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FUNCTIONAL SERVICING REPORT

Millbrook South West Subdivision

787 & 825 Fallis Line
Community of Millbrook
Township of Cavan Monaghan
County of Peterborough

September 2017
Rev: June 2021

Prepared For: **Bromont Homes Inc.**

File: **16119**

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VALDOR WATER RESOURCES

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1.0 INTRODUCTION

Valdor Engineering Inc. has been retained by Bromont Homes Inc. to provide consulting engineering services for the proposed Millbrook South West Subdivision located on a 49.2 hectare parcel on the south of Fallis Line, west of County Road 10, in the Community of Millbrook, Township of Cavan Monaghan, County of Peterborough as illustrated in **Figure 1**. The subject site is known municipally as 787 & 825 Fallis Line

1.1 Existing Conditions

The subject site is bounded to the west by existing agricultural lands, to the north by Fallis Line, to the south by valley lands associated with Baxter Creek and to the east by the Millbrook Subdivision which is currently being serviced.

The subject site is currently occupied by two detached dwellings, a barn and various out buildings with driveway access to Fallis Line. The majority of the subject site is presently a vacant field and the south part of the site is tree covered. East half of the site is bisected by the relatively deep cut of a former railway corridor which traverses the site in a north-south alignment.

1.2 Proposed Development

The proposed residential development consists of lots for detached dwellings having frontages of 10.7 m, 13.7 m and 15.9 m, street townhouses having frontages of 7.6 m, and medium density blocks (5-storey buildings) fronting Fallis Line. The proposed development will also include parkland, walkway blocks, two stormwater management facilities, and a waste water treatment plant.

Access for the subdivision will consist of a road network with a road connection to the Millbrook Subdivision to the east which is currently under construction. A reduced copy of the proposed Draft Plan of Subdivision is contained in **Appendix "A"**. The development statistics and the equivalent population data are summarized in **Table 1**.

Table 1. Development Statistics

Land Use	**Area** (Ha)	**Residential Units** (No.)	**Equivalent Population** (persons)
Detached Dwellings	16.09	371	1,299
Street Townhomes	3.57	125	438
Medium Density	0.88	200	400
Parkland & Trails	2.06		
Natural Heritage Systems	16.43		
Stormwater Management Ponds	2.34		
Roads & Road Widenings	7.84		
TOTAL	**49.21**	**696**	**2,136**

1.3 Purpose of Report

This report has been prepared in support of the application for draft plan approval for the subject property. The primary intent of the report is to demonstrate the viability of water and wastewater servicing, storm drainage and stormwater management, grading as well as vehicular and pedestrian access with respect to applicable guidelines, policies and design criteria.

This report has been prepared based on a review of the topographic survey and background studies, discussions with municipal staff and a visit to the site. This document provides guidance for detailed engineering design of the subdivision.

1.4 Approving Authorities

This report will be circulated for review, comment and approval to:

1. The Township of Cavan Monaghan;
2. The County of Peterborough; and
3. The Otonabee Region Conservation Authority (ORCA).

2.0 WATER SERVICING

The existing Millbrook water servicing system consists of a water treatment facility, with water taken from three local wells, a water storage tank and a network of watermains that service most of the existing urban area of the community.

The existing Millbrook Water Treatment Plant (WTP) consists of 3 wells, each with 25L/s capacity, chlorine disinfection and a chlorine contact tank. The existing water storage tank was built in 1976 and is located on the east end of Millbrook on a local high point of land. The existing 10.4m diameter tank has a useable storage capacity of 1,410m^3 with a top water level at an elevation of 278.0m.

The municipal water system was expanded including the northerly extension of a watermain with a water storage tank constructed on the site of the Township's municipal office. The water system was further expanded to service the existing subdivision to the east. The external water distribution system is illustrated in **Figure 2**.

The following is a summary of the water servicing requirements for the subject site.

2.1 Domestic Demand

The domestic water demand is to be calculated using the Township and Ministry of the Environment design standards which includes the following parameters:

Residential Average Day Demand:	450 L/person/day
Maximum Day Factor:	2.00
Peak Hour Factor	3.00

A detailed tabulation of the domestic water demand calculation is detailed in **Table B1** of **Appendix "B"**. The demands are summarized in **Table 2** below.

Table 2. Domestic Water & Fire Flow Demand

Land Use	Equivalent Population (Persons)	Domestic Demand (L/min)	Maximum Day Demand (L/min)	Peak Hour Demand (L/min)	Fire Flow (L/min)	Maximum Day Plus Fire Flow (L/min)
Detached Dwellings	1,299	405.9	811.9	1,217.8	8,000	
Street Townhomes	438	136.9	273.8	410.6	7,000	
Medium Density	400	125.0	250.0	375.0		
TOTAL	**2,136**	**667.8**	**1,335.6**	**2,003.4**	**8,000**	**9,336**

2.2 Local Watermains & Service Connections

The local water distribution system within the subdivision will consist of watermains ranging in diameter from 150mm to 250mm. This water system will connect to the existing watermain on Fallis Line and the existing watermain within the adjacent Millbrook Subdivision.

In accordance with Township standards the individual detached dwellings are each to have separate water connections. Based on Ontario Building Code (OBC 2012) regulations (7.6.3.4.(1) and (5) and Table 7.6.3.4), the dwellings will be serviced with 25mm diameter water connections given that it is anticipated that the dwellings will each have more than 16 fixture units.

Water meters are to be purchased from the Township and will be installed in the basement of each dwelling with a remote readout device located on the exterior ground floor wall of the house. Generally, residential water meters are selected to be one size smaller than the water service and therefore 20mm x 25mm water meters will be installed.

The configuration of the site watermain is illustrated on the **Preliminary Servicing & Grading Plan**. A copy of the Township standard water service connection and water meter details is included in **Appendix "B"**.

2.3 Fire Protection

The fire flow required for the proposed dwelling units was calculated using the criteria indicated in the *Water Supply for Public Fire Protection Manual*, 1999, by the Fire Underwriters Survey (FUS). The calculation incorporates various parameters such as coefficient for fire-resistant construction, an area reduction accounting for a fire-resistant (one hour rating) protection, a reduction for low-hazard occupancies, and a factor for neighbouring building proximity.

The calculation was completed to reflect the governing conditions which is the largest detached dwelling. Based on the calculations, the minimum fire suppression flow required for the detached dwellings and street townhomes are 8,000 L/min and 7,000 L/min, respectively. The detailed fire flow calculation is provided in **Table B2-1** and **Table B2-2** which are contained in **Appendix "B"**. In accordance with the Township standards, this flow must be available at the nearest hydrant with a minimum pressure of 140 KPa.

Fire hydrants will be provided along the municipal roads such that a fire hydrant will be available within 90m of the principle entrance of each unit as set out in the Ontario Building Code (OBC 2012). A copy of the standard fire hydrant detail is included in **Appendix "B"**.

3.0 WASTEWATER SERVICING

The community of Millbrook is currently serviced by the existing Millbrook Wastewater Treatment Plant (WWTP) located at the east limit of Centennial Lane. This WWTP was built in 1975 and the plant was upgraded in 2004 to improve the treatment quality. The WWTP has recently been expanded and upgraded to accommodate the additional flow from the urban expansion area which included a high-level tertiary treatment that would be able to provide improved effluent quality to meet the new effluent discharge criteria.

The Township has recently initiated a Water and Wastewater Master Servicing Study as part of a Municipal Class Environmental Assessment to examine water and wastewater servicing alternatives within the current urban boundary and beyond. This study should consider the proposed draft plan for the subject site.

The following is a summary of the wastewater servicing analysis for the subject site.

3.1 Wastewater Loading

The wastewater loading is to be calculated using the Township engineering design standards which include the following parameters:

Residential Average Daily Flow: 450 L/person/day

Residential Peaking Factor: $K_H = 1 + \frac{14}{4 + \sqrt{P}}$

Where: K_H = Harmon Peaking Factor (Max. 4.0, Min. 2.75)
p = Population in thousands

Extraneous Flow, *I*: 0.14 L/s/Ha (Infiltration)

Design Flow, Q = Q x K_H + *I*

Based on the above criteria the sewage flow calculations are provided in **Table C1** contained in **Appendix "C"** and the total flow is summarized in **Table 3**.

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Table 3. Wastewater Loading Summary

Land Use	**Area** (Ha)	**Equivalent Population** (Persons)	**Average Daily Flow** (L/s)	**Harmon Peaking Factor**	**Peak Daily Flow** (L/s)	**Infiltration Rate** (L/s)	**Total Flow** (L/s)
Detached Dwellings	16.09	1,299	6.77	3.72	25.19	4.51	29.70
Street Townhomes	3.57	438	2.28	4.00	9.13	1.00	10.13
Medium Density	0.88	400	2.08	4.02	8.38	0.25	8.63
Roads	7.84					2.20	2.20
TOTAL	**28.38**	**2,136**	**11.13**		**44.13**	**7.95**	**50.65**

3.2 External Sanitary Sewers

A trunk sanitary sewer was constructed from the existing Millbrook community, along County Road 10, to service the urban expansion area including the subject lands. This 375mm diameter trunk sanitary sewer extends through the existing adjacent subdivision to the west along Highland Boulevard. It is proposed to service the lots on Street "A" via a connection to the existing 250mm diameter sanitary sewer on Pristine Trail at the east limit of the subject site. The external sanitary sewers are illustrated in **Figure 3**.

Availability of treatment capacity to service new development in the existing WWTP is currently being reviewed by the Township of Cavan Monaghan. In addition, the Township has been searching for a location to construct a new treatment facility in order to meet its projected growth target over the long term. A second treatment facility is therefore being proposed on the subject site to service the subject lands which can be phased to also service future development. Treatment capacity will therefore be available either through the existing WWTP or the proposed WWTP and it will be a condition of development that will need to be satisfied for registration and release of building permits. As such it is expected that prior to approval there will be sufficient planned capacity in a centralized waste water treatment facility to service the proposed development. A schematic for the WWTP and the manufactures brochure is included in **Appendix "C"**.

3.3 Local Sanitary Sewers & Service Connections

The subject site will be serviced by a local sanitary system consisting of 200mm diameter sewers. The local sewers will be designed such that the upstream end of each length will have a minimum 1% slope to assist with self-cleansing. In accordance with standard practice, manholes will be provided for maintenance access at a maximum spacing of 120m. The proposed sanitary sewers are indicated on the **Preliminary Servicing & Grading Plan**.

Each dwelling unit will be provided with a 100mm diameter single connection in accordance with Township standards. The Township's standard detail for sanitary service connections is included in **Appendix "C"**.

4.0 STORM CONVEYANCE SYSTEM

The subject site is located in the Baxter Creek watershed, which is one of the twelve watersheds under the jurisdiction of the Otonabee Region Conservation Authority (ORCA). Baxter Creek originates from the Oak Ridges Moraine and flows in an easterly direction and outlets into the Otonabee River. Baxter Creek meets the Otonabee River approximately 20 km upstream of Rice Lake. A map illustrating the Baxter Creek watershed is contained in **Appendix "D"**.

In accordance with Township standards, a major / minor system storm conveyance concept has been incorporated into the functional servicing design for the subject development. The following sections provide a brief summary of the storm drainage components:

4.1 Minor System Design

In accordance with the Township standards, the subject development will be serviced with a minor storm sewer system that has been designed to convey runoff from the 5-year storm event. Minor system flows from the north half of the development will be conveyed to the North SWM Pond located in the north-east corner of the development through a servicing block. Minor system flows from the south half of the development will be conveyed to the South SWM Pond located near the south limit of the development through a servicing block.

The rainfall intensity values, *I*, are calculated in accordance with the 2014 rainfall intensity duration frequency (IDF) data for the Peterborough Airport weather station. Based on this data the rainfall intensity for the 5- and 100-year rainfall events is calculated as follows:

$$I_5 = \frac{1098}{(t+10.1)^{0.83}} \qquad I_{100} = \frac{2507}{(t+14.8)^{0.88}}$$

The peak flows are calculated using the following formula:

$Q = R \times A \times I \times 2.778$ where: Q = peak flow (L/s)
A = area in hectares (Ha)
I = rainfall intensity (mm/hr)
R = composite runoff coefficient
t = time of concentration (min)

The IDF curve data is included in **Appendix "D"**. A schematic design of the minor system is illustrated on the **Preliminary Servicing & Grading Plan**.

4.2 Major System Design

The major system will generally be comprised of an overland flow route along the municipal road network directing drainage to a safe outlet. This major system will convey flows which are in excess of the capacity of the minor storm sewer system. Major system flows from the north half of the development will be conveyed to the North SWM Pond. Major system flows from the south half of the development will be conveyed to the South SWM Pond. The major system flow route is illustrated on the **Preliminary Servicing & Grading Plan**.

4.3 Foundation Drainage

In accordance with Township standards, storm service connections are to be provided to each dwelling unit. It is anticipated that the dwellings will have basements and therefore a foundation weeping tile system will be required which will discharge to storm service connections.

4.4 Roof Drainage

It is anticipated that the proposed dwellings will have conventional peaked roof with eaves troughs and downspouts. As per standard practice the downspouts are to discharge to grade over splash pads, preferably towards sodded areas. Roof downspouts are not to be connected to the storm sewer.

5.0 STORMWATER MANAGEMENT

5.1 Storm Drainage Areas

Based on the topographic survey and the proposed draft plan of subdivision, the following is a summary of the pre- and post-development drainage areas, accounting.

5.1.1 Pre-Development

Under existing conditions, drainage from the subject site is generally split between two separate tributaries of Baxter Creek, located to the north and south of the site. The northern half of the site (*Catchment 1-101*, 18.16 ha) drains northward to a tributary of Baxter Creek (referred to as the North Tributary in this report) via an existing 600 mm CSP culvert under Fallis Line. It is noted that this tributary will be realigned as part of the Millbrook Subdivision, Phase 2, located on the north side of Fallis Line. The southern half of the site (*Catchment 2-101*, 14.77 ha) drains southward to a tributary of the Baxter Creek (referred to as the South Tributary in this report) via a wetland. The North and South Tributaries join at a confluence approximately 2.2 km east of County Road 10.

Drainage from the lands to the west of the subject site is similarly split between drainage to the north and south. Some of this external drainage to the north will drain through the subject site (*Catchment 1-301*, 5.10 ha), whereas the remainder of external drainage to the north drains directly to Fallis Line (*Catchment 1-302*, 6.52 ha). The external drainage to the south will not flow through the subject site because it is intercepted by a raised hedgerow running along the length of property boundary which acts like a berm and serves to conveys this flow directly to the valley lands associated with the South Tributary of Baxter Creek. As such, this external drainage area is not discussed in this report.

A small area along the south side of Fallis Line (*Catchment 1-303*, 0.53 ha) accounts for the road and ditch areas on southern side of Fallis Line, which drain directly to the North Tributary of Baxter Creek.

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Elevations vary from 267.00 m along the west property line of the site, to approximately 244.00 m along the south limit of development. The existing slopes throughout the site range from 0.8% to approximately 10.0%.

The existing site land use is primarily agricultural with a wooded area at the south-east corner of the site. **Figure 4A** illustrates the drainage patterns for existing conditions.

5.1.2 Post-Development

Under proposed conditions, drainage from the subject site will be split between the North and South Tributaries of Baxter Creek to maintain the pre-development drainage patterns. The northern half of the site (*Catchment 1-201*, 18.91 ha) drains to the North SWM Pond and then to the North Tributary. The southern half of the site (*Catchment 2-201*, 10.85 ha) drains to the South SWM Pond and then to the South Tributary. The rear of lots along the southern limit (*Catchment 2-202*, 3.17 ha) will drain uncontrolled to the South Tributary, but adequate overcontrol will be provided by the South SWM Pond.

The external drainage area draining through the site (*Catchment 1-301*, 5.10 ha) will be captured and conveyed to the North SWM Pond. The external drainage areas draining to Fallis Line (*Catchment 1-302*, 6.52 ha, and *Catchment 1-303*, 0.53 ha) will be conveyed via a proposed storm sewer under Fallis Line to the North Tributary.

Figure 4B illustrates the details of the proposed drainage plan for the subject site.

5.2 Stormwater Management Design Criteria

The proposed SWM facility shall be designed to provide the following levels of control as per the requirements of the Ministry of the Environment (MOE), Otonabee Region Conservation Authority (ORCA) and Township of Cavan Monaghan:

- **Quality control**: The permanent pool shall be sized to provide Enhanced (Level 1) treatment of stormwater runoff for the proposed development.
- **Erosion control**: Stormwater runoff from the 25 mm storm event shall be stored and released over a minimum 24-hour period.
- **Flood control**: Flood storage and control shall be provided to maintain peak outflows from the pond at or below pre-development levels for the critical of the 6, 12 & 24-hour SCS, 6, 12 & 24-hour AES storm distributions, and 4-hour Chicago storm distribution, for the 2-year through 100-year design storm events.

5.3 Stormwater Management Pond Design

Two stormwater management wet ponds are proposed to serve the subject site, the North and South SWM Ponds. The North SWM Pond is located in the north-east corner of the site, as illustrated in **Figure 5A**, and services a total drainage area of approximately 24.01 ha. The South SWM Pond is located at the southern limit of the site, as illustrated in **Figure 5B**, and services a total drainage area of approximately 10.85 ha.

A Visual OTTHYMO 5.1 (VO5) model was created to determine the pre-development flows for the subject site and assess the post-development flows and performance of the proposed SWM ponds. Design storms were generated from the IDF curve and storm depth data provided in the City's standards. The supporting VO5 model documentation, model schematics and output are provided in **Appendix "E"**.

As per the Township standards and the MOE SWM pond criteria, the SWM pond design includes 3H:1V side slopes below and above the permanent pool, with a 5H:1V safety shelf for 3.0m on either side of the permanent pool elevation. A 4.0 m wide access road with maximum 10% slope is provided from the subdivision.

5.3.1 Quality Control

Various source controls, conveyance and end-of-pipe SWM facilities were considered to provide the appropriate level of stormwater quality control. Reduced lot grades, rear and side yard swales, and discharge of roof leaders to pervious surfaces will augment the control provided by the SWM facility and promote infiltration where possible. Based on a preliminary review of available controls, it appears that the primary and most effective option to provide water quality control for runoff from the contributing drainage areas is a SWM facility. The options reviewed are as follows:

- Roof Leader to Ponding Areas or Soakaway Pits (Lot Level): The Township design criteria do not address the use of ponding areas or soakaway pits in the rear yards. Roof leaders will discharge directly to pervious surfaces to encourage infiltration and filtration on the lots. Soakaway pits can be an effective means of improving infiltration of stormwater, but require a large area in comparison to typical residential rear yard dimensions. As a result, soakaway pits and ponding areas are not recommended.
- Grassed Swales (Conveyance): Rear and side yard swales will be incorporated into the grading plan. The swales will convey runoff to rear lot catch basins. The number of rear lot catch basins will be minimized in order to encourage infiltration via swales.
- Stormwater Management Facilities (End-of-Pipe): SWM facilities are required to provide water quality, extended detention and flood control of stormwater runoff. Stormwater management facilities will be constructed within the Subject Property.
- Oil/Grit Separation Technologies (End-of-Pipe): These SWMF's can be effective for smaller, high impervious sites where spill protection is desired and when area for a stormwater pond is unavailable. The construction of the stormwater pond will eliminate the need for any oil/grit separation units.
- Infiltration Trenches/Basins (End-of-Pipe): These SWMF's are most effective in areas with highly pervious soils and large areas.

Permanent Pool Sizing Calculations

In accordance with the ORCA requirements for development within the Baxter Creek watershed, Enhanced (Level 1) water quality protection shall be provided by the proposed SWM facility. This shall be achieved for both ponds with a permanent pool.

In order to maintain a permanent pool of water in the ponds and to prevent the mixing of surface water with ground water, the ponds must be constructed in native, undisturbed till material or lined with either an imported clay material or synthetic material. It is assumed that a pond liner will be required, but this will be confirmed at detailed design.

North SWM Pond

The drainage area to the North SWM Pond (24.01 ha) has an average imperviousness of approximately 55%. The required permanent pool volume for the North SWM Pond is provided below:

Volume required for catchment with 55% imperviousness:	190.0 m^3/ha
Less 40 m^3/ha of extended detention storage zone:	- 40.0 m^3/ha
Permanent Pool Volume Required:	150.0 m^3/ha

The permanent pool storage volume required for the North SWM Pond is 150.0 m^3/ha × 24.01 ha = 3,602 m^3.

The normal water level of the permanent pool for the North SWM Pond is set at an elevation of 247.00 m. The bottom of the pond in the main cell is set at an elevation of 245.00 m, providing a permanent pool depth of 2.00 m. The actual permanent pool storage volume provided is approximately 4,429 m^3 which is greater than the minimum required volume. The required and provided quality control volume together with the elevation of the normal water level are summarized in **Table 5A**.

South SWM Pond

The drainage area to the South SWM Pond (10.85 ha) has an average imperviousness of approximately 60%. The required permanent pool volume for the South SWM Pond is provided below:

Volume required for catchment with 60% imperviousness:	201.7 m^3/ha
Less 40 m^3/ha of extended detention storage zone:	- 40.0 m^3/ha
Permanent Pool Volume Required:	161.7 m^3/ha

The permanent pool storage volume required for the South SWM Pond is 161.7 m^3/ha × 10.85 ha = 1,754 m^3.

The normal water level of the permanent pool for the South SWM Pond is set at an elevation of 245.50 m. The bottom of the pond in the main cell is set at an elevation of 243.50 m, providing a permanent pool depth of 2.00 m. The actual permanent pool storage volume provided is approximately 2,710 m^3 which is greater than the minimum required volume. The required and provided quality control volume together with the elevation of the normal water level are summarized in **Table 5B**.

Forebay Sizing Calculations

The SWM ponds have been designed with forebays sized based on the MOE design criteria.

North SWM Pond

Using the methodology provided in the Stormwater Management Planning and Design Manual, the minimum recommended forebay length based on particulate settling is calculated using the following expression:

$$Dist = \sqrt{\frac{r \cdot Q_p}{V_s}} \qquad [1]$$

where: *Dist* is the forebay length (m)
r is the minimum length-to-width ratio of the forebay (2:1 or r = 2)
Q_p is the pond's peak discharge (0.025 m^3/s, VO5 modelling of 25 mm storm)
V_s is the settling velocity (0.0003 m/s for 150 µm particles)

Solving [1] gives:

$$Dist = \sqrt{\frac{2 \times 0.025}{0.0003}} = 12.9\ m$$

The recommended forebay length based on flow dispersion calculations is calculated using the following expression:

$$Dist = \frac{8 \cdot Q}{d \cdot V_f} \qquad [2]$$

where: *Dist* is the forebay length (m)
Q is the peak inlet flow (2.763 m^3/s, OTTHYMO modeling of 5-year storm)
d is the depth of the permanent pool in the forebay (2.00 m)
V_f is the desired velocity in the forebay (0.50 m/s)

Solving [2] gives:

$$Dist_w = \frac{8 \times 2.763}{2.00 \times 0.50} = 22.1\ m$$

The distance from the headwall to the forebay berm is 28 m; therefore, the proposed design satisfies the minimum forebay length recommendations.

The minimum recommended forebay bottom width is calculated as follows, based on the maximum distance from the calculations above:

$$Width = \frac{Dist}{8} = \frac{22.1}{8} = 2.8\ m$$

The design proposes an average forebay bottom width of 8.0 m, which satisfies this criterion.

South SWM Pond

Using the methodology provided in the Stormwater Management Planning and Design Manual, the minimum recommended forebay length based on particulate settling is calculated using the following expression:

$$Dist = \sqrt{\frac{r \cdot Q_p}{V_s}} \quad [1]$$

where: *Dist* is the forebay length (m)
r is the minimum length-to-width ratio of the forebay (2:1 or r = 2)
Q_p is the pond's peak discharge (0.012 m^3/s, OTTHYMO modelling of 25 mm storm)
V_s is the settling velocity (0.0003 m/s for 150 µm particles)

Solving [1] gives:

$$Dist = \sqrt{\frac{2 \times 0.012}{0.0003}} = 8.9\ m$$

The recommended forebay length based on flow dispersion calculations is calculated using the following expression:

$$Dist = \frac{8 \cdot Q}{d \cdot V_f} \quad [2]$$

where: *Dist* is the forebay length (m)
Q is the peak inlet flow (1.473 m^3/s, VO5 modeling of 5-year storm)
d is the depth of the permanent pool in the forebay (2.00 m)
V_f is the desired velocity in the forebay (0.50 m/s)

Solving [2] gives:

$$Dist_w = \frac{8 \times 1.473}{2.00 \times 0.50} = 11.8\ m$$

The distance from the headwall to the forebay berm is 43 m; therefore, the proposed design satisfies the minimum forebay length recommendations.

The minimum recommended forebay bottom width is calculated as follows, based on the maximum distance from the calculations above:

$$Width = \frac{Dist}{8} = \frac{11.8}{8} = 1.5\ m$$

The design proposes an average forebay bottom width of 4.0 m, which satisfies this criterion.

5.3.2 Erosion Control

In accordance with the ORCA guidelines, erosion control shall be provided using an extended detention active storage zone sized to capture the runoff resulting from a 25 mm rainfall event (the 25 mm Chicago storm distribution) and to release the runoff over a period of at least 24 hours (48-hours preferred).

North SWM Pond

Based on hydrologic modelling of the 25 mm storm using the VO5 model, the estimated runoff volume is 11.19 mm distributed over the 24.01 ha catchment area draining to the North SWM Pond, for a required extended detention capture volume of 2,687 m^3. The available volume provided in the extended detention storage zone, up to the elevation of 247.80, is approximately 3,113 m^3, which meets the volumetric criterion. The proposed extended detention depth is 0.80 m, which is less than the maximum recommended extended detention depth of 1.00 m.

The required detention time and release rate will be achieved using an orifice plate installed within the pond outlet control structure. Based on the calculations below, the drawdown time for the North SWM Pond is approximately 51.4 hours with a 125 mm diameter orifice, which meets the minimum 24-hour release criteria.

The drawdown time can be calculated using the following expressions, from the *Stormwater Management Planning and Design Manual*:

$$t_d = \frac{0.66 \cdot C_2 \cdot {h_1}^{1.5} + 2 \cdot C_3 \cdot {h_1}^{0.5}}{2.75 \cdot A_o} \qquad [4]$$

where: t_d is the drawdown time (s)
h is the maximum water elevation above the orifice (0.7375 m)
A_o is the cross-sectional area of the orifice (0.012272 m^2)
C_2 is the slope coefficient from area-depth linear regression (1431.3)
C_3 is the intercept from area-depth linear regression (3288.0)

The variable *h* is the maximum water elevation above the centroid of the orifice and is calculated as follows (invert of orifice set at normal water level):

$$h_1 = HWL_{25mm} - \left[NWL + \frac{D}{2}\right] = 247.80 - \left[247.00 + \frac{0.125}{2}\right] = 0.7375\ m$$

where: HWL_{25mm} is the high water level for the 25 mm rainfall (247.80 m)

NWL	is the normal water level (247.00 m)
D	is the diameter of the orifice (0.125 m)

Solving [4] yields:

$$t_d = \frac{0.66\times(1431.3)\times(0.7375)^{1.5}+2\times(3288.0)\times(0.7375)^{0.5}}{2.75\times(0.012272)} = 185{,}068\ s = 51.4\ h$$

The orifice size, erosion control release rate, draw down time, extended detention volume and water level are summarized in **Table 5A**.

South SWM Pond

Based on hydrologic modelling of the 25 mm storm using the VO5 model, the estimated runoff volume is 12.16 mm distributed over the 10.85 ha catchment area draining to the South SWM Pond, for a required extended detention capture volume of 1,319 m^3. The available volume provided in the extended detention storage zone, up to the elevation of 246.10, is approximately 1,563 m^3, which meets the volumetric criterion. The proposed extended detention depth is 0.60 m, which is less than the maximum recommended extended detention depth of 1.00 m.

The required detention time and release rate will be achieved using an orifice plate installed within the pond outlet control structure. Based on the calculations below, the drawdown time for the South SWM Pond is approximately 52.0 hours with a 95 mm diameter orifice, which meets the minimum 24-hour release criteria.

The drawdown time can be calculated using the following expressions, from the *Stormwater Management Planning and Design Manual*:

$$t_d = \frac{0.66\cdot C_2\cdot {h_1}^{1.5}+2\cdot C_3\cdot {h_1}^{0.5}}{2.75\cdot A_o} \qquad [4]$$

where: t_d is the drawdown time (s)
h is the maximum water elevation above the orifice (0.5525 m)
A_o is the cross-sectional area of the orifice (0.007088 m^2)
C_2 is the slope coefficient from area-depth linear regression (1293.3)
C_3 is the intercept from area-depth linear regression (2217.0)

The variable *h* is the maximum water elevation above the centroid of the orifice and is calculated as follows (invert of orifice set at normal water level):

$$h_1 = HWL_{25mm} - \left[NWL + \frac{D}{2}\right] = 246.10 - \left[245.50 + \frac{0.095}{2}\right] = 0.5525\ m$$

where: HWL_{25mm} is the high water level for the 25 mm rainfall (246.10 m)
NWL is the normal water level (245.50 m)
D is the diameter of the orifice (0.095 m)

Solving [4] yields:

$$t_d = \frac{0.66\times(1293.3)\times(0.5525)^{1.5}+2\times(2217.0)\times(0.5525)^{0.5}}{2.75\times(0.007088)} = 187{,}064\ s = 52.0\ h$$

The orifice size, erosion control release rate, draw down time, extended detention volume and water level are summarized in **Table 5B**.

5.3.3 Quantity Control

As per the ORCA and the Township's standards, the SWM ponds shall be designed to control the post-development peak flow to pre-development levels for the 2-year through 100-year design storms and to safely convey the Regional flow.

A preliminary analysis of pond storage requirements based on the 6-hr, 12-hr and 24-hr SCS storm distribution, the 6-hr,12-hr and 24-hr AES storm distribution and the 4-hour Chicago storm distribution was completed using the VO5 model to determine the critical storm distribution (see **Table E.9**). Based on this analysis, the 6-hour SCS storm requires the largest storage volume, for both SWM ponds. Therefore, the 6-hour SCS storm distribution was determined to be the critical storm and was used to design both SWM ponds. The design storms were created using the 2014 City of Peterborough airport IDF data.

Tables 4A and **4B** show the VO5 simulation results for pre- and post-development drainage to the north and south, respectively. **Tables 5A** and **5B** show the SWM facility performance characteristics for each return period event based on the preliminary rating curve for the North and South SWM Ponds, respectively. As shown in **Tables 4A** and **4B**, the peak discharge rates are equal to or less than the target release rates.

The preliminary rating curve includes a control structure consisting of various orifies and an emergency spillway. The actual pond performance will be finalized and confirm at the detailed design stage. The preliminary rating curve is presented in **Table E.5** which is included in **Appendix "E"** together with the VO5 model schematic, catchments and modelling output.

North SWM Pond

The North SWM Pond has been designed with a total active storage volume of 9,165 m^3 at an elevation of 249.00 m. The expected maximum storage required during 100-year storm conditions is approximately 7,354 m^3. The provided active storage for the pond is therefore sufficient.

Table 4A. Summary of Storm Drainage Peak Flows to the North (Flow Node #1)

Return Period	Existing Peak Flows (m^3/s)	Proposed Peak Flow (m^3/s)
25mm Chicago	-	0.061
2-year	0.487	0.232
5-year	0.915	0.688
10-year	1.242	1.032
25-year	1.685	1.473
50-year	2.037	1.743
100-year	2.405	1.993

South SWM Pond

The South SWM Pond has been designed with a total active storage volume of 6,570 m^3 at an elevation of 247.50 m. The expected maximum storage required during 100-year storm conditions is approximately 3,811 m^3. The provided active storage for the pond is therefore sufficient.

Table 4B. Summary of Storm Drainage Peak Flows to the South (Flow Node #2)

Return Period	Existing Peak Flows (m^3/s)	Proposed Peak Flow (m^3/s)
25mm Chicago	-	0.021
2-year	0.275	0.091
5-year	0.522	0.269
10-year	0.712	0.433
25-year	0.974	0.649
50-year	1.182	0.808
100-year	1.398	0.945

5.3.4 Thermal Mitigation Measures

Mitigation measures shall be incorporated into the SWM pond design to minimize thermal impacts to the receiving watercourse. These measures include a bottom draw pipe and a planting strategy to promote shading along the pond perimeter.

Bottom Draw Pipe

Instead of the common perforated riser configuration, a bottom draw pipe will be implemented for the extended detention component to discharge water from the deepest section of the pond where the water temperature is lowest. This outlet consists of a submerged intake headwall and a bottom draw pipe which discharges via an orifice plate in the quality control structure. Given that this pipe is sized for frequent rainfall events (25mm storm), it will provide the greatest benefit to the thermal regime of the receiving watercourse.

Planting Strategy

In accordance with the Township and ORCA requirements, the SWM facility will be planted to provide a natural appearance and to provide environmental benefits. The landscape plan will specify shade producing species to minimize solar heating of the permanent pool during summer months. The forebay design provides additional pond perimeter where shade producing vegetation can be planted.

5.3.5 SWM Pond Inspection & Maintenance

The SWM ponds should be inspected periodically to determine the frequency of maintenance activities. As such, maintenance activities will be performed on an as-required basis. During the first two years of operation, it is recommended that the stormwater management facility be inspected following significant storm events to determine if and when maintenance activities are required. Subsequently, inspections should be carried out twice per year. The following items should be considered when inspecting the pond:

- Sediment accumulation to determine cleanout requirements;
- Erosion of side slopes and outfall channel;
- Safety hazards;
- Hydraulic operation of the pond;
- Drawdown time following a rainfall event (extended drawdown time greater than 52 hours may indicate a blocked orifice or intake);
- Condition of terrestrial and aquatic vegetation;
- Trash accumulation near hydraulic structures; and
- Surface sheen indicating possible oil contamination.

Table 5A: North SWM Pond Performance Summary

Quality Control		
Permanent Pool	Protection Level	Level 1 (Enhanced)
	Permanent Pool Required (m^3)	3,602
	Permanent Pool Provided (m^3)	4,429
	Normal Water Level, NWL (m)	**247.00**

Erosion Control		
25-mm 4-hour Chicago	Orifice Size (mm)	125
	Draw Down Time (hrs)	51.4
	Flow In (m^3/s)	0.989
	Flow Out (m^3/s)	0.025
	Storage Used (m^3)	2,437
	Pond W.S. Elevation (m)	**247.64**

Quantity Control		
2 Year Storm Event	Flow in (m^3/s)	1.881
	Flow Out (m^3/s)	0.150
	Storage Used (m^3)	3,602
	Pond W.S. Elevation (m)	**247.91**
5 Year Storm Event	Flow in (m^3/s)	2.763
	Flow Out (m^3/s)	0.456
	Storage Used (m^3)	4,487
	Pond W.S. Elevation (m)	**248.10**
10 Year Storm Event	Flow in (m^3/s)	3.388
	Flow Out (m^3/s)	0.701
	Storage Used (m^3)	5,065
	Pond W.S. Elevation (m)	**248.22**
25 Year Storm Event	Flow in (m^3/s)	4.207
	Flow Out (m^3/s)	1.009
	Storage Used (m^3)	5,866
	Pond W.S. Elevation (m)	**248.38**
50 Year Storm Event	Flow in (m^3/s)	4.840
	Flow Out (m^3/s)	1.186
	Storage Used (m^3)	6,594
	Pond W.S. Elevation (m)	**248.52**
100 Year Storm Event	Flow in (m^3/s)	5.689
	Flow Out (m^3/s)	1.341
	Storage Used (m^3)	7,354
	Pond W.S. Elevation (m)	**248.67**
Regional (Timmins)	Flow in (m^3/s)	2.368
	Flow Out (m^3/s)	1.547
	Storage Used (m^3)	8,569
	Pond W.S. Elevation (m)	**248.89**

Table 5B: South SWM Pond Performance Summary

Quality Control		
Permanent Pool	Protection Level	Level 1 (Enhanced)
	Permanent Pool Required (m^3)	1,754
	Permanent Pool Provided (m^3)	2,710
	Normal Water Level, NWL (m)	**245.50**

Erosion Control		
25-mm 4-hour Chicago	Orifice Size (mm)	95
	Draw Down Time (hrs)	52.0
	Flow In (m^3/s)	0.538
	Flow Out (m^3/s)	0.012
	Storage Used (m^3)	1,207
	Pond W.S. Elevation (m)	**245.98**

Quantity Control		
2 Year Storm Event	Flow in (m^3/s)	1.004
	Flow Out (m^3/s)	0.064
	Storage Used (m^3)	1,769
	Pond W.S. Elevation (m)	**246.17**
5 Year Storm Event	Flow in (m^3/s)	1.473
	Flow Out (m^3/s)	0.199
	Storage Used (m^3)	2,266
	Pond W.S. Elevation (m)	**246.33**
10 Year Storm Event	Flow in (m^3/s)	1.806
	Flow Out (m^3/s)	0.329
	Storage Used (m^3)	2,575
	Pond W.S. Elevation (m)	**246.42**
25 Year Storm Event	Flow in (m^3/s)	2.337
	Flow Out (m^3/s)	0.514
	Storage Used (m^3)	3,041
	Pond W.S. Elevation (m)	**246.56**
50 Year Storm Event	Flow in (m^3/s)	2.689
	Flow Out (m^3/s)	0.648
	Storage Used (m^3)	3,420
	Pond W.S. Elevation (m)	**246.67**
100 Year Storm Event	Flow in (m^3/s)	3.050
	Flow Out (m^3/s)	0.748
	Storage Used (m^3)	3,811
	Pond W.S. Elevation (m)	**246.78**
Regional (Timmins)	Flow in (m^3/s)	1.096
	Flow Out (m^3/s)	0.801
	Storage Used (m^3)	4,048
	Pond W.S. Elevation (m)	**246.84**

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5.4 Site Water Balance

In accordance with the requirements of the ORCA, a site water balance assessment for the subject development area was completed by GHD Ltd. and included in the Hydrogeological Assessment Report (March 28, 2021). The goal of the water balance assessment is to determine the overall infiltration deficit under proposed conditions and to design infiltration mitigation measures as part of an overall mitigation strategy to maintain pre-development infiltration volumes. The water balance assessment was completed based on the preliminary draft plan with a total site area of 49.22 ha. Excerpts from the GHD letter report regarding the water balance analysis are included in **Appendix "F"**. The findings of the GHD water balance analysis are summarized below.

For the pre-development condition, a total estimated infiltration of 70,356 m^3/year for the site was determined.

For the post-development condition, without infiltration enhancements, a total estimated infiltration of 42,674 m^3/year for the site was determined. This corresponds to a total infiltration deficit of 27,682 m^3/year, a 39% decrease in annual infiltration compared to the pre-development condition.

The decrease in annual infiltration indicates the need for Low Impact Development (LID) strategies be implemented in order to maintain pre-development infiltration rates. Primary enhancement LID measures identified by GHD include reducing lot grades, increasing topsoil depth, and directing residential roof leaders to grassed areas. Additional enhancement LID measures identified by GHD include, but are not limited to, rainwater harvesting, infiltration trenches, vegetated filter strips, bioretention, permeable pavement, enhanced grass swales, dry swales and perforated pipe systems.

The water budget calculations were repeated for the post-development condition, with the inclusion of roof downspout disconnection infiltration enhancement LIDs, which direct clean water from rooftops to lawn areas to be infiltrated. Based on this calculation, it was determined that the pre-development infiltration volume (70,356 m^3/year) can be maintained, resulting in no infiltration deficit.

Further refinement to the water balance calculations and the design of LID measures (if required) will be completed at detailed design.

6.0 VEHICULAR & PEDESTRIAN ACCESS

The layout of the proposed subdivision has been developed with consideration for efficient and safe access and circulation of both vehicular and pedestrian traffic.

6.1 Municipal Roads

The subject site has frontage on Fallis Line which is an original 20.0m wide concession road which is operated and maintained by the Township. This municipal road allowance consists of a two lane rural paved road with roadside ditches.

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The vehicular access to the subdivision will be facilitated by a connection Fallis Line as well as to Pristine Trail which was constructed in the adjacent subdivision to the east. The municipal roads will have an 8.5m pavement, crowned with 2% cross fall and edged with concrete curb and gutter. The longitudinal slope of the road will generally be 0.50% with some length of road ranging up to 5% slope. A copy of a typical road cross section is included in **Appendix "G"**.

Based on the recommendations contained in the Geotechnical Investigation Report for the site, the recommended minimum pavement structure for the proposed roads is as follows:

Municipal Roads

Material	Compacted Depth
HL3 Surface Course Asphalt	40mm
HL8 Base Course Asphalt	50mm
Granular "A"	150mm
Granular "B"	450mm

6.2 Driveways

Each dwelling will have an attached garage and driveway. The recommended pavement structure for the residential driveways is as follows:

Driveways

Material	Compacted Depth
HL3 Surface Course Asphalt	40mm
Granular "A"	150mm

The residential driveways will be either single or double car width. The slope of driveways is to be within the range of 1.0% to 7.0% in accordance with Township criteria.

6.3 Sidewalks, Walkways & Trails

Internal pedestrian access will be provided by standard 1.5m wide concrete sidewalks to safely guide residents through the subdivision for access to the proposed sidewalks on Fallis Line as well as the proposed sidewalks within the adjacent subdivision to the east. Sidewalks will be generally be constructed on one side of each road.

Walkway blocks will be provided at the south end of Street "A" as well as on the south side of Street "M" to facilitate access to the open space lands. Standard details for the sidewalk including details for the required tactile walking surface indicators is included in **Appendix "G"**.

7.0 GRADING

As is typical will all subdivision, earthmoving is required, to varying degrees, in order to achieve the municipal design criteria and accommodate the development form.

7.1 Grading Criteria

The subject site is to be graded in accordance with the Township grading criterion which dictates that road grades are to range from 0.5% to 5.0% and that sodded yard areas are to range from 2.0% to 5.0%. For large grade differentials, a maximum slope 3H : 1V can be used for sodded embankments. In areas where space is limited, retaining walls can be utilized to accommodate grade differentials, however, their use should be minimized.

7.2 Preliminary Design

Based on the topographic survey, the proposed subdivision configuration and the Township's criteria, a preliminary grading design has been prepared. The preliminary grading design, considered the following factors:

- Achieve the Township's lot grading criteria.
- Meet the Township's vertical road design parameters.
- Minimize the requirement for retaining walls.
- Match existing grades along the adjacent properties and road allowances.
- Grading along existing road allowances is to have consideration for their future urbanization and grades are to be established to accommodate future boulevard slopes in the range of 2 to 4%.
- Provide an overland flow route to direct drainage to a safe outlet.
- Provide sufficient cover over the sanitary sewer.

