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FUNCTIONAL SERVICING REPORT

Proposed Estate Residential Subdivision

West Side of Mount Pleasant Rd., South of Highway 9
Community of Palgrave
Town of Caledon
Region of Peel
Files: 21T-18002C & RZ 18-06

May 2018
Rev. October 2019
Rev. August 2020

Prepared For: **Tropical Land Developments Ltd.**

File: **17122**

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VALDOR WATER RESOURCES

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1.0 INTRODUCTION

Valdor Engineering Inc. has been retained by Tropical Land Developments Ltd. to provide consulting engineering services for the proposed estate residential subdivision located on a 12.28 hectare parcel on the west side of Mount Pleasant Road, south of Highway 9 in the Palgrave Community of the Town of Caledon as illustrated in **Figure 1**.

1.1 Existing Conditions

The subject site is currently vacant and has rolling topography. The site is bounded to the north by a large lot with a detached dwelling and to the east by Mount Pleasant Road. The subject site is bounded to the west and south by woodlots. The tributary of the Beeton Creek traverses the east part of the site.

An estate residential subdivision is located further to the north and west (Pine Glen Estates, 21T-88051C). An estate residential subdivision (2366125 Ontario Inc., Beaverhall Homes, 21T-95027C) is planned on the east side of Mount Pleasant Road.

1.2 Proposed Development

The proposed development consists of eight estate residential lots for detached dwellings with lot sizes ranging from 0.62 to 3.97 hectares. The development will also include a municipal road allowance and a block for a future road. The total number of lots include one bonus lot which was achieved through the creation of environmental protection zone having a minimum area of 4.0 hectares. The environmental protection zones are generally located in the rear yard area and are to remain undisturbed.

The configuration of the proposed development is illustrated in **Figure 2**. The development statistics and the equivalent population data are summarized in **Table 1**. A copy of the draft plan of subdivision indicating the configuration of the lots is included in **Appendix "A"** together with a site plan indicating the conceptual house locations.

Table 1. Development Statistics

Land Use	**Area** (Ha)	**Residential Units** (No.)
Estate Residential Lots	11.12	8
Road Allowances & 0.30m Reserves	1.16	
TOTAL	**12.28**	**8**

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 for the proposed development 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 engineering staff at the Town of Caledon, Region of Peel and the Nottawasaga River Conservation Authority, as well as visits to the site. The conceptual design is documented on a series of large size preliminary plans which are contained in a pocket at the rear of this report. This document provides guidance for detailed engineering design of the subdivision.

2.0 WATER SERVICING

The Region of Peel is responsible for the treatment and distribution of water within the Town of Caledon as well as the City of Brampton and the City of Mississauga. The Region's South Peel Drinking Water System is a lake-based system that supplies a population of over 1.3 million people in the urban area drawing water from Lake Ontario after which it is treated at either the Lakeview or Lornepark water treatment facilities. The rural communities of Caledon including Alton, Caledon East, Caledon Village, Cheltenham Village, Inglewood as well as Palgrave are serviced by well based water systems which are operated by the Region of Peel.

The community of Palgrave is serviced by the Palgrave Drinking Water System. This system consists of two water treatment plants, three municipal wells, one water storage reservoir, 75 kilometres of watermain and 134 fire hydrants. 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 Region of Peel engineering design standards which includes the following parameters:

Residential Average Day Demand:	280 L/person/day
Maximum Day Factor:	2.0
Peak Hour Factor	3.0

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)	**Maximum Day Plus Fire Flow** (L/s)
Estate Lots	32	6.2	12.4	18.7	6,000	6,012	100.2

2.2 Local Watermains & Service Connections

The local water distribution system within the subdivision will consist of watermains of 150mm and 200mm diameter. This internal water system will connect to the recently constructed 200mm diameter watermain on the east side of Mount Pleasant Road.

The Mount Pleasant Road watermain was extended approximately 2 km and is not looped so the Region is currently implemented a flushing program to maintain water quality. Based on discussion with Region staff, the water volumes lost during the flushing of this watermain are significant and are a strain on the groundwater well supply. Based on the above the Region requires that this watermain be looped. A review of the possible options for looping the watermain network are illustrated in **Figure 3B** and summarized as follows:

- **Option A:** The extension of the watermain by the landowner of the proposed subdivision (21T-08001C) from the Beaverhall subdivision northerly to the intersection of Mount Pleasant Road / McGuire Trail having a length of approximately 635m.
- **Option B:** The extension of the watermain from Street "A" within the subject site, northerly through the property to the north, to the intersection of Rowley Drive / McGuire Trail having a length of approximately 210m.
- **Option C:** The extension of the Mount Pleasant Road watermain from Catherine Duffey Gate northerly to McGuire Trail having a length of approximately 875m.

The preferred alternative for the watermain looping will be assessed at the detailed design stage.

Based on Ontario Building Code (OBC 2012) regulations (7.6.3.4.(1) and (5) and Table 7.6.3.4), the houses 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 Region and will be installed in the basement of each dwelling unit with a remote readout device located on the exterior ground floor wall of the unit. A copy of the standard water service connection detail are included in **Appendix "B"**. The location of the watermains and service connections are indicated in **Figure 3A**.

2.3 Fire Protection

The fire flow required for the proposed detached dwelling units and commercial buildings 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.

Based on the calculations, the minimum fire suppression flow required for the detached dwellings is 6,000 L/min. The preliminary fire flow calculation is shown in **Table B2-1** contained in **Appendix "B"**. In accordance with the Region of Peel standards, this flow must be available at the nearest hydrant with a minimum pressure of 140 KPa.

Fire hydrants will be provided along the road at a 150m spacing in accordance with the Region of Peel design criteria. A copy of the standard fire hydrant connection detail is included in **Appendix "B"**. The location of the proposed fire hydrants are indicated in **Figure 3A**.

3.0 WASTEWATER SERVICING

The Region of Peel operates and maintains approximately 3,500 Km of sanitary sewer including those within the urban areas of Caledon as well as those in the City of Brampton and the City of Mississauga. Wastewater treatment for these urban areas is provided by the Clarkson and G.E. Booth Lakeview Wastewater Treatment facilities located on the shore of Lake Ontario. Caledon's Inglewood Community is serviced by the Inglewood Communal Wastewater Treatment Station which discharges to the Credit River. Homes in the balance of Caledon's rural communities, including Palgrave are serviced by individual private on-site sewage systems.

The following sections detail the sizing of the private on-site sewage systems in accordance with the Ontario Building Code.

3.1 Wastewater Design Flow

In accordance with Part 8 of the Ontario Building Code (OBC) the daily design flow for a dwelling is to be calculated based on the floor area of the dwelling, the number of bedrooms and the number of fixture units.

Although architectural house plans are not yet available, for the purpose of confirming servicing feasibility, it is assumed that the proposed detached dwellings will have four bedrooms, 460 m^2 (4,950 sq.ft) of floor area with 40 fixture units. Based on these parameters the design sewage flow has been calculated to be 4,450 L/day as summarized in **Table 3**. The calculation of the design flow is provided in **Table C1** and the listing of fixture units is provided in **Table C2** which are both included in **Appendix "C".**

Table 3. Wastewater Flow

House Size:	460 m^2 (4,950 sq.ft.), 4 bedrooms, 40 fixture units
Design Flow, Q:	4,450 L/day
Septic Tank Size:	9,000 L
Native Soils:	Sand
Percolation Rate:	10 minutes / cm (Native Sand)
Required Length of Distribution Pipe for Conventional In-Ground Bed:	222.5m
Proposed Size of Conventional In-Ground Bed:	9 runs @ 24.8m = 223.2 (24.8m x 12.8m)

3.2 Septic System Components

The septic system is comprised of several components which are to be sized based on the daily design flow and the percolation rate ("T" time) of the native soil conditions. The configuration of the proposed septic system is illustrated in **Figure 4** and on the **Preliminary Servicing Plan (Dwg PS-1)**. The sizing of the components is summarized in the following sections.

3.2.1 Septic Tank

A 100mm diameter gravity sanitary drain will convey sewage flows to the septic tank from plumbing fixtures on the main floor of the dwelling and above. Fixtures in the basement will typically require an internal sewage ejector to pump flow up to the gravity sanitary drain.

In accordance with Section 8.2.2.3 of the OBC the septic tank volume is to be a minimum of twice the daily design flow as follows:

Minimum Tank Size = 4,450 L/day x 2 = 8,900 L

Commercially Available Sizes = 4,500 L, 6,800 L, 9,000 L & 13,500 L

Selected Tank Size = 9,000 L

In accordance with Section 8.6.2.1 of the OBC, an effluent filter is to be installed in the outlet of the septic tank. Access risers over both the inlet and outlet of the tank are to extend to finished grade to allow for inspection and maintenance. A detail of the septic tank is included in **Appendix "C"**.

3.2.2 Pump Tank / Balancing Tank

Given that the daily sewage flow is higher than 3,000 L/day effluent gravity flow is not permitted and therefore effluent is to be pumped to the disposal bed. The pump is to be installed in a pump tank which is to be located downstream of the septic tank.

For situations where a very large home is constructed with a high occupant load, a larger pump tank can be utilized in the form of a balancing tank. This tank can provide storage of varying peak flows so that discharge to the disposal bed can be balanced over several days with the pump discharging lower flows at prescribed intervals set by a control panel.

3.2.3 Subsurface Disposal

A preliminary geotechnical investigation prepared by Sirati & Partners Consultants Limited determined that the native soils across all of the lots consist of sand. With regards to the preliminary sizing of septic systems a percolation rates ("T" time) of 10 min/cm has been assumed.

During drilling, groundwater was found in the boreholes at depths ranging from 4.6 to 9.1m below the existing grade. The stabilized groundwater table observed in the monitoring wells approximately two weeks after drilling was at depths ranging from 4.7m to 9.8 m. A copy of the preliminary geotechnical investigation is included in **Appendix "I"**.

Based on the native sand soils, the proposed lots would be suitable for conventional in-ground bed. The sizing of the disposal beds is summarized as follows:

a) Conventional Septic Beds

Conventional in-ground septic tile beds have a solid header pipe with a series of perforated distribution pipes. The total length of distribution pipe is calculated as follows:

Length of Pipe = Q x T / 200 where Q= design flow in L/Day
T = Percolation Rate in min/cm

Length of Pipe = 4,450 x 10 / 200 = 222.5m

Based on 9 runs of distribution pipe each being 24.8m long the total length of distribution pipe is 223.2m. Using the required pipe spacing of 1.6m the size of the in-ground septic bed would be 317.44 m^2 in area with the dimensions 12.8m (8 x 1.6m) x 24.8m. The preliminary location of the proposed septic tile beds is indicated in **Figure 4**. The septic bed sizing calculations are included in **Appendix "C"**.

b) Alternate Bed Designs

In order to minimize the land area required for the disposal bed and to achieve a level of treatment higher than that of a conventional septic system, the use of an alternative treatment system can be utilized.

There are several alternative treatment systems available which have been approved by the Ministry of Municipal Affairs & Housing (MMAH) and recognized in the OBC. Alternative treatment systems designed as "Treatment Units" other than septic tanks must meet the requirements of Section 8.6.2.2 of the OBC and must produce tertiary quality effluent. One such technology providing tertiary treatment is the Waterloo Biofilter® manufactured by Waterloo Biofilter Systems Inc. The Waterloo Biofilter® is an aerobic trickling filter that uses an absorbent synthetic filter material developed by researchers at the University of Waterloo and was incorporated into the OBC in 1998. Septic tank effluent is applied intermittently over modules of plastic foam pieces (patented biofilter medium) contained in wire mesh baskets. This synthetic media is a support for microbiological growth, and these microorganisms are responsible for the aerobic breakdown of the wastewater. Approximately 50% of the effluent exiting the unit is pumped back to the septic tank, while the other half is directed to a disposal bed.

An area bed dispersal system is typically utilized with alternative treatment systems for subsurface disposal. The area bed is to be comprised of a stone layer overlying a sand layer where the stone layer is to be a minimum of 250mm in depth, wrapped with a permeable geo-textile fabric, and comprised of stone meeting the requirements of either Subclause 8.7.3.3.(1)(b)(i) or (ii) of the OBC. Distribution pipes having 75mm diameter are to be spaced evenly within the stone layer with spacing not exceeding 1.2m. The sand layer is to be a minimum of 300mm in depth having a percolation rate ("T" time) of 6 to 10 min/cm. The sand layer covers the entire area bed and is sized as follows:

Minimum Sand Area = Q x T / 400 = 4,450 x 10 / 400 = 111.25m^2

4.0 STORM CONVEYANCE SYSTEM

The subject site is located within the Nottawasaga River watershed which is under the jurisdiction of the Nottawasaga Valley Conservation Authority. The Nottawasaga River is approximately 122 km in length along its main channel and has a drainage area of 3,361 km^2. The main branch of the river's source is in the till moraines of Amaranth Township at an elevation of almost 490 metres. The Nottawasaga River has a total drop of 310 metres to its outlet into Georgian Bay at Wasaga Beach. The Nottawasaga River has 6 primary tributaries; the Boyne River, the Mad River, the Pine River, Innisfil Creek, Bear Creek, and Willow Creek. In addition to the Nottawasaga's major drainage basin, four streams draining directly into Georgian Bay from the Niagara Escarpment are in the Nottawasaga Valley Conservation Authority's jurisdiction. These watercourses, all located in the north western section of the Authority's jurisdiction include; the Pretty River, Batteaux River, Silver Creek, and Black Ash Creek.

The subject site is located in the Innisfil Creek Sub-Watershed which has a catchment area of approximately 491 km^2 and is located in the south-east corner of the NVCA's watershed. Innisfil creek enters the Nottawasaga River south of Alliston. The Innisfil Creek sub-watershed includes the tributaries of Bailey, Beeton, Cookstown and Penville Creeks and includes catchment areas in the municipalities of Innisfil, New Tecumseth, Mono, Adjala-Tosorontio, Bradford-West Gwillimbury, Essa and Caledon.

The subject site is tributary to the Beeton Creek. With its headwaters in the Oak Ridges Moraine, Beeton Creek flows northward joining Bailey Creek just upstream of Innisfil Creek. Maps illustrating the watershed and sub-watershed are contained in **Appendix "D"**.

In accordance with Town 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 Town engineering design criteria, the proposed development is to be serviced with a minor storm sewer system that is designed to convey runoff from the 5-year storm event. The rainfall intensity values, *I*, are calculated in accordance with the Town's rainfall intensity duration frequency (IDF). Based on this data the rainfall intensity for the 5 and 100 year rainfall events is calculated as follows:

$$I_5 = \frac{1593}{(t+11)^{0.8789}} \qquad I_{100} = \frac{4688}{(t+17)^{0.9624}}$$

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 detailed in the Town's Engineering Standards is included in **Appendix "D"**. A schematic design of the minor system is illustrated in on the **Preliminary Servicing Plan (Dwg. PS-1**).

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. The major system flow route is illustrated in **Figure 9**.

As per the hydrologic modelling completed for the proposed development (refer to *Section 6.3.3*), the major system flow (i.e. the uncontrolled 100- minus 5-year peak flow) is 0.211 cms. *FlowMaster* modelling has been completed to demonstrate that the right-of-way and spillway/overflow channel has adequate capacity to convey the major flow. *FlowMaster* modelling output is provide in **Appendix F**.

4.3 Foundation Drainage

It is anticipated that the proposed dwellings will have conventional basements which will have foundation weeping tile. Given the rural nature of the development storm service connection will not be provided and therefore sump pumps will be required. The sump pumps are to discharge over splash pads to grassed areas. The sump pump is not to discharge to the septic system.

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.

5.0 FLOODPLAIN ANALYSIS

As requested by the NVCA, Valdor has completed hydraulic modelling of the floodplain associated with the subject site for both the pre-development and proposed post-development conditions.

5.1 Hydrologic Analysis

A hydrologic model using Visual OTTHYMO Version 5.0 (VO5) was prepared in order to determine the peak flows to be used in the hydraulic model.

The contributing drainage area to the subject site (*Catchment 301*) is shown on **Figure 5**. The catchment area was delineated based on the available Ontario Base Mapping and contours *(Sheets 1017590048650*, *1017590048700* and *1017595048650*, Ministry of Natural Resources, 2002). The area-weighted hydrologic soil group for the catchment was determined based on the *Soil Map of Peel County* (Soil Survey Report No. 18, Department of Soils, Ontario Agricultural College, 1953) and the *Soil Map of Dufferin County* (Soil Survey Report No. 38, Department of Soils, Ontario Agricultural College, 1963). Land uses for the catchment were determined based on satellite imagery.

In order to determine the Regulatory flow (the greater flow of either the 100-year storm of the Regional storm) a critical storm analysis was completed to determine which storm distribution resulted in the largest 100-year flows. Based on the NVCA's *Natural Hazards Technical Guide*, the following three storm distributions were analyzed: the Timmins Storm, the 100-year 4-hour Chicago storm (based on the Town of Caledon's IDF data, provided in **Appendix D**) and the 100-year 24-hour SCS Type II storm (based on the latest Toronto Pearson Airport IDF data obtained from Environment Canada). It was determined that the Timmins Storm is the critical storm, resulting in a flow of 5.903 cms, compared to 3.475 cms for the 100-year 4-hour Chicago, and 3.795 cms for the 100-year 24-hour SCS Type II storm distributions.

The Regional flow (i.e. Timmins Storm) is therefore the Regulatory flow and used in the hydraulic modelling to determine the extents of the Regulatory floodplain. The supporting calculations, schematic and model output for the hydrologic model are provided in **Appendix E**.

5.2 Existing Floodplain Conditions

A HEC-RAS Version 4.1.0 hydraulic model was prepared for the subject site using the topographic survey completed by Van Harten Surveying Inc. (*Topographic Survey of Part of Lot 27, Concession 8, Geographic Township of Albion, Town of Caledon, Regional Municipality of Peel*, September 18, 2017). 1 m interval contour data based on the Ontario Base Mapping was utilized to define the model geometry where the model sections extend beyond the limits of the site. Appropriate model Manning's roughness "n" coefficients were chosen for each land cover type, following a site visit and review of satellite imagery, based on the standard values indicated in *Table 3-1* of the HEC-RAS *Hydraulic Reference Manual, Version 4.1* (Hydrologic Engineering Center, U.S. Army Corps of Engineers, January 2010). A site visit was completed by Valdor staff on January 29, 2018 to acquire and confirm data for the preparation of the hydraulic model.

The results of the hydraulic analysis for the existing condition are provided in **Tables E.4** and **E.5**, and the extent of the existing Regulatory floodplain is show in **Figure 6**.

As is shown in **Figure 6**, the existing culvert under Mount Pleasant Road does not have enough capacity to convey the Regional flow, and Mount Pleasant Road is overtopped, with a maximum flow depth of approximately 0.31 m over the crown of the road. There is a drop of approximately 0.89 m in water surface elevations from the cross-section immediately upstream of Mount Pleasant Road (*XS-8*) to the cross-section immediately downstream (*XS-6*), indicating that the upstream water surface elevations are governed by the existing culvert conveyance capacity and the weir flow depth over the road.

The Regulatory floodplain elevation through the subject site varies between 292.45 and 292.46 m, indicating that the existing extent of flooding is due primarily to the backwater effects cause by the existing culvert, and that upgrading the culvert could reduce the extent of flooding upstream.

5.3 Proposed Floodplain Conditions

Given that the existing floodplain is largely a result of the constraint associated with the existing culvert under Mount Pleasant Road, it is proposed that two new 1200 mm diameter CSP culverts be installed under Mount Pleasant Road (the existing culvert is to remain). These culverts will be installed such that the inverts are 0.50 m lower than the existing culvert, as shown on the **Preliminary Grading Plan** (**Dwg. PGR-1**). Tie-in grading will be required between the proposed downstream headwall and the existing watercourse.

In addition to this, a grass-lined channel is proposed to convey flow through the site, as shown on the grading plan (there is no defined channel under existing conditions). The proposed channel is approximately 1.0 m deep (cut into the existing ground) with a 4.0 m wide bottom width and 3:1 side slopes to match the existing grade on either side of the channel. The proposed channel will be wider along the north edge of the site in order to capture the upstream flows entering the site.

The proposed road to service the development will be raised above the floodplain, to a low-point elevation of 294.07 m. Two 1200 mm diameter CSP culverts are proposed under this road to convey the Regulatory flow. Furthermore, the east limit of *Lot 1* will be filled to a top elevation of 292.50 m in order to be above the Regulatory floodplain, with a minimum freeboard of 0.30 m.

The results of the hydraulic analysis for the proposed condition are provided in **Tables E.4** and **E.6**, and the extent of the proposed Regulatory floodplain is show in **Figure 7**.

Based on the results of the proposed condition modelling, and as shown in **Figure 7**, the proposed culverts will be able to convey the Regulatory flow without overtopping Mount Pleasant Road, thereby reducing the extent of the upstream floodplain. The proposed floodplain elevation varies between 290.90 to 292.17 m, a decrease of up to 1.55 m when compared to the existing condition. There is no modelled increase in the floodplain elevations either upstream or downstream of the subject site.

6.0 STORMWATER MANAGEMENT

6.1 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.

6.1.1 Pre-Development

The existing site consists of agricultural lands draining either to the south-west (*Catchment 101*, 3.67 ha) or to the east to Mount Pleasant Road (*Catchment 103*, 2.58 ha, and *Catchment 104*, 3.97 ha). Only one external area is considered as part of the pre-drainage pattern through the site (*Catchment 102*, 1.10 ha) because this area will have to be routed through the proposed development's storm sewer system. The external drainage contributing flows to the watercourse traversing the north-east portion of the site has already been investigated as part of the floodplain assessment (refer to *Section 5.0*).

Site elevations vary from approximately 298.25 m at the top of the hill bisecting the site, to approximately 289.50 m at the western-most corner of the site. The existing slopes range from approximately 0.5% to approximately 8.0%.

Figure 8 shows the pre-development condition storm drainage plan for the subject site.

6.1.2 Post-Development

The subject site will be developed into an estate residential subdivision consisting of 8 detached-home lots, a road and environmental zones.

In an effort to reduce grading on the site and maintain the existing topography to the greatest extent possible, the post-development drainage patterns will generally match the pre-development drainage patterns. To this effect, the south-western (*Catchment 201*, 3.47 ha), eastern (*Catchment 204*, 1.52 ha) and north-eastern (*Catchment 205*, 3.47 ha) portions of the site will drain uncontrolled while maintaining the existing drainage patterns.

The proposed development area (*Catchment 203*, 1.76 ha) and external drainage area (*Catchment 202*, 1.10 ha) draining to the proposed road will be controlled by bioswale stormwater management (SWM) facilities installed within the road boulevard to service the site. The bioswales will provide quality, quantity and erosion control for these drainage areas. The bioswales will discharge to a storm sewer which will in turn discharge to the watercourse.

Figure 9 shows the post-development condition storm drainage plan for the subject site.

6.2 Stormwater Management Design Criteria

The proposed SWM facilities shall be designed to provide the following levels of control as per the requirements of the Ministry of the Environment (MOE), Nottawasaga Valley Conservation Authority (NVCA) and the Town of Caledon:

- **Quality Control**: Water quality control shall be provided to achieve Enhanced (Level 1) treatment of stormwater runoff (80% TSS removal).
- **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 site at or below pre-development levels for the 2-year through 100-year design storm events.
- **Water Balance**: Pre-development annual infiltration rates are to be maintained or exceeded under post-development conditions.
- **Phosphorus Loading**: “Best-efforts” phosphorus mitigation measures are to be implemented to reduce post-development phosphorus loading rates to pre-development levels.

6.3 Stormwater Management Design

Given the very low density of development and the favourable sandy soil conditions, stormwater management for the subdivision will be addressed through the implementation of Low Impact Development (LID) measures. LID implements source and conveyance stormwater management controls to promote infiltration and pollutant removal on a local site by site basis. These measures rely on eliminating the direct connection between impervious surfaces such as roofs, roads, parking areas, and the storm drainage system. Quantity controls can also be incorporated into the LID measures through the addition of orifice controls.

Bioswales have been selected as the LID measure to service the proposed development. The bioswales will be located within the boulevards of the proposed road allowance, as per the details provided by the Town (refer to the *Typical Section – 22m Local Urban/Rural (7.9m Pavement)* and *Bioswale Concept Plan* details provided in **Appendix H**). The preliminary bioswale design is presented on the **Preliminary Storm Drainage Plan** (**Dwg. PS-1)** and a detail is shown in **Figure 10**.

The following is a summary of the stormwater management analysis for the subdivision.

6.3.1 Quality Control

Bioswales (also referred to as bioretention swales or infiltration swales) provide effective pollutant removal as a result of sedimentation, filtering, plant uptake, soil absorption and microbial processes.

Based on recommended design practices, typical drainage inlet configurations include options for either sheet flow into the bioswale or storm inlets at various locations along the bioswale. Based on the bioswale detail provided by the Town, curb cut spillways along the gutter will convey road runoff to the upstream end of the bioswale.

Runoff will flow along the length of the vegetated bioswale, and percolate through the engineered filtration media (as per the filter media composition specified on detail *Typical Section – 22m Local Urban/Rural (7.9m Pavement)* provided in **Appendix H**) to the stone-filled trench below. The vegetation within the bioswale will help reduce the flow velocity of the runoff in order to enhance sedimentation and promote filtration. The length of each bioswale (varies from 25-67 m) has been maximized based on the longitudinal slope and driveway locations in order to provide the greatest sedimentation and filtration potential.

Based on *Table 4.9.3 – Factors that influence the pollutant removal capacity of dry swales* of the *Low Impact Development Stormwater Management Planning and Design Guide* (Credit Valley Conservation & Toronto and Region Conservation, 2010), the following design factors incorporated into the proposed bioswales will enhance pollution removal rates:

- **Longitudinal slope between 0.5 to 3.0%:** The proposed bioswale longitudinal slopes vary between 0.5 and 2.0%.

- **Measured soil infiltration rate is 15 mm/hr or greater:** Based on the results of the in-situ soil hydraulic conductivity test completed for the *Hydrogeological Impact Study* (Sirati & Partners Consultants Limited, April 23, 2018), the average soil infiltration rate is 22.5 mm/hr.

- **Filter media P-Index values < 30 ppm:** Based on the specified bioswale filter media composition (refer to the *Typical Section – 22m Local Urban/Rural (7.9m Pavement)* detail provided in **Appendix H**), the P-Index value is to vary between 10-30 ppm.

- **Flow velocity within the swale is 0.5 m/s or less during a 4-hour 25mm Chicago storm event:** Based on a conservative calculation (i.e. assuming all flow from the 25mm event enters only two bioswales, instead of split among 12 bioswales) it is demonstrated that the flow velocity does not exceed 0.5 m/s. A supporting *FlowMaster* calculation is provided in **Appendix F**.

- **Swale side slopes 3:1 (H:V) or less:** The proposed bioswales will have 5:1 (H:V) side slopes.

Based on **Table F.7**, included in **Appendix F**, a total TSS removal of 88.5% is achieved for the 1.76 ha site drainage area (*Catchment 203*) to the proposed bioswales and storm sewer (excluding the external drainage which is already clean or will provide its own quality control if developed in the future). The required Enhanced (Level 1) goal of 80% TSS removal is therefore being achieved.

6.3.2 Erosion Control

In accordance with the NVCA guidelines, erosion control shall be provided to capture the runoff resulting from a 25 mm rainfall event, and to release the runoff over a period of at least 24 hours. At minimum, the 5 mm rainfall event is to be retained on site.

Based on hydrologic modelling of the 25 mm rainfall event (4-hour, 25 mm Chicago distribution storm), the estimated runoff volume is 4.92 mm distributed over the total 2.86 ha catchment area draining to the proposed bioswales (including external drainage). This corresponds to a required capture volume of 141 m^3.

The stone-lined trenches beneath the proposed bioswales will incorporate a storage volume beneath the outlet orifice to promote infiltration for water balance purposes (refer to *Section 6.3.4*). The bottom of this storage will be 0.40 m below the outlet orifice, and accounts for a total storage volume of 94.6 m^3 distributed among the 12 proposed bioswales (refer to **Table F.5 & F.6** for the bioswale stage/storage information, provided in **Appendix F**). 95 m^3 of the 141 m^3 of runoff associated with the 25 mm event will therefore be infiltrated (67%).

An active storage volume of 285 m^3 is provided above the outlet orifice to the top of the stone-filled trench, 1.20 m above the orifice (refer to **Table F.6**). The remainder of the 25 mm event runoff (46.1 m^3) will utilize this storage volume and discharge via the 75 mm orifice plates located at the outlet of each trench. Due to the size (the minimum allowed orifice diameter is 75 mm) and the number of orifices (there is one orifice for each of the 12 bioswales), it is not possible to retain this volume for discharge over a period of 24 hours.

Nevertheless, the results of the VO5 modelling indicate that peak flows from the 25 mm event under the post-development condition are either maintained or reduced compared to the pre-development condition (refer to **Tables 4A** and **4B**). Based on this, it is determined that the proposed bioswales will provide adequate erosion control.

In accordance with the NVCA guidelines, the 5 mm rainfall event is to be retained on site as a minimum. For the proposed development area draining to the bioswales (1.76 ha) the 5 mm runoff depth (not accounting for initial abstractions) results in a runoff volume of 88 m^3. The proposed infiltration storage volume is 94.9 m^3, indicating that the 5 mm runoff will be fully infiltrated.

6.3.3 Quantity Control

As per the NVCA's and the Town's standards, the SWM facilities shall be designed to control the post-development peak flow to pre-development levels for the 2-year through 100-year design storms (for the 4-hour Chicago and 24-hour SCS storm distributions) and to safely convey the larger of either the uncontrolled 100-year or Regional (Timmins Storm) flow. The modelled 4-hour Chicago storm distribution is based on the Town of Caledon's IDF data, provided in **Appendix D**). The modelled

24-hour SCS storm distribution is based on the latest Toronto Pearson Airport IDF data obtained from Environment Canada.

The overall drainage area to the proposed SWM facility is approximately 2.86 ha, of which approximately 1.10 ha consists of external drainage. A Visual OTTHYMO Version 5.0 (VO5) model was created to determine the predevelopment flows for the subject site. The pre-development flow targets at *Flow Nodes #1* and #2 are provided in **Tables 4A** and **4B**, respectively.

The proposed bioswales will provide quantity control by capturing, storing and releasing runoff at or below predevelopment flow rates. Each bioswale is equipped with a ditch-inlet catchbasin (DICB) at the downstream end to capture flows which exceed the filtration rate of the bioswale's engineered filtration media. A perforated pipe running the length of the stone-filled trench beneath the bioswale will be connected to the DICB, allowing captured runoff to fill the trench. A 75 mm orifice plate installed inside the DICB will control flows discharging to the storm sewer via a 250 mm diameter lead. An infiltration storage volume of 95 m^3 is provided below the outlet orifice, and an active storage volume of 285 m^3 is provided above the outlet orifice (refer to **Table F.6**).

In order to be conservative when modelling the proposed storage, it is assumed that only the minor system flow (i.e. the 5-year flow) is captured and controlled by the bioswales, and that the major system flow (i.e. the 100 minus 5-year flow) is uncontrolled. This is achieved in the VO5 model by including a DuHyd routine to split the minor and major flow. Runoff that is not captured by a bioswale (either due to flow bypassing the bioswale curb cut or the bioswale trench storage being exceeded) will simply continue to flow along the road curb to the next downstream bioswale.

Based on the VO5 model of the post-development condition, the post-development peak flows will be controlled to pre-development levels for the 2-year through 100-year design storms (for both the 4-hour Chicago and 24-hour SCS storm distributions). The post-development flows at *Flow Nodes #1* and #2 are provided in **Tables 4A** and **4B**, respectively.

As shown in **Tables 4A** and **4B**, the peak discharge rates are equal to or less than the target release rates. The VO5 model schematic and output is provided in **Appendix "F"**.

Table 4A. Peak Flow Summary – Flow Node #1: Drainage to West

Return Period	Existing Peak Flows (m^3/s)	Proposed Peak Flow (m^3/s)
25 mm Chicago	0.012	0.012
4-hour Chicago		
2-year	0.043	0.036
5-year	0.095	0.075
10-year	0.141	0.110
25-year	0.209	0.162
50-year	0.264	0.204
100-year	0.326	0.253
24-hour SCS		
2-year	0.062	0.049
5-year	0.125	0.096
10-year	0.175	0.133
25-year	0.244	0.186
50-year	0.299	0.228
100-year	0.356	0.273
Regional (Timmins)	-	0.237

Table 4B. Peak Flow Summary – Flow Node #2: Drainage East to Mt. Pleasant Rd.

Return Period	Existing Peak Flows (m^3/s)	Proposed Peak Flow (m^3/s)
25 mm Chicago	0.023	0.016
4-hour Chicago		
2-year	0.074	0.064
5-year	0.164	0.148
10-year	0.241	0.209
25-year	0.358	0.295
50-year	0.450	0.375
100-year	0.556	0.474
24-hour SCS		
2-year	0.105	0.092
5-year	0.210	0.183
10-year	0.292	0.247
25-year	0.407	0.348
50-year	0.500	0.432
100-year	0.597	0.527
Regional (Timmins)	-	0.504

6.3.4 Site Water Balance

In accordance with the requirements of the NVCA, an annual site water balance assessment is required in order to determine the overall infiltration deficit under post-development conditions and identify opportunities to meet or exceed the pre-development infiltration rates through the design and implementation of various LID measures.

Based on the site water balance assessment prepared by Sirati & Partners Consultants Ltd. (*Hydrogeological Impact Study*, 17 October 2019), the total annual pre-development infiltration is 20,384 m^3, and the total annual post-development infiltration is 18,093 m^3. This represents an annual deficit of 2,290 m^3. Excerpts from the *Hydrogeological Impact Study* regarding the water balance assessment are included in **Appendix G**.

In order to mitigate this deficit, the stone-filled trenches beneath the proposed bioswales have been design to provide a storage volume below the outlet orifice for infiltration. Based on the geotechnical report, the soil infiltration rate is 22.5 mm/hr. Applying a 2.5 safety factor, the design infiltration rate is 9.0 mm/hr. Based on an infiltration storage depth of 0.40 m, a drawdown time of 44.4 hours is achieved, which meets NVCA's maximum 48-hour drawdown time criteria. The total infiltration storage volume provided is 94.9 m^3.

Through the implementation of the proposed infiltration trench storage, an additional annual infiltration capacity of 2,745 m^3 is being provided. As a result, the post-development annual infiltration volumes for the site will be 20,838 m^3 (18,093 m^3 + 2,745 m^3 = 20,838 m^3), which corresponds to 102.2% of the annual pre-development infiltration volume.

Tables G.1 to **G.2** in **Appendix "G"** provides a summary of the infiltration trench sizing and rainfall analysis.

6.3.5 Phosphorus Loading Analysis

In accordance with the requirements of the NVCA, a phosphorus loading analysis was completed for the subject development to determine the pre- and post-development phosphorus loading, and to identify mitigation measures to maintain post-development phosphorus loading at or below pre-development conditions. The phosphorus loading assessment was completed using the online Nottawasaga Valley Conservation Authority (NVCA) *Phosphorus Loading Development Tool*. The NVCA tool uses estimates of phosphorus export that were developed for specific land uses coupled to standard estimates of phosphorus reduction efficiencies for various BMPs and LID techniques.

The following is a summary of the phosphorus analysis performed for the site using the NVCA tool. The NVCA tool output for is provided in **Appendix J**.

Pre-Development Loading

Under pre-development conditions, based on the land use categories of the NVCA tool, the 10.22 ha site area is considered to be primarily "*Cropland*", as illustrated in **Figure 11**. Based on this category, the NVCA tool indicates that the pre-development phosphorus loading is 1.78 kg/year.

Post-Development Loading (Without Mitigation BMPs)

Under post-development conditions, based on the land use categories of the NVCA tool, the proposed development consists of "*Residential*" areas (6.14 ha) and the "*Transition*" reforestation/protection areas (4.08 ha), as illustrated in **Figure 12**. Based on these categories, the NVCA tool indicates that the post-development phosphorus loading without mitigation BMPs is 2.81 kg/year. This corresponds to phosphorus loading increase of 1.03 kg/year, or 57.9%, compared to the pre-development condition.

Post-Development Loading (With Mitigation BMPs)

In order to maintain post-development phosphorus loading at or below pre-development condition, mitigation BMPs in the form of the bioswales discussed in *Section 6.3.1* are proposed. These bioswales have been sized to provide water quality treatment for the contributing 1.76 ha drainage area (1.71 ha residential, 0.05 ha transition). The “water quality swales” BMP option was used in the NVCA tool to model this BMP. The remainder of the site will drain uncontrolled. A summary of the post-development areas and corresponding BMPs is provided in **Figure 12**.

Based on the proposed BMPs, the NVCA tool indicates that the post-development phosphorus loading with mitigation BMPs is 2.11 kg/year, which corresponds to a loading reduction of 24.9% compared to the post-development condition without mitigation BMPs. Compared to the pre-development condition, the proposed development will result in a loading increase of 18.5%.

Although the proposed phosphorus loading mitigation BMPs do not reduce loading rates to pre-development levels, they represent a “best-efforts” attempt, as required by the NVCA.

6.4 SWM Inspection & Maintenance

The SWM facilities 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 SWM 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 facilities:

- Sediment accumulation to determine cleanout requirements;
- Erosion of side slopes and outfall channel;
- Safety hazards;
- Drawdown time following a rainfall event (extended drawdown time greater than 24 hours may indicate a blocked orifice or intake);
- Condition of vegetation;
- Trash accumulation near hydraulic structures; and
- Surface sheen indicating possible oil contamination.

7.0 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.

7.1 Municipal Roads

The subject site has frontage on Mount Pleasant Road which is under the jurisdiction of the Town of Caledon. This existing road allowances consist of a two lane rural paved road with roadside ditches. The vehicular access to the subdivision will be facilitated by road proposed connection to Mount Pleasant Road. A Block has been established to accommodate the future extension of McGuire Trail, southerly to the subject site.

The proposed municipal road will be constructed to urban standards which includes an asphalt pavement, crowned with 2% cross fall and edged with concrete curb and gutter. Based on the implementation of road side bioswales, a special road cross section has been developed which provides wider 7.05m boulevards and narrower 7.9m pavement contained in a 22.0m wide road allowance. The longitudinal slope of the road will generally be 0.50% with some length of road ranging up to 2.00% slope. A copy of the special road cross section is included in **Appendix "H"**.

7.2 Driveways

Each dwelling will have an attached garage and driveway. It is anticipated that the slope of driveways is to be within the range of 2.0% to 6.0% in accordance with Town standards and will be designed at the in conjunction with the individual site grading plans at the building permit stage.

8.0 GRADING

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

8.1 Grading Criteria

The subject site is to be graded in accordance with the Town grading criterion which dictates that road grades are to range from 0.5% to 6.0% (8.0% for 18.5m ROW) and that sodded yard areas are to range from 2.0% to 5.0%. For large grade differentials, a maximum slope 4H : 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.

The subdivision earthworks should be limited to just the road allowance with 4:1 grading transitions on to the lots. Earthworks within each lot should be completed in conjunction with an approved site grading plan for the individual lot at the building permit stage in order to minimize disturbance to the existing ground with respect to the septic tile beds.

8.2 Preliminary Design

Based on the topographic survey, the proposed subdivision configuration and the Town's criteria, a preliminary grading design has been prepared and is provided on the **Preliminary Grading Plans (Dwg PGR-1** & **Dwg PGR-2)**. The preliminary grading design, considered the following factors:

- Achieve the Town's lot grading criteria.
- Meet the Town's vertical road design parameters.
- Minimize the depth of cut and of fill.
- Minimize the requirement for retaining walls.
- Match existing grades along the adjacent properties and road allowances.
- Provide an overland flow route to direct drainage to a safe outlet.
- Provide sufficient cover over the storm sewer.
- Establish a "structural envelope" on each lot which will contain the house, driveway, septic system and amenity area. Grading within the lots will be restricted to the structural envelope.
- The area of the lots outside the structural envelope is to remain undisturbed in the form of a reforested / protection area.

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 or an earthworks balance.

8.3 Permitting

A review of the Regulation Mapping indicates that the subject site is located within an area that is regulated by the NVCA. 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.

9.0 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. It is of particular concern for this site given the proximity of the site to a watercourse.

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:

9.1 Control Measures

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

- **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, 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.
- **Cofferdams** are to be installed upstream of the proposed permanent road crossing of the watercourse to permit installation of the culvert in dry conditions. The coffer dam will consist of bags filled with pea gravel and a polyethylene waterproof membrane. Pumps will be required to temporarily by-pass flow from upstream of the coffer dams to downstream of the work area.

The proposed sediment controls are illustrated on the **Preliminary Erosion & Sediment Control Plan (Dwg ESC-1)**.

9.2 Construction Sequencing

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

Stage 1 – Subdivision Earthworks – Road Allowance

1. Construct mud mat for temporary construction access.
2. Install silt fencing around the limits of grading prior to topsoil stripping.
3. Strip topsoil from the road allowance, stockpile where indicated and install silt fence around the perimeter.
4. Rough grade the road allowance 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 – Culvert Installation: Street "A" & Mount Pleasant Road

1. A coffer dam and by-pass pumping is to be implemented to facilitate installation of the culverts for the watercourse crossing under dry conditions.
2. Install a rock check dam downsteam of the culvert installations.
3. Install culverts and place fill for road crossing with 4:1 sloped enbankments and grade the watercourse channel.
4. Road embankments and channel are to be stabilized immediately upon completion of the road construction with topsoil and hydroseed. If work takes place outside the growing season, single net straw erosion control blanket S31 supplied by Terrafix or equivalent shall be used as necessary.

Stage 3 – 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 and install sediment controls at curb spillways and at catchbasins.
3. Construct road side bio-retention swales and install construction fencing to protect from construction equipment.

Stage 4 – House Construction

1. Strip topsoil on a lot by lot basis once the individual site plans are approved. Stripping is to be limited to the area that is required to accommodate the driveway, house and areas of the lot that are to be re-graded.
2. Rough grade the construction area of the lot to the pre-grade elevations.
3. Inspect silt fence regularly and make repairs as necessary.
4. Construct house, install the septic system, pave the driveway and stabilize the lot with topsoil and hydroseed.
5. remove silt fencing on a phased basis as areas are stabilized.

9.3 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.

10.0 UTILITIES

While some external upgrades may be necessary by the utility providers, it is anticipated that utilities such as hydro (Hydro One Networks Inc.), natural gas (Enbridge Gas Distribution Inc.), cable television (Rogers Cable Inc.), and telephone service (Bell Canada) 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 and the various utility companies 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 joint trench as outlined in the Town’s Design Standards. 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. Joint trenching maximizes the efficiency of the available area in the utility corridor and provides for a safe installation.

11.0 SUMMARY

Based on the analysis contained herein, the proposed residential subdivision can be adequately serviced (watermain, wastewater and storm) in accordance with the standards of the Town of Caledon, Region of Peel and the Nottawasaga Valley Conservation Authority design criteria as follows:

Water

- The community of Palgrave is serviced by the Palgrave Drinking Water System which is owned and operated by the Region of Peel. This system consists of two water treatment plants, three municipal wells, one water storage reservoir and approximately 75 kilometres of watermain.
- The subject site will be serviced by a connection to the recently constructed 200mm diameter Mount Pleasant Road watermain. The local water distribution system within the subdivision will consist of watermains ranging in diameter from 150mm to 200mm.
- The looping of the Mount Pleasant Road watermain will be required to address water quality concerns. The options for looping will be assessed at the detailed design stage.
- The proposed development will have a fire flow plus maximum day demand of 100.2 L/s.

Waste Water

- There are no municipal sanitary sewers in the community of Palgrave and therefore each lot within the development will be serviced by a private on-site sewage system.
- Based on the sand soil conditions the proposed dwellings can each be serviced with a private septic system consisting of a septic tank, pump tank and in-ground septic tile bed.

Storm Drainage

- The subject site is tributary to the Beeton Creek located in the Innisfil Creek sub-watershed which is located in the Nottawasaga River watershed. A tributary to the Beeton Creek traverses the east part of the site.
- In accordance with Town criteria, the subject site will be serviced by minor system comprised of a municipal storm sewer sized for the 5-year storm event.
- 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 the watercourse traversing the site.

Floodplain

- A floodplain analysis has been undertaken to delineate the regional floodplain for the watercourse traversing the site. Based on the analysis, it was determined that the extent of the floodplain throughout the site is due to an undersized culvert under Mount Pleasant Road. The proposed channel through the site and the proposed culvert improvements under Mount Pleasant Road (two 1200 mm diameter CSP culverts) will decrease the extent of the floodplain such that it will be contained entirely within the valley lands. The residential development will therefore be outside the Regulatory floodplain.

- In order to accommodate the proposed road connection to Mount Pleasant Road, a crossing of the watercourse be required. This road crossings will be constructed using two 1200 mm diameter CSP culverts to convey the regional flow.

