

**FUNCTIONAL SERVICING & PRELIMINARY
STORMWATER MANAGEMENT REPORT**

CASCADES OF NIAGARA

**CITY OF NIAGARA FALLS
NIAGARA REGION**

**PREPARED FOR:
NIAGARA PROPERTY CORP.**

**PREPARED BY:
C.F. CROZIER & ASSOCIATES INC.
2800 HIGH POINT DRIVE, SUITE 100
MILTON, ON L9T 6P4**

DECEMBER 2023

CFCA FILE NO. 1688-5603

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| Revision Number | Date | Comments |
|------------------------|---------------|----------------------------------|
| Rev.0 | April 2021 | Issued for First Submission ZBA |
| Rev.1 | December 2023 | Issued for Second Submission ZBA |

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1.0 Introduction

C.F. Crozier & Associates Inc. (Crozier) was retained by Niagara Property Corp. (Owner) to prepare a Functional Servicing and Preliminary Stormwater Management Report in support of the Zoning By-Law Amendment (ZBA) application for the property located at Part 29, Registered Plan 59R-14189, Part of Lots 163 & 170 (the Site), in the City of Niagara Falls.

This report will demonstrate that the proposed development can be developed in accordance with the City of Niagara Falls and Niagara Region guidelines from a functional servicing and preliminary stormwater management perspective.

The reports and design standards referenced during the preparation of this report include:

- Engineering Design Guidelines Manual – City of Niagara Falls (January 2012)
- Fire Underwriters Survey – Water Supply for Public Fire Protection (1999)
- Water-Wastewater Project Design Manual – Niagara Region (August 2019)
- Water and Wastewater Master Servicing Plan Update – Niagara Region (June 2017)
- Stormwater Management Planning and Design Manual – Ministry of Environment (March 2003)

2.0 General Site Description

The Site covers an area of approximately 1.82 ha and currently consists of a vacant grassed lot with rock and soil stockpiles. An additional 0.08 ha is proposed to be conveyed from the adjacent property. Therefore, the total area to be subdivided is 1.90 ha. The property, situated in a primarily commercial area, is bounded by Montrose Road to the east, an existing commercial development to the south, vacant land to the north, and Charnwood Park to the west.

The elements envisioned for this development include:

- 14 separate townhouse blocks with a total of 83 units
- Two site accesses from Montrose Road
- Two 7.5 m wide right-of-ways (Street A and Street B)
- A 4.5 m wide servicing easement south of Block 13 and an 8.0 m wide servicing easement between Block 8 and 9
- Surface parking for visitors

The pertinent background information for the Site have been reviewed, including:

- Draft Plan of Condominium by Mainline Planning Services Inc. (November 2023)
- Concept Site Plan by ACK Architect dated April 2021
- Topographic Survey by J.D. Barnes Ltd. (July 7, 2020)

3.0 Water Servicing

3.1 Existing Water Servicing

Through coordination with the Region, we understand that the Montrose Road reconstruction and widening was completed. As the construction was recently completed, no as-constructed drawings have been prepared; therefore, the design drawings were reviewed for the location of available services. Based on the review of the design drawings Dwg. No. RR98-PP-04 dated and RR98-PP-05 dated June 7, 2019, it indicated that:

- There is a 200 mm diameter PVC watermain along the east boulevard of the Montrose Road.
- There is a 150 mm diameter PVC water service stub available for the Site. The installation of the service stub was confirmed through correspondence with the Region.
- There are two fire hydrants located along the east boulevard of the Montrose Road, just east of the Site. One located near the northeast corner of the Site and the other located near the southeast corner of the Site.

3.2 Design Water Demand

The Niagara Region 2016 Master Servicing Plan (MSP) Update, Volume III was used to estimate the domestic water demand generated for the proposed development. The MSP indicates in the design criteria a value for residential average daily water demand of 300 L/capita/day.

The population equivalent is calculated based on Region of Niagara Development Charge Background Study (April 28, 2017), Schedule 3, which indicates that an average 2.12 persons per unit is assumed for townhomes.

Table 1 summarizes the domestic water demands and detailed calculations are provided in Appendix A.

Table 1: Estimated Design Water Demand

| Standard | Average Daily Demand (L/s) | Maximum Day Demand (L/s) | Peak Hour Demand (L/s) |
|--|----------------------------|--------------------------|------------------------|
| Niagara Region 2016 Master Servicing Plan Update, Volume III (June 2017) | 0.6 | 1.3 | 2.4 |

Using design criteria from the Niagara Region 2016 MSP Update, Volume III, for domestic water demand, the estimated average daily demand is 0.6 L/s and peak hour demand is 2.4 L/s.

3.3 Fire Flow Demand

Referencing City of Niagara Falls Engineering Design Guidelines Manual, the Fire Underwriters Survey method was used to estimate the fire flow requirements for the proposed development.

This calculation is based on an assumed building type of ordinary material with adequately protected vertical openings, this will be confirmed by Architect in the detailed design. A gross floor area from Block 11 is used in the fire flow calculation, as outlined in the Concept Site Plan by ACK Architect dated April 2021. To be conservative, the fire demand calculation is based on Block 11 (8 units), as it is the largest footprint proposed and has exposure to the buildings to the north, south, east, and west.

Table 2 summarizes the estimated fire flow demand and duration necessary to meet fire protection for the proposed development.

Table 2: Estimated Fire Demand Flows

| Method | Demand (L/s) | Duration (hr) |
|--------------------------|-------------------------|--------------------------|
| Fire Underwriters Survey | 133 | 2.0 |

The proposed water service is required to accommodate a fire flow of 133 L/s for a duration of 2.0 hours. Appendix A contains the Fire Underwriters Survey Calculations.

Please note that the Fire Underwriters Survey calculated value for the estimated fire flow is a conservative estimate.

3.4 Proposed Water Servicing

The proposed development will be connected to the existing 150 mm diameter water service stub provided during the Montrose Road reconstruction. An internal watermain network of 150 mm diameter PVC watermain will be designed to service the development. The 150 mm diameter watermain will provide domestic water supply and fire flow supply. Each individual unit will have its own 20 mm diameter soft copper water service (to be designed at detailed design).

Two internal fire hydrants are proposed to satisfy the requirement per Ontario Building Code 3.2.5.8. Please refer to Dwg C 702 for preliminary water servicing layout. The details of the proposed fire hydrants and appurtenances will be provided in the detailed design Stage. If requested by the Region, a hydrant flow test will be conducted to confirm the water flow and pressure available in the existing municipal watermain to service this development.

4.0 Sanitary Servicing

4.1 Existing Sanitary Servicing

Through coordination with the Region, we understand that the Montrose Road reconstruction and widening was completed. As the construction was recently completed, no as-constructed drawings have been prepared; therefore, the design drawings were reviewed for the location of available services. Based on the review of the design drawings Dwg. No. RR98-PP-04 dated and RR98-PP-05 dated June 7, 2019, it indicated that:

- There is a 250 mm diameter PVC sanitary sewer within the Montrose Road R.O.W., flowing south to north.
- There is a 200 mm diameter PVC sanitary service stub available for the Site, connecting to SAN MH A.

4.2 Design Sanitary Flow

The Niagara Region 2016 Master Servicing Plan (MSP) Update, Volume IV was referenced to calculate the sanitary sewage design flows for the proposed development. The MSP indicates in the design criteria a value for residential average daily sanitary flow of 275 L/capita/day, peaking factor based on the Harmon formula and an infiltration allowance of 0.286 L/s/ha.

The population equivalent is calculated based on Region of Niagara Development Charge Background Study (April 28, 2017), Schedule 3, which indicates that an average 2.12 persons per unit is assumed for townhomes.

Table 3 summarizes the sanitary design flows and detailed design calculations are provided in Appendix B.

Table 3: Estimated Sanitary Design Flows

| Standard | Average Daily Flows (L/s) | Harmon Peaking Factor | Peak Flows (L/s) | Infiltration Flow (L/s) | Total Design Flow (L/s) |
|---|---------------------------|-----------------------|------------------|-------------------------|-------------------------|
| Niagara Region 2016 Master Servicing Plan Update, Volume IV (June 2017) | 0.6 | 4.0 | 2.2 | 0.5 | 2.8 |

Using design criteria from the Niagara Region 2016 MSP Update Volume IV, the estimated total sanitary design flow is 2.8 L/s.

4.3 Proposed Servicing

The proposed development will be connected to the 200 mm diameter PVC sanitary stub provided during the Montrose Road reconstruction. An internal sanitary sewer network of 200 mm diameter sewers will be designed to collect sanitary flow from the townhouse blocks. Each individual unit will be serviced by a 100 mm diameter PVC sanitary service. The Site Servicing Plan (Drawing C701) illustrates the location of the sanitary sewer. Individual service connections to each unit will be provided at detailed design.

5.0 Drainage Conditions

The drainage conditions for the Site in both the existing and proposed conditions have been outlined separately below.

5.1 Existing Drainage

The Site consists of a vacant grassed lot with rock and soil stockpiles. Based on the review of the design drawings Dwg. No. RR98-PP-04 dated and RR98-PP-05 dated June 7, 2019, it indicated that:

- There is an 825 mm diameter concrete storm sewer with the Montrose R.O.W., flowing from north to south.
- There is a 600 mm diameter concrete storm service stub available for the Site, connecting to CBMH3 within the Montrose Road R.O.W.

The topographic survey prepared by J.D. Barnes Ltd. dated July 7, 2020, was used to determine the pre-development conditions. The topographic survey indicates several irregularities in the topo due to stockpiles on-site, however generally the Site drains from the north to south. The stormwater runoff from the Site has been split into three (3) catchments, to better delineate which flows will be uncontrolled in the post-development condition:

- Catchment 101 (A = 1.66 ha, RC = 0.20) consists of drainage that will be controlled in the post-development condition. Under existing conditions, the catchment generally drains north to southeast, eventually into the Montrose Road R.O.W.
- Catchment UC01 (A = 0.12 ha, RC = 0.20) consists of four (4) areas that will drain uncontrolled directly into the Montrose Road R.O.W in the post-development condition. Under existing conditions, the catchment generally drains from northwest to southeast, eventually into the Montrose Road R.O.W.
- Catchment UC02 (A = 0.12 ha, RC = 0.20) consists of two (2) areas that will drain uncontrolled into the City owned land external of the Site, in the post-development condition. Under existing conditions, the catchment generally drains north to south towards the Plaza Road. The Plaza Road drains from west to east and eventually into Montrose Road R.O.W.

The existing drainage conditions are illustrated on Figure 1 – Pre-Development Drainage Plan.

5.2 Proposed Drainage

Based on the proposed draft plan of condominium prepared by Mainline Planning Services Inc., the proposed development consists of 14 townhouse blocks (83 units total), two site access from Montrose Road with internal roads, servicing easements, and surface parking.

Upon the development, minor system will be conveyed via swales, catchbasins, and internal storm sewers. The flow will be controlled with a 100 mm diameter orifice tube and storage tank upstream of the proposed storm maintenance manhole 10, attenuating peak flows to equal or less than the pre-development flows. An additional 100 mm diameter orifice tube will be installed upstream of control manhole 12 as well. Based on the grading plan, the proposed development has been divided into seven (7) post-development drainage catchment areas as shown in Figure 2.

Outlet to Montrose Road R.O.W.

- Catchment 201 (A = 1.66 ha, RC = 0.76) consists of drainage from 14 townhouse blocks, two site access from Montrose Road with the internal roads, concrete sidewalks, and driveway surface parking. The stormwater will be collected by catchbasins along the internal roads, and then conveyed to an underground storage tank before discharging to the storm sewer on Montrose Road. The proposed emergency overland flow for the property is towards Montrose Road.
- Catchment UC01A (A = 0.02 ha, RC = 0.41) consists of uncontrolled drainage from the southeast corner of the property, discharging east into the Montrose Road R.O.W.
- Catchment UC01B (A = 0.008 ha, RC = 0.20) consists of uncontrolled drainage between Units 71 and 72 along the east property line, discharging east into the Montrose Road R.O.W.

- Catchment UC01C (A = 0.014 ha, RC = 0.20) consists of uncontrolled drainage between Units 49 and 50 along the east property line, discharging east into the Montrose Road R.O.W.
- Catchment UC01D (A = 0.08 ha, RC = 0.28) consists of uncontrolled drainage from the rear yards at the northeastern portion of the property. The catchment drains east via a swale and 3:1 grading into the Montrose Road R.O.W.

Outlet to City owned land

- Catchment UC02A (A = 0.04, RC = 0.20) consists of uncontrolled drainage from rear yards at the northwest portion of the property. The catchment drains south via a swale and eventually into the City owned land external of the proposed development.
- Catchment UC02B (A = 0.08, RC = 0.23) consists of uncontrolled drainage from rear yards at the southwest portion of the property. The catchment drains south via a swale and conveying the flow into City owned land, external of the proposed development.

