.064**	**m3/s/ha**
100-Year Allowable Flow Rate	**1.90**	**m3/s**

C_D=	**0.62**
C_{weir} =	**1.48**
C_{DICB} =	**1.71**

V-Notch weir coefficient

Φ/2	**84.29**	(This angle is equivalent to 10H:1V)
tan(Φ/2)	**10.000**	
$C_{V\text{-}notch}$	**1.270**	

	Orifice Quality	**Emergency Weir**	**DICB**	**Orifice - 1**
Pipe diameter (m)	**0.185**			**0.450**
L = Weir Width (m)		**7.00**	**1.20**	
A = Area of pipe (m^2)	**0.0269**			**0.1590**

H = Elevation of Orifice **ICB lead Orifice Top Elevation =** **214.65**

	MAIN BODY OF THE POND														**DETENTION TIME**			
DESCRIPTION	**Stage**	**Depth to Permanent Pond Level**	**Downstream Backwater Elevation**	**Qout Emergency weir**	**Q_{out} DICB**	**Q_{out} with Orifices - 1**	**Q_{out} quality**	**Total flow Qout**	**Pond Surface Area**	**Incremental Storage**	**Active Storage**	**Flow rate (SWMHYMO)**	**Required Storage (SWMHYMO)**	**Target release Rates**	**Total Storage**	**Incremental Time**	**Cumulative Time**	**CummulativeTime**
	(m)	**(m)**	**(m)**	**(m^3/s)**	**(m^3/s)**	**(m^3/s)**	**(m^3/s)**	**(m^3/s)**	**(m^2)**	**(m^3)**	**(m^3)**	**(m^3/s)**	**(m^3)**	**(m^3/s)**	**(m^3)**	**(Sec)**	**(Sec)**	**(hr)**
Top of Pond	217.71	**3.21**		34.24	**20.37**	**1.471**	0.130	35.844	15,106	-	**28,886**				47,490	-	98,050	**27.2**
	217.40	2.90		18.60	**17.21**	**1.388**	0.124	20.116	14,968	-	**28,886**				47,490	-	98,050	**27.2**
	217.10	2.60		8.36	**14.32**	**1.303**	0.117	9.776	14,872	1,504	**28,886**				47,490	154	98,050	**27.2**
	216.80	**2.30**		2.33	**11.61**	**1.212**	0.110	3.650	14,673	2,969	**27,383**				45,986	813	97,896	**27.2**
Emergency Spillway crest- 100 Year	216.50	2.00		0.00	**9.10**	**1.114**	0.102	1.216	14,478	2,896	**24,414**				43,017	2,382	97,083	**27.0**
	216.30	1.80			**7.54**	**1.043**	0.096	1.139	14,285	1,419	**21,518**				40,121	1,245	94,700	**26.3**
50-year	216.20	1.70			**6.80**	**1.006**	0.094	1.099	14,093	2,781	**20,099**				38,703	2,530	93,455	**26.0**
	216.00	1.50			**5.39**	**0.927**	0.088	1.014	13,713	1,362	**17,318**				35,922	1,343	90,925	**25.3**
25-year	215.80	1.30			**4.10**	**0.840**	0.081	0.921	13,526	1,343	**15,956**				34,560	1,458	89,582	**24.9**
10-Year	215.70	1.20			**3.50**	**0.793**	0.078	0.871	13,340	1,325	**14,613**				33,217	1,521	88,124	**24.5**
	215.60	1.10			**2.94**	**0.744**	0.074	0.818	13,155	2,594	**13,288**				31,892	3,172	86,603	**24.1**
5-Year	215.42	0.92			**2.00**	**0.645**	0.067	0.712	12,790	1,270	**10,694**				29,298	1,784	83,431	**23.2**
2-Year	215.30	0.80			**1.45**	**0.569**	0.062	0.632	12,610	1,252	**9,424**				28,028	1,982	81,648	**22.7**
	215.20	0.70			**1.04**	**0.498**	0.058	0.556	12,432	1,234	**8,172**				26,775	2,222	79,665	**22.1**
	215.10	0.60			**0.67**	**0.414**	0.053	0.467	12,254	1,217	**6,938**				25,541	2,606	77,443	**21.5**
25 mm	215.00	0.50			**0.37**	**0.309**	0.047	0.356	12,079	1,199	**5,721**				24,324	3,369	37,643	**10.5**
	214.90	0.40			**0.13**	**0.000**	0.041	0.041	11,904	1,182	**4,522**				23,125	28,869	74,838	**20.8**
Extended Detention	214.80	0.30			**0.00**	**0.000**	0.034	0.034	11,731	1,153	**3,340**				21,944	34,275	34,275	**9.5**
	214.70	0.20					0.024	0.024	11,320	1,113	**2,187**				20,791	45,968	45,968	**12.8**
	214.60	0.10					0.006	0.006	10,932	1,075	**1,075**				19,678		-	0.0
Top of Permanent Pool	**214.50**	**0.00**					**0.000**	**0.000**	10,564	-	**-**				18,604	**-**	**-**	**0.0**

								PERMANENT POOL			**SEDIMENT FOREBAY**							
								Pond Surface Area (m^2)	**Incremental Storage (m^3)**	**Total Storage (m3)**	**Surface Area (m^2)**	**Incremental Storage (m^3)**	**Total Storage (m3)**	**Total Storage (m3)**				
														9000				
Top of Permanent Pool	**214.50**	**0.00**						10,564		18,604								
	214.40	**-0.10**						10,192		17,566							-	
	214.30	-0.20						9,844		16,564								
	214.10	-0.40						9,517		15,588							-	
	213.90	-0.60						9,197		13,685								
	213.70	-0.80						8,883		11,845								
	213.50	-1.00						8,573		10,068								
	213.30	-1.20						8,266		8,354								
	213.10	-1.40						7,963		6,701								
	212.90	-1.60						7,663		5,108								
	212.70	-1.80						7,368		3,575								
	212.50	-2.00						7,076		2,102								
	212.40	-2.10						6,932		1,387								
	212.29	-2.21								-								

SWM DESIGN CALCULATIONS

SWM Pond 2 Design

URBANTECH

Project Name: Lynden garden
Municipality:
Project No.: 19-617
Date: 2023-10-30

Prepared by: M.B.
Checked by: N.P
Submission #: 1

Drainage Areas	**7.29**	ha
% Impervious	**79%**	
100-Year Allowable Flow Rate	**0.060**	**m3/s/ha**
100-Year Allowable Flow Rate	**0.44**	**m3/s**

C_D=	**0.62**
C_{weir} =	**1.48**
C_{DICB} =	**1.71**

V-Notch weir coefficient

Φ/2	**84.29**	(This angle is equivalent to 10H:1V)
tan(Φ/2)	**10.000**	
$C_{V\text{-}notch}$	**1.270**	

	Orifice Quality	Emergency Weir	DICB	Orifice - 1
Pipe diameter (m)	**0.075**			**0.345**
L = Weir Width (m)		**7.00**	**1.20**	
A = Area of pipe (m^2)	**0.0044**			**0.0935**

CB lead Orifice Top Elevation = **206.95**

H = Elevation of Orifice

	MAIN BODY OF THE POND														DETENTION TIME			
DESCRIPTION	**Stage**	**Depth to Permanent Pond Level**	**Downstream Backwater Elevation**	**Qout Emergency weir**	**Q_{out} DICB**	**Q_{out} with Orifices - 1**	**Q_{out} quality**	**Total flow Qout**	**Pond Surface Area**	**Incremental Storage**	**Active Storage**	**Flow rate (SWMHYMO)**	**Required Storage (SWMHYMO)**	**Target release Rates**	**Total Storage**	**Incremental Time**	**Cumulative Time**	**CummulativeTime**
	(m)	**(m)**	**(m)**	**(m^3/s)**	**(m^3/s)**	**(m^3/s)**	**(m^3/s)**	**(m^3/s)**	**(m^2)**	**(m^3)**	**(m^3)**	**(m^3/s)**	**(m^3)**	**(m^3/s)**	**(m^3)**	**(Sec)**	**(Sec)**	**(hr)**
Top of Pond	208.61	**1.93**		18.19	**7.62**	**0.626**	0.017	18.832	6,345	629	**10,407**				13,735	33	209,011	**58.1**
	208.50	1.82		13.96	**6.80**	**0.603**	0.016	14.580	6,239	619	**9,778**				13,106	42	208,978	**58.0**
	208.40	1.72		10.65	**6.08**	**0.580**	0.016	11.248	6,133	1,205	**9,160**				12,488	107	208,936	**58.0**
	208.20	**1.52**		5.47	**4.73**	**0.533**	0.015	6.020	5,919	1,162	**7,954**				11,282	193	208,828	**58.0**
	208.00	1.32		2.06	**3.50**	**0.481**	0.014	2.557	5,704	565	**6,792**				10,120	221	208,635	**58.0**
Regional	207.90	1.22		0.97	**2.94**	**0.453**	0.013	1.432	5,596	554	**6,227**				9,555	387	208,414	**57.9**
	207.80	1.12		0.26	**2.40**	**0.423**	0.013	0.693	5,488	544	**5,673**				9,001	785	208,027	**57.8**
100-year	207.72	1.04		0.00	**2.00**	**0.397**	0.012	0.409	5,383	532	**5,129**				8,457	1,302	207,243	**57.6**
50-Year	207.62	0.94			**1.54**	**0.362**	0.012	0.374	5,264	520	**4,597**				7,925	1,393	205,941	**57.2**
25-Year	207.60	0.92			**1.45**	**0.355**	0.011	0.366	5,145	509	**4,076**				7,405	1,389	204,548	**56.8**
10-Year	207.50	0.82			**1.04**	**0.315**	0.011	0.326	5,025	497	**3,568**				6,896	1,522	203,159	**56.4**
5-year	207.30	0.62			**0.37**	**0.216**	0.009	0.226	4,905	484	**3,071**				6,399	2,148	201,637	**56.0**
2-Year	207.20	**0.52**			**0.13**	**0.143**	0.008	0.138	4,784	472	**2,587**				5,915	3,417	199,490	**55.4**
25 mm	207.10	0.42			**0.00**	**0.000**	0.008	0.008	4,662	460	**2,115**				5,443	61,322	196,072	54.5
	207.00	0.32					0.006	0.006	4,540	869	**1,654**				4,983	134,750	134,750	37.4
	206.80	0.12					0.003	0.003	4,149	786	**786**				4,114		-	0.0
Top of Permanent Pool	**206.68**	**0.00**					**0.000**	**0.000**	3,720	-	**-**				3,328	**-**	**-**	**0.0**

			PERMANENT POOL			SEDIMENT FOREBAY			
			Pond Surface Area (m^2)	**Incremental Storage (m^3)**	**Total Storage (m3)**	**Surface Area (m^2)**	**Incremental Storage (m^3)**	**Total Storage (m3)**	**Total Storage (m3)**
									9000
Top of Permanent Pool	**206.68**	**0.00**	3,720		3,710				
	206.60	**-0.08**	3,720		3,328				
	206.50	-0.18	3,551		2,965				
	206.40	-0.28	3,420		2,616				
	206.30	-0.38	3,302		2,280				
	206.20	-0.48	3,185		2,280				
	206.10	-0.58	3,070		1,956				
	206.00	-0.68	2,957		1,643				
	205.90	-0.78	2,845		1,341				
	205.80	-0.88	2,735		1,051				
	205.70	-0.98	2,627		772				
	205.60	-1.08	2,521		504				
	205.50	-1.18	2,416		247				
	205.47	-1.21			-				

SWM DESIGN CALCULATIONS

Superpipes SWM Storage Desgin

URBANTECH

Project Name: Lynden garden
Municipality:
Project No.: 19-617
Date: 2023-10-30

Prepared by: N Pokharel, P.Eng.
Checked by:
Submission #: 1

Designer Inputs: Underground Storage

	Orifice		Height=	1800	mm	Length=	300.00	m	
Orifice Plate Diameter (m) =	0.215	m		1.800	m	Area	900	m^2	
			Width=	3000		Storage Provided=	1620	m^3	
Area of Pipe (m^2) =	0.036	m2		3.00	m				**Drainage Area =** 2.800 ha
Cd =	0.62								**% Impervious =** 70%
									Allowable Flow = 0.131 (m3/s)

	Stage (%)	stage (mm)	Stage (m)	Elevation (m)	Storage Used - Events	Depth to Centre of Orifice (m)	Q_{out} Orifice (m^3/s)	He	Flow Control	Qout (m^3/s)	Qout (L/s)	Incremental Volume (m^3)	Total Storage (m^3)	Total Storage (m-ha)	Inc. Time (s)	Cum. Time (s)	Cum. Time (hr)
Top of Storage	100	1800	1.800	80.54	100-Year	1.693	0.1297		Orifice Plate	0.130	130	81.0	1620	0.1620	12,489	167,880	46.6
	95	1710	1.710	80.45		1.603	0.1262		Orifice Plate	0.126	126	81.0	1539	0.1539	12,194	155,390	43.2
	90	1620	1.620	80.36		1.513	0.1226		Orifice Plate	0.123	123	81.0	1458	0.1458	11,891	143,197	39.8
	85	1530	1.530	80.27		1.423	0.1189		Orifice Plate	0.119	119	81.0	1377	0.1377	11,580	131,306	36.5
	80	1440	1.440	80.18		1.333	0.1151		Orifice Plate	0.115	115	81.0	1296	0.1296	11,261	119,726	33.3
	75	1350	1.350	80.09		1.243	0.1111		Orifice Plate	0.111	111	81.0	1215	0.1215	10,933	108,466	30.1
	70	1260	1.260	80.00		1.153	0.1070		Orifice Plate	0.107	107	81.0	1134	0.1134	10,595	97,533	27.1
	65	1170	1.170	79.91		1.063	0.1028		Orifice Plate	0.103	103	81.0	1053	0.1053	10,246	86,939	24.1
	60	1080	1.080	79.82		0.973	0.0983		Orifice Plate	0.098	98	162.0	972	0.0972	9,886	76,693	21.3
	50	900	0.900	79.64		0.793	0.0888		Orifice Plate	0.089	89	81.0	810	0.0810	9,126	66,807	18.6
	45	810	0.810	79.55		0.703	0.0836		Orifice Plate	0.084	84	81.0	729	0.0729	8,724	57,681	16.0
	40	720	0.720	79.46		0.613	0.0780		Orifice Plate	0.078	78	81.0	648	0.0648	8,305	48,957	13.6
	35	630	0.630	79.37		0.523	0.0721		Orifice Plate	0.072	72	81.0	567	0.0567	7,867	40,653	11.3
	30	540	0.540	79.28		0.433	0.0656		Orifice Plate	0.066	66	81.0	486	0.0486	7,412	32,785	9.1
	25	450	0.450	79.19		0.343	0.0583		Orifice Plate	0.058	58	81.0	405	0.0405	6,941	25,373	7.0
	20	360	0.360	79.10		0.253	0.0501		Orifice Plate	0.050	50	81.0	324	0.0324	6,467	18,432	5.1
	15	270	0.270	79.01		0.163	0.0402		Orifice Plate	0.040	40	48.6	243	0.0243	6,046	11,965	3.3
	12	216	0.216	78.96		0.109	0.0328		Orifice Plate	0.033	33	50.4	194	0.0194	5,919	5,919	1.6
	7	160	0.160	78.90		0.053	0.0228		Orifice Plate	0.030	30	144.0	144	0.0144	-	-	0.0
Bottom of Storage	0	0	0.000	78.74	Orifice Invert	0.000	0.0000		Orifice Plate	0.000	0	0.00	0	0.0000	-	-	0.0