Stormwater Management

- In order to address the stormwater management criteria, given the very low density of development and the favourable sandy soil conditions, Low Impact Development (LID) measures will be implemented in the form of bioswales as follows:
    - Enhance (Level 1) quality control is being achieve for the site, with a TSS removal of 88.5% for the drainage area to the proposed bioswales.
    - A minimum drawdown time of 24-hours for erosion control cannot be achieved for the drainage area to the proposed bioswales due to the small drainage area and the minimum orifice size requirements. However, based on the hydrologic modelling completed, the peak runoff for the 25 mm event under post-development conditions does not exceed the pre-development rate. The 5 mm runoff volume will be infiltrated.
    - Quantity control is provided for the 2- through 100-year storm events to meet pre-development flow targets. Runoff storage is provided beneath each bioswale in the form of a stone-filled trench. Discharge from each bioswale is controlled by an orifice plate discharging to the storm sewer.
    - The site water balance included in the *Hydrogeological Impact Study* determined that the development would result in a reduction in infiltration in the amount of 658 m^3/year. In order to address this deficit, each bioswale trench has been designed with an additional 0.40 m depth of storage beneath the outlet orifice invert, for a total infiltration storage volume of 95 m^3. Through the implementation of the proposed infiltration trench storage, an additional annual infiltration capacity of 2,745 m^3 is being provided to meet and exceed the pre-development annual infiltration rate.
    - Phosphorus mitigation measures in the form of the bioswales (water quality swales) will be provided to reduce loading rates from the drainage area to the bioswales. There will be a net increase of 18% compared to the pre-development condition, but this represents a “best-efforts” attempt to reduce phosphorus loading, as required by the NVCA.

Vehicular Access

- Vehicular access to the subject site will be provided by road connection to Mount Pleasant Road which is under the jurisdiction of the Town of Caledon.
- Based on the implementation of road side bioswales, a special road cross section has been developed with which provides wider 7.05m boulevards and narrower 7.9m contained in a 22.0m wide road allowance.

Grading

- As is typical with subdivision development, earthmoving will be required to achieve the proposed subdivision grading necessary to meet the criteria of the Town. 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 NVCA, 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.

12.0 REFERENCES & BIBLIOGRAPHY

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Respectfully Submitted,

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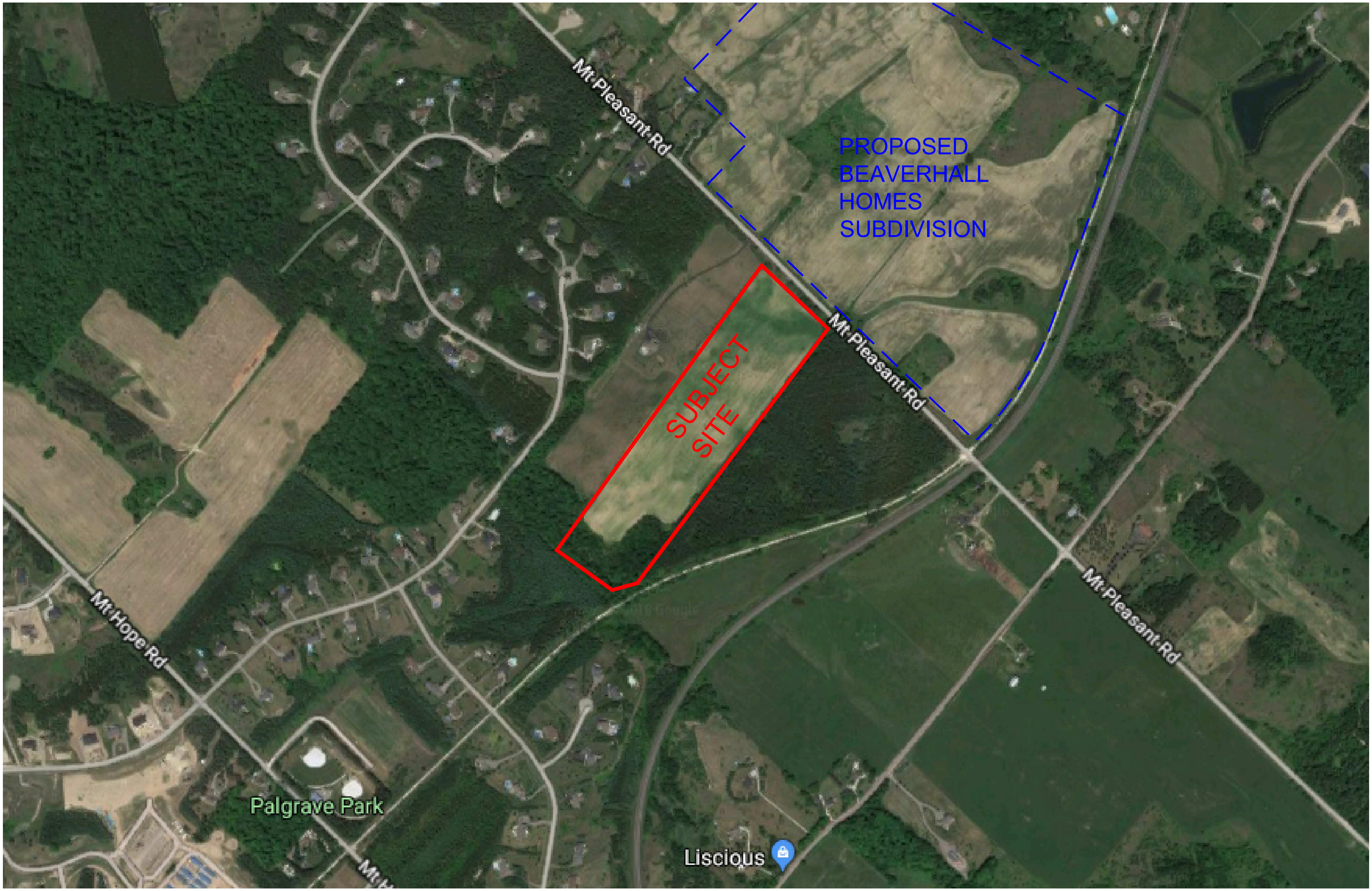

LEGEND

━━━ PROPERTY BOUNDARY

– – – PROPOSED BEAVERHALL HOMES SUBDIVISION

PROPOSED ESTATE RESIDENTIAL SUBDIVISION DEVELOPMENT

TOWN OF CALEDON
REGION OF PEEL

PROPOSED SITE LOCATION

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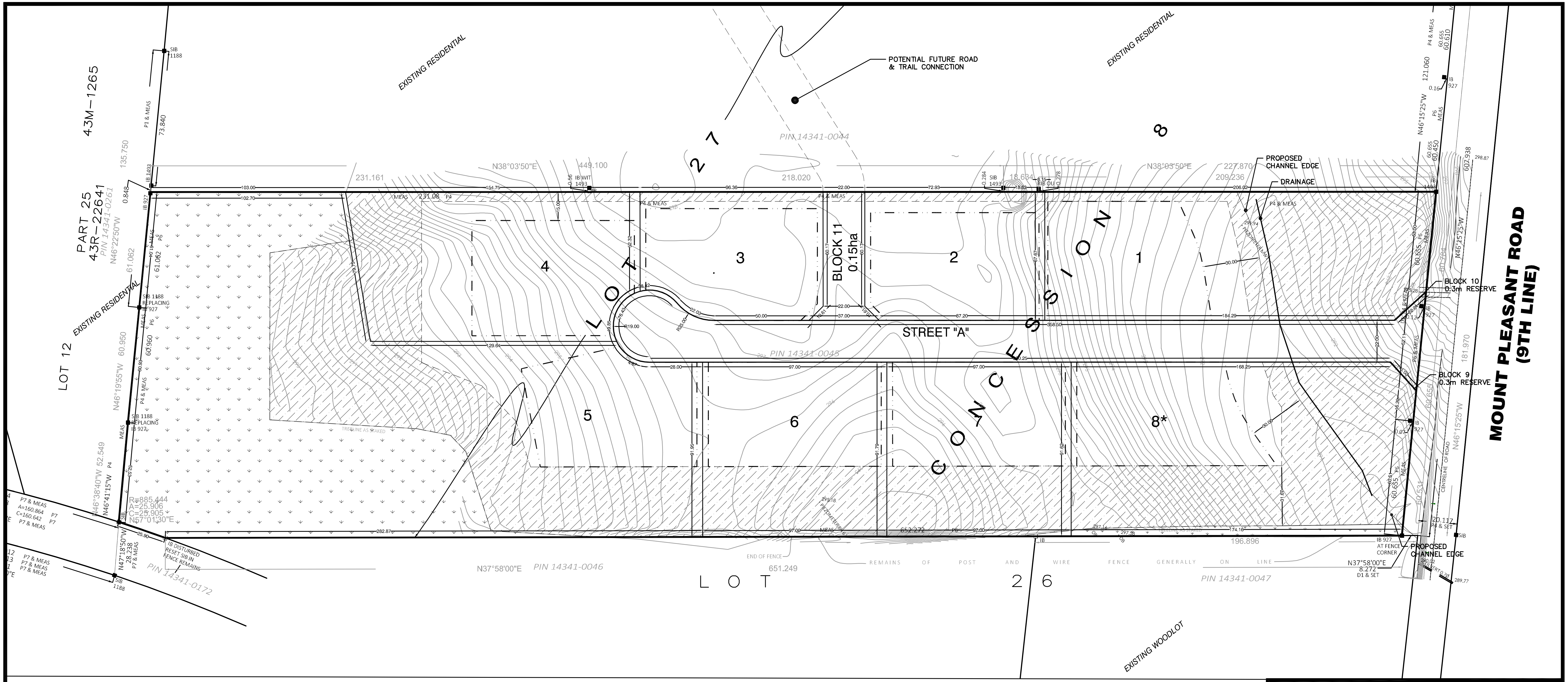
SCALE	N.T.S.	CKD. BY	D.G	DWG.	FIGURE 1
DATE	OCT 2019	DRAWN BY	D.M	PROJECT	17122



LEGEND

⁘ ENVIRONMENTAL PROTECTION

▨ REFORESTED / PROTECTION AREA

— · — STRUCTURAL ENVELOPE

PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

PROPOSED DEVELOPMENT

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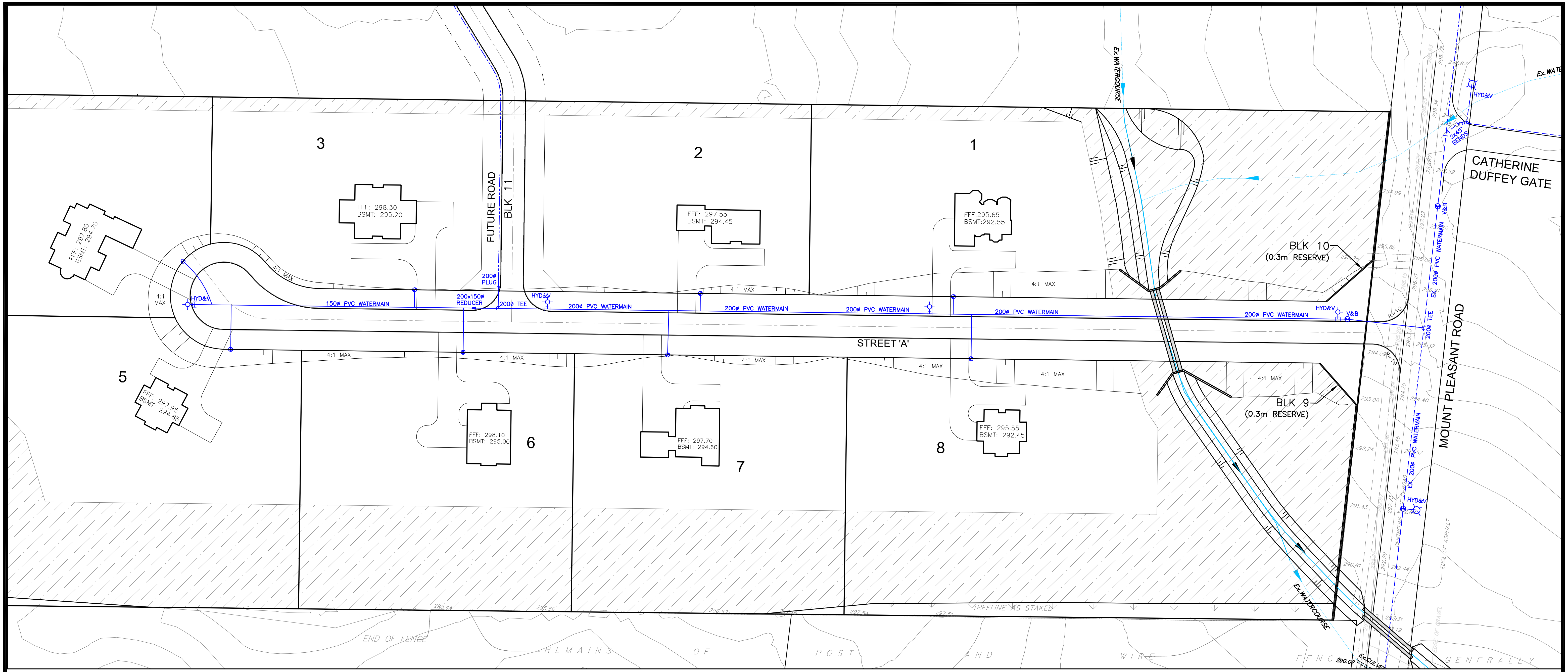
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

PREPARED BY D.M	CKD. BY D.G.
SCALE 1:2000	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 2



LEGEND

———	PROP. WATERMAIN
– – – –	EX. WATERMAIN
— · —	FUT. WATERMAIN
⊗—	WATER SERVICE CONNECTIONS
⌖	HYDRANT AND VALVE
⊗	VALVE AND BOX
◀	REDUCER
⊏	PLUG
⊢	TEE

PROJECT
ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

INTERNAL WATER SERVICING PLAN

VALDOR ENGINEERING INC.
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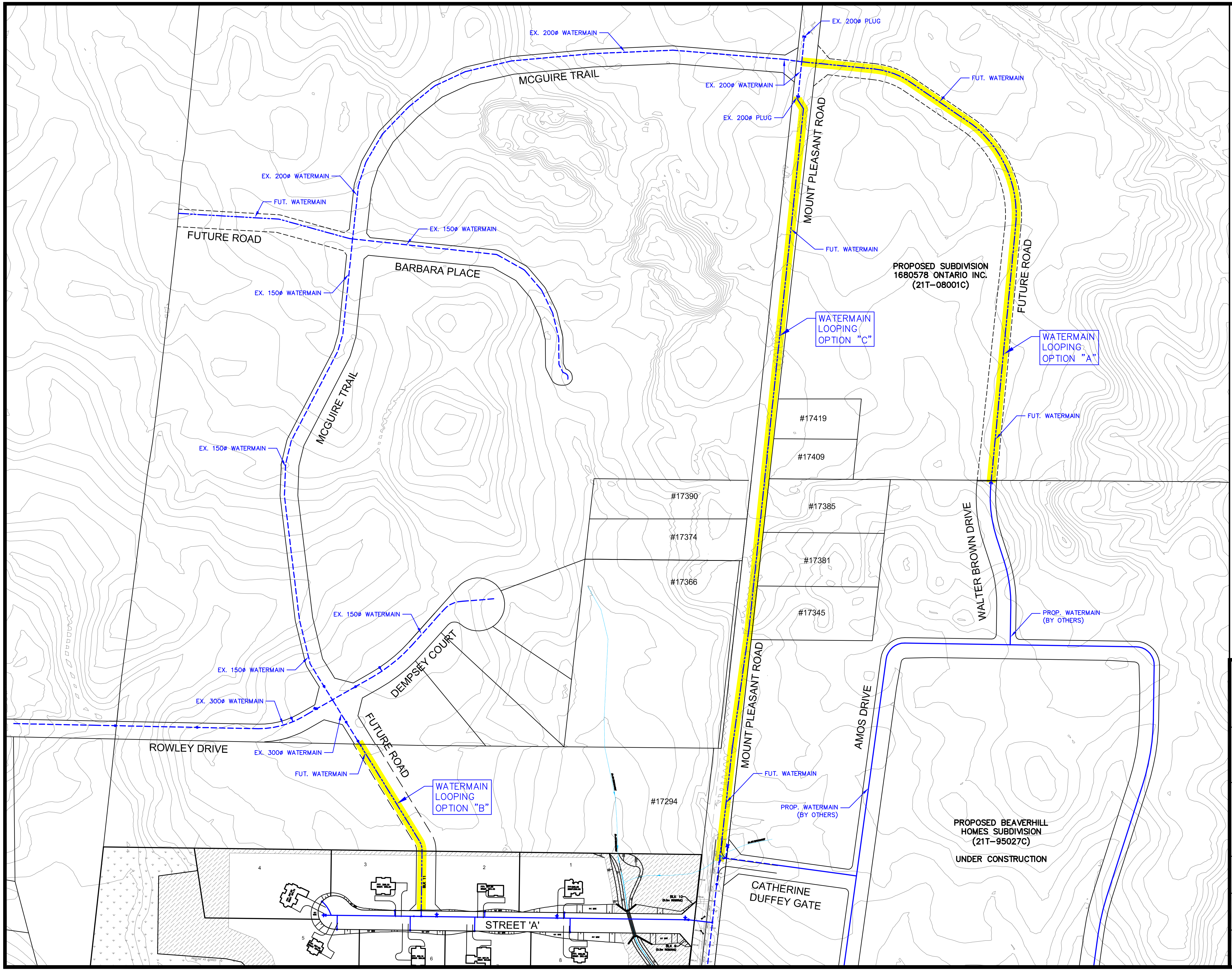
SCALE N.T.S	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 3A



LEGEND

—	PROP. WATERMAIN
– – –	EX. WATERMAIN
– · –	FUT. WATERMAIN
⊗—	WATER SERVICE CONNECTIONS
-○-⌶	HYDRANT AND VALVE
⊗	VALVE AND BOX
◀	REDUCER
⊓	PLUG
⊢⊣	TEE

PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

EXTERNAL WATER SERVICING PLAN

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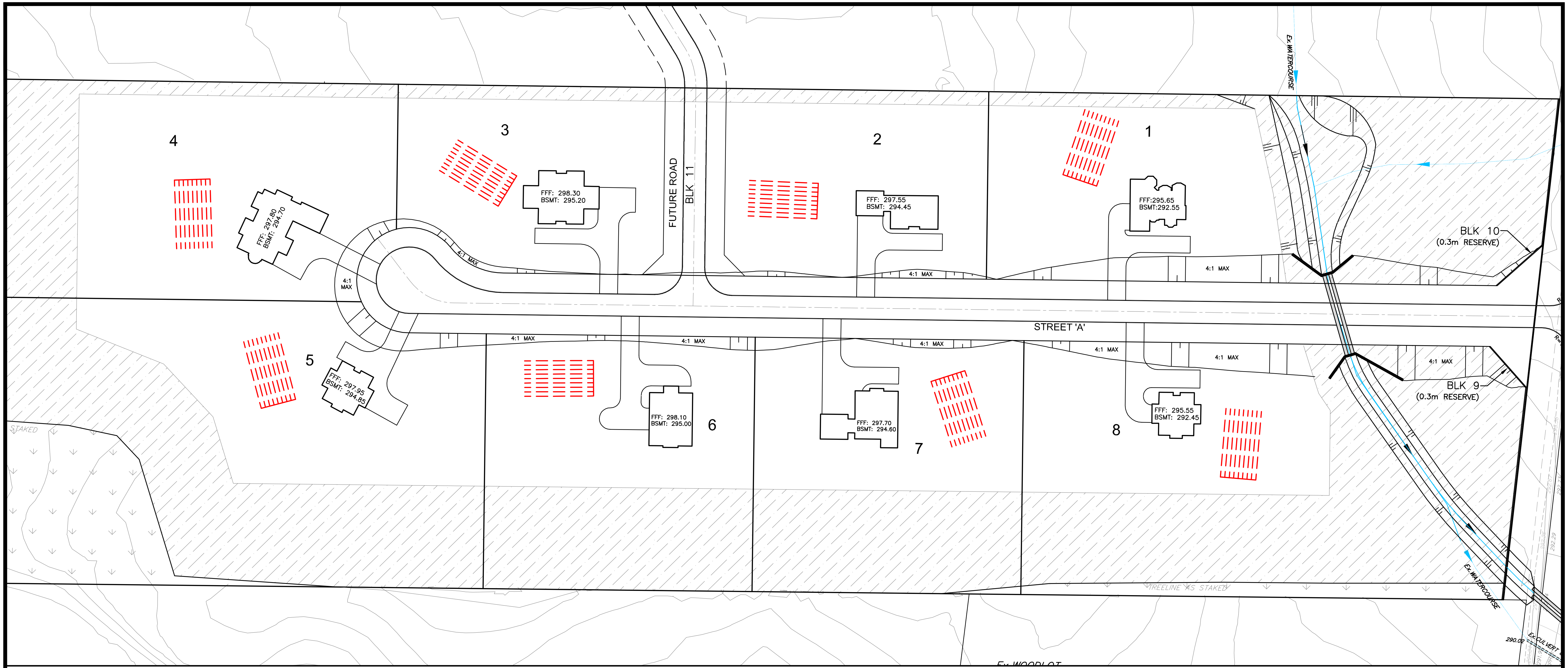
SCALE N.T.S	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 3B



LEGEND

▤ SEPTIC TILE BED

PROJECT
ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

SANITARY SERVICING PLAN

VALDOR ENGINEERING INC.
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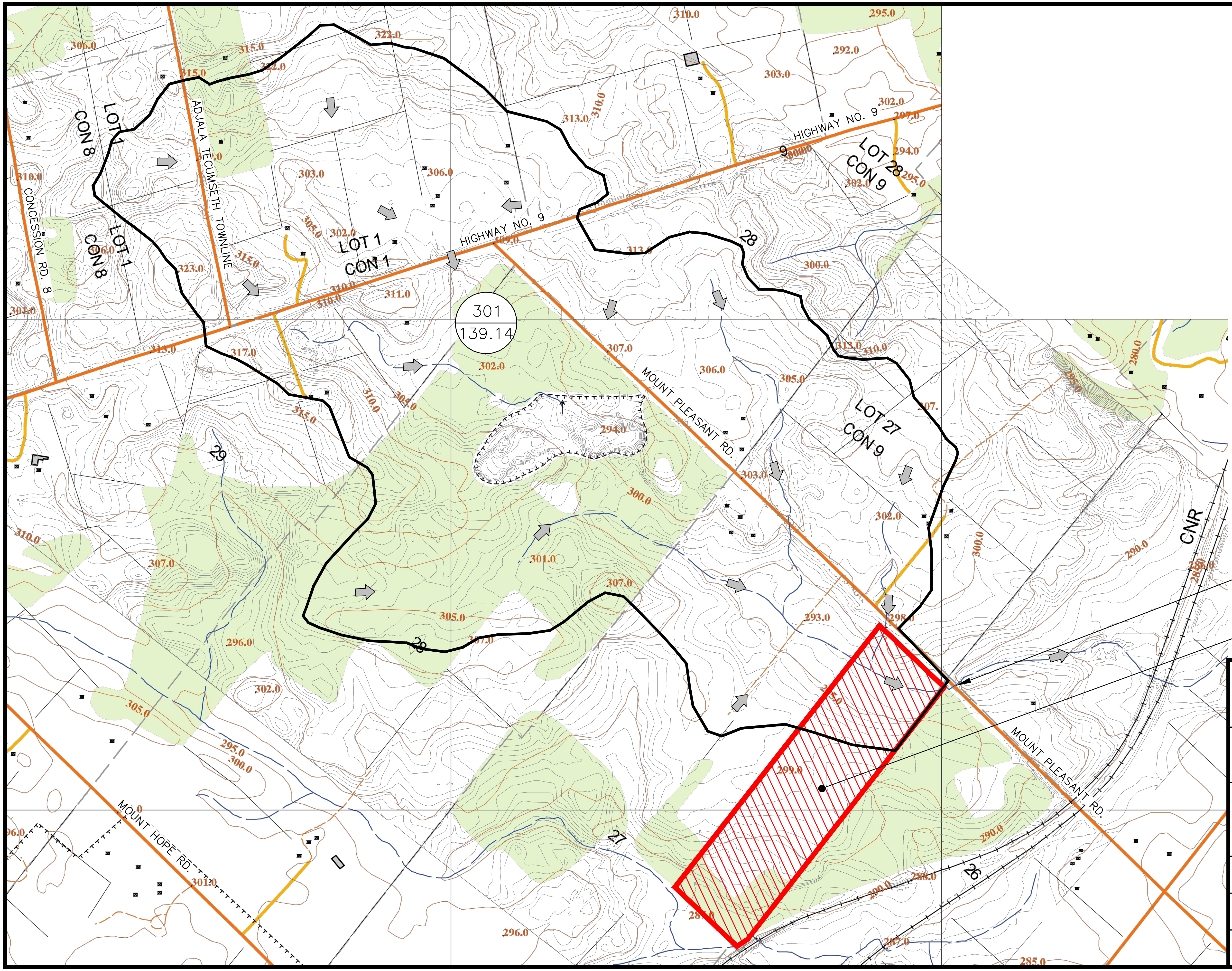
SCALE N.T.S.	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 4



LEGEND

301 / 139.14	CATCHMENT ID AREA (HA)
▬	DRAINAGE BOUNDARY
⇨	OVERLAND FLOW

PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

FLOODPLAIN MAPPING
EXTERNAL DRAINAGE PLAN

VALDOR ENGINEERING INC.
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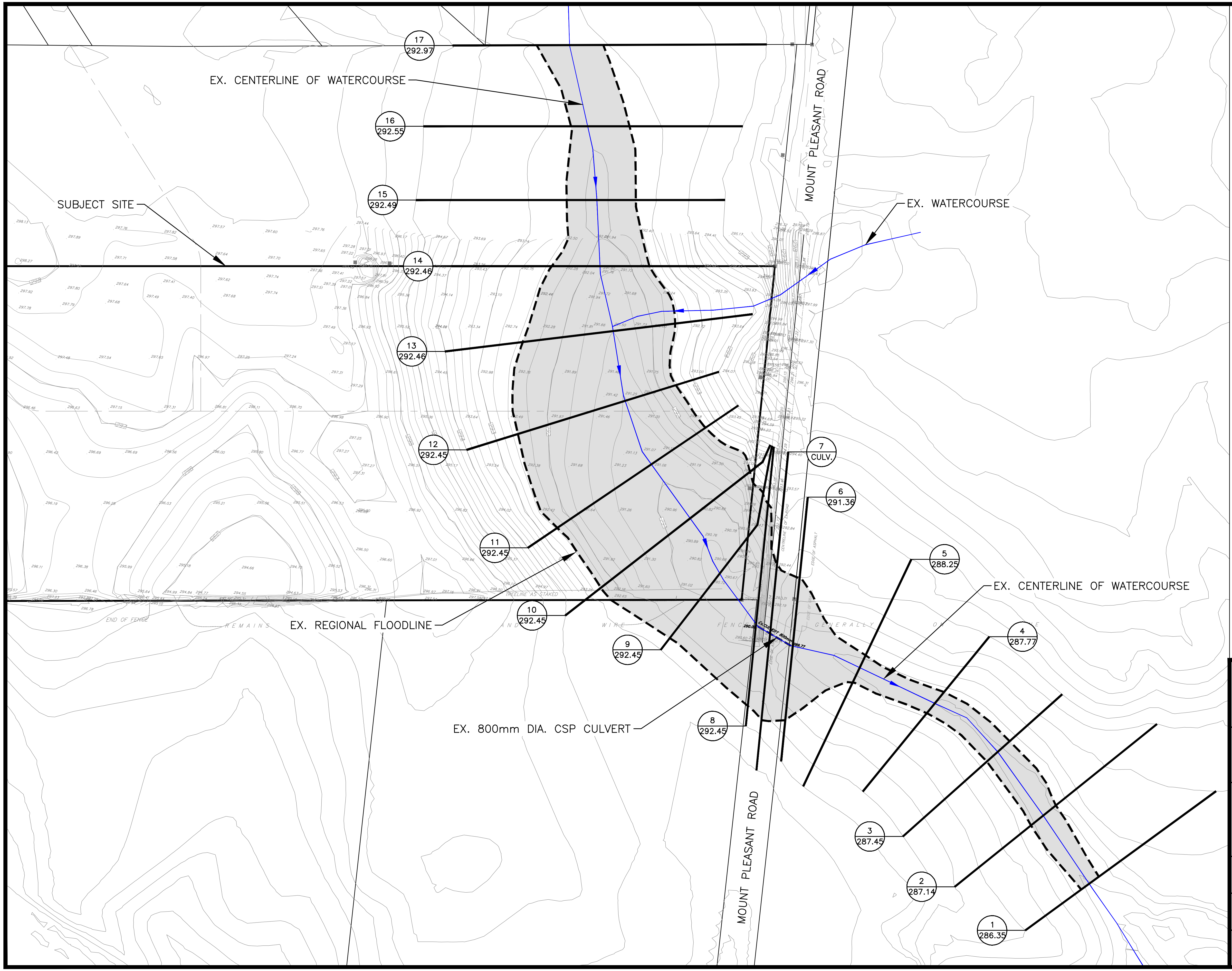
SCALE 1:7500	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 5



LEGEND

- - - - EXISTING REGIONAL FLOODLINE

—— PROPERTY LINE

(1 / 286.35) ← HEC–RAS CROSS–SECTION ← EX. REGIONAL WATER SURFACE ELEVATION (m)

SURVEY DATA PROVIDED BY VAN HARTEN SURVEYING INC. (TOPOGRAPHIC SURVEY OF PART OF LOT 27, CONCESSION 8, GEOGRAPHIC TOWNSHIP OF ALBION, TOWN OF CALEDON, REGIONAL MUNICIPALITY OF PEEL, 18 SEPTEMBER 2017). BEARINGS ARE GRID BEARINGS AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE REFERRED TO THE UTM PROJECTION, ZONE 17, NAD 83 (CSRS–2010) ADJUSTMENT.

PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

FLOODPLAIN MAPPING
EXISTING CONDITIONS

VALDOR ENGINEERING INC.
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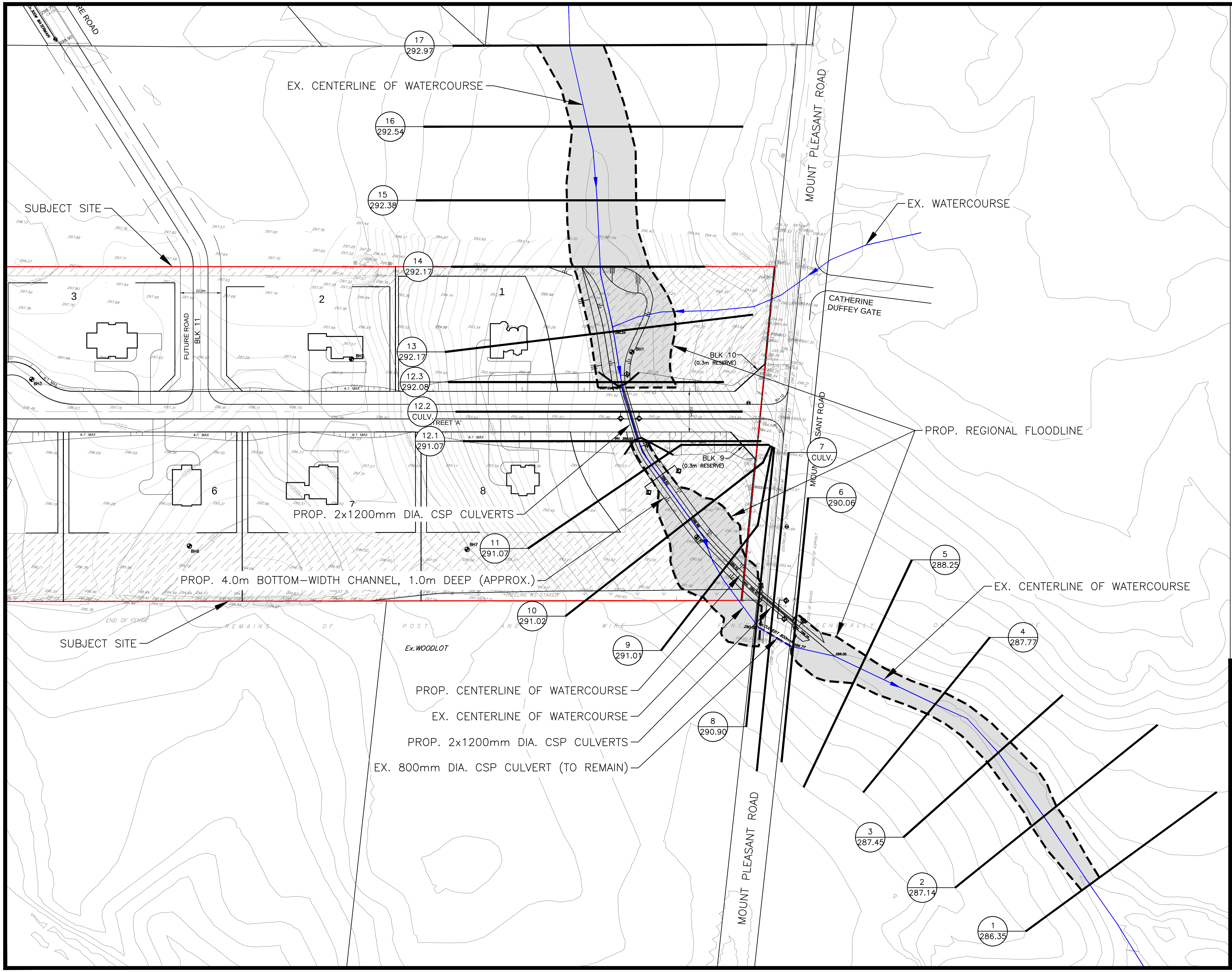
PREPARED BY O.B.	CKD. BY D.G.
SCALE 1:2000	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 6



LEGEND

╍╍╍ PROPOSED REGIONAL FLOODLINE

── PROPERTY LINE

① 286.35 ← HEC-RAS CROSS-SECTION ← PROP. REGIONAL WATER SURFACE ELEVATION (m)

SURVEY DATA PROVIDED BY VAN HARTEN SURVEYING INC. (TOPOGRAPHIC SURVEY OF PART OF LOT 27, CONCESSION 8, GEOGRAPHIC TOWNSHIP OF ALBION, TOWN OF CALEDON, REGIONAL MUNICIPALITY OF PEEL, 18 SEPTEMBER 2017). BEARINGS ARE GRID BEARINGS AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE REFERRED TO THE UTM PROJECTION, ZONE 17, NAD 83 (CSRS-2010) ADJUSTMENT.

PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

FLOODPLAIN MAPPING PROPOSED CONDITIONS

VALDOR ENGINEERING INC.
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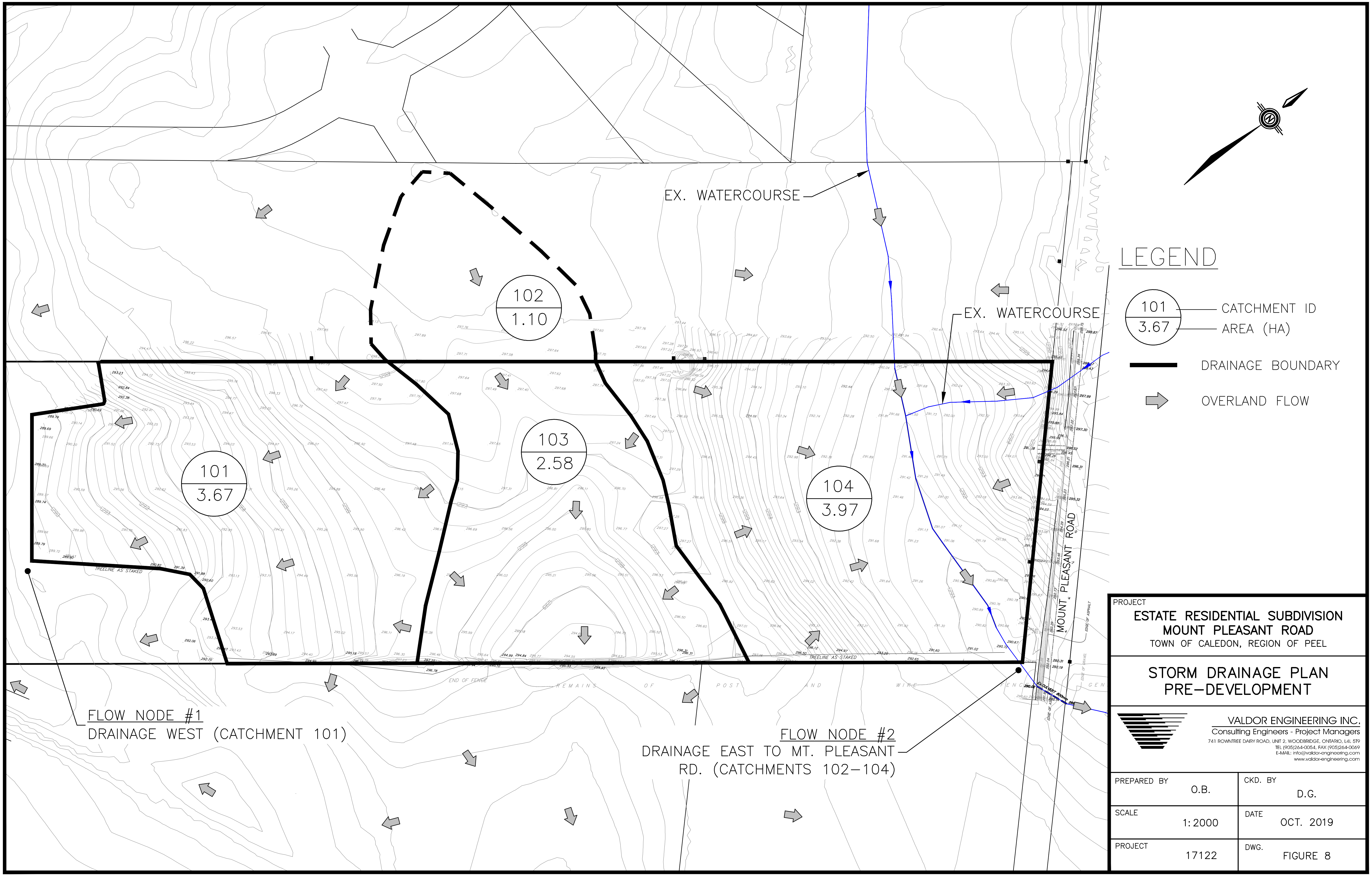
SCALE	1:2000	DATE	OCT. 2019
PROJECT	17122	DWG.	FIGURE 7



PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

STORM DRAINAGE PLAN
PRE–DEVELOPMENT

VALDOR ENGINEERING INC.
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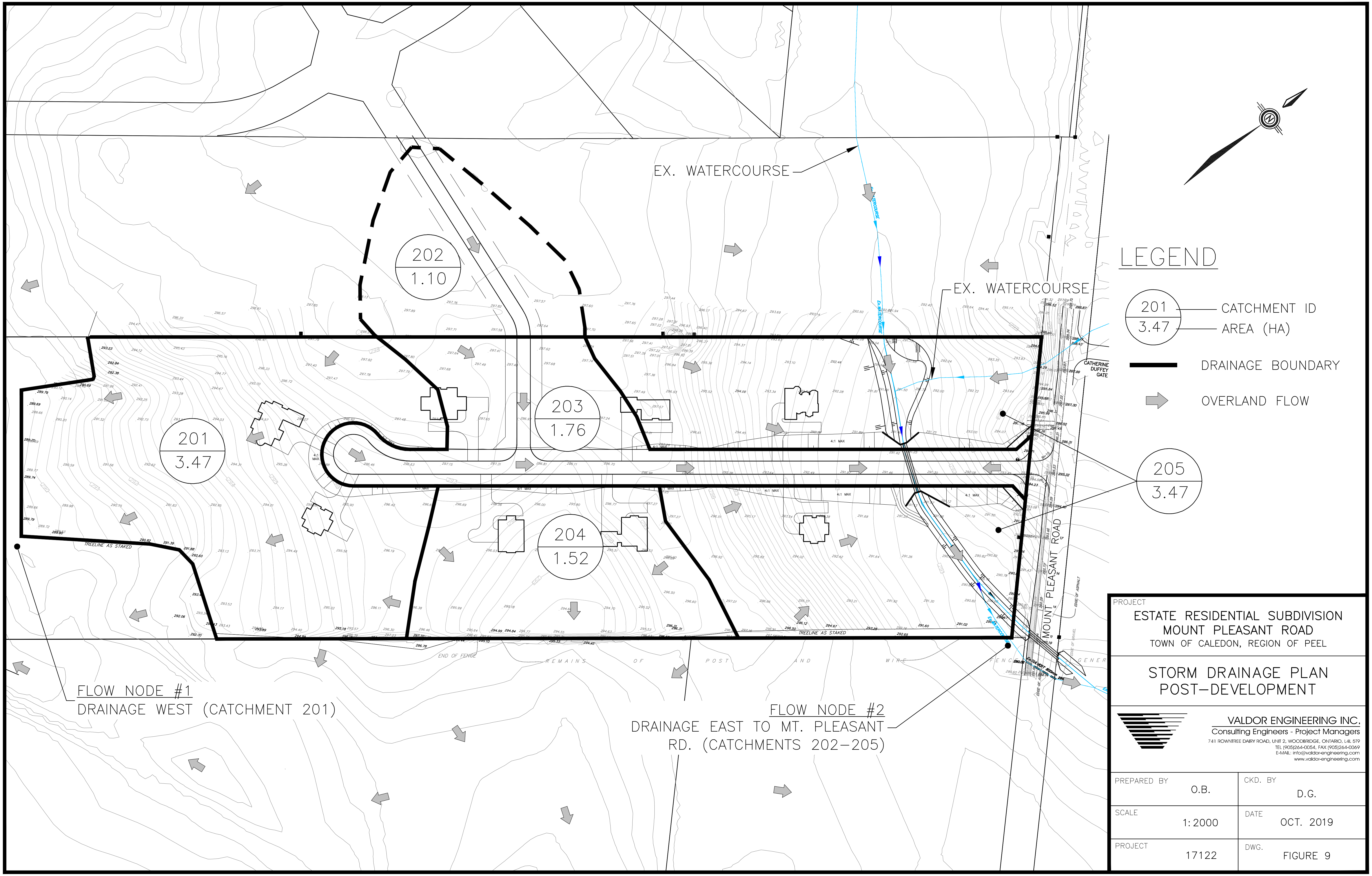
www.valdor-engineering.com

PREPARED BY O.B.	CKD. BY D.G.
SCALE 1:2000	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 8