Refer to the Site Grading Plan (Drawing) C702 and Post-Development Drainage Plan (Figure 2) for the proposed grading and drainage patterns.

6.0 Stormwater Management

Management of stormwater and drainage for the proposed development must adhere to the policies and standards of the Ministry of Environment, Conservation, and Parks (MECP). The stormwater management (SWM) criteria for the development have been summarized below:

- Quantity Control: The MECP standards indicate that post-development peak flows from the proposed development must be attenuated to pre-development conditions for the 2-year to 100-year storm events.
- Quality Control: The MECP enhanced level of protection indicates that 80% of the total suspended solids must be removed on average long-term.

The detailed design of erosion and sediment control is provided in drawing C703. Refer to section 7.0 of this report for plan details.

6.1 Stormwater Quantity Control

As outlined in Section 6.0, the proposed development is required to control the post-development peak flows to the pre-development peak flows for the 2-year to 100-year storm events. Due to the limited information on the existing capacity for the municipal infrastructure (the existing 825 mm diameter storm sewer) along Montrose Road, the preliminary design in the submission is based on 100-year post-development to the 2-year pre-development peak flows. During detailed design, the existing capacity of the 825 mm diameter storm sewer will be reviewed, and the storm strategy will follow post-development peak flows to the pre-development peak flow for 2-year to 100-year storm events.

Using the City of Niagara Fall intensity-duration-frequency (IDF) data, the Rational Method was used to determine the 2-year to 100-year pre-development peak flows, post-development uncontrolled peak flows, and post-development controlled peak flows. The Modified Rational Method was then used to determine the level of required stormwater quantity control required for the proposed development.

The pre-development peak flow rates generated by the existing catchments are presented in Table 4. Supporting calculations are provided in Appendix C.

Table 4: Pre-Development Peak Flows (L/s)

| Return Period | To Montrose Road | | To Plaza Road | Total |
|---------------|------------------|------|---------------|---------------------|
| | 101 | UC01 | UC02 | Q _{Target} |
| 2-Year | 61.4 | 4.3 | 4.6 | 70.3 |
| 5-Year | 78.2 | 5.5 | 5.9 | 89.6 |
| 10-Year | 99.4 | 7.0 | 7.5 | 113.9 |
| 25-Year | 103.2 | 7.3 | 7.7 | 118.2 |
| 100-Year | 124.5 | 8.8 | 9.4 | 142.7 |

Note: Plaza Road runoff eventually drains to Montrose Road R.O.W.

As presented in Table 4, the constraining peak flow is the 2-year pre-development peak flow at a rate of 70.3 L/s. This peak flow has been taken as the target rate for stormwater quantity control for drainage to the Montrose Road storm sewer network.

The Rational Method has also been used to determine the post-development peak flow rates generated by the proposed catchments in an uncontrolled condition. Results are presented in Table 5. Supporting calculations are provided in Appendix C.

Table 5: Post-Development Peak Flows – Uncontrolled (L/s)

| Return Period | To Montrose Road | | | | | To Plaza Road | | Total |
|---------------|------------------|-------|-------|-------|-------|---------------|-------|--------------------------------|
| | 201 | UC01A | UC01B | UC01C | UC01D | UC02A | UC02B | Q _{Post Uncontrolled} |
| 2-Year | 234.2 | 1.4 | 0.3 | 0.5 | 4.0 | 1.6 | 3.6 | 245.5 |
| 5-Year | 298.4 | 1.7 | 0.4 | 0.6 | 5.1 | 2.0 | 4.5 | 312.9 |
| 10-Year | 379.2 | 2.2 | 0.5 | 0.8 | 6.5 | 2.6 | 5.8 | 397.6 |
| 25-Year | 393.7 | 2.3 | 0.5 | 0.9 | 6.8 | 2.7 | 6.0 | 412.7 |
| 100-Year | 475.2 | 2.8 | 0.6 | 1.0 | 8.2 | 3.2 | 7.2 | 498.2 |

Note: Plaza Road runoff eventually drains to Montrose Road R.O.W.

As presented in Table 5, the post-development peak flows generated by the development conveyed to Montrose Road storm sewer network exceed the target rate. Therefore, stormwater quantity controls are required for the proposed development.

The Modified Rational Method was used to determine the required level of stormwater quantity control for the post-development catchments draining to the Montrose Road storm sewer network. Stormwater runoff from Catchments UC01A, UC01B, UC01C, UC01D, UC02A, and UC02B will drain uncontrolled, maintaining the drainage patterns of UC01 and UC02 under the pre-development conditions. As outlined in Section 5.2, stormwater runoff from Catchment 201 will be captured and controlled within an underground storage tank prior to discharging to the Montrose Road storm sewer. A summary of the controlled flow from the proposed development, as well as the required stormwater quantity control volume, is presented in Table 6. Supporting calculations are provided in Appendix C.

Table 6: Post-Development Peak Flows – Controlled (L/s)

| Return Period | To Montrose Road | | | | To Plaza Road | | Total | |
|---------------|------------------|-------|-------|-------|---------------|-------|-------|------------------------------|
| | 201 | UC01A | UC01B | UC01C | UC01D | UC02A | UC02B | Q _{Post Controlled} |
| 2-Year | 42.0 | 1.4 | 0.3 | 0.5 | 4.0 | 1.6 | 3.6 | 53.3 |
| 5-Year | | 1.7 | 0.4 | 0.6 | 5.1 | 2.0 | 4.5 | 56.5 |
| 10-Year | | 2.2 | 0.5 | 0.8 | 6.5 | 2.6 | 5.8 | 60.4 |
| 25-Year | | 2.3 | 0.5 | 0.9 | 6.8 | 2.7 | 6.0 | 61.1 |
| 100-Year | | 2.8 | 0.6 | 1.0 | 8.2 | 3.2 | 7.2 | 65.0 |

Note: Plaza Road runoff eventually drains to Montrose Road R.O.W.

As shown in Table 6, Catchment 201 will be controlled to a flow rate of 42.0 L/s with a 100 mm diameter orifice tube. Based on the 100-year controlled flow of 65.0 L/s, a total storage volume of 368 m³ will be required. See Table 7 for a summary of the storage required and peak flows.

Table 7: Summary of Peak Flows and Required Storage

| Return Period | Q _{target} (L/s) | Q _{Post Uncontrolled} (L/s) | Q _{Post Controlled} (L/s) | Required Storage (m ³) | Provided Storage (m ³) |
|---------------|---------------------------|--------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| 2-Year | 70.3 | 245.5 | 53.3 | 368 | 415 |
| 5-Year | 89.6 | 312.9 | 56.5 | | |
| 10-Year | 113.9 | 397.6 | 60.4 | | |
| 25-Year | 118.2 | 412.7 | 61.1 | | |
| 100-Year | 142.7 | 498.2 | 65.0 | | |

6.2 Stormwater Quality Control

Stormwater quality controls for the proposed development must incorporate measures to provide an Enhanced Level of Protection (Level) 1 according to the MECP (March 2003) guidelines. Enhanced water quality protection requires at least 80% TSS removal from 90% of the annual runoff volume.

Water quality control for catchment 201 will be provided using an oil-grit-separator (Stormceptor EFO6). The oil-grit-separator located downstream of the underground stormwater storage unit will provide quality control for runoff before leaving the proposed development. During the detailed design, further sustainable stormwater features can be explored to improve the quality control on-site. Some of these features include permeable pavers, increased depth of topsoil, and lot level LID features.

Catchments UC01A, UC01B, UC01C, and UC01D discharge uncontrolled towards the Montrose Road R.O.W., following existing condition patterns. Catchments UC02A and UC02B discharge uncontrolled towards the Plaza Road, also following existing condition patterns. Since these uncontrolled catchments are predominantly pervious, landscaped areas, runoff is assumed to be clean and therefore water quality control is not proposed for these catchments.

7.0 Erosion and Sediment Controls During Construction

A design of erosion and sediment control will take place at Site Plan Application stage and it will be installed prior to the beginning of any construction activities. They will be maintained until the Site is stabilized or as directed by the Site Engineer and/or City of Niagara Falls. Controls will be inspected after each significant rainfall event and maintained in proper working condition.

Silt Fencing

Silt fencing will be installed on the perimeter of the Site to intercept sheet flow. Additional silt fencing may be added based on field decisions by the Site Engineer and Owner, prior to, during, and following construction.

Rock Mud Mat

A rock mud mat will be installed at the entrance to the construction zone to prevent mud tracking from the Site onto the surrounding lands and perimeter roadway network. All construction traffic will be restricted to this access only.

Siltsacks in Catchbasins

Siltsacks will be installed in the existing catchbasins along Montrose Road affected by the construction activities. The siltsacks will provide sediment control to prevent silt and sediment from entering the storm water system.

8.0 Conclusion and Recommendations

The proposed development of the Site includes the construction of 14 townhouse blocks (83 units total), two site access from Montrose Road with internal roads, servicing easements, and surface parking. Based on the information provided in this report, the proposed development can be serviced from a functional servicing and preliminary stormwater management perspective.

Our conclusions for the proposed development include:

- The domestic peak hour water demand for the proposed development is 2.4 L/s. The design fire flow is 133 L/s for 2.0 hours per the Fire Underwriters Survey.
- The proposed development will be serviced with a 150 mm diameter PVC watermain, connecting to the existing 150 mm diameter watermain stub from provided from Montrose Road during road reconstruction. Two private hydrants are proposed to provide fire protection for the development.
- Sanitary service for the proposed development will be provided using a 200 mm diameter PVC sanitary sewer network. The internal sanitary sewer network will outlet to Montrose Road via the 200 mm diameter PVC sanitary stub provided during Montrose Road reconstruction.
- Stormwater runoff from catchment 201 will store within an underground stormwater cistern. It will be controlled with 100 mm diameter orifice tubes, and then discharge into the municipal storm sewer system along Montrose Road. Stormwater runoff from UC01A, UC01B, UC01C, and UC01D will flow uncontrolled to Montrose Road and stormwater runoff from UC02A and UC02B will flow uncontrolled towards the Plaza Road, draining east eventually to Montrose Road.

- Due to limited information on the existing 825 mm diameter storm sewer capacity, to be conservative, the water quantity control is being achieved by attenuating the 100-year post-development peak flows to the 2-year pre-development flow in this submission. During detailed design, the existing capacity of the 825 mm diameter storm sewer will be reviewed, and the storm strategy will follow post-development peak flows to the pre-development peak flow for 2-year to 100-year storm events.
- Erosion Sediment Controls will be implemented on-site during construction and will be maintained until the Site is stabilized.
- Water quality requirements for catchment 201 will be provided through an oil-grit-separator (Stormceptor EFO6). No water quality treatment is required for catchments UC01A, UC01B, UC01C, UC01D, UC02A, and UC02B as they are predominantly landscaped.

Based on the above conclusions, we recommend the approval of Official Plan Amendment and Zoning Bylaw Amendment for the proposed residential development from the perspective of functional servicing and preliminary stormwater management.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.



Shiyang (Heaven) Lin, P.Eng.
Project Engineer

HL:JL/stm

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C.F. CROZIER & ASSOCIATES INC.