The design is provided on the **Preliminary Servicing & Grading Plan**. An analysis of the earthworks will be conducted using digital terrain modelling software at the detailed design stage to optimize the cut and fill volumes in an effort to achieve a balance. Based on the preliminary design, no significant difficulties are anticipated in achieving the municipal grading design standards.

7.3 Permitting

A review of the Regulation Mapping indicates that the subject site is located within an area that is regulated by the ORCA. A grading permit is therefore required from their office under Ontario Regulation 166/06 prior to commencing topsoil stripping and earthworks. The permit application should be submitted in conjunction with the detailed design at the subdivision engineering stage.

8.0 EROSION & SEDIMENT CONTROL DURING CONSTRUCTION

Construction activity, especially operations involving the handling of earthen material, dramatically increases the availability of particulate matter for erosion and transport by surface drainage. In order to mitigate the adverse environmental impacts caused by the release of silt-laden stormwater runoff into receiving watercourses, measures for erosion and sediment control are required for construction sites. This is an extremely important component of land development that plays a large role in the protection of downstream watercourses and aquatic habitat.

The impact of construction on the environment is recognized by the Greater Golden Horseshoe Area Conservation Authorities. In December 2006 they released their document titled Erosion &

Sediment Control Guidelines for Urban Construction (ESC Guideline). This document provides guidance for the preparation of effective erosion and sediment control plans.

Control measures must be selected that are appropriate for the erosion potential of the site and it is important that they be implemented and modified on a staged basis to reflect the site activities. Furthermore, their effectiveness decreases with sediment loading and therefore inspection and maintenance is required. The selection, implementation, inspection and maintenance of the control features are summarized as follows:

8.1 Control Measures

On relatively large sites, measures for erosion and sediment control typically include the use of sediment control basins, silt fencing, a mud mat and sediment traps. The following is a description of the sediment controls to be implemented on the subject site:

- **Temporary Sediment Control Basins** are commonly used to clarify silt-laden stormwater runoff by promoting sedimentation of the suspended particles in the runoff through long detention times. The proposed SWM ponds will be utilized as temporary sediment control basins during construction. The basins are to be sized in accordance with the ESC Guideline based on a required storage volume of 250 m^3 per hectare of disturbed area (125 m^3/ha of permanent pool and 125 m^3/ha of active storage). The basins' outlets are to have a Hickenbottom riser and a minimum 75 mm diameter orifice plate sized to provide a drawdown time in the order of 48 hours.
- **Silt Fences** are to be installed adjacent to all property limits subject to drainage from the development area prior to topsoil stripping and in other locations, such as at the bases of topsoil stockpiles. It is recommended that earthworks not extend immediately adjacent to the silt fence and instead 1m to 2m vegetated buffer be maintained for additional protection. The silt fences are to be constructed with 150 x 150mm wire farm fence fabric to properly support the geotextile. Heavy duty silt fence is recommended to be installed adjacent the South Wetland consisting of two rows of fence with a row of staked straw bales between.
- **Mud Mat** is to be installed at the construction entrance prior to commencing earthworks to minimize the tracking of mud onto municipal roads.
- **Sediment Traps** are to be installed at all catchbasin locations once the storm sewer system has been constructed to prevent silt laden runoff from entering.
- **Rock Check Dams** are to be constructed in swales and ditches to reduce velocities and trap sediment.

A set of Erosion and Sediment Control Plans are to be prepared at the detailed engineering design stage to reflect the various construction stages. Details of typical erosion and sediment control measures are included in **Appendix "I"**.

8.2 Construction Sequencing

The following is a summary of the scheduling of construction activities and the related implementation of sediment controls:

Stage 1 – Subdivision Earthworks

1. Construct mud mat for temporary construction access.
2. Install primary silt fencing around the limits of grading and secondary silt fencing along the south limit of the work area adjacent the existing wetland.
3. Install temporary swales and rock check dams.
4. Excavate and construct the temporary sediment basins including installation of hickenbottom drain and spillway and connect to temporary swales.
5. Strip any remaining topsoil, stockpile where indicated and install silt fence around the perimeter.
6. Rough grade the site by placing cut material in fill areas and spreading and compacting of imported fill. Maintain the mud mat to minimize the tracking of silt onto the municipal road and provide street sweeping as necessary.

Stage 2 – Subdivision Servicing & Road Construction

1. Install underground servicing, covering the end of the pipe at the end of each work day to ensure that silt does not enter the storm sewer.
2. Construct roads, install sediment controls on catchbasins and install temporary hickenbottom drains at low point of lot blocks.

Stage 3 – House Construction

1. Construct houses and maintain all sediment controls including regular street sweeping and catchbasin cleaning.
2. Stabilize all lot surfaces as soon as possible after completion of the houses.
3. Remove silt fencing on a phased basis as areas are stabilized.

8.3 ESC Inspection & Maintenance

In order to ensure that the erosion and sediment control measures operate effectively, they are to be regularly monitored and they will require periodic cleaning (e.g., removal of accumulated silt), maintenance and/or re-construction.

Inspections of all of the erosion and sediment controls on the construction site should be undertaken with the following frequency:

- On a weekly basis
- After every rainfall event
- After significant snow melt events
- Prior to forecasted rainfall events

If damaged control measures are found they should be repaired and/or replaced within 48 hours. Site inspection staff and construction managers should refer to the Erosion and Sediment Control Inspection Guide (2008) prepared by the Greater Golden Horseshoe Area Conservation Authorities. This Inspection Guide provides information related to the inspection reporting, problem response and proper installation techniques.

9.0 UTILITIES

While some external upgrades may be necessary by the utility providers, it is anticipated that utilities such as hydro, natural gas, cable television, and telephone service will be available to service the subject development. As per standard practice in subdivisions, utilities will be installed underground. Co-ordination with the local hydro authority, Hydro One Networks Inc., and the various utility companies including Enbridge Gas Distribution Inc. (natural gas) and Nexicom Inc. (cable & telephone) will be undertaken at the detailed engineering design stage to determine appropriate locations for pedestals, transformers and street lights.

It is recommended that the utility installation be in the form of a four party joint trench. The process of joint trenching allows all of the utility companies to co-ordinate the placement of their lines in a common trench excavated by a single utility contractor. Four party joint trenching maximizes the efficiency of the available area in the utility corridor and provides for a safe installation. A copy of a typical four party joint trench detail is included in **Appendix "J"**.

10.0 SUMMARY

Based on the analysis contained herein, the proposed residential subdivision can be adequately serviced with full municipal services (watermain, wastewater and storm) in accordance with the standards of the Township of Cavan Monaghan, the County of Peterborough and the Otonabee Region Conservation Authority design criteria and consists of the following:

Water

- The community of Millbrook is currently serviced by a well based water system with a treatment plant and water storage tank. A trunk watermain was constructed on County Road 10 which extends to a water storage tank located on the existing site of the municipal offices. This trunk system feeds the existing subdivision to the west including as well as the existing Fallis Line watermain. It is proposed to service the subject subdivision via the extension of the 250mm diameter Fallis Line watermain as well as a connection to the 250mm diameter water on the road stub of Pristine Trail in the adjacent subdivision.
- The water service connections for the individual detached dwelling units will be 25mm diameter.

Waste Water

- It is proposed to service the lots on Street "A" via a connection to the existing 250mm diameter sanitary sewer on Pristine Trail at the east limit of the subject site with the balance of the site to be serviced by a new WWTP to be constructed within the subject site.
- Availability of treatment capacity to service new development in the existing WWTP is currently being reviewed by the Township of Cavan Monaghan. In addition, the Township has been searching for a location to construct a new treatment facility in order to meet its projected growth target over the long term. A second treatment facility is therefore being proposed on the subject site to service the subject lands which can be phased to also service future development. Treatment capacity will therefore be available either through the existing WWTP or the proposed WWTP and it will be a condition of development that will need to be satisfied for registration and release of building permits. As such it is expected that prior to approval there will be sufficient planned capacity in a centralized waste water treatment facility to service the proposed development.
- The subject site will be serviced by a local sanitary system consisting of 200mm diameter sewers. Each dwelling unit will be provided with a 100mm diameter single connection in accordance with Township standards.

Storm Drainage

- The subject site is located in the Baxter Creek subwatershed. The Baxter Creek drains to the Otonabee River which discharges to Rice Lake.
- In accordance with Township criteria, the subject site will be serviced by minor system comprised of a municipal storm sewer sized for the 5-year storm event. The storm sewer system will outlet to one of two SWM ponds.
- The major system will be comprised of an overland flow route which will convey runoff from rainfall events in excess of the capacity of the municipal storm sewer to a safe outlet.

Stormwater Management

- Two SWM ponds will be constructed to service the subject property, for drainage to the north and to the south. These facilities have been designed as wet ponds to provide Enhanced (Level 1) water quality treatment, extended detention for erosion control and flood control using the calculated pre-development flow targets up to and including the 100-year storm event. The SWM ponds consists of a sediment forebay and a main cell separated by a forebay berm.
- Thermal mitigation measures are to be incorporated in the design of the SWM ponds, including bottom draw pipe and a planting strategy to provide shading around the pond perimeter.
- A site water balance assessment has been undertaken to ensure that pre-development infiltration volumes are maintained. Based on the analysis it was determined that the pre-development infiltration volumes can be achieved through roof downspout disconnections.

Vehicular & Pedestrian Access

- Vehicular access to the subject site will be provided by a road connection to Fallis Line as well as a road connection to Pristine Trail in the adjacent subdivision to the east.
- The proposed local roads will be constructed to urban standards having an 8.5m pavement width within 18.0m and 20.0m wide road allowances.
- Pedestrian access will be provided by 1.5m wide concrete sidewalks which are to be generally located on one side of each road. In addition, walkway connections will be provided to the open space lands to the south

Grading

- As is typical with large subdivision projects, earthmoving will be required to achieve the proposed subdivision grading necessary to meet the criteria of the Township. A detailed analysis of the earthworks will be conducted at the detailed design stage to optimize the cut and fill volumes. Based on the preliminary design, no significant difficulties are anticipated in achieving the municipal grading design standards.
- Since the subject site is located in an area which regulated by the ORCA, a permit will be required from their office prior to commencing earthworks.

Erosion & Sediment Control During Construction

- Erosion and sediment control (ESC) measures are to be implemented during construction to prevent silt laden runoff downstream in accordance with the Erosion & Sediment Control Guidelines for Urban Construction (December 2006). The ESC plans are to be prepared at the detailed engineering design stage and are to reflect the various construction stages.

Subdivision Engineering Design

- Detailed design for the proposed development is to be prepared at the subdivision engineering stage. This detailed design is to include servicing and grading plans as well as a stormwater management report based on the criteria established in this Functional Servicing Report.

11.0 REFERENCES & BIBLIOGRAPHY

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Respectfully Submitted,

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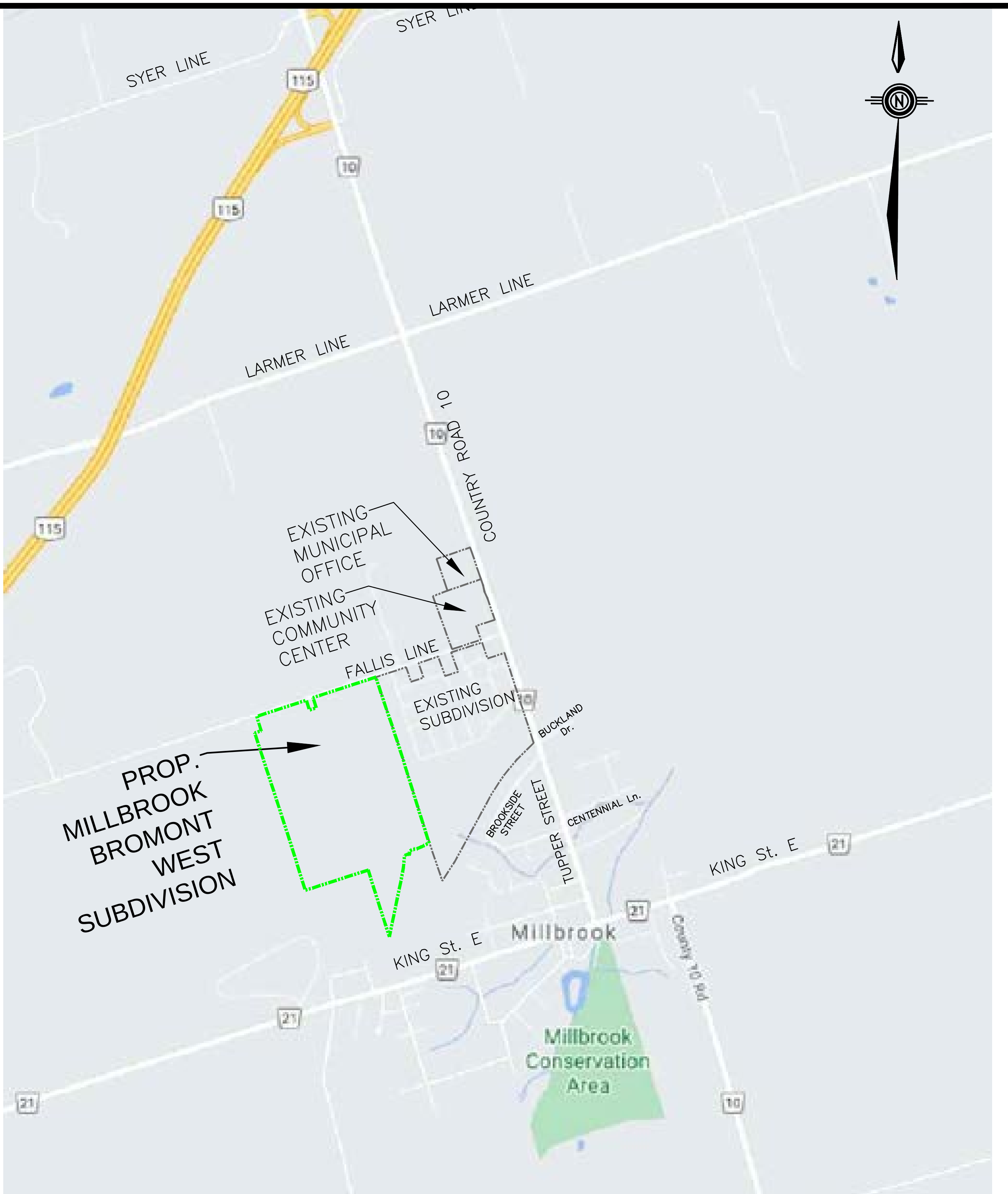

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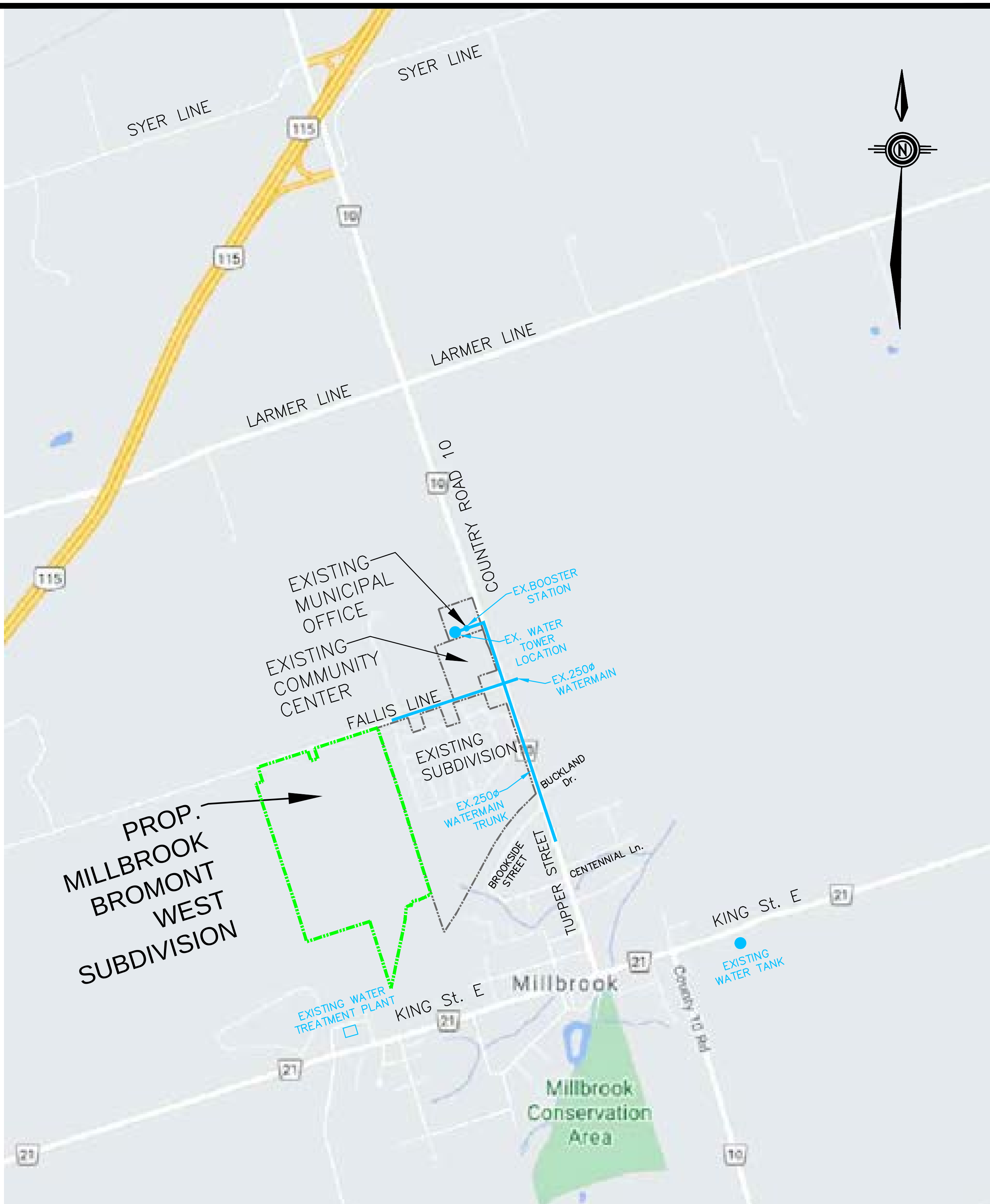
LOCATION MAP	SCALE N.TS.	PROJECT 16119	FIGURE 1	
	DATE May, 2021	DRAWN BY V.L.		

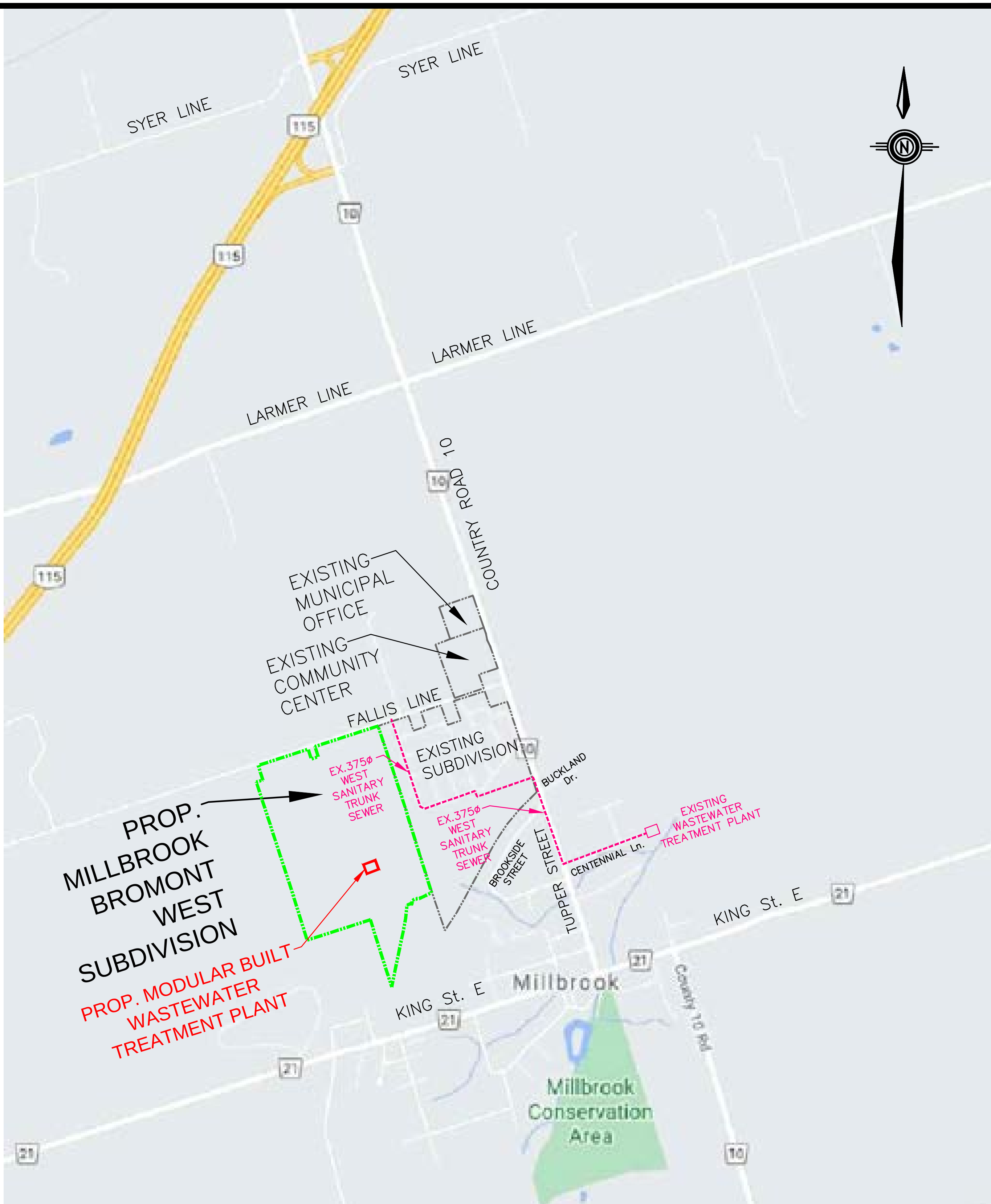


MILLBROOK SOUTH WEST SUBDIVISION

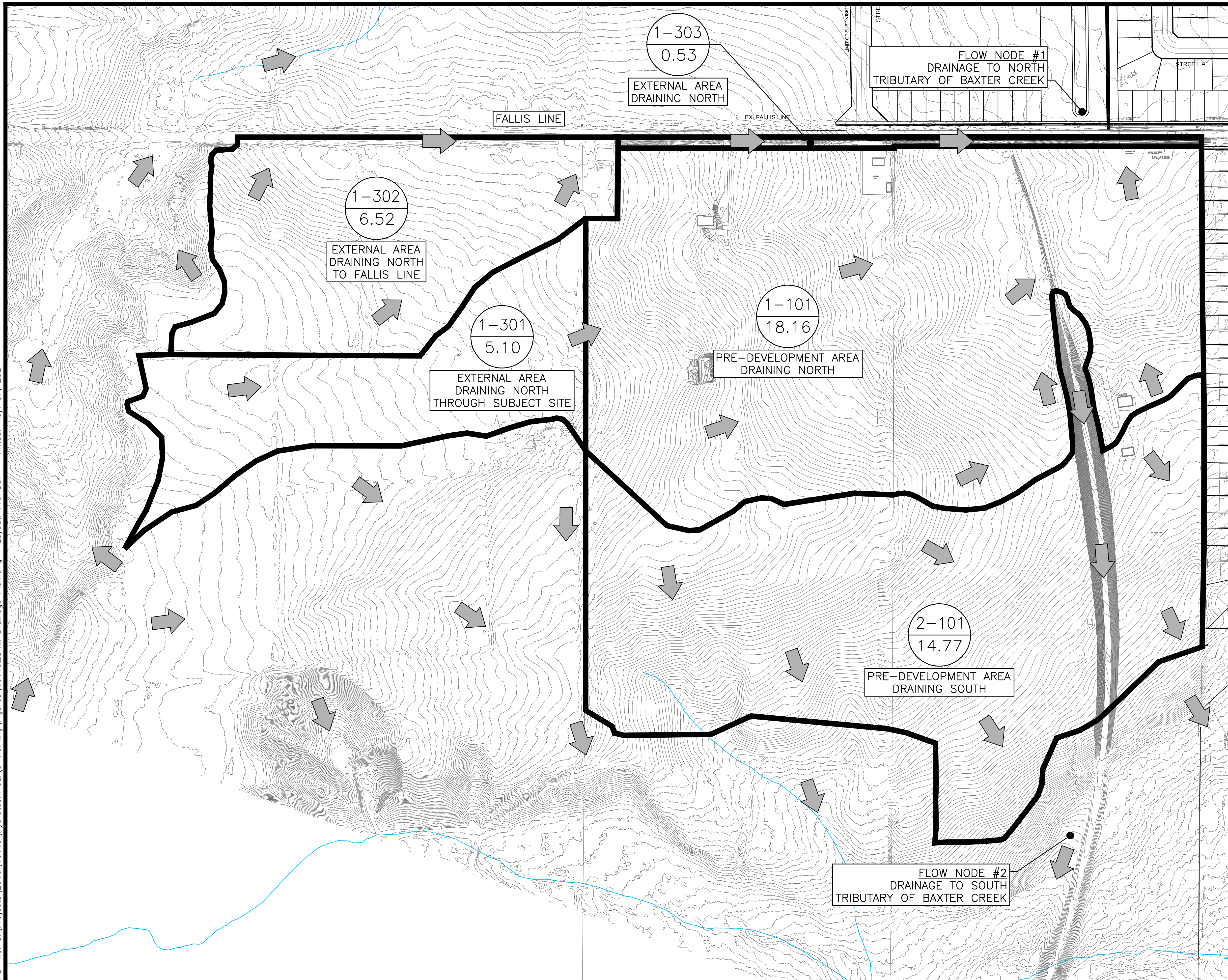
WATER SERVICING EXTERNAL

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

SCALE N.T.S.		PROJECT 16119		FIGURE 2
DATE May, 2021		DRAWN BY V.L.		



MILLBROOK SOUTH WEST SUBDIVISION	VALDOR ENGINEERING INC. Consulting Engineers - Project Managers 741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9 TEL (905)264-0054, FAX (905)264-0069 E-MAIL: info@valdor-engineering.com www.valdor-engineering.com
WASTEWATER SERVICING EXTERNAL	SCALE N.T.S. | PROJECT 16119 | DATE May, 2021 | DRAWN BY V.L. | FIGURE 3



LEGEND

(thin line)	EXISTING CONTOUR
(thick line)	DRAINAGE BOUNDARY
1-101	CATCHMENT ID
18.16	AREA (HA)
(arrow)	OVERLAND FLOW

PROJECT	MILLBROOK SOUTH WEST SUBDIVISION
TITLE	SWM DRAINAGE PLAN PRE-DEVELOPMENT

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
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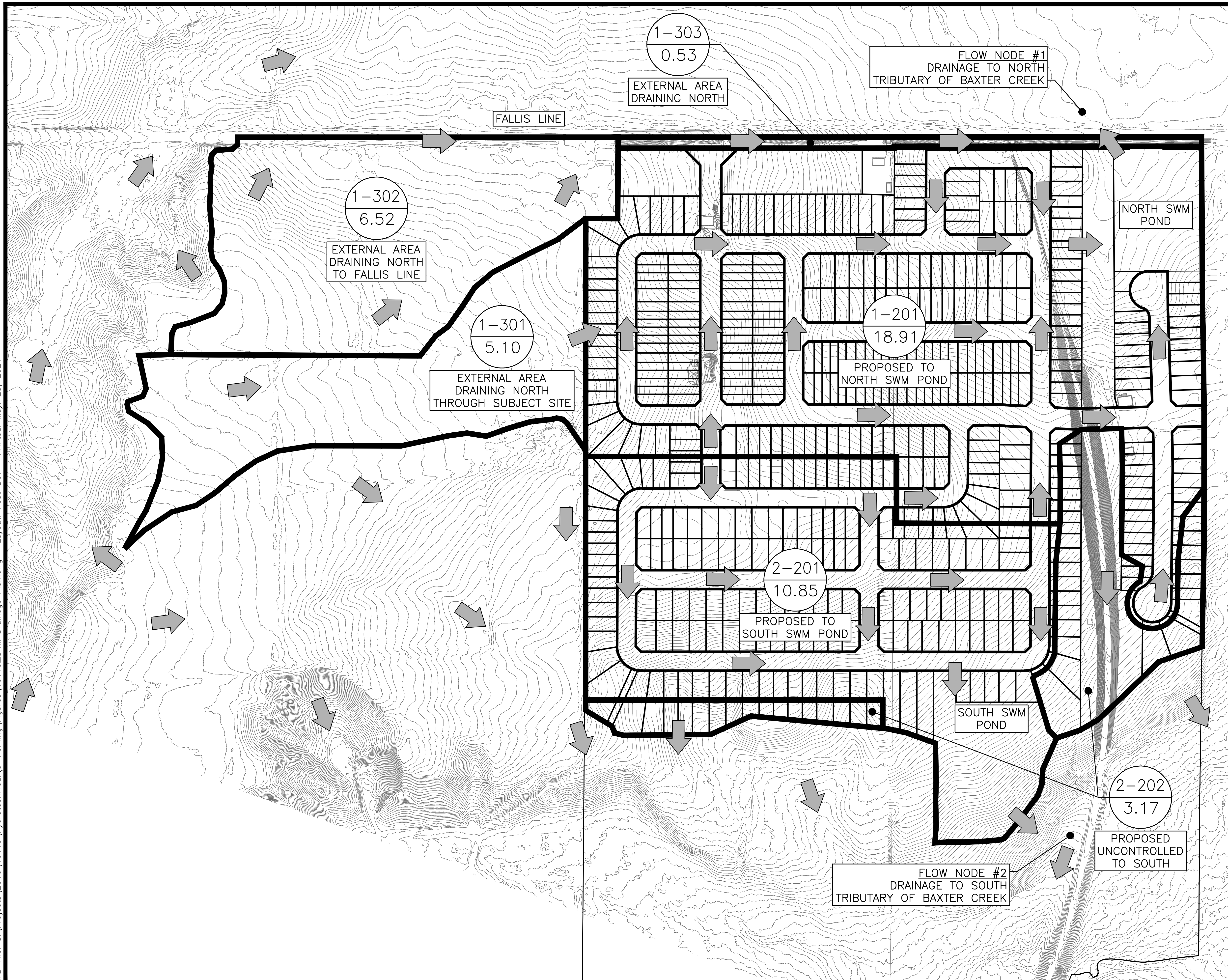
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

PREPARED BY	O.B.	CKD. BY	O.B.
SCALE	NTS	DATE	MAY 2021
PROJECT	16119	FIGURE 4A	

ACAD File: S:\Projects\2016\16119\Hydrotechnical\0-Working\Figures\16119_SWM Drainage Plan.dwg Layout: Pre-Dev Printed: May. 07, 2021



LEGEND

(thin line)	EXISTING CONTOUR
(thick line)	DRAINAGE BOUNDARY
1-201	CATCHMENT ID
18.91	AREA (HA)
(arrow)	OVERLAND FLOW

PROJECT	MILLBROOK SOUTH WEST SUBDIVISION
TITLE	SWM DRAINAGE PLAN POST-DEVELOPMENT

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
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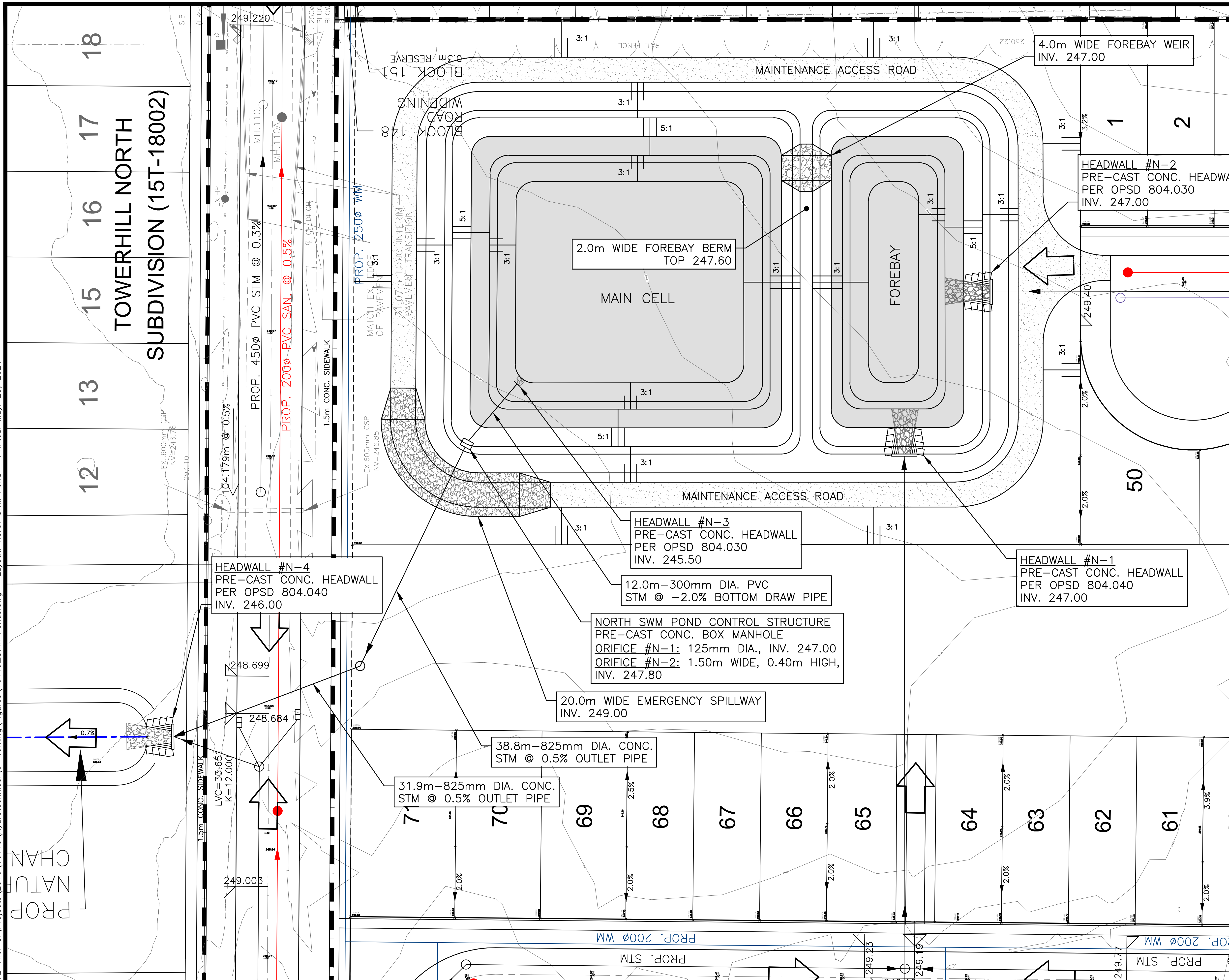
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

PREPARED BY	O.B.	CKD. BY	O.B.
SCALE	NTS	DATE	MAY 2021
PROJECT	16119		**FIGURE 4B**

ACAD File: S:\Projects\2016\16119\Hydrotechnical\0-Working\Figures\16119_SWM Drainage Plan.dwg Layout: Post-Dev Printed: May. 25, 2021



LEGEND

- OVERLAND FLOW
- PERMANENT POOL
- RIP-RAP EROSION PROTECTION
- MAINTENANCE ACCESS ROAD

RETURN PERIOD	POND WSEL (m)
25 mm	247.64
2-YEAR	247.91
5-YEAR	248.10
10-YEAR	248.22
25-YEAR	248.38
50-YEAR	248.52
100-YEAR	248.67
REGIONAL	248.89

PROJECT
MILLBROOK SOUTH WEST SUBDIVISION

TITLE
PRELIMINARY NORTH SWM POND

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
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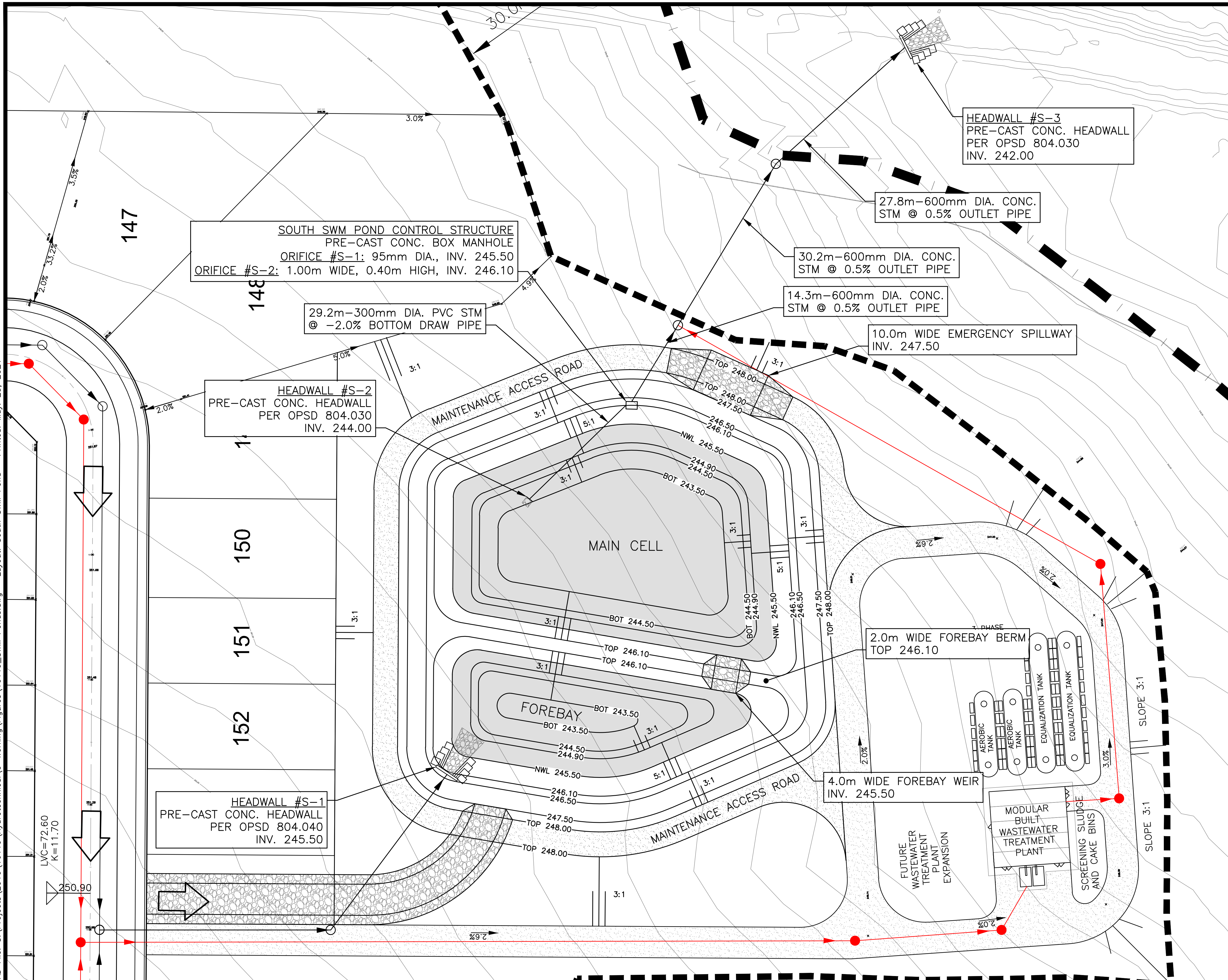
PREPARED BY O.B.	CKD. BY O.B.
SCALE 1:600	DATE MAY 2021
PROJECT 16119	**FIGURE 5A**

ACAD File: S:\Projects\2016\16119\Hydrotechnical\0-Working\Figures\16119_SWM Ponds.dwg Layout: North SWM Pond Printed: May. 25, 2021



LEGEND

- OVERLAND FLOW
- PERMANENT POOL
- RIP-RAP EROSION PROTECTION
- MAINTENANCE ACCESS ROAD

RETURN PERIOD	POND WSEL (m)
25 mm	245.98
2-YEAR	246.17
5-YEAR	246.33
10-YEAR	246.42
25-YEAR	246.56
50-YEAR	246.67
100-YEAR	246.78
REGIONAL	246.84

PROJECT
MILLBROOK SOUTH WEST SUBDIVISION

TITLE
PRELIMINARY SOUTH SWM POND

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
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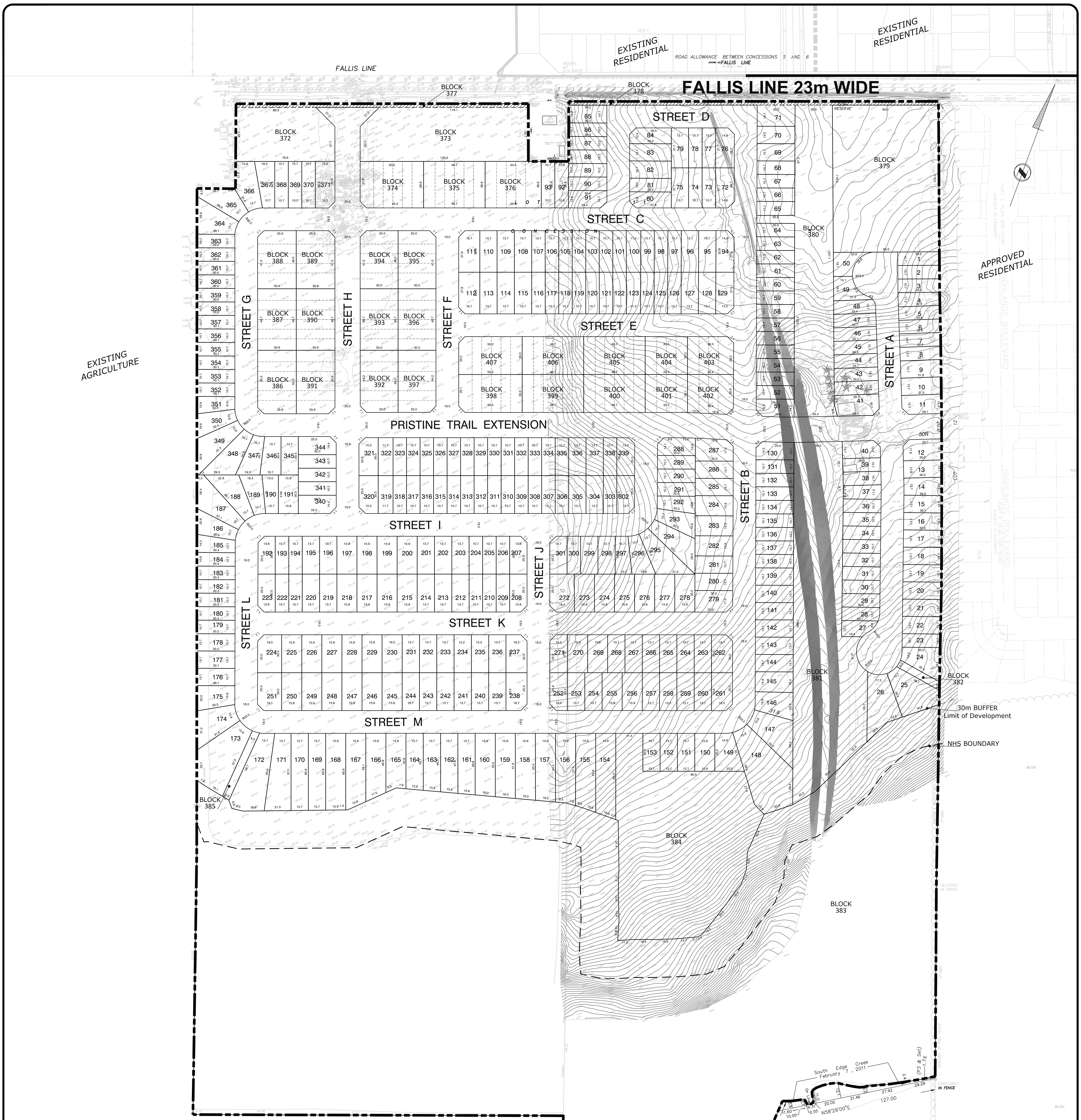
www.valdor-engineering.com

PREPARED BY O.B.	CKD. BY O.B.
SCALE 1:600	DATE MAY 2021
PROJECT 16119	**FIGURE 5B**

APPENDIX "A"

Draft Plan of Subdivision



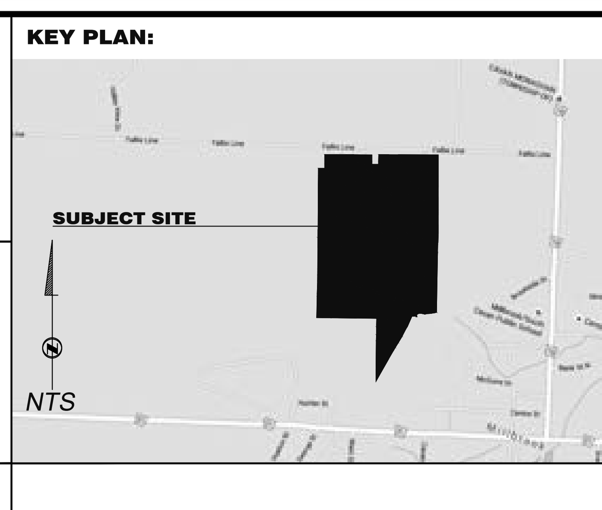
Schedule of Land Use

	Units		Blocks	Area (ha)
7.62m (24') Street Townhouse	125		374-376, 386-407	3.57
10.7m (35') Single Detached	208	C	1-8, 23, 24, 27-48, 51-68, 72-74, 76-78, 80, 81, 85-94, 97-107, 116-126, 129-138, 179-190, 192-194, 204-211, 221-223, 252, 271, 279-281, 285-297, 300-303, 306-335, 338-344, 347-363, 366-371	7.61
13.7m (45') Single Deatched	106	B	9-22, 25, 49, 50, 69-71, 75, 79, 82-84, 95, 96, 108-115, 127, 128, 139-144, 151-153, 161-164, 169-172, 176-178, 191, 195, 196, 201-203, 212,-214, 219, 220, 231-244, 253, 254, 257-268, 298, 299, 304, 305, 336, 337, 345, 346, 364, 365,	4.93
15.9m (52') Single Detached	57	A	145-150, 154-160, 165-168, 173-175, 197-200, 215-218, 224-230, 245-251, 255, 256, 269, 270, 272-278, 282-284,	3.56
Medium Density (5-Storey Building)	200		372, 373	0.88
TOTAL	696			**20.54**
Parkland & Trails			380, 381, 382, 385	2.06
Natural Heritage System			383	16.43
Stormwater Management Pond			379, 384	2.34
Road Widening			377, 378	0.16
R.O.W.			PRISTINE TRAIL EXTENSION, STREETS A-M	7.68
TOTAL SUBJECT SITE				**49.21**

TITLE:

DRAFT PLAN OF SUBDIVISION

KEY PLAN:



LEGAL DESCRIPTION:

DRAFT PLAN OF PROPOSED SUBDIVISION
PART OF LOT 11, CONCESSION 5
(Geographic Village of Millbrook, Township of Cavan)
PART OF LOT 11, CONCESSION 5 (Geographic Township of Cavan)
TOWNSHIP OF CAVAN-MONAGHAN
NORTH MONAGAN
(COUNTY OF PETERBOROUGH)

787 - 825 Fallis Line West
Township of Cavan Monaghan

NOTE:
DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AS SHOWN ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATE AND CORRECTLY SHOWN IN ACCORDANCE WITH A PLAN OF SURVEY PREPARED BY:SURVEYOR_COMPANY

SURVEYOR_NAME — SURVEYOR'S_DATE
SURVEYOR_COMPANY

OWNER'S CERTIFICATE

I HEREBY AUTHORIZE THE BIGLIERI GROUP LTD. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE MUNICIPALITY

OWNER'S_NAME — OWNER'S_DATE
COMPANY'S_NAME

REQUIRED INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT R.S.O. 1990.