PROJECT
ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

STORM DRAINAGE PLAN
POST–DEVELOPMENT

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
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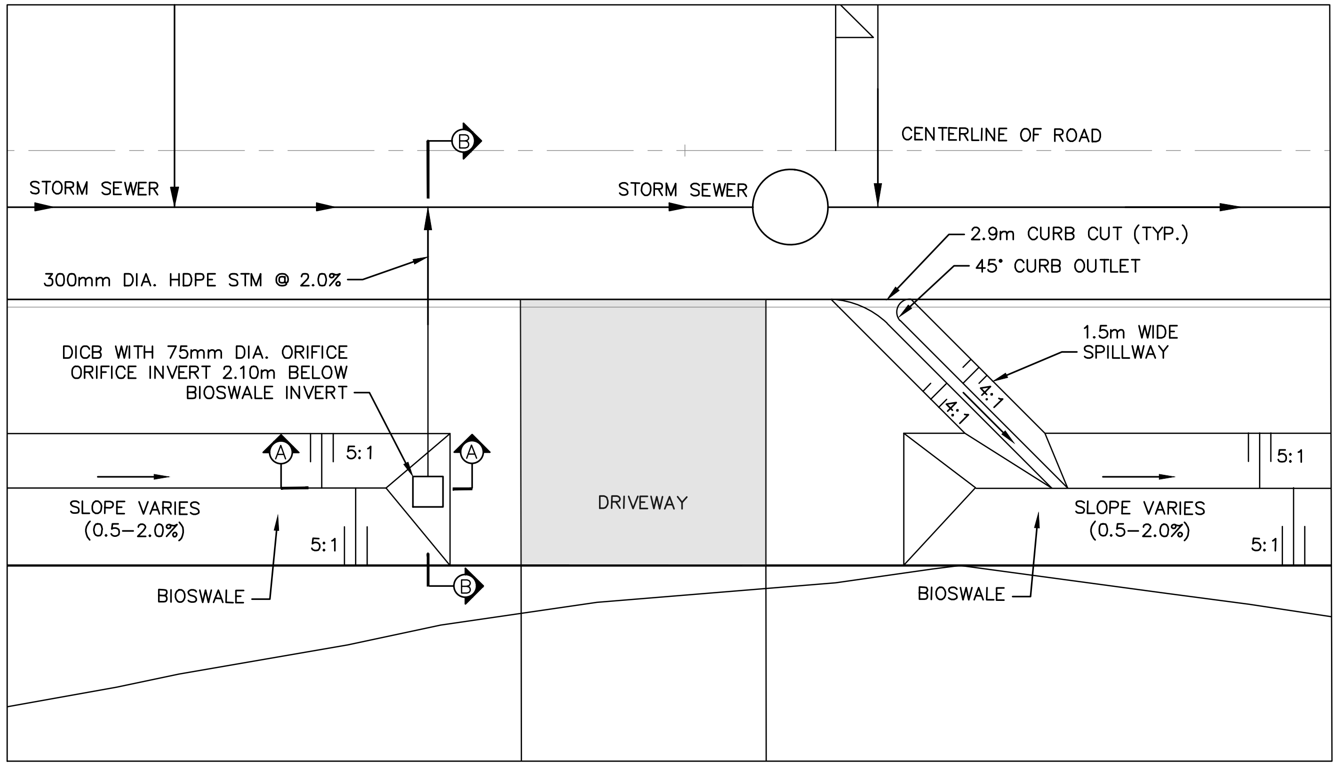
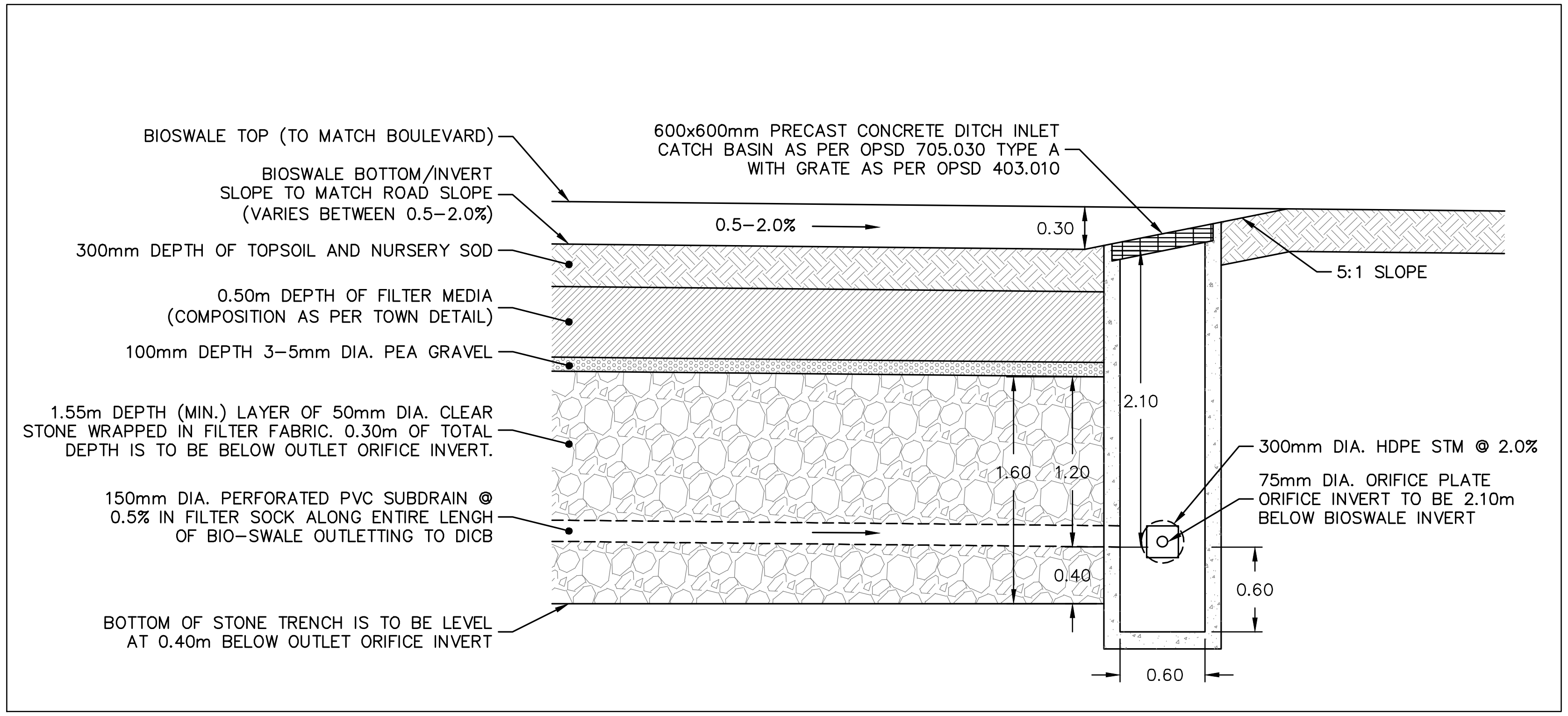
SCALE 1:2000	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 9



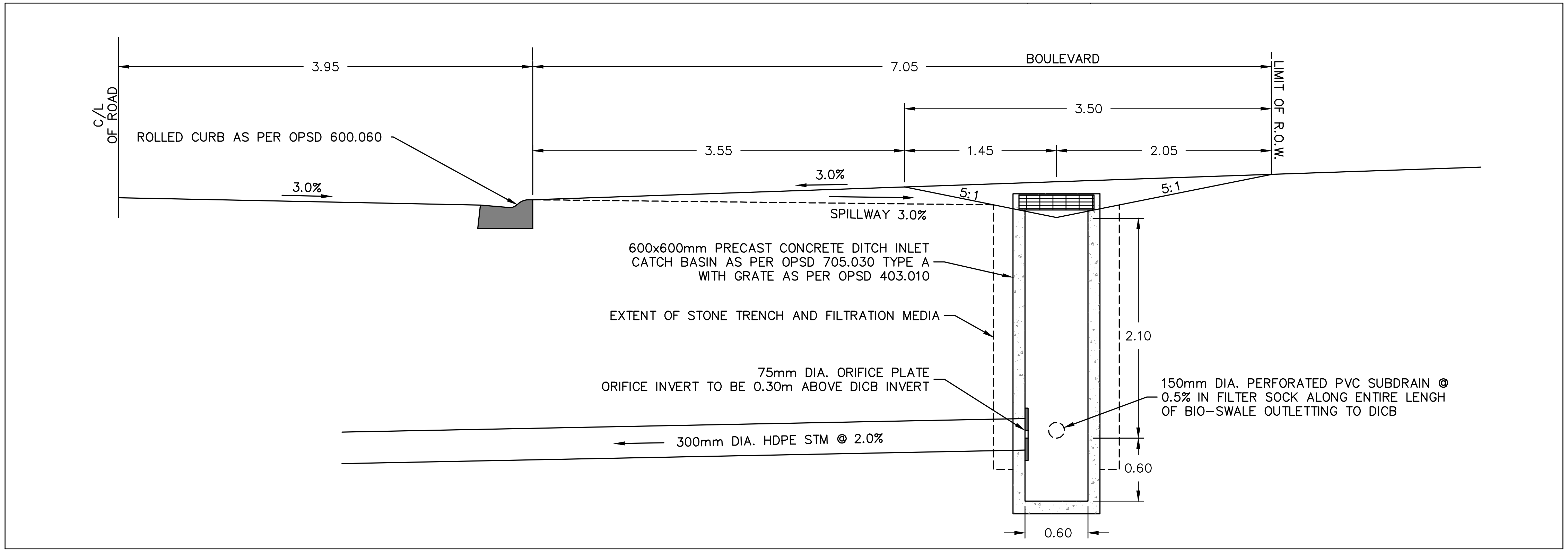
TYPICAL BIOSWALE PLAN VIEW

SCALE: 1:200



SECTION A–A

NTS



SECTION B–B

NTS

PROJECT

ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

PRELIMINARY BIOSWALE DESIGN

VALDOR ENGINEERING INC.
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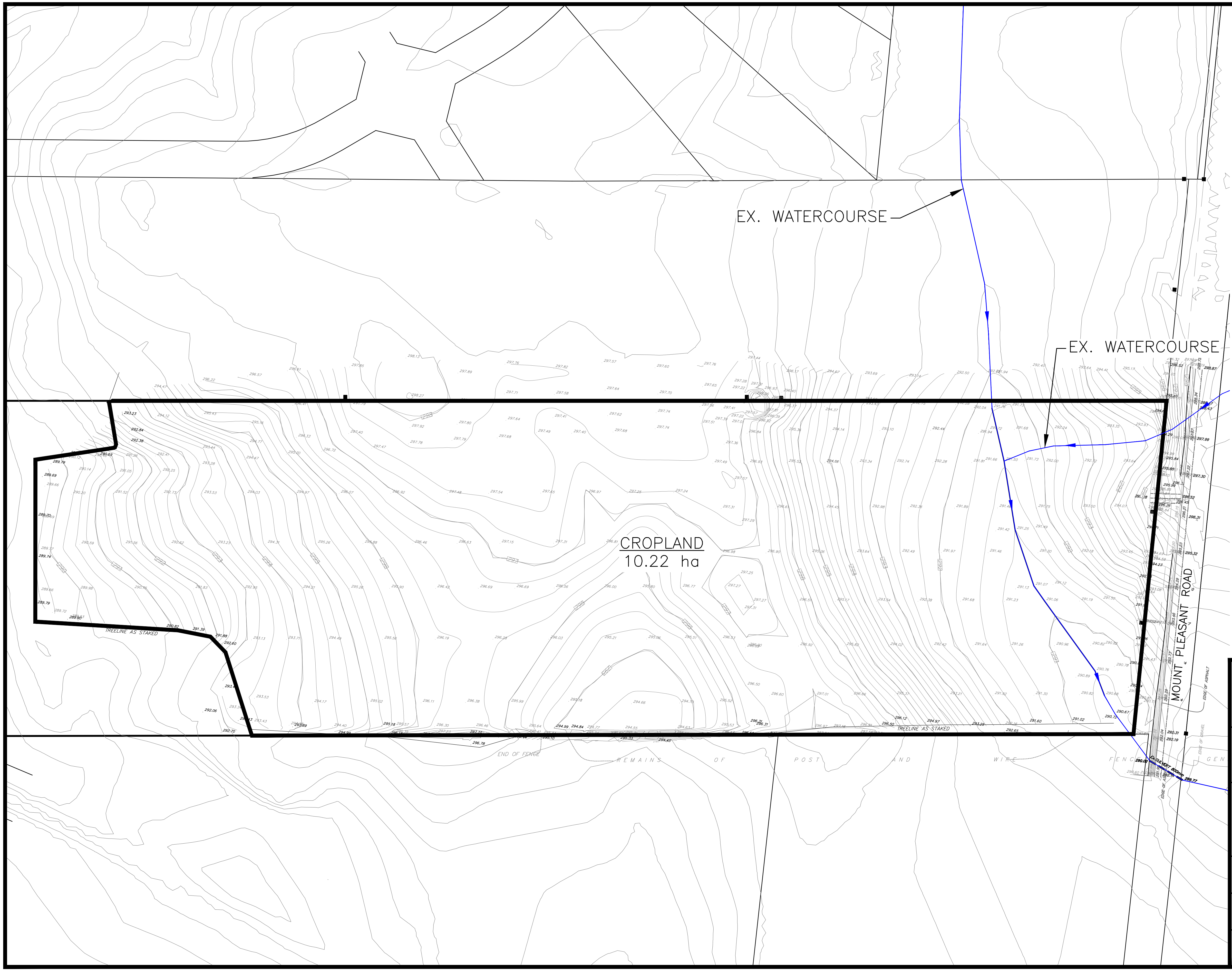
SCALE AS SHOWN	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 10



LEGEND

▬ LAND USE BOUNDARY

PROJECT
ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

PHOSPHORUS LOADING PLAN PRE–DEVELOPMENT

VALDOR ENGINEERING INC.
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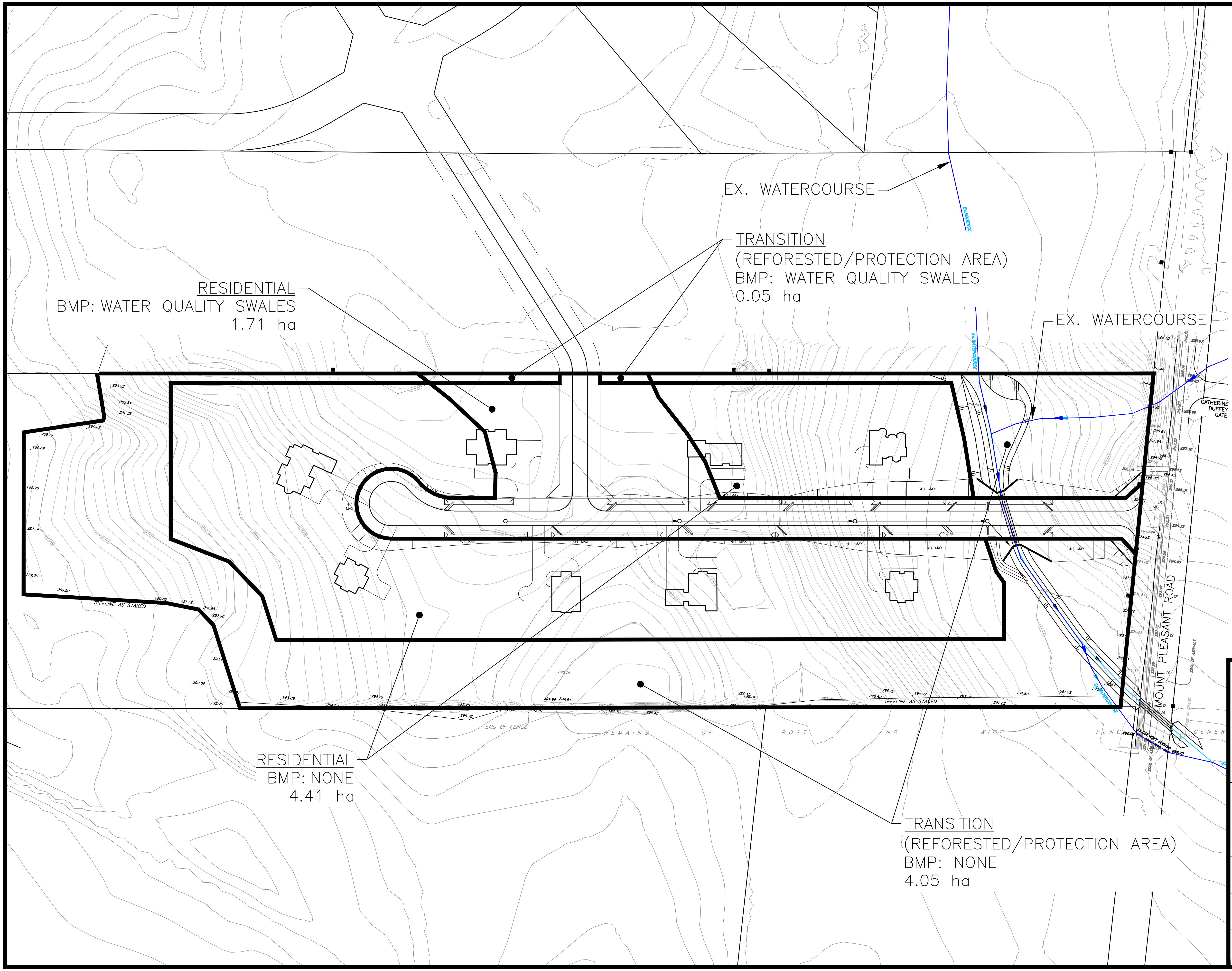
PREPARED BY O.B.	CKD. BY D.G.
SCALE 1:2000	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 11



LEGEND

▬ LAND USE BOUNDARY

PROJECT
ESTATE RESIDENTIAL SUBDIVISION
MOUNT PLEASANT ROAD
TOWN OF CALEDON, REGION OF PEEL

PHOSPHORUS LOADING PLAN
POST-DEVELOPMENT

VALDOR ENGINEERING INC.
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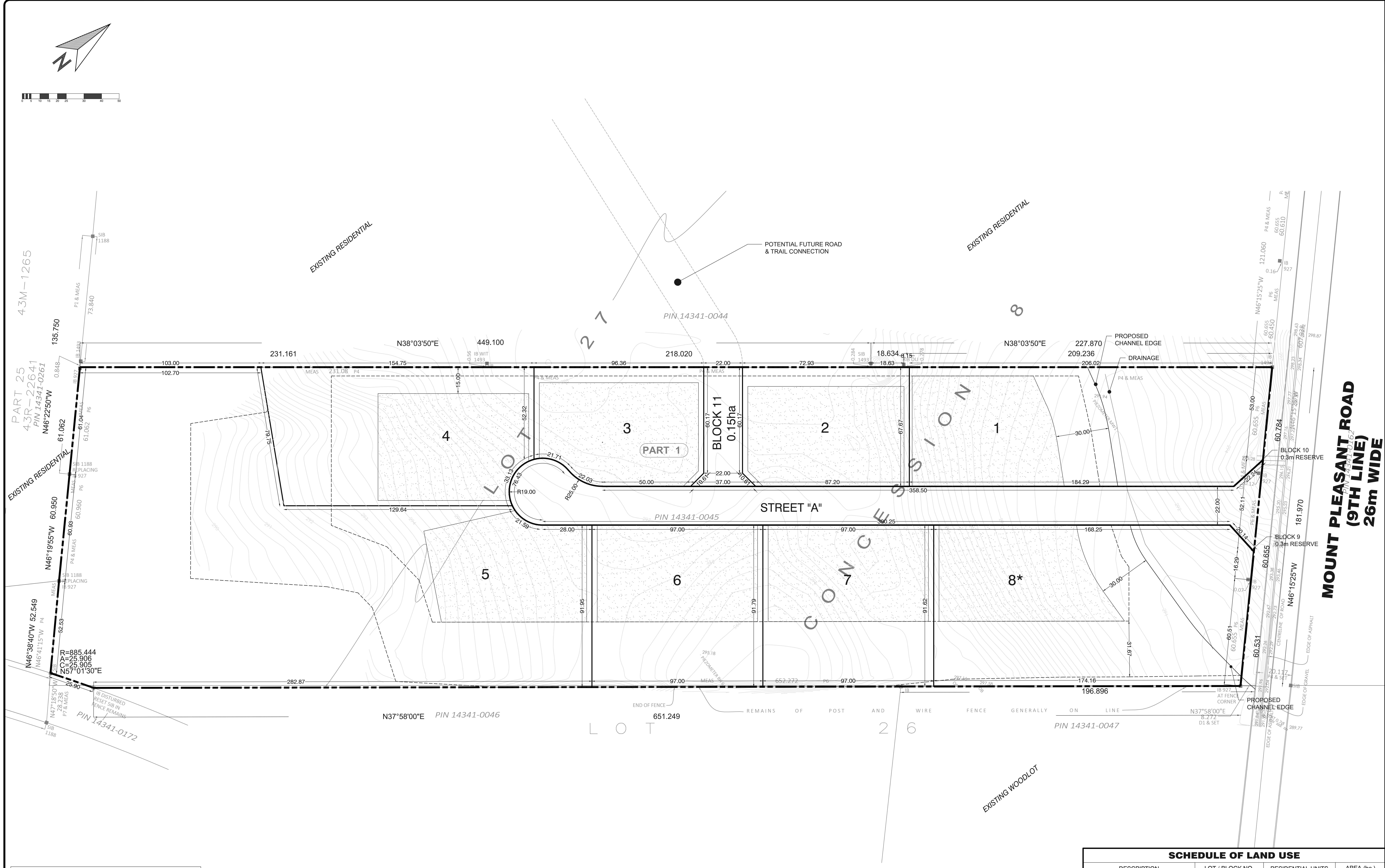
PREPARED BY O.B.	CKD. BY D.G.
SCALE 1:2000	DATE OCT. 2019
PROJECT 17122	DWG. FIGURE 12

APPENDIX “A”

Draft Plan, Site Plan & Equivalent Population Calculation



LEGEND

- ☐ ENVIRONMENTAL PROTECTION
- ▭ REFORESTED / PROTECTION AREA AREA = 4.00ha
- ▨ STRUCTURE ENVELOPE
- * DENSITY BONUS LOT PER O.P. POLICY 7.19.12

LOT SIZE SUMMARY CHART

LOT #	LOT AREA (Ha)	STRUCTURE ENVELOPE (Ha)
1	1.358	0.500
2	0.638	0.500
3	0.616	0.499
4	1.138	0.500
5	3.965	0.500
6	0.891	0.499
7	0.890	0.498
8	1.621	0.484

SCHEDULE OF LAND USE

DESCRIPTION	LOT / BLOCK NO.	RESIDENTIAL UNITS	AREA (ha.)
SINGLE DETACHED RESIDENTIAL	1 - 8	8	11.117
TOTAL SINGLE DETACHED		8	
NET DEVELOPABLE TOTAL		8	11.117
0.3 RESERVE	09, 10		0.005
FUTURE ROAD & TRAIL CONNECTION	11		0.154
RIGHT OF WAY	STREET "A"		0.999
TOTAL SITE AREA		8	12.275

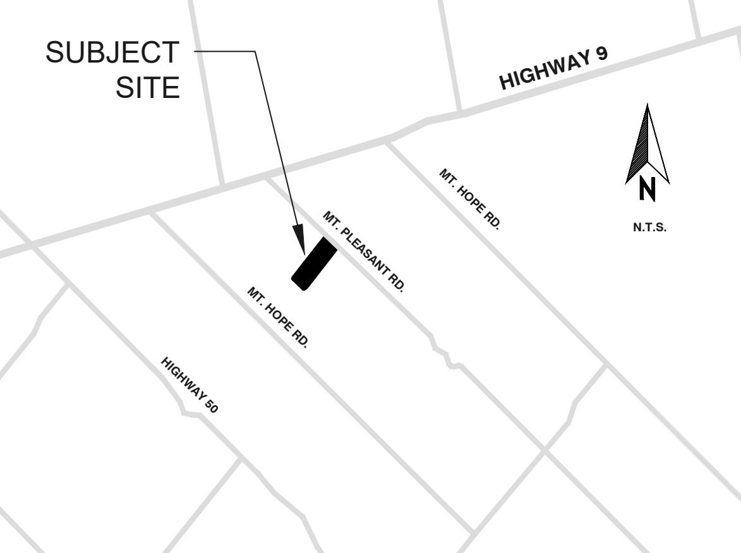
TITLE:

PROPOSED DRAFT PLAN OF SUBDIVISION

LEGAL DESCRIPTION:

PART OF LOT 27
CONCESSION 8
GEOGRAPHIC TOWNSHIP OF ALBION
TOWN OF CALEDON
REGIONAL MUNICIPALITY OF PEEL

KEY PLAN:



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 PIPED WATER AVAILABLE AT TIME OF DEVELOPMENT
- (i) TOP SOIL, SAND, SANDY SILT, CLAYEY SILT
- (j) SEE PLAN
- (k) GARBAGE COLLECTION & FIRE PROTECTION
- (l) SEE PLAN

NOTE: CONTOURS RELATE TO CANADIAN GEODETIC DATUM

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 VAN HARTEN

See Original

RON MAK
VAN HARTEN
See Original
DATE

OWNER'S CERTIFICATE:

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

See Original

DAVID GOODMAN
TROPICAL LAND DEVELOPMENT LIMITED
See Original
DATE

0 MOUNT PLEASANT ROAD

APPROVAL STAMP:

ANTHONY BIGLIERI
REGISTERED PROFESSIONAL PLANNER
R.P.P.

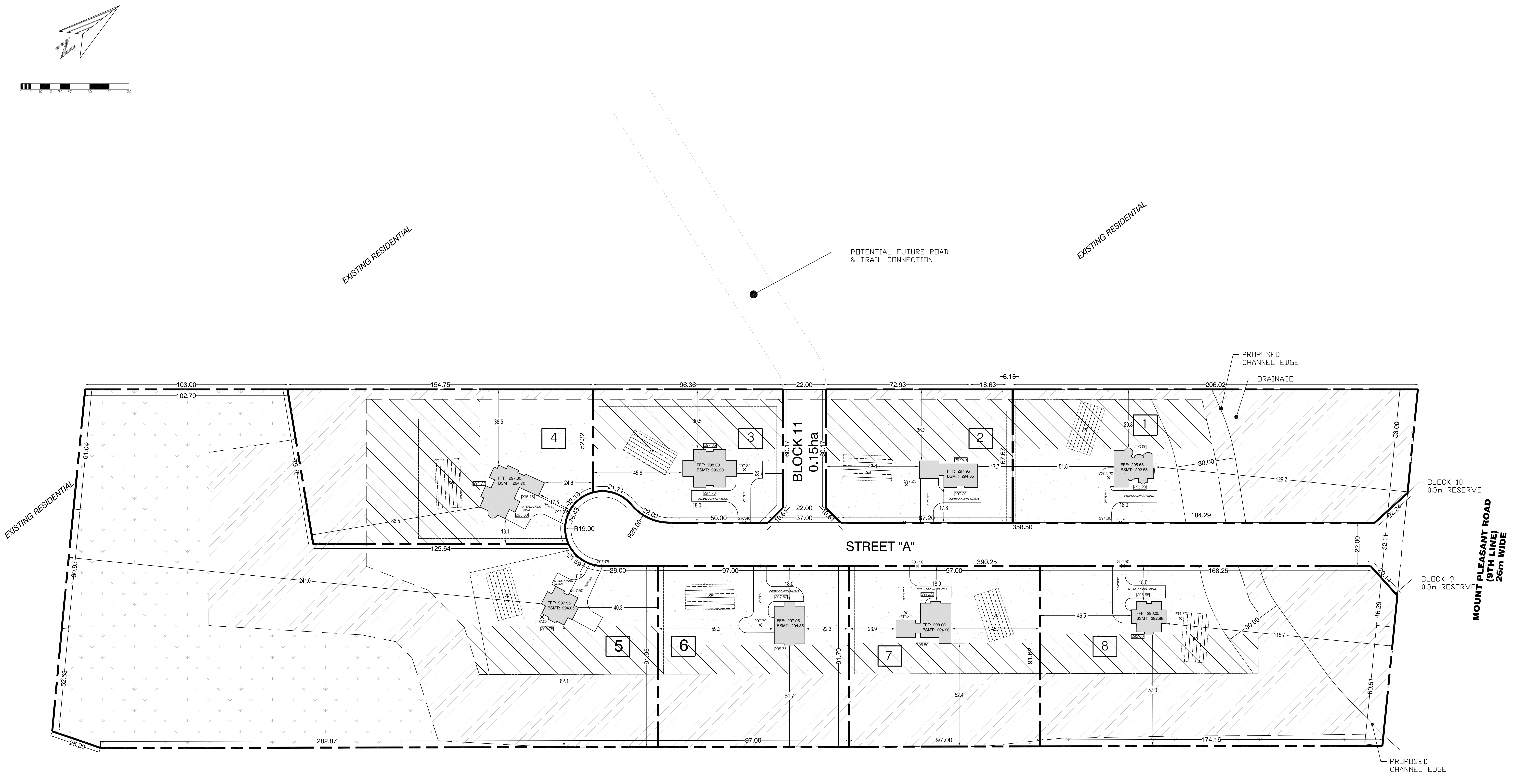
TROPICAL LAND DEVELOPMENT LTD.

REVISIONS

No.	Description	Date	Int.
3			
2			
1	REVISION	6/12/19	JS

PROJECT No.: 17445
DATE: May 4, 2018
SCALE: 1:1000
DRAFTED BY: JS
CHECKED BY: MJ
DRAWING No.: **DP-01**

THE BIGLIERI GROUP LTD.
Planning | Development | Project Management | Urban Design
20 Leslie Street, Suite 121, Toronto
126 Catharine Street North, Hamilton
(416) 693-9155
thebiglierigroup.com



LEGEND:

- ▨ **ENVIRONMENTAL PROTECTION**
- ▨ **REFORESTED / PROTECTION AREA**
- ▨ **USABLE REAR YARD**
- SB **SEPTIC BED**
- ▩ **BUILDING**
- ☐ **STRUCTURAL ENVELOPE**

Revision	Issued for	Date
14	ISSUED FOR CLIENT REVIEW	Aug. 01, 2019
13	ISSUED FOR CLIENT REVIEW	July 25, 2019
12	ISSUED FOR CLIENT REVIEW	July 18, 2019
11	ISSUED FOR CLIENT REVIEW	June 14, 2018
10	ISSUED FOR CLIENT REVIEW	June 12, 2018
9	ISSUED FOR CLIENT REVIEW	June 8, 2018
8	ISSUED FOR CLIENT REVIEW	June 7, 2018
7	ISSUED FOR CLIENT REVIEW	May 18, 2018
6	ISSUED FOR CLIENT REVIEW	May 2, 2018
5	ISSUED FOR CLIENT REVIEW	Apr. 19, 2018
4	ISSUED FOR CLIENT REVIEW	Jan. 10, 2018
3	ISSUED FOR CLIENT REVIEW	Dec. 7, 2017
2	ISSUED FOR CLIENT REVIEW	Dec. 1, 2017
1	ISSUED FOR CLIENT REVIEW	Oct. 17, 2017

Figured dimensions only shall be taken from this drawing, do not scale drawing. All contractors and sub-contractors shall visit the site, check and verify all dimensions, and report all discrepancies to the architect. This drawing shall not be used for construction purposes until issued for construction, and sealed by the architect. All drawings, specifications and related documents are the property of the architect and may not be used or reproduced without the architect's expressed permission.

MMH Architects Inc.
Architects & Planning Consultants
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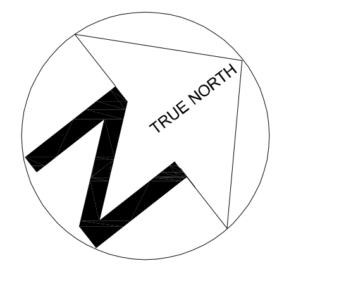
Toronto, Ontario. Canada. M3A1B2
E-mail: architects@mmh.ca
Telephone: 416 492-4949
Fax: 416 492-7207

Orientation



Stamp

Project Title
0 MOUNT PLEASANT ROAD, CALEDON
TROPICAL LAND DEVELOPMENT LTD.

Location
MOUNT PLEASANT ROAD-CALEDON

Drawing Title
SITE PLAN

Scale	1:1000	Date	October 3, 2017
Drawn By	C.K./S.R	Checked By	F.C
Project No.	201711	Drawing No.	A-101

VALDOR ENGINEERING INC.
741 Rowntree Dairy Road, Suite 2, Woodbridge, ON L4L 5T9
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www.valdor-engineering.com

TABLE: A1

EQUIVALENT POPULATION CALCULATION

Project Name: **Mount Pleasnat Road, Palgrave, Town of Caledon**
File: 17122
Date: December 2017

A. Based on Region of Peel Criteria

Land Use	Density		Area (Ha)	Equivalent Population
Detached Dwellings	50	persons per hectare	10.0	500.0
			Total Equivalent Population (persons):	**500**

B. Based on Persons Per Unit

Land Use	Density		Number of Units	Equivalent Population
Detached Dwellings	4	persons per unit	8	32.0
			Total Equivalent Population (persons):	**32**

APPENDIX “B”

Water Demand Calculations & Details

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www.valdor-engineering.com

TABLE: B1

WATER DEMAND CALCULATION

Project Name: Estate Residential Subdivision, Palgrave
File: 17122
Date: December 2017

Demand Critera:

	Base Demand		**Peaking Factors**	
Residential	280	L/capita/day	Max Day	2.00
			Peak Hour	3.00

	Equivalent Population	**Average Day** (L/day)	**Average Day** (L/min)	**Max Day** (L/min)	**Peak Hour** (L/min)
Detached Dwellings	32.0	8,960	6.2	12.4	18.7

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TABLE: B2

REQUIRED FIRE FLOW CALCULATION

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

Project Name: Estate Residential Subdivision, Palgrave
File: 17122
Date: December 2017

Notes:

Type of Construction - Ordinary Construction
C = 1.0

Total Floor Area: 460.00 sq.m
A = 460 sq.m
(Total Floor Area includes all storeys, but excludes basements at least 50 percent below grade)

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

F = 4,718 L/min
F = 5,000 (to nearest 1,000 Lmin)

Occupancy Factor

		Charge
Type:	Limited Combustible	-15%
	f_1 =	-15%

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%

$$F' = F \times (1+f_1) \times (1+f_2)$$

F' = 4,250 L/min

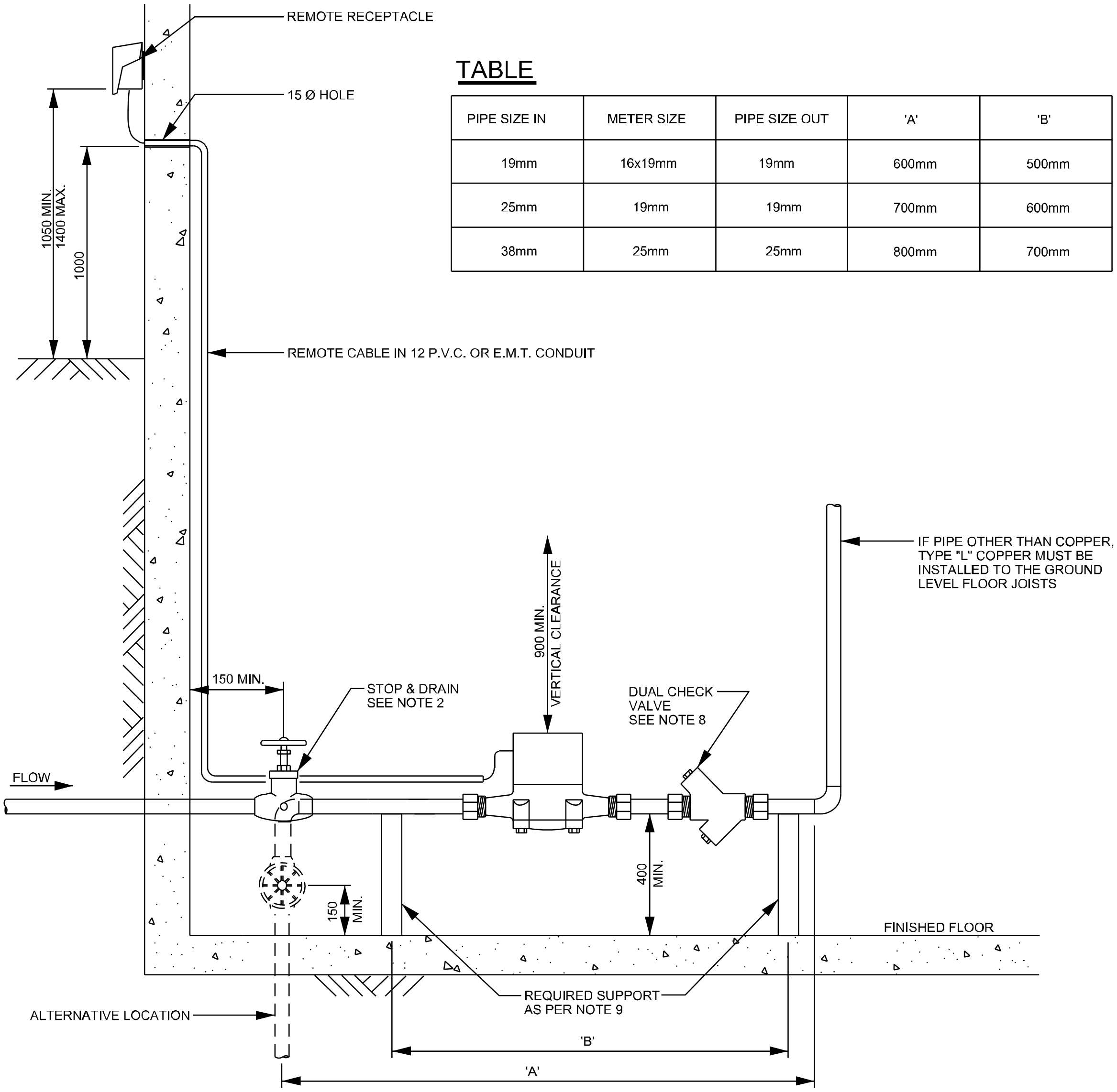
Exposure Factor

			Charge	
Side 1 - Distance to Building (m):	20.1 to 30m		10%	
Side 2 - Distance to Building (m):	20.1 to 30m		10%	
Side 3 - Distance to Building (m):	20.1 to 30m		10%	
Side 4 - Distance to Building (m):	20.1 to 30m		10%	
		f_3 =	40%	(maximum of 75%)

$$F'' = F' \times (1+f_3)$$

F'' = 5,950 L/min

REQUIRED FIRE FLOW
F'' = **6,000** **L/min** (to nearest 1,000 L/min)



TABLE

PIPE SIZE IN	METER SIZE	PIPE SIZE OUT	'A'	'B'
19mm	16x19mm	19mm	600mm	500mm
25mm	19mm	19mm	700mm	600mm
38mm	25mm	25mm	800mm	700mm

NOTE

1. 175mm MINIMUM CLEARANCE BETWEEN WALL AND C/L OF PIPE AND 75mm HORIZONTAL CLEARANCE BETWEEN WALL AND METER.
2. STOP AND DRAIN TO BE THE SAME SIZE AS INCOMING PIPE.
3. IF HOT WATER TANK IS WITHIN 3.0m OF METER, THEN A CHECK VALVE IS REQUIRED BETWEEN METER AND HOT WATER TANK.
4. ALL COPPER PIPING AFTER THE STOP AND DRAIN SHALL BE TYPE "L" COPPER.
   PIPING FOR METER TO BE RUN HORIZONTALLY & METER TO BE INSTALLED ON HORIZONTAL PIPING ONLY.
5. WHERE THE INCOMING PIPE IS OTHER THAN COPPER, 500mm OF HORIZONTAL TYPE "L" COPPER PIPE (AS PER ABOVE TABLE).
6. METER SIZE TO BE ONE PIPE SIZE SMALLER THAN INCOMING SERVICE SIZE.
7. METERS MUST NOT BE LOCATED BEHIND FURNACES, WATER TANKS, ETC.
8. WHERE REQUIRED, DUAL CHECK VALVE BACKFLOW PREVENTER IS TO BE INSTALLED DOWNSTREAM OF THE METER
9. IF PLUMBING RISER/WATER SERVICE IS PLASTIC, SUPPORTS SHALL BE REQUIRED FOR METER ASSEMBLY AREA.
   TO AVOID INSTALLING SUPPORTS, RISER SHALL BE COPPER AND ATTACHED TO LOWER FLOOR LEVEL JOISTS

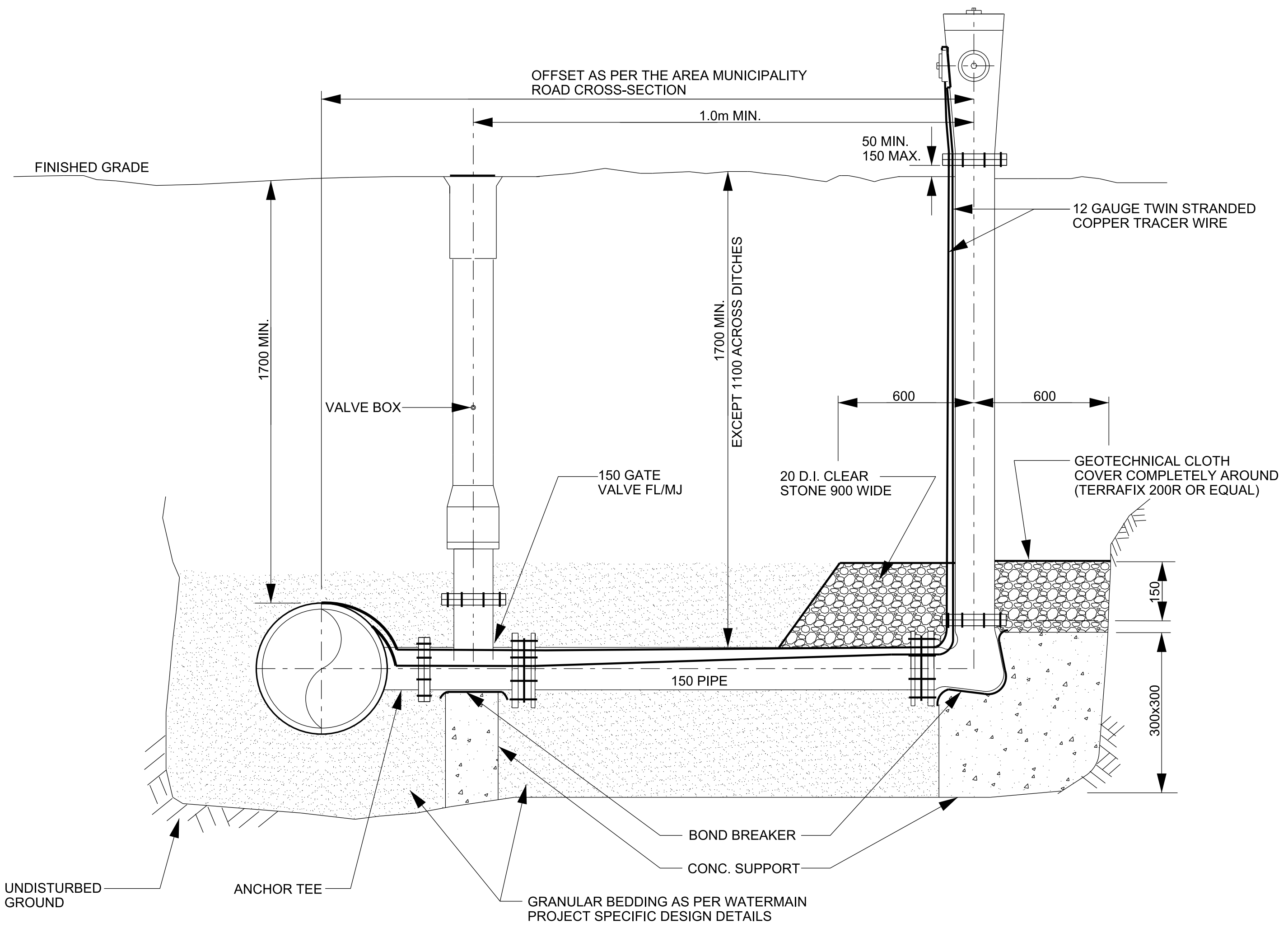
Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY	DRAWN BY
J.K.	AINLEY GROUP - RDP
STD. DWG. NUMBER	SCALE
1-4-7	N.T.S.

16mm x 19mm TO 25mm METER INSTALLATION FOR 25mm 'K' COPPER WATER SERVICE IN BUILDING



NOTE

1. IF THE WATERMAIN IS NOT AT THE STANDARD OFFSET, THE LOCATION OF THE HYDRANT TO BE AS PER CONSTRUCTION DRAWINGS.
2. BACKFILL TRENCH WITH GRANULAR 'B' COMPACTED TO 100% STD. PROCTOR DENSITY.
3. MECHANICAL RESTRAINTS REQUIRED ON ALL PVC HYDRANT LATERALS INCLUDING VALVES AND FITTINGS AS PER REGION STANDARD DRAWING 1-5-9.
4. ALL PIPING, FITTINGS, VALVES, APPURTENANCES AND MECHANICAL RESTRAINTS TO BE c/w DENSO PASTE, DENSO MASTIC AND DENSO TAPE OR APPROVED EQUAL, APPLIED TO MANUFACTURER'S RECOMMENDATIONS.