Nick Constantin, P.Eng.
Senior Project Manager



APPENDIX A

Water Demand Calculations



Project: 1688-5603
Project No.: Cascades of Niagara Falls
Created: 2020-11-18

Design: JL/HL
Check: NC
Revised: 2023-12-06

Proposed Population Estimate

Site Area 1.90 ha

| Proposed Dwelling | # of Units |
|--------------------------|-------------------|
| 14 Townhouse Blocks | 83 |
| TOTAL | 83 |

Refer to Concept Site Plan provided by ACK Architect, dated April 2021 and Draft Plan of Subdivision provided by Mainline Planning Services Inc. dated November 2023

Proposed Population:

| | | |
|--------------------------|------------|--------------|
| Equivalent - Residential | 2.12 | persons/unit |
| Residential Population: | 176 | persons |

PPU per Schedule 4 (Multiples) Region of Niagara Development Charge Background Study April 28, 2017



Project: 1688-5603
Project No.: Cascades of Niagara Falls
Created: 2020-11-18

Design: DD/HL
Check: NC
Revised: 2021-04-12

Proposed Water Demand

Population Estimate:

Residential: 176 persons

Design Criteria:

Average Consumption Rate: 300 Lpcd
 Maximum Daily Demand Peaking Factor: 2.2
 Maximum Hourly Demand Peaking Factor: 4.0

Niagara Region 2016 Master Servicing Plan Volume III
 Max Daily is 5 Year Peak Table 3.A.4
 Max Hourly for Residential (Section 2.4 Design Criteria)

Residential Demand:

Average Daily Demand: 52,788.0 L/day
 0.6 L/s

Maximum Daily Demand: 113,494.2 L/day
 1.3 L/s

Maximum Hourly Demand: 211,152.0 L/day
 2.4 L/s

APPENDIX B

Sanitary Flow Calculations

Propose Sanitary Flow

Infiltration Area:

1.90 ha

Population Estimate:

Residential: 176 persons

Design Criteria:

Unit Sewage Flow: 275 Lpcd
 Infiltration: 0.286 L/s/ha
 Harmon Peaking Factor: 4.0

Source: Niagara Region 2016 Master Servicing Plan Update, Volume IV

Modified Harmon Formula

$$M = 1 + \frac{14}{4 + \sqrt{Pe}}$$

Residential Sanitary Flow:

Average Dry Weather Flow: 48.4 m³/day
 0.6 L/s

Average Dry Weather Sanitary Flow: 0.6 L/s

Peaking Factor: 4.0

Peak Sanitary Flow: 2.2 L/s

Inflow/Infiltration Allowance: 0.5 L/s

Design Sanitary Flow: 2.8 L/s

APPENDIX C

Stormwater Management Calculations



Project: Cascades of Niagara Falls
 Project No.: 1688-5603
 Created By: JL
 Checked By: HL
 Date: 2023-11-24
 Updated: 2023-12-06

Modified Rational Calculations - Input Parameters

Storm Data: Niagara Falls (NPCA SWM Guidelines, March 17, 2010)

Time of Concentration: $T_c = 10$ min

| Return Period | A | B | C | I (mm/hr) |
|---------------|---------|-------|--------|-----------|
| 2 yr | 521.97 | 5.28 | 0.7588 | 65.94 |
| 5 yr | 719.50 | 6.34 | 0.7687 | 84.02 |
| 10 yr | 577.93 | 2.483 | 0.669 | 106.77 |
| 25 yr | 1020.69 | 7.29 | 0.779 | 110.83 |
| 100 yr | 1264.57 | 7.72 | 0.7814 | 133.78 |

| Pre - Development Conditions | | | |
|------------------------------|-------------|------------------------|-------------|
| CATCHMENT | Area (ha) | Area (m ²) | C |
| 101 | 1.66 | 16625 | 0.20 |
| UC01 | 0.12 | 1171 | 0.20 |
| UC02 | 0.12 | 1249 | 0.20 |
| Total Site Area | 1.90 | 19044 | 0.20 |

| Post - Development Conditions | | | |
|------------------------------------|-------------|------------------------|-------------|
| CATCHMENT | Area (ha) | Area (m ²) | C |
| 201 | 1.66 | 16625 | 0.76 |
| UC01A | 0.02 | 180 | 0.41 |
| UC01B | 0.008 | 79 | 0.20 |
| UC01C | 0.01 | 138 | 0.20 |
| UC01D | 0.08 | 774 | 0.28 |
| Site Draining to Montrose | 1.78 | 17795 | 0.73 |
| UC02A | 0.04 | 428 | 0.20 |
| UC02B | 0.08 | 821 | 0.23 |
| Site Draining to Plaza Road | 0.12 | 1249 | 0.22 |
| Total Site Area | 1.90 | 19044 | 0.70 |

Equations:

$$Q_{\text{post}} = 0.0028 \cdot C_{\text{post}} \cdot i(T_d) \cdot A$$

Peak Flow

$$I = \frac{A}{(t_c + B)^C}$$

Intensity (mm/hr)



Project: Cascades of Niagara Falls
 Project No.: 1688-5603
 Created By: JL
 Checked By: HL
 Date: 2023-11-24
 Updated: 2023.12.06

Peak Flows Summary

Pre - Development Peak Flows (L/s)

| Return Period | To Montrose Road | | To Plaza Road | Total |
|---------------|------------------|------|---------------|---------------------|
| | 101 | UC01 | UC02 | Q _{Target} |
| 2-Year | 61.4 | 4.3 | 4.6 | 70.3 |
| 5-Year | 78.2 | 5.5 | 5.9 | 89.6 |
| 10-Year | 99.4 | 7.0 | 7.5 | 113.9 |
| 25-Year | 103.2 | 7.3 | 7.7 | 118.2 |
| 100-Year | 124.5 | 8.8 | 9.4 | 142.7 |

Peak Flow (m³/s)
 $Q = 0.0028 \cdot C \cdot i(T_d) \cdot A$

Post - Development Peak Flows - Uncontrolled (L/s)

| Return Period | To Montrose Road | | | | | To Plaza Road | | Total |
|---------------|------------------|-------|-------|-------|-------|---------------|-------|--------------------------------|
| | 201 | UC01A | UC01B | UC01C | UC01D | UC02A | UC02B | Q _{Post Uncontrolled} |
| 2-Year | 234.2 | 1.4 | 0.3 | 0.5 | 4.0 | 1.6 | 3.6 | 245.5 |
| 5-Year | 298.4 | 1.7 | 0.4 | 0.6 | 5.1 | 2.0 | 4.5 | 312.9 |
| 10-Year | 379.2 | 2.2 | 0.5 | 0.8 | 6.5 | 2.6 | 5.8 | 397.6 |
| 25-Year | 393.7 | 2.3 | 0.5 | 0.9 | 6.8 | 2.7 | 6.0 | 412.7 |
| 100-Year | 475.2 | 2.8 | 0.6 | 1.0 | 8.2 | 3.2 | 7.2 | 498.2 |

Post - Development Peak Flows - Controlled (L/s)

| Return Period | To Montrose Road | | | | | To Plaza Road | | Total |
|---------------|------------------|-------|-------|-------|-------|---------------|-------|------------------------------|
| | 201 | UC01A | UC01B | UC01C | UC01D | UC02A | UC02B | Q _{Post Controlled} |
| 2-Year | 42.0 | 1.4 | 0.3 | 0.5 | 4.0 | 1.6 | 3.6 | 53.3 |
| 5-Year | | 1.7 | 0.4 | 0.6 | 5.1 | 2.0 | 4.5 | 56.5 |
| 10-Year | | 2.2 | 0.5 | 0.8 | 6.5 | 2.6 | 5.8 | 60.4 |
| 25-Year | | 2.3 | 0.5 | 0.9 | 6.8 | 2.7 | 6.0 | 61.1 |
| 100-Year | | 2.8 | 0.6 | 1.0 | 8.2 | 3.2 | 7.2 | 65.0 |

Peak Flow Summary and Required Storage

| Return Period | Q _{target} (L/s) | Q _{Post Uncontrolled} (L/s) | Q _{Post Controlled} (L/s) | Required Storage (m ³) | Provided Storage (m ³) |
|---------------|---------------------------|--------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| 2-Year | 70.3 | 245.5 | 53.3 | 368 | 415 |
| 5-Year | 89.6 | 312.9 | 56.5 | | |
| 10-Year | 113.9 | 397.6 | 60.4 | | |
| 25-Year | 118.2 | 412.7 | 61.1 | | |
| 100-Year | 142.7 | 498.2 | 65.0 | | |



Project: Cascades of Niagara Fall
Project No.: 1688-5603

Date: 2023-11-24

Revised: 2023-12-06

Designed By: JL

Checked By: HL

MODIFIED RATIONAL METHOD CALCULATIONS - 2-YEAR STORM EVENT

| Rainfall Intensity Equation: | | CONTROLLED AREA | | |
|-----------------------------------|----------------------------|----------------------------------|----------------------------|---|
| $I = \frac{A}{(T+b)^c}$ | | Drainage Area ID = | 201 | |
| | | Drainage Area = | 1.66 ha | |
| | | Runoff Coefficient = | 0.76 | |
| | | Target Release Rate = | 70.3 L/s | |
| | | Controlled Release Rate = | 53.3 L/s | |
| City of Niagra Falls IDF (2-Year) | | Max. Storage Volume Required = | 127.6 m3 | |
| a= | 521.97 | Storage Volume Provided = | 415.0 m3 | |
| b= | 5.28 | | | |
| c= | 0.7588 | | | |
| Time (minutes) | Rainfall Intensity (mm/hr) | Q _{Runoff} (L/s) | Q _{Release} (L/s) | Storage Volume Required (m ³) |
| 5 | 89.1 | 314.1 | 53.3 | 78.2 |
| 10 | 65.9 | 232.5 | 53.3 | 107.5 |
| 15 | 53.2 | 187.6 | 53.3 | 120.8 |
| 20 | 45.0 | 158.7 | 53.3 | 126.4 |
| 25 | 39.2 | 138.4 | 53.3 | 127.6 |
| 30 | 34.9 | 123.2 | 53.3 | 125.8 |
| 35 | 31.6 | 111.4 | 53.3 | 122.0 |
| 40 | 28.9 | 102.0 | 53.3 | 116.7 |
| 45 | 26.7 | 94.2 | 53.3 | 110.3 |
| 50 | 24.9 | 87.6 | 53.3 | 102.9 |
| 55 | 23.3 | 82.1 | 53.3 | 94.8 |
| 60 | 21.9 | 77.3 | 53.3 | 86.1 |
| 65 | 20.7 | 73.0 | 53.3 | 76.8 |
| 70 | 19.7 | 69.3 | 53.3 | 67.2 |
| 75 | 18.7 | 66.0 | 53.3 | 57.1 |
| 80 | 17.9 | 63.1 | 53.3 | 46.7 |
| 85 | 17.1 | 60.4 | 53.3 | 36.0 |
| 90 | 16.4 | 58.0 | 53.3 | 25.0 |
| 95 | 15.8 | 55.8 | 53.3 | 13.9 |
| 100 | 15.2 | 53.8 | 53.3 | 2.5 |
| 105 | 14.7 | 51.9 | 51.9 | 0.0 |
| 110 | 14.2 | 50.2 | 50.2 | 0.0 |
| 115 | 13.8 | 48.6 | 48.6 | 0.0 |
| 120 | 13.4 | 47.1 | 47.1 | 0.0 |
| 125 | 13.0 | 45.7 | 45.7 | 0.0 |
| 130 | 12.6 | 44.4 | 44.4 | 0.0 |
| 135 | 12.3 | 43.2 | 43.2 | 0.0 |
| 140 | 11.9 | 42.1 | 42.1 | 0.0 |
| 145 | 11.6 | 41.0 | 41.0 | 0.0 |
| 150 | 11.4 | 40.0 | 40.0 | 0.0 |
| 155 | 11.1 | 39.1 | 39.1 | 0.0 |
| 160 | 10.8 | 38.2 | 38.2 | 0.0 |
| 165 | 10.6 | 37.3 | 37.3 | 0.0 |



Project: Cascades of Niagara Fall
Project No.: 1688-5603

Date: 2023-11-24
Revised: 2023-12-06
Designed By: JL
Checked By: HL

MODIFIED RATIONAL METHOD CALCULATIONS - 5-YEAR STORM EVENT

| Rainfall Intensity Equation: | | CONTROLLED AREA | | |
|-----------------------------------|----------------------------|----------------------------------|----------------------------|---|
| $I = \frac{A}{(T+b)^c}$ | | Drainage Area ID = | 201 | |
| | | Drainage Area = | 1.66 ha | |
| | | Runoff Coefficient = | 0.76 | |
| | | Target Release Rate = | 89.6 L/s | |
| | | Controlled Release Rate = | 56.5 L/s | |
| City of Niagra Falls IDF (5-Year) | | Max. Storage Volume Required = | 186.9 m3 | |
| a= | 719.50 | Storage Volume Provided = | 415.0 m3 | |
| b= | 6.34 | | | |
| c= | 0.7687 | | | |
| Time (minutes) | Rainfall Intensity (mm/hr) | Q _{Runoff} (L/s) | Q _{Release} (L/s) | Storage Volume Required (m ³) |
| 5 | 111.3 | 392.4 | 56.5 | 100.8 |
| 10 | 84.0 | 296.3 | 56.5 | 143.9 |
| 15 | 68.4 | 241.3 | 56.5 | 166.4 |
| 20 | 58.2 | 205.3 | 56.5 | 178.6 |
| 25 | 50.9 | 179.6 | 56.5 | 184.7 |
| 30 | 45.5 | 160.3 | 56.5 | 186.9 |
| 35 | 41.2 | 145.2 | 56.5 | 186.3 |
| 40 | 37.7 | 133.0 | 56.5 | 183.6 |
| 45 | 34.9 | 122.9 | 56.5 | 179.4 |
| 50 | 32.4 | 114.4 | 56.5 | 173.9 |
| 55 | 30.4 | 107.2 | 56.5 | 167.4 |
| 60 | 28.6 | 100.9 | 56.5 | 160.1 |
| 65 | 27.1 | 95.4 | 56.5 | 152.0 |
| 70 | 25.7 | 90.6 | 56.5 | 143.4 |
| 75 | 24.5 | 86.3 | 56.5 | 134.2 |
| 80 | 23.4 | 82.4 | 56.5 | 124.6 |
| 85 | 22.4 | 78.9 | 56.5 | 114.6 |
| 90 | 21.5 | 75.8 | 56.5 | 104.2 |
| 95 | 20.7 | 72.9 | 56.5 | 93.6 |
| 100 | 19.9 | 70.2 | 56.5 | 82.6 |
| 105 | 19.2 | 67.8 | 56.5 | 71.4 |
| 110 | 18.6 | 65.5 | 56.5 | 59.9 |
| 115 | 18.0 | 63.4 | 56.5 | 48.2 |
| 120 | 17.4 | 61.5 | 56.5 | 36.4 |
| 125 | 16.9 | 59.7 | 56.5 | 24.3 |
| 130 | 16.4 | 58.0 | 56.5 | 12.1 |
| 135 | 16.0 | 56.4 | 56.4 | 0.0 |
| 140 | 15.6 | 54.9 | 54.9 | 0.0 |
| 145 | 15.2 | 53.5 | 53.5 | 0.0 |
| 150 | 14.8 | 52.2 | 52.2 | 0.0 |
| 155 | 14.5 | 51.0 | 51.0 | 0.0 |
| 160 | 14.1 | 49.8 | 49.8 | 0.0 |
| 165 | 13.8 | 48.7 | 48.7 | 0.0 |



