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STORMWATER MANAGEMENT REPORT

SNELL'S HOLLOW EAST SECONDARY PLAN AREA
TOWN OF CALEDON

PROJECT NO.: 2019-4851 FEBRUARY 2021

Revision	Description	Prepared		Checked	
		By	Date	By	Date
0.	Original Report	Y.Gollamudi	February 2021	K. Shahbikian	February 2021

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1.0 INTRODUCTION TO THE STUDY AREA

1.1 Study Area

The objective of this report is to provide a stormwater servicing plan for the proposed development.

The subject site is located south of Highway 410, northwest of Mayfield Road, and northeast of Kennedy Road, in the Town of Caledon, Region of Peel, as shown in **Figure 1.1**.

The Snell's Hollow Secondary Plan area is approximately 62.4ha that includes lands on both sides of Heart Lake Road, with the majority of the site area on the west side of Heart Lake Road. Out of the 62.4ha, development is proposed in approximately 36.97ha, as discussed in **Section 1.3** below.

1.2 Background Studies

The following documents were referenced in preparing the following report:

- *Snell's Hollow East Secondary Plan Draft Comprehensive Environmental Impact Study and Management Plan (CEISMP) Terms of Reference*, dated April 3, 2019.
- *Stormwater Management Criteria, Toronto and Region Conservation Authority*, dated August 2012. (Version 1.0);
- *Draft Final Report-Etobicoke Creek Hydrology Update*, by MMM Group Limited, dated April 2013.
- *Kennedy Pond-Stormwater Management Facility Retrofit, Mayfield Road and Kennedy Road*, by GHD, dated May 2017.
- *Snell's Hollow East Secondary Plan Baseline Conditions Report-2019*, by R.J. Burnside & Associates Limited, dated August 2020.
- *Technical Memorandum-2019 Headwater Drainage Feature Assessment*, by R.J. Burnside & Associates Limited, dated January 2020.
- *Snell's Hollow East Secondary Plan Annual Wetland Monitoring Report-Year 1 (2019)*, by R.J. Burnside & Associates Limited, dated January 2020.

1.3 Proposed Development Plan and Population

The secondary plan area is approximately 62.4ha, including 36.97 ha of developable area, 0.7ha of existing SWM pond and 24.68ha of Natural Heritage System area, including buffer area. The proposed development consists of detached houses, semi-detached houses, townhouses, Medium-High density residential areas, commercial areas, roads, park blocks, open space and SWM blocks.

The proposed commercial block and Medium High-density residential blocks will be developed as part of a separate site plan.

Table 1-1 below summarizes the proposed development and estimated population based on the Peel Region design criteria. For ease of identification, areas have been divided into A, B and C, as shown in **Figure 1.2**.

Table 1-1: Development Proposal and Estimated Population

	ID As per Figure 1.2	**Block Land Use**	**Area (ha)**	**Units**	**Population Density (Peel Region Design Criteria) (persons/unit)**	**Population Estimate (persons)**
Developable Area	**A**	Low Density (Detached, Semi-Detached & ST. Townhouses)	10.02	351	3.43	1204
		Medium Density (Townhouses)	2.73	210	2.92	613
		SWM blocks	3.33	-		
		Right of Way	8.8	-		
		Park blocks	1.31	-		
		Open Space (MTO Setback)	2.01	-		
	B	Low Density (Detached, Semi-Detached & ST. Townhouses)	0.37	13	3.43	45
		Medium Density (Townhouses)	1.70	135	2.92	394
		Medium-High Density	1.27	190	2.23	424
		Right of Way	2.3	-		
		Park blocks	0.38	-		
		Open Space (MTO Setback)	0.02	-		
		Servicing Block	0.01	-		
	C	Medium-High Density	1.25	188	2.23	419
		Commercial	1.47	-	-	93
		Sub-Total	**36.97**	**1087**		**3192**
		Natural Heritage System	21.95	-	-	
		Open Space (Buffer)	2.73	-	-	
		Existing SWM Pond	0.7	-	-	
		Total Area	**62.4**	**1087**		**3192**

**Based on 63 Jobs/ha for Commercial Area as per the Concept Plan*

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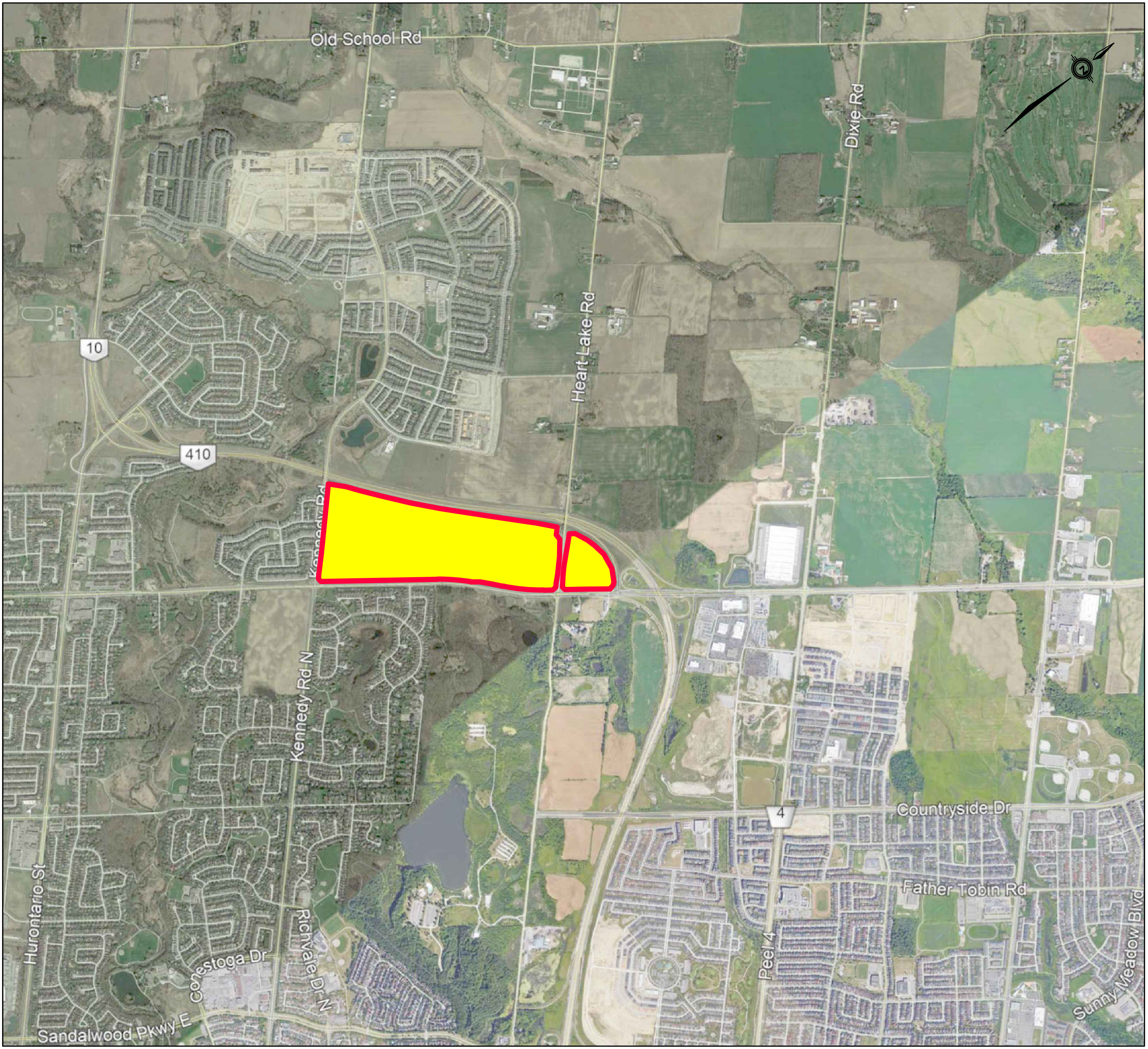

SNELL'S HOLLOW SECONDARY PLAN
TOWN OF CALEDON

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🟨 SNELL'S HOLLOW SECONDARY PLAN AREA

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FIGURE 1.1
LOCATION PLAN

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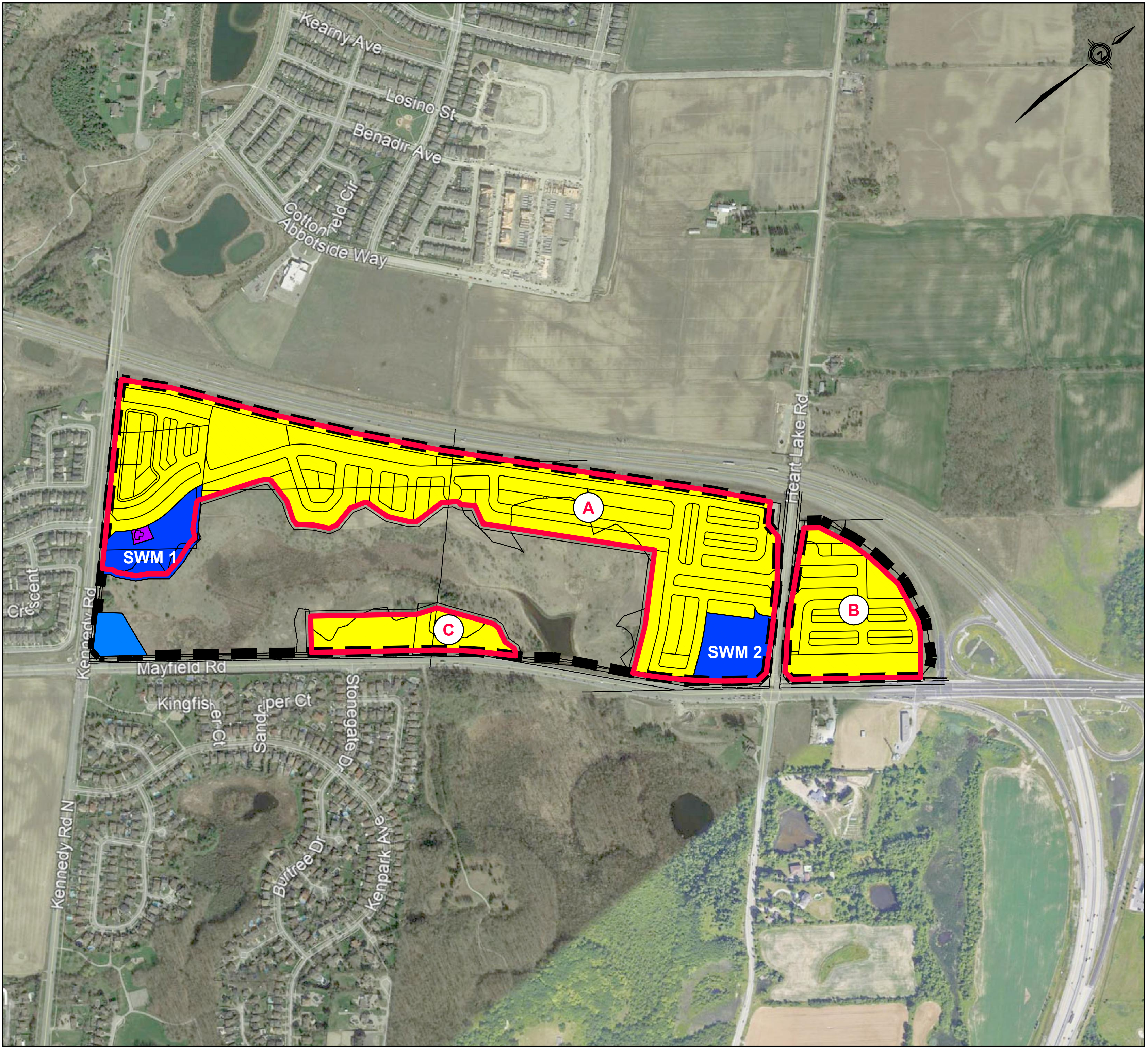

SNELL'S HOLLOW SECONDARY PLAN
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▬ ▬	SNELL'S HOLLOW SECONDARY PLAN AREA
🟨	DEVELOPMENT BOUNDARY
🟦	PROPOSED SWM POND
🟦	EXISTING SWM POND
🟪	EXISTING HERITAGE DWELLING

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FIGURE 1.2
DEVELOPMENT PLAN

2019-4851	FEBRUARY 2021	SCALE: N.T.S.

2.0 EXITING CONDITIONS

2.1 Existing Drainage

The subject site is located within the Etobicoke Creek watershed. The majority of the subject site west of Heartlake roads generally drains southeast towards the tributary of the Etobicoke located within the site. There is a drainage divide located within the site which diverts the flows from the site to east towards another tributary of the Etobicoke Creek. Please refer to **Figure 2.1** for more details.

Based on the TRCA design criteria (August 2012), the site is located within TRCA defined catchment 224.

MMM Group Limited completed a *Draft Final Report-Etobicoke Creek Hydrology Update* (April 2013), which further breaks down the catchment drainage boundaries located within the Etobicoke Creek "Spring Creek" subwatershed. The subject site was identified as part of three (3) pre-development catchment area IDs. The west portion of the site drains southerly and is within catchment ID area 41. The easterly portion of the subject site is split between catchment ID 447 and 24.

The catchment areas defined in the *Draft Final Report-Etobicoke Creek Hydrology Update* (April 2013) can be seen in **Figure J-1** (provided in **Appendix A**).

The pre-development drainage areas located within the site boundary were determined based on the available topography data and can be seen in **Figure 2.1** and summarized in **Table 2-1**.

Table 2-1: Summary of Pre-development Drainage Areas

TRCA Design Criteria (August 2012)	*Draft Final Report-Etobicoke Creek Hydrology Update* (April 2013)		SCE Pre-development Drainage Areas (Based on **Figure 2.1)**		
Catchment ID	Subwatershed	Catchment ID	Catchment ID	Runoff Direction	Area (ha)
224	Spring Creek	41	1	SW	46.2
224	Spring Creek	24	2	SE	12.6
224	Spring Creek	447	3	NE	2.9

2.2 Existing Land Use and Soil Conditions

Based on google satellite imagery, the subject site is currently primarily agricultural land. The *Draft Final*

Report-Etobicoke Creek Hydrology Update (April 2013) defines existing land use in **Figure A-1 (**provided in **Appendix A**) where the subject site land use is identified as agricultural, meadow, successional, estate residential, and open water. A portion of the Heart Lake Provincially Significant Wetland (PSW) is located within the site as discussed in the R.J. Burnside & Associates Limited *Baseline Conditions Report* (August 2020),.

As per *Draft Final Report-Etobicoke Creek Hydrology Update* (April 2013) **Figure A-3**, the subject site soils are ONEIDA throughout the developable area of the site. Similarly, the York Region Soil map identifies the soils as the Oneida series with soil type defined as clay loam. Subject site soils are therefore identified as type D.

Borehole logs from the preliminary Geotechnical Investigations completed by Golder Associates Ltd. (Refer to **Appendix A**) for the subject site confirm the soil type to be Silty clay.

2.3 Existing Storm Servicing

The existing storm infrastructure within the vicinity of the site includes existing SWM ponds, culverts and a storm sewer system on Mayfield Road, collecting the road drainage. Please refer to **Figure 2.1,** which identifies the existing SWM ponds and existing culverts.

There are two existing SWM ponds located near the sites. One of the existing stormwater management ponds is located southwest of the subject site in the northeast corner of the Kennedy Road and Mayfield Road intersection. The pond was originally designed by Stantec (2007) as was sized to accommodate the runoff from Mayfield Road and additional external area. A facility retrofit report was completed by GHD (May 2017) to ensure that the pond was providing adequate quality and quantity control. Based on the tributary drawing, the estate lots along Mayfield Road, which are within the subject boundary, were accommodated in the Pond as an external area; however, the Stantec (2007) report identifies that any future development of the external lands should provide their own quantity and quality control. The pond was sized to accommodate the Mayfield Road Widening. The pond discharges to the Spring Creek tributary that runs through the subject site.

The other SWM pond is located south of Mayfield Road and west of Heart Lake Road, as identified in **Figure 2.1**. The background data collected for the existing two SWM ponds is presented in **Appendix F** for additional information.

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SNELL'S HOLLOW SECONDARY PLAN
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🟪	AREA 1 DRAINAGE AREA = 46.2ha
🟧	AREA 2 DRAINAGE AREA = 12.6ha
🟩	AREA 3 DRAINAGE AREA = 2.9ha
➡	DIRECTION OF DRAINAGE FLOW
━	EXISTING WATERCOURSE
🟥	EXISTING CULVERT
🟦	EXISTING SWM POND

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FIGURE 2.1
PRE-DEVELOPMENT DRAINAGE PLAN

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3.0 EXISTING HYDROLOGY MODEL

3.1 TRCA Existing Hydrology Model

The latest Etobicoke Creek Hydrology Model was completed by MMM Group Limited (April 2013). The model was created for TRCA to determine quantity control criteria for development located within the watershed. Etobicoke Creek watershed runs through Caledon, Brampton, Mississauga and Toronto. The Etobicoke Creek model delineated sub-basins, in which the Snell's Hollow East Secondary Plan Area is located within the Spring Creek subwatershed in sub-basin number 6.

3.1.1 Existing Catchment Parameters

The *Draft Final Report-Etobicoke Creek Hydrology Update* (April 2013) by MMM Group Limited determined watershed parameters through the DTM, aerial photographs, and soil maps. SCS Curve Number method was used in the model, which is a function of land use, soil type, and AMC conditions; the weighted average was calculated using GIS software. Initial abstraction was calculated based on the Visual OTTHYMO Model Hydraulic Reference manual. As discussed in **Section 2.1**, the subject site falls within three (3) catchment areas of the Spring Creek subcatchment. **Table 3-1** summarizes the existing catchment parameters defined in the MMM Group Limited TRCA hydrology model (April 2013).

Table 3-1: Summary of TRCA Existing Model Catchment Parameters

TRCA Model		TRCA Catchment ID	TRCA Catchment Area (ha)	CN	IA	TP (hr)
Existing-2 to 100yr	AMCII	41	263.00	74	8.9	0.516
Existing-Regional_12hr_AMCIII	AMCIII	41	263.00	88	8.9	0.516
Existing-2 to 100yr	AMCII	24	140.14	76	8.1	0.557
Existing-Regional_12hr_AMCIII	AMCIII	24	140.14	89	8.1	0.557
Existing-2 to 100yr	AMCII	447	106.74	79	6.8	0.585
Existing-Regional_12hr_AMCIII	AMCIII	447	106.74	91	6.8	0.585

3.1.2 Corresponding Flows

The Flows from the TRCA Hydrology modelling corresponding to the catchments 41, 24 and 447 are summarized below in **Table 3-2**

Table 3-2 Existing TRCA Flows for catchments 41, 24 and 447

Storm Event	TRCA Catchment ID 41	TRCA Catchment ID 24	TRCA Catchment ID 447
2-Year	2.66 cms	1.55 cms	1.41 cms
5-Year	4.69 cms	2.69 cms	2.36 cms
10-Year	6.25 cms	3.55 cms	3.06 cms
25-Year	8.36 cms	4.71 cms	4.00 cms
50-Year	10.01 cms	5.62 cms	4.73 cms
100-Year	11.74 cms	6.57 cms	5.48 cms
Regional Event	32.36 cms	17.05 cms	12.96 cms

3.2 Subject Site Hydrology

A separate hydrology model was not prepared for the subject site to analyze the peak flows from the subject site. Instead, the flows from the existing TRCA model was used to establish the flows from the subject site using the MTO Prorating Methodology. This approach was used to establish the flows to ensure that the subject site flows correspond to the calibrated TRCA Existing model.

The existing flows for the subject site are summarized in **Table 3-3** below. Detailed calculations are provided in **Appendix B**.

Table 3-3 Existing Peak Flows for catchments 1, 2 and 3

Storm Event	SCE Catchment ID 1	SCE Catchment ID 2	SCE Catchment ID 3
2-Year	0.72 cms	0.26 cms	0.09 cms
5-Year	1.27 cms	0.44 cms	0.16 cms
10-Year	1.70 cms	0.58 cms	0.20 cms
25-Year	2.27 cms	0.77 cms	0.27 cms
50-Year	2.72 cms	0.92 cms	0.32 cms
100-Year	3.19 cms	1.08 cms	0.37 cms
Regional Event	8.78 cms	2.80 cms	0.87 cms

4.0 STORMWATER MANAGEMENT DESIGN CRITERIA

As per TRCA design criteria (August 2012), the following design criteria will need to be considered in the development of the Snell's Hollow East Secondary Plan Area;

- **Quantity control:** Peak flows are to be controlled to the unit flow rates described in the TRCA Appendix A, for Etobicoke Creek Catchment 224. The unit flow rates are summarized in the table below:

Table 4-1: TRCA Unit Flow Rate Equations for Etobicoke Creek, Catchment 224.

Return Period (years)	Unit flow Equation (l/s/ha)
2	7.5
5	13.3
10	18.7
25	27
50	35.2
100	42.1

- **Design Storms:** Peak flows are to be modelled using the 6-hour AES storm as defined in the TRCA criteria.

- **Erosion control:** Erosion control will be provided either through the 5mm retention (for site plans < 2.0ha) or the 25mm 48hour detention in SWM ponds.

- **Quality control:** Enhanced level of quality protection (80% TSS removal) is required as per the latest MOE SWMP Manual.

- **Water Balance:** The subject site is within a significant groundwater recharge area (SGRA); therefore pre-development recharge conditions are to be maintained in post-development conditions;

- **Feature-Based Water Balance (FBWB)**: PSW's have been identified on the subject site, runoff to these features should be maintained in post-development conditions.

The following design criteria were established in the *Draft Final Report-Etobicoke Creek Hydrology Update*, by MMM Group Limited, dated April 2013:

- **Design Storms:** The report recommends utilizing the 12hr AES rainfall distribution for a 2-100 year rainfall event to establish the peak flows. The Regional event should be modelled with the final 12-hours of the Hazel event under AMC III conditions.

- **Quantity Control:** New unit flow rates were established for infill developments for both the 2-100 storm events and regional storm events (please see the table below); however, any development on the subject site cannot be considered infill.

  It was confirmed with TRCA, that the regional control is required for this site based on the release rate of the 127.44l/s/ha.

As per the report, the pre-development Regional flows are to be maintained in post-development conditions and unit flow rates have been developed. Regional storage will require an additional 214m^3/ha, which is to be added after the Regional Storm storage has been sized using the unit flow rates.

Table 4-2: Unit Flow Rate as per the *Draft Final Report-Etobicoke Creek Hydrology Update*

Return Period (years)	Unit flow Equation Catchment 41 (l/s/ha)	Unit flow Equation Catchment 24 (l/s/ha)	Unit flow Equation Catchment 447 (l/s/ha)
2	10.11	11.09	13.21
5	17.85	19.20	22.06
10	23.75	25.34	28.65
25	31.77	33.63	37.45
50	38.08	40.12	44.28
100	44.65	46.85	51.32
Regional	127.44 (Basin 6)		

The subject site is bounded by Mayfield Region of Peel Right of Way (ROW. The applicable design criteria stated in the Region of Peel Public Works Stormwater Design Criteria and Procedural Manual, June 2019 will apply for works within the Regional ROW.

5.0 Proposed Stormwater Management Scheme

To provide the required stormwater management control and meet the design criteria presented in **Section 4**, two (2) stormwater management facilities are proposed, as shown in **Figure 5.1**. The two SWM facilities service for the majority of the site. SWM Facility 1 discharges to the Etobicoke tributary located within the subject site and SWM Facility 2 discharges to the existing 525mm diameter storm sewer on Heart Lake Road. The remaining catchment (South Site Plan – Catchment 203) is proposed to follow the existing drainage conditions and drain towards the Etobicoke's tributary located within the site, providing on-site controls.

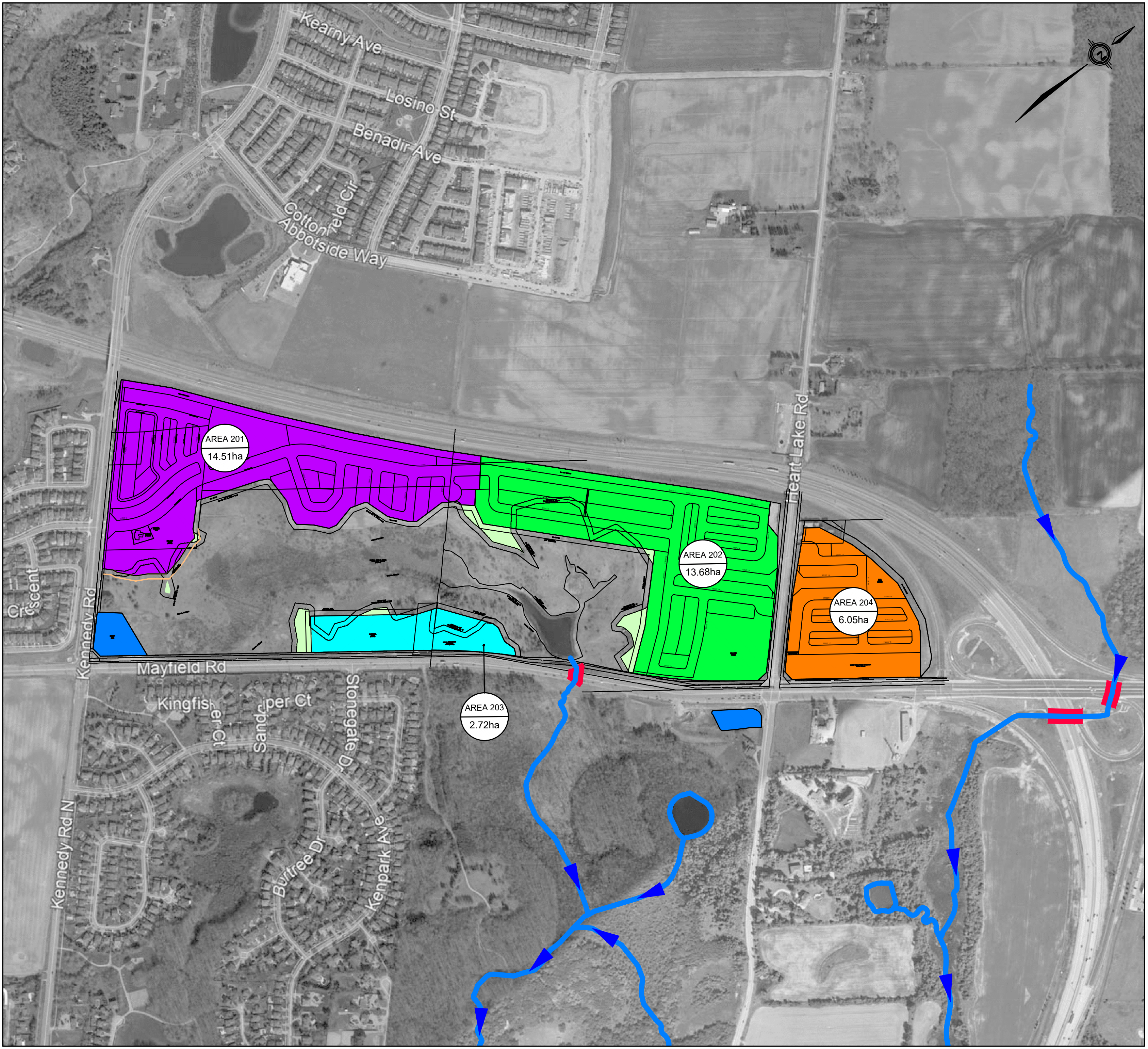
The proposed SWM 1 and SWM 2 facilities are proposed to provide water quality, quantity treatment and erosion control during the post-development conditions. SWM Facility 1 services the western half of the subject site lands west of Heart Lake Road, and SWM Facility 2 services the eastern half and the subject lands east of Heart Lake Road. The water balance criterion is proposed to be met site-wide as discussed in **Section 6.1** below.

The tributary to each SWM facility and the corresponding imperviousness is presented in **Figure 5.1** and **Table 5-1** below. Detailed calculations are presented in **Appendix C**.

Table 5-1: Post Development Drainage Areas

Facility	Post Development Catchment ID	Area (ha)	Total area (ha)	Imperviousness	Runoff Coefficient
SWM Facility 1	201	14.51	14.51	54%	0.58
SWM Facility 2	202	13.68	19.73	63%	0.64
	204	6.05			
On-site Controls	203	2.72	2.72	90%	0.83

Please refer to **Figure 5.1** for an illustration of the post-development drainage plan. The proposed Stormwater infrastructure is presented in **Figure 5.2**.



SNELL'S HOLLOW SECONDARY PLAN
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🟪	AREA 201 DRAINAGE AREA = 14.51ha RUNOFF COEFFICIENT = 0.58
🟩	AREA 202 DRAINAGE AREA = 13.68ha RUNOFF COEFFICIENT = 0.62
🟦	AREA 203 DRAINAGE AREA = 2.72ha RUNOFF COEFFICIENT = 0.83
🟧	AREA 204 DRAINAGE AREA = 6.05ha RUNOFF COEFFICIENT = 0.67
━	EXISTING WATERCOURSE
🟥	EXISTING CULVERT
🟦	EXISTING SWM POND

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FIGURE 5.1
POST-DEVELOPMENT DRAINAGE PLAN

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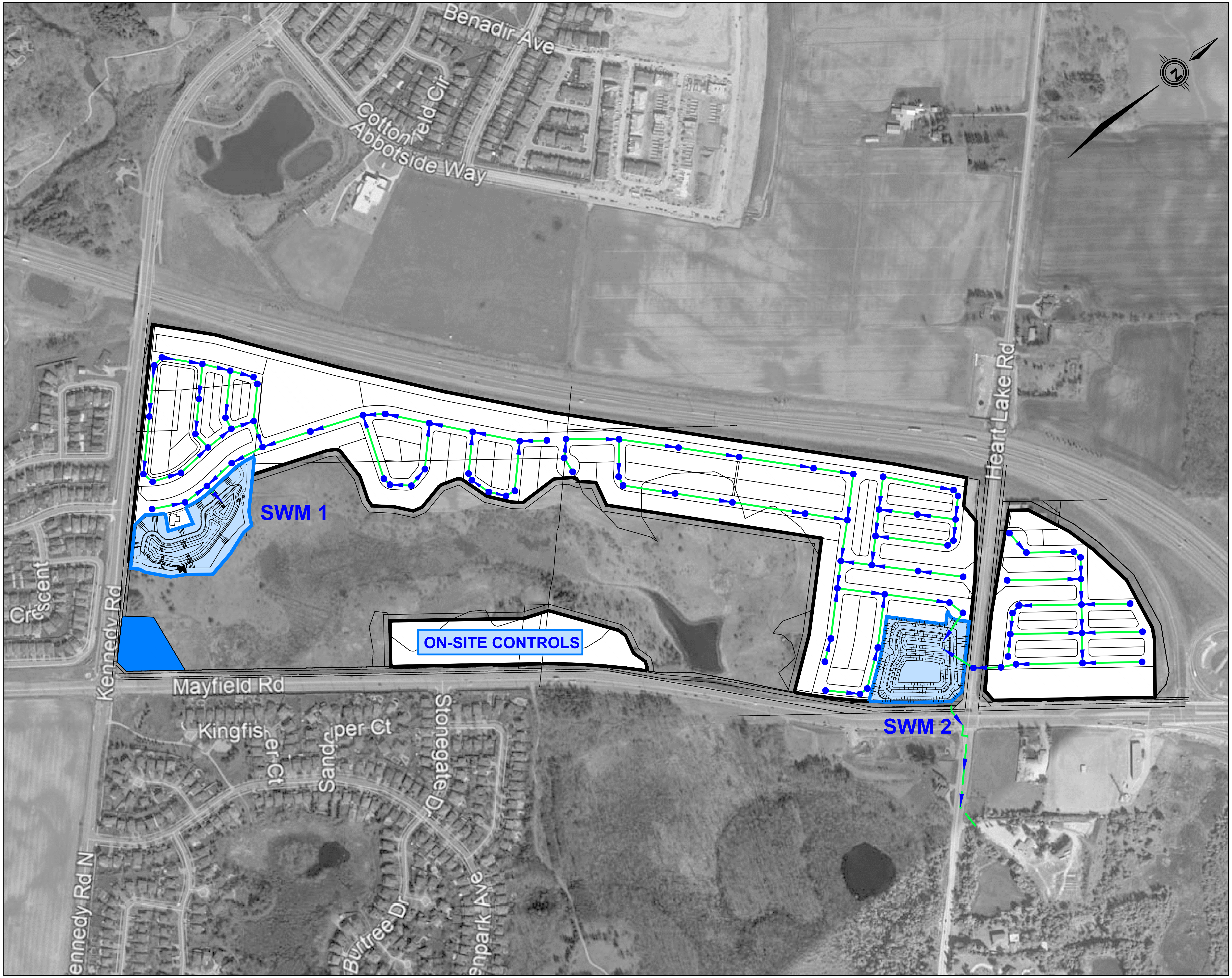

SNELL'S HOLLOW SECONDARY PLAN
TOWN OF CALEDON

LEGEND

☐ DEVELOPMENT BOUNDARY

▨ PROPOSED SWM PONDS

— PROPOSED STORM SEWERS

■ EXISTING SWM POND

– – EXISTING STORM SEWER
(PLEASE REFER TO BACKGROUND INFORMATION PRESENTED IN APPENDIX A.1)

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FIGURE 5.2
STORM SERVICING PLAN

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5.1 SWM strategy – Area Draining to SWM Pond 1 (Catchment 201)

A detailed evaluation of the SWM and Low Impact development measures that apply to the proposed development were reviewed and presented in the CEISMP Section 8.3.1. As presented in the report, a SWM Pond is proposed to achieve the quality, quantity and erosion control requirements for Catchment 201, as per the design criteria discussed in **Section 4.** SWM Pond 1 discharges to the creek located within the subject site.

5.1.1 Allowable Release Rates

As discussed in the previous sections, approximately 14.51 ha is proposed to drain to the SWM facility 1. The maximum allowable release rates from SWM Pond 1 are based on the unit flow rates described in the TRCA guidelines Appendix A, for Etobicoke Creek Catchment 224. The pond release rates are based on a pre-development drainage area of 19.44ha. A summary of the allowable flows from SWM Pond 1 are outlined in **Table 5-2** below.

Table 5-2: Summary of the Allowable Design Flows for SWM Pond 1

Return Period (years)	Target Flow Rate ($m^3/s/ha$)	Target Rate (m^3/s)
2	0.0075	0.146
5	0.0133	0.259
10	0.0187	0.364
25	0.0270	0.525
50	0.0352	0.684
100	0.0421	0.819
Regional Event	0.123*	1.785

**The regional unit flow rate is based on TRCA's existing peak flow of 32.36cms for catchment 41 with an area of 263 ha.*

5.1.2 Quantity Control

According to the latest stormwater management plan, it is proposed to drain approximately 14.51 ha of the subject site to SWM Pond 1.

Based on the calculations presented in **Appendix C.4,** the required 100-year storage volume is 2863 $m^{3,}$ and the required regional event volume is 5968 m^3. Please note that since the post-development regional peak flow of 1.47m^3/s was less than the allowable release rate of 1.785cms, the regional storage volume was estimated by adding the 214m3/ha to the 100-year storage volume.

Currently, SWM Pond 1 is adequately sized to provide 100-year storage of 4200 m^3 and a regional volume of 7810 m^3. The full VO results are provided in **Appendix C.6**.

Table 5-3: Storage Volume for SWM Pond 1

Return Period (years)	Target Flow Rate (m^3/s/ha)	Target Rate (m^3/s)	Required volume (m^3) (Governing Storm)
2	0.0075	0.146	2350
5	0.0133	0.259	2500
10	0.0187	0.364	2594
25	0.0270	0.525	2723
50	0.0352	0.684	2789
100	0.0421	0.819	2863
Regional Event	0.123	1.785	5968

5.1.3 Quality Control

Quality Control for the tributary area to SWM Pond 1 (14.51 ha) will be provided at the pond. The permanent pool was sized to provide 80% of TSS removal based on Table 3.2 in the MOE. *SWM Planning and Design Manual*. The required permanent pool volume is summarized in **Table 5-4** below, and calculations are provided in **Appendix C.5** for reference.

Table 5-4: Permanent Pool Volume for SWM Pond 1

Contributing Area	Overall Imperviousness (%)	Required Permanent Pool Volume (m^3)	Provided Permanent Pool Volume (m^3)
14.51	54	2137	2250

5.1.4 Erosion Control

As per the TRCA SWM guidelines, erosion control is required by detaining 25mm event over 48 hours. Additionally, the Fluvial Geomorphological Assessment completed by GeoMorphix (April 15, 2020) recommended a 24 hour or 48-hour detention of the 25mm to prevent erosion in the subject site area and downstream.

Therefore, SWM Pond 1 was sized to ensure that the 25mm event is released over 48 hours. Please refer to **Appendix C.3** for erosion control calculations. **Table 5-5** below provides a summary of the required erosion control volume.

Table 5-5: Erosion control required volume for SWM Pond 1

Contributing Area	RV (mm) (Value from VO model)	Required Storage Volume (m^3)	Peak Outflow (m^3/s)
14.51	14.8	2147	0.019

5.2 SWM Strategy – Area Draining to SWM Pond 2 (Catchments 202 & 204)

A detailed evaluation of the SWM and Low Impact development measures that apply to the proposed development were reviewed and presented in the CEISMP Section 8.3.1. As presented in the report, a SWM Pond is proposed to achieve the quantity, quality and erosion control requirements for Catchments 202 and 204, as per the design criteria discussed in **Section 4.** SWM Pond 2 discharges to the existing 525mm diameter storm sewer on Heart Lake Road.

5.2.1 Allowable Release Rates

As discussed in the previous sections, approximately 19.73ha is proposed to drain to the SWM facility 2. The maximum allowable release rates from SWM Pond 2 are based on the unit flow rates described in the TRCA guidelines Appendix A, for Etobicoke Creek Catchment 224. The pond release rates are based on a pre-development drainage area of 12.65ha. A summary of the allowable flows from SWM Pond 2 are outlined in **Table 5-6** below.

Table 5-6: Summary of the Allowable Design Flows for SWM Pond 2

Return Period (years)	Target Flow Rate (m^3/s/ha)	Target Rate (m^3/s)
2	0.0075	0.095
5	0.0133	0.168
10	0.0187	0.236
25	0.0270	0.341
50	0.0352	0.445
100	0.0421	0.532
Regional Event	0.122*	1.538

**The regional unit flow rate is based on TRCA's existing peak flow of 17.05cms for catchment 24 with an area of 140.14 ha.*

5.2.2 Quantity Control

According to the latest stormwater management plan, it is proposed to drain approximately 19.73 ha of the subject site to SWM Pond 2.

Based on the calculations presented in **Appendix C.4,** the required 100-year storage volume is 7925 $m^{3,}$ and the required regional event volume is 19037 m^3. The regional storage volume was estimated by adding the 214m3/ha to the regional storm storage sized using the unit flow rates.

Currently, SWM Pond 2 is adequately sized to provide 100-year storage of 7980 m^3 and a regional volume of 19510 m^3. The full VO results are provided in **Appendix C.6**.

Table 5-7: Storage Volume for SWM Pond 2

Return Period (years)	Target Flow Rate (m^3/s/ha)	Target Rate (m^3/s)	Required volume (m^3) (Governing Storm)
2	0.0075	0.095	4594
5	0.0133	0.168	5719
10	0.0187	0.236	6392
25	0.0270	0.341	7099
50	0.0352	0.445	7484
100	0.0421	0.532	7925
Regional Event	0.122	1.538	19037

5.2.3 Quality Control

Quality Control for the tributary area to SWM Pond 2 (19.73 ha) will be provided at the pond. The permanent pool was sized to provide 80% of TSS removal based on Table 3.2 in the MOE. *SWM Planning and Design Manual*. The required permanent pool volume is summarized in **Table 5-8** below and calculations are provided in **Appendix C.5** for reference.

Table 5-8: Permanent Pool Volume for SWM Pond 2

Contributing Area	Overall Imperviousness (%)	Required Permanent Pool Volume (m^3)	Provided Permanent Pool Volume (m^3)
19.73	63	3317	4400

5.2.4 Erosion Control

As per the TRCA SWM guidelines, erosion control is required by detaining 25mm event over 48 hours.

Additionally, the Fluvial Geomorphological Assessment completed by GeoMorphix (April 15, 2020) recommended a 24 hour or 48-hour detention of the 25mm to prevent erosion in the subject site area and downstream.

Therefore, SWM Pond 2 was sized to ensure that the 25mm event is released over 48 hours. Please refer to **Appendix C.3** for erosion control calculations. **Table 5-9** below provides a summary of the required erosion control volume.

Table 5-9: Erosion control required volume for SWM Pond 2

Contributing Area	RV (mm) (Value from VO model)	Required Storage Volume (m^3)	Peak Outflow (m^3/s)
19.73	16.776	3310	0.029

5.3 SWM Strategy – South Site Plan Area (Catchment 203)

5.3.1 Allowable Release Rates

As previously discussed, the site plan area (Catchment 203) located at the south side of the subject lands is proposed to have on-site controls. The on-site storage will control peak flows to the unit flow rates described in the TRCA guidelines Appendix A, for Etobicoke Creek Catchment 224. The release rates are based on a pre-development drainage area of 2.72ha. A summary of the south site plan's allowable flows is outlined in **Table 5-10** below.

Table 5-10: Summary of the Allowable Design Flows for the South Site Plan (Catchment 203)

Return Period (years)	Target Flow Rate ($m^3/s/ha$)	Target Rate (m^3/s)
2	0.0075	0.020
5	0.0133	0.036
10	0.0187	0.051
25	0.0270	0.073
50	0.0352	0.096
100	0.0421	0.115
Regional Event	0.123*	0.335

**The regional unit flow rate is based on TRCA's existing peak flow of 32.356cms for catchment 41 with an area of 263 ha.*

5.3.2 Quantity Control

On-site controls are proposed for the South Site Plan in order to maintain the allowable release rates presented in **Section 5.3.1** above.

Based on the calculations presented in **Appendix C.4,** the required 100-year storage volume is 1486 $m^{3,}$ and the required regional event volume is 2550 m^3. The full VO results are provided in **Appendix C.6**.

The on-site retention methods (Underground storage, parking storage or roof storage) will be determined at the site plan stage when additional information is available.

Table 5-11: Storage Volume for the South Site Plan (Catchment 203)

Return Period (years)	Target Flow Rate (m^3/s/ha)	Target Rate (m^3/s)	Required volume (m^3) (Governing Storm)
2	0.0075	0.020	819
5	0.0133	0.036	1002
10	0.0187	0.051	1117
25	0.0270	0.073	1265
50	0.0352	0.096	1376
100	0.0421	0.115	1486
Regional Event	0.123	0.335	2550

5.3.3 Quality Control

On-site measures should be designed to provide 80% TSS removal to achieve the quality control requirements.

The on-site measures can be stand-alone units like Jellyfish Filter units or a combination of Lot-level techniques, including but not limited to infiltration galleries, bioswales, tree pits, permeable pavers or underground infiltration/ retention tanks.

5.3.4 Erosion Control

As per the TRCA SWM guidelines, erosion control is required by detaining 25mm event over 48 hours. Please refer to **Appendix C.3** for erosion control calculations. **Table 5-12** below provides a summary of the required erosion control volume.

Table 5-12: Erosion control required volume for the South Site Plan

Contributing Area	**RV (mm) (Value from VO model)**	**Required Storage Volume (m^3)**	**Peak Outflow (m^3/s)**
2.72	22.692	617	0.005

Since achieving an outflow of 5 L/s is not feasible, the erosion control requirements can be met via 5mm on-site retention given the small area of the site (2.72 ha).

6.0 Water Balance and Feature-Based Water Balance

6.1 Water Balance

The subject site is not located within a WHPA-Q1/Q2 area; however, some areas are located within a significant groundwater recharge area (SGRA). Therefore, as per TRCA design criteria (August 2012), the subject site requires that post-development infiltration matches existing conditions. A post to pre-development conditions detailed water balance was undertaken for the proposed development. The total precipitation value was based on the TRCA water budget tool.

As the TRCA water budget tool inputs do not equal outputs, the evaporation value was determined based on prorating the precipitation value. The infiltration factor for pervious areas was determined based on the M.O.E. factors. M.O.E. factors were determined to assume the site has tight clay soils, the terrain has rolling hills, and land cover varies between agricultural, meadow, and natural feature areas. The existing rooftops were considered impervious areas.

It is determined that the site annual infiltration capacity for pre-development conditions is approximately 112,905 $m^{3,}$ and it will drop to 75,621 m^3 per year under the post-development conditions. Thus, the approximate annual infiltration deficit is calculated to be 37,284 m^3.

In order to achieve the post to pre infiltration for the subject lands, the following options were explored in detail. Please note the below options are explored only for the lands west of Heart Lake Road. There are limited options for lands east of Heart Lake Road due to limited space. For example, the clean water collector system (proposed in Option 3) below will be challenging as it introduces a new sewer system that requires crossing the Regional ROW. Additionally, grading constraints and limited spacing constrict the ability to propose infiltration facilities.

Option 1: Infiltration Trenches for Catchments 201 and 202 & On-site measures for Catchment 203

The following option proposes infiltration trenches where feasible to meet the water balance requirements and assumes the Catchment 203 will provide its own site plan measures.

The proposed measures in this option are detailed below.

- Catchment 203 to provide own site plan control to achieve 5mm infiltration
    - Various LID measures that can help achieve the required SWM criteria were discussed in the CEISMP report. Please refer to Section 8.4 of the CEISMP for more details.
- Infiltration Trenches are proposed at Low-Density Development area (Detached/Semi-

Detached/St. Townhouses).

    - Based on the preliminary calculation presented in **Appendix D**, approximately 2000m of Infiltration trench (Width = 1.5m and Depth = 0.72m) is required to meet the water balance. A design infiltration rate of 15mm/hr with a safety factor of 2.5 was utilized to complete these calculations. Based on the development plan, approximately 2339m is available for infiltration trenches, as shown in the figure in **Appendix D.**

- Infiltration trenches in the Park area
    - Based on the preliminary calculation presented in **Appendix D**, approximately 201m of Infiltration trench (Width = 1.5m and Depth = 0.72m) is required to meet the water balance. A design infiltration rate of 15mm/hr with a safety factor of 2.5 was utilized to complete these calculations.

The above measures help achieve the 34820m^3/y of the above mentioned 37284m^3/y deficit. This option is currently recommended for the proposed development. It helps achieve the required post to pre-water balance, and the operation and maintenance costs are estimated to be low compared to the other options discussed below. In addition to our analysis, R.J. Burnside has prepared and provided their analysis as shown in **Appendix D.** The analysis by R.J. Burnside also confirms that the proposed mitigation measures in Option 1 satisfy the post-to-pre water balance requirement.

Table 6-1 summarizes the pre to post-development conditions water balance with mitigation measures presented in Option 1.

Table 6-1: Water Balance Summary

Characteristics	Site				
	Total Pre-development	Post-development	Percent Change (Pre to Post)	Post-development with mitigation (OPTION 1)	Change (pre to post with mitigation) (OPTION1)
Inputs (Volumes)					
Precipitation (m^3/year)	535,556	535,556	0%	535556	0%
Total Inputs (m^3/year)	535,556	535,556	0%	535556	0%
Outputs (Volumes)					
Precipitation surplus (m^3/year)	258,625	340,197	24%	340197	24%
Net Surplus (m^3/year	258,625	340,197	24%	340197	24%
Total Evapotranspiration (m^3/year)	276,931	195,359	-42%	195359	-42%
Total Infiltration (m^3/year)	112,905	75,621	-49%	110441	-2%
Total Runoff (m^3/year)	145,720	264,576	45%	229756	37%
Total Outputs (m^3/year)	535,556	535,556	0%	535556	0%

Option 2: Infiltration Trenches (Catchments 201 and 202), Infiltration Gallery (Catchment 201) & On-site measures for Catchment 203

The following option proposes infiltration trenches where feasible to meet the water balance requirements and assumes the Catchment 203 will provide its own site plan measures. Additionally, an infiltration gallery is proposed to provide a post to pre-water balance for the area draining to the facility.

The proposed measures in this option are detailed below.

- Catchment 203 to provide own site plan control to achieve 5mm infiltration
    - Various LID measures that can help achieve the required SWM criteria were discussed in the CEISMP report. Please refer to Section 8.4 of the CEISMP for more details.
- Infiltration Gallery in Park Area (Catchment 201)
    - A separate CWC is proposed to convey the flows to an infiltration galley (approximately 0.3ha) to provide infiltration for the roof areas within Catchment 201.
- Infiltration Trenches are proposed at Low-Density Development area(Detached/Semi-Detached/St. Townhouses) within Catchment 202 and Catchment 201.

  - Based on the preliminary calculation presented in **Appendix D**, approximately 935m of Infiltration trench (Width = 1.5m and Depth = 0.72m) is required to meet the water balance. A design infiltration rate of 15mm/hr with a safety factor of 2.5 was utilized to complete these calculations. Based on the development plan, approximately 1111m is available for infiltration trenches, as shown in the figure in **Appendix D.**

The above measures help achieve the 39940m^3/year, which is greater than the 37284m^3/year deficit. This option is currently not recommended as it involves a third pipe system and a separate infiltration gallery. However, this option can be explored in the detail design stage to achieve the requirements, if the agency requires.

Option 3: Perforated Clean Water Collector System & On-site measures for Catchment 203

The following option proposes a perforated clean water pipe system that collects clean water from the roofs and promotes infiltration. Similar to the other two options, catchment 203 is proposed to provide its infiltration measures.

The proposed measures in this option are detailed below.

- Catchment 203 to provide own site plan control to achieve 5mm infiltration
  - Various LID measures that can help achieve the required SWM criteria were discussed in the CEISMP report. Please refer to Section 8.4 of the CEISMP for more details.
- Perforated CWC's
  - A perforated CWC system is proposed and the storm sewers to enable infiltration from the clean roof areas. As shown in the calculations in **Appendix D**, approximately 1950m of 300mm diameter perforated pipe is required to satisfy the infiltration requirements.

The above measures help achieve the 37284m^3/year deficit. This option is currently not recommended as it involves a third pipe system. However, this option can be explored in the detail design stage to achieve the requirements.

6.2 Feature Base Water Balance

The *Snell's Hollow East Secondary Plan Baselines Condition* Report by R.J. Burnside (August 2020) identifies that the subject site drains to the Heart Lake Provincial Significant Wetlands (PSW) defined by the Ministry of Natural Resources (MNRF). A portion of the PSW is within the site boundary.

R.J Burnside and Schaeffers Consulting Engineers completed a Wetland Water Balance Risk Evaluation that classified the wetlands within the subject side as "High Risk." As required by TRCA, a continuous water balance model was prepared by Schaeffers Consulting Engineers. The details are presented in the report titled "Feature-Based Water Balance – Snells Hollow Secondary Plan Area," dated April 2021.

7.0 FLOODPLAIN ANALYSIS

A floodplain analysis has been conducted for the subject site to determine the conveyance capacity of the tributary. The method of establishing the existing floodplain has been discussed with the TRCA due to the backwater conditions caused by the 1050 mm diameter culvert under the Mayfield Road crossing. Schaeffer's previously conducted the analysis using conventional 1-D HEC-RAS Modelling. It was found that the water spills over the Mayfield Road at various locations, including the culvert's location. Due to the very limited capacity of the culvert, the system acts in backwater; 1-D modelling ignores the impacts of storage available within the valley. This information was conveyed to the TRCA during a meeting held on August 7th, 2020 between the TRCA and Schaeffers. It was concluded to establish the floodplain assuming the culvert being plugged and assuming the valley as a complete storage unit.

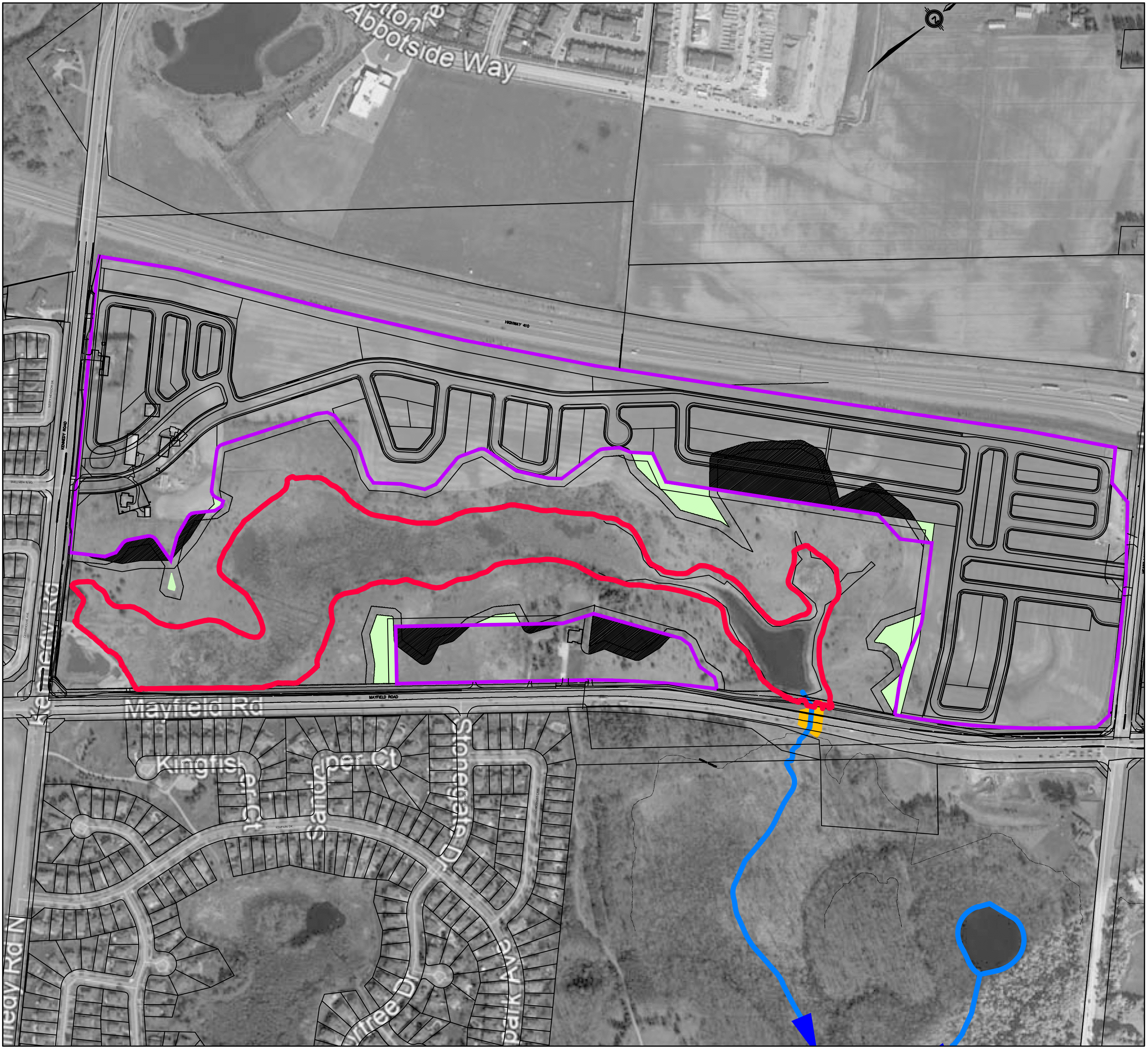
In following this methodology, Schaeffer's established the floodline for the subdivision based on the total runoff volume generated from the Future drainage conditions at the request of the TRCA. It is to note that the spill elevation to Mayfield Road has been established based on the field survey as 257.50 masl. The total available storage within the valley is calculated to be 183,870 m^3 at the elevation of 257.50 masl. Please refer to the floodplain shown in **Figure 7.1**.The overall drainage area towards the watercourse in Future conditions is calculated to be 51.75ha. This area includes the 9.76ha drainage area to the Kennedy SWM Pond as per the SWM report by GHD (SWM Facility Retrofit Report), the 17.23 ha from the proposed subdivision, and the 24.76 ha of drainage from the valley. Please refer to the future conditions drainage area in **Figure 7.2.**

7.1 Runoff Generated

The runoff volume calculation has been carried out using Visual OTTHYMO. Overall drainage parameters have been updated to reflect the future drainage conditions and the land uses. Based on the VO hydrograph output for the Hurrican HAZEL regional storm case, a total runoff volume of 184.452mm is expected. This amounts to 95,454 m^3 of volume. VO modelling results are presented in **Appendix E**. With the assumption that the culvert is plugged, it has been estimated that the water surface elevation will be 256.65 masl within the valley when retaining 95,454 m^3 of water, lower than the spill elevation. As such, the proposed grading and servicing has been carried out to safely maintain a freeboard from this elevation. The proposed floodline is depicted in **Figure 7.1.** Furthermore, this floodline has been delineated on the existing floodplain drawing.

W:\4800's\4851 - Snells Hollow\Drawings\Drainage\2021-02-08-4851-Future Floodline Drainage.dwg

Phil Gotfried



SNELL'S HOLLOW SECONDARY PLAN
TOWN OF CALEDON

LEGEND

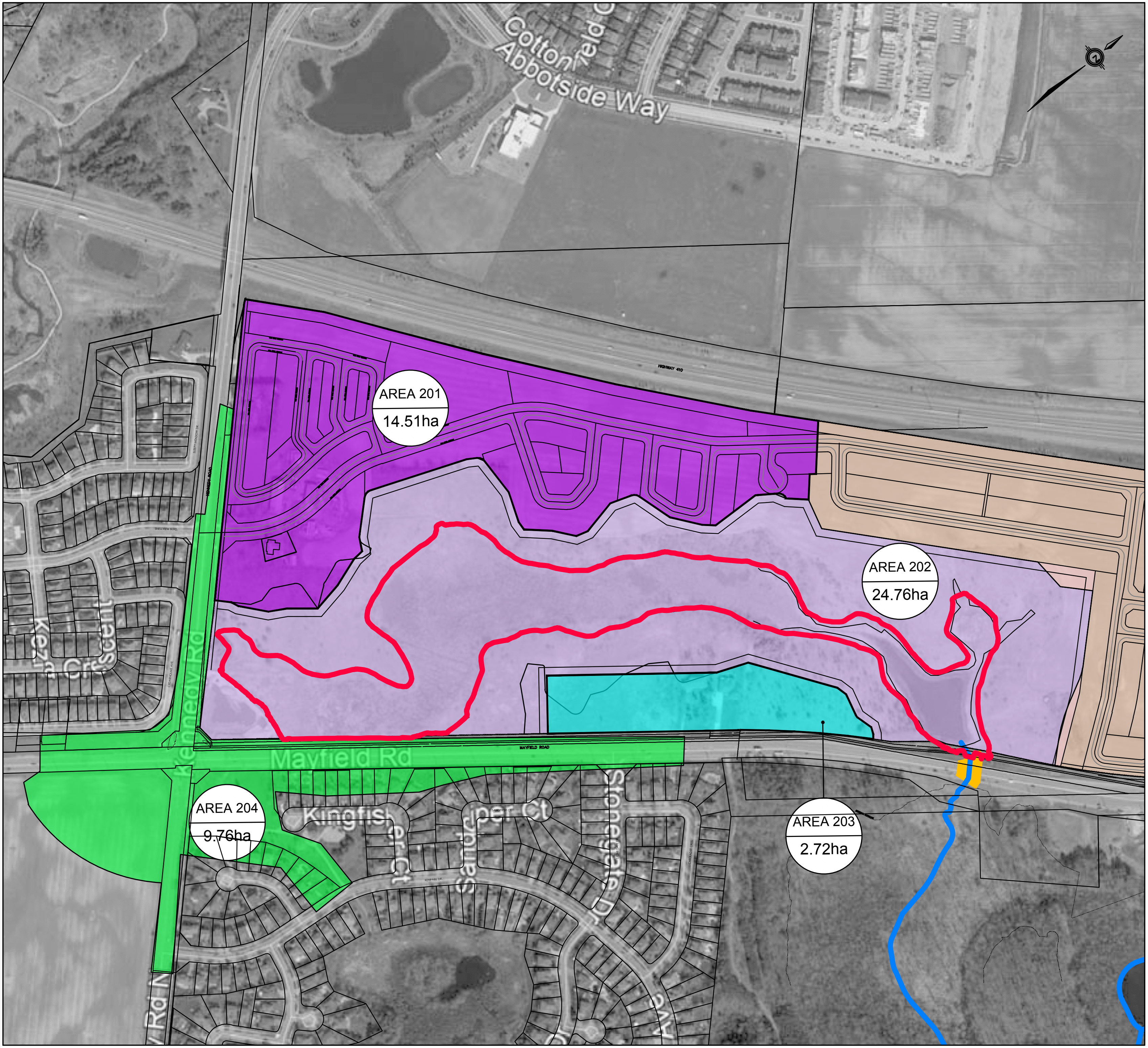
▬	EXISTING WATERCOURSE
—	FUTURE REGIONAL FLOODLINE ELEVATION 256.65m
▬	EXISTING CULVERT
—	DEVELOPMENT BOUNDARY

PLEASE NOTE THE DRAFT PLAN
SHOWN HERE IS CONCEPTUAL

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 7.1
FUTURE REGIONAL FLOODLINE

2019-4851	FEBRUARY 2021	SCALE: N.T.S.



SNELL'S HOLLOW SECONDARY PLAN
TOWN OF CALEDON

LEGEND

🟪 AREA 201 DRAINAGE
AREA = 14.51ha
RUNOFF COEFFICIENT = 0.58

🟪 AREA 202 DRAINAGE
AREA = 24.76ha
RUNOFF COEFFICIENT = 0.25

🟦 AREA 203 DRAINAGE
AREA = 2.72ha
RUNOFF COEFFICIENT = 0.83

🟫 AREA DRAINING TO EAST
AWAY FROM THE VALLEY
CORRIDOR

🟩 AREA 204 DRAINAGE
AREA = 9.76ha
RUNOFF COEFFICIENT = 0.52
AREA OBTAINED FROM GHD
SWM POND REPORT

━ EXISTING WATERCOURSE

🟨 EXISTING CULVERT

— FUTURE REGIONAL FLOODLINE
ELEVATION 256.65m

PLEASE NOTE THE DRAFT PLAN
SHOWN HERE IS CONCEPTUAL

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 7.2
FUTURE DRAINAGE AREA

2019-4851	FEBRUARY 2021	SCALE: N.T.S.

8.0 SUMMARY

This report presents the stormwater management plan for the proposed Snell's Hollow Secondary Plan Area located in the Town of Caledon. The report demonstrates that adequate stormwater servicing will be available for the proposed development. The key points discussed in this report are summarized below.

- Two stormwater management facilities are proposed to meet the required quantity, quality and erosion requirements for Catchments 201, 202 and 204.
- The South Site Plan (Catchment 203) is proposed to have on-site controls.
- A floodplain assessment was completed to determine the conveyance capacity of the tributary.
- Post to pre-water balance is proposed via infiltration trenches and infiltration galleries in Catchment 201 and 202. Catchment 203 will provide its own measures to achieve 5mm infiltration.

Should you have any questions or comments, please do not hesitate to call the undersigned.

Respectfully Submitted,

SCHAEFFER & ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
K. SHAHBIKIAN
100090411
Feb 18/2021
PROVINCE OF ONTARIO

Sarah Fanous

Sarah Fanous, B.Sc., E.I.T.

Water Resources Analyst

Koryun Shahbikian, LLM, M. Eng., P. Eng.

Partner

Yashaswy

Yashaswy Gollamudi, B.Sc., E.I.T.