Region of Peel
Working for you

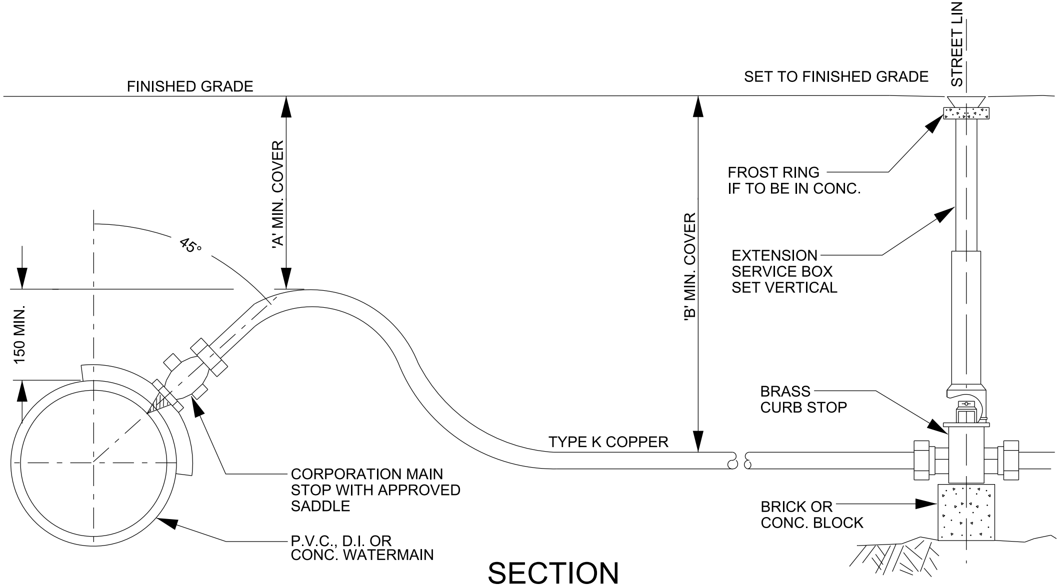
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: APRIL 2014

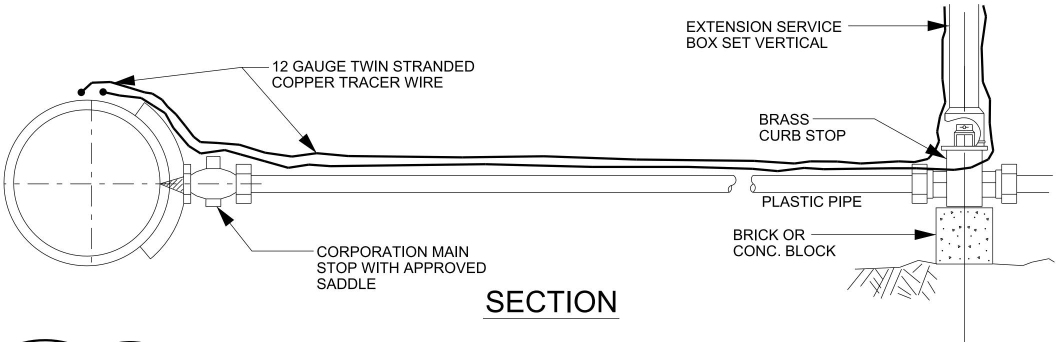
APPROVED BY	DRAWN BY
A.P.	**AINLEY GROUP**
STD. DWG. NUMBER	SCALE
1-6-1	**N.T.S.**

HYDRANT SETTING
FOR D.I. OR P.V.C. PIPE

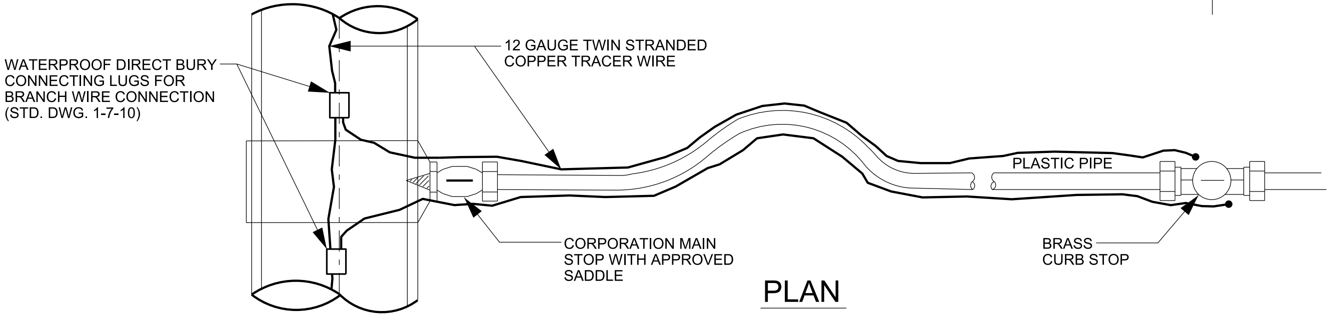
	'A'	'B'
ON UNIMPROVED ROADS	1950	2100
ON CURB AND GUTTER ROADS	1500	1700



SECTION



SECTION



PLAN

NOTE

1. ALL SERVICES TO BE AT 90° TO THE WATERMAIN UNLESS OTHERWISE SPECIFIED.
2. WATER SERVICE TO BE A MIN. OF 1100mm UNDER THE BOTTOM OF DITCH.
3. SERVICE BOX TO BE SET TO FINISH GRADE.
4. NO DIRECT TAPPING OF PVC WATERMAINS. ALL CONNECTIONS TO PVC PIPE TO BE MADE USING AN APPROVED WIDE-BAND SERVICE SADDLE.
5. TRACER WIRE TO BE INSTALLED AS PER REGION STANDARDS.
6. ALL WATER SERVICE MATERIALS SHALL BE STORED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

REV. DATE: APRIL 2014

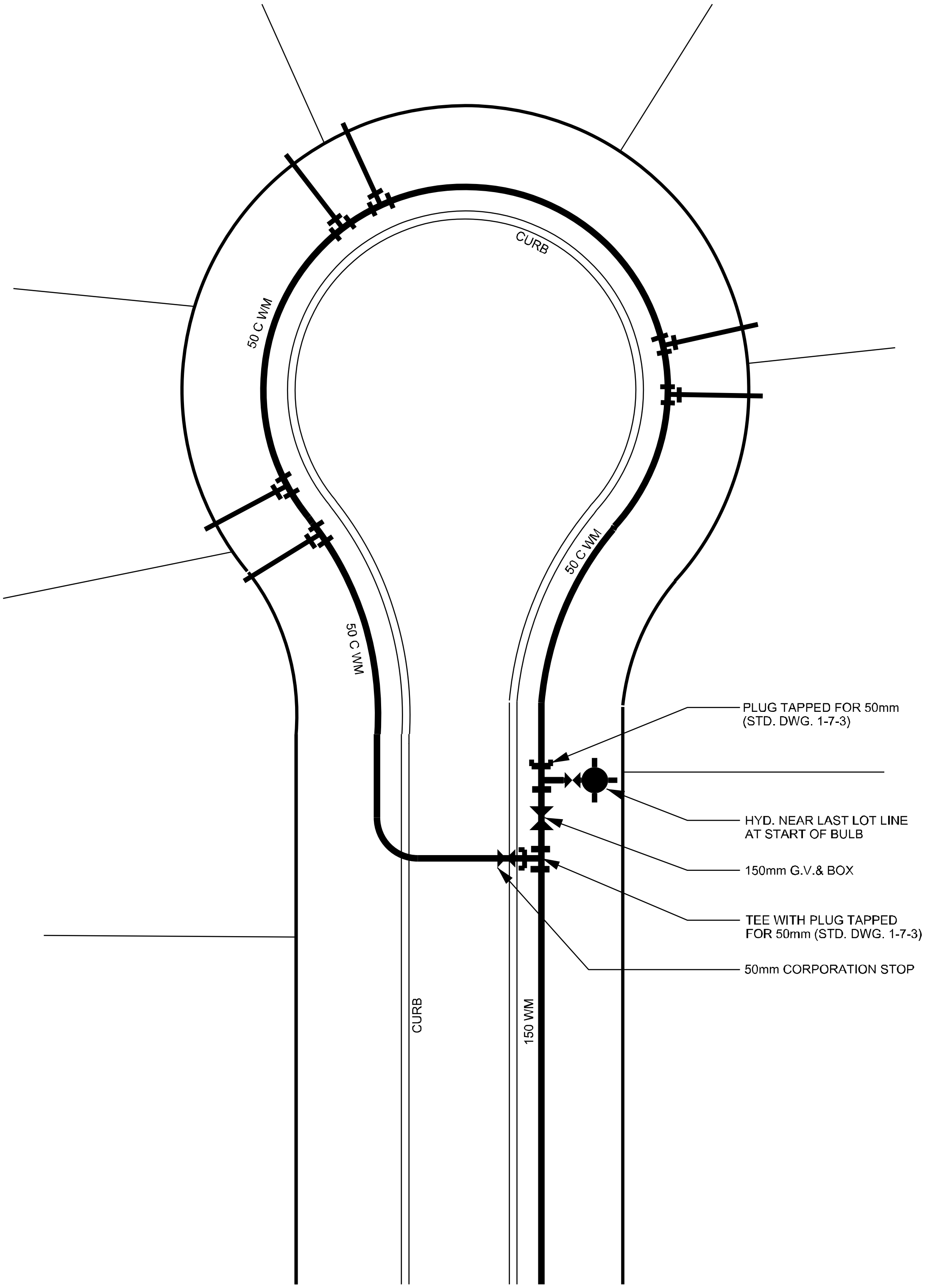
APPROVED BY
A.P.

DRAWN BY
AINLEY GROUP

WATER SERVICE CONNECTION

STD. DWG. NUMBER
1-7-1

SCALE
N.T.S.



NOTE

1. PROVIDE 25mm DIA. SERVICE FOR LOTS 500sq.m OR GREATER
2. FOR OFFSET OF WATERMAIN FROM STREETLINE, REFER TO THE LOCAL MUNICIPALITIES RELEVANT STTANDARD CROSS-SECTION.

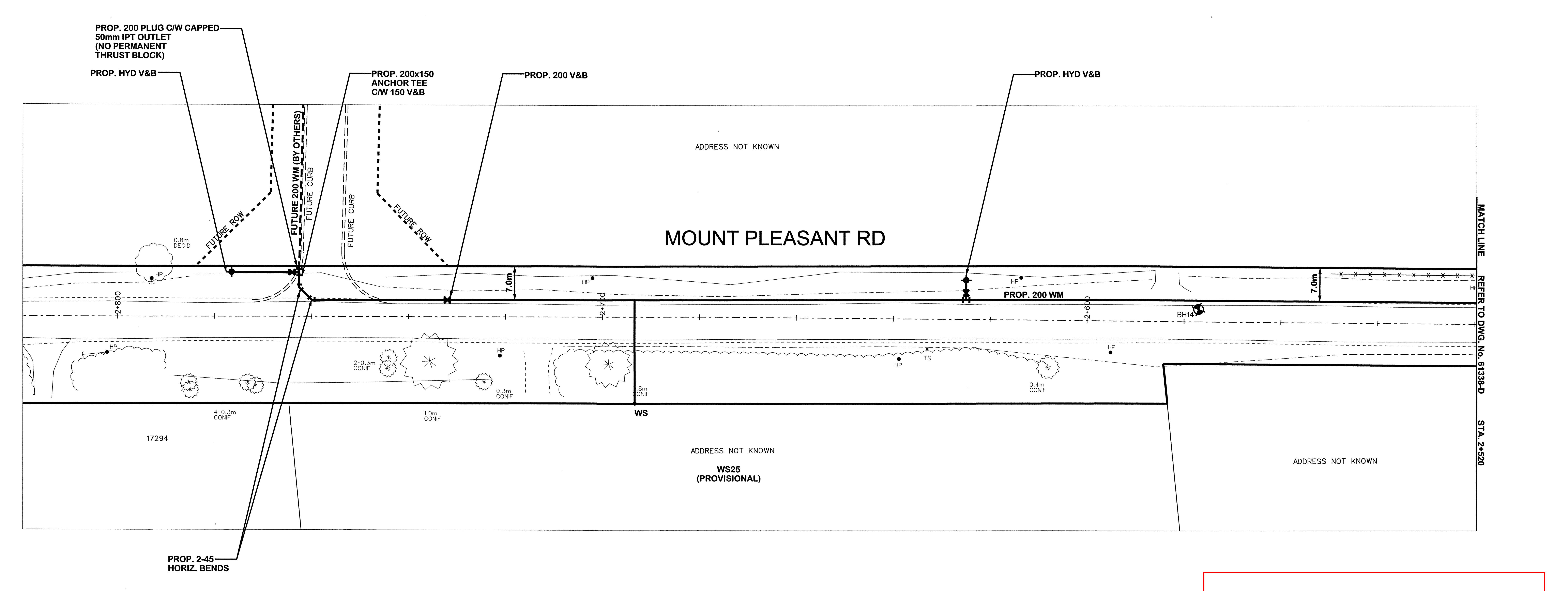
Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

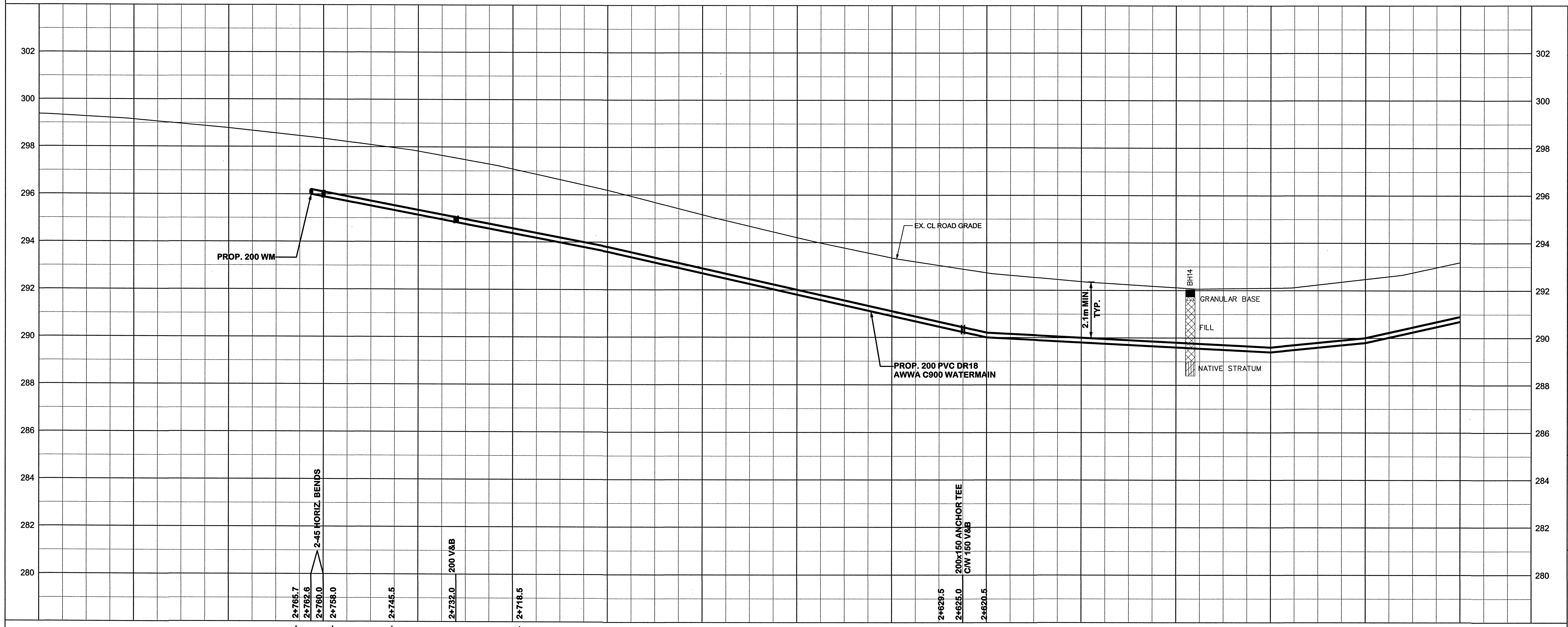
REV. DATE: NOVEMBER 2011

APPROVED BY	DRAWN BY
A.P.	**AINLEY GROUP**
STD. DWG. NUMBER	SCALE
1-7-4	**N.T.S.**

TYPICAL 50mm WATERMAIN ON CUL-DE-SAC



ISSUED FOR CONSTRUCTION
DATE: JUNE 28, 2017



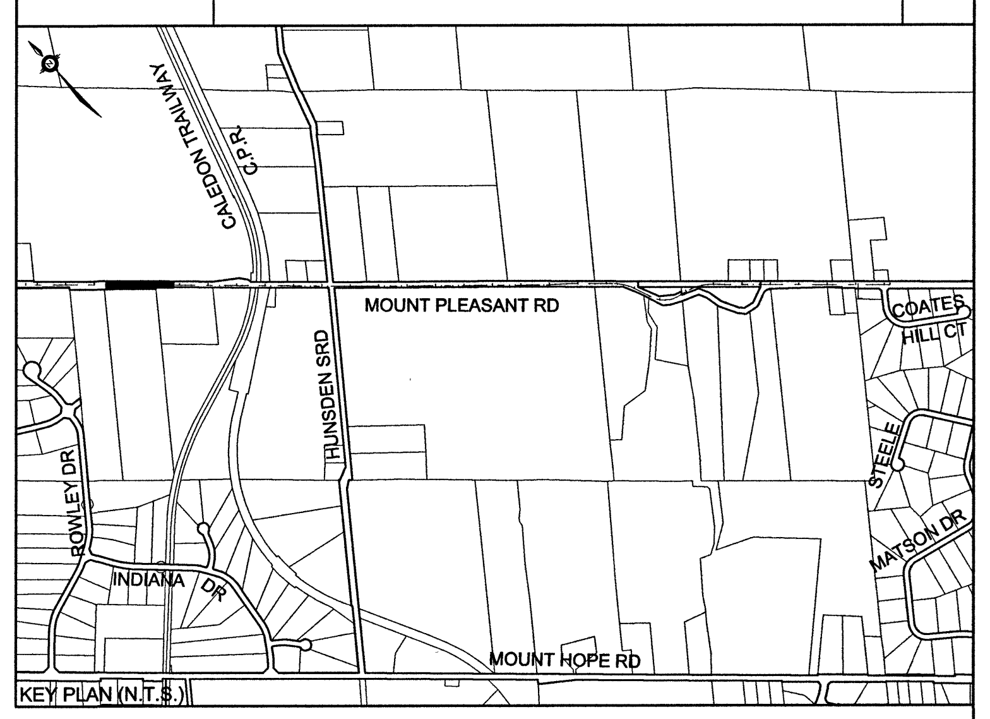
	295.90	295.13	294.37	293.60	292.70	291.80	290.90	290.00	289.80	289.60	289.40	289.80	290.70	BOT.EL. OF WM.
298.78	298.35	297.82	297.08	296.19	295.16	294.21	293.35	292.73	292.37	292.12	292.10	292.48	293.19	EX. ROAD ELEV.
2+780	2+760	2+740	2+720	2+700	2+680	2+660	2+640	2+620	2+600	2+580	2+560	2+540	2+520	ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS	OCT. 01, 2016	M.T.	GAS MAINS	MAY 13, 2016	M.T.
STORM SEWERS	OCT. 01, 2016	M.T.	BELL U/G CABLE	MAY 26, 2016	M.T.
WATERMAINS	OCT. 01, 2016	M.T.	HYDRO U/G CABLE		
TRANSIT			HYDRO ONE	MAY 25, 2016	M.T.
PARKS & REC.			CTV	MAY 30, 2016	M.T.
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS

DATE	DETAILS	INIT.
DEC. 09, 2016	ISSUED FOR 60% REVIEW	M.T.
MAR. 27, 2017	ISSUED FOR PUCC	M.T.
MAY 05, 2017	ISSUED FOR 90% REVIEW	M.T.
MAY 24, 2017	ISSUED FOR TENDER	M.T.
JUNE 28, 2017	**ISSUED FOR CONSTRUCTION**	**M.T.**



KEY PLAN (N.T.S.)

NOTE:

1. FOR GENERAL NOTES, DETAILS AND LEGEND SEE DWG. 61340-D

THIS DRAWING TO BE USED FOR WATERMAIN CONSTRUCTION ONLY

General Notes

All Driveways Are ASPHALT Unless Otherwise Noted

All Water And Sanitary Service Locations Are Approximate And Must Be Located Accurately In The Field

All Horizontal And Vertical Bends Are In Degrees

All Pipes Size In mm

20C Existing Water Service, Size In mm

WS25 Proposed Water Service, Size In mm

B.M. No. Elev.
Description
Location

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction. Location Of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

LYLE LEDREW
No 808920
Designed by
MAY 24 2017
Chkd.

2017/05/26
D. E. DODDS
Approved by

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF MISSISSAUGA WORKS DEPT.
CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
BELL CANADA
ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Working for you

MOUNT PLEASANT ROAD

(FROM COATES HILL CRT TO 17294 MT. PLEASANT RD)

PROP. 200mm WATERMAIN

STA. 2+520 TO STA. 2+765

CAD Area		Area	C-44/C-55	Project No.	17-1381
Checked by	C.L. MAY 24/17	Drawn by	M.T.		
Date	OCT. 2016	Sheet	12 of 12	Plan No.	61339-D

APPENDIX "C"

Wastewater Servicing Calculations & Details

VALDOR ENGINEERING INC.
File: 17122
December 2017

PROJECT: **Proposed Estate Residential Subdivision**
Mount Pleasant Road, Palgrave
Town of Caledon

TABLE C1

House Data	
House Model	
Number of bedrooms	**4**
Floor Area (ft^2)	**4,950**
Floor Area (m^2)	459.9
Fixture Count (see attached calcs)	**40.0**

Soils Data	
t-time for native soil (min/cm)	**10**
t-time for fill (min/cm)	**10**

Daily Design Flow*		
Dwelling Flow (L/day) up to 5 bedrooms		2,000
Additional Flow:		2,450
i) for over 5 bedrooms	0	
ii) area - A	2,000	
area - B	450	
area - C	0	
iii) fixtures over 20 units	1,000	
Peak Daily Design Flow (L/day)		4,450
Total Peak Daily Design Flow (L/day)		**4,450**
Septic Tank Capacity (L)	Minimum:	8,900
(Available Sizes 4500L, 6800L, 9000L, 13500L)	Use:	**9,000**

* based on Ontario Building Code Table 8.2.1.3.A

if t <= 20min - Trench In-Ground Bed		
		Peak Flow
Length of pipe (m)	L = [Q*t/200]	**222.5**
Approx Bed Area (m^2)	A = [L*1.6]	356.0
if t >20min - Raised Conventional Bed		
		Peak Flow
Length of pipe (m)	L = [Q*t/200]	**222.5**
Minimum Loading Area (m^2)		445.0
if t >20min - Raised Filter Bed		
		Peak Flow
Bed Area Required (m^2)		445
Minimum Contact Area (m^2)		52
Effective Filter Area Required (m^2)		89

Dwelling design flows (L/day)*		
a) 1 Bedroom	1	750
b) 2 Bedroom	2	1100
c) 3 Bedroom	3	1600
d) 4 Bedroom	4	2000
e) 5 Bedroom	5	2500
f) Additional for:		
i) each bedroom over 5		500
ii) A) each 10m^2 (or part thereof) over 200m^2 up to 400m^2		100
B) each 10m^2 (or part thereof) over 400m^2 up to 600m^2		75
C) each 10m^2 (or part thereof) over 600m^2, or		50
iii) each fixture unit over 20 fixture units		50

* part of Ontario Building Code Table 8.2.1.3.A

Loading Rates*	
Percolation Time of Soil (min/cm)	Loading Rates (L/m^2/day)
1 < t <= 20	10
20 < t <= 35	8
35 < t <= 50	6
t > 50	4

* part of Ontario Building Code Table 8.7.4.1.A

PROJECT: **Proposed Estate Residential Subdivision**
Mount Pleasant Road, Palgrave
Town of Caledon

TABLE C2

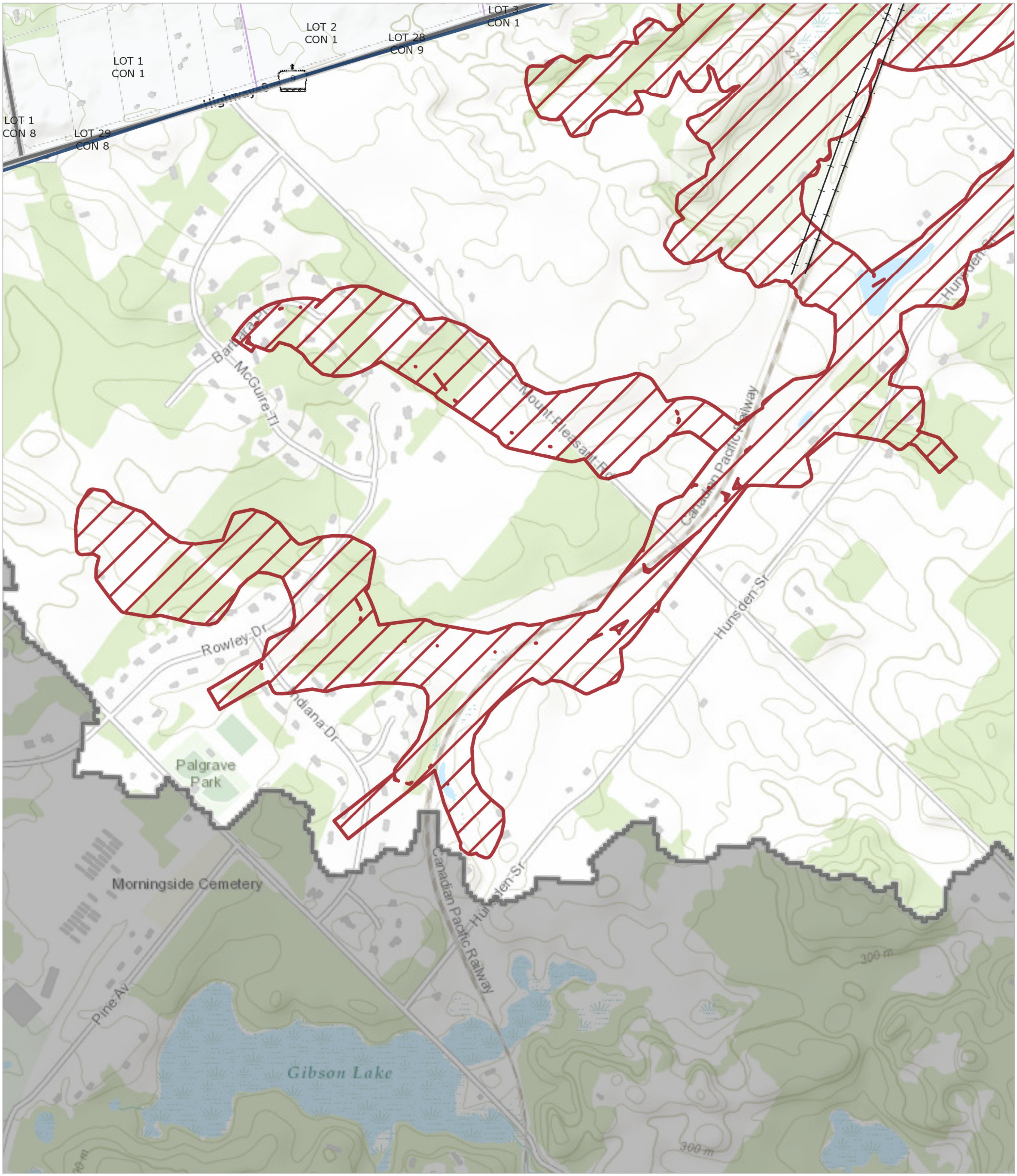
FIXTURE COUNTS			
Fixture	**Load* (units)**	**Number of Fixtures**	**Calculated Units**
BASEMENT			
Kitchen sink	1.5		0.0
Dishwasher	1.0		0.0
Toilet	4.0		0.0
Bidet	1.0		0.0
Tub/shower	1.5		0.0
Shower	1.5		0.0
Lavatory	1.0		0.0
Whirlpool	1.5		0.0
Other sink	1.5		0.0
Clothes washer	1.5	1	1.5
Laundry tub	1.5	1	1.5
Bathroom group	6.0	1	6.0
2" Floor Drain	2.0		0.0
3" Floor Drain	3.0	1	3.0
Other			0.0
Main Floor			
Kitchen sink	1.5	1	1.5
Dishwasher	1.0	1	1.0
Toilet	4.0	1	4.0
Bidet	1.0		0.0
Tub/shower	1.5		0.0
Shower	1.5		0.0
Lavatory	1.0	1	1.0
Whirlpool	1.5		0.0
Other sink	1.5		0.0
Clothes washer	1.5		0.0
Laundry tub	1.5		0.0
Bathroom group	6.0		0.0
Other			0.0
Second Floor			
Kitchen sink	1.5		0.0
Dishwasher	1.0		0.0
Toilet	4.0		0.0
Bidet	1.0		0.0
Tub/shower	1.5	1	1.5
Shower	1.5		0.0
Lavatory	1.0	1	1.0
Whirlpool	1.5		0.0
Other sink	1.5		0.0
Clothes washer	1.5		0.0
Laundry tub	1.5		0.0
Bathroom group	6.0	3	18.0
Other			0.0
TOTAL			**40.0**

* part of Ontario Building Code Table 7.4.9.3

APPENDIX “D”

Watershed Map, Regulation Mapping & IDF Data

NVCA - Web Map

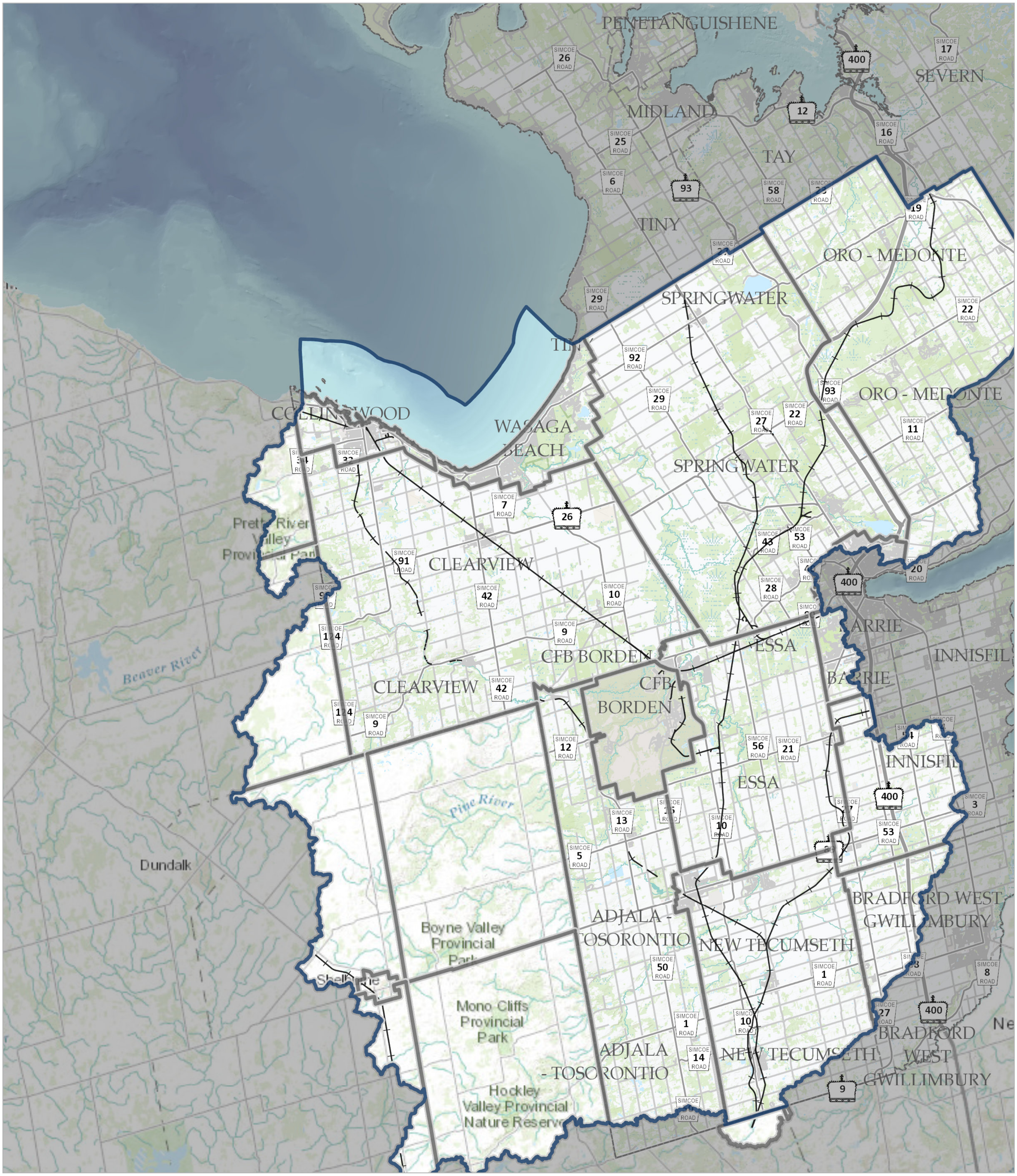


0 0.275 0.55 1.1 km

1:18,056

November 12, 2017

NVCA - Web Map



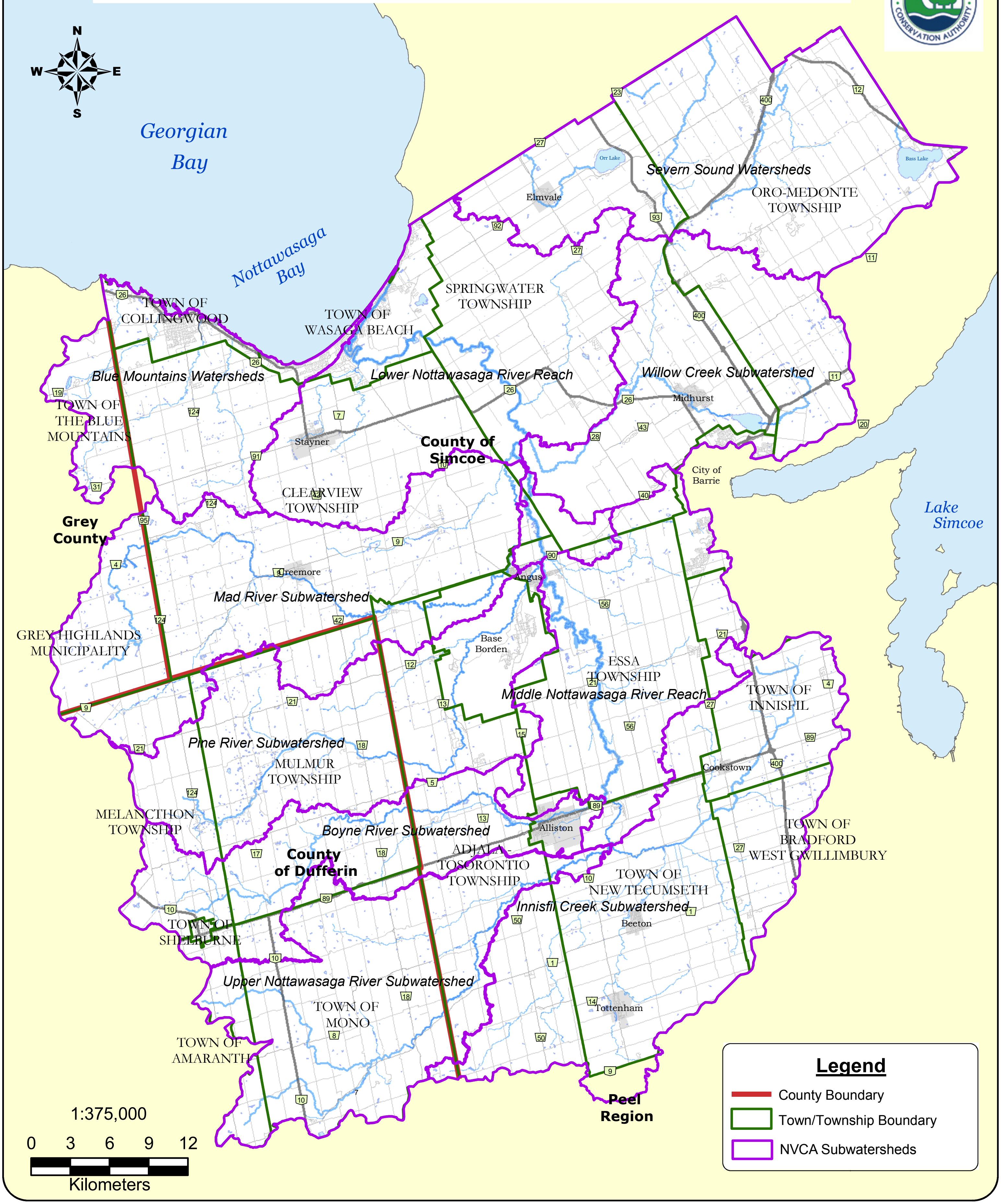
0 5 10 20 km

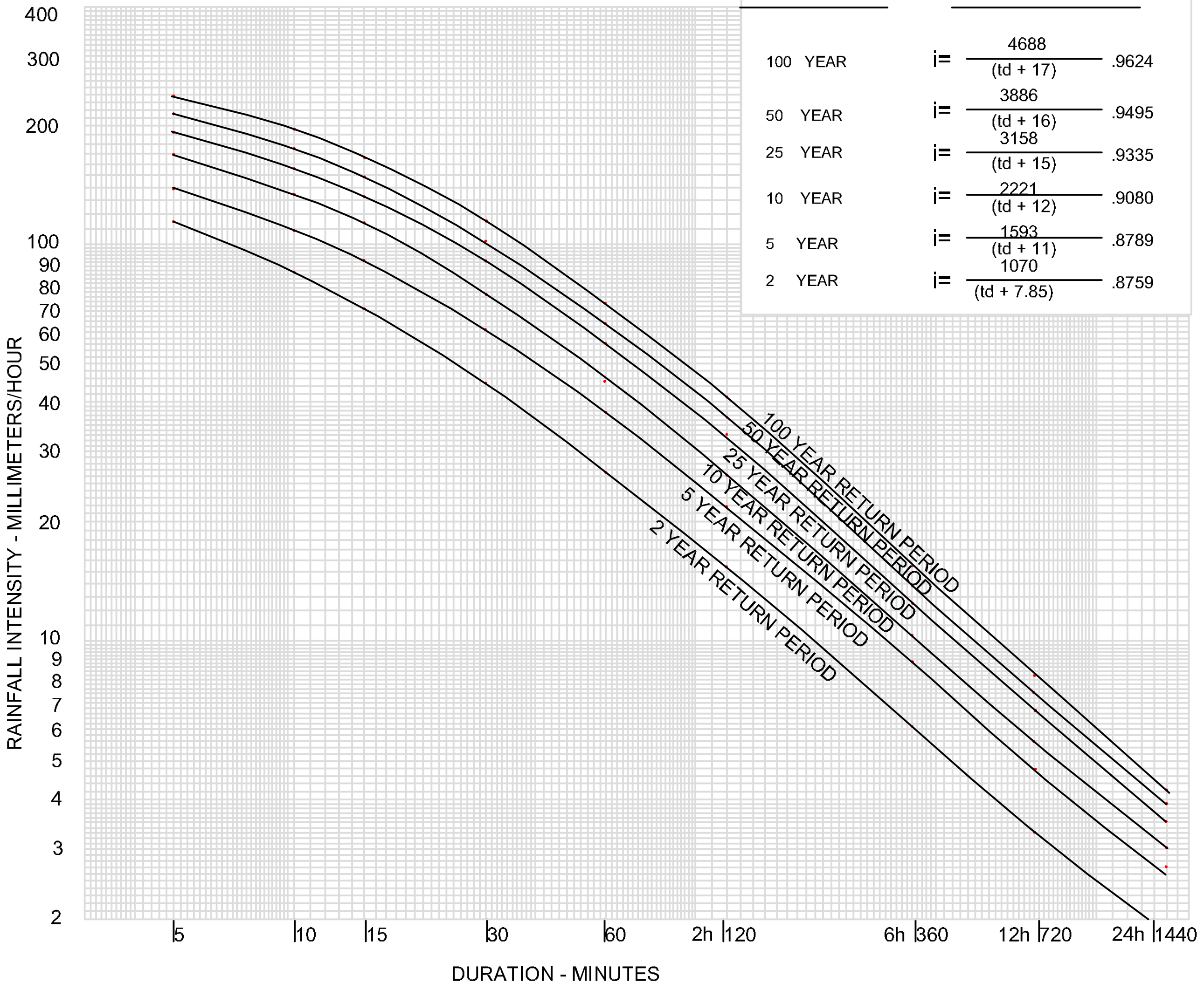
1:577,791

November 12, 2017

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

Nottawasaga Valley Conservation Authority





RETURN PERIOD	EQUATION OF CURVE
100 YEAR	$i= \frac{4688}{(td + 17)}\,.9624$
50 YEAR	$i= \frac{3886}{(td + 16)}\,.9495$
25 YEAR	$i= \frac{3158}{(td + 15)}\,.9335$
10 YEAR	$i= \frac{2221}{(td + 12)}\,.9080$
5 YEAR	$i= \frac{1593}{(td + 11)}\,.8789$
2 YEAR	$i= \frac{1070}{(td + 7.85)}\,.8759$

INLET TIMES

SUBURBAN RESIDENTIAL	
(ROOF DRAINS UNCONNECTED)	15 min
(ROOF DRAINS CONNECTED)	10 min
SUBURBAN, COMMERCIAL, INDUSTRIAL MULTIPLE FAMILY	10 min
DOWNTOWN COMMERCIAL, HIGH DENSITY APARTMENTS, EXPRESSWAYS	5 min

RUNOFF COEFFICIENT

COMMERCIAL	
- DOWNTOWN & SUBURBAN SHOPPING	0.90
INDUSTRIAL	
- DOWNTOWN	0.90
- SUBURBAN INDUSTRIAL PARKS	0.75
RESIDENTIAL	
- APARTMENTS	0.75
- ROW DWELLINGS	0.70
- DUPLEX DWELLINGS	0.70
- SEMIDETACHED - DOWNTOWN	0.60
- SINGLE FAMILY - DOWNTOWN	0.60
- SEMIDETACHED - SUBURBAN	0.50
- SINGLE FAMILY - SUBURBAN	0.40
SCHOOLS, CHURCHES, HOSPITALS	0.75
PARKS, CEMETERIES, RAIL YARDS	
(OVER 4 Ha)	0.20
(UNDER 4 Ha)	0.25

TOWN OF CALEDON

RAINFALL INTENSITY CURVES

NO.	REVISION	APR'D	DATE
1	STANDARD 112.01 NOW 104		JUNE 08

APR'D: C.C.
DATE: FEB 2000
DRAWN: BJM
SCALE: N.T.S.

STANDARD No. 104

APPENDIX “E”

Floodplain Mapping

VALDOR ENGINEERING INC.
Project: Proposed Estate Residential Subdivision
File: 17122
Date: May 2018

Table E.1: External Drainage Area - VO5 Model Parameters

Subcatchment	Area (ha)	DT (min)	TIMP	XIMP	CN II	IA (mm)	Tp (hr)
301	139.14	5	-	-	60	7.1	1.39
Total	**139.14**						

VALDOR ENGINEERING INC.
Project: Proposed Estate Residential Subdivision
File: 17122
Date: May 2018

Table E.2: Calculation of CN Values, Initial Abstractions and Runoff Coefficients

Subcatchment	Area (ha)	Land Use and Land Cover		[1]CN II	Area Weighted CN II	[2]IA (mm)	Area Weighted IA (mm)	[3]C-Value	Area Weighted C-Value
		Type	Area (ha)						
301	139.14	Woods (HSG 'AB')	36.35	46	**60**	**10**	**7.1**	0.08	**0.20**
		Meadow (HSG 'AB')	24.30	51		**8**		0.10	
		Cultivated (HSG 'AB')	36.47	68		**7**		0.22	
		Lawn (HSG 'AB')	29.58	59		**5**		0.10	
		Impervious	12.44	100		**2**		0.95	

VALDOR ENGINEERING INC.

Project: Proposed Estate Residential Subdivision
File: 17122
Date: May 2018

Table E.3: 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	[1]T_c (min)	[1]T_p (hr)
301	0.20	2235	321.00	290.00	1.39	124.5	1.39

Notes:

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

VALDOR ENGINEERING INC.