Project: Cascades of Niagara Fall
Project No.: 1688-5603

Date: 2023-11-24
Revised: 2023-12-06
Designed By: JL
Checked By: HL

MODIFIED RATIONAL METHOD CALCULATIONS - 10-YEAR STORM EVENT

| Rainfall Intensity Equation: | | CONTROLLED AREA | | |
|------------------------------------|----------------------------|----------------------------------|----------------------------|---|
| $I = \frac{A}{(T+b)^c}$ | | Drainage Area ID = | 201 | |
| | | Drainage Area = | 1.66 ha | |
| | | Runoff Coefficient = | 0.76 | |
| | | Target Release Rate = | 113.9 L/s | |
| | | Controlled Release Rate = | 60.4 L/s | |
| City of Niagra Falls IDF (10-Year) | | Max. Storage Volume Required = | 253.4 m3 | |
| a= | 577.93 | Storage Volume Provided = | 415.0 m3 | |
| b= | 2.483 | | | |
| c= | 0.669 | | | |
| Time (minutes) | Rainfall Intensity (mm/hr) | Q _{Runoff} (L/s) | Q _{Release} (L/s) | Storage Volume Required (m ³) |
| 5 | 150.4 | 530.2 | 60.4 | 141.0 |
| 10 | 106.8 | 376.5 | 60.4 | 189.7 |
| 15 | 85.2 | 300.5 | 60.4 | 216.2 |
| 20 | 72.0 | 254.0 | 60.4 | 232.4 |
| 25 | 63.0 | 222.1 | 60.4 | 242.6 |
| 30 | 56.3 | 198.6 | 60.4 | 248.8 |
| 35 | 51.2 | 180.4 | 60.4 | 252.2 |
| 40 | 47.1 | 165.9 | 60.4 | 253.4 |
| 45 | 43.7 | 154.0 | 60.4 | 252.9 |
| 50 | 40.8 | 144.1 | 60.4 | 251.1 |
| 55 | 38.4 | 135.5 | 60.4 | 248.1 |
| 60 | 36.4 | 128.2 | 60.4 | 244.2 |
| 65 | 34.5 | 121.8 | 60.4 | 239.4 |
| 70 | 32.9 | 116.1 | 60.4 | 234.0 |
| 75 | 31.5 | 111.0 | 60.4 | 227.9 |
| 80 | 30.2 | 106.5 | 60.4 | 221.3 |
| 85 | 29.0 | 102.3 | 60.4 | 214.1 |
| 90 | 28.0 | 98.6 | 60.4 | 206.6 |
| 95 | 27.0 | 95.2 | 60.4 | 198.6 |
| 100 | 26.1 | 92.1 | 60.4 | 190.2 |
| 105 | 25.3 | 89.2 | 60.4 | 181.5 |
| 110 | 24.5 | 86.5 | 60.4 | 172.6 |
| 115 | 23.8 | 84.0 | 60.4 | 163.3 |
| 120 | 23.2 | 81.7 | 60.4 | 153.7 |
| 125 | 22.6 | 79.6 | 60.4 | 144.0 |
| 130 | 22.0 | 77.5 | 60.4 | 134.0 |
| 135 | 21.4 | 75.6 | 60.4 | 123.7 |
| 140 | 20.9 | 73.9 | 60.4 | 113.3 |
| 145 | 20.5 | 72.2 | 60.4 | 102.7 |
| 150 | 20.0 | 70.6 | 60.4 | 91.9 |
| 155 | 19.6 | 69.1 | 60.4 | 81.0 |
| 160 | 19.2 | 67.6 | 60.4 | 69.9 |
| 165 | 18.8 | 66.3 | 60.4 | 58.6 |



Project: Cascades of Niagara Fall
Project No.: 1688-5603

Date: 2023-11-24
Revised: 2023-12-06
Designed By: JL
Checked By: HL

MODIFIED RATIONAL METHOD CALCULATIONS - 25-YEAR STORM EVENT

| Rainfall Intensity Equation: | | CONTROLLED AREA | | |
|------------------------------|----------------------------|---|----------------------------|---|
| $I = \frac{A}{(T+b)^c}$ | | Drainage Area ID = 201 Drainage Area = 1.66 ha Runoff Coefficient = 0.76 Target Release Rate = 118.2 L/s Controlled Release Rate = 61.1 L/s | | |
| | | City of Niagra Falls IDF (25-Year) | | |
| | | a= 1020.69 b= 7.29 c= 0.779 | | |
| | | Max. Storage Volume Required = 281.8 m3 Storage Volume Provided = 415.0 m3 | | |
| Time (minutes) | Rainfall Intensity (mm/hr) | Q _{Runoff} (L/s) | Q _{Release} (L/s) | Storage Volume Required (m ³) |
| 5 | 144.6 | 509.9 | 61.1 | 134.7 |
| 10 | 110.8 | 390.8 | 61.1 | 197.9 |
| 15 | 90.9 | 320.7 | 61.1 | 233.7 |
| 20 | 77.7 | 273.9 | 61.1 | 255.4 |
| 25 | 68.1 | 240.3 | 61.1 | 268.8 |
| 30 | 60.9 | 214.8 | 61.1 | 276.7 |
| 35 | 55.2 | 194.7 | 61.1 | 280.7 |
| 40 | 50.6 | 178.5 | 61.1 | 281.8 |
| 45 | 46.8 | 165.0 | 61.1 | 280.8 |
| 50 | 43.6 | 153.7 | 61.1 | 278.0 |
| 55 | 40.8 | 144.0 | 61.1 | 273.7 |
| 60 | 38.5 | 135.6 | 61.1 | 268.4 |
| 65 | 36.4 | 128.2 | 61.1 | 262.0 |
| 70 | 34.5 | 121.7 | 61.1 | 254.8 |
| 75 | 32.9 | 115.9 | 61.1 | 246.9 |
| 80 | 31.4 | 110.7 | 61.1 | 238.4 |
| 85 | 30.1 | 106.0 | 61.1 | 229.3 |
| 90 | 28.9 | 101.8 | 61.1 | 219.7 |
| 95 | 27.7 | 97.9 | 61.1 | 209.7 |
| 100 | 26.7 | 94.3 | 61.1 | 199.4 |
| 105 | 25.8 | 91.0 | 61.1 | 188.6 |
| 110 | 24.9 | 88.0 | 61.1 | 177.6 |
| 115 | 24.1 | 85.1 | 61.1 | 166.2 |
| 120 | 23.4 | 82.5 | 61.1 | 154.6 |
| 125 | 22.7 | 80.1 | 61.1 | 142.7 |
| 130 | 22.1 | 77.8 | 61.1 | 130.6 |
| 135 | 21.5 | 75.7 | 61.1 | 118.3 |
| 140 | 20.9 | 73.7 | 61.1 | 105.9 |
| 145 | 20.4 | 71.8 | 61.1 | 93.2 |
| 150 | 19.8 | 70.0 | 61.1 | 80.3 |
| 155 | 19.4 | 68.3 | 61.1 | 67.4 |
| 160 | 18.9 | 66.7 | 61.1 | 54.2 |
| 165 | 18.5 | 65.2 | 61.1 | 40.9 |



Project: Cascades of Niagara Fall
Project No.: 1688-5603

Date: 2023-11-24
Revised: 2023-12-06
Designed By: JL
Checked By: HL

MODIFIED RATIONAL METHOD CALCULATIONS - 100 YEAR STORM EVENT

| Rainfall Intensity Equation: | | CONTROLLED AREA | | |
|-------------------------------------|----------------------------|----------------------------------|----------------------------|---|
| $I = \frac{A}{(T+b)^c}$ | | Drainage Area ID = | 201 | |
| | | Drainage Area = | 1.66 ha | |
| | | Runoff Coefficient = | 0.76 | |
| | | Target Release Rate = | 142.7 L/s | |
| | | Controlled Release Rate = | 65.0 L/s | |
| City of Niagra Falls IDF (100-Year) | | Max. Storage Volume Required = | 367.9 m3 | |
| | | Storage Volume Provided = | 415.0 m3 | |
| a= | 1264.57 | | | |
| b= | 7.72 | | | |
| c= | 0.7814 | | | |
| Time (minutes) | Rainfall Intensity (mm/hr) | Q _{Runoff} (L/s) | Q _{Release} (L/s) | Storage Volume Required (m ³) |
| 5 | 173.3 | 611.3 | 65.0 | 163.9 |
| 10 | 133.8 | 471.8 | 65.0 | 244.1 |
| 15 | 110.2 | 388.5 | 65.0 | 291.2 |
| 20 | 94.3 | 332.6 | 65.0 | 321.1 |
| 25 | 82.8 | 292.2 | 65.0 | 340.7 |
| 30 | 74.1 | 261.4 | 65.0 | 353.6 |
| 35 | 67.3 | 237.2 | 65.0 | 361.6 |
| 40 | 61.7 | 217.5 | 65.0 | 366.1 |
| 45 | 57.1 | 201.3 | 65.0 | 367.9 |
| 50 | 53.2 | 187.5 | 65.0 | 367.5 |
| 55 | 49.8 | 175.7 | 65.0 | 365.3 |
| 60 | 46.9 | 165.5 | 65.0 | 361.8 |
| 65 | 44.4 | 156.5 | 65.0 | 357.0 |
| 70 | 42.1 | 148.6 | 65.0 | 351.1 |
| 75 | 40.1 | 141.5 | 65.0 | 344.4 |
| 80 | 38.3 | 135.2 | 65.0 | 336.9 |
| 85 | 36.7 | 129.5 | 65.0 | 328.8 |
| 90 | 35.2 | 124.3 | 65.0 | 320.0 |
| 95 | 33.9 | 119.5 | 65.0 | 310.7 |
| 100 | 32.7 | 115.1 | 65.0 | 300.9 |
| 105 | 31.5 | 111.1 | 65.0 | 290.7 |
| 110 | 30.5 | 107.4 | 65.0 | 280.0 |
| 115 | 29.5 | 104.0 | 65.0 | 269.1 |
| 120 | 28.6 | 100.8 | 65.0 | 257.8 |
| 125 | 27.7 | 97.8 | 65.0 | 246.1 |
| 130 | 26.9 | 95.0 | 65.0 | 234.3 |
| 135 | 26.2 | 92.4 | 65.0 | 222.1 |
| 140 | 25.5 | 90.0 | 65.0 | 209.7 |
| 145 | 24.9 | 87.7 | 65.0 | 197.1 |
| 150 | 24.2 | 85.5 | 65.0 | 184.3 |
| 155 | 23.7 | 83.4 | 65.0 | 171.3 |
| 160 | 23.1 | 81.5 | 65.0 | 158.1 |
| 165 | 22.6 | 79.6 | 65.0 | 144.8 |



Project: Cascades of Niagara Falls
Project No.: 1688-5603

Date: 2023-11-24
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Designed By: JL
Checked By: HL

ORIFICE FLOW CALCULATIONS

Orifice Equation:

$$Q = C \times A \times \sqrt{2 \times g \times h}$$

Where:

Q = Flow Rate (m³/s)

C = Orifice Coefficient of Discharge

A = Orifice Opening Area (m²)

g = Gravitational Constant (m/s²)

h = Head Acting on Orifice Centroid (m)

| Storm Event | Drainage Area ID | Orifice Location | Orifice Coefficient | Diameter of Orifice (mm) | Orifice Invert (m) | Headwater Elevation (m) | Total Head (m) | Area of Orifice (m ²) | Release Rate (L/s) |
|-------------|------------------|------------------|---------------------|--------------------------|--------------------|-------------------------|----------------|-----------------------------------|--------------------|
| 100-Year | 201 | MH1 | 0.80 | 100.00 | 186.49 | 188.82 | 2.28 | 0.008 | 42.0 |

Note: To be conservative in the preliminary design, the stormwater quantity strategy is to control 100-year post-development to 2-year pre-development. Therefore, the orifice is sized with 100-year maximum head with release rate less than the 2-year pre-development peak flows.