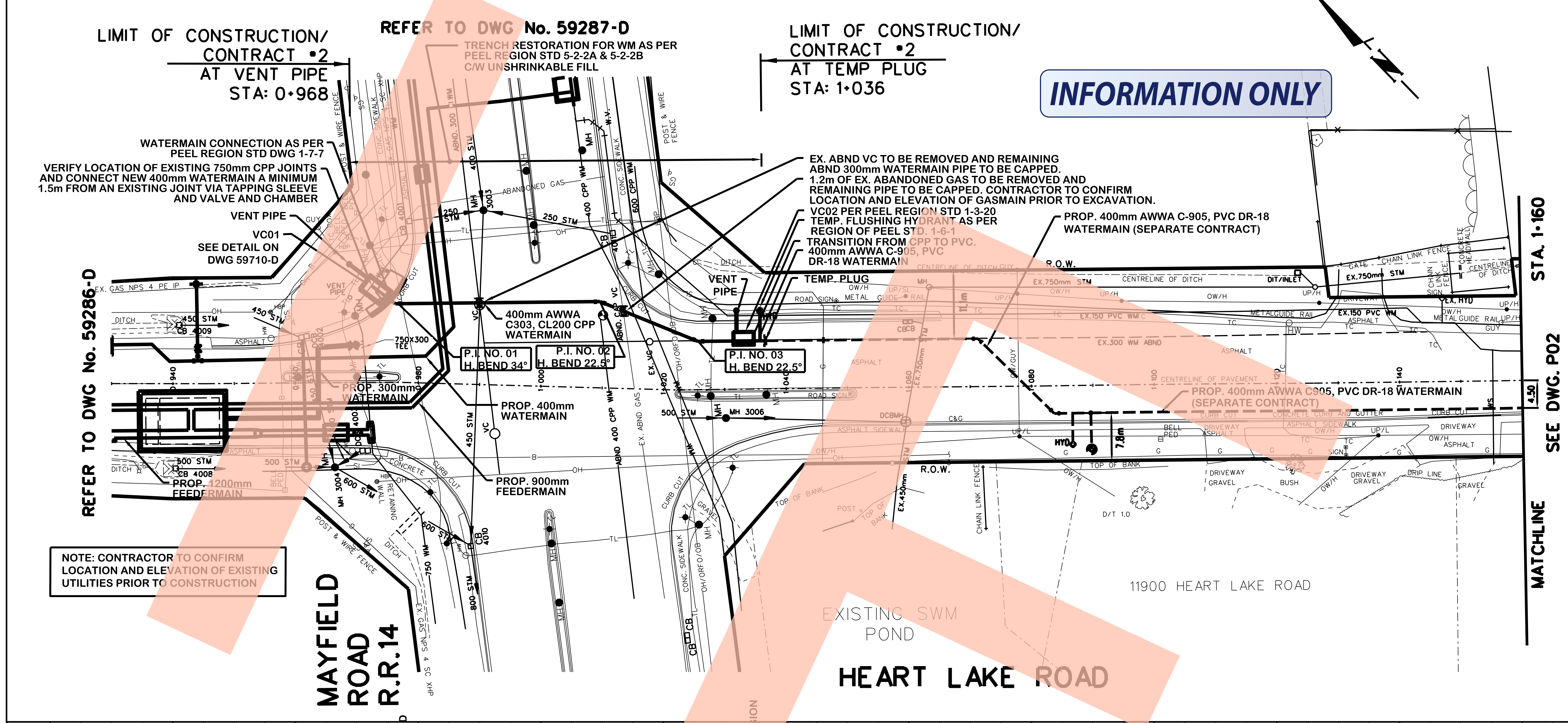
Water Resources Analyst

APPENDIX A: BACKGROUND INFORMATION

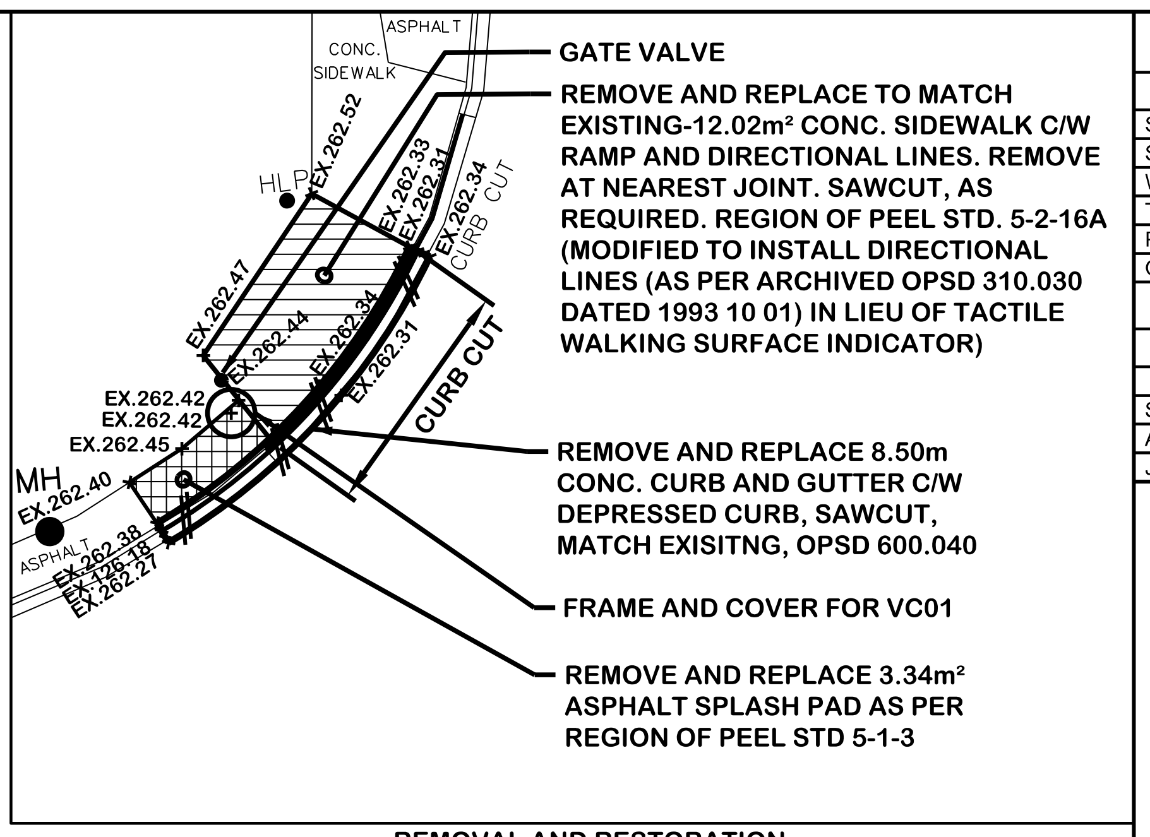
GENERAL NOTES

1. INSTALL TRACER WIRE FOR ALL PVC WATERMAINS, REGION OF PEEL STD 1-7-10.
2. CONTRACTOR SHALL NOTIFY GAS UTILITY 48 HOURS IN ADVANCE OF WORKS IN PROXIMITY OF THE ABANDONED GASMAIN.
3. BACKFILL TRENCHES ACROSS DRIVEWAYS WITH GRANULAR 'A'.
4. WIDE TRENCH RESTORATION FOR WM AND LAP JOINT DETAIL AS PER DWG. 59712-D (TYP.)
5. MAINTAIN 0.6m HORIZONTAL AND 0.6m VERTICAL DISTANCE FROM STREET LIGHTS PLANT. HAND DIG IF WITHIN 1m OF STREET LIGHT PLANT. CALL ONTARIO ONE AT 1-800-400-2255 FOR STREET LIGHT LOCATES.
6. MAINTAIN A 1.2m MINIMUM HORIZONTAL CLEARANCE FROM EXISTING HYDRO PLANT (POLES AND ANCHORS).
7. MAINTAIN 0.6m HORIZONTAL AND 0.3m VERTICAL DISTANCE FROM BELL PLANT. HAND DIG IF WITHIN 1m OF BELL PLANT. CALL ONTARIO ONE AT 1-800-400-2255 FOR BELL LOCATES.
8. MAINTAIN 0.3m MINIMUM VERTICAL CLEARANCE AND 0.6m MINIMUM HORIZONTAL CLEARANCE. GAS MAINS MUST BE FIELD LOCATED. EXPOSURE BY HAND IS REQUIRED. CALL ONTARIO ONE AT 1-800-400-2255 FOR GAS MAIN LOCATES.
9. MAINTAIN 0.6m HORIZONTAL AND 0.3m VERTICAL DISTANCE FROM ROGERS PLANT. HAND DIG IF WITHIN 1m OF ROGERS PLANT. CALL 1-800-738-7893 FOR ROGERS PLANT LOCATES.

MINIMUM DESIGN PRESSURE:
374.5 KPa (54.3 psi)



NOTE: CONTRACTOR TO CONFIRM LOCATION AND ELEVATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION



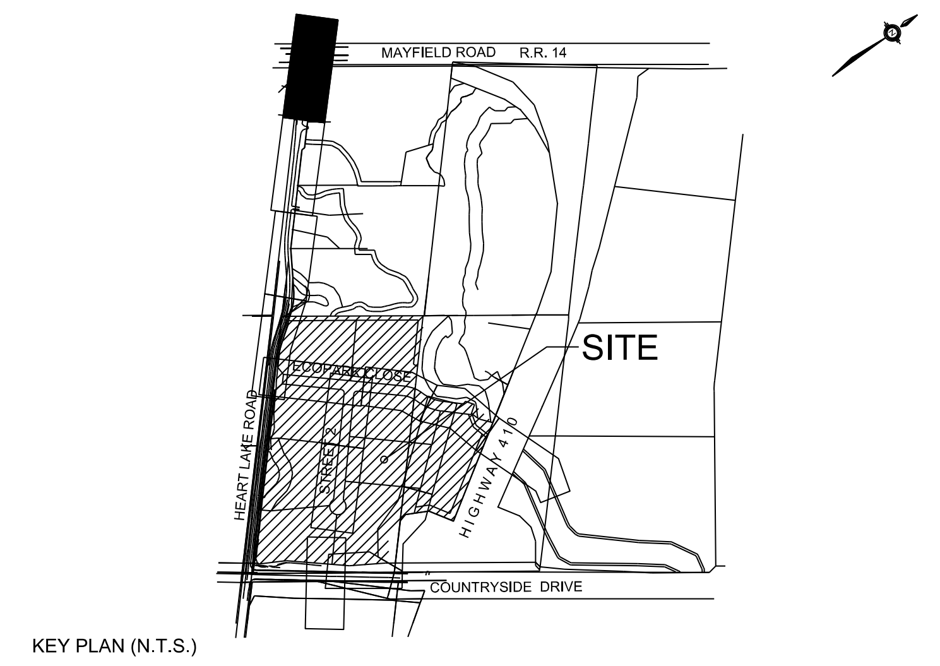
REMOVAL AND RESTORATION
DETAIL FOR VC01 INSTALLATION
N.T.S.

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			HYDRO ONE		
PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS

DATE	DETAILS	INIT.
SEPT 14/17	ISSUED FOR CONTRUCTION	D.S.
APR 6/17	ISSUED FOR TENDER	A.C.
JUN 14/17	ADDENDUM 4	A.C.



KEY PLAN (N.T.S.)

400 CPP WATERMAIN

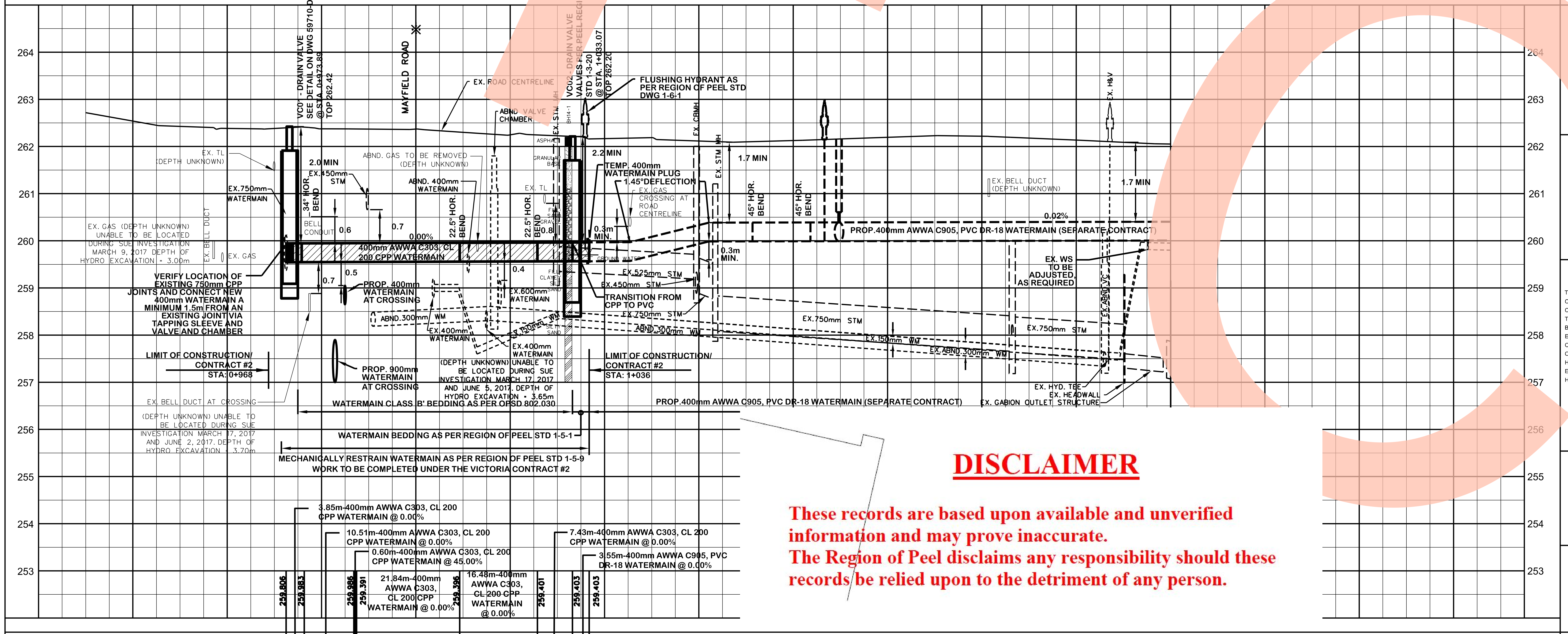
P.I. NO.	STATION	EASTING	NORTHING
CONNECT TO 750mm	0+972.45	596340.46	4845146.64
STUB	1+036.72	596379.55	4845094.89

400 CPP WATERMAIN

P.I. NO.	STATION	EASTING	NORTHING
01	0+976.32	596341.13	4845141.82
02	1+009.25	596364.98	4845118.46
03	1+025.73	596371.70	4845102.58

LEGEND

▭	PROPOSED VALVE CHAMBER
⋈	PROPOSED VALVE & BOX
●	PROPOSED HYDRANT & VALVE
○	EXISTING SANITARY MANHOLE
○	EXISTING STORM MANHOLE
□ EX.CB	EXISTING CATCHBASIN
⊗ EX.V&C	EXISTING VALVE & CHAMBER
◇ EX.HYD	EXISTING HYDRANT & VALVE
═	PROPOSED CURB AND GUTTER PROPOSED DEPRESSED CURB
●	PROPOSED SWABBING OUTLET (SEPARATE CONTRACT)
WS	EXISTING WATER SERVICE



DISCLAIMER

These records are based upon available and unverified information and may prove inaccurate.
The Region of Peel disclaims any responsibility should these records be relied upon to the detriment of any person.

												BOT.EL. OF WM.
EX.262.54	EX.262.38	EX.262.38	EX.262.37	EX.262.25	EX.262.17	EX.262.12	EX.262.13	EX.262.20	EX.262.22	EX.262.14	EX.262.05	EX. ROAD ELEV.
0+940	0+960	0+980	1+000	1+020	1+040	1+060	1+080	1+100	1+120	1+140	1+160	ROAD CHAINAGE

TMIG
The Municipal Infrastructure Group Ltd

8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

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
WS20 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.

D.A.F. SMITH
100012984
2017-09-15

Designed by ______ ______ ______ ______ Chkd. ______

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
1m 0 1 2 3m VERTICAL SCALE

Region of Peel
Working for you

HEART LAKE ROAD

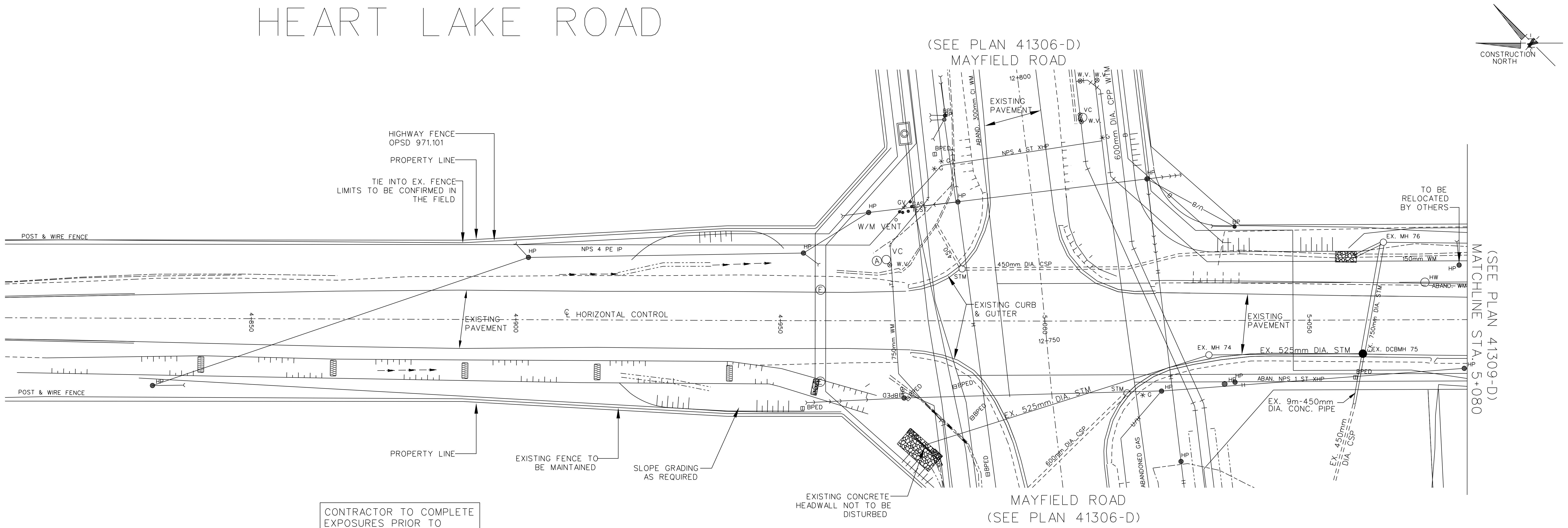
(FROM HEART LAKE ROAD TO HEART LAKE ROAD)

PROP. 400mm WATERMAIN

STA. 0+930 TO STA. 1+160

Designed by	J.F./A.C./V.P.	Area	C-06/C-07	Project No.	12-1181
Checked by	S.R.	Drawn by	R.S.		
Date	SEPTEMBER 2017	Sheet	137 of 143	Plan No.	59706-D

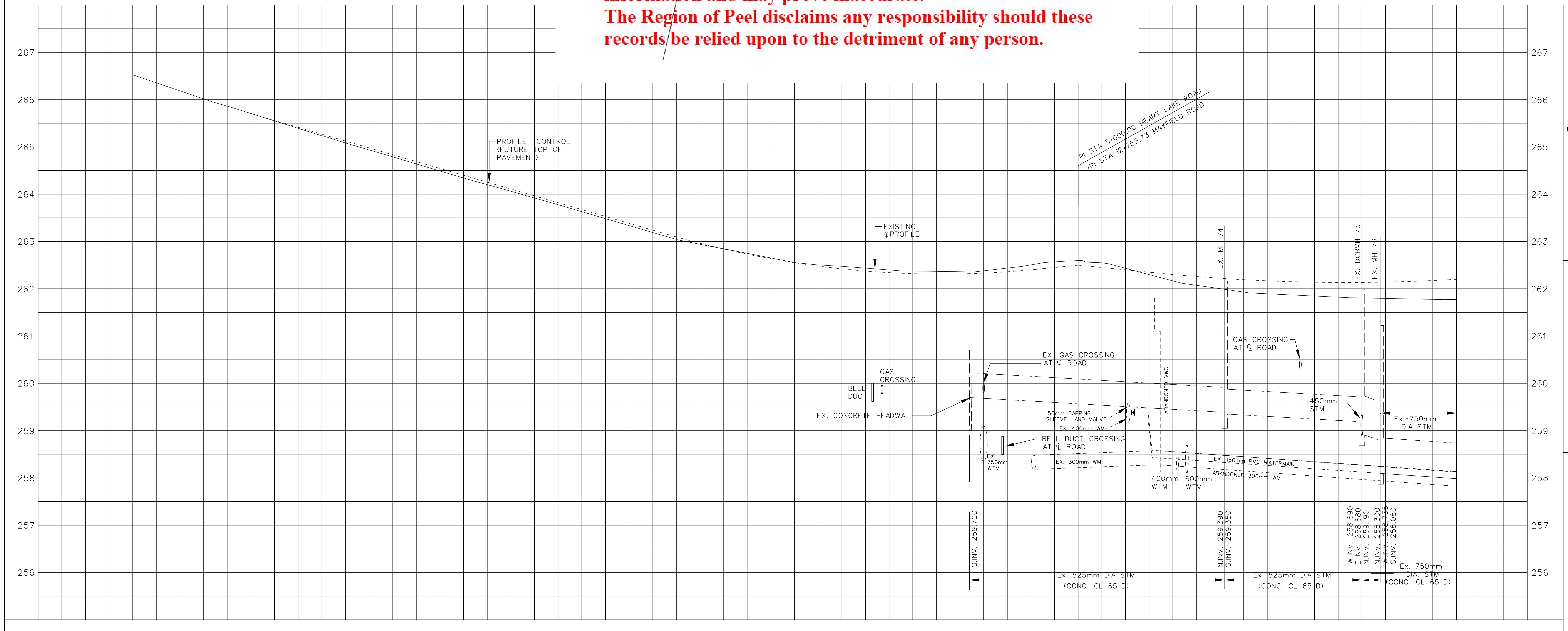
HEART LAKE ROAD



CONTRACTOR TO COMPLETE EXPOSURES PRIOR TO ORDERING OF MATERIALS

DISCLAIMER

These records are based upon available and unverified information and may prove inaccurate.
The Region of Peel disclaims any responsibility should these records be relied upon to the detriment of any person.



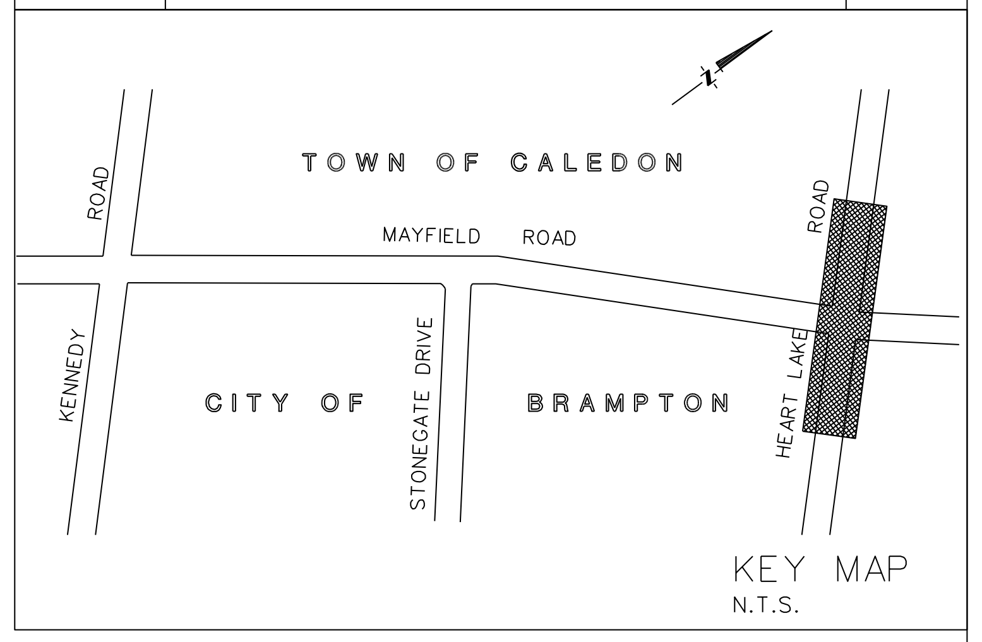
PROFILE CONTROL															
EXIST. GROUND	266.526	265.862	265.237	264.639	264.063	263.483	262.941	262.555	262.397	262.379	262.597	262.167	261.894	261.805	261.775
ROAD CHAINAGE	4+800	4+820	4+840	4+860	4+880	4+900	4+920	4+940	4+960	4+980	5+000	5+020	5+040	5+060	5+080

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
2008.06.25	RELEASED FOR TENDER	DJH
2008.08.11	ISSUED FOR CONSTRUCTION	DJH
2011.01.17	AS RECORDED	DJH



KEY MAP
N.T.S.

GENERAL NOTES:

1. RESTORATION LIMITS AS SHOWN ARE APPROXIMATE. ACTUAL LIMITS OF RESTORATION WILL BE DETERMINED/CONFIRMED ON THE FIELD BY THE ENGINEER.
2. SEE HORIZONTAL AND VERTICAL CONTROL DRAWING FOR ℄ CONTROL INFORMATION.
3. SEE TYPICAL CROSS SECTION DRAWINGS FOR ADDITIONAL INFORMATION AND DETAILS.
4. SEE EROSION CONTROL DETAILS DRAWINGS FOR ADDITIONAL INFORMATION/DETAILS (SHEETS 20 TO 27).
5. WATERMAINS TO BE INSTALLED AS PER MOE "PROCEDURE F-6-1 WITH THE FOLLOWING CLEAR SEPARATIONS:
   - 2.5 METERS HORIZONTAL SEPARATION FROM ANY SEWER
   - 0.5 METERS VERTICAL SEPARATION WHEN WATERMAIN BELOW A SEWER.
6. ENTRANCE RESTORATIONS:
   - ASPHALT ENTRANCE
     30mm HL3
     50mm HL8
     200mm - 19mm CRUSHER RUN LIMESTONE
   - GRAVEL ENTRANCE
     150mm GRANULAR 'A'

Stantec

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.

Designed by ____ ____ ____ __Chkd.____
Approved by ____ ____ ____ ____ ____

NOTICE TO CONTRACTOR
48 HOURS PRIOR TO COMMMENCING 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 TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF MISSISSAUGA
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

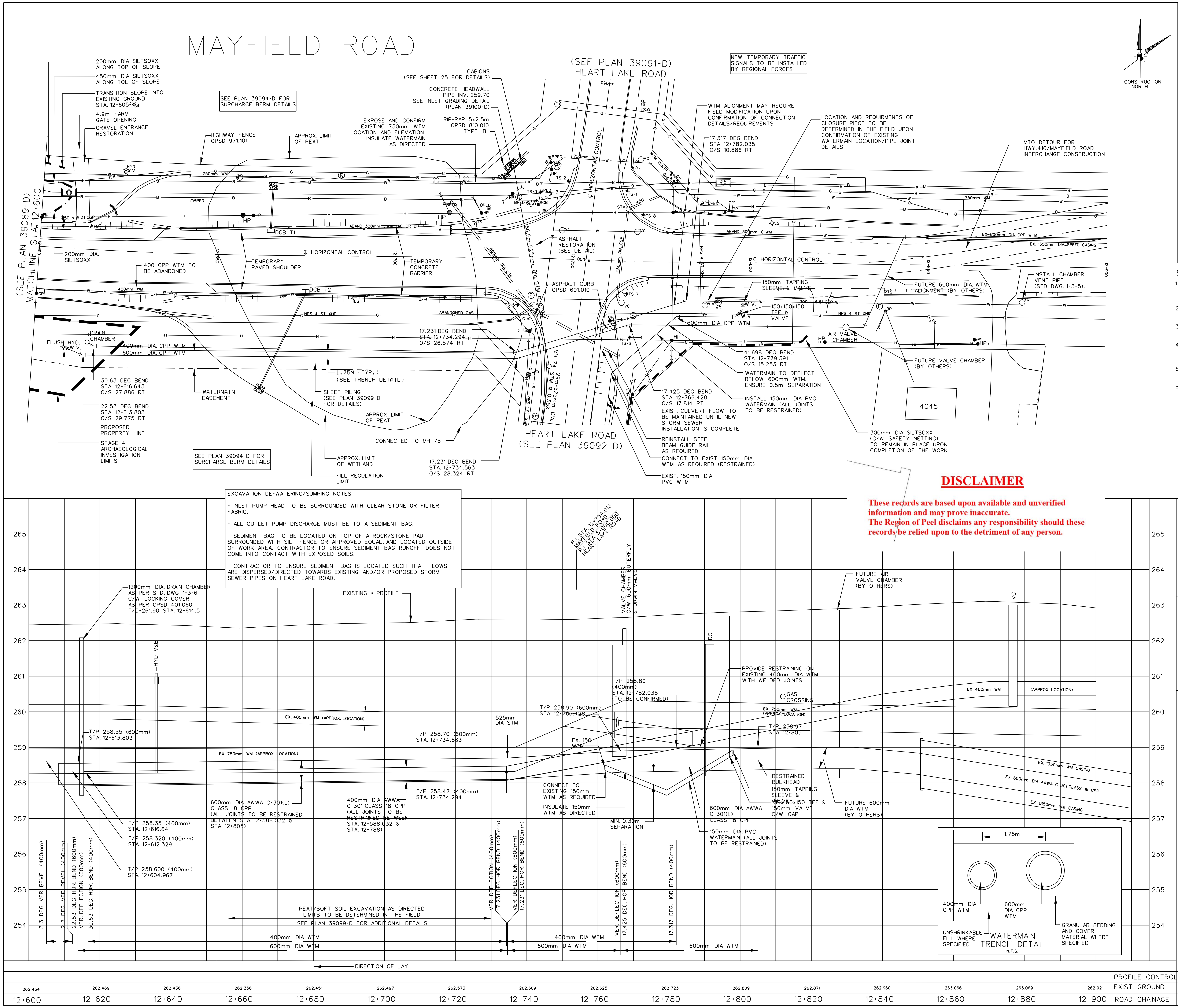
10m 0 10 20 30m HORIZONTAL SCALE
1m 0 1 2 3m VERTICAL SCALE

Region of Peel
Working for you

MAYFIELD ROAD CONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)

NEW CONSTRUCTION
HEART LAKE ROAD
STA. 4+800 TO STA. 5+080

Lots	Area B-30, B-31	Project No. 01-4830
Checked by DH/MG	Drawn by WRW	Plan No. 41308-D
Date Jan. 17, 2011	Sheet 37 of 65	



EXCAVATION DE-WATERING/SUMPING NOTES

- INLET PUMP HEAD TO BE SURROUNDED WITH CLEAR STONE OR FILTER FABRIC.

- ALL OUTLET PUMP DISCHARGE MUST BE TO A SEDIMENT BAG.

- SEDIMENT BAG TO BE LOCATED ON TOP OF A ROCK/STONE PAD SURROUNDED WITH SILT FENCE OR APPROVED EQUAL, AND LOCATED OUTSIDE OF WORK AREA. CONTRACTOR TO ENSURE SEDIMENT BAG RUNOFF DOES NOT COME INTO CONTACT WITH EXPOSED SOILS.

- CONTRACTOR TO ENSURE SEDIMENT BAG IS LOCATED SUCH THAT FLOWS ARE DISPERSED/DIRECTED TOWARDS EXISTING AND/OR PROPOSED STORM SEWER PIPES ON HEART LAKE ROAD.

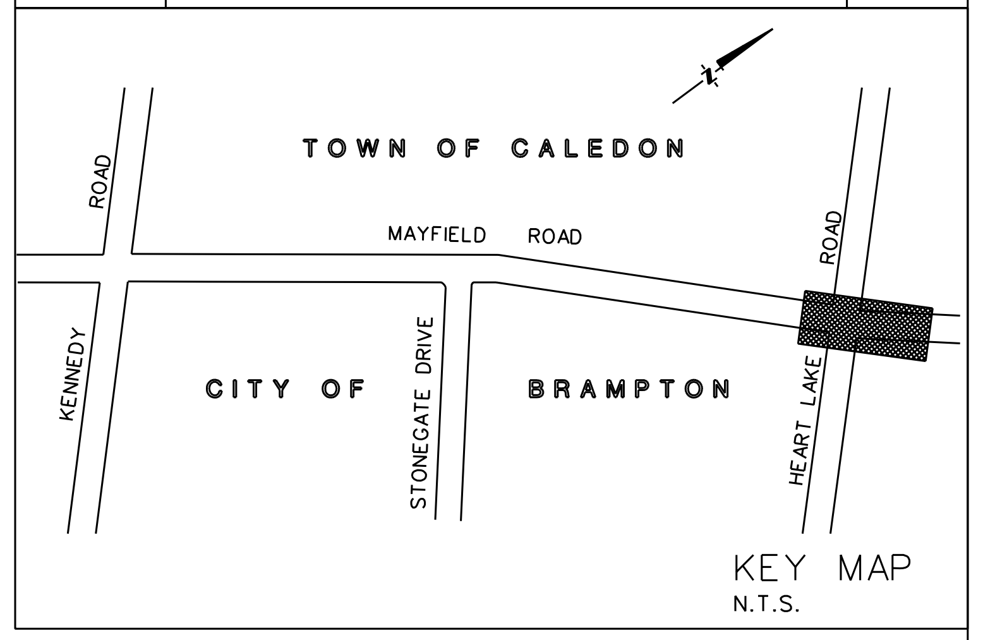
																PROFILE CONTROL
262.464	262.469	262.436	262.356	262.451	262.497	262.573	262.609	262.625	262.723	262.809	262.871	262.960	263.066	263.069	262.921	EXIST. GROUND
12+600	12+620	12+640	12+660	12+680	12+700	12+720	12+740	12+760	12+780	12+800	12+820	12+840	12+860	12+880	12+900	ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
Aug. 2007	RELEASED FOR TENDER	DH
Oct. 2007	RELEASED FOR CONSTRUCTION	DH
Jan 2009	AS RECORDED	KC



GENERAL NOTES:

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3. SEE TYPICAL CROSS SECTION DRAWINGS FOR ADDITIONAL INFORMATION AND DETAILS.
4. HYDRO POLES THAT REQUIRE SUPPORT DURING CONSTRUCTION ARE TO BE SUPPORTED BY HYDRO ONE BRAMPTON FORCES, TRAFFIC AND LIGHT POLES ARE TO BE SUPPORTED BY A REGION APPROVED CONTRACTOR.
5. SEE EROSION CONTROL DETAILS DRAWINGS FOR ADDITIONAL INFORMATION/DETAILS.
6. WATERMAINS TO BE INSTALLED AS PER MOE "PROCEDURE F-6-1 WITH THE FOLLOWING CLEAR SEPARATIONS:
   - 2.5 METERS HORIZONTAL SEPARATION FROM ANY SEWER
   - 0.5 METERS VERTICAL SEPARATION WHEN WATERMAIN BELOW A SEWER.

Stantec

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Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Designed by ____ ____ ____ __Chkd. ____

Approved by ____ ____ ____ ____ ____

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HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF MISSISSAUGA
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

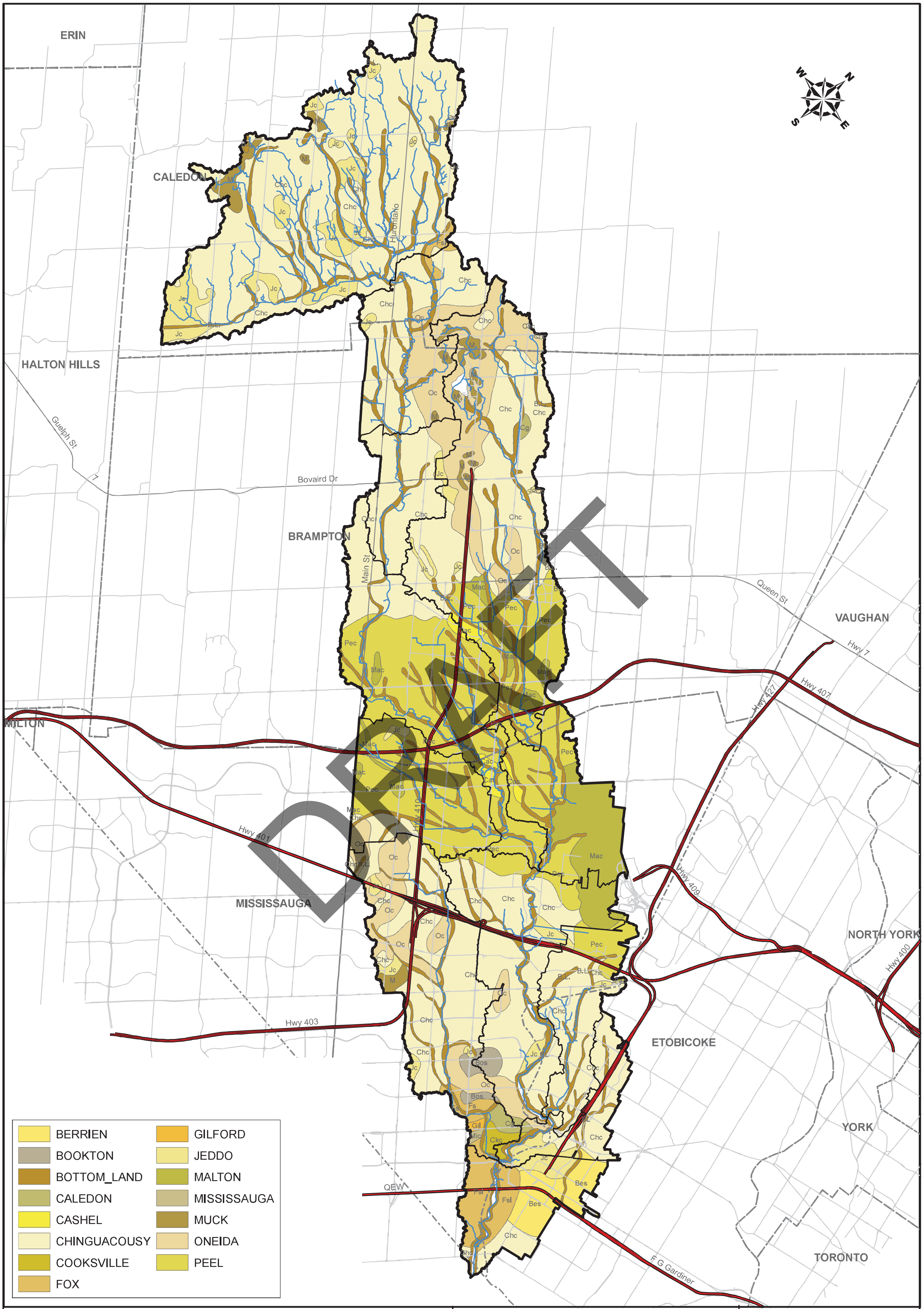
1m 0 1 2 3m VERTICAL SCALE

Region of Peel
Working for you

MAYFIELD ROAD CONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)

NEW CONSTRUCTION
MAYFIELD ROAD
STA. 12+600 TO STA. 12+900

Lots	Area	Project No. 01-4830
Checked by DH/MG	Drawn by WRW	Plan No. 39090-D
Date 01.14.09	Sheet 14 of 30	



Legend

- Watershed Boundary
- Sub-Watersheds
- Municipal Boundaries
- Watercourse
- Freeway
- Collector
- Expressway/Highway

0 750 1,500 3,000 4,500 6,000 Meters

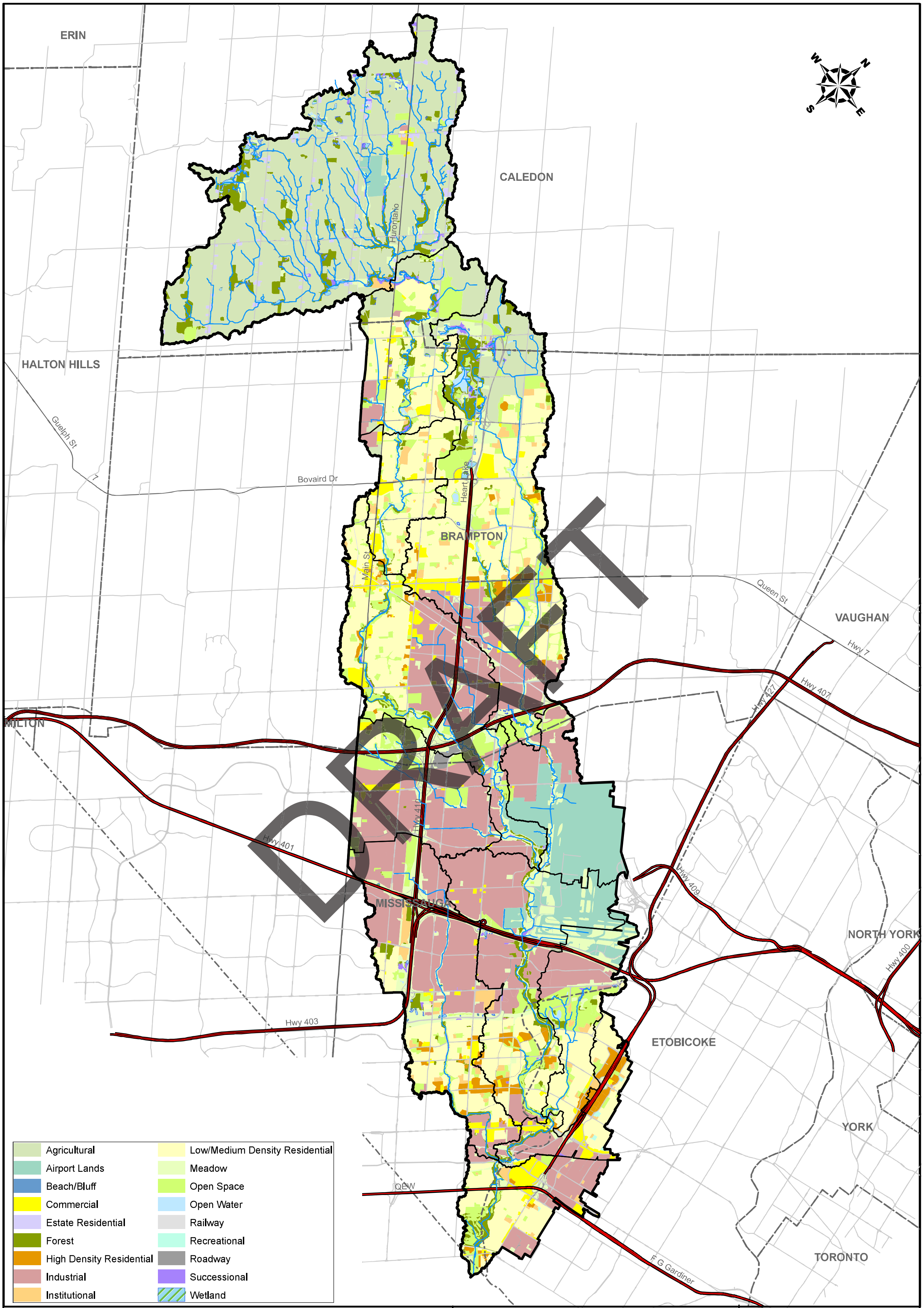
CLIENT
TORONTO AND REGION CONSERVATION AUTHORITY

TITLE
ETOBICOKE CREEK WATERSHED STUDY

SOIL MAP

MMM GROUP

Checked A.Z	Drawn S.Y
Date December 2012	Proj. No. 14-11605-001-WR1
Scale As Shown	Figure No. A-3



Legend

Watershed Boundary	Freeway
Sub-Watersheds	Collector
Municipal Boundaries	Expressway/Highway
Watercourse	

0 750 1,500 3,000 4,500 6,000 Meters

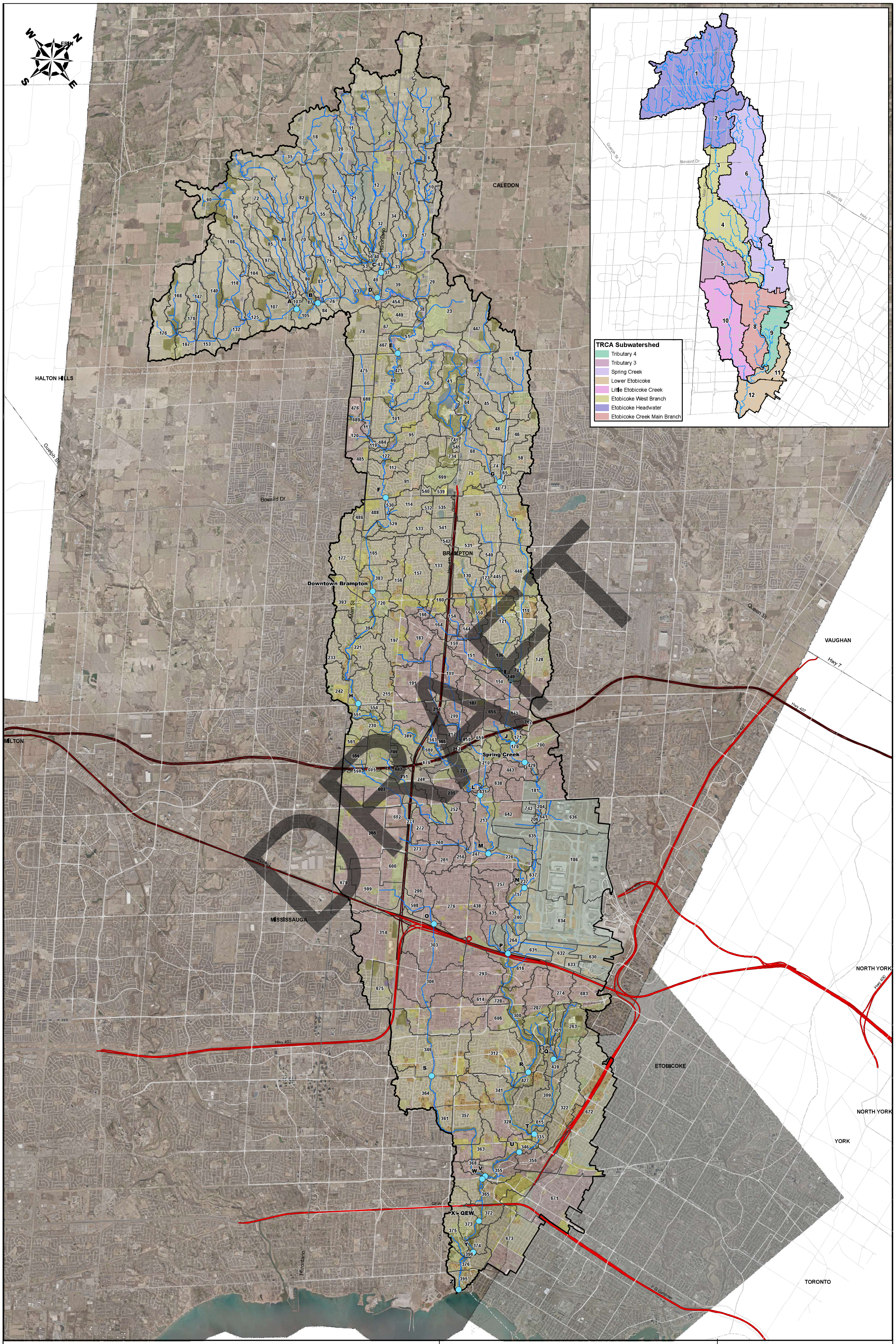
CLIENT
TORONTO AND REGION CONSERVATION AUTHORITY

TITLE
ETOBICOKE CREEK WATERSHED STUDY

EXISTING LANDUSE MAP

MMM GROUP

Checked A.Z	Drawn S.Y
Date December 2012	Proj. No. 14-11605-001-WR1
Scale As Shown	Figure No. **A-1**



Legend

- ▭ Watershed Boundary
- ┆ Municipal Boundaries
- ● Key Flow Nodes
- — Watercourse
- — Collector
- — Expressway/Highway
- — Freeway

0 750 1,500 3,000 4,500 6,000 Meters

CLIENT

TORONTO AND REGION CONSERVATION AUTHORITY

TITLE

ETOBICOKIE CREEK WATERSHED STUDY

EXISTING CATCHMENTS

MMM GROUP

Checked	Drawn
A.Z	S.Y
Date March 2013	Proj. No. 14-11605-001-WR1
Scale As Shown	Drawing No. J-1

Table 5.1 Potential Storm Distributions for Etobicoke Creek

Return Period	Design Storms
2 to 100 Year	Chicago (3, 4 and 12 hours)
	AES (1, 6, 12 and 24 hours)
	SCS Type II (6, 12, and 24 hours)

Tables included in Appendix F2 present the resulting 100-year flows for all design storm distributions at all selected flow node locations. As seen from these Tables, the most conservative peak flow rates were generally found to be associated with the 12-hour AES rainfall distribution. Given that the 12-hour AES distribution is also used by TRCA in other urban watersheds (i.e., Humber and Rouge River watersheds), the present study recommends the 12-hour AES distribution for use in the Etobicoke Creek watershed for establishing peak flows. Tables 5.2 and 5.3 summarize the resulting 2 to 100-year peak flow rates by using selected 12-hour AES design storm distributions for existing and future conditions respectively.

It is recommended that for sites with small drainage areas (i.e., individual site) that the Chicago storm with 5 min time steps be used for hydrologic modelling.

6.2.3 Lower-Basins (Sub-Basins # 8, 11 and 12)

As mentioned previously, for the downstream part of the watershed (Sub-Basins #8, 11 and 12), no controls are typically required. This is because if storages are provided for the infill re-development areas (with increased imperviousness) to attenuate the peak flows to the existing levels, such controls (storage routing) will delay the peak flows (i.e., longer time to peak values) from infill areas. For large sized watersheds (e.g., Etobicoke Creek watershed has a total drainage area more than 200 km^2), such delayed peak flows from the downstream watersheds will be added to the peak flows in the main branch coming from the upstream watersheds which typically occur later. As such, the peak flows in the main branch of the water course will increase due to this "timing effect" if the infill re-developments within the lower downstream part of the watershed (Sub-Basins #8, 11 and 12) are controlled. Detailed information for the Lower-Basins is included in Appendix J3.

6.2.4 Summary of Established Unit Flow Rates for 1 in 2 to 1 in 100 year Design Storm Events

In order to examine the identified quantity control strategies on an overall watershed basis, the entire Etobicoke Creek hydrology model was modified to reflect:

- Headwatersheds (Sub-Basin #1) – Control peak flows from ultimate development areas to 60% of the existing levels.
- Mid-Basins and Tributaries (Sub-Basins # 2 to 7, 9 and 10) – Control peak flows from infill re-development lands (maximum 20% increases of imperviousness) to existing levels; and
- Lower-Basins (Sub-Basins # 8, 11 and 12) – No quantity controls are required.

A summary of the resulting flows is presented in Table 6.1. As shown in the Table, by implementing the identified quantity control strategy (1 in 2 to 1 in 100 year) for the Etobicoke Creek watershed under ultimate development conditions, there will be no hydrological impact to the flows in the Etobicoke Creek watercourses (e.g.see results from Run 4 vs. target flows for existing conditions).

Consequently, the recommended Unit Flow Rates (UFRs) for 2- to 100-year design storm events (12hr AES) for Etobicoke Creek watershed are summarized in Appendix J4. The existing catchment numbers are shown in Drawing J.1 in the rear pocket.

6.3 Development of Unit Flow Rates for Regional Storms

Based on discussion with TRCA staff, for Regional Storm (final 12-hours of Hurricane Hazel), ultimate developments are required to be controlled so that there are no increases of peak flows from future development models for the Etobicoke Creek water courses.

Similar to the approaches applied to establish Unit Flow Rates for 1 in 2 to 1 in 100 year design storms, the following control strategies were implemented in the Etobicoke Creek watershed model for Regional Storms:

- Headwatersheds (Sub-Basin #1) – Control peak flows from ultimate development areas to 60% of resulting flows from the future conditions model.
- Mid-Basins and Tributaries (Sub-Basins # 2 to 7, 9 and 10) - Control peak flows from infill re-development lands (maximum 20% increases of imperviousness) to those from base model; and
- Lower-Basins (Sub-Basins # 8, 11 and 12) – No quantity controls are required.

A summary of the resulting flows is presented in Table 6.2. As shown in Table 6.2, by implementing the identified quantity control strategy for Regional Storm for the Etobicoke Creek watershed under ultimate development conditions, there will be no hydrological impact to the flows in the Etobicoke Creek watercourses (e.g. results from Run 8 vs. target flows for future conditions).

Consequently, the recommended Unit Flow Rates (UFRs) for Regional Storms (final 12-hours of Hurricane Hazel with no SWM ponds) for Etobicoke Creek watershed are summarized in Appendix J5. The future catchment numbers are shown in Drawing J.2 in the rear pocket.

Required Additional Storages for Regional Controls

Hurricane Hazel is a 48-hr duration historical storm. As discussed previously, final 12-hours of Hurricane Hazel has been identified as Regional Storm for Etobicoke Creek watershed. The saturated antecedent moisture condition (AMC III) is required to be applied for the catchment to simulate the wet soil conditions resulting from the first 36-hours of Hurricane Hazel. As such, when determining the required detention storage for regional controls, it is necessary to provide additional storage to accommodate the first 36-hours of Hurricane Hazel. Since no distribution was recorded during first 36-hour Hurricane Hazel historical storm, two hypothetical distributions (constant intensities and increased intensities, both with a total depth of 73mm) were applied in the existing model to determine the storage volumes used by the existing SWM ponds within the Etobicoke Creek watershed. All study results are included in Appendix J6. As indicated, a unit storage volume of 214 m^3/ha will be required as additional storages for Regional controls. Such storages should be added to the calculated storage volumes to control the post-development peak flows to the identified Unit Flow Rates for the Regional Storm.

ETOBICOKE WATERSHED QUANTITY CONTROL STRATEGY - UNIT FLOW RATES

Basin 6 - Spring Creek (U/S of Spring Creek Flow Guge) - Control to Existing Flow

Existing Catchment #	Unit Flow Rates (m^3/s/ha)					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
16	0.01111	0.01854	0.02409	0.03151	0.03728	0.04325
24	0.01109	0.01920	0.02534	0.03363	0.04012	0.04685
41	0.01011	0.01785	0.02375	0.03177	0.03808	0.04465
45	0.01234	0.02085	0.02721	0.03576	0.04240	0.04928
64	0.01283	0.02240	0.02964	0.03945	0.04713	0.05511
447	0.01321	0.02206	0.02865	0.03745	0.04428	0.05132
699	0.01475	0.02503	0.03273	0.04305	0.05108	0.05939
734	0.01667	0.02851	0.03723	0.04878	0.05768	0.06676
All Others	0.03300	0.04485	0.05300	0.06337	0.07113	0.07894

ETOBICOKE WATERSHED QUANTITY CONTROL STRATEGY - UNIT FLOW RATES REGIONAL CONTROL

Basin 6 - Spring Creek (U/S of Spring Creek Flow Guge) - Control to Future Flow

Future Catchment #	Unit Flow Rates (m^3/s/ha)
	Regional
542, 734, 764, 765, 769, 6992, 7602, 7612	0.11835
All Others	0.12744

Fluvial Geomorphological Assessment and Flow Monitoring

Tributary of Etobicoke Creek

Snell's Hollow Secondary Plan
Town of Caledon, Ontario

Prepared for:
Snell's Hollow Landowners Group
c/o Jason Afonso, MCIP, RPP
Glen Schnarr and Associates Inc.
700-10 Kingsbridge Garden Circle
Mississauga, ON L5R 3K6

April 15, 2020
PN19033

GEO MORPHIX
Geomorphology
Earth Science
Observations

Report Prepared by: GEO Morphix Ltd.
36 Main St. N.
Campbellville, ON
L0P 1B0

Report Title: Fluvial Geomorphological Assessment and Flow Monitoring, Tributary of Etobicoke Creek
Snell's Hollow Secondary Plan Area
Town of Caledon

Project Number: PN19033
Status: FINAL
Version: 1.0
Submission Date: April 17, 2020

Prepared by: Suzanne St. Onge, M.Sc., Tye Rusnak, B.Sc. Env.
Approved by: Paul Villard, Ph.D., P.Geo., CAN-CISEC, EP, CERP

Table of Contents

List of Tables

Appendices

1 Introduction and Background

GEO Morphix Ltd. was retained to complete a fluvial geomorphological assessment and flow monitoring in support of the Snell's Hollow Secondary Plan in the Town of Caledon, hereafter referred to as the subject lands. The subject lands are bounded by Highway 410 to the north and east, Kennedy Road to the west, and Mayfield Road to the south. A portion of the Heart Lake Wetland Complex, a provincially significant wetland (PSW), is located in the southern portion of the subject lands. This wetland complex and associated drainage features are located within the Etobicoke Creek watershed and the jurisdiction of Toronto and Region Conservation Authority (TRCA).

The following activities were completed as part of the fluvial geomorphological assessment:

- Conduct rapid geomorphological assessments and collect general observations to document existing channel conditions
- Complete a detailed geomorphological assessment, including a survey of the longitudinal profile and six (6) cross sections (including two monumented cross sections)
- Install erosion pins to quantify the rate and extent of erosion at monumented cross-sections
- Complete grain size analysis using a modified Wolman (1954) pebble count or through collection of bed sample to observe changes in bed composition over time, as appropriate
- Determine an erosion threshold for the reach downstream of Mayfield Road
- Collect time stamped monumented photographs to provide a record of existing conditions

The following activities were completed as part of the 2019 flow monitoring program:

- Install stream flow monitoring equipment in four (4) locations within the subject lands to record water level and temperature at 15-minute intervals
- Record local atmospheric temperature and pressure at 15-minute intervals
- Install monumented cross-sections at each monitoring station for the periodic collection of velocity measurements
- Collect time stamped monumented photographs to provide a record of existing conditions

Stream flow monitoring activities will continue in 2020, with all 4 monitoring stations re-installed on March 24, 2020 for the April 1st start of the monitoring season. This report will subsequently be updated to include additional data following removal of all monitoring equipment in the late fall of 2020.

2 Background Review and Desktop Assessment

2.1 Physiography and Geology

Channel morphodynamics are largely governed by the flow regime and the availability and type of sediments (i.e., surficial geology) within the stream corridor. These factors are explored as they not only offer insight into existing conditions, but also potential changes that could be expected in the future as they relate to a proposed activity.

The subject lands are located within the gently sloping drumlinized till plains of South Slope physiographic region (Chapman and Putnam, 2007). Published mapping indicates that the local surficial geology within and north of the subject lands consists of clay to silt-textured till derived from glaciolacustrine deposits or shale. These fine-grained till deposits are considered to be relatively resistant to erosion. In areas where wetlands are currently present, surficial geology consists of organic deposits (OGS, 2010).

2.2 Reach Delineation

Reaches are homogeneous segments of channel used in geomorphological investigations. They are studied semi-independently as each is expected to function in a manner that is at least slightly different from adjoining reaches. This allows for the meaningful characterization of a watercourse as the aggregate of reaches, or an understanding of a particular reach, for example, as it relates to a proposed activity. Reaches in the study area were delineated first through a desktop assessment using the Ministry of Natural Resources and Forestry (MNRF) stream layer and recent digital aerial photography from Google Earth Pro. Reaches were delineated based on changes in the following:

- Channel planform
- Channel gradient
- Physiography
- Land cover (land use or vegetation)
- Flow, due to tributary inputs
- Soil type and surficial geology
- Certain types of anthropogenic channel modifications

This follows scientifically defensible methodology proposed by Montgomery and Buffington (1997), Richards et al. (1997), Brierley and Fryirs (2005), and the Toronto and Region Conservation Authority (2004). A reach map is provided in **Appendix A**. Reaches were numbered from downstream to upstream to provide geographic context and then verified during field reconnaissance.

Five reaches were delineated within the subject lands. Reach **EC-1** extended from Mayfield Road to Heart Lake. Reach **EC-2** consisted of the pond feature north of Mayfield Road. Reach **EC-2a** extended from an agricultural field at the north extent of the subject lands to the pond feature. Reach **EC-3** contained the wetland that extended from Kennedy Road to the pond feature. Reach **EC-3a** extended from the property line of a landowner in the western extent of the subject lands to the wetland feature.

R.J. Burnside and Associates Limited (Burnside) completed headwater drainage feature assessments (HDFAs) within the subject lands in 2019. Existing conditions documented herein focus on geomorphologic observations and should be considered in conjunction with HDFA assessment results prepared by Burnside under separate cover.

3 Field Assessment

Field assessments of reaches within the subject lands were completed on May 10, 2019 and included the following activities:

- Observations of riparian conditions
- Estimates of bankfull channel dimensions, as appropriate
- Characterization of bed and bank material composition and structure
- Observations of erosion, scour, or deposition
- Collection of georeferenced photographs

These observations and measurements are summarized below and in **Table 1** in the following section. The descriptions are supplemented and supported with representative photographs, which are included in **Appendix B**. Reach summary field sheets are provided in **Appendix C**. The Rapid Geomorphological Assessment (RGA; MOE, 2003) and the Rapid Stream Assessment Technique (RSAT; Galli, 1996) were not applicable due to the poorly defined nature of the features.

3.1 General Reach Observations

Reach **EC-1** began at the outlet of the pond feature (**EC-2**) and flowed through a steel culvert under Mayfield Road, continuing south through a confined valley towards Heart Lake. The reach had a low gradient and where defined, contained a wide, shallow channel. Riparian vegetation was mainly comprised of mature trees and was greater than 10 channel widths. Bank materials ranged from clay to sand and little to no bank erosion was observed. There were no riffles or pools. Bed materials consisted of organic material, clay, silt, and fine sand. Two trail crossings were present across the channel and valley. Woody debris was present in the channel but was not attributed to channel widening. Reach **EC-1** was chosen as the location for the detailed geomorphological assessment and erosion threshold analysis.

Reach **EC-2** consisted of a pond feature that separated wetland reach **EC-3** upstream to the west and Mayfield Road downstream to the southeast. Reach **EC-2a** extended from the border of an agricultural field to the north. This feature was characterized as poorly defined and had a moderate gradient. Burnside identified the upstream portion of this reach as a headwater drainage feature. The riparian vegetation buffer was continuous and comprised of grasses that extended more than 10 channel widths. The feature was extensively encroached with grasses, and a large, man-made woody debris pile was present in the middle of the reach. Bankfull width and depth at the downstream extent of the reach were 6.0 m and 0.4 m, respectively. Bank materials consisted of clay, silt, and sand. Bank angles ranged from 30 – 60 degrees with little to no erosion. There was no evidence of riffle-pool morphology. Bed materials were comprised of clay, silt, and sand.

Reach **EC-3** consisted of a large wetland feature that began at the southwest extent of the subject lands. The southwest corner of the feature was bound by a retaining wall adjacent to Mayfield Road and the stormwater management (SWM) pond at the corner of Kennedy Road and Mayfield Road. Recorded velocity measurements showed that the wetland slowly drained eastwards into the pond feature (**EC-2**). Vegetation within the wetland consisted of cattails, deciduous trees, shrubs and grasses.

Reach **EC-3a** began at the property line of a landowner in the northwest corner of the subject lands. The reach was unconfined, and consisted of a low gradient channelized feature that was moderately entrenched. Burnside identified the upstream portion of this reach as a headwater drainage feature. The riparian buffer zone was wide and mainly comprised of grasses. Average bankfull width and depth were 1.4 m and 0.3 m, respectively. Bank angles ranged from 60 – 90 degrees and the reach showed minimal signs of erosion. Bank materials consisted of clay, silt, and sand. Riffle-pool morphology was not present. Bed materials were comprised of sand and gravel.

Table 1. General channel characteristics

Reach	Average Bankfull Width (m)	Average Bankfull Depth (m)	Substrate		Riparian Vegetation	Notes
			Bed	Bank		
EC-1	17.95	0.32	Organic material, clay, silt, Find Sand	Clay, silt, sand	Mature trees	Wetland-like channel; confined valley; wide, shallow channel; no evidence of channel widening

Reach	Average Bankfull Width (m)	Average Bankfull Depth (m)	Substrate		Riparian Vegetation	Notes
			Bed	Bank		
EC-2	N/A-Pond Feature		N/A		Grasses	Outlets south to steel culvert crossing at Mayfield Road
EC-2a	6.0	0.4	Clay, Silt, Sand	Clay, Silt, Sand	Grasses	Extensive vegetation encroached; large man-made woody debris pile mid-reach
EC-3	N/A; Wetland Feature		N/A		Grasses	Unconfined; no defined channel; cattails, trees, shrubs, grasses present
EC-3a	1.4	0.3	Clay, Silt, Sand	Sand, Gravel	Grasses	Channelized feature; moderately entrenched

3.2 Detailed Geomorphological Assessment

A detailed geomorphological assessment was completed on May 6, 2019 within Reach **EC-1** as this reach was identified as the most sensitive to erosion. The specific location within the reach was chosen as it had the most defined section of channel. The assessment included a longitudinal survey of the channel bed and water level to determine gradients, and the completion of six detailed cross-section surveys. Two of these cross-sections were monumented and included the installation of erosion pins. At each cross section, bankfull geometry was recorded, as well as riparian conditions, bank material, bank height/angle, the presence of undercutting, and bank root density. Characterization of channel bed material at each cross section was completed using a modified Wolman (1954) pebble count technique or through collection of bed samples, as appropriate. Photographs of each cross section and both channel banks were also collected at the time of the survey. Results from the detailed assessment are summarized in **Table 2.** A complete summary of the detailed assessment is provided in **Appendix D.**

Table 2. Measured and computed channel parameters

Channel Parameter	EC-1
Measured	
Average bankfull channel width (m)	17.95
Average bankfull channel depth (m)	0.32
Bankfull channel gradient (%)	0.66
D_{50} (mm)	< 2.0
Manning’s n roughness coefficient	0.050
Computed	
Bankfull discharge (m^3/s) *	4.30
Average bankfull velocity (m/s)*	0.76

* Based on Manning’s Equation

4 Erosion Threshold Assessment

4.1 Methodology

Erosion thresholds are used to determine the magnitude of flow required to potentially entrain and transport bed and/or bank materials. As such, they may be used to inform erosion reduction strategies in channels influenced by conceptual flow management plans. The erosion threshold analysis provides a depth, velocity, or discharge at which sediment of a particular size may potentially be entrained. This is then field-validated through sediment transport observations under a range of flows. Due to the variability between bed and bank composition and structure, erosion thresholds are typically determined for both bed and bank materials. Threshold targets are determined using different methods that are dependent on channel and sediment characteristics. For example, thresholds for non-cohesive sediments are commonly estimated using a shear stress approach, similar to that of Miller et al. (1977), which is based on a modified Shield's curve. A velocity approach could also be applied. For non-cohesive materials, a method such as that described by Komar (1987), or empirically-derived values such as those compiled by Fischenich (2001) or Julien (1994), could be applied.

An erosion threshold is quantified based on the bed and bank materials and local channel geometry, in the form of a critical discharge. Theoretically, above this discharge, entrainment and transport of sediment can occur. The velocity, *U* is calculated at various depths, until the average velocity in the cross section slightly exceeds the critical velocity of the bed material. The velocity is determined using a Manning's approach, where the Manning's *n* value is visually estimated through a method described by Arcement and Schneider (1989) or calculated using Limerinos's (1970) approach. The velocity is mathematically represented as

$$U = \frac{1}{n} d^{2/3} S^{1/2} \qquad \text{[Eq. 1]}$$

where, *d* is depth of water, *S* is channel slope, and *n* is the Manning's roughness. The discharge is then calculated using the area of a typical cross section at that depth.

For the bank materials, following Chow (1959) in a simplified cross section, 75% of the bed shear stress acts on the channel banks. In a similar approach, the depth of flow is increased until the shear stress acting on the banks exceeds the resisting shear strength of the bank materials.

4.2 Results

Erosion thresholds were determined for the bed and bank materials within **Reach EC-1** of the Tributary of Etobicoke Creek. This reach was deemed to be the most sensitive to erosion of the reaches assessed, although it was still considered to be a low risk environment as it was depositional.