Project: Proposed Estate Residential Subdivision
File: 17122
Date: May 2018

Table E.4: Summary of HEC-RAS Results - Regional Flow

HEC-RAS Cross-Section		Regional Flow Water Surface Elevation (m)		
Existing	**Proposed**	**Existing**	**Proposed**	**Difference with Existing**
17	17	292.97	292.97	**0.00**
16	16	292.55	292.54	**-0.01**
15	15	292.49	292.38	**-0.11**
14	14	292.46	292.16	**-0.30**
13	13	292.46	292.17	**-0.29**
12	12.3	292.45	292.08	**-0.37**
	12.2		Prop. Culvert	
	12.1		291.02	**-1.43**
11	11	292.45	291.07	**-1.38**
10	10	292.45	291.02	**-1.43**
9	9	292.45	291.01	**-1.44**
8	8	292.45	290.90	**-1.55**
7	7	Ex./Prop. Culvert		
6	6	291.36	290.06	**-1.30**
5	5	288.25	288.25	**0.00**
4	4	287.77	287.77	**0.00**
3	3	287.45	287.45	**0.00**
2	2	287.14	287.14	**0.00**
1	1	286.35	286.35	**0.00**

VALDOR ENGINEERING INC.
Project: Proposed Estate Residential Subdivision
File: 17122
Date: May 2018

Table E.5: HEC-RAS Output - Existing Conditions

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	17	Regional (Timmins)	5.90	292.63	292.97		293.02	0.009743	1.32	6.53	38.54	0.74
1	16	Regional (Timmins)	5.90	292.14	292.55		292.61	0.008473	1.38	6.09	29.73	0.71
1	15	Regional (Timmins)	5.90	291.95	292.49		292.50	0.001058	0.61	13.10	40.16	0.27
1	14	Regional (Timmins)	5.90	291.83	292.46		292.47	0.000776	0.40	19.99	54.53	0.16
1	13	Regional (Timmins)	5.90	291.51	292.46		292.46	0.000109	0.20	43.29	84.20	0.07
1	12	Regional (Timmins)	5.90	291.24	292.45		292.45	0.000036	0.14	62.15	90.64	0.04
1	11	Regional (Timmins)	5.90	291.06	292.45		292.45	0.000011	0.08	91.14	96.52	0.02
1	10	Regional (Timmins)	5.90	290.85	292.45		292.45	0.000006	0.06	112.96	102.44	0.02
1	9	Regional (Timmins)	5.90	290.66	292.45		292.45	0.00002	0.08	99.55	93.74	0.02
1	8	Regional (Timmins)	5.90	290.02	292.45	291.81	292.45	0.000012	0.08	122.27	109.62	0.02
1	7		Culvert									
1	6	Regional (Timmins)	5.90	289.77	291.36	291.36	291.36	0.000018	0.10	71.47	72.26	0.03
1	5	Regional (Timmins)	5.90	287.73	288.25		288.34	0.023417	1.34	4.49	15.34	0.74
1	4	Regional (Timmins)	5.90	287.00	287.77		287.81	0.006739	0.92	6.58	15.73	0.42
1	3	Regional (Timmins)	5.90	286.64	287.45		287.50	0.007428	1.01	6.15	15.13	0.45
1	2	Regional (Timmins)	5.90	286.30	287.14		287.18	0.007384	0.90	6.58	15.56	0.43
1	1	Regional (Timmins)	5.90	285.60	286.35	286.35	286.51	0.044444	1.76	3.35	10.61	1.00

VALDOR ENGINEERING INC.
Project: Proposed Estate Residential Subdivision
File: 17122
Date: May 2018

Table E.6: HEC-RAS Output - Proposed Conditions

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	17	Regional (Timmins)	5.90	292.63	292.97		293.02	0.009056	1.29	6.71	39.08	0.72
1	16	Regional (Timmins)	5.90	292.14	292.54		292.60	0.009209	1.42	5.90	29.26	0.74
1	15	Regional (Timmins)	5.90	291.95	292.38		292.41	0.002781	0.85	9.18	34.12	0.42
1	14	Regional (Timmins)	5.90	291.83	292.16		292.20	0.016199	1.17	6.66	34.20	0.67
1	13	Regional (Timmins)	5.90	290.24	292.17		292.17	0.000151	0.38	26.13	38.78	0.09
1	12.3	Regional (Timmins)	5.90	290.10	292.08	290.90	292.15	0.001246	1.11	5.32	33.80	0.25
1	12.2		Culvert									
1	12.1	Regional (Timmins)	5.90	289.93	291.02	290.73	291.23	0.009464	2.04	2.90	10.28	0.63
1	11	Regional (Timmins)	5.90	289.86	291.07		291.09	0.001335	0.82	8.83	11.00	0.24
1	10	Regional (Timmins)	5.90	289.68	291.02		291.05	0.001126	0.81	11.87	33.25	0.22
1	9	Regional (Timmins)	5.90	289.52	291.01		291.02	0.000412	0.53	17.35	34.50	0.14
1	8	Regional (Timmins)	5.90	289.40	290.90	290.23	290.98	0.002556	1.31	4.70	34.31	0.34
1	7		Culvert									
1	6	Regional (Timmins)	5.90	289.25	290.06	290.06	290.39	0.027607	2.6	2.38	36.85	0.93
1	5	Regional (Timmins)	5.90	287.73	288.25		288.34	0.023417	1.34	4.49	15.34	0.74
1	4	Regional (Timmins)	5.90	287.00	287.77		287.81	0.006739	0.92	6.58	15.73	0.42
1	3	Regional (Timmins)	5.90	286.64	287.45		287.50	0.007428	1.01	6.15	15.13	0.45
1	2	Regional (Timmins)	5.90	286.30	287.14		287.18	0.007384	0.9	6.58	15.56	0.43
1	1	Regional (Timmins)	5.90	285.60	286.35	286.35	286.51	0.044444	1.76	3.35	10.61	1.00

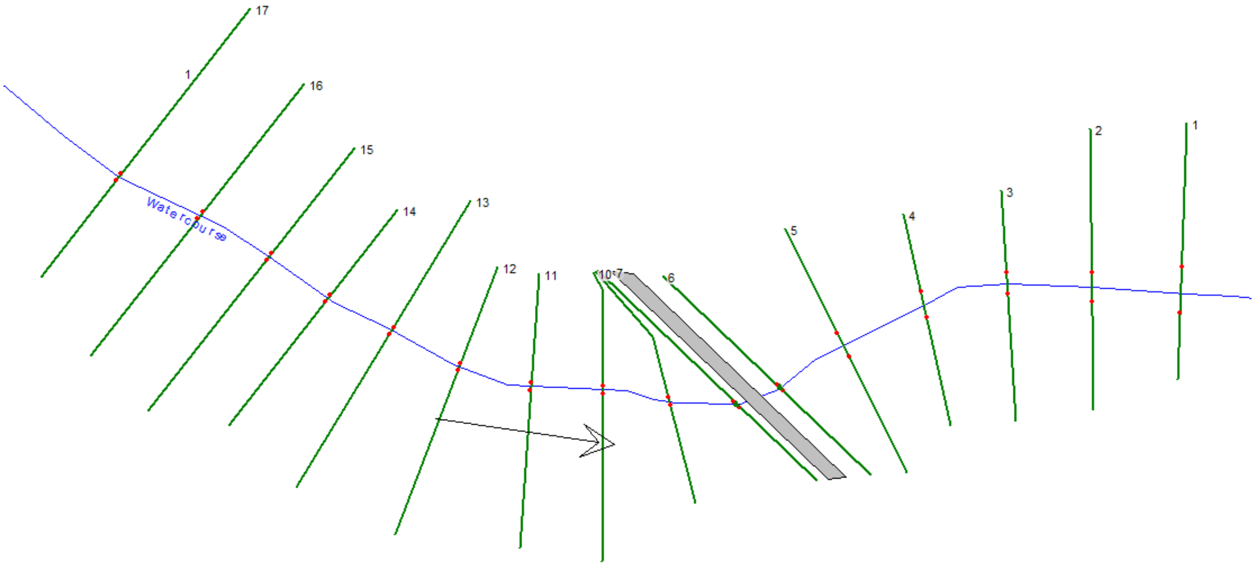


Figure E.1: HEC-RAS Model Schematic – Existing Condition

Valdor Engineering Inc.
File: 17122
Date: May 2018

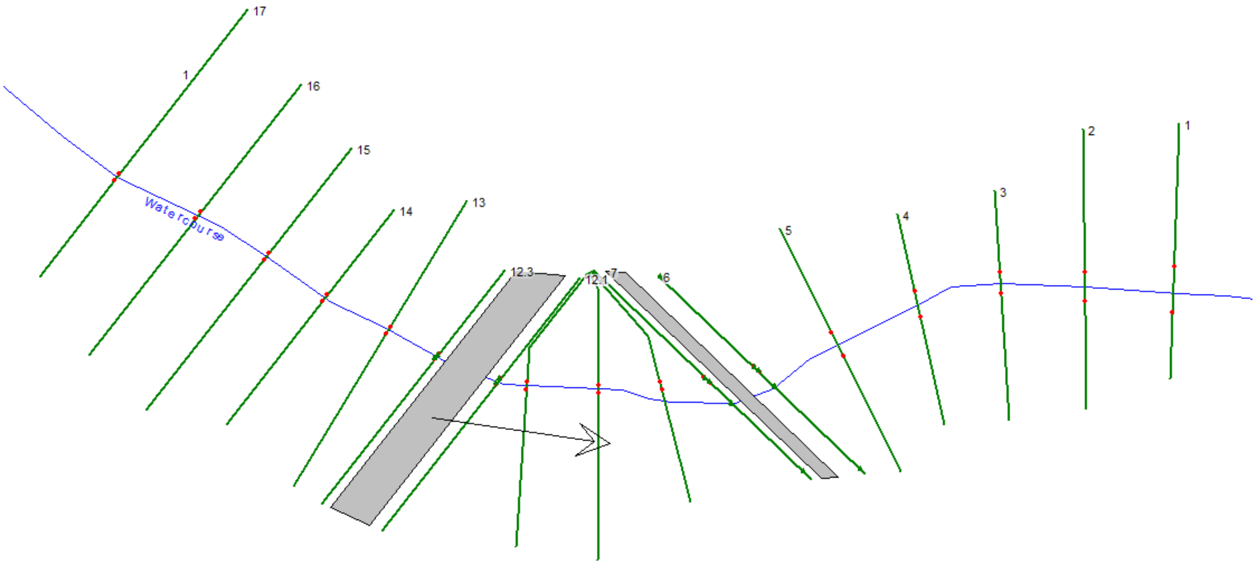


Figure E.2: HEC-RAS Model Schematic – Proposed Condition

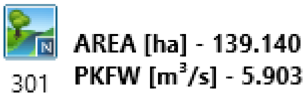


Figure E.3: VO5 Model Schematic – Flow for Floodplain Mapping

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

       V    V   I    SSSSS  U   U    A    L
       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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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\32d9a36d-94ea-430d-81b4-958ede1af514\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\32d9a36d-94ea-430d-81b4-958ede1af514\scena


DATE: 05-24-2018                           TIME: 03:51:37

USER:


COMMENTS: VO5 Model Output – Flow for Floodplain Mapping


--------------------------------------------------------------------------------------------
---------------
  ************************************************
  ** SIMULATION : Chicago_4hr_100yr             **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\Valdor\AppD
|                  |              ata\Local\Temp\
|                  |              044de69d-3027-42d0-b604-39d8a8aa92be\7454d05d
| Ptotal= 89.89 mm |    Comments:
--------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.08    2.55 |  1.08   29.10 |  2.08   14.80 |  3.08    4.24
                0.17    2.83 |  1.17   50.50 |  2.17   12.73 |  3.17    3.95
                0.25    3.16 |  1.25  113.67 |  2.25   11.09 |  3.25    3.70
                0.33    3.58 |  1.33  239.35 |  2.33    9.76 |  3.33    3.47
                0.42    4.09 |  1.42  141.25 |  2.42    8.68 |  3.42    3.26
                0.50    4.73 |  1.50   86.23 |  2.50    7.78 |  3.50    3.08
                0.58    5.57 |  1.58   58.55 |  2.58    7.02 |  3.58    2.91
                0.67    6.68 |  1.67   42.60 |  2.67    6.37 |  3.67    2.76
                0.75    8.21 |  1.75   32.53 |  2.75    5.82 |  3.75    2.62
                0.83   10.40 |  1.83   25.76 |  2.83    5.34 |  3.83    2.49
                0.92   13.73 |  1.92   20.97 |  2.92    4.93 |  3.92    2.37
                1.00   19.18 |  2.00   17.46 |  3.00    4.56 |  4.00    2.26

------------------------------------------------------------------------------

--------------------
| CALIB            |
```

```
| NASHYD   (  0301)|   Area    (ha)= 139.14   Curve Number   (CN)= 60.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.39

     Unit Hyd Qpeak  (cms)=   3.823

     PEAK FLOW       (cms)=   3.475 (i)
     TIME TO PEAK    (hrs)=   3.083
     RUNOFF VOLUME    (mm)=  27.185
     TOTAL RAINFALL   (mm)=  89.888
     RUNOFF COEFFICIENT   =   0.302

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

------------------------------------------------------------------------------
============================================================================================
===============

       V    V   I    SSSSS  U   U    A    L
       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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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\f38a096e-d274-4181-bca6-5bdf74fffc1b\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\f38a096e-d274-4181-bca6-5bdf74fffc1b\scena


DATE: 05-24-2018                           TIME: 03:51:37

USER:


COMMENTS: ____________________________________________________________


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  ************************************************
  ** SIMULATION : SCS_24hr_100yr                **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\Valdor\AppD
|                  |              ata\Local\Temp\
|                  |              044de69d-3027-42d0-b604-39d8a8aa92be\8aca5f92
| Ptotal=119.47 mm |    Comments:
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  6.50    2.39 | 12.75   17.21 | 19.00    2.15
                 0.50    1.20 |  6.75    2.39 | 13.00    8.84 | 19.25    2.15
                 0.75    1.20 |  7.00    2.39 | 13.25    8.84 | 19.50    2.15
```

```
                 1.00    1.20 |  7.25    2.39 | 13.50    1.67 | 19.75    2.15
                 1.25    1.20 |  7.50    2.39 | 13.75    1.67 | 20.00    2.15
                 1.50    1.20 |  7.75    2.39 | 14.00    9.80 | 20.25    2.15
                 1.75    1.20 |  8.00    2.39 | 14.25    9.80 | 20.50    1.43
                 2.00    1.20 |  8.25    2.39 | 14.50    3.58 | 20.75    1.43
                 2.25    2.15 |  8.50    3.23 | 14.75    3.58 | 21.00    1.43
                 2.50    1.55 |  8.75    3.23 | 15.00    3.58 | 21.25    1.43
                 2.75    1.55 |  9.00    3.23 | 15.25    3.58 | 21.50    1.43
                 3.00    1.55 |  9.25    3.23 | 15.50    3.58 | 21.75    1.43
                 3.25    1.55 |  9.50    3.82 | 15.75    3.58 | 22.00    1.43
                 3.50    1.55 |  9.75    3.82 | 16.00    3.58 | 22.25    1.43
                 3.75    1.55 | 10.00    4.30 | 16.25    3.58 | 22.50    1.43
                 4.00    1.55 | 10.25    4.30 | 16.50    2.15 | 22.75    1.43
                 4.25    1.55 | 10.50    5.50 | 16.75    2.15 | 23.00    1.43
                 4.50    1.91 | 10.75    5.50 | 17.00    2.15 | 23.25    1.43
                 4.75    1.91 | 11.00    7.41 | 17.25    2.15 | 23.50    1.43
                 5.00    1.91 | 11.25    7.41 | 17.50    2.15 | 23.75    1.43
                 5.25    1.91 | 11.50   11.47 | 17.75    2.15 | 24.00    1.43
                 5.50    1.91 | 11.75   11.47 | 18.00    2.15 | 24.25    1.43
                 5.75    1.91 | 12.00   49.71 | 18.25    2.15 |
                 6.00    1.91 | 12.25  131.93 | 18.50    2.15 |
                 6.25    1.91 | 12.50   17.21 | 18.75    2.15 |

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--------------------
| CALIB            |
| NASHYD   (  0301)|   Area    (ha)= 139.14   Curve Number   (CN)= 60.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.39

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


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 6.167    1.91 |12.250  131.93 | 18.33    2.15
                0.167    0.00 | 6.250    1.91 |12.333   17.22 | 18.42    2.15
                0.250    0.00 | 6.333    2.39 |12.417   17.21 | 18.50    2.15
                0.333    1.20 | 6.417    2.39 |12.500   17.21 | 18.58    2.15
                0.417    1.20 | 6.500    2.39 |12.583   17.21 | 18.67    2.15
                0.500    1.20 | 6.583    2.39 |12.667   17.21 | 18.75    2.15
                0.583    1.20 | 6.667    2.39 |12.750   17.21 | 18.83    2.15
                0.667    1.20 | 6.750    2.39 |12.833    8.84 | 18.92    2.15
                0.750    1.20 | 6.833    2.39 |12.917    8.84 | 19.00    2.15
                0.833    1.20 | 6.917    2.39 |13.000    8.84 | 19.08    2.15
                0.917    1.20 | 7.000    2.39 |13.083    8.84 | 19.17    2.15
                1.000    1.20 | 7.083    2.39 |13.167    8.84 | 19.25    2.15
                1.083    1.20 | 7.167    2.39 |13.250    8.84 | 19.33    2.15
                1.167    1.20 | 7.250    2.39 |13.333    1.67 | 19.42    2.15
                1.250    1.20 | 7.333    2.39 |13.417    1.67 | 19.50    2.15
                1.333    1.20 | 7.417    2.39 |13.500    1.67 | 19.58    2.15
                1.417    1.20 | 7.500    2.39 |13.583    1.67 | 19.67    2.15
                1.500    1.20 | 7.583    2.39 |13.667    1.67 | 19.75    2.15
                1.583    1.20 | 7.667    2.39 |13.750    1.67 | 19.83    2.15
                1.667    1.20 | 7.750    2.39 |13.833    9.80 | 19.92    2.15
                1.750    1.20 | 7.833    2.39 |13.917    9.80 | 20.00    2.15
                1.833    1.20 | 7.917    2.39 |14.000    9.80 | 20.08    2.15
                1.917    1.20 | 8.000    2.39 |14.083    9.80 | 20.17    2.15
                2.000    1.20 | 8.083    2.39 |14.167    9.80 | 20.25    2.15
                2.083    2.15 | 8.167    2.39 |14.250    9.80 | 20.33    1.43
                2.167    2.15 | 8.250    2.39 |14.333    3.58 | 20.42    1.43
                2.250    2.15 | 8.333    3.23 |14.417    3.58 | 20.50    1.43
                2.333    1.55 | 8.417    3.23 |14.500    3.58 | 20.58    1.43
                2.417    1.55 | 8.500    3.23 |14.583    3.58 | 20.67    1.43
                2.500    1.55 | 8.583    3.23 |14.667    3.58 | 20.75    1.43
                2.583    1.55 | 8.667    3.23 |14.750    3.58 | 20.83    1.43
                2.667    1.55 | 8.750    3.23 |14.833    3.58 | 20.92    1.43
                2.750    1.55 | 8.833    3.23 |14.917    3.58 | 21.00    1.43
```

```
                2.833    1.55 | 8.917    3.23 |15.000    3.58 | 21.08    1.43
                2.917    1.55 | 9.000    3.23 |15.083    3.58 | 21.17    1.43
                3.000    1.55 | 9.083    3.23 |15.167    3.58 | 21.25    1.43
                3.083    1.55 | 9.167    3.23 |15.250    3.58 | 21.33    1.43
                3.167    1.55 | 9.250    3.23 |15.333    3.58 | 21.42    1.43
                3.250    1.55 | 9.333    3.82 |15.417    3.58 | 21.50    1.43
                3.333    1.55 | 9.417    3.82 |15.500    3.58 | 21.58    1.43
                3.417    1.55 | 9.500    3.82 |15.583    3.58 | 21.67    1.43
                3.500    1.55 | 9.583    3.82 |15.667    3.58 | 21.75    1.43
                3.583    1.55 | 9.667    3.82 |15.750    3.58 | 21.83    1.43
                3.667    1.55 | 9.750    3.82 |15.833    3.58 | 21.92    1.43
                3.750    1.55 | 9.833    4.30 |15.917    3.58 | 22.00    1.43
                3.833    1.55 | 9.917    4.30 |16.000    3.58 | 22.08    1.43
                3.917    1.55 |10.000    4.30 |16.083    3.58 | 22.17    1.43
                4.000    1.55 |10.083    4.30 |16.167    3.58 | 22.25    1.43
                4.083    1.55 |10.167    4.30 |16.250    3.58 | 22.33    1.43
                4.167    1.55 |10.250    4.30 |16.333    2.15 | 22.42    1.43
                4.250    1.55 |10.333    5.50 |16.417    2.15 | 22.50    1.43
                4.333    1.91 |10.417    5.50 |16.500    2.15 | 22.58    1.43
                4.417    1.91 |10.500    5.50 |16.583    2.15 | 22.67    1.43
                4.500    1.91 |10.583    5.50 |16.667    2.15 | 22.75    1.43
                4.583    1.91 |10.667    5.50 |16.750    2.15 | 22.83    1.43
                4.667    1.91 |10.750    5.50 |16.833    2.15 | 22.92    1.43
                4.750    1.91 |10.833    7.41 |16.917    2.15 | 23.00    1.43
                4.833    1.91 |10.917    7.41 |17.000    2.15 | 23.08    1.43
                4.917    1.91 |11.000    7.41 |17.083    2.15 | 23.17    1.43
                5.000    1.91 |11.083    7.41 |17.167    2.15 | 23.25    1.43
                5.083    1.91 |11.167    7.41 |17.250    2.15 | 23.33    1.43
                5.167    1.91 |11.250    7.41 |17.333    2.15 | 23.42    1.43
                5.250    1.91 |11.333   11.47 |17.417    2.15 | 23.50    1.43
                5.333    1.91 |11.417   11.47 |17.500    2.15 | 23.58    1.43
                5.417    1.91 |11.500   11.47 |17.583    2.15 | 23.67    1.43
                5.500    1.91 |11.583   11.47 |17.667    2.15 | 23.75    1.43
                5.583    1.91 |11.667   11.47 |17.750    2.15 | 23.83    1.43
                5.667    1.91 |11.750   11.47 |17.833    2.15 | 23.92    1.43
                5.750    1.91 |11.833   49.71 |17.917    2.15 | 24.00    1.43
                5.833    1.91 |11.917   49.71 |18.000    2.15 | 24.08    1.43
                5.917    1.91 |12.000   49.71 |18.083    2.15 | 24.17    1.43
                6.000    1.91 |12.083  131.92 |18.167    2.15 | 24.25    1.43
                6.083    1.91 |12.167  131.93 |18.250    2.15 |

     Unit Hyd Qpeak  (cms)=   3.823

     PEAK FLOW       (cms)=   3.795 (i)
     TIME TO PEAK    (hrs)=  13.583
     RUNOFF VOLUME    (mm)=  44.822
     TOTAL RAINFALL   (mm)= 119.468
     RUNOFF COEFFICIENT   =   0.375

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

-------------------------------------------------------------------------------
============================================================================================
===============

       V    V   I    SSSSS  U   U    A    L
       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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```

```
                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\02a15476-f52d-42ef-b14e-6896fd5b9043\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\02a15476-f52d-42ef-b14e-6896fd5b9043\scena


DATE: 05-24-2018                           TIME: 03:51:37

USER:


COMMENTS: ____________________________________________________________

---------------------------------------------------------------------------------------------
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  ************************************************
  ** SIMULATION : TIMMINS                       **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\Valdor\AppD
|                  |              ata\Local\Temp\
|                  |              044de69d-3027-42d0-b604-39d8a8aa92be\054db87d
| Ptotal=193.00 mm |    Comments:
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25   15.00 |  3.25    3.00 |  6.25   43.00 |  9.25   13.00
                 0.50   15.00 |  3.50    3.00 |  6.50   43.00 |  9.50   13.00
                 0.75   15.00 |  3.75    3.00 |  6.75   43.00 |  9.75   13.00
                 1.00   15.00 |  4.00    3.00 |  7.00   43.00 | 10.00   13.00
                 1.25   20.00 |  4.25    5.00 |  7.25   20.00 | 10.25   13.00
                 1.50   20.00 |  4.50    5.00 |  7.50   20.00 | 10.50   13.00
                 1.75   20.00 |  4.75    5.00 |  7.75   20.00 | 10.75   13.00
                 2.00   20.00 |  5.00    5.00 |  8.00   20.00 | 11.00   13.00
                 2.25   10.00 |  5.25   20.00 |  8.25   23.00 | 11.25    8.00
                 2.50   10.00 |  5.50   20.00 |  8.50   23.00 | 11.50    8.00
                 2.75   10.00 |  5.75   20.00 |  8.75   23.00 | 11.75    8.00
                 3.00   10.00 |  6.00   20.00 |  9.00   23.00 | 12.00    8.00

-------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD   (  0301)|   Area    (ha)= 139.14   Curve Number   (CN)= 60.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.39

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


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083   15.00 | 3.083    3.00 | 6.083   43.00 |  9.08   13.00
                0.167   15.00 | 3.167    3.00 | 6.167   43.00 |  9.17   13.00
                0.250   15.00 | 3.250    3.00 | 6.250   43.00 |  9.25   13.00
                0.333   15.00 | 3.333    3.00 | 6.333   43.00 |  9.33   13.00
                0.417   15.00 | 3.417    3.00 | 6.417   43.00 |  9.42   13.00
                0.500   15.00 | 3.500    3.00 | 6.500   43.00 |  9.50   13.00
                0.583   15.00 | 3.583    3.00 | 6.583   43.00 |  9.58   13.00
                0.667   15.00 | 3.667    3.00 | 6.667   43.00 |  9.67   13.00
                0.750   15.00 | 3.750    3.00 | 6.750   43.00 |  9.75   13.00
                0.833   15.00 | 3.833    3.00 | 6.833   43.00 |  9.83   13.00
                0.917   15.00 | 3.917    3.00 | 6.917   43.00 |  9.92   13.00
                1.000   15.00 | 4.000    3.00 | 7.000   43.00 | 10.00   13.00
                1.083   20.00 | 4.083    5.00 | 7.083   20.00 | 10.08   13.00
                1.167   20.00 | 4.167    5.00 | 7.167   20.00 | 10.17   13.00
                1.250   20.00 | 4.250    5.00 | 7.250   20.00 | 10.25   13.00
                1.333   20.00 | 4.333    5.00 | 7.333   20.00 | 10.33   13.00
                1.417   20.00 | 4.417    5.00 | 7.417   20.00 | 10.42   13.00
                1.500   20.00 | 4.500    5.00 | 7.500   20.00 | 10.50   13.00
                1.583   20.00 | 4.583    5.00 | 7.583   20.00 | 10.58   13.00
                1.667   20.00 | 4.667    5.00 | 7.667   20.00 | 10.67   13.00
                1.750   20.00 | 4.750    5.00 | 7.750   20.00 | 10.75   13.00
                1.833   20.00 | 4.833    5.00 | 7.833   20.00 | 10.83   13.00
                1.917   20.00 | 4.917    5.00 | 7.917   20.00 | 10.92   13.00
                2.000   20.00 | 5.000    5.00 | 8.000   20.00 | 11.00   13.00
                2.083   10.00 | 5.083   20.00 | 8.083   23.00 | 11.08    8.00
                2.167   10.00 | 5.167   20.00 | 8.167   23.00 | 11.17    8.00
                2.250   10.00 | 5.250   20.00 | 8.250   23.00 | 11.25    8.00
                2.333   10.00 | 5.333   20.00 | 8.333   23.00 | 11.33    8.00
                2.417   10.00 | 5.417   20.00 | 8.417   23.00 | 11.42    8.00
                2.500   10.00 | 5.500   20.00 | 8.500   23.00 | 11.50    8.00
                2.583   10.00 | 5.583   20.00 | 8.583   23.00 | 11.58    8.00
                2.667   10.00 | 5.667   20.00 | 8.667   23.00 | 11.67    8.00
                2.750   10.00 | 5.750   20.00 | 8.750   23.00 | 11.75    8.00
                2.833   10.00 | 5.833   20.00 | 8.833   23.00 | 11.83    8.00
                2.917   10.00 | 5.917   20.00 | 8.917   23.00 | 11.92    8.00
                3.000   10.00 | 6.000   20.00 | 9.000   23.00 | 12.00    8.00

     Unit Hyd Qpeak  (cms)=   3.823

     PEAK FLOW      (cms)=   5.903 (i)
     TIME TO PEAK    (hrs)=   9.250
     RUNOFF VOLUME    (mm)=  97.285
     TOTAL RAINFALL   (mm)= 193.000
     RUNOFF COEFFICIENT   =   0.504

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

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 FINISH
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APPENDIX “F”

Stormwater Management Calculations

VALDOR ENGINEERING INC.
File: 17122
Date: October 2019

Table F.1: Existing Condition - VO5 Model Parameters

Subcatchment	Area (ha)	VO5 Routine	TIMP	XIMP	CN II	IA (mm)	Tp (hr)
101	3.67	NasHyd	-	-	68	7.0	0.33
102	1.10	NasHyd	-	-	59	5.0	0.37
103	2.58	NasHyd	-	-	68	7.0	0.40
104	3.97	NasHyd	-	-	68	7.0	0.46
Total	**11.32**						

Table F.2: Proposed Condition - VO5 Model Parameters

Subcatchment	Area (ha)	VO5 Routine	TIMP	XIMP	CN II	IA (mm)	Tp (hr)
201	3.47	NasHyd	-	-	61	4.9	0.35
202	1.10				[1]N/A		
203	1.76	StandHyd	35	20	59	5.0	-
204	1.52	NasHyd	-	-	61	4.9	0.32
205	3.47	NasHyd	-	-	59	5.0	0.50
Total	**11.32**						

Notes:

1) *Catchment 202* consists of external areas that might be development in the future. Should this area be developed, it is to provide its own stormwater management infrastructure (likely in the form of bioretention swales) in order to maintain pre-development flows. The associated pre-development catchment (*Catchment 102*) is therefore used in the proposed conditions VO5 model to simulate discharge from this catchment at pre-development flow rates.

VALDOR ENGINEERING INC.
File: 17122
Date: October 2019

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

Subcatchment	Area (ha)	Land Use and Land Cover		[1]CN II	Area Weighted CN II	[2]IA (mm)	Area Weighted IA (mm)	[3]C-Value	Area Weighted C-Value
		Type	Area (ha)						
101	3.67	Woods (HSG 'AB')	0.00	46	**68**	**10**	**7.0**	0.08	**0.22**
		Meadows (HSG 'AB')	0.00	51		**8**		0.10	
		Cultivated (HSG 'AB')	3.67	68		**7**		0.22	
		Lawns (HSG 'AB')	0.00	59		**5**		0.10	
		Other Impervious	0.00	100		**2**		0.95	

VALDOR ENGINEERING INC.
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Date: October 2019

Table F.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	[1]T_c (min)	[1]T_p (hr)
101	0.22	241	298.25	289.50	3.63	29.2	0.33
102	0.10	121	299.00	297.50	1.24	33.5	0.37
103	0.22	203	297.50	294.50	1.48	36.0	0.40
104	0.22	333	297.50	290.50	2.10	41.1	0.46
201	0.14	241	298.25	289.50	3.63	31.8	0.35
204	0.13	122	296.75	294.50	1.84	28.5	0.32
205	0.13	333	297.50	290.50	2.10	45.1	0.50

Notes:

1) T_p calculation is based on the Airport Method:

$$T_c = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{\ 0.33}} \qquad T_P = 0.67 T_c$$

Table F.5: Bioswale Storage Trench Dimensions and Equivalent Bottom Area

Bioswale #	Length (m)	Width (m)	Total Bottom Area (m^2)	Void Ratio	Equivalent Bottom Area Available for Storage Based on Void Ratio (m^2)
1	37.5	1.2	45.0	0.4	18.0
2	42.0	1.2	50.4	0.4	20.2
3	40.5	1.2	48.6	0.4	19.4
4	37.5	1.2	45.0	0.4	18.0
5	40.5	1.2	48.6	0.4	19.4
6	26.0	1.2	31.2	0.4	12.5
7	45.0	1.2	54.0	0.4	21.6
8	60.5	1.2	72.6	0.4	29.0
9	48.5	1.2	58.2	0.4	23.3
10	48.5	1.2	58.2	0.4	23.3
11	32.0	1.2	38.4	0.4	15.4
12	36.0	1.2	43.2	0.4	17.3
Total	494.5	-	593.4	**-**	**237.4**

Table F.6: Bioswale Storage Trench Stage/Storage/Discharge Curve

Stage Storage Curve						**Outlet Structure**				
								Discharge (m^3/s)		
Elevation Above Bottom of Trench (m)	[1]Total Trench Sectional Area (m^2)	Average Bottom Area (m^2)	Sectional Volume (m^3)	Cumulative Volume (m^3)	Active Storage (m^3)	Invert Elevation(m) Diameter(mm)/Length(m) Box Orifice Height (m) Orifice Area (m^2)	Stage Active (m)	Typ. Orifice 0.40 75 - 0.0044	[2]Total Flow (1 orifice per trench for a total of 12 orifices)	**Comments:**
										Spillway Design: $Q=1.67xLxH^{1.5}$ Orifice Eq'n: $Q = 0.6A(2gH)^{0.5}$
0.00	237	-	-	0		**Bottom of Trench**				
0.10	237	237	24	24						**Infiltration Provided Below Outlet Invert**
0.20	237	237	24	47						
0.30	237	237	24	71						
0.40	237	237	24	95	0	**Outlet Invert**	0.00	0.000	**0.000**	
0.50	237	237	24	119	24		0.10	0.002	**0.028**	
0.60	237	237	24	142	47		0.20	0.005	**0.057**	
0.70	237	237	24	166	71		0.30	0.006	**0.072**	
0.80	237	237	24	190	95		0.40	0.007	**0.085**	
0.90	237	237	24	214	119		0.50	0.008	**0.096**	
1.00	237	237	24	237	142		0.60	0.009	**0.106**	
1.10	237	237	24	261	166		0.70	0.010	**0.115**	
1.20	237	237	24	285	190		0.80	0.010	**0.123**	
1.30	237	237	24	309	214		0.90	0.011	**0.131**	
1.40	237	237	24	332	237		1.00	0.012	**0.138**	
1.50	237	237	24	356	261		1.10	0.012	**0.145**	
1.60	237	237	24	380	285	**Top of Trench**	1.20	0.013	**0.152**	
2.40	0	0	0	380	285	**Ground/Top of Swale**	2.00	0.016	**0.197**	

NOTES:

1) The total trench sectional area is based on the equivalent trench bottom area available for storage, based on the void ratio, as indicated in **Table F.5**.

2) Each of the 12 bioswales will be equipped with a 75 mm diameter orifice. The total discharge (as entered into the VO5 model) is therefore 12x the discharge of a single 75 mm orifice.

Table F.7: TSS Removal (Site Drainage Area to Bioswales)

Surface Type	[1]Area (Ha)	Effective TSS Removal	% Area	Weighted Overall TSS Removal
Rooftop	0.040	80%	2.3%	1.8%
Pavement	0.575	0%	32.7%	0.0%
Landscape	1.145	80%	65.1%	52.0%
Total (before bioswales)	1.760		100.0%	**53.9%**
[2]Bioswales provide an additional 75% removal rate to the remaining possible TSS removal of 46.1% (ie. 100.0% - 53.9% = 46.1%), for an additional overall TSS removal of 34.6% (46.1% x 75% = 34.6 %).		75%	100.0%	34.6%
Total (after bioswales)	1.760		100.0%	**88.5%**

Notes:
1) Only the proposed development draining to the bioswales (*Catchment 203* , 1.76 ha) is considered for the quality control calculations. If the external drainage area is to be developed in the future, it shall provided it's own quality control.
2) The proposed bioswales have a TSS removal efficiency of 75%, as per *Section 3.6.1 - LID/Best Management Practices Removal Efficiencies* of the *Low Impact Development Treatment Train Tool Help Guide* (Lake Simcoe Region Conservation Authority, Credit Valley Conservation, Toronto and Region Conservation Authority, 2017).

Bioswale Flow Capacity: 5-year Event

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00500	m/m
Left Side Slope	5.00	m/m (H:V)
Right Side Slope	5.00	m/m (H:V)
Discharge	0.128	m³/s

Results

Normal Depth	0.23	m
Flow Area	0.27	m²
Wetted Perimeter	2.37	m
Hydraulic Radius	0.11	m
Top Width	2.32	m
Critical Depth	0.17	m
Critical Slope	0.02816	m/m
Velocity	0.47	m/s
Velocity Head	0.01	m
Specific Energy	0.24	m
Froude Number	0.44	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.23	m
Critical Depth	0.17	m
Channel Slope	0.00500	m/m
Critical Slope	0.02816	m/m

Bioswale Flow Velocity: 25mm Event

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.02000	m/m
Left Side Slope	5.00	m/m (H:V)
Right Side Slope	5.00	m/m (H:V)
Discharge	0.019	m³/s

Results

Normal Depth	0.09	m
Flow Area	0.04	m²
Wetted Perimeter	0.89	m
Hydraulic Radius	0.04	m
Top Width	0.88	m
Critical Depth	0.08	m
Critical Slope	0.03632	m/m
Velocity	0.50	m/s
Velocity Head	0.01	m
Specific Energy	0.10	m
Froude Number	0.76	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.09	m
Critical Depth	0.08	m
Channel Slope	0.02000	m/m
Critical Slope	0.03632	m/m

ROW 22m Wide: Major Flow

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	m/m
Discharge	0.211	m³/s

Section Definitions

Station (m)	Elevation (m)
0+00	0.30
0+07	0.15
0+07	0.00
0+11	0.12
0+15	0.00
0+15	0.15
0+22	0.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.30)	(0+07, 0.15)	0.035
(0+07, 0.15)	(0+15, 0.15)	0.013
(0+15, 0.15)	(0+22, 0.30)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.10	m
Elevation Range	0.00 to 0.30 m	
Flow Area	0.30	m²
Wetted Perimeter	6.54	m

ROW 22m Wide: Major Flow

Results

Hydraulic Radius	0.05	m
Top Width	6.34	m
Normal Depth	0.10	m
Critical Depth	0.10	m
Critical Slope	0.00474	m/m
Velocity	0.70	m/s
Velocity Head	0.02	m
Specific Energy	0.12	m
Froude Number	1.02	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.10	m
Critical Depth	0.10	m
Channel Slope	0.00500	m/m
Critical Slope	0.00474	m/m

ROW Overflow Channel: Major Flow

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.20000	m/m
Left Side Slope	4.00	m/m (H:V)
Right Side Slope	4.00	m/m (H:V)
Bottom Width	1.50	m
Discharge	0.211	m³/s

Results

Normal Depth	0.06	m
Flow Area	0.11	m²
Wetted Perimeter	2.03	m
Hydraulic Radius	0.06	m
Top Width	2.02	m
Critical Depth	0.11	m
Critical Slope	0.02701	m/m
Velocity	1.86	m/s
Velocity Head	0.18	m
Specific Energy	0.24	m
Froude Number	2.51	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.06	m
Critical Depth	0.11	m
Channel Slope	0.20000	m/m

ROW Spillway: Major Flow

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	0.211	m³/s
Crest Elevation	0.00	m
Tailwater Elevation	0.00	m
Crest Surface Type	Gravel	
Crest Breadth	2.00	m
Crest Length	3.00	m

Results

Headwater Elevation	0.13	m
Headwater Height Above Crest	0.13	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.47	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.47	SI
Flow Area	0.39	m²
Velocity	0.53	m/s
Wetted Perimeter	3.26	m
Top Width	3.00	m

Valdor Engineering Inc.
File: 17112
Date: October 2019

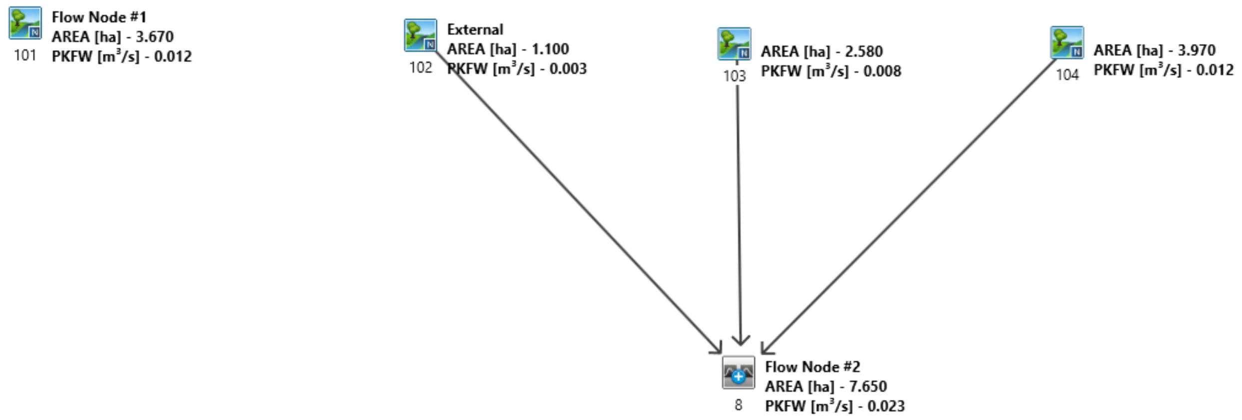

Figure F.1: VO5 Model Schematic – Pre-Development Condition

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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
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       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: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : 25mmchi                       **
  ************************************************

  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 ]
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    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.01  2.08   2.36 0.09   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
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    remark:
*
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*
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    [ Ptot= 25.02 mm ]
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21821791e5b9\3ef95cde-092c-4778-a88f-032e
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.01  2.17   2.36 0.09   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\3ef95cde-092c-4778-a88f-032e
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.01  2.33   2.36 0.09   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.01  2.17   2.26  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.02  2.25   2.31  n/a   0.000
*
 FINISH

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       V    V   I    SSSSS  U   U    A    L
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         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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f5bcedbf072b\6250bdea-6198-45fd-83b1-3d7d4d24bdfb\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\6250bdea-6198-45fd-83b1-3d7d4d24bdfb\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_002yr             **
  ************************************************

  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                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.04  1.75   5.05 0.15   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.01  1.83   4.15 0.12   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.03  1.92   5.05 0.15   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.04  2.00   5.05 0.15   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.04  1.83   4.78  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.07  1.92   4.92  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\dc9c8a8d-1272-4df6-936d-38af232cde52\scena
```

```
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\dc9c8a8d-1272-4df6-936d-38af232cde52\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_005yr             **
  ************************************************

  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                 5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.10  1.75  11.17 0.23   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                 5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.02  1.83   8.98 0.18   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.06  1.92  11.18 0.23   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.08  1.92  11.18 0.23   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.08  1.83  10.52  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.16  1.92  10.86  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
```

```
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2a2e1d49-b5c7-47c0-9895-4a90c40aa5cd\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2a2e1d49-b5c7-47c0-9895-4a90c40aa5cd\scena


DATE: 05-29-2018                         TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_010yr            **
  ************************************************

  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                 5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.14  1.75  15.57 0.27   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                 5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.03  1.83  12.49 0.21   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.09  1.83  15.57 0.27   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
```

```
*
    READ STORM                 5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.12  1.92  15.57 0.27   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.12  1.83  14.65  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.24  1.92  15.13  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\db2a6cd5-c837-414a-8b3e-95be457ec0f8\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\db2a6cd5-c837-414a-8b3e-95be457ec0f8\scena


DATE: 05-29-2018                         TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_025yr            **
  ************************************************

  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                 5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.21  1.75  22.66 0.32   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
```

```
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.05  1.83  18.24 0.25   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.13  1.83  22.66 0.32   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.18  1.92  22.66 0.32   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.18  1.83  21.34  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.36  1.92  22.03  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\93390687-3d21-4e21-9067-a3169caf0fd3\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\93390687-3d21-4e21-9067-a3169caf0fd3\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________
```

```


  ************************************************
  ** SIMULATION : Chicago_4hr_050yr             **
  ************************************************

  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                  5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.26  1.75  27.88 0.35   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                  5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.06  1.83  22.53 0.28   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                  5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.16  1.83  27.88 0.35   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                  5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.23  1.92  27.88 0.35   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.22  1.83  26.28  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.45  1.92  27.11  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2fc9ed8c-3e7a-4b80-aa0f-14bfb26a21c3\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2fc9ed8c-3e7a-4b80-aa0f-14bfb26a21c3\scena


DATE: 05-29-2018                           TIME: 01:23:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_100yr             **
  ************************************************

  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                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD        0101  1  5.0    3.67    0.33  1.75  33.93 0.38   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD        0102  1  5.0    1.10    0.07  1.83  27.56 0.31   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD        0103  1  5.0    2.58    0.20  1.83  33.94 0.38   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD        0104  1  5.0    3.97    0.29  1.92  33.94 0.38   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
```

```
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.28  1.83  32.03  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.56  1.92  33.02  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\a6a66d4c-1b56-495f-a232-72e2d462b4b0\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\a6a66d4c-1b56-495f-a232-72e2d462b4b0\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_002yr                **
  ************************************************

  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= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD        0101  1  5.0    3.67    0.06 12.42  10.30 0.22   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD        0102  1  5.0    1.10    0.01 12.50   8.28 0.17   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
```

```
*
    READ STORM                 15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.04 12.50  10.30 0.22   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.05 12.58  10.30 0.22   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.05 12.50    9.70  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.11 12.58  10.01  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2597c3a0-9735-459b-8988-ce319bbc554c\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2597c3a0-9735-459b-8988-ce319bbc554c\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_005yr                **
  ************************************************

  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= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.13 12.42  19.93 0.30   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                 15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.03 12.50  16.02 0.24   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.08 12.50  19.93 0.30   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.11 12.58  19.93 0.30   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.10 12.50  18.76  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.21 12.58  19.37  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\7dd6d3e5-2f77-4504-bf1a-d68ad0152b11\scena
```

```
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\7dd6d3e5-2f77-4504-bf1a-d68ad0152b11\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_010yr                **
  ************************************************

  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= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.17 12.42  27.43 0.34   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.04 12.50  22.16 0.28   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.11 12.50  27.43 0.34   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.15 12.58  27.43 0.34   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.15 12.50  25.85  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.29 12.58  26.67  n/a   0.000
*
==============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
```

```
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\3ef0e9e5-17ba-4190-b6f8-d3ecbd2ccc61\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\3ef0e9e5-17ba-4190-b6f8-d3ecbd2ccc61\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_025yr                **
  ************************************************

  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= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.24 12.42  37.76 0.39   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.05 12.50  30.77 0.32   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.15 12.50  37.76 0.39   0.000
    [CN=68.0        ]
    [ N = 3.0:Tp 0.40]
```

```
*
    READ STORM                 15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.21 12.58  37.76 0.39   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.20 12.50  35.67  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.41 12.58  36.76  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2a9546e4-8ba7-44d6-97c6-e88e6438be0d\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2a9546e4-8ba7-44d6-97c6-e88e6438be0d\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_050yr                **
  ************************************************

  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=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.30 12.42  45.97 0.43   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
```

```
*
    READ STORM                 15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.07 12.50  37.72 0.35   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.18 12.50  45.98 0.43   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                 15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.26 12.58  45.98 0.43   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.25 12.50  43.51  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.50 12.50  44.79  n/a   0.000
*
============================================================================================
===============


       V    V   I    SSSSS  U   U    A    L
       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 5.0\VO2\voin.dat
  Output  filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\59e40f23-ceb7-4721-9c29-b273f706801a\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\59e40f23-ceb7-4721-9c29-b273f706801a\scena


DATE: 05-29-2018                           TIME: 01:23:16

USER:


COMMENTS: ____________________________________________________________
```

```
  ************************************************
  ** SIMULATION : SCS_24hr_100yr                **
  ************************************************

  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=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0101  1  5.0    3.67    0.36 12.42  54.51 0.46   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.33]
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.08 12.50  45.02 0.38   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0103  1  5.0    2.58    0.22 12.50  54.52 0.46   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.40]
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\b7d4359b-92e1-46ae-b5a0-
21821791e5b9\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0104  1  5.0    3.97    0.30 12.58  54.52 0.46   0.000
    [CN=68.0         ]
    [ N = 3.0:Tp 0.46]
*
    ADD [  0102+  0103]  0008  3  5.0    3.68    0.30 12.50  51.68  n/a   0.000
*
    ADD [  0008+  0104]  0008  1  5.0    7.65    0.60 12.50  53.15  n/a   0.000
*
```