Stormceptor® EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

12/06/2023

| | |
|---------------------------|------------------|
| Province: | Ontario |
| City: | Niagara Falls |
| Nearest Rainfall Station: | ST CATHARINES AP |
| Climate Station Id: | 6137287 |
| Years of Rainfall Data: | 33 |

| | |
|-------------------|---------------------------|
| Project Name: | Cascades of Niagara Falls |
| Project Number: | 1688-5603 |
| Designer Name: | Justin Lawrence |
| Designer Company: | Crozier |
| Designer Email: | jlawrence@cfcrozier.ca |
| Designer Phone: | 416-567-6504 |
| EOR Name: | |
| EOR Company: | |
| EOR Email: | |
| EOR Phone: | |

| | |
|------------|---------------------------|
| Site Name: | Cascades of Niagara Falls |
|------------|---------------------------|

| | |
|---------------------|------|
| Drainage Area (ha): | 1.66 |
|---------------------|------|

| | |
|-------------------------|------|
| Runoff Coefficient 'c': | 0.76 |
|-------------------------|------|

| | |
|-----------------------------|------|
| Particle Size Distribution: | Fine |
|-----------------------------|------|

| | |
|-------------------------|------|
| Target TSS Removal (%): | 80.0 |
|-------------------------|------|

| | |
|--|-------|
| Required Water Quality Runoff Volume Capture (%): | 90.00 |
| Estimated Water Quality Flow Rate (L/s): | 39.23 |
| Oil / Fuel Spill Risk Site? | Yes |
| Upstream Flow Control? | Yes |
| Upstream Orifice Control Flow Rate to Stormceptor (L/s): | 42.00 |
| Peak Conveyance (maximum) Flow Rate (L/s): | |
| Influent TSS Concentration (mg/L): | 100 |
| Estimated Average Annual Sediment Load (kg/yr): | 708 |
| Estimated Average Annual Sediment Volume (L/yr): | 576 |

| Net Annual Sediment (TSS) Load Reduction Sizing Summary | |
|---|--------------------------|
| Stormceptor Model | TSS Removal Provided (%) |
| EFO4 | 70 |
| EFO6 | 82 |
| EFO8 | 89 |
| EFO10 | 94 |
| EFO12 | 97 |

Recommended Stormceptor EFO Model: **EFO6**

Estimated Net Annual Sediment (TSS) Load Reduction (%): **82**

Water Quality Runoff Volume Capture (%): **> 90**



Stormceptor® **EF** Sizing Report

THIRD-PARTY TESTING AND VERIFICATION

► Stormceptor® EF and Stormceptor® EFO are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

► Stormceptor® EF and EFO remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

► The Canadian ETV PSD shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

| Particle Size (µm) | Percent Less Than | Particle Size Fraction (µm) | Percent |
|--------------------|-------------------|-----------------------------|---------|
| 1000 | 100 | 500-1000 | 5 |
| 500 | 95 | 250-500 | 5 |
| 250 | 90 | 150-250 | 15 |
| 150 | 75 | 100-150 | 15 |
| 100 | 60 | 75-100 | 10 |
| 75 | 50 | 50-75 | 5 |
| 50 | 45 | 20-50 | 10 |
| 20 | 35 | 8-20 | 15 |
| 8 | 20 | 5-8 | 10 |
| 5 | 10 | 2-5 | 5 |
| 2 | 5 | <2 | 5 |



Stormceptor® EF Sizing Report

Upstream Flow Controlled Results

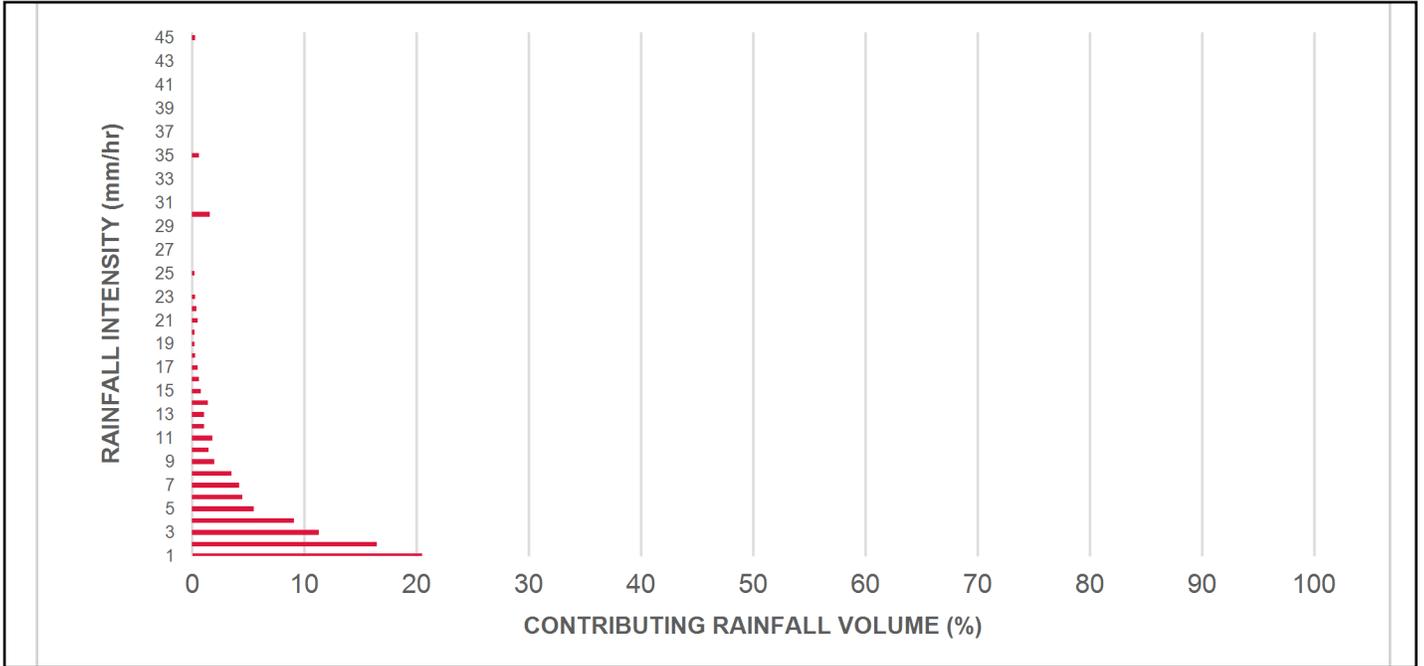
| Rainfall Intensity (mm / hr) | Percent Rainfall Volume (%) | Cumulative Rainfall Volume (%) | Flow Rate (L/s) | Flow Rate (L/min) | Surface Loading Rate (L/min/m²) | Removal Efficiency (%) | Incremental Removal (%) | Cumulative Removal (%) |
|---|-----------------------------|--------------------------------|-----------------|-------------------|---------------------------------|------------------------|-------------------------|------------------------|
| 0.50 | 9.2 | 9.2 | 1.75 | 105.0 | 40.0 | 100 | 9.2 | 9.2 |
| 1.00 | 20.5 | 29.7 | 3.51 | 210.0 | 80.0 | 98 | 20.2 | 29.4 |
| 2.00 | 16.5 | 46.2 | 7.01 | 421.0 | 160.0 | 88 | 14.6 | 43.9 |
| 3.00 | 11.3 | 57.5 | 10.52 | 631.0 | 240.0 | 81 | 9.2 | 53.2 |
| 4.00 | 9.1 | 66.7 | 14.03 | 842.0 | 320.0 | 78 | 7.1 | 60.2 |
| 5.00 | 5.5 | 72.2 | 17.54 | 1052.0 | 400.0 | 74 | 4.1 | 64.3 |
| 6.00 | 4.5 | 76.7 | 21.04 | 1263.0 | 480.0 | 70 | 3.2 | 67.5 |
| 7.00 | 4.2 | 80.9 | 24.55 | 1473.0 | 560.0 | 66 | 2.8 | 70.3 |
| 8.00 | 3.5 | 84.4 | 28.06 | 1683.0 | 640.0 | 64 | 2.3 | 72.5 |
| 9.00 | 2.0 | 86.5 | 31.57 | 1894.0 | 720.0 | 64 | 1.3 | 73.8 |
| 10.00 | 1.5 | 88.0 | 35.07 | 2104.0 | 800.0 | 63 | 0.9 | 74.8 |
| 11.00 | 12.0 | 100.0 | 38.58 | 2315.0 | 880.0 | 62 | 7.5 | 82.3 |
| 12.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 13.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 14.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 15.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 16.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 17.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 18.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 19.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 20.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 21.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 22.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 23.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 24.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 25.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 30.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 35.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 40.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| 45.00 | 0.0 | 100.0 | 42.00 | 2520.0 | 958.0 | 62 | 0.0 | 82.3 |
| Estimated Net Annual Sediment (TSS) Load Reduction = | | | | | | | | 82 % |

Climate Station ID: 6137287 Years of Rainfall Data: 33

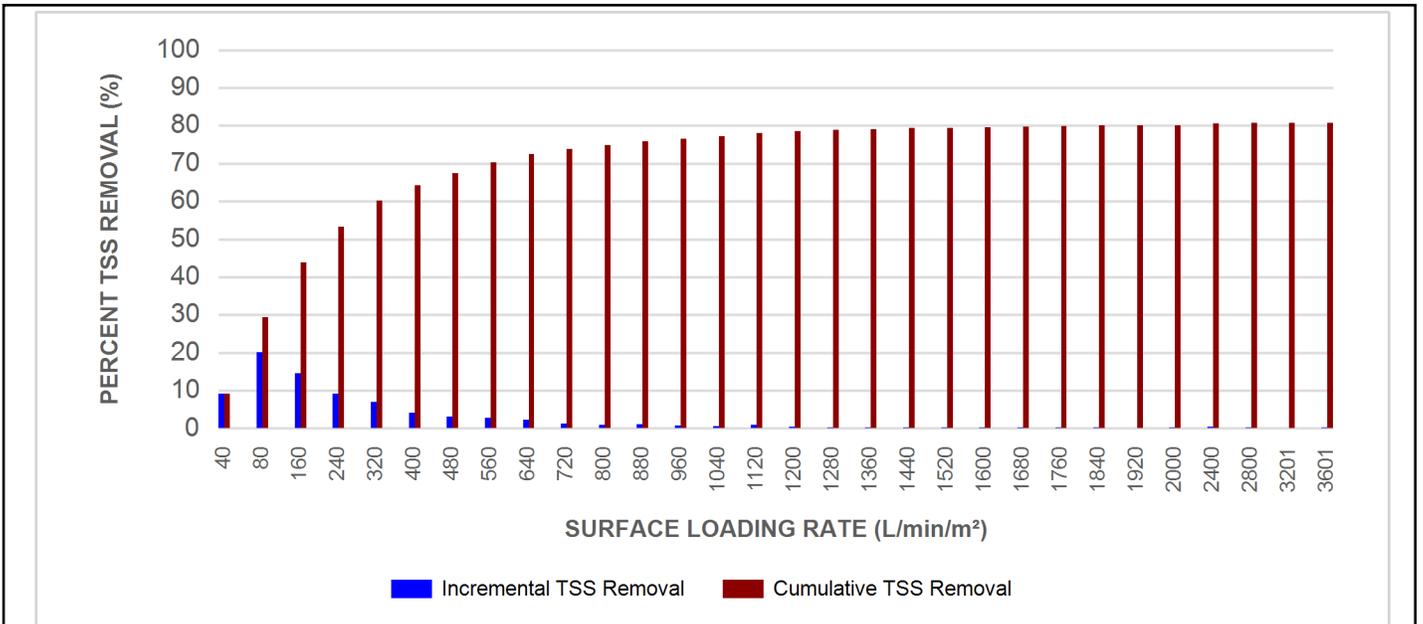


Stormceptor® EF Sizing Report

RAINFALL DATA FROM ST CATHARINES AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Stormceptor® **EF** Sizing Report