(a) SEE PLAN
(b) SEE PLAN
(c) SEE KEY MAP
(d) SEE SCHEDULE OF LAND USE
(e) SEE PLAN
(f) SEE PLAN
(g) SEE PLAN
(h) MUNICIPAL WATER AND SEWAGE AVAILABLE
(i)
(j) SEE PLAN
(k) MUNICIPAL WATER AND SEWAGE AVAILABLE
(l) SEE PLAN

NOTE: CONTOURS RELATE TO CANADIAN GEODETIC DATUM

REVISIONS

No.	Description	Date	Int.
3			
2			
1			

PROJECT No.:	20697
DATE:	May 13, 2021
SCALE:	1:1500
DRAFTED BY: JS	CHECKED BY: MT
DRAWING No.:	**DP-01**

THE BIGLIERI GROUP LTD.
Planning | Development | Project Management | Urban Design
20 Leslie Street, Suite 121, Toronto, Ontario M4M 3L4
126 Catharine Street North, Hamilton, Ontario, L8R 1J4
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VALDOR ENGINEERING INC.
741 Rowntree Dairy Road, Suite 2, Woodbridge, ON L4L 5T9
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

TABLE: A1

EQUIVALENT POPULATION

Project Name: **Millbrook South West Subdivision**
File: 16119
Date: May 2021

Land Use	Area (Hectares)	Criteria	No. of Units	Equivalent Population
Detached Dwellings	16.09	3.50 persons per unit	371	1,299
Street Townhomes	3.57	3.50 persons per unit	125	438
Medium Density	0.88	2.00 persons per unit	200	400
Parkland & Trails	2.06			
Natural Heritage Systems	16.43			
Stormwater Management Ponds	2.34			
Roads & Road Widenings	7.84			
Total:	**49.21**		**696**	**2,136**

APPENDIX "B"

Water Demand Calculations & Details

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Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

TABLE: B1

DOMESTIC WATER DEMAND CALCULATION

Project Name: **Millbrook South West Subdivision, Township of Cavan Monaghan**
File: 16119
Date: May 2021

Conditions:		
Residential Average Day Demand	450	L/person/day
Maximum Day Factor	2.0	
Peak Hour Factor	3.0	

Land Use	**Equivalent Population** (persons)	**Domestic Demand** (L/min)	**Maximum Day Demand** (L/min)	**Peak Hour Demand** (L/min)
Detached Dwellings	1,299	405.9	811.9	1,217.8
Street Townhomes	438	136.9	273.8	410.6
Medium Density	400	125.0	250.0	375.0
Total	**2,136**	**667.8**	**1,335.6**	**2,003.4**

VALDOR ENGINEERING INC.
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www.valdor-engineering.com

TABLE: B2-1

CALCULATION OF REQUIRED FIRE FLOW

In accordance to Water Supply for Public Fire Protection, Fire Underwriters Survey 1999

Project Name: **Millbrook South West Subdivision**
File: 16125
Date: May 2021

Notes: **DETACHED DWELLING**
Assume:
- 3,500 sq.ft total floor area
- interior unit for max exposure

Type of Construction - Wood Frame

$C =$ 1.5

Total Floor Area: 325 sq.m
$A =$ 325 sq.m

(Total Floor Area includes all storeys, but excludes basements at least 50 percent below grade)

$F = 220\,C\,\sqrt{A}$

$F =$ 5,949 L/min

$F =$ 6,000 (to nearest 1,000 Lmin)

Occupancy Factor

		Charge
Type:	Non-Combustible	-25%
	$f_1 =$	-25%

$F' = F \times (1+f_1)$

$F' =$ 4,500 L/min

Sprinkler Credit

		Charge
NFPA 13 Sprinkler Standard:	NO	0%
Standard Water Supply:	NO	0%
Fully Supervised System:	NO	0%
Total Charge to Fire Flow:	$f_2 =$	0%

Exposure Factor

		Charge
Side 1 - Distance to Building (m):	0 to 3m	25%
Side 2 - Distance to Building (m):	0 to 3m	25%
Side 3 - Distance to Building (m):	3.1 to 10m	20%
Side 4 - Distance to Building (m):	3.1 to 10m	20%
	$f_3 =$	75% (maximum of 75%)

$F'' = F' + F' \times f_2 + F' \times f_3$

$F'' =$ 7,875 L/min

REQUIRED FIRE FLOW

$F'' =$ **8,000** **L/min** (to nearest 1,000 L/min)

VALDOR ENGINEERING INC.
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www.valdor-engineering.com

TABLE: B2-2

CALCULATION OF REQUIRED FIRE FLOW

In accordance to Water Supply for Public Fire Protection, Fire Underwriters Survey 1999

Project Name: **Millbrook South West Subdivision**
File: 16125
Date: May 2021

Notes: **STREET TOWNHOMES DWELLING**
Assume:
- 2,500 sq.ft total floor area
- interior unit for max exposure

Type of Construction - Wood Frame
C = 1.5

Total Floor Area: 233 sq.m
A = 233 sq.m
(Total Floor Area includes all storeys, but excludes basements at least 50 percent below grade)

$F = 220\,C\,\sqrt{A}$
F = 5,037 L/min
F = 5,000 (to nearest 1,000 Lmin)

Occupancy Factor

		Charge
Type:	Non-Combustible	-25%
	f_1 =	-25%

$F' = F \times (1+f_1)$
F' = 3,750 L/min

Sprinkler Credit

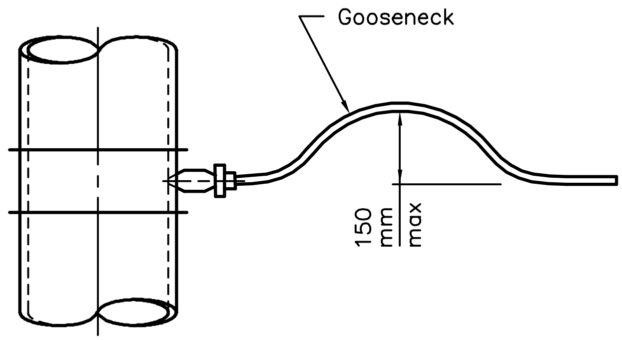
		Charge
NFPA 13 Sprinkler Standard:	NO	0%
Standard Water Supply:	NO	0%
Fully Supervised System:	NO	0%
Total Charge to Fire Flow:	f_2 =	0%

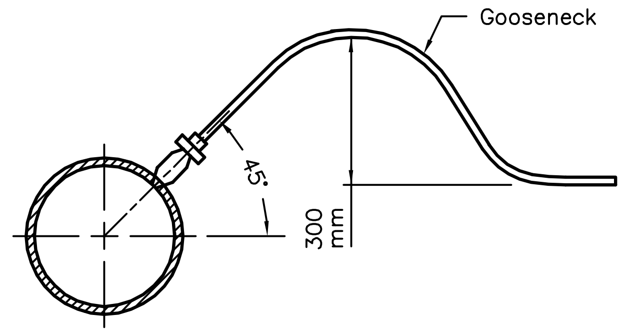
Exposure Factor

		Charge
Side 1 - Distance to Building (m):	0 to 3m	25%
Side 2 - Distance to Building (m):	0 to 3m	25%
Side 3 - Distance to Building (m):	3.1 to 10m	20%
Side 4 - Distance to Building (m):	3.1 to 10m	20%
	f_3 =	75% (maximum of 75%)

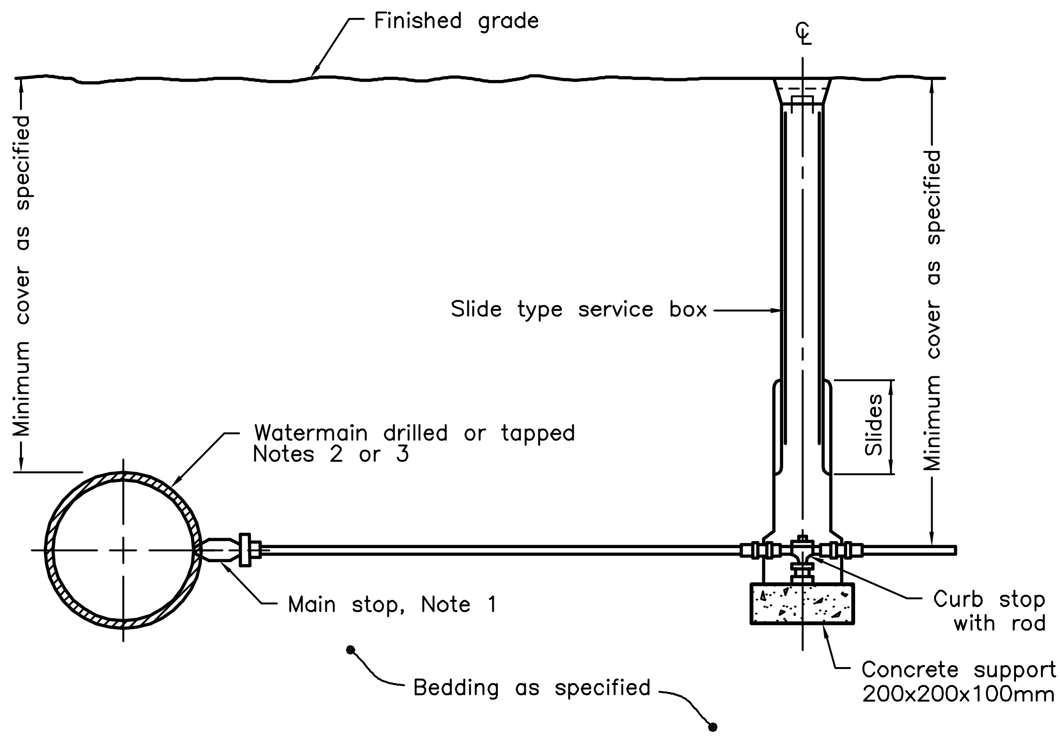
$F'' = F' + F' \times f_2 + F' \times f_3$
F'' = 6,563 L/min

REQUIRED FIRE FLOW
F'' = **7,000** **L/min** (to nearest 1,000 L/min)





HORIZONTAL GOOSENECK | **VERTICAL GOOSENECK OPTION**



VERTICAL SECTION

NOTES:

1 For plastic service pipes, install main stop at 15° above horizontal with a minimum 1.2m long gooseneck.

2 Direct tap ductile iron pipe with approved tool with standard AWWA inlet thread.

3 Service connections to plastic watermains shall be made using service saddles or factory made tees.

A When specified, the vertical gooseneck option shall be used.

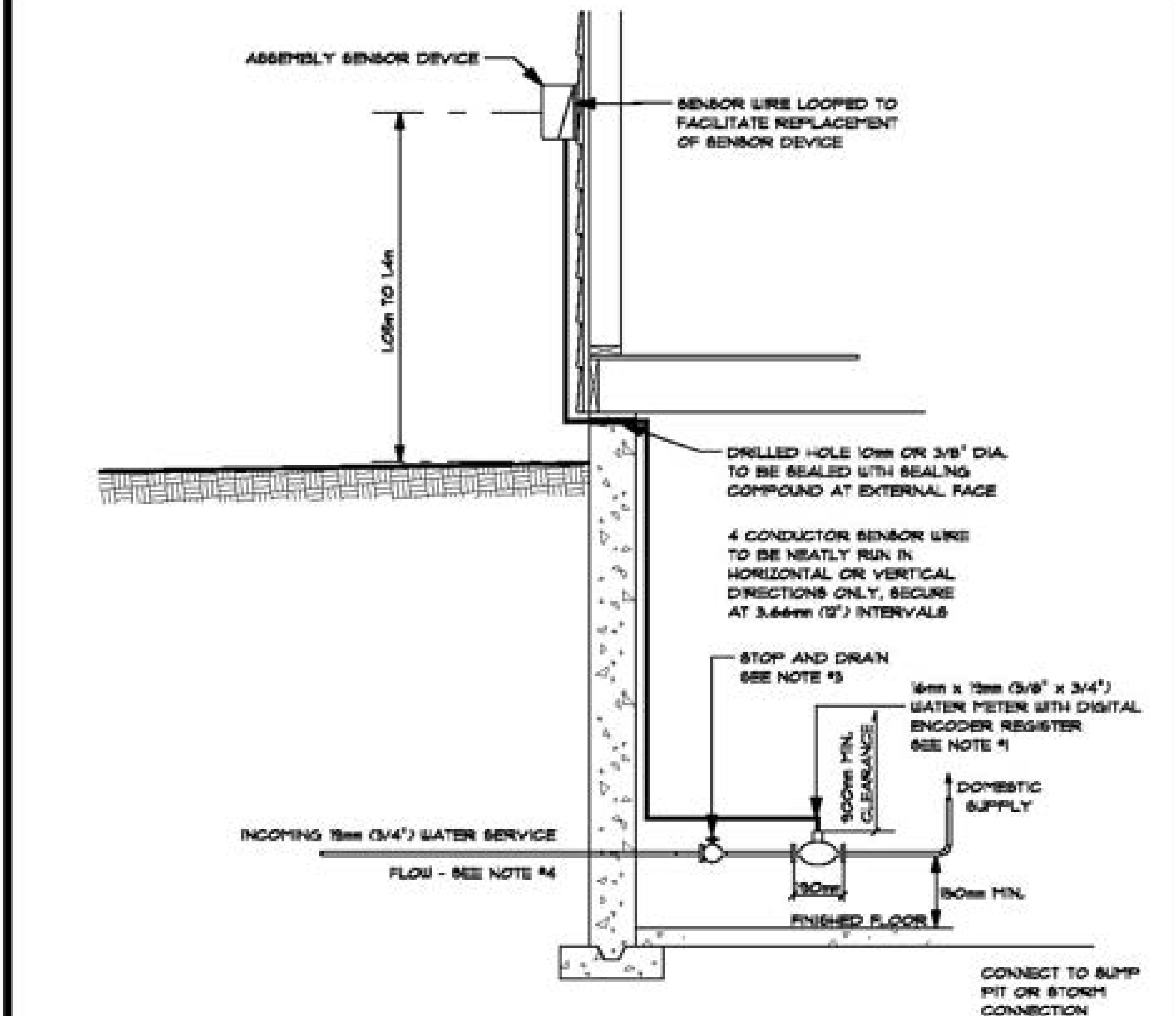
B Couplings shall not be permitted unless the service length exceeds 20m between the main stop and curb stop.

C All water services shall be installed 90° to the longitudinal axis of the watermain.

D Backfill material within 500mm of service box shall be native or imported, as specified.

E All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2013	Rev 3
WATER SERVICE CONNECTION 19 and 25mm DIAMETER SIZES	**OPSD 1104.010**	



NOTES:

1 - METER SHALL BE 16mm (5/8") METER, REGISTRATION IN CUBIC METERES. 19mm (3/4") THREADED CONNECTIONS

2 - SUPPLY AND INSTALL REMOTE READOUT DEVICE ON OUTSIDE WALL WITHIN 3.0m OF THE FROST WALL AND IN THE SAME SIDE AS THE HYDRO METER. REMOTE READOUT DEVICE SHALL BE SUITABLE FOR TOUCH READ AUTOMATED READING AND BILLING SYSTEM.

3 - STOP AND DRAIN VALVE TO BE THE SAME SIZE AS INCOMING PIPE

4 - IF HOT WATER TANK IS WITHIN 3.0m OF THE METER, A CHECK VALVE IS REQUIRED BETWEEN THE METER AND THE HOT WATER TANK.

5 - METER SHALL BE INSTALLED USING THREADED CONNECTIONS ONLY

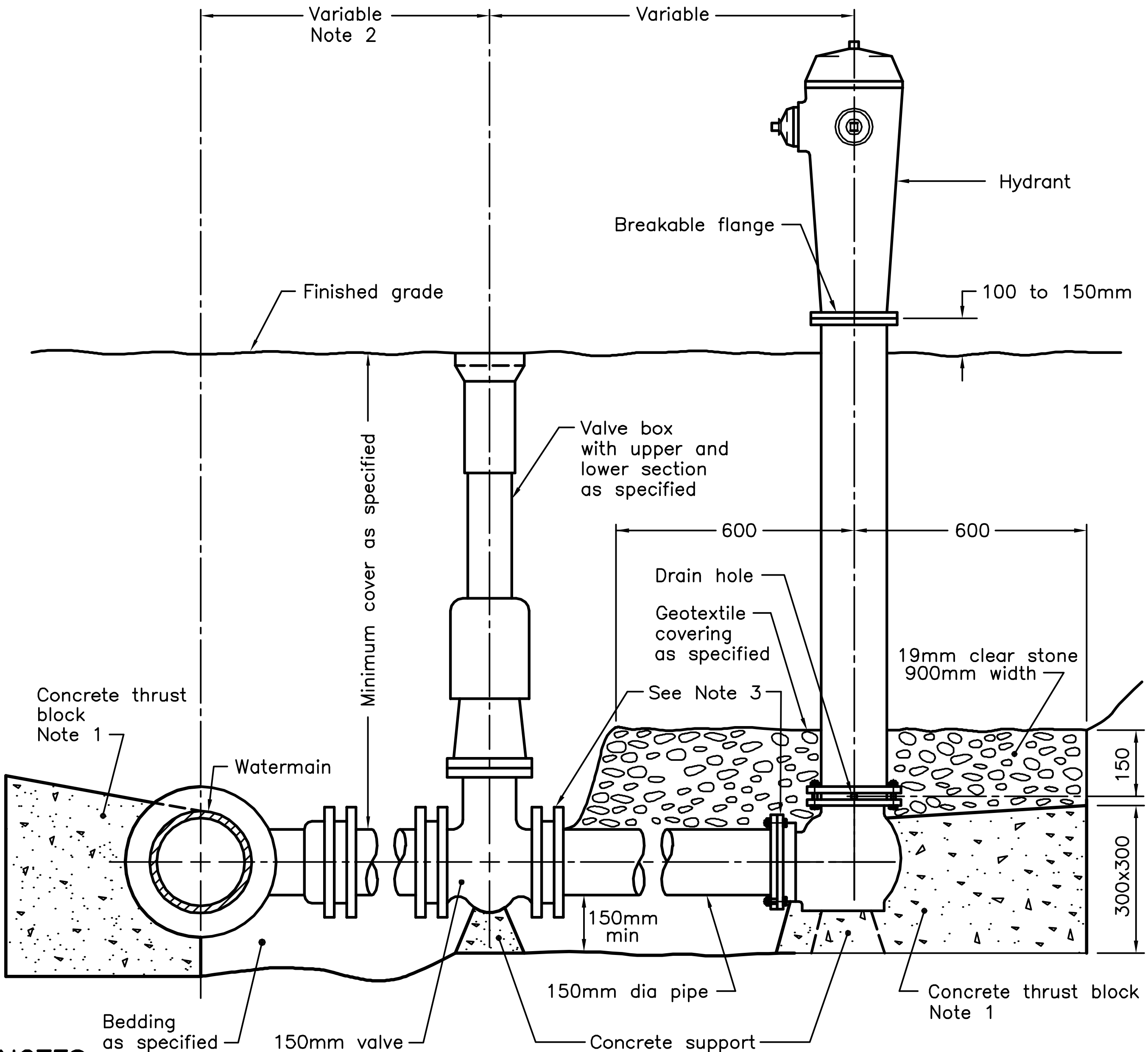
TOWNSHIP OF CAVAN MONAGHAN

TYPICAL WATER METER INSTALLATION

SCALE: NOT TO SCALE

DATE: AUGUST 2013

STD. S7



NOTES:

1 All concrete thrust blocks shall be poured against undisturbed ground.

2 When specified, for watermains 400mm and less, locate valve within 1.0m of centreline of watermain. Retaining and restraining devices shall be utilized. For watermains 600mm and over, bolt valve with flanged end directly to flanged tee.

3 When specified, retaining and restraining devices shall be utilized, in addition to thrust blocks.

A Bond breaker shall be used between the concrete and the fittings and appurtenances.

B Bolts and nuts for buried flange to flange connections shall be stainless steel.

C When required, flange of standpipe extensions shall not be in frost zone.

D This OPSD shall be read in conjunction with OPSD 1103.010 and 1103.020.

E Backfill material within 500mm of service box shall be native or imported, as specified.

F All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2013	Rev 2
HYDRANT INSTALLATION		
	OPSD 1105.010	

APPENDIX "C"

Wastewater Servicing Calculations & Details

VALDOR ENGINEERING INC.
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Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

TABLE: C1

WASTEWATER FLOW CALCULATIONS

Project Name: **Millbrook South West Subdivision, Township of Cavan Monaghan**
File: 16119
Date: May 2021

Conditions:

Residential Average Daily Flow: 450 L/person/day

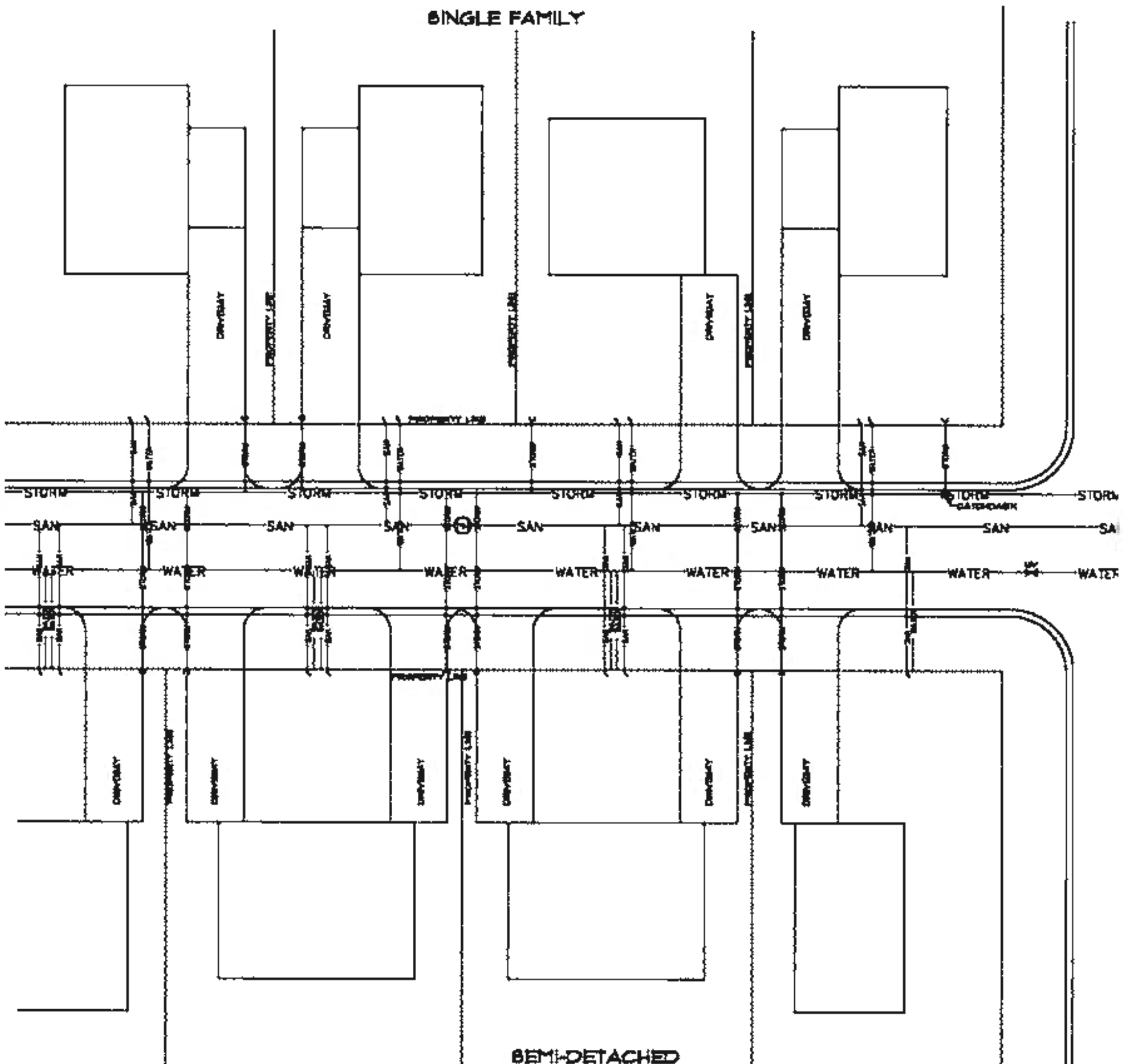
Residential Peaking Factor: $K_H = 1 + \frac{14}{4 + \sqrt{P}}$ where K_H = Harmon Peaking Factor (max. 4.5, min. 2.0)
p = population in thousands

Extraneous Flow (I): 0.28 L/s/ha. (infiltration)

Design Flow (Q_D): Q x K_H + I

Commercial/instituational Average Daily Flow: 1.15 L/s/ha
Commercial/Instituational Peaking Factor: 2.5

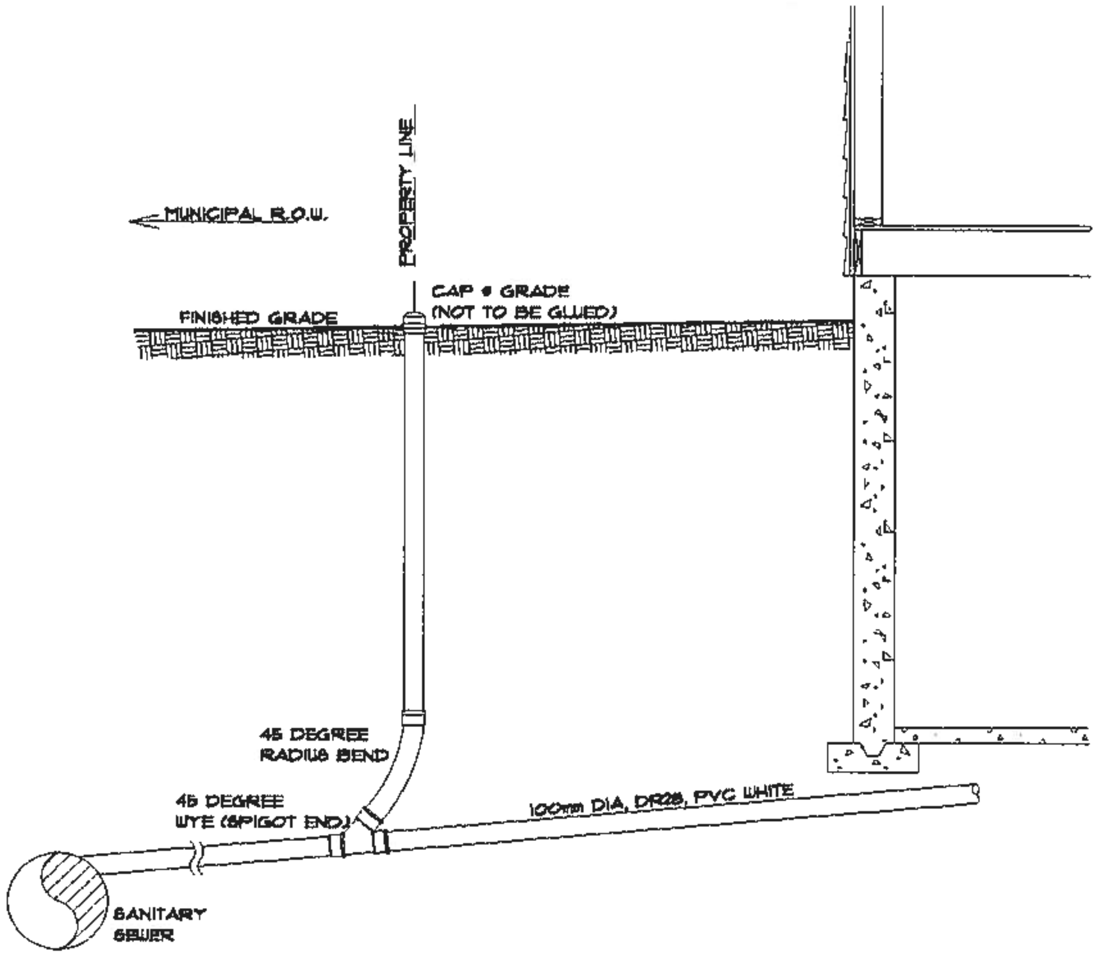
Land Use	**Area** (ha.)	**Equivalent Population** (persons)	**Average Daily Flow** (L/s)	**Harmon Peaking Factor**	**Peak Daily Flow** (L/s)	**Extraneous Flow** (L/s)	**Total Flow** (L/s)
Detached Dwellings	16.09	1,299	6.77	3.72	25.19	4.51	29.70
Street Townhomes	3.57	438	2.28	4.00	9.13	1.00	10.13
Medium Density	0.88	400	2.08	4.02	8.38	0.25	8.63
Roads	7.84					2.20	2.20
Total	**28.38**	**2,136**	**11.13**		**42.71**	**7.95**	**50.65**



NOTES:

1. 1.5m MIN. BETWEEN SEWER & WATER SERVICE CONNECTIONS AT CENTRE OF LOT.
2. STORM SEWER SERVICES 1.5m MIN. FROM LOT LINE.
3. WATERMAIN VALVES, HYDRANTS & CATCHBASINS NOT TO BE LOCATED IN WALKWAYS OR DRIVEWAYS.
4. ALL SERVICES TO RUN IN A STRAIGHT LINE, PERPENDICULAR TO CENTERLINE OF ROAD FROM MAIN TO PROPERTY LINE.

TOWNSHIP OF CAVAN MONAGHAN	TYPICAL SERVICING LAYOUT	STD. S1
	SCALE: NOT TO SCALE	
	DATE: AUGUST 2013	



TOWNSHIP OF CAVAN MONAGHAN

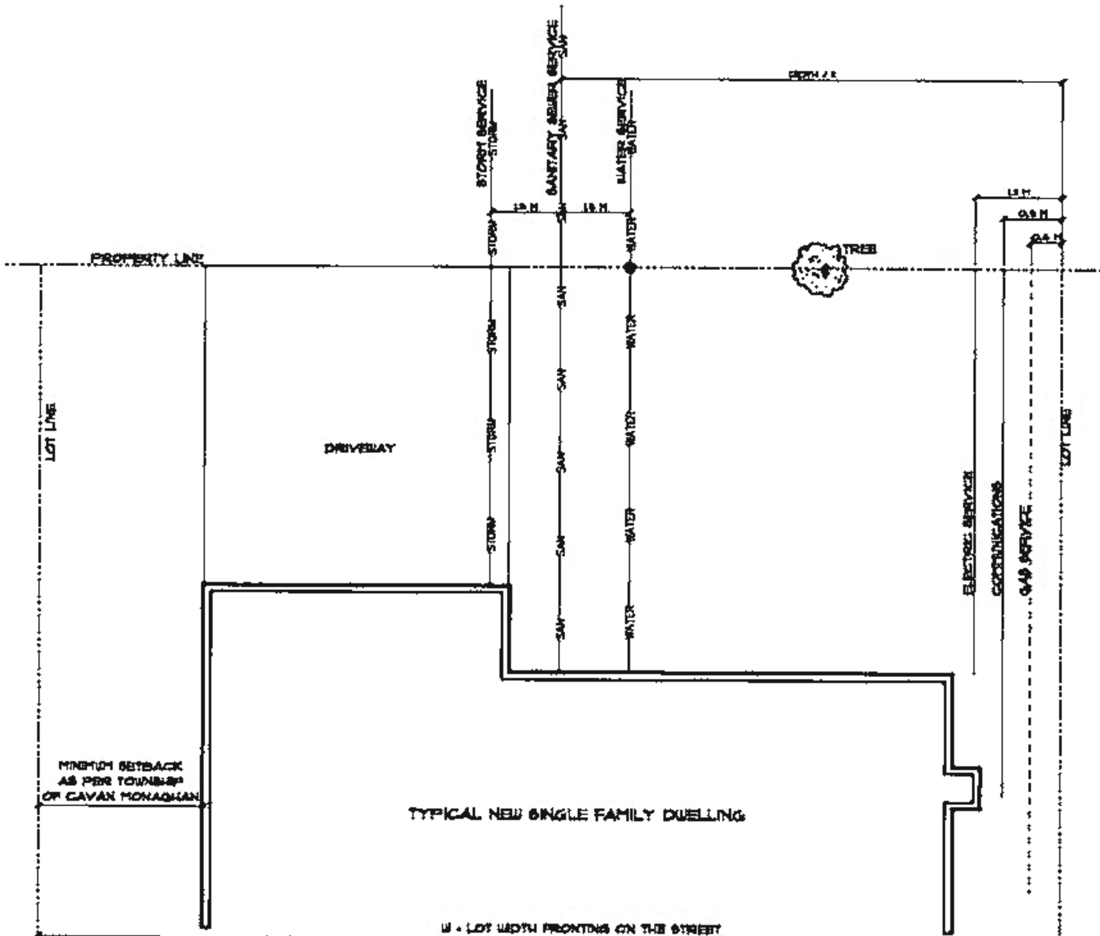
SANITARY SERVICE CONNECTION WITH CLEAN-OUT

SCALE: NOT TO SCALE

DATE: AUGUST 2013

STD.

S3



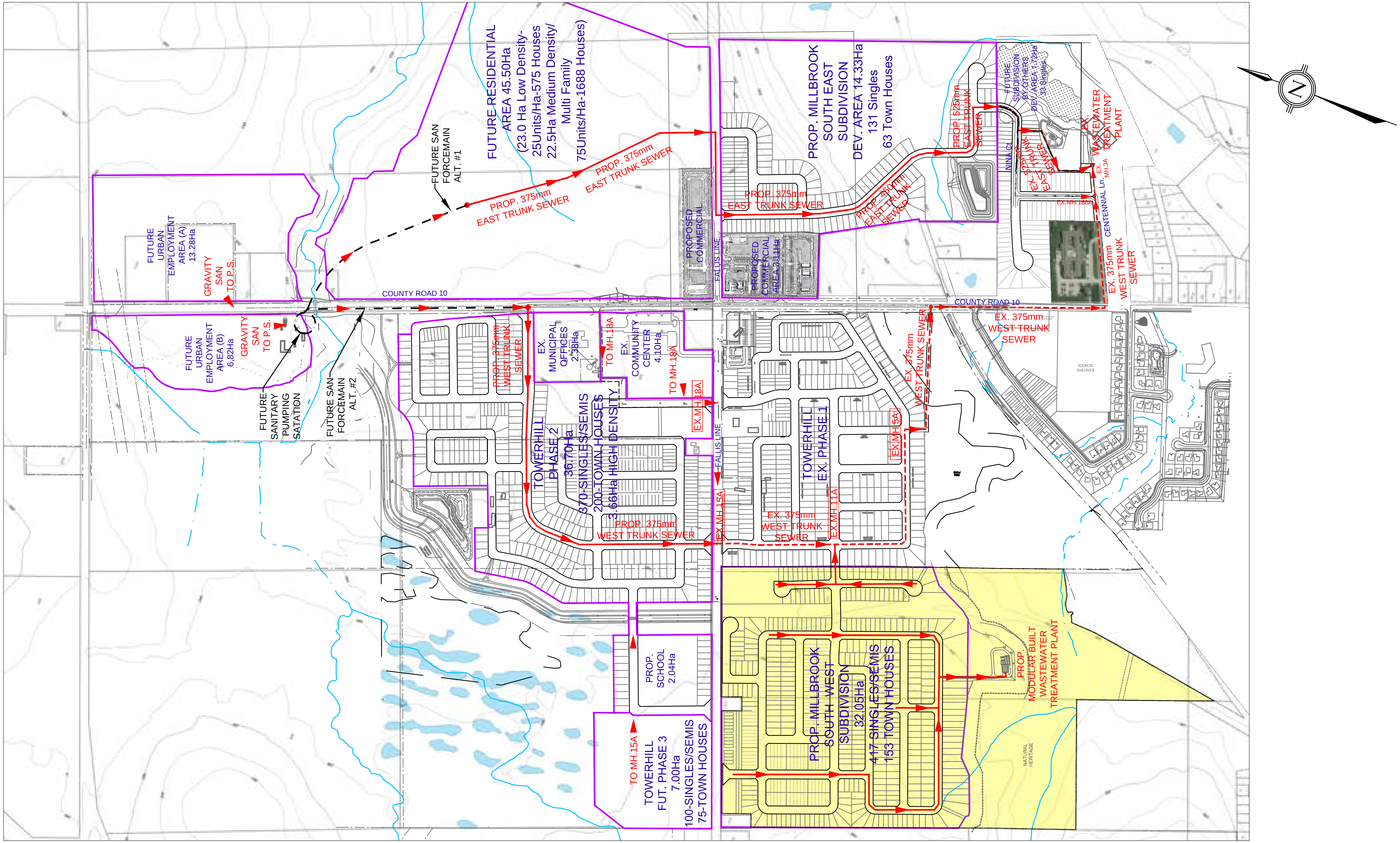
1. SANITARY SEWER CONNECTION LOCATED AT CENTER LINE OF THE LOT (WIDTH / 2)
2. WATER SERVICE LOCATION IS 1.5 M FROM SANITARY SEWER ON OPPOSITE SIDE OF DRIVEWAY.
3. STORM SEWER CONNECTION (IF APPLICABLE) LOCATED 1.5 M FROM SANITARY SEWER ON OPPOSITE SIDE FROM WATER SERVICE.
4. ELECTRIC SERVICE CONNECTION - 1200mm FROM THE LOT LINE.
5. COMMUNICATIONS SERVICE CONNECTION - MINIMUM OF 300mm FROM ELECTRIC SERVICE.
6. GAS SERVICE CONNECTION - 300mm FROM COMMUNICATIONS SERVICE.
7. VARIATIONS FROM THE ABOVE LOCATIONS SHOULD ONLY BE MADE WITH THE APPROVAL OF THE UTILITIES AFFECTED BY THE VARIATION. VARIATIONS IN THE LOCATION OF THE SANITARY SEWER CONNECTION SHALL BE CONFINED TO THE LOWER HALF OF THE LOT AS DETERMINED BY THE DIRECTION OF FLOW OF THE SANITARY SEWER MAIN.