Appendix B4: VO Model Output (Existing and Proposed Conditions)

VO Model Output

Project Name:	Lynden Garden Block Plan	**Prepared by:**	M.B.
Municipality:	City of Brantford	**Checked by:**	N.P.
Project No.:	19-617	**Submission #:**	1st Submission
Date:	30-Oct-2023		

VO model Schematic – Existing Conditions

```
*****************************************
** SIMULATION:25MM4HRC_10min Edited 2012 **
*****************************************

--------------------
|    READ STORM    |    Filename: C:\Users\abrasher\AppD
|                  |              ata\Local\Temp\
|                  |              c1a0325a-2c60-4d42-a7b8-7db83ab25b61\5248186c
| Ptotal= 25.00 mm |    Comments: 25MM4HRC_10min Edited 2012
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	2.07	1.17	5.70	2.17	5.19	3.17	2.80
0.33	2.27	1.33	10.78	2.33	4.47	3.33	2.62
0.50	2.52	1.50	50.21	2.50	3.95	3.50	2.48
0.67	2.88	1.67	13.37	2.67	3.56	3.67	2.35
0.83	3.38	1.83	8.29	2.83	3.25	3.83	2.23
1.00	4.18	2.00	6.30	3.00	3.01	4.00	2.14

```
--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.07	1.083	5.70	2.083	5.19	3.08	2.80
0.167	2.07	1.167	5.70	2.167	5.19	3.17	2.80
0.250	2.27	1.250	10.78	2.250	4.47	3.25	2.62
0.333	2.27	1.333	10.78	2.333	4.47	3.33	2.62
0.417	2.52	1.417	50.21	2.417	3.95	3.42	2.48
0.500	2.52	1.500	50.21	2.500	3.95	3.50	2.48
0.583	2.88	1.583	13.37	2.583	3.56	3.58	2.35
0.667	2.88	1.667	13.37	2.667	3.56	3.67	2.35
0.750	3.38	1.750	8.29	2.750	3.25	3.75	2.23
0.833	3.38	1.833	8.29	2.833	3.25	3.83	2.23
0.917	4.17	1.917	6.30	2.917	3.01	3.92	2.14
1.000	4.18	2.000	6.29	3.000	3.01	4.00	2.14

```
     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   0.152 (i)
     TIME TO PEAK    (hrs)=   3.083
```

```
     RUNOFF VOLUME    (mm)=   4.789
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =   0.192

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
                0.167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
                0.250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
                0.333    2.27 | 1.333   10.78 | 2.333    4.47 |  3.33    2.62
                0.417    2.52 | 1.417   50.21 | 2.417    3.95 |  3.42    2.48
                0.500    2.52 | 1.500   50.21 | 2.500    3.95 |  3.50    2.48
                0.583    2.88 | 1.583   13.37 | 2.583    3.56 |  3.58    2.35
                0.667    2.88 | 1.667   13.37 | 2.667    3.56 |  3.67    2.35
                0.750    3.38 | 1.750    8.29 | 2.750    3.25 |  3.75    2.23
                0.833    3.38 | 1.833    8.29 | 2.833    3.25 |  3.83    2.23
                0.917    4.17 | 1.917    6.30 | 2.917    3.01 |  3.92    2.14
                1.000    4.18 | 2.000    6.29 | 3.000    3.01 |  4.00    2.14

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.045 (i)
     TIME TO PEAK    (hrs)=   2.250
     RUNOFF VOLUME    (mm)=   4.788
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =   0.192

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                    ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
      hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
     0.083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
     0.167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
     0.250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
     0.333    2.27 | 1.333   10.78 | 2.333    4.47 |  3.33    2.62
     0.417    2.52 | 1.417   50.21 | 2.417    3.95 |  3.42    2.48
     0.500    2.52 | 1.500   50.21 | 2.500    3.95 |  3.50    2.48
     0.583    2.88 | 1.583   13.37 | 2.583    3.56 |  3.58    2.35
     0.667    2.88 | 1.667   13.37 | 2.667    3.56 |  3.67    2.35
     0.750    3.38 | 1.750    8.29 | 2.750    3.25 |  3.75    2.23
     0.833    3.38 | 1.833    8.29 | 2.833    3.25 |  3.83    2.23
     0.917    4.17 | 1.917    6.30 | 2.917    3.01 |  3.92    2.14
     1.000    4.18 | 2.000    6.29 | 3.000    3.01 |  4.00    2.14

     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   0.325 (i)
     TIME TO PEAK    (hrs)=   3.083
     RUNOFF VOLUME    (mm)=   4.789
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =   0.192

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                    ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
      hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
     0.083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
     0.167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
     0.250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
```

0.333	2.27	1.333	10.78	2.333	4.47	3.33	2.62
0.417	2.52	1.417	50.21	2.417	3.95	3.42	2.48
0.500	2.52	1.500	50.21	2.500	3.95	3.50	2.48
0.583	2.88	1.583	13.37	2.583	3.56	3.58	2.35
0.667	2.88	1.667	13.37	2.667	3.56	3.67	2.35
0.750	3.38	1.750	8.29	2.750	3.25	3.75	2.23
0.833	3.38	1.833	8.29	2.833	3.25	3.83	2.23
0.917	4.17	1.917	6.30	2.917	3.01	3.92	2.14
1.000	4.18	2.000	6.29	3.000	3.01	4.00	2.14

Max.Eff.Inten.(mm/hr)=	50.21	42.99	
over (min)	5.00	20.00	
Storage Coeff. (min)=	6.25 (ii)	16.14 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.19	0.06	
			TOTALS
PEAK FLOW (cms)=	0.48	0.23	0.576 (iii)
TIME TO PEAK (hrs)=	1.50	1.75	1.50
RUNOFF VOLUME (mm)=	24.00	12.11	16.27
TOTAL RAINFALL (mm)=	25.00	25.00	25.00
RUNOFF COEFFICIENT =	0.96	0.48	0.65

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
**********************************
** SIMULATION:Brantford 100-Year **
**********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=4688.000
| Ptotal= 97.84 mm |                          B=  17.000
--------------------                          C=   0.962
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 12.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	0.50	3.08	2.35	6.08	4.80	9.08	0.96
0.17	0.51	3.17	2.56	6.17	4.43	9.17	0.93
0.25	0.52	3.25	2.80	6.25	4.10	9.25	0.91
0.33	0.54	3.33	3.09	6.33	3.81	9.33	0.89
0.42	0.55	3.42	3.43	6.42	3.55	9.42	0.87

0.50	0.57	3.50	3.84	6.50	3.32	9.50	0.85
0.58	0.58	3.58	4.34	6.58	3.12	9.58	0.83
0.67	0.60	3.67	4.96	6.67	2.93	9.67	0.81
0.75	0.62	3.75	5.74	6.75	2.77	9.75	0.79
0.83	0.63	3.83	6.74	6.83	2.61	9.83	0.77
0.92	0.65	3.92	8.07	6.92	2.48	9.92	0.76
1.00	0.67	4.00	9.90	7.00	2.35	10.00	0.74
1.08	0.70	4.08	12.49	7.08	2.24	10.08	0.73
1.17	0.72	4.17	16.37	7.17	2.13	10.17	0.71
1.25	0.74	4.25	22.63	7.25	2.03	10.25	0.70
1.33	0.77	4.33	33.76	7.33	1.94	10.33	0.68
1.42	0.80	4.42	56.81	7.42	1.86	10.42	0.67
1.50	0.83	4.50	119.41	7.50	1.78	10.50	0.66
1.58	0.86	4.58	239.35	7.58	1.71	10.58	0.65
1.67	0.89	4.67	138.69	7.67	1.64	10.67	0.63
1.75	0.93	4.75	82.30	7.75	1.58	10.75	0.62
1.83	0.97	4.83	54.94	7.83	1.52	10.83	0.61
1.92	1.01	4.92	39.52	7.92	1.47	10.92	0.60
2.00	1.06	5.00	29.95	8.00	1.42	11.00	0.59
2.08	1.11	5.08	23.58	8.08	1.37	11.08	0.58
2.17	1.17	5.17	19.12	8.17	1.32	11.17	0.57
2.25	1.23	5.25	15.86	8.25	1.28	11.25	0.56
2.33	1.29	5.33	13.41	8.33	1.24	11.33	0.55
2.42	1.36	5.42	11.51	8.42	1.20	11.42	0.54
2.50	1.44	5.50	10.02	8.50	1.17	11.50	0.54
2.58	1.53	5.58	8.81	8.58	1.13	11.58	0.53
2.67	1.63	5.67	7.82	8.67	1.10	11.67	0.52
2.75	1.74	5.75	7.00	8.75	1.07	11.75	0.51
2.83	1.86	5.83	6.32	8.83	1.04	11.83	0.50
2.92	2.00	5.92	5.73	8.92	1.01	11.92	0.50
3.00	2.16	6.00	5.23	9.00	0.98	12.00	0.49

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   2.163 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  55.132
     TOTAL RAINFALL   (mm)=  97.840
     RUNOFF COEFFICIENT   =   0.563

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

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--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.748 (i)
     TIME TO PEAK    (hrs)=   5.250
     RUNOFF VOLUME    (mm)=  55.130
     TOTAL RAINFALL   (mm)=  97.840
     RUNOFF COEFFICIENT   =   0.563

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   4.622 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  55.132
     TOTAL RAINFALL   (mm)=  97.840
     RUNOFF COEFFICIENT   =   0.563

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     239.35     ********
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.35 (ii)    8.32 (ii)
```

```
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.13
                                                              *TOTALS*
     PEAK FLOW       (cms)=       2.40         2.59          4.367 (iii)
     TIME TO PEAK    (hrs)=       4.58         4.67           4.67
     RUNOFF VOLUME    (mm)=      96.84        77.70          84.40
     TOTAL RAINFALL   (mm)=      97.84        97.84          97.84
     RUNOFF COEFFICIENT   =       0.99         0.79           0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*********************************
** SIMULATION:Brantford 10-Year **
*********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=2221.000
| Ptotal= 66.80 mm |                          B=  12.000
--------------------                          C=   0.908
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.38

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    0.60 |  3.08    2.03 |  6.08    3.60 |  9.08    1.01
                 0.17    0.62 |  3.17    2.17 |  6.17    3.37 |  9.17    0.99
                 0.25    0.63 |  3.25    2.34 |  6.25    3.17 |  9.25    0.97
                 0.33    0.64 |  3.33    2.52 |  6.33    2.99 |  9.33    0.95
                 0.42    0.65 |  3.42    2.74 |  6.42    2.82 |  9.42    0.94
                 0.50    0.67 |  3.50    3.00 |  6.50    2.68 |  9.50    0.92
                 0.58    0.68 |  3.58    3.32 |  6.58    2.54 |  9.58    0.90
                 0.67    0.70 |  3.67    3.70 |  6.67    2.42 |  9.67    0.89
                 0.75    0.71 |  3.75    4.17 |  6.75    2.31 |  9.75    0.87
                 0.83    0.73 |  3.83    4.77 |  6.83    2.21 |  9.83    0.86
                 0.92    0.75 |  3.92    5.55 |  6.92    2.12 |  9.92    0.84
                 1.00    0.77 |  4.00    6.59 |  7.00    2.03 | 10.00    0.83
                 1.08    0.79 |  4.08    8.07 |  7.08    1.95 | 10.08    0.81
                 1.17    0.81 |  4.17   10.25 |  7.17    1.88 | 10.17    0.80
                 1.25    0.83 |  4.25   13.76 |  7.25    1.81 | 10.25    0.79
                 1.33    0.85 |  4.33   20.05 |  7.33    1.75 | 10.33    0.78
                 1.42    0.88 |  4.42   33.57 |  7.42    1.69 | 10.42    0.77
```

```
                1.50    0.90 |  4.50   74.61 |  7.50    1.64 | 10.50    0.75
                1.58    0.93 |  4.58  169.55 |  7.58    1.58 | 10.58    0.74
                1.67    0.96 |  4.67   87.95 |  7.67    1.54 | 10.67    0.73
                1.75    0.99 |  4.75   49.31 |  7.75    1.49 | 10.75    0.72
                1.83    1.02 |  4.83   32.40 |  7.83    1.45 | 10.83    0.71
                1.92    1.05 |  4.92   23.36 |  7.92    1.41 | 10.92    0.70
                2.00    1.09 |  5.00   17.89 |  8.00    1.37 | 11.00    0.69
                2.08    1.13 |  5.08   14.30 |  8.08    1.33 | 11.08    0.68
                2.17    1.18 |  5.17   11.79 |  8.17    1.30 | 11.17    0.67
                2.25    1.22 |  5.25    9.97 |  8.25    1.26 | 11.25    0.67
                2.33    1.27 |  5.33    8.59 |  8.33    1.23 | 11.33    0.66
                2.42    1.33 |  5.42    7.52 |  8.42    1.20 | 11.42    0.65
                2.50    1.39 |  5.50    6.66 |  8.50    1.18 | 11.50    0.64
                2.58    1.45 |  5.58    5.97 |  8.58    1.15 | 11.58    0.63
                2.67    1.53 |  5.67    5.40 |  8.67    1.12 | 11.67    0.62
                2.75    1.61 |  5.75    4.92 |  8.75    1.10 | 11.75    0.62
                2.83    1.70 |  5.83    4.51 |  8.83    1.07 | 11.83    0.61
                2.92    1.79 |  5.92    4.17 |  8.92    1.05 | 11.92    0.60
                3.00    1.90 |  6.00    3.86 |  9.00    1.03 | 12.00    0.60


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   1.101 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  30.478
     TOTAL RAINFALL   (mm)=  66.796
     RUNOFF COEFFICIENT   =   0.456

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.379 (i)
     TIME TO PEAK    (hrs)=   5.250
     RUNOFF VOLUME    (mm)=  30.477
```

```
     TOTAL RAINFALL   (mm)=  66.796
     RUNOFF COEFFICIENT   =   0.456

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   2.352 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  30.478
     TOTAL RAINFALL   (mm)=  66.796
     RUNOFF COEFFICIENT   =   0.456

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     169.55       189.48
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.84 (ii)    9.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.25         0.12
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.61         1.50          2.669 (iii)
     TIME TO PEAK    (hrs)=       4.58         4.67           4.67
     RUNOFF VOLUME    (mm)=      65.80        48.32          54.43
     TOTAL RAINFALL   (mm)=      66.80        66.80          66.80
     RUNOFF COEFFICIENT   =       0.99         0.72           0.81