Maximum Pipe Diameter / Peak Conveyance

| Stormceptor EF / EFO | Model Diameter | | Min Angle Inlet / Outlet Pipes | Max Inlet Pipe Diameter | | Max Outlet Pipe Diameter | | Peak Conveyance Flow Rate | |
|-------------------------|----------------|------|-----------------------------------|----------------------------|------|-----------------------------|------|------------------------------|-------|
| | (m) | (ft) | | (mm) | (in) | (mm) | (in) | (L/s) | (cfs) |
| EF4 / EFO4 | 1.2 | 4 | 90 | 609 | 24 | 609 | 24 | 425 | 15 |
| EF6 / EFO6 | 1.8 | 6 | 90 | 914 | 36 | 914 | 36 | 990 | 35 |
| EF8 / EFO8 | 2.4 | 8 | 90 | 1219 | 48 | 1219 | 48 | 1700 | 60 |
| EF10 / EFO10 | 3.0 | 10 | 90 | 1828 | 72 | 1828 | 72 | 2830 | 100 |
| EF12 / EFO12 | 3.6 | 12 | 90 | 1828 | 72 | 1828 | 72 | 2830 | 100 |

SCOUR PREVENTION AND ONLINE CONFIGURATION

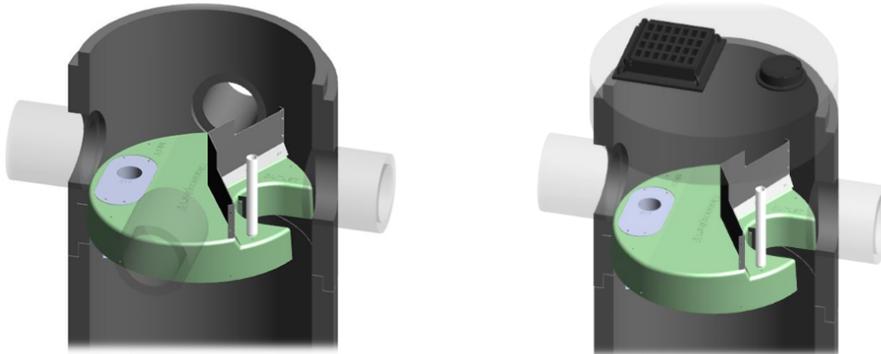
► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

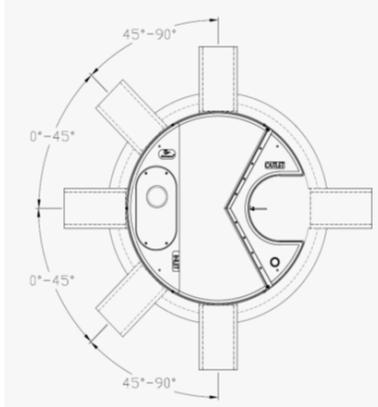
► Stormceptor® EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

► While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, Stormceptor® EFO has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.



Stormceptor® EF Sizing Report



INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

| Stormceptor EF / EFO | Model Diameter | | Depth (Outlet Pipe Invert to Sump Floor) | | Oil Volume | | Recommended Sediment Maintenance Depth * | | Maximum Sediment Volume * | | Maximum Sediment Mass ** | |
|----------------------|----------------|------|--|------|------------|-------|--|------|---------------------------|-------|--------------------------|--------|
| | (m) | (ft) | (m) | (ft) | (L) | (Gal) | (mm) | (in) | (L) | (ft³) | (kg) | (lb) |
| EF4 / EFO4 | 1.2 | 4 | 1.52 | 5.0 | 265 | 70 | 203 | 8 | 1190 | 42 | 1904 | 5250 |
| EF6 / EFO6 | 1.8 | 6 | 1.93 | 6.3 | 610 | 160 | 305 | 12 | 3470 | 123 | 5552 | 15375 |
| EF8 / EFO8 | 2.4 | 8 | 2.59 | 8.5 | 1070 | 280 | 610 | 24 | 8780 | 310 | 14048 | 38750 |
| EF10 / EFO10 | 3.0 | 10 | 3.25 | 10.7 | 1670 | 440 | 610 | 24 | 17790 | 628 | 28464 | 78500 |
| EF12 / EFO12 | 3.6 | 12 | 3.89 | 12.8 | 2475 | 655 | 610 | 24 | 31220 | 1103 | 49952 | 137875 |

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

| Feature | Benefit | Feature Appeals To |
|---|---|---|
| Patent-pending enhanced flow treatment and scour prevention technology | Superior, verified third-party performance | Regulator, Specifying & Design Engineer |
| Third-party verified light liquid capture and retention for EFO version | Proven performance for fuel/oil hotspot locations | Regulator, Specifying & Design Engineer, Site Owner |
| Functions as bend, junction or inlet structure | Design flexibility | Specifying & Design Engineer |
| Minimal drop between inlet and outlet | Site installation ease | Contractor |
| Large diameter outlet riser for inspection and maintenance | Easy maintenance access from grade | Maintenance Contractor & Site Owner |

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit <http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef>

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit <http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef>

**STANDARD PERFORMANCE SPECIFICATION FOR
“OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREATMENT DEVICE**

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program’s **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

| | | |
|-------|-------------------------------------|---|
| 2.1.1 | 4 ft (1219 mm) Diameter OGS Units: | 1.19 m ³ sediment / 265 L oil |
| | 6 ft (1829 mm) Diameter OGS Units: | 3.48 m ³ sediment / 609 L oil |
| | 8 ft (2438 mm) Diameter OGS Units: | 8.78 m ³ sediment / 1,071 L oil |
| | 10 ft (3048 mm) Diameter OGS Units: | 17.78 m ³ sediment / 1,673 L oil |
| | 12 ft (3657 mm) Diameter OGS Units: | 31.23 m ³ sediment / 2,476 L oil |

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall



Stormceptor® EF Sizing Report

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m² to 1400 L/min/m², and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m² and 1400 L/min/m² shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m² shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m². No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m².

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m².

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m².

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

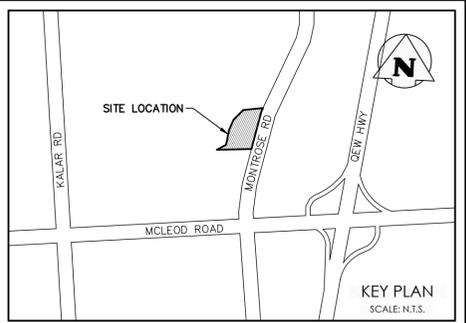
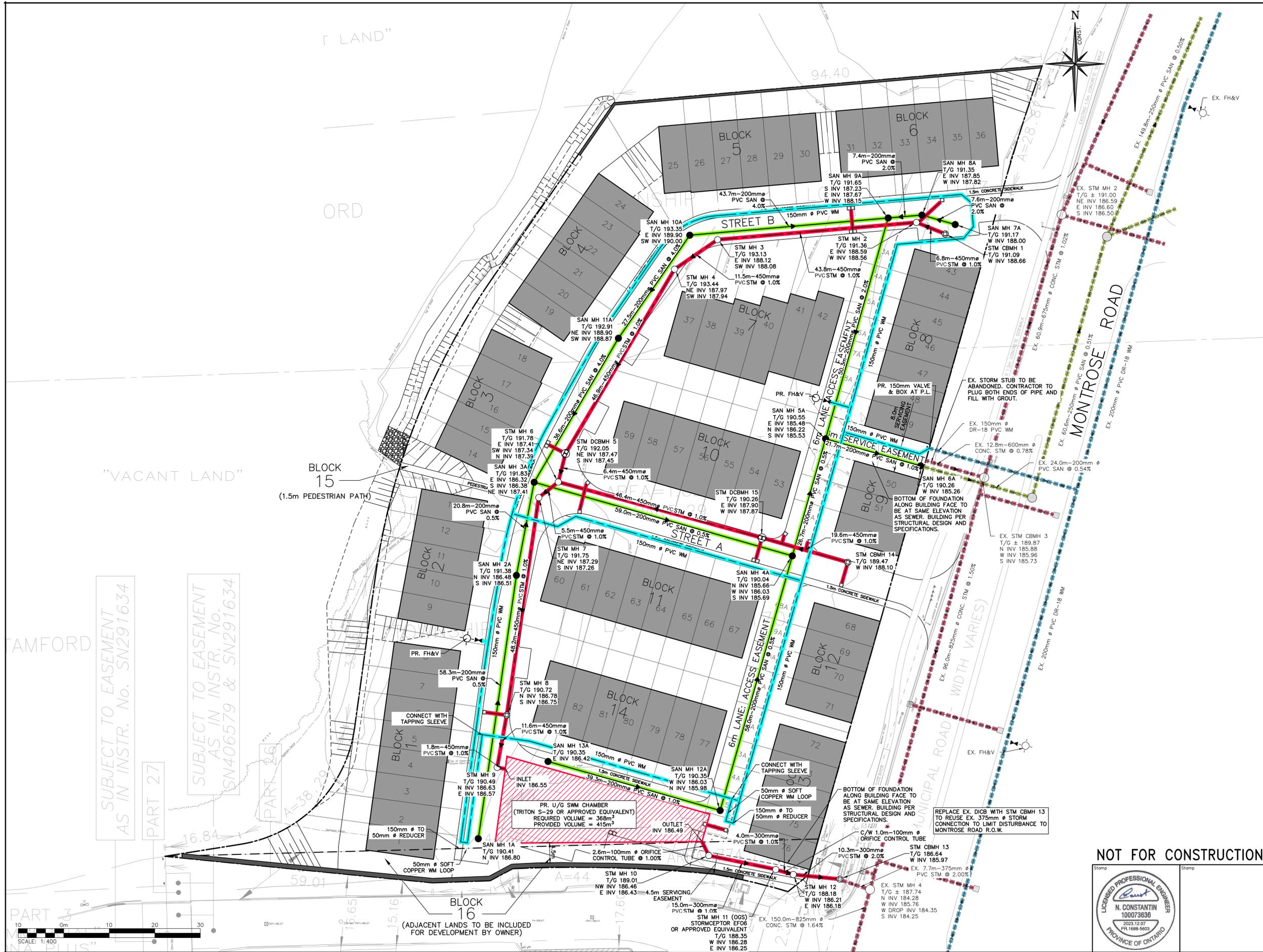
The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators**, with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

Stormceptor® EF Sizing Report

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m² to 2600 L/min/m²) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

FIGURES



LEGEND

- PROPERTY LINE
- EXISTING WATERMAIN & GATE VALVE
- EXISTING STORM SEWER & MANHOLE
- EXISTING SINGLE / DOUBLE CATCHBASIN
- EXISTING SANITARY SEWER & MANHOLE
- PROPOSED WATERMAIN & GATE VALVE
- PROPOSED FIRE HYDRANT & GATE VALVE
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED SINGLE / DOUBLE CATCHBASIN
- PROPOSED SANITARY SEWER & MANHOLE

SERVICE CONNECTIONS:
ALL UNITS TO HAVE INDIVIDUAL CONNECTIONS TO SANITARY SEWER AND WATERMAIN. SERVICE CONNECTIONS TO BE DESIGNED AT DETAILED DESIGN.

| | | |
|---|------------------------------|-------------|
| 1 | ISSUED FOR SECOND SUBMISSION | 2023/DEC/07 |
| 0 | ISSUED FOR FIRST SUBMISSION | 2021/APR/20 |

LEGAL DESCRIPTION:
PART OF TOWNSHIP LOTS 163 AND 170 TOWNSHIP OF STAMFORD (BEING IN THE CITY OF NIAGARA FALLS) REGIONAL MUNICIPALITY OF NIAGARA.

ELEVATION NOTE:
ELEVATIONS ARE OF GEODETIC ORIGIN (CGVD-1928.78), DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOD.

SURVEY NOTES:
SURVEY COMPLETED BY J.D. BARNES LTD. (JUNE 7, 2020)
REFERENCE No.: 20-16-122-00

BEARINGS SHOWN HEREON ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SmartNet v6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010)

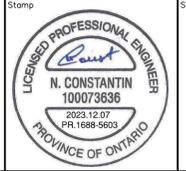
SITE PLAN NOTES:
DESIGN ELEMENTS ARE BASED ON DRAFT PLAN OF CONDOMINIUM, PREPARED BY MAINLINE PLANNING SERVICES INC.
DRAWING No.: DPC-1 DATED NOVEMBER 2023. (REV.5)

DRAWING NOTES:
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART OF IT WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.
THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.
THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT. DO NOT SCALE THIS DRAWING.
ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project: **CASCADES OF NIAGARA CITY OF NIAGARA FALLS**

Drawing: **SITE SERVICING PLAN**

NOT FOR CONSTRUCTION



CROZIER CONSULTING ENGINEERS
2800 HIGH POINT DRIVE SUITE 100 MILTON, ON L9T 6P4 905-875-0026 T 905-875-4915 F WWW.CFCROZIER.CA

Drawn: R.L. Design: J.L./H.L. Project No: **1688-5603**
Check: N.C. Scale: 1:400 Dwg: **C701**

I:\16011688 - Villanovis5603 - Montrose Rd\CAD\Civil_Sheets\5603_C701.dwg, 12/27/2023 4:20:30 PM, AutoCAD PDF (General Documentation).pc3

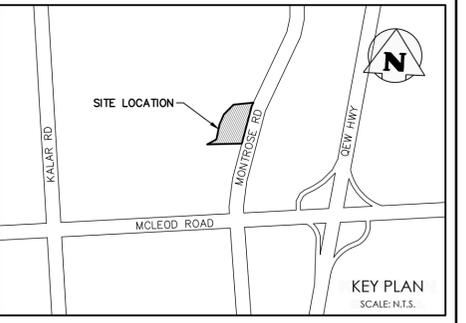
NOTE: ALL CURBS TO BE SEMI-MOUNTABLE WITH STANDARD GUTTER PER OPSD 600.060, UNLESS OTHERWISE INDICATED. CURBS NOT PROVIDED ON DRAFT PLAN OF CONDOMINIUM. CATCHBASINS ARE PLACED ALONG GUTTER LINE AND FOLLOW 6m DRIVE AISLE.