TOWNSHIP OF CAVAN MONAGHAN

TYPICAL SERVICE CONNECTION LOCATIONS FOR SINGLE FAMILY DWELLING

SCALE: NOT TO SCALE

DATE: AUGUST 2013



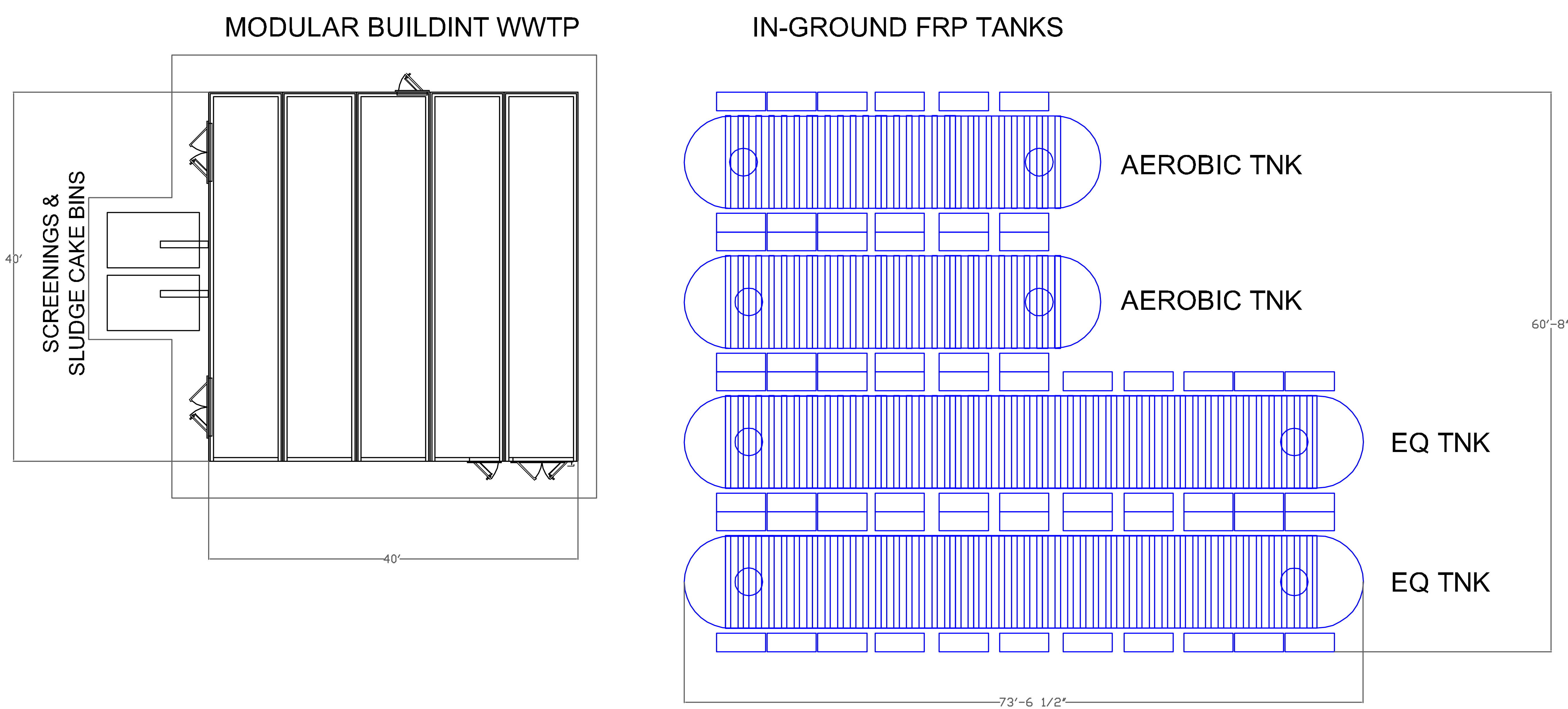
MILLBROOK SOUTH WEST SUBDIVISION

SANITARY DRAINAGE PLAN

DRAWN BY	V.L.
CKD. BY	D.G.
DATE	May, 2021

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

SCALE	PROJECT	
N.T.S.	16119	FIGURE C



NOTES

SUPPLY BY OTHERS, INSTALL BY OTHERS

SUPPLY BY NEWTERRA, INSTALL BY NEWTERRA (INSIDE MODULAR BUILDING)

SUPPLY BY NEWTERRA, INSTALL BY OTHERS

INTERCONNECTING PIPING BETWEEN BUILDING AND TANKS, AND BETWEEN TANKS, IS TO BE REQUIRED BY CONTRACTOR.

newterra

PHONE:
(800) 420-4056

www.newterra.com

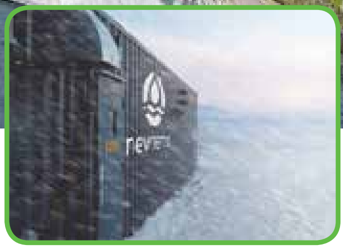
LEVEL	REVISION	DATE (mm/dd/yy)	BY
R0	PRELIMINARY FOR QUOTE		

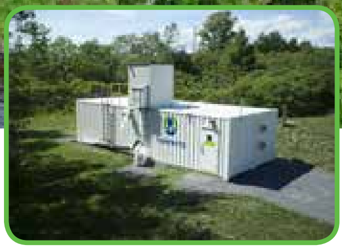
PROJECT NUMBER: MC 500DT

TITLE AND LOCATION: PRELIMINARY LAYOUT

CUSTOMER

DRAWN BY | DATE | SHEET | SHEETS





Modular Decentralized Water & Wastewater Systems

Scalable, cost-effective solutions for development projects and existing wastewater treatment plant retrofits.

newterra®
clean water. modular solutions. *simple.*™

newterra.com

Newterra Pre-Fabricated Modular Systems Are Designed To Grow As Your Development Grows

Newterra is leading the way with decentralized wastewater solutions that help you reduce project costs with a sustainable treatment approach. Our modular membrane bioreactor (MBR) systems are scalable – allowing treatment infrastructure to be added in stages as capacity requirements grow.

The Right Solution for a Wide Range of Projects

Newterra's innovative wastewater treatment systems are ideally suited to many types of projects, including:

- Greenfield & Retrofit Projects
- Existing Infrastructure Tie-ins
- Municipal WWTPs
- New Residential Developments
- Hotels, Resorts & Restaurants
- Campgrounds & Trailer Parks
- Mobile Home Communities
- Off-Grid & Remote Municipal Plants
- New Commercial Developments
- Service Area Expansions
- LEED® Certified & Green Buildings
- Schools & Hospitals
- Golf Courses
- Sports & Recreational Facilities
- Highway Rest Areas

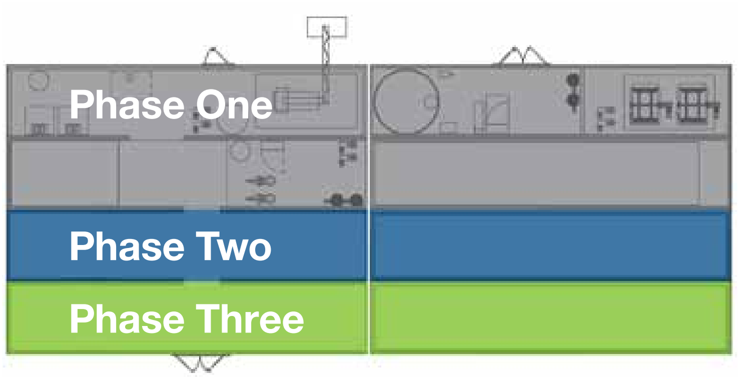
Self-Contained and Enclosed Systems

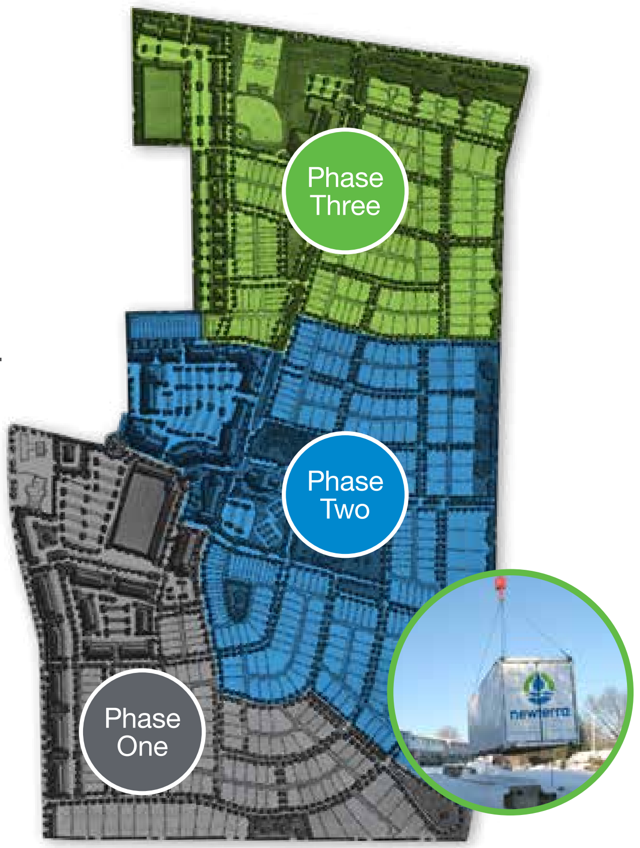
Newterra MBR wastewater systems are modular, and can be configured as fully self-contained units that can be clad with a variety of materials to blend in with surrounding structures, or integrated into new or existing treatment structures. They are built in our MET-certified manufacturing facility and have UL electrical certification.

Newterra systems can be clad to blend in with their surroundings *(above)*, or be loose-shipped for use with inground tanks and buildings *(inset, right)*.

Add Infrastructure with Each Phase of a Project

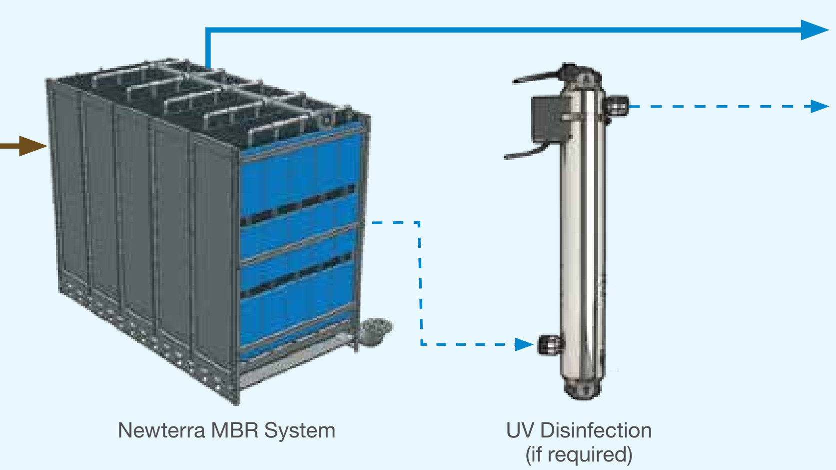
Our modular, scalable treatment technology allows you to phase in wastewater infrastructure in parallel with the treatment demands of your development. Newterra MBR systems can handle high loads, and are very resilient to flow and loading fluctuations. They are also extremely space efficient – reducing land requirements and providing more options of where the plant can be located. Newterra systems can be loose-shipped or pre-manufactured, and we offer you the option of renting or leasing to minimize your initial capital expenditures.





Sewage Treatment That Offers A Wide Range of Reuse Applications

Newterra sewage treatment systems have been designed to extract clean water from sewage – delivering permeate of such high quality that it can be reused for a wide range of applications. Supplementary technologies, such as activated carbon and ultraviolet (UV) disinfection broaden the reuse opportunities.



Compact, Operator-Friendly & Sustainable

Designed & Built for Minimal Maintenance

Newterra MBR systems are field proven in some of the most extreme conditions on the planet. Feedback from operators has been a key ingredient in the development and refinement of our low maintenance solutions:

- Intuitive, user-friendly controls and instrumentation
- Built-in telemetry & remote monitoring reduce plant visits by operator
- Air scouring & periodic membrane relaxation minimize CIP requirements
- Built-in redundancy to eliminate downtime
- Proven in a wide range of regions, climates and altitudes

Ambient Temperatures	High Altitudes
-40˚F to +104˚F	13,125 ft.
-40˚C to +40˚C	4,000 m

Integrated cellular telemetry and our ***SiteLink***™ *technology allow 24/7 monitoring and operation by your staff, and proactive troubleshooting by our technical team*

Cost-Effective for New Facilities & Retrofits

At Newterra, we offer both custom-designed and pre-engineered, packaged MBR treatment systems for new facilities. Our technology is also very well suited to retrofitting conventional BNR and ENR plants to comply with higher regulatory standards or expand capacity. Newterra MBR modules can be easily incorporated into existing clarification tanks – more than tripling plant capacity within the current footprint and eliminating the need for costly infrastructure expansion.

A Global Water Technology Leader

Newterra is recognized as a leader in the development of modular treatment solutions for water, sewage, wastewater and groundwater remediation for industrial, municipal, land development, commercial & residential markets. Our heritage of innovation in providing clean water solutions dates all the way back to 1863. Over that time, Newterra has grown to over 200 people and we've installed thousands of treatment systems – some of which operate in the most extreme conditions on the planet.

Full Control from Start to Finish

At Newterra, we take full control of virtually every aspect of the treatment systems we build – from process design and engineering to manufacturing, installation, operations and ongoing parts & service support. That also includes manufacturing our own MicroClear® UF membranes in Newterra's ISO 9001:2008 certified facility. This award-winning approach ensures Newterra treatment systems meet our high standards for quality and on-time delivery.

200+ Employees

40+ Professional Engineers

10,000+ Installations Worldwide

CANADA BEST MANAGED COMPANIES Platinum member

2015 Global Cleantech 100 TOP 100 COMPANY

newterra®

clean water. modular solutions. *simple*.™

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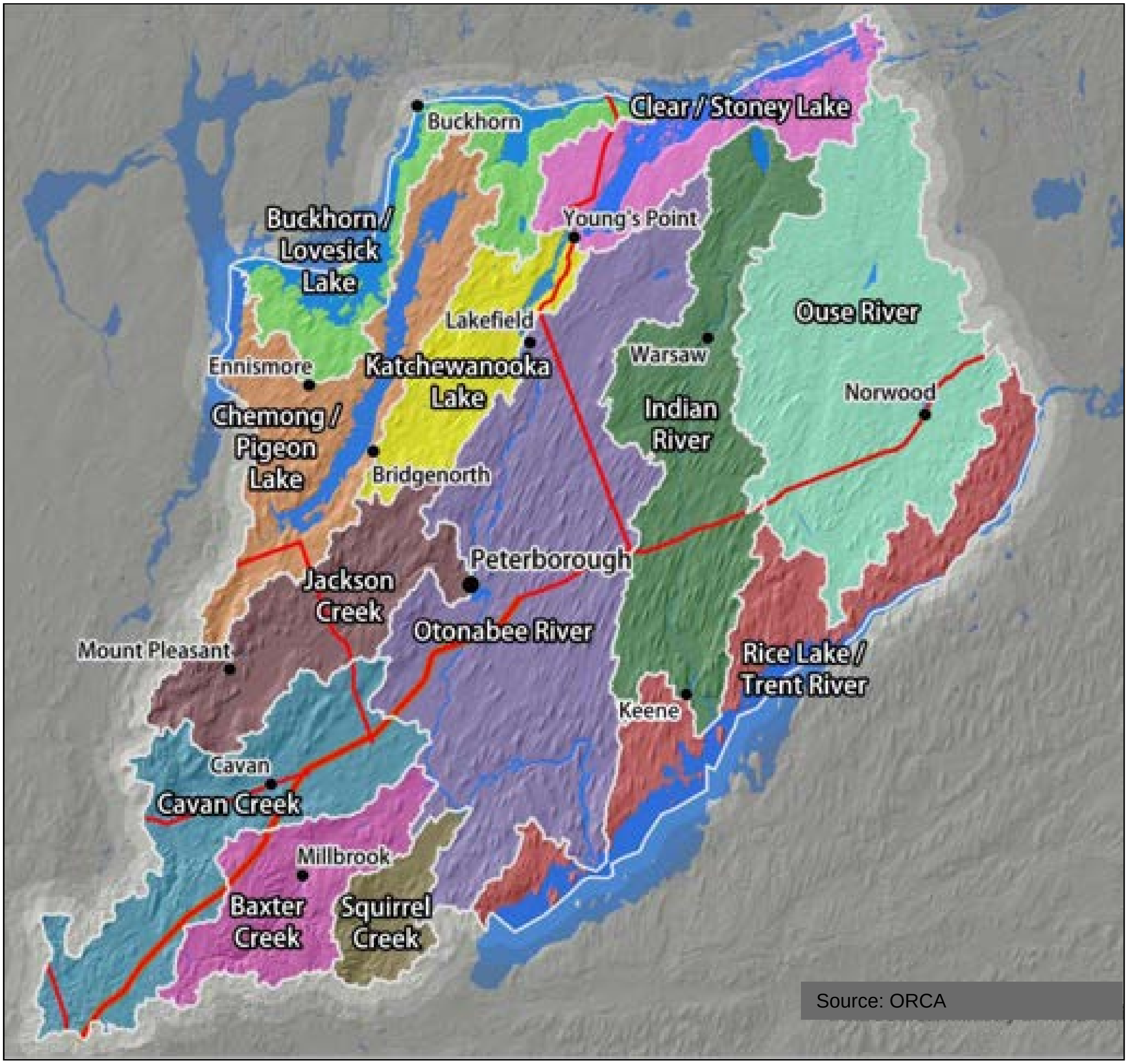
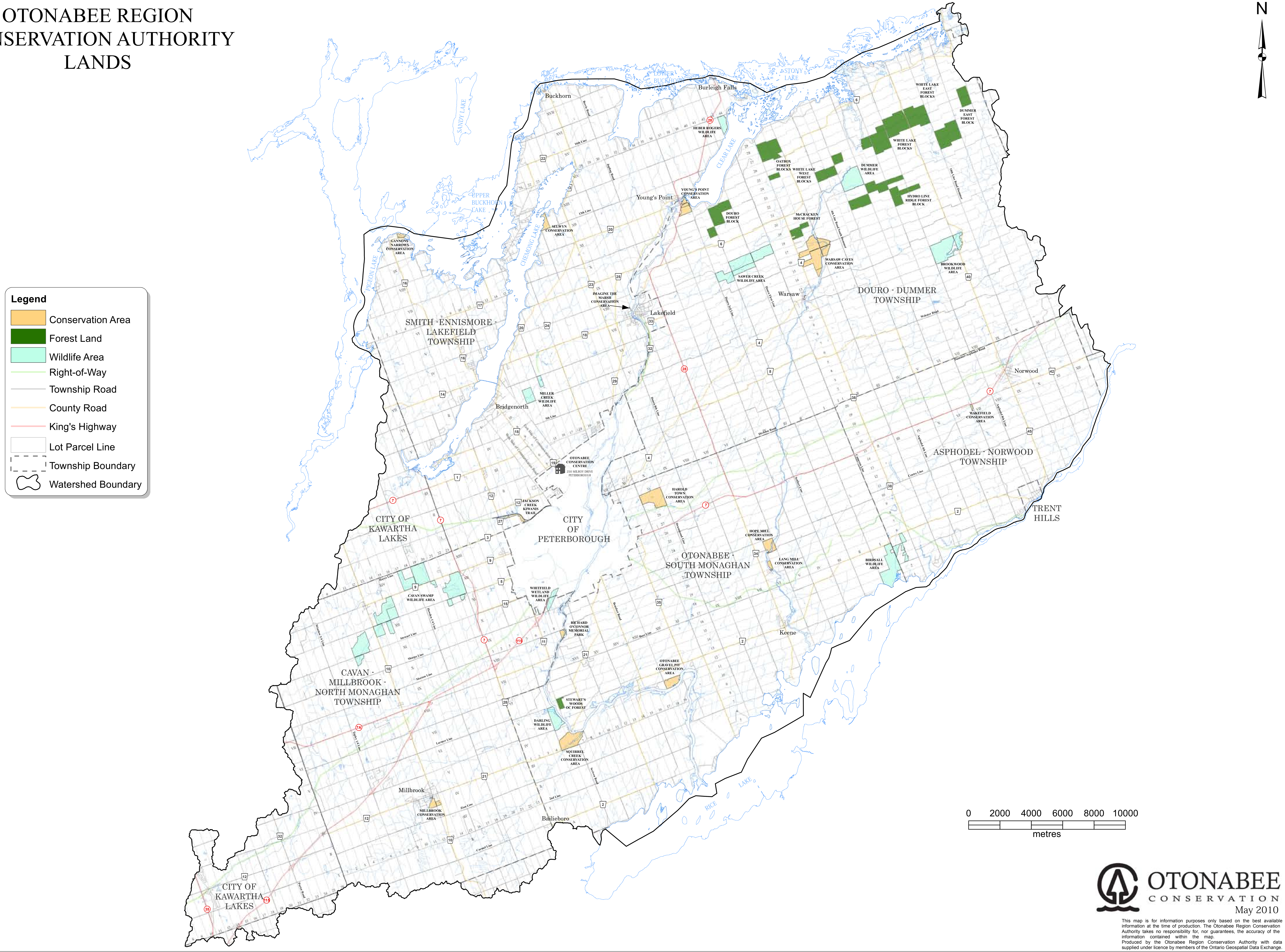
APPENDIX “D”

Watershed Map & IDF Data



Clear / Stoney Lake
Buckhorn
Young's Point
Buckhorn / Lovesick Lake
Ouse River
Lakefield
Warsaw
Ennismore
Katchewanooka Lake
Indian River
Norwood
Chemong / Pigeon Lake
Bridgenorth
Peterborough
Jackson Creek
Otonabee River
Mount Pleasant
Rice Lake / Trent River
Keene
Cavan
Cavan Creek
Millbrook
Baxter Creek
Squirrel Creek
Source: ORCA

OTONABEE REGION CONSERVATION AUTHORITY LANDS



OTONABEE CONSERVATION

May 2010

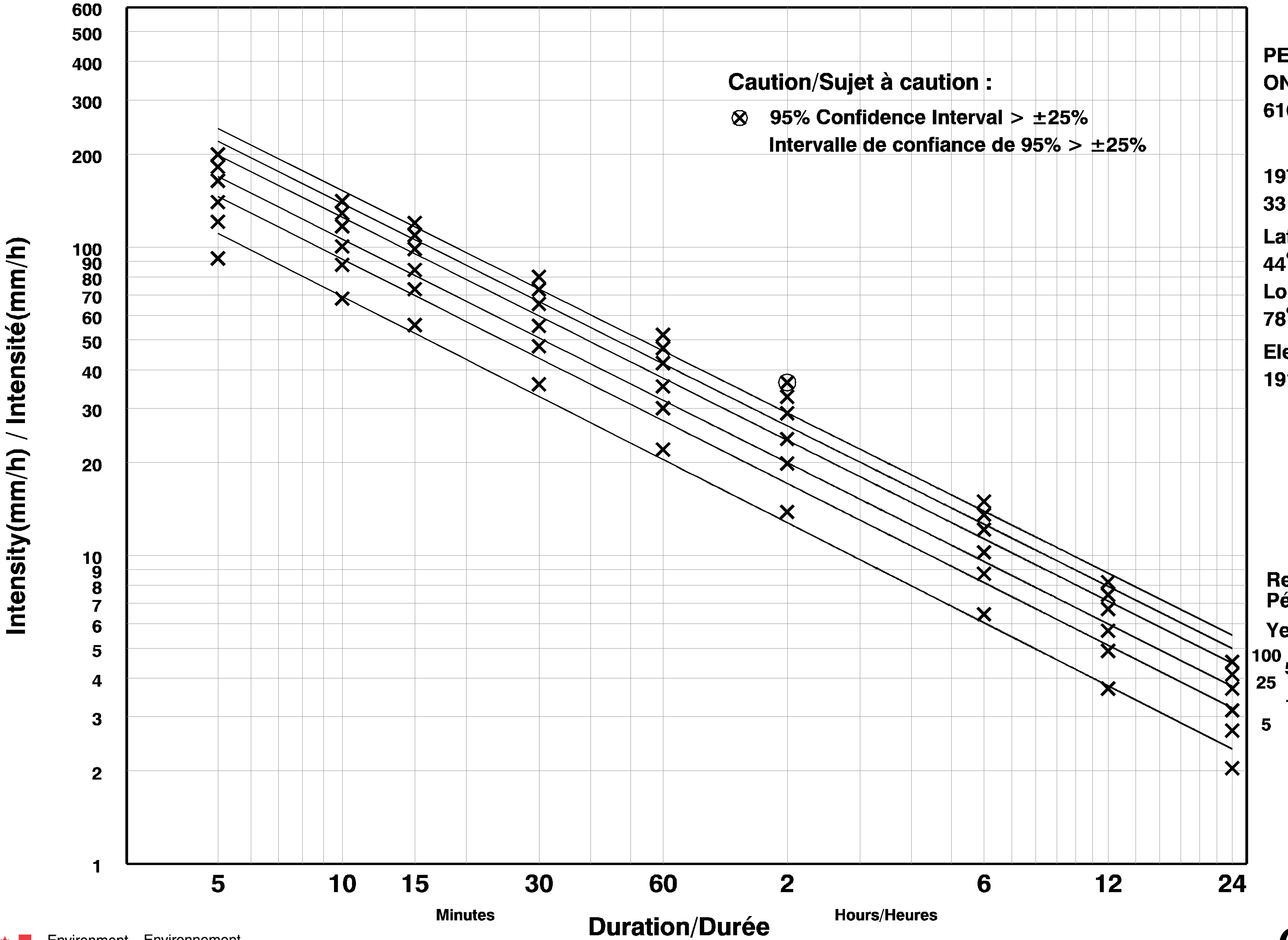
This map is for information purposes only based on the best available information at the time of production. The Otonabee Region Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained within the map.

Produced by the Otonabee Region Conservation Authority with data supplied under licence by members of the Ontario Geospatial Data Exchange.

Short Duration Rainfall Intensity-Duration-Frequency Data

2014/12/21

Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée



PETERBOROUGH A
ON
6166418

1971 - 2006
33 years / ans

Latitude
44° 14'N
Longitude
78° 22'W
Elevation / Altitude
191 m

Return Periods/
Périodes de retour
Years / ans

Environment Canada Environnement Canada

Canada

Intensity Duration Frequency Statistics for Peterborough

Location - Peterborough Airport 2014 Data

Rainfall Intensity = a/(Tc+b)^c

Tc = Time of Concentration

2 Year Return Period		
a	b	c
583.351	6.010	0.773
Duration	**Intensity**	
5	92.0	
10	68.2	
15	56.0	
30	35.9	
60	22.1	
120	13.9	
360	6.4	
720	3.7	
1440	2.0	

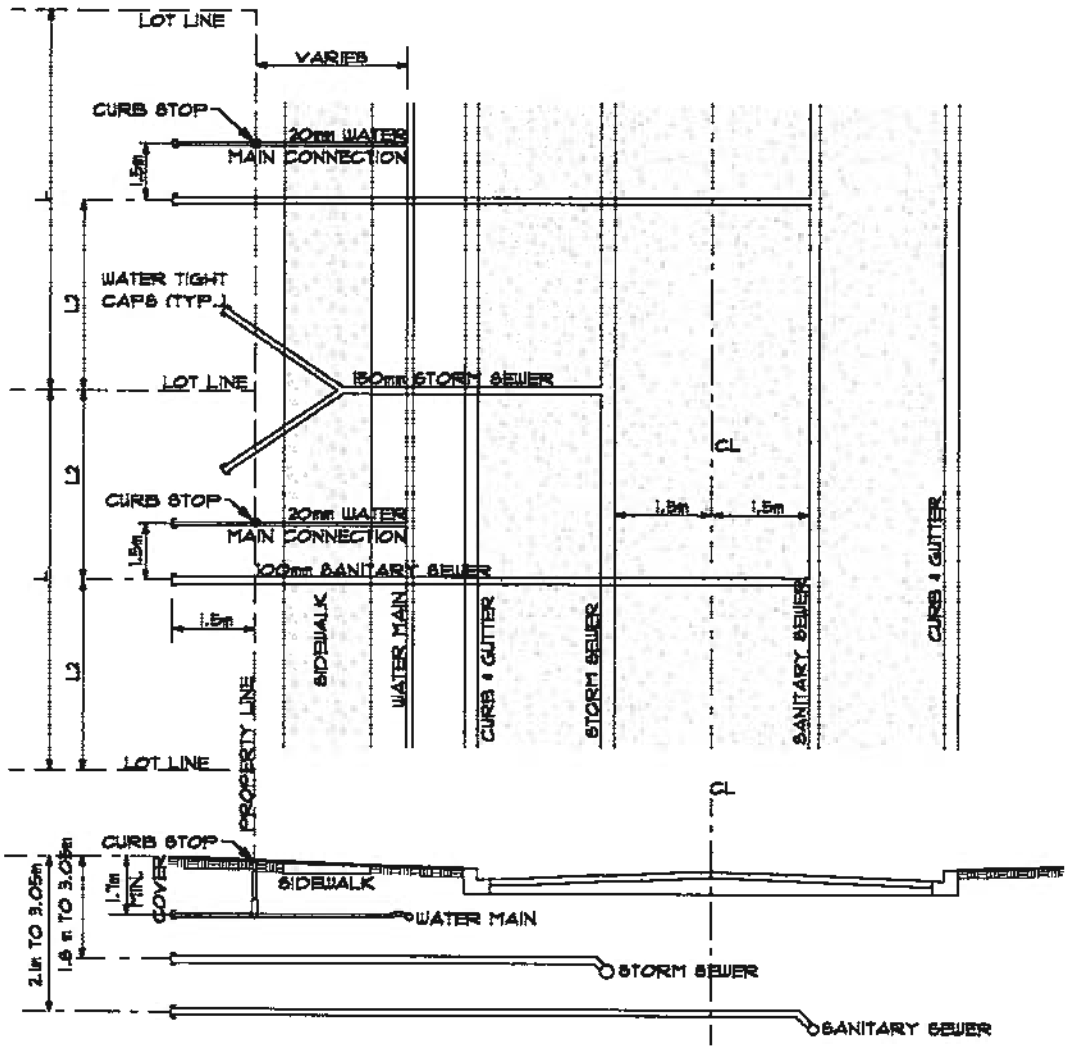
5 Year Return Period		
a	b	c
843.799	7.500	0.783
Duration	**Intensity**	
5	121.0	
10	87.7	
15	73.1	
30	47.8	
60	30.1	
120	19.9	
360	8.7	
720	4.9	
1440	2.7	

10 Year Return Period		
a	b	c
1034.243	8.265	0.791
Duration	**Intensity**	
5	140.2	
10	100.7	
15	84.5	
30	55.6	
60	35.4	
120	23.9	
360	10.2	
720	5.7	
1440	3.1	

25 Year Return Period		
a	b	c
1263.414	9.012	0.795
Duration	**Intensity**	
5	164.4	
10	117.0	
15	98.8	
30	65.5	
60	42.1	
120	29.0	
360	12.2	
720	6.7	
1440	3.7	

50 Year Return Period		
a	b	c
1468.915	9.751	0.801
Duration	**Intensity**	
5	182.3	
10	129.1	
15	109.4	
30	72.9	
60	47.1	
120	32.7	
360	13.6	
720	7.5	
1440	4.1	

100 Year Return Period		
a	b	c
1696.952	10.502	0.808
Duration	**Intensity**	
5	200.2	
10	141.1	
15	120.0	
30	80.2	
60	52.0	
120	36.4	
360	15.0	
720	8.2	
1440	4.5	



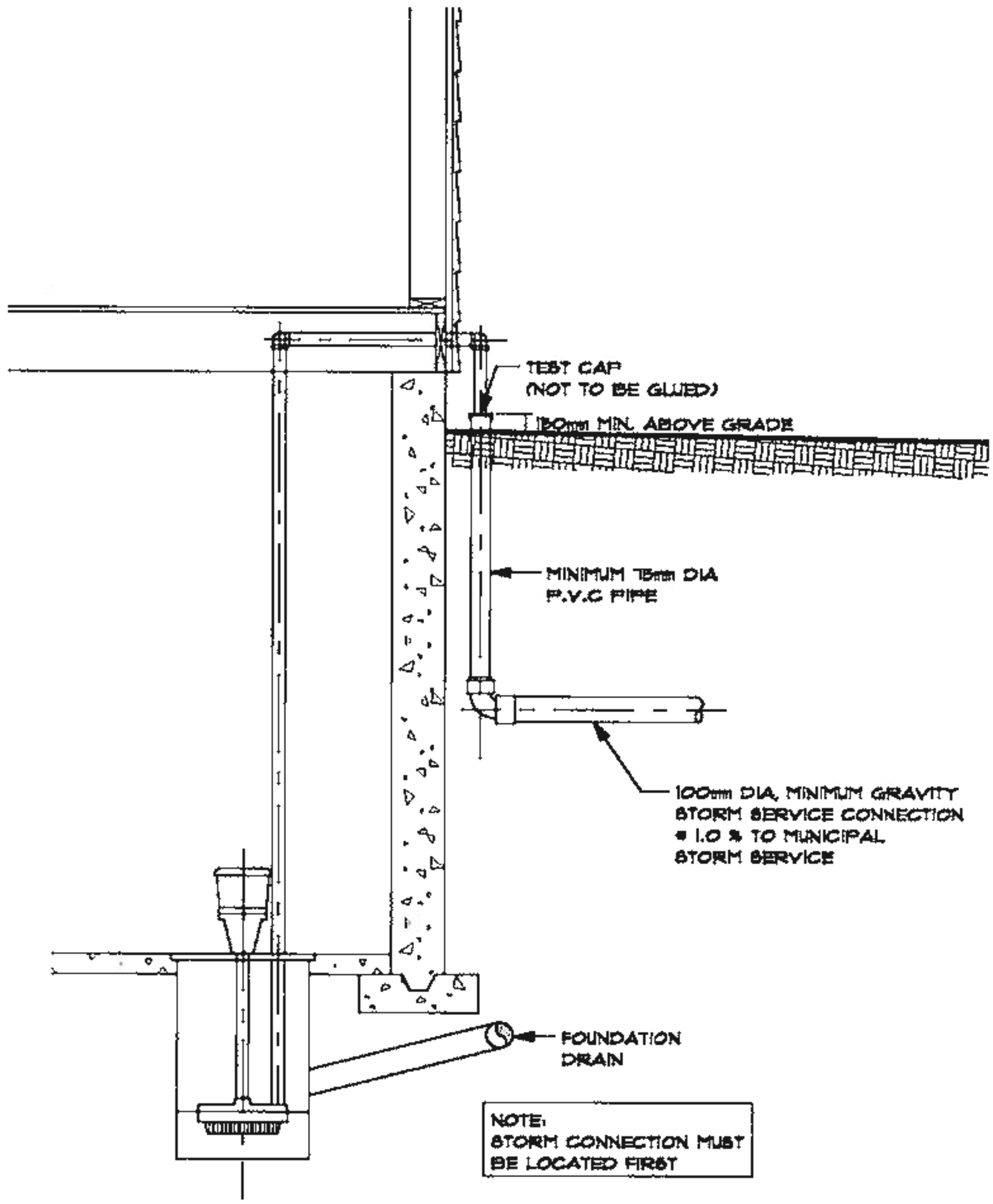
NOTES:
1. WATERTIGHT CAPS ON ALL SERVICES.
2. ALL DIMENSIONS SHOWN ARE CENTRE TO CENTRE.
3. STORM PIPE MATERIALS IS TO BE PVC SDR 28 AND WHITE IN COLOUR
4. L = FRONTAGE OF ONE UNIT

TOWNSHIP OF CAVAN MONAGHAN

STORM SERVICE RESIDENTIAL SERVICE CONNECTION

SCALE: NOT TO SCALE

DATE: AUGUST 2013



TOWNSHIP OF CAVAN MONAGHAN

SUMP PUMP TO STORM SEWER CONNECTION

SCALE: NOT TO SCALE

DATE: AUGUST 2013

STD. **S2**

APPENDIX "E"

Stormwater Management Calculations

VALDOR ENGINEERING INC.
File: 16119
Date: May 2021

Table E.1: VO Model Parameters - Pre-Development

Subcatchment	Area (ha)	VO Routine	TIMP	XIMP	CN II	IA (mm)	Tp (hr)
Flow Node #1: Drainage to North							
1-101	18.16	NasHyd	-	-	75	7.3	0.50
1-301	5.10	NasHyd	-	-	77	6.5	0.49
1-302	6.52	NasHyd	-	-	79	6.7	0.42
1-303	0.53	StandHyd	0.70	0.70	61	5.0	-
Total	**30.31**						
Flow Node #2: Drainage to South							
2-101	14.77	NasHyd	-	-	77	7.4	0.39
Total	**14.77**						

VALDOR ENGINEERING INC.
File: 16119
Date: May 2021

Table E.2: VO Model Parameters - Post-Development							
Subcatchment	**Area (ha)**	**VO Routine**	**TIMP**	**XIMP**	**CN II**	**IA (mm)**	**Tp (hr)**
Flow Node #1: Drainage to North							
1-201	18.91	StandHyd	0.65	0.50	61	5.0	-
1-301	5.10	NasHyd	-	-	77	6.5	0.49
1-302	6.52	NasHyd	-	-	79	6.7	0.42
1-303	0.53	StandHyd	0.70	0.70	61	5.0	-
Total	**31.06**						
Flow Node #2: Drainage to South							
2-201	10.85	StandHyd	0.60	0.45	61	5.0	-
2-202	3.17	NasHyd	-	-	66	6.2	0.42
Total	**14.02**						

VALDOR ENGINEERING INC.
File: 16119
Date: May 2021

Table E.3: Calculation of CN Values, Initial Abstractions and Runoff Coefficients

Subcatchment	Area (ha)	Land Use and Land Cover		CN II	Area Weighted CN II	IA (mm)	Area Weighted IA (mm)	C-Value	Area Weighted C-Value
		Type	Area (ha)						
1-101	18.16	Forest (HSG 'B')	1.10	55	**75**	**10**	**7.3**	0.25	**0.33**
		Meadow (HSG 'B')	3.14	58		**8**		0.28	
		Row Crops (HSG 'B')	13.22	81		**7**		0.35	
		Open Space (HSG 'B')	0.56	61		**5**		0.11	
		Other Impervious	0.14	98		**2**		0.95	
1-301	5.10	Forest (HSG 'B')	0.00	55	**77**	**10**	**6.5**	0.25	**0.30**
		Meadow (HSG 'B')	0.00	58		**8**		0.28	
		Row Crops (HSG 'B')	3.95	81		**7**		0.35	
		Open Space (HSG 'B')	1.13	61		**5**		0.11	
		Other Impervious	0.02	98		**2**		0.95	
1-302	6.52	Forest (HSG 'B')	0.00	55	**79**	**10**	**6.7**	0.25	**0.33**
		Meadow (HSG 'B')	0.00	58		**8**		0.28	
		Row Crops (HSG 'B')	5.67	81		**7**		0.35	
		Open Space (HSG 'B')	0.80	61		**5**		0.11	
		Other Impervious	0.05	98		**2**		0.95	
2-101	14.77	Forest (HSG 'B')	1.75	55	**77**	**10**	**7.4**	0.25	**0.34**
		Meadow (HSG 'B')	0.31	58		**8**		0.28	
		Row Crops (HSG 'B')	12.69	81		**7**		0.35	
		Open Space (HSG 'B')	0.00	61		**5**		0.11	
		Other Impervious	0.02	98		**2**		0.95	
2-202	3.17	Forest (HSG 'B')	1.14	55	**66**	**10**	**6.2**	0.25	**0.32**
		Meadow (HSG 'B')	0.00	58		**8**		0.28	
		Row Crops (HSG 'B')	0.00	81		**7**		0.35	
		Open Space (HSG 'B')	1.41	61		**5**		0.11	
		Other Impervious	0.61	98		**2**		0.95	

VALDOR ENGINEERING INC.
File: 16119
Date: May 2021

Table E.4: Calculation of Time to Peak (Airport Method)

Subcatchment	C Runoff Coefficient (Area Weighted)	L(m) Catchment Length	Highest Elevation (m)	Lowest Elevation (m)	S(%) Catchment Slope	T_c (min)	T_p (hr)
1-101	0.33	625	265.00	247.20	2.85	44.6	0.50
1-301	0.30	560	280.00	264.00	2.86	43.8	0.49
1-302	0.33	475	276.50	261.00	3.26	37.4	0.42
2-101	0.34	485	261.60	242.00	4.04	34.6	0.39
2-202	0.32	270	247.60	244.00	1.33	38.0	0.42

Note:

1) T_p calculation is based on Airport Method $T_c = 3.26 \times (1.1 - C) \times L^{0.5} / S_w^{0.33}$ and $T_P = 0.67 T_c$