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
```

```
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*********************************
** SIMULATION:Brantford 25-Year **
*********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=3158.000
| Ptotal= 78.92 mm |                          B=  15.000
--------------------                          C=   0.936
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.38
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	0.56	3.08	2.17	6.08	4.13	9.08	0.99
0.17	0.57	3.17	2.35	6.17	3.83	9.17	0.97
0.25	0.58	3.25	2.54	6.25	3.58	9.25	0.95
0.33	0.60	3.33	2.77	6.33	3.35	9.33	0.93
0.42	0.61	3.42	3.05	6.42	3.14	9.42	0.91
0.50	0.63	3.50	3.37	6.50	2.96	9.50	0.89
0.58	0.64	3.58	3.76	6.58	2.80	9.58	0.87
0.67	0.66	3.67	4.25	6.67	2.65	9.67	0.86
0.75	0.67	3.75	4.85	6.75	2.52	9.75	0.84
0.83	0.69	3.83	5.62	6.83	2.39	9.83	0.82
0.92	0.71	3.92	6.63	6.92	2.28	9.92	0.81
1.00	0.73	4.00	8.00	7.00	2.18	10.00	0.79
1.08	0.75	4.08	9.95	7.08	2.08	10.08	0.78
1.17	0.77	4.17	12.84	7.17	2.00	10.17	0.77
1.25	0.79	4.25	17.49	7.25	1.92	10.25	0.75
1.33	0.82	4.33	25.76	7.33	1.84	10.33	0.74
1.42	0.84	4.42	43.09	7.42	1.77	10.42	0.73
1.50	0.87	4.50	91.94	7.50	1.71	10.50	0.72
1.58	0.90	4.58	191.56	7.58	1.65	10.58	0.70
1.67	0.93	4.67	107.27	7.67	1.59	10.67	0.69
1.75	0.97	4.75	62.59	7.75	1.54	10.75	0.68
1.83	1.00	4.83	41.66	7.83	1.49	10.83	0.67
1.92	1.04	4.92	30.06	7.92	1.44	10.92	0.66
2.00	1.08	5.00	22.93	8.00	1.39	11.00	0.65
2.08	1.13	5.08	18.19	8.08	1.35	11.08	0.64
2.17	1.18	5.17	14.88	8.17	1.31	11.17	0.63
2.25	1.23	5.25	12.46	8.25	1.28	11.25	0.62
2.33	1.29	5.33	10.64	8.33	1.24	11.33	0.61
2.42	1.35	5.42	9.22	8.42	1.21	11.42	0.60

```
                 2.50    1.42 |  5.50    8.09 |  8.50    1.18 | 11.50    0.60
                 2.58    1.49 |  5.58    7.19 |  8.58    1.15 | 11.58    0.59
                 2.67    1.58 |  5.67    6.44 |  8.67    1.12 | 11.67    0.58
                 2.75    1.67 |  5.75    5.82 |  8.75    1.09 | 11.75    0.57
                 2.83    1.77 |  5.83    5.29 |  8.83    1.06 | 11.83    0.57
                 2.92    1.89 |  5.92    4.84 |  8.92    1.04 | 11.92    0.56
                 3.00    2.02 |  6.00    4.46 |  9.00    1.01 | 12.00    0.55


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   1.493 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  39.761
     TOTAL RAINFALL   (mm)=  78.919
     RUNOFF COEFFICIENT   =   0.504

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.514 (i)
     TIME TO PEAK    (hrs)=   5.250
     RUNOFF VOLUME    (mm)=  39.760
     TOTAL RAINFALL   (mm)=  78.919
     RUNOFF COEFFICIENT   =   0.504

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00
```

```
     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   3.190 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  39.762
     TOTAL RAINFALL   (mm)=  78.919
     RUNOFF COEFFICIENT   =   0.504

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     191.56       230.04
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.66 (ii)    8.71 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.25         0.12
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.87         1.90          3.290 (iii)
     TIME TO PEAK    (hrs)=       4.58         4.67           4.67
     RUNOFF VOLUME    (mm)=      77.92        59.67          66.06
     TOTAL RAINFALL   (mm)=      78.92        78.92          78.92
     RUNOFF COEFFICIENT   =       0.99         0.76           0.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
********************************
** SIMULATION:Brantford 2-Year **
********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 743.000
| Ptotal= 46.19 mm |                          B=   6.000
```

---------- C= 0.799

used in: INTENSITY = A / (t + B)^C

Duration of storm = 12.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.38

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	0.81	3.08	2.05	6.08	3.12	9.08	1.21
0.17	0.82	3.17	2.16	6.17	2.97	9.17	1.19
0.25	0.84	3.25	2.27	6.25	2.84	9.25	1.18
0.33	0.85	3.33	2.41	6.33	2.72	9.33	1.16
0.42	0.86	3.42	2.56	6.42	2.61	9.42	1.14
0.50	0.88	3.50	2.74	6.50	2.51	9.50	1.13
0.58	0.89	3.58	2.94	6.58	2.42	9.58	1.11
0.67	0.91	3.67	3.18	6.67	2.34	9.67	1.09
0.75	0.92	3.75	3.47	6.75	2.26	9.75	1.08
0.83	0.94	3.83	3.83	6.83	2.19	9.83	1.07
0.92	0.96	3.92	4.27	6.92	2.12	9.92	1.05
1.00	0.98	4.00	4.85	7.00	2.05	10.00	1.04
1.08	1.00	4.08	5.62	7.08	2.00	10.08	1.03
1.17	1.02	4.17	6.73	7.17	1.94	10.17	1.01
1.25	1.04	4.25	8.42	7.25	1.89	10.25	1.00
1.33	1.06	4.33	11.35	7.33	1.84	10.33	0.99
1.42	1.08	4.42	17.60	7.42	1.79	10.42	0.98
1.50	1.11	4.50	38.95	7.50	1.75	10.50	0.96
1.58	1.13	4.58	109.40	7.58	1.71	10.58	0.95
1.67	1.16	4.67	46.39	7.67	1.67	10.67	0.94
1.75	1.19	4.75	25.14	7.75	1.63	10.75	0.93
1.83	1.22	4.83	17.04	7.83	1.59	10.83	0.92
1.92	1.25	4.92	12.87	7.92	1.56	10.92	0.91
2.00	1.29	5.00	10.35	8.00	1.53	11.00	0.90
2.08	1.32	5.08	8.68	8.08	1.50	11.08	0.89
2.17	1.36	5.17	7.48	8.17	1.47	11.17	0.88
2.25	1.40	5.25	6.59	8.25	1.44	11.25	0.87
2.33	1.45	5.33	5.89	8.33	1.41	11.33	0.87
2.42	1.49	5.42	5.34	8.42	1.39	11.42	0.86
2.50	1.54	5.50	4.88	8.50	1.36	11.50	0.85
2.58	1.60	5.58	4.51	8.58	1.34	11.58	0.84
2.67	1.66	5.67	4.19	8.67	1.31	11.67	0.83
2.75	1.72	5.75	3.91	8.75	1.29	11.75	0.82
2.83	1.79	5.83	3.68	8.83	1.27	11.83	0.82
2.92	1.87	5.92	3.47	8.92	1.25	11.92	0.81
3.00	1.96	6.00	3.28	9.00	1.23	12.00	0.80

CALIB

```
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   0.475 (i)
     TIME TO PEAK    (hrs)=   5.833
     RUNOFF VOLUME    (mm)=  16.207
     TOTAL RAINFALL   (mm)=  46.192
     RUNOFF COEFFICIENT   =   0.351

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.159 (i)
     TIME TO PEAK    (hrs)=   5.250
     RUNOFF VOLUME    (mm)=  16.207
     TOTAL RAINFALL   (mm)=  46.192
     RUNOFF COEFFICIENT   =   0.351

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   1.014 (i)
     TIME TO PEAK    (hrs)=   5.833
     RUNOFF VOLUME    (mm)=  16.207
     TOTAL RAINFALL   (mm)=  46.192
     RUNOFF COEFFICIENT   =   0.351

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
```

```
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     109.40        99.93
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.58 (ii)   11.64 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.23         0.09
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.95         0.68          1.246 (iii)
     TIME TO PEAK    (hrs)=       4.58         4.75           4.58
     RUNOFF VOLUME    (mm)=      45.19        29.63          35.07
     TOTAL RAINFALL   (mm)=      46.19        46.19          46.19
     RUNOFF COEFFICIENT   =       0.98         0.64           0.76

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*********************************
** SIMULATION:Brantford 50-Year **
*********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=3886.000
| Ptotal= 88.43 mm |                          B=  16.000
--------------------                          C=   0.950
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 12.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    0.53 |  3.08    2.27 |  6.08    4.47 |  9.08    0.98
                 0.17    0.55 |  3.17    2.46 |  6.17    4.14 |  9.17    0.96
                 0.25    0.56 |  3.25    2.68 |  6.25    3.85 |  9.25    0.94
```

0.33	0.57	3.33	2.94	6.33	3.59	9.33	0.92
0.42	0.59	3.42	3.25	6.42	3.36	9.42	0.90
0.50	0.60	3.50	3.61	6.50	3.15	9.50	0.88
0.58	0.62	3.58	4.06	6.58	2.97	9.58	0.86
0.67	0.63	3.67	4.61	6.67	2.80	9.67	0.84
0.75	0.65	3.75	5.30	6.75	2.65	9.75	0.82
0.83	0.67	3.83	6.18	6.83	2.51	9.83	0.81
0.92	0.69	3.92	7.35	6.92	2.39	9.92	0.79
1.00	0.71	4.00	8.94	7.00	2.27	10.00	0.78
1.08	0.73	4.08	11.20	7.08	2.17	10.08	0.76
1.17	0.75	4.17	14.58	7.17	2.07	10.17	0.75
1.25	0.78	4.25	20.02	7.25	1.98	10.25	0.73
1.33	0.80	4.33	29.69	7.33	1.90	10.33	0.72
1.42	0.83	4.42	49.86	7.42	1.83	10.42	0.71
1.50	0.86	4.50	105.64	7.50	1.75	10.50	0.69
1.58	0.89	4.58	215.80	7.58	1.69	10.58	0.68
1.67	0.92	4.67	122.98	7.67	1.63	10.67	0.67
1.75	0.96	4.75	72.35	7.75	1.57	10.75	0.66
1.83	0.99	4.83	48.20	7.83	1.51	10.83	0.65
1.92	1.04	4.92	34.72	7.92	1.46	10.92	0.64
2.00	1.08	5.00	26.38	8.00	1.42	11.00	0.63
2.08	1.13	5.08	20.85	8.08	1.37	11.08	0.62
2.17	1.18	5.17	16.97	8.17	1.33	11.17	0.61
2.25	1.24	5.25	14.14	8.25	1.29	11.25	0.60
2.33	1.30	5.33	12.01	8.33	1.25	11.33	0.59
2.42	1.37	5.42	10.36	8.42	1.21	11.42	0.58
2.50	1.44	5.50	9.05	8.50	1.18	11.50	0.57
2.58	1.52	5.58	7.99	8.58	1.15	11.58	0.56
2.67	1.61	5.67	7.13	8.67	1.12	11.67	0.56
2.75	1.72	5.75	6.41	8.75	1.09	11.75	0.55
2.83	1.83	5.83	5.81	8.83	1.06	11.83	0.54
2.92	1.96	5.92	5.29	8.92	1.03	11.92	0.53
3.00	2.10	6.00	4.85	9.00	1.01	12.00	0.53

```
-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   1.822 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  47.370
     TOTAL RAINFALL   (mm)=  88.427
     RUNOFF COEFFICIENT   =   0.536
```

```
     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.629 (i)
     TIME TO PEAK    (hrs)=   5.250
     RUNOFF VOLUME    (mm)=  47.369
     TOTAL RAINFALL   (mm)=  88.427
     RUNOFF COEFFICIENT   =   0.536

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   3.892 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  47.370
     TOTAL RAINFALL   (mm)=  88.427
     RUNOFF COEFFICIENT   =   0.536

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     215.80       267.86
```

```
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.49 (ii)    8.25 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.13         2.28          3.859 (iii)
     TIME TO PEAK    (hrs)=       4.58         4.67           4.67
     RUNOFF VOLUME    (mm)=      87.43        68.70          75.25
     TOTAL RAINFALL   (mm)=      88.43        88.43          88.43
     RUNOFF COEFFICIENT   =       0.99         0.78           0.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
********************************
** SIMULATION:Brantford 5-Year **
********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1593.000
| Ptotal= 58.12 mm |                          B=  11.000
--------------------                          C=   0.879
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 12.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	0.66	3.08	2.02	6.08	3.42	9.08	1.06
0.17	0.67	3.17	2.15	6.17	3.22	9.17	1.04
0.25	0.68	3.25	2.30	6.25	3.04	9.25	1.03
0.33	0.70	3.33	2.47	6.33	2.88	9.33	1.01
0.42	0.71	3.42	2.66	6.42	2.73	9.42	0.99
0.50	0.73	3.50	2.89	6.50	2.60	9.50	0.97
0.58	0.74	3.58	3.17	6.58	2.48	9.58	0.96
0.67	0.76	3.67	3.50	6.67	2.38	9.67	0.94
0.75	0.77	3.75	3.91	6.75	2.28	9.75	0.93
0.83	0.79	3.83	4.42	6.83	2.19	9.83	0.91
0.92	0.81	3.92	5.08	6.92	2.10	9.92	0.90
1.00	0.82	4.00	5.95	7.00	2.02	10.00	0.88
1.08	0.84	4.08	7.17	7.08	1.95	10.08	0.87
1.17	0.86	4.17	8.96	7.17	1.89	10.17	0.86
1.25	0.89	4.25	11.80	7.25	1.82	10.25	0.85

1.33	0.91	4.33	16.84	7.33	1.77	10.33	0.83
1.42	0.93	4.42	27.59	7.42	1.71	10.42	0.82
1.50	0.96	4.50	60.50	7.50	1.66	10.50	0.81
1.58	0.98	4.58	139.29	7.58	1.61	10.58	0.80
1.67	1.01	4.67	71.27	7.67	1.57	10.67	0.79
1.75	1.04	4.75	40.11	7.75	1.52	10.75	0.78
1.83	1.07	4.83	26.66	7.83	1.48	10.83	0.77
1.92	1.11	4.92	19.47	7.92	1.44	10.92	0.76
2.00	1.14	5.00	15.11	8.00	1.41	11.00	0.75
2.08	1.18	5.08	12.23	8.08	1.37	11.08	0.74
2.17	1.22	5.17	10.21	8.17	1.34	11.17	0.73
2.25	1.27	5.25	8.73	8.25	1.31	11.25	0.72
2.33	1.32	5.33	7.60	8.33	1.28	11.33	0.71
2.42	1.37	5.42	6.72	8.42	1.25	11.42	0.71
2.50	1.43	5.50	6.01	8.50	1.22	11.50	0.70
2.58	1.49	5.58	5.43	8.58	1.20	11.58	0.69
2.67	1.56	5.67	4.95	8.67	1.17	11.67	0.68
2.75	1.63	5.75	4.55	8.75	1.15	11.75	0.67
2.83	1.71	5.83	4.20	8.83	1.13	11.83	0.67
2.92	1.80	5.92	3.90	8.92	1.11	11.92	0.66
3.00	1.91	6.00	3.64	9.00	1.08	12.00	0.65

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  33.87   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   1.294

     PEAK FLOW       (cms)=   0.822 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  24.193
     TOTAL RAINFALL   (mm)=  58.116
     RUNOFF COEFFICIENT   =   0.416

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   7.29   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.54

     Unit Hyd Qpeak  (cms)=   0.516

     PEAK FLOW       (cms)=   0.281 (i)
```

```
     TIME TO PEAK    (hrs)=   5.250
     RUNOFF VOLUME    (mm)=  24.192
     TOTAL RAINFALL   (mm)=  58.116
     RUNOFF COEFFICIENT   =   0.416

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0003)|   Area    (ha)=  72.36   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.00

     Unit Hyd Qpeak  (cms)=   2.764

     PEAK FLOW       (cms)=   1.757 (i)
     TIME TO PEAK    (hrs)=   5.750
     RUNOFF VOLUME    (mm)=  24.193
     TOTAL RAINFALL   (mm)=  58.116
     RUNOFF COEFFICIENT   =   0.416

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  11.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  65.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.67         4.13
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     280.49        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     139.29       148.04
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.15 (ii)   10.19 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.24         0.09
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.29         1.08          1.777 (iii)
     TIME TO PEAK    (hrs)=       4.58         4.75           4.67
     RUNOFF VOLUME    (mm)=      57.12        40.33          46.20
     TOTAL RAINFALL   (mm)=      58.12        58.12          58.12
     RUNOFF COEFFICIENT   =       0.98         0.69           0.79

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
```

```
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
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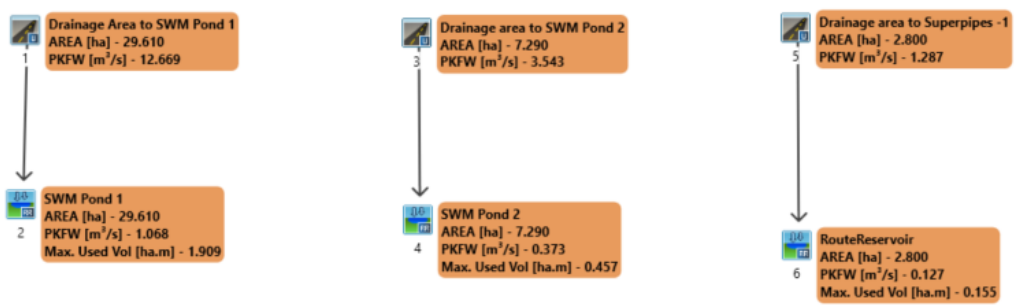
URBANTECH®

VO Model Output

Project Name:	Lynden Garden Block Plan	**Prepared by:**	M.B.
Municipality:	City of Brantford	**Checked by:**	N.P.
Project No.:	19-617	**Submission #:**	1st Submission
Date:	30-Oct-2023		

VO model Schematic – Proposed Conditions