ALL GRADING ON CITY LAND TO BE COORDINATED BETWEEN OWNER AND CITY OF NIAGARA FALLS PRIOR TO START OF CONSTRUCTION

PR. 124.3m RETAINING WALL C/W 1.5m CHAIN LINK FENCE ON TOP PER STRUCTURAL DESIGN AND SPECIFICATIONS MAX WALL HEIGHT 3.92m

PR. 108.1m RETAINING WALL C/W 1.5m CHAIN LINK FENCE ON TOP PER STRUCTURAL DESIGN AND SPECIFICATIONS MAX WALL HEIGHT 2.06m

(ADJACENT LANDS TO BE INCLUDED FOR DEVELOPMENT BY OWNER)



| LEGEND | |
|--------|--|
| | PROPERTY LINE |
| | EXISTING CONTOUR (0.5m) |
| | EXISTING CONTOUR (1.0m) |
| | EXISTING GRADE |
| | PROPOSED GRADE |
| | PROPOSED GRADE (TO MATCH EXISTING) |
| | PROPOSED MINOR FLOW DIRECTION |
| | PROPOSED GRASSED SWALE |
| | PROPOSED RETAINING WALL |
| | PROPOSED SLOPE (3:1 MAX.) |
| | PROPOSED MAJOR OVERLAND FLOW DIRECTION |
| | EXISTING OVERLAND FLOW DIRECTION |
| | EXISTING STORM MANHOLE |
| | EXISTING SINGLE / DOUBLE CATCHBASIN |
| | EXISTING SANITARY MANHOLE |
| | PROPOSED FIRE HYDRANT & GATE VALVE |
| | PROPOSED STORM MANHOLE |
| | PROPOSED SINGLE / DOUBLE CATCHBASIN |
| | PROPOSED SANITARY MANHOLE |

| No. | ISSUE / REVISION | DATE |
|-----|------------------------------|-------------|
| 1 | ISSUED FOR SECOND SUBMISSION | 2023/DEC/07 |
| 0 | ISSUED FOR FIRST SUBMISSION | 2021/APR/20 |

LEGAL DESCRIPTION:
PART OF TOWNSHIP LOTS 163 AND 170 TOWNSHIP OF STAMFORD (BEING IN THE CITY OF NIAGARA FALLS) REGIONAL MUNICIPALITY OF NIAGARA.

ELEVATION NOTE:
ELEVATIONS ARE OF GEODETIC ORIGIN (CGVD-1928.78), DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOD

SURVEY NOTES:
SURVEY COMPLETED BY J.D. BARNES LTD. (JUNE 7, 2020)
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BEARINGS SHOWN HEREON ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SmartNet v6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010)

DISTANCES AND ELEVATIONS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SITE PLAN NOTES:
DESIGN ELEMENTS ARE BASED ON DRAFT PLAN OF CONDOMINIUM, PREPARED BY MAINLINE PLANNING SERVICES INC.
DRAWING No.: DPC-1 DATED NOVEMBER 2023. (REV.5)

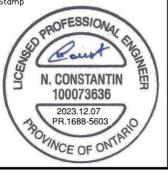
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Project: **CASCADES OF NIAGARA CITY OF NIAGARA FALLS**

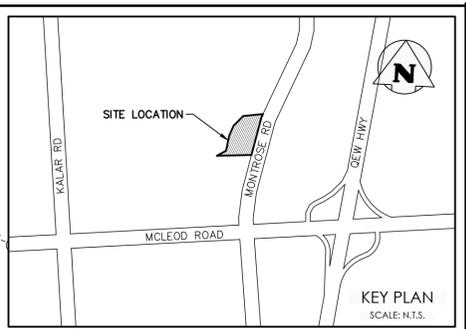
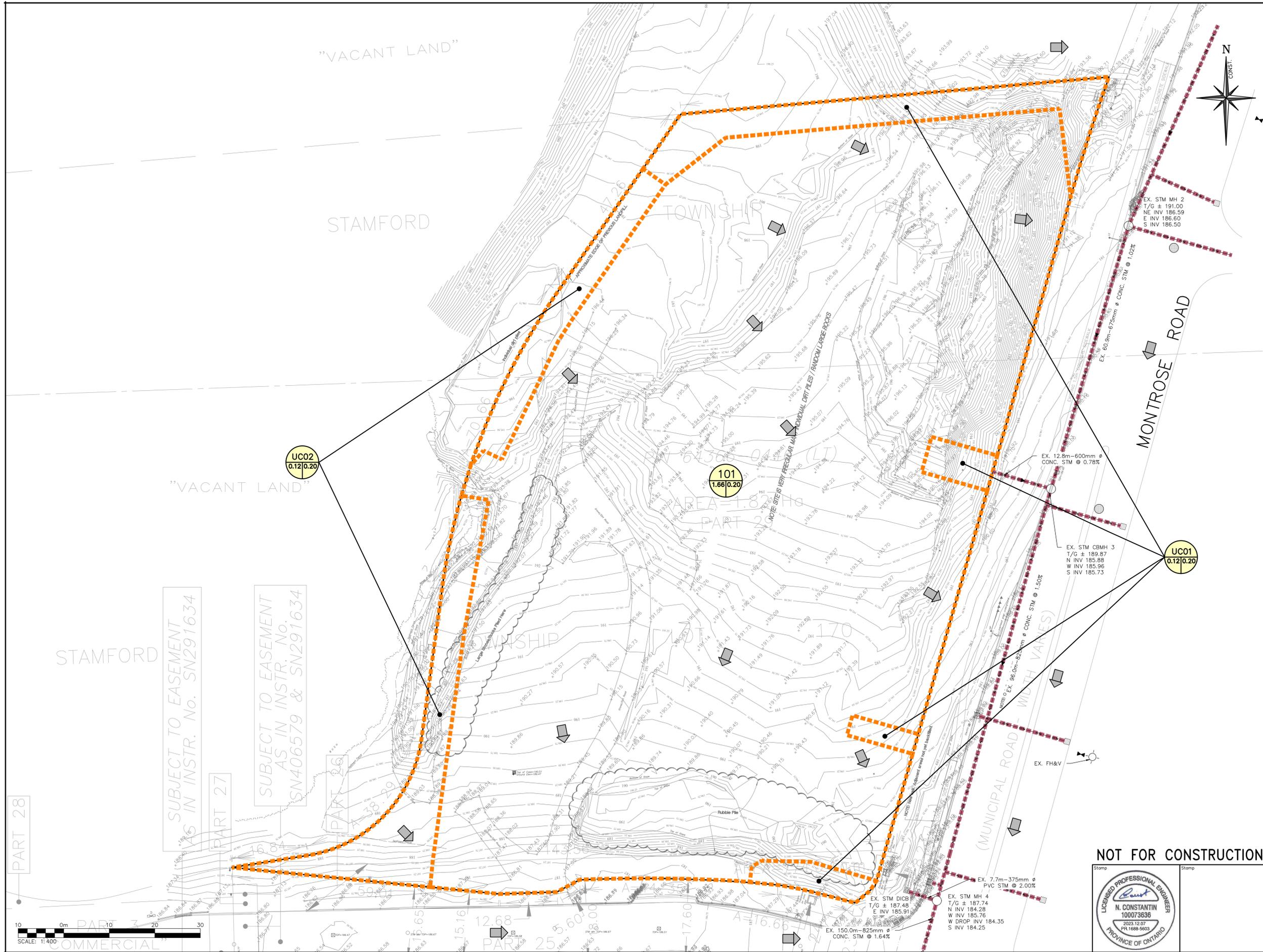
Drawing: **SITE GRADING PLAN**

NOT FOR CONSTRUCTION



CROZIER CONSULTING ENGINEERS
2800 HIGH POINT DRIVE SUITE 100 MILTON, ON L9T 6P4 905-875-0026 T 905-875-4915 F WWW.CFCROZIER.CA

| | | | | | |
|-------|------|--------|-----------|-------------|------------------|
| Drawn | R.L. | Design | J.L./H.L. | Project No. | 1688-5603 |
| Check | N.C. | Check | N.C. | Scale | 1:400 |
| | | | | Dwg. | C702 |



LEGEND

- PROPERTY LINE
- - - EXISTING CONTOUR (0.5m)
- - - EXISTING CONTOUR (1.0m)
- EXISTING GRADE
- EXISTING OVERLAND FLOW DIRECTION
- STORM DRAINAGE CATCHMENT
- ID
- AREA
- RUNOFF COEFFICIENT

| | | |
|-----|------------------------------|-------------|
| 1 | ISSUED FOR SECOND SUBMISSION | 2023/DEC/07 |
| 0 | ISSUED FOR FIRST SUBMISSION | 2021/APR/20 |
| No. | ISSUE / REVISION | YYYY/MM/DD |

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ELEVATIONS ARE OF GEODETIC ORIGIN (CGVD-1928:78), DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOD

SURVEY NOTES:
SURVEY COMPLETED BY J.D. BARNES LTD. (JUNE 7, 2020)
REFERENCE No.: 20-16-122-00

BEARINGS SHOWN HEREON ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SmartNet v6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010)

DISTANCES AND ELEVATIONS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

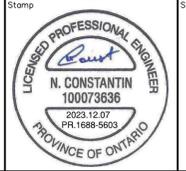
SITE PLAN NOTES:
DESIGN ELEMENTS ARE BASED ON DRAFT PLAN OF CONDOMINIUM, PREPARED BY MAINLINE PLANNING SERVICES INC.
DRAWING No.: DPC-1 DATED NOVEMBER 2023. (REV.5)

DRAWING NOTES:
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART OF IT WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.
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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project: **CASCADES OF NIAGARA CITY OF NIAGARA FALLS**

Drawing: **PRE-DEVELOPMENT DRAINAGE PLAN**

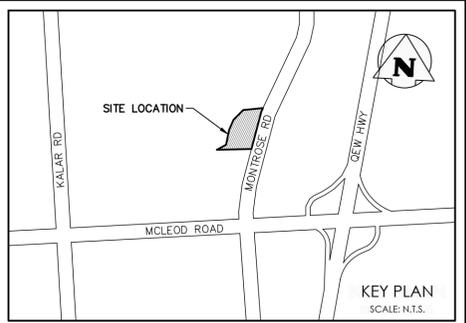
NOT FOR CONSTRUCTION



CROZIER CONSULTING ENGINEERS
2800 HIGH POINT DRIVE SUITE 100 MILTON, ON L9T 6P4 905-875-0026 T 905-875-4915 F WWW.CFCROZIER.CA

| | | | | | | |
|-------|------|--------|-----------|-------------|------------------|--------------|
| Drawn | R.L. | Design | J.L./H.L. | Project No. | 1688-5603 | |
| Check | N.C. | Check | N.C. | Scale | 1:400 | |
| | | | | | Dwg. | FIG 1 |

I:\1688-5603 - Villanov5603 - Montrorse Rd\CAD\Civil_Sheets\5603_C7101.dwg, 12/27/2023 4:20:42 PM, AutoCAD PDF (General Documentation).pc3



LEGEND

- PROPERTY LINE
- - - EXISTING CONTOUR (0.5m)
- - - EXISTING CONTOUR (1.0m)
- EXISTING GRADE
- PROPOSED MAJOR OVERLAND FLOW DIRECTION
- EXISTING OVERLAND FLOW DIRECTION
- STORM DRAINAGE CATCHMENT
- ID
- AREA (ha) | RUNOFF COEFFICIENT

| | | |
|---|------------------------------|-------------|
| 1 | ISSUED FOR SECOND SUBMISSION | 2023/DEC/07 |
| 0 | ISSUED FOR FIRST SUBMISSION | 2021/APR/20 |

LEGAL DESCRIPTION:
PART OF TOWNSHIP LOTS 163 AND 170 TOWNSHIP OF STAMFORD (BEING IN THE CITY OF NIAGARA FALLS) REGIONAL MUNICIPALITY OF NIAGARA.