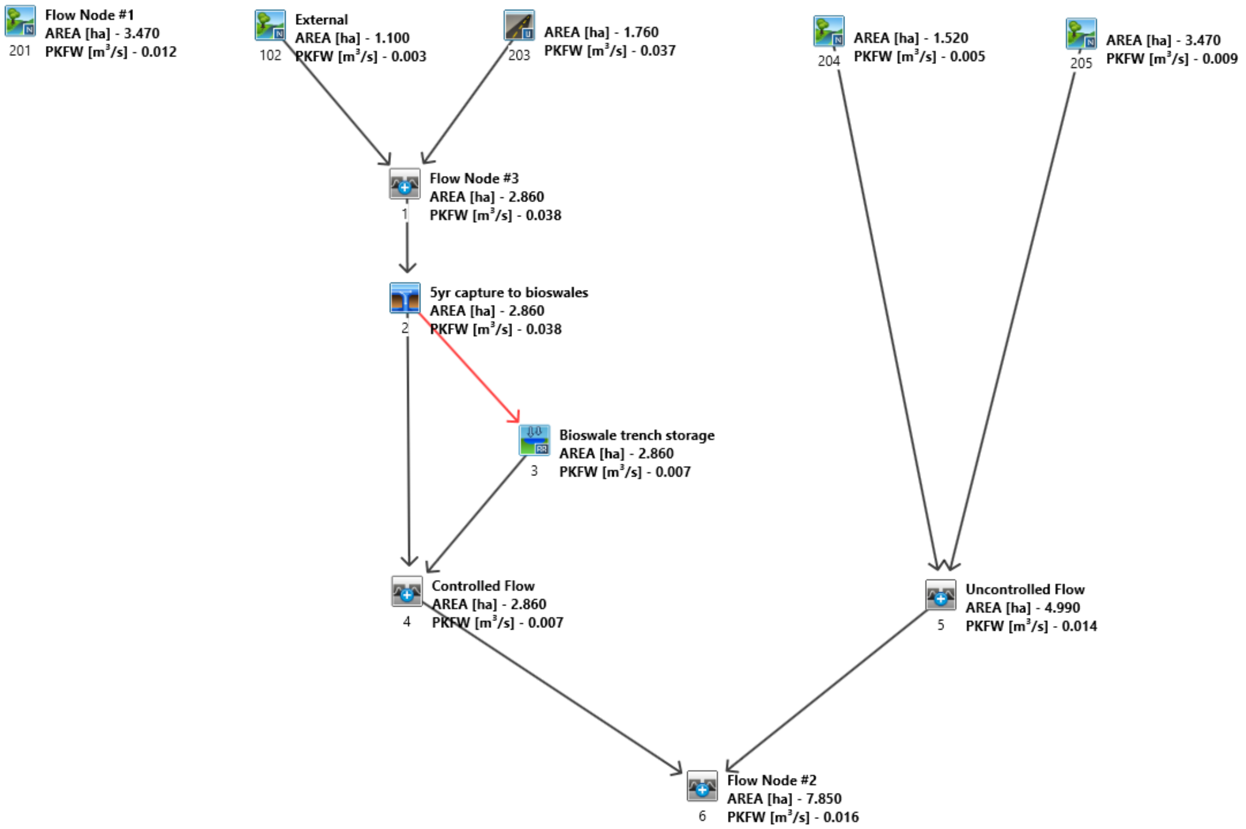

Figure F.2: VO5 Model Schematic – Post-Development Condition

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

       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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\55ee2a7f-7aae-4d5c-8902-b10b37051502\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\55ee2a7f-7aae-4d5c-8902-b10b37051502\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : 25mmchi                       **
  ************************************************

  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\e9937693-20cb-4a18-959c-
fd9b12b6a073\3ef95cde-092c-4778-a88f-032e
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.01  2.00   2.22 0.09   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\3ef95cde-092c-4778-a88f-032e
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.01  2.00   2.22 0.09   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\3ef95cde-092c-4778-a88f-032e
```

```
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.01  2.25   2.04 0.08   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.01  2.17   2.09  n/a   0.000
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\3ef95cde-092c-4778-a88f-032e
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.00  2.08   2.04 0.08   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 10.0
    [ Ptot= 25.02 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\3ef95cde-092c-4778-a88f-032e
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.04  1.50   6.73 0.27   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.04  1.50   4.92  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.04  1.50   4.92  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.00    0.00  0.00   0.00  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.86    0.04  1.50   4.92  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.86    0.01  3.50   1.60  n/a   0.000
      {ST=  0.00 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.01  3.50   1.60  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.02  3.33   1.91  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\ed3a2e7c-fd74-4629-a284-08ffb9eb42ec\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\ed3a2e7c-fd74-4629-a284-08ffb9eb42ec\scena


DATE: 10-03-2019                           TIME: 10:57:15
```

```
USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_002yr            **
  ************************************************

  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                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.04  1.75   4.48 0.13   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.02  1.75   4.48 0.13   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.03  2.00   4.15 0.12   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.04  1.92   4.25  n/a   0.000
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.01  1.83   4.15 0.12   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 34.23 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8ab5ad10-0f48-4253-a08a-702d
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.10  1.33  10.63 0.31   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.10  1.33   8.14  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.10  1.33   8.14  n/a   0.000
```

```
       MAJOR SYSTEM:     0002  2  5.0    0.00    0.00  0.00   0.00  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.86    0.10  1.33   8.14  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.86    0.03  2.08   4.81  n/a   0.000
      {ST=  0.00 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.03  2.08   4.81  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.06  2.00   4.46  n/a   0.000
*
 FINISH

============================================================================================
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============================================================================================
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       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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\662a0fc6-859d-421f-b609-c01d71286567\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\662a0fc6-859d-421f-b609-c01d71286567\scena


DATE: 10-03-2019                         TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_005yr            **
  ************************************************

  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                 5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.08  1.83   9.63 0.19   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
```

```
*
    READ STORM                  5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.03  1.75   9.63 0.19   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                  5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.06  2.00   8.98 0.18   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.09  1.92   9.18  n/a   0.000
*
    READ STORM                  5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8138b3db-7f27-405d-809a-9a43
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.02  1.83   8.98 0.18   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                  5.0
    [ Ptot= 49.56 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8138b3db-7f27-405d-809a-9a43
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.13  1.33  18.27 0.37   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.13  1.33  14.70  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.13  1.33  14.70  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.00    0.00  1.33  14.70  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.86    0.13  1.33  14.70  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.86    0.06  2.00  11.37  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.06  2.00  11.37  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.15  1.92   9.98  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\9437b666-b4d1-4f6a-9fe4-a49ac1120d7c\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\9437b666-b4d1-4f6a-9fe4-a49ac1120d7c\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_010yr             **
  ************************************************

  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                  5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.11  1.75  13.35 0.23   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                  5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.05  1.75  13.35 0.23   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                  5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.08  2.00  12.50 0.21   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.13  1.92  12.76  n/a   0.000
*
    READ STORM                  5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.03  1.83  12.49 0.21   0.000
```

```
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                  5.0
    [ Ptot= 58.63 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\ecada1de-6e05-4f3e-b64f-12a7
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.16  1.33  23.35 0.40   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.16  1.33  19.17  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.16  1.33  19.17  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.06    0.04  1.33  19.17  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.80    0.13  1.33  19.17  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.80    0.08  2.00  15.78  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.08  2.00  15.85  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.21  1.92  13.88  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\e396291d-f855-4831-8cb0-ba01211c18b4\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\e396291d-f855-4831-8cb0-ba01211c18b4\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_025yr             **
  ************************************************

  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                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.16  1.75  19.42 0.27   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.08  1.75  19.42 0.27   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.12  2.00  18.25 0.25   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.19  1.92  18.60  n/a   0.000
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\685dd626-3b41-405f-a04e-5d98
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.05  1.83  18.24 0.25   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                  5.0
    [ Ptot= 71.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\685dd626-3b41-405f-a04e-5d98
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.19  1.33  31.22 0.44   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.20  1.33  26.23  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.20  1.33  26.23  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.30    0.07  1.33  26.23  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.56    0.13  1.33  26.23  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.56    0.10  2.08  22.51  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.11  1.67  22.90  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.29  1.83  20.17  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\264464bc-f93f-4159-9e9d-db33d8464cb0\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\264464bc-f93f-4159-9e9d-db33d8464cb0\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : Chicago_4hr_050yr             **
  ************************************************

  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                 5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.20  1.75  23.92 0.30   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                 5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.09  1.75  23.92 0.30   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                 5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.15  2.00  22.53 0.28   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
```

```
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.24  1.92  22.96  n/a   0.000
*
    READ STORM                 5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\de894682-31de-42cb-934a-2264
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.06  1.83  22.53 0.28   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 80.34 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\de894682-31de-42cb-934a-2264
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.23  1.33  36.85 0.46   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.24  1.33  31.34  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.24  1.33  31.34  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.57    0.11  1.33  31.34  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.29    0.13  1.33  31.34  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.29    0.10  2.17  27.18  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.16  1.58  28.02  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.37  1.75  24.80  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\1f0df8e5-0136-40a1-a0f3-72a4c98cb595\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\1f0df8e5-0136-40a1-a0f3-72a4c98cb595\scena


DATE: 10-03-2019                           TIME: 10:57:14

USER:


COMMENTS: ____________________________________________________________
```

```
  ************************************************
  ** SIMULATION : Chicago_4hr_100yr             **
  ************************************************

  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                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.25  1.75  29.19 0.32   0.000
    [CN=61.0        ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.12  1.75  29.19 0.32   0.000
    [CN=61.0        ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.19  2.00  27.57 0.31   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.29  1.92  28.06  n/a   0.000
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.07  1.83  27.56 0.31   0.000
    [CN=59.0        ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 5.0
    [ Ptot= 89.89 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\7454d05d-51ae-40c2-9047-7b74
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.26  1.33  43.28 0.48   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.27  1.33  37.23  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.27  1.33  37.23  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.79    0.14  1.33  37.23  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.07    0.13  1.33  37.23  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.07    0.11  2.25  32.65  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.21  1.58  33.91  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.47  1.75  30.19  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\cd9e5b07-4d5b-4614-be1f-2a5bd65f7801\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\cd9e5b07-4d5b-4614-be1f-2a5bd65f7801\scena


DATE: 10-03-2019                          TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_002yr                **
  ************************************************

  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= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.05 12.50   8.89 0.19   0.000
    [CN=61.0        ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.02 12.42   8.89 0.19   0.000
    [CN=61.0        ]
    [ N = 3.0:Tp 0.32]
```

```
*
    READ STORM                15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.04 12.67   8.29 0.17   0.000
    [CN=59.0          ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.06 12.58   8.47  n/a   0.000
*
    READ STORM                15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\4740d578-5912-48f6-b0dd-d859
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.01 12.50   8.28 0.17   0.000
    [CN=59.0          ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot= 47.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\4740d578-5912-48f6-b0dd-d859
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.06 12.25  17.23 0.36   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.07 12.25  13.79  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.07 12.25  13.79  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.00    0.00  0.00   0.00  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.86    0.07 12.25  13.79  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.86    0.04 12.75  10.46  n/a   0.000
      {ST=  0.01 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.04 12.75  10.46  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.09 12.58   9.20  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\87604373-ac29-4506-a9cf-745f24250e2e\scena
```

```
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\87604373-ac29-4506-a9cf-745f24250e2e\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_005yr                **
  ************************************************

  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= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.10 12.50  17.07 0.26   0.000
    [CN=61.0          ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.04 12.42  17.07 0.26   0.000
    [CN=61.0          ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.07 12.67  16.02 0.24   0.000
    [CN=59.0          ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.11 12.50  16.34  n/a   0.000
*
    READ STORM                15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.03 12.50  16.02 0.24   0.000
    [CN=59.0          ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot= 66.79 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\c8c709b6-5ebb-49f5-9c34-3f38
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.10 12.25  28.22 0.42   0.000
```

```
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.12 12.25  23.53  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.12 12.25  23.53  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.00    0.00  0.00   0.00  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.86    0.12 12.25  23.53  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.86    0.07 12.67  20.20  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.07 12.67  20.20  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.18 12.58  17.75  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2633f70a-5a8a-4a06-bcca-f07c45f9991f\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\2633f70a-5a8a-4a06-bcca-f07c45f9991f\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_010yr                **
  ************************************************

  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= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.13 12.50  23.53 0.30   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
```

```
*
    READ STORM                 15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.06 12.42  23.53 0.30   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                 15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.10 12.67  22.16 0.28   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.15 12.50  22.58  n/a   0.000
*
    READ STORM                 15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.04 12.50  22.16 0.28   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                 15.0
    [ Ptot= 79.60 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\789b73b3-9d94-41c7-9517-94ca
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.13 12.25  36.36 0.46   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.16 12.25  30.90  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.16 12.25  30.90  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.04    0.03 12.25  30.90  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.82    0.13 12.17  30.90  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.82    0.09 12.67  27.53  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.11 12.25  27.58  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.25 12.58  24.40  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\c5950f05-6ae0-4f03-b70d-49aa7e820d7f\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\c5950f05-6ae0-4f03-b70d-49aa7e820d7f\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_025yr                **
  ************************************************

  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= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.19 12.50  32.54 0.34   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.09 12.42  32.54 0.34   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.14 12.67  30.77 0.32   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.21 12.50  31.31  n/a   0.000
*
    READ STORM                15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\304f617c-1542-4b56-97b9-57db
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.05 12.50  30.77 0.32   0.000
```

```
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot= 95.68 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\304f617c-1542-4b56-97b9-57db
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.18 12.25  47.30 0.49   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.21 12.25  40.94  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.21 12.25  40.94  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.21    0.08 12.25  40.94  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.65    0.13 12.08  40.94  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.65    0.10 12.75  37.36  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.16 12.25  37.62  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.35 12.50  33.61  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\835c0dc3-5d95-44f9-9c85-ba588d9dac4c\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\835c0dc3-5d95-44f9-9c85-ba588d9dac4c\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_050yr                **
  ************************************************

  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=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.23 12.50  39.79 0.37   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.11 12.42  39.78 0.37   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.17 12.67  37.72 0.35   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.26 12.50  38.35  n/a   0.000
*
    READ STORM                15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.07 12.50  37.72 0.35   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot=107.61 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\bcbd752a-fcc8-4226-b284-03bc
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.23 12.25  55.85 0.52   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.28 12.25  48.88  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.28 12.25  48.88  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.35    0.15 12.25  48.88  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.51    0.13 12.08  48.88  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.51    0.11 12.83  45.08  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.23 12.25  45.55  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.43 12.42  40.97  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\541ef274-ef17-4302-b9bc-64f0c3a2927b\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\541ef274-ef17-4302-b9bc-64f0c3a2927b\scena


DATE: 10-03-2019                           TIME: 10:57:15

USER:


COMMENTS: ____________________________________________________________


  ************************************************
  ** SIMULATION : SCS_24hr_100yr                **
  ************************************************

  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=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.27 12.42  47.38 0.40   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.13 12.42  47.38 0.40   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.20 12.67  45.03 0.38   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
```

```
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.32 12.50  45.74  n/a   0.000
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.08 12.50  45.02 0.38   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot=119.47 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\8aca5f92-48ed-4344-86fc-c747
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.27 12.25  64.65 0.54   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.33 12.25  57.10  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.33 12.25  57.10  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.46    0.20 12.25  57.10  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.40    0.13 12.08  57.10  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.40    0.11 12.92  53.14  n/a   0.000
      {ST=  0.02 ha.m }
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.29 12.25  53.78  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.53 12.42  48.67  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\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\460892bb-abd1-4adf-bdf0-1021ac6b6e17\scena
  Summary filename: C:\Users\Valdor\AppData\Local\Civica\VH5\c5d7a53e-68a7-49cd-8ccf-
f5bcedbf072b\460892bb-abd1-4adf-bdf0-1021ac6b6e17\scena


DATE: 10-03-2019                           TIME: 10:57:15

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 ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\054db87d-ec65-400a-99d5-5e9a
    remark:
*
 ** CALIB NASHYD         0201  1  5.0    3.47    0.24  7.08 100.93 0.52   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.35]
*
    READ STORM                15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\054db87d-ec65-400a-99d5-5e9a
    remark:
*
 ** CALIB NASHYD         0204  1  5.0    1.52    0.11  7.00 100.92 0.52   0.000
    [CN=61.0         ]
    [ N = 3.0:Tp 0.32]
*
    READ STORM                15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\054db87d-ec65-400a-99d5-5e9a
    remark:
*
 ** CALIB NASHYD         0205  1  5.0    3.47    0.21  7.17  96.96 0.50   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.50]
*
    ADD [  0204+  0205]  0005  3  5.0    4.99    0.31  7.08  98.16  n/a   0.000
*
    READ STORM                15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\054db87d-ec65-400a-99d5-5e9a
    remark:
*
 ** CALIB NASHYD         0102  1  5.0    1.10    0.07  7.08  96.95 0.50   0.000
    [CN=59.0         ]
    [ N = 3.0:Tp 0.37]
*
    READ STORM                15.0
    [ Ptot=193.00 mm ]
    fname : C:\Users\Valdor\AppData\Local\Temp\e9937693-20cb-4a18-959c-
fd9b12b6a073\054db87d-ec65-400a-99d5-5e9a
    remark:
*
 *  CALIB STANDHYD       0203  1  5.0    1.76    0.14  7.00 124.12 0.64   0.000
    [I%=20.0:S%= 2.00]
*
    ADD [  0102+  0203]  0001  3  5.0    2.86    0.21  7.00 113.67  n/a   0.000
*
    DUHYD                0002  1  5.0    2.86    0.21  7.00 113.67  n/a   0.000
       MAJOR SYSTEM:     0002  2  5.0    0.23    0.09  7.00 113.67  n/a   0.000
       MINOR SYSTEM:     0002  3  5.0    2.63    0.13  6.25 113.67  n/a   0.000
*
    RESRVR [ 2:  0002]   0003  1  5.0    2.63    0.13  9.17 110.05  n/a   0.000
      {ST=  0.03 ha.m }
```