VALDOR ENGINEERING INC.
File: 16119
Date: May 2021

Table E.5-A: Stage-Storage-Discharge Table - North SWM Pond

Stage Storage Curve						Outlet Structure							Comments:
Elevation (m)	Sec Area (m^2)	Avg Area (m^2)	Sec Volume (m^3)	Cumulative Volume (m^3)	Volume Above NWL (m^3)		Stage Active (m)	[1]Discharge m^3/s Orifice #N-1	Orifice #N-2 (Weir Flow)	Orifice #N-2 (Orifice Flow)	Spillway	Total Flow	
						Invert Elevation (m)		247.00	247.80	247.80	249.00		
						Diameter (mm)/Length (m)		125	1.50	1.50	20.00		
						Height (m)		-	0.40	0.40			
						Orifice Area (m^2)		0.0123	-	0.6000	-		
													Weir Equation: $Q=1.837xLxH^{1.5}$
Forebay Below NWL													Orifice Eq'n: $Q = 0.6A(2gH)^{0.5}$
245.00	**249**	**-**	**-**	**0**		**Bottom of Forebay**							Spillway Design: $Q=1.67xLxH^{1.5}$
246.00	**526**	**388**	**388**	**388**									
246.40	**657**	**592**	**237**	**624**									
247.00	**980**	**819**	**491**	**1,115**		**NWL**							
Main Cell Below NWL													
245.00	**1,167**	**-**	**-**	**0**		**Bottom of Main Cell**							
246.00	**1,615**	**1,391**	**1,391**	**1,391**									
246.40	**1,815**	**1,715**	**686**	**2,077**									
247.00	**2,308**	**2,062**	**1,237**	**3,314**		**NWL**							
Forebay & Main Cell Above NWL													
247.00	**3,288**	**-**	**-**	**4,429**	**0**	**NWL**	0.00	0.000				**0.000**	
247.20	3,595	3,441	688	5,117	688		0.20	0.012				**0.012**	**Extended Detention Provided**
247.40	3,902	3,748	750	5,867	1,438		0.40	0.019				**0.019**	
247.60	**4,209**	**4,055**	**811**	**6,678**	**2,249**		0.60	0.024				**0.024**	
247.80	4,433	4,321	864	7,542	3,113	**Extended Detention**	0.80	0.028	0.000	-		**0.028**	
248.00	**4,657**	**4,545**	**909**	**8,451**	**4,022**		1.00	0.032	0.224	-		**0.256**	
248.20	4,851	4,754	951	9,402	4,973		1.20	0.035	0.634	-		**0.669**	
248.40	5,045	4,948	990	10,392	5,963		1.40	0.038	-	1.009		**1.046**	
248.60	5,240	5,142	1,028	11,420	6,991		1.60	0.040	-	1.235		**1.276**	
248.80	5,434	5,337	1,067	12,488	8,059		1.80	0.043	-	1.426		**1.469**	
249.00	**5,628**	**5,531**	**1,106**	**13,594**	**9,165**	**100-year Storage**	2.00	0.045	-	1.595	0.000	**1.640**	**100-year Storage Provided**
249.10	5,718	5,673	567	14,161	9,732		2.10	0.047	-	1.672	1.056	**2.775**	
249.20	5,808	5,763	576	14,737	10,308		2.20	0.048	-	1.747	2.987	**4.782**	
249.50	**6,077**	**5,942**	**1,783**	**16,520**	**12,091**	**Top of Berm**	2.50	0.051	-	1.953	11.809	**13.813**	

VALDOR ENGINEERING INC.
File: 16119
Date: May 2021

Table E.5-B: Stage-Storage-Discharge Table - South SWM Pond

Stage Storage Curve						Outlet Structure							
Elevation (m)	Sec Area (m^2)	Avg Area (m^2)	Sec Volume (m^3)	Cumulative Volume (m^3)	Volume Above NWL (m^3)		Stage Active (m)	[1]Discharge m^3/s Orifice #S-1	Orifice #S-2 (Weir Flow)	Orifice #S-2 (Orifice Flow)	Spillway	Total Flow	Comments:
						Invert Elevation (m)		245.50	246.10	246.10	247.50		
						Diameter (mm)/Length (m)		95	1.00	1.00	20.00		
						Height (m)		-	0.40	0.40			
						Orifice Area (m^2)		0.0071	-	0.4000	-		
													Weir Equation: $Q=1.837xLxH^{1.5}$
Forebay Below NWL													Orifice Eq'n: $Q = 0.6A(2gH)^{0.5}$
243.50	**82**	**-**	**-**	**0**		**Bottom of Forebay**							Spillway Design: $Q=1.67xLxH^{1.5}$
244.50	**291**	**187**	**187**	**187**									
244.90	**407**	**349**	**140**	**326**									
245.50	**684**	**546**	**327**	**653**		**NWL**							
Main Cell Below NWL													
243.50	**647**	**-**	**-**	**0**		**Bottom of Main Cell**							
244.50	**995**	**821**	**821**	**821**									
244.90	**1,154**	**1,075**	**430**	**1,251**									
245.50	**1,533**	**1,344**	**806**	**2,057**		**NWL**							
Forebay & Main Cell Above NWL													
245.50	**2,217**	**-**	**-**	**2,710**	**0**	**NWL**	0.00	0.000				**0.000**	
245.70	2,476	2,346	469	3,180	469		0.20	0.007				**0.007**	
245.90	2,734	2,605	521	3,701	990		0.40	0.011				**0.011**	**Extended Detention Provided**
246.10	**2,993**	**2,864**	**573**	**4,273**	**1,563**	**Extended Detention**	0.60	0.014	0.000	-		**0.014**	
246.30	3,193	3,093	619	4,892	2,182		0.80	0.016	0.149	-		**0.166**	
246.50	**3,393**	**3,293**	**659**	**5,551**	**2,840**		1.00	0.018	0.422	-		**0.441**	
246.70	3,528	3,460	692	6,243	3,532		1.20	0.020	-	0.672		**0.693**	
246.90	3,662	3,595	719	6,962	4,251		1.40	0.022	-	0.823		**0.845**	
247.10	3,797	3,729	746	7,707	4,997		1.60	0.023	-	0.951		**0.974**	
247.30	3,931	3,864	773	8,480	5,770		1.80	0.025	-	1.063		**1.088**	
247.50	**4,066**	**3,999**	**800**	**9,280**	**6,570**	**Emergency Spillway**	2.00	0.026	-	1.165	0.000	**1.191**	**100-year Storage Provided**
247.75	4,245	4,156	1,039	10,319	7,609		2.25	0.028	-	1.280	4.175	**5.483**	
248.00	**4,424**	**4,335**	**1,084**	**11,403**	**8,692**	**Top of Berm**	2.50	0.030	-	1.386	11.809	**13.224**	

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File: 16119
Date: May 2021

Table E.6-A: Permanent Pool Volume Requirements - North SWM Pond

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	**55%**	**70%**	**85%**
Level 1	*Infiltration*	25	30	35	40
	Wetlands [2]	80	105	120	140
	Wet Pond [2]	140	190	225	250
	Hybrid Wet Pond/Wetland [4]	110	150	175	195
Level 2	*Infiltration*	20	20	25	30
	Wetlands	60	70	80	90
	Wet Pond	90	110	130	150
	Hybrid Wet Pond/Wetland	75	90	105	120
Level 3	*Infiltration*	20	20	20	20
	Wetlands	60	60	60	60
	Wet Pond	60	75	85	95
	Hybrid Wet Pond/Wetland	60	70	75	80
	Dry Pond	90	150	200	240

Source: Stormwater Management Planning and Design Manual (Table 3.2), Ministry of the Environment, Ontario, March 2003

1. Table 3.2 was based on specific design parameters (depth, length to width ratio) for each type of end-of-pipe stormwater management facility. The values of these parameters are provided in Appendix I of the Manual. All values in Table 4.1 are based on a 24 hour detention.
2. For wetlands, wet ponds and hybrid ponds, all of the storage, except 40 m^3/ha, in Table 3.2 represents the permanent pool volume. The 40 m^3/ha represents the extended detention storage.
3. For hybrid ponds, 50% to 60% of the permanent pool volume shall be contained in deeper portions of the facility.

PERMANENT POOL VOLUME CALCULATOR

SWMP Type:	WET POND	(IN - infiltration, WET - wetlands, WP - wet pond, HYB - hybrid wet pond/wetland, DP - dry pond)
Protection Level:	1	(1 - 80% TSS, 2 - 70% TSS, 3 - 60% TSS)
Average Imperviousness:	55.0 %	
Volume Level:	150.0 m^3/ha	Excluding Extended Detention
Area:	24.01 ha	
Total Required Volume:	**3,602 m^3**	

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File: 16119
Date: May 2021

Table E.6-B: Permanent Pool Volume Requirements - South SWM Pond

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Level 1	*Infiltration*	25	30	35	40
	Wetlands [2]	80	105	120	140
	Wet Pond [2]	140	190	225	250
	Hybrid Wet Pond/Wetland [4]	110	150	175	195
Level 2	*Infiltration*	20	20	25	30
	Wetlands	60	70	80	90
	Wet Pond	90	110	130	150
	Hybrid Wet Pond/Wetland	75	90	105	120
Level 3	*Infiltration*	20	20	20	20
	Wetlands	60	60	60	60
	Wet Pond	60	75	85	95
	Hybrid Wet Pond/Wetland	60	70	75	80
	Dry Pond	90	150	200	240

Source: Stormwater Management Planning and Design Manual (Table 3.2),
Ministry of the Environment, Ontario, March 2003

1. Table 3.2 was based on specific design parameters (depth, length to width ratio) for each type of end-of-pipe stormwater management facility. The values of these parameters are provided in Appendix I of the Manual. All values in Table 4.1 are based on a 24 hour detention.
2. For wetlands, wet ponds and hybrid ponds, all of the storage, except 40 m^3/ha, in Table 3.2 represents the permanent pool volume. The 40 m^3/ha represents the extended detention storage.
3. For hybrid ponds, 50% to 60% of the permanent pool volume shall be contained in deeper portions of the facility.

PERMANENT POOL VOLUME CALCULATOR

SWMP Type:	WET POND	(IN - infiltration, WET - wetlands, WP - wet pond, HYB - hybrid wet pond/wetland, DP - dry pond)
Protection Level:	1	(1 - 80% TSS, 2 - 70% TSS, 3 - 60% TSS)
Average Imperviousness:	60.0 %	
Volume Level:	161.7 m^3/ha	Excluding Extended Detention
Area:	10.85 ha	
Total Required Volume:	**1,754 m^3**	

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File: 16119
Date: May 2021

Table E.7-A: Extended Detention Requirements - North SWM Pond

Event	Area (ha)	R.V. (mm)	Required Ext. Det. Volume (m^3)	Provided Ext. Det. Volume (m^3)
25mm 4-hour Chicago Storm	24.01	11.19	2,687	3,113

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Date: May 2021

Table E.7-B: Extended Detention Requirements - South SWM Pond

Event	Area (ha)	R.V. (mm)	Required Ext. Det. Volume (m^3)	Provided Ext. Det. Volume (m^3)
25mm 4-hour Chicago Storm	10.85	12.16	1,319	1,563

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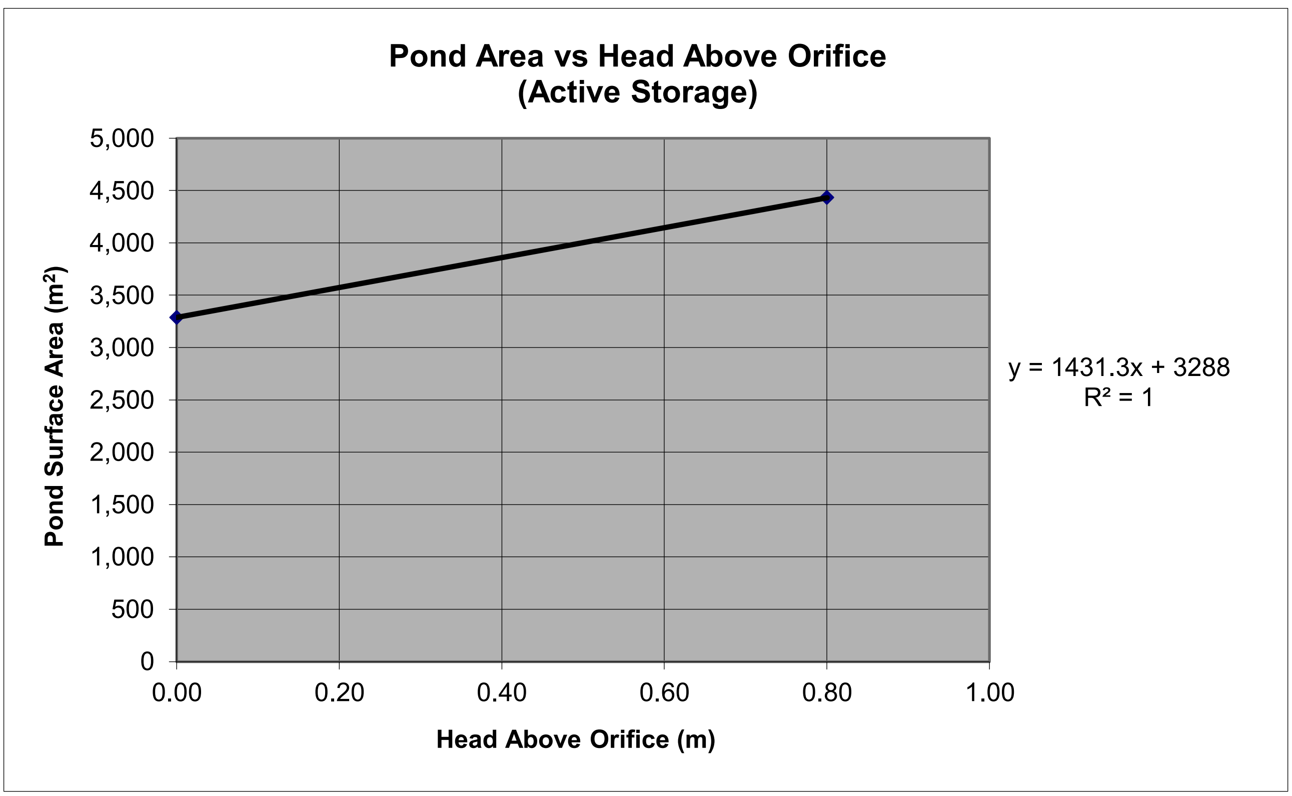
Table E.8-A: Extended Detention Drawdown Time - North SWM Pond

Extended Detention - SWM Pond

Orifice Sizing		
Orifice Size	125	mm
Orifice Inve	247.00	m
Orifice Area	0.012271846	sq. m
[1]$EDL_{erosion}$	247.80	m
NWL	247.00	m
C_2	1431.3	
C_3	3288.0	
h	0.7375	m
Drawdown '	51.4	hr

$y = mx + b$
$C_2 = m$
$C_3 = b$



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File: 16119
Date: May 2021

Table E.8-B: Extended Detention Drawdown Time - South SWM Pond

Extended Detention - SWM Pond

Orifice Sizing		
Orifice Size	95	mm
Orifice Inve	245.50	m
Orifice Area	0.007088218	sq. m
[1]$EDL_{erosion}$	246.10	m
NWL	245.50	m
C_2	1293.3	
C_3	2217.0	
h	0.5525	m
Drawdown '	52.0	hr

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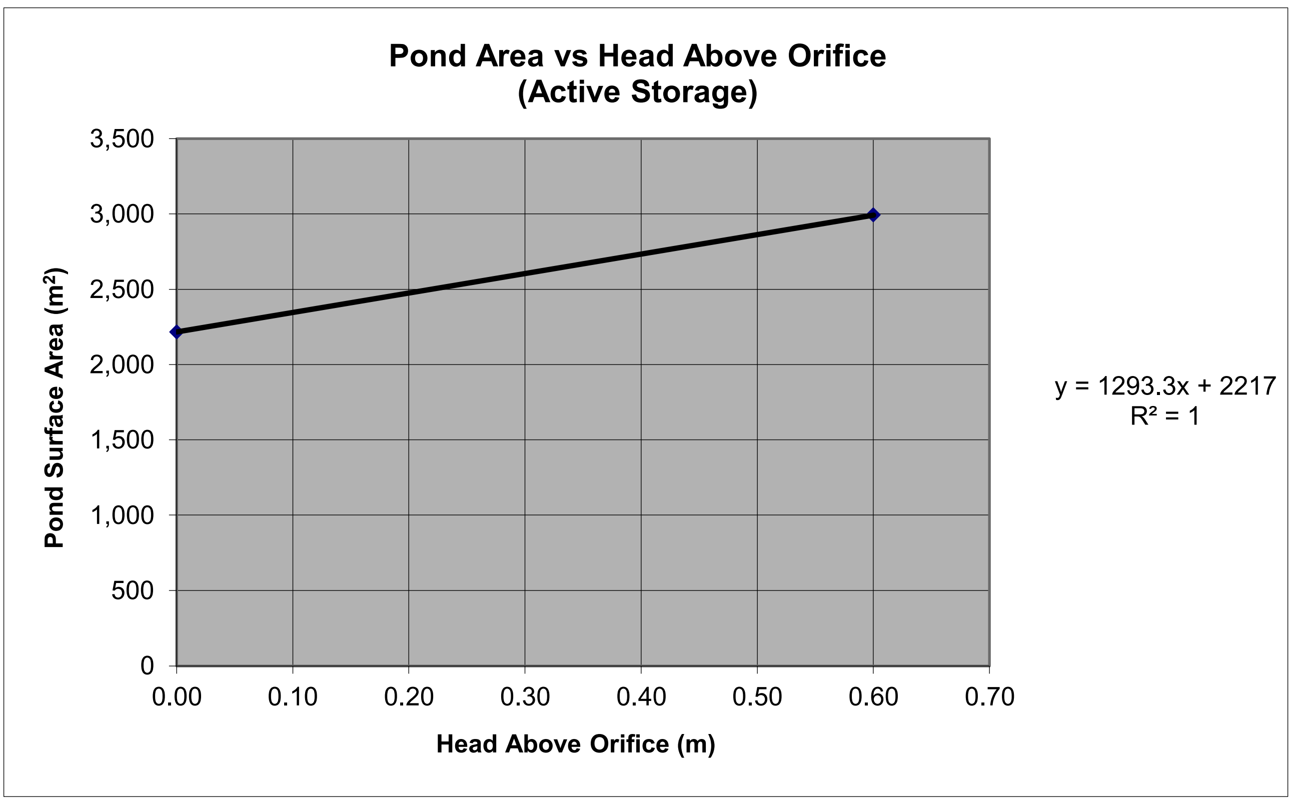
$C_2 = m$
$C_3 = b$



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File: 16119
Date: May 2021

Table E.9-A: Critical Storm Analysis - North SWM Pond

Storm Distribution	Theoretical 100-year Storage Volume Required (m^3)	Note
6-hour SCS	**5,510**	**Critical**
12-hour SCS	5,078	
24-hour SCS	4,705	
6-hour AES	5,115	
12-hour AES	4,405	
24-hour AES	3,702	
4-hour Chicago	4,902	

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Table E.9-B: Critical Storm Analysis - South SWM Pond

Storm Distribution	Theoretical 100-year Storage Volume Required (m^3)	Note
6-hour SCS	**2,994**	**Critical**
12-hour SCS	2,782	
24-hour SCS	2,575	
6-hour AES	2,624	
12-hour AES	2,013	
24-hour AES	1,515	
4-hour Chicago	2,616	

North SWM Pond: Forebay Spillway

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	247.80	m
Crest Elevation	247.00	m
Tailwater Elevation	247.00	m
Crest Surface Type	Gravel	
Crest Breadth	8.00	m
Crest Length	4.00	m

Results

Discharge	4.769	m³/s
Headwater Height Above Crest	0.80	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.67	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.67	SI
Flow Area	3.20	m²
Velocity	1.49	m/s
Wetted Perimeter	5.60	m
Top Width	4.00	m

South SWM Pond: Forebay Spillway

Project Description

Solve For	Discharge

Input Data

Headwater Elevation		246.10	m
Crest Elevation		245.50	m
Tailwater Elevation		245.50	m
Crest Surface Type	Gravel		
Crest Breadth		5.60	m
Crest Length		4.00	m

Results

Discharge	3.052	m^3/s
Headwater Height Above Crest	0.60	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.64	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.64	SI
Flow Area	2.40	m^2
Velocity	1.27	m/s
Wetted Perimeter	5.20	m
Top Width	4.00	m

Culvert Calculator Report
North SWM Pond: Outlet Pipe, 100yr Controlled

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	0.00 m	Headwater Depth/Height	1.00
Computed Headwater Elevation	247.42 m	Discharge	1.3410 m³/s
Inlet Control HW Elev.	247.35 m	Tailwater Elevation	246.60 m
Outlet Control HW Elev.	247.42 m	Control Type	Entrance Control

Grades

Upstream Invert	246.35 m	Downstream Invert	246.00 m
Length	70.70 m	Constructed Slope	0.004950 m/m

Hydraulic Profile

Profile	S2	Depth, Downstream	0.64 m
Slope Type	Steep	Normal Depth	0.64 m
Flow Regime	Supercritical	Critical Depth	0.65 m
Velocity Downstream	2.40 m/s	Critical Slope	0.004580 m/m

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.07 m
Section Size	1050 mm	Rise	1.07 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	247.42 m	Upstream Velocity Head	0.28 m
Ke	0.50	Entrance Loss	0.14 m

Inlet Control Properties

Inlet Control HW Elev.	247.35 m	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	0.9 m²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
South SWM Pond: Outlet Pipe, 100yr Controlled

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	0.00 m	Headwater Depth/Height	2.07
Computed Headwater Elevation	244.76 m	Discharge	0.7480 m^3/s
Inlet Control HW Elev.	244.76 m	Tailwater Elevation	242.00 m
Outlet Control HW Elev.	244.61 m	Control Type	Inlet Control

Grades

Upstream Invert	243.50 m	Downstream Invert	242.00 m
Length	72.30 m	Constructed Slope	0.020747 m/m

Hydraulic Profile

Profile	S2	Depth, Downstream	0.42 m
Slope Type	Steep	Normal Depth	0.42 m
Flow Regime	Supercritical	Critical Depth	0.55 m
Velocity Downstream	3.52 m/s	Critical Slope	0.012028 m/m

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	0.61 m
Section Size	600 mm	Rise	0.61 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	244.61 m	Upstream Velocity Head	0.37 m
Ke	0.50	Entrance Loss	0.19 m

Inlet Control Properties

Inlet Control HW Elev.	244.76 m	Flow Control	Submerged
Inlet Type	Square edge w/headwall	Area Full	0.3 m^2
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

North SWM Pond: Emergency Spillway, 100yr Uncontrolled

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		5.689	m^3/s
Crest Elevation		249.00	m
Tailwater Elevation		249.00	m
Crest Surface Type	Gravel		
Crest Breadth		7.00	m
Crest Length		20.00	m

Results

Headwater Elevation	249.32	m
Headwater Height Above Crest	0.32	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.57	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.57	SI
Flow Area	6.41	m^2
Velocity	0.89	m/s
Wetted Perimeter	20.64	m
Top Width	20.00	m

South SWM Pond: Emergency Spillway, 100yr Uncontrolled

Project Description

Solve For	Headwater Elevation

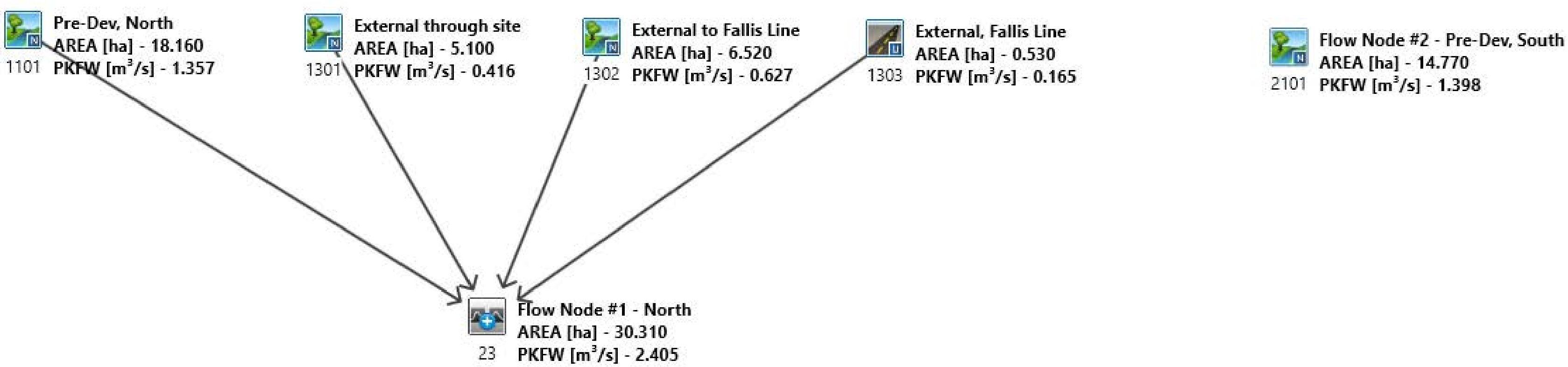
Input Data

Discharge	3.050	m³/s
Crest Elevation	247.50	m
Tailwater Elevation	247.50	m
Crest Surface Type	Gravel	
Crest Breadth	7.00	m
Crest Length	10.00	m

Results

Headwater Elevation	247.84	m
Headwater Height Above Crest	0.34	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.57	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.57	SI
Flow Area	3.35	m²
Velocity	0.91	m/s
Wetted Perimeter	10.67	m
Top Width	10.00	m

Valdor Engineering Inc.
File: 16119
Date: May 2021



VO5 Model Schematic – Pre-Development

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USER:


COMMENTS: ____________________________________________________________


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        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```



```
                    *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\1d125601-d1cd-4f03-8084-036fa7d860ff\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\1d125601-d1cd-4f03-8084-036fa7d860ff\scena


DATE: 05-07-2021                           TIME: 01:37:10

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_010Y                   **
  ************************************************

  W/E COMMAND            HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min    ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        2101  1  5.0   14.77    0.71  3.50  22.52 0.37   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.39]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        1101  1  5.0   18.16    0.69  3.67  21.15 0.34   0.000
    [CN=75.0        ]
    [ N = 3.0:Tp 0.50]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        1301  1  5.0    5.10    0.22  3.67  23.11 0.38   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
```

```
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        1302  1  5.0    6.52    0.33  3.58  24.55 0.40   0.000
    [CN=79.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD      1303  1  5.0    0.53    0.10  3.25  46.71 0.76   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1101+  1301]  0023  3  5.0   23.26    0.90  3.67  21.58  n/a   0.000
*
    ADD [  0023+  1302]  0023  1  5.0   29.78    1.22  3.67  22.23  n/a   0.000
*
    ADD [  0023+  1303]  0023  3  5.0   30.31    1.24  3.67  22.66  n/a   0.000
*
==========================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```


```
                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\632a0c00-5277-401c-a06c-52dbb365d1d2\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\632a0c00-5277-401c-a06c-52dbb365d1d2\scena


DATE: 05-07-2021                           TIME: 01:37:10

USER:


COMMENTS: ____________________________________________________________


  ***********************************************
  ** SIMULATION : SCS_6H_025Y                  **
  ***********************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min     ha  '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        2101  1  5.0   14.77    0.97  3.50  30.34 0.42   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.39]
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        1101  1  5.0   18.16    0.94  3.67  28.64 0.39   0.000
    [CN=75.0        ]
    [ N = 3.0:Tp 0.50]
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        1301  1  5.0    5.10    0.29  3.67  30.99 0.43   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD        1302  1  5.0    6.52    0.44  3.58  32.77 0.45   0.000
    [CN=79.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD      1303  1  5.0    0.53    0.13  3.25  56.33 0.77   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1101+  1301]  0023  3  5.0   23.26    1.23  3.67  29.15  n/a   0.000
*
    ADD [  0023+  1302]  0023  1  5.0   29.78    1.66  3.67  29.94  n/a   0.000
*
    ADD [  0023+  1303]  0023  3  5.0   30.31    1.68  3.67  30.41  n/a   0.000
*
==========================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```

```
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                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\bd87c9ab-f3a3-48d2-a78d-93262d2a121d\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\bd87c9ab-f3a3-48d2-a78d-93262d2a121d\scena


DATE: 05-07-2021                           TIME: 01:37:10

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_050Y                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min    ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                 15.0
    [ Ptot= 81.40 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         2101  1  5.0   14.77    1.18  3.50  36.53 0.45   0.000
    [CN=77.0         ]
    [ N = 3.0:Tp 0.39]
*
    READ STORM                 15.0
    [ Ptot= 81.40 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         1101  1  5.0   18.16    1.14  3.67  34.58 0.42   0.000
    [CN=75.0         ]
    [ N = 3.0:Tp 0.50]
*
    READ STORM                 15.0
    [ Ptot= 81.40 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         1301  1  5.0    5.10    0.35  3.67  37.21 0.46   0.000
    [CN=77.0         ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                 15.0
    [ Ptot= 81.40 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         1302  1  5.0    6.52    0.53  3.58  39.23 0.48   0.000
    [CN=79.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot= 81.40 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.15  3.25  63.61 0.78   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1101+  1301]  0023  3  5.0   23.26    1.50  3.67  35.16  n/a   0.000
*
    ADD [  0023+  1302]  0023  1  5.0   29.78    2.01  3.67  36.05  n/a   0.000
*
    ADD [  0023+  1303]  0023  3  5.0   30.31    2.04  3.67  36.53  n/a   0.000
*
=============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M  OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M  OOO
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                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\c5631843-708e-4913-8262-12c9734d26c8\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\c5631843-708e-4913-8262-12c9734d26c8\scena


DATE: 05-07-2021                           TIME: 01:37:10

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_100Y                   **
  ************************************************

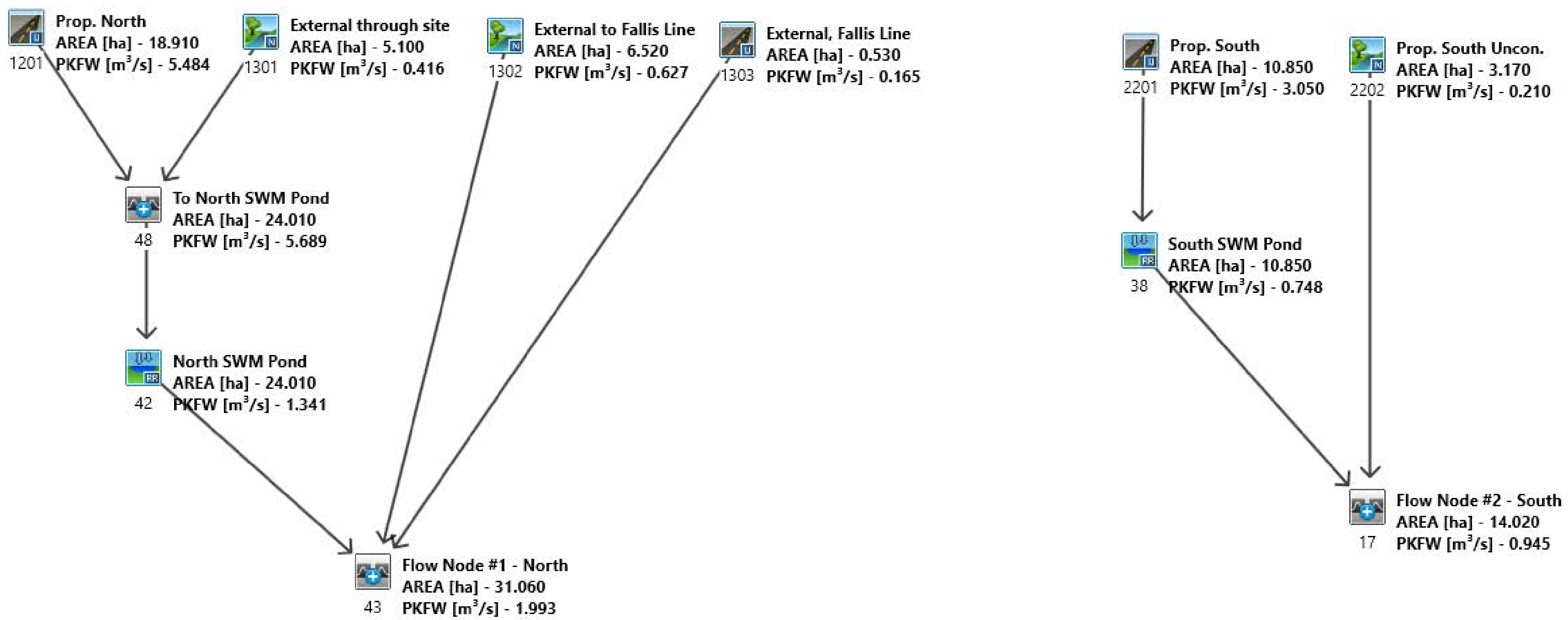
  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min    ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                 15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         2101  1  5.0   14.77    1.40  3.50  42.97 0.48   0.000
    [CN=77.0         ]
    [ N = 3.0:Tp 0.39]
```

```
*
    READ STORM                 15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         1101  1  5.0   18.16    1.36  3.67  40.79 0.45   0.000
    [CN=75.0         ]
    [ N = 3.0:Tp 0.50]
*
    READ STORM                 15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         1301  1  5.0    5.10    0.42  3.67  43.67 0.49   0.000
    [CN=77.0         ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                 15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         1302  1  5.0    6.52    0.63  3.58  45.92 0.51   0.000
    [CN=79.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e83b3bd8-7a87-4fe1-b733-
389a2c6571d4\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.16  3.25  70.97 0.79   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1101+  1301]  0023  3  5.0   23.26    1.77  3.67  41.42  n/a   0.000
*
    ADD [  0023+  1302]  0023  1  5.0   29.78    2.38  3.67  42.41  n/a   0.000
*
    ADD [  0023+  1303]  0023  3  5.0   30.31    2.40  3.67  42.90  n/a   0.000
*
 FINISH

===========================================================================================
===============
```

Valdor Engineering Inc.
File: 16119
Date: May 2021



VO5 Model Schematic – Post-Development

```
==========================================================================================
===============

       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\9aedd227-c1cc-49dd-a183-d84895375be8\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\9aedd227-c1cc-49dd-a183-d84895375be8\scena


DATE: 05-07-2021                           TIME: 01:40:28

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : 25mm 4H Chicago               **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min    ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      -------------------
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\da349100-c2d2-4d3c-9137-e4d1
    remark: 25mm CHICAGO Storm
*
 ** CALIB NASHYD         2202  1  5.0    3.17    0.01  2.17   2.37 0.09   0.000
    [CN=66.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\da349100-c2d2-4d3c-9137-e4d1
    remark: 25mm CHICAGO Storm
*
 ** CALIB STANDHYD       2201  1  5.0   10.85    0.54  1.50  12.16 0.49   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]   0038  1  5.0   10.85    0.01  4.17  12.02  n/a   0.000
      {ST=  0.12 ha.m }
*
    ADD [  2202+  0038]  0017  3  5.0   14.02    0.02  2.33   9.83  n/a   0.000
*
```

```
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\da349100-c2d2-4d3c-9137-e4d1
    remark: 25mm CHICAGO Storm
*
 ** CALIB NASHYD         1302  1  5.0    6.52    0.03  2.17   3.91 0.16   0.000
    [CN=79.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\da349100-c2d2-4d3c-9137-e4d1
    remark: 25mm CHICAGO Storm
*
 ** CALIB NASHYD         1301  1  5.0    5.10    0.02  2.33   3.63 0.15   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\da349100-c2d2-4d3c-9137-e4d1
    remark: 25mm CHICAGO Storm
*
 ** CALIB STANDHYD       1201  1  5.0   18.91    0.99  1.50  13.22 0.53   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  1201+  1301]  0048  3  5.0   24.01    0.99  1.50  11.19  n/a   0.000
*
    RESRVR [ 2:  0048]   0042  1  5.0   24.01    0.02  4.25  11.13  n/a   0.000
      {ST=  0.24 ha.m }
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\da349100-c2d2-4d3c-9137-e4d1
    remark: 25mm CHICAGO Storm
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.04  1.50  17.43 0.70   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1302+  1303]  0043  3  5.0    7.05    0.05  1.50   4.93  n/a   0.000
*
    ADD [  0043+  0042]  0043  1  5.0   31.06    0.06  2.17   9.72  n/a   0.000
*
==========================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
```

```
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\d0616cb9-5003-4901-8698-cfb942d4cf6e\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\d0616cb9-5003-4901-8698-cfb942d4cf6e\scena


DATE: 05-07-2021                          TIME: 01:40:28

USER:


COMMENTS: ____________________________________________________________


  ***********************************************
  ** SIMULATION : SCS_6H_002Y                  **
  ***********************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                 15.0
    [ Ptot= 38.70 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\96d71607-4471-4ada-b919-ba6c
    remark: 2yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD          2202  1  5.0    3.17    0.04  3.58   6.46 0.17   0.000
    [CN=66.0          ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot= 38.70 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\96d71607-4471-4ada-b919-ba6c
    remark: 2yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD        2201  1  5.0   10.85    1.00  3.25  20.93 0.54   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]    0038  1  5.0   10.85    0.06  4.42  20.78  n/a   0.000
      {ST=  0.18 ha.m }
*
    ADD [  2202+  0038]  0017  3  5.0   14.02    0.09  3.92  17.54  n/a   0.000
*
    READ STORM                 15.0
    [ Ptot= 38.70 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\96d71607-4471-4ada-b919-ba6c
    remark: 2yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD          1302  1  5.0    6.52    0.13  3.58  10.29 0.27   0.000
    [CN=79.0          ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot= 38.70 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\96d71607-4471-4ada-b919-ba6c
    remark: 2yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD          1301  1  5.0    5.10    0.09  3.75   9.59 0.25   0.000
    [CN=77.0          ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                 15.0
    [ Ptot= 38.70 mm ]
```

```
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\96d71607-4471-4ada-b919-ba6c
    remark: 2yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD        1201  1  5.0   18.91    1.85  3.25  22.51 0.58   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  1201+  1301]  0048  3  5.0   24.01    1.88  3.25  19.77  n/a   0.000
*
    RESRVR [ 2:  0048]    0042  1  5.0   24.01    0.15  4.67  19.71  n/a   0.000
      {ST=  0.36 ha.m }
*
    READ STORM                 15.0
    [ Ptot= 38.70 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\96d71607-4471-4ada-b919-ba6c
    remark: 2yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD        1303  1  5.0    0.53    0.06  3.25  28.10 0.73   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1302+  1303]  0043  3  5.0    7.05    0.14  3.58  11.63  n/a   0.000
*
    ADD [  0043+  0042]  0043  1  5.0   31.06    0.23  3.92  17.87  n/a   0.000
*
==========================================================================================
==============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\6f45f1d2-d35a-4a58-a1de-d8c406734d39\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\6f45f1d2-d35a-4a58-a1de-d8c406734d39\scena


DATE: 05-07-2021                          TIME: 01:40:27

USER:


COMMENTS: ____________________________________________________________


  ***********************************************
  ** SIMULATION : SCS_6H_005Y                  **
  ***********************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
```

```
     --------------------
   READ STORM                15.0
   [ Ptot= 52.40 mm ]
   fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\3c8faa6e-dacf-48a0-9e51-0730
   remark: 5yr/6hr Peterborough A SCS
*
** CALIB NASHYD         2202  1  5.0    3.17    0.08  3.58  12.05 0.23   0.000
   [CN=66.0         ]
   [ N = 3.0:Tp 0.42]
*
   READ STORM                15.0
   [ Ptot= 52.40 mm ]
   fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\3c8faa6e-dacf-48a0-9e51-0730
   remark: 5yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       2201  1  5.0   10.85    1.47  3.25  30.52 0.58   0.000
   [I%=45.0:S%= 2.00]
*
   RESRVR [ 2:  2201]   0038  1  5.0   10.85    0.20  3.83  30.37  n/a   0.000
     {ST=  0.23 ha.m }
*
   ADD [  2202+  0038]  0017  3  5.0   14.02    0.27  3.75  26.23  n/a   0.000
*
   READ STORM                15.0
   [ Ptot= 52.40 mm ]
   fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\3c8faa6e-dacf-48a0-9e51-0730
   remark: 5yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1302  1  5.0    6.52    0.24  3.58  18.44 0.35   0.000
   [CN=79.0         ]
   [ N = 3.0:Tp 0.42]
*
   READ STORM                15.0
   [ Ptot= 52.40 mm ]
   fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\3c8faa6e-dacf-48a0-9e51-0730
   remark: 5yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1301  1  5.0    5.10    0.16  3.67  17.30 0.33   0.000
   [CN=77.0         ]
   [ N = 3.0:Tp 0.49]
*
   READ STORM                15.0
   [ Ptot= 52.40 mm ]
   fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\3c8faa6e-dacf-48a0-9e51-0730
   remark: 5yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1201  1  5.0   18.91    2.69  3.25  32.55 0.62   0.000
   [I%=50.0:S%= 2.00]
*
   ADD [  1201+  1301]  0048  3  5.0   24.01    2.76  3.25  29.31  n/a   0.000
*
   RESRVR [ 2:  0048]   0042  1  5.0   24.01    0.46  3.83  29.25  n/a   0.000
     {ST=  0.45 ha.m }
*
   READ STORM                15.0
   [ Ptot= 52.40 mm ]
   fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\3c8faa6e-dacf-48a0-9e51-0730
   remark: 5yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.09  3.25  39.18 0.75   0.000
   [I%=70.0:S%= 2.00]
*
   ADD [  1302+  1303]  0043  3  5.0    7.05    0.26  3.58  20.00  n/a   0.000
*
```

```
   ADD [  0043+  0042]  0043  1  5.0   31.06    0.69  3.75  27.15  n/a   0.000
*
==========================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\3f6a7d6f-36fd-40bb-8afb-a6df443f47d3\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\3f6a7d6f-36fd-40bb-8afb-a6df443f47d3\scena


DATE: 05-07-2021                           TIME: 01:40:27

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_010Y                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min     ha  '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         2202  1  5.0    3.17    0.10  3.58  16.43 0.27   0.000
    [CN=66.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       2201  1  5.0   10.85    1.81  3.25  37.24 0.61   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]   0038  1  5.0   10.85    0.33  3.58  37.09  n/a   0.000
      {ST=  0.26 ha.m }
*
```

```
    ADD [  2202+  0038]  0017  3  5.0   14.02    0.43  3.58  32.42  n/a   0.000
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1302  1  5.0    6.52    0.33  3.58  24.55 0.40   0.000
    [CN=79.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1301  1  5.0    5.10    0.22  3.67  23.11 0.38   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1201  1  5.0   18.91    3.29  3.25  39.55 0.64   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  1201+  1301]  0048  3  5.0   24.01    3.39  3.25  36.06  n/a   0.000
*
    RESRVR [ 2:  0048]   0042  1  5.0   24.01    0.70  3.75  36.00  n/a   0.000
      {ST=  0.51 ha.m }
*
    READ STORM                15.0
    [ Ptot= 61.50 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\4d7be5e1-6471-48e3-b90f-74b8
    remark: 10yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.10  3.25  46.71 0.76   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1302+  1303]  0043  3  5.0    7.05    0.35  3.58  26.21  n/a   0.000
*
    ADD [  0043+  0042]  0043  1  5.0   31.06    1.03  3.67  33.78  n/a   0.000
*
===========================================================================================
===============

       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```