Channel bed and bank materials were considered equivalent, and conservatively estimated to consist of a fairly compact to loose clay. A critical shear stress approach was taken using the criteria of Julien (1994) for this material, which has a critical shear stress of 6.2 N/m^2. This threshold shear stress was then applied to a representative cross section measured from the detailed assessment to calculate the critical discharge, or the discharge at which it is expected that sediment entrainment will begin to occur. The results of the erosion assessment are provided in **Table 4**. Using the criteria of Chow, the critical discharge to entrain the bed materials within **Reach EC-1**, was determined to be 1.25 m^3/s.

We note that **Reach EC-1,** as well as the others that may receive stormwater flows in the subject lands, are relatively resilient to potential erosion given their low gradient and wide, oversized bankfull channels. Consequently, we do not advocate for using the erosion threshold assigned to **Reach EC-1** to aid in designing the associated SWM pond and outlet structure given the high volume of water the channel has the capacity to tolerate. Doing so could conceivably cause downstream erosion concerns in other reaches that are more sensitive to erosion. Instead, we suggest using the 24 or 48 hour detention of the 25 mm event to prevent erosion both within the study area, and downstream within Etobicoke Creek.

Table 3. Erosion thresholds and average channel parameters

Channel Parameter	Reach EC-1
Average bankfull channel width (m)	17.95
Maximum bankfull channel depth (m)	0.32
Average channel gradient (%)	0.66
Calculated bankfull discharge (m^3/s)	4.3
Bankfull shear stress (N/m^2)	20.53
Erosion thresholds for bed and bank materials	
Critical shear stress (N/m^2)	6.2
Critical discharge (m^3/s)	1.25

5 Flow Monitoring

During 2019, flow monitoring was conducted at four (4) locations on the subject lands to assess water quantity characteristics. A map of monitoring locations is provided for reference in **Appendix A**. **Table 4,** below, summarizes monitoring activities at each location.

Table 4. Flow monitoring sites, sampling parameters, and sampling duration in 2019

Site	Sampling Parameters	Monitoring Duration	# Visits
W Inlet	Continuous water level & temperature Velocity measurements when possible	April 4 – November 30	8
S Inlet	Continuous water level & temperature Velocity measurements when possible	April 4 – November 30	8
Bridge	Continuous water level & temperature Velocity measurements when possible	April 4 – November 30	8
Outlet	Continuous water level & temperature Velocity & discharge measurements when possible	April 4 – October 30*	8

*Sensor stolen/lost between October 30 visit and sensor removal

Activities at all locations included the following:

- Collect water level and temperature data at 15-minute intervals using a HOBO U20 pressure and temperature logger, with an additional control sensor to measure atmospheric pressure and air temperature on- site

- Record velocity measurements using Acoustic Doppler Velocimeter (ADV), when possible, to calculate discharge
- Collect monumented photographs of all sampling activities to verify location and timing

All sampling activities adhere to the Ontario Stream Assessment Protocol outlined by the Ontario Ministry of Natural Resources and Forestry (MNRF, 2017). Daily rainfall data was acquired from a Weather Underground weather station (Climate ID: ICALED1) located approximately 1.5 km west of the subject lands to account for precipitation and climatic conditions.

5.1 Water Level Monitoring

Water level loggers recorded continuous pressure throughout the entire monitoring season (April 4 – November 30). Discrete stilling well measurements were taken during each site visit in order to ensure data quality and data verification.

Baseflow is the portion of streamflow derived from natural storage sources and does not include direct runoff from precipitation. There must not be any evidence in the stage discharge hydrograph of any recent storm events to be considered baseflow. Due to the intermittent/ephemeral nature of these watercourses, all four sites were dry following the spring freshet. During spring, the baseflow levels of the **W inlet, S inlet, Bridge,** and **Outlet** sites were approximately 0.02 m, 0.13 m, 0.10 m, and 0.03 m respectively.

Water level responses are dependent on the magnitude of the rainfall event and antecedent conditions. The maximum water levels during 2019 for the **W Inlet** site was observed on May 25 following a 33.53 mm rain event. The maximum water depth at the **W Inlet** site was 0.09 m on this day. Maximum water depths at the **S Inlet, Bridge,** and **Outlet** sites were 0.20 m, 0.19 m, and 0.09 m respectively, recorded on April 26, following a 23.37 mm rain event.

Minimum and maximum water levels recorded by monitoring equipment is summarized below in **Table 5**. The full set of continuous water level measurements, as well as discrete measurements, are provided in **Appendix E.**

Table 5. Minimum and maximum water depths at each sampling location

Sampling Location	2019 Water Depth (m)	
	Minimum	Maximum
W Inlet	0.00	0.09
S Inlet	0.00	0.20
Bridge	0.00	0.19
Outlet	0.00	0.09

5.2 Velocity and Discharge Monitoring

In addition to continuous water level and temperature monitoring, discrete measurements of velocity (**W Inlet, S Inlet,** and **Bridge** sites) were recorded, when possible. A summary of measured discharge at each sampling location is summarized below in **Table 6.**

Table 6. Average velocity and measured discharge at each sampling location

Measurement Date (mm-dd-yyyy)	Location	Average Velocity (m/s)	Discharge (m^3/s)
04-09-2019	W Inlet	0.0114	0.0002
	S Inlet	0	0
	Bridge	0	0
	Outlet	0.2734	0.0150
05-10-2019	W Inlet	0.0538	0.0009
	S Inlet	0	0
	Bridge	0.0400	0.0023
	Outlet	0.3392	0.0180
06-20-2019	W Inlet	0	0
	S Inlet	N/A*	N/A*
	Bridge	N/A*	N/A*
	Outlet	0.0170	0.0004

*Channel dry or too shallow for measurement

Due to the intermittent/ephemeral nature of these sites, velocity measurements were only possible during the spring freshet. A full record of attempted velocity readings is provided in **Appendix E**. Velocity measurements were not possible during monitoring visits at the **S Inlet** site. This is due to the lack of channel definition and wetland characteristics at the sensor location. Maximum discharges at the **W Inlet, Bridge,** and **Outlet** sites were 0.0009 m^3/s, 0.0025 m^3/s, and 0.0180 m^3/s respectively, which occurred on May 10, 2019 following 21.59 mm of rainfall in 24 hours.

6 Summary and Conclusions

GEO Morphix was retained to complete a fluvial geomorphological assessment of the drainage features within the subject lands. This assessment included a background review, reach delineation and rapid field reconnaissance to confirm existing conditions. A detailed geomorphic assessment was completed downstream of the subject lands, along Reach **EC-1**, to determine an appropriate erosion threshold in support of the stormwater management strategy. The critical discharge to entrain the bed materials within **Reach EC-1** was determined to be 1.25 m^3/s. Notably, reaches within and downstream of the subject lands are relatively resilient to potential erosion due to their generally low gradients and wide, oversized bankfull channels. Consequently, the erosion threshold assigned to **Reach EC-1** could potentially cause downstream erosion concerns in other reaches that are more sensitive to erosion. Rather, the 24 or 48 hour detention of the 25 mm event is recommended to prevent erosion both within the study area, and downstream within Etobicoke Creek.

Water level and temperature data were collected at 15-minute intervals at 4 sites within the subject lands. Monumented cross sections were installed at each site to collect periodic velocity measurements to determine discharge. Monitoring results revealed that these drainage features are ephemeral, as they only contained water during the spring freshet. Due to a lack of channel definition, discharge could not be calculated for the **S Inlet** site. Maximum discharges at the **W**

Inlet, Bridge, and **Outlet** sites were 0.0009 m^3/s, 0.0025 m^3/s, and 0.0180 m^3/s respectively, which occurred on May 10, 2019 following 21.59 mm of rainfall in 24 hours.

We trust this report meets your requirements. Should you have any questions please contact the undersigned.

Respectfully submitted,

Suzanne St. Onge

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Director, Principal Geomorphologist

Suzanne St. Onge, M.Sc.
Senior Environmental Scientist

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Appendix A
Reach Delineation and Monitoring Station Locations

Legend

- Reach break
- Watercourse
- Wetland
- Contour (1 m)
- Secondary Plan Area
- Atmospheric sensor
- Pressure logger
- Detailed assessment
- Top of bank*

*Staked by TRCA (Oct. 23, 2018) and Biason Surveying Inc. (Sept. 20, 2011)

Reach Delineation and Monitoring Station Locations

Tributary of Etobicoke Creek

Snell's Hollow Secondary Plan Area

0 100
Metres

GEO MORPHIX™

Imagery: Google Earth Pro, 2018.
Top of bank: GSAI, 2019.
Reach break, Monitoring locations, and
Detailed assessment: GEO Morphix Ltd., 2019.
Watercourse and Wetland: MNRF and GEO Morphix Ltd., 2019.
Contour: J.H. Gelbloom Surveying Limited and GEO Morphix Ltd., 2019.

Appendix B
Photographic Record

Photo 1
Tributary of Etobicoke Creek
Reach EC-1 Cross section 1

Channel flowed through a confined, wooded valley with a low gradient. Yellow arrow denotes flow direction.

Photo 2
Tributary of Etobicoke Creek,
Reach EC-1 Cross section 1

Woody debris present in the channel was not attributed to channel adjustment (e.g. widening or planform adjustment) as there was limited erosion in the reach.

Photo 3
Tributary of Etobicoke Creek
Reach EC-1 Cross section 2

Channel was wide and shallow, with low bank angles on both sides.

Photo 4
Tributary of Etobicoke Creek,
Reach EC-1 Cross section 2

View of one of two pedestrian crossings observed in the reach.

Photo 5
Tributary of Etobicoke Creek
Reach EC-1 Cross section 3-M

Representative view of one of two monumented cross sections installed as part of the detailed geomorphological assessment.

Photo 6
Tributary of Etobicoke Creek
Reach EC-1 Cross section 3-M

Vegetation established in the channel bed was indicative of low flow velocities

Photo 7
Tributary of Etobicoke Creek
Reach EC-1 Cross section 4-M

Channel showed wetland-like characteristics and contained clay, silt and sand substrates. No riffles or pools were present.

Photo 8
Tributary of Etobicoke Creek,
Reach EC-1 Cross section 4-M

View of the left bank and associated riparian vegetation, which provided shade to the feature.

Photo 9
Tributary of Etobicoke Creek
Reach EC-1 Cross section 5

Photo taken from the downstream trail crossing facing upstream.

Photo 10
Tributary of Etobicoke Creek
Reach EC-1 Cross section 5

Photo taken facing downstream towards tail crossing, near the downstream extent of the detailed assessment.

Photo 11
Tributary of Etobicoke Creek
Reach EC-1 Cross section 6

Photo taken facing upstream towards trail crossing.

Photo 12
Tributary of Etobicoke Creek
Reach EC-1 Cross section 6

Photo taken from the trail crossing downstream into the reach.

Photo 13
Tributary of Etobicoke Creek,
Reach EC-2

Photo taken from the upstream extent of the reach showing the open water feature.

Photo 14
Tributary of Etobicoke Creek
Reach EC-2

Photo taken from Mayfield Road, facing north towards the pond.

Photo 15
Tributary of Etobicoke Creek
Reach EC-2a

View of conditions mid-reach. Flows drain from adjacent agricultural fields and flow downslope to the pond feature.

Photo 16
Tributary of Etobicoke Creek
Reach EC-2a

Photo taken from mid-reach towards the pond feature. The channel was poorly defined and lacked riffles and pools

Photo 17
Tributary of Etobicoke Creek
Reach EC-2a

A large brush pile was present mid-reach.

Photo 18
Tributary of Etobicoke Creek,
Reach EC-3

View from the southwest corner of the subject lands. The wetland receives input from an adjacent stormwater management pond.

Photo 19
Tributary of Etobicoke Creek
Reach EC-3

Middle of the wetland feature, where standing water was present.

Photo 20
Tributary of Etobicoke Creek
Reach EC-3

Photo taken from the west side of **Reach EC-3**, facing east across the wetland feature towards Mayfield Road.

Photo 21
Tributary of Etobicoke Creek
Reach EC-3

Photo taken near the **W Inlet** flow monitoring station facing northeast.

Photo 22
Tributary of Etobicoke Creek
Reach EC-3

Photo taken near the **Bridge** flow monitoring site facing southwest.

Photo 23
Tributary of Etobicoke Creek
Reach EC-3a

Photo taken at the **W Inlet** flow monitoring site facing downstream. Reach was a ditch feature draining a property upstream.

Photo 24
Tributary of Etobicoke Creek
Reach EC-3a

Photo taken facing upstream.

Photo 25 **Tributary of Etobicoke Creek,** **Flow Monitoring Site: W Inlet**	 Photo taken facing upstream after a 21.59 mm rain event.
Photo 26 **Tributary of Etobicoke Creek** **Flow Monitoring Site: W Inlet**	 Photo taken facing site showing baseline conditions.

Photo 27
Tributary of Etobicoke Creek
Flow Monitoring Site: S Inlet

Photo taken facing downstream after a 21.59 mm rain event.

Photo 28
Tributary of Etobicoke Creek
Flow Monitoring Site: S Inlet

Photo taken facing upstream showing baseline conditions.

Photo 29
Tributary of Etobicoke Creek
Flow Monitoring Site: Bridge

Photo taken facing upstream after a 21.59 mm rain event.

Photo 30
Tributary of Etobicoke Creek
Flow Monitoring Site: Bridge

Photo taken facing upstream showing baseline conditions.

Photo 31
Tributary of Etobicoke Creek
Flow Monitoring Site: Outlet

Photo taken facing downstream towards the Mayfield Road culvert after a 21.59 mm rain event.

Photo 32
Tributary of Etobicoke Creek
Flow Monitoring Site: Outlet

Photo taken facing downstream showing baseline conditions.

Appendix C
Field Observations

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Geomorphology
Earth Science
Observations

Reach Characteristics

Project Code: PM 19033

Date:	2019-05-10	**Stream/Reach:**	Pond U/S Mayfield Rd. / EC-2
Weather:	overcast 8°C	**Location:**	Mayfield Rd & Kennedy Rd
Field Staff:	LG + KIM	**Watershed/Subwatershed:**	Etobicoke Crk
UTM (Upstream)		**UTM (Downstream)**	

Land Use (Table 1) 3
Valley Type (Table 2) 3
Channel Type (Table 3) NA
Channel Zone (Table 4) NA
Flow Type (Table 5) NA
☐ Groundwater
Evidence: None

Riparian Vegetation

Dominant Type: (Table 6) 3
Species: ______

Coverage:
☐ None
☐ Fragmented
☒ Continuous

Channel widths
☒ 1-4
☐ 4-10
☐ > 10

Age Class (yrs):
☐ Immature (<5)
☒ Established (5-30)
☐ Mature (>30)

Encroachment: (Table 7) 1

Aquatic/Instream Vegetation

Type (Table8) NA
Coverage of Reach (%) 0

Woody Debris
☐ Present in Cutbank
☐ Present in Channel
☒ Not Present

Density of WD:
☐ Low
☐ Moderate
☐ High

WDJ/50m: NA

Water Quality

Odour (Table 16) 1
Turbidity (Table 17) 1

Channel Characteristics

Sinuosity (Type) (Table 9) NA
Sinuosity (Degree) (Table 10) NA
Gradient (Table 11) NA
Number of Channels (Table 12) NA
Entrenchment (Table 13) NA
Type of Bank Failure (Table 14) NA
Downs's Classification (Table 15) NA

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	N/A	☐	☐	☐	☐	☐	☐
Pool Substrate	N/A	☐	☐	☐	☐	☐	☐
Bank Material	☒	☐	☐	☐	☐	☐	☐

Bankfull Width (m) NA → **Wetted Width (m)** NA →
Bankfull Depth (m) NA → **Wetted Depth (m)** NA →
Riffle/Pool Spacing (m) NA **% Riffles:** NA **% Pools:** NA **Meander Amplitude:** NA
Pool Depth (m) NA **Riffle Length (m)** NA **Undercuts (m)** NA **Comments:** Pond.
Velocity (m/s) NA → **Wiffle ball / ADV / Estimated**

N/A

Bank Angle
☐ 0 – 30
☐ 30 – 60
☐ 60 – 90
☐ Undercut

Bank Erosion
☐ < 5%
☐ 5 – 30%
☐ 30 – 60%
☐ 60 – 100%

Notes:

Completed by: ______ Checked by: ______

Reach Characteristics

Project Code: PN19033

Date:	2019-05-16	**Stream/Reach:**	N inlet of Wetland / EC-2a
Weather:	overcast, 8°C	**Location:**	Mayfield Rd @ Kennedy Road
Field Staff:	LG + WM	**Watershed/Subwatershed:**	Etobicoke Crk.
UTM (Upstream)	595897.89 m E 4845049.02 m N	**UTM (Downstream)**	595954.91 m E 4844971.78 m N

Land Use (Table 1): 3
Valley Type (Table 2): 2
Channel Type (Table 3): 11
Channel Zone (Table 4): 2
Flow Type (Table 5): 3
☐ Groundwater
Evidence: ____________

Riparian Vegetation

Dominant Type: (Table 6) 3
Species: ____________
Coverage: ☐ None ☐ Fragmented ☒ Continuous
Channel widths: ☐ 1-4 ☐ 4-10 ☒ > 10
Age Class (yrs): ☒ Immature (<5) ☐ Established (5-30) ☐ Mature (>30)
Encroachment: (Table 7) 4

Aquatic/Instream Vegetation

Type (Table8) 1
Coverage of Reach (%) 100
Woody Debris: ☐ Present in Cutbank ☒ Present in Channel ☐ Not Present
Density of WD: ☒ Low ☐ Moderate ☐ High
WDJ/50m: 1

Water Quality

Odour (Table 16) 1
Turbidity (Table 17) 1

Channel Characteristics

Sinuosity (Type) (Table 9) 2
Sinuosity (Degree) (Table 10) 1
Gradient (Table 11) 2
Number of Channels (Table 12) 1
Entrenchment (Table 13) 1
Type of Bank Failure (Table 14) 1
Downs's Classification (Table 15) d

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	N/A	☐	☐	☐	☐	☐	☐
Pool Substrate	☒	☒	☐	☐	☐	☐	☐
Bank Material	☒	☒	☐	☐	☐	☐	☐

Bankfull Width (m)	6	N/A	N/A
Bankfull Depth (m)	0.4	N/A	N/A
Wetted Width (m)	4	N/A	N/A
Wetted Depth (m)	0.05	N/A	N/A

Riffle/Pool Spacing (m) N/A **% Riffles:** N/A **% Pools:** N/A **Meander Amplitude:** N/A
Pool Depth (m) N/A **Riffle Length (m)** N/A **Undercuts (m)** N/A
Velocity (m/s) 0 Wiffle ball / ADV / Estimated

Bank Angle: ☐ 0 – 30 ☒ 30 – 60 ☒ 60 – 90 ☐ Undercut
Bank Erosion: ☒ < 5% ☐ 5 – 30% ☐ 30 – 60% ☐ 60 – 100%

Comments: Drainage feature from Ag. field

Notes: Large Man-made WDJ halfway down reach. No riffles or pools

BFW and BFD taken at DS end of reach

Completed by: LG
Checked by: ________

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Geomorphology
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Observations

Reach Characteristics

Project Code: PN19033

Date:	2019-05-10	**Stream/Reach:**	Wetland US Mayfield Rd. / EC-3
Weather:	Overcast 8°C	**Location:**	Mayfield Rd. @ Kennedy Road
Field Staff:	LG + WM	**Watershed/Subwatershed:**	Etobicoke Crk.
UTM (Upstream)	595371.06 mE 4844455.82 m N	**UTM (Downstream)**	596062.82 mE 4844847.98 m N

Land Use (Table 1) 3
Valley Type (Table 2) 3
Channel Type (Table 3) N/A
Channel Zone (Table 4) N/A
Flow Type (Table 5) N/A
☐ Groundwater
Evidence: ____________

Riparian Vegetation

Dominant Type: (Table 6) 3
Species: ____________

Coverage:
☐ None
☐ Fragmented
☒ Continuous

Channel widths
☒ 1-4
☐ 4-10
☐ > 10

Age Class (yrs):
☐ Immature (<5)
☒ Established (5-30)
☐ Mature (>30)

Encroachment: (Table 7) 1

Cattails, and deciduous trees in wetland.

Aquatic/Instream Vegetation

Type (Table8) 1
Coverage of Reach (%) 100

Woody Debris
☐ Present in Cutbank
☒ Present in Channel
☐ Not Present

Density of WD:
☐ Low
☒ Moderate
☐ High

WDJ/50m: N/A

Water Quality

Odour (Table 16) 1
Turbidity (Table 17) 1

Channel Characteristics

Sinuosity (Type) (Table 9) N/A
Sinuosity (Degree) (Table 10) N/A
Gradient (Table 11) N/A
Number of Channels (Table 12) N/A
Entrenchment (Table 13) N/A
Type of Bank Failure (Table 14) N/A
Downs's Classification (Table 15) N/A

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	N/A ☐	☐	☐	☐	☐	☐	☐
Pool Substrate	N/A ☐	☐	☐	☐	☐	☐	☐
Bank Material	☒	☐	☐	☐	☐	☐	☐

Bankfull Width (m)	N/A →		→	**Wetted Width (m)**	N/A	→	→
Bankfull Depth (m)	N/A →		→	**Wetted Depth (m)**	N/A →		→

Valley Slope
Bank Angle
☐ 0 – 30
☒ 30 – 60
☐ 60 – 90
☐ Undercut

No erosion
Bank Erosion
☒ < 5%
☐ 5 – 30%
☐ 30 – 60%
☐ 60 – 100%

Riffle/Pool Spacing (m) N/A
% Riffles: N/A
% Pools: N/A
Meander Amplitude: N/A

Pool Depth (m) N/A
Riffle Length (m) N/A
Undercuts (m) N/A
Comments: BFW and BFD taken at North, South, and West inlet channels.

Velocity (m/s) N/A → →
Wiffle ball / ADV / Estimated

Notes: Wet land, no defined channel through wetland. Documented flow between wetland and small pond.

Completed by: LG
Checked by: ________

- North inlet, South inlet, West inlet, and outlet channels have seperate XS surveys and velocity data during WQM visits.

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Reach Characteristics

Project Code: PN19033

Date:	2019-05-10	**Stream/Reach:**	W inlet of Wetland / EC-3a
Weather:	overcast 8°C	**Location:**	Mayfield Rd @ Kennedy Road
Field Staff:	LG + WM	**Watershed/Subwatershed:**	Etobicoke Crk.
UTM (Upstream)	595368.19mE 484445299mN	**UTM (Downstream)**	595431.33mE 4844513.44mN

Land Use (Table 1) 3
Valley Type (Table 2) 3
Channel Type (Table 3) 11
Channel Zone (Table 4) 2
Flow Type (Table 5) 1
☐ Groundwater
Evidence: ____________

Riparian Vegetation

Dominant Type: (Table 6) 3
Species: ____________

Coverage:
☐ None
☐ Fragmented
☒ Continuous

Channel widths
☐ 1-4
☒ 4-10
☐ > 10

Age Class (yrs):
☒ Immature (<5)
☐ Established (5-30)
☐ Mature (>30)

Encroachment: (Table 7) 3

Aquatic/Instream Vegetation

Type (Table8) 1
Coverage of Reach (%) 100

Woody Debris
☐ Present in Cutbank
☐ Present in Channel
☒ Not Present

Density of WD:
☒ Low
☐ Moderate
☐ High

WDJ/50m: 0

Water Quality

Odour (Table 16) 1
Turbidity (Table 17) 1

Channel Characteristics

Sinuosity (Type) (Table 9) 1
Sinuosity (Degree) (Table 10) 1
Gradient (Table 11) 1
Number of Channels (Table 12) 1
Entrenchment (Table 13) 2
Type of Bank Failure (Table 14) 1
Downs's Classification (Table 15) d

	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
Riffle Substrate	☐	☒	☒	☐	☐	☐	☐
Pool Substrate	☒	☒	☐	☐	☐	☐	☐
Bank Material	☒	☒	☐	☐	☐	☐	☐

Bankfull Width (m)	1.4	→	→
Bankfull Depth (m)	0.3	→	→
Wetted Width (m)	0.5	→	→
Wetted Depth (m)	0.05	→	→

Riffle/Pool Spacing (m) N/A **% Riffles:** N/A **% Pools:** N/A **Meander Amplitude:** N/A
Pool Depth (m) N/A **Riffle Length (m)** N/A **Undercuts (m)** N/A **Comments:** ____________
Velocity (m/s) 0.1 → → Wiffle ball / [✓ ADV] / Estimated

Bank Angle
☐ 0 – 30
☐ 30 – 60
☒ 60 – 90
☐ Undercut

Bank Erosion
☒ < 5%
☐ 5 – 30%
☐ 30 – 60%
☐ 60 – 100%

Notes: Ditch w̄ sand / fine sediment deposition

- XS surveyed w̄ RTK unit at pressure logger
- velocity and wetted measurements will be taken during each WQM visit

Completed by: LG
Checked by: ____________

Reach Characteristics Key

Table 1 Land Use

1. Forest
2. Pasture
3. Agricultural
4. Industrial
5. Park
6. Institutional
7. Residential
8. Golf Course
9. Commercial

Table 2 Valley Type

1. Unconfined
2. Confined
3. Partially Confined

Table 3 Channel Type

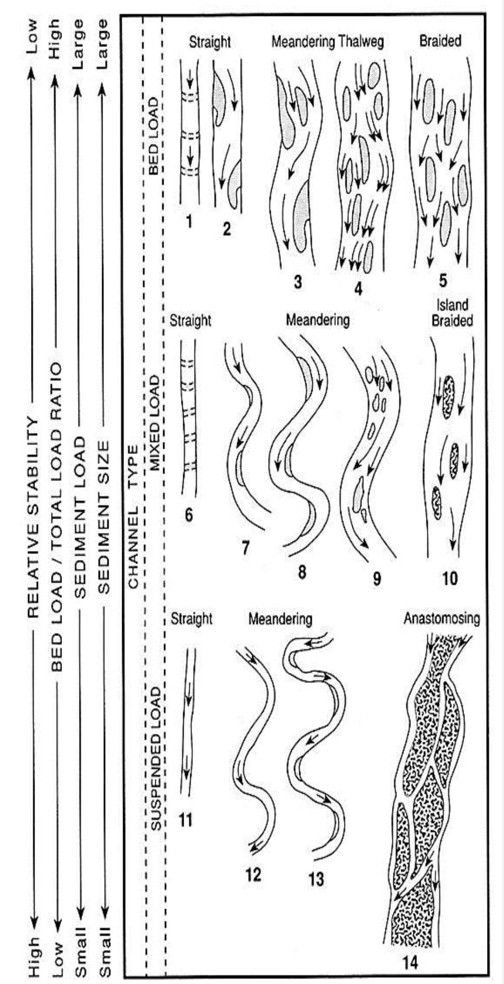


Table 4 Channel Zone

1. Headwater zone
2. Transfer zone
3. Deposition zone

Table 5 Flow Type

1. Perennial
2. Intermittent
3. Ephemeral

Table 6 Dominant Vegetation Type

1. Trees
2. Shrubs
3. Grasses
4. Herbaceous

Table 7 Extent of Encroachment into Channel

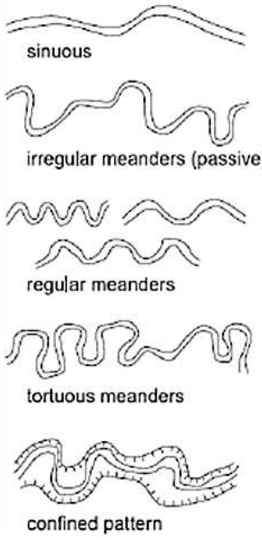
1. None
2. Minimal
3. Moderate
4. Heavy
5. Extreme

Table 8 Type of Aquatic Vegetation

1. Rooted Emergent
2. Rooted Submergent
3. Rooted Floating
4. Free Floating Roots
5. Floating Algae
6. Attached Algae

Table 9 Type of Sinuosity

1. Sinuous
2. Irregular Meanders
3. Regular Meanders
4. Tortuous Meanders
5. Confined pattern (within valley)



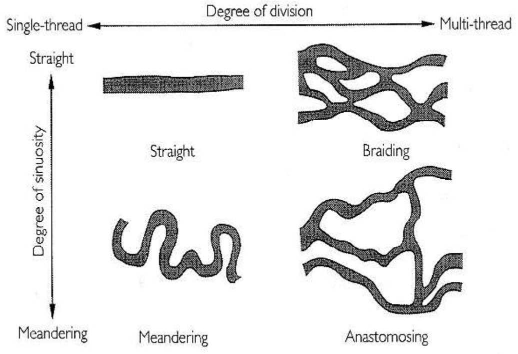


Table 10 Degree of Sinuosity

1. Straight (1 – 1.05)
2. Low sinuosity (1.06–1.30)
3. Meandering (1.31 - 3.0)

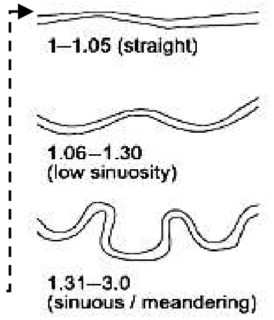


Table 11 Gradient

1. Low
2. Moderate
3. High

Table 12 Number of Channels

1. Single
2. Up to 3 (Wandering)
3. >3 (Braided)
4. >3 (Anastamosing or Anabranching)
5. Discontinuous or Absent

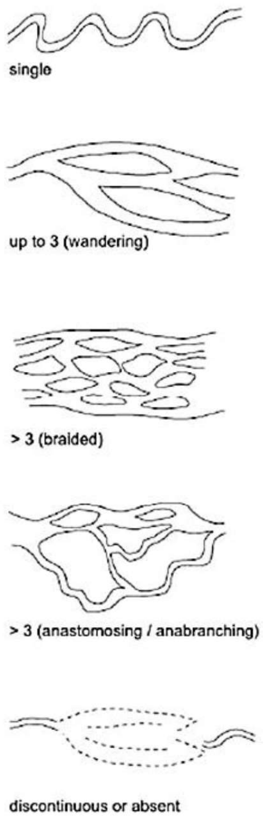
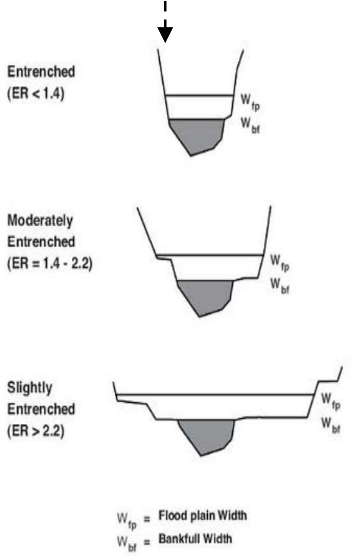
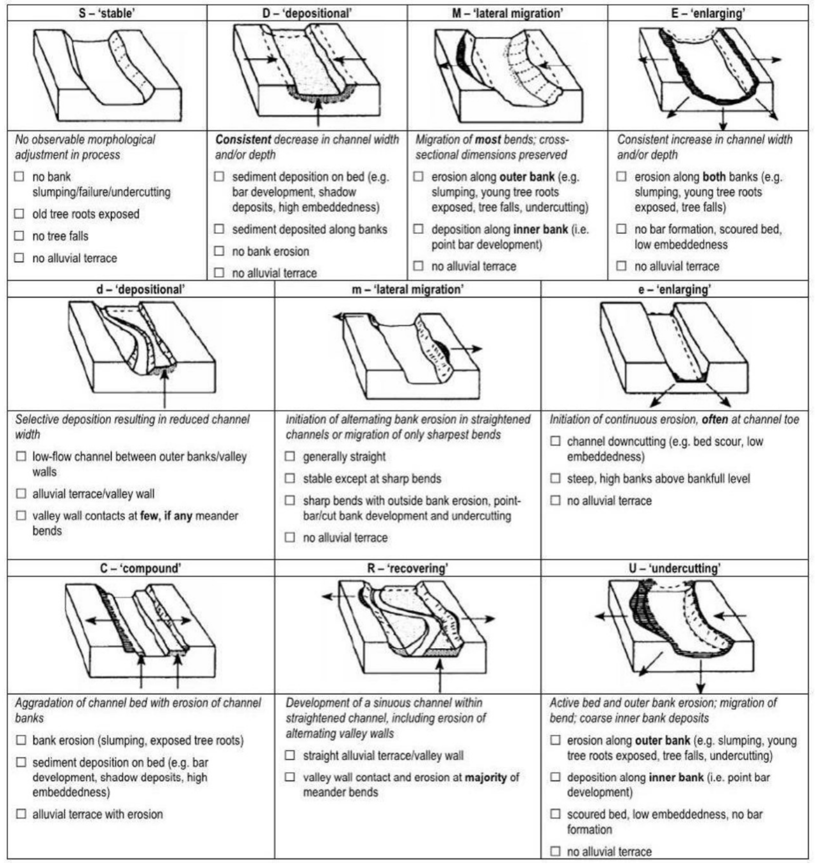


Table 13 Entrenchment

1. Low (>2.2)
2. Moderate (1.4 – 2.2)
3. High (<1.4)





S – 'stable'

No observable morphological adjustment in process

☐ no bank slumping/failure/undercutting
☐ old tree roots exposed
☐ no tree falls
☐ no alluvial terrace

D – 'depositional'

***Consistent** decrease in channel width and/or depth*

☐ sediment deposition on bed (e.g. bar development, shadow deposits, high embeddedness)
☐ sediment deposited along banks
☐ no bank erosion
☐ no alluvial terrace

M – 'lateral migration'

*Migration of **most** bends; cross-sectional dimensions preserved*

☐ erosion along **outer bank** (e.g. slumping, young tree roots exposed, tree falls, undercutting)
☐ deposition along **inner bank** (i.e. point bar development)
☐ no alluvial terrace

E – 'enlarging'

Consistent increase in channel width and/or depth

☐ erosion along **both** banks (e.g. slumping, young tree roots exposed, tree falls)
☐ no bar formation, scoured bed, low embeddedness
☐ no alluvial terrace

d – 'depositional'

Selective deposition resulting in reduced channel width

☐ low-flow channel between outer banks/valley walls
☐ alluvial terrace/valley wall
☐ valley wall contacts at **few, if any** meander bends

m – 'lateral migration'

Initiation of alternating bank erosion in straightened channels or migration of only sharpest bends

☐ generally straight
☐ stable except at sharp bends
☐ sharp bends with outside bank erosion, point-bar/cut bank development and undercutting
☐ no alluvial terrace

e – 'enlarging'

*Initiation of continuous erosion, **often** at channel toe*

☐ channel downcutting (e.g. bed scour, low embeddedness)
☐ steep, high banks above bankfull level
☐ no alluvial terrace

C – 'compound'

Aggradation of channel bed with erosion of channel banks

☐ bank erosion (slumping, exposed tree roots)
☐ sediment deposition on bed (e.g. bar development, shadow deposits, high embeddedness)
☐ alluvial terrace with erosion

R – 'recovering'

Development of a sinuous channel within straightened channel, including erosion of alternating valley walls

☐ straight alluvial terrace/valley wall
☐ valley wall contact and erosion at **majority** of meander bends

U – 'undercutting'

Active bed and outer bank erosion; migration of bend; coarse inner bank deposits

☐ erosion along **outer bank** (e.g. slumping, young tree roots exposed, tree falls, undercutting)
☐ deposition along **inner bank** (i.e. point bar development)
☐ scoured bed, low embeddedness, no bar formation
☐ no alluvial terrace

Table 14 Type of Bank Failure

1. Fluvial Entrainment (Hydraulic action)
2. Undercutting (Hydraulic action)
3. Slab Failure (Mass failure)
4. Parallel slide (Mass failure)
5. Fall/Sloughing (Mass failure)
6. Rotational slip and slump (Mass failure)

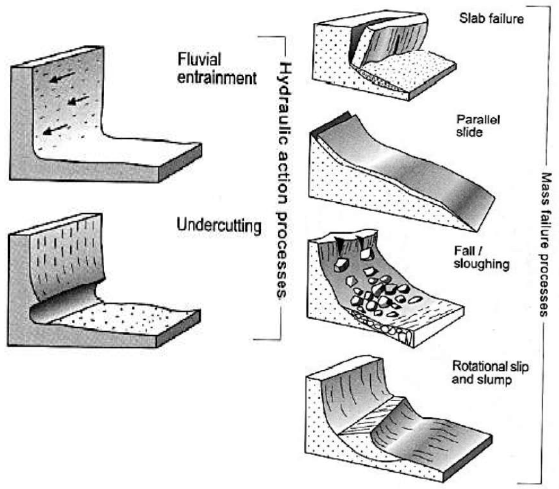


Table 15 Downs's Model of Channel Classification

S – Stable
D or d – Depositional
M or m – Lateral Migration
E or e – Enlarging
C – Compound
R – Recovering
U – Undercutting

Table 16 Odours

1. None
2. Fishy
3. Petroleum
4. Sewage
5. Chemical
6. Other

Table 17 Turbidity

1. Clear
2. Slightly turbid
3. Turbid
4. Opaque
5. Stained
6. Other

Appendix D
Detailed Geomorphological Assessment Summary

GEO | MORPHIX
Geomorphology
Earth Science
Observations

General Site Characteristics

Project Code: PH19033

Date:	May 6, 2019	**Stream/Reach:**	N/A
Weather:	Sun + 15°C	**Location:**	Heart Lake CA
Field Staff:	CH + KIM	**Watershed/Subwatershed:**	Etobicoke Crk

Features

- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

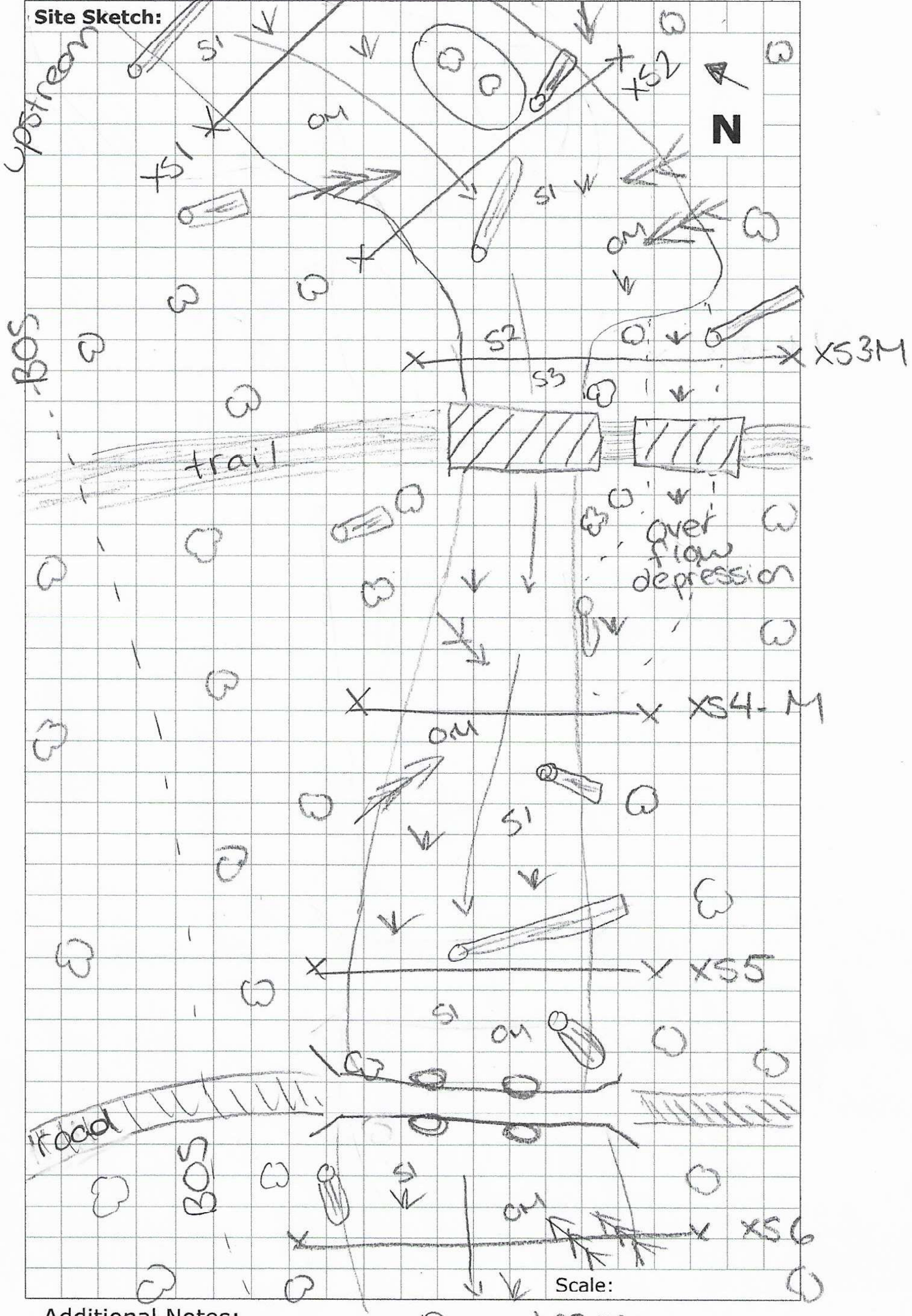
Substrate

S1	Silt	S6	Small boulder
S2	Sand	S7	Large boulder
S3	Gravel	S8	Bimodal
S4	Small cobble	S9	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	EP	Erosion pin
BS	Backsight	RB	Rebar
DS	Downstream	US	Upstream
WDJ	Woody debris jam	TR	Terrace
VWC	Valley wall contact	FC	Flood chute
BOS	Bottom of slope	FP	Flood plain
TOS	Top of slope	KP	Knick point

Site Sketch:



Scale:

Additional Notes:

* This area was chosen as it is the most narrow section of wetland.

Completed by: CH Checked by: ________

Detailed Geomorphological Assessment Summary

Reach EC-1

Project Number:	PN19033	**Date:**	May 10, 2016
Client:	Snell's Hollow Landowner Group	**Length Surveyed (m):**	105.6
Location:	Heart Lake Conservation Park	**# of Cross-Sections:**	6

Reach Characteristics

Drainage Area:	Not measured	**Dominant Riparian Vegetation Type:**	Trees
Geology/Soils:	Clay to silt-textured till	**Extent of Riparian Cover:**	Continuous
Surrounding Land Use:	Forest	**Width of Riparian Cover:**	>10 channel widths
Valley Type:	Confined	**Age Class of Riparian Vegetation:**	Mature (>30 years)
Dominant Instream Vegetation Type:	Rooted submergent	**Extent of Encroachment into Channel:**	Minimal
Portion of Reach with Vegetation:	20%	**Density of Woody Debris:**	Moderate

Hydrology

Measured Discharge (m^3/s):	Not measured	**Calculated Bankfull Discharge (m^3/s):**	4.30
Modelled 2-year Discharge (m^3/s):	Not modelled	**Calculated Bankfull Velocity (m/s):**	0.76
Modelled 2-year Velocity (m/s):	Not modelled		

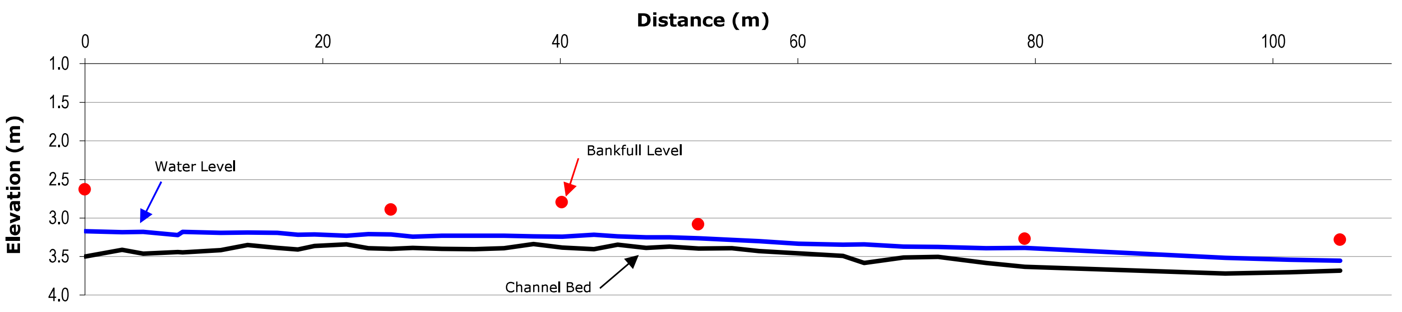
Profile Characteristics

Bankfull Gradient (%):	0.66
Channel Bed Gradient (%):	0.26
Riffle Gradient (%):	N/A: no riffles
Riffle Length (m):	N/A: no riffles
Riffle-Pool Spacing (m):	N/A: no riffle and pools

Planform Characteristics

Sinuosity:	1.13
Meander Belt Width (m):	Not measured
Radius of Curvature (m):	Not measured
Meander Amplitude (m):	Not measured
Meander wavelength (m):	Not measured

Longitudinal Profile



Bank Characteristics

	Minimum	Maximum	Average
Bank Height (m):	0.2	0.70	0.45
Bank Angle (deg):	10	45	24
Root Depth (m):	0.05	0.20	0.10
Root Density (%):	10	70	42
Bank Undercut (m):		No undercuts	

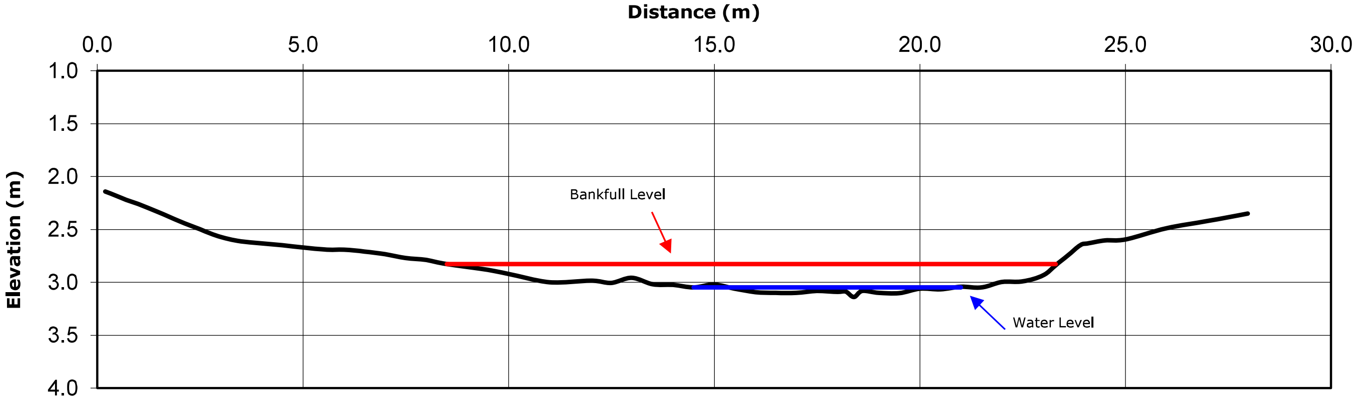
	Minimum	Maximum	Average
Torvane Value (kg/cm^2):		Not measured	
Penetrometer Value (kg/cm^3):		Not measured	
Bank Material (range):		Clay, silt, sand	

Cross-Sectional Characteristics

	Minimum	Maximum	Average
Bankfull Width (m):	12.70	27.90	17.95
Average Bankfull Depth (m):	0.18	0.49	0.32
Bankfull Width/Depth (m/m):	29	108	61
Wetted Width (m):	4.90	18.50	11.95
Average Water Depth (m):	0.04	0.25	0.13
Wetted Width/Depth (m/m):	48	175	108
Entrenchment (m):		Not measured	
Entrenchment Ratio (m/m):		Not measured	
Maximum Water Depth (m):	0.09	0.54	0.26
Manning's *n* :		0.050	

Photograph at cross section 4 (left bank)

Representative Cross-Section 4



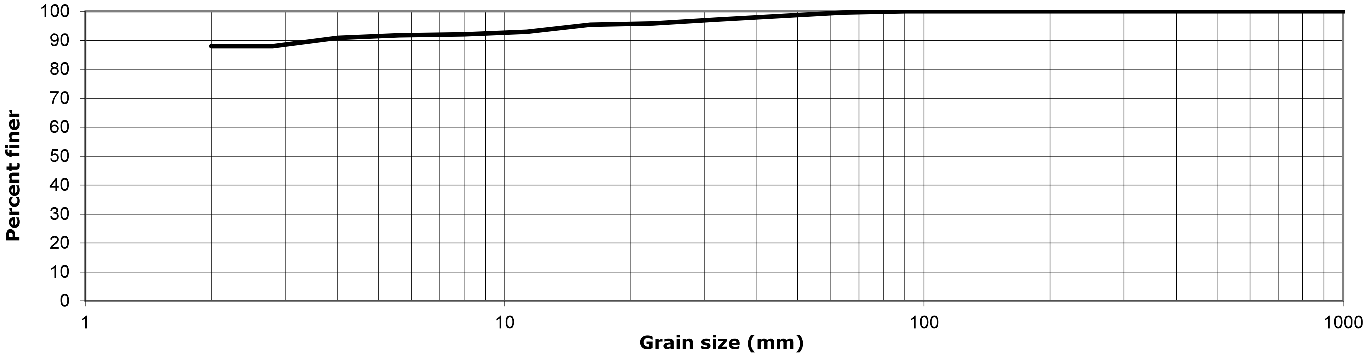
Substrate Characteristics

Particle Size (mm)

D_{10} :	<	2.0
D_{50} :	<	2.0
D_{84} :	<	2.0

Subpavement:	Clay, silt, sand
Particle shape:	N/A: fine graind materials
Embeddedness (%):	N/A: fine grained materials
Particle range (riffle):	N/A: no riffles
Particle Range (pool):	N/A: no pools

Cumulative Particle Size Distribution



Channel Thresholds

Flow Competency (m/s):		**Tractive Force at Bankfull (N/m^2):**	20.53
for D_{50}:	0.00	**Tractive Force at 2-year flow (N/m^2):**	Not modelled
for D_{84}:	0.00	**Critical Shear Stress (D_{50}) (N/m^2):**	0.00
Unit Stream Power at Bankfull (W/m^2):	15.50		

General Field Observations

Channel Description

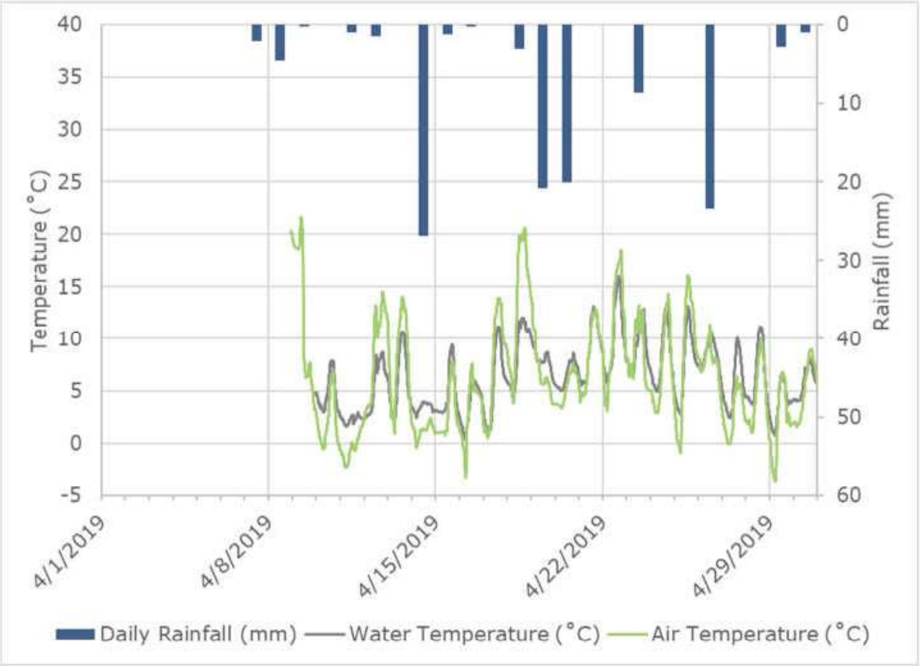
Reach EC-1 consisted of a fairly straight and low gradient channel through a confined valley. The continuous and wide riparian buffer zone consisted of mature trees. The average bankfull width and depth were 17.95 m and 0.32 m. Bank materials ranged from clay to sand. Little to no bank erosion was observed. There were no riffles or pools. Bed materials consisted of organic material, clay, silt, and fine sand. Two trail crossings were present across the channel and valley. Woody debris was present within the channel but not due to the channel widening.

Cross Section 4 - Facing Downstream

Appendix E
Flow Monitoring Data

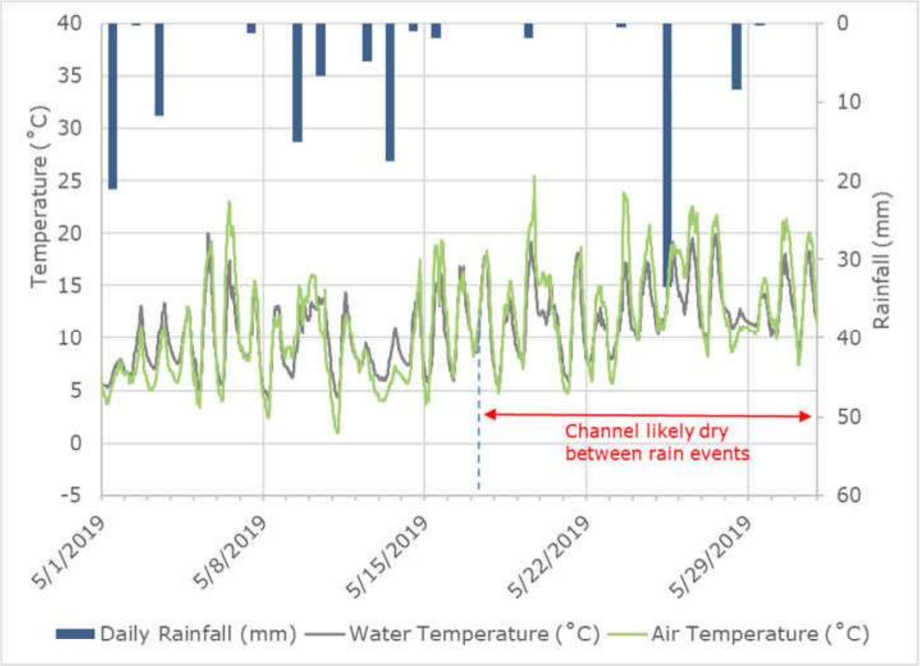
W Inlet Water Temperature

Figure 1



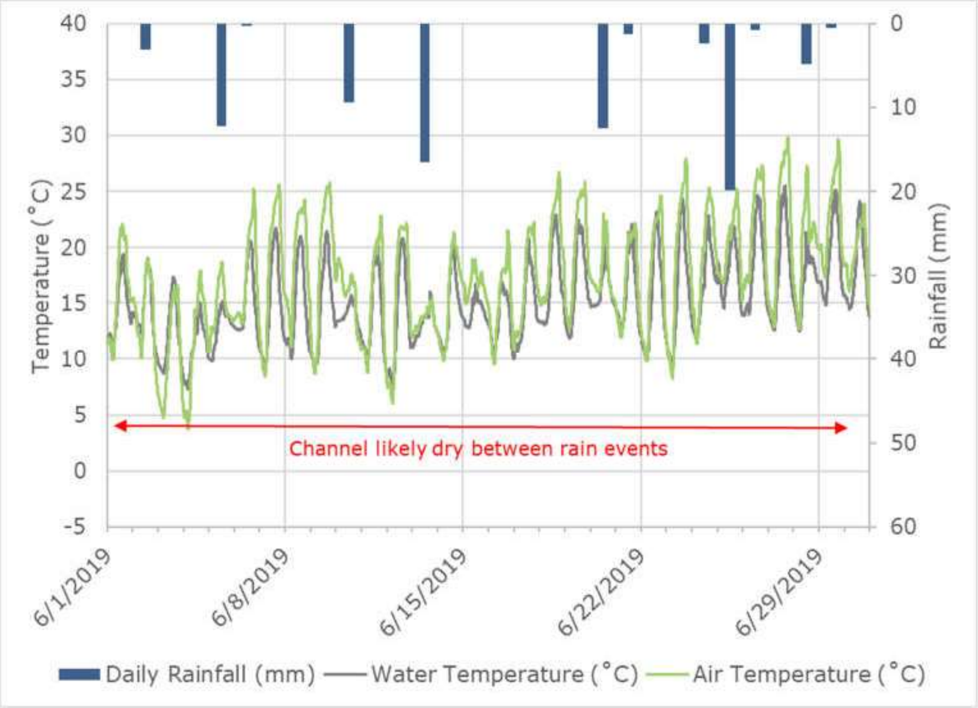
Water temperature, air temperature and daily rainfall at **W Inlet** for April 2019.

Figure 2



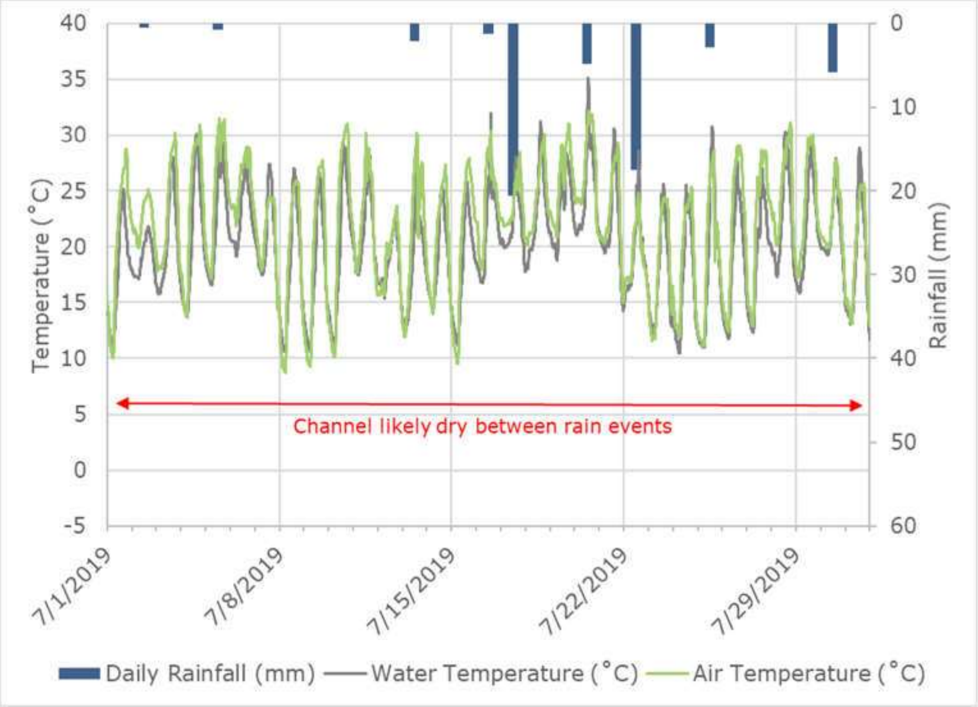
Water temperature, air temperature and daily rainfall at **W Inlet** for May 2019.

Figure 3



Water temperature, air temperature and daily rainfall at **W Inlet** for June 2019.

Figure 4



Water temperature, air temperature and daily rainfall at **W Inlet** for July 2019.

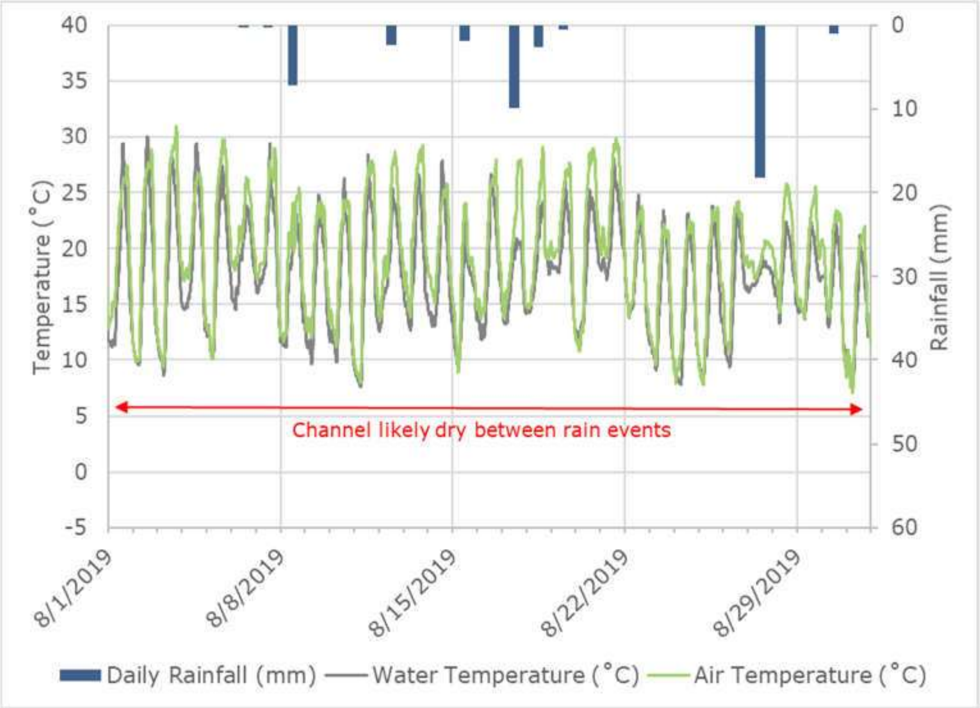
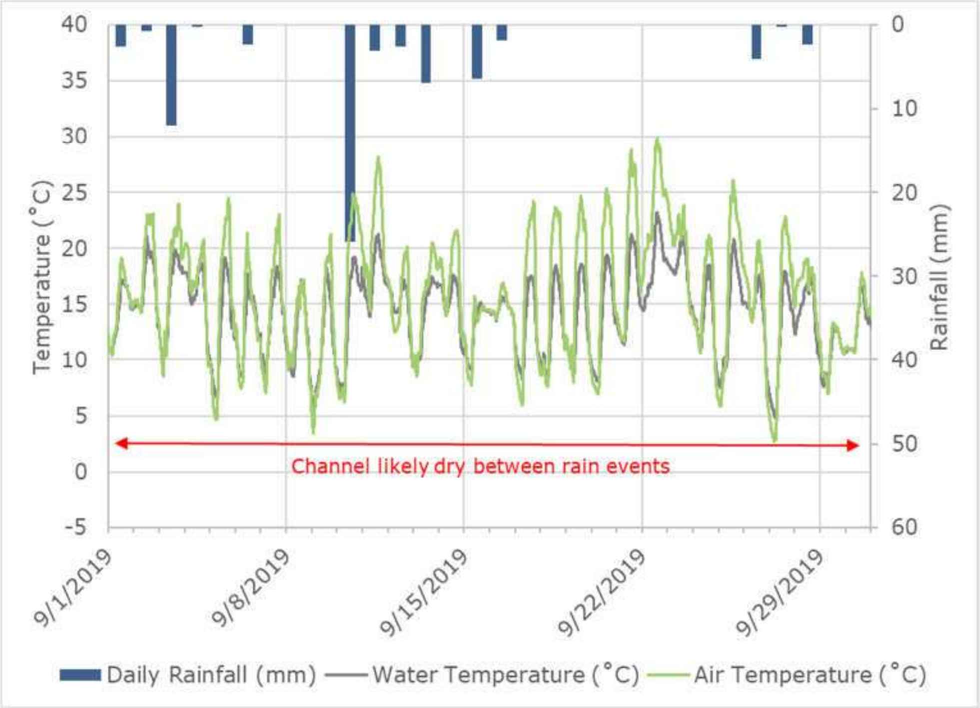
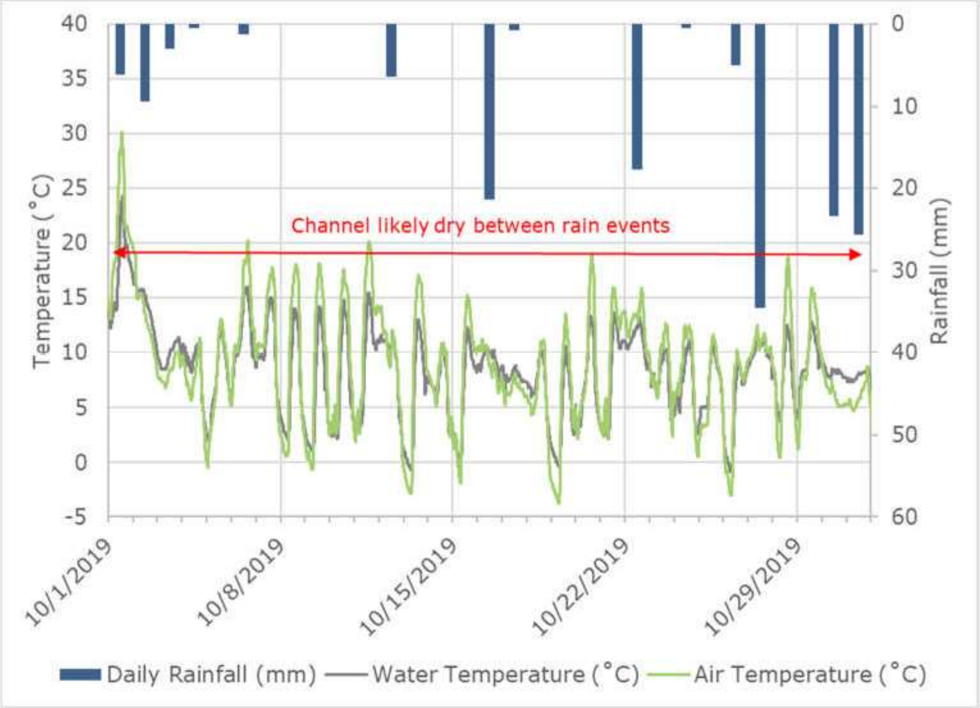
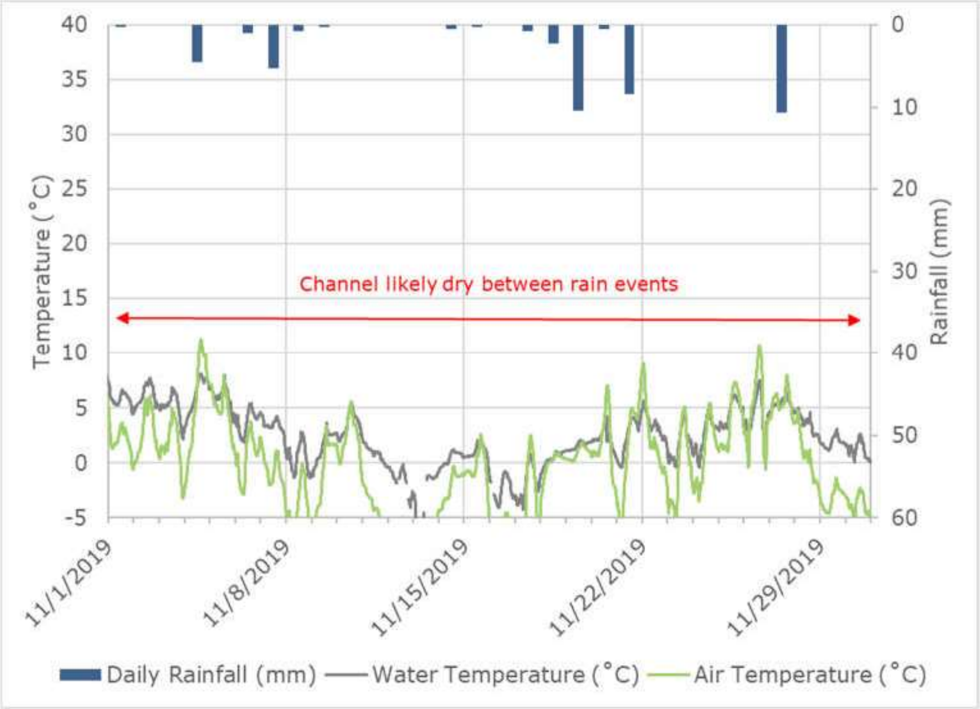
Figure 5	
	Water temperature, air temperature and daily rainfall at **W Inlet** for August 2019.
Figure 6	
	Water temperature, air temperature and daily rainfall at **W Inlet** for September 2019.