```
*****************************************
** SIMULATION:25MM4HRC_10min Edited 2012 **
*****************************************

--------------------
|    READ STORM    |    Filename: C:\Users\mberjis\AppD
|                  |              ata\Local\Temp\
|                  |              3387b7bf-98a8-46ed-8a4f-78e508cf795f\5248186c
| Ptotal= 25.00 mm |    Comments: 25MM4HRC_10min Edited 2012
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	2.07	1.00	5.70	2.00	5.19	3.00	2.80
0.17	2.27	1.17	10.78	2.17	4.47	3.17	2.62
0.33	2.52	1.33	50.21	2.33	3.95	3.33	2.48
0.50	2.88	1.50	13.37	2.50	3.56	3.50	2.35
0.67	3.38	1.67	8.29	2.67	3.25	3.67	2.23
0.83	4.18	1.83	6.30	2.83	3.01	3.83	2.14

```
--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	22.80	6.81
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	444.30	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.07	1.083	5.70	2.083	5.19	3.08	2.80
0.167	2.07	1.167	5.70	2.167	5.19	3.17	2.80
0.250	2.27	1.250	10.78	2.250	4.47	3.25	2.62
0.333	2.27	1.333	10.78	2.333	4.47	3.33	2.62
0.417	2.52	1.417	50.21	2.417	3.95	3.42	2.48
0.500	2.52	1.500	50.21	2.500	3.95	3.50	2.48
0.583	2.88	1.583	13.37	2.583	3.56	3.58	2.35
0.667	2.88	1.667	13.37	2.667	3.56	3.67	2.35
0.750	3.38	1.750	8.29	2.750	3.25	3.75	2.23
0.833	3.38	1.833	8.29	2.833	3.25	3.83	2.23
0.917	4.17	1.917	6.30	2.917	3.01	3.92	2.14

```
                1.000    4.18 | 2.000    6.29 | 3.000    3.01 |  4.00    2.14

     Max.Eff.Inten.(mm/hr)=      50.21        13.24
                over (min)       10.00        25.00
     Storage Coeff.  (min)=       8.23 (ii)   24.08 (ii)
     Unit Hyd. Tpeak (min)=      10.00        25.00
     Unit Hyd. peak  (cms)=       0.13         0.05
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.90         0.13          1.962 (iii)
     TIME TO PEAK    (hrs)=       1.58         1.83           1.58
     RUNOFF VOLUME    (mm)=      24.00         8.03          19.05
     TOTAL RAINFALL   (mm)=      25.00        25.00          25.00
     RUNOFF COEFFICIENT   =       0.96         0.32           0.76


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                           0.0060     0.1100   |   0.8710      1.4600
                           0.0240     0.2200   |   0.9210      1.6000
                           0.0340     0.3300   |   1.0140      1.7300
                           0.0410     0.4500   |   1.0990      2.0100
                           0.3560     0.5700   |   1.1390      2.1500
                           0.4670     0.6900   |   1.2160      2.4400
                           0.5560     0.8200   |   3.6500      2.7400
                           0.6320     0.9400   |   9.7760      2.8900
                           0.7120     1.0700   |  20.1160      2.8900
                           0.8180     1.3300   |  35.8440      2.8900

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610      1.962      1.58      19.05
   OUTFLOW: ID= 1 (  0002)     29.610      0.140      4.08      18.68

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.13
                   TIME SHIFT OF PEAK FLOW         (min)=150.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.4878

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| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
                0.167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
                0.250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
                0.333    2.27 | 1.333   10.78 | 2.333    4.47 |  3.33    2.62
                0.417    2.52 | 1.417   50.21 | 2.417    3.95 |  3.42    2.48
                0.500    2.52 | 1.500   50.21 | 2.500    3.95 |  3.50    2.48
                0.583    2.88 | 1.583   13.37 | 2.583    3.56 |  3.58    2.35
                0.667    2.88 | 1.667   13.37 | 2.667    3.56 |  3.67    2.35
                0.750    3.38 | 1.750    8.29 | 2.750    3.25 |  3.75    2.23
                0.833    3.38 | 1.833    8.29 | 2.833    3.25 |  3.83    2.23
                0.917    4.17 | 1.917    6.30 | 2.917    3.01 |  3.92    2.14
                1.000    4.18 | 2.000    6.29 | 3.000    3.01 |  4.00    2.14

     Max.Eff.Inten.(mm/hr)=      50.21        15.85
                over (min)        5.00        25.00
     Storage Coeff.  (min)=       5.41 (ii)   20.15 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.21         0.05
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.63         0.03          0.641 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.83           1.50
     RUNOFF VOLUME    (mm)=      24.00         8.18          19.41
     TOTAL RAINFALL   (mm)=      25.00        25.00          25.00
     RUNOFF COEFFICIENT   =       0.96         0.33           0.78


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4090      0.5100
                          0.0030     0.0800   |   0.6930      0.5700
                          0.0060     0.1700   |   1.4320      0.6200
                          0.0080     0.2100   |   2.5570      0.6800
                          0.1380     0.2600   |   6.0200      0.8000
                          0.2260     0.3100   |  11.2480      0.9200
                          0.3260     0.3600   |  14.5800      0.9800
                          0.3660     0.4100   |  18.8320      1.0400
                          0.3740     0.4600   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      0.641      1.50      19.41
   OUTFLOW: ID= 1 (  0004)      7.290      0.005      4.42      17.27

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  0.76
                   TIME SHIFT OF PEAK FLOW         (min)=175.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1365

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--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.96         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
                0.167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
                0.250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
                0.333    2.27 | 1.333   10.78 | 2.333    4.47 |  3.33    2.62
                0.417    2.52 | 1.417   50.21 | 2.417    3.95 |  3.42    2.48
                0.500    2.52 | 1.500   50.21 | 2.500    3.95 |  3.50    2.48
                0.583    2.88 | 1.583   13.37 | 2.583    3.56 |  3.58    2.35
```

0.667	2.88	1.667	13.37	2.667	3.56	3.67	2.35
0.750	3.38	1.750	8.29	2.750	3.25	3.75	2.23
0.833	3.38	1.833	8.29	2.833	3.25	3.83	2.23
0.917	4.17	1.917	6.30	2.917	3.01	3.92	2.14
1.000	4.18	2.000	6.29	3.000	3.01	4.00	2.14

Max.Eff.Inten.(mm/hr)=	50.21	12.98	
over (min)	5.00	25.00	
Storage Coeff. (min)=	4.06 (ii)	20.03 (ii)	
Unit Hyd. Tpeak (min)=	5.00	25.00	
Unit Hyd. peak (cms)=	0.24	0.05	
			TOTALS
PEAK FLOW (cms)=	0.22	0.02	0.224 (iii)
TIME TO PEAK (hrs)=	1.50	1.83	1.50
RUNOFF VOLUME (mm)=	24.00	7.97	17.58
TOTAL RAINFALL (mm)=	25.00	25.00	25.00
RUNOFF COEFFICIENT =	0.96	0.32	0.70

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0009) IN= 2---> OUT= 1 DT= 5.0 min	OVERFLOW IS OFF			
	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0888	0.0810
	0.0300	0.0144	0.0983	0.0972
	0.0328	0.0194	0.1028	0.1053
	0.0402	0.0243	0.1070	0.1134
	0.0501	0.0324	0.1111	0.1215
	0.0583	0.0405	0.1151	0.1296
	0.0656	0.0486	0.1189	0.1377
	0.0721	0.0567	0.1226	0.1458
	0.0780	0.0648	0.1262	0.1539
	0.0836	0.0729	0.1297	0.1620

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0008)	2.800	0.224	1.50	17.58
OUTFLOW: ID= 1 (0009)	2.800	0.038	2.17	17.54

PEAK FLOW REDUCTION [Qout/Qin](%)= 17.13
TIME SHIFT OF PEAK FLOW (min)= 40.00

MAXIMUM STORAGE USED (ha.m.)= 0.0231

****
** SIMULATION:Brantford 100-Year **
****

CHICAGO STORM
Ptotal=101.55 mm

IDF curve parameters: A=4688.000
B= 17.000
C= 0.962

used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.38

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.21	6.00	0.86	12.00	1.71	18.00	0.38
0.08	0.21	6.08	0.89	12.08	1.64	18.08	0.38
0.17	0.21	6.17	0.93	12.17	1.58	18.17	0.37
0.25	0.22	6.25	0.97	12.25	1.52	18.25	0.37
0.33	0.22	6.33	1.01	12.33	1.47	18.33	0.36
0.42	0.22	6.42	1.06	12.42	1.42	18.42	0.36
0.50	0.22	6.50	1.11	12.50	1.37	18.50	0.36
0.58	0.23	6.58	1.17	12.58	1.32	18.58	0.35
0.67	0.23	6.67	1.23	12.67	1.28	18.67	0.35
0.75	0.23	6.75	1.29	12.75	1.24	18.75	0.34
0.83	0.24	6.83	1.36	12.83	1.20	18.83	0.34
0.92	0.24	6.92	1.44	12.92	1.17	18.92	0.34
1.00	0.24	7.00	1.53	13.00	1.13	19.00	0.33
1.08	0.24	7.08	1.63	13.08	1.10	19.08	0.33
1.17	0.25	7.17	1.74	13.17	1.07	19.17	0.33
1.25	0.25	7.25	1.86	13.25	1.04	19.25	0.32
1.33	0.25	7.33	2.00	13.33	1.01	19.33	0.32
1.42	0.26	7.42	2.16	13.42	0.98	19.42	0.32
1.50	0.26	7.50	2.35	13.50	0.96	19.50	0.31
1.58	0.27	7.58	2.56	13.58	0.93	19.58	0.31
1.67	0.27	7.67	2.80	13.67	0.91	19.67	0.31
1.75	0.27	7.75	3.09	13.75	0.89	19.75	0.31
1.83	0.28	7.83	3.43	13.83	0.87	19.83	0.30
1.92	0.28	7.92	3.84	13.92	0.85	19.92	0.30
2.00	0.28	8.00	4.34	14.00	0.83	20.00	0.30
2.08	0.29	8.08	4.96	14.08	0.81	20.08	0.29
2.17	0.29	8.17	5.74	14.17	0.79	20.17	0.29
2.25	0.30	8.25	6.74	14.25	0.78	20.25	0.29
2.33	0.30	8.33	8.07	14.33	0.76	20.33	0.29
2.42	0.31	8.42	9.90	14.42	0.74	20.42	0.28
2.50	0.31	8.50	12.49	14.50	0.73	20.50	0.28
2.58	0.32	8.58	16.37	14.58	0.71	20.58	0.28

2.67	0.32	8.67	22.63	14.67	0.70	20.67	0.28
2.75	0.33	8.75	33.76	14.75	0.68	20.75	0.27
2.83	0.33	8.83	56.81	14.83	0.67	20.83	0.27
2.92	0.34	8.92	119.41	14.92	0.66	20.92	0.27
3.00	0.34	9.00	239.35	15.00	0.65	21.00	0.27
3.08	0.35	9.08	138.69	15.08	0.63	21.08	0.26
3.17	0.36	9.17	82.30	15.17	0.62	21.17	0.26
3.25	0.36	9.25	54.94	15.25	0.61	21.25	0.26
3.33	0.37	9.33	39.52	15.33	0.60	21.33	0.26
3.42	0.38	9.42	29.95	15.42	0.59	21.42	0.26
3.50	0.38	9.50	23.58	15.50	0.58	21.50	0.25
3.58	0.39	9.58	19.12	15.58	0.57	21.58	0.25
3.67	0.40	9.67	15.86	15.67	0.56	21.67	0.25
3.75	0.41	9.75	13.41	15.75	0.55	21.75	0.25
3.83	0.42	9.83	11.51	15.83	0.54	21.83	0.25
3.92	0.42	9.92	10.02	15.92	0.54	21.92	0.24
4.00	0.43	10.00	8.81	16.00	0.53	22.00	0.24
4.08	0.44	10.08	7.82	16.08	0.52	22.08	0.24
4.17	0.45	10.17	7.00	16.17	0.51	22.17	0.24
4.25	0.46	10.25	6.32	16.25	0.50	22.25	0.24
4.33	0.47	10.33	5.73	16.33	0.50	22.33	0.24
4.42	0.49	10.42	5.23	16.42	0.49	22.42	0.23
4.50	0.50	10.50	4.80	16.50	0.48	22.50	0.23
4.58	0.51	10.58	4.43	16.58	0.47	22.58	0.23
4.67	0.52	10.67	4.10	16.67	0.47	22.67	0.23
4.75	0.54	10.75	3.81	16.75	0.46	22.75	0.23
4.83	0.55	10.83	3.55	16.83	0.46	22.83	0.23
4.92	0.57	10.92	3.32	16.92	0.45	22.92	0.22
5.00	0.58	11.00	3.12	17.00	0.44	23.00	0.22
5.08	0.60	11.08	2.93	17.08	0.44	23.08	0.22
5.17	0.62	11.17	2.77	17.17	0.43	23.17	0.22
5.25	0.63	11.25	2.61	17.25	0.43	23.25	0.22
5.33	0.65	11.33	2.48	17.33	0.42	23.33	0.22
5.42	0.67	11.42	2.35	17.42	0.42	23.42	0.21
5.50	0.70	11.50	2.24	17.50	0.41	23.50	0.21
5.58	0.72	11.58	2.13	17.58	0.40	23.58	0.21
5.67	0.74	11.67	2.03	17.67	0.40	23.67	0.21
5.75	0.77	11.75	1.94	17.75	0.40	23.75	0.21
5.83	0.80	11.83	1.86	17.83	0.39	23.83	0.21
5.92	0.83	11.92	1.78	17.92	0.39	23.92	0.21

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--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      22.80          6.81
```

```
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     444.30        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     239.35       187.07
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.41 (ii)    7.62 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.23         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=      10.97         2.65        12.669 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17          9.08
     RUNOFF VOLUME    (mm)=     100.55        68.37         90.57
     TOTAL RAINFALL   (mm)=     101.55       101.55        101.55
     RUNOFF COEFFICIENT   =       0.99         0.67          0.89

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                        0.0060     0.1100   |   0.8710      1.4600
                        0.0240     0.2200   |   0.9210      1.6000
                        0.0340     0.3300   |   1.0140      1.7300
                        0.0410     0.4500   |   1.0990      2.0100
                        0.3560     0.5700   |   1.1390      2.1500
                        0.4670     0.6900   |   1.2160      2.4400
                        0.5560     0.8200   |   3.6500      2.7400
                        0.6320     0.9400   |   9.7760      2.8900
                        0.7120     1.0700   |  20.1160      2.8900
                        0.8180     1.3300   |  35.8440      2.8900

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610     12.669      9.08      90.57
   OUTFLOW: ID= 1 (  0002)     29.610      1.068      9.92      90.07

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.43
                  TIME SHIFT OF PEAK FLOW         (min)= 50.00
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                    MAXIMUM  STORAGE   USED       (ha.m.)=  1.9090

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     239.35       193.31
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.90 (ii)    5.95 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.28         0.15
                                                              *TOTALS*
     PEAK FLOW       (cms)=       3.10         0.68          3.543 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=     100.55        68.92          91.38
     TOTAL RAINFALL   (mm)=     101.55       101.55         101.55
     RUNOFF COEFFICIENT   =       0.99         0.68           0.90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4090      0.5100
                          0.0030     0.0800   |   0.6930      0.5700
                          0.0060     0.1700   |   1.4320      0.6200
                          0.0080     0.2100   |   2.5570      0.6800
                          0.1380     0.2600   |   6.0200      0.8000
                          0.2260     0.3100   |  11.2480      0.9200
                          0.3260     0.3600   |  14.5800      0.9800
                          0.3660     0.4100   |  18.8320      1.0400
                          0.3740     0.4600   |   0.0000      0.0000
```

```
                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      3.543      9.08      91.38
   OUTFLOW: ID= 1 (  0004)      7.290      0.373      9.75      87.14

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.54
                   TIME SHIFT OF PEAK FLOW         (min)= 40.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.4570

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.96         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     239.35       184.35
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.17 (ii)    5.95 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.31         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.06         0.35          1.287 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=     100.55        68.12          87.58
     TOTAL RAINFALL   (mm)=     101.55       101.55         101.55
     RUNOFF COEFFICIENT   =       0.99         0.67           0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0009)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0888      0.0810
```