```
                   *****  S U M M A R Y   O U T P U T  *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.1\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\86f51cd2-5122-4fa5-9a94-173d448cc0ad\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
5e475049aa89\86f51cd2-5122-4fa5-9a94-173d448cc0ad\scena


DATE: 05-07-2021                           TIME: 01:40:27

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_025Y                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min     ha  '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         2202  1  5.0    3.17    0.14  3.58  22.52 0.31   0.000
    [CN=66.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       2201  1  5.0   10.85    2.34  3.25  45.99 0.63   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]   0038  1  5.0   10.85    0.51  3.42  45.84  n/a   0.000
      {ST=  0.30 ha.m }
*
    ADD [  2202+  0038]  0017  3  5.0   14.02    0.65  3.50  40.57  n/a   0.000
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1302  1  5.0    6.52    0.44  3.58  32.77 0.45   0.000
    [CN=79.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1301  1  5.0    5.10    0.29  3.67  30.99 0.43   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                15.0
```

```
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1201  1  5.0    18.91    4.07  3.25  48.60 0.67   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  1201+  1301]  0048  3  5.0    24.01    4.21  3.25  44.86  n/a   0.000
*
    RESRVR [ 2:  0048]   0042  1  5.0    24.01    1.01  3.58  44.80  n/a   0.000
      {ST=  0.59 ha.m }
*
    READ STORM                 15.0
    [ Ptot= 72.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\fda52cd9-78b3-464c-ae09-5a47
    remark: 25yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0     0.53    0.13  3.25  56.33 0.77   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1302+  1303]  0043  3  5.0     7.05    0.46  3.58  34.54  n/a   0.000
*
    ADD [  0043+  0042]  0043  1  5.0    31.06    1.47  3.58  42.47  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  S U M M A R Y   O U T P U T  *****


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5e475049aa89\ad68ddcc-f445-46f6-aa5d-44e66cbbec44\scena


DATE: 05-07-2021                             TIME: 01:40:28

USER:


COMMENTS: __________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_050Y                   **
  ************************************************

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                                   min    ha   '  cms   hrs     mm          cms
```