Figure 7



Water temperature, air temperature and daily rainfall at **W Inlet** for October 2019.

Figure 8



Water temperature, air temperature and daily rainfall at **W Inlet** for November 2019.

S Inlet Water Temperature

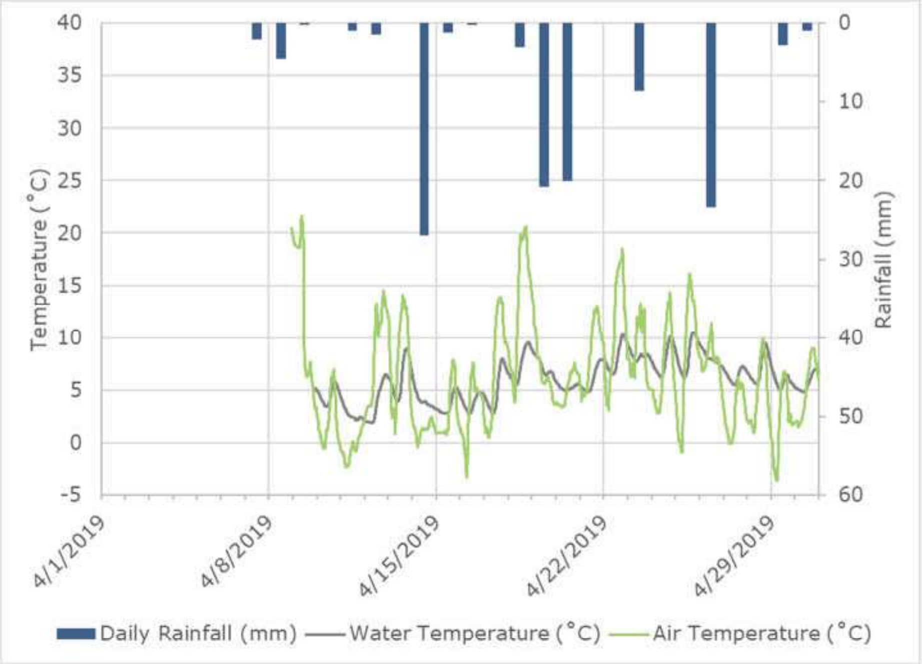
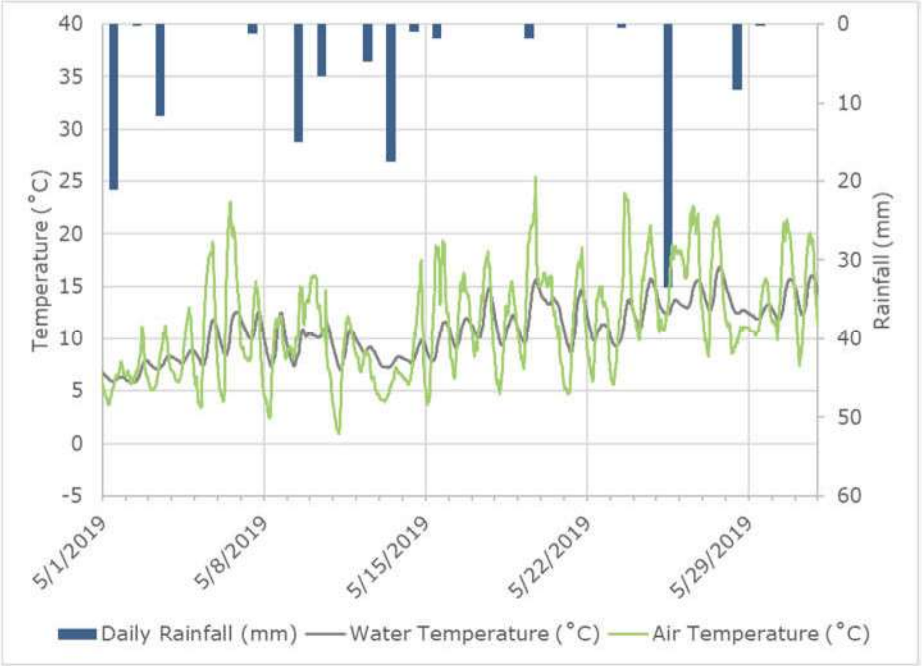
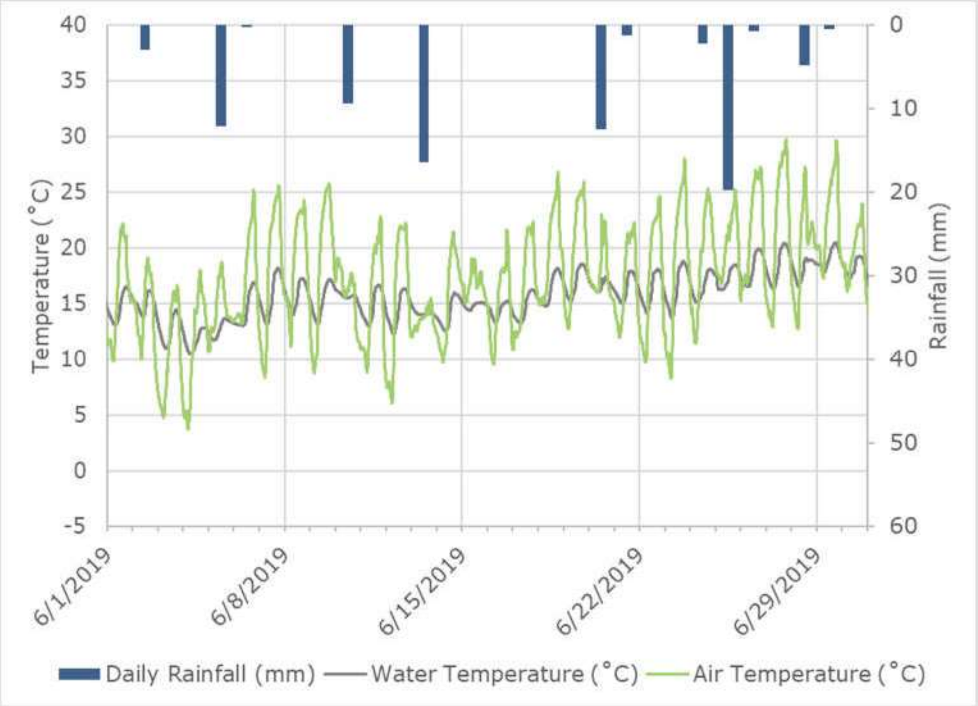
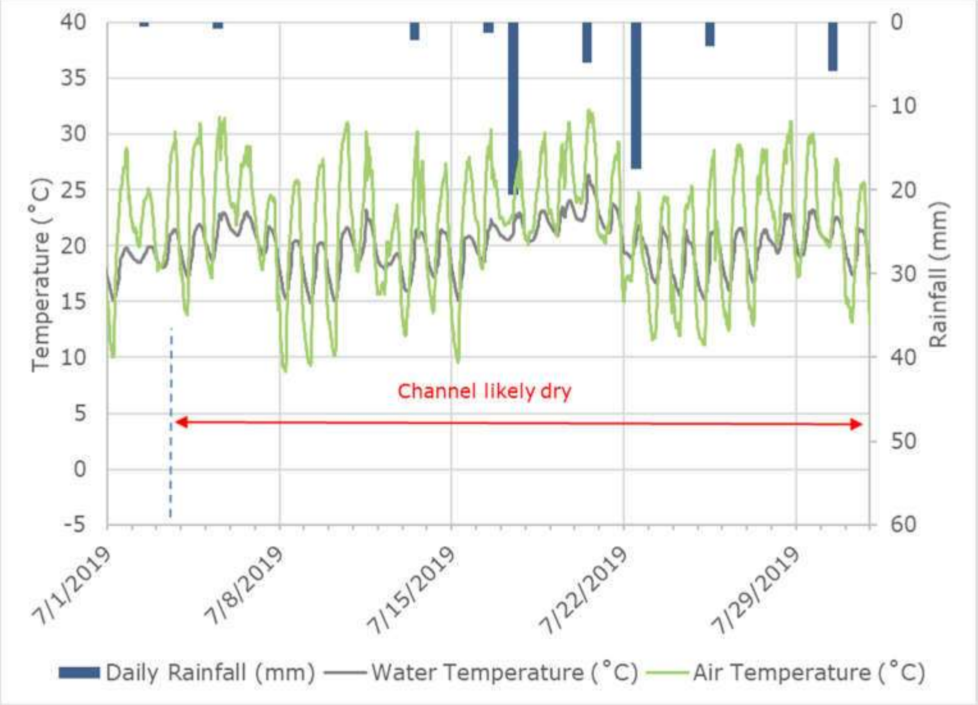
Figure 9	
	Water temperature, air temperature and daily rainfall at **S Inlet** for April 2019.
Figure 10	
	Water temperature, air temperature and daily rainfall at **S Inlet** for May 2019.

Figure 11



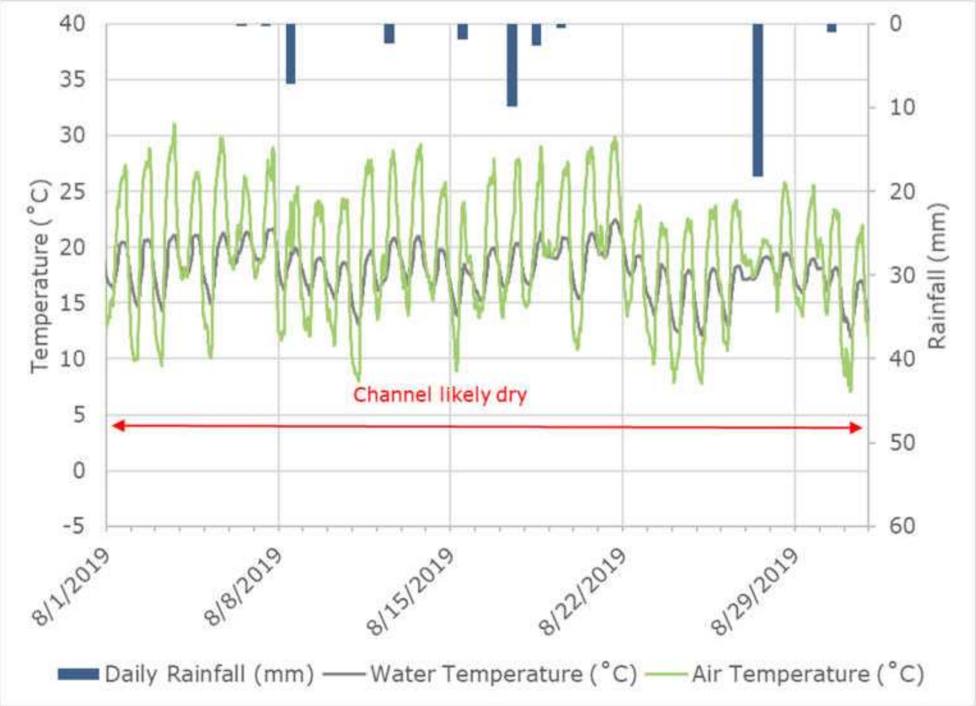
Water temperature, air temperature and daily rainfall at **S Inlet** for June 2019.

Figure 12



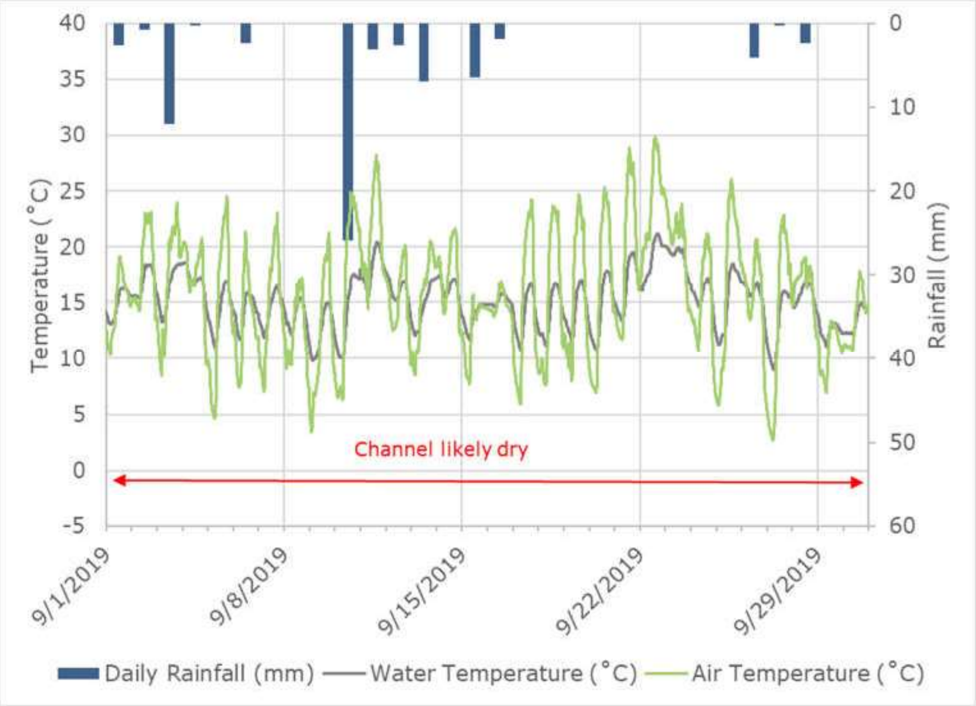
Water temperature, air temperature and daily rainfall at **S Inlet** for July 2019.

Photo 13



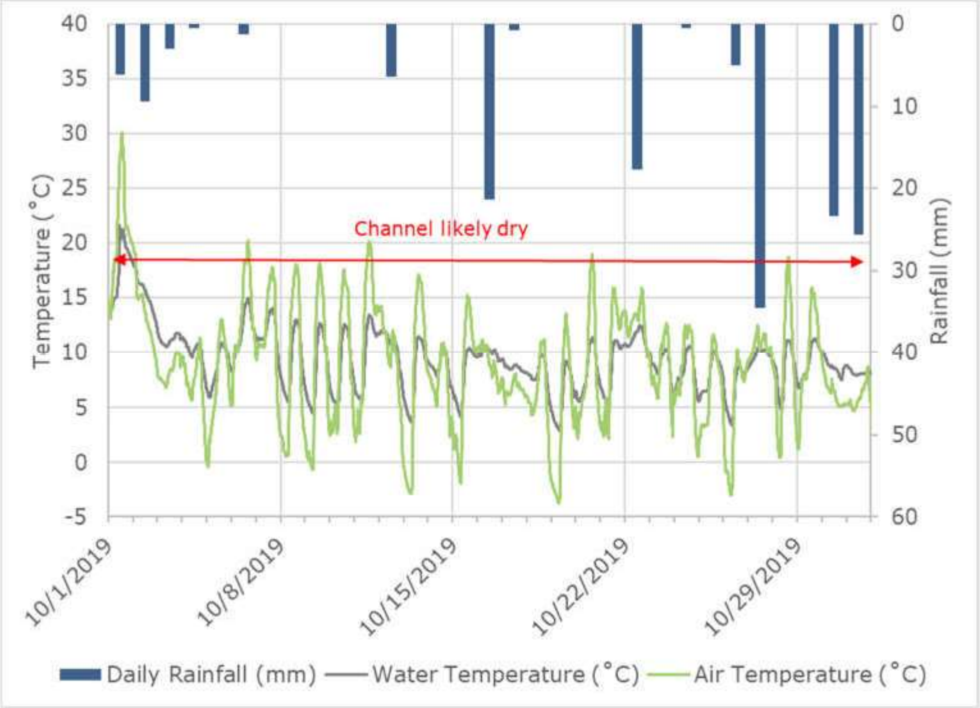
Water temperature, air temperature and daily rainfall at **S Inlet** for August 2019.

Figure 14



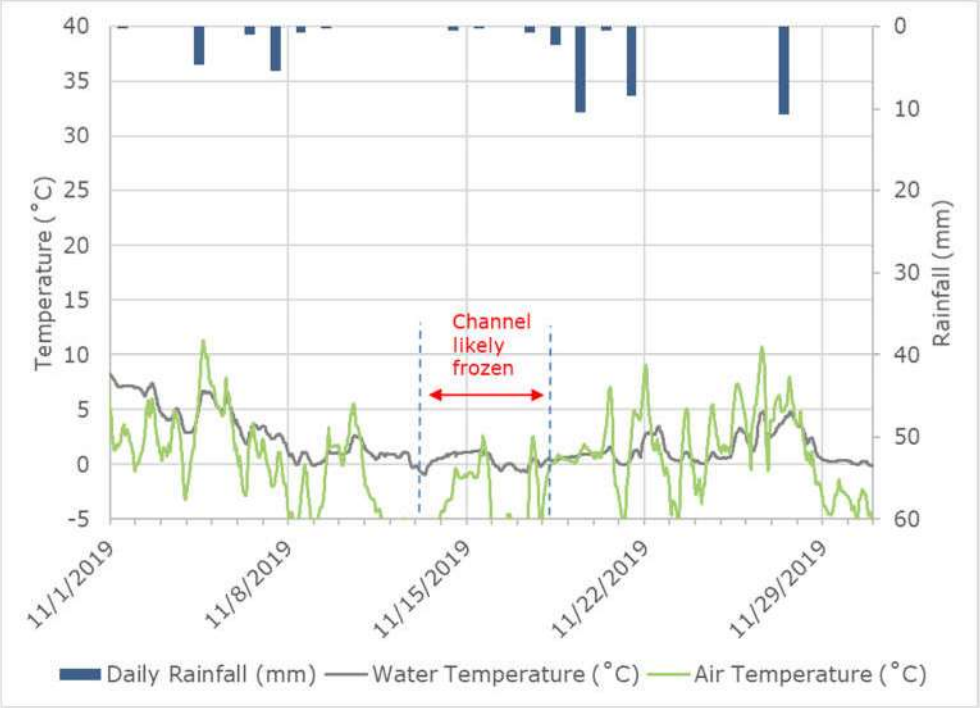
Water temperature, air temperature and daily rainfall at **S Inlet** for September 2019.

Figure 15



Water temperature, air temperature and daily rainfall at **S Inlet** for October 2019.

Figure 16



Water temperature, air temperature and daily rainfall at **S Inlet** for November 2019.

Bridge Water Temperature

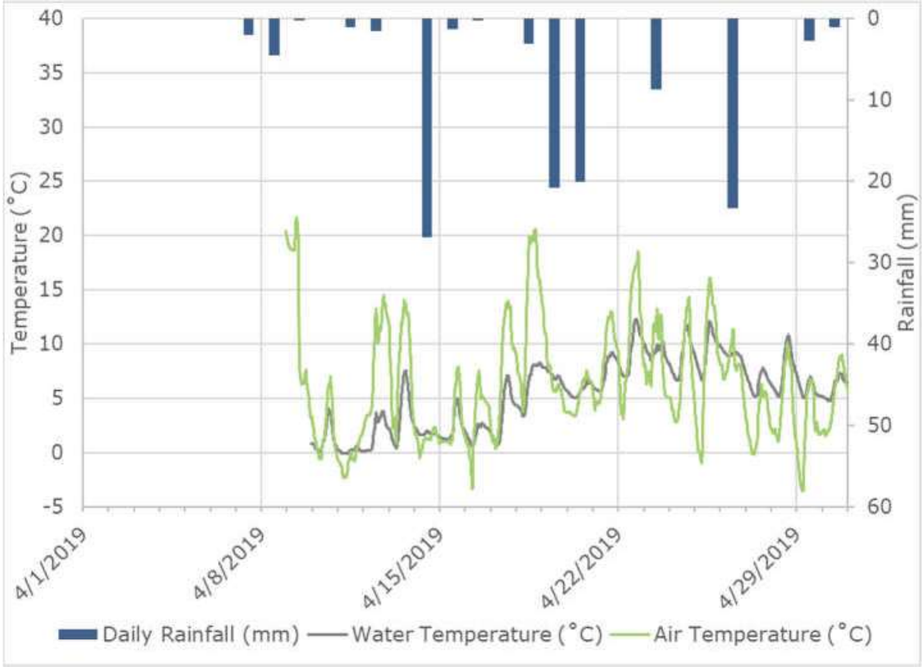
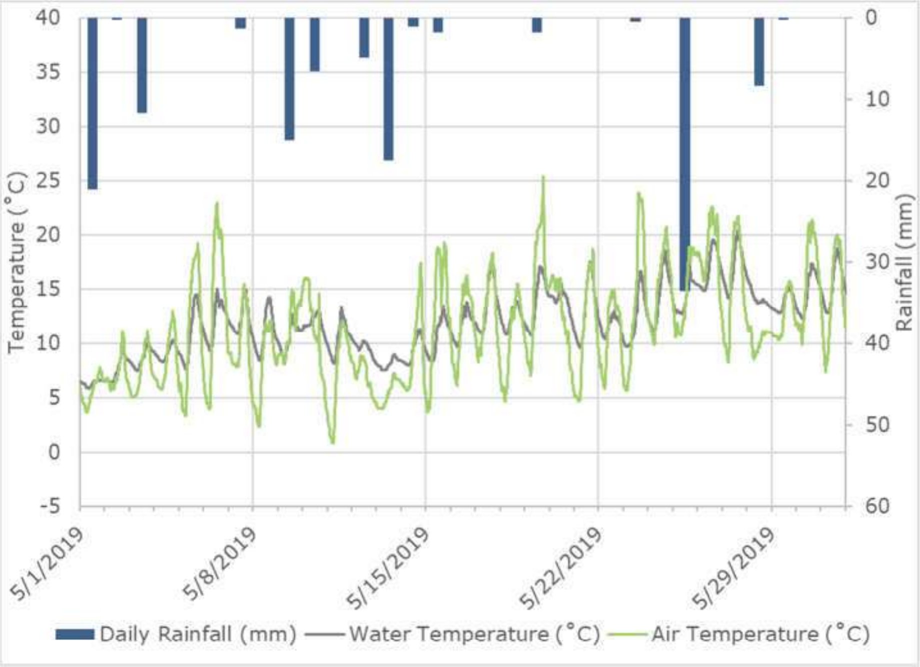
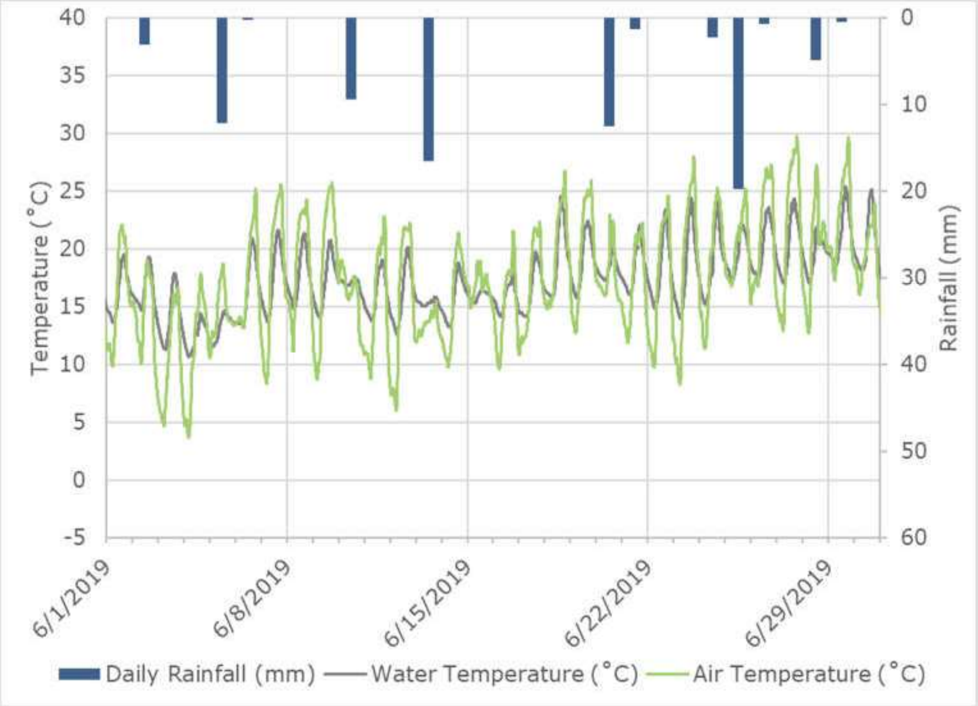
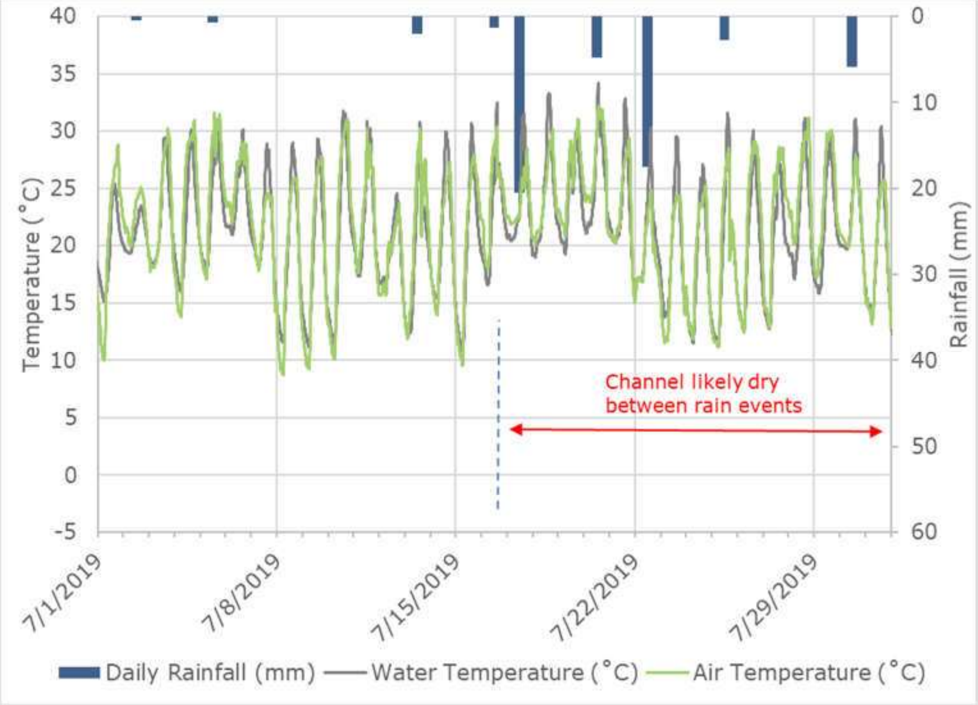
Figure 17	
	Water temperature, air temperature and daily rainfall at **Bridge** for April 2019.
Figure 18	
	Water temperature, air temperature and daily rainfall at **Bridge** for May 2019.

Figure 19



Water temperature, air temperature and daily rainfall at **Bridge** for June 2019.

Figure 20



Water temperature, air temperature and daily rainfall at **Bridge** for July 2019.

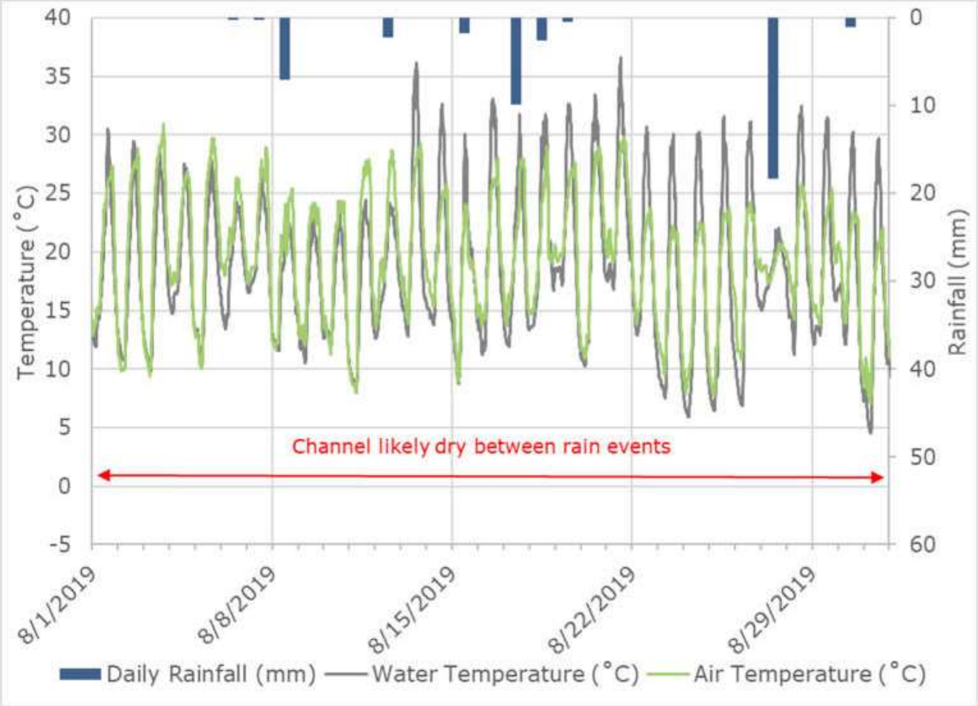
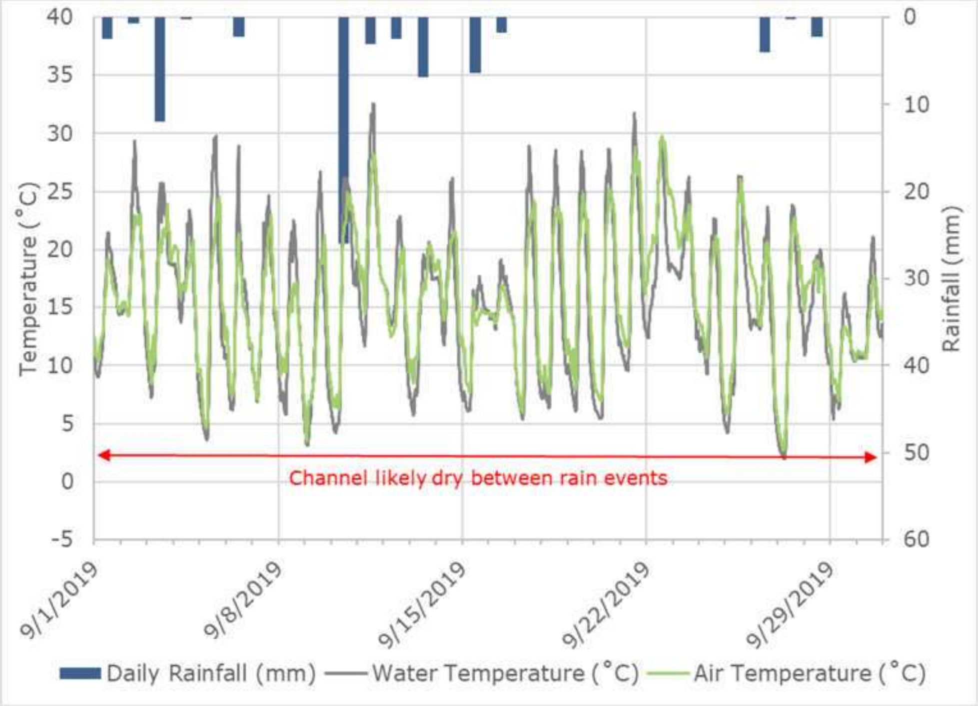
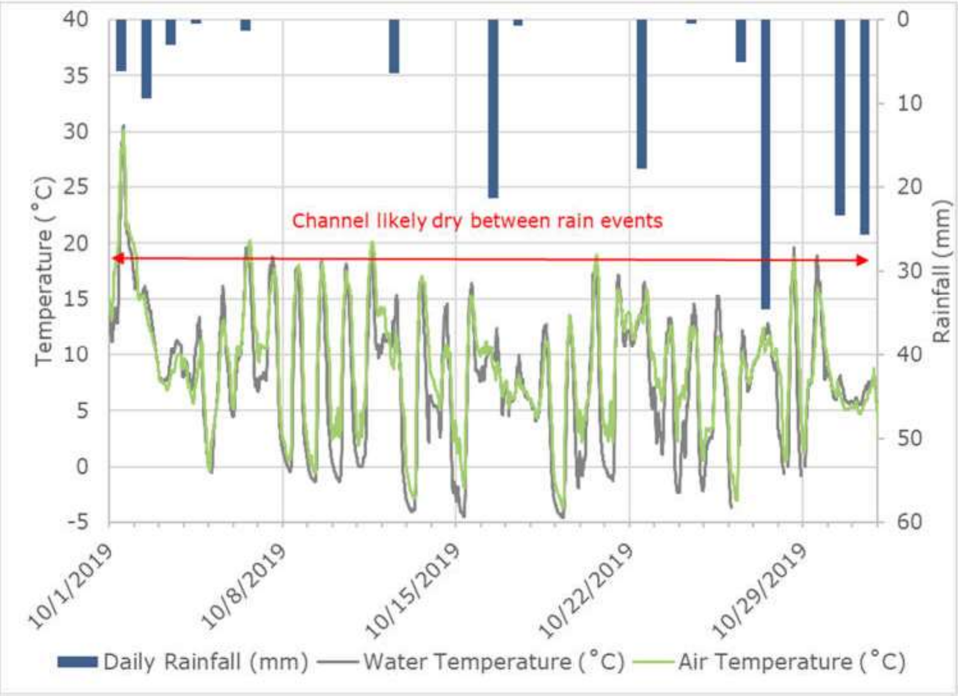
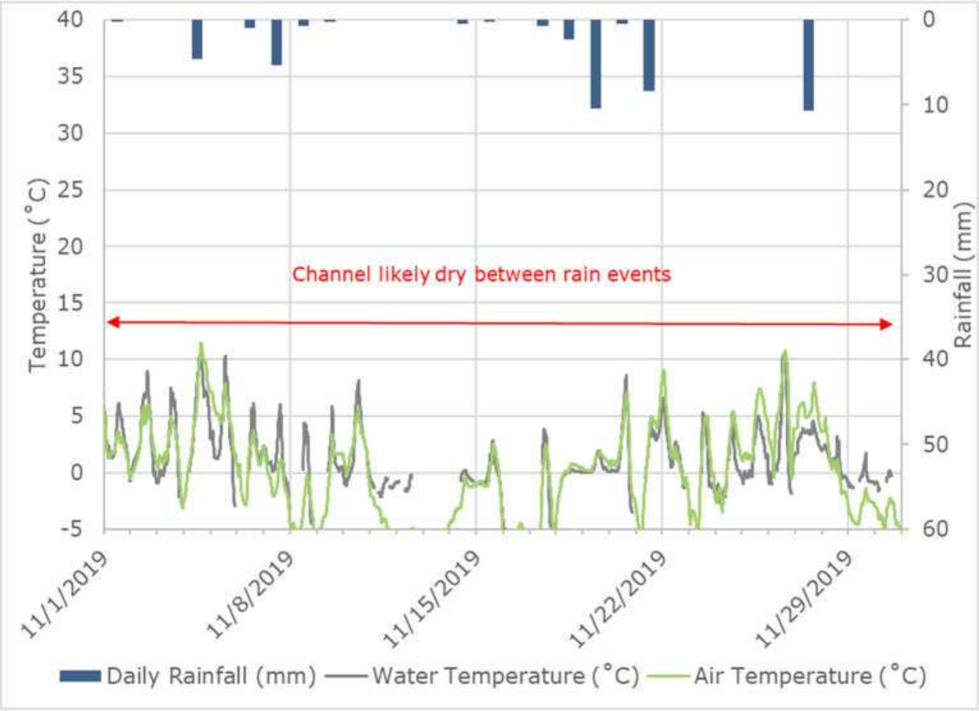
Figure 21	
	Water temperature, air temperature and daily rainfall at **Bridge** for August 2019.
Figure 22	
	Water temperature, air temperature and daily rainfall at **Bridge** for September 2019.

Figure 23



Water temperature, air temperature and daily rainfall at **Bridge** for October 2019.

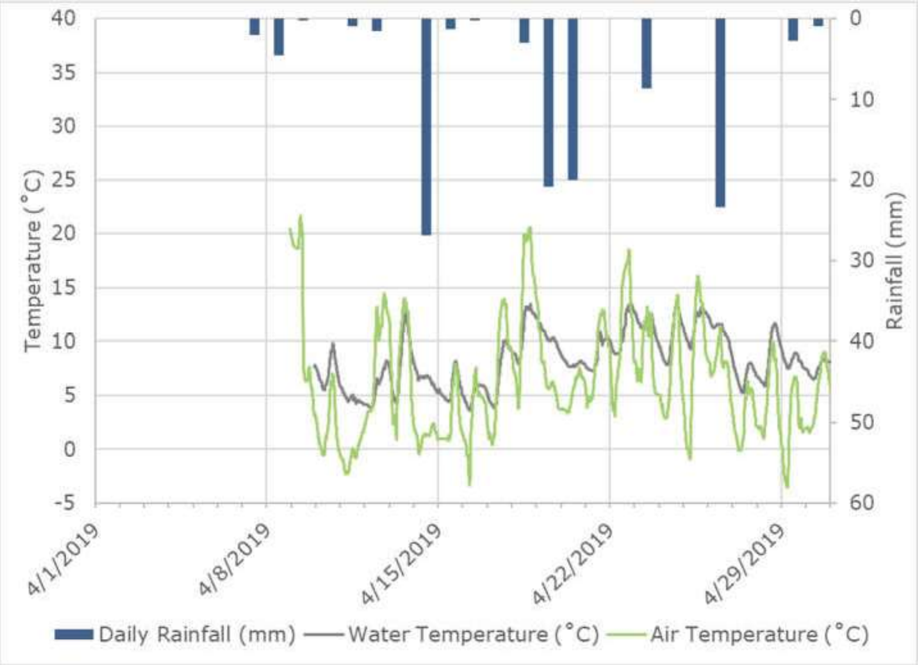
Figure 24



Water temperature, air temperature and daily rainfall at **Bridge** for November 2019.

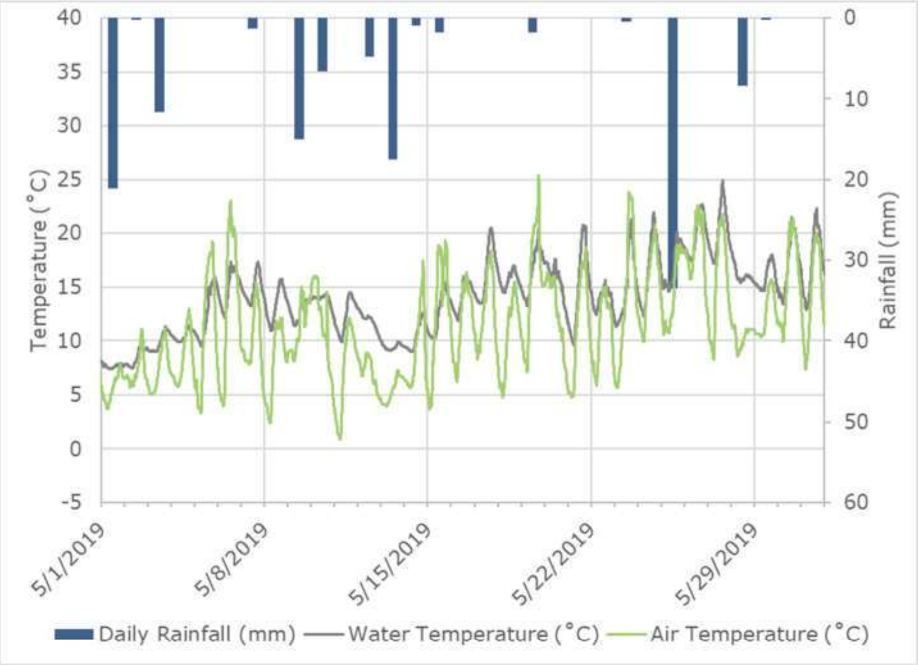
Outlet Water Temperature

Figure 25



Water temperature, air temperature and daily rainfall at **Outlet** for April 2019.

Figure 26



Water temperature, air temperature and daily rainfall at **Outlet** for May 2019.

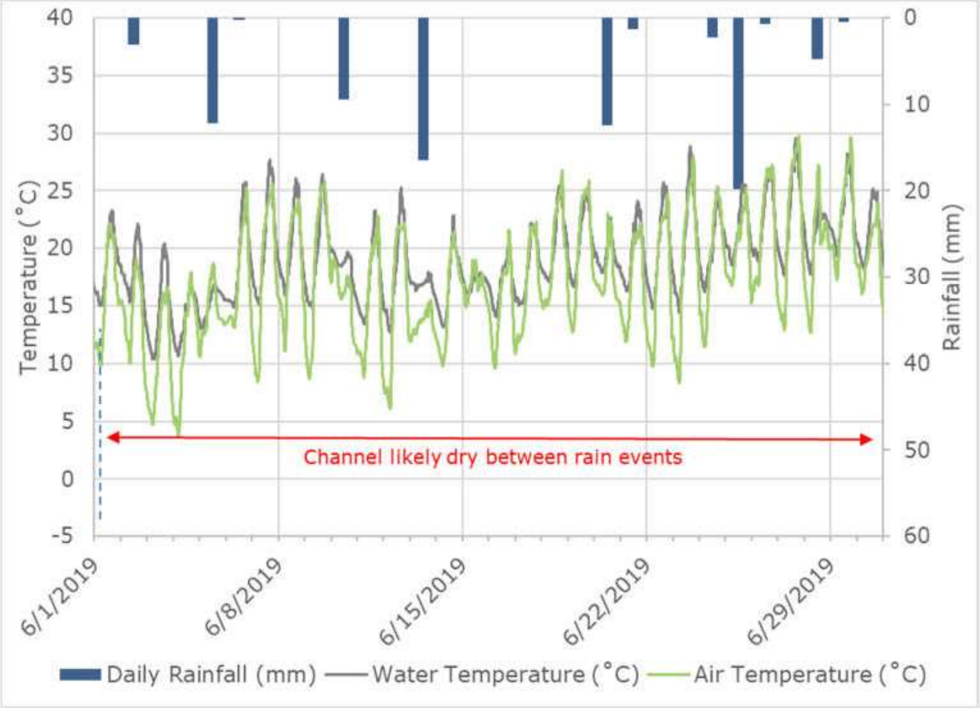
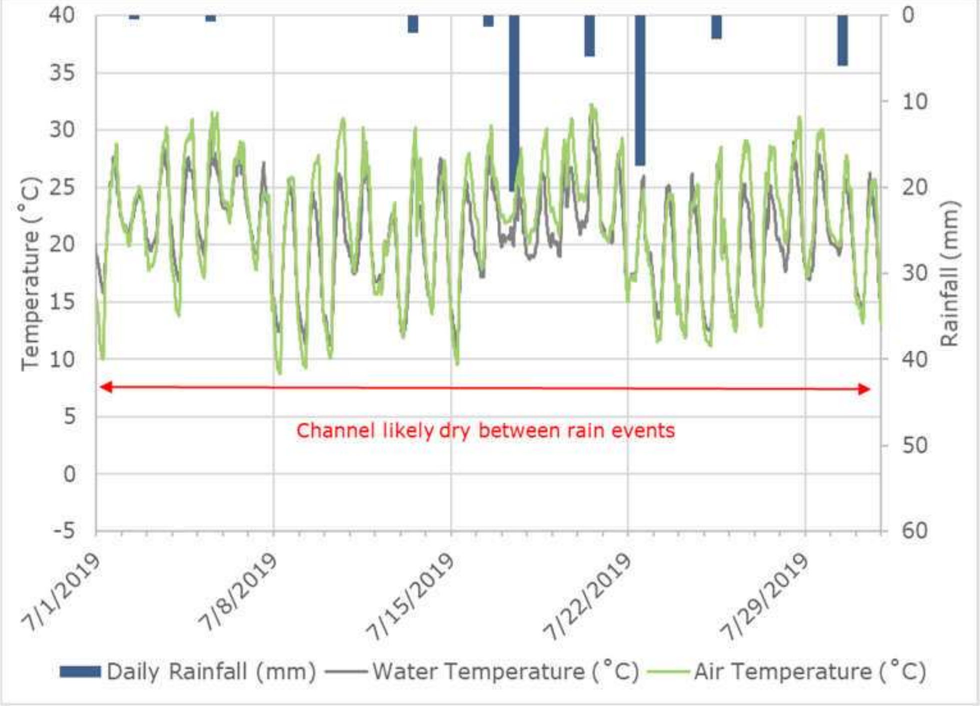
Figure 27	
	Water temperature, air temperature and daily rainfall at **Outlet** for June 2019.
Figure 28	
	Water temperature, air temperature and daily rainfall at **Outlet** for July 2019.

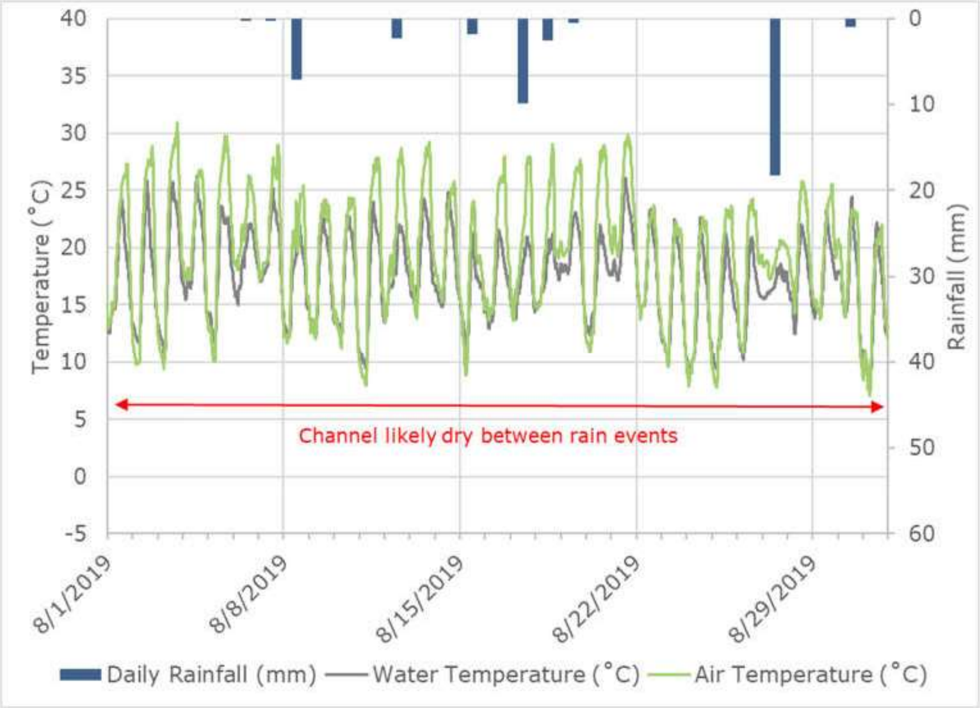
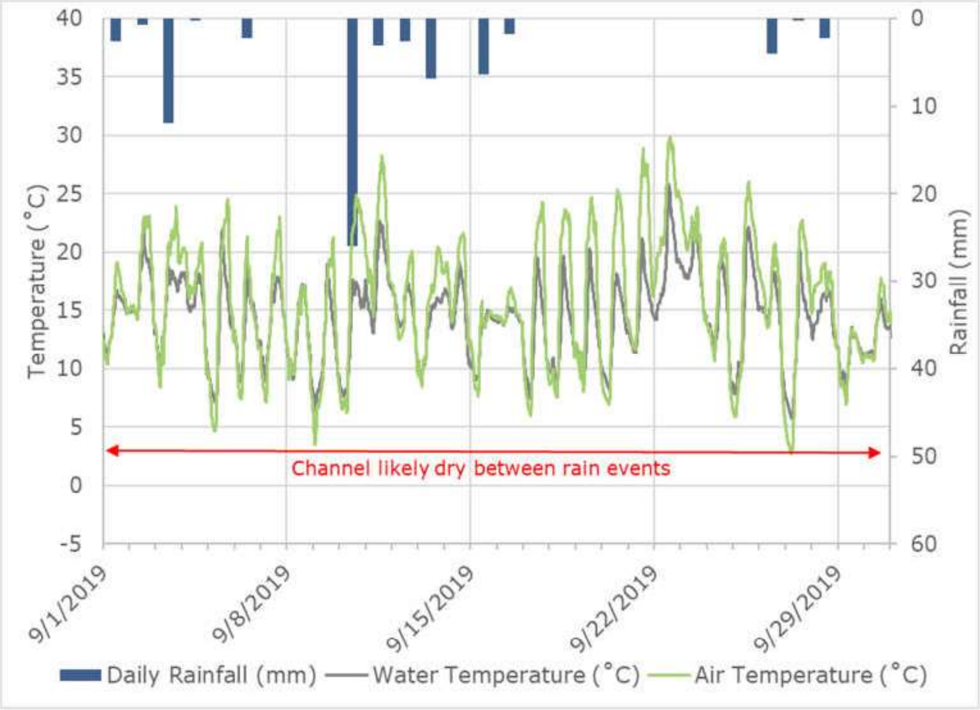
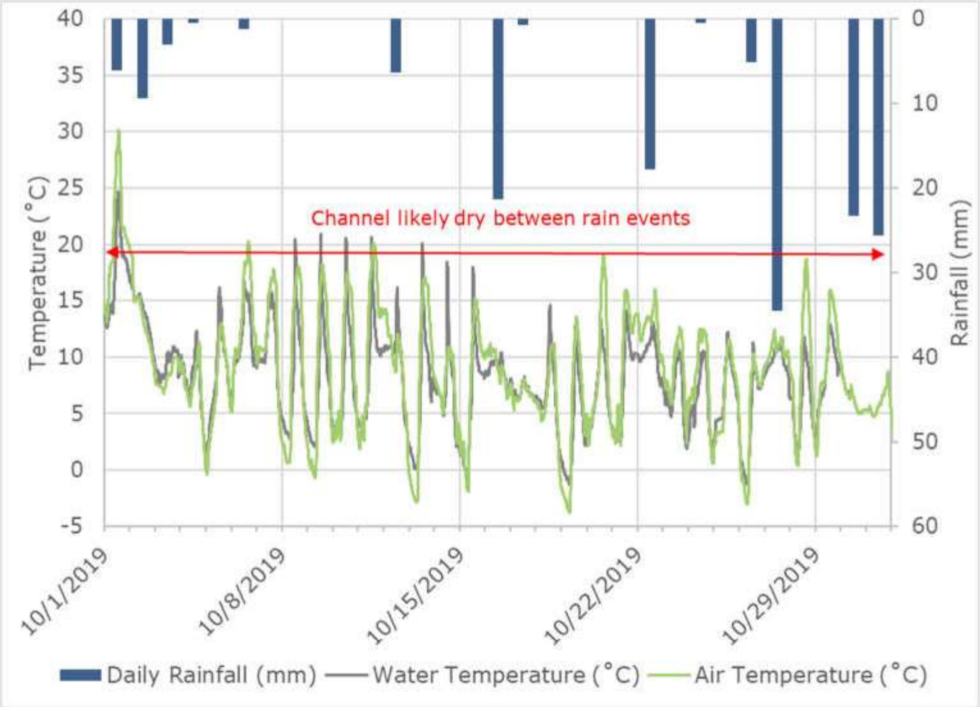
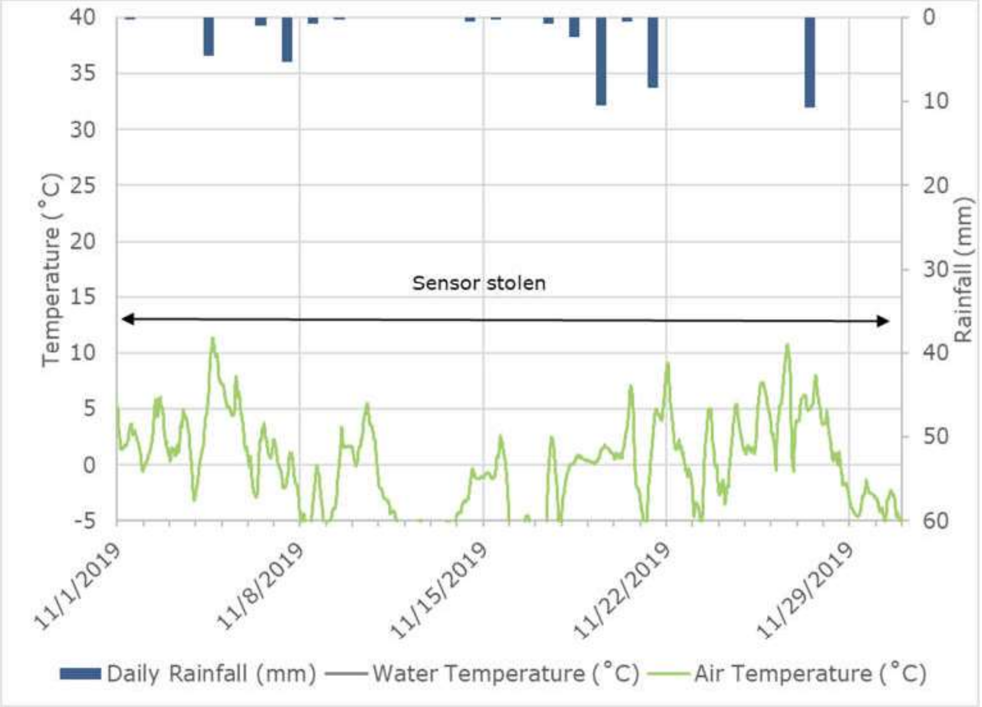
Figure 29	
	Water temperature, air temperature and daily rainfall at **Outlet** for August 2019.
Figure 30	
	Water temperature, air temperature and daily rainfall at **Outlet** for September 2019.

Figure 31



Water temperature, air temperature and daily rainfall at **Outlet** for October 2019.

Figure 32



Water temperature, air temperature and daily rainfall at **Outlet** for November 2019.

W Inlet Water Level

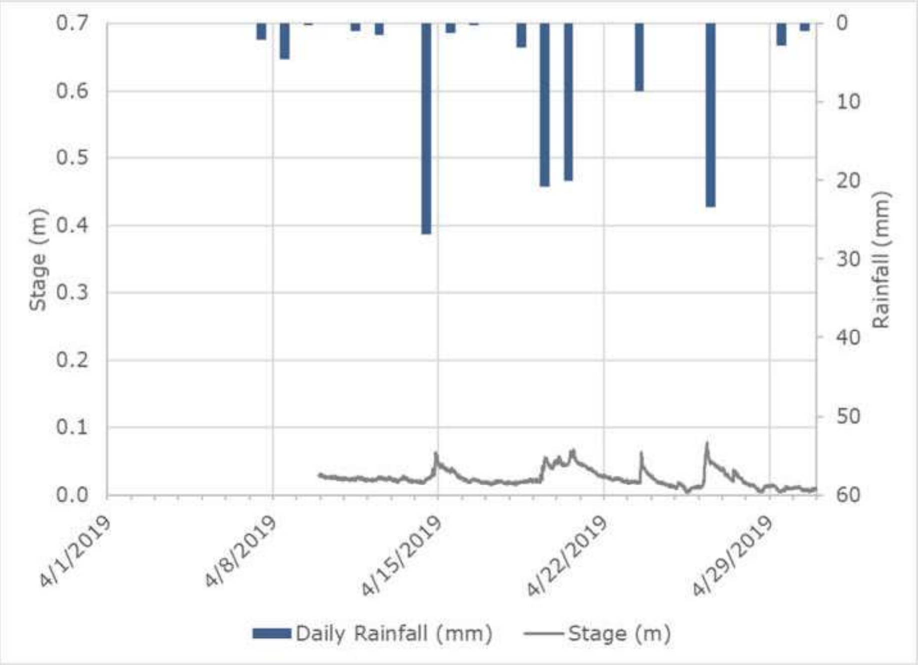
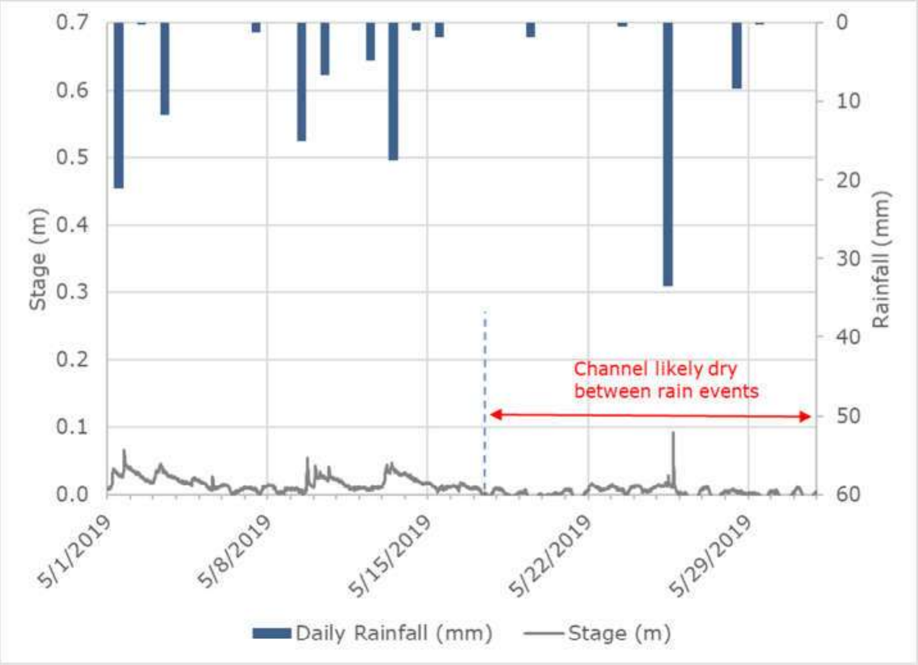
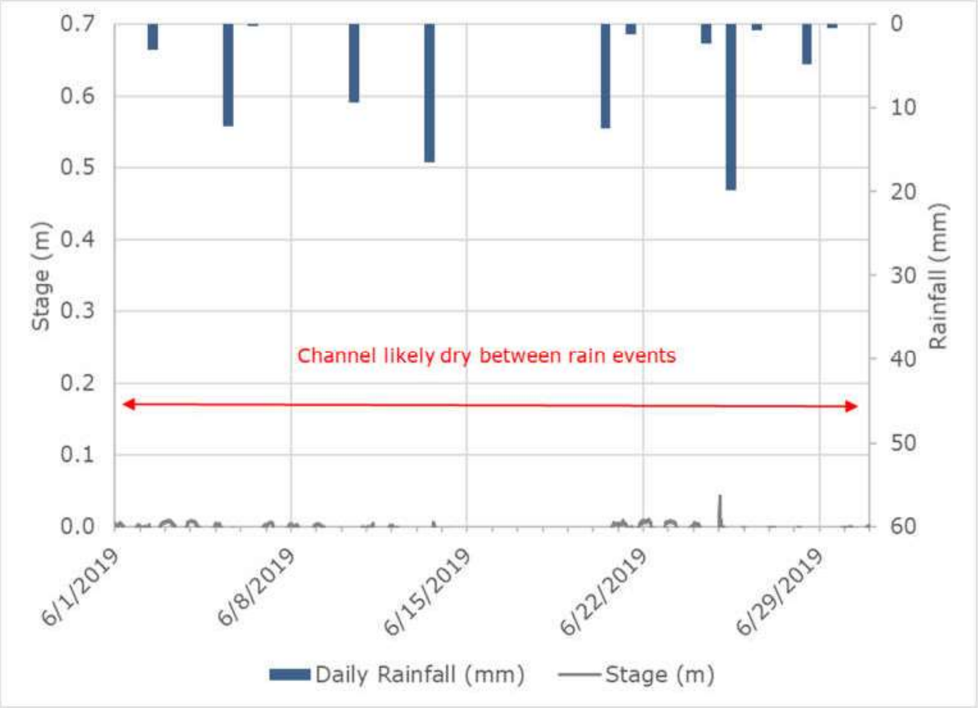
Figure 33	
	Water level and daily rainfall at **W Inlet** for April 2019.
Figure 34	
	Water level and daily rainfall at **W Inlet** for May 2019.

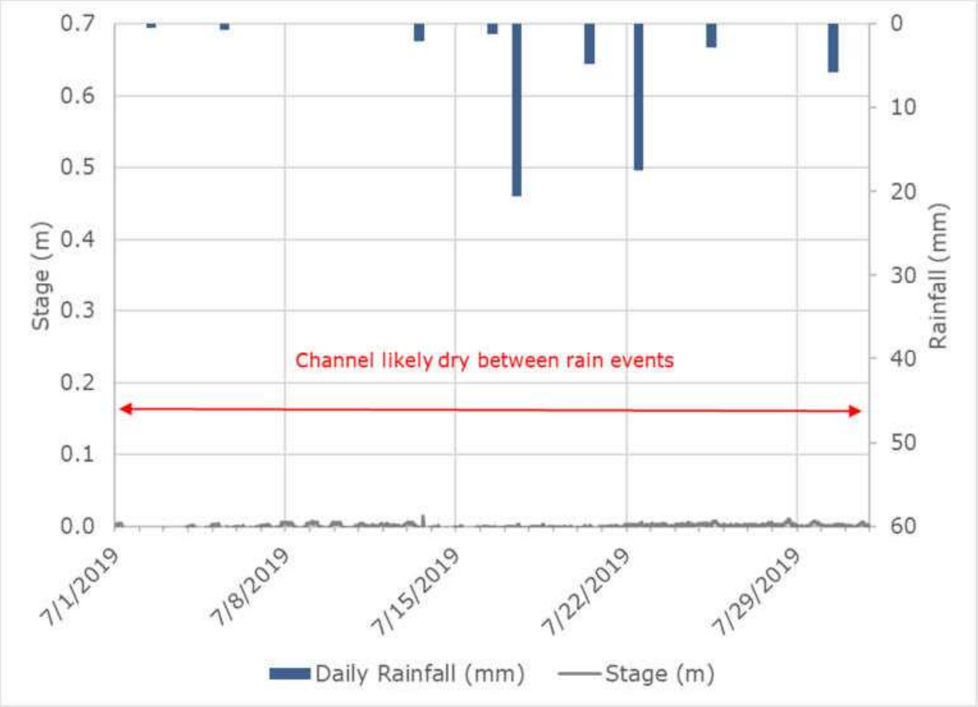
Figure 35



Channel likely dry between rain events

Water level and daily rainfall at **W Inlet** for June 2019.

Figure 36



Channel likely dry between rain events

Water level and daily rainfall at **W Inlet** for July 2019.