0.0300	0.0144	0.0983	0.0972
0.0328	0.0194	0.1028	0.1053
0.0402	0.0243	0.1070	0.1134
0.0501	0.0324	0.1111	0.1215
0.0583	0.0405	0.1151	0.1296
0.0656	0.0486	0.1189	0.1377
0.0721	0.0567	0.1226	0.1458
0.0780	0.0648	0.1262	0.1539
0.0836	0.0729	0.1297	0.1620

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0008)	2.800	1.287	9.08	87.58
OUTFLOW: ID= 1 (0009)	2.800	0.127	9.75	87.54

```
PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.83
TIME SHIFT OF PEAK FLOW         (min)= 40.00
MAXIMUM  STORAGE   USED       (ha.m.)=  0.1548
```

```
**********************************
** SIMULATION:Brantford 10-Year **
**********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=2221.000
| Ptotal= 71.73 mm |                          B=  12.000
--------------------                          C=   0.908
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 24.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.30	6.00	0.93	12.00	1.58	18.00	0.49
0.08	0.30	6.08	0.96	12.08	1.54	18.08	0.48
0.17	0.31	6.17	0.99	12.17	1.49	18.17	0.48
0.25	0.31	6.25	1.02	12.25	1.45	18.25	0.48
0.33	0.31	6.33	1.05	12.33	1.41	18.33	0.47
0.42	0.32	6.42	1.09	12.42	1.37	18.42	0.47
0.50	0.32	6.50	1.13	12.50	1.33	18.50	0.46
0.58	0.32	6.58	1.18	12.58	1.30	18.58	0.46
0.67	0.33	6.67	1.22	12.67	1.26	18.67	0.46
0.75	0.33	6.75	1.27	12.75	1.23	18.75	0.45
0.83	0.33	6.83	1.33	12.83	1.20	18.83	0.45
0.92	0.34	6.92	1.39	12.92	1.18	18.92	0.44
1.00	0.34	7.00	1.45	13.00	1.15	19.00	0.44
1.08	0.34	7.08	1.53	13.08	1.12	19.08	0.44
1.17	0.35	7.17	1.61	13.17	1.10	19.17	0.43

1.25	0.35	7.25	1.70	13.25	1.07	19.25	0.43
1.33	0.35	7.33	1.79	13.33	1.05	19.33	0.43
1.42	0.36	7.42	1.90	13.42	1.03	19.42	0.42
1.50	0.36	7.50	2.03	13.50	1.01	19.50	0.42
1.58	0.36	7.58	2.17	13.58	0.99	19.58	0.42
1.67	0.37	7.67	2.34	13.67	0.97	19.67	0.41
1.75	0.37	7.75	2.52	13.75	0.95	19.75	0.41
1.83	0.38	7.83	2.74	13.83	0.94	19.83	0.41
1.92	0.38	7.92	3.00	13.92	0.92	19.92	0.40
2.00	0.39	8.00	3.32	14.00	0.90	20.00	0.40
2.08	0.39	8.08	3.70	14.08	0.89	20.08	0.40
2.17	0.40	8.17	4.17	14.17	0.87	20.17	0.39
2.25	0.40	8.25	4.77	14.25	0.86	20.25	0.39
2.33	0.41	8.33	5.55	14.33	0.84	20.33	0.39
2.42	0.41	8.42	6.59	14.42	0.83	20.42	0.39
2.50	0.42	8.50	8.07	14.50	0.81	20.50	0.38
2.58	0.42	8.58	10.25	14.58	0.80	20.58	0.38
2.67	0.43	8.67	13.76	14.67	0.79	20.67	0.38
2.75	0.43	8.75	20.05	14.75	0.78	20.75	0.37
2.83	0.44	8.83	33.57	14.83	0.77	20.83	0.37
2.92	0.44	8.92	74.61	14.92	0.75	20.92	0.37
3.00	0.45	9.00	169.55	15.00	0.74	21.00	0.37
3.08	0.46	9.08	87.95	15.08	0.73	21.08	0.36
3.17	0.46	9.17	49.31	15.17	0.72	21.17	0.36
3.25	0.47	9.25	32.40	15.25	0.71	21.25	0.36
3.33	0.48	9.33	23.36	15.33	0.70	21.33	0.36
3.42	0.48	9.42	17.89	15.42	0.69	21.42	0.35
3.50	0.49	9.50	14.30	15.50	0.68	21.50	0.35
3.58	0.50	9.58	11.79	15.58	0.67	21.58	0.35
3.67	0.51	9.67	9.97	15.67	0.67	21.67	0.35
3.75	0.52	9.75	8.59	15.75	0.66	21.75	0.35
3.83	0.52	9.83	7.52	15.83	0.65	21.83	0.34
3.92	0.53	9.92	6.66	15.92	0.64	21.92	0.34
4.00	0.54	10.00	5.97	16.00	0.63	22.00	0.34
4.08	0.55	10.08	5.40	16.08	0.62	22.08	0.34
4.17	0.56	10.17	4.92	16.17	0.62	22.17	0.34
4.25	0.57	10.25	4.51	16.25	0.61	22.25	0.33
4.33	0.58	10.33	4.17	16.33	0.60	22.33	0.33
4.42	0.59	10.42	3.86	16.42	0.60	22.42	0.33
4.50	0.60	10.50	3.60	16.50	0.59	22.50	0.33
4.58	0.62	10.58	3.37	16.58	0.58	22.58	0.32
4.67	0.63	10.67	3.17	16.67	0.58	22.67	0.32
4.75	0.64	10.75	2.99	16.75	0.57	22.75	0.32
4.83	0.65	10.83	2.82	16.83	0.56	22.83	0.32
4.92	0.67	10.92	2.68	16.92	0.56	22.92	0.32
5.00	0.68	11.00	2.54	17.00	0.55	23.00	0.32
5.08	0.70	11.08	2.42	17.08	0.55	23.08	0.31
5.17	0.71	11.17	2.31	17.17	0.54	23.17	0.31
5.25	0.73	11.25	2.21	17.25	0.53	23.25	0.31
5.33	0.75	11.33	2.12	17.33	0.53	23.33	0.31

```
                5.42    0.77 | 11.42    2.03 | 17.42    0.52 | 23.42    0.31
                5.50    0.79 | 11.50    1.95 | 17.50    0.52 | 23.50    0.30
                5.58    0.81 | 11.58    1.88 | 17.58    0.51 | 23.58    0.30
                5.67    0.83 | 11.67    1.81 | 17.67    0.51 | 23.67    0.30
                5.75    0.85 | 11.75    1.75 | 17.75    0.50 | 23.75    0.30
                5.83    0.88 | 11.83    1.69 | 17.83    0.50 | 23.83    0.30
                5.92    0.90 | 11.92    1.64 | 17.92    0.49 | 23.92    0.30


-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      22.80         6.81
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     444.30        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     169.55       109.99
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       5.06 (ii)    8.74 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.21         0.12
                                                            *TOTALS*
     PEAK FLOW       (cms)=       7.25         1.44          8.128 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      70.73        42.36          61.93
     TOTAL RAINFALL   (mm)=      71.73        71.73          71.73
     RUNOFF COEFFICIENT   =       0.99         0.59           0.86


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                           0.0060     0.1100   |   0.8710      1.4600
                           0.0240     0.2200   |   0.9210      1.6000
```

```
                          0.0340     0.3300   |   1.0140      1.7300
                          0.0410     0.4500   |   1.0990      2.0100
                          0.3560     0.5700   |   1.1390      2.1500
                          0.4670     0.6900   |   1.2160      2.4400
                          0.5560     0.8200   |   3.6500      2.7400
                          0.6320     0.9400   |   9.7760      2.8900
                          0.7120     1.0700   |  20.1160      2.8900
                          0.8180     1.3300   |  35.8440      2.8900

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610      8.128      9.08      61.93
   OUTFLOW: ID= 1 (  0002)     29.610      0.766      9.83      61.42

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.43
                   TIME SHIFT OF PEAK FLOW         (min)= 45.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  1.2037

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     169.55       113.96
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.32 (ii)    6.83 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.14
                                                            *TOTALS*
     PEAK FLOW       (cms)=       2.10         0.38          2.335 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      70.73        42.79          62.63
     TOTAL RAINFALL   (mm)=      71.73        71.73          71.73
     RUNOFF COEFFICIENT   =       0.99         0.60           0.87

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

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--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4090      0.5100
                          0.0030     0.0800   |   0.6930      0.5700
                          0.0060     0.1700   |   1.4320      0.6200
                          0.0080     0.2100   |   2.5570      0.6800
                          0.1380     0.2600   |   6.0200      0.8000
                          0.2260     0.3100   |  11.2480      0.9200
                          0.3260     0.3600   |  14.5800      0.9800
                          0.3660     0.4100   |  18.8320      1.0400
                          0.3740     0.4600   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      2.335      9.08      62.63
   OUTFLOW: ID= 1 (  0004)      7.290      0.220      9.75      58.33

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.43
                   TIME SHIFT OF PEAK FLOW         (min)= 40.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.3067

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.96         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     169.55       108.25
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.49 (ii)    6.82 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.29         0.14
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.73         0.20          0.848 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      70.73        42.16          59.30
     TOTAL RAINFALL   (mm)=      71.73        71.73          71.73
     RUNOFF COEFFICIENT   =       0.99         0.59           0.83
```

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0009)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0888      0.0810
                          0.0300     0.0144   |   0.0983      0.0972
                          0.0328     0.0194   |   0.1028      0.1053
                          0.0402     0.0243   |   0.1070      0.1134
                          0.0501     0.0324   |   0.1111      0.1215
                          0.0583     0.0405   |   0.1151      0.1296
                          0.0656     0.0486   |   0.1189      0.1377
                          0.0721     0.0567   |   0.1226      0.1458
                          0.0780     0.0648   |   0.1262      0.1539
                          0.0836     0.0729   |   0.1297      0.1620

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0008)      2.800      0.848      9.08      59.30
   OUTFLOW: ID= 1 (  0009)      2.800      0.095      9.67      59.26

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.16
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0912

--------------------------------------------------------------------------------
*********************************
** SIMULATION:Brantford 25-Year **
*********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=3158.000
| Ptotal= 83.32 mm |                          B=  15.000
--------------------                          C=   0.936
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 24.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
```

hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.26	6.00	0.90	12.00	1.65	18.00	0.44
0.08	0.26	6.08	0.93	12.08	1.59	18.08	0.44
0.17	0.27	6.17	0.97	12.17	1.54	18.17	0.43
0.25	0.27	6.25	1.00	12.25	1.49	18.25	0.43
0.33	0.27	6.33	1.04	12.33	1.44	18.33	0.43
0.42	0.27	6.42	1.08	12.42	1.39	18.42	0.42
0.50	0.28	6.50	1.13	12.50	1.35	18.50	0.42
0.58	0.28	6.58	1.18	12.58	1.31	18.58	0.41
0.67	0.28	6.67	1.23	12.67	1.28	18.67	0.41
0.75	0.29	6.75	1.29	12.75	1.24	18.75	0.41
0.83	0.29	6.83	1.35	12.83	1.21	18.83	0.40
0.92	0.29	6.92	1.42	12.92	1.18	18.92	0.40
1.00	0.30	7.00	1.49	13.00	1.15	19.00	0.39
1.08	0.30	7.08	1.58	13.08	1.12	19.08	0.39
1.17	0.30	7.17	1.67	13.17	1.09	19.17	0.39
1.25	0.31	7.25	1.77	13.25	1.06	19.25	0.38
1.33	0.31	7.33	1.89	13.33	1.04	19.33	0.38
1.42	0.31	7.42	2.02	13.42	1.01	19.42	0.38
1.50	0.32	7.50	2.17	13.50	0.99	19.50	0.37
1.58	0.32	7.58	2.35	13.58	0.97	19.58	0.37
1.67	0.33	7.67	2.54	13.67	0.95	19.67	0.37
1.75	0.33	7.75	2.77	13.75	0.93	19.75	0.36
1.83	0.33	7.83	3.05	13.83	0.91	19.83	0.36
1.92	0.34	7.92	3.37	13.92	0.89	19.92	0.36
2.00	0.34	8.00	3.76	14.00	0.87	20.00	0.36
2.08	0.35	8.08	4.25	14.08	0.86	20.08	0.35
2.17	0.35	8.17	4.85	14.17	0.84	20.17	0.35
2.25	0.36	8.25	5.62	14.25	0.82	20.25	0.35
2.33	0.36	8.33	6.63	14.33	0.81	20.33	0.34
2.42	0.37	8.42	8.00	14.42	0.79	20.42	0.34
2.50	0.37	8.50	9.95	14.50	0.78	20.50	0.34
2.58	0.38	8.58	12.84	14.58	0.77	20.58	0.34
2.67	0.38	8.67	17.49	14.67	0.75	20.67	0.33
2.75	0.39	8.75	25.76	14.75	0.74	20.75	0.33
2.83	0.39	8.83	43.09	14.83	0.73	20.83	0.33
2.92	0.40	8.92	91.94	14.92	0.72	20.92	0.33
3.00	0.40	9.00	191.56	15.00	0.70	21.00	0.32
3.08	0.41	9.08	107.27	15.08	0.69	21.08	0.32
3.17	0.42	9.17	62.59	15.17	0.68	21.17	0.32
3.25	0.42	9.25	41.66	15.25	0.67	21.25	0.32
3.33	0.43	9.33	30.06	15.33	0.66	21.33	0.31
3.42	0.44	9.42	22.93	15.42	0.65	21.42	0.31
3.50	0.45	9.50	18.19	15.50	0.64	21.50	0.31
3.58	0.45	9.58	14.88	15.58	0.63	21.58	0.31
3.67	0.46	9.67	12.46	15.67	0.62	21.67	0.31
3.75	0.47	9.75	10.64	15.75	0.61	21.75	0.30
3.83	0.48	9.83	9.22	15.83	0.61	21.83	0.30
3.92	0.49	9.92	8.09	15.92	0.60	21.92	0.30
4.00	0.50	10.00	7.19	16.00	0.59	22.00	0.30

4.08	0.51	10.08	6.44	16.08	0.58	22.08	0.29
4.17	0.52	10.17	5.82	16.17	0.57	22.17	0.29
4.25	0.53	10.25	5.29	16.25	0.57	22.25	0.29
4.33	0.54	10.33	4.84	16.33	0.56	22.33	0.29
4.42	0.55	10.42	4.46	16.42	0.55	22.42	0.29
4.50	0.56	10.50	4.13	16.50	0.54	22.50	0.29
4.58	0.57	10.58	3.83	16.58	0.54	22.58	0.28
4.67	0.58	10.67	3.58	16.67	0.53	22.67	0.28
4.75	0.60	10.75	3.35	16.75	0.52	22.75	0.28
4.83	0.61	10.83	3.14	16.83	0.52	22.83	0.28
4.92	0.63	10.92	2.96	16.92	0.51	22.92	0.28
5.00	0.64	11.00	2.80	17.00	0.51	23.00	0.27
5.08	0.66	11.08	2.65	17.08	0.50	23.08	0.27
5.17	0.67	11.17	2.52	17.17	0.49	23.17	0.27
5.25	0.69	11.25	2.39	17.25	0.49	23.25	0.27
5.33	0.71	11.33	2.28	17.33	0.48	23.33	0.27
5.42	0.73	11.42	2.18	17.42	0.48	23.42	0.27
5.50	0.75	11.50	2.08	17.50	0.47	23.50	0.26
5.58	0.77	11.58	2.00	17.58	0.47	23.58	0.26
5.67	0.79	11.67	1.92	17.67	0.46	23.67	0.26
5.75	0.82	11.75	1.84	17.75	0.46	23.75	0.26
5.83	0.84	11.83	1.77	17.83	0.45	23.83	0.26
5.92	0.87	11.92	1.71	17.92	0.45	23.92	0.26

```
-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      22.80         6.81
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     444.30        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     191.56       136.65
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.82 (ii)    8.33 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.22         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       8.47         1.85          9.627 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      82.32        52.26          73.00
     TOTAL RAINFALL   (mm)=      83.32        83.32          83.32
     RUNOFF COEFFICIENT   =       0.99         0.63           0.88
```

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                        0.0060     0.1100   |   0.8710      1.4600
                        0.0240     0.2200   |   0.9210      1.6000
                        0.0340     0.3300   |   1.0140      1.7300
                        0.0410     0.4500   |   1.0990      2.0100
                        0.3560     0.5700   |   1.1390      2.1500
                        0.4670     0.6900   |   1.2160      2.4400
                        0.5560     0.8200   |   3.6500      2.7400
                        0.6320     0.9400   |   9.7760      2.8900
                        0.7120     1.0700   |  20.1160      2.8900
                        0.8180     1.3300   |  35.8440      2.8900

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610      9.627      9.08      73.00
   OUTFLOW: ID= 1 (  0002)     29.610      0.875      9.92      72.49

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.09
                  TIME SHIFT OF PEAK FLOW         (min)= 50.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.4723

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     191.56       141.42
                over (min)        5.00        10.00
```

```
     Storage Coeff.  (min)=       3.17 (ii)    6.51 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.27         0.14
                                                              *TOTALS*
     PEAK FLOW       (cms)=       2.43         0.48          2.730 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      82.32        52.74          73.74
     TOTAL RAINFALL   (mm)=      83.32        83.32          83.32
     RUNOFF COEFFICIENT   =       0.99         0.63           0.89

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4090      0.5100
                          0.0030     0.0800   |   0.6930      0.5700
                          0.0060     0.1700   |   1.4320      0.6200
                          0.0080     0.2100   |   2.5570      0.6800
                          0.1380     0.2600   |   6.0200      0.8000
                          0.2260     0.3100   |  11.2480      0.9200
                          0.3260     0.3600   |  14.5800      0.9800
                          0.3660     0.4100   |  18.8320      1.0400
                          0.3740     0.4600   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      2.730      9.08      73.74
   OUTFLOW: ID= 1 (  0004)      7.290      0.323      9.67      69.47

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.83
                    TIME SHIFT OF PEAK FLOW         (min)= 35.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.3586

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=       1.96         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     191.56       134.57
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.38 (ii)    6.50 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.30         0.14
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.83         0.25          0.991 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      82.32        52.04          70.21
     TOTAL RAINFALL   (mm)=      83.32        83.32          83.32
     RUNOFF COEFFICIENT   =       0.99         0.62           0.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0009)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0888      0.0810
                          0.0300     0.0144   |   0.0983      0.0972
                          0.0328     0.0194   |   0.1028      0.1053
                          0.0402     0.0243   |   0.1070      0.1134
                          0.0501     0.0324   |   0.1111      0.1215
                          0.0583     0.0405   |   0.1151      0.1296
                          0.0656     0.0486   |   0.1189      0.1377
                          0.0721     0.0567   |   0.1226      0.1458
                          0.0780     0.0648   |   0.1262      0.1539
                          0.0836     0.0729   |   0.1297      0.1620

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0008)      2.800      0.991      9.08      70.21
   OUTFLOW: ID= 1 (  0009)      2.800      0.108      9.75      70.17

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.87
                   TIME SHIFT OF PEAK FLOW         (min)= 40.00
```

MAXIMUM STORAGE USED (ha.m.)= 0.1149

****
** SIMULATION:Brantford 2-Year **
****

CHICAGO STORM
Ptotal= 53.28 mm

IDF curve parameters: A= 743.000
B= 6.000
C= 0.799

used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.38

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.46	6.00	1.13	12.00	1.71	18.00	0.68
0.08	0.46	6.08	1.16	12.08	1.67	18.08	0.68
0.17	0.47	6.17	1.19	12.17	1.63	18.17	0.67
0.25	0.47	6.25	1.22	12.25	1.59	18.25	0.67
0.33	0.47	6.33	1.25	12.33	1.56	18.33	0.66
0.42	0.48	6.42	1.29	12.42	1.53	18.42	0.66
0.50	0.48	6.50	1.32	12.50	1.50	18.50	0.65
0.58	0.48	6.58	1.36	12.58	1.47	18.58	0.65
0.67	0.49	6.67	1.40	12.67	1.44	18.67	0.64
0.75	0.49	6.75	1.45	12.75	1.41	18.75	0.64
0.83	0.50	6.83	1.49	12.83	1.39	18.83	0.64
0.92	0.50	6.92	1.54	12.92	1.36	18.92	0.63
1.00	0.51	7.00	1.60	13.00	1.34	19.00	0.63
1.08	0.51	7.08	1.66	13.08	1.31	19.08	0.62
1.17	0.51	7.17	1.72	13.17	1.29	19.17	0.62
1.25	0.52	7.25	1.79	13.25	1.27	19.25	0.61
1.33	0.52	7.33	1.87	13.33	1.25	19.33	0.61
1.42	0.53	7.42	1.96	13.42	1.23	19.42	0.61
1.50	0.53	7.50	2.05	13.50	1.21	19.50	0.60
1.58	0.54	7.58	2.16	13.58	1.19	19.58	0.60
1.67	0.54	7.67	2.27	13.67	1.18	19.67	0.59
1.75	0.55	7.75	2.41	13.75	1.16	19.75	0.59
1.83	0.55	7.83	2.56	13.83	1.14	19.83	0.59
1.92	0.56	7.92	2.74	13.92	1.13	19.92	0.58
2.00	0.56	8.00	2.94	14.00	1.11	20.00	0.58
2.08	0.57	8.08	3.18	14.08	1.09	20.08	0.58
2.17	0.57	8.17	3.47	14.17	1.08	20.17	0.57
2.25	0.58	8.25	3.83	14.25	1.07	20.25	0.57
2.33	0.59	8.33	4.27	14.33	1.05	20.33	0.57
2.42	0.59	8.42	4.85	14.42	1.04	20.42	0.56
2.50	0.60	8.50	5.62	14.50	1.03	20.50	0.56
2.58	0.60	8.58	6.73	14.58	1.01	20.58	0.56

2.67	0.61	8.67	8.42	14.67	1.00	20.67	0.55
2.75	0.62	8.75	11.35	14.75	0.99	20.75	0.55
2.83	0.62	8.83	17.60	14.83	0.98	20.83	0.55
2.92	0.63	8.92	38.95	14.92	0.96	20.92	0.54
3.00	0.64	9.00	109.40	15.00	0.95	21.00	0.54
3.08	0.65	9.08	46.39	15.08	0.94	21.08	0.54
3.17	0.65	9.17	25.14	15.17	0.93	21.17	0.53
3.25	0.66	9.25	17.04	15.25	0.92	21.25	0.53
3.33	0.67	9.33	12.87	15.33	0.91	21.33	0.53
3.42	0.68	9.42	10.35	15.42	0.90	21.42	0.53
3.50	0.69	9.50	8.68	15.50	0.89	21.50	0.52
3.58	0.70	9.58	7.48	15.58	0.88	21.58	0.52
3.67	0.70	9.67	6.59	15.67	0.87	21.67	0.52
3.75	0.71	9.75	5.89	15.75	0.87	21.75	0.51
3.83	0.72	9.83	5.34	15.83	0.86	21.83	0.51
3.92	0.73	9.92	4.88	15.92	0.85	21.92	0.51
4.00	0.74	10.00	4.51	16.00	0.84	22.00	0.51
4.08	0.75	10.08	4.19	16.08	0.83	22.08	0.50
4.17	0.76	10.17	3.91	16.17	0.82	22.17	0.50
4.25	0.77	10.25	3.68	16.25	0.82	22.25	0.50
4.33	0.79	10.33	3.47	16.33	0.81	22.33	0.50
4.42	0.80	10.42	3.28	16.42	0.80	22.42	0.49
4.50	0.81	10.50	3.12	16.50	0.79	22.50	0.49
4.58	0.82	10.58	2.97	16.58	0.79	22.58	0.49
4.67	0.84	10.67	2.84	16.67	0.78	22.67	0.49
4.75	0.85	10.75	2.72	16.75	0.77	22.75	0.48
4.83	0.86	10.83	2.61	16.83	0.77	22.83	0.48
4.92	0.88	10.92	2.51	16.92	0.76	22.92	0.48
5.00	0.89	11.00	2.42	17.00	0.75	23.00	0.48
5.08	0.91	11.08	2.34	17.08	0.75	23.08	0.47
5.17	0.92	11.17	2.26	17.17	0.74	23.17	0.47
5.25	0.94	11.25	2.19	17.25	0.73	23.25	0.47
5.33	0.96	11.33	2.12	17.33	0.73	23.33	0.47
5.42	0.98	11.42	2.05	17.42	0.72	23.42	0.47
5.50	1.00	11.50	2.00	17.50	0.72	23.50	0.46
5.58	1.02	11.58	1.94	17.58	0.71	23.58	0.46
5.67	1.04	11.67	1.89	17.67	0.70	23.67	0.46
5.75	1.06	11.75	1.84	17.75	0.70	23.75	0.46
5.83	1.08	11.83	1.79	17.83	0.69	23.83	0.45
5.92	1.11	11.92	1.75	17.92	0.69	23.92	0.45

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      22.80          6.81
```

```
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     444.30        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     109.40        55.94
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       6.03 (ii)   10.42 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.19         0.09
                                                          *TOTALS*
     PEAK FLOW       (cms)=       4.20         0.65          4.474 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.25           9.08
     RUNOFF VOLUME    (mm)=      52.28        27.41          44.57
     TOTAL RAINFALL   (mm)=      53.28        53.28          53.28
     RUNOFF COEFFICIENT   =       0.98         0.51           0.84


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                        0.0060     0.1100   |   0.8710      1.4600
                        0.0240     0.2200   |   0.9210      1.6000
                        0.0340     0.3300   |   1.0140      1.7300
                        0.0410     0.4500   |   1.0990      2.0100
                        0.3560     0.5700   |   1.1390      2.1500
                        0.4670     0.6900   |   1.2160      2.4400
                        0.5560     0.8200   |   3.6500      2.7400
                        0.6320     0.9400   |   9.7760      2.8900
                        0.7120     1.0700   |  20.1160      2.8900
                        0.8180     1.3300   |  35.8440      2.8900

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610      4.474      9.08      44.57
   OUTFLOW: ID= 1 (  0002)     29.610      0.504      9.92      44.04

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.26
                  TIME SHIFT OF PEAK FLOW         (min)= 50.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7444
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--------------------
| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     109.40        58.12
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.96 (ii)    8.14 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.24         0.13
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.26         0.18          1.368 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      52.28        27.75          45.16
     TOTAL RAINFALL   (mm)=      53.28        53.28          53.28
     RUNOFF COEFFICIENT   =       0.98         0.52           0.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.4090      0.5100
                         0.0030     0.0800   |   0.6930      0.5700
                         0.0060     0.1700   |   1.4320      0.6200
                         0.0080     0.2100   |   2.5570      0.6800
                         0.1380     0.2600   |   6.0200      0.8000
                         0.2260     0.3100   |  11.2480      0.9200
                         0.3260     0.3600   |  14.5800      0.9800
                         0.3660     0.4100   |  18.8320      1.0400
                         0.3740     0.4600   |   0.0000      0.0000
```

```
                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      1.368      9.08      45.16
   OUTFLOW: ID= 1 (  0004)      7.290      0.052     10.83      40.82

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.79
                   TIME SHIFT OF PEAK FLOW         (min)=105.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2269

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.96         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     109.40        54.99
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       2.97 (ii)   11.94 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.28         0.09
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.45         0.07          0.477 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.25           9.08
     RUNOFF VOLUME    (mm)=      52.28        27.26          42.27
     TOTAL RAINFALL   (mm)=      53.28        53.28          53.28
     RUNOFF COEFFICIENT   =       0.98         0.51           0.79

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0009)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0888      0.0810
                          0.0300     0.0144   |   0.0983      0.0972
```