ELEVATION NOTE:
ELEVATIONS ARE OF GEODETIC ORIGIN (CGVD-1928.78), DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOD.

SURVEY NOTES:
SURVEY COMPLETED BY J.D. BARNES LTD. (JUNE 7, 2020)
REFERENCE No.: 20-16-122-03

BEARINGS SHOWN HEREON ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SmartNet v6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010)

DISTANCES AND ELEVATIONS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

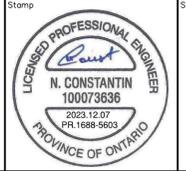
SITE PLAN NOTES:
DESIGN ELEMENTS ARE BASED ON DRAFT PLAN OF CONDOMINIUM, PREPARED BY MAINLINE PLANNING SERVICES INC.
DRAWING No.: DPC-1 DATED NOVEMBER 2023. (REV.5)

DRAWING NOTES:
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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project: **CASCADES OF NIAGARA CITY OF NIAGARA FALLS**

Drawing: **POST-DEVELOPMENT DRAINAGE PLAN**

NOT FOR CONSTRUCTION



| | | | | | |
|-------|------|--------|-----------|-------------|------------------|
| Drawn | R.L. | Design | J.L./H.L. | Project No. | 1688-5603 |
| Check | N.C. | Check | N.C. | Scale | 1:400 |
| | | | | Dwg. | FIG 2 |

1:\1688\1688 - Villanovi\5603 - Montrorse Rd\CAD\Civil_Sheets\5603_C7100.dwg, 12/77/2023 4:20:45 PM, AutoCAD PDF (General Documentation).pc3

SUBJECT TO EASEMENT AS IN INSTR. No. SN291634

SUBJECT TO EASEMENT AS IN INSTR. No. SN406579 & SN291634

PART 28

PART 27

PART 26

PART 25

PART 24

PART 23

PART 22

PART 21

PART 20

PART 19

PART 18

PART 17

PART 16

PART 15

PART 14

PART 13

PART 12

PART 11

PART 10

PART 9

PART 8

PART 7

PART 6

PART 5

PART 4

PART 3

PART 2

PART 1

SCALE: 1:400

GENERAL NOTE:

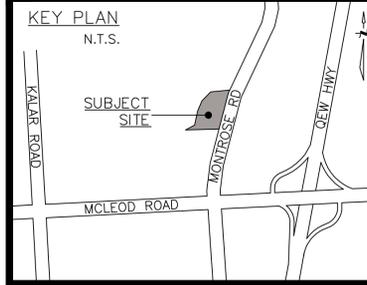
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DO NOT SCALE THESE DRAWINGS. ANY ERROR OR DISCREPANCY IS TO BE REPORTED IMMEDIATELY TO: MAINLINE PLANNING SERVICES INC.

ADDITIONAL INFORMATION AS REQUIRED UNDER SECTION 51(17) OF THE ONTARIO PLANNING ACT, R.S.O. 1990, c.P.13 (AS AMENDED 2016, c.25, Sched. 4, s.8(1))

- a) AS SHOWN
- b) AS SHOWN
- c) SEE LAND USE SCHEDULE
- d) AS SHOWN
- e) AS SHOWN
- f) AS SHOWN
- g) AS SHOWN
- h) MUNICIPAL WATER SUPPLY AVAILABLE
- i) SANDY CLAY
- j) AS SHOWN
- k) MUNICIPAL SANITARY/STORM AVAILABLE
- l) AS SHOWN

VACANT RESIDENTIAL
ZONE: R5C-H-912 (RESIDENTIAL APARTMENT 5C)
HOLDING WITH EXCEPTION)
OP DESIGNATION: MAJOR COMMERCIAL



LAND USE SCHEDULE

| | |
|----------------------------|-------------------------|
| TOTAL SITE AREA: | 18,960.6 sq.m. (100.0%) |
| AREA OF EXISTING SITE | 18,186.1 sq.m. |
| BLOCK 16 ADDITIONAL LANDS: | 774.5 sq.m. |

LANDUSE:

| | |
|--|------------------------|
| TOWNHOUSES: BLOCKS 1 - 14 (83 LAND LOTS) | 15,536.7 sq.m. (81.9%) |
| PEDESTRIAN PATH: BLOCK 15 | 39.5 sq.m. (0.2%) |
| 0.3m. RESERVE: BLOCKS 16-17 | 5.1 sq.m. (0.0%) |
| LANDSCAPED AREA: (SOUTH PARKING LOT) | 308.3 sq.m. (1.6%) |
| ROADS: STREETS A-B, PARKING LOT | 3,071.0 sq.m. (16.3%) |

LAND CONDOMINIUM:

TOTAL LAND UNITS = 83
TOTAL NUMBER OF TOWNHOUSES = 83
MAX DENSITY= 44 TOWNHOUSE UNITS/ GROSS HA.
COMMON AREA = STREET A-B, PARKING LOT, PEDESTRIAN PATH,
EXCLUSIVE USE COMMON AREA = REAR LANE DRIVEWAY EASEMENT OVER 43A - 52A AND 68A -76A
TOTAL SITE COVERAGE = 34.6%

EXISTING OFFICIAL PLAN: MAJOR COMMERCIAL
PROPOSED USE OF LAND: MAJOR COMMERCIAL
ADJACENT USE OF LAND: SEE PLAN

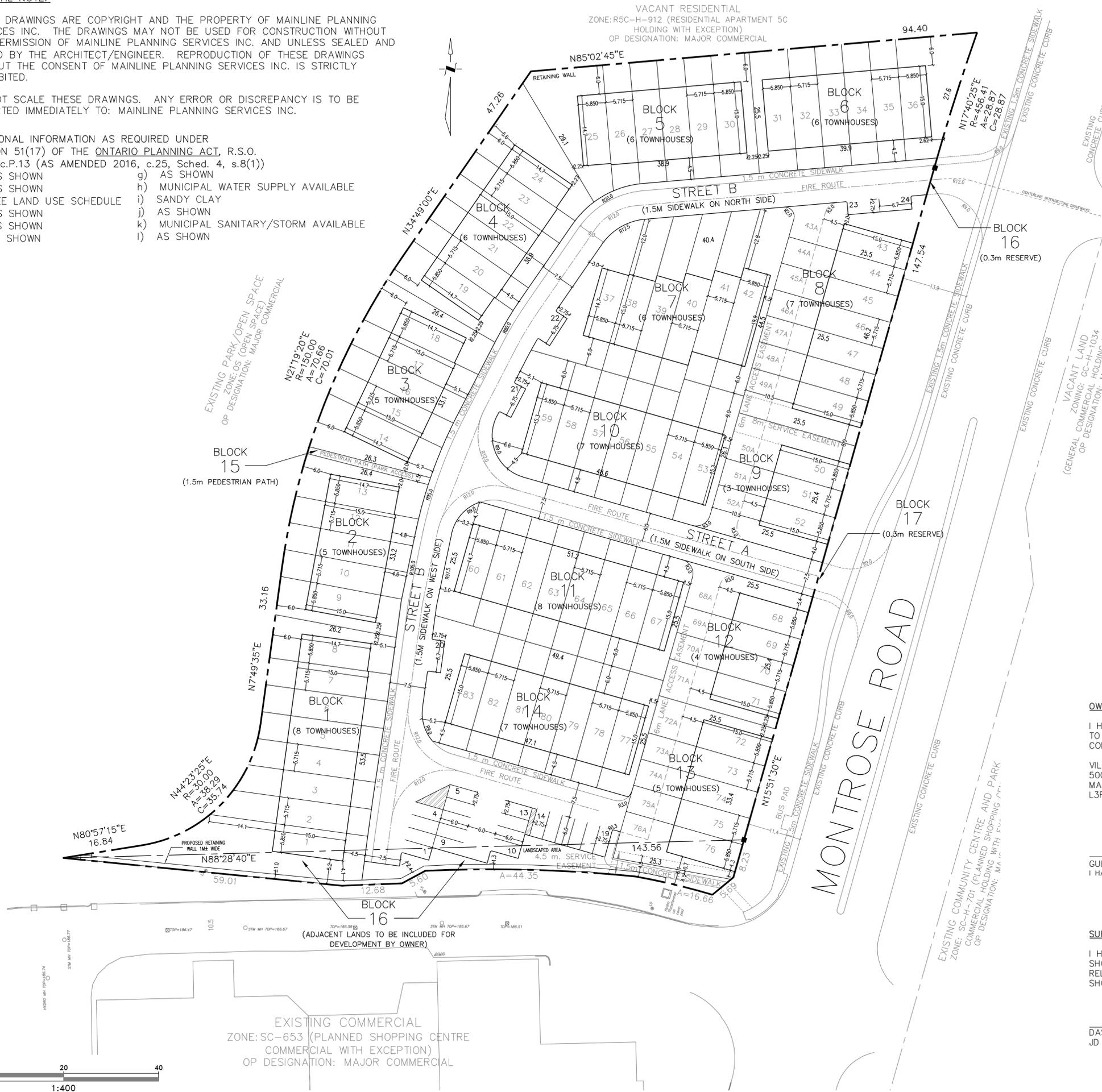
REQUIRED PARKING: 1.4 ps / unit = 116
PROVIDED PARKING: 107 ps (1.3 ps / unit)

EXISTING ZONING: R5C-H-912 (BY-LAW 2010-132)
PROPOSED ZONING: R5C-912 (BY-LAW 2010-132 - WITH EXCEPTIONS)

TOWNHOUSE UNIT STATISTICS

| | |
|----------------------|--|
| MIN. LAND UNIT WIDTH | = 5.715 m |
| MIN. LAND UNIT DEPTH | = 25.5 m |
| MIN. LAND UNIT AREA | = 145.7 sq.m (Pursuant to By-law 79-200) |

- LEGEND**
- LS DENOTES LIGHT STANDARD
 - CATCH BASIN
 - MANHOLE
 - TRAFFIC SIGN
 - POLE
 - BELL PEDESTAL
 - CABLE PEDESTAL
 - HYDRANT
 - MH MANHOLE
 - GAS METER
 - JUNCTION BOX
 - WATER VALVE
 - GAS VALVE
 - TRAFFIC LIGHT
 - BOLLARD
 - HYDRO POLE
 - BELL POLE
 - UTILITY POLE
 - OVERHEAD WIRE
 - STW STORMWATER
 - SAN SANITARY



LEGAL DESCRIPTION

PART OF TOWNSHIP LOTS 163 AND 170
TOWNSHIP OF STAMFORD
(BEING IN THE CITY OF NIAGARA FALLS)
REGIONAL MUNICIPALITY OF NIAGARA

NOTE:
SURVEY INFORMATION PROVIDED BY: J.D. BARNES LIMITED,
4318 PORTAGE ROAD, UNIT 2, NIAGARA FALLS ONTARIO L2E 6A4

| NO. | DATE | DESCRIPTION | BY |
|-----|--------|-------------------------------|--------|
| 5 | NOV-23 | REVISED 'BLOCK 16' | J.P.P. |
| 4 | MAR-22 | REISSUED FOR MUNICIPAL REVIEW | J.P.P. |
| 3 | AUG-21 | REVISED PER REGION COMMENTS | J.P.P. |
| 2 | JUL-21 | REVISED PER STAFF COMMENTS | J.P.P. |
| 1 | APR-21 | ISSUED FOR MUNICIPAL REVIEW | J.P.P. |

OWNER'S CERTIFICATE

I HEREBY AUTHORIZE MAINLINE PLANNING SERVICES INC. TO PREPARE AND SUBMIT A DRAFT PLAN OF CONDOMINIUM.

VILLARBOIT NIAGARA FALLS HOLDING LIMITED PARTNERSHIP
500 COCHERANE DRIVE, UNIT 4
MARKHAM, ONTARIO
L3R 8E2

Query Goyo
APRIL 26, 2020
I HAVE THE AUTHORITY TO BIND THE CORPORATION

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS SHOWN ON THIS PLAN OF SUBDIVISION AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECTLY SHOW.

Dasha Page
APRIL 26, 2020
DASHA PAGE, O.E.S.
JD BARNES LIMITED

mainline
planning services inc.

PH (905) 893-0046 FAX (888) 370-9474
P.O. BOX 319, KLEINBURG, ONTARIO, L0J 1C0

DRAWING TITLE
DRAFT PLAN OF SUBDIVISION
(LAND CONDOMINIUM)

PROJECT
CASCADES OF NIAGARA FALLS

DEVELOPER/OWNER
McLEOD SQUARE INC.

| | | | |
|----------|---------|---------|----------|
| DRAWN | CHECKED | SCALE | DWG. NO. |
| K.A.R. | J.P.P. | 1 = 400 | DPC-1 |
| DATE | ISSUED | JOB NO. | |
| APRIL-21 | J.P.P. | | |