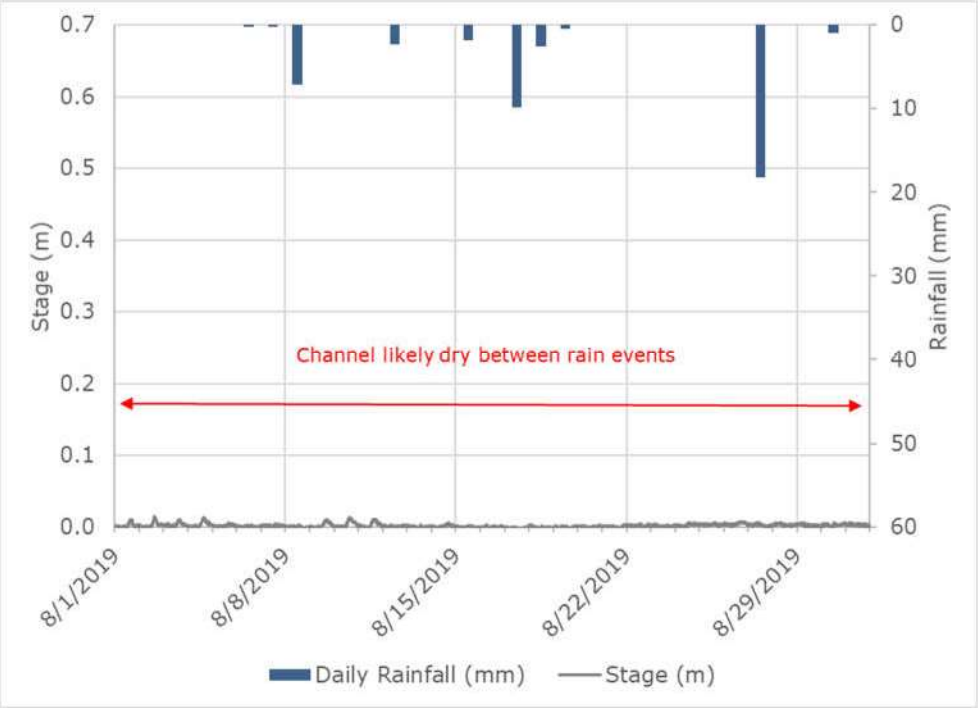
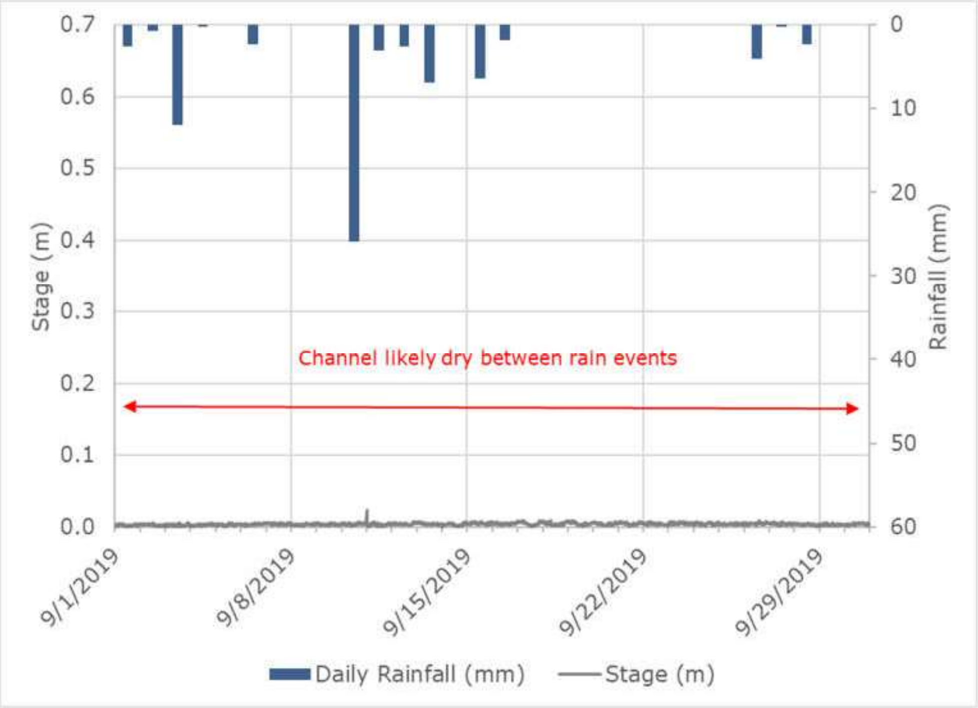
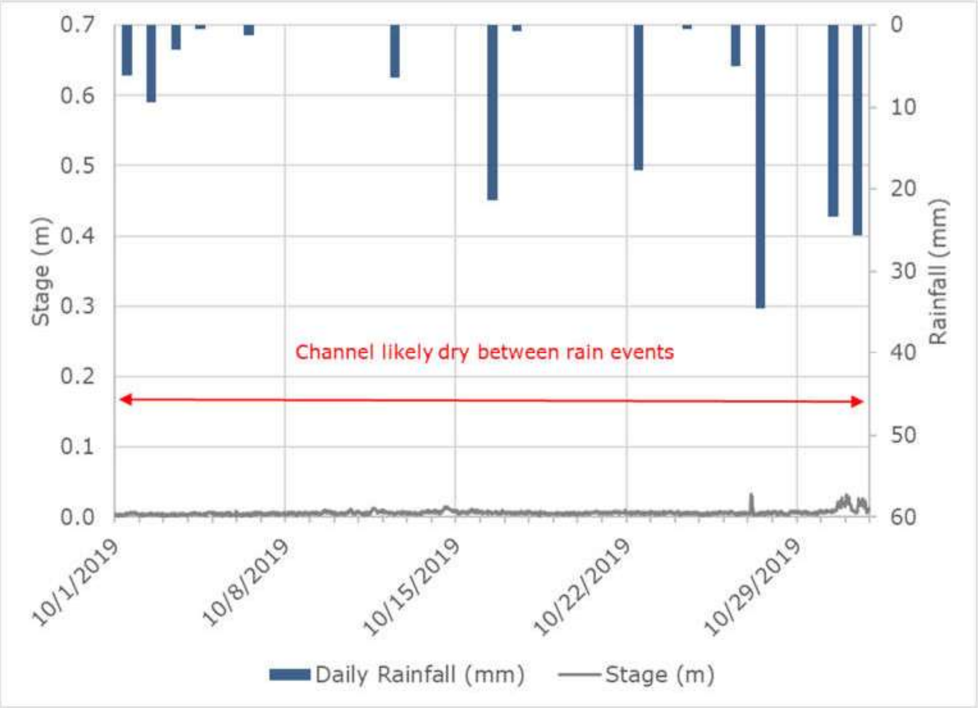
Figure 37	
	Water level and daily rainfall at **W Inlet** for August 2019.
Figure 38	
	Water level and daily rainfall at **W Inlet** for September 2019.

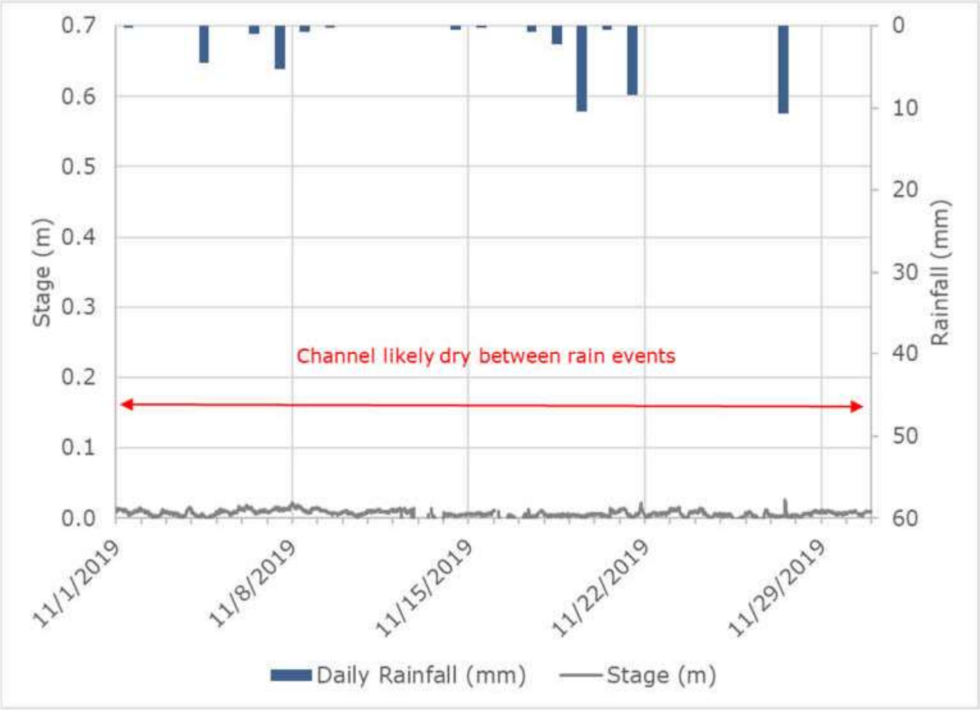
Figure 39



Channel likely dry between rain events

Water level and daily rainfall at **W Inlet** for October 2019.

Figure 40



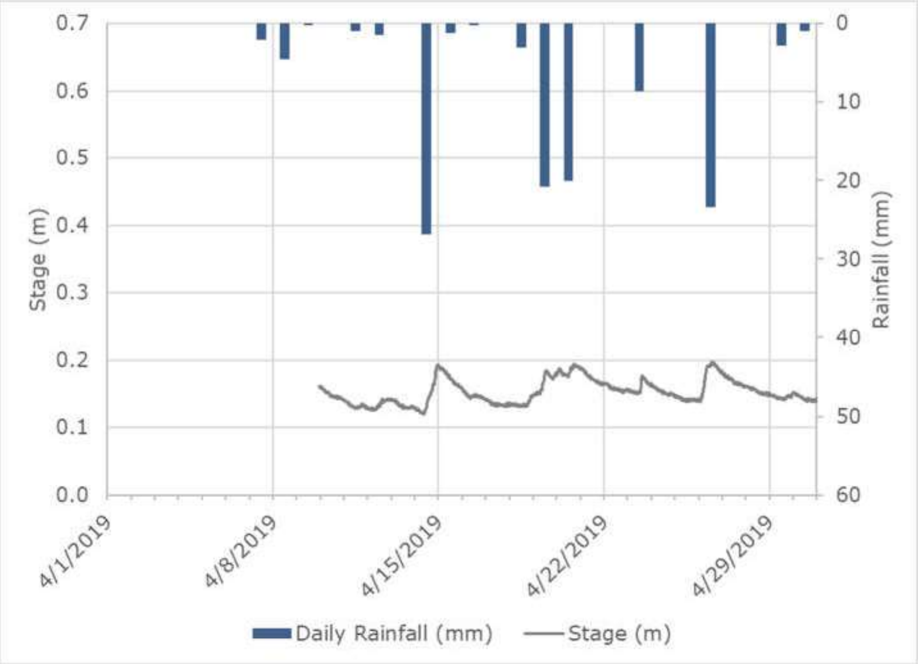
Channel likely dry between rain events

3

Water level and daily rainfall at **W Inlet** for November 2019.

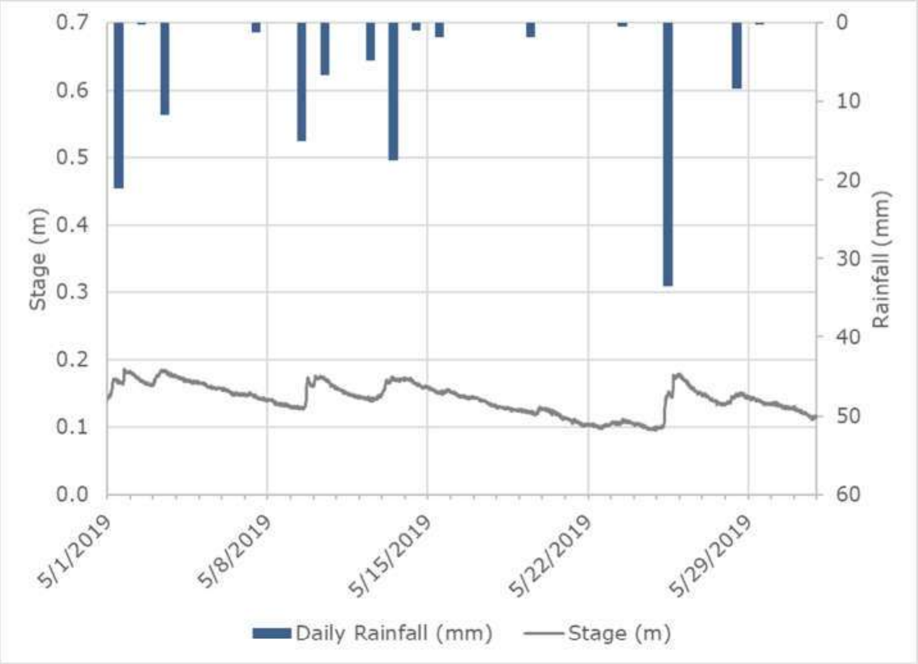
S Inlet Water Level

Figure 41



Water level and daily rainfall at **S Inlet** for April 2019.

Figure 42



Water level and daily rainfall at **S Inlet** for May 2019.

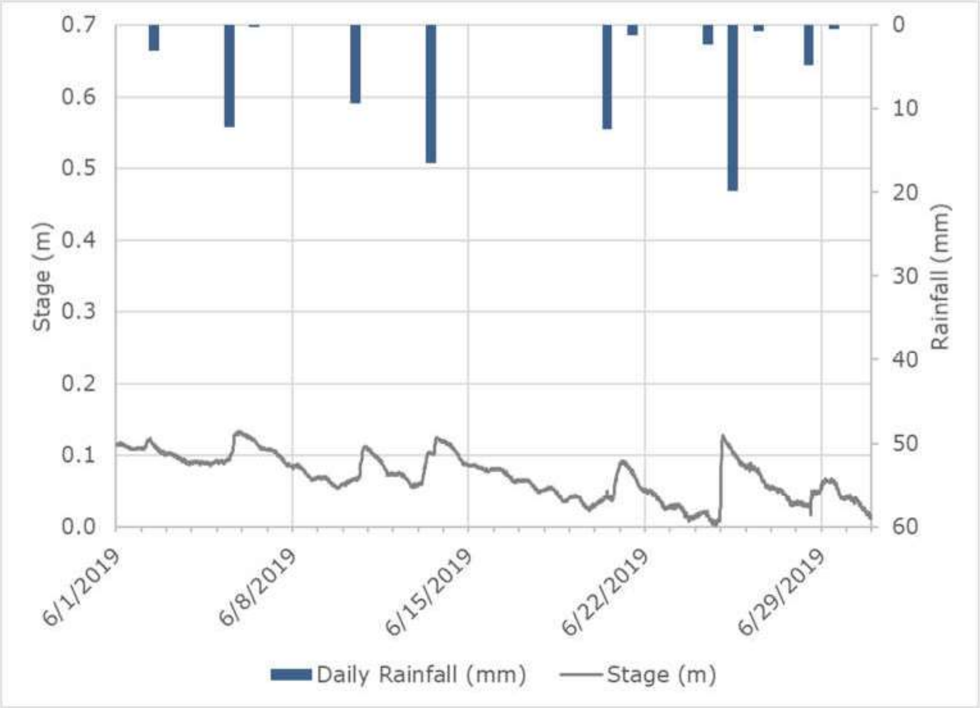
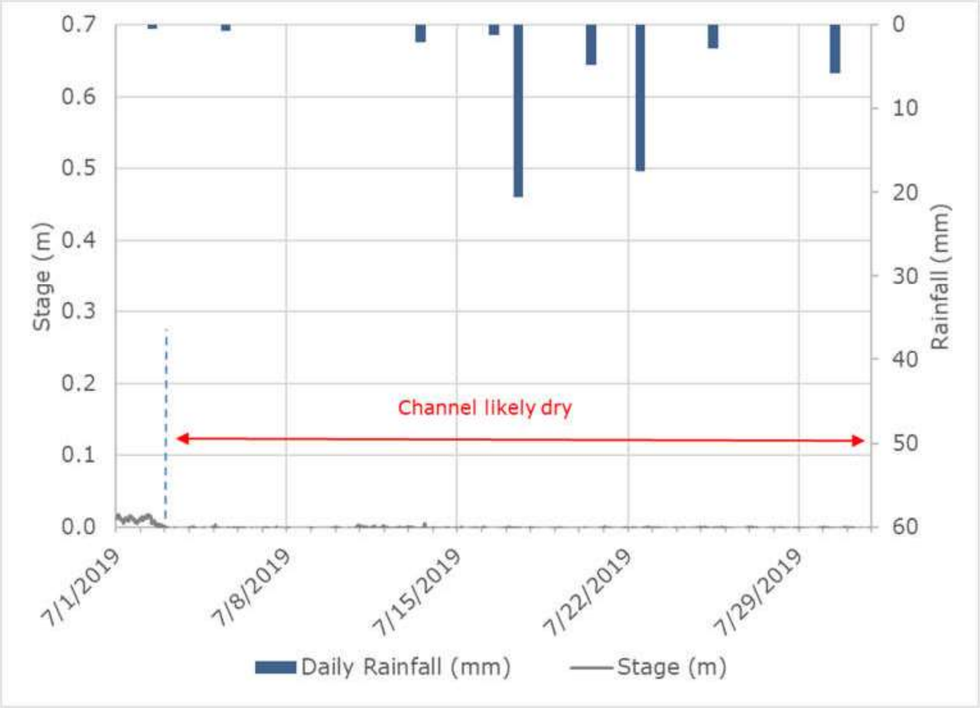
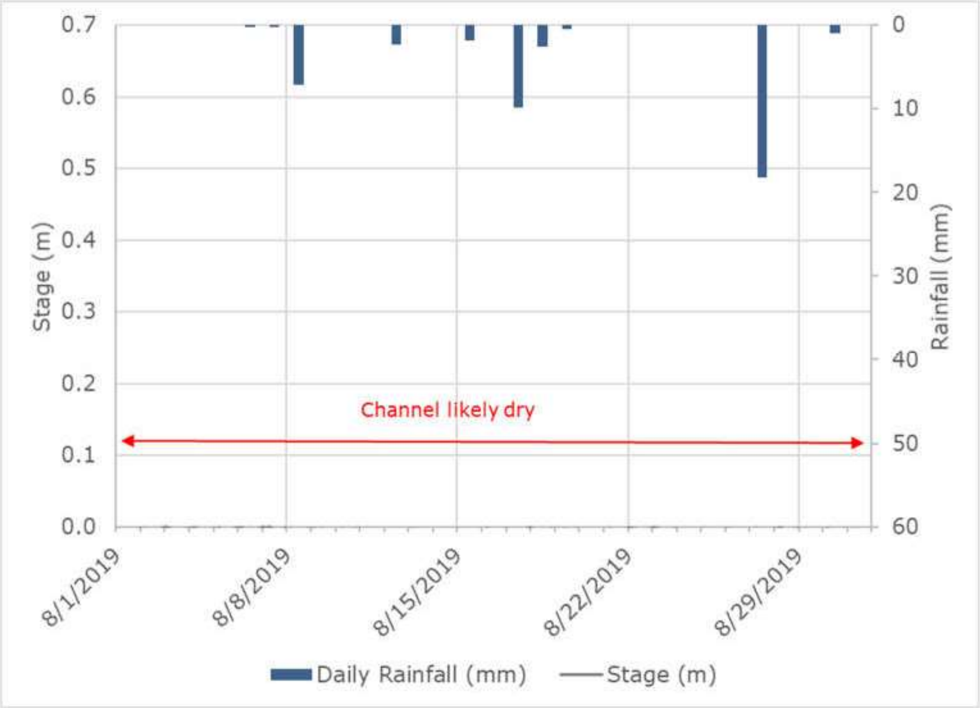
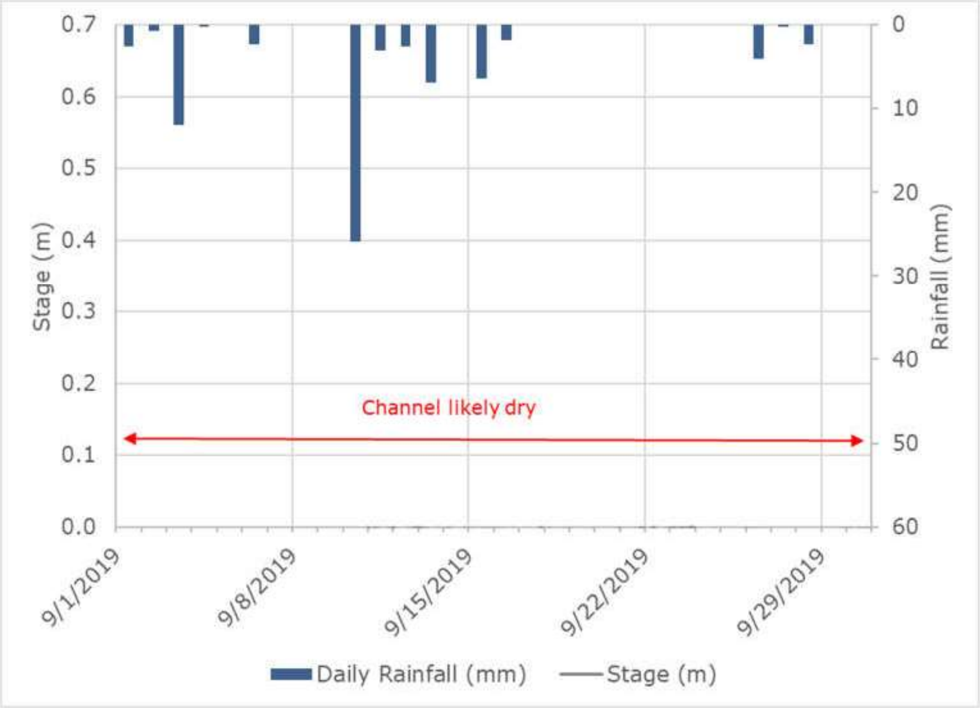
Figure 43	
	Water level and daily rainfall at **S Inlet** for June 2019.
Figure 44	
	Water level and daily rainfall at **S Inlet** for July 2019.

Figure 45



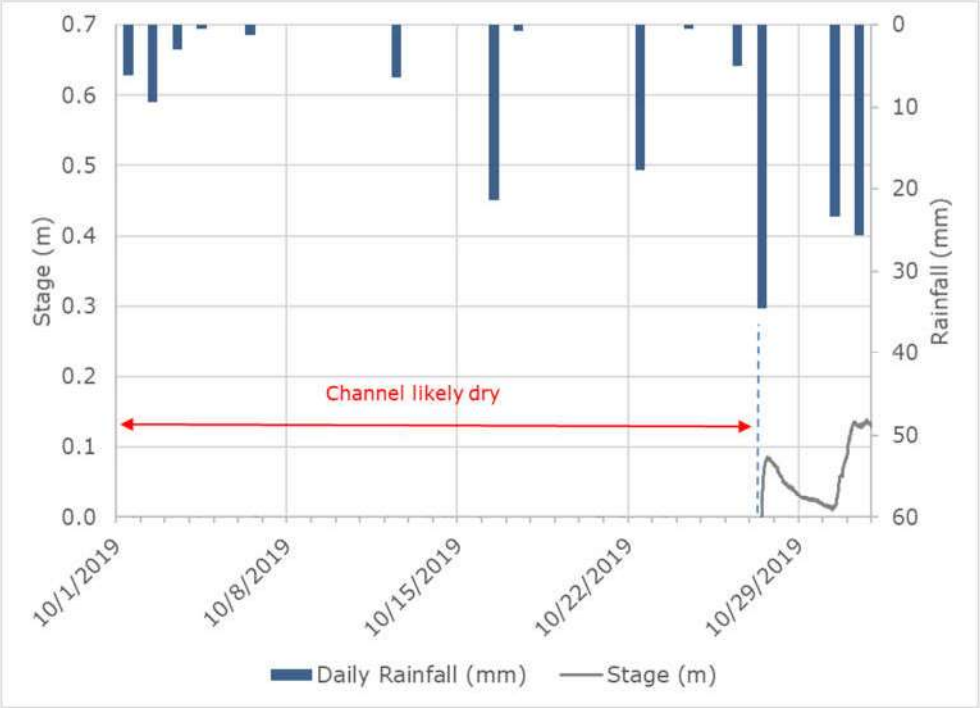
Water level and daily rainfall at **S Inlet** for August 2019.

Figure 46



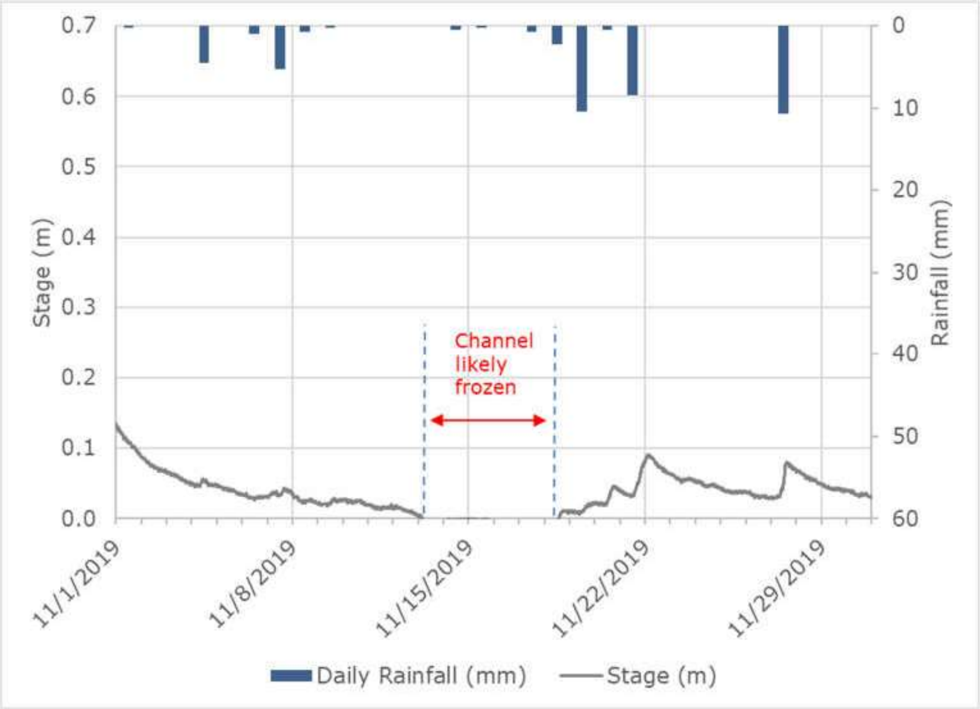
Water level and daily rainfall at **S Inlet** for September 2019.

Figure 47



Water level and daily rainfall at **S Inlet** for October 2019.

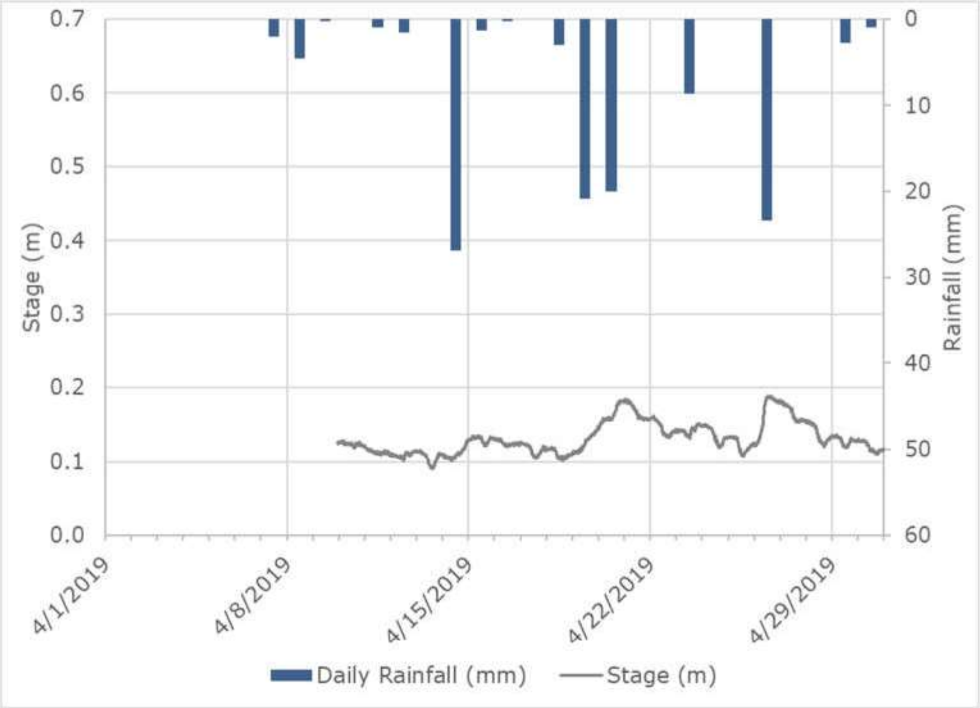
Figure 48



Water level and daily rainfall at **S Inlet** for November 2019.

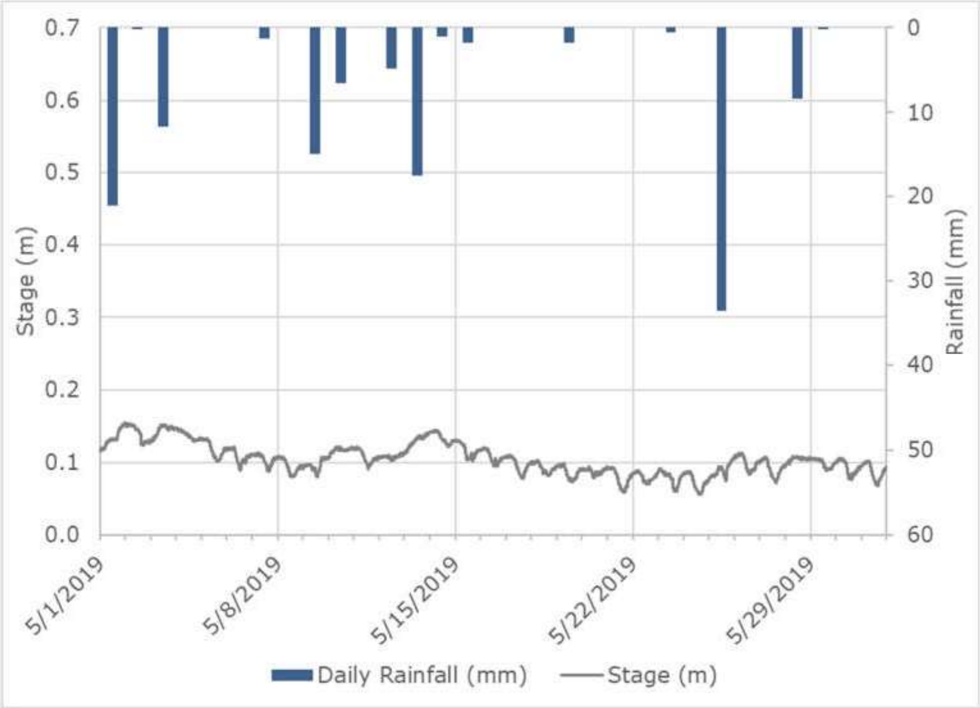
Bridge Water Level

Figure 49



Water level and daily rainfall at **Bridge** for April 2019.

Figure 50



Water level and daily rainfall at **Bridge** for May 2019.

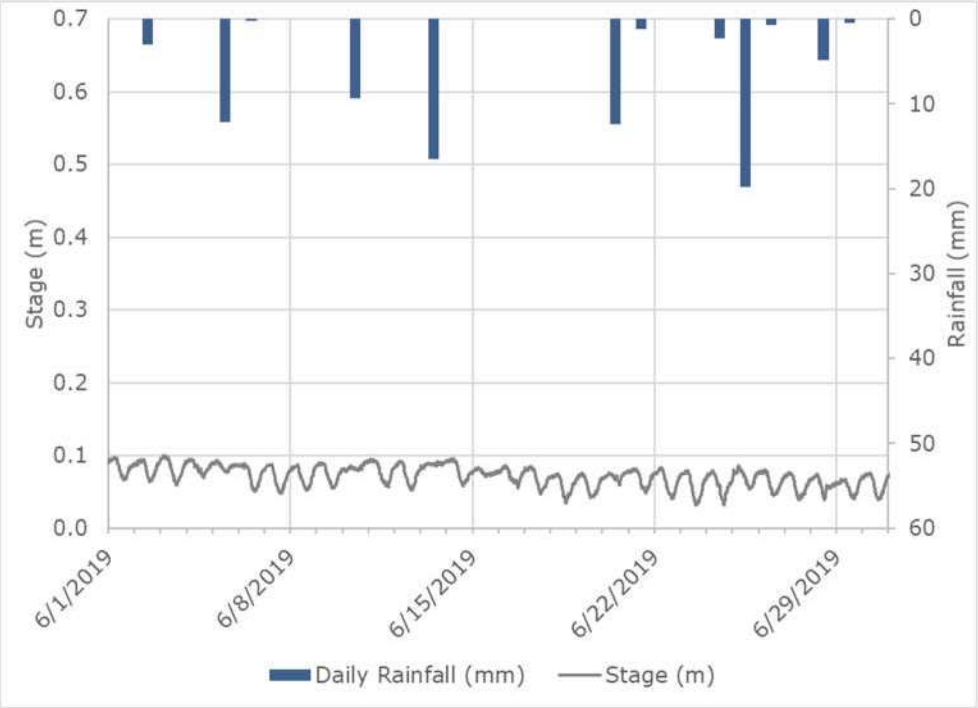
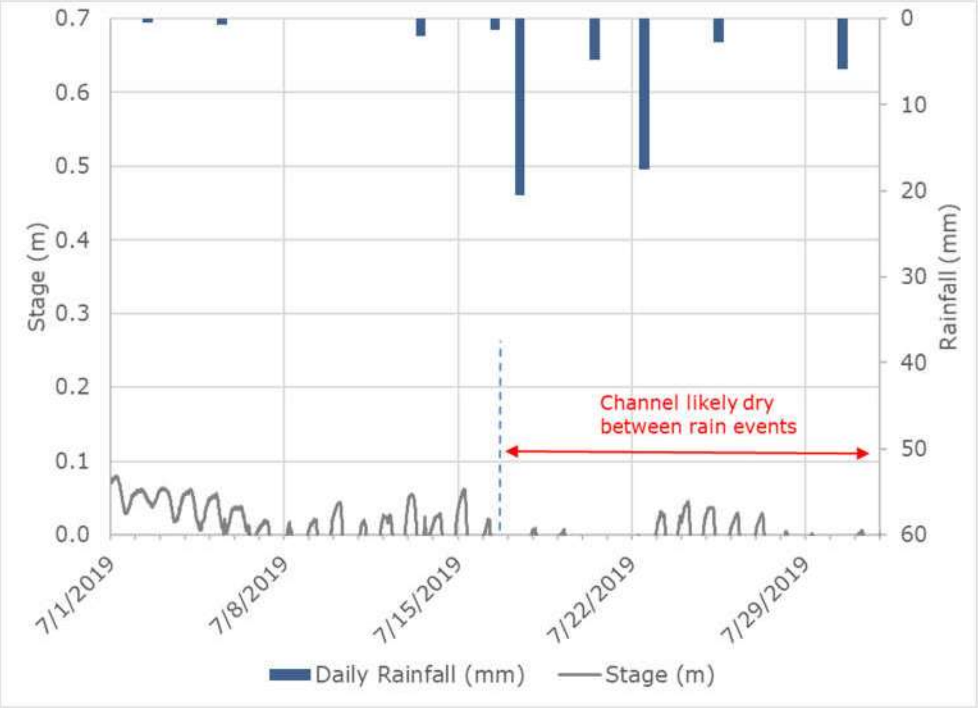
Figure 51	
	Water level and daily rainfall at **Bridge** for June 2019.
Figure 52	
	Water level and daily rainfall at **Bridge** for July 2019.

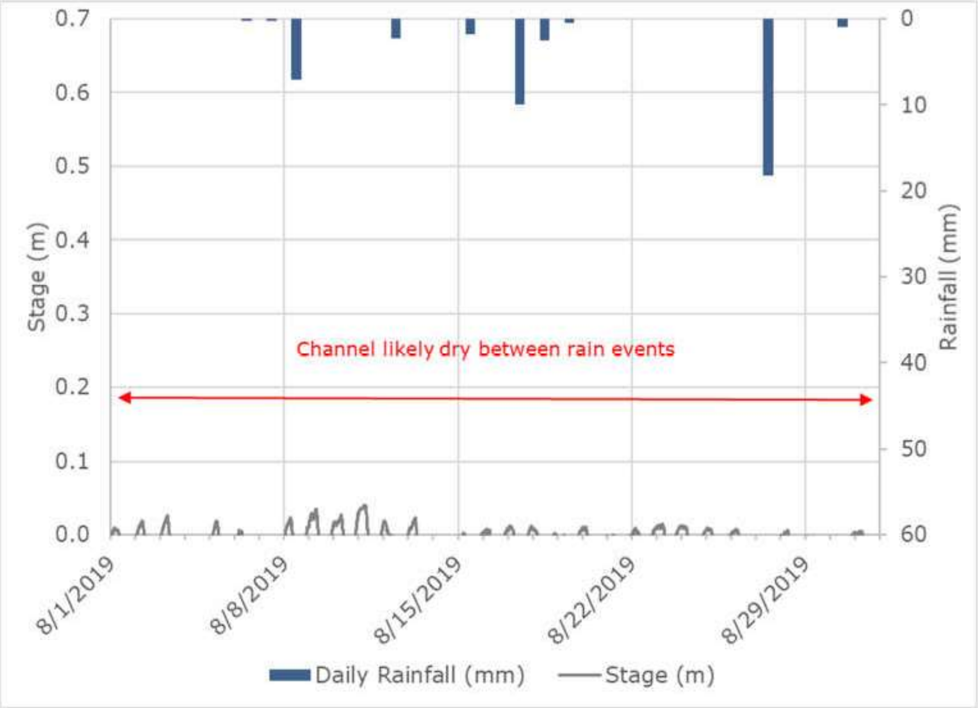
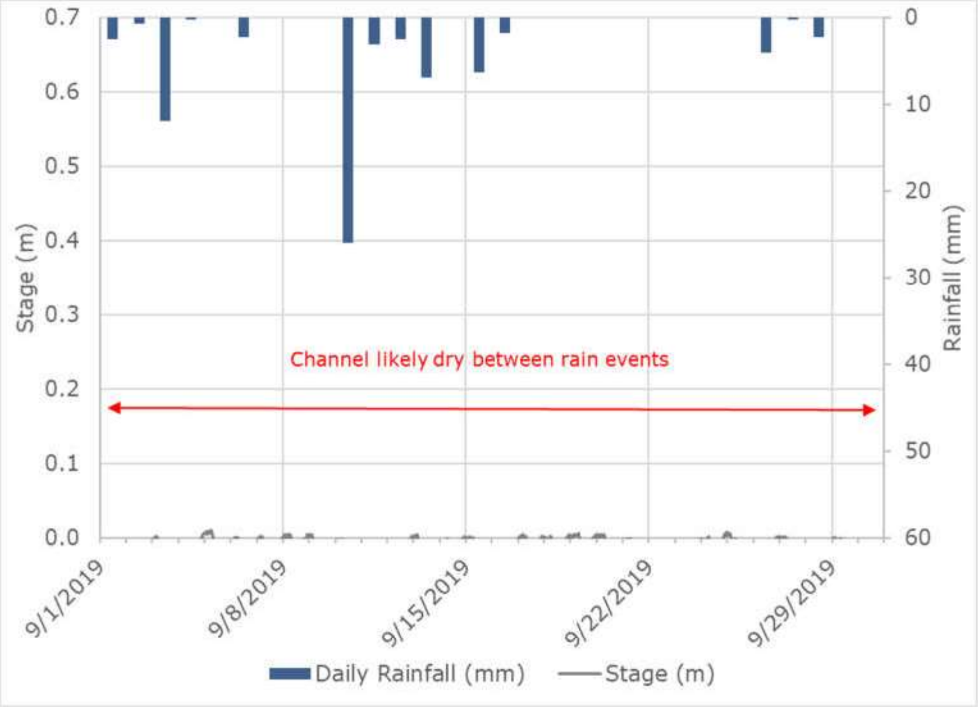
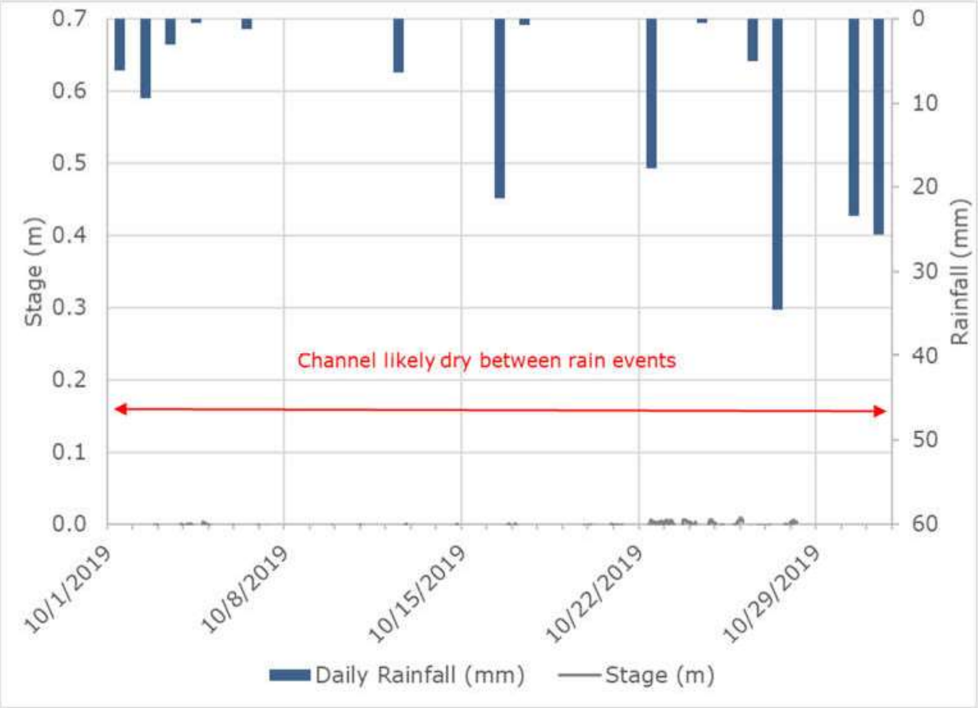
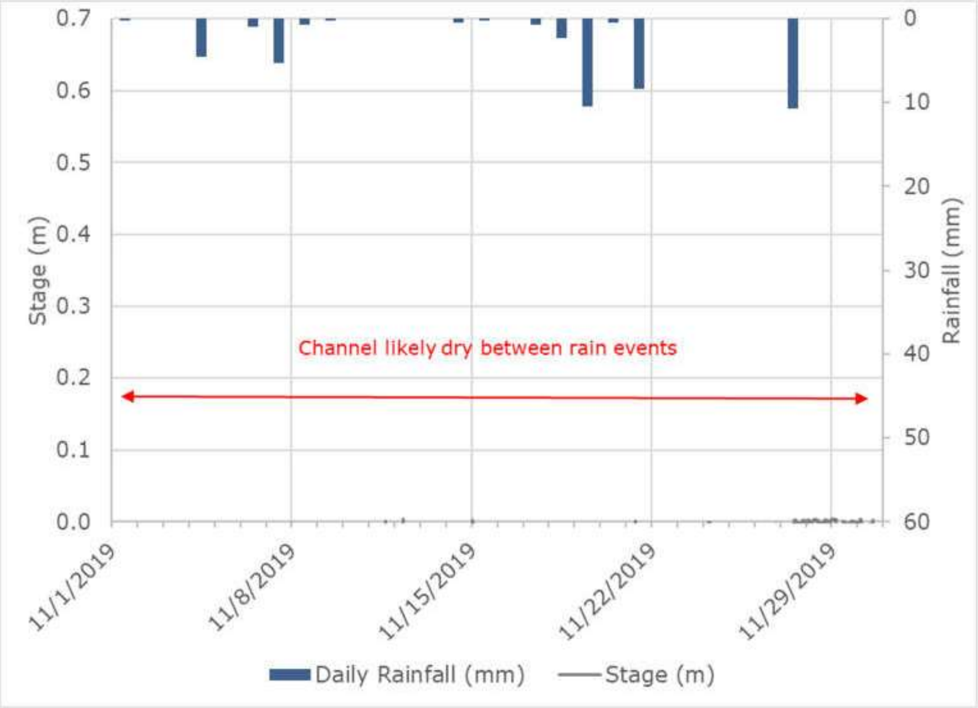
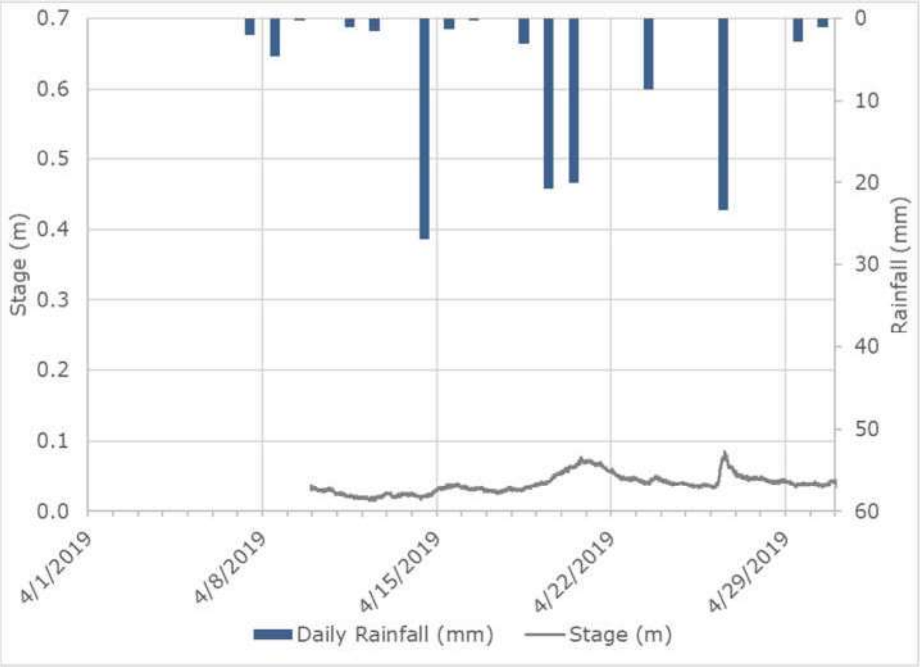
Figure 53	
	Water level and daily rainfall at **Bridge** for August 2019.
Figure 54	
	Water level and daily rainfall at **Bridge** for September 2019.

Figure 55	
	Water level and daily rainfall at **Bridge** for October 2019.
Figure 56	
	Water level and daily rainfall at **Bridge** for November 2019.

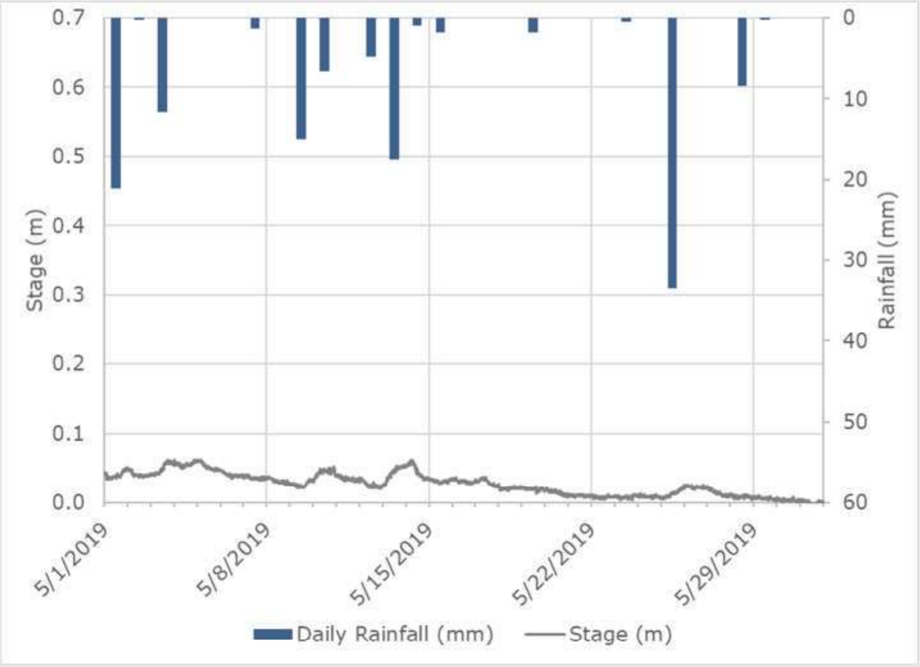
Outlet Water Level

Figure 57



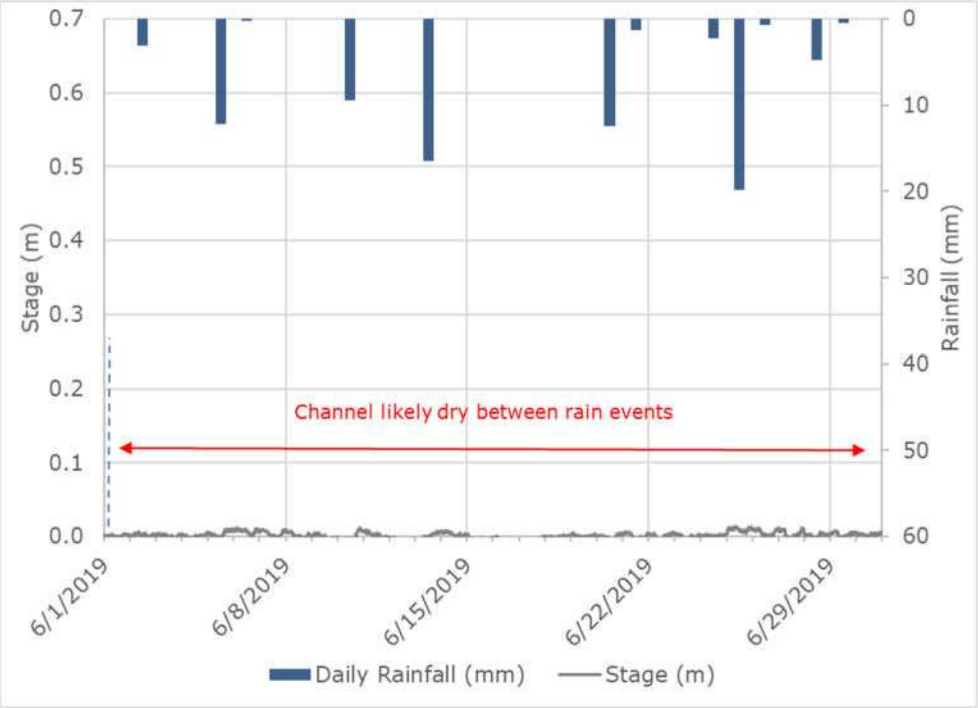
Water level and daily rainfall at **Outlet** for April 2019.

Figure 58



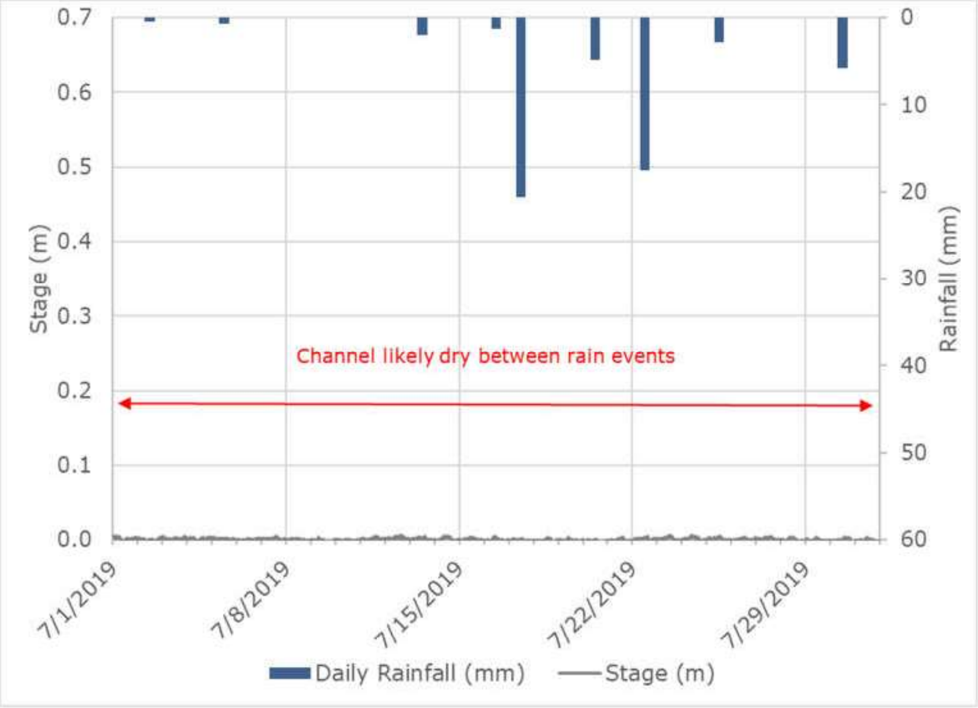
Water level and daily rainfall at **Outlet** for May 2019.

Figure 59



Water level and daily rainfall at **Outlet** for June 2019.

Figure 60



Water level and daily rainfall at **Outlet** for July 2019.

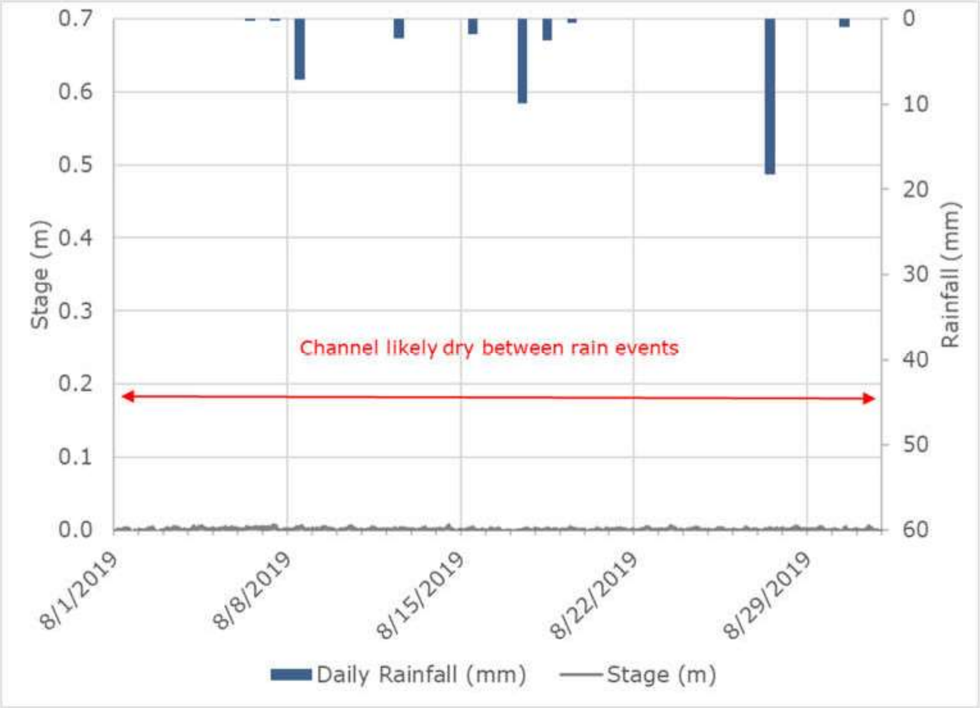
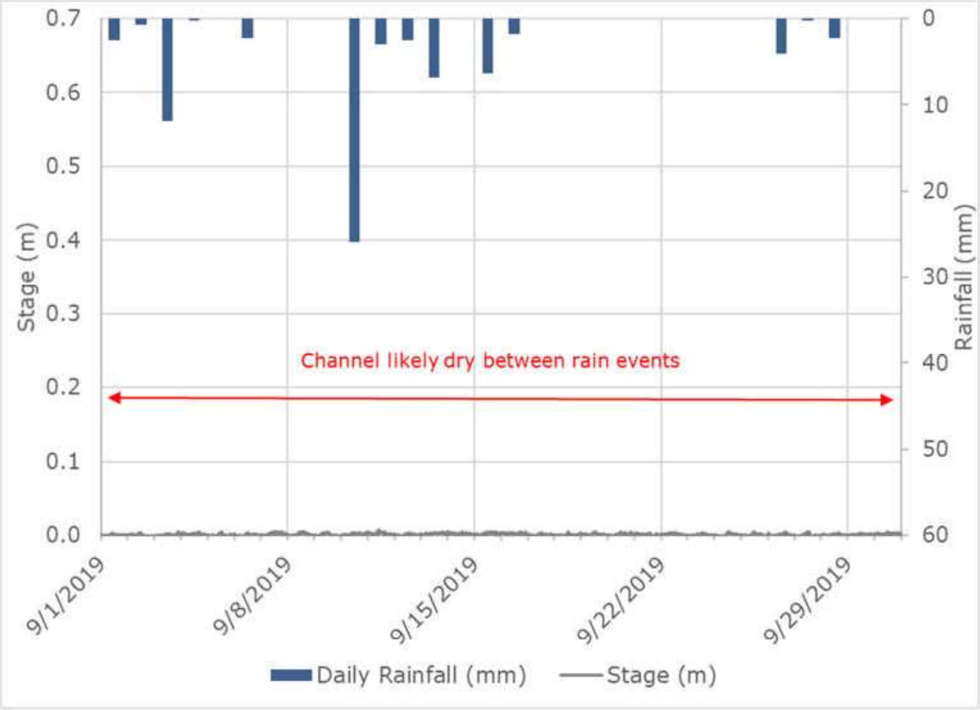
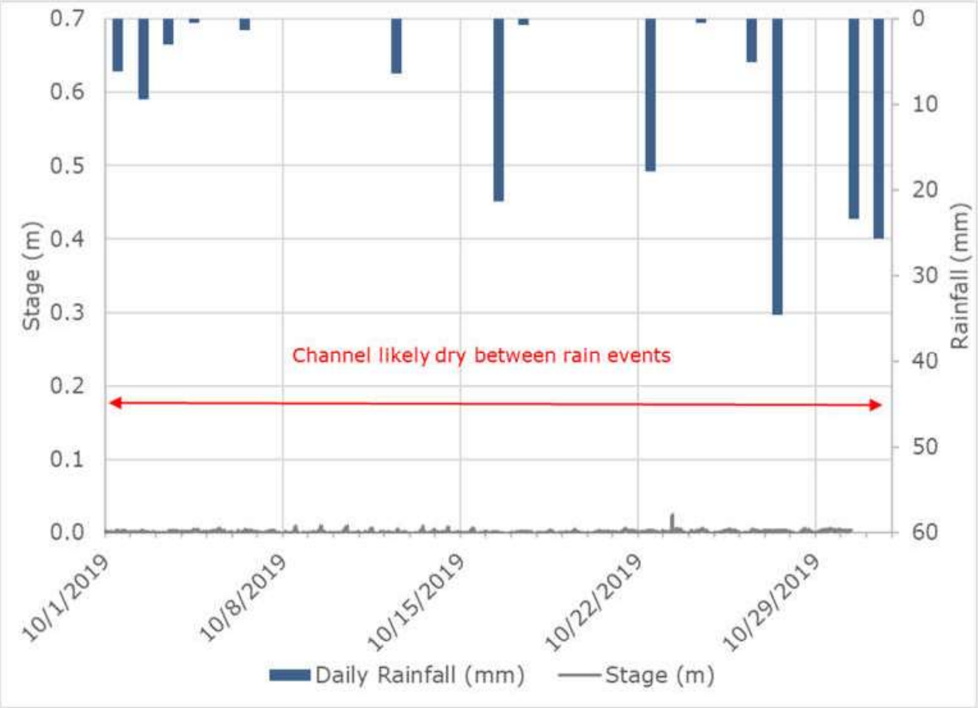
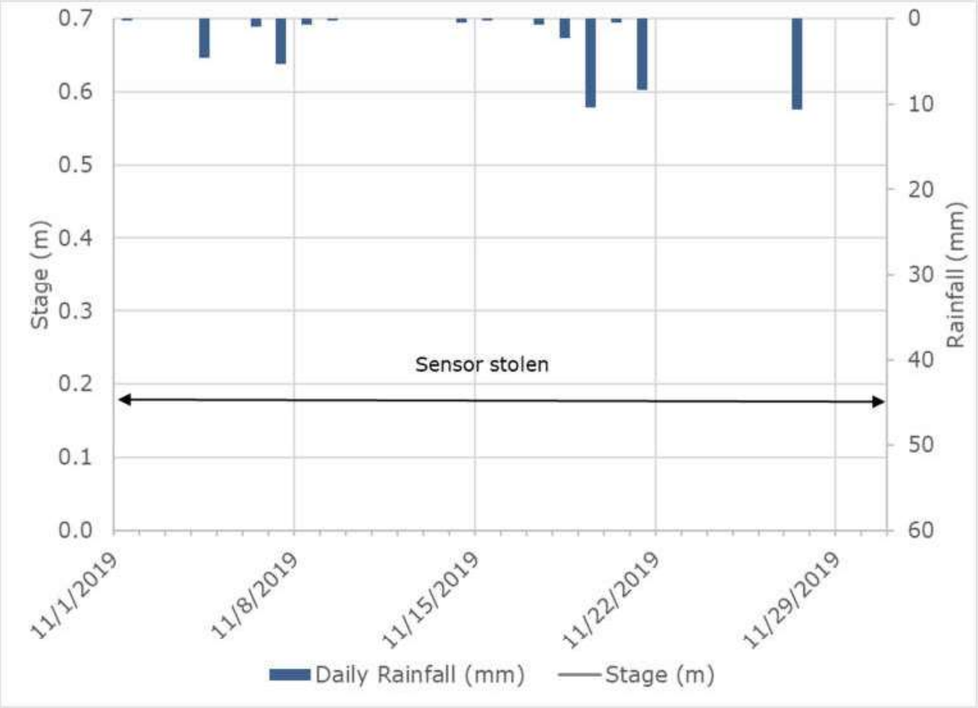
Figure 61	
	Water level and daily rainfall at **Outlet** for August 2019.
Figure 62	
	Water level and daily rainfall at **Outlet** for September 2019.

Figure 63	
	Water level and daily rainfall at **Outlet** for October 2019.
Figure 64	
	Water level and daily rainfall at **Outlet** for November 2019.

ADV Discharge Measurement Summary

Measurement Date (mm-dd-yyyy)	Location	Average Velocity (m/s)	Measured Discharge (m^3/s)
04-09-2019	W Inlet	0.0114	0.0002
	S Inlet	0	0
	Bridge	0	0
	Outlet	0.2734	0.0150
05-10-2019	W Inlet	0.0538	0.0009
	S Inlet	0	0
	Bridge	0.0400	0.0023
	Outlet	0.3392	0.0180
06-20-2019	W Inlet	0	0
	S Inlet	N/A	N/A
	Bridge	N/A	N/A
	Outlet	0.0170	0.0004
07-16-2019	W Inlet	N/A	N/A
	S Inlet	N/A	N/A
	Bridge	N/A	N/A
	Outlet	N/A	N/A
08-13-2019	W Inlet	N/A	N/A
	S Inlet	N/A	N/A
	Bridge	N/A	N/A
	Outlet	N/A	N/A
08-30-2019	W Inlet	N/A	N/A
	S Inlet	N/A	N/A
	Bridge	N/A	N/A
	Outlet	N/A	N/A
10-01-2019	W Inlet	N/A	N/A
	S Inlet	N/A	N/A
	Bridge	N/A	N/A
	Outlet	N/A	N/A
10-30-2019	W Inlet	N/A	N/A
	S Inlet	N/A	N/A
	Bridge	N/A	N/A
	Outlet	N/A	N/A

N/A - Channel dry/too shallow, unable to complete measurement

REPORT

Preliminary Geotechnical Investigation, Coscorp Inc. In Trust

Proposed Residential Development, Snell's Hollow Secondary Plan, Caledon, Ontario

Submitted to:

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June 17, 2019

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1 e-copy: Snell's Hollow Developers Group

1 e-copy: Glen Schnarr & Associates Inc.

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APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Coscorp Inc. In Trust (Coscorp) to provide preliminary geotechnical consulting services to support a draft plan approval for a future residential subdivision development located north east of Heart Lake Road and Mayfield Road in Caledon, Ontario (the Site), as shown in the Site and Borehole Location Plan, ***Figure 1.***

The terms of reference for the geotechnical consulting services are included in Golder's proposal No. P19115264 Rev 1, dated March 8, 2019.

The purpose of the investigation is to obtain information on the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of boreholes and geotechnical laboratory tests. Based on our interpretation of the factual information collected as part of the preliminary geotechnical investigation carried out at this site, a general description of the subsurface conditions across the site is presented herein. The interpreted subsurface conditions and available project details were used to develop preliminary engineering parameters and recommendations on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

This report provides the results of the preliminary geotechnical investigation and should be read in conjunction with the *"Important Information and Limitations of This Report"* in ***Appendix D***. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder should be given an opportunity to confirm that the recommendations in this report are still valid.

2.0 SITE DESCRIPTION AND BACKGROUND

The subject property is located north east of Kennedy Road and Mayfield Road and is part of the Snell's Hollow Secondary Plan, which is a proposed residential development to be located in the southern part of the Town of Caledon. The site is bounded by Kennedy Road to the west, adjacent agricultural properties with a valley creek to the east and south, which further connects to Mayfield Road and Heart Lake Road and Highway 410 to the north, as shown in Figure 1.

The site has a total area of approximately 7.4 hectares (18.3 acres) of predominantly flat land which slightly slopes at the property limit next to Highway 410. The site consists of agricultural land as noted by the presence of previous farming activities (crops). There are two residential dwellings outside the property boundaries located to the south-west of the site which has a municipal address of 12097 and 12141 Kennedy Road, Caledon, Ontario.

Based on our understanding, the Site is to be developed into a residential development, with associated underground services and supporting roads. For the purposes of this report, we have assumed that the future residential houses will be constructed utilizing shallow strip/spread footings, with an interior slab-on-grade, and one-level of underground basement. We have also assumed cuts and/or fills required for site grading purposes will not exceed 2.0 m and that the invert of the site servicing will be no greater than 3.0 m below existing site grades.

3.0 ADJACENT GEOTECHNICAL SITE INFORMATION

Additional geotechnical investigations consisting of seventeen boreholes were also carried out as part of the Snell's Hollow Secondary Plan on the southwest, south and east adjacent properties (Golder, 2019). Also, a previous geotechnical investigation consisting of five boreholes was carried out by Edward Wong and Associates, 2017 (Wong, 2017), on the south property.