```
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      --------------------
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    [ Ptot= 81.40 mm ]
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db4e3a3851ae\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
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    [CN=66.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot= 81.40 mm ]
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db4e3a3851ae\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       2201  1  5.0    10.85    2.69  3.25  52.71 0.65   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]   0038  1  5.0    10.85    0.65  3.42  52.56  n/a   0.000
      {ST=  0.34 ha.m }
*
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*
    READ STORM                 15.0
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    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1302  1  5.0     6.52    0.53  3.58  39.23 0.48   0.000
    [CN=79.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
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db4e3a3851ae\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
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 *  CALIB NASHYD         1301  1  5.0     5.10    0.35  3.67  37.21 0.46   0.000
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*
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db4e3a3851ae\d8695a31-63a1-48e7-b178-0ba7
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 *  CALIB STANDHYD       1201  1  5.0    18.91    4.67  3.25  55.54 0.68   0.000
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*
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*
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*
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    [ Ptot= 81.40 mm ]
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db4e3a3851ae\d8695a31-63a1-48e7-b178-0ba7
    remark: 50yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0     0.53    0.15  3.25  63.61 0.78   0.000
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*
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```

```
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*
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        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c7e9b9dc-2878-4b8a-9d26-
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DATE: 05-07-2021                           TIME: 01:40:28

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_6H_100Y                  **
  ************************************************

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                                  min     ha   '  cms   hrs     mm          cms

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      --------------------
    READ STORM                15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 ** CALIB NASHYD         2202  1  5.0    3.17    0.21  3.58  32.65 0.36   0.000
    [CN=66.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       2201  1  5.0   10.85    3.05  3.25  59.58 0.66   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]   0038  1  5.0   10.85    0.75  3.42  59.43  n/a   0.000
      {ST=  0.38 ha.m }
```

```
*
    ADD [  2202+  0038]  0017  3  5.0   14.02    0.95  3.50  53.38  n/a   0.000
*
    READ STORM                15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1302  1  5.0    6.52    0.63  3.58  45.92 0.51   0.000
    [CN=79.0         ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                15.0
    [ Ptot= 89.90 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 *  CALIB NASHYD         1301  1  5.0    5.10    0.42  3.67  43.67 0.49   0.000
    [CN=77.0         ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                15.0
    [ Ptot= 89.90 mm ]
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db4e3a3851ae\d3ed2ac6-ce87-4fd6-a4f9-ab5d
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*
 *  CALIB STANDHYD       1201  1  5.0   18.91    5.48  3.25  62.61 0.70   0.000
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*
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*
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*
    READ STORM                15.0
    [ Ptot= 89.90 mm ]
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db4e3a3851ae\d3ed2ac6-ce87-4fd6-a4f9-ab5d
    remark: 100yr/6hr Peterborough A SCS
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.16  3.25  70.97 0.79   0.000
    [I%=70.0:S%= 2.00]
*
    ADD [  1302+  1303]  0043  3  5.0    7.05    0.65  3.58  47.81  n/a   0.000
*
    ADD [  0043+  0042]  0043  1  5.0   31.06    1.99  3.58  56.09  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L              (v 5.1.2000)
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        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  S U M M A R Y   O U T P U T  *****
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DATE: 05-07-2021                           TIME: 01:40:28

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Timmins                       **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    READ STORM                 15.0
    [ Ptot=193.00 mm ]
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db4e3a3851ae\50758f93-5b19-437c-bd5a-bd75
    remark: * Timmins Storm
*
 ** CALIB NASHYD         2202  1  5.0    3.17    0.23  7.08 109.84 0.57   0.000
    [CN=66.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\50758f93-5b19-437c-bd5a-bd75
    remark: * Timmins Storm
*
 ** CALIB STANDHYD       2201  1  5.0   10.85    1.10  7.00 150.09 0.78   0.000
    [I%=45.0:S%= 2.00]
*
    RESRVR [ 2:  2201]   0038  1  5.0   10.85    0.80  7.08 149.95  n/a   0.000
      {ST=  0.40 ha.m }
*
    ADD [  2202+  0038]  0017  3  5.0   14.02    1.03  7.08 140.88  n/a   0.000
*
    READ STORM                 15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\50758f93-5b19-437c-bd5a-bd75
    remark: * Timmins Storm
*
 ** CALIB NASHYD         1302  1  5.0    6.52    0.59  7.08 136.73 0.71   0.000
    [CN=79.0        ]
    [ N = 3.0:Tp 0.42]
*
    READ STORM                 15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\50758f93-5b19-437c-bd5a-bd75
    remark: * Timmins Storm
*
 ** CALIB NASHYD         1301  1  5.0    5.10    0.43  7.17 132.56 0.69   0.000
    [CN=77.0        ]
    [ N = 3.0:Tp 0.49]
*
    READ STORM                 15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\50758f93-5b19-437c-bd5a-bd75
    remark: * Timmins Storm
*
 ** CALIB STANDHYD       1201  1  5.0   18.91    1.95  7.00 154.72 0.80   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  1201+  1301]  0048  3  5.0   24.01    2.37  7.00 150.02  n/a   0.000
*
    RESRVR [ 2:  0048]   0042  1  5.0   24.01    1.55  7.25 149.96  n/a   0.000
      {ST=  0.86 ha.m }
*
    READ STORM                 15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\59cff961-397f-4763-a62e-
db4e3a3851ae\50758f93-5b19-437c-bd5a-bd75
    remark: * Timmins Storm
*
 *  CALIB STANDHYD       1303  1  5.0    0.53    0.06  7.00 164.64 0.85   0.000
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*
    ADD [  1302+  1303]  0043  3  5.0    7.05    0.64  7.00 138.83  n/a   0.000
*
    ADD [  0043+  0042]  0043  1  5.0   31.06    2.16  7.17 147.43  n/a   0.000
*
 FINISH

==========================================================================================
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```

APPENDIX “F”

Excerpts from the Hydrogeological Assessment Report

Hydrogeological Assessment Report

Proposed Subdivision Development
787 and 825 Fallis Line
Millbrook, Ontario

Prepared For:
The Bromont Group

6. Conclusions and Recommendations

Supporting data upon which our recommendations are based have been presented in the foregoing sections of this report. Based on the results of our hydrogeologic assessment, it is our professional opinion that the Site is suitable for the proposed house (and garage) and there is low potential for groundwater impact due to the planned construction. It is recommended that good construction and mitigation techniques must be used to minimize the potential for impact. Detailed conclusions and recommendations are presented in the following sections regarding the water balance and impacts.

6.1 Water Balance Evaluation

An evaluation of the water balance was completed to compute the potential impacts that may occur in the recharge/discharge characteristics related to the proposed house construction. The objective of the water balance is to illustrate that post-development infiltration within the developable area can meet or be close to pre-development values. The computations have used detailed parameters such as precipitation (Peterborough A weather station data from 1981 to 2006 was used), regional evapotranspiration, infiltration and runoff. Information from the Peterborough A weather station was selected as it was the closest weather station to the Site (~10 km). The detailed calculations can be reviewed in Appendix F. The calculations are based on a total Site area of 49.22 ha (121.6 acres). A summary of the expected pre-development water balance values for the proposed house construction is described in the following section based on current information.

6.2 Pre-Development Water Balance

The pre-development water balance incorporated the existing soils, slope and agricultural areas. The infiltration factor for the area was calculated from the table of values presented in the "Land Development Guidelines" (MOEE, 1995). It is based on three sub-factors which are:

- Topography sub-factor;
- Soil sub-factor; and
- Cover sub-factor.

The subfactor for topography used a range of representative parameters for the surrounding areas including 0.1 for the forested areas; 0.15 for the agricultural areas and 0.20 for a flatter, naturalized area. The soils are generally comprised of till as per the water balance calculations. The existing vegetation sub-factor was selected to represent both the wooded and agricultural areas of the Site (see Appendix F.2 for breakdown of areas). Table 6.1 summarizes the expected pre-development water balance values for the Site.

Table 6.1 Pre-Development Summary

Total Precipitation (Peterborough A):	- 855 mm/year
Regional Evapotranspiration:	- 556 mm/year
Recharge Available:	- 299 mm/year
Area of Recharge Available (Site):	- 49.22 ha
Total Water Surplus:	- 148,335 m^3/year
Total Estimated Infiltration:	- 70,356 m^3/year
Total Estimated Runoff:	- 77,979 m^3/year

Based upon these values, the overall Sites infiltrate on the order of 70,350 m^3 per year or about 145 mm/year.

6.3 Post-Development Water Balance (No Enhancements)

The computation of the water budget was repeated for the proposed house construction assuming no mitigation techniques, that is, runoff from impervious surfaces is unrecoverable and not infiltrated into the ground. The anticipated impact of the proposed construction is related to increased runoff from imperious surfaces such as building roof tops, paved roadways, driveways and parking areas. These are assumed to be impervious surfaces with zero infiltration capacity in this model. A summary of the computations is provided in Table 6.2.

Table 6.2 Post-Development Summary (No Enhancements)

Area of Site:	- 49.22 ha
Impervious Surfaces:	- 20.56 ha
Pervious Surfaces	- 28.66 ha
Total Water Surplus:	- 226,439 m^3/year
Total Estimated Infiltration:	- 42,674 m^3/year
Infiltration % Difference (pre- vs. post-):	- (-39%) (decrease)
Total Estimated Runoff:	- 183,765 m^3/year
Runoff % Difference (pre- vs. post-):	- (136%) (increase)

Information that was provided to GHD in order to compute the post-development water budget in Table 6.2 included evaporation from impervious surfaces (20% of precipitation) and development areas gleaned from the "Draft Concept" prepared by The Biglieri Group Ltd., dated February 20, 2020:

- Single detached lots – 15.86 ha:
  - Assume rooftops cover 60% of the lots;
  - Assume paved driveways cover 15% of the lots; and
  - Assume manicured lawns cover 25% of the lots.
- Townhouse lots – 3.57 ha:
  - Assume rooftops cover 75% of the lots;
  - Assume paved driveways cover 5% of the lots; and
  - Assume manicured lawns cover 20% of the lots.
- Medium density (5-storey building) lot – 0.88 ha:
  - Assume rooftop covers 60% of the lot;
  - Assume paved parking area / driveway covers 20 of the lot; and
  - Assume manicured lawn covers 20% of the lots.
- Parkland and trails – 2.10 ha;
- Right-of-ways – 7.65 ha:
  - Assume paved asphalt / concrete surfaces cover 50% of the right-of-ways; and
  - Assume manicured lawn covers 50% of the right-of-ways.
- Natural heritage system – 16.43 ha;
- Easement – 0.01 ha;
- Stormwater facility – 2.57 ha;
  - Assume pond area – 1.285 ha; and
  - Grass / open space – 1.285 ha.
- Road widening – 0.16 ha.

Under this scenario, the total infiltration volume decreased by 39% and runoff volume increased by 136%.

Within the areas evaluated, the infiltration has reduced and the runoff increased versus the pre-development values. Groundwater base flow would be expected to decrease over time in this scenario. Based upon this scenario, mitigative strategies are required to minimize infiltration losses and reduce storm water runoff. The following section discusses the water balance after considering the mitigation strategy of conveying rooftop stormwater to the ground for infiltration.

6.4 Post-Development Water Balance (Enhanced Infiltration)

The post-construction water budget computations were repeated considering enhanced infiltration options which are also known as Low Impact Development (LID) technologies. These technologies include and are not restricted to rainwater harvesting, downspout disconnection, infiltration trenches, vegetated filter strips, bioretention, permeable pavement, enhanced grass swales, dry swales and perforated pipe systems. For this Site, downspout disconnection was considered as a LID used to balance the water budget.

Based upon LID documentation, downspout disconnections can reduce rooftop runoff by 25% to 50% (i.e. 25% to 50% of the rooftop runoff can be infiltrated). Our water balance suggests that about 31% of all the available rooftop runoff (after evaporation) is needed to infiltrate the soils to maintain the pre-development infiltration values.

A summary of the post-construction water budget with enhancements for infiltration is presented in Table 6.3.

Table 6.3 Post-Development Summary (With Downspout Disconnection)

Area of Site:	- 49.22 ha
Total Water Surplus:	- 226,439 m^3/year
% of Rooftop Runoff Required for Infiltration	- 31.8%
Rooftop Runoff Infiltrated	- 27,682 m^3/year
Total Estimated Infiltration:	- 70,356 m^3/year
Infiltration % Difference (pre- vs. post-):	- (0%) (meets pre-development)
Total Estimated Runoff:	- 156,083 m^3/year
Runoff % Difference (pre- vs. post-):	- 100% (increase)

In this scenario and based on the information provided, the post-development infiltration values meet the pre-development values. Runoff has increased as compared with the pre-development conditions and will need to be managed as per a storm water management plan. In general, these water balance calculations indicate development infiltration values can be maintained at pre-development values for the overall development.

Appendix F
Water Balance Calculations

Appendix F.1

Revised Water Budget (Thornthwaite Method) - Average Values*

Weather Station: Peterborough A

Climate Station: 6166418 **Elevation:** 191 masl **Distance Away:** ~ 10.2 km

Month	Mean Temperature (°C)	Heat Index	Unadjusted Potential ET (mm)	Daylight Correction Factor	Adjusted ET (mm)	Total Precipitation (mm)
January	-8.5	0	0	0.78	0	57.4
February	-7.5	0	0	0.88	0	51.5
March	-1.8	0	0	0.99	0	56.1
April	5.9	1.28	28.8	1.12	32.2	68.6
May	12.1	3.81	60.1	1.22	73.3	81.5
June	17	6.38	85.1	1.28	109.0	79.9
July	19.6	7.91	98.5	1.25	123.1	70.6
August	18.3	7.13	91.8	1.15	105.6	77
September	13.9	4.70	69.2	1.04	72.0	85.3
October	7.5	1.85	36.8	0.92	33.8	76.9
November	1.9	0.23	9.0	0.8	7.2	86.4
December	-4.4	0	0	0.76	0	64.2
TOTAL	6.2	33.3	479.3		556.2	855.4

TOTAL WATER SURPLUS: 299.2 mm

Notes:

*Average values of precipitation were used. Average values of temperature were also used.

Appendix F.2

Water Budget Pre-Development

Catchment Designation	PRE-DEVELOPMENT SITE							TOTAL
	Agricultural Area	Naturalized Areas	Forested Area	787 & 825 Residential Areas				
				Lawn	Rooftops	Pool/Concrete	Gravel Drive	
Area (m^2)	270855	30200	183400	4935	725	185	1900	492200
Pervious Area (m^2)	270855	30200	183400	4935	0	0	1900	491290
% Pervious	55.0%	6.1%	37.3%	1.0%	0%	0%	0.4%	99.8%
Impervious Area (m^2)	0	0	0	0	725	185	0	910
% Impervious	0%	0%	0%	0%	0.1%	0.04%	0%	0.2%
INFILTRATION FACTORS								
Topography Infiltration Factor	0.15	0.2	0.1	0.2	0	0	0.2	
Soil Infiltration Factor	0.2	0.2	0.2	0.2	0	0	0.3	
Land Cover Infiltration Factor	0.1	0.15	0.2	0.15	0	0	0	
MECP Infiltration Factor	0.45	0.55	0.5	0.55	0	0	0.5	
Actual Infiltration Factor	0.45	0.55	0.5	0.55	0	0	0.4	
Runoff Coefficient	0.55	0.45	0.5	0.45	1	1	0.6	
Runoff from Impervious Surfaces*	0	0	0	0	0.8	0.8	0.8	
INPUTS (PER UNIT AREA)								
Precipitation (mm/yr)	855	855	855	855	855	855	855	855
Run On (mm/yr)	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	855	855	855	855	855	855	855	855
OUTPUTS (PER UNIT AREA)								
Precipitation Surplus (mm/yr)	299	299	299	299	684	684	684	301
Net Surplus (mm/yr)	299	299	299	299	684	684	684	301
Evaportranspiration (mm/yr)	556	556	556	556	171	171	171	554
Infiltration (mm/yr)	135	165	150	165	0	0	274	143
Rooftop Infiltration (mm/yr)	0	0	0	0	171	171	0	0
Total Infiltration (mm/yr)	135	165	150	165	171	171	274	143
Runoff Pervious Areas	165	135	150	135	0	0	411	157
Runoff Impervious Areas	0	0	0	0	513	513	0	1
Total Runoff (mm/yr)	165	135	150	135	513	513	411	158
Total Outputs (mm/yr)	855	855	855	855	855	855	855	855
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0
INPUTS (VOLUMES)								
Precipitation (m^3/yr)	231689	25833	156880	4221	620	158	1625	421028
Run On (m^3/yr)	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	231689	25833	156880	4221	620	158	1625	421028
OUTPUTS (VOLUMES)								
Precipitation Surplus (m^3/yr)	81032	9035	54868	1476	496	127	1300	148335
Net Surplus (m^3/yr)	81032	9035	54868	1476	496	127	1300	148335
Evaportranspiration (m^3/yr)	150657	16798	102012	2745	124	32	325	272693
Infiltration (m^3/yr)	36465	4969	27434	812	0	0	520	70200
Rooftop Infiltration (m^3/yr)	0	0	0	0	124	32	0	156
Total Infiltration (m^3/yr)	36465	4969	27434	812	124	32	520	70356
Runoff Pervious Areas (m^3/yr)	44568	4066	27434	664	0	0	780	77512
Runoff Impervious Areas (m^3/yr)	0	0	0	0	372	95	0	467
Total Runoff (m^3/yr)	44568	4066	27434	664	372	95	780	77979
Total Outputs (m^3/yr)	231689	25833	156880	4221	620	158	1625	421028
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0

Notes:

Forested areas include hedge rows

Naturalized areas are open, vacant areas that are not used for agriculture and are not forested areas

Table 2: Infiltration Factors

Description of Area/Development Site	Value of Infiltration Factor
TOPOGRAPHY	
■ Flat land, average slope not exceeding 0.6 m per km	0.30
■ Rolling land, average slope of 2.8 m to 3.8 m per km	0.20
■ Hilly land, average slope of 28 m to 47 m per km	0.10
SOIL	
■ Tight impervious clay	0.10
■ Medium combinations of clay and loam	0.20
■ Open sandy loam	0.4
COVER	
■ Cultivated lands	0.1
■ Woodland	0.2

Table 3: Typical Ground Water Recharge Rates

Soil Texture	Ground Water Recharge Rate	
	(mm/yr)	*(L/Day/Hectare)*
■ coarse sand and gravel	250+	7000+
■ fine to medium sand	200 - 250	5600 - 7000
■ silty sand to sandy silt	150 - 200	4200 - 5600
■ silt	125 - 150	3500 - 4200
■ clayey silt	100 - 125	2800 - 3500
■ clay	less than 100	less than 2800

Appendix F.3

Water Budget Post-Development - No Mitigation Strategies

Catchment Designation	POST-DEVELOPMENT SITE																	TOTAL
	Low Density - Blocks A,B,C - 329 units			**Med. Density - Townhouses**			**Natural Heritage**	**Road Widening**	**Road ROWs**		**Parkland & Trails**	**Medium Density - 5-storey bldg**			**Easement**	**SWM Pond**		
	Lawns	Rooftops	Driveways	Lawns	Rooftops	Driveways			Asphalt	Grass		Landscaping	Rooftops	Asphalt		Grass	Pond	
Area (m^2)	39650	95160	23790	7140	26775	1785	164300	1600	38200	38200	21000	1760	5280	1760	100	12850	12850	492200
Pervious Area (m^2)	39650	0	0	7140	0	0	164300	1600	0	38200	21000	1760	0	0	100	12850	0	286600
% Pervious	8.1%	0%	0%	1%	0%	0%	33.4%	0.3%	0%	7.8%	4.3%	0.4%	0%	0%	0.02%	2.6%	0%	58.2%
Impervious Area (m^2)	0	95160	23790	0	26775	1785	0	0	38200	0	0	0	5280	1760	0	0	12850	205600
% Impervious	0%	19.3%	4.8%	0%	5.4%	0.4%	0%	0%	7.8%	0%	0%	0%	1.1%	0.4%	0%	0%	2.6%	41.8%
	INFILTRATION FACTORS																	
Topography Infiltration Factor	0.15	0	0	0.15	0	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0	0	0.2	0.1	0	
Soil Infiltration Factor	0.2	0	0	0.2	0	0	0.2	0.2	0	0.2	0.2	0.2	0	0	0.2	0.2	0	
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0.2	0.15	0	0.15	0	0.15	0	0	0.15	0.15	0	
MECP Infiltration Factor	0.5	0	0	0.5	0	0.2	0.5	0.55	0.2	0.55	0.4	0.55	0	0	0.55	0.45	0	
Actual Infiltration Factor	0.5	0	0	0.5	0	0	0.5	0.55	0	0.55	0.4	0.55	0	0	0.55	0.45	0	
Runoff Coefficient	0.5	1	1	0.5	1	1	0.5	0.45	1	0.45	0.6	0.45	1	1	0.45	0.55	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0	0	0.8	0	0.8	0	0.8	0.8	0	0	0.8	
	INPUTS (PER UNIT AREA)																	
Precipitation (mm/yr)	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855
	OUTPUTS (PER UNIT AREA)																	
Precipitation Surplus (mm/yr)	299	684	684	299	684	684	299	299	684	299	299	299	684	684	299	299	684	460
Net Surplus (mm/yr)	299	684	684	299	684	684	299	299	684	299	299	299	684	684	299	299	684	460
Evaportranspiration (mm/yr)	556	171	171	556	171	171	556	556	171	556	556	556	171	171	556	556	171	395
Infiltration (mm/yr)	150	0	0	150	0	0	150	165	0	165	120	165	0	0	165	135	0	87
Rooftop Infiltration (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/yr)	150	0	0	150	0	0	150	165	0	165	120	165	0	0	165	135	0	87
Runoff Pervious Areas	150	0	0	150	0	0	150	135	0	135	180	135	0	0	135	165	0	88
Runoff Impervious Areas	0	684	684	0	684	684	0	0	684	0	0	0	684	684	0	0	684	286
Total Runoff (mm/yr)	150	684	684	150	684	684	150	135	684	135	180	135	684	684	135	165	684	373
Total Outputs (mm/yr)	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	INPUTS (VOLUMES)																	
Precipitation (m^3/yr)	33917	81400	20350	6108	22903	1527	140542	1369	32676	32676	17963	1506	4517	1506	86	10992	10992	421028
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	33917	81400	20350	6108	22903	1527	140542	1369	32676	32676	17963	1506	4517	1506	86	10992	10992	421028
	OUTPUTS (VOLUMES)																	
Precipitation Surplus (m^3/yr)	11862	65120	16280	2136	18323	1222	49154	479	26141	11428	6283	527	3613	1204	30	3844	8794	226439
Net Surplus (m^3/yr)	11862	65120	16280	2136	18323	1222	49154	479	26141	11428	6283	527	3613	1204	30	3844	8794	226439
Evaportranspiration (m^3/yr)	22054	16280	4070	3971	4581	305	91388	890	6535	21248	11681	979	903	301	56	7148	2198	194589
Infiltration (m^3/yr)	5931	0	0	1068	0	0	24577	263	0	6286	2513	290	0	0	16	1730	0	42674
Rooftop Infiltration (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/yr)	5931	0	0	1068	0	0	24577	263	0	6286	2513	290	0	0	16	1730	0	42674
Runoff Pervious Areas (m^3/yr)	5931	0	0	1068	0	0	24577	215	0	5143	3770	237	0	0	13	2114	0	43069
Runoff Impervious Areas (m^3/yr)	0	65120	16280	0	18323	1222	0	0	26141	0	0	0	3613	1204	0	0	8794	140696
Total Runoff (m^3/yr)	5931	65120	16280	1068	18323	1222	24577	215	26141	5143	3770	237	3613	1204	13	2114	8794	183765
Total Outputs (m^3/yr)	33917	81400	20350	6108	22903	1527	140542	1369	32676	32676	17963	1506	4517	1506	86	10992	10992	421028
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

*Evaporation from impervious areas was assumed to be 20% of precipitation.

Asphalt has 0% infiltration capability

Low Density Single Lots: Assume rooftops cover about 60% of the lot. Driveways cover about 15% of the lot; Grass (lawns) cover about 25% of the lot.

Medium Density 5-storey building lot: Assume rooftops cover about 60% of the lot. Parking areas cover about 20% of the lot; Grass (lawns) cover about 20% of the lot.

Medium Density Townhouse Lots: Assume rooftops cover about 75% of the lot. Driveways cover about 5% of the lot; Grass (lawns) cover about 20% of the lot.

Commercial Lots: Based upon information provided to GHD, assume rooftops covers about 13% of the lot. Asphalt parking covers about 80% of the lot; Landscaping covers about 7% of the lot.

Road ROWs assumed to be 50% asphalt and 50% grass

Appendix F.4

Water Budget Post-Development - With Downspout Disconnection Mitigation Strategies

Catchment Designation				POST-DEVELOPMENT SITE														TOTAL
	Low Density - Blocks A,B,C - 329 units			Med. Density - Townhouses			Natural	Road	Road ROWs		Parkland	Medium Density - 5-storey bldg			Easement	SWM Pond		
	Lawns	Rooftops	Driveways	Lawns	Rooftops	Driveways	Heritage	Widening	Asphalt	Grass	& Trails	Landscaping	Rooftops	Asphalt		Grass	Pond	
Area (m^2)	39650	95160	23790	7140	26775	1785	164300	1600	38200	38200	21000	1760	5280	1760	100	12850	12850	492200
Pervious Area (m^2)	39650	0	0	7140	0	0	164300	1600	0	38200	21000	1760	0	0	100	12850	0	286600
% Pervious	8.1%	0%	0%	1%	0%	0%	33.4%	0.3%	0%	7.8%	4.3%	0.4%	0%	0%	0.02%	2.6%	0%	58.2%
Impervious Area (m^2)	0	95160	23790	0	26775	1785	0	0	38200	0	0	0	5280	1760	0	0	12850	205600
% Impervious	0%	19.3%	4.8%	0%	5.4%	0.4%	0%	0%	7.8%	0%	0%	0%	1.1%	0.4%	0%	0%	2.6%	41.8%
	INFILTRATION FACTORS																	
Topography Infiltration Factor	0.15	0	0	0.15	0	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0	0	0.2	0.1	0	
Soil Infiltration Factor	0.2	0	0	0.2	0	0	0.2	0.2	0	0.2	0.2	0.2	0	0	0.2	0.2	0	
Land Cover Infiltration Factor	0.15	0	0	0.15	0	0	0.2	0.15	0	0.15	0	0.15	0	0	0.15	0.15	0	
MECP Infiltration Factor	0.5	0	0	0.5	0	0.2	0.5	0.55	0.2	0.55	0.4	0.55	0	0	0.55	0.45	0	
Actual Infiltration Factor	0.5	0	0	0.5	0	0	0.5	0.55	0	0.55	0.4	0.55	0	0	0.55	0.45	0	
Runoff Coefficient	0.5	1	1	0.5	1	1	0.5	0.45	1	0.45	0.6	0.45	1	1	0.45	0.55	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0	0.8	0.8	0	0	0.8	0	0.8	0	0.8	0.8	0	0	0.8	
	INPUTS (PER UNIT AREA)																	
Precipitation (mm/yr)	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855
Run On (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (mm/yr)	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855
	OUTPUTS (PER UNIT AREA)																	
Precipitation Surplus (mm/yr)	299	684	684	299	684	684	299	299	684	299	299	299	684	684	299	299	684	460
Net Surplus (mm/yr)	299	684	684	299	684	684	299	299	684	299	299	299	684	684	299	299	684	460
Evaportranspiration (mm/yr)	556	171	171	556	171	171	556	556	171	556	556	556	171	171	556	556	171	395
Infiltration (mm/yr)	150	0	0	150	0	0	150	165	0	165	120	165	0	0	165	135	0	87
%Rooftop Required to Meet Pre-Development	--	32%	--	--	32%	--	--	--	--	--	--	--	32%	--	--	--	--	
Rooftop Infiltration (mm/yr)	0	218	0	0	218	0	0	0	0	0	0	0	218	0	0	0	0	56
Total Infiltration (mm/yr)	150	218	0	150	218	0	150	165	0	165	120	165	218	0	165	135	0	143
Runoff Pervious Areas	150	0	0	150	0	0	150	135	0	135	180	135	0	0	135	165	0	88
Runoff Impervious Areas	0	467	684	0	467	684	0	0	684	0	0	0	467	684	0	0	684	230
Total Runoff (mm/yr)	150	467	684	150	467	684	150	135	684	135	180	135	467	684	135	165	684	317
Total Outputs (mm/yr)	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855	855
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	INPUTS (VOLUMES)																	
Precipitation (m^3/yr)	33917	81400	20350	6108	22903	1527	140542	1369	32676	32676	17963	1506	4517	1506	86	10992	10992	421028
Run On (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inputs (m^3/yr)	33917	81400	20350	6108	22903	1527	140542	1369	32676	32676	17963	1506	4517	1506	86	10992	10992	421028
	OUTPUTS (VOLUMES)																	
Precipitation Surplus (m^3/yr)	11862	65120	16280	2136	18323	1222	49154	479	26141	11428	6283	527	3613	1204	30	3844	8794	226439
Net Surplus (m^3/yr)	11862	65120	16280	2136	18323	1222	49154	479	26141	11428	6283	527	3613	1204	30	3844	8794	226439
Evaportranspiration (m^3/yr)	22054	16280	4070	3971	4581	305	91388	890	6535	21248	11681	979	903	301	56	7148	2198	194589
Infiltration (m^3/yr)	5931	0	0	1068	0	0	24577	263	0	6286	2513	290	0	0	16	1730	0	42674
Rooftop Infiltration (m^3/yr)	0	20707	0	0	5826	0	0	0	0	0	0	0	1149	0	0	0	0	27682
Total Infiltration (m^3/yr)	5931	20707	0	1068	5826	0	24577	263	0	6286	2513	290	1149	0	16	1730	0	70356
Runoff Pervious Areas (m^3/yr)	5931	0	0	1068	0	0	24577	215	0	5143	3770	237	0	0	13	2114	0	43069
Runoff Impervious Areas (m^3/yr)	0	44413	16280	0	12496	1222	0	0	26141	0	0	0	2464	1204	0	0	8794	113015
Total Runoff (m^3/yr)	5931	44413	16280	1068	12496	1222	24577	215	26141	5143	3770	237	2464	1204	13	2114	8794	156083
Total Outputs (m^3/yr)	33917	81400	20350	6108	22903	1527	140542	1369	32676	32676	17963	1506	4517	1506	86	10992	10992	421028
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

*Evaporation from impervious areas was assumed to be 20% of precipitation.

Asphalt has 0% infiltration capability

Low Density Single Lots: Assume rooftops cover about 60% of the lot. Driveways cover about 15% of the lot; Grass (lawns) cover about 25% of the lot.

Medium Density Townhouse Lots: Assume rooftops cover about 75% of the lot. Driveways cover about 5% of the lot; Grass (lawns) cover about 20% of the lot.

Medium Density 5-storey Residential lot: Assume rooftops cover about 60% of the lot. Asphalt covers about 20% of the lot; Grass (lawn) cover about 20% of the lot.

Road ROWs assumed to be 50% asphalt and 50% grass

Appendix F.5

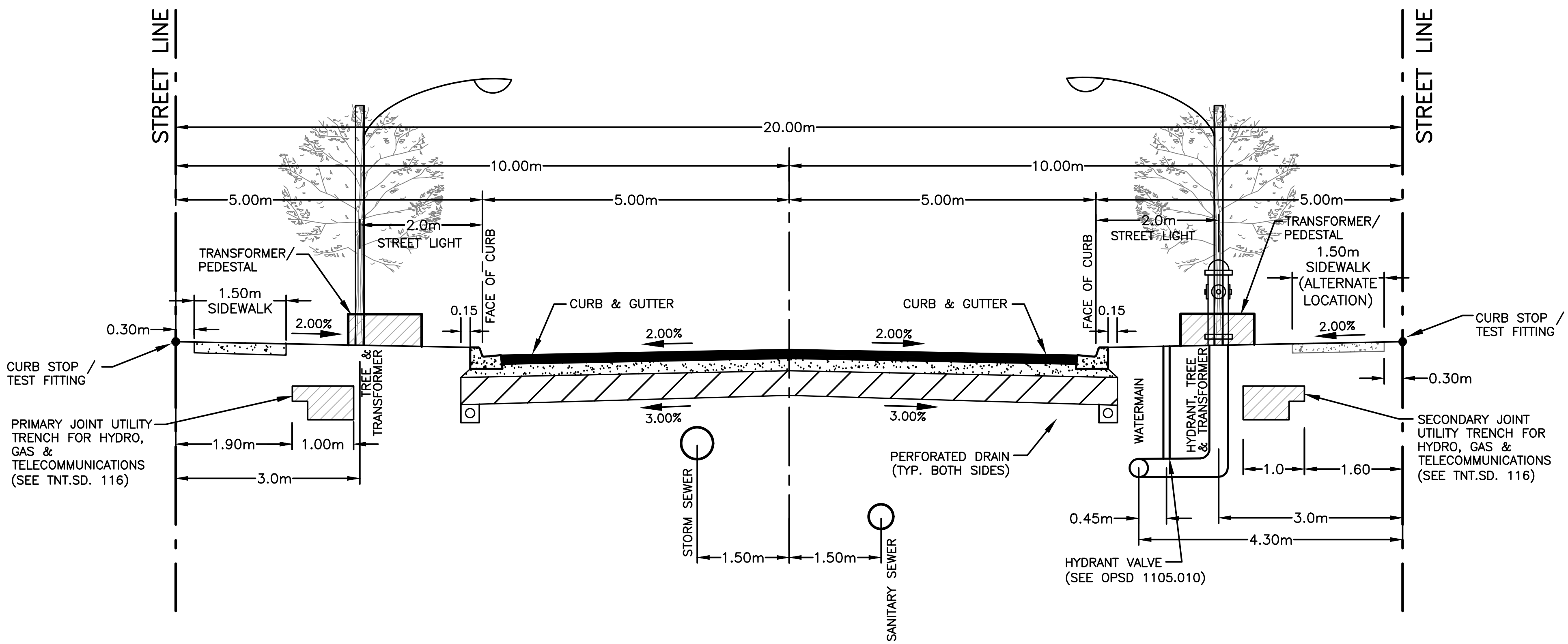
Water Budget Summary

PARAMETER	SITE				
	Pre-Development	***Post-Development No Mitigation***	***Difference Pre- vs. Post-***	***Post-Development With Mitigation***	***Difference Pre- vs. Post-***
	INPUTS (VOLUMES)				
Precipitation (m^3/yr)	421028	421028	0%	421028	0%
Run On (m^3/yr)	0	0	0%	0	0%
Other Inputs (m^3/yr)	0	0	0%	0	0%
Total Inputs (m^3/yr)	421028	421028	0%	421028	0%
	OUTPUTS (VOLUMES)				
Precipitation Surplus (m^3/yr)	148335	226439	53%	226439	53%
Net Surplus (m^3/yr)	148335	226439	53%	226439	53%
Evapotranspiration (m^3/yr)	272693	194589	-29%	194589	-29%
Infiltration (m^3/yr)	70200	42674	-39%	42674	-39%
% Rooftop Runoff to balance infiltration	--	--	--	32%	--
Rooftop Infiltration (m^3/yr)	156	0	0%	27682	--
Total Infiltration (m^3/yr)	70356	42674	-39%	70356	0%
Runoff Pervious Areas (m^3/yr)	77512	43069	-44%	43069	-44%
Runoff Impervious Areas (m^3/yr)	467	140696	--	113015	--
Total Runoff (m^3/yr)	77979	183765	136%	156083	100%
Total Outputs (m^3/yr)	421028	421028	0%	421028	0%

To maintain pre-development infiltration values; 32% of post-development rooftop runoff needs to be infiltrated.

APPENDIX "G"

Standard Road Cross Sections



METRIC
ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN

MILLBROOK SOUTH WEST SUBDIVISION

URBAN LOCAL
20.0m RIGHT-OF-WAY (10.0m ROAD)

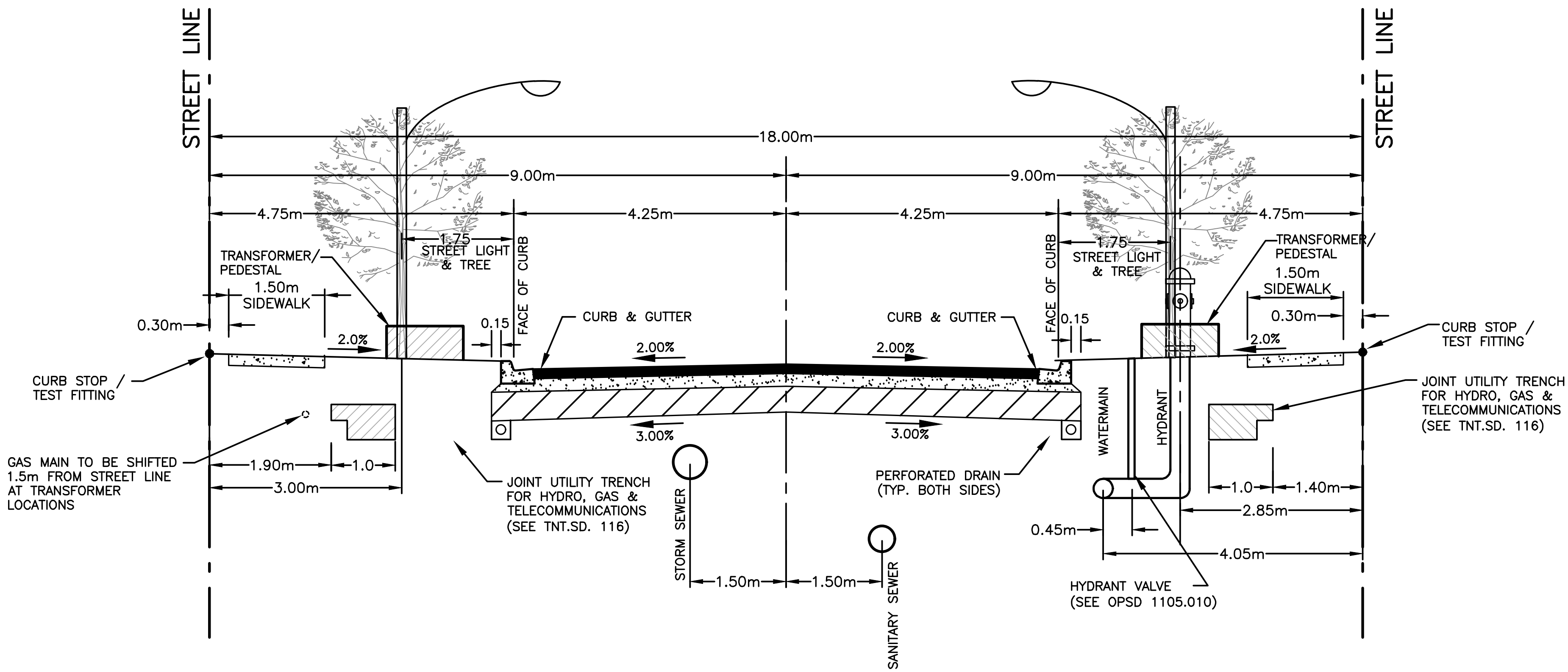
NO.	REVISIONS	DATE	APR'D

SCALE: N.T.S.

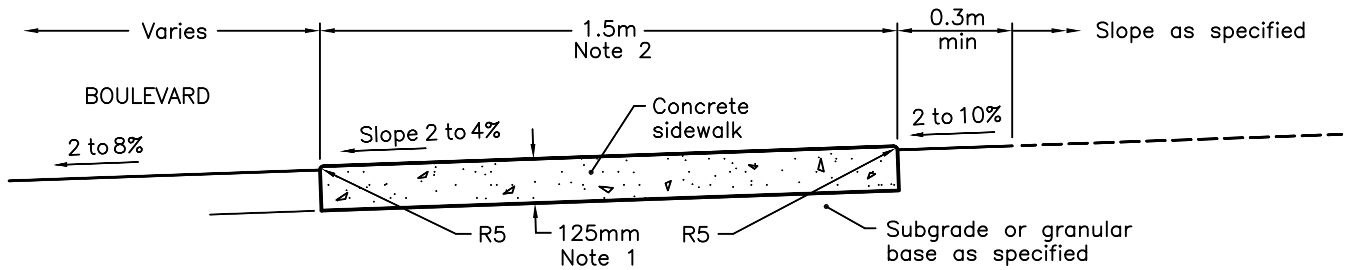
DATE: May 2021

FIGURE G1

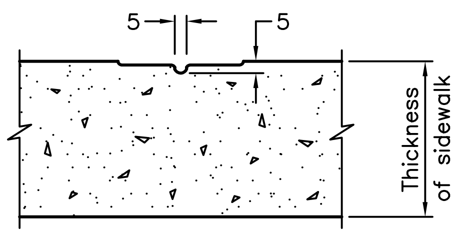
METRIC
ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN



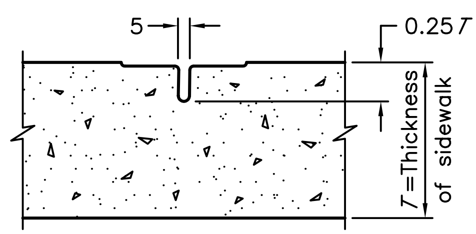
MILLBROOK SOUTH WEST SUBDIVISION	NO.	REVISIONS	DATE	APR'D	SCALE: N.T.S.
URBAN MINOR LOCAL 18.0m RIGHT-OF-WAY (8.50m ROAD)					DATE: May 2021
					FIGURE G2



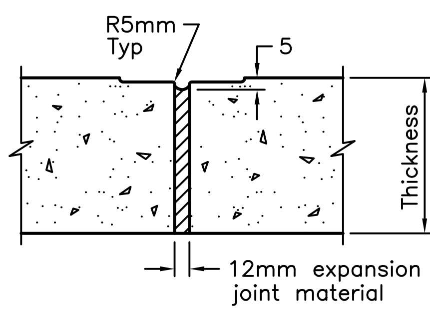
TYPICAL SECTION



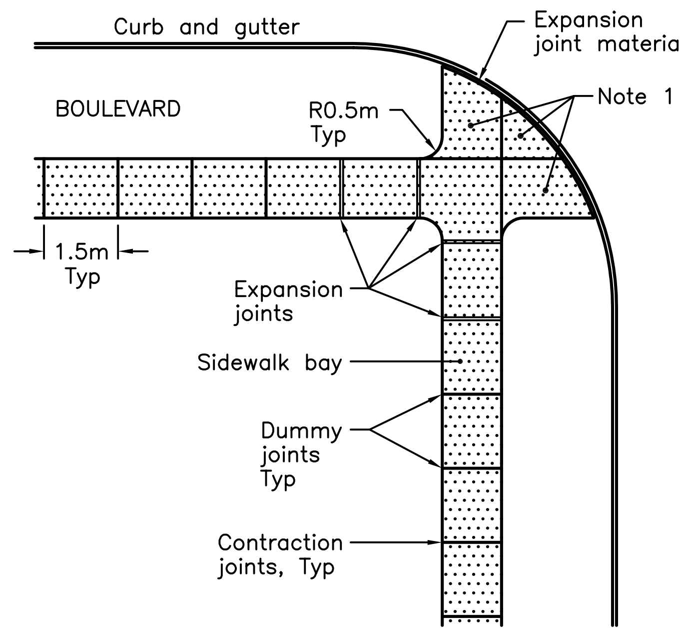
DUMMY JOINT



CONTRACTION JOINT



EXPANSION JOINT



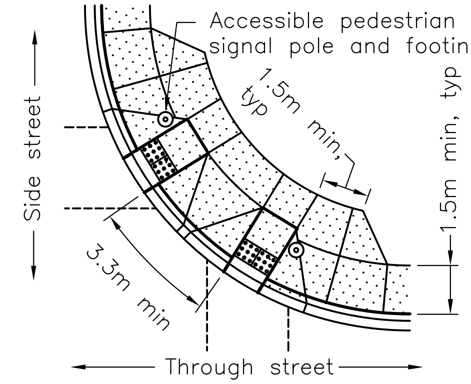
JOINT LAYOUT

NOTES:

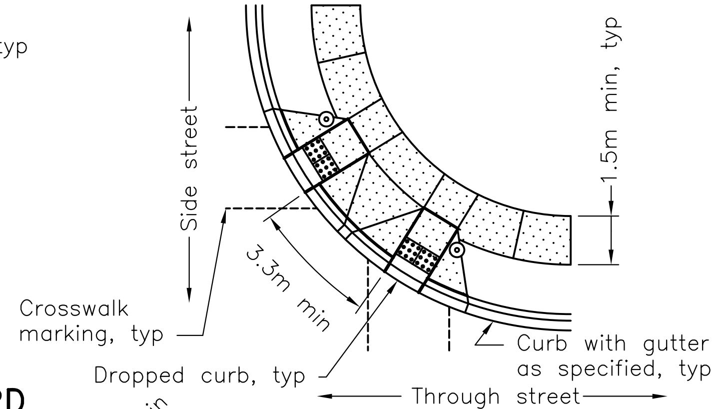
1. Sidewalk thickness at residential driveways and adjacent to curb shall be 150mm. At commercial and industrial driveways, the thickness shall be 200mm.
2. Sidewalk width shall be increased to 2.4m at schools, bus stops, and other high pedestrian areas.

A. This OPSD to be read in conjunction with OPSD–310.030.
B. All dimensions are in millimetres unless otherwise shown.

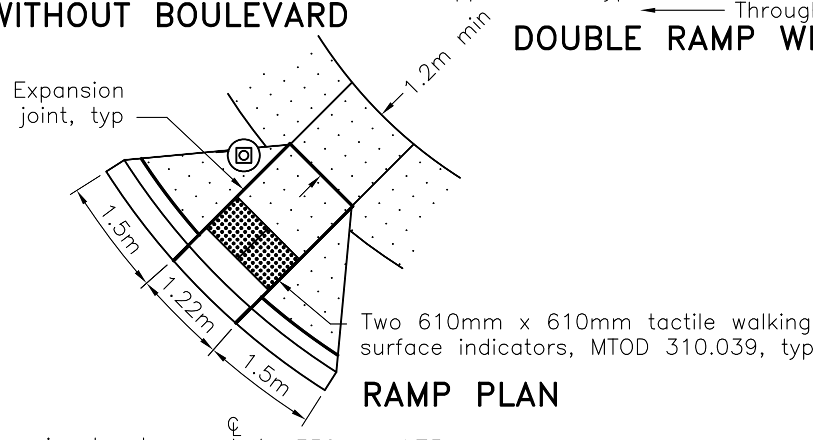
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2005	Rev 1
CONCRETE SIDEWALK		
	OPSD – 310.010	



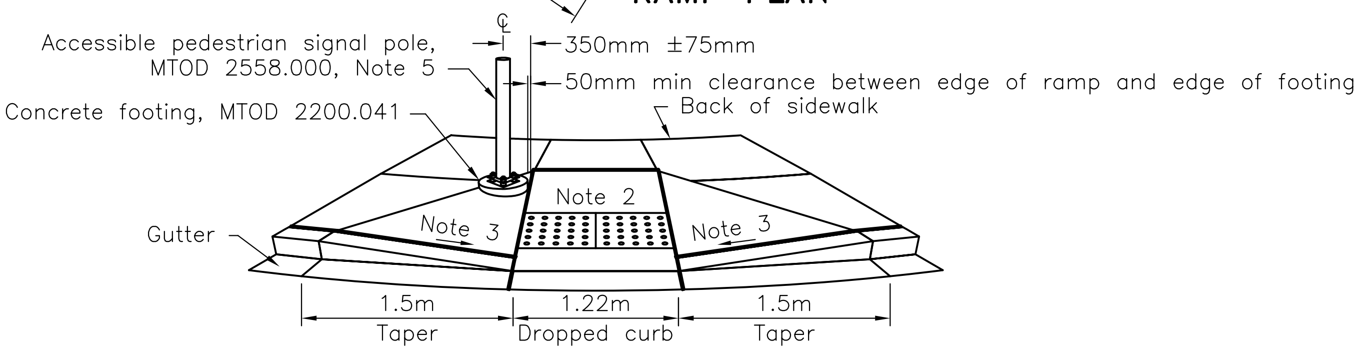
DOUBLE RAMP WITHOUT BOULEVARD



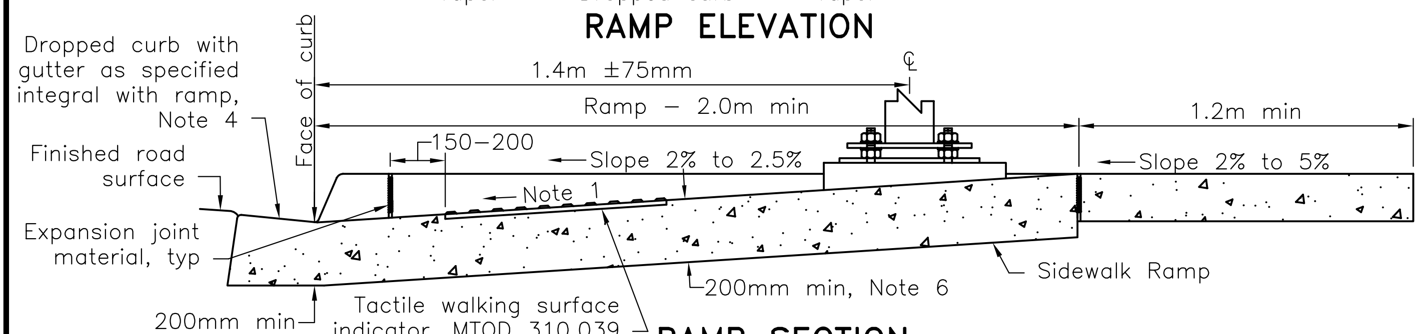
DOUBLE RAMP WITH BOULEVARD



RAMP PLAN



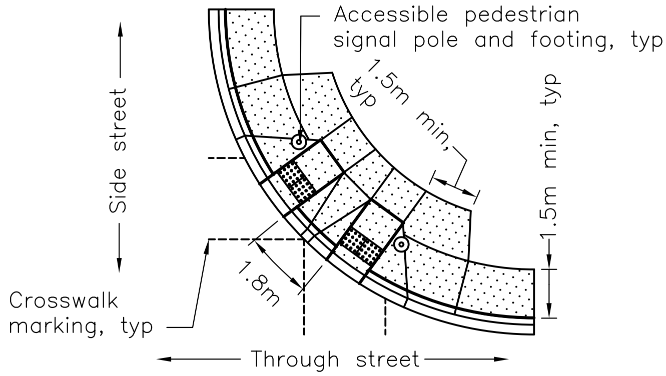
RAMP ELEVATION



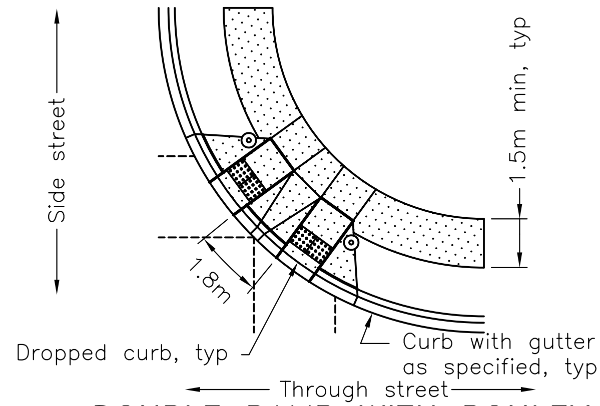
RAMP SECTION

NOTES:
1 Slope of ramp shall not exceed 10%.
2 Cross slope of ramp shall not exceed 2% in either direction.
3 Cross slope of flared side of ramp shall not exceed 10%.
4 Dropped curb at ramp shall be modified to eliminate 30 mm step at gutter.
5 Accessible pedestrian signal to have tactile arrow that aligns with direction of crosswalk.
6 Minimum thickness of ramp is 200mm. Minimum thickness of sidewalk and flared sides adjacent to ramp is 150mm.
A Where only one crosswalk is present at an intersection, only one curb ramp is required.
B All dimensions are in millimetres unless otherwise shown.

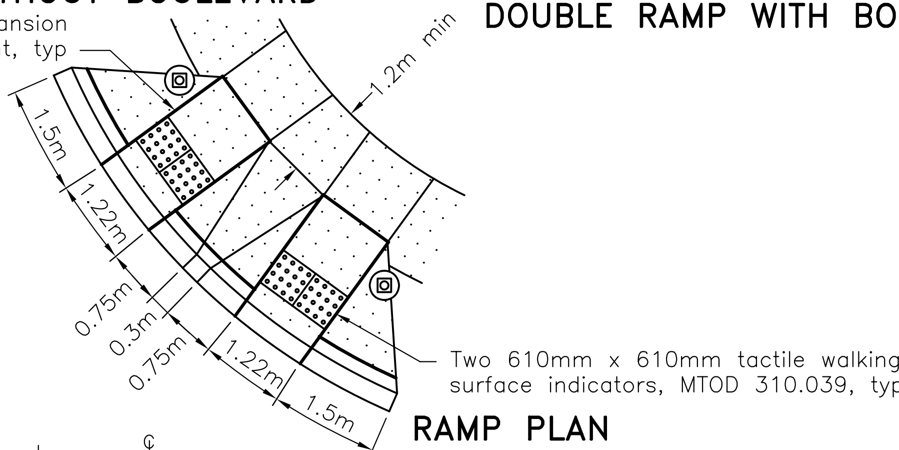
MINISTRY OF TRANSPORTATION ONTARIO DRAWING	Mar 2014	Rev
CONCRETE SIDEWALK RAMPS AT SIGNALIZED INTERSECTIONS	MTOD - 310.030	



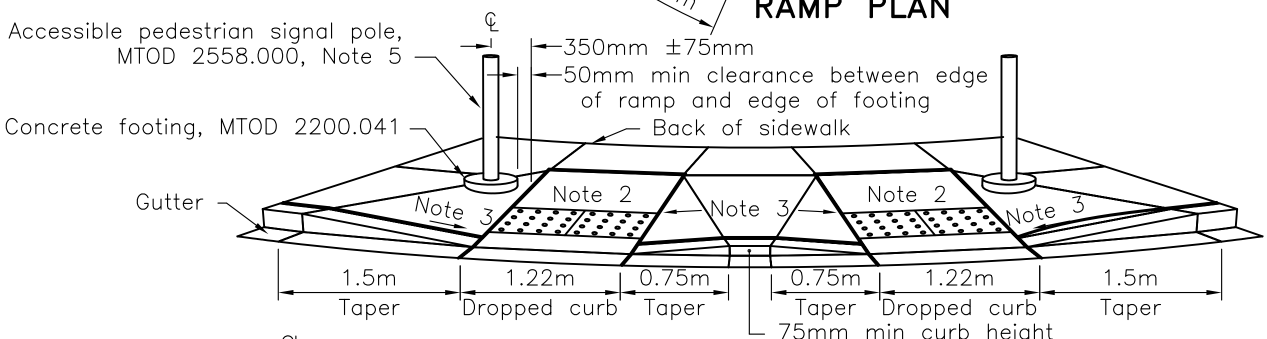
DOUBLE RAMP WITHOUT BOULEVARD



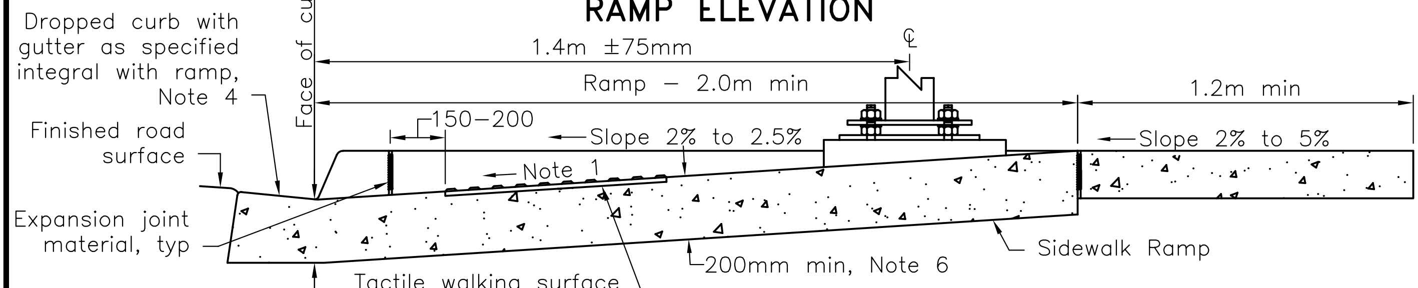
DOUBLE RAMP WITH BOULEVARD



RAMP PLAN



RAMP ELEVATION

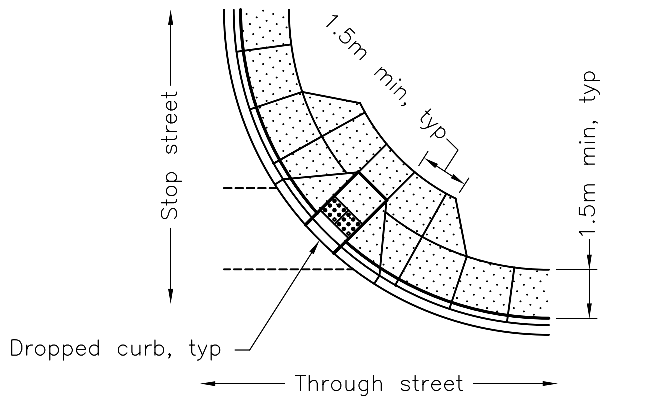


RAMP SECTION

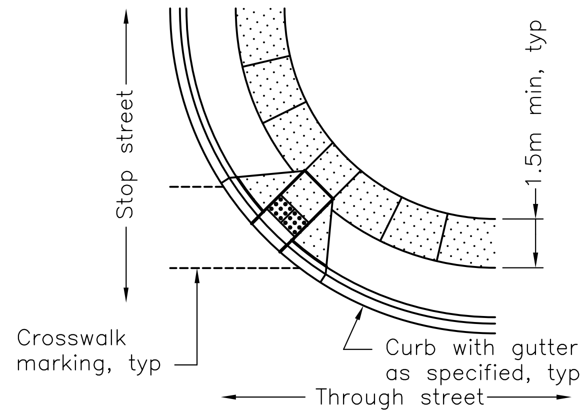
NOTES:

1 Slope of ramp shall not exceed 10%.
2 Cross slope of ramp shall not exceed 2% in either direction.
3 Cross slope of flared side of ramp shall not exceed 10%.
4 Dropped curb at ramp shall be modified to eliminate 30 mm step at gutter line.
5 Accessible pedestrian signal to have tactile arrow that aligns with direction of crosswalk.