0.0328	0.0194	0.1028	0.1053
0.0402	0.0243	0.1070	0.1134
0.0501	0.0324	0.1111	0.1215
0.0583	0.0405	0.1151	0.1296
0.0656	0.0486	0.1189	0.1377
0.0721	0.0567	0.1226	0.1458
0.0780	0.0648	0.1262	0.1539
0.0836	0.0729	0.1297	0.1620

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0008)	2.800	0.477	9.08	42.27
OUTFLOW: ID= 1 (0009)	2.800	0.065	9.67	42.23

PEAK FLOW REDUCTION [Qout/Qin](%)= 13.57
TIME SHIFT OF PEAK FLOW (min)= 35.00
MAXIMUM STORAGE USED (ha.m.)= 0.0477

```
**********************************
** SIMULATION:Brantford 50-Year **
**********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=3886.000
| Ptotal= 92.53 mm |                          B=  16.000
--------------------                          C=   0.950
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 24.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.24	6.00	0.89	12.00	1.69	18.00	0.42
0.08	0.24	6.08	0.92	12.08	1.63	18.08	0.41
0.17	0.24	6.17	0.96	12.17	1.57	18.17	0.41
0.25	0.25	6.25	0.99	12.25	1.51	18.25	0.40
0.33	0.25	6.33	1.04	12.33	1.46	18.33	0.40
0.42	0.25	6.42	1.08	12.42	1.42	18.42	0.40
0.50	0.25	6.50	1.13	12.50	1.37	18.50	0.39
0.58	0.26	6.58	1.18	12.58	1.33	18.58	0.39
0.67	0.26	6.67	1.24	12.67	1.29	18.67	0.38
0.75	0.26	6.75	1.30	12.75	1.25	18.75	0.38
0.83	0.27	6.83	1.37	12.83	1.21	18.83	0.38
0.92	0.27	6.92	1.44	12.92	1.18	18.92	0.37
1.00	0.27	7.00	1.52	13.00	1.15	19.00	0.37
1.08	0.28	7.08	1.61	13.08	1.12	19.08	0.36
1.17	0.28	7.17	1.72	13.17	1.09	19.17	0.36
1.25	0.28	7.25	1.83	13.25	1.06	19.25	0.36

1.33	0.29	7.33	1.96	13.33	1.03	19.33	0.35
1.42	0.29	7.42	2.10	13.42	1.01	19.42	0.35
1.50	0.29	7.50	2.27	13.50	0.98	19.50	0.35
1.58	0.30	7.58	2.46	13.58	0.96	19.58	0.35
1.67	0.30	7.67	2.68	13.67	0.94	19.67	0.34
1.75	0.30	7.75	2.94	13.75	0.92	19.75	0.34
1.83	0.31	7.83	3.25	13.83	0.90	19.83	0.34
1.92	0.31	7.92	3.61	13.92	0.88	19.92	0.33
2.00	0.32	8.00	4.06	14.00	0.86	20.00	0.33
2.08	0.32	8.08	4.61	14.08	0.84	20.08	0.33
2.17	0.33	8.17	5.30	14.17	0.82	20.17	0.32
2.25	0.33	8.25	6.18	14.25	0.81	20.25	0.32
2.33	0.34	8.33	7.35	14.33	0.79	20.33	0.32
2.42	0.34	8.42	8.94	14.42	0.78	20.42	0.32
2.50	0.35	8.50	11.20	14.50	0.76	20.50	0.31
2.58	0.35	8.58	14.58	14.58	0.75	20.58	0.31
2.67	0.36	8.67	20.02	14.67	0.73	20.67	0.31
2.75	0.36	8.75	29.69	14.75	0.72	20.75	0.31
2.83	0.37	8.83	49.86	14.83	0.71	20.83	0.30
2.92	0.37	8.92	105.64	14.92	0.69	20.92	0.30
3.00	0.38	9.00	215.80	15.00	0.68	21.00	0.30
3.08	0.39	9.08	122.98	15.08	0.67	21.08	0.30
3.17	0.39	9.17	72.35	15.17	0.66	21.17	0.29
3.25	0.40	9.25	48.20	15.25	0.65	21.25	0.29
3.33	0.41	9.33	34.72	15.33	0.64	21.33	0.29
3.42	0.41	9.42	26.38	15.42	0.63	21.42	0.29
3.50	0.42	9.50	20.85	15.50	0.62	21.50	0.29
3.58	0.43	9.58	16.97	15.58	0.61	21.58	0.28
3.67	0.44	9.67	14.14	15.67	0.60	21.67	0.28
3.75	0.44	9.75	12.01	15.75	0.59	21.75	0.28
3.83	0.45	9.83	10.36	15.83	0.58	21.83	0.28
3.92	0.46	9.92	9.05	15.92	0.57	21.92	0.27
4.00	0.47	10.00	7.99	16.00	0.56	22.00	0.27
4.08	0.48	10.08	7.13	16.08	0.56	22.08	0.27
4.17	0.49	10.17	6.41	16.17	0.55	22.17	0.27
4.25	0.50	10.25	5.81	16.25	0.54	22.25	0.27
4.33	0.51	10.33	5.29	16.33	0.53	22.33	0.27
4.42	0.52	10.42	4.85	16.42	0.53	22.42	0.26
4.50	0.53	10.50	4.47	16.50	0.52	22.50	0.26
4.58	0.55	10.58	4.14	16.58	0.51	22.58	0.26
4.67	0.56	10.67	3.85	16.67	0.50	22.67	0.26
4.75	0.57	10.75	3.59	16.75	0.50	22.75	0.26
4.83	0.59	10.83	3.36	16.83	0.49	22.83	0.25
4.92	0.60	10.92	3.15	16.92	0.49	22.92	0.25
5.00	0.62	11.00	2.97	17.00	0.48	23.00	0.25
5.08	0.63	11.08	2.80	17.08	0.47	23.08	0.25
5.17	0.65	11.17	2.65	17.17	0.47	23.17	0.25
5.25	0.67	11.25	2.51	17.25	0.46	23.25	0.25
5.33	0.69	11.33	2.39	17.33	0.46	23.33	0.24
5.42	0.71	11.42	2.27	17.42	0.45	23.42	0.24

```
                 5.50    0.73 | 11.50    2.17 | 17.50    0.45 | 23.50    0.24
                 5.58    0.75 | 11.58    2.07 | 17.58    0.44 | 23.58    0.24
                 5.67    0.78 | 11.67    1.98 | 17.67    0.44 | 23.67    0.24
                 5.75    0.80 | 11.75    1.90 | 17.75    0.43 | 23.75    0.24
                 5.83    0.83 | 11.83    1.83 | 17.83    0.43 | 23.83    0.24
                 5.92    0.86 | 11.92    1.75 | 17.92    0.42 | 23.92    0.23


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      22.80         6.81
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     444.30        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     215.80       161.80
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.60 (ii)    7.94 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.23         0.13
                                                            *TOTALS*
     PEAK FLOW       (cms)=       9.73         2.25         11.151 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      91.53        60.33          81.86
     TOTAL RAINFALL   (mm)=      92.53        92.53          92.53
     RUNOFF COEFFICIENT   =       0.99         0.65           0.88

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                           0.0060     0.1100   |   0.8710      1.4600
                           0.0240     0.2200   |   0.9210      1.6000
```

```
                          0.0340     0.3300   |   1.0140      1.7300
                          0.0410     0.4500   |   1.0990      2.0100
                          0.3560     0.5700   |   1.1390      2.1500
                          0.4670     0.6900   |   1.2160      2.4400
                          0.5560     0.8200   |   3.6500      2.7400
                          0.6320     0.9400   |   9.7760      2.8900
                          0.7120     1.0700   |  20.1160      2.8900
                          0.8180     1.3300   |  35.8440      2.8900

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610     11.151      9.08      81.86
   OUTFLOW: ID= 1 (  0002)     29.610      0.986      9.92      81.35

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.84
                   TIME SHIFT OF PEAK FLOW         (min)= 50.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  1.6912

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     215.80       167.31
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.02 (ii)    6.21 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.27         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.77         0.58          3.139 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      91.53        60.85          82.63
     TOTAL RAINFALL   (mm)=      92.53        92.53          92.53
     RUNOFF COEFFICIENT   =       0.99         0.66           0.89

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

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--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4090      0.5100
                          0.0030     0.0800   |   0.6930      0.5700
                          0.0060     0.1700   |   1.4320      0.6200
                          0.0080     0.2100   |   2.5570      0.6800
                          0.1380     0.2600   |   6.0200      0.8000
                          0.2260     0.3100   |  11.2480      0.9200
                          0.3260     0.3600   |  14.5800      0.9800
                          0.3660     0.4100   |  18.8320      1.0400
                          0.3740     0.4600   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      3.139      9.08      82.63
   OUTFLOW: ID= 1 (  0004)      7.290      0.362      9.67      78.38

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.52
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.4050

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.96         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     215.80       159.40
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.26 (ii)    6.20 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.30         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.95         0.30          1.140 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      91.53        60.10          78.96
     TOTAL RAINFALL   (mm)=      92.53        92.53          92.53
     RUNOFF COEFFICIENT   =       0.99         0.65           0.85
```

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0009)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0888      0.0810
                          0.0300     0.0144   |   0.0983      0.0972
                          0.0328     0.0194   |   0.1028      0.1053
                          0.0402     0.0243   |   0.1070      0.1134
                          0.0501     0.0324   |   0.1111      0.1215
                          0.0583     0.0405   |   0.1151      0.1296
                          0.0656     0.0486   |   0.1189      0.1377
                          0.0721     0.0567   |   0.1226      0.1458
                          0.0780     0.0648   |   0.1262      0.1539
                          0.0836     0.0729   |   0.1297      0.1620

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0008)      2.800      1.140      9.08      78.96
   OUTFLOW: ID= 1 (  0009)      2.800      0.117      9.75      78.92

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.30
                   TIME SHIFT OF PEAK FLOW         (min)= 40.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1346

--------------------------------------------------------------------------------
********************************
** SIMULATION:Brantford 5-Year **
********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1593.000
| Ptotal= 63.63 mm |                          B=  11.000
--------------------                          C=   0.879
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 24.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.38

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
```

hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.34	6.00	0.98	12.00	1.61	18.00	0.54
0.08	0.35	6.08	1.01	12.08	1.57	18.08	0.54
0.17	0.35	6.17	1.04	12.17	1.52	18.17	0.53
0.25	0.35	6.25	1.07	12.25	1.48	18.25	0.53
0.33	0.36	6.33	1.11	12.33	1.44	18.33	0.52
0.42	0.36	6.42	1.14	12.42	1.41	18.42	0.52
0.50	0.36	6.50	1.18	12.50	1.37	18.50	0.51
0.58	0.37	6.58	1.22	12.58	1.34	18.58	0.51
0.67	0.37	6.67	1.27	12.67	1.31	18.67	0.51
0.75	0.37	6.75	1.32	12.75	1.28	18.75	0.50
0.83	0.38	6.83	1.37	12.83	1.25	18.83	0.50
0.92	0.38	6.92	1.43	12.92	1.22	18.92	0.49
1.00	0.38	7.00	1.49	13.00	1.20	19.00	0.49
1.08	0.39	7.08	1.56	13.08	1.17	19.08	0.49
1.17	0.39	7.17	1.63	13.17	1.15	19.17	0.48
1.25	0.39	7.25	1.71	13.25	1.13	19.25	0.48
1.33	0.40	7.33	1.80	13.33	1.11	19.33	0.48
1.42	0.40	7.42	1.91	13.42	1.08	19.42	0.47
1.50	0.41	7.50	2.02	13.50	1.06	19.50	0.47
1.58	0.41	7.58	2.15	13.58	1.04	19.58	0.46
1.67	0.42	7.67	2.30	13.67	1.03	19.67	0.46
1.75	0.42	7.75	2.47	13.75	1.01	19.75	0.46
1.83	0.42	7.83	2.66	13.83	0.99	19.83	0.45
1.92	0.43	7.92	2.89	13.92	0.97	19.92	0.45
2.00	0.43	8.00	3.17	14.00	0.96	20.00	0.45
2.08	0.44	8.08	3.50	14.08	0.94	20.08	0.45
2.17	0.44	8.17	3.91	14.17	0.93	20.17	0.44
2.25	0.45	8.25	4.42	14.25	0.91	20.25	0.44
2.33	0.45	8.33	5.08	14.33	0.90	20.33	0.44
2.42	0.46	8.42	5.95	14.42	0.88	20.42	0.43
2.50	0.47	8.50	7.17	14.50	0.87	20.50	0.43
2.58	0.47	8.58	8.96	14.58	0.86	20.58	0.43
2.67	0.48	8.67	11.80	14.67	0.85	20.67	0.42
2.75	0.48	8.75	16.84	14.75	0.83	20.75	0.42
2.83	0.49	8.83	27.59	14.83	0.82	20.83	0.42
2.92	0.50	8.92	60.50	14.92	0.81	20.92	0.42
3.00	0.50	9.00	139.29	15.00	0.80	21.00	0.41
3.08	0.51	9.08	71.27	15.08	0.79	21.08	0.41
3.17	0.52	9.17	40.11	15.17	0.78	21.17	0.41
3.25	0.52	9.25	26.66	15.25	0.77	21.25	0.41
3.33	0.53	9.33	19.47	15.33	0.76	21.33	0.40
3.42	0.54	9.42	15.11	15.42	0.75	21.42	0.40
3.50	0.54	9.50	12.23	15.50	0.74	21.50	0.40
3.58	0.55	9.58	10.21	15.58	0.73	21.58	0.40
3.67	0.56	9.67	8.73	15.67	0.72	21.67	0.39
3.75	0.57	9.75	7.60	15.75	0.71	21.75	0.39
3.83	0.58	9.83	6.72	15.83	0.71	21.83	0.39
3.92	0.59	9.92	6.01	15.92	0.70	21.92	0.39
4.00	0.60	10.00	5.43	16.00	0.69	22.00	0.38