The following is a summary of subsurface conditions obtained from boreholes located adjacent to the site (BH/MW19-02 and BH19-10 to BH/MW19-13) from Golder 2019, and (BH1 and BH5) from Wong, 2017 as shown on the Site and Borehole Location Plan, ***Figure 1.***

In general, the subsurface conditions encountered typically consist of a surficial topsoil ranging in thickness from about 200 mm to over 610 mm overlying a disturbed/reworked dark to light brown silty clay layer, which contains various amounts organics, underlain by glacial till composed of stiff to hard brown silty clay to a depth ranging from 4.0 m to 6.7 m below ground surface. A 4.5 m clayey silt fill deposit was indicated in BH5 (Wong, 2017), however the fill material was not encountered in BH/MW19-02.

A stiff to hard grey clayey silt till or very dense silty sand to sand was generally found below the brown silty clay till layer. These subsurface conditions were found to be similar to the subsurface conditions encountered in the boreholes located on Coscorp site (discussed in detail in subsequent sections).

Groundwater was encountered in BH/MW19-02 at approximately Elev. 244.5 m, BH5 at approximately Elev. 262.2 m and BH19-10 at approximately Elev. 263.7 m, upon the completion of drilling and ranged from 2.8 m to 12.7 m below existing ground surface, whereas Borehole BH19-11, BH/MW19-13 and BH1, were found to be dry upon the completion of drilling.

Four, 50 mm diameter monitoring wells were installed at Boreholes BH5, BH/MW19-02 and BH/MW19-13 to permit further monitoring of the groundwater levels. The groundwater levels measured at Borehole BH/MW19-02 within the shallow 50 mm diameter monitoring well on April 17, 2019 were recorded to be 0.25 m below existing ground surface. (Elev. 257 m) and at 6.3 m below existing ground surface (Elev. 250.9 m) within the deep monitoring well. The groundwater level measured at Borehole BH/MW19-13 on April 17, 2019, was measured at 9.4 m below ground surface (Elev. 258.2 m).

The record of borehole logs from the adjacent properties are enclosed in ***Appendix C***. The approximate locations of the boreholes drilled at these sites are shown on the Site and Borehole Location Plan, ***Figure 1.***

4.0 REGIONAL GEOLOGY

The surficial geology aspects of the general site area were reviewed from the following publication:

- Chapman, L.J., and Putnam, D.F., 2007, *"The Physiography of Southern Ontario"*; 4th Edition, Ontario Geological Survey.

Physiographic mapping in the area according to the above noted reference indicates that the site lies within the physiographic region of southern Ontario known as the South Slope. The South Slope region slopes gradually downward towards Lake Ontario. The overburden immediately below ground surface within the South Slope generally consists of clayey silt till and silty clay till and at depth, consists of alternating deposits of dense lacustrine sands and silts and overconsolidated lacustrine clays and clay tills overlying the bedrock.

The subsurface conditions encountered during the investigation are generally consistent with the physiographic mapping.

5.0 INVESTIGATION PROCEDURE

The field work for the preliminary geotechnical investigation was carried out on April 4, 2019, during which time two boreholes (designated as Boreholes BH/MW19-01 and BH/MW19-03) were advanced at the site to depths between about 8.2 m and 9.8 m below existing ground surface at the approximate locations shown on the Site and Borehole Location Plan, ***Figure 1***, attached.

The boreholes were advanced using a track-mounted drill rig supplied and operated by a specialist drilling contractor, subcontracted to Golder. Standard Penetration Testing (SPT) and sampling was carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer, in accordance with ASTM D1586 (99). Two, 50 mm diameter monitoring wells were installed to permit further monitoring of the groundwater levels at each borehole location. Groundwater level measurements were recorded immediately following drilling procedures for all boreholes and on the monitoring wells on April 17, 2019. The well installation and water level readings are presented on the Record of Borehole sheets in **Appendix A**.

The field work for this investigation was directed by members of our engineering staff who located the boreholes in the field, directed the sampling and in-situ testing operation, logged the boreholes and cared for the samples obtained. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory for further examination and laboratory testing. Index and classification tests, consisting of water content determinations, Atterberg limits and grain size distribution, were carried out on selected soil samples. The results of the geotechnical laboratory tests are included in **Appendix B** and on the Record of Borehole sheets in **Appendix A**.

The borehole locations were determined in the field using a GPS instrument based on UTM coordinates. Geodetic ground surface elevations at the borehole locations were derived from the site grading plan provided by GSAI, "Snell's Hollow Contour Plan, Town of Caledon" dated December 2018. and as such, the elevations and borehole locations given on the Record of Borehole sheets and referred to herein should be considered as approximate.

6.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes and the results of the field and laboratory testing, are shown on the Record of Boreholes sheets, in **Appendix A**. Method of Soil Classification and Symbols and Terms Used on Records of Boreholes are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summary of the subsurface conditions of the boreholes advanced during this investigation followed by a more detailed description of the major soil strata and groundwater conditions.

In general, the subsurface conditions encountered at the boreholes advanced at the site typically consist of a surficial topsoil/silty clay layer underlain by native soil deposits of glacial till composed of silty clay to clayey silt containing varying amounts of sand and gravel. A gravelly sandy silt deposit was encountered in between the brown silty clay till and grey clayey silt till, about 4 m in thickness.

Details of the observations of the groundwater conditions during and upon completion of drilling are included on the Record of Borehole sheets. Shallow ground water was encountered at depths ranging from 4.0 m to 7.3 m below existing ground surface upon the completion of drilling activities. Shallow groundwater levels measured in the 50 mm diameter monitoring wells installed at the site are also presented below.

6.1 Topsoil and Reworked/Disturbed Materials

Topsoil materials were encountered in all the boreholes and extended to depths ranging from 0.25 m to 0.35 m. A summary of topsoil thickness in each of the boreholes is outlined in the table below.

Table 1: Approximate Topsoil Thickness

Borehole No.	Approximate Topsoil Thickness (m)
BH/MW19-01	0.25
BH/MW19-03	0.35

Materials identified as topsoil in this report were classified based on visual and textural evidence as no other testing for organic content or other nutrients was carried out. As such, the ability for these materials to support vegetation has not been assessed.

Reworked/disturbed silty clay material was encountered in both boreholes below the surficial topsoil. Reworked material thickness was observed to be approximately 0.45 m to 1.0 m. The reworked material consisted of silty clay with various amounts of sand and gravel and traces of organics. SPT ‘N’ values within the cohesive reworked material ranged from about 5 blows to 10 blows per 0.3 m of penetration indicating a firm to stiff consistency.

The natural water content of the reworked material was measured at 19 percent.

6.2 (CL) sandy Silty Clay (Upper Glacial Till)

A glacial till deposit consisting of cohesive sandy silty clay was generally encountered directly underneath the topsoil/reworked till deposits to depths of about 5.8 m below existing ground surface (Elev. 261 m). The till deposit is light brown to brown mottled with oxidation staining, about 2.7 m to 5 m in thickness, with various amounts of sand and gravel. The silty clay till increases in sand content in both boreholes at depth. The till is believed to contain cobbles and/or possible boulders which have been inferred as a result of auger grinding observed in boreholes BH/MW19-03.

The SPT ‘N’ values measured in these till materials range from 11 blows per 0.3 m of penetration to 32 blows per 0.3 m of penetration, indicating that the silty clay till is generally stiff to hard in consistency.

The results of grain size distribution tests carried out on selected samples from this deposit are presented in **Figure B1.** Atterberg limits tests that were carried out on the same samples from this deposit measured liquid limit values ranging from about 23 to 24 and plastic limit values ranging from about 13 to 15; yielding corresponding plasticity index values ranging from about 10, which suggests that the upper till is a clay of low plasticity. These results are plotted on the plasticity chart as shown in **Figure B2**.

The water content of selected samples ranged from about 9 percent to 17 percent.

6.3 (ML) gravelly sandy SILT

A non-cohesive gravelly sandy silt was encountered underneath the brown cohesive silty clay till, in BH/MW19-03. The sandy silt deposit, is light brown, has slight plasticity, contains various amount of gravel, with cobbles/boulders being inferred from auger grinding and is about 3 m in thickness.

The SPT 'N' values measured in this deposit ranged from 75 blows per 0.3 m to 100 blows per 0.3 m of penetration. These SPT 'N' values indicate a very dense compactness.

The water content of selected samples ranged from about 8 percent.

6.4 (CL-ML) Clayey Silt (Lower Glacial Till)

A clayey silt till deposit was encountered directly underneath the sandy silty clay till and/or sandy silt from a depth of about 5.8 m and 7.0 m below existing ground surface. The boreholes were terminated in this layer at a depth of about 8.2 m and 9.8 m below existing ground surface. The cohesive till deposit contains various amounts of sand and gravel and is grey in colour.

The SPT 'N' values of this till deposit was 12 blows to 100 per 0.3 m of penetration indicating stiff to hard consistency.

6.5 Groundwater Conditions

Groundwater level measurements were recorded immediately following drilling procedures. Monitoring wells were installed in both boreholes to permit monitoring of the groundwater level at the site. Details of the monitoring well installation and the measured groundwater levels are shown on the Record of Borehole sheets in ***Appendix A***. The groundwater level measurements in the drilled boreholes and in the monitoring wells are summarized in Table 2, below.

Table 2: Groundwater Level Measurements

Borehole No.	Measurements Upon Completion of Drilling		Measurements in Monitoring Wells	
	Approximate Groundwater Depth (begs)*	Date	Approximate Groundwater Depth (begs)*	Date
BH/MW19-01	Dry	April 4, 2019	4.0 m (Elev. 262.8 m)	April 17, 2019
BH/MW19-03	9.1 m (Elev. 257.8 m)	April 4, 2019	7.3 m (Elev. 259.5 m)	April 17, 2019

*begs- below existing ground surface.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year.

7.0 GEOTECHNICAL ENGINEERING DISCUSSION

This section of the report provides preliminary geotechnical engineering recommendations on the geotechnical aspects of the proposed development based on our interpretation of the limited borehole information and on our understanding of the project scope and requirements. The information in this portion of the report is provided for the guidance of the design engineers and professionals.

Based on the results of this investigation, the subsurface soil conditions encountered at the site are considered to be generally suitable for the proposed residential development.

As noted above, at the time of this report, proposed design grades (i.e. footing elevation, pavement subgrade and utility invert levels) were not available for the proposed development. The following engineering recommendations regarding the geotechnical design aspects of the project including underground services, pavements and building foundations should be considered as preliminary only, and should be reviewed when the design grades and utility invert levels have been finalized.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

This report addresses only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report.

7.1 Site Preparation

7.1.1 Subgrade Preparation

The existing site vegetation, surficial topsoil/organics and other near-surface soils containing significant amounts of organic matter are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grade(s).

Disturbed/reworked materials containing excessive amounts of construction debris or organic material should be disposed of following appropriate environmental procedures. Furthermore; excessively-wet soils should be suitably dried before reuse as engineered fill.

Following the stripping of the surficial topsoil and soils containing significant amounts of organics and/or soft/disturbed surficial soils, the exposed subgrade should be heavily proof-rolled with suitable equipment, in conjunction with inspection by qualified geotechnical personnel to confirm that the exposed soils are competent and have been adequately stripped of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e., further subexcavation and replacement) should be carried out on poorly-performing areas identified during the proof-rolling activities, as directed by Golder.

Any filling carried out at the site in conjunction with regrading should be carried out as under engineered fill procedures. Recommendations for the placement of engineered fill are outlined in Section 7.1.2 of this report.

7.1.2 Engineered Fill Requirements

As described above, the anticipated site grading activities may include both cutting and raising (filling) the original grade to meet the final design site grades. At the time of this report, the design cut and fill depths were not available for review. As such, for the purposes of this report, it has been assumed that cuts will not exceed 2 m and grade raises will not exceed more than 2 m.

In general, the existing native material is considered to be acceptable for reuse as engineered fill. Based on the laboratory test results, the water content of soils present at the site are considered to be generally near or above their optimum water contents for compaction, and therefore may require minor drying prior to placement, in general.

It should be noted that the native materials at the site are silty in nature, and as such are susceptible to over-wetting and subsequent freezing during inclement weather. Therefore, it is recommended that site grading activities not be carried out during late fall, winter, early spring seasons or any periods of inclement weather conditions. All oversized cobbles (i.e., greater than 150 mm in size) and boulders, if present, should be removed from excavated material that will be used as engineered fill material.

If imported material is required for the engineered fill process, the material that is proposed for use as engineered fill should be approved by the geotechnical engineer at its source, prior to importing the material to the site. Suitable soils, free of topsoil, organic matter or other deleterious materials can be used as engineered fill provided that the water content of the soil at the time of placement does not vary by more than 2 percent above or below its optimum water content for compaction. Otherwise, the soils may require treatment (i.e., drying or wetting) prior to placement.

Following the inspection and approval of the subgrade as described previously in this report, engineered fill materials should be placed in maximum 300 mm-thick loose lifts and uniformly compacted to 98 percent of the Standard Proctor maximum dry density (SPMDD). Filling should continue until the design elevations are achieved.

Full-time monitoring and in-situ density testing should be carried out by Golder during placement of engineered fill.

The final surface of the engineered fill should be protected as necessary from construction traffic and should be sloped to provide positive drainage for surface water during the construction period. If the engineered fill materials will be left exposed (i.e. uncovered) during periods of freezing weather, additional soil cover should be placed above final subgrade to provide some level of frost protection. Prior to placing the granular subbase and/or base courses within pavement areas, the surface of the engineered fill/subgrade should be inspected by Golder.

7.2 Installation of Underground Services

7.2.1 Temporary Excavations

Details of the underground servicing for the proposed development are unknown at the time of this investigation; as such, for the purpose of this report, the maximum depth of the underground services was assumed to be about 3 m below the existing ground surface. Once detailed design is completed, review of the underground services should be completed by this office for compliance with the recommendations contained herein.

The founding soils are anticipated to generally consist of the native sandy silty clay or engineered fill. These materials are considered to be suitable for supporting the underground services provided that the integrity of the base of the trench excavations is maintained during construction. Where softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

Care should be taken to direct surface water away from any open excavations and all temporary excavations should be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects.

In general, the groundwater level in the open boreholes, upon completion of drilling, was measured to be at depths ranging from being dry to 9.1 m below existing ground surface or elevation 257.8 m. Whereas, the groundwater level in the monitoring wells, one month after drilling, was measured to be at depths ranging from 4.0 m to 7.0 m below existing ground surface, (Elev. 259.5 m to Elev. 262.8 m).

The groundwater in the excavations within the native deposits, are likely to be handled by collection via properly constructed and filtered sumps, located within the excavations, and then pumping and discharging the water to a suitable discharge point. However, should excavations deeper than 3-4m below existing ground surface be required, the following recommendations will need to be review and revised to determine if some form of active dewatering, such as well points, may have to be implemented.

Excavations for the site servicing would generally extend through the native sandy silty clay deposit. Conventional excavation equipment should be suitable to excavate through these materials.

The stiff to hard native clayey till soils are classified as a “Type 2” soils under the OH&S Act. As such, all conventional temporary trench excavations should consist of open cuts with side slopes not steeper than 1 horizontal to 1 vertical in the overburden soils to within 1.2 m of the base of the excavation and then may be made vertical to the base. Where engineered fill (based on silty clay material) is used or the native sandy silt/silty clay exhibits signs of water seepage, the soil is classified as a “Type 3”, as such all conventional temporary trench excavations should consist of gradient of 1 horizontal to 1 vertical.

Where the side slopes of excavations are required to be steepened to limit the extent of the excavation, then some form of trench support may be required. Some trench excavations could be carried out using a vertically-excavated, unsupported excavation (using a properly-engineered trench liner box for protection, certified by an experienced engineer); or by a supported (sheeted) excavation if conditions warrant so; such as in wet areas and/or in close proximity to adjacent underground services

7.2.2 Pipe Bedding and Cover

The bedding for the sewers and watermains should be compatible with the size, type and class of pipe and the surrounding subsoil and the requirements of the Town of Caledon. If granular bedding is deemed to be acceptable, then Ontario Provincial Standard Specifications (OPSS) Granular A should be used from at least 150 mm below invert of the pipe to the springline. Clear stone should not be used as bedding material. From springline to 300 mm above the obvert of the pipe, sand cover could be used. All bedding and cover material should be placed in 150 mm loose lifts and uniformly compacted to at least 100 percent of SPMDD. Where variable fill materials, softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

7.2.3 Trench Backfill

The excavated materials from the site will consist predominantly of silty clay till materials. Based on the measured water contents, in general, the native materials encountered at the site are estimated to be near or below their optimum water contents for compaction, and therefore, will probably require only minor wetting prior to placement.

Care should be taken to maintain the water content of the soils close to/at the optimum water content for compaction during the construction operations, as difficulties with compaction and/or backfill performance would be anticipated with fine-grained soils where the water content is significantly above the optimum for compaction purposes. Soils that contain significant quantities of organics or debris are also not suitable for use as trench backfill within settlement-sensitive areas. In addition, all boulders and cobbles greater than 150 mm in size should be removed from the trench backfill materials. If there is a shortage of suitable in-situ material, an approved imported material such as Ontario Provincial Standard Specifications Select Subgrade Material should be used for trench backfill. Again, as noted above, the trench backfill materials are silty in nature and are very susceptible to wetting/freezing temperatures. Backfilling trenches during cold or wet weather is not recommended.

Trench backfill should be placed in maximum 300 mm loose lift thickness and uniformly compacted to at least 98 percent of the SPMDD of the material. Soil that is frozen should not be used as backfill.

Normal post-construction settlement of the compacted trench backfill should be anticipated with the majority of such settlement taking place within about 12 months following the completion of trench backfilling operations. If the trench backfill operations are completed during the winter months, post-construction settlements may increase beyond typical anticipated values. These settlements will be reflected at the ground surface. If the asphalt binder course is laid shortly following the completion of the trench backfilling operations, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding. If possible, the surface course asphalt should not be placed over the binder course asphalt for about 12 months. Where scheduling requires that the surface course be placed over the binder course asphalt before this period, trench backfill settlement would be reflected by subsidence and possible cracking of the finished pavement surface in these areas which, depending upon the extent and magnitude, may require local repairs.

7.3 Building Foundations

As previously indicated, the existing site vegetation, surficial topsoil/organics and other near-surface soils containing significant amounts of organic matter are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grades.

Based on the subsurface conditions encountered in the boreholes, strip and spread footings that may be used, provided that the footings are founded on the native sandy silty clay deposit or on engineered fill (based on existing site soils) placed in accordance with the recommendation outlined in Section 7.1, and maintained a minimum depth of soil embedment below finished adjacent ground surface and top of slab of 1.2 m.

For such strip and spread footings, a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa and a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa may be assumed for design purposes, provided that the strip footings dimensions of 0.45 m in width and 10 m in length or spread footings have a minimum width of 0.60 m and a maximum width of 1.0 m.

Where spread footings are constructed at different elevations, the difference in elevation between the individual footings should not be greater than one half the clear distance 650 mm between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with the Ontario Building Code (2012), Section 9.15.3.9.

The maximum total and differential settlements are expected to be less than 25 mm and 20 mm; respectively, for footings designed, constructed and inspected as outlined above.

All exterior footings, and interior footings in unheated areas, should be founded at a minimum depth of 1.2 m below finished grade level in order to provide adequate protection against frost penetration.

The native soils are susceptible to disturbance from construction activity, especially during wet or freezing weather. Care should be taken to preserve the integrity of the materials as bearing strata. It is essential that the founding surface for the footings be inspected by qualified geotechnical personnel prior to placing concrete. If the concrete for the footings cannot be placed immediately after excavation and inspection of the subgrade, it is recommended that a working mat of lean concrete be placed in the excavation to protect the integrity of the bearing stratum.

Resistance to lateral forces/sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the CHBDC. The unfactored coefficient of friction, tan δ, for the interface between the cast-in-place concrete footing and the properly-prepared subgrade can be assumed to be 0.35.

7.3.1 Below Grade Walls

The exterior perimeter of all housing basement walls should be backfilled with an imported free draining, non-frost susceptible granular material approved by a geotechnical engineer, carefully placed and compacted in 200 mm thick loose lifts. The design of the foundation walls for the below-grade walls should take into account the horizontal soil loads as well as surcharge loads that may occur during or after construction and should be designed using a lateral (at-rest) earth pressure coefficient of 0.5 and a unit weight of backfill of 20 kN/m^3.

The wall backfill layers should be compacted to at least 95 per cent of the materials' standard Proctor maximum dry density. Light compaction equipment should be used immediately adjacent to the foundation wall, otherwise compaction stresses on the wall may be greater than that imposed by the backfill material. With the exception of the driveway area, the upper 0.3 m of backfill should consist of clayey material to provide a low permeability cap and the exterior grade should also be shaped to slope away from the building.

Provided that the excavations adjacent to foundation/basement walls are backfilled with free-draining granular materials and a drainage collection system is provided around the perimeter of the building, the design of below-grade walls does not need to take into account hydrostatic forces acting on the walls. However, it is recommended that the exterior of the below-grade walls be damp-proofed.

7.4 Pavement Design within the Proposed Development

Following site grading operations, as noted previously, the proposed pavement subgrade will generally consist of either re-compacted engineered fill or native silty clay till. These materials are considered to be frost susceptible, and as such, the pavement design provided in ***Table 3*** below has taken this condition into consideration.

Based on the proposed pavement usage, (i.e. residential development type traffic and loads/frequencies) frost susceptibility and strength of the subgrade soils, the following pavement component given are recommended for the proposed development of access roads and streets, however the Town of Caledon/Region of Peel design standards should be followed:

Table 3: Pavement Design

Material		Minimum Thickness of Pavement Components (mm)	
		Local Road (8.5m Roadway)	Neighbourhood Collector (9.5 m Roadway)
Asphaltic Concrete (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	90
Granular Materials (OPSS.MUNI 1010)	Granular A Base	150	150
	Granular B Type II Subbase	350	500
Total Pavement Thickness (mm)		605	780
		Prepared and Approved Subgrade	

As part of the subgrade preparation, proposed access roads should be stripped of topsoil and other obviously unsuitable fill or organic materials. Fill required to raise the grades to design elevations should conform to the engineered fill requirements outlined previously in the report. Soft or spongy trench backfill areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98 percent SPMDD. Prior to placing pavement subbase and/or base materials, the exposed soil subgrade should be heavily proof-rolled in conjunction with an inspection by Golder. The granular subbase and base materials should be placed in loose layers no thicker than 200 mm and uniformly compacted to 100 percent of their SPMDD. The binder course and surface course asphalt materials should be compacted to minimum 92.0 percent of their Marshall Maximum Relative Density according to OPSS 310, as measured in the field using a nuclear density gauge.

Where new pavement abuts existing pavement (e.g. at the development limits), proper longitudinal lap joints should be constructed to key the new asphalt into the existing asphalt surface. The existing asphalt edges should be provided with a proper sawcut edge prior to keying-in the new asphalt. It should be ensured that any undermining or broken edges resulting from the construction activities are removed by the sawcut.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength may not be adequate to support heavy construction loading especially during wet weather or where backfill materials wet of optimum have been placed. In this regard, the design subbase thickness may not be sufficient for a construction haul road and additional subbase (in the order of 450 mm) may be required. In any event, the subgrade should be proofrolled and inspected by Golder prior to placing the subbase and any additional material, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

7.4.1 Subgrade Drainage

In order to preserve the integrity of the pavement, continuous subdrains should be placed at the concrete curb lines along both sides of the proposed streets. The invert of the subdrains should be at least 300 mm below the bottom of the Granular "B" subbase and should be sloped to drain to catchbasins. The subdrains should consist of perforated pipe wrapped in a suitable geotextile and surrounded on all sides with a minimum thickness of 150 mm of OPSS.PROV 1002 Concrete Fine Aggregate (i.e. concrete sand).

8.0 SEISMIC SITE CLASSIFICATION

Seismic hazard is defined in the 2012 Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 second, 0.5 second, 1.0 second and 2.0 seconds and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity, Standard Penetration Test (SPT) resistance, undrained soil shear strength, etc.) in the 30 m below the foundation level. There are six site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain acceleration and velocity-based site coefficients F_a and F_v; respectively, used to modify the UHS to account for the effects of site-specific soil conditions in design.

Based on the results of the preliminary geotechnical investigation and assuming soils below the maximum depth investigated exhibit similar properties / strengths, a **Site Class D** is estimated for planning purposes. The Site Class will need to be verified, and adjusted as necessary, during detail design.

9.0 INSPECTION AND TESTING

During construction, full-time observation should be carried out during engineered fill and site servicing backfill placement, and sufficient foundation inspections, subgrade inspections and in-situ materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.

10.0 CLOSING

We trust that this preliminary report provides enough preliminary geotechnical engineering information to proceed with the detailed design of the proposed development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Signature Page

Golder Associates Ltd.

Erti

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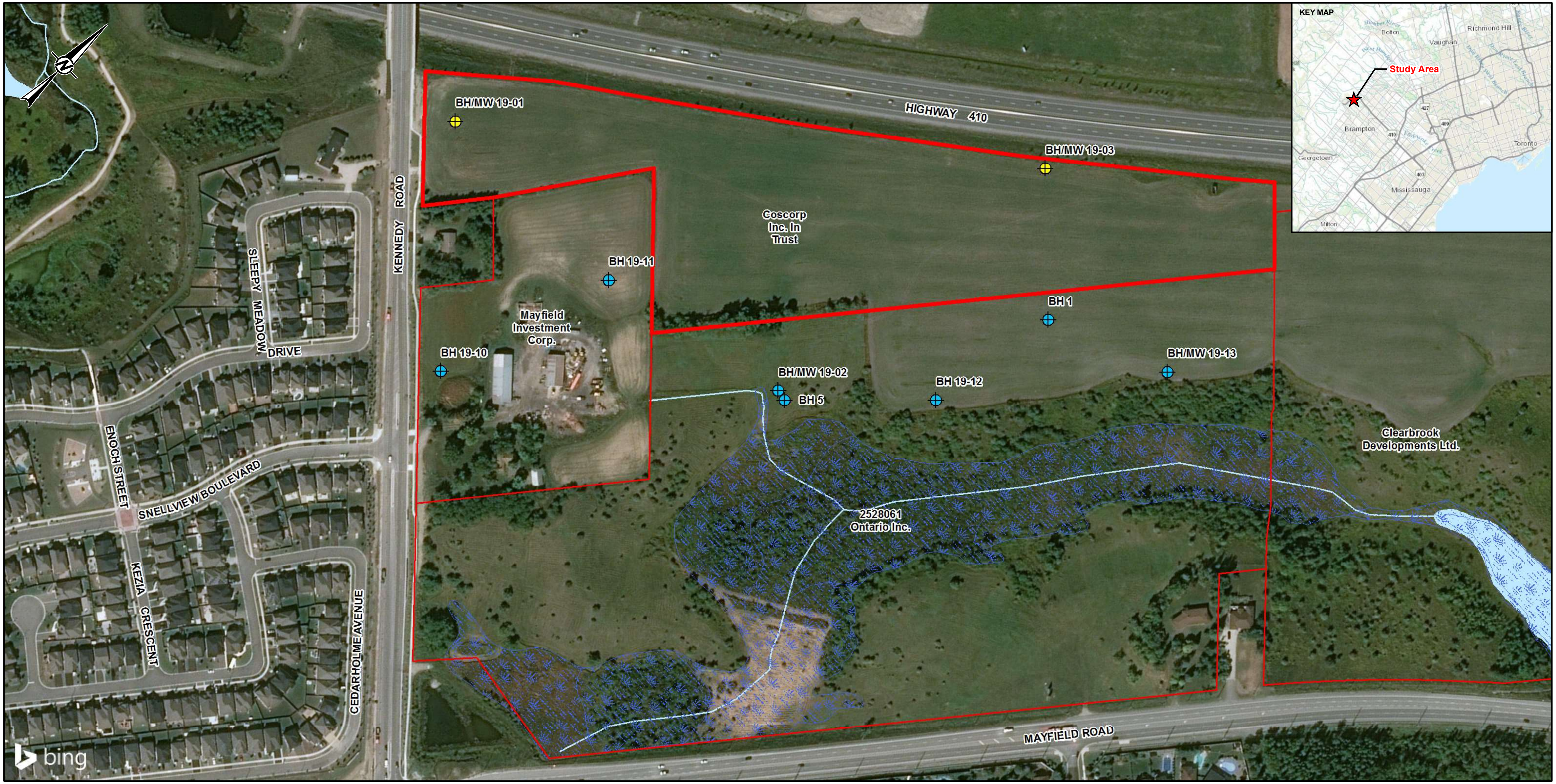
JD/EM/JET/sm

https://golderassociates.sharepoint.com/sites/102461/technical work/phase 3000 - coscorp in trust/19115264 (3000) draft georeport coscorp in trust.docx



LEGEND

⊕	Approximate Borehole and Monitoring Well Location
⊕	Approximate Previous and Adjacent Properties Geotechnical Borehole (Edward Wong, 2017, Golder 2019)
—	Watercourse
🟦	Waterbody
▨	Wetland
☐	Site Boundary
🟥	Coscorp Inc. In Trust Site Boundary

0 75 150

1:3,000 METRES

REFERENCE(S)
1. IMAGERY: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
© 2019 MICROSOFT CORPORATION © 2019 DIGITALGLOBE ©CNES (2019) DISTRIBUTION AIRBUS DS
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
COSCORP INC. IN TRUST

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, COSCORP INC. IN TRUST, CALEDON, ON

CONSULTANT
GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	MM
PREPARED	MM
REVIEWED	EM
APPROVED	-

TITLE
SITE AND BOREHOLE LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
19115264	3000	-	1

PATH: S:\Clients\Snells_Hollow_Developer_Group\Mayfield_Rd_Caledon\99_PROJ\19115264\40_PROD\0002_Prelim_Geotechnical_Investigation\19115264-0002-BG-0002.mxd PRINTED ON: 2019-05-31 AT: 12:43:38 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

APPENDIX A

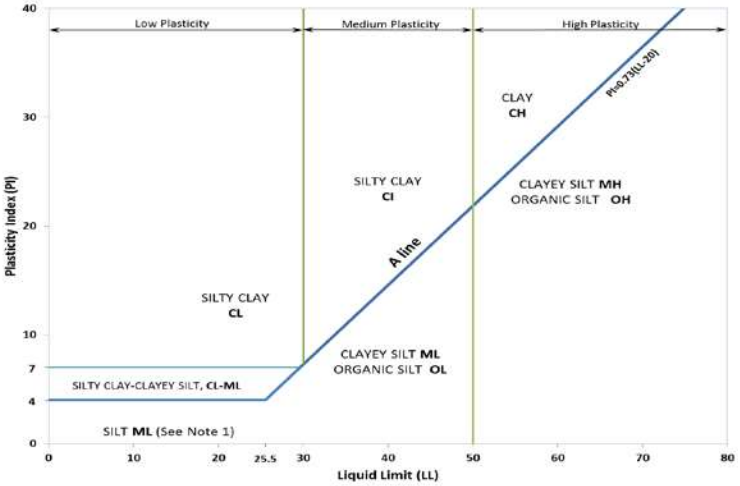
Method of Soil Classification
Abbreviations and Terms used on Record of Borehole
List of Symbols
Record of Boreholes

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\ \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index $= (w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_C	consistency index $= (w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

PROJECT: 19115264-3000

LOCATION: Lat. 43.747371 Long. -79.818742

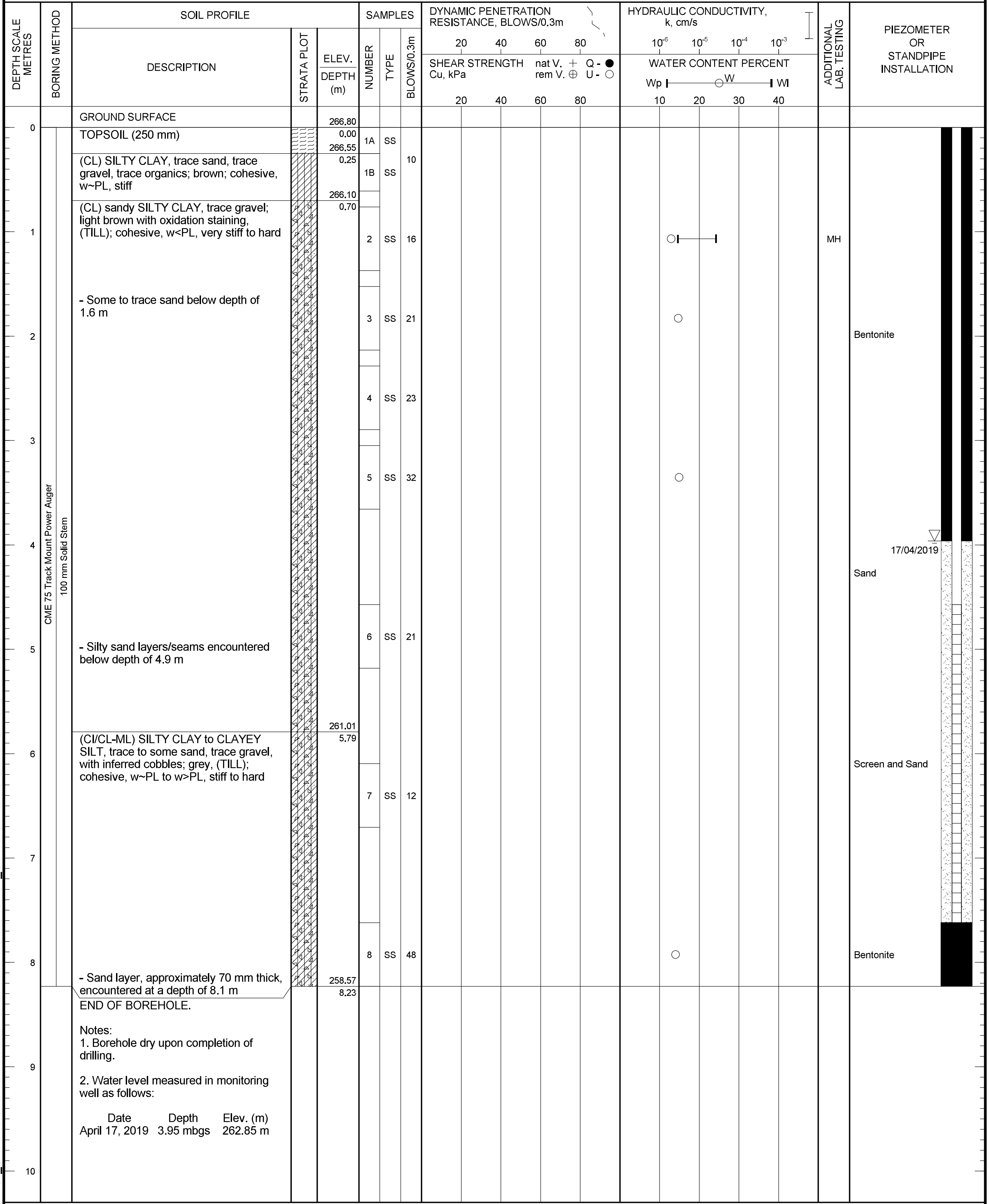
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-01

BORING DATE: April 4, 2019

SHEET 1 OF 1

DATUM: Geodetic



DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	266.80					
0	TOPSOIL (250 mm)	0.00	1A	SS	10		
	(CL) SILTY CLAY, trace sand, trace gravel, trace organics; brown; cohesive, w~PL, stiff	266.55 0.25	1B	SS			
1	(CL) sandy SILTY CLAY, trace gravel; light brown with oxidation staining, (TILL); cohesive, w<PL, very stiff to hard	266.10 0.70	2	SS	16	MH	
2	- Some to trace sand below depth of 1.6 m		3	SS	21		Bentonite
3			4	SS	23		
			5	SS	32		
4							Sand
5	- Silty sand layers/seams encountered below depth of 4.9 m		6	SS	21		
6	(CI/CL-ML) SILTY CLAY to CLAYEY SILT, trace to some sand, trace gravel, with inferred cobbles; grey, (TILL); cohesive, w~PL to w>PL, stiff to hard	261.01 5.79	7	SS	12		Screen and Sand
8	- Sand layer, approximately 70 mm thick, encountered at a depth of 8.1 m		8	SS	48		Bentonite
	END OF BOREHOLE.	258.57 8.23					

Notes:
1. Borehole dry upon completion of drilling.

2. Water level measured in monitoring well as follows:

Date	Depth	Elev. (m)
April 17, 2019	3.95 mbgs	262.85 m

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

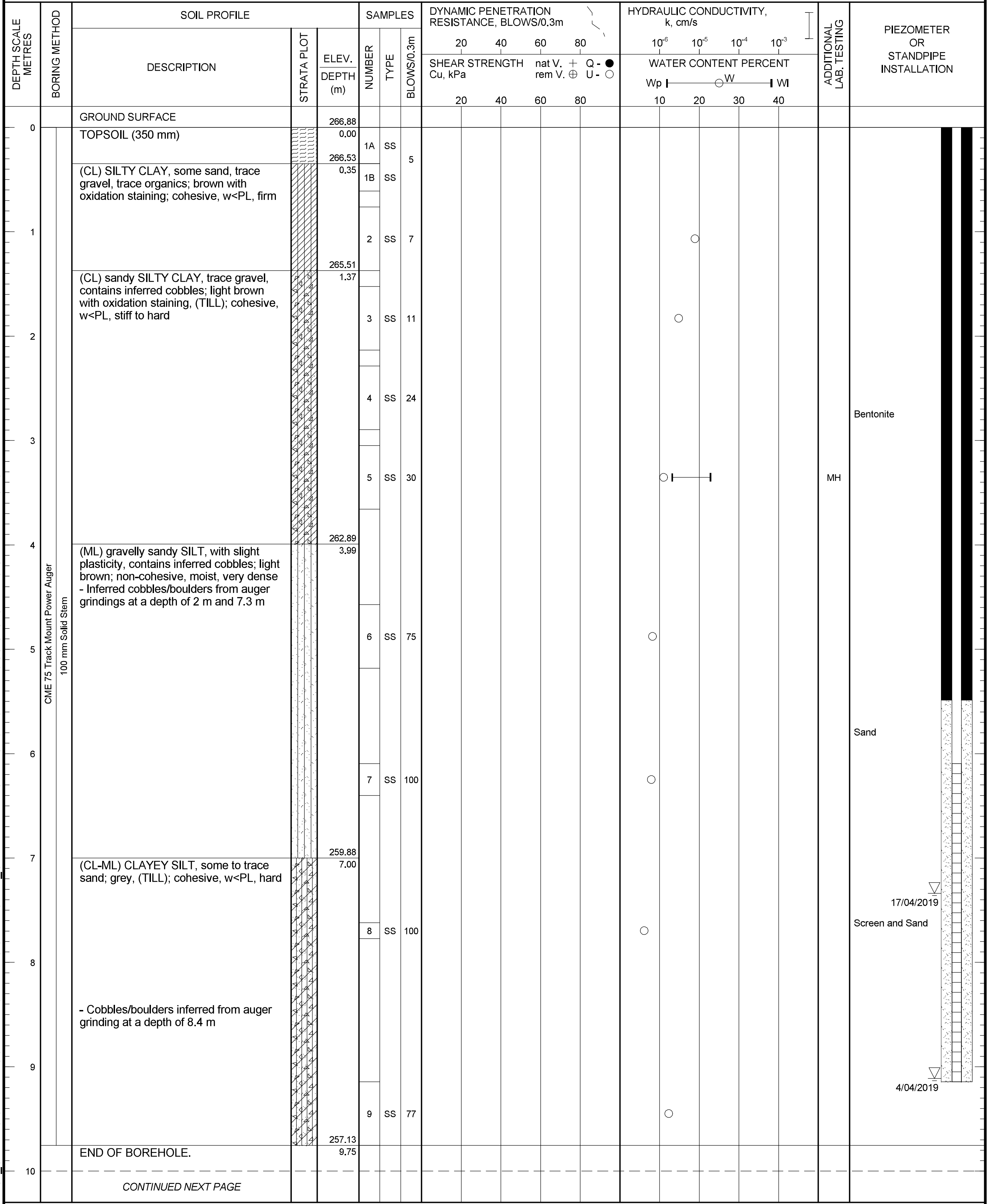
PROJECT: 19115264-3000
LOCATION: Lat. 43.750098 Long. -79.814418
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-03

BORING DATE: April 4, 2019

SHEET 1 OF 2

DATUM: Geodetic



ELEV. DEPTH (m)	DESCRIPTION
266.88	GROUND SURFACE
0.00	TOPSOIL (350 mm)
266.53 0.35	(CL) SILTY CLAY, some sand, trace gravel, trace organics; brown with oxidation staining; cohesive, w<PL, firm
265.51 1.37	(CL) sandy SILTY CLAY, trace gravel, contains inferred cobbles; light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to hard
262.89 3.99	(ML) gravelly sandy SILT, with slight plasticity, contains inferred cobbles; light brown; non-cohesive, moist, very dense - Inferred cobbles/boulders from auger grindings at a depth of 2 m and 7.3 m
259.88 7.00	(CL-ML) CLAYEY SILT, some to trace sand; grey, (TILL); cohesive, w<PL, hard - Cobbles/boulders inferred from auger grinding at a depth of 8.4 m
257.13 9.75	END OF BOREHOLE.

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	5	
1B	SS		
2	SS	7	
3	SS	11	
4	SS	24	
5	SS	30	MH
6	SS	75	
7	SS	100	
8	SS	100	
9	SS	77	

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-3000

LOCATION: Lat. 43.750098 Long. -79.814418
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-03

BORING DATE: April 4, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Water level measured at 9.1 mbgs upon completion of drilling. 2. Water level measured in monitoring well as follows: Date / Depth / Elev. (m) April 17, 2019 / 7.34 mbgs / 259.54 m									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

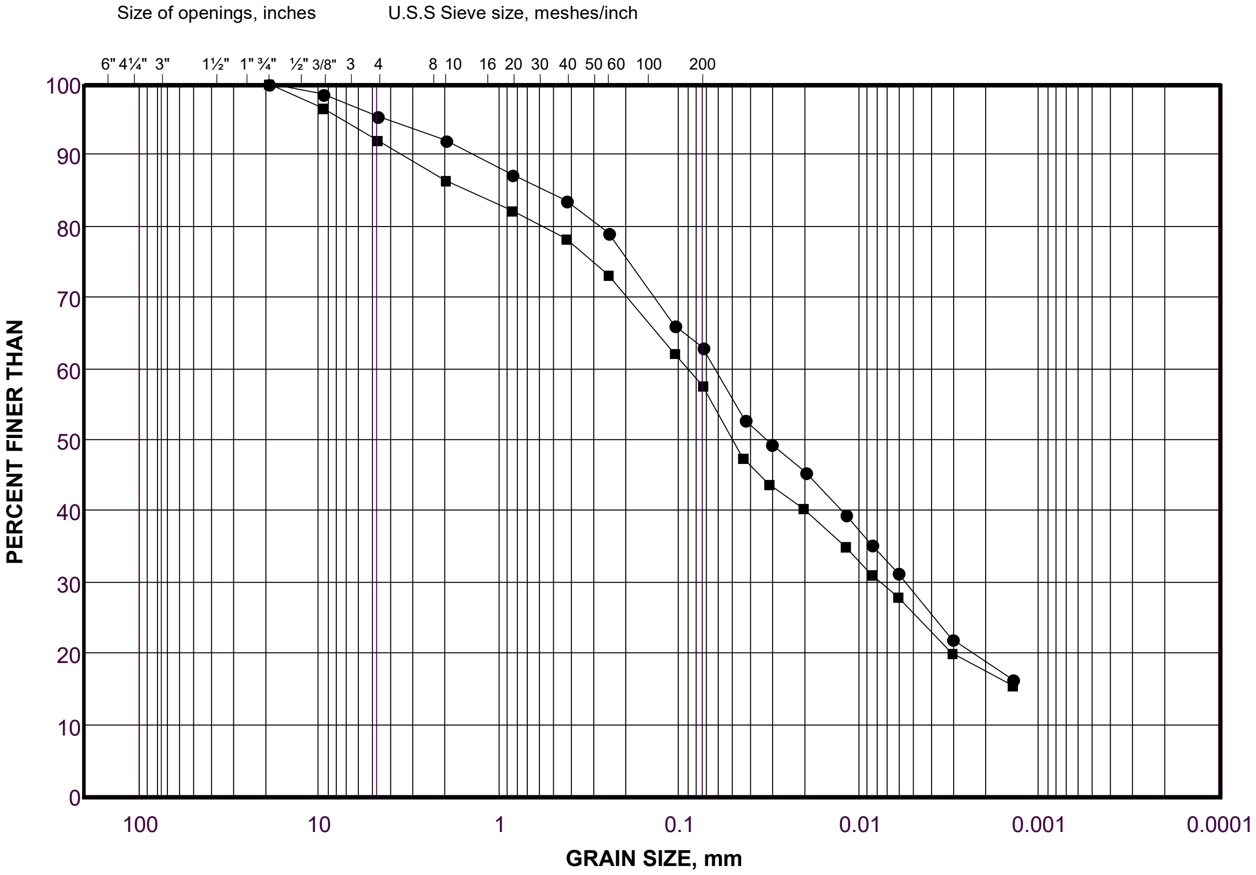
APPENDIX B

Geotechnical Laboratory Figures

GRAIN SIZE DISTRIBUTION

sandy SILT CLAY (CL) - TILL

FIGURE B1



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

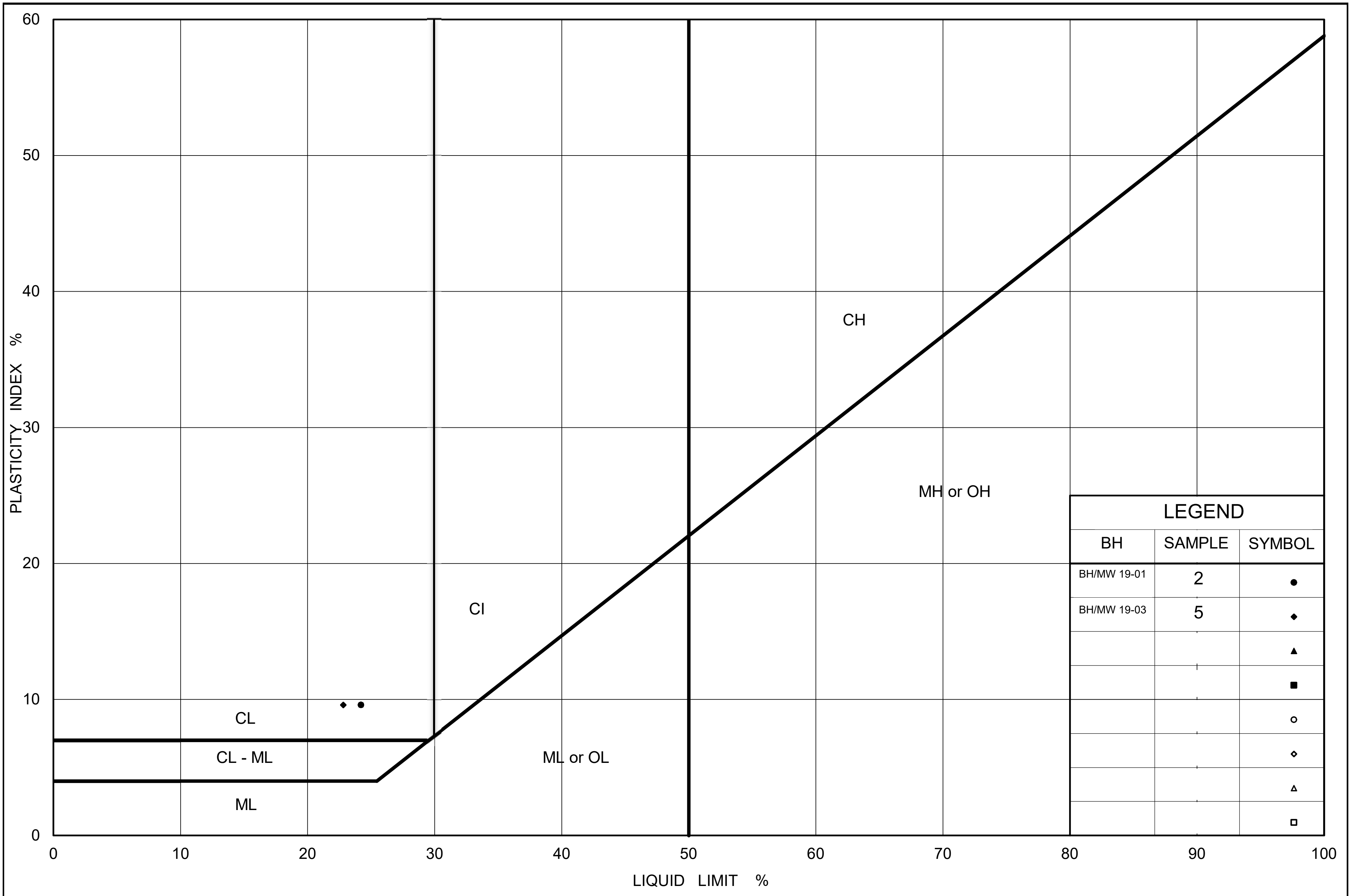
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH/MW 19-01	2	0.76 - 1.37
■	BH/MW 19-03	5	3.05 - 3.66

Project Number: 19115264

(3000) Checked By: EM

Golder Associates

Date: 12-Jun-19



GOLDER

PLASTICITY CHART
sandy SILTY CLAY (CL) TILL

Figure No. B2

Project No. 19115264 (3000)

Checked By: EM

APPENDIX C

Adjacent Properties and Previous Geotechnical Borehole Logs

PROJECT: 19115264-1000/2000
LOCATION: Lat. 43.747664 Long. -79.814643
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-02

BORING DATE: April 2, 2019

SHEET 1 OF 2
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT
	GROUND SURFACE	257.20				
0	TOPSOIL (610 mm)	0.00	1	SS	4	
	(CL)SILTY CLAY, some to trace sand, trace gravel, trace organics; brown/dark brown with oxidation staining; w>PL, firm	256.59 0.61	2A	SS		59.7
1	(CL) sandy SILTY CLAY, trace gravel; light brown with oxidation staining, (TILL); cohesive, w~PL, firm to stiff	256.35 0.85	2B	SS	8	
	- Silt/sand seams/layers below 1.7 m		3	SS	8	
2			4	SS	13	
3			5	SS	9	
4	(CL-ML) CLAYEY SILT, some to trace sand, trace gravel; grey, (TILL); cohesive, w>PL, very stiff to stiff to hard	253.24 3.96				
5			6	SS	15	
6			7	SS	13	
7						
8			8	SS	17	
9	- Becoming sandy at 9.1 m					
	- Auger grinding at a depth of 9.5 m to 11 m		9	SS	57	
10						

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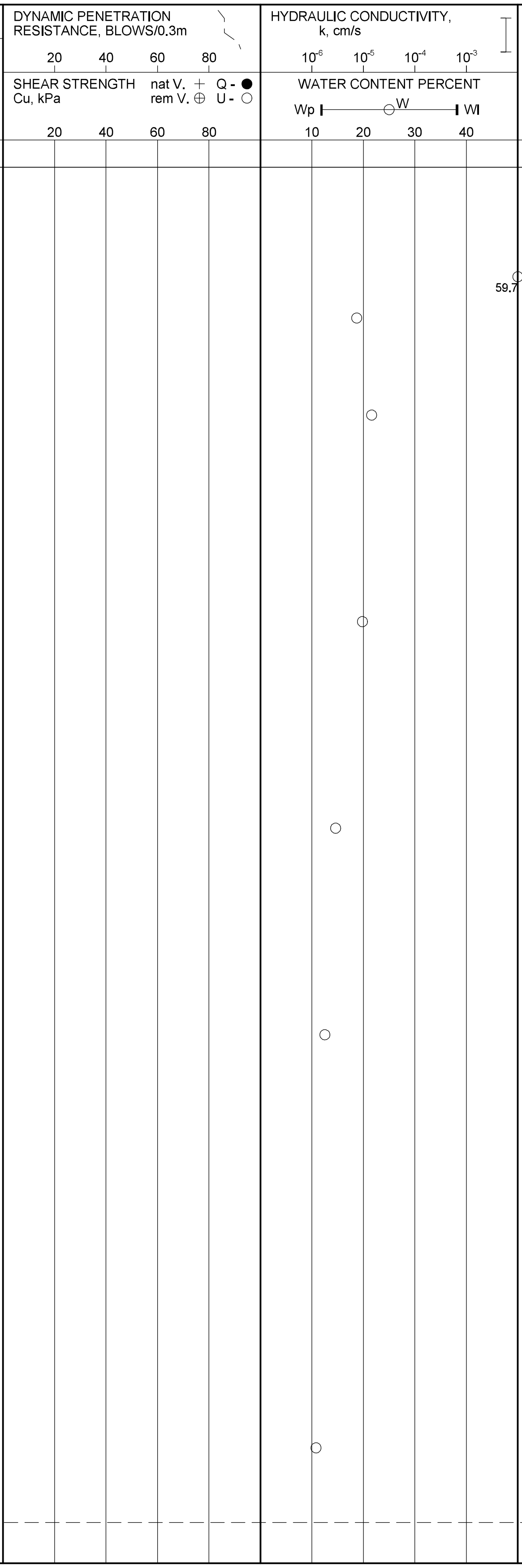
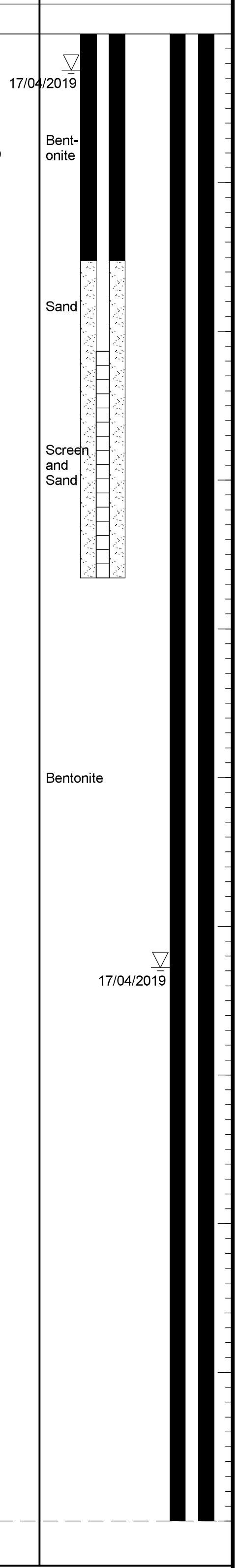


ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.747664 Long. -79.814643

(See Figure 1)

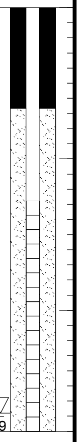
RECORD OF BOREHOLE: BH/MW19-02

BORING DATE: April 2, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---								
10	CME 75 Track Mount Power Auger 100 mm Solid Stem	(SW-SM) SAND to SILTY SAND, medium grained, contains inferred cobbles/boulders; light brown; non-cohesive, wet, compact to very dense	247.14 10.06							Bentonite
11				10	SS	26				Sand
12		- Cobbles/boulders inferred from auger grinding at a depth of 12 m								Screen and Sand
				11	SS	52				2/04/2019
			244.40 12.80							
13		END OF BOREHOLE.								
14										
15										
16										
17										
18										
19										
20										



Notes:
1. Water level measured in monitoring well as follows:

Deep Well

Date	Depth	Elev. (m)
April 2, 2019	12.67 mbgs	244.53 m
April 17, 2019	6.27 mbgs	250.93 m

Shallow Well

Date	Depth	Elev. (m)
April 17, 2019	0.25 mbgs	256.95 m

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-4000

LOCATION: Lat. 43.74607 Long. -79.817117

(See Figure 1)

RECORD OF BOREHOLE: BH19-10

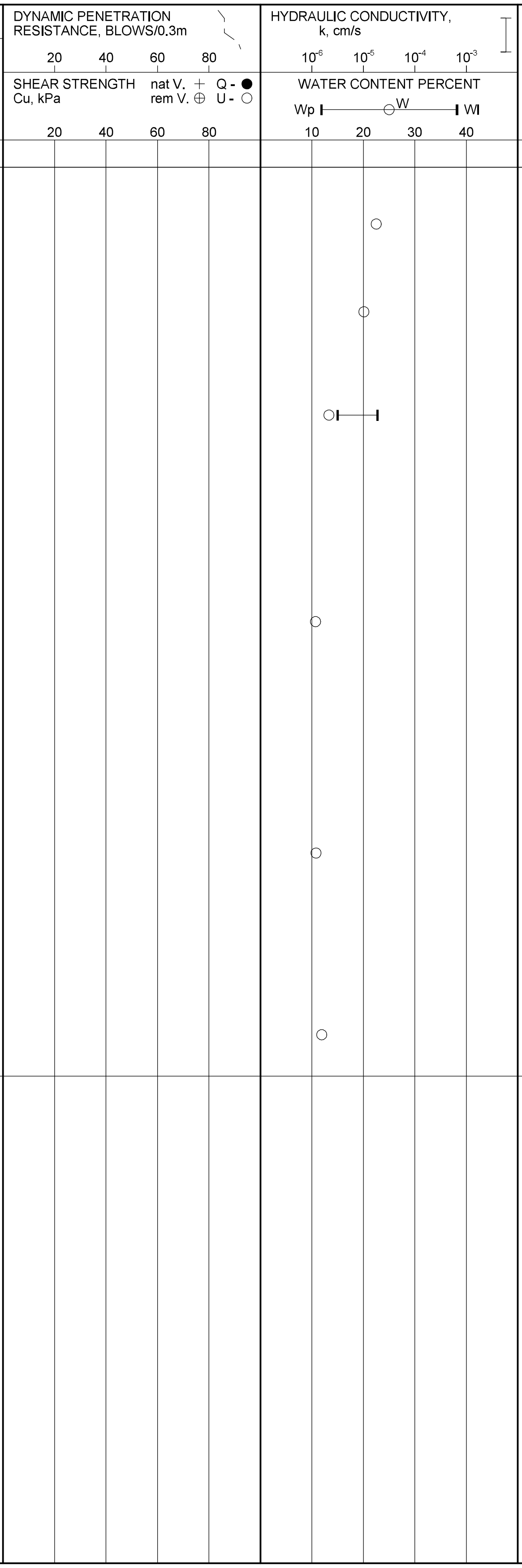
BORING DATE: April 3, 2019

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	267.80					
CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (230 mm)	0.00	1A	SS	5		
	(CL-ML) CLAYEY SILT, some sand, trace gravel; dark brown to brown, mottled; cohesive, w~PL, firm	267.57 0.23	1B	SS			
	(CL) sandy SILTY CLAY, some sand, trace gravel, contains inferred cobbles/boulders; light brown with oxidation staining, (TILL); cohesive, w<PL, very stiff to hard	267.04 0.76	2	SS	18		
			3	SS	29	MH	
			4	SS	35		
	- Auger grinding on inferred cobbles at a depth of 3 m		5	SS	31		
							∇ 2/04/2019
			6A	SS	25		
	(CL-ML) CLAYEY SILT, some sand, some gravel; grey, (TILL); cohesive, w~PL to w>PL, stiff to very stiff	262.86 4.94	6B	SS			
			7A	SS	10		
			7B	SS			
			8	SS	22		
	END OF BOREHOLE.	261.09 6.71					

Notes:
1. Water level measured at 4.1 mbgs upon completion of drilling.



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

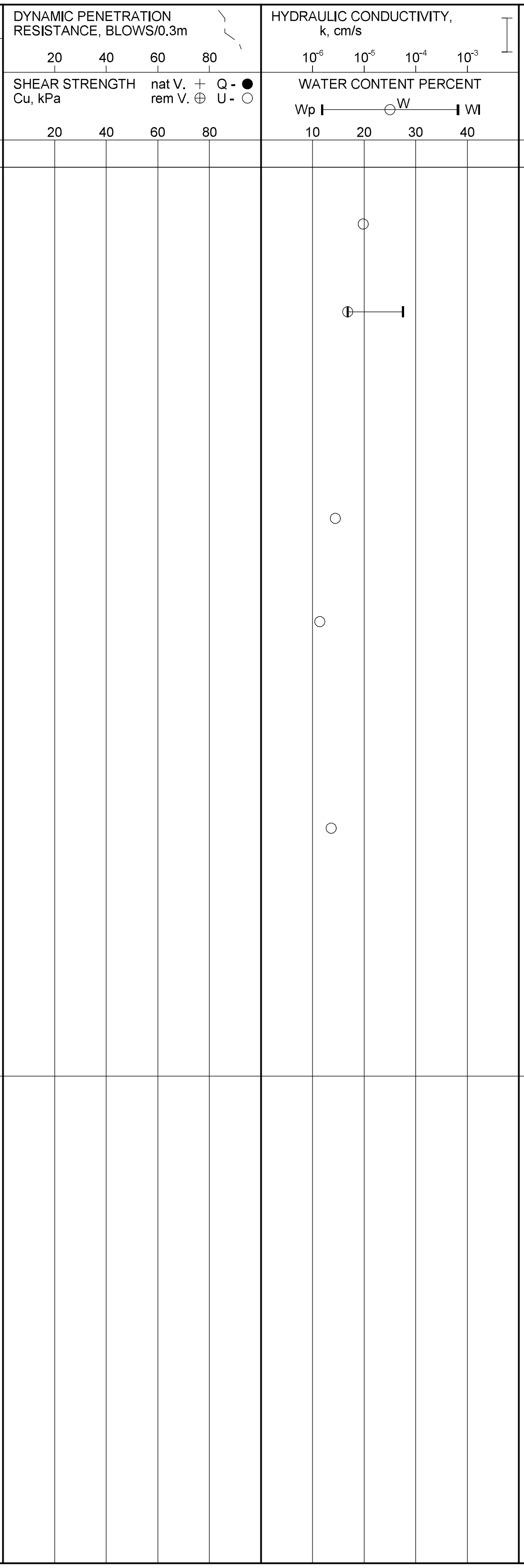
PROJECT: 19115264-4000
LOCATION: Lat. 43.74736 Long. -79.816608
(See Figure 1)

RECORD OF BOREHOLE: BH19-11

BORING DATE: April 3, 2019

SHEET 1 OF 1
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		265.00					
0	CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (230 mm)		0.00	1A	SS			
		(CL) sandy SILTY CLAY, trace gravel; brown, mottled brown/light brown; cohesive, w<PL, firm to stiff - Cobbles/boulders inferred from auger grinding at 6 m		264.77 0.23	1B	SS	10		
1					2	SS	4	MH	
		(CL) sandy SILTY CLAY, trace gravel; mottled light brown to brown, (TILL); cohesive, w<PL, very stiff to hard		263.60 1.40	3	SS	10		
2–3					4	SS	28		
3					5	SS	29		
5					6	SS	33		
6					7	SS	30		
7		END OF BOREHOLE. Notes: 1. Borehole dry upon completion of drilling.		258.29 6.71					



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DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000

RECORD OF BOREHOLE: BH19-12

SHEET 1 OF 2

LOCATION: Lat. 43.748408 Long. -79.813559
(See Figure 1)

BORING DATE: April 4, 2019

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
		GROUND SURFACE	266.33				
0	CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (380 mm)	0.00	1A	SS	5	
		(CL) sandy SILTY CLAY, trace gravel, trace organics; brown with oxidation staining; w<PL, firm	265.95 0.38	1B	SS		PP = 25 kPa
1		(CL) sandy SILTY CLAY, trace gravel; brown with oxidation staining, (TILL); cohesive, w<PL, stiff to hard	265.57 0.76	2	SS	10	PP = 220 kPa MH
2				3	SS	9	PP = 220 kPa
				4	SS	30	PP = 440 kPa
3		- Cobbles inferred from auger grinding at 3 m		5	SS	33	PP = 345 kPa
4		(SM) gravelly SILTY SAND, trace clay nodules, slight plasticity; light brown; non-cohesive, moist, dense to very dense	262.23 4.10				
				6A	SS	113	MH
5				6B	SS		
		- Cobbles/boulders inferred from auger grinding at 5.3 m					
6		- Becoming silty sand, some gravel below a depth of 6.2 m		7	SS	150	MH
7							
8				8	SS	32	
9		- Contains layers of fine sand and silt, some clay below depth of 9.2 m		9	SS	47	MH
10				10	SS	42	

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40
PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000

LOCATION: Lat. 43.748408 Long. -79.813559
(See Figure 1)

RECORD OF BOREHOLE: BH19-12

BORING DATE: April 4, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(SM) gravelly SILTY SAND, trace clay nodules, slight plasticity; light brown; non-cohesive, moist, dense to very dense		255.81	10	SS	42		○		
		END OF BOREHOLE. Notes: 1. Borehole dry upon completion of drilling. 2. PP= unconfined compressive strength measured with pocket penetrometer in the field.		10.52							
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.749709 Long. -79.812182
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-13

BORING DATE: April 4, 2019

SHEET 1 OF 2

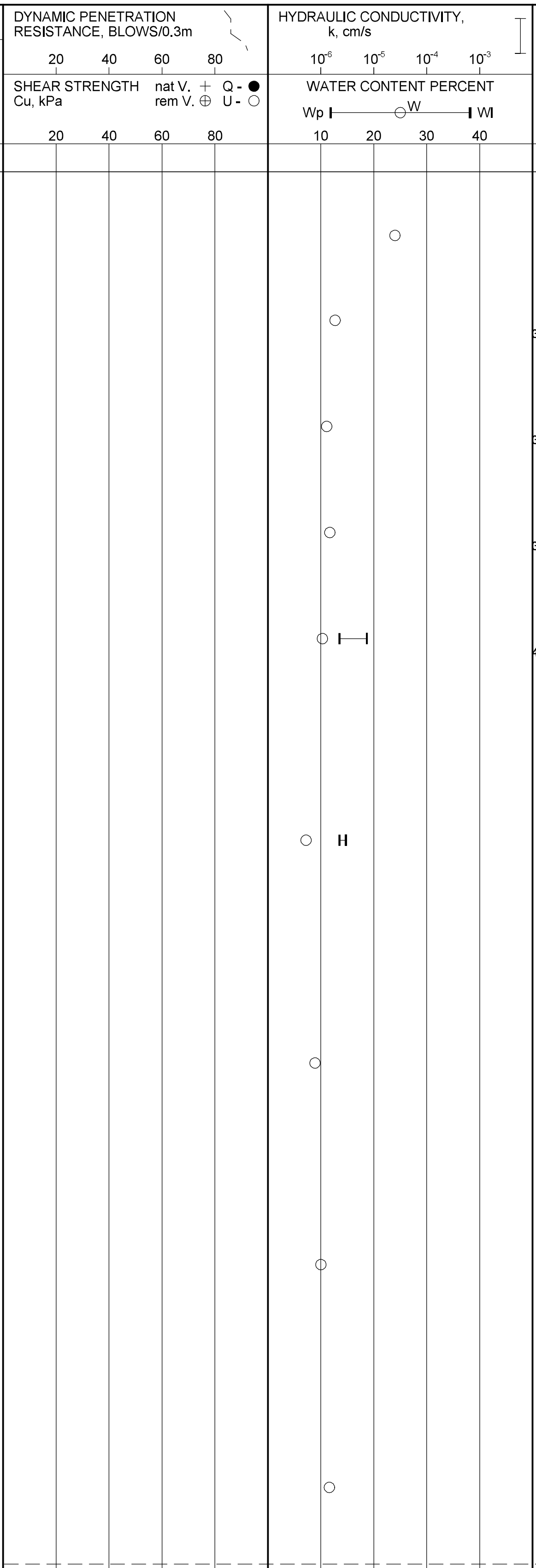
DATUM: Geodetic

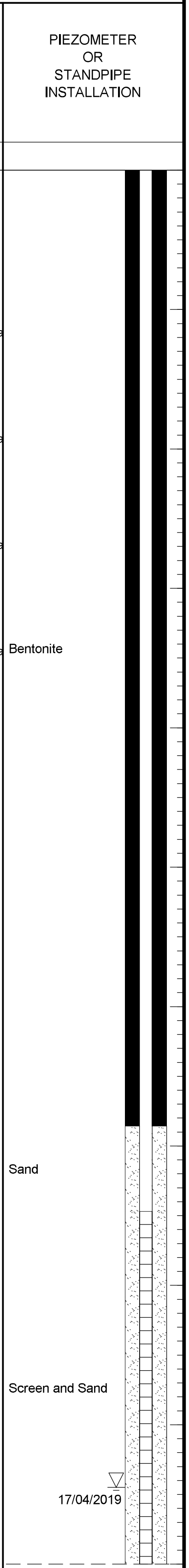
BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

ELEV. (m)	DEPTH (m)	SOIL PROFILE DESCRIPTION
267.61		GROUND SURFACE
	0.00	TOPSOIL (300 mm)
267.31	0.30	(CL) SILTY CLAY, some sand, trace organics; dark brown; cohesive, w<PL, firm
266.65	0.96	(CL) SILTY CLAY and SAND, trace gravel, inferred cobbles/boulders; mottled light brown/brown, (TILL); w<PL, very stiff to hard - Cobbles/boulders inferred from auger grinding at 1.7 m
263.61	4.00	(SM) gravelly SILTY SAND, cobbles/boulders inferred from auger grinding; light brown; non-cohesive, dry to moist, very dense - Heavy auger grinding below depth of 5.4 m
259.99	7.62	(ML) sandy SILT, with slight plasticity, trace gravel; light brown; moist, very dense

CONTINUED NEXT PAGE

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	5	
1B	SS		
2	SS	17	PP = 320 kPa
3	SS	19	PP = 320 kPa
4	SS	22	PP = 340 kPa
5	SS	33	PP = 440 kPa MH
6	SS	154	MH
7	SS	115	
8	SS	138	MH
9	SS	137	
10	SS	146	





DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/2000
LOCATION: Lat. 43.749709 Long. -79.812182
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-13

BORING DATE: April 4, 2019

SHEET 2 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(ML) sandy SILT, with slight plasticity, trace gravel; light brown; moist, very dense		257.09 10.52	10	SS	146		⊕⊣	MH	Screen and Sand
11		END OF BOREHOLE.									
12											
13											
14											
15											
16											
17											
18											
19											
20											

Notes:
1. Borehole dry upon completion of drilling.