```
*
    ADD [  0002+  0003]  0004  3  5.0    2.86    0.20  7.00 110.34  n/a   0.000
*
    ADD [  0004+  0005]  0006  3  5.0    7.85    0.50  7.00 102.60  n/a   0.000
*
```

APPENDIX “G”

Water Balance Calculations

VALDOR ENGINEERING INC.
File: 17122
Date: August 2020

Table G.1: Infiltration Trench Calculations

[1] *Total Req'd Annual Infiltration Volume to Achieve Target (m^3)*	*Infiltration Trench Volume Provided (m^3)*	[2] *Req'd Design Storm Depth to Achieve Annual Infiltration Requirements (Assuming Ia=4.0 mm) (mm)*	[3] *Initial Abstraction (Trench Drainage Area) (mm)*	*Minimum Drainage Area Required to Infiltration Trenches (ha)*	[4] *Total Drainage Area Available to Infiltration Trenches (ha)*	*Total Annual Rainfall Depth (Per 1981-2010 Climate Normals for Orangeville) (mm)*	*Total Rainfall Depth Available for Infiltration Per Rainfall Analysis Assuming Ia=4.0mm (mm)*	*Total Actual Annual Infiltration Volume per Design (m^3)*
2,290	94.9	15.0	4.0	0.86	1.76	750.1	317.99	**2,745**

Design Infiltration Rate

In-Situ Measured Infiltration Rate (mm/hr):	**22.5**
Factor of Safety:	**2.5**
P, Design Soil Infiltration Rate (mm/h):	**9.0**

Maximum Allowable Depth

P, Design Soil Infiltration Rate (mm/h):	**9.0**
T, Max. Allowable Drawdown Time (hr):	**48**
d, Max. Allowable Depth (m):	**0.43**

$$d = \frac{P \cdot T}{1000}$$

$Equation\ 4.2, Stormwater\ Management\ Planning\ and\ Design\ Manual, MOE, 2003$

Minimum Bottom Area

V, Storage Volume Provided (m³):	**94.9**
P, Design Soil Infiltration Rate (mm/h):	**9.0**
n, Void Ratio (clear stone):	**0.40**
Δt, Max. Drawdown Time (hr):	**48**
A, Min. Bottom Area (m²):	**549**

$$A = \frac{1000 \cdot V}{P \cdot n \cdot \Delta t}$$

$Equation\ 4.3, Stormwater\ Management\ Planning\ and\ Design\ Manual, MOE, 2003$

Drawdown Time Based on Design Depth

P, Design Soil Infiltration Rate (mm/h):	**9.0**
d, Design Depth (m):	**0.40**
T, Drawdown Time (hr):	**44.4**

Infiltration Trench Design

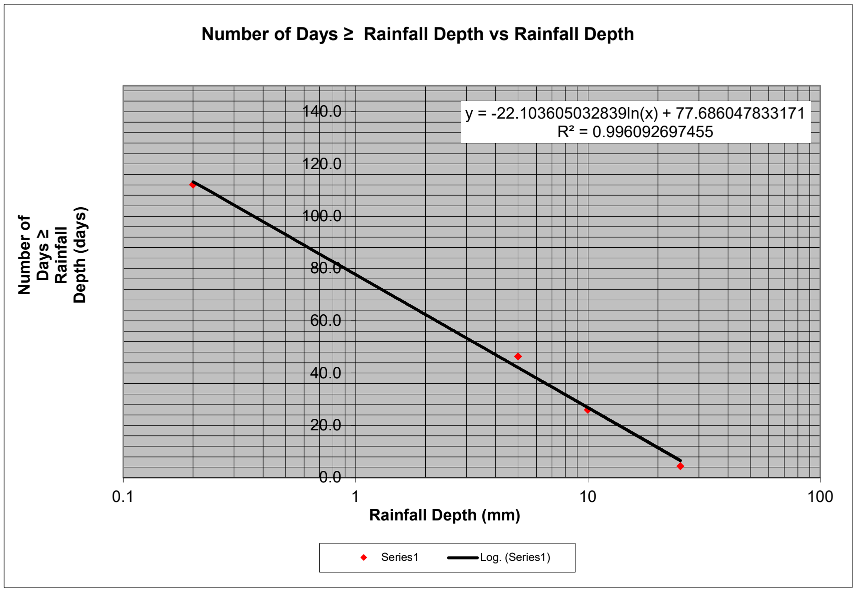
Infiltration Trench Location	**Length (m)**	**Width (m)**	**Design Depth (m)**	**Bottom Area (m²)**	**Void Ratio**	**Infiltration Volume (m³)**
Bioswale #1	37.5	1.20	0.40	45	0.40	7.2
Bioswale #2	42.0	1.20	0.40	50	0.40	8.1
Bioswale #3	40.5	1.20	0.40	49	0.40	7.8
Bioswale #4	37.5	1.20	0.40	45	0.40	7.2
Bioswale #5	40.5	1.20	0.40	49	0.40	7.8
Bioswale #6	26.0	1.20	0.40	31	0.40	5.0
Bioswale #7	45.0	1.20	0.40	54	0.40	8.6
Bioswale #8	60.5	1.20	0.40	73	0.40	11.6
Bioswale #9	48.5	1.20	0.40	58	0.40	9.3
Bioswale #10	48.5	1.20	0.40	58	0.40	9.3
Bioswale #11	32.0	1.20	0.40	38	0.40	6.1
Bioswale #12	36.0	1.20	0.40	43	0.40	6.9
					Total Infiltration Volume Provided (m³):	**94.9**
					Total Bottom Area Provided (m²):	**593**

Notes:

(1) The annual water balance infiltration deficit is 658 m3, as per the *Hydrogeological Impact Study* (Sirati & Partners Consultants Ltd., 23 April 2018).
(2) Infiltration trench volume should be sized based on the runoff generated by a 4-hr 15-mm event or smaller (SWMPDM, MOE, 2003).
(3) The area-weighted initial abstraction for *Catchment 203* is 4.0 mm (2 mm for impervious x 35% + 5 mm for lawns x 65% = 4.0 mm)
(4) Drainage area should be sufficient to provide required runoff quantity.
(3) The maximum allowable depth of the infiltration facility is based on the soil infiltrate rate and the retention time.
(4) It is feasible to convey the runoff to the infiltration facility.
(5) The seasonal high water table should be at least 1 m below the infiltration trench.

VALDOR ENGINEERING INC.
File: 17122
Date: August 2020

Table G2: Rainfall Analysis



Normal Rainfall Depth (mm)	Normal Days ≥ Rainfall Depth (days)
0.2	112.0
5	46.4
10	25.9
25	4.4

Orangeville MOE Climate Normals (1981-2010)
750.1 Normal Annual Rainfall Depth (mm)
112.0 Normal Annual Days with Rainfall (≥ 0.2 mm)
901.5 Normal Annual Precipitation Depth (mm)

Simulated Depth (mm)	Simulated Days ≥ Sim Depth (days)	Average Event Depth (mm)	Simulated Days Equal to Avg Depth (days)	Assumed IA (mm)	Runoff (Rain - IA) (mm)	INF Design Storm (mm)	Event Based Maximum Design INF Depth (mm)	Event Based Design INF Depth (mm)	Annual Incremental Design INF Depth (mm)	Annual Cumulative Design INF Depth (mm)	Annual Incremental Total Rain Depth (mm)	Annual Percent of Total Rain (%)	Annual Cumulative Total Rain Depth (mm)	Annual Cumulative Percent of Total Depth (%)
0.2	113.26													
0.5	93.01	0.2 - 0.5	20.25	**4.00**	0.00	**15.00**	11.00	0.00	0.00	0.00		0.000	0.0	0.0%
1.5	68.72	1	24.28	4.00	0.00	15.00	11.00	0.00	0.00	0.00	24.28	0.032	24.3	3.2%
2.5	57.43	2	11.29	4.00	0.00	15.00	11.00	0.00	0.00	0.00	22.58	0.030	46.9	6.2%
3.5	50.00	3	7.44	4.00	0.00	15.00	11.00	0.00	0.00	0.00	22.31	0.030	69.2	9.2%
4.5	44.44	4	5.55	4.00	0.00	15.00	11.00	0.00	0.00	0.00	22.22	0.030	91.4	12.2%
5.5	40.00	5	4.44	4.00	1.00	15.00	11.00	1.00	4.44	4.44	22.18	0.030	113.6	15.1%
6.5	36.31	6	3.69	4.00	2.00	15.00	11.00	2.00	7.38	11.82	22.15	0.030	135.7	18.1%
7.5	33.15	7	3.16	4.00	3.00	15.00	11.00	3.00	9.49	21.31	22.14	0.030	157.9	21.0%
8.5	30.38	8	2.77	4.00	4.00	15.00	11.00	4.00	11.07	32.38	22.13	0.030	180.0	24.0%
9.5	27.92	9	2.46	4.00	5.00	15.00	11.00	5.00	12.29	44.67	22.13	0.029	202.1	26.9%
10.5	25.71	10	2.21	4.00	6.00	15.00	11.00	6.00	13.27	57.94	22.12	0.029	224.3	29.9%
11.5	23.70	11	2.01	4.00	7.00	15.00	11.00	7.00	14.08	72.02	22.12	0.029	246.4	32.8%
12.5	21.86	12	1.84	4.00	8.00	15.00	11.00	8.00	14.74	86.76	22.12	0.029	268.5	35.8%
13.5	20.16	13	1.70	4.00	9.00	15.00	11.00	9.00	15.31	102.07	22.11	0.029	290.6	38.7%
14.5	18.58	14	1.58	4.00	10.00	15.00	11.00	10.00	15.80	117.87	22.11	0.029	312.7	41.7%
15.5	17.10	15	1.47	4.00	11.00	15.00	11.00	11.00	16.22	134.08	22.11	0.029	334.8	44.6%
16.5	15.72	16	1.38	4.00	12.00	15.00	11.00	11.00	15.20	149.28	22.11	0.029	356.9	47.6%
17.5	14.42	17	1.30	4.00	13.00	15.00	11.00	11.00	14.31	163.59	22.11	0.029	379.0	50.5%
18.5	13.19	18	1.23	4.00	14.00	15.00	11.00	11.00	13.51	177.10	22.11	0.029	401.2	53.5%
19.5	12.03	19	1.16	4.00	15.00	15.00	11.00	11.00	12.80	189.90	22.11	0.029	423.3	56.4%
20.5	10.92	20	1.11	4.00	16.00	15.00	11.00	11.00	12.16	202.06	22.11	0.029	445.4	59.4%
21.5	9.87	21	1.05	4.00	17.00	15.00	11.00	11.00	11.58	213.64	22.11	0.029	467.5	62.3%
22.5	8.87	22	1.00	4.00	18.00	15.00	11.00	11.00	11.05	224.69	22.11	0.029	489.6	65.3%
23.5	7.90	23	0.96	4.00	19.00	15.00	11.00	11.00	10.57	235.27	22.11	0.029	511.7	68.2%
24.5	6.98	24	0.92	4.00	20.00	15.00	11.00	11.00	10.13	245.40	22.11	0.029	533.8	71.2%
25.5	6.10	25	0.88	4.00	21.00	15.00	11.00	11.00	9.73	255.13	22.11	0.029	555.9	74.1%
26.5	5.25	26	0.85	4.00	22.00	15.00	11.00	11.00	9.35	264.48	22.11	0.029	578.0	77.1%
27.5	4.43	27	0.82	4.00	23.00	15.00	11.00	11.00	9.01	273.48	22.11	0.029	600.1	80.0%
28.5	3.64	28	0.79	4.00	24.00	15.00	11.00	11.00	8.68	282.17	22.11	0.029	622.2	83.0%
29	3.26	≥ 29	3.26	4.00	25.00	15.00	11.00	11.00	35.82	**317.99**	127.87	0.170	750.1	100.0%

HYDROGEOLOGICAL IMPACT STUDY
Proposed New Sub-Division
0 Mount Pleasant Road
Town of Caledon, Ontario

Prepared for:

Tropical Land Development Limited
c/o David Goodman
1500-439 University Ave
Toronto, ON M5G 1Y8

Prepared By:

SIRATI & PARTNERS CONSULTANTS LIMITED

Project: SP17-212-00
October 17, 2019

12700 Keele Street
King City, Ontario L7B 1H5
Tel: 905.833.1582
Fax:905.833.5360

- Promote awareness of the importance of SGRAs and HVAs by means of sign boards explaining the linkage between surface activities and their impact on groundwater quality and quantity.
- A salt management plan may be considered to be developed and implemented.

14. WATER BALANCE

Based on the site topographic map and the existing surficial drainage, the Subject Property can be bisected topographically into two (2) catchments, Catchment 1 and Catchment 2, as depicted in Figures 3-1 to 3-3. Accordingly, as per the "Hydrogeological Assessment Submissions" Conservation Authority Guidelines for Development Applications, June 2013, a preliminary water balance was completed separately for Catchment 1 and Catchment 2.

A preliminary water balance for the Site was calculated for both pre-development and post-development conditions in order to assess the change in overall rate of infiltration. Impermeable and permeable surfaces in pre-development and post-development plans were identified and their surface areas (as measured and cross-checked using the drawings/information provided by the Client) were used for calculating the amount of run-off and infiltration. The pre- and post-development plans consist of different types of surface as listed in Table 14.1.

Table 14.1: Pre-and Post-development Statistics for Catchments 1 and 2

Catchment 1: **Type of Land Coverage**	**Pre-Development** **Area (m^2)**	**Post- Development** **Area (m^2)**
Roofs	0	2,050
Roadway/Paving/Parking	0	9,200
Landscape/Vegetated Area	67,100	55,850
Total	**67,100**	**67,100**
Catchment 2: **Type of Land Coverage**	**Pre-Development** **Area (m^2)**	**Post- Development** **Area (m^2)**
Roofs	-	750
Roadway/Paving/Parking	-	1,800
Landscape/Vegetated Area	55,700	53,150
Total	**55,700**	**55,700**

14.1 Site Level Water Balance

Based on the Thornthwaite and Mather methodology (1957), the water balance is an accounting of water in the hydrologic cycle. Precipitation (P) falls as rain and snow. It can run off towards lakes and streams (R), infiltrate to the groundwater table (I), or evaporate from ground or evapotranspiration by vegetation (ET). When long-term average values of P, R, I, and ET are used, there is minimal or no net change to groundwater storage (ΔS).

The annual water budget can be expressed as:

$$P = ET + R + I + \Delta S$$

Where:

P = Precipitation (mm/year)

ET = Evapotranspiration (mm/year)

R = Run-off (mm/year)

I = Infiltration (mm/year)

ΔS = Change in groundwater storage (taken as zero) (mm/year)

14.2 Climatic Data

Monthly average temperature and precipitation data were obtained from Environment Canada, for Orangeville WPCP station (climate identifier: 6155790) as the nearest station located at about 8 km distance from the Property. Data was available between the years 1962 to 2006. Temporal variations of temperature and precipitation are shown on Figures 14-1 and 14-2.

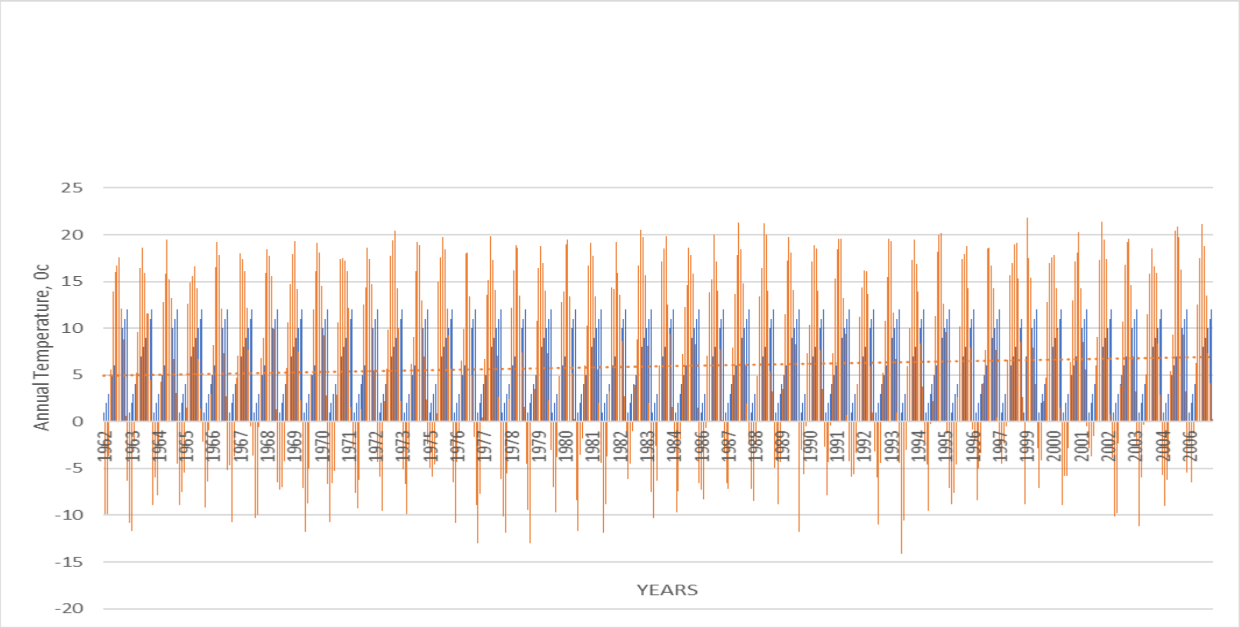


Figure 14-1: Mean Annual Temperature at the Site

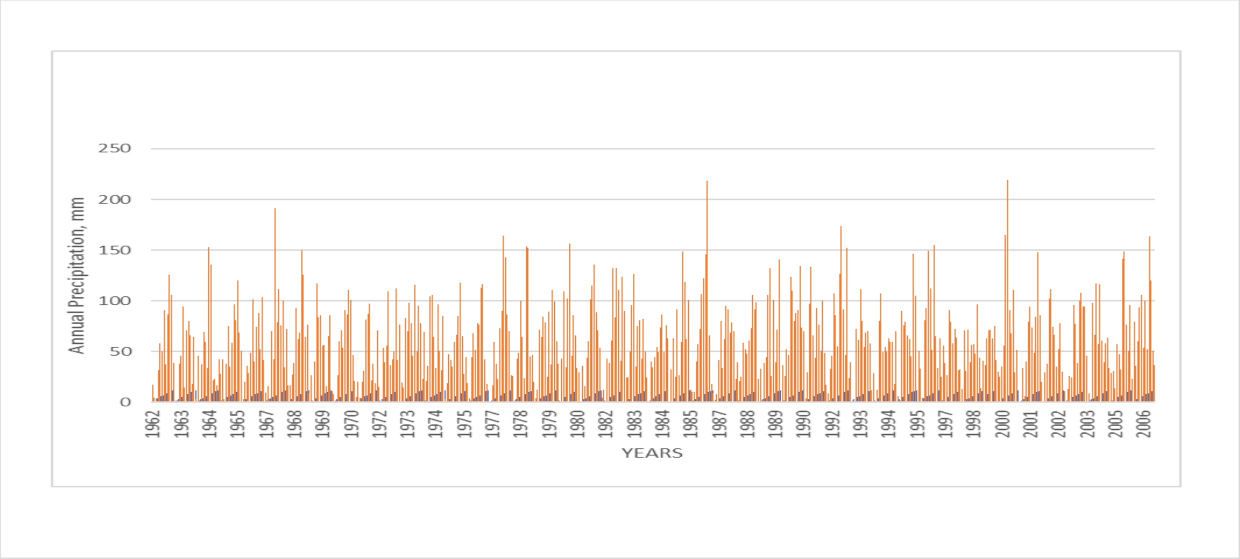


Figure 14-2: Mean Annual Precipitation at the Site

Average monthly variations of both temperature and precipitation were calculated for the period from 1962 to 2006 and is presented below on Figures 14-3 and 14-4, respectively. The highest temperature was recorded in the month of July, while the highest rainfall was in the month of August.

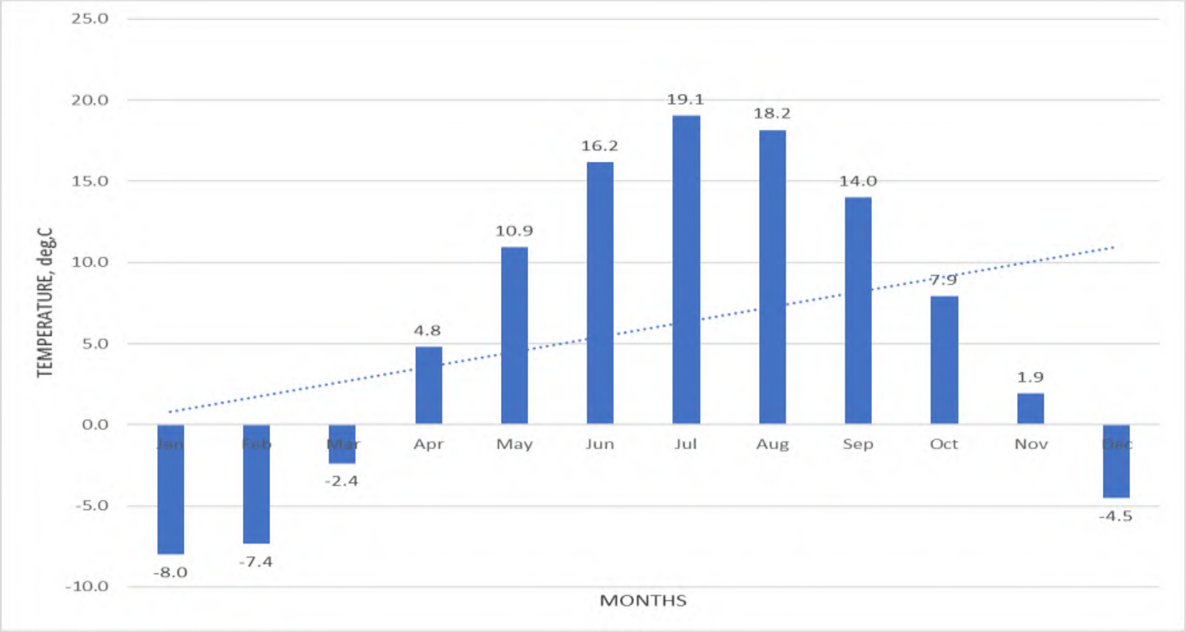


Figure 14-3: Average Monthly Temperature at the Site

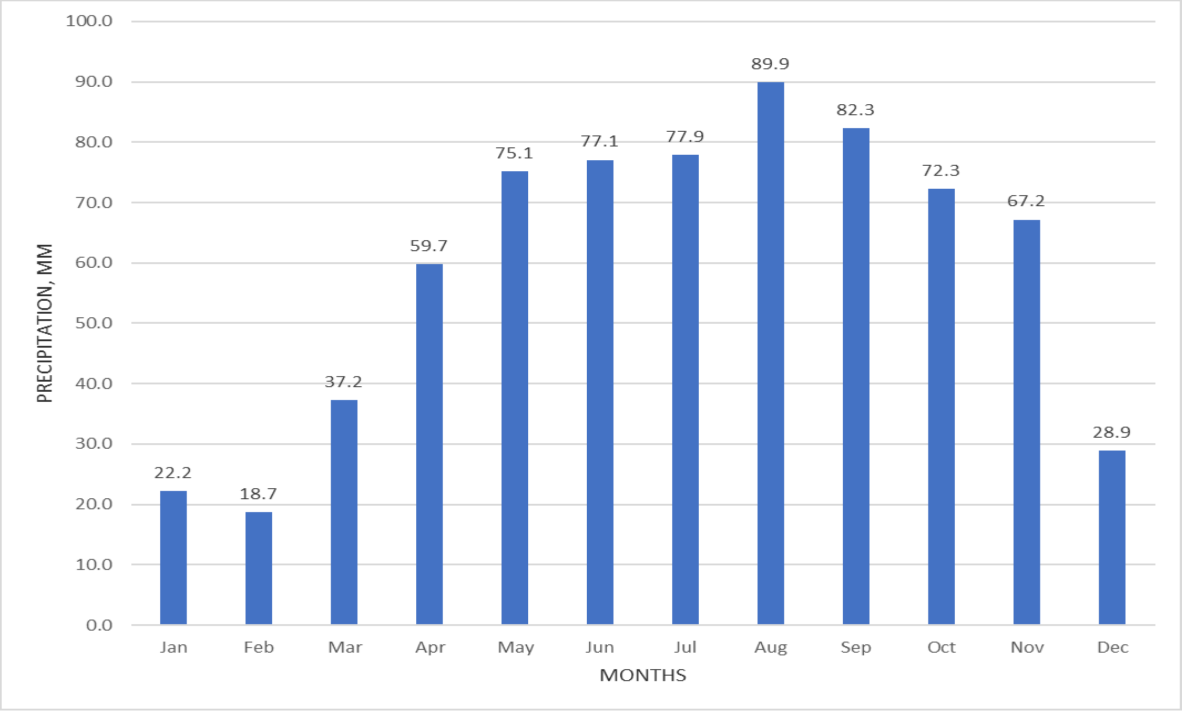


Figure 14-4: Average Monthly Precipitation at the Site

14.3 Infiltration and Runoff

Potential evapotranspiration was estimated to be about 529 mm/annum using the USGS Thornthwaite Monthly Water Balance software (Appendix C) utilizing average monthly temperature and precipitation results of Environment Canada Orangeville weather station.

As mentioned above, given the potential evapotranspiration at 529 mm/annum and the average annual precipitation of 725 mm/annum, there is a net water surplus of 196 (=725-529) mm/annum occurring at the Site, which can either infiltrate into subsurface or go as run-off.

The rate of infiltration at a site is expected to vary, based on a number of factors to be considered in any infiltration model. To partition the available water surpluses into infiltration and surface run-off, the Ministry of Environment (MOE) infiltration factor was used. The MOE Storm Water Management Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding run-off component was calculated for the soil moisture storage conditions. Please, note that MOE has been changed into Ministry of Environment, Conservation and Parks (MECP).

14.4 Water Balance – Catchment 1

The calculation of infiltration and runoff in the stages of pre-development and post-development is provided in Appendix C, and are presented in Tables 14-2 to 14-5, below.

Table 14-2: Annual Pre-Development Water Balance

Land Use		**Area (m^2)**	**Precipitation (m3)**	**Evapotranspiration (m^3)**	**Infiltration (m^3)**	**Run-off (m^3)**
Impervious Areas	Paved Area	0	0	0	0	0
	Roof Area	0	0	0	0	0
Pervious Areas	Landscape	67,100	48,648	28,397	11,138	9,113
Total		**67,100**	**48,648**	**28,397**	**11,138**	**9,113**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

Table 14-3: Annual Post-Development Water Balance

Land Use		Area (m2)	Precipitation (m3)	Evapotranspiration (m3)	Infiltration (m3)	Run-off (m3)
Impervious Areas	Paved Area	9200	6,670	667	0	6,003
	Roof Area	2050	1,486	149	0	1,338
Pervious Areas	Landscape Area	55850	40,491	23,636	9,271	7,585
		67,100	**48,648**	**24,451**	**9,271**	**14,926**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

Table 14-4: Comparison of Pre- and Post Development Water Balance Components

	Precipitation (m3)	Evapotranspiration (m3)	Infiltration (m3)	Run-off (m3)
Pre-Development	**48,648**	**28,397**	**11,138**	**9,113**
Post-Development	**48,648**	**24,451**	**9,271**	**14,926**
Change in %			**-17**	**64**

Table 14-5: Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration	11,138
Volume of Post-Development Infiltration	9,271
Deficit from Pre to Post Development Infiltration	1,867
Percentage of **Roof Runoff** required to match the pre-development infiltration (%)	140

14.5 Summary of Water Balance Calculation- Catchment 1

Based on the above calculations, a summary could be made as follows:

1) There is a net increase in run-off at the Site of about 5,813 m^3/annum (or 64% increase), from 9,113 m^3/annum to 14,926 m^3/annum. This increase is a result of the development of the Site with more impervious areas such as roof and paved areas, and reduction in pervious areas.
2) Without implementation of mitigation measures, there is a net deficit of about 1,867 m^3 /annum (17% declikrease) in the post-development infiltration from 11,138 m^3 to 9,271 m^3 on a yearly basis.
3) There is a volume of 1,338 m^3/annum collected from the roof area, which can be used for the enhanced infiltration for the purpose of implementing the Low Impact Development (LID) measures. However, the total volume is not sufficient to compensate for the total infiltration

deficit. Extra source should be considered.

14.6 Water Balance – Catchment 2

The detailed calculations for Catchment 2 are provided in Appendix C, and are presented in Tables 14-6 to 14-9, below.

Table 14-6: Annual Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	0	0	0	0	0
	Roof Area	0	0	0	0	0
Pervious Areas	Landscape	55,700	40,383	23,572	9,246	7,565
Total		**55,700**	**40,383**	**23,572**	**9,246**	**7,565**

Table 14-7: Annual Post-Development Water Balance

Land Use		Area (m2)	Precipitation (m3)	Evapotranspiration (m3)	Infiltration (m3)	Run-off (m3)
Impervious Areas	Paved Area	1800	1,305	131	0	1,175
	Roof Area	750	544	54	0	489
Pervious Areas	Landscape Area	53150	38,534	22,493	8,822	7,218
		55,700	**40,383**	**22,678**	**8,822**	**8,882**
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

Table 14-8: Comparison of Pre- and Post Development Water Balance Components

	Precipitation (m3)	Evapotranspiration (m3)	Infiltration (m3)	Run-off (m3)
Pre-Development	**40,383**	**23,572**	**9,246**	**7,565**
Post-Development	**40,383**	**22,678**	**8,822**	**8,882**
Change in %			**-5**	**17**

Table 14-9: Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration	9,246
Volume of Post-Development Infiltration	8,822
Deficit from Pre to Post Development Infiltration	423
Percentage of ***Roof Runoff*** required to match the pre-development infiltration (%)	86

14.7 Summary of Water Balance Calculation- Catchment 2

Based on the above calculations, a summary could be made as follows:

1) There is a net increase in run-off at the Site of about 1,446 m^3/annum (or 19% increase), from 7,565 m^3/annum to 8,882 m^3/annum.
2) Without implementation of mitigation measures, there is a net deficit of about 423 m^3 /annum (or 5% decrease) in the post-development infiltration from 9,246 m^3 to 8,822 m^3 on a yearly basis.
3) There is a net volume of 489 m^3/annum collected from the roof area, which can be used for the enhanced infiltration for the purpose of implementing the Low Impact Development (LID) measures. This volume is sufficient for compensate for the total infiltration deficit in Catchment 2 area.

14.8 Discussions on LID Measures

Based on the above water balance calculations, an infiltration deficit will be anticipated in an amount of 1,867 m^3/year in Catchment 1 Area, and 423 m^3/year in Catchment 2 Area, with a total amount of 2,290 m^3/year at the whole Site.

On the other hand, a total amount of 1,827 m^3/year of roof water is expected at the whole Site, which can be used to compensate for the infiltration deficit through implementing LID measures. However, this volume does not fully cover the total anticipated infiltration deficit. Other sources of clean water should be considered, such as collecting and diverting the runoff in the proposed landscaped areas for infiltration.

Based on the borehole drilling and observations, the soils at shallow depths were found to be mainly composed of sand and/or silty sand, which have relatively high infiltration rates and are good for application and implementation of the LID measures.

It should be noted that SIRATI is not providing any design of LID techniques since selection and designing of applicable LID techniques shall be conducted by engineering designers.

It is understood that road side bio-retention swales have been proposed to be used in the development project. The water will flow along the length of the bioretention swale and filter through a 0.50 m deep filtration media to a 1.2 m wide by 1.2 m deep stone trench below for infiltration.

Considering that the Site is located in a significant groundwater recharge area, the quality of the water to be used for infiltration shall be considered in order to protect the groundwater from contamination.

15. WATER QUALITY

The Nottawasaga Valley Conservation Authority (NVCA), in their review comments on this report has requested to provide a background water quality characterization of the unconfined/groundwater table aquifer. Accordingly, groundwater samples were collected from monitoring wells MW1, MW2 and MW4 on July 17, 2019, and analyzed as per Water Quality Assessment package provided by AGAT laboratories. The analytical results for the groundwater samples are provided in Laboratory Certificate of Analysis in Appendix D.

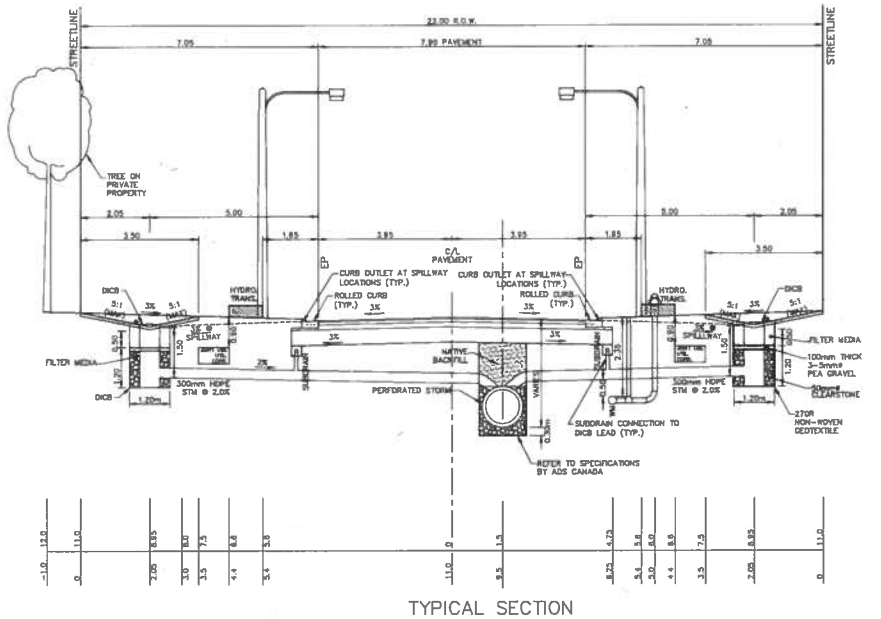
The results were compared to Ontario Drinking Water Quality Standards (ODWQS)-Aesthetic Objectives and Operational Guidelines, and are summarized in Table 15-1.

Table 15-1: Guideline Violation of Groundwater Samples Compared to ODWQS-AO&OG

Sample ID	Parameter	Guideline	Guideline Value (mg/L)	Measured Concentration (mg/L)
MW1	Aluminum	ODWQS	0.1	2.30
MW1	Iron	ODWQS	0.3	2.65
MW1	Manganese	ODWQS	0.05	0.834
MW1	Total Hardness (as $CaCO_3$)	ODWQS	80-100	321
MW1	Turbidity	ODWQS	5	7480
MW1	Nitrate as N	ODWQS	10	33.1
MW2	Aluminum	ODWQS	0.1	0.719
MW2	Iron	ODWQS	0.3	1.31
MW2	Manganese	ODWQS	0.05	0.230
MW2	Total Hardness (as $CaCO_3$)	ODWQS	80-100	232
MW2	Turbidity	ODWQS	5	4210
MW4	Aluminum	ODWQS	0.1	0.802
MW4	Iron	ODWQS	0.3	0.654
MW4	Manganese	ODWQS	0.05	2.40
MW4	Total Hardness (as $CaCO_3$)	ODWQS	80-100	202
MW4	Turbidity	ODWQS	5	29700

APPENDIX “H”

Road Details



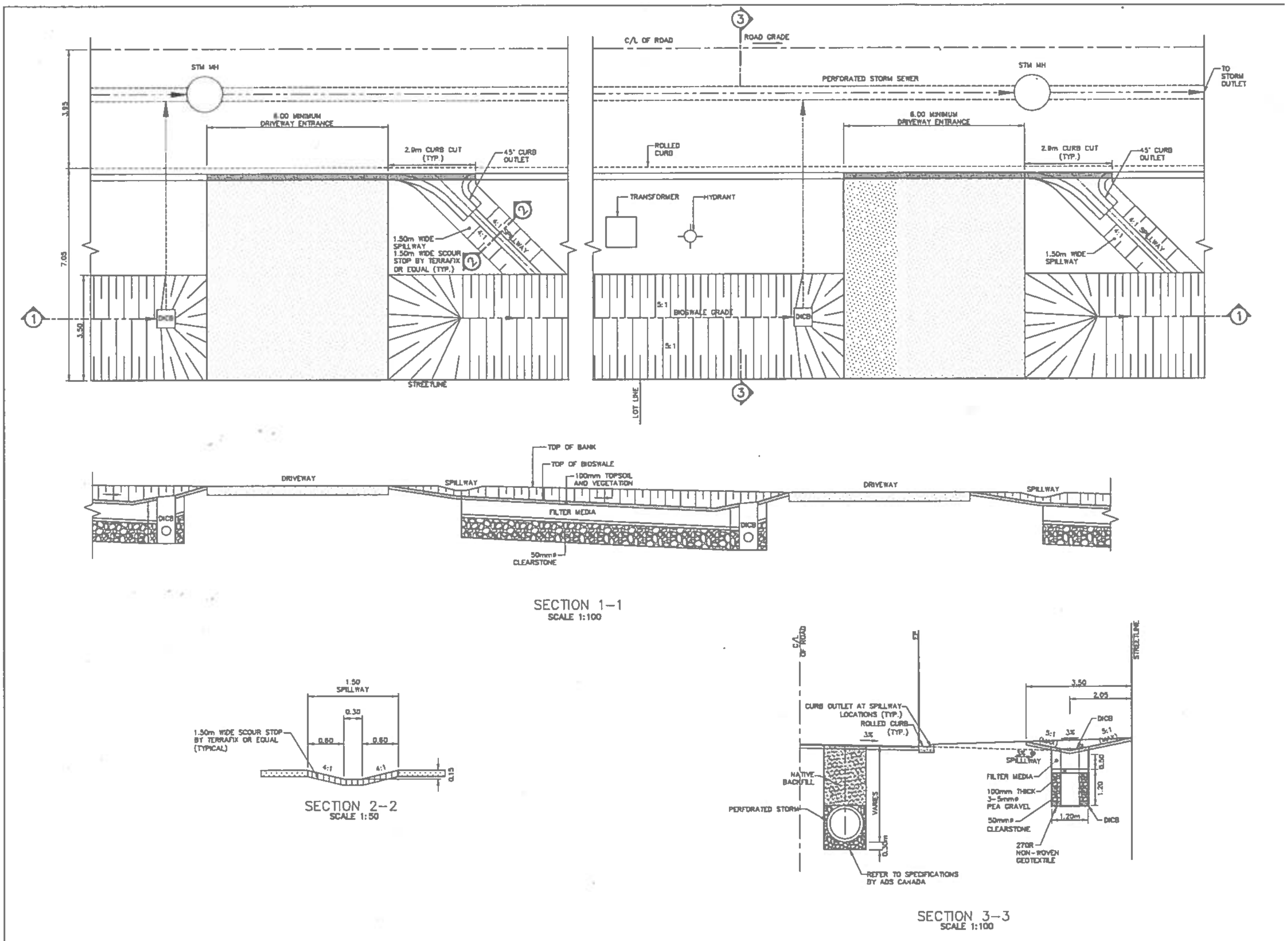
NOTES:

1. UTILITY CORRIDOR TO HAVE A MINIMUM COVER OF 0.9m.
2. WATERMAIN TO HAVE MINIMUM COVER OF 2.35m.
3. THE FOLLOWING IS A MINIMUM ROAD BASE AND WILL REQUIRE A SOILS REPORT VERIFICATION
   40mm HL-3
   65mm HL-8
   150mm GRANULAR "A"
   400mm GRANULAR "B"
4. THE BOULEVARDS REQUIRE A MINIMUM OF 300mm OF TOPSOIL AND NURSERY SOD.
5. FILTER MEDIA COMPOSITION
   FILTER SOIL MIXTURES TO CONTAIN
   -85 TO 88% SAND
   - 8 TO 12% SOIL FINES
   - 3 TO 5% ORGANIC MATTER IN FORM OF LEAF COMPOST
   OTHER CRITERIA:
   - PHOSPHORUS SOIL TEST (P-INDEX) VALUE 10 TO 30 PPM
   - CATIONIC EXCHANGE CAPACITY (CEC) GREATER THAN 10 MEQ/100G
   - PH BETWEEN 5.5 TO 7.5
   CLEAR STONE:
   - WASHED 50MM DIAMETER CLEAR STONE SHOULD BE USED AND FOR THE GRAVEL STORAGE LAYER. WASHED 3 TO 10MM DIAMETER PEA GRAVEL CHOKING LAYER.
6. TREES TO BE PLACED IN LOCATIONS PER APPROVED LANDSCAPE PLAN.
7. STREETLIGHT FIXTURE PER APPROVED TOWN STANDARD.
8. ON A CRESCENT THE WATERMAIN SHALL BE PLACED ON THE OUTSIDE.
9. FULL LENGTH MINIMUM 100mm DIA. SUB-DRAINS C/W FILTERCLOTH SHALL BE INSTALLED AS PER TOWN OF CALEDON APPROVED STANDARDS No.218.
10. SUB-GRADE SHALL BE COMPACTED TO A MINIMUM 95% OF S.P.D. AT OPTIMUM MOISTURE CONTENT.
11. WHERE POSSIBLE MANHOLE LIDS TO BE LOCATED OUT OF TIRE LANE TRAFFIC.

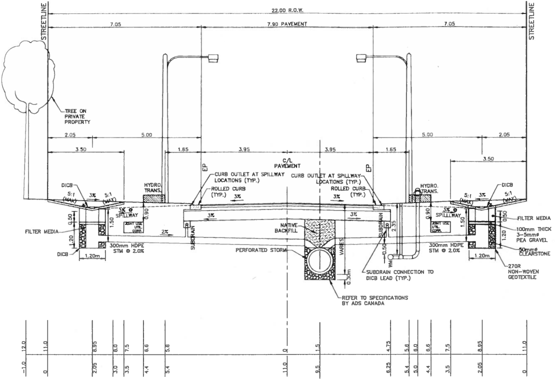
NOTE:

1. TEMPORARY ASPHALT CURB OUTLET SHALL BE CONSTRUCTED AND MAINTAINED UNTIL TOP OF ASPHALT IS PLACED ON THE ROAD.

TYPICAL SECTION
22m LOCAL URBAN/RURAL
(7.9m PAVEMENT)
SCALE 1:100



BIOSWALE CONCEPT PLAN



TYPICAL SECTION
22m LOCAL URBAN/RURAL
(7.9m PAVEMENT)

SCALE 1:100

NOTES:

1. UTILITY CORRIDOR TO HAVE A MINIMUM COVER OF 0.9m.
2. WATERMAIN TO HAVE MINIMUM COVER OF 2.35m.
3. THE FOLLOWING IS A MINIMUM ROAD BASE AND WILL REQUIRE A SOILS REPORT VERIFICATION
   40mm HL-3
   65mm HL-8
   150mm GRANULAR "A"
   400mm GRANULAR "B"
4. THE BOULEVARDS REQUIRE A MINIMUM OF 300mm OF TOPSOIL AND NURSERY SOD.
5. FILTER MEDIA COMPOSITION
   FILTER SOIL MIXTURES TO CONTAIN
   -85 TO 88% SAND
   - 8 TO 12% SOIL FINES
   - 3 TO 5% ORGANIC MATTER IN FORM OF LEAF COMPOST
   OTHER CRITERIA.
   - PHOSPHORUS SOIL TEST (P-INDEX) VALUE 10 TO 30 PPM
   - CATIONIC EXCHANGE CAPACITY (CEC) GREATER THAN 10 MEQ/100G
   - PH BETWEEN 5.5 TO 7.5
   CLEAR STONE.
   - WASHED 50MM DIAMETER CLEAR STONE SHOULD BE USED AND FOR THE GRAVEL STORAGE LAYER. WASHED 3 TO 10MM DIAMETER PEA GRAVEL CHOKING LAYER.
6. TREES TO BE PLACED IN LOCATIONS PER APPROVED LANDSCAPE PLAN.
7. STREETLIGHT FIXTURE PER APPROVED TOWN STANDARD.
8. ON A CRESCENT THE WATERMAIN SHALL BE PLACED ON THE OUTSIDE.
9. FULL LENGTH MINIMUM 100mm DIA. SUB-DRAINS C/W FILTERCLOTH SHALL BE INSTALLED
   AS PER TOWN OF CALEDON APPROVED STANDARDS No.218.
10. SUB-GRADE SHALL BE COMPACTED TO A MINIMUM 95% OF S.P.D. AT OPTIMUM MOISTURE CONTENT.
11. WHERE POSSIBLE MANHOLE LIDS TO BE LOCATED OUT OF TIRE LANE TRAFFIC.

NOTE:

1. TEMPORARY ASPHALT CURB OUTLET SHALL BE CONSTRUCTED AND MAINTAINED UNTIL TOP OF ASPHALT IS PLACED ON THE ROAD.

APPENDIX “I”

Excerpts from Preliminary Geotechnical Investigation

REPORT ON
PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED NEW SUBDIVISION
MOUNT PLEASANT ROAD
CALEDON, ONTARIO

Prepared for:

1029629 ONTARIO INC.

Prepared By:

SIRATI & PARTNERS CONSULTANTS LIMITED

Sirati & Partners Consultants Ltd.
Geotechnical & Environmental Services
Engineering Solutions

Project: SP17-212-10
July 21, 2017

750 Millway Avenue, Unit 8
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Fax: 905.669.4488

flight auger equipment by a drilling sub-contractor under the direction and supervision of SPCL personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the SPCL laboratory for detailed examination by the project engineer and for laboratory testing.

In addition to visual examination in the laboratory, all soil samples were tested for moisture content. Selected three soil samples were subjected to grain size analyses and gradation curves are presented in Figure 12.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Monitoring wells were installed in five (5) boreholes (BH1, BH2, BH4, BH6 and BH8) for the long-term (stabilized) groundwater level monitoring.

The elevations at the borehole locations were surveyed by an SPCL personnel using differential GPS system and varied from 290.9 to 297.7m.

3. SITE AND SUBSURFACE CONDITIONS

The borehole location plan is shown in Drawing 1. Notes on soil descriptions are presented in Drawing 1A. The subsurface conditions in the boreholes are presented in the individual borehole logs (Encl. 2 to 9 inclusive). Generalized sub-surface profiles are presented on Drawings 10 and 11. The subsurface conditions in the boreholes are summarized in the following paragraphs.

3.1 SOIL CONDITIONS:

Topsoil/Fill Material: A 150 mm to 500 mm thick surficial layer of topsoil was found at all borehole locations, except BH5. The thickness of the topsoil in each borehole was shown in the borehole log. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the entire site and should not be relied on to calculate the amount of topsoil at the site.

Below the topsoil, fill material was encountered in boreholes BH1, BH4, BH6, BH7, and BH8, extending to depths ranging from 0.8 m to 1.6 m. The fill material mainly consisted of sand, silty sand, and sandy silt with trace to some inclusions of topsoil. The measured SPT ‘N’ values in the fill material ranged from 2 to 7 blows for 300mm penetration, indicating its very loose to loose state.

Sand to Silty Sand: The native soil underlying the fill material in all boreholes consisted of cohesionless soils of sand and silty sand. The layer was found to be in a loose to dense state, with measured SPT ‘N’ values ranging from 2 to 41 blows per 300 mm penetration. The layer was not fully penetrated in BH1 and BH3.

Grain size analysis of one (1) sand sample (BH1/SS5) was conducted and the results are presented in Figure 12, with the following fractions:

Clay:	2%
Silt:	2%
Sand:	96%

Silt to Sandy Silt: A water bearing silt to sandy silt deposit was observed underlying the above-mentioned sand to silty sand deposit in BH2, BH4, BH5, and BH6, and overlain by a layer of silty clay to clayey silt deposits in BH8. This deposit was found to be in a compact to dense state, with measured SPT 'N' values ranging from 13 to 42 blows per 300 mm penetration. The layer was not fully penetrated in BH4, BH5, BH6, and BH7.

Grain size analyses of two (2) silt to sandy silt samples (BH2/SS7 and BH5/SS6) were conducted and the results are presented in Figure 12, with the following fractions:

Clay:	12 to 24%
Silt:	65 to 66%
Sand:	10 to 23%

Clayey Silt to Silty Clay: A cohesive layer of clayey silt to silty clay soils was observed in BH2 and BH8, underlying the sand to silty sand layer. The layer was found to be in a firm to stiff state, with measured SPT 'N' values ranging from 9 to 13 blows per 300 mm penetration. The layer was not fully penetrated in BH2.

3.2 GROUNDWATER CONDITIONS

During drilling (short-term), groundwater was found in the boreholes at depths ranging from 4.6 to 9.1m below the existing grade. The stabilized groundwater table observed in the monitoring wells on June 16, 2017 was at depths ranging from 4.7 to 9.8 mbgs, corresponding to Elevations ranging from 286.9 to 282.1 m, as listed on Table 1. Monitoring well installed in BH6 was found to be wet at bottom. It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

Table 1: Groundwater Levels Observed in Monitoring Wells

BH No.	Date of Drilling	Date of Observation	Depth of Groundwater (m)	Elevation of Groundwater (m)
BH1	June 2, 2017	June 16, 2017	9.8	282.1
BH2	June 1, 2017	June 16, 2017	9.6	286.2
BH4	June 1, 2017	June 16, 2017	4.7	286.9
BH6	June 1, 2017	June 16, 2017	8.2	286.9
BH8	June 2, 2017	June 16, 2017	8.8	282.1

Drawings

BH ID	Easting	Northing
1	594852.00	4869286.00
2	594760.00	4869162.00
3	594661.00	4869016.00
4	594585.00	4868883.00
5	594694.00	4868909.00
6	594787.00	4869029.00
7	594882.00	4869149.00
8	594954.00	4869253.00

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North:

N

Legend:

-·-·- Property Boundary

⊕ BH# BH: Borehole

Project Title:

Geotechnical Investigation