6 Minimum thickness of ramp is 200mm. Minimum thickness of sidewalk and flared sides adjacent to ramp is 150mm.
A All dimensions are in millimetres unless otherwise shown.

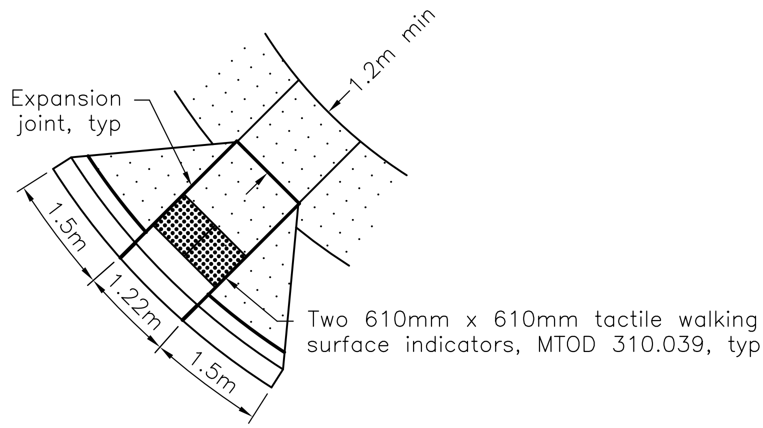
MINISTRY OF TRANSPORTATION ONTARIO DRAWING	Mar 2014	Rev
CONCRETE SIDEWALK RAMPS AT SIGNALIZED INTERSECTIONS WITH INTERSECTING CROSSWALKS		
	MTOD – 310.031	



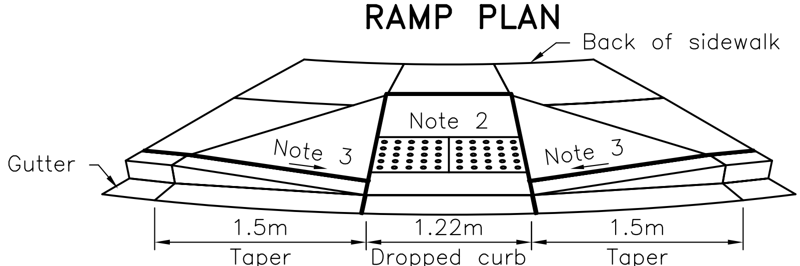
SINGLE RAMP WITHOUT BOULEVARD



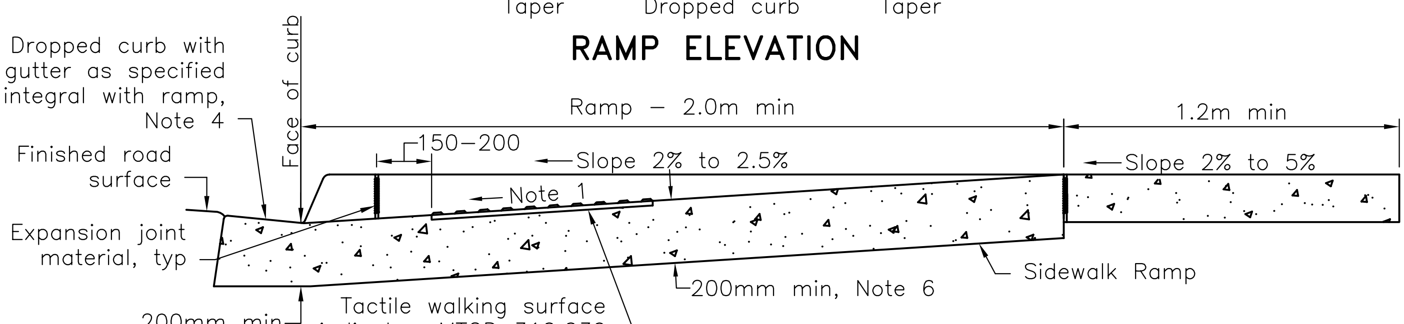
SINGLE RAMP WITH BOULEVARD



RAMP PLAN



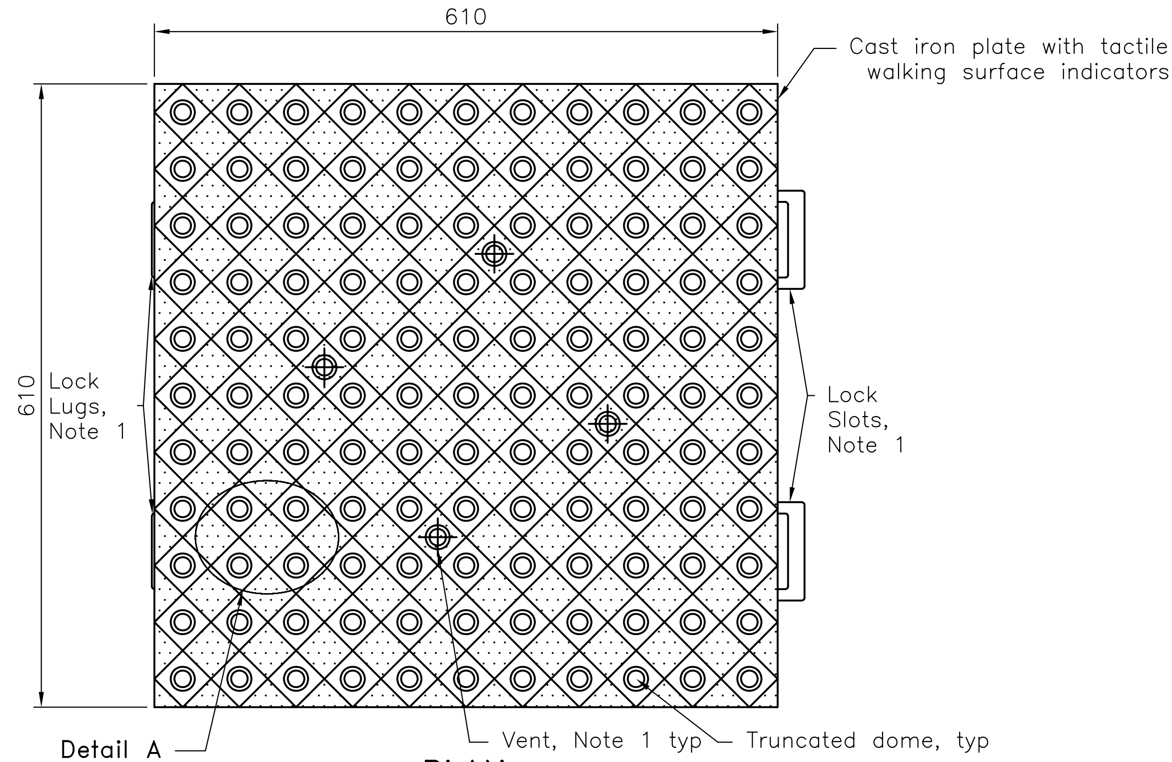
RAMP ELEVATION



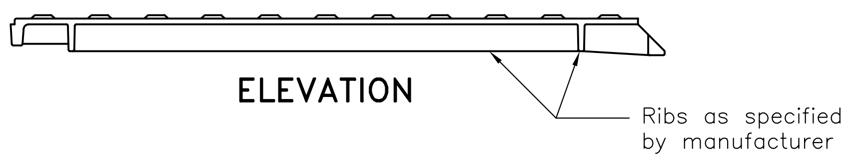
RAMP SECTION

NOTES:
1 Slope of ramp shall not exceed 10%.
2 Cross slope of ramp shall not exceed 2% in either direction.
3 Cross slope of flared side of ramp shall not exceed 10%.
4 Dropped curb at ramp shall be modified to eliminate 30 mm step at gutter line.
5 Minimum thickness of ramp is 200mm. Minimum thickness of sidewalk and flared sides adjacent to ramp is 150mm.
A All dimensions are in millimetres unless otherwise shown.

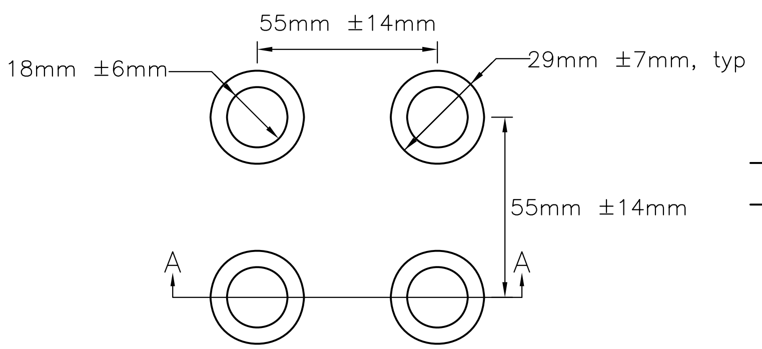
MINISTRY OF TRANSPORTATION ONTARIO DRAWING	Mar 2014	Rev
CONCRETE SIDEWALK RAMPS AT UNSIGNALIZED INTERSECTIONS	MTOD – 310.032	



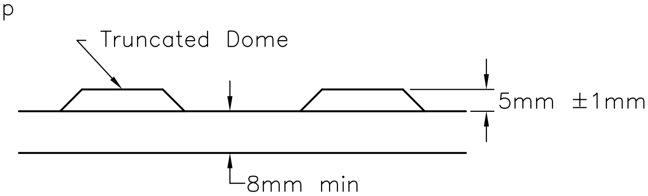
PLAN



ELEVATION



DETAIL A
TRUNCATED DOMES PLAN



SECTION A–A

NOTES:

1 Lock lug and slots to interconnect adjacent cast iron plates, and vents, are proprietary to manufacturer

A The coefficient of friction of the cast iron plate shall not be less than 0.8.

B All dimensions are in millimetres unless otherwise shown.

MINISTRY OF TRANSPORTATION ONTARIO DRAWING	Mar 2014	Rev
CONCRETE SIDEWALK RAMPS TACTILE WALKING SURFACE INDICATORS COMPONENT	MTOD – 310.039	

APPENDIX "H"

Borehole Logs

Geotechnical Investigation Report

Proposed Subdivision Development
787 and 825 Fallis Line
Millbrook, Ontario

Report for:
The Bromont Group

374 Pido Road Peterborough Ontario K9J 6X7 Canada | 11224019 | 01 | Report No 3 | March 23, 2021

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-1

BOREHOLE REPORT

BOREHOLE No.: **BH1-17**

ELEVATION: 251.3 m

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd

DATE: 22 August 2017

DRILLING COMPANY: Landshark Drilling

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702910E 4892792N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); w_p w_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Comments
0.0	GROUND SURFACE						
	TOPSOIL (380 mm)	SS-1	79	25	1, 3, 5, 5	8	Borehole open and dry upon completion of drilling
0.4	**TILL** - Brown Silty Clay, Some Sand, Trace Gravel, Moist, Compact - Occasional Organics to 0.6m	SS-2	100	18	5, 6, 11, 18	17	
		SS-3	100	20	4, 10, 16, 21	26	SS-3: 4% Gravel, 10% Sand, 86% Silt and Clay, 31% between 5-75 µm
2.3	Occasional Cobbles, Dense	SS-4	89	14	15, 13, 22	35	
3.0	Damp to Moist, Very Dense	SS-5	100	7	24, 38, 50=4"	100+	
		SS-6	100	9	21, 28, 40	68	
6.1	Dense	SS-7	100	13	8, 17, 18	35	
6.6	END OF BOREHOLE						

Depth scale: 1–24 ft; 1.0–7.0 m

BOREHOLE LOG GEOTECH 11148475-01, 17-08-22, BOREHOLE LOG, LR.GPJ GEOLOGIC.GDT 24/10/17

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-2

BOREHOLE No.: BH2-17

ELEVATION: 252.8 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd

DATE: 22 August 2017

DRILLING COMPANY: Landshark Drilling

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702952E 4892690N

Shear test (Cu) △ Field ☐ Lab; Sensitivity (S); ○ Water content (%); Atterberg limits (%) (w_p, w_l); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index N	Comments
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)	SS-1	83	13	2, 5, 6, 8	11	Borehole open and dry upon completion of drilling
0.3	**TILL** - Brown Silty Clay, Some Sand, Trace Gravel, Damp, Compact - Occasional Organics to 0.5m	SS-2	100	17	3, 3, 8	11	
		SS-3	100	24	3, 5, 6	11	
2.3	Brown Silty Sand, Some Clay, Trace Gravel, Damp, Compact	SS-4	100	16	5, 6, 5	11	
		SS-5	100	10	6, 6, 9	15	
		SS-6	100	8	6, 6, 8	14	
		SS-7	100	15	7, 7, 9	16	
6.6	END OF BOREHOLE						

REFERENCE No.: 11224019-01 | ENCLOSURE No.: A-3

BOREHOLE REPORT

BOREHOLE No.: **BH3-17**
ELEVATION: 248.3 m

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering
PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario
LOGGED BY: S. Shepherd DATE: 22 August 2017
DRILLING COMPANY: Landshark Drilling METHOD: Solid Stem Augers and Split Spoons
NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703062E 4892759N

Shear test (Cu), Sensitivity (S): △ Field, □ Lab; ○ Water content (%); Wp–Wl Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE; — 1.0 m

m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index N	Comments
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)						
0.3	**TILL** - Brown Silty Clay, Some Sand, Trace Gravel, Moist, Compact - Occasional Organics to 0.6m	SS-1	33	41	0 0 0 2	0	
		SS-2	100	25	2 3 6	9	WL - 0.9 m 9/7/2017
		SS-3	100	20	5 8 10	18	
		SS-4	100	12	7 10 15	25	
		SS-5	100	12	7 9 11	20	
4.6	Grey Sandy Silt, Some Clay, Trace Gravel, Wet, Very Loose	SS-6	100	34	0 1 3	4	Groundwater seepage encountered at 4.6 m during drilling
6.1	Compact Sand Seam at 6.2m	SS-7	100	10	19 15 9	24	
6.6	END OF BOREHOLE						33 mm inside diameter piezometer installed to 6.6 m

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-4

BOREHOLE No.: BH4-17

ELEVATION: 251.6 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd DATE: 22 August 2017

DRILLING COMPANY: Landshark Drilling METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703055E 4892637N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

Stickup: 0.91 m

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)						Borehole open and dry upon completion of drilling
0.3	**TILL** - Brown Silty Clay, Trace Sand, Moist, Compact - Occasional Organics to 0.6m	SS-1	83	26	1 3 5 6	8	
		SS-2	89	30	2 3 5	8	WL - Dry 9/7/2017; WL - Dry 10/17/2017
1.5	Some Gravel, Damp	SS-3	100	12	4 7 11	18	
		SS-4	100	9	9 22 35	57	
2.6	**SAND** - Brown Sand, Some Silt, Damp, Dense to Very Dense	SS-5	94	3	40 25 26	51	
	Silt Seam at 4.6m	SS-6	100	25	16 22 21	43	SS-6: 0% Gravel, 74% Sand, 26% Silt and Clay, 20% between 5-75 µm
		SS-7	100	5	21 35 40	75	51 mm inside diameter monitoring well installed to 6.1 m
6.6	END OF BOREHOLE						

BOREHOLE LOG GEOTECH 11148475-01, 17-08-22, BOREHOLE LOG, LR.GPJ GEOLOGIC.GDT 24/10/17

REFERENCE No.: 11224019-01 ENCLOSURE No.: A-5

GHD

BOREHOLE No.: BH5-17
ELEVATION: 255.2 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd DATE: 22 August 2017

DRILLING COMPANY: Landshark Drilling METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703000E 4892563N

Chart legend: Shear test (Cu) / Sensitivity (S) — △ Field, □ Lab; ○ Water content (%); w_p w_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE. Scale: 10 20 30 40 50 60 70 80 90

Depth (ft)	Depth (m)	m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index N	Comments
		0.0	GROUND SURFACE						
			TOPSOIL (300 mm)						Borehole open and dry upon completion of drilling
1		0.3	**TILL** - Brown Sandy Silty Clay, Trace Gravel, Moist, Compact - Occasional Organics to 0.6m	SS-1	79	18	0 3 4 8	7	
3	1.0			SS-2	89	14	4 14 21	35	
5		1.5	**SAND** - Brown Sand, Some Silt, Trace Gravel, Damp, Very Dense						
6				SS-3	100	3	25 30 50=4"	100+	
8				SS-4	100	3	38 50=5"	100+	
10	3.0			SS-5	100	3	46 50=4"	100+	
16				SS-6	100	6	36 33 35	38	
20				SS-7	100	5	28 50=5"	100+	
21		6.4	END OF BOREHOLE						

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-6

GHD	**BOREHOLE No.:** **BH6-17** **ELEVATION:** 252.4 m	**BOREHOLE REPORT** Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703151E 4892614N

Plot legend: Shear test (Cu), Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE. Scale: 10 20 30 40 50 60 70 80 90

Depth (ft)	Depth (m)	m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
		0.0	GROUND SURFACE						
			TOPSOIL (300 mm)						Borehole open and dry upon completion of drilling
1		0.3	**TILL** - Brown Sandy Silty Clay, Some Gravel, Moist, Compact - Occasional Organics to 0.6m	SS-1	79	13	5 5 8 9	13	
3	1.0			SS-2	100	23	5 5 5	10	
5		1.5	Dense	SS-3	83	20	5 10 25	35	SS-2: 12% Gravel 20% Sand 68% Silt and Clay 33% between 5-75 µm
7	2.0	2.3	Brown Silty Sand, Some Clay, Trace Gravel, Moist, Dense	SS-4	94	12	31 24 14	38	
10	3.0	3.0	Very Dense	SS-5	83	14	3 24 41	65	
15		4.6	**SAND** - Brown Sand, Some Silt, Trace Gravel, Damp, Very Dense	SS-6	100	4	16 50=5"	100+	
20	6.0	6.1	Dense	SS-7	100	5	15 15 29	44	
		6.6	END OF BOREHOLE						

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-7

BOREHOLE No.: BH7-17

ELEVATION: 254.5 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd

DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703108E 4892501N

Shear test (Cu) △ Field □ Lab; Sensitivity (S); ○ Water content (%); Atterberg limits (%) (w_p, w_l); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

Depth (m)	m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
	0.0	GROUND SURFACE						
		TOPSOIL (300 mm)	SS-1	83	18	0, 3, 3, 5	6	Borehole open and dry upon completion of drilling
	0.3	**TILL** - Brown Silty Sand, Some Clay, Trace Gravel, Moist, Compact - Occasional Organics to 1.1m	SS-2	83	15	4, 3, 20	23	
	1.5	Very Dense	SS-3	100	3	50=5"	100+	
			SS-4	100	6	50=5"	100+	
			SS-5	100	6	50=4"	100+	
			SS-6	100	6	46, 50=4"	100+	
			SS-7	100	7	25, 31, 44	75	
	6.6	END OF BOREHOLE						

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-8

GHD

BOREHOLE No.: **BH8-17**

ELEVATION: 255.4 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd

DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703046E 4892430N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)	SS-1	88	21	0 2 3 5	5	Borehole open and dry upon completion of drilling WL - Dry 9/7/2017
0.3	**TILL** - Brown Silty Sand, Some Clay, Trace Gravel, Moist, Compact - Occasional Organics to 1.1m	SS-2	100	19	1 50=1"	100+	
1.5	Damp, Very Dense	SS-3	100	7	27 50=4"	100+	SS-3: 8% Gravel 56% Sand 36% Silt and Clay
		SS-4	100	5	30 34 40	74	
		SS-5	100	6	34 40 42	82	
		SS-6	100	4	46 50=4"	100+	
6.1	END OF BOREHOLE	SS-7	100	6	50=2"	100+	33 mm inside diameter piezometer installed to 6.1 m

Piezometer stick-up: 1.0 m

REFERENCE No.: 11224019-01 ENCLOSURE No.: A-9

BOREHOLE No.: BH9-17
ELEVATION: 251.6 m

BOREHOLE REPORT

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703145E 4892381N

Shear test (Cu), Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

Water level: — m, — 0.91 m

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)						Borehole open and dry upon completion of drilling
0.3	**TILL** - Brown Silty Sand, Some Clay, Trace Gravel, Moist, Compact - Occasional Organics to 0.6m	SS-1	83	25	0 2 3 3	5	WL - Dry 9/7/2017
		SS-2	100	7	14 14 13	27	WL - Dry 10/17/2017
1.7	Brown Silt, Some Clay, Some Sand, Trace Gravel, Moist, Compact	SS-3	89	17	25 7 11	18	
2.4	Brown Gravelly Silty Sand, Some Clay, Moist, Very Dense	SS-4	100	10	17 22 32	54	
		SS-5	100	8	24 33 25	38	SS-5: 31% Gravel 42% Sand 27% Silt and Clay 18% between 5-75 µm
		SS-6	100	7	35 50=5"	100+	
		SS-7	100	5	50=2"	100+	51 mm inside diameter monitoring well installed to 5.6 m
6.1	END OF BOREHOLE						

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-10

BOREHOLE No.: **BH10-17**

ELEVATION: 250.7 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd

DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703105E 4892285N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); w_p w_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Comments
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)						Borehole open upon completion of drilling
0.3	**TILL** - Brown Silty Sand, Some Clay, Trace Gravel, Moist, Compact - Occasional Organics to 0.9m	SS-1	92	15	0 2 5 5	7	
		SS-2	100	19	3 4 6	10	
		SS-3	100	19	6 6 8	14	
2.3	Brown Silty Sand, Some Clay, Trace Gravel, Wet, Loose	SS-4	100	14	2 3 6	9	Slight groundwater seepage encountered at 2.3 m during drilling
3.0	**SAND** - Brown Sand, Some Silt, Trace Gravel, Damp, Very Dense	SS-5	94	6	39 42 24	66	
4.6	Moist	SS-6	100	7	24 32 38	70	
		SS-7	100	6	50=5"	100+	
6.2	END OF BOREHOLE						

REFERENCE No.: 11224019-01 ENCLOSURE No.: A-11

	BOREHOLE No.: BH11-17 ELEVATION: 246.5 m	**BOREHOLE REPORT** Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703134E 4892182N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p — W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE. Well: — m, — 0.91 m

m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	N	Comments
0.0	GROUND SURFACE						
	TOPSOIL (300 mm)				0		Borehole open upon completion of drilling
0.3	**TILL** - Brown Silty Sand, Some Clay, Trace Gravel, Moist, Compact - Occasional Organics to 0.8m	SS-1	83	22	2, 3, 7	5	
		SS-2	78	9	11, 6, 7	13	
		SS-3	100	14	7, 6, 7	13	
		SS-4	100	12	9, 10, 9	19	
3.0	Dense	SS-5	72	10	14, 17, 18	35	Slight groundwater seepage encountered at 4.6 m during drilling WL - 4.8 m 10/17/2017
4.6	Wet, Compact	SS-6	100	10	6, 8, 7	15	WL - 4.7 m 9/7/2017 SS-7: 21% Gravel 48% Sand 31% Silt and Clay 20% between 5-75 µm
6.1	Dense, With Gravel	SS-7	100	6	9, 20, 27	47	51 mm inside diameter monitoring well installed to 6.1 m
6.6	END OF BOREHOLE						

REFERENCE No.: 11224019-01

ENCLOSURE No.: A-12

BOREHOLE No.: BH12-17

ELEVATION: 246.1 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group c/o Valdor Engineering

PROJECT: Proposed Residential Development - Fallis Line, Millbrook, Ontario

LOGGED BY: S. Shepherd

DATE: 23 August 2017

DRILLING COMPANY: Landshark Drilling

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from concept plan provided by Valdor Engineering with electronic title "16119_Fallis Line Subdivision_Preliminary Concept.pdf" by email dated July 11, 2017.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703196E 4892253N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (460 mm)	SS-1	75	17	0 2 2 1	4	
0.5	**TILL** - Brown Silty Sand, Some Clay, Trace Gravel, Moist, Compact - Occasional Organics to 0.9m	SS-2	94	11	4 7 10	17	
1.5	Dense	SS-3	100	6	12 20 24	44	
1.8	**SAND** - Brown Sand, Some Silt, Trace Gravel, Damp, Very Dense	SS-4	100	4	21 50=5"	100+	
		SS-5	100	7	30 40 50	90	
		SS-6	100	6	50=5"	100+	Groundwater seepage encountered at 5.2 m during drilling
5.2	Wet						WL - 5.2 m 8/23/2017
6.1	Damp	SS-7	100	9	50=4"	100+	
6.2	END OF BOREHOLE						

REFERENCE No.: 11224019 ENCLOSURE No.: A-13

BOREHOLE REPORT

BOREHOLE No.: **BH1D-21**

ELEVATION: 248.0 m

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J. Scott DATE: 3 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

UTM: +/- 17T 703105.4E 4892846.0N

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); Atterberg limits (%) (w_p, w_l); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

Well: — m, — 0.90 m

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (460mm)	SS-1	0		0 0 0 1	0	WL - 0.2 m 3/17/2021
0.5	**TILL** - Clayey Silt, Few Sand, Trace Gravel, Very Soft, Brown, Moist						
0.8	Very Stiff	SS-2	100	17	9 10 11 12	21	- Borehole open upon completion with water level at approximately 3.7m
		SS-3	100	15	9 9 15 12	24	
		SS-4	100	22	7 8 8 8	16	
3.0	Stiff	SS-5	100	19	5 5 6 6	11	- SS5: 1% Gravel 5% Sand 54% Silt 40% Clay (<0.002mm) LL - 30% PI - 16%
4.6	Wet	SS-6	100	31	0 0 1 2	1	- Groundwater seepage first observed at approximately 4.6 m
6.1	Hard	SS-7	83	11	13 16 16 17	32	- 50 mm diamter monitoring well installed to 6.1m
6.7	END OF BOREHOLE						

BOREHOLE LOG GEOTECH 11224019-DSG-21-03-19, GINT BOREHOLE LOGS, JS.GPJ GEOLOGIC.GDT 22/3/21

REFERENCE No.: 11224019 | ENCLOSURE No.: A-14

GHD

BOREHOLE No.: BH1S-21

ELEVATION: 248.0 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J. Scott | DATE: 3 March 2021

DRILLING COMPANY: Landshark Group | METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703105.4E 4892846.0N

Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / RQD / CONE (10 20 30 40 50 60 70 80 90)	Well (— m, — 0.65 m)	COMMENTS
	0.0		GROUND SURFACE								
			TOPSOIL (460mm)							▼	WL - 0.2 m 3/17/2021
	0.5		**TILL** - Clayey Silt Few Sand Trace Gravel, Very Soft, Brown. Moist								
	0.8		Very Stiff								- Strata obtained from BH1D-21
	2.4		END OF BOREHOLE								- 50 mm diamter monitoring well installed to 2.3m

Depth scale: ft 1–24; m 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

BOREHOLE LOG GEOTECH 11224019-DSG-21-03-19, GINT BOREHOLE LOGS, JS.GPJ GEOLOGIC.GDT 22/3/21

REFERENCE No.: 11224019

ENCLOSURE No.: A-15

BOREHOLE No.: BH2-21

ELEVATION: 249.0 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J. Scott

DATE: 3 March 2021

DRILLING COMPANY: Landshark Group

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703243.9E 4892529.9N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (200mm)	SS-1A	67	26	3 3	6	- Borehole open and free of groundwater accumulation upon completion.
0.2	**TILL** - Sandy Silt, With Clay, Few Gravel, Loose, Dark Brown to Brown, Moist - Occasional Organics to 0.70m.	SS-1B		25	3 2		
0.7	Dense, Brown	SS-2A	50	21	3 10	32	
		SS-2B		9	22 19		
1.5	Very Dense	SS-3	79	7	12 22 50=5"	100+	
2.3	Dense	SS-4	67	11	13 15 18 12	33	
		SS-5	100	8	15 14 18 16	32	
4.6	Very Dense	SS-6	13	6	50=3"	100+	
		SS-7A	46	9	32 50=5"	100+	
6.2	**SAND** - Sand, With Silt and Clay, Very Dense, Brown, Moist	SS-7B		4			
6.7	END OF BOREHOLE						

REFERENCE No.: 11224019 | ENCLOSURE No.: A-16

BOREHOLE REPORT

BOREHOLE No.: **BH3-21**
ELEVATION: 255.1 m

CLIENT: Bromont Group
PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook
LOGGED BY: J. Scott
DATE: 4 March 2021
DRILLING COMPANY: Landshark Group
METHOD: Solid Stem Augers and Split Spoons
NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702896.8E 4892621.1N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (230mm)	SS-1A	54	34	2 3	5	- Borehole open upon completion with water level at approximately 6.4m
0.2	**TILL** - Clayey Silt, Few Sand, Trace Gravel, Firm, Dark Brown to Brown, Moist - Occasional Organics to 0.85m.	SS-1B		35	2 2		
0.8		SS-2A	33	36	2 2	5	
	Brown	SS-2B		33	3 2		
1.5	Very Stiff Sand Seam at 1.8m	SS-3	100	19	5 6 10 13	16	- SS3: 1% Gravel 11% Sand 45% Silt 43% Clay (<0.002mm)
2.3	Hard	SS-4	100	10	12 20 16 18	36	
3.0	Very Stiff Sand Seam at 3.2m	SS-5	100	10	10 10 15 12	25	
3.7	Hard	SS-6	46	10	12 50=5"	100+	
		SS-7	100	21	18 16 21 24	37	
6.7	END OF BOREHOLE						

REFERENCE No.: 11224019 ENCLOSURE No.: A-17

BOREHOLE No.: BH4-21
ELEVATION: 257.0 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J.Scott DATE: 3 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

UTM: +/- 17T 702801.4E 4892676.0N

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)
0.0	GROUND SURFACE					
	TOPSOIL (205mm)	SS-1A	83	33	2, 2	5
0.2	**TILL** - Clayey Silt, Few Sand, Trace Gravel, Firm, Dark Brown to Brown, Moist	SS-1B		25	3, 4	
0.6	- Occasional Organics to 0.60m.					
	Stiff, Brown	SS-2	50	18	5, 4, 5, 5	9
		SS-3	88	19	3, 4, 5, 5	9
2.3	Very Stiff Sand Seam at 2.4m	SS-4	100	15	12, 10, 14, 12	24
3.0	Hard, Occasional Cobbles	SS-5	46	9	17, 23, 50=4"	100+
		SS-6	21	7	50=5"	100+
6.1	**SAND** - Sand, With Silt and Clay, Very Dense, Brown, Moist	SS-7	46	8	39, 50=5"	100+
6.4	END OF BOREHOLE					

COMMENTS:

- Borehole open and free of groundwater accumulation upon completion.

REFERENCE No.: 11224019 ENCLOSURE No.: A-18

BOREHOLE No.: BH5D-21
ELEVATION: 262.4 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J.Scott DATE: 5 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data. Well Tag Number A301561.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702694.7E 4892571.5N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

Well: — m, — 1.08 m

Depth (m)	m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Comments
	0.0	GROUND SURFACE						
		TOPSOIL (915mm)	SS-1	45	19	9 8 3 2	11	- Borehole open and free of groundwater accumulation upon completion.
	0.9	**FILL** - Sand, With Silt and Clay, Very Loose, Brown, Moist	SS-2A	71	29	3 2 2 1	4	WL - Dry 3/17/2021
			SS-2B		7			
	1.5	**ORGANIC SILT**	SS-3A	79	26	4 4 5 2	9	
	1.7	**SAND** - Sand, With Silt and Clay, Loose, Brown, Moist	SS-3B		5			
	2.3	Very Loose	SS-4	42	7	2 1 1 2	2	- SS4: 0% Gravel 82% Sand 11% Silt 7% Clay (<0.002mm)
	3.0	Dense	SS-5	67	7	14 14 17 18	31	
	4.6	Very Dense	SS-6	54	9	24 50=5"	100+	- 50 mm diamter monitoring well installed to 5.8m
	6.2	END OF BOREHOLE	SS-7	29	4	50=5"	100+	

Depth scale: ft 1–24; m 1.0–7.0

REFERENCE No.: 11224019 ENCLOSURE No.: A-19

BOREHOLE No.: BH5S-21
ELEVATION: 262.4 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J.Scott DATE: 5 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702694.7E 4892571.5N

Column headings: Depth (ft, m); m Below Existing Grade; Stratigraphy; DESCRIPTION OF SOIL AND BEDROCK; Type and Number; Recovery (%); Moisture Content (%); Blows per 6 in. / 15 cm; Penetration Index (N); Shear test (Cu), Sensitivity (S) (△ Field, □ Lab), ○ Water content (%), W_p W_l Atterberg limits (%), × "N" Value (blows / 0.3 m), ◆ RQD, ◎ CONE (10 20 30 40 50 60 70 80 90); — m — 0.80 m; COMMENTS

m Below Existing Grade	Description of Soil and Bedrock	Comments
0.0	GROUND SURFACE	
	TOPSOIL (915mm)	WL - Dry 3/17/2021
0.9	**FILL** - Sand, With Silt and Clay, Very Loose, Brown, Moist	
1.5	**ORGANIC SILT**	- Strata obtained from BH5D-21
1.7	**SAND** - Sand, With Silt and Clay, Loose, Brown, Moist	
2.2	END OF BOREHOLE	- 50 mm diamter monitoring well installed to 2.2m

REFERENCE No.: 11224019 ENCLOSURE No.: A-20

BOREHOLE No.: BH6-21	BOREHOLE REPORT
ELEVATION: 259.1 m	Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J.Scott DATE: 5 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702833.9E 4892513.0N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); Atterberg limits (%) (w_p, w_l); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (915mm)	SS-1	71	38	3, 2, 4, 4	6	- Borehole open and free of groundwater accumulation upon completion.
0.9	**FILL** - Sand, With Silt and Clay, Dense, Brown, Moist	SS-2A	67	19	2, 5, 29, 20	34	
		SS-2B		10			
1.6	**ORGANIC SILT**	SS-3A	63	11	16, 14, 15, 50=5"	29	
1.8	**TILL** - Sandy Silt, With Clay, Few Gravel, Compact, Brown, Moist	SS-3B		22			
		SS-3C		7			
2.3	Dense, Occasional Cobbles	SS-4	100	7	14, 14, 18, 22	32	
3.0	Very Dense	SS-5	67	8	22, 25, 36, 32	61	
		SS-6	13	6	50=3"	100+	
6.2	END OF BOREHOLE	SS-7	21	6	50=5"	100+	

Depth scale: ft 0–24; m 1.0–7.0

REFERENCE No.: 11224019 ENCLOSURE No.: A-21

GHD

BOREHOLE No.: BH7-21

ELEVATION: 259.3 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J.Scott DATE: 4 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702936.2E 4892456.8N

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); Atterberg limits (%) (w_p, w_l); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE. Plot scale: 10 20 30 40 50 60 70 80 90

Depth (m)	m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Comments
	0.0	GROUND SURFACE						
		TOPSOIL (300mm)	SS-1A	63	27	4 5 5 4	10	- Borehole open and free of groundwater accumulation upon completion.
	0.3	**TILL** - Sandy Silt, With Clay, Few Gravel, Loose to Compact, Dark Brown to Brown, Moist - Occasional Organics to 0.75m.	SS-1B		16			
1.0			SS-2A	58	24	3 3 4 4	7	
	1.1	Compact, Brown	SS-2B		9			
			SS-3	67	11	9 7 7 8	14	
2.0			SS-4	71	16	6 8 13 14	21	
3.0			SS-5	100	11	16 13 12 8	25	- SS5: 6% Gravel 34% Sand 46% Silt 14% Clay (<0.002mm)
	3.7	Very Dense, Occasional Cobbles						
4.0			SS-6	17	6	50=4"	100+	
5.0								
6.0			SS-7	21	5	50=5"	100+	
	6.2	END OF BOREHOLE						
7.0								

REFERENCE No.: 11224019 ENCLOSURE No.: A-22

BOREHOLE No.: BH8-21
ELEVATION: 261.8 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J. Scott DATE: 5 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

UTM: +/- 17T 702771.1E 4892372.6N

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); w_p – w_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK
0.0	GROUND SURFACE
0.0	**TOPSOIL** (255mm)
0.3	**TILL** - Sandy Silt, With Clay, Few Gravel, Loose, Brown, Moist
0.8	Very Dense
2.0	Occasional Cobbles
6.4	END OF BOREHOLE

Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index N
SS-1		27	1, 2, 3, 2	5
SS-2		13	5, 11, 50=1"	100+
SS-3		5	22, 37, 37, 30	74
SS-4		5	27, 44, 50=5"	100+
SS-5		6	35, 42, 49, 44	91
SS-6		7	48, 50=5"	100+
SS-7		7	37, 50=5"	100+

COMMENTS

- Borehole open and free of groundwater accumulation upon completion.

REFERENCE No.: 11224019 ENCLOSURE No.: A-23

BOREHOLE No.: **BH9-21**
ELEVATION: 259.0 m

BOREHOLE REPORT

CLIENT: Bromont Group
PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook
LOGGED BY: J. Scott DATE: 4 March 2021
DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons
NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- WATER LEVEL

UTM: +/- 17T 702887.4E 4892348.3N

Shear test (Cu) Sensitivity (S) △ Field ☐ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (255mm)	SS-1A	12	28	5 5 7 4	12	- Borehole open and free of groundwater accumulation upon completion.
0.3	**TILL** - Sandy Silt, With Clay, Few Gravel, Compact, Dark Brown to Brown, Moist - Occasional Organics to 0.75m.	SS-1B		27			
0.8	Brown	SS-2	24	19	4 6 8 7	14	
		SS-3	19	19	4 6 8 9	14	
		SS-4	24	15	9 6 8 11	14	
		SS-5	24	10	12 12 13 10	25	
4.6	Dense	SS-6	24	17	19 17 24 24	41	
6.1	Very Dense, Occasional Cobbles	SS-7	22	10	10 18 50=4"	100+	
6.5	END OF BOREHOLE						

REFERENCE No.: 11224019 ENCLOSURE No.: A-24

GHD

BOREHOLE No.: BH10-21
ELEVATION: 253.0 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group
PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook
LOGGED BY: J. Scott DATE: 4 March 2021
DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons
NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 703013.4E 4892304.0N

Shear test (Cu) △ Field ☐ Lab; Sensitivity (S); ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

m Below Existing Grade	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	COMMENTS
0.0	GROUND SURFACE						
	TOPSOIL (230mm)	SS-1A	71	24	3 3	6	- Borehole open and free of groundwater accumulation upon completion.
0.2	**TILL** - Sandy Silt, With Clay Few Gravel, Loose, Dark Brown to Brown, Moist - Occasional Organics to 0.30m	SS-1B		23	3		
		SS-1C		23	5		
0.8	Compact	SS-2	92	22	3 4 6 7	10	
		SS-3	83	24	6 12 8 10	20	
		SS-4	88		32 6 22 19	28	
2.6	Dense, Occasional Cobbles	SS-5	100	15	16 20 26 26	46	
4.6	Very Dense, Occasional Cobbles	SS-6	42	16	25 50=3"	100+	
6.2	END OF BOREHOLE	SS-7	16	6	50=4"	100+	

REFERENCE No.: 11224019 ENCLOSURE No.: A-25

BOREHOLE REPORT

BOREHOLE No.: BH11D-21

ELEVATION: 254.9 m

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J. Scott DATE: 4 March 2021

DRILLING COMPANY: Landshark Group METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

UTM: +/- 17T 702829.8E 4892241.8N

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Shear test (Cu) / Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

Well stick-up: — m, — 0.85 m

m Below Existing Grade	Description of Soil and Bedrock	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	Comments
0.0	GROUND SURFACE						
	TOPSOIL (275mm)	SS-1A	75	33	5, 2, 3, 3	5	- Borehole open upon completion with water level at approximately 6.5m
0.3	**TILL** - Clayey Silt, Few Sand, Trace Gravel, Firm, Dark Brown to Brown, Moist - Occasional Organics to 0.90m	SS-1B		29			
		SS-2A	67	21	3, 2, 2, 2	4	
0.9	Soft, Brown	SS-2B		25			- SS2B: 0% Gravel, 6% Sand, 54% Silt, 40% Clay (<0.002mm)
1.5	Stiff	SS-3	100	10	3, 6, 7, 10	13	
2.3	Very Stiff	SS-4	71	9	5, 8, 8, 9	16	WL - 2.5 m 3/17/2021
3.0	Wet	SS-5	100	16	6, 8, 12, 10	20	- Groundwater seepage first observed at approximately 3.0 m
		SS-6	100	18	7, 8, 11, 11	19	
		SS-7	100	17	10, 12, 13, 14	25	- 50 mm diamter monitoring well installed to 6.0m
6.7	END OF BOREHOLE						

Depth scale: ft 1–24; m 1.0–7.0

Chart scale: 10 20 30 40 50 60 70 80 90

REFERENCE No.: 11224019

ENCLOSURE No.: A-26

GHD

BOREHOLE No.: BH11S-21

ELEVATION: 254.9 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Bromont Group

PROJECT: Geotechnical Investigation - 787 & 825 Fallis Line, Millbrook

LOGGED BY: J. Scott

DATE: 4 March 2021

DRILLING COMPANY: Landshark Group

METHOD: Solid Stem Augers and Split Spoons

NOTES: Ground surface elevation interpolated from ODTM Lidar Derived data.

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

UTM: +/- 17T 702829.8E 4892241.8N

Shear test (Cu) Sensitivity (S): △ Field, □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); × "N" Value (blows / 0.3 m); ◆ RQD; ◎ CONE

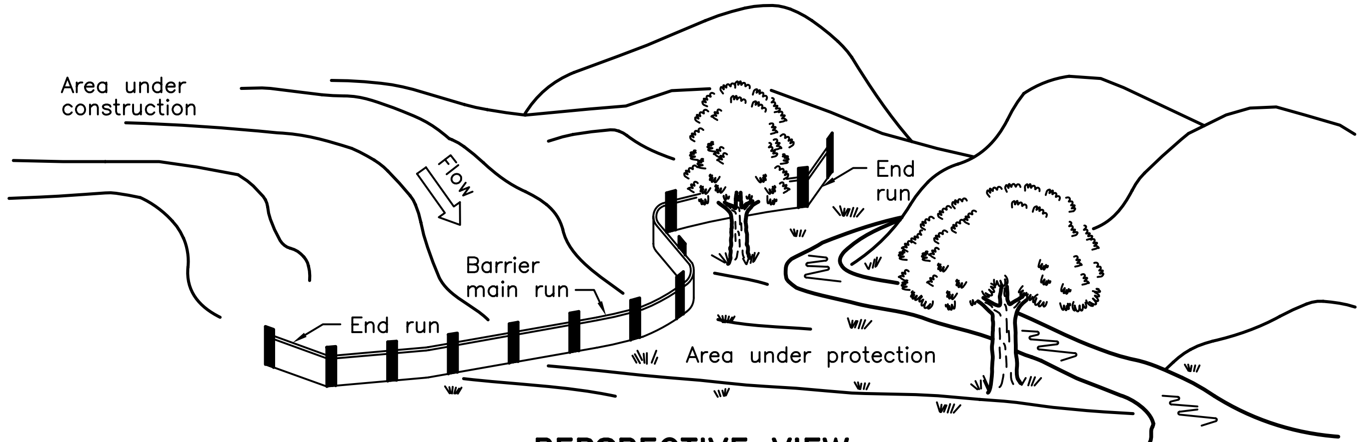
Well: — m, — 0.75 m

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery (%)	Moisture Content (%)	Blows per 6 in. / 15 cm	Penetration Index (N)	Shear test / N Value (10 20 30 40 50 60 70 80 90)	COMMENTS
		0.0		GROUND SURFACE							
				TOPSOIL (275mm)							
1–3		0.3		**TILL** - Clayey Silt, Few Sand, Trace Gravel, Firm, Dark Brown to Brown, Moist - Occasional Organics to 0.90m							WL - 0.6 m 3/17/2021
3–5	1.0	0.9		Soft, Brown							
5–7	2.0	1.5		Stiff							- Strata obtained from BH11D-21
		2.3		END OF BOREHOLE							- 50 mm diamter monitoring well installed to 2.3m

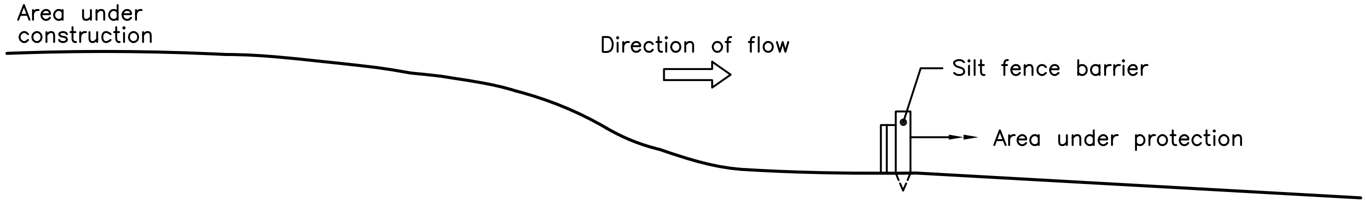
Depth scale: ft 1–24; m 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

APPENDIX "I"

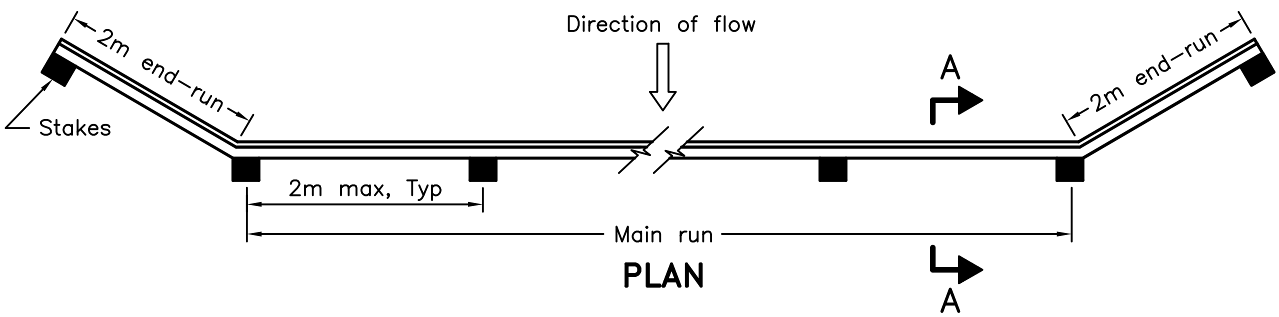
Erosion & Sediment Control Details



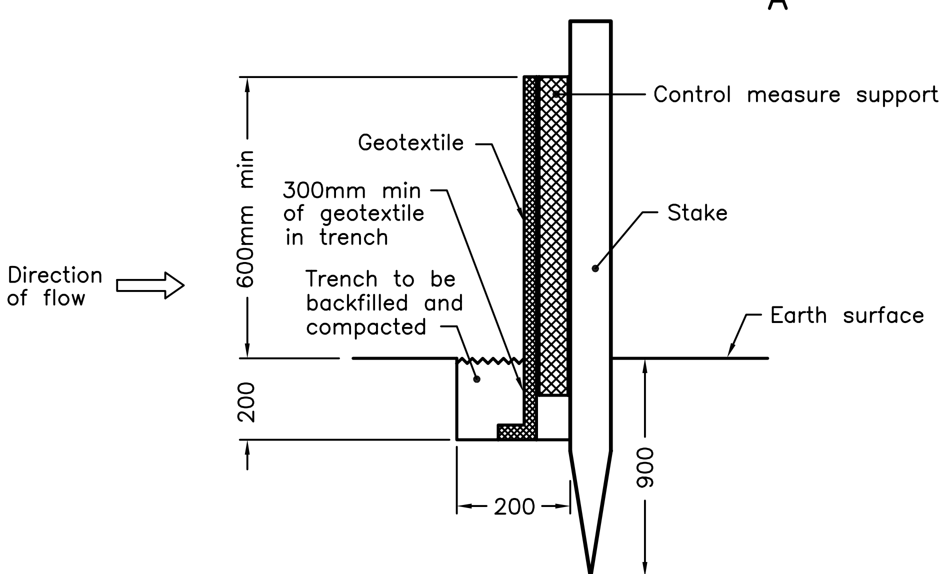
PERSPECTIVE VIEW



SECTION



PLAN

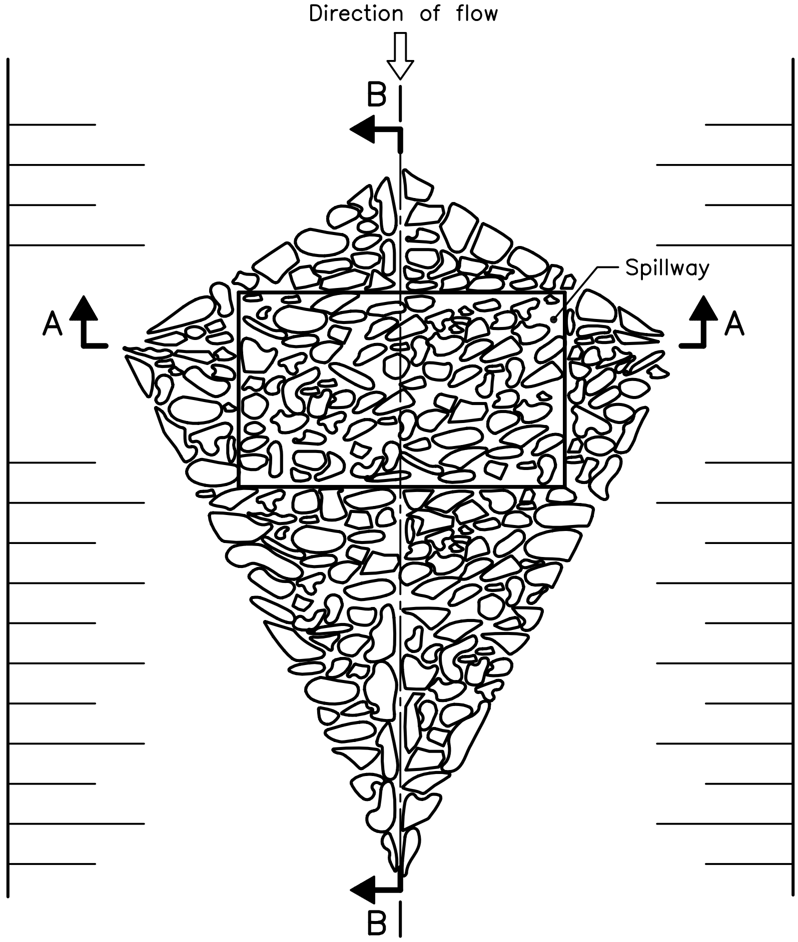


SECTION A–A

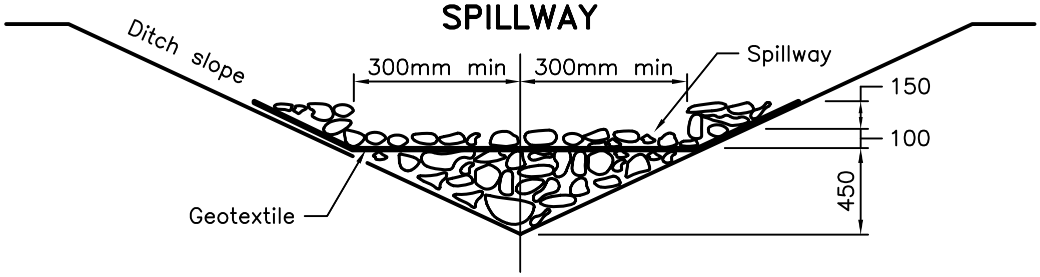
NOTE:

A All dimensions are in millimetres unless otherwise shown.

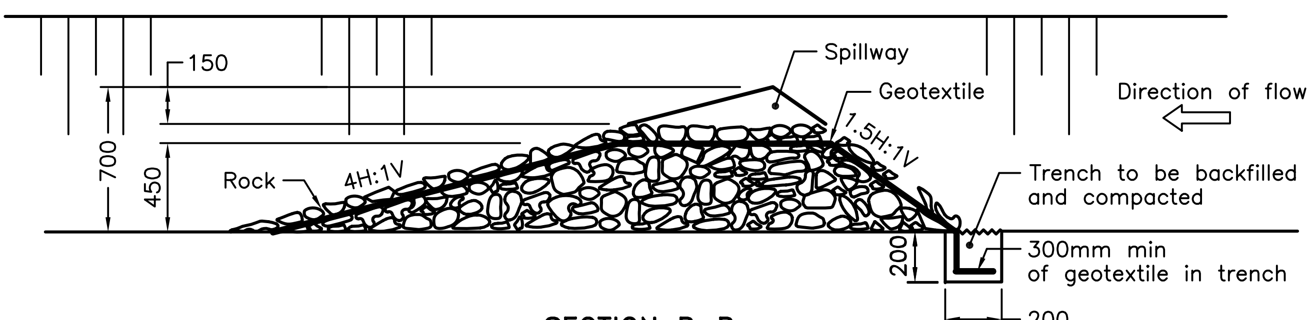
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2006	Rev 1
HEAVY–DUTY SILT FENCE BARRIER		
	OPSD 219.130	



PLAN
SPILLWAY



SECTION A–A



SECTION B–B

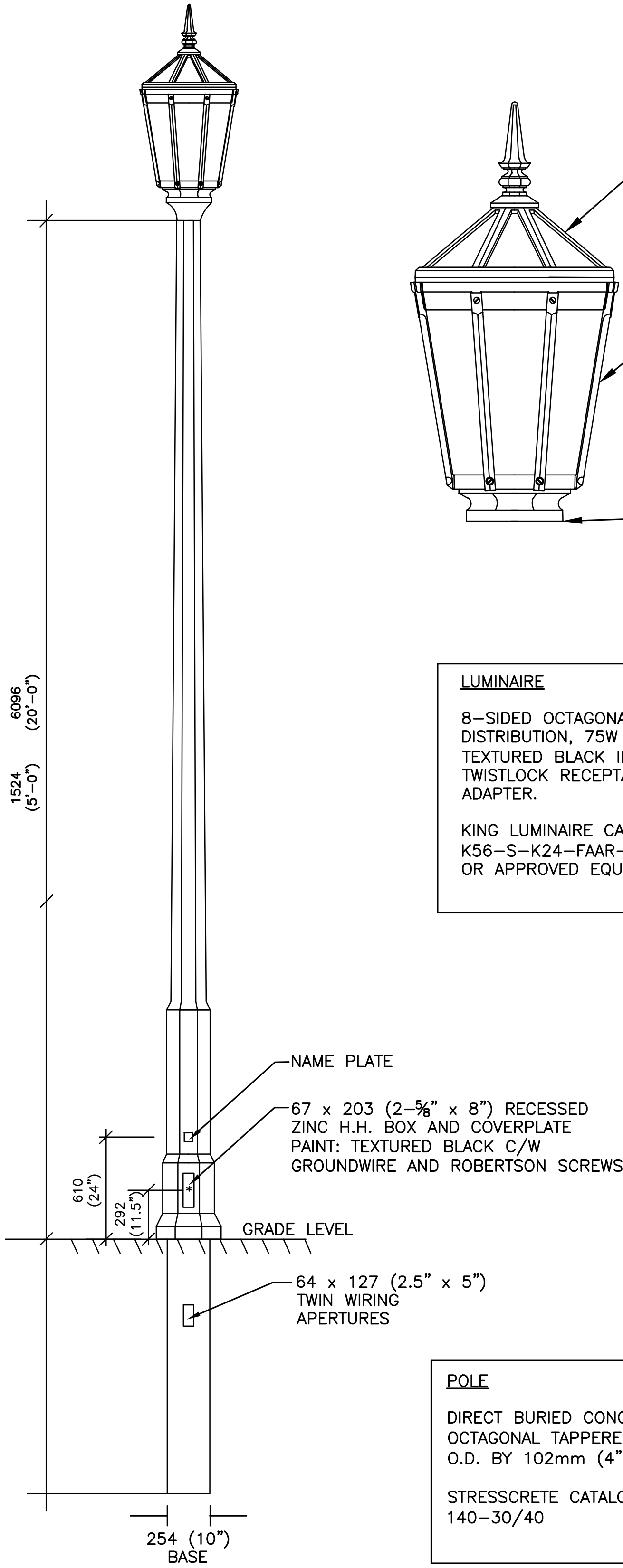
NOTE:

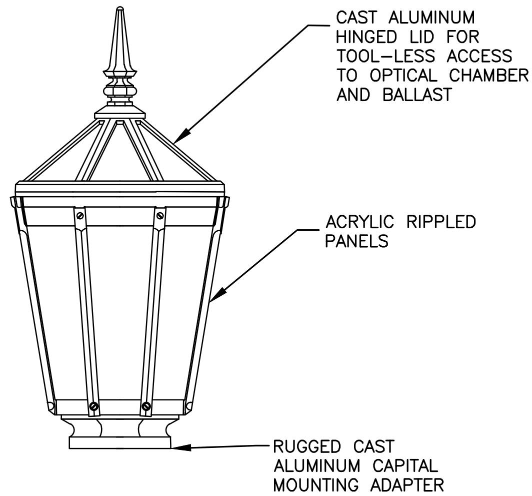
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2006	Rev 1
ROCK FLOW CHECK DAM V–DITCH		
	OPSD 219.210	

APPENDIX “J”

Typical Joint Utility Trench Detail





LUMINAIRE

8-SIDED OCTAGONAL POST-TOP LUMINAIRE, TYPE III DISTRIBUTION, 75W LED, RIPPLED ACRYLIC LENS, TEXTURED BLACK IN COLOUR, 120VAC, C/W TWISTLOCK RECEPTACLE AND K24 CAPITAL POLE ADAPTER.

KING LUMINAIRE CATALOGUE NO:
K56-S-K24-FAAR-III-75(SSL)-5000-120-PR-#6
OR APPROVED EQUAL

POLE

DIRECT BURIED CONCRETE POLE, BLACK POLISHED AND, OCTAGONAL TAPPERED SECTION, COMPLETE WITH 76mm (3") O.D. BY 102mm (4") LONG TENON

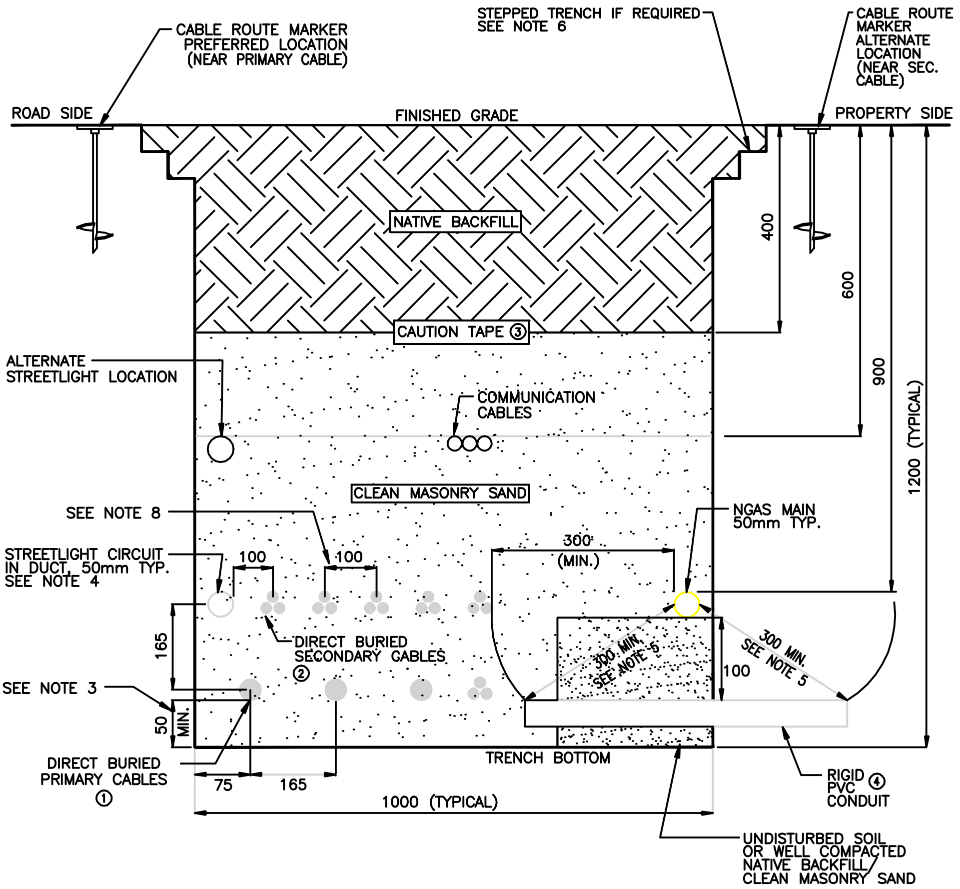
STRESSCRETE CATALOGUE NO.: KCH20-G-S11-DB C/W 140-30/40

MILLBROOK SOUTH WEST SUBDIVISION

STREET LIGHT DETAIL

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, SUITE 2, WOODBRIDGE, ONTARIO, L4L 5T9
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

SCALE	N.T.S.	PROJECT	16119	FIGURE J1
DATE	May, 2021	DRAWN BY	V.L.	



NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM.
3. IN THE PRESENCE OF SHARP ROCK, DEBRIS OR RUBBLE, INCREASE SAND PADDING TO 100mm
4. STREETLIGHT WIRE DUCT MAY BE INSTALLED AT A REDUCED BURIAL DEPTH, UP TO A MINIMUM DEPTH OF 600mm. SEPARATIONS TO SUPPLY CABLE BASED ON MAXIMUM STREETLIGHT DUCT DIAMETER OF 50mm.
5. MUST MAINTAIN 300mm MINIMUM FROM ALL EXPOSED SUPPLY CABLES TO GAS MAIN. WHEN CROSSING GAS MAIN AND IF 300mm OF CLEAR VERTICAL SEPARATION IS NOT ACHIEVABLE, SECONDARY CABLES SHALL BE INSTALLED IN SHORT LENGTH OF RIGID PVC CONDUIT.
6. CONSTRUCTION, STEPPING AND/OR SUPPORTING OF THE TRENCH WALL TO CONFORM TO THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT.
7. NON-REQUIRED CIRCUITS OR JOINT USE COMPONENTS MAY BE OMITTED PROVIDED THAT CLEARANCES AND SEPARATIONS ARE MAINTAINED. PRIMARY CABLES (IF PRESENT) MUST BE INSTALLED ON THE BOTTOM ROW OF SUPPLY CABLES. SECONDARY CABLE BUNDLES MAY BE SUBSTITUTED IN PLACE OF PRIMARY CABLE(S) WHEN REQUIRED.
8. INTERMITTENT CONTACT IS ALLOWABLE BETWEEN SECONDAY CABLES WHERE REQUIRED.

PART #	MASTER MATERIAL #	DESCRIPTION	QTY.
①	30010134 30006080	CABLE PRIMARY, 28kV, UGROUND, 2/0 AWG, AL CABLE PRIMARY, 28kV, UGROUND, 350 KCMIL, CU	
②	30005908 30005915	SERVICE CABLE, UGROUND, 3/0AWG, 3 COND, AL SERVICE CABLE, UGROUND, 250KCMIL, 3 COND, AL	
③	20002181	CAUTION TAPE	
④	30007542	RIGID PVC CONDUIT	

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
02	JULY 2011	GENERAL REVISIONS	PC	

hydro one

Hydro One Networks Inc.

Drawn: P.CIARMOLI | Approved: * | Date: JULY.20,2011

JOINT TRENCH - POWER, COMMUNICATION & GAS DISTRIBUTION LINES - TYPICAL

Dwg. No. **DU-03-206.1** | Rev. **02**

NOTE:

Distances Shown On This Plan Are In Metres And Can Be Converted To Feet By Dividing By 0.3048

The Position of Pole Lines, Conduits, Watermains, Sewers and Other Underground and Overground Utilities and Structures is Not Necessarily Shown On The Contract Drawing, And Where Shown, The Accuracy Of The Position of Such Utilities and Structures is Not Guaranteed Before Starting Work, The Contractor Shall Inform Himself Of The Exact Location of All Such Utilities and Structures, and Shall Assume All Liability For Damage To Them.

LEGEND

	SUBDIVISION BOUNDARY
× 225.14	PROPOSED ELEVATION
× 224.27	EXISTING ELEVATION
224.25	EXISTING CONTOUR ELEVATION
	PROPOSED OVERLAND FLOW DIRECTION
	PEDESTRIAN NETWORK
	PROP. SANITARY MAINTENANCE HOLE
	PROP. STORM MAINTENANCE HOLE
	PROP. FDC MAINTENANCE HOLE
	PROP. SANITARY SEWER
	PROP. STORM SEWER
	PROP. WATERMAIN
	PROP. FDC SEWER

NOTE

THIS PLAN HAS BEEN PREPARED TO DEMONSTRATE FEASIBILITY OF THE PROPOSED DEVELOPMENT WITH RESPECT TO GRADING IN CONJUNCTION WITH THE DRAFT PLAN APPLICATION. DETAILED GRADING DESIGN WILL BE PREPARED AT THE SUBDIVISION ENGINEERING STAGE.

No.	Revision	Date	By	Appr'd

CONSULTANT:

PRELIMINARY

MILLBROOK SOUTH WEST SUBDIVISION

BROMONT HOMES INC.

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
741 ROWNTREE DAIRY ROAD, UNIT 2, WOODBRIDGE, ONTARIO, L4L 5T9
TEL (905)264-0054, FAX (905)264-0069 E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

TOWNSHIP OF CAVAN MONAGHAN
COUNTY OF PETERBOROUGH

PRELIMINARY SITE SERVICING AND GRADING PLAN

Surveyed by:	Checked by: P.S.Z.	Project No. 16119
Drawn by: V.L.	Approved by: D.G.	
Designed by: V.L.	Date: May 7, 2021	Drawing No. PSG-1
Scale: 1:750		Sheet No.