2. Water level measured in monitoring well as follows:

Date	Depth	Elev. (m)
April 17, 2019	9.45 mbgs	258.16 m

3. PP= unconfined compressive strength measured with pocket penetrometer in the field.

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

BORING NUMBER 1

PAGE 1 OF 1

CLIENT Dilip Kumar Jain

PROJECT NAME 3278 Mayfield Road

PROJECT NUMBER Ma002995a

PROJECT LOCATION Town of Caledon

DATE STARTED 10/19/17 **COMPLETED** 10/19/17

GROUND ELEVATION 270 m **HOLE SIZE** 150 mm

DRILLING CONTRACTOR Fadroy Enterprise

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Augers

AT TIME OF DRILLING Dry

LOGGED BY J.J. **CHECKED BY** E.W.

AT END OF DRILLING Dry

NOTES

AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG		MATERIAL DESCRIPTION	
					0.20	**TOPSOIL** - ~200 mm thick.	269.80
	SS 1	3-4-5-7 (9)	MC = 17%			**CLAYEY SILT** - some sand, occasional gravel, brown, very moist, hard.	
1	SS 2	5-6-10 (16)	PP = 400 kPa MC = 17%				
2	SS 3	4-6-10 (16)	PP >450 kPa MC = 15%				
	SS 4	6-10-14 (24)	PP >450 kPa MC = 14%				
3					3.00	**SAND TILL** - trace clay, trace gravel, brown, very moist, compact.	267.00
	SS 5	5-10-12 (22)	PP >450 kPa MC = 11%				
4							
	SS 6	6-16-20 (36)	PP >450 kPa MC = 13%			-becoming dense below ~4.5 m depth	
5							
6							
	SS 7	50-0-0/-0.15	PP >450 kPa MC = 10%		6.15	-becoming very dense below ~6.0 m depth	263.85
						Bottom of hole at 6.15 m.	

EDWARD WONG

WELL NUMBER 5

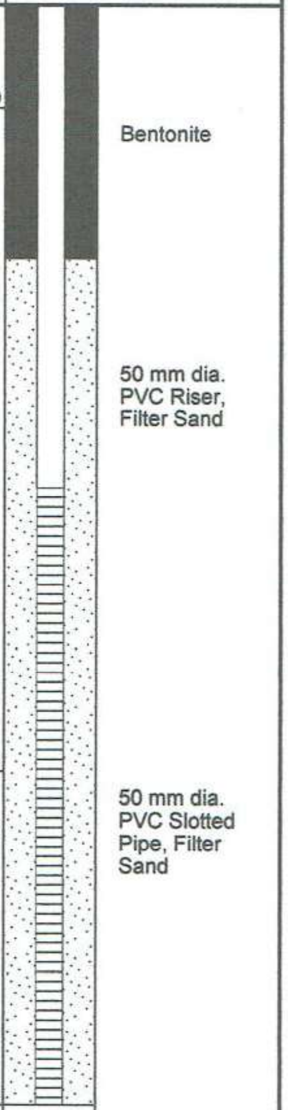
PAGE 1 OF 1

CLIENT Dilip Kumar Jain
PROJECT NUMBER Ma002995a
PROJECT NAME 3278 Mayfield Road
PROJECT LOCATION Town of Caledon

DATE STARTED 10/18/17 **COMPLETED** 10/18/17
DRILLING CONTRACTOR Fadroy Enterprise
DRILLING METHOD Solid Stem Augers
LOGGED BY J.J. **CHECKED BY** E.W.
NOTES
GROUND ELEVATION 265 m **HOLE SIZE** 150 mm
GROUND WATER LEVELS:
AT TIME OF DRILLING Dry
▼ **AT END OF DRILLING** 2.85 m / Elev 262.15 m
▼ **AFTER DRILLING** 2.85 m / Elev 262.15 m

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
	SS 1	1-3-3-3 (6)	MC = 23%	0.60	**TOPSOIL** - ~600 mm thick. 264.40
1	SS 2	3-4-5 (9)	MC = 16%		**FILL** - clayey silt, rootlets, topsoil inclusions, dark brown and brown, very moist.
2	SS 3	2-4-5 (9)	MC = 22%		
	SS 4	4-7-10 (17)	MC = 19%		
3					▼
	SS 5	2-5-9 (14)	MC = 21%		
4				4.50	260.50
5	SS 6	3-6-8 (14)	PP = 400 kPa MC = 16%		**SILTY CLAY** - trace gravel, grey, very moist, hard.
6	SS 7	4-6-8 (14)	PP = 250 kPa MC = 16%	6.45	-becoming very stiff below ~6.0 m depth 258.55
					Bottom of hole at 6.45 m.

WELL DIAGRAM



APPENDIX D

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

golder.com

REPORT

Preliminary Geotechnical Investigation, Mayfield Kennedy Investment Corp.

Proposed Residential Development, Snell's Hollow Secondary Plan, Caledon, Ontario

Submitted to:

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Marco Benigno, President
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19115264 Phase 4000

June 24, 2019

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1 e-copy: Mayfield Kennedy Investment Corp.

1 e-copy: Snell's Hollow Developers Group

1 e-copy: Glen Schnarr & Associates Inc.

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TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Mayfield Kennedy Investment Corp. (MKIC) to provide preliminary geotechnical consulting services to support a draft plan approval for a future residential subdivision development located north east of Kennedy Road and Mayfield Road in Caledon, Ontario (the Site), as shown in the Site and Borehole Location Plan, ***Figure 1.***

The terms of reference for the geotechnical consulting services are included in Golder's proposal No. P19115264 Rev 1, dated March 8, 2019.

The purpose of the investigation is to obtain information on the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of boreholes and geotechnical laboratory tests. Based on our interpretation of the factual information collected as part of the preliminary geotechnical investigation carried out at this site, a general description of the subsurface conditions across the site is presented herein. The interpreted subsurface conditions and available project details were used to develop preliminary engineering parameters and recommendations on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

This report provides the results of the preliminary geotechnical investigation and should be read in conjunction with the *"Important Information and Limitations of This Report"* ***Appendix D***. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder should be given an opportunity to confirm that the recommendations in this report are still valid.

2.0 SITE DESCRIPTION AND BACKGROUND

The subject property is located north east of Kennedy Road and Mayfield Road and is part of the Snell's Hollow Secondary Plan, which is a proposed residential development to be located in the southern part of the Town of Caledon. The site is bounded by Kennedy Road to the west, adjacent agricultural properties to the east, south and west, which further connects to Mayfield Road to the south and Heart Lake Road to the west and Highway 410 to the north, as shown in ***Figure 1.***

The site has a total area of approximately 4.5 hectares (11.2 acres) of predominantly flat land which slightly slopes towards Highway 410. The site consists of small agricultural land with a small pond, a two-storey residential house with three metal framed sheds, a previously demolished building, remaining concrete foundations, construction vehicles and trailers, with gravel road and localized asphalt/concrete pads. The property has a municipal address of 12141 Kennedy Road, Caledon, Ontario.

Based on our understanding, the Site is to be developed into a residential development with associated underground services and supporting roads. For the purposes of this report, we have also assumed that the future residential houses will be constructed utilizing shallow strip/spread footings, with an interior slab-on-grade, and one-level of underground basement. We have also assumed cuts and/or fills required for site grading purposes will not exceed 2.0 m and that the invert of the site servicing will be no greater than 3.0 m below existing site grades.

3.0 ADJACENT GEOTECHNICAL SITE INFORMATION

Additional geotechnical investigations consisting of seventeen boreholes were also carried out as part of the Snell's Hollow Secondary Plan on the north and southeast adjacent properties (Golder, 2019). Also, previous geotechnical investigation consisting of five boreholes was also carried out by Edward Wong and Associates, 2017 (Wong, 2017), to the property to the southeast.

The following is a summary of subsurface conditions obtained from boreholes located adjacent to the site (BH/MW19-01, BH/MW19-02 and BH/MW19-09) from Golder 2019, and (BH5 and BH6) from Wong, 2017 as shown on the Site and Borehole Location Plan, ***Figure 1***.

In general, the subsurface conditions encountered typically consist of a surficial topsoil ranging in thickness from about 250 mm to over 600 mm overlying a disturbed/reworked dark to light brown silty clay layer or a silty sand, which contains various amounts of organics, underlain by glacial till composed of very stiff to hard brown silty clay which extends to depths ranging from about 5.8 m to about 10.6 m below ground surface. A silty sand to sand was generally found below the brown/grey silty clay till layer. These subsurface conditions were found to be similar to the subsurface conditions encountered in the recently completed boreholes located on the MKIC site (discussed in detail in subsequent sections).

The record of borehole logs from these reports are enclosed in ***Appendix C***. The approximate locations of the boreholes drilled at these sites are shown on the Site and Borehole Location Plan, ***Figure 1.***

The groundwater level measurements in the drilled boreholes are summarized in ***Table 1***, below.

Table 1: Groundwater Level Measurements (Adjacent Properties)

Borehole No.	Measurements Upon Completion of Drilling		Measurements in Monitoring Wells	
	Approximate Groundwater Depth (begs)*	Date	Approximate Groundwater Depth (begs)*	Date
BH/MW19-01	Dry	April 4, 2019	4.0 m (Elev. 262.8 m)	April 17, 2019
BH/MW19-02 (Shallow)	N/A	April 4, 2019	0.3 m (Elev. 257.0 m)	April 17, 2019
BH/MW19-02 (Deep)	12.7 m (Elev. 244.5 m)	April 4, 2019	6.3 m (Elev. 244.5 m)	April 17, 2019
BH/MW19-09	6.6 m (Elev. 250.0 m)	April 4, 2019	6.5 m (Elev. 250.4 m)	April 17, 2019
BH5	2.85 m (Elev. 262.2 m)	October 18, 2017	N/A	N/A
BH6	Dry	Dry	N/A	N/A

*begs- below existing ground surface.

4.0 REGIONAL GEOLOGY

The surficial geology aspects of the general site area were reviewed from the following publication:

- Chapman, L.J., and Putnam, D.F., 2007, *"The Physiography of Southern Ontario"*; 4th Edition, Ontario Geological Survey.

Physiographic mapping in the area according to the above noted reference indicates that the site lies within the physiographic region of southern Ontario known as the South Slope. The South Slope region slopes gradually downward towards Lake Ontario. The overburden immediately below ground surface within the South Slope generally consists of clayey silt till and silty clay till and at depth consists of alternating deposits of dense lacustrine sands and silts and over consolidated lacustrine clays and clay tills overlying the bedrock.

The subsurface conditions encountered during the investigation are generally consistent with the physiographic mapping.

5.0 INVESTIGATION PROCEDURE

The field work for the preliminary geotechnical investigation was carried out on April 3, 2019, during which time two boreholes (designated as Boreholes BH19-10 and BH19-11) were advanced at the site to depths between about 6.7 m below existing ground surface at the approximate locations shown on the Site and Borehole Location Plan, ***Figure 1***, attached.

The boreholes were advanced using a track-mounted drill rig supplied and operated by a specialist drilling contractor, subcontracted to Golder. Standard Penetration Testing (SPT) and sampling was carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer, in accordance with ASTM D1586 (99). Groundwater level measurements were recorded immediately following completion of drilling for all boreholes.

The field work for this investigation was directed by members of our engineering staff who located the boreholes in the field, directed the sampling and in-situ testing operation, logged the boreholes and cared for the samples obtained. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder’s Mississauga geotechnical laboratory for further examination and laboratory testing. Index and classification tests, consisting of water content determinations, Atterberg limits and grain size distribution, were carried out on selected soil samples. The results of the geotechnical laboratory tests are included in **Appendix B** and on the Record of Borehole sheets in **Appendix A**.

The borehole locations were determined in the field using a GPS instrument based on UTM coordinates. Geodetic ground surface elevations at the borehole locations were derived from the site grading plan provided by GSAI, “Snell’s Hollow Contour Plan, Town of Caledon” dated December 2018. and as such, the elevations and borehole locations given on the Record of Borehole sheets and referred to herein should be considered as approximate.

6.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes and the results of the field and laboratory testing, are shown on the Record of Boreholes sheets, in **Appendix A**. Method of Soil Classification and Symbols and Terms Used on Records of Boreholes are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summary of the subsurface conditions of the boreholes advanced during this investigation followed by a more detailed description of the major soil strata and groundwater conditions.

In general, the subsurface conditions encountered at the boreholes advanced at the site typically consist of a surficial topsoil/silty clay layer underlain by native soil deposits of glacial till composed of silty clay to clayey silt containing varying amounts of sand and gravel.

Details of the observations of the groundwater conditions during and upon completion of drilling are included on the Record of Borehole sheets. Shallow groundwater was encountered at depth of 4.1 m below existing ground surface in Borehole BH19-10, and Borehole BH19-11 was dry upon the completion of drilling activities.

6.1 Topsoil and Reworked/Disturbed Materials

Topsoil materials were encountered in all the boreholes and extended to depths ranging from 0.23 m. A summary of topsoil thickness in each of the boreholes is outlined in the table below.

Table 2: Approximate Topsoil Thickness

Borehole No.	Approximate Topsoil Thickness (m)
BH/MW19-10	0.23
BH/MW19-11	0.23

Materials identified as topsoil in this report were classified based on visual and textural evidence as no other testing for organic content or other nutrients was carried out. As such, the ability for these materials to support vegetation has not been assessed.

Reworked/disturbed silty clay material was encountered in both boreholes below the surficial topsoil. Reworked material thickness was observed to be approximately 0.8 m to 1.4 m. The reworked material consisted of silty clay with various amounts of sand and gravel and traces of organics. SPT ‘N’ values within the reworked material was found to be about 4 blows to 10 blows per 0.3 m of penetration indicating a firm to stiff consistency.

The natural water content of the reworked material was measured at 17 to 22 percent.

The results of grain size distribution tests carried out on one selected sample from this deposit is presented in **Figure B1.** Atterberg limits tests that were carried out on the same sample from this deposit measured a liquid limit value of about 28 and a plastic limit value of about 17; yielding a corresponding plasticity index value of about 11. These results are plotted on the plasticity chart as shown in **Figure B2**.

6.2 (CL) sandy Silty Clay (Upper Glacial Till)

A glacial till deposit consisting of cohesive sandy silty clay was encountered directly underneath the topsoil/reworked till deposit at depths ranging from about 0.8 m to 1.4 m below existing ground surface. This deposit extended to a depth of about 5 m below ground surface in Borehole BH19-10 and Borehole BH19-11 was terminated within this deposit. The till deposit is described to be light brown to brown mottled with oxidation staining, with various amounts of sand and gravel. The till is believed to contain cobbles and/or possible boulders which have been inferred as a result of auger grinding observed in both boreholes.

The SPT ‘N’ values measured in these till materials range from 10 blows per 0.3 m of penetration to 35 blows per 0.3 m of penetration, indicating that the silty clay till is generally stiff to hard in consistency.

The results of grain size distribution tests carried out on a selected sample from this deposit is presented in **Figure B1.** An Atterberg limit test was carried out on a single sample obtained from this deposit, which measured a liquid limit value of about 23 and a plastic limit value of about 15; yielding a corresponding plasticity index value of about 8. These results are plotted on the plasticity chart as shown in **Figure B2**.

The water content of the selected samples ranged from about 11 percent to 14 percent.

6.3 (CL-ML) Clayey Silt (Lower Glacial Till)

A clayey silt till deposit was encountered directly underneath the sandy silty clay till at Borehole BH19-10 from a depth of 4.9 m below existing ground surface. The borehole was terminated in this layer at a depth of 6.7 m below existing ground surface. The cohesive till deposit contains various amounts of sand and gravel and is grey in colour.

The SPT ‘N’ values of this till deposit was 10 to 22 blows per 0.3 m of penetration indicating stiff to very stiff consistency.

6.4 Groundwater Conditions

Groundwater level measurements were recorded immediately following drilling procedures. The groundwater level measurements in the drilled boreholes are summarized in ***Table 3***, below.

Table 3: Groundwater Level Measurements (MKIC Property)

Borehole No.	Measurements Upon Completion of Drilling	
	Approximate Groundwater Depth (mbegs)*	Date
BH19-10	4.1	April 3, 2019
BH19-11	dry	April 3, 2019

*mbegs- metres below existing ground surface.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year.

7.0 GEOTECHNICAL ENGINEERING DISCUSSION

This section of the report provides preliminary geotechnical engineering recommendations on the geotechnical aspects of the proposed development based on our interpretation of the limited borehole information and on our understanding of the project scope and requirements. The information in this portion of the report is provided for the guidance of the design engineers and professionals.

Based on the results of this investigation, the subsurface soil conditions encountered at the site are considered to be generally suitable for the proposed residential development.

As noted above, at the time of this report, proposed design grades (i.e., finished floor slab elevation, pavement subgrade and utility invert levels) were not available for the proposed development. The following engineering recommendations regarding the geotechnical design aspects of the project including underground services, pavements and building foundations should be considered as preliminary only, and should be reviewed when the final design grades and utility invert levels have been finalized.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

This report addresses only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report.

7.1 Site Preparation

7.1.1 Subgrade Preparation

Based on the existing site topography, it is assumed that only minor cut and/or fill site grading operations of less than 2.0 m will be required to establish subgrade levels and permit the construction of the proposed residential development. However, in the area of the existing residential dwellings, fills of up to 2.5 m may be required once the former underground structures/basement are removed during the redevelopment.

Any filling carried out at the site in conjunction with regrading (with the exception of future green spaces) should be carried out as engineered fill. Recommendations for the placement of engineered fill are outlined in **Section 7.1.2** of this report, titled “Engineered Fill Requirements”.

In general, the existing site vegetation, surficial topsoil/organics, surficial asphalt/concrete or any other near-surface soils containing significant amounts of organic matter or construction debris are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grade(s), following appropriate environmental procedures. Furthermore, excessively wet soils should be dried before reuse as engineered fill.

Furthermore; excessively-wet soils should be suitably dried before reuse as engineered fill.

The thicknesses of the concrete slabs within the footprint of the existing buildings and the condition of any fill underneath the slab or around the existing residential houses, was not assessed during this investigation. Therefore, when the granular fill and the underlying subgrade material is encountered underneath the existing structures or concrete slabs during construction activities, the acceptance of such fill as suitable for reuse on the site should be assessed by a qualified geotechnical engineer.

Former structures (existing buildings, sewers, etc.) located on site, will have to be removed or decommissioned. Remedial actions, such as removal of existing foundations or re-compaction of backfill will be required, as directed by the geotechnical engineer and the recommendations contained in the report.

Following the stripping of the surficial topsoil and soils containing significant amounts of organics and/or soft/disturbed surficial soils, the exposed subgrade should be heavily proof-rolled with suitable equipment, in conjunction with inspection by qualified geotechnical personnel to confirm that the exposed soils are competent and have been adequately stripped of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e., further subexcavation and replacement) should be carried out on poorly-performing areas identified during the proof-rolling activities, as directed by Golder.

7.1.2 Engineered Fill Requirements

As described above, the anticipated site grading activities may include both cutting and raising (filling) the original grade to meet the final design site grades. At the time of this report, the design cut and fill depths were not available for review. As such, for the purposes of this report, it has been assumed that cuts will not exceed 2 m and grade raises will not exceed more than 2 m.

In general, the existing native material is considered to be acceptable for reuse as engineered fill. Based on the laboratory test results, the water content of soils present at the site are considered to be generally near or above their optimum water contents for compaction, and therefore may require minor drying prior to placement, in general.

It should be noted that the native materials at the site are silty in nature, and as such are susceptible to over-wetting and subsequent freezing during inclement weather. Therefore, it is recommended that site grading activities not be carried out during late fall, winter, early spring seasons or any periods of inclement weather conditions. All oversized cobbles (i.e., greater than 150 mm in size) and boulders, if present, should be removed from excavated material that will be used as engineered fill material.

If imported material is required for the engineered fill process, the material that is proposed for use as engineered fill should be approved by the geotechnical engineer at its source, prior to importing the material to the site. Suitable soils, free of topsoil, organic matter or other deleterious materials can be used as engineered fill provided that the water content of the soil at the time of placement does not vary by more than 2 percent above or below its optimum water content for compaction. Otherwise, the soils may require treatment (i.e., drying or wetting) prior to placement.

Following the inspection and approval of the subgrade as described previously in this report, engineered fill materials should be placed in maximum 300 mm-thick loose lifts and uniformly compacted to 98 percent of the Standard Proctor maximum dry density (SPMDD). Filling should continue until the design elevations are achieved.

Full-time monitoring and in-situ density testing should be carried out by Golder during placement of engineered fill.

The final surface of the engineered fill should be protected as necessary from construction traffic and should be sloped to provide positive drainage for surface water during the construction period. If the engineered fill materials will be left exposed (i.e. uncovered) during periods of freezing weather, additional soil cover should be placed above final subgrade to provide some level of frost protection. Prior to placing the granular subbase and/or base courses within pavement areas, the surface of the engineered fill/subgrade should be inspected by Golder.

7.2 Installation of Underground Services

7.2.1 Temporary Excavations

Details of the underground servicing for the proposed development are unknown at the time of this investigation; as such, for the purpose of this report, the maximum depth of the underground services was assumed to be about 3 m below the existing ground surface. Once detailed design is completed, review of the underground services should be completed by this office for compliance with the recommendations contained herein.

The founding soils are anticipated to generally consist of the native sandy silty clay or engineered fill. These materials are considered to be suitable for supporting the underground services provided that the integrity of the base of the trench excavations is maintained during construction. Where softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

Care should be taken to direct surface water away from any open excavations and all temporary excavations should be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects.

The groundwater level in the open boreholes, upon completion of drilling, was measured to be at a depth 4 m below existing ground surface. Whereas, the groundwater level in the monitoring wells within close proximity, was measured to be at depths ranging from 0.4 m to 6.3 m below existing ground surface, (Elev. 245 m to Elev. 263 m).

In general, groundwater in the excavations within the native deposits, are likely to be handled by collection via properly constructed and filtered sumps, located within the excavations, and then pumping and discharging the water to a suitable discharge point. However, should excavations deeper than 3-4m below existing ground surface be required, the following recommendations will need to be review and revised to determine if some form of active dewatering, such as well points, may have to be implemented.

Excavations for the site servicing would generally extend through the native sandy silty clay deposit. Conventional excavation equipment should be suitable to excavate through these materials.

The stiff to hard native silt clay till soils are classified as a “Type 2” soils under the OH&S Act. As such, all conventional temporary trench excavations should consist of open cuts with side slopes not steeper than 1 horizontal to 1 vertical in the overburden soils to within 1.2 m of the base of the excavation and then may be made vertical to the base. Where engineered fill (based on silty clay material) is used or the native silty clay exhibits signs of water seepage, the soil is classified as a “Type 3”, as such all conventional temporary trench excavations should consist of gradient of 1 horizontal to 1 vertical.

Where the side slopes of excavations are required to be steepened to limit the extent of the excavation, then some form of trench support may be required. Some trench excavations could be carried out using a vertically-excavated, unsupported excavation (using a properly-engineered trench liner box for protection, certified by an experienced engineer); or by a supported (sheeted) excavation if conditions warrant so; such as in wet areas and/or in close proximity to adjacent underground services

7.2.2 Pipe Bedding and Cover

The bedding for the sewers and watermains should be compatible with the size, type and class of pipe and the surrounding subsoil and the requirements of the Town of Caledon. If granular bedding is deemed to be acceptable, then Ontario Provincial Standard Specifications (OPSS) Granular A should be used from at least 150 mm below invert of the pipe to the springline. Clear stone should not be used as bedding material. From springline to 300 mm above the obvert of the pipe, sand cover could be used. All bedding and cover material should be placed in 150 mm loose lifts and uniformly compacted to at least 100 percent of SPMDD. Where variable fill materials, softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

7.2.3 Trench Backfill

The excavated materials from the site will consist predominantly of silty clay till materials. Based on the measured water contents, in general, the native materials encountered at the site are estimated to be near or below their optimum water contents for compaction, and therefore, will probably require only minor wetting prior to placement.

Care should be taken to maintain the water content of the soils close to/at the optimum water content for compaction during the construction operations, as difficulties with compaction and/or backfill performance would be anticipated with fine-grained soils where the water content is significantly above the optimum for compaction purposes. Soils that contain significant quantities of organics or debris are also not suitable for use as trench backfill within settlement-sensitive areas. In addition, all boulders and cobbles greater than 150 mm in size should be removed from the trench backfill materials. If there is a shortage of suitable in-situ material, an approved imported material such as Ontario Provincial Standard Specifications Select Subgrade Material should be used for trench backfill. Again, as noted above, the trench backfill materials are silty in nature and are very susceptible to wetting/freezing temperatures. Backfilling trenches during cold or wet weather is not recommended.

Trench backfill should be placed in maximum 300 mm loose lift thickness and uniformly compacted to at least 98 percent of the SPMDD of the material. Soil that is frozen should not be used as backfill.

Normal post-construction settlement of the compacted trench backfill should be anticipated with the majority of such settlement taking place within about 12 months following the completion of trench backfilling operations. If the trench backfill operations are completed during the winter months, post-construction settlements may increase beyond typical anticipated values. These settlements will be reflected at the ground surface. If the asphalt binder course is laid shortly following the completion of the trench backfilling operations, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding. If possible, the surface course asphalt should not be placed over the binder course asphalt for about 12 months. Where scheduling requires that the surface course be placed over the binder course asphalt before this period, trench backfill settlement would be reflected by subsidence and possible cracking of the finished pavement surface in these areas which, depending upon the extent and magnitude, may require local repairs.

7.3 Building Foundations

As previously indicated, the existing site vegetation, surficial topsoil/organics and other near-surface soils containing significant amounts of organic matter are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grades.

Based on the subsurface conditions encountered in the boreholes, strip and spread footings that may be used, provided that the footings are founded on the native sandy silty clay deposit or on engineered fill (based on existing site soils) placed in accordance with the recommendation outlined in ***Section 7.1***, and maintained a minimum depth of soil embedment below finished adjacent ground surface and top of slab of 1.2 m.

For such strip and spread footings, a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa and a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa may be assumed for design purposes, provided that the strip footings dimensions of 0.45 m in width and 10 m in length or spread footings have a minimum width of 0.60 m and a maximum width of 1.0 m.

Where spread footings are constructed at different elevations, the difference in elevation between the individual footings should not be greater than one half the clear distance 650 mm between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with the Ontario Building Code (2012), Section 9.15.3.9.

The maximum total and differential settlements are expected to be less than 25 mm and 20 mm; respectively, for footings designed, constructed and inspected as outlined above.

All exterior footings, and interior footings in unheated areas, should be founded at a minimum depth of 1.2 m below finished grade level in order to provide adequate protection against frost penetration.

The native soils are susceptible to disturbance from construction activity, especially during wet or freezing weather. Care should be taken to preserve the integrity of the materials as bearing strata. It is essential that the founding surface for the footings be inspected by qualified geotechnical personnel prior to placing concrete. If the concrete for the footings cannot be placed immediately after excavation and inspection of the subgrade, it is recommended that a working mat of lean concrete be placed in the excavation to protect the integrity of the bearing stratum.

Resistance to lateral forces/sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the CHBDC. The unfactored coefficient of friction, tan δ, for the interface between the cast-in-place concrete footing and the properly-prepared subgrade can be assumed to be 0.35.

7.3.1 Below Grade Walls

The exterior perimeter of all housing basement walls should be backfilled with an imported free draining, non-frost susceptible granular material approved by a geotechnical engineer, carefully placed and compacted in 200 mm thick loose lifts. The design of the foundation walls for the below-grade walls should take into account the horizontal soil loads as well as surcharge loads that may occur during or after construction and should be designed using a lateral (at-rest) earth pressure coefficient of 0.5 and a unit weight of backfill of 20 kN/m3.

The wall backfill layers should be compacted to at least 95 per cent of the materials' standard Proctor maximum dry density. Light compaction equipment should be used immediately adjacent to the foundation wall, otherwise compaction stresses on the wall may be greater than that imposed by the backfill material. With the exception of the driveway area, the upper 0.3 m of backfill should consist of clayey material to provide a low permeability cap and the exterior grade should also be shaped to slope away from the building.

Provided that the excavations adjacent to foundation/basement walls are backfilled with free-draining granular materials and a drainage collection system is provided around the perimeter of the building, the design of below-grade walls does not need to take into account hydrostatic forces acting on the walls. However, it is recommended that the exterior of the below-grade walls be damp-proofed.

7.4 Pavement Design within the Proposed Development

Following site grading operations, as noted previously, the proposed pavement subgrade will generally consist of either re-compacted engineered fill or native silty clay till. These materials are considered to be frost susceptible, and as such, the pavement design provided in ***Table 4***, below has taken this condition into consideration.

Based on the proposed pavement usage, (i.e. residential development type traffic and loads/frequencies) frost susceptibility and strength of the subgrade soils, the following pavement component given are recommended for the proposed development of access roads and streets, however the Town of Caledon/Region of Peel design standards should be followed:

Table 4: Pavement Design

Material		Minimum Thickness of Pavement Components (mm)	
		Local Road (7.9m Road Pavement Width)	9.5 m Neighbourhood Collector (8.9 m Road Pavement Width)
Asphaltic Concrete (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	90
	Granular A Base	150	150

Material		**Minimum Thickness of Pavement Components (mm)**	
		Local Road (7.9m Road Pavement Width)	**9.5 m Neighbourhood Collector (8.9 m Road Pavement Width)**
Granular Materials (OPSS.MUNI 1010)	Granular B Type II Subbase	350	500
Total Pavement Thickness (mm)		605	780
		Prepared and Approved Subgrade	

As part of the subgrade preparation, proposed access roads should be stripped of topsoil and other obviously unsuitable fill or organic materials. Fill required to raise the grades to design elevations should conform to the engineered fill requirements outlined previously in the report. Soft or spongy trench backfill areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98 percent SPMDD. Prior to placing pavement subbase and/or base materials, the exposed soil subgrade should be heavily proof-rolled in conjunction with an inspection by Golder. The granular subbase and base materials should be placed in loose layers no thicker than 200 mm and uniformly compacted to 100 percent of their SPMDD. The binder course and surface course asphalt materials should be compacted to minimum 92.0 percent of their Marshall Maximum Relative Density according to OPSS 310, as measured in the field using a nuclear density gauge.

Where new pavement abuts existing pavement (e.g. at the development limits), proper longitudinal lap joints should be constructed to key the new asphalt into the existing asphalt surface. The existing asphalt edges should be provided with a proper sawcut edge prior to keying-in the new asphalt. It should be ensured that any undermining or broken edges resulting from the construction activities are removed by the sawcut.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength may not be adequate to support heavy construction loading especially during wet weather or where backfill materials wet of optimum have been placed. In this regard, the design subbase thickness may not be sufficient for a construction haul road and additional subbase (in the order of 450 mm) may be required. In any event, the subgrade should be proofrolled and inspected by Golder prior to placing the subbase and any additional material, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

7.4.1 Subgrade Drainage

In order to preserve the integrity of the pavement, continuous subdrains should be placed at the concrete curb lines along both sides of the proposed streets. The invert of the subdrains should be at least 300 mm below the bottom of the Granular “B” subbase and should be sloped to drain to catchbasins. The subdrains should consist of perforated pipe wrapped in a suitable geotextile and surrounded on all sides with a minimum thickness of 150 mm of OPSS.PROV 1002 Concrete Fine Aggregate (i.e. concrete sand).

8.0 SEISMIC SITE CLASSIFICATION

Seismic hazard is defined in the 2012 Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 second, 0.5 second, 1.0 second and 2.0 seconds and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity, Standard Penetration Test (SPT) resistance, undrained soil shear strength, etc.) in the 30 m below the foundation level. There are six site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain acceleration and velocity-based site coefficients F_a and F_v; respectively, used to modify the UHS to account for the effects of site-specific soil conditions in design.

Based on the results of the preliminary geotechnical investigation and assuming soils below the maximum depth investigated exhibit similar properties / strengths, a **Site Class D** is estimated for planning purposes. The Site Class will need to be verified, and adjusted as necessary, during detail design.

9.0 INSPECTION AND TESTING

During construction, full-time observation should be carried out during engineered fill and site servicing backfill placement, and sufficient foundation inspections, subgrade inspections and in-situ materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.

10.0 CLOSING

We trust that this preliminary report provides enough preliminary geotechnical engineering information to proceed with the detailed design of the proposed development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Signature Page

Golder Associates Ltd.

Erti

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Geotechnical Engineer

Jeff Tolton, C.E.T.
Associate, Senior Geotechnical Technologist

JD/EM/JET/sm

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https://golderassociates.sharepoint.com/sites/102461/technical work/phase 4000 - kenndy mayfield investement/19115264 (4000) draft georeport mayfield kennedy.docx

LEGEND

⊕	Approximate Borehole Location
⊕	Approximate Previous and Adjacent Properties Geotechnical Borehole (Edward Wong 2017, Golder 2019)
—	Watercourse
▭	Waterbody
▨	Wetland
▭	Site Boundary
▭	Mayfield Investment Corp. Site Boundary

0 75 150
1:3,000 METRES

REFERENCE(S)
1. IMAGERY: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
© 2019 MICROSOFT CORPORATION © 2019 DIGITALGLOBE ©CNES (2019) DISTRIBUTION AIRBUS DS
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
MAYFIELD KENNEDY INVESTMENT CORP.

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, MAYFIELD KENNEDY INVESTMENT CORP., CALEDON, ON

CONSULTANT
GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	MM
PREPARED	MM
REVIEWED	EM
APPROVED	-

TITLE
SITE AND BOREHOLE LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
19115264	4000	-	1

PATH: S:\Clients\Snells_Hollow_Developer_Group\Mayfield_Rd_Caledon\99_PROJ\19115264\40_PROD\0002_Prelim_Geotechnical_Investigation\19115264-0002-BG-0003.mxd PRINTED ON: 2019-05-31 AT: 12:53:29 PM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX A

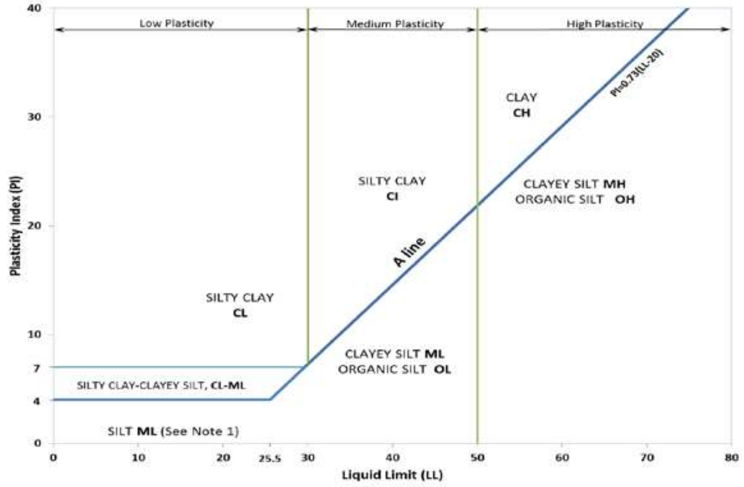
Method of Soil Classification
Abbreviations and Terms used on Record of Borehole
List of Symbols
Record of Boreholes

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index $= (w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_C	consistency index $= (w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan\delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

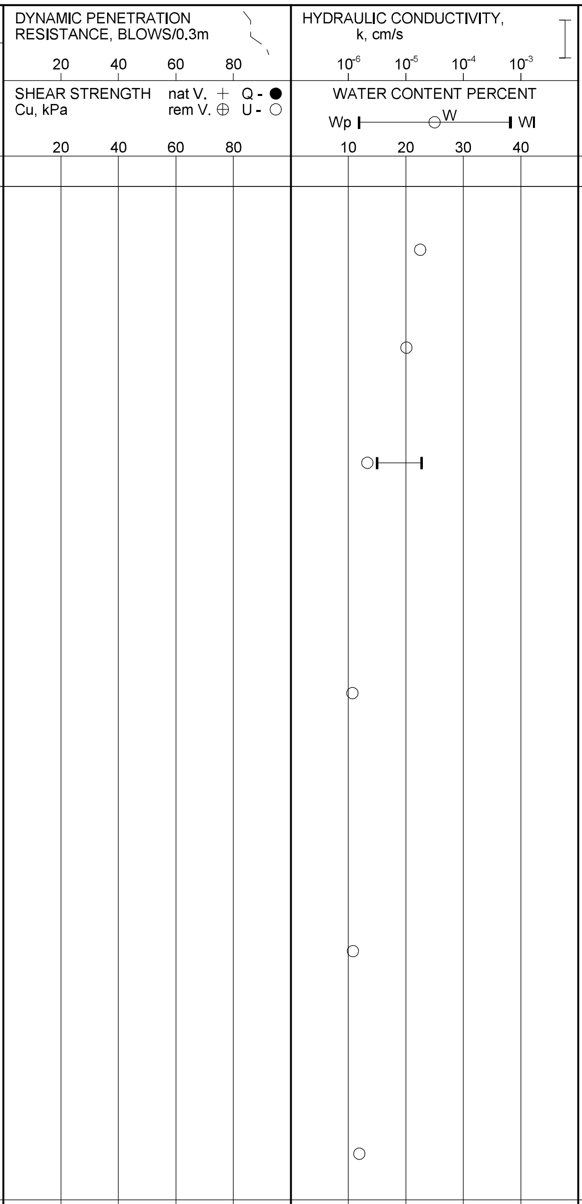
PROJECT: 19115264-4000
LOCATION: Lat. 43.74607 Long. -79.817117
(See Figure 1)

RECORD OF BOREHOLE: BH19-10

BORING DATE: April 3, 2019

SHEET 1 OF 1
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	267.80					
0	CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (230 mm)	0.00	1A	SS			
		(CL-ML) CLAYEY SILT, some sand, trace gravel; dark brown to brown, mottled; cohesive, w~PL, firm	267.57 0.23	1B	SS	5		
1		(CL) sandy SILTY CLAY, some sand, trace gravel, contains inferred cobbles/boulders; light brown with oxidation staining, (TILL); cohesive, w<PL, very stiff to hard	267.04 0.76	2	SS	18		
2				3	SS	29	MH	
				4	SS	35		
3		- Auger grinding on inferred cobbles at a depth of 3 m		5	SS	31		
4								2/04/2019
				6A	SS	25		
5		(CL-ML) CLAYEY SILT, some sand, some gravel; grey, (TILL); cohesive, w~PL to w>PL, stiff to very stiff	262.86 4.94	6B	SS			
				7A	SS	10		
6				7B	SS			
				8	SS	22		
7		END OF BOREHOLE. Notes: 1. Water level measured at 4.1 mbgs upon completion of drilling.	261.09 6.71					
8								
9								
10								



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

PROJECT: 19115264-4000
LOCATION: Lat. 43.74736 Long. -79.816608
(See Figure 1)

RECORD OF BOREHOLE: BH19-11

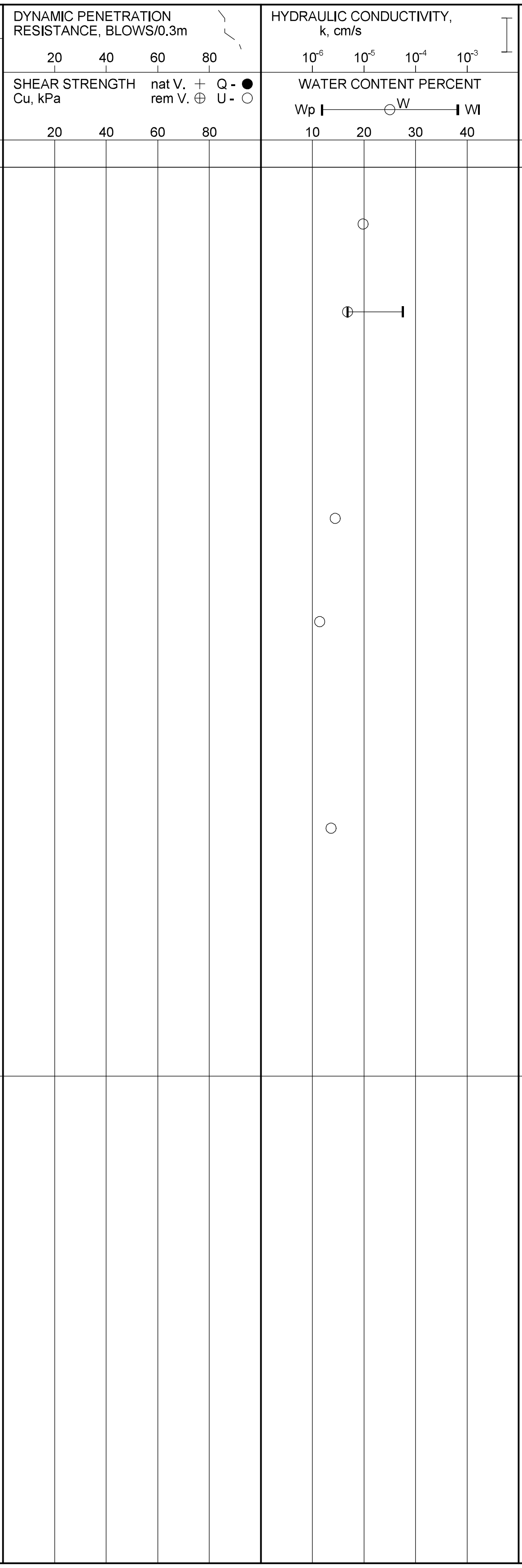
BORING DATE: April 3, 2019

SHEET 1 OF 1
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

DEPTH (m)	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	265.00				
0	TOPSOIL (230 mm)	0.00	1A	SS		
	(CL) sandy SILTY CLAY, trace gravel; brown, mottled brown/light brown; cohesive, w<PL, firm to stiff - Cobbles/boulders inferred from auger grinding at 6 m	264.77 0.23	1B	SS	10	
1			2	SS	4	MH
	(CL) sandy SILTY CLAY, trace gravel; mottled light brown to brown, (TILL); cohesive, w<PL, very stiff to hard	263.60 1.40	3	SS	10	
			4	SS	28	
			5	SS	29	
			6	SS	33	
			7	SS	30	
	END OF BOREHOLE.	258.29 6.71				

Notes:
1. Borehole dry upon completion of drilling.



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: EM

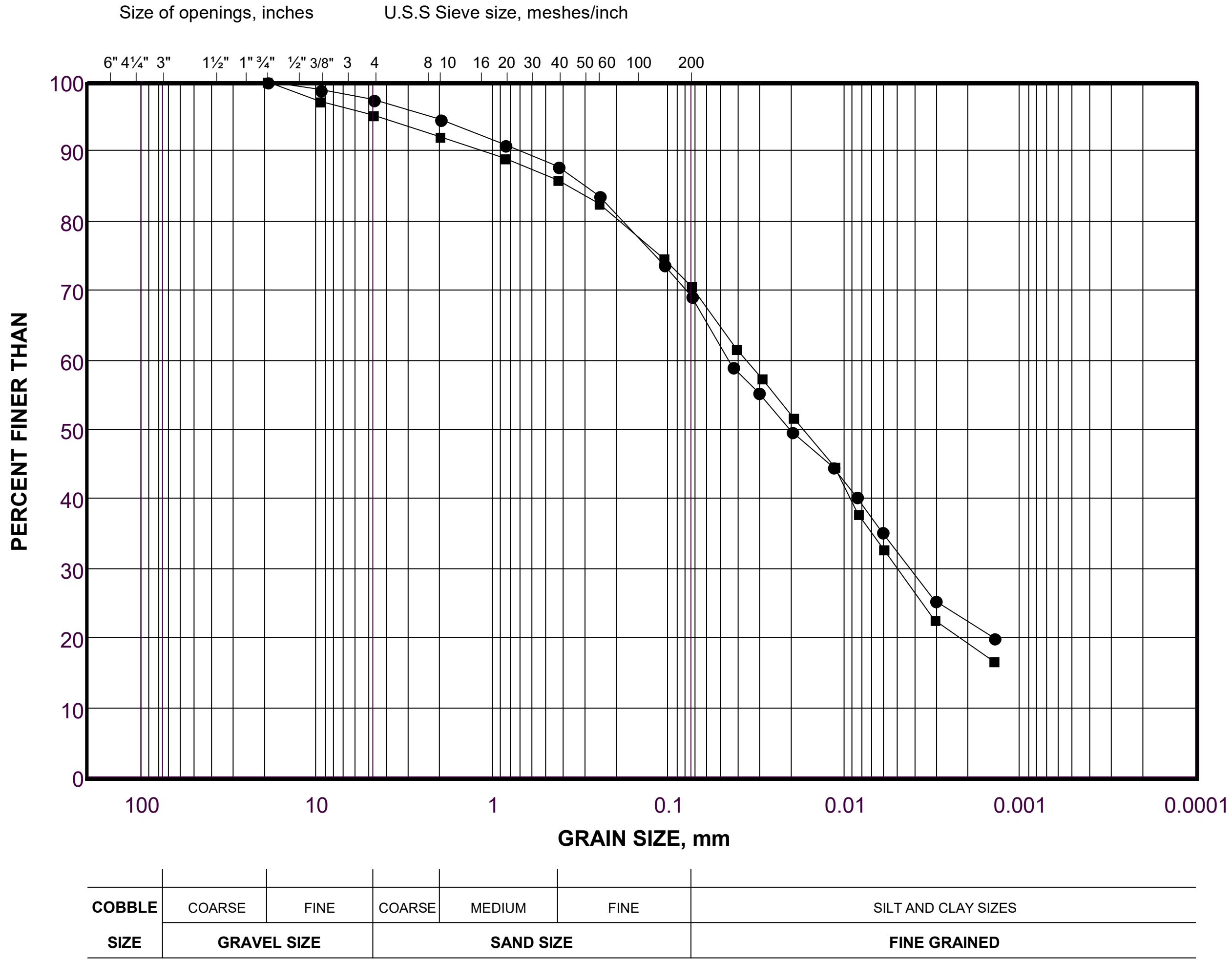
APPENDIX B

Geotechnical Laboratory Figures

GRAIN SIZE DISTRIBUTION

sandy SILTY CLAY (CL)

FIGURE B1



LEGEND

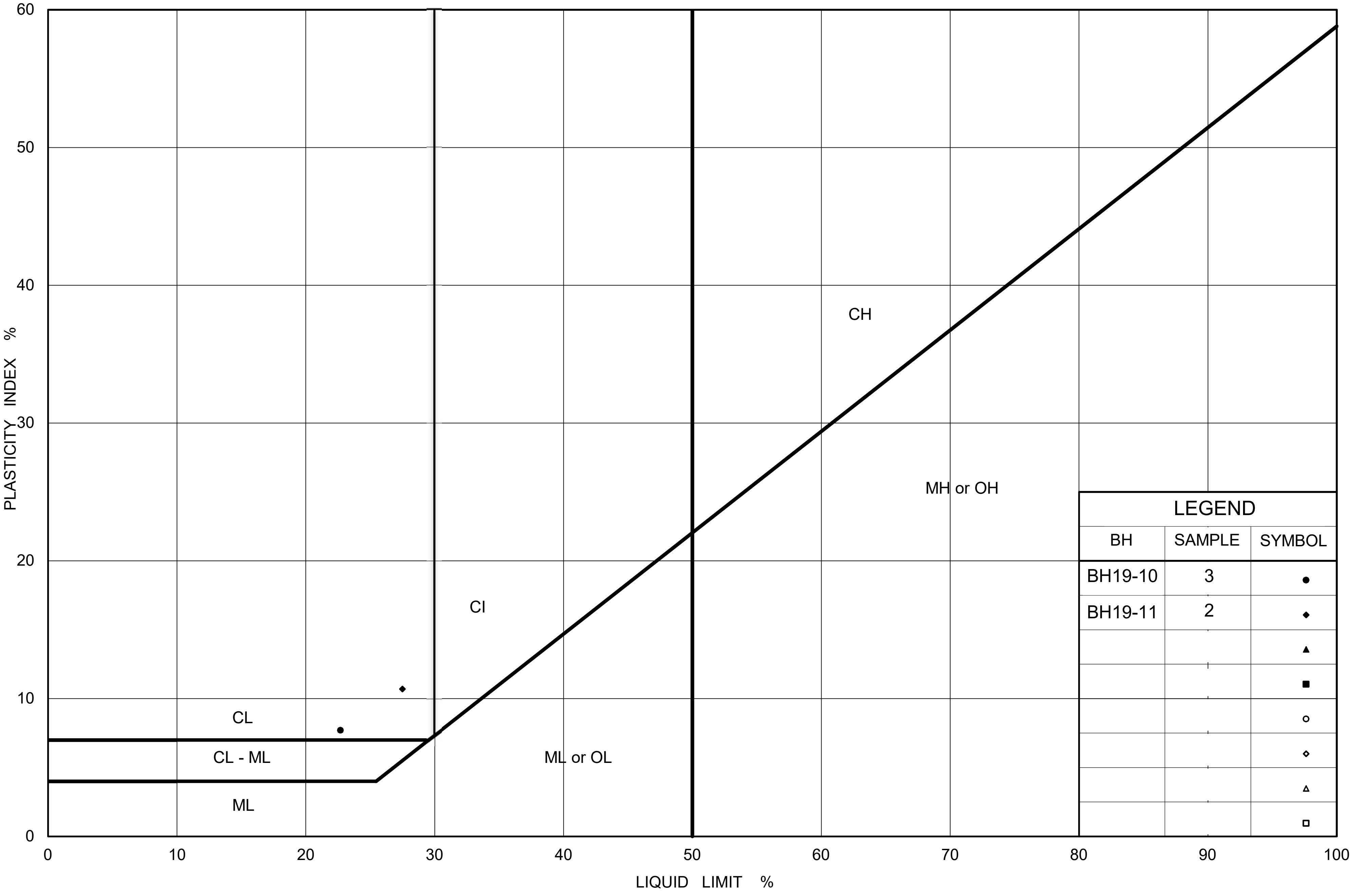
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH19-11	2	0.76 - 1.37
■	BH19-10	3	1.52 - 2.13

Project Number: 19115264

(4000) Checked By:EM

Golder Associates

Date: 12-Jun-19



GOLDER

PLASTICITY CHART
sandy SILTY CLAY (CL)

Figure No. B2

Project No. 19115264 (4000)

Checked By: EM

APPENDIX C

Previous Geotechnical Borehole Logs

PROJECT: 19115264-3000
LOCATION: Lat. 43.747371 Long. -79.818742
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-01

BORING DATE: April 4, 2019

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

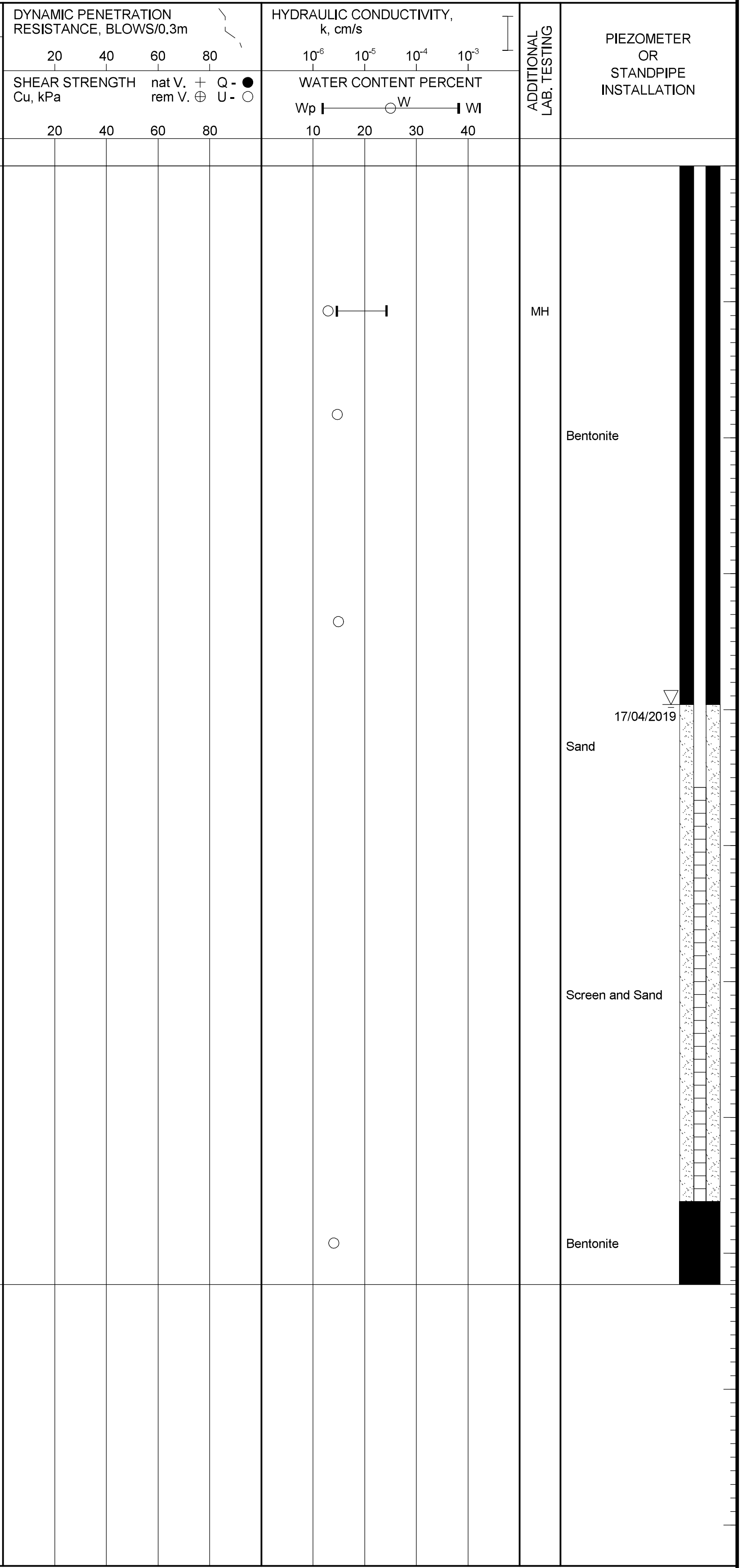
DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	266.80
0	TOPSOIL (250 mm)	0.00
	(CL) SILTY CLAY, trace sand, trace gravel, trace organics; brown; cohesive, w~PL, stiff	266.55 0.25
1	(CL) sandy SILTY CLAY, trace gravel; light brown with oxidation staining, (TILL); cohesive, w<PL, very stiff to hard	266.10 0.70
2	- Some to trace sand below depth of 1.6 m	
5	- Silty sand layers/seams encountered below depth of 4.9 m	
6	(CI/CL-ML) SILTY CLAY to CLAYEY SILT, trace to some sand, trace gravel, with inferred cobbles; grey, (TILL); cohesive, w~PL to w>PL, stiff to hard	261.01 5.79
8	- Sand layer, approximately 70 mm thick, encountered at a depth of 8.1 m	
	END OF BOREHOLE.	258.57 8.23

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1A	SS	10
1B	SS	
2	SS	16
3	SS	21
4	SS	23
5	SS	32
6	SS	21
7	SS	12
8	SS	48

Notes:
1. Borehole dry upon completion of drilling.

2. Water level measured in monitoring well as follows:

Date	Depth	Elev. (m)
April 17, 2019	3.95 mbgs	262.85 m



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/2000

RECORD OF BOREHOLE: BH/MW19-02

SHEET 1 OF 2

LOCATION: Lat. 43.747664 Long. -79.814643
(See Figure 1)

BORING DATE: April 2, 2019

DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	257.20			
TOPSOIL (610 mm)	0.00	1	SS	4
(CL)SILTY CLAY, some to trace sand, trace gravel, trace organics; brown/dark brown with oxidation staining; w>PL, firm	256.59 0.61	2A	SS	
(CL) sandy SILTY CLAY, trace gravel; light brown with oxidation staining, (TILL); cohesive, w~PL, firm to stiff	256.35 0.85	2B	SS	8
- Silt/sand seams/layers below 1.7 m		3	SS	8
		4	SS	13
		5	SS	9
(CL-ML) CLAYEY SILT, some to trace sand, trace gravel; grey, (TILL); cohesive, w>PL, very stiff to stiff to hard	253.24 3.96			
		6	SS	15
		7	SS	13
		8	SS	17
- Becoming sandy at 9.1 m				
- Auger grinding at a depth of 9.5 m to 11 m		9	SS	57

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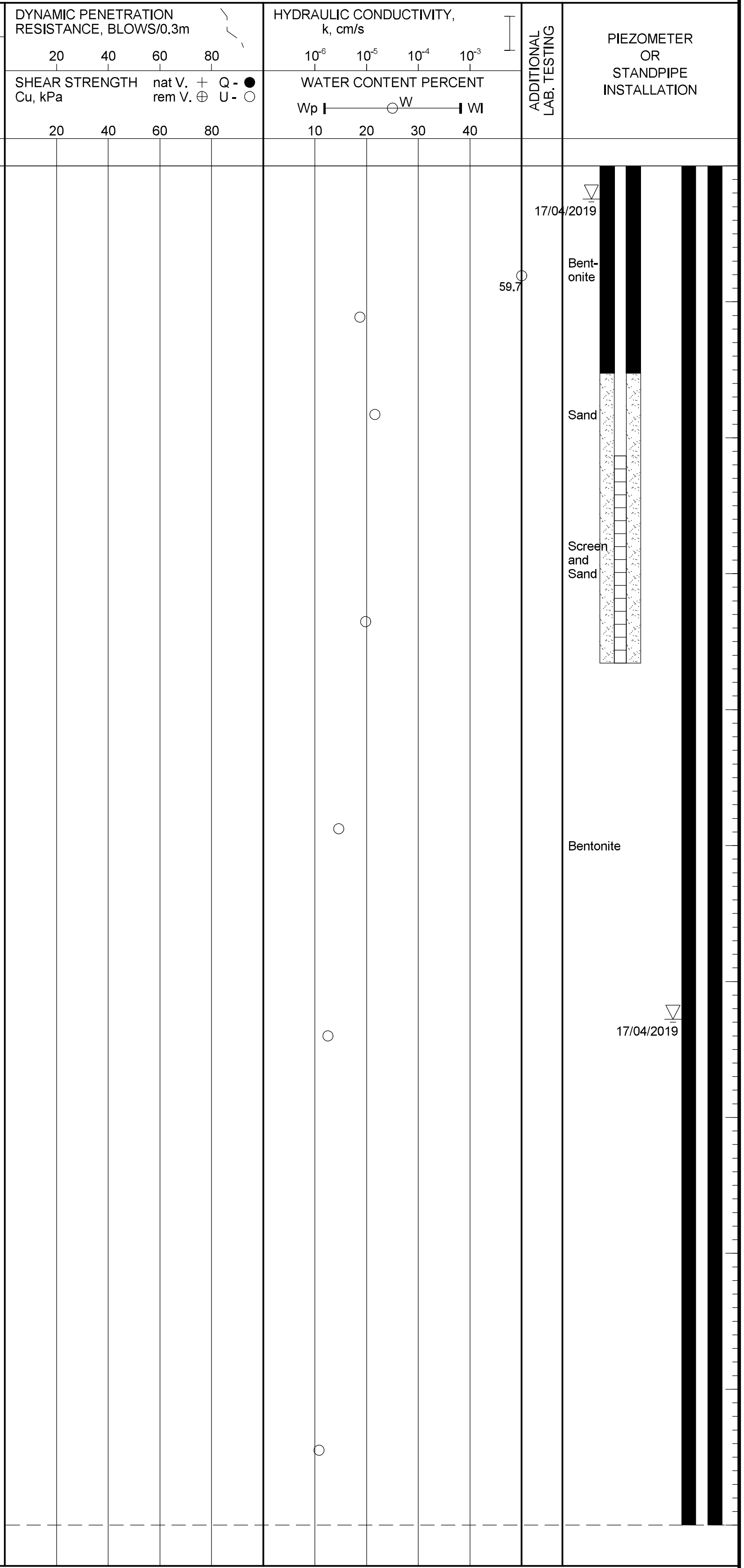


DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.747664 Long. -79.814643

(See Figure 1)

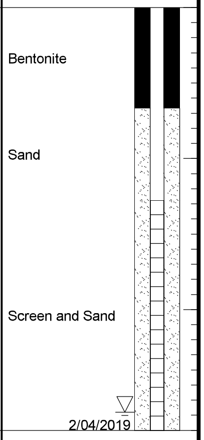
RECORD OF BOREHOLE: BH/MW19-02

BORING DATE: April 2, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME 75 Track Mount Power Auger 100 mm Solid Stem	(SW-SM) SAND to SILTY SAND, medium grained, contains inferred cobbles/boulders; light brown; non-cohesive, wet, compact to very dense		247.14 10.06							Bentonite
11					10	SS	26				Sand
12		- Cobbles/boulders inferred from auger grinding at a depth of 12 m									Screen and Sand
				244.40 12.80	11	SS	52				2/04/2019
13		END OF BOREHOLE.									
14											
15											
16											
17											
18											
19											
20											



Notes:
1. Water level measured in monitoring well as follows:

Deep Well

Date	Depth	Elev. (m)
April 2, 2019	12.67 mbgs	244.53 m
April 17, 2019	6.27 mbgs	250.93 m

Shallow Well

Date	Depth	Elev. (m)
April 17, 2019	0.25 mbgs	256.95 m

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.745322 Long. -79.814288

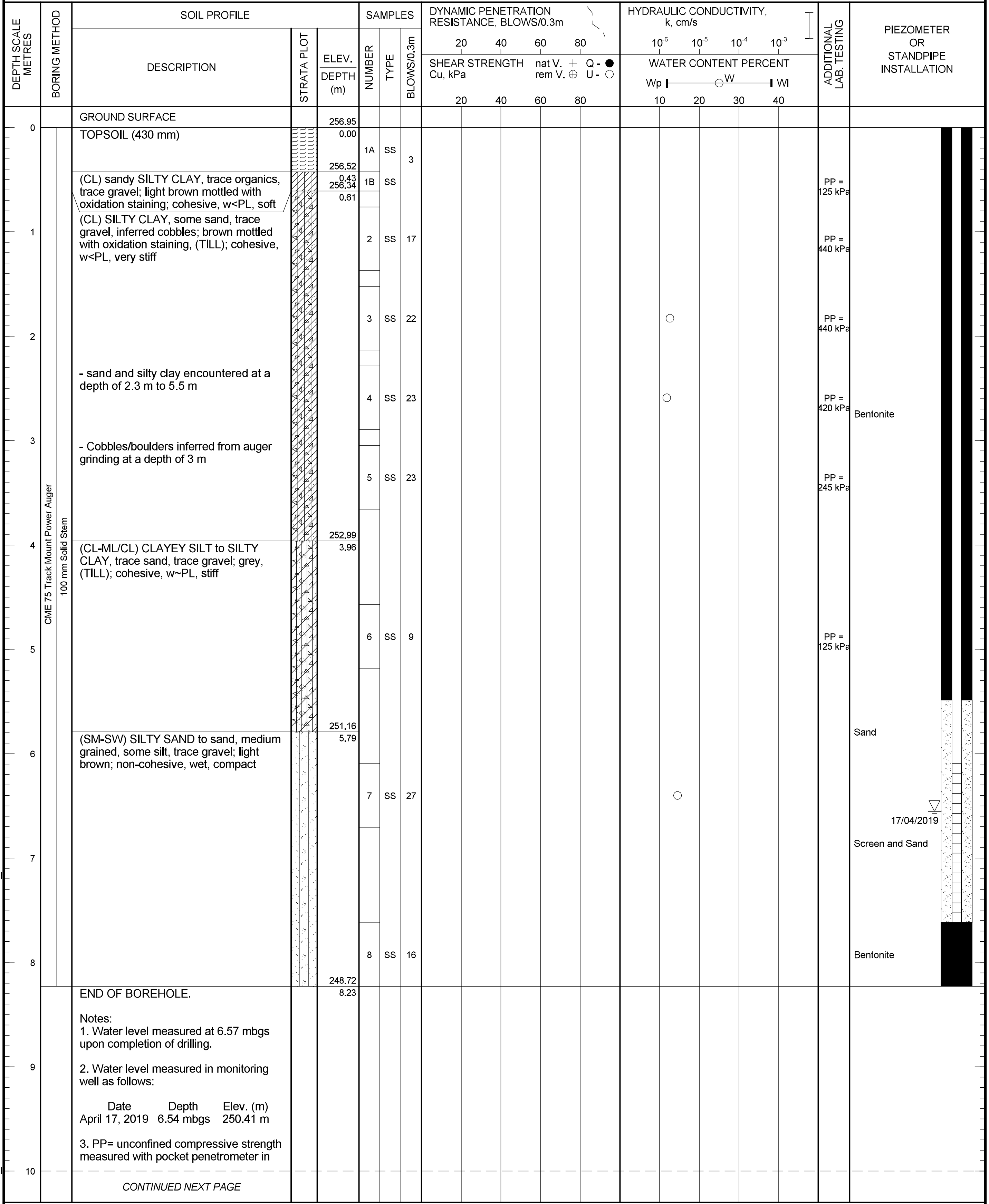
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-09

BORING DATE: April 3, 2019

SHEET 1 OF 2

DATUM: Geodetic



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	256.95
TOPSOIL (430 mm)	0.00
(CL) sandy SILTY CLAY, trace organics, trace gravel; light brown mottled with oxidation staining; cohesive, w<PL, soft	256.52 0.43
(CL) SILTY CLAY, some sand, trace gravel, inferred cobbles; brown mottled with oxidation staining, (TILL); cohesive, w<PL, very stiff - sand and silty clay encountered at a depth of 2.3 m to 5.5 m - Cobbles/boulders inferred from auger grinding at a depth of 3 m	256.34 0.61
(CL-ML/CL) CLAYEY SILT to SILTY CLAY, trace sand, trace gravel; grey, (TILL); cohesive, w~PL, stiff	252.99 3.96
(SM-SW) SILTY SAND to sand, medium grained, some silt, trace gravel; light brown; non-cohesive, wet, compact	251.16 5.79
END OF BOREHOLE.	248.72 8.23

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	3	
1B	SS		PP = 125 kPa
2	SS	17	PP = 440 kPa
3	SS	22	PP = 440 kPa
4	SS	23	PP = 420 kPa
5	SS	23	PP = 245 kPa
6	SS	9	PP = 125 kPa
7	SS	27	
8	SS	16	

Notes:

1. Water level measured at 6.57 mbgs upon completion of drilling.

2. Water level measured in monitoring well as follows:

Date	Depth	Elev. (m)
April 17, 2019	6.54 mbgs	250.41 m

3. PP= unconfined compressive strength measured with pocket penetrometer in

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.745322 Long. -79.814288
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-09

BORING DATE: April 3, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		the field.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

EDWARD WONG

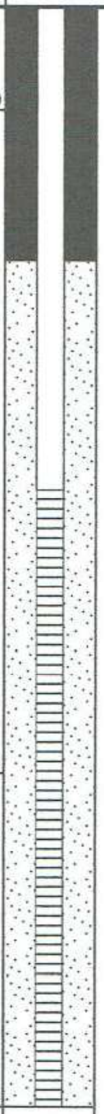
WELL NUMBER 5

PAGE 1 OF 1

CLIENT Dilip Kumar Jain
PROJECT NUMBER Ma002995a
PROJECT NAME 3278 Mayfield Road
PROJECT LOCATION Town of Caledon

DATE STARTED 10/18/17 **COMPLETED** 10/18/17
DRILLING CONTRACTOR Fadroy Enterprise
DRILLING METHOD Solid Stem Augers
LOGGED BY J.J. **CHECKED BY** E.W.
NOTES
GROUND ELEVATION 265 m **HOLE SIZE** 150 mm
GROUND WATER LEVELS:
AT TIME OF DRILLING Dry
▼ **AT END OF DRILLING** 2.85 m / Elev 262.15 m
▽ **AFTER DRILLING** 2.85 m / Elev 262.15 m

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 1	1-3-3-3 (6)	MC = 23%		**TOPSOIL** - ~600 mm thick.	
				0.60	264.40	
1	SS 2	3-4-5 (9)	MC = 16%		**FILL** - clayey silt, rootlets, topsoil inclusions, dark brown and brown, very moist.	Bentonite
2	SS 3	2-4-5 (9)	MC = 22%			
	SS 4	4-7-10 (17)	MC = 19%			50 mm dia. PVC Riser, Filter Sand
3					▼	
	SS 5	2-5-9 (14)	MC = 21%			
4						
				4.50	260.50	
5	SS 6	3-6-8 (14)	PP = 400 kPa MC = 16%		**SILTY CLAY** - trace gravel, grey, very moist, hard.	50 mm dia. PVC Slotted Pipe, Filter Sand
6						
	SS 7	4-6-8 (14)	PP = 250 kPa MC = 16%		-becoming very stiff below ~6.0 m depth	
				6.45	258.55	
					Bottom of hole at 6.45 m.	