Site Location:

Mt. Pleasant Road, Caledon, ON

Figure Title:

Borehole Location Plan

Scale: As Shown

Project Number: SP17-212-10

Date: May 2017

Figure Number: 1

LOG OF BOREHOLE BH1

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/02/2017

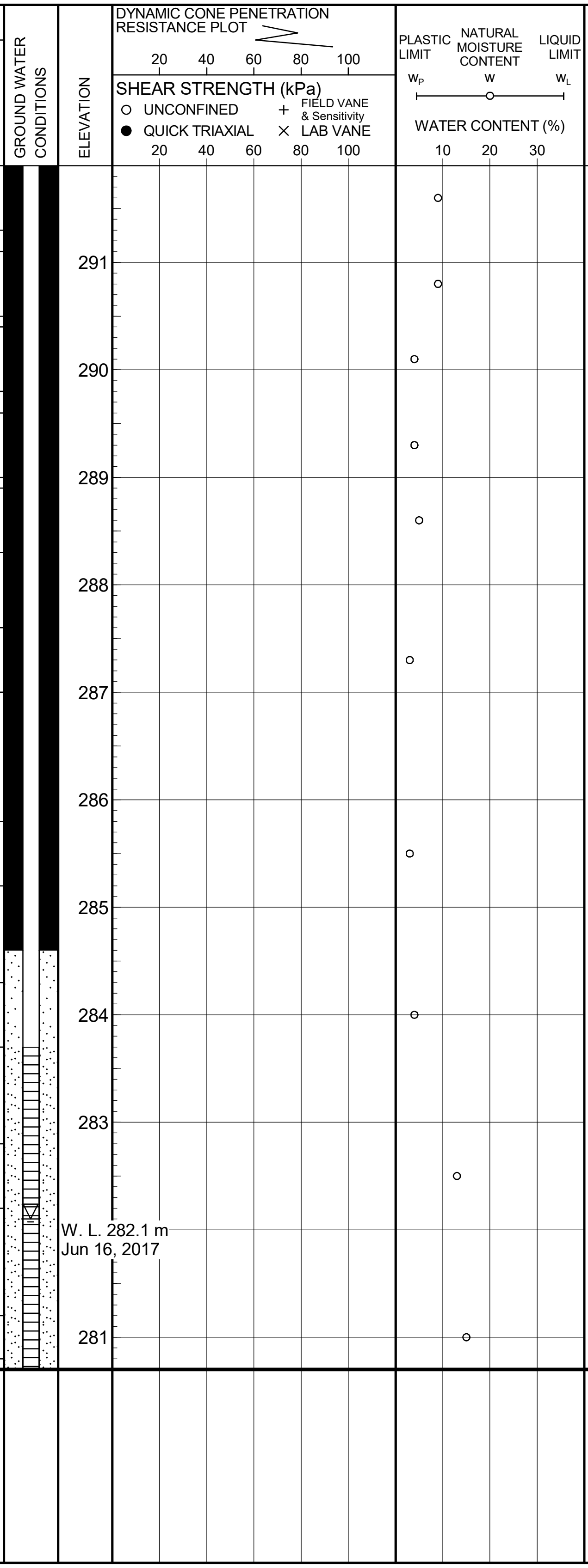
REF. NO.: SP17-212-10
ENCL NO.: 2

SOIL PROFILE

(m) ELEV DEPTH	DESCRIPTION
291.9	
0.0	**TOPSOIL:** 350mm
291.6 0.4	**FILL:** silty sand, trace clay, trace rootlets, brown, moist, loose
291.1 0.8	**SAND:** trace silt, trace gravel, brown, moist, very loose compact below 6.1m very moist to wet below 9.1m
280.7 11.2	**END OF BOREHOLE** Notes: 1) Monitoring well installed in the borehole upon completion. 2) Water level in monitoring well at 9.8m on June 16, 2017.

SAMPLES

NUMBER	TYPE	"N" BLOWS / 0.3 m	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	7	
2	SS	3	
3	SS	2	
4	SS	2	
5	SS	4	0 96 2 2
6	SS	2	
7	SS	12	
8	SS	22	
9	SS	17	
10	SS	17	



POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m^3)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES +3, ×3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH2

1 OF 1

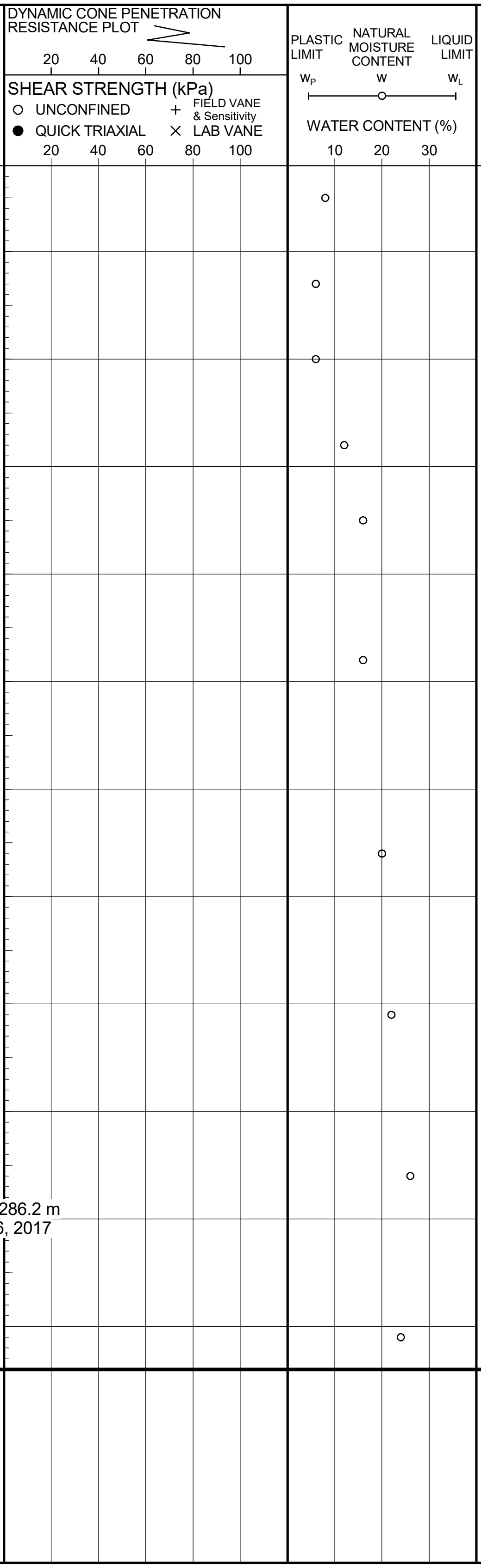
PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/01/2017

REF. NO.: SP17-212-10
ENCL NO.: 3

SOIL PROFILE		SAMPLES			REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m	GR	SA	SI	CL
295.8								
295.6	**TOPSOIL:** 200mm							
0.2	**SAND:** trace silt, trace gravel, brown, moist, loose to compact	1	SS	6				
		2	SS	18				
		3	SS	21				
		4	SS	16				
	occasional silt seams at 3m	5	SS	20				
		6	SS	26				
289.7 6.1	**SILT TO SANDY SILT:** trace clay, trace gravel, grey, wet, compact	7	SS	20	0	10	66	24
288.2 7.6	**SILTY SAND:** trace clay, brown, wet, compact	8	SS	29				
286.7 9.1	**CLAYEY SILT TO SILTY CLAY:** trace sand, occasional sand seams, greyish brown, wet, stiff	9	SS	9				
		10	SS	13				
284.6 11.2	**END OF BOREHOLE** Notes: 1) Monitoring well installed in the borehole upon completion. 2) Water level in monitoring well at 9.6m on June 16, 2017.							

W. L. 286.2 m
Jun 16, 2017



POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH3

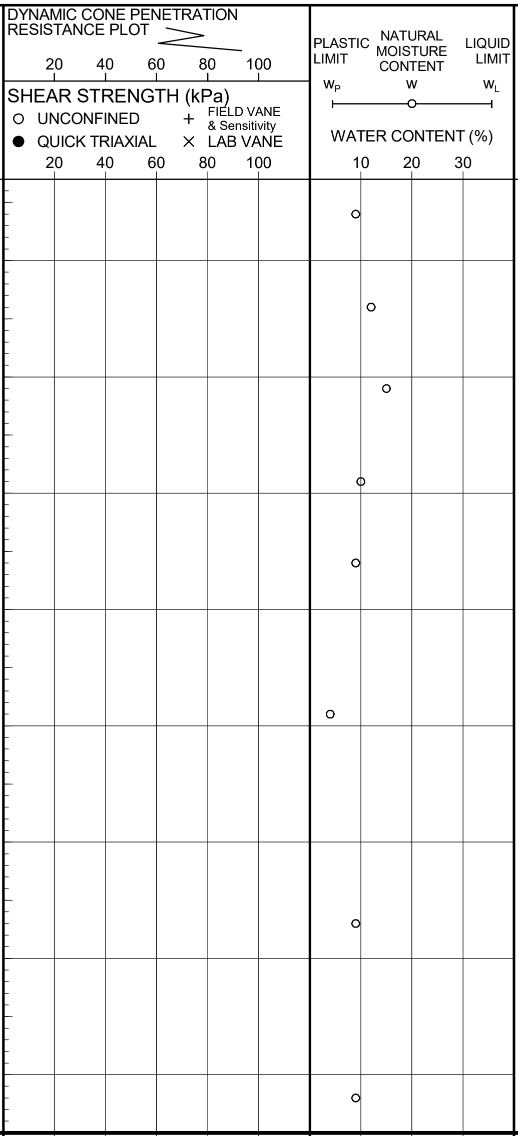
PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/01/2017

REF. NO.: SP17-212-10
ENCL NO.: 4

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION
297.7	
297.6 0.2	**TOPSOIL:** 150mm **SAND:** weathered/disturbed, trace silt, brown, moist, loose
296.9 0.8	**SAND:** trace silt, brown, moist, compact occasional silt seams at 1.5m
289.5 8.2	**END OF BOREHOLE** Notes: 1) Borehole dry on completion.

SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m
1	SS	6
2	SS	12
3	SS	23
4	SS	27
5	SS	24
6	SS	25
7	SS	25
8	SS	26



ELEVATION: 297, 296, 295, 294, 293, 292, 291, 290

GROUND WATER CONDITIONS | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m^3) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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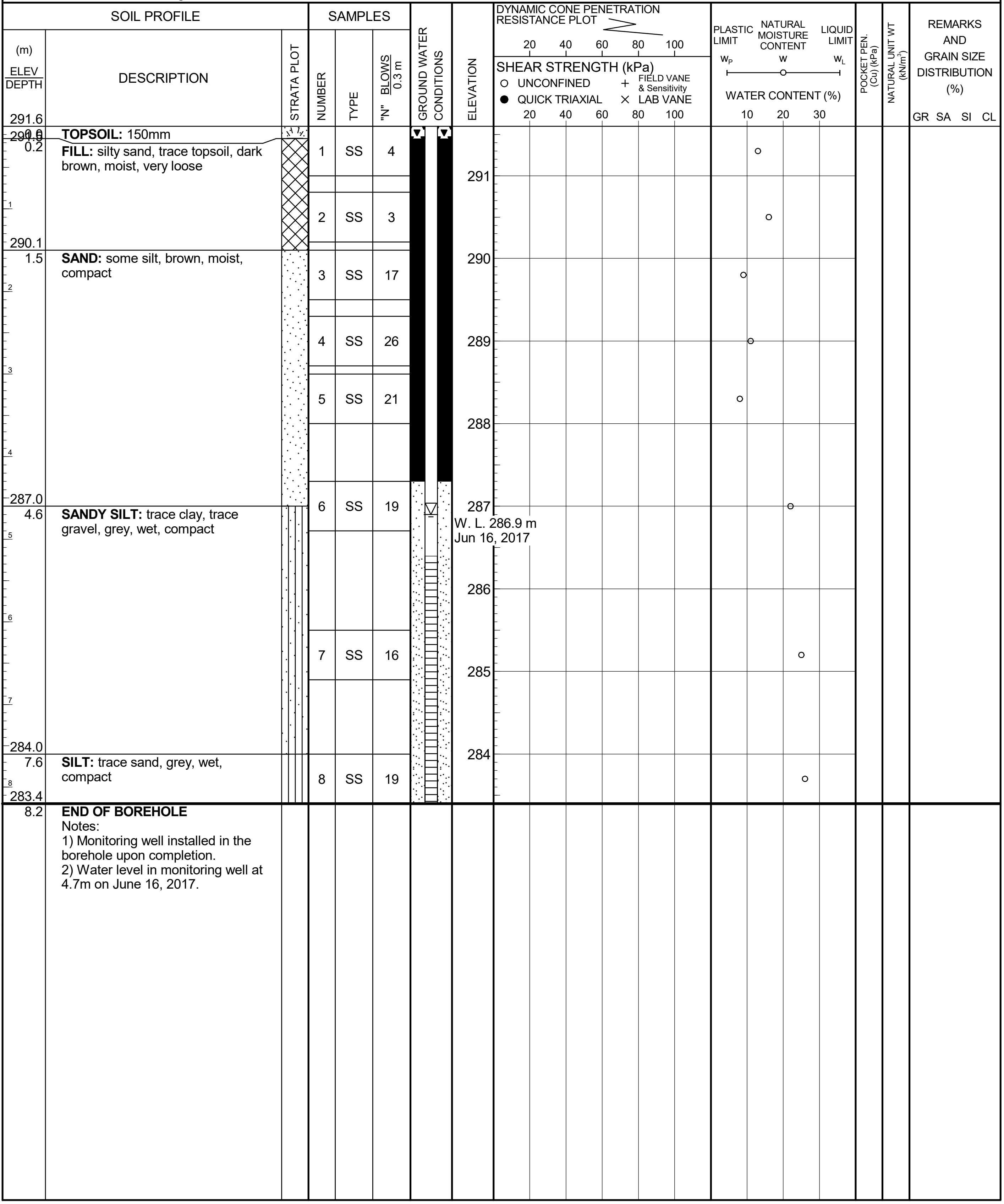
LOG OF BOREHOLE BH4

1 OF 1

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/01/2017

REF. NO.: SP17-212-10
ENCL NO.: 5



(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
291.6 / 0.0	**TOPSOIL:** 150mm			
291.5 / 0.2	**FILL:** silty sand, trace topsoil, dark brown, moist, very loose	1	SS	4
		2	SS	3
290.1 / 1.5	**SAND:** some silt, brown, moist, compact	3	SS	17
		4	SS	26
		5	SS	21
287.0 / 4.6	**SANDY SILT:** trace clay, trace gravel, grey, wet, compact	6	SS	19
		7	SS	16
284.0 / 7.6	**SILT:** trace sand, grey, wet, compact	8	SS	19
283.4 / 8.2	**END OF BOREHOLE** Notes: 1) Monitoring well installed in the borehole upon completion. 2) Water level in monitoring well at 4.7m on June 16, 2017.			

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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Engineering Solutions

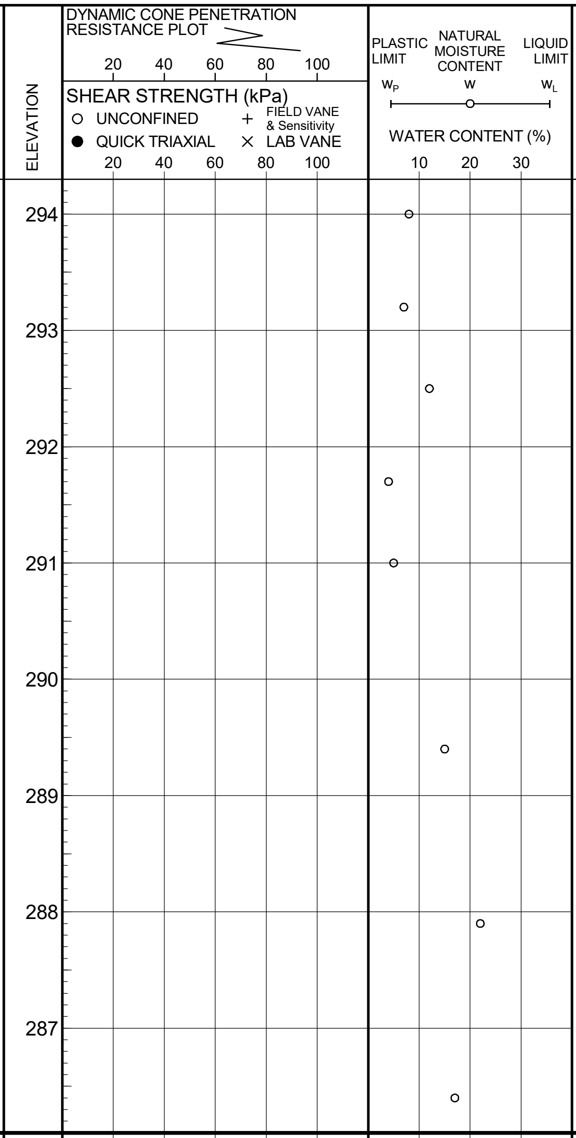
LOG OF BOREHOLE BH5

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/01/2017

REF. NO.: SP17-212-10
ENCL NO.: 6

SOIL PROFILE			SAMPLES						REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	GR	SA	SI	CL
294.3												
0.0	**SAND:** trace silt, trace gravel, brown, moist, loose to compact		1	SS	7							
			2	SS	6							
			3	SS	9							
			4	SS	11							
			5	SS	13							
289.7 4.6	**SANDY SILT TO SILTY SAND:** trace clay, greyish brown, moist to wet, compact		6	SS	25				0	23	65	12
			7	SS	22							
286.7 7.6	**INTERBEDED SAND AND SILT:** trace clay, brown, moist, dense		8	SS	35							
286.1 8.2	**END OF BOREHOLE** Notes: 1) Borehole open and dry on completion.											



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

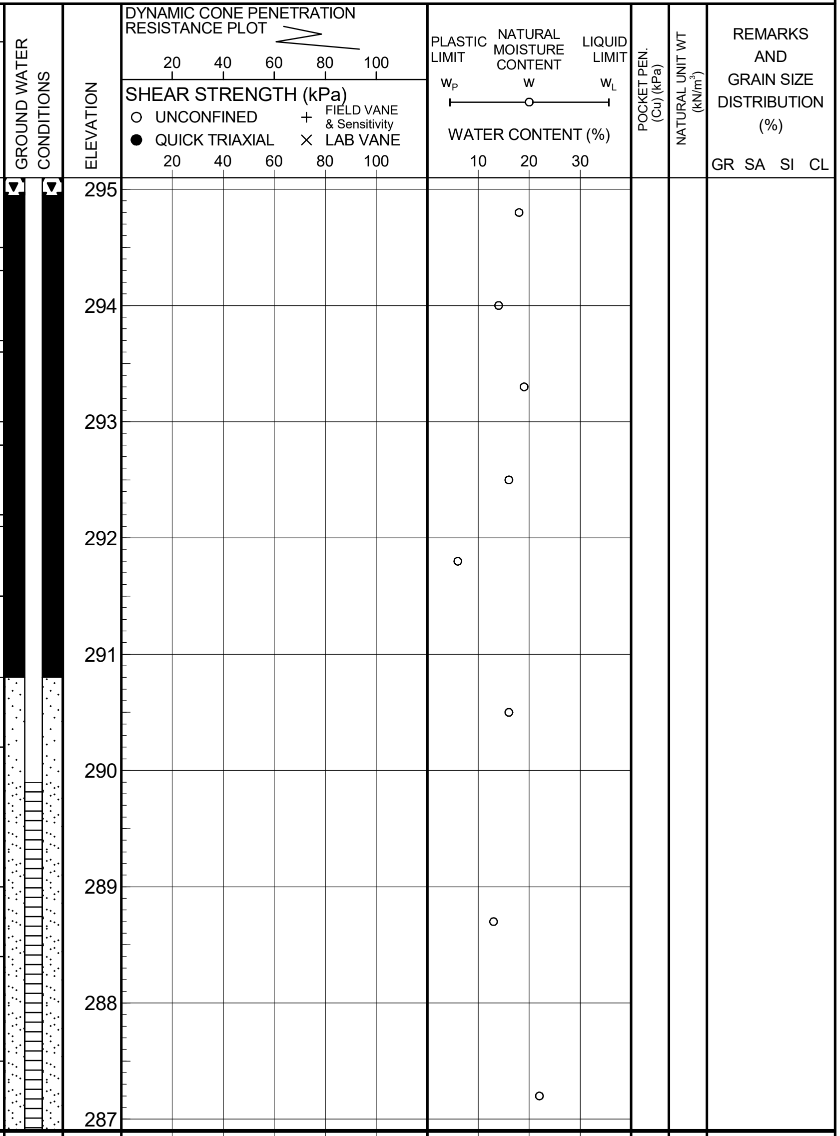
LOG OF BOREHOLE BH6

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/01/2017

REF. NO.: SP17-212-10
ENCL NO.: 7

SOIL PROFILE		SAMPLES		
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
295.1 / 0.0	**TOPSOIL:** 500mm	1	SS	5
294.6 / 0.5	**FILL:** sandy silt, trace topsoil, brown, moist, loose			
294.3 / 0.8	**POSSIBLE FILL:** sand, trace silt, brown, moist, very loose	2	SS	2
293.5 / 1.6	**SILTY SAND:** trace clay, brown, moist, very loose	3	SS	4
292.8 / 2.3	**SAND:** trace silt, trace gravel, occasional silt layers, brown to greyish brown, moist to very moist, compact to dense	4	SS	25
		5	SS	27
		6	SS	34
		7	SS	41
287.5 / 7.6	**SILT TO SANDY SILT:** trace clay, grey, moist, compact	8	SS	28
286.9 / 8.2	**END OF BOREHOLE** Notes: 1) Monitoring well installed in the borehole upon completion.			



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + ^{3}, × ^{3}: Numbers refer to Sensitivity ○ $^{\varepsilon}$=3% Strain at Failure

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LOG OF BOREHOLE BH7

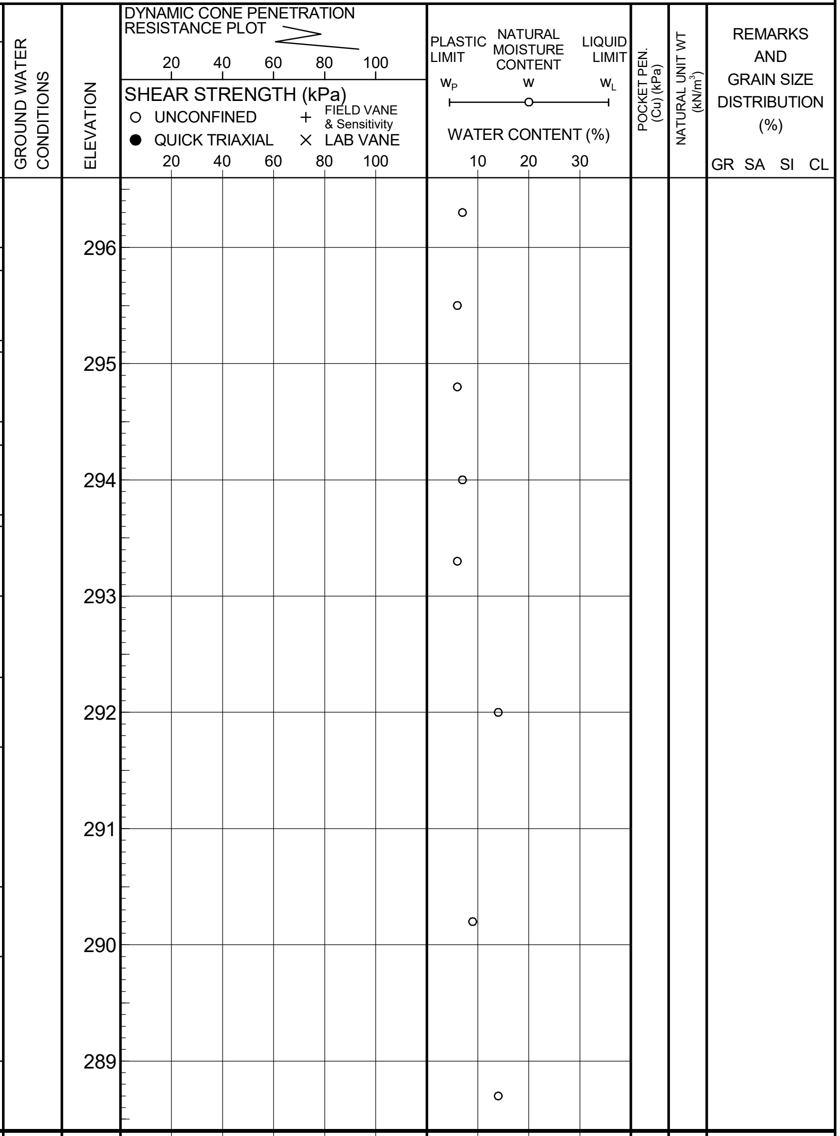
1 OF 1

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/02/2017

REF. NO.: SP17-212-10
ENCL NO.: 8

SOIL PROFILE		SAMPLES		
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
296.6 0.0	**TOPSOIL:** 250mm			
296.4 0.3	**FILL:** sand, some silt, brown, moist, loose	1	SS	6
295.8 0.8	**FILL:** sandy silt to silty sand mixed with topsoil, brown, moist, compact	2	SS	15
295.7 0.9	**SAND:** trace silt, trace gravel, brown to greyish brown, moist, compact			
		3	SS	18
		4	SS	22
		5	SS	33
		6	SS	21
		7	SS	22
289.0 7.6	**SILTY FINE SAND:** trace clay, layer of silt, brown, wet, compact	8	SS	21
288.4 8.2	**END OF BOREHOLE** Notes: 1) Borehole open and water level at 7.8m during drilling.			



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon}$=3% Strain at Failure

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Engineering Solutions

LOG OF BOREHOLE BH8

1 OF 1

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc.
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jun/02/2017

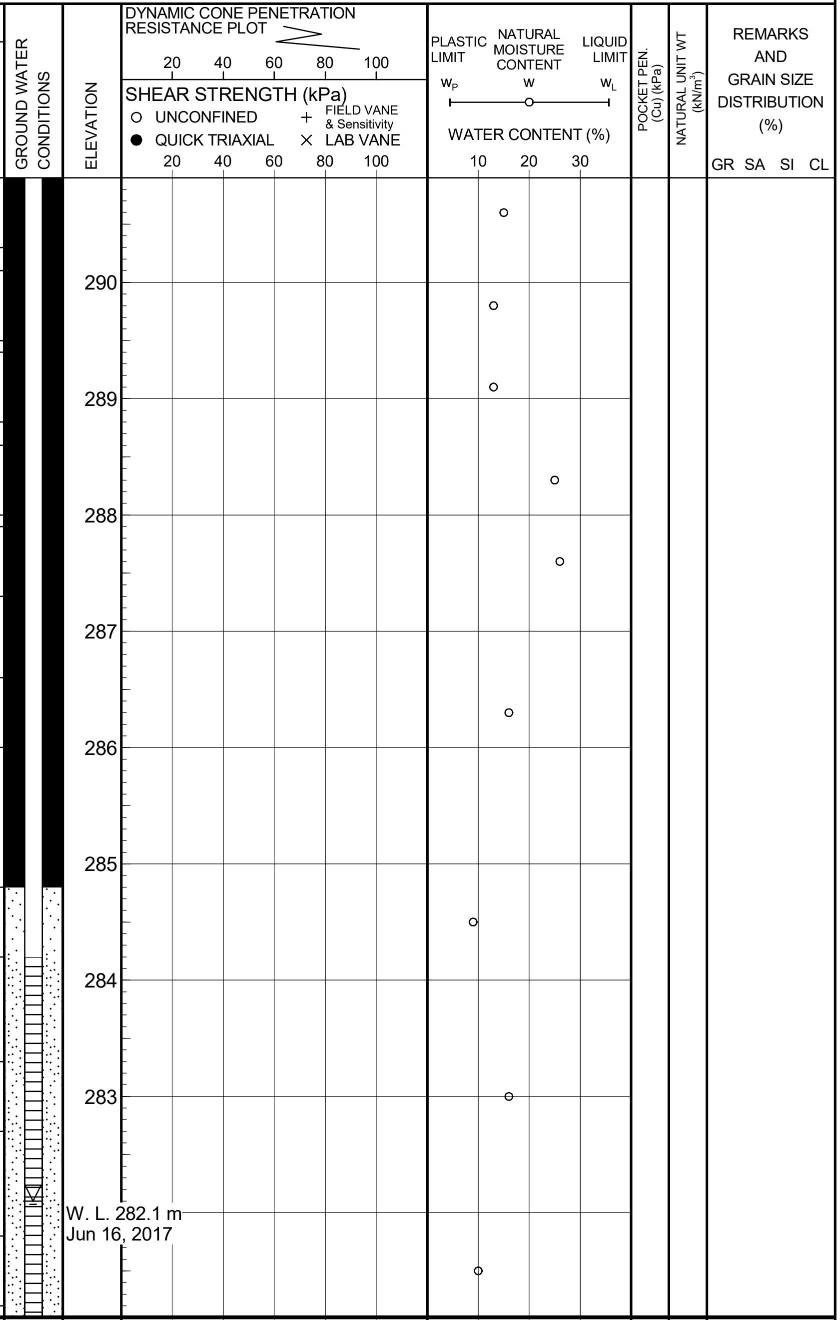
REF. NO.: SP17-212-10
ENCL NO.: 9

SOIL PROFILE

(m) ELEV DEPTH	DESCRIPTION
290.9	
0.0	**TOPSOIL:** 430mm
290.5 0.4	**FILL:** silty sand, trace clay, dark brown, moist, loose
290.0 0.9	**SAND:** trace silt, brown, moist, very loose to compact
289.1 1.8	**CLAYEY SILT TO SILTY CLAY:** trace sand, brown, moist, stiff
287.9 3.0	**SANDY SILT TO SILTY SAND:** trace clay, trace gravel, brown, moist, compact to dense wet below 7.6m
281.1 9.8	**END OF BOREHOLE** Notes: 1) Monitoring well installed in the borehole upon completion. 2) Water level in monitoring well at 8.8m on June 16, 2017.

SAMPLES

NUMBER	TYPE	"N" BLOWS / 0.3 m
1	SS	8
2	SS	4
3	SS	11
4	SS	10
5	SS	13
6	SS	42
7	SS	37
8	SS	34
9	SS	25

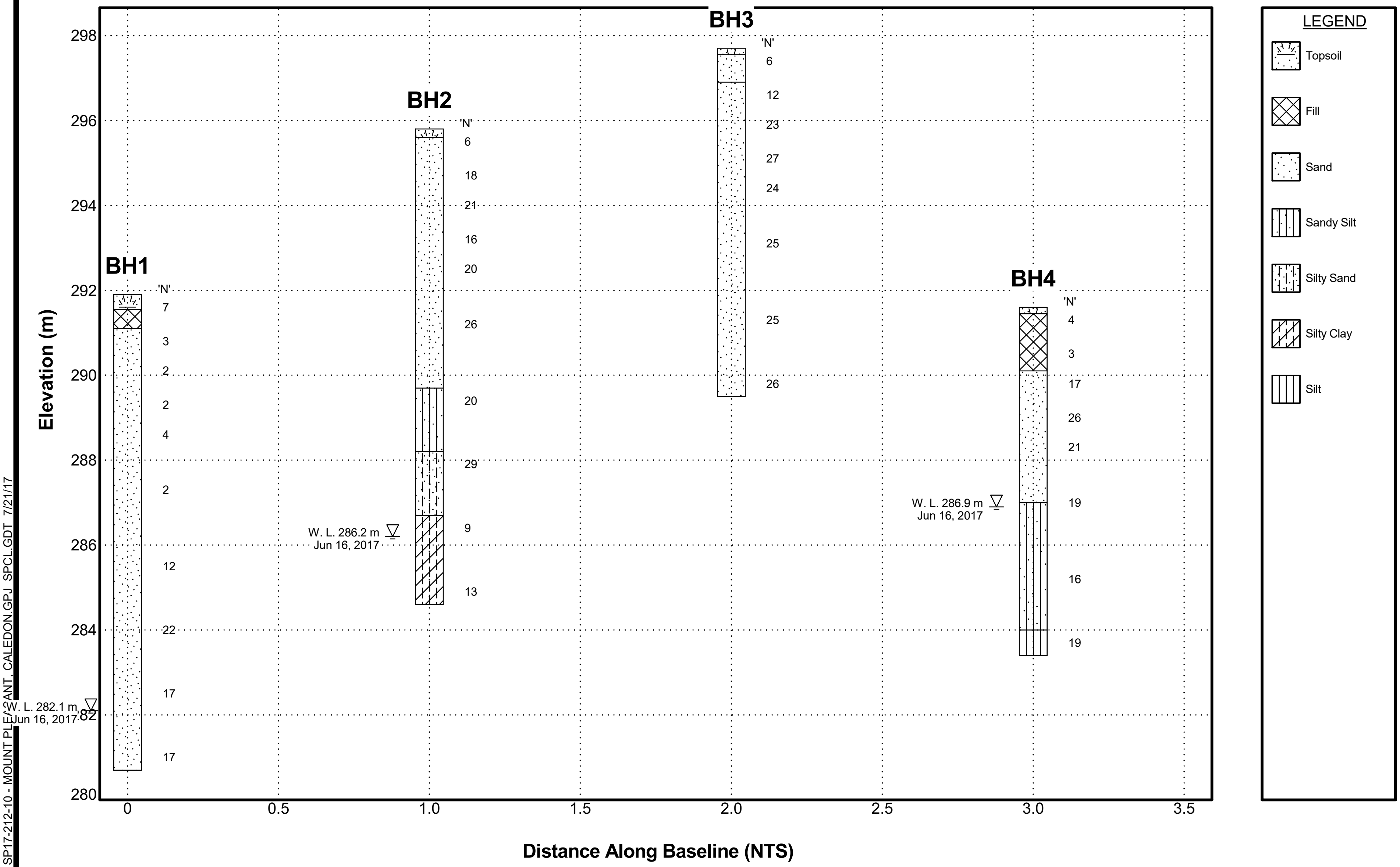


GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity

○ ε=3% Strain at Failure



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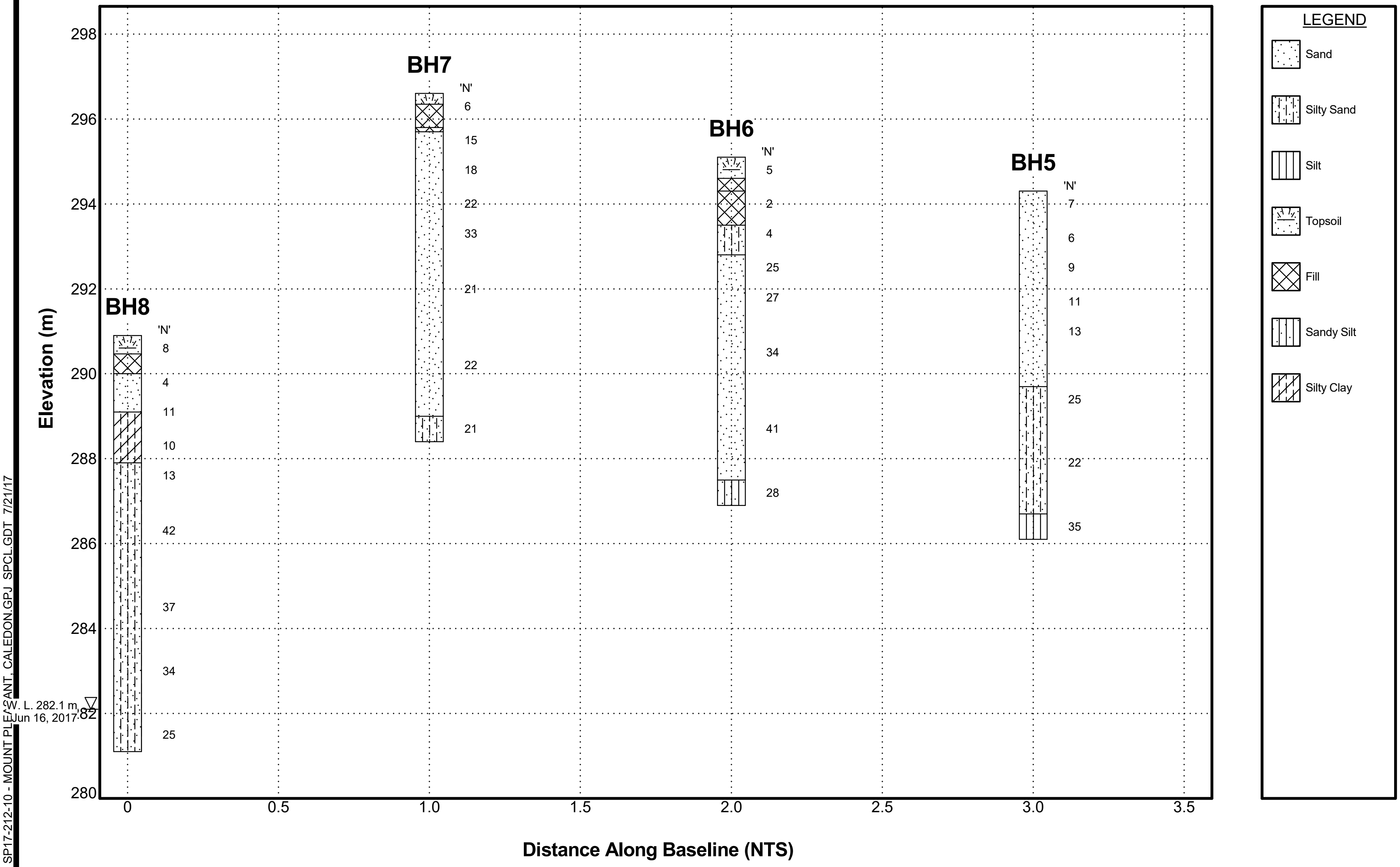
Engineering Solutions

GENERALIZED SUB-SURFACE PROFILE

DRAWING NO.	10
JOB NO.	SP17-212-10
DATE	July, 2017

SPCL FENCE (M) SP17-212-10 - MOUNT PLEASANT, CALEDON.GPJ SPCL.GDT 7/21/17

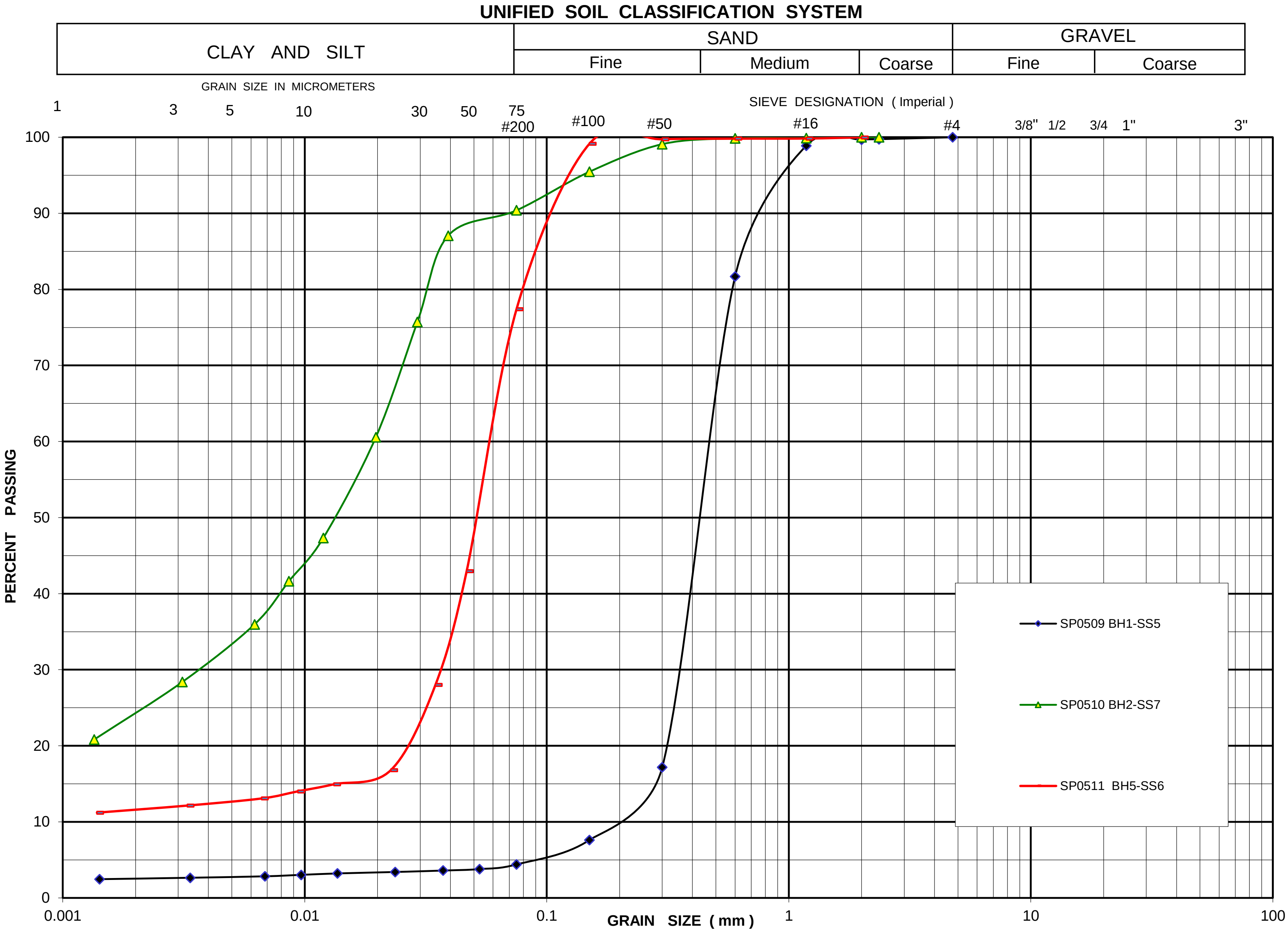


SPCL FENCE (M) SP17-212-10 - MOUNT PLEASANT, CALEDON.GPJ SPCL.GDT 7/21/17

Sirati & Partners Consultants Ltd.
Geotechnical & Environmental Services
Engineering Solutions

GENERALIZED SUB-SURFACE PROFILE

DRAWING NO.	11
JOB NO.	SP17-212-10
DATE	July 2017



Sirati & Partners Consultants Ltd.
Geotechnical & Environmental Services
Engineering Solutions

GRAIN SIZE DISTRIBUTION

Fig: 12

Project: SP17-212-10

Date: June 2017

Project No.: SP17-212-30

August 28, 2019

1029629 Ontario Inc.
c/o Carriage House Realty Corporation
16 Reagan Road, Unit 35
Brampton, ON
L7A 1C1

Attention: Mr. Mark Jacobs

Re: **TEST PITTING PROGRAM – LID MEASURES-PROPOSED ROADSIDE BIOSWALES – 0 Mt. PLEASANT ROAD, CALEDON-LETTER REPORT**

Dear Mr. Jacobs,

1. INTRODUCTION

Sirati & Partners Consultants Ltd. (SIRATI) was retained by 1029629 Ontario Inc. (the "Client"), c/o Carriage House Realty Corporation, to conduct a test pitting program at the Subject Property located at 0 Mt. Pleasant Road, Town of Caledon, Ontario.

As part of the permitting process for the Subject Property proposed development application, the Town of Caledon has requested a test pitting program in order to assess the effectiveness of the proposed Low Impact Development measures (LIDs) at the Subject Property.

The Client is proposing roadside bioretention swales (Figure 1-1), as per the Town's standard detail, to capture and convey road run-off. The water will flow along the length of the bioretention swale and filter through a 0.50 m deep filtration media to a 1.2 m wide by 1.2 m deep stone trench below for infiltration.

A Hydrogeological Impact Study (HIS) was previously carried out by SIRATI, [1] Hydrogeological Impact Study, dated May 17, 2018 prepared by SIRATI, on be-half of 1029629 Ontario Inc., c/o Carriage House Realty Corporation.

As part of the above HIS, eight (8) boreholes were drilled to depths ranging between 8.2 and 11.2 metres below ground surface (mbgs). All the wells, except borehole BH8, have encountered fill materials consisting of sand and gravel of varying proportions up to 1.5 mbgs, followed by fine to medium sand from ground surface to a maximum depth of 4.6 mbgs.

Borehole BH8, however, encountered clayey silt to silty clay from 1.8 m to 3.0 mbgs and as such verification of the presence or otherwise of clayey silt to silty clay layer along the proposed LIDs across the site was considered necessary.

As part of the permitting process and to verify the local stratigraphy along the proposed LIDs, a test pitting program was conducted by SIRATI during August 16, 2019.

This report is provided based on terms of reference above, and on the assumption that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the hydrogeological analysis, or any questions concerning the hydrogeological aspects, this office should be contacted to review the design.

This report has been prepared for 1029629 Ontario Inc., and its designers. Third party use of this report without SIRATI's consent is prohibited. The limitations presented in Appendix B form an integral part of the report. This report should be read in conjunction with the Hydrogeological Impact Study report prepared by SIRATI.

Outlined below are the results of the test pitting program and recommendations on the implementation of LID measures at the Subject Property.

1.1 TEST PITTING PROGRAM

A test pitting program was conducted at nine (9) locations along the proposed roadside bioswale LIDs, as shown in Figure 1-1. Test pitting was conducted on August 16, 2019 at nine (9) test pit locations as shown on Figure 1-1.

Test pits with dimensions of 1.5 m width x 1.5 m length x 2.0 m depth were dug using a back-hoe excavator supplied by Nexxgen Environmental Ltd. Prior to the intrusive testing, the excavation area was cleared for any buried utilities. Following excavation, lithology of the test pit was logged by qualified person from SIRATI. Soil samples were collected from 1.0 mbgs and from the bottom of the test pit at about 2 .0 m depth.

Upon completion of each test pit, the excavations were back-filled and compacted immediately using the excavated materials to the existing ground level.

2. RESULTS OF TEST PITTING

A detailed record of the test pitting program was documented and the logs of all the nine (9) test pits are presented in Appendix A.

As per the lithological descriptions in the logs, the site is characterized at the test pit locations by brown sand and gravel with trace cobbles to a depth of 1.0 mbgs and mostly by sand with trace silt and gravel from 1.0 to 2.0 mbgs. All test pits were dry to moist and no standing water was encountered in any of the test pits excavated.

No test hole encountered any trace of clay or silty clay materials to the excavated depth of 2.0 mbgs.

3. CONCLUSIONS

Based on the results of the test pitting program, the soils at the test pit locations are predominantly sand and gravel with trace silt and cobbles. The bottom of the test holes has not encountered any clay or silty clay materials, indicating the suitability of the proposed LID locations for the installation of roadside bioswales to divert the road runoff in order to increase the groundwater recharge at the Subject Property.

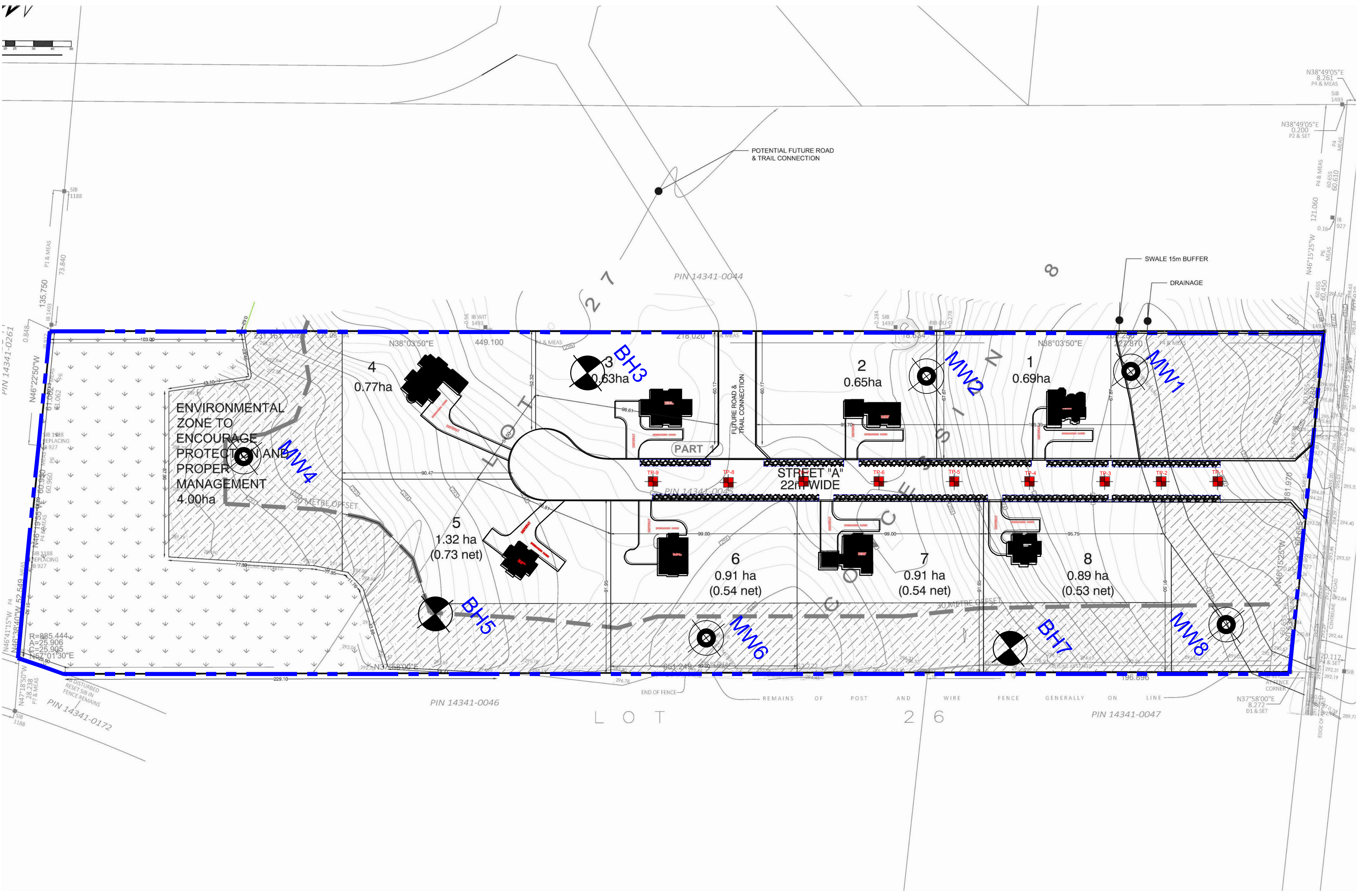
Should you have any questions in regard to this report, please contact the undersigned.

Best Regards,

Sirati & Partners Consultants Ltd.

Archie Sirati (Ph.D., P.Eng.)
CEO/President

Sudhakar Kurli, P.Geo.
Hydrogeologist/Project Manager



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- - — - -	Property Boundary
🟥	Test Pit Location
◎	Monitoring Well
⊕	Borehole
▨	Proposed Bioswale

Project Title:

Hydrogeological Investigation

Site Location:

0 Mt. Pleasant Road, Caledon, ON.

Figure Title:

Test Pit Location Plan

Scale: As Shown

Project Number: SP17-212-30

Date: April 2018

Figure Number: 1-1

APPENDIX A

SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

LOG OF TEST PIT TP 1

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 2

SOIL PROFILE			SAMPLES									
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** 150 mm											
0.2	**SAND AND GRAVEL:** brown, dry		1	GRAB								
1.0	**SAND:** some gravel, brown, dry		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF TEST PIT TP 2

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 3

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					
0.0	**TOPSOIL:** 75 mm											
0.1	**SAND:** some gravel, some silt, trace cobbles, brown, dry		1	GRAB								
	- becoming trace to some gravel, trace silt, brown, moist		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF TEST PIT TP 3

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 4

SOIL PROFILE			SAMPLES									
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** 250 mm											
0.3	**SAND:** some gravel, trace silt, trace cobbles, brown, moist		1	GRAB								
	- becoming trace gravel, trace silt, brown, moist		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF TEST PIT TP 4

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 5

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					GR SA SI CL
0.0 0.1	**TOPSOIL:** 75 mm **SILTY SAND TO SAND:** some gravel, trace cobbles, brown, moist		1	GRAB								
1.0	**SAND:** trace to some gravel, brown, dry		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF TEST PIT TP 5

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 6

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION					
0.0 0.1	**TOPSOIL:** 75 mm **SILTY SAND TO SAND:** trace gravel, trace organics, brown, moist -trace organics		1	GRAB								
1.0	**SAND:** trace gravel, brown, moist		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES $+^{3}, \times^{3}$: Numbers refer to Sensitivity   ○ $^{\varepsilon}$=3% Strain at Failure

LOG OF TEST PIT TP 6

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 7

SOIL PROFILE (m) ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** 75 mm											
0.1	**SAND:** some silt, trace organics, brown, moist -trace organics		1	GRAB								
	-becoming, trace gravel, grey, moist		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 3 =3% Strain at Failure

LOG OF TEST PIT TP 7

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 8

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION					
0.0 0.1	**TOPSOIL:** 75 mm **SAND:** trace to some silt, some organics, brown, moist -some organics		1	GRAB								
	-becoming trace silt		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF TEST PIT TP 8

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 9

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					
0.0	**TOPSOIL:** 75 mm											
0.1	**SAND:** trace gravel, trace organics, brown, moist -trace organics		1	GRAB								
	-becoming some gravel, trace silt, brown to grey, moist		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF TEST PIT TP 9

PROJECT: Geotechnical, Environmental and Hydrogeological Services
CLIENT: 1029629 Ontario Inc., c/o Carriage House Realty Corporation
PROJECT LOCATION: Mt Pleasent Road, Caledon, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 0 E

DRILLING DATA
Method: Open Excavation
Diameter: N/A
Date: Aug/16/2019

REF. NO.: SP17-212-10
ENCL NO.: 10

SOIL PROFILE			SAMPLES									
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0 0.1	**TOPSOIL:** 75 mm **SAND:** trace gravel, trace organics, brown, dry to moist -trace organics		1	GRAB								
	-becoming some silt, trace gravel, brown, moist		2	GRAB								
2.0	**END OF TESTPIT** Notes: Testpit Open and Dry Upon Completion of Excavation											

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

APPENDIX “J”

Phosphorus Loading Analysis

Development Export Summary

Development :17122_Mt. Pleasant Road

Pre-Development Phosphorus Export

DEVELOPMENT : 17122_Mt. Pleasant Road

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	Existing	10.22		1.78
	Agricultural Land use Class Total :	**10.22**		**1.78**
	Development Total :	**10.22**		**1.78**

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : 17122_Mt. Pleasant Road

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : Existing

Slope Area (ha)	10.22
Surface Slope Gradient (%)	2.00
Length of Slope (m)	250.00
Cropt Type Factor)	0.02
Tillage Type Factor	0.60

R (rainfall / runoff for Lake Simcoe)	90.00
K (soil errodability factor)	0.29
NN (determined by slope)	0.30
LS (slope length gradient factor)	0.38
C (crop management factor)	0.01
P (prevention + capture)	0.75
Soil Loss (kg/year)	0.09
Phosphorus export (kg/ha/yr)	0.17
Phosphorus load (kg/yr)	1.78

PRE Developed Area (ha) :	**10.22**
Phosphorus export (kg/ha/yr) :	**0.17**
Phosphorus load (kg/yr) :	**1.78**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : 17122_Mt. Pleasant Road

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Natural Heritage				
Transition		4.08	0.07	0.29
	Natural Heritage Land use Class Total :	**4.08**		**0.29**
Urban				
Residential		6.14	0.41	2.52
	Urban Land use Class Total :	**6.14**		**2.52**
	Development Total :	**10.22**		**2.81**

10/2/2019 Page 1 of 1

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : 17122_Mt. Pleasant Road

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea :

Slope Area (ha)
Surface Slope Gradient (%)
Length of Slope (m)

Cropt Type Factor)
Tillage Type Factor

R (rainfall / runoff for Lake Simcoe)
K (soil errodability factor)
NN (determined by slope)

LS (slope length gradient factor)
C (crop management factor)
P (prevention + capture)
Soil Loss (kg/year)
Phosphorus export (kg/ha/yr)
Phosphorus load (kg/yr)

PRE Developed Area (ha) :

Phosphorus export (kg/ha/yr) :

Phosphorus load (kg/yr) :

10/2/2019 Page 1 of 1

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Residential					
1.71	100	0.41	100 %	0.70	
Enhanced Grass/Water Quality Swales					
Transition					
0.05	100	0.07	100 %		
Enhanced Grass/Water Quality Swales					

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	10.22
PreDevelopment Area excluding Wetlands (ha):	10.22
Total PostDevelopment Area (ha):	10.22
Total Area treated by BMP's (ha):	1.76
Treated Area total:	1.76
Total PreDevelopment Load (kg/yr):	1.78
Total PostDevelopment Load (kg/yr):	2.81
Total P Load Reduction with BMP's (kg/yr):	0.70
Minimum P Load Reduction Required:	1.03
Total PostDevelopment Load with BMP's (kg/yr)	2.11

Conclusion : Net increase in P load, additional reduction is required.

Hutchinson

Environmental Sciences Ltd.

Managing New Urban Development in Phosphorus-Sensitive Watersheds

Prepared for: Nottawasaga Valley Conservation Authority
Job #: J130014

October 31, 2014

Final Report

1-5 Chancery Lane, Bracebridge ON, P1L 2E3 | 705-645-0021
Suite 202 – 501 Krug Street, Kitchener, ON N2B 1L3 | 519-576-1711

Table 1. Recommended Phosphorus Export Coefficients for Use in the Generic Phosphorus Budget Tool

Land Use	Export Coefficient (kg/ha/yr)	Notes
Forest	0.06	Mean phosphorus export for all 'monitored' Lake Simcoe subwatersheds (n = 7) derived using phosphorus loads from CANWET modeling. Monitored subwatersheds are those with sufficient measured data to validate and calibrate the model.
Transition	0.07	
Wetland	0.05	
Turf/Sod	0.11	
Hay/Pasture	0.08	
Low Intensity Residential	0.13	
Unpaved Roads	0.83	
Open Water	0.26	Calculated from the mean measured atmospheric load of 19 tonnes/yr averaged over 5 years from 2002 to 2007 to the surface of Lake Simcoe (surface area = 722 km^2) (Scott et al., 2006; LSRCA, 2009).
Cropland	0.16 x A +0.16	Developed from the relationship between CANWET derived phosphorus export for Lake Simcoe subwatersheds and soil loss. Where: A = soil loss determined using the Universal Soil Loss Equation (USLE) **Detailed derivation is provided in Section 3.1.**
Residential	TP_i x Precip x P_j x R_V x 10^{-2}	Where: TP_i is total phosphorus concentration (mg/L) in runoff measured from land use (i) from the SWAMP studies (TRCA, 2005), Precip is the annual precipitation (mm/yr), Pj is the fraction of Precip that produces runoff, and R_V is the runoff coefficient = 0.05 + 0.91 x impervious fraction following US EPA's Simple Method. **Detailed derivation is provided in Section 3.2.**
Commercial		
Industrial		
Transportation		

Table 2. Description of Land Uses for the NVCA Tool

Land Use	Description
Forest	Tree cover >60% of the land area. Includes ELC Forest (FO) and Cultural Plantation (CUP) classes. Also includes ELC Cultural Woodland (CUW) classes with tree cover between 35% and 60%).
Transition	Tree cover generally <60% and often with a large proportion of non-native plant species. Includes ELC Cultural Meadow (CUM), Cutltural Thicket (CUT), Open Alvar (ALO) and Open Tallgrass Prairie (TPO) classes.
Wetland	Water generally <2 m deep, with variable flooding regimes, standing water or saturated soils. Includes ELC Swamp (SW), Fen (FE), Bog (BO), Marsh (MA) and Shallow Water (SA) classes.
Turf/Sod	Turf/sod farms. Includes Golf courses, including lane ways, but not the isolated woodlots within, unless the area of the woodlots is < 0.5 ha.
Hay/Pasture	Hay and pasture fields, including the related agricultural buildings such as barns, silos and the farm residence. Fields are dominated with herbaceous vegetation and grasses with an understory of similar material in a state of decay. Weedy hay and/or pasture covers more than 50% of the area.
Low Intensity Residential	Cleared areas with a low density of trees, including lawns and landscaping. Land use is dominated by gardens, parkland and lawns, e.g., cemeteries, urban parks, ski hills and residential estate properties with a minimum size of 2 ha or with <5% impervious area. Includes rail lines and associated cleared adjacent areas and rural development properties not directly associated with an agricultural operation. On developed portions, these properties are under intensive use. Based on canopy cover, these areas will often appear as Cultural Savannah or Cultural Woodland in aerial photographs or satellite imagery. However, the presence of buildings and manicured lands identify the properties as Rural Development.
Unpaved Roads	Unpaved roads and associated shoulders. Excludes driveways and unpaved parking lots.
Open Water	Water generally >2 m deep, with no tree or shrub cover, as per ELC Open Water (OW) class. Also includes streams and rivers.
Cropland	Cultivated row crops, including the related agricultural buildings (e.g., barns, silos and the farm residence), producing crops in varying degrees (e.g., corn and wheat) and includes specialty agriculture (i.e., orchards, market gardens, Christmas tree plantations and nurseries).
Residential	Urban related land uses with >10% impervious area. Includes residential properties (single, semi-detached and strip dwellings, apartment buildings and associated out-buildings, driveways, parking lots and paved roadways). Excludes green land areas such as parks or river valleys.
Commercial	Impervious properties that contain a building and an adjacent parking lot (e.g., shopping and strip malls, power centres, scrap yards). Excludes green land areas such as parks or river valleys. Exludes roadways.
Industrial	Impervious properties that are not commercial and include industrial operations e.g., factories, manufacturing facilities, processing facilities, bulk fuel storage. Excludes green land areas such as parks or river valleys. Excludes roadways.
Transportation	Includes major transportation corridors (highways) and paved roadways that are not considered in other land use designations. Excludes driveways.

Notes: ELC is the provincial Ecological Land Classification for Southern Ontario

Table 11. Phosphorus Removal Efficiencies for Major Classes of BMPs Using the Decision Tree

BMP Class	Reference IDs[1]	Reported Phosphorus Removal Efficiency (%)		Relevant to Ontario?	Range <40%?	Are Non-Ontario values acceptable?	Possible design criteria?	Median % Removal Efficiency
		Min	Max					
Bioretention Systems	8-10, 12,13, 34-38, 40	-1552	80	no	no	no	No	**100***
Constructed Wetlands	104, 106, 109	72	87	yes	yes			77
Dry Detention Ponds	104, 109	0	20	no	yes	yes		10
Dry Swales	24, 26-32	-216	94	no	No	no	possible	none
Enhanced Grass/Water Quality Swales	21, 104	34	55	no	yes	no	No	**100***
Flow Balancing Systems	106	77		no	?	yes	Min data	77
Green Roofs	2	-248		no	No	no	No	**100***
Hydrodynamic Devices	109	-8		no	?	yes		none
Perforated Pipe Infiltration/Exfiltration Systems	7, 4	81	93	yes	yes			87
Permeable Pavement								**100***
Sand or Media Filters	104, 109	30	59	no	yes	yes		45
Soakaways - Infiltration Trenches	6, 104	50	70	no	yes	yes		60 (**100***)
Sorbtive Media Interceptors	111	78	80	no	yes	yes		79
Underground Storage	106	25		no	?	yes	Min data	25
Vegetated Filter Strips/Stream Buffers	6, 42, 104	60	70	no	yes	yes	Yes	65
Wet Detention Ponds	104-106, 109	42	85	yes	yes			63

Notes: [1]References associated with IDs are provided in Appendix C.; * infiltration techniques are credited with 100% removal efficiency if their effectiveness is verified in the SWM plan (Refer to Section 5.1.1), where no % efficiency is recommended, the user can assign an efficiency with scientific rationale for review and consideration by approval agencies in the SWM plan.

A treatment train approach, where more than one BMP is used in a series to treat stormwater runoff from the same land use area, can be used in the Tool. In a treatment train approach, the total phosphorus removal efficiency of the train is not necessarily the sum of the efficiencies for the individual BMPs in the train. This occurs because the efficiencies of several BMPs are influenced by phosphorus input concentrations. Treatment of runoff by one BMP may reduce the phosphorus concentration in the runoff to a level that reduces the effectiveness of the next BMP in the train. In addition, the Tool cannot anticipate or accommodate the many combinations of techniques that can make up a treatment train. The Tool,