4.08	0.61	10.08	4.95	16.08	0.68	22.08	0.38
4.17	0.62	10.17	4.55	16.17	0.67	22.17	0.38
4.25	0.63	10.25	4.20	16.25	0.67	22.25	0.38
4.33	0.64	10.33	3.90	16.33	0.66	22.33	0.37
4.42	0.65	10.42	3.64	16.42	0.65	22.42	0.37
4.50	0.66	10.50	3.42	16.50	0.64	22.50	0.37
4.58	0.67	10.58	3.22	16.58	0.64	22.58	0.37
4.67	0.68	10.67	3.04	16.67	0.63	22.67	0.37
4.75	0.70	10.75	2.88	16.75	0.62	22.75	0.36
4.83	0.71	10.83	2.73	16.83	0.62	22.83	0.36
4.92	0.73	10.92	2.60	16.92	0.61	22.92	0.36
5.00	0.74	11.00	2.48	17.00	0.61	23.00	0.36
5.08	0.76	11.08	2.38	17.08	0.60	23.08	0.36
5.17	0.77	11.17	2.28	17.17	0.59	23.17	0.35
5.25	0.79	11.25	2.19	17.25	0.59	23.25	0.35
5.33	0.81	11.33	2.10	17.33	0.58	23.33	0.35
5.42	0.82	11.42	2.02	17.42	0.58	23.42	0.35
5.50	0.84	11.50	1.95	17.50	0.57	23.50	0.35
5.58	0.86	11.58	1.89	17.58	0.57	23.58	0.34
5.67	0.89	11.67	1.82	17.67	0.56	23.67	0.34
5.75	0.91	11.75	1.77	17.75	0.56	23.75	0.34
5.83	0.93	11.83	1.71	17.83	0.55	23.83	0.34
5.92	0.96	11.92	1.66	17.92	0.55	23.92	0.34

```
-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0001)|   Area    (ha)=  29.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  77.00   Dir. Conn.(%)=  69.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      22.80         6.81
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     444.30        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     139.29        84.37
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       5.47 (ii)    9.46 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.20         0.12
                                                          *TOTALS*
     PEAK FLOW       (cms)=       5.76         1.07          6.416 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      62.63        35.65          54.26
     TOTAL RAINFALL   (mm)=      63.63        63.63          63.63
     RUNOFF COEFFICIENT   =       0.98         0.56           0.85
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```
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0002)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                        0.0060     0.1100   |   0.8710      1.4600
                        0.0240     0.2200   |   0.9210      1.6000
                        0.0340     0.3300   |   1.0140      1.7300
                        0.0410     0.4500   |   1.0990      2.0100
                        0.3560     0.5700   |   1.1390      2.1500
                        0.4670     0.6900   |   1.2160      2.4400
                        0.5560     0.8200   |   3.6500      2.7400
                        0.6320     0.9400   |   9.7760      2.8900
                        0.7120     1.0700   |  20.1160      2.8900
                        0.8180     1.3300   |  35.8440      2.8900

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0001)     29.610      6.416      9.08      54.26
   OUTFLOW: ID= 1 (  0002)     29.610      0.672      9.83      53.75

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.48
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.0060

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--------------------
| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   7.29
|ID= 1 DT= 5.0 min |   Total Imp(%)=  79.00   Dir. Conn.(%)=  71.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.76         1.53
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     220.45        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     139.29        87.51
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.60 (ii)    7.39 (ii)
```

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     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.13
                                                                  *TOTALS*
     PEAK FLOW       (cms)=       1.69         0.28          1.862 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      62.63        36.04          54.92
     TOTAL RAINFALL   (mm)=      63.63        63.63          63.63
     RUNOFF COEFFICIENT   =       0.98         0.57           0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.4090      0.5100
                          0.0030     0.0800   |   0.6930      0.5700
                          0.0060     0.1700   |   1.4320      0.6200
                          0.0080     0.2100   |   2.5570      0.6800
                          0.1380     0.2600   |   6.0200      0.8000
                          0.2260     0.3100   |  11.2480      0.9200
                          0.3260     0.3600   |  14.5800      0.9800
                          0.3660     0.4100   |  18.8320      1.0400
                          0.3740     0.4600   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0003)      7.290      1.862      9.08      54.92
   OUTFLOW: ID= 1 (  0004)      7.290      0.152      9.83      50.60

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.16
                   TIME SHIFT OF PEAK FLOW         (min)= 45.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2680

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--------------------
| CALIB            |
| STANDHYD (  0008)|   Area    (ha)=   2.80
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.96         0.84
```

```
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.63        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     139.29        83.00
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.70 (ii)    7.38 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.29         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.59         0.15          0.678 (iii)
     TIME TO PEAK    (hrs)=       9.08         9.17           9.08
     RUNOFF VOLUME    (mm)=      62.63        35.47          51.76
     TOTAL RAINFALL   (mm)=      63.63        63.63          63.63
     RUNOFF COEFFICIENT   =       0.98         0.56           0.81

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0009)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0888      0.0810
                          0.0300     0.0144   |   0.0983      0.0972
                          0.0328     0.0194   |   0.1028      0.1053
                          0.0402     0.0243   |   0.1070      0.1134
                          0.0501     0.0324   |   0.1111      0.1215
                          0.0583     0.0405   |   0.1151      0.1296
                          0.0656     0.0486   |   0.1189      0.1377
                          0.0721     0.0567   |   0.1226      0.1458
                          0.0780     0.0648   |   0.1262      0.1539
                          0.0836     0.0729   |   0.1297      0.1620

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0008)      2.800      0.678      9.08      51.76
   OUTFLOW: ID= 1 (  0009)      2.800      0.084      9.67      51.72

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 12.33
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0729
```

Appendix B5: Sanitary Sewer Design Sheet

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SANITARY SEWER DESIGN SHEET

299 Lynden Road

City of Brantford

PROJECT DETAILS

Project No: 19-617
Date: 28-Sep-22
Designed by: Bob Moir
Checked by: Nava Pokharel, P.Eng.

DESIGN CRITERIA

Min Diameter =	250	mm	Avg. Domestic Flow =	245.0	l/c/d
Mannings 'n'=	0.013		Infiltration =	0.300	l/s/ha
Min. Velocity =	1.00	m/s	Max. Peaking Factor =	4.00	
Max. Velocity =	2.50	m/s	Min. Peaking Factor=	2.00	
Factor of Safety =	4	%			

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
Street H	9A	8A	0.58	0.58	7		3.05	22	22							0.2	22	4.00	0.2			0.4	1.00	250	59.5	1.21	0.31	1%
Street H	8A	7A	1.70	2.28	32		3.05	98	120							0.7	120	4.00	1.4			2.0	1.00	250	59.5	1.21	0.55	3%
Street H	7A	6A	0.91	3.19	18		3.05	55	175							1.0	175	4.00	2.0			2.9	0.50	250	42.0	0.86	0.49	7%
Street H	6A	5A	0.84	4.03	12		3.05	37	212							1.2	212	4.00	2.4			3.6	0.50	250	42.0	0.86	0.53	9%
Street A	5A	4A	1.62	5.65	42		2.71	114	326							1.7	326	4.00	3.7			5.4	0.50	250	42.0	0.86	0.59	13%
Street A	10A	4A	1.42	1.42	22		2.64	59	59							0.4	59	4.00	0.7			1.1	1.00	250	59.5	1.21	0.42	2%
Street C	4A	3A	0.31	7.38	9		2.47	23	408							2.2	408	4.00	4.6			6.8	0.50	250	42.0	0.86	0.63	16%
Street F	14A	13A	1.62	1.62	30		3.05	92	92							0.5	92	4.00	1.0			1.5	1.00	250	59.5	1.21	0.47	3%
street E	7A	13A	0.13	2.41					120							0.7	120	4.00	1.4			2.1						
Street F	13A	12A	0.85	4.88	18		3.05	55	267							1.5	267	4.00	3.0			4.5	0.50	250	42.0	0.86	0.57	11%
Street F	12A	11A	0.85	5.73	18		3.05	55	322							1.7	322	4.00	3.7			5.4	0.50	250	42.0	0.86	0.59	13%
Street B	5A	11A	0.17	4.20					212							1.3	212	4.00	2.4			3.7						
Street F	11A	3A	1.43	11.36	42		2.71	114	648							3.4	648	3.91	7.2			10.6	0.50	250	42.0	0.86	0.69	25%
Street C	3A	2A	0.37	19.11	12		2.47	30	1086							5.7	1086	3.78	11.6			17.4	0.50	250	42.0	0.86	0.80	41%
Street M	21A	20A	0.71	0.71	9		3.05	28	28							0.2	28	4.00	0.3			0.5	1.00	250	59.5	1.21	0.31	1%
Street E	13A	20A	0.13	4.16					212							1.2	212	4.00	2.4			3.7						
Street G	20A	19A	0.30	5.17	5		3.05	16	256							1.6	256	4.00	2.9			4.5	1.00	250	59.5	1.21	0.69	7%
Street G	19A	18A	0.36	5.53	7		3.05	22	278							1.7	278	4.00	3.2			4.8	1.00	250	59.5	1.21	0.71	8%
Street G	18A	17A	0.34	5.87	6		3.05	19	297							1.8	297	4.00	3.4			5.1	0.50	250	42.0	0.86	0.57	12%
Street B	11A	17A	0.17	10.10					534							3.0	534	3.96	6.0			9.0		250				
Street G	17A	16A	0.30	16.27	5		3.05	16	847							4.9	847	3.85	9.2			14.1	0.50	250	42.0	0.86	0.75	34%
Street G	16A	15A	0.36	16.63	7		3.05	22	869							5.0	869	3.84	9.5			14.4	0.50	250	42.0	0.86	0.75	34%
Street G	15A	2A	0.23	16.86	4		3.05	13	882							5.1	882	3.83	9.6			14.6	0.50	250	42.0	0.86	0.77	35%
Street C	2A	1A	1.29	37.26	57		2.47	141	2109							11.2	2109	3.57	21.3			32.5	0.50	250	42.0	0.86	0.93	77%
Street L	30A	28A	0.88	0.88	12		3.05	37	37							0.3	37	4.00	0.4			0.7	1.00	250	59.5	1.21	0.31	1%
Street E	29A	28A	0.37	0.37	7		3.05	22	22							0.1	22	4.00	0.2			0.4	1.00	250	59.5	1.21	0.31	1%
Street E	28A	27A	0.81	2.06	18		3.05	55	114							0.6	114	4.00	1.3			1.9	1.00	250	59.5	1.21	0.51	3%
Street I	31A	27A	0.48	0.48	6		3.05	19	19							0.1	19	4.00	0.2			0.4	1.00	250	59.5	1.21	0.31	1%
Street I	27A	26A	0.13	2.67					133							0.8	133	4.00	1.5			2.3	0.50	250	42.0	0.86	0.45	5%
Street I	26A	25A	0.13	2.80					133							0.8	133	4.00	1.5			2.3	0.50	250	42.0	0.86	0.46	6%
Street I	25A	24A	0.14	2.94					133							0.9	133	4.00	1.5			2.4	0.50	250	42.0	0.86	0.46	6%
Street I	24A	23A	0.17	3.11					133							0.9	133	4.00	1.5			2.4	0.50	250	42.0	0.86	0.46	6%
Street I	23A	22A	0.16	3.27					133							1.0	133	4.00	1.5			2.5	0.50	250	42.0	0.86	0.46	6%
Street I	22A	1A	0.11	3.38					133							1.0	133	4.00	1.5			2.5	0.50	250	42.0	0.86	0.46	6%
Street J	32A	26A	1.45	1.45	34		3.05	104	104							0.4	104	4.00	1.2			1.6	1.00	250	59.5	1.21	0.47	3%
Street K	33A	25A	1.45	1.45	34		3.05	104	104							0.4	104	4.00	1.2			1.6	1.00	250	59.5	1.21	0.47	3%
Street B	34A	24A	1.58	1.58	45		2.71	122	122							0.5	122	4.00	1.4			1.9	1.00	250	59.5	1.21	0.51	3%
Street N	35A	23A	1.46	1.46	56		2.47	139	139							0.4	139	4.00	1.6			2.0	1.00	250	59.5	1.21	0.55	3%

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STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
Street O	36A	22A	1.26	1.26	56		2.47	139	139							0.4	139	4.00	1.6			2.0	1.00	250	59.5	1.21	0.55	3%
Street E	38A	37A	0.67	0.67	7		3.05	22	22							0.2	22	4.00	0.2			0.5	1.00	250	59.5	1.21	0.31	1%
Street E	37A	27A	1.58	2.25	28		3.05	86	108							0.7	108	4.00	1.2			1.9	0.50	250	42.0	0.86	0.42	5%
Street J	38A	26A	1.26	1.26	28		3.05	86	86							0.4	86	4.00	1.0			1.4	1.00	250	59.5	1.21	0.47	2%
Street E	38A	39A	0.32	0.32	5		3.05	16	16							0.1	16	4.00	0.2			0.3	1.00	250	59.5	1.21	0.31	0%
Street K	42A	40A	0.74	0.74	9		3.05	28	28							0.2	28	4.00	0.3			0.5	1.00	250	59.5	1.21	0.31	1%
Street K	40A	39A	1.08	1.82	18		3.05	55	83							0.5	83	4.00	0.9			1.5	1.00	250	59.5	1.21	0.47	3%
Street K	39A	25A	1.25	3.39	28		3.05	86	185							1.0	185	4.00	2.1			3.1	0.50	250	42.0	0.86	0.49	7%
Street B	42A	41A	1.05	1.05	20		3.05	61	61							0.3	61	4.00	0.7			1.0	1.00	250	59.5	1.21	0.38	2%
Street B	41A	24A	1.33	2.38	37		2.70	100	161							0.7	161	4.00	1.8			2.5	1.00	250	59.5	1.21	0.59	4%
Street N	45A	44A	0.52	0.52	7		3.05	22	22							0.2	22	4.00	0.2			0.4	0.50	250	42.0	0.86	0.22	1%
Street N	44A	43A	0.60	1.12	10		3.05	31	53							0.3	53	4.00	0.6			0.9	1.00	250	59.5	1.21	0.38	2%
Street N	43A	23A	1.22	2.34	46		2.47	114	167							0.7	167	4.00	1.9			2.6	0.50	250	42.0	0.86	0.46	6%
Street O	47A	46A	0.49	0.49	8		3.05	25	25							0.1	25	4.00	0.3			0.4	0.50	250	42.0	0.86	0.22	1%
Street O	PARK	46A	2.38	2.38		90		215	215							0.7	215	4.00	2.4			3.2						
Street O	46A	22A	1.20	4.07	46		2.47	114	354							1.2	354	4.00	4.0			5.2	1.00	250	59.5	1.21	0.75	9%
Street D	COMM	1A	3.58	3.58		90		323	323							1.1	323	4.00	3.7			4.7						
Street D	1A	2B	0.88	45.10	19		2.47	47	2612							13.5	2612	3.49	25.9			39.4	0.50	250	42.0	0.86	0.97	94%
Employment Lands	4B	3B	68.08	68.08				7466	7466							20.4	7466	3.08	65.2			85.6	0.30	375	96.0	0.87	0.97	89%
	3B	2B		68.08					7466							20.4	7466	3.08	65.2			85.6	0.30	375	96.0	0.87	0.97	89%
	2B	1B		113.18					10078							34.0	10078	2.95	84.3			118.3	0.30	450	156.2	0.98	1.07	76%
	1B	SPS		113.18					10078							34.0	10078	2.95	84.3			118.3	0.30	450	156.2	0.98	1.07	76%
	SPS	5B		113.18					10078							34.0	10078	2.95	84.3			118.3		525				

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