BORING NUMBER 6

CLIENT Dilip Kumar Jain
PROJECT NAME 3278 Mayfield Road
PROJECT NUMBER Ma002995a
PROJECT LOCATION Town of Caledon

DATE STARTED 10/18/17 **COMPLETED** 10/18/17
GROUND ELEVATION 260 m **HOLE SIZE** 150 mm
DRILLING CONTRACTOR Fadroy Enterprise
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Augers
AT TIME OF DRILLING Dry
LOGGED BY J.J. **CHECKED BY** E.W.
AT END OF DRILLING Dry
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				0.20	**TOPSOIL** - ~200 mm thick.	259.80
	SS 1	4-5-5-5 (10)	MC = 17%		**SILTY SAND** - scattered clay seams, brown, loose.	
				0.90		259.10
1	SS 2	6-13-20 (33)	PP >450 kPa MC = 14%		**CLAYEY SILT** - some sand, trace gravel, oxidized, brown, very moist, hard.	
	SS 3	6-16-24 (40)	PP >450 kPa MC = 13%			
2						
	SS 4	12-17-27 (44)	PP >450 kPa MC = 14%			
3						
	SS 5	6-11-21 (32)	PP >450 kPa MC = 15%			
4						
	SS 6	7-24-15 (39)	PP >450 kPa MC = 13%			
5						
6				6.00		254.00
	SS 7	10-20-33 (53)	PP >450 kPa MC = 12%		**SAND TILL** - brown, very moist, very dense.	
				6.45		253.55
					Bottom of hole at 6.45 m.	

APPENDIX D

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

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REPORT

Preliminary Geotechnical Investigation, Clearbrook Developments Limited

Proposed Residential Development, Snells Hollow Secondary Plan, Caledon, Ontario

Submitted to:

Clearbrook Developments Limited
Jane Deighton, President
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19115264 Phase 5000

June 24, 2019

Distribution List

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1 e-copy: Snells Hollow Developers Group

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TABLES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Clearbrook Development Limited (CDL) to provide preliminary geotechnical consulting services to support a draft plan approval for a future residential subdivision development located north east of Kennedy Road and Mayfield Road in Caledon, Ontario (the Site), as shown in the Site and Borehole Location Plan, ***Figure 1.***

The terms of reference for the geotechnical consulting services are included in Golder's proposal No. P19115264 Rev 1, dated March 8, 2019.

The purpose of the investigation is to obtain information on the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of boreholes and geotechnical laboratory tests. Based on our interpretation of the factual information collected as part of the preliminary geotechnical investigation carried out at this site, a general description of the subsurface conditions across the site is presented herein. The interpreted subsurface conditions and available project details were used to develop preliminary engineering parameters and recommendations on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

This report provides the results of the preliminary geotechnical investigation and should be read in conjunction with the *"Important Information and Limitations of This Report"* ***Appendix D***. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder should be given an opportunity to confirm that the recommendations in this report are still valid.

2.0 SITE DESCRIPTION AND BACKGROUND

The subject property is located north west of Heart Lake Road and Mayfield Road and is part of the Snells Hollow Secondary Plan, which is a proposed residential development to be located in the southern part of the Town of Caledon. The site is bounded by Heart Lake Road to the east, Mayfield Road to the south, adjacent agricultural properties to the west and Highway 410 to the north, as shown in **Figure 1**.

The site has a total area of approximately 24 hectares (61 acres) of agricultural land, a pond and a valley creek lands. The valley and watercourse / wetland running through the southern portion of the Site, understood to be a tributary to Heart Lake and Etobicoke Creek. The site is predominantly flat land which slopes towards the north to Highway 410 and towards the pond and creek to the south.

Based on our understanding, the Site is to be developed into a residential development with associated underground services and associated roads. For the purposes of this report, we have assumed that the future residential houses will be constructed utilizing shallow strip/spread footings, with an interior slab-on-grade, and one-level of underground basement. We have also assumed cuts and/or fills required for site grading purposes will not exceed 2.0 m and that the invert of the site servicing will be no greater than 3.0 m below existing site grades.

A separate geotechnical slope stability assessment report is carried out as part of the development setback of the property and documented in report titled, "Geotechnical Setback Assessment For Erosion Hazard Limit, Snell's Hollow Secondary Plan, Caledon, Ontario" dated June 2019, by Golder Associated.

3.0 ADJACENT GEOTECHNICAL SITE INFORMATION

An additional geotechnical investigation consisting of ten boreholes were also carried out as part of the Snells Hollow Secondary Plan to the east and west adjacent properties (Golder, 2019). Also, a previous geotechnical investigation consisting of three boreholes was also carried out by Edward Wong and Associates, 2017 (Wong, 2017), to the west property.

The following is a summary of subsurface conditions obtained from boreholes located adjacent to the site (BH/MW19-03, BH/MW19-13, BH/MW19-07 and BH19-18 to BH19-19) from Golder, 2019, and (BH1, BH2 and BH4) from Wong, 2017 as shown on the Site and Borehole Location Plan, ***Figure 1***.

In general, the subsurface conditions encountered typically consist of a surficial topsoil ranging in thickness from about 200 mm to over 350 mm overlying a disturbed/reworked dark to light brown silty clay layer, which contains various amounts organics, underlain by glacial till composed of very stiff to hard brown silty clay to sandy silty clay/clayey silt (which in BH4 is possible considered as clayey silty fill) extending to depth ranging from 4 m to 6.1 m below ground surface. A stiff to hard grey clayey silt till was generally found below the brown silty clay till layer. A deposit of gravelly silty sand was found between the brow silty clay till and grey clayey silt till. These subsurface conditions were found to be similar to the subsurface conditions encountered in the boreholes located on CDL site (discussed in detail in subsequent sections).

The record of borehole logs from these reports are enclosed in ***Appendix C***. The approximate locations of the boreholes drilled at these sites are shown on the Site and Borehole Location Plan, ***Figure 1.***

The groundwater level measurements in the drilled boreholes are summarized in ***Table 1***, below.

Table 1: Groundwater Level Measurements (Adjacent Properties)

Borehole No.	Measurements Upon Completion of Drilling		Measurements in Monitoring Wells	
	Approximate Groundwater Depth (mbegs)*	Date	Approximate Groundwater Depth (mbegs)*	Date
BH/MW19-03	9.1 m (Elev. 257.8 m)	April 4, 2019	7.3 m (Elev. 259.5 m)	April 17, 2019
BH/MW19-07 (Shallow)	N/A	March 27, 2019	6.9 m	April 17, 2019
BH/MW19-07 (Deep)	12.8 m	March 27, 2019	12.8 m	April 17, 2019
BH/MW19-13	Dry	April 4, 2019	9.5 m (Elev. 258.2 m)	April 17, 2019
BH19-18	2.7 m	March 27, 2019	N/A	N/A
BH19-19	Dry	March 28, 2019	N/A	N/A
BH1	Dry	Oct 19, 2018	N/A	N/A
BH2	Dry	Oct 19, 2018	N/A	N/A
BH4	Dry	Oct 18, 2018	N/A	N/A

*mbegs- meters below existing ground surface.

4.0 REGIONAL GEOLOGY

The surficial geology aspects of the general site area were reviewed from the following publication:

- Chapman, L.J., and Putnam, D.F., 2007, *"The Physiography of Southern Ontario"*; 4th Edition, Ontario Geological Survey.

Physiographic mapping in the area according to the above noted reference indicates that the site lies within the physiographic region of southern Ontario known as the South Slope. The South Slope region slopes gradually downward towards Lake Ontario. The overburden immediately below ground surface within the South Slope generally consists of clayey silt till and silty clay till and at depth consists of alternating deposits of dense lacustrine sands and silts and overconsolidated lacustrine clays and clay tills overlying the bedrock.

The subsurface conditions encountered during the investigation are generally consistent with the physiographic mapping.

5.0 INVESTIGATION PROCEDURE

The field work for the preliminary geotechnical investigation was carried out between March 28, 2019 and on April 5, 2019, during which time seven boreholes (designated as Boreholes BH/MW19-04 to BH/MW19-06, BH19-14 to BH19-17) were advanced at the site to depths between about 6.7 m to 17.4 m below existing ground surface at the approximate locations shown on the Site and Borehole Location Plan, ***Figure 1***, attached.

The boreholes were advanced using a track-mounted drill rig supplied and operated by a specialist drilling contractor, subcontracted to Golder. Standard Penetration Testing (SPT) and sampling was carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer, in accordance with ASTM D1586 (99).

The shallow groundwater conditions were noted in the open boreholes during and immediately following the drilling operations. Three of the boreholes advanced at the site were equipped with 50 mm diameter monitoring wells to permit further monitoring of the groundwater levels on April 17, 2019. The well installation details and water level readings are presented on the Record of Borehole sheets in ***Appendix A***.

The field work for this investigation was directed by members of our engineering staff who located the boreholes in the field, directed the sampling and in-situ testing operation, logged the boreholes and cared for the samples obtained. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory for further examination and laboratory testing. Index and classification tests, consisting of water content determinations, Atterberg limits and grain size distribution, were carried out on selected soil samples. The results of the geotechnical laboratory tests are included in **Appendix B** and on the Record of Borehole sheets in **Appendix A**.

The borehole locations were determined in the field using a GPS instrument based on UTM coordinates. Geodetic ground surface elevations at the borehole locations were derived from the site grading plan provided by GSAI, "Snell's Hollow Contour Plan, Town of Caledon" dated December 2018. And as such, the elevations and borehole locations given on the Record of Borehole sheets and referred to herein should be considered as approximate.

6.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes and the results of the field and laboratory testing, are shown on the Record of Boreholes sheets, in **Appendix A**. Method of Soil

Classification and Symbols and Terms Used on Records of Boreholes are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summary of the subsurface conditions of the boreholes advanced during this investigation followed by a more detailed description of the major soil strata and groundwater conditions.

In general, the subsurface conditions encountered at the boreholes advanced at the site typically consist of a surficial topsoil/silty clay layer underlain by native soil deposits of glacial till composed of silty clay to clayey silt containing varying amounts of sand and gravel. Deposits of silty sand to sand were found below and in between the till deposits in one of the boreholes. The presence of cobbles and/or boulders in the till deposit are inferred from auger grinding, effective refusal of the SPT, and/or rock fragments collected within the SPT sampler.

Details of the observations of the groundwater conditions during and upon completion of drilling are included on the Record of Borehole sheets. Shallow ground water was encountered at depths ranging from 0.4 m to 14.5 m below existing ground surface or between Elev. 252 m to Elev. 262.8 m upon the completion of drilling activities.

6.1 Topsoil and (CL-ML) Silty Clay / Clayey Silt (possibly re-worked)

Topsoil materials were encountered in all the boreholes and extended to depths ranging from 0.23 m to 0.41 m. A summary of topsoil thickness in each of the boreholes is outlined in the table below.

Table 2: Approximate Topsoil Thickness

Borehole No.	Approximate Topsoil Thickness (m)
BH/MW19-04	0.20
BH/MW19-05	0.28
BH/MW19-06	0.41
BH19-14	0.30

Borehole No.	Approximate Topsoil Thickness (m)
BH19-15	0.30
BH19-16	0.33
BH19-17	0.33

Materials identified as topsoil in this report were classified based on visual and textural evidence as no other testing for organic content or other nutrients was carried out. As such, the ability for these materials to support vegetation has not been assessed.

A layer of silty clay/clayey silt soil was encountered in the relevant boreholes (with exception of BH19-14 and BH19-17) below the surficial topsoil. The silty clay / clayey silt resembled a disturbed till or reworked soil, likely the result of past agricultural or re-grading activities, with an interpreted thickness ranging from about 0.3 m to 1.0 m. Variable amounts of organics (rootlets), sand and gravel were observed in the silty clay / clayey silt soils.

SPT ‘N’ values within the reworked material was found to be 4 blows to 12 blows per 0.3 m of penetration indicating a firm to stiff consistency.

The natural water content of the reworked material was measured at 19 to 21 percent.

The results of grain size distribution tests carried out on one selected sample from this deposit is presented in **Figure B1.** Atterberg limits tests that were carried out on the same sample from this deposit measured liquid limit value of about 25 and plastic limit value of about 15; yielding corresponding plasticity index value at about 10. These results are plotted on the plasticity chart as shown in **Figure B2**.

6.2 (CL) Silty Clay to sandy Silty Clay (Upper Glacial Till)

A till deposit consisting of cohesive silty clay to sandy silty clay was generally encountered directly underneath the topsoil and clayey (reworked till) deposit to depths ranging from about 0.3 m to 6.7 m below ground surface (Elev. 259.8 m to Elev. 269.7m). The upper till deposit is mottled light brown to brown with oxidation staining, about 1.6 m to 4 m in thickness and contains various amounts of sand and gravel. Silt and sand seams / layers were encountered within the till and a strata of silty sand (about 3 m thick) was found within the till in BH19-14 (as described in section 6.3). Based on previous experience with glacial tills in this area and frequent auger grinding during the advancement of the augers during this investigation, the presence of cobbles and/or possible boulders are inferred within the till deposit.

The SPT ‘N’ values measured in these till materials range from 6 blows to 44 blows per 0.3 m of penetration, but typically are greater than 7 blows and less than 30 blows, suggesting that the silty clay till is firm to hard in consistency, but generally stiff to very stiff.

The results of grain size distribution tests carried out on three samples of the silty clay till are presented in ***Figure B2.***

Three Atterberg Limits tests carried out on selected samples of this till deposit measured liquid limits ranging between 21 and 27, and plastic limits between 14 and 15; yielding a corresponding plasticity index between 8 and 11. These results are plotted on the plasticity chart as shown in ***Figure B3.***

The water content measured on selected samples of the upper till ranged from about 7 percent to 19 percent.

6.3 (SM to ML) SILTY SAND to sandy SILT

A deposit of silty sand to sandy silt was encountered within and below the silty clay till deposit in Boreholes BH/MW19-04 and BH19-14 and within the clayey silt till deposit in borehole BH19-15. In Borehole BH/MW19-04, the gravelly silty sand to sand deposit was encountered at depths ranging from 10.7 m to 17 m, and Borehole BH/MW19-04 was terminated within this deposit. In Borehole BH/MW19-14 the silty sand deposit was encountered at depths ranging from about 4 m to 7 m below ground surface and about 8 m to 10 m below ground surface. Borehole BH/MW19-14 was terminated within this deposit. In Borehole BH19-15, the silty sand was about 1 m in thickness, found at a depth of about 10 m to 11 m below ground surface. The silty sand to sand to gravelly sandy silt contains various amounts of gravel, clay nodules, is light brown to grey in colour, and is considered non-cohesive in nature with slight plasticity. Similar layers/seems were also found in other boreholes.

The SPT ‘N’ values measured in the silty sand to sandy silt deposit range from 19 to over 120 blows per 0.15 m of penetration; however, most of the SPT ‘N’ values measured were greater then 30 blows per 0.3 m of penetration, indicating a compact to very dense, but generally dense to very dense compactness.

The results of grain size distribution tests carried out on selected samples from this deposit are presented in ***Figure B5.*** Atterberg Limits tests that were carried out on one sample of this deposit measured a liquid limit value about 19, a plastic limit value about 15; yielding a corresponding plasticity index value about 3. These results are plotted on the plasticity chart as shown in ***Figure B6, Appendix B.***

The water content of selected samples ranged from about 4 percent to 19 percent.

6.4 (CL-ML) Clayey Silt (Lower Glacial Till)

A clayey silt to sandy clayey silt till deposit was generally encountered directly underneath the silty clay till in all boreholes (with exception of BH19-14) between a depth of 2.1 m to 14.3 m below existing ground surface. The till deposit is cohesive and contains various amounts of sand and gravel, is grey in colour and is believed to contain cobbles and/or possible boulders which have been inferred in this deposit as a result of auger grinding and limestone fragments within the SPT sampler. Silt/sand layers were encountered within BH/MW19-05, BH19-15 and BH19-16 at depths of 6.1 m to 7.6 m below ground surface as noted above.

The SPT 'N' values measured in the of this till deposit range from 14 blows per 0.3 m of penetration to 100 blows per 0.3 m of penetration; however, most of the SPT 'N' values measured within the till were greater between 13 blow to about 34 blows per 0.3 m of penetration, suggesting a stiff to hard consistency. The higher blow counts are possibly attributed to the presents of the cobbles/boulders within the till deposit.

The results of grain size distribution tests carried out on a sample of this till deposit are presented in ***Figure B7.*** One Atterberg Limit test was carried out on a selected sample of clayey silt till deposit and measured a liquid limit of about 15, plastic limit of about 10; yielding a corresponding plasticity index of 4. These results are plotted on the plasticity chart as shown in ***Figure B8, Appendix B***.

The water content of selected samples ranged from about 4 percent to 18 percent.

6.5 Groundwater Conditions

Groundwater level measurements were recorded immediately following drilling procedures. The groundwater level measurements in the drilled boreholes are summarized in ***Table 3***, below.

Table 3: Groundwater Level Measurements (CDL Property)

Borehole No.	Measurements Upon Completion of Drilling		Measurements in Monitoring Wells	
	Approximate Groundwater Depth (begs)*	Date	Approximate Groundwater Depth (begs)*	Date
BH/MW19-04 (Shallow)	N/A	March 29, 2019	3.8 m (Elev. 262.8 m)	April 17, 2019
BH/MW19-04 (Deep)	14.8 m (Elev. 251.7 m)	March 29, 2019	14.5 m (Elev. 252 m)	April 17, 2019
BH/MW19-05	Dry	March 28, 2019	8.3 m (Elev. 262.2 m)	April 17, 2019
BH/MW19-06	2.5 m (Elev. 259. 5 m)	March 28, 2019	0.4 m (Elev. 262.4 m)	April 17, 2019
BH19-14	Dry	April 5, 2019	N/A	N/A
BH19-15	6.0 m (Elev. 257.5 m)	April 1, 2019	N/A	N/A
BH19-16	1.4 m (Elev. 257.0 m)	March 26, 2019	N/A	N/A

*begs- below existing ground surface.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year.

7.0 GEOTECHNICAL ENGINEERING DISCUSSION

This section of the report provides preliminary geotechnical engineering recommendations on the geotechnical aspects of the proposed development based on our interpretation of the limited borehole information and on our understanding of the project scope and requirements. The information in this portion of the report is provided for the guidance of the design engineers and professionals.

Based on the results of this investigation, the subsurface soil conditions encountered at the site are considered to be generally suitable for the proposed residential development.

As noted above, at the time of this report, proposed design grades (i.e., finished floor slab elevation, pavement subgrade and utility invert levels) were not available for the proposed development. The following engineering recommendations regarding the geotechnical design aspects of the project including underground services, pavements and building foundations should be considered as preliminary only, and should be reviewed when the final design grades and utility invert levels have been finalized.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

This report addresses only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report.

7.1 Site Preparation

7.1.1 Subgrade Preparation

Based on the existing site topography, it is assumed that only minor cut and/or fill site grading operations of less than 2.0 m will be required to establish subgrade levels and permit the construction of the proposed residential development.

Any filling carried out at the site in conjunction with regrading (with the exception of future green spaces) should be carried out as engineered fill. Recommendations for the placement of engineered fill are outlined in **Section 7.1.2** of this report, titled “Engineered Fill Requirements”.

In general, the existing site vegetation, surficial topsoil/organics, surficial asphalt/concrete or any other near-surface soils containing significant amounts of organic matter or construction debris are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grade(s), following appropriate environmental procedures. Furthermore, excessively wet soils should be dried before reuse as engineered fill.

Furthermore; excessively-wet soils should be suitably dried before reuse as engineered fill.

Following the stripping of the surficial topsoil and soils containing significant amounts of organics and/or soft/disturbed surficial soils, the exposed subgrade should be heavily proof-rolled with suitable equipment, in conjunction with inspection by qualified geotechnical personnel to confirm that the exposed soils are competent and have been adequately stripped of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e., further subexcavation and replacement) should be carried out on poorly-performing areas identified during the proof-rolling activities, as directed by Golder.

7.1.2 Engineered Fill Requirements

As described above, the anticipated site grading activities may include both cutting and raising (filling) the original grade to meet the final design site grades. At the time of this report, the design cut and fill depths were not available for review. As such, for the purposes of this report, it has been assumed that cuts will not exceed 2 m and grade raises will not exceed more than 2 m.

In general, the existing native material is considered to be acceptable for reuse as engineered fill. Based on the laboratory test results, the water content of soils present at the site are considered to be generally near or above their optimum water content for compaction, and therefore may require minor drying prior to placement, in general.

It should be noted that the native materials at the site are silty in nature, and as such are susceptible to over-wetting and subsequent freezing during inclement weather. Therefore, it is recommended that site grading activities not be carried out during late fall, winter, early spring seasons or any periods of inclement weather conditions. All oversized cobbles (i.e., greater than 150 mm in size) and boulders, if present, should be removed from excavated material that will be used as engineered fill material.

If imported material is required for the engineered fill process, the material that is proposed for use as engineered fill should be approved by the geotechnical engineer at its source, prior to importing the material to the site. Suitable soils, free of topsoil, organic matter or other deleterious materials can be used as engineered fill provided that the water content of the soil at the time of placement does not vary by more than 2 percent above or below its optimum water content for compaction. Otherwise, the soils may require treatment (i.e., drying or wetting) prior to placement.

Following the inspection and approval of the subgrade as described previously in this report, engineered fill materials should be placed in maximum 300 mm-thick loose lifts and uniformly compacted to 98 percent of the Standard Proctor maximum dry density (SPMDD). Filling should continue until the design elevations are achieved.

Full-time monitoring and in-situ density testing should be carried out by Golder during placement of engineered fill.

The final surface of the engineered fill should be protected as necessary from construction traffic and should be sloped to provide positive drainage for surface water during the construction period. If the engineered fill materials will be left exposed (i.e. uncovered) during periods of freezing weather, additional soil cover should be placed above final subgrade to provide some level of frost protection. Prior to placing the granular subbase and/or base courses within pavement areas, the surface of the engineered fill/subgrade should be inspected by Golder.

7.2 Installation of Underground Services

7.2.1 Temporary Excavations

Details of the underground servicing for the proposed development are unknown at the time of this investigation; as such, for the purpose of this report, the maximum depth of the underground services was assumed to be about 3 m below the existing ground surface. Once detailed design is completed, review of the underground services should be completed by this office for compliance with the recommendations contained herein.

The founding soils are anticipated to generally consist of the native sandy silty clay or engineered fill. These materials are considered to be suitable for supporting the underground services provided that the integrity of the base of the trench excavations is maintained during construction. Where softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

Care should be taken to direct surface water away from any open excavations and all temporary excavations should be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects.

In general, the groundwater level in the open boreholes, upon completion of drilling, was measured to be at depths ranging from about 1.4 m to 14.8 m below existing ground surface (Elev. 251.7 m to 261.6 m)Whereas, the groundwater level in the monitoring wells within close proximity, was measured to be at depths ranging from 0.4 m to 14.5 m below existing ground surface, (Elev. 252.0 m to Elev. 262.8 m).

In general, groundwater in the excavations within the native deposits, are likely to be handled by collection via properly constructed and filtered sumps, located within the excavations, and then pumping and discharging the water to a suitable discharge point. However, should excavations deeper than 3m below existing ground surface be required, the following recommendations will need to be review and revised to determine if some form of active dewatering, such as well points, may have to be implemented.

Excavations for the site servicing would generally extend through the native sandy silty clay deposit. Conventional excavation equipment should be suitable to excavate through these materials.

The stiff to hard native silt clay till soils are classified as a “Type 2” soils under the OH&S Act. As such, all conventional temporary trench excavations should consist of open cuts with side slopes not steeper than 1 horizontal to 1 vertical in the overburden soils to within 1.2 m of the base of the excavation and then may be made vertical to the base. Where engineering fill (based on silty clay material) is used or the native silty clay exhibits signs of water seepage, the soil is classified as a “Type 3”, as such all conventional temporary trench excavations should consist of gradient of 1 horizontal to 1 vertical.

Where the side slopes of excavations are required to be steepened to limit the extent of the excavation, then some form of trench support may be required. Some trench excavations could be carried out using a vertically-excavated, unsupported excavation (using a properly-engineered trench liner box for protection, certified by an experienced engineer); or by a supported (sheeted) excavation if conditions warrant so; such as in wet areas and/or in close proximity to adjacent underground services

7.2.2 Pipe Bedding and Cover

The bedding for the sewers and watermains should be compatible with the size, type and class of pipe and the surrounding subsoil and the requirements of the City of Caledon. If granular bedding is deemed to be acceptable, then Ontario Provincial Standard Specifications (OPSS) Granular A should be used from at least 150 mm below invert to springline. Clear stone should not be used as bedding material. From springline to 300 mm above the obvert of the pipe, sand cover could be used. All bedding and cover material should be placed in 150 mm loose lifts and uniformly compacted to at least 100 percent of SPMDD. Where variable fill materials, softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

7.2.3 Trench Backfill

The excavated materials from the site will consist predominantly of silty clay till materials. Based on the measured water contents, in general, the native materials encountered at the site are estimated to be near or above their optimum water contents for compaction, and therefore, will probably require only minor drying prior to placement.

Care should be taken to maintain the water content of the soils close to/at the optimum water content for compaction during the construction operations, as difficulties with compaction and/or backfill performance would be anticipated with fine-grained soils where the water content is significantly above the optimum for compaction purposes. Soils that contain significant quantities of organics or debris are also not suitable for use as trench backfill within settlement-sensitive areas. In addition, all boulders and cobbles greater than 150 mm in size should be removed from the trench backfill materials. If there is a shortage of suitable in-situ material, an approved imported material such as Ontario Provincial Standard Specifications Select Subgrade Material should be used for trench backfill. Again, as noted above, the trench backfill materials are silty in nature and are very susceptible to wetting/freezing temperatures. Backfilling trenches during cold or wet weather is not recommended.

Trench backfill should be placed in maximum 300 mm loose lift thickness and uniformly compacted to at least 98 percent of the SPMDD of the material. Soil that is frozen should not be used as backfill.

Normal post-construction settlement of the compacted trench backfill should be anticipated with the majority of such settlement taking place within about 12 months following the completion of trench backfilling operations. If the trench backfill operations are completed during the winter months, post-construction settlements may increase beyond typical anticipated values. These settlements will be reflected at the ground surface. If the asphalt binder course is laid shortly following the completion of the trench backfilling operations, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding. If possible, the surface course asphalt should not be placed over the binder course asphalt for about 12 months. Where scheduling requires that the surface course be placed over the binder course asphalt before this period, trench backfill settlement would be reflected by subsidence and possible cracking of the finished pavement surface in these areas which, depending upon the extent and magnitude, may require local repairs.

7.3 Building Foundations

As previously indicated, the existing site vegetation, surficial topsoil/organics and other near-surface soils containing significant amounts of organic matter are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grades.

Based on the subsurface conditions encountered in the boreholes, strip and spread footings that may be used, provided that the footings are founded on the native sandy silty clay deposit or on engineered fill (based on existing site soils) placed in accordance with the recommendation outlined in ***Section 7.1***, and maintained a minimum depth of soil embedment below finished adjacent ground surface and top of slab of 1.2 m.

For such strip and spread footings, a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa and a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa may be assumed for design purposes, provided that the strip footings dimensions of 0.45 m in width and 10 m in length or spread footings have a minimum width of 0.60 m and a maximum width of 1.0 m.

Where spread footings are constructed at different elevations, the difference in elevation between the individual footings should not be greater than one half the clear distance 650 mm between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with the Ontario Building Code (2012), Section 9.15.3.9.

The maximum total and differential settlements are expected to be less than 25 mm and 20 mm; respectively, for footings designed, constructed and inspected as outlined above.

All exterior footings, and interior footings in unheated areas, should be founded at a minimum depth of 1.2 m below finished grade level in order to provide adequate protection against frost penetration.

The native soils are susceptible to disturbance from construction activity, especially during wet or freezing weather. Care should be taken to preserve the integrity of the materials as bearing strata. It is essential that the founding surface for the footings be inspected by qualified geotechnical personnel prior to placing concrete. If the concrete for the footings cannot be placed immediately after excavation and inspection of the subgrade, it is recommended that a working mat of lean concrete be placed in the excavation to protect the integrity of the bearing stratum.

Resistance to lateral forces/sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the CHBDC. The unfactored coefficient of friction, tan δ, for the interface between the cast-in-place concrete footing and the properly-prepared subgrade can be assumed to be 0.35.

7.3.1 Below Grade Walls

The exterior perimeter of all housing basement walls should be backfilled with an imported free draining, non-frost susceptible granular material approved by a geotechnical engineer, carefully placed and compacted in 200 mm thick loose lifts. The design of the foundation walls for the below-grade walls should take into account the horizontal soil loads as well as surcharge loads that may occur during or after construction and should be designed using a lateral (at-rest) earth pressure coefficient of 0.5 and a unit weight of backfill of 20 kN/m^3.

The wall backfill layers should be compacted to at least 95 per cent of the materials' standard Proctor maximum dry density. Light compaction equipment should be used immediately adjacent to the foundation wall, otherwise compaction stresses on the wall may be greater than that imposed by the backfill material. With the exception of the driveway area, the upper 0.3 m of backfill should consist of clayey material to provide a low permeability cap and the exterior grade should also be shaped to slope away from the building.

Provided that the excavations adjacent to foundation/basement walls are backfilled with free-draining granular materials and a drainage collection system is provided around the perimeter of the building, the design of below-grade walls does not need to take into account hydrostatic forces acting on the walls. However, it is recommended that the exterior of the below-grade walls be damp-proofed.

All foundation elements in unheated areas must be provided with at least 1.2 meter of earth cover for frost protection purposes. In addition, the bearing soil and fresh concrete should be protected from freezing during cold weather construction.

7.4 Pavement Design within the Proposed Development

Following site grading operations, as noted previously, the proposed pavement subgrade will generally consist of either re-compacted engineered fill or native silty clay till. These materials are considered to be frost susceptible, and as such, the pavement design provided in ***Table 4***, below has taken this condition into consideration.

Based on the proposed pavement usage, (i.e. residential development type traffic and loads/frequencies) frost susceptibility and strength of the subgrade soils, the following pavement component given are recommended for the proposed development of access roads and streets, however the Town of Caledon/Region of Peel design standards should be followed:

Table 4: Pavement Design

Material		Minimum Thickness of Pavement Components (mm)	
		Local Road (7.9m Road Pavement Width)	9.5 m Neighbourhood Collector (8.9 m Road Pavement Width)
Asphaltic Concrete (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	90
Granular Materials (OPSS.MUNI 1010)	Granular A Base	150	150
	Granular B Type II Subbase	350	500
Total Pavement Thickness (mm)		605	780
		Prepared and Approved Subgrade	

As part of the subgrade preparation, proposed access roads should be stripped of topsoil and other obviously unsuitable fill or organic materials. Fill required to raise the grades to design elevations should conform to the engineered fill requirements outlined previously in the report. Soft or spongy trench backfill areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98 percent SPMDD. Prior to placing pavement subbase and/or base materials, the exposed soil subgrade should be heavily proof-rolled in conjunction with an inspection by Golder. The granular subbase and base materials should be placed in loose layers no thicker than 200 mm and uniformly compacted to 100 percent of their SPMDD. The binder course and surface course asphalt materials should be compacted to minimum 92.0 percent of their Marshall Maximum Relative Density according to OPSS 310, as measured in the field using a nuclear density gauge.

Where new pavement abuts existing pavement (e.g. at the development limits), proper longitudinal lap joints should be constructed to key the new asphalt into the existing asphalt surface. The existing asphalt edges should be provided with a proper sawcut edge prior to keying-in the new asphalt. It should be ensured that any undermining or broken edges resulting from the construction activities are removed by the sawcut.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength may not be adequate to support heavy construction loading especially during wet weather or where backfill materials wet of optimum have been placed. In this regard, the design subbase thickness may not be sufficient for a construction haul road and additional subbase (in the order of 450 mm) may be required. In any event, the subgrade should be proofrolled and inspected by Golder prior to placing the subbase and any additional material, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

7.4.1 Subgrade Drainage

In order to preserve the integrity of the pavement, continuous subdrains should be placed at the concrete curb lines along both sides of the proposed streets. The invert of the subdrains should be at least 300 mm below the bottom of the Granular “B” subbase and should be sloped to drain to catchbasins. The subdrains should consist of perforated pipe wrapped in a suitable geotextile and surrounded on all sides with a minimum thickness of 150 mm of OPSS.PROV 1002 Concrete Fine Aggregate (i.e. concrete sand).

8.0 SEISMIC SITE CLASSIFICATION

Seismic hazard is defined in the 2012 Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 second, 0.5 second, 1.0 second and 2.0 seconds and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity, Standard Penetration Test (SPT) resistance, undrained soil shear strength, etc.) in the 30 m below the foundation level. There are six site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain acceleration and velocity-based site coefficients F_a and F_v; respectively, used to modify the UHS to account for the effects of site-specific soil conditions in design.

Based on the results of the preliminary geotechnical investigation and assuming soils below the maximum depth investigated exhibit similar properties / strengths, a **Site Class D** is estimated for planning purposes. The Site Class will need to be verified, and adjusted as necessary, during detail design.

9.0 INSPECTION AND TESTING

During construction, full-time observation should be carried out during engineered fill and site servicing backfill placement, and sufficient foundation inspections, subgrade inspections and in-situ materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.

10.0 CLOSING

We trust that this preliminary report provides enough preliminary geotechnical engineering information to proceed with the detailed design of the proposed development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Signature Page

Golder Associates Ltd.

Erti

Erti Mansaku, P.Eng.
Geotechnical Engineer

Jeff Tolton, C.E.T.
Associate, Senior Geotechnical Technologist

JD/EM/JET/sm

https://golderassociates.sharepoint.com/sites/102461/technical work/phase 5000 - clearbrook developments ltd/19115264 (5000) final georeport clearbrook.docx

LEGEND

- ⊕ Approximate Borehole Location
- ⊕ Approximate Borehole and Monitoring Well Location
- ⊕ Approximate Previous and Adjacent Properties Geotechnical Borehole (Edward Wong 2017, Golder 2019)
- — Watercourse
- ▭ Waterbody
- ▨ Wetland
- ▭ Site Boundary
- ▭ Clearbrook Developments Ltd. Site Boundary

0 75 150

1:3,000 METRES

REFERENCE(S)

1. IMAGERY: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
© 2019 MICROSOFT CORPORATION © 2019 DIGITALGLOBE ©CNES (2019) DISTRIBUTION AIRBUS DS
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
CLEARBROOK DEVELOPMENTS LTD.

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, CLEARBROOK DEVELOPMENTS, CALEDON, ON

CONSULTANT
GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	MM
PREPARED	MM
REVIEWED	EM
APPROVED	-

TITLE
SITE AND BOREHOLE LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
19115264	5000	-	1

PATH: S:\Clients\Snells_Hollow_Developer_Group\Mayfield_Rd_Caledon\99_PROJ\19115264\40_PROD\0002_Prelim_Geotechnical_Investigation\19115264-0002-BG-0004.mxd PRINTED ON: 2019-05-31 AT: 2:13:54 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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APPENDIX A

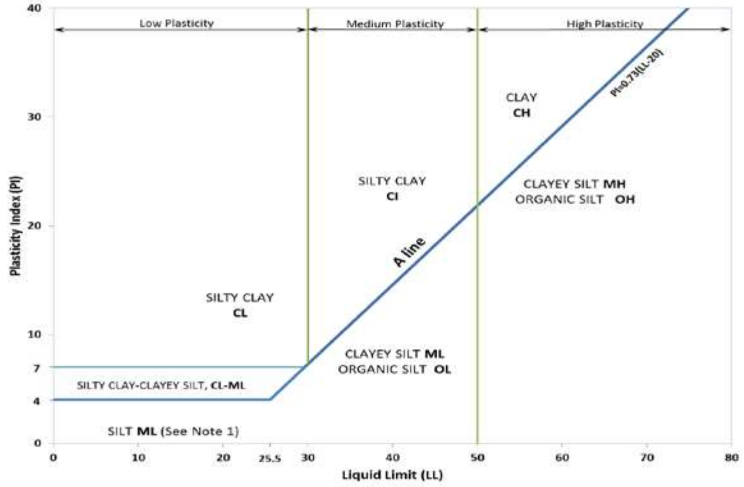
Method of Soil Classification
Abbreviations and Terms used on Record of Borehole
List of Symbols
Record of Boreholes

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)
An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\ \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$
2 shear strength = (compressive strength)/2

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

PROJECT: 19115264-1000/5000

LOCATION: Lat. 43.750748 Long. -79.810026

(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-04

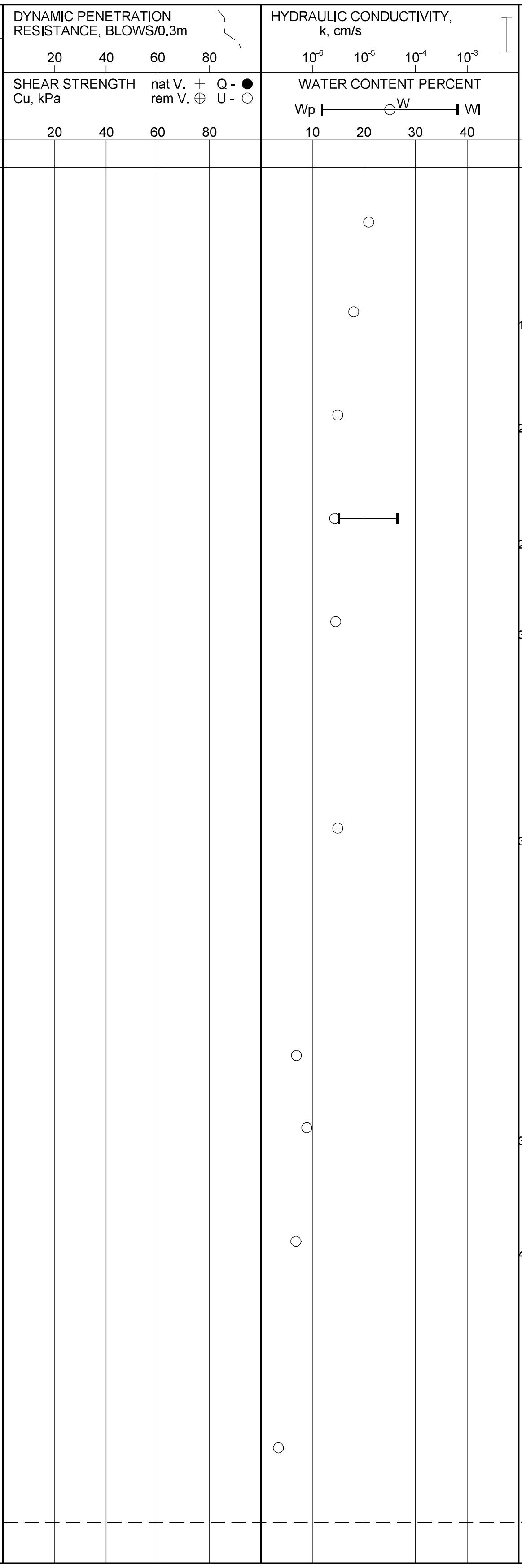
BORING DATE: March 28, 2019

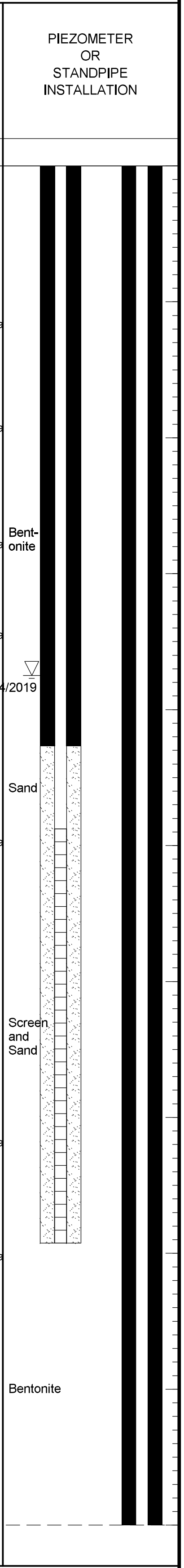
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	266.50				
0	TOPSOIL (200 mm)	0.00 266.30	1A	SS		
	(CL) SILTY CLAY, some sand, trace organics; dark brown; cohesive, w<PL, firm	0.20	1B	SS	8	
	(CL) gravelly sandy SILTY CLAY; light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to very stiff	265.74 0.76				
1			2	SS	16	PP = 150 kPa
2			3	SS	12	PP = 245 kPa
			4	SS	12	MH PP = 290 kPa
3			5	SS	19	PP = 345 kPa
5			6	SS	28	PP = 390 kPa
6	- Cobble/boulders inferred from auger grinding at a depth of 6 m - Silty sand seam at a depth of 6.2 m		7	SS	30	
	(CL-ML) sandy CLAYEY SILT, trace gravel; grey, (TILL); cohesive, w>PL, stiff to hard	259.79 6.71				
7			8	SS	13	PP = 340 kPa
8			9	SS	37	PP = 440 kPa
9			10	SS	79	
10						





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DEPTH SCALE

1 : 50

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.750748 Long. -79.810026
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-04

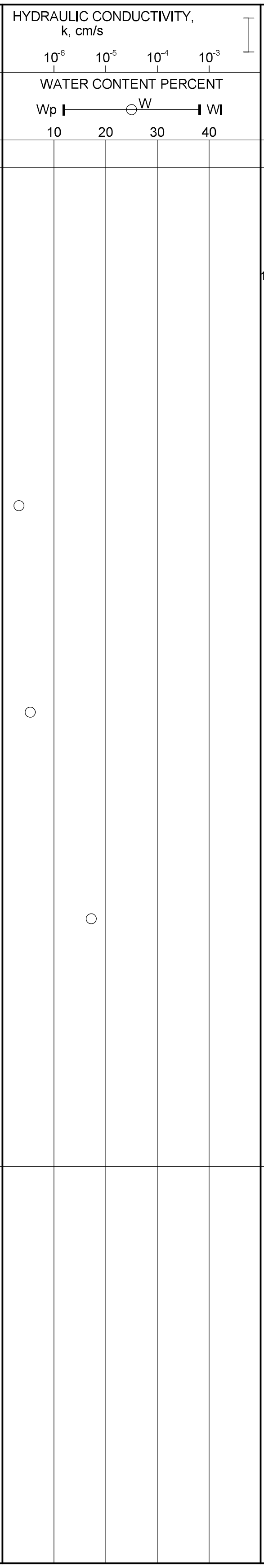
BORING DATE: March 28, 2019

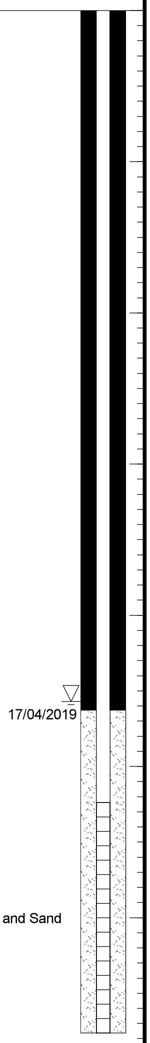
SHEET 2 OF 2
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

--- *CONTINUED FROM PREVIOUS PAGE* ---

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	(CL-ML) sandy CLAYEY SILT, trace gravel; grey, (TILL); cohesive, w>PL, stiff to hard	255.76 10.74	11A	SS			
	(SW/SM) gravelly SILTY SAND, coarse to fine; light brown to brown; non-cohesive, dry to wet, compact to very dense		11B	SS	120/6"	PP = 150 kPa	
12			12	SS	62		
14			13	SS	19		17/04/2019
	(SP) SAND, some silt, trace clay; light grey; wet, compact to dense	251.75 14.75					Sand
15			14	SS	31	MH	Screen and Sand
16			15	SS	22		
	END OF BOREHOLE.	249.13 17.37					





Notes:
1. Water level measured in monitoring well as follows:

Deep Well

Date	Depth	Elev. (m)
March 29, 2019	14.8 mbgs	251.7 m
April 17, 2019	14.55 mbgs	251.95 m

Shallow Well

Date	Depth	Elev. (m)
April 17, 2019	3.75 mbgs	262.75 m

2. PP = unconfined compressive strength measured using pocket penetrometer on sample in the field.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/5000

LOCATION: Lat. 43.75409 Long. -79.807715

(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-05

BORING DATE: March 28, 2019

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	270.50			
TOPSOIL (280 mm)	0.00	1A	SS	12
(CL) SILTY CLAY, trace gravel, trace organics; dark to light brown; cohesive, w~PL, stiff	270.22 0.28	1B	SS	
(CL) SILTY CLAY, some sand, trace gravel; light brown with oxidation staining, (TILL); w<PL, very stiff	269.74 0.76	2	SS	24
		3	SS	26
		4	SS	23
		5	SS	26
		6A	SS	44
(CL-ML) CLAYEY SILT, trace sand to sandy, trace gravel; grey, (TILL); cohesive, w<PL, hard	265.64 4.86	6B	SS	
- Becoming sandy, with sand seams below a depth of 6.1 m		7	SS	77
- Silty sand layer/stratum encountered at a depth of 7.6 m		8	SS	94
		9	SS	100
END OF BOREHOLE.	260.75 9.75			

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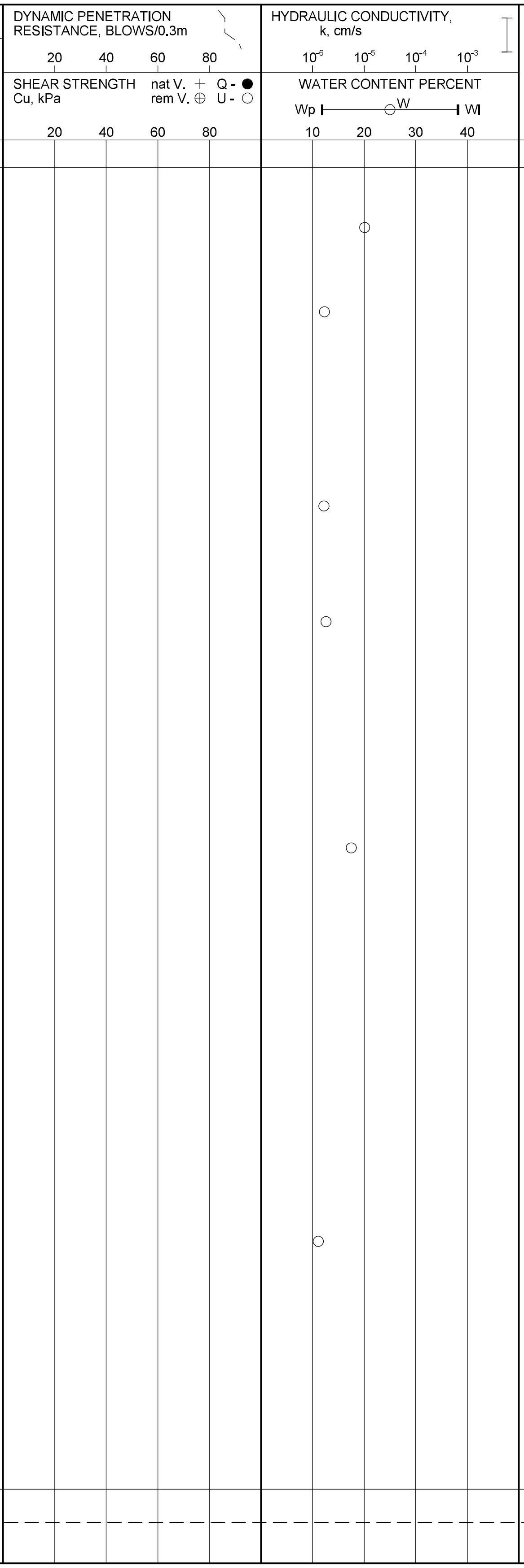
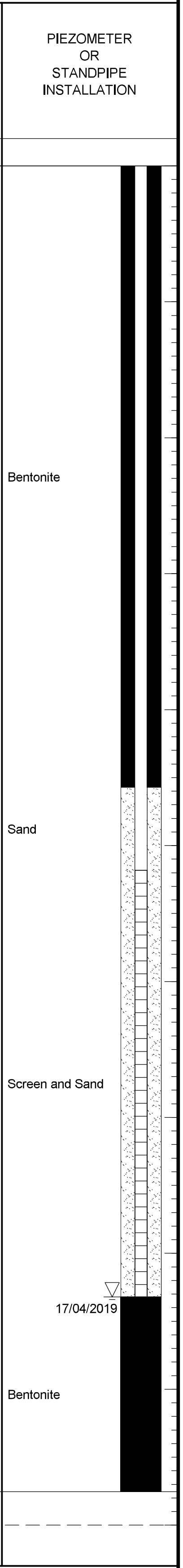


ADDITIONAL LAB. TESTING



DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-1000/5000

RECORD OF BOREHOLE: BH/MW19-05

SHEET 2 OF 2

LOCATION: Lat. 43.75409 Long. -79.807715
(See Figure 1)

BORING DATE: March 28, 2019

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Borehole dry upon completion of drilling. 2. Water level measured in monitoring well as follows:									

Date	Depth	Elev. (m)
March 28, 2019	Dry	Dry
April 17, 2019	8.32 mbgs	262.18 m

11

12

13

14

15

16

17

18

19

20

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.752469 Long. -79.804999
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-06

BORING DATE: March 2, 2019

SHEET 1 OF 1
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

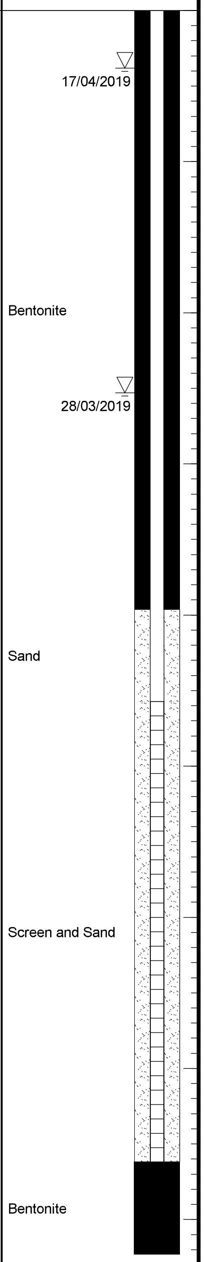
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ├──○W──┤ Wl 10 20 30 40
ADDITIONAL LAB. TESTING

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	262.00			
TOPSOIL (410 mm)	0.00	1A	SS	9
(CL) SILTY CLAY, trace organics, some to trace sand, trace gravel; dark brown; cohesive, w>PL, firm	261.59 0.41	1B	SS	
		2	SS	5
(CL) SILTY CLAY, some sand to sandy, trace gravel; light brown, (TILL); cohesive, w>PL, stiff to very stiff	260.55 1.45	3	SS	14
		4	SS	28
		5A	SS	
(CL-ML) CLAYEY SILT, trace sand and gravel; grey, (TILL); cohesive, w>PL, very stiff to hard	258.88 3.12	5B	SS	39
		6	SS	15
		7	SS	27
		8	SS	36
END OF BOREHOLE.	253.68 8.32			

Notes:
1. Water level measured in monitoring well as follows:

Date	Depth	Elev. (m)
March 28, 2019	2.54 mbgs	259.46 m
April 17, 2019	0.38 mbgs	261.62 m

PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.749015 Long. -79.809338
(See Figure 1)

RECORD OF BOREHOLE: BH19-14

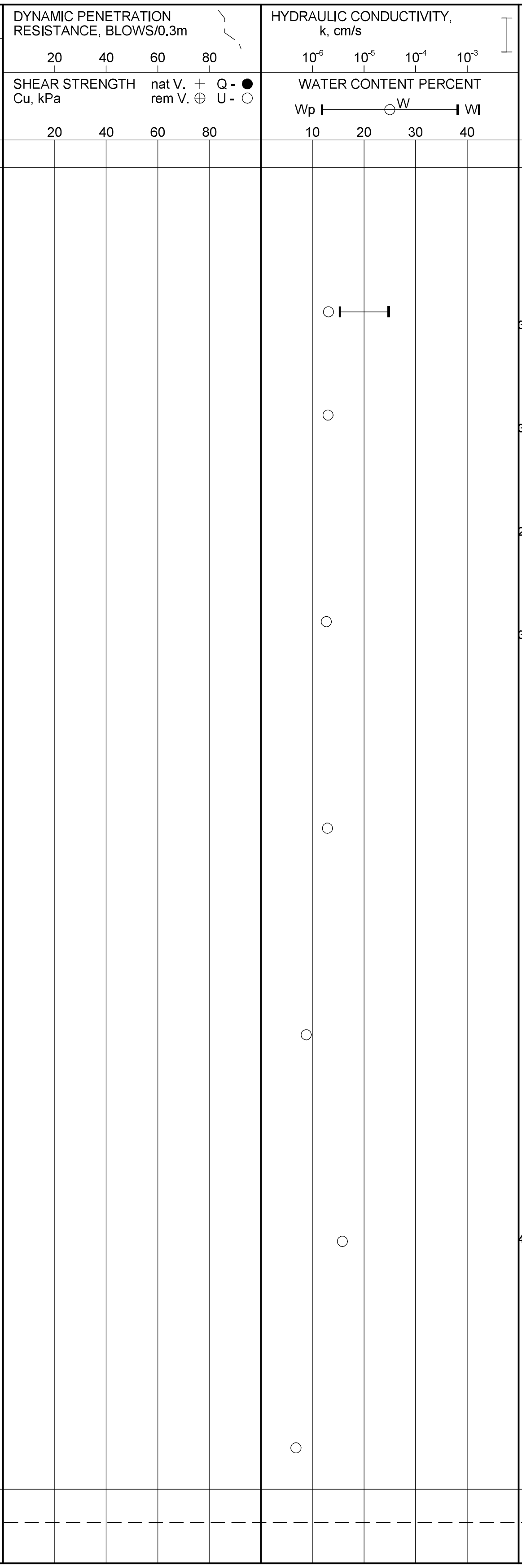
BORING DATE: April 5, 2019

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	269.00				
0	TOPSOIL (300 mm)	0.00	1A	SS	6	
		268.70				
	(CL) sandy SILTY CLAY, trace to some gravel; brown with oxidation staining, (TILL); cohesive, w<PL, firm to hard	0.30	1B	SS		
1			2	SS	19	PP = 320 kPa MH
2			3	SS	21	PP = 320 kPa
	- Cobbles/boulders inferred from auger grinding at 2.3 m		4	SS	23	PP = 245 kPa
3			5	SS	36	PP = 340 kPa
4		265.00				
	(SM) SILTY SAND, trace gravel; light brown; moist, compact to dense	4.00				
5			6	SS	24	
6			7	SS	32	MH
7		261.99				
	(CL) sandy SILTY CLAY, trace gravel; brown, (TILL); cohesive, w~PL, hard	7.01	8A	SS	94	PP = 440 kPa
8		261.00				
	(ML/SM) gravelly sandy SILT to gravelly SILTY SAND, fine grained, trace clay, slight plasticity, trace cobbles inferred from auger grinding; light brown; non-cohesive, moist, very dense	8.00	8B	SS		
9			9	SS	96	
		259.25				
	END OF BOREHOLE.	9.75				
10						



PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

PROJECT: 19115264-1000/5000

LOCATION: Lat. 43.749015 Long. -79.809338

(See Figure 1)

RECORD OF BOREHOLE: BH19-14

BORING DATE: April 5, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Borehole dry upon completion of drilling. 2. PP= unconfined compressive strength measured with pocket penetrometer in the field.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.751797 Long. -79.80950
(See Figure 1)

RECORD OF BOREHOLE: BH19-15

BORING DATE: April 1, 2019

SHEET 1 OF 2
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	263.50				
TOPSOIL (300 mm)	0.00	1A	SS	7	
(CL) SILTY CLAY, trace organics, trace gravel; brown; cohesive, w>PL, firm	263.20 0.30	1B	SS		
(CL) SILTY CLAY and SAND, trace gravel; mottled light brown to brown, (TILL); cohesive, w<PL, firm to stiff	262.89 0.61	2	SS	7	
		3A	SS	13	PP = 250 kPa
(CL-ML) CLAYEY SILT, some sand to sandy, trace gravel; grey, (TILL); cohesive, w<PL, stiff to hard	261.52 1.98	3B	SS		
		4	SS	14	PP = 345 kPa MH
		5	SS	15	PP = 250 kPa
		6	SS	31	PP = 300 kPa
		7	SS	15	PP = 320 kPa
- Contains sand layers at 7.8 m		8	SS	17	PP = 320 kPa
		9A	SS	27	PP = 320 kPa
(SM) SILTY SAND to SILT, trace to some clay; grey; wet, compact	253.84 9.66	9B	SS		MH

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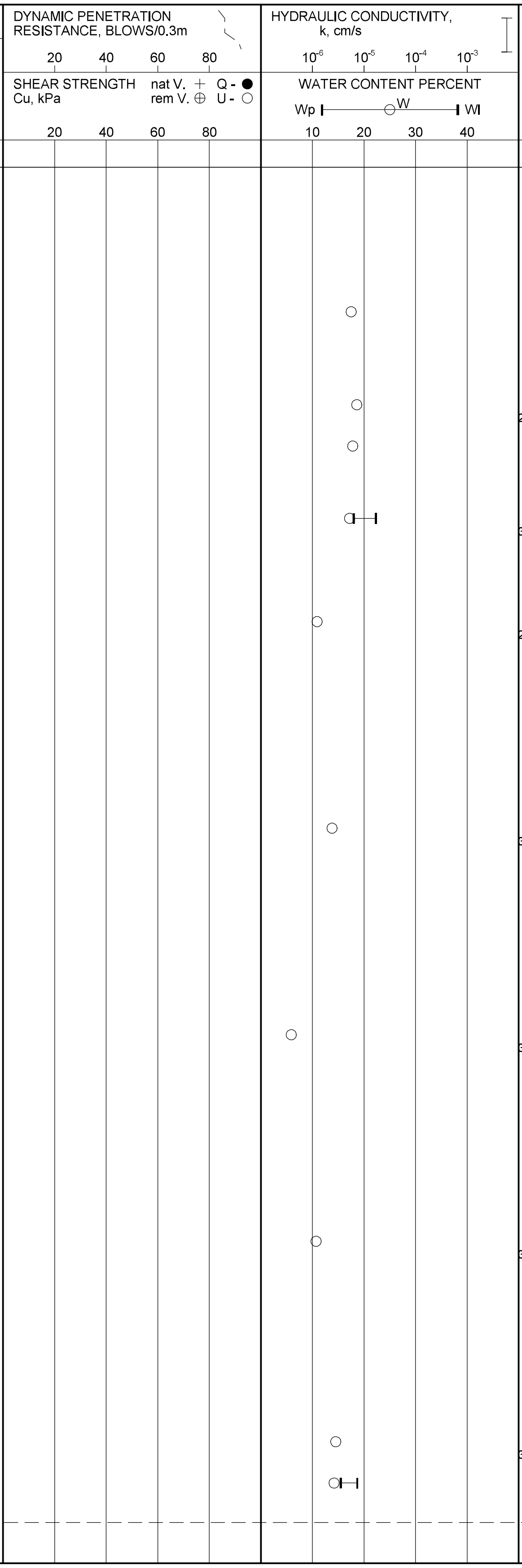


DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.751797 Long. -79.80950
(See Figure 1)

RECORD OF BOREHOLE: BH19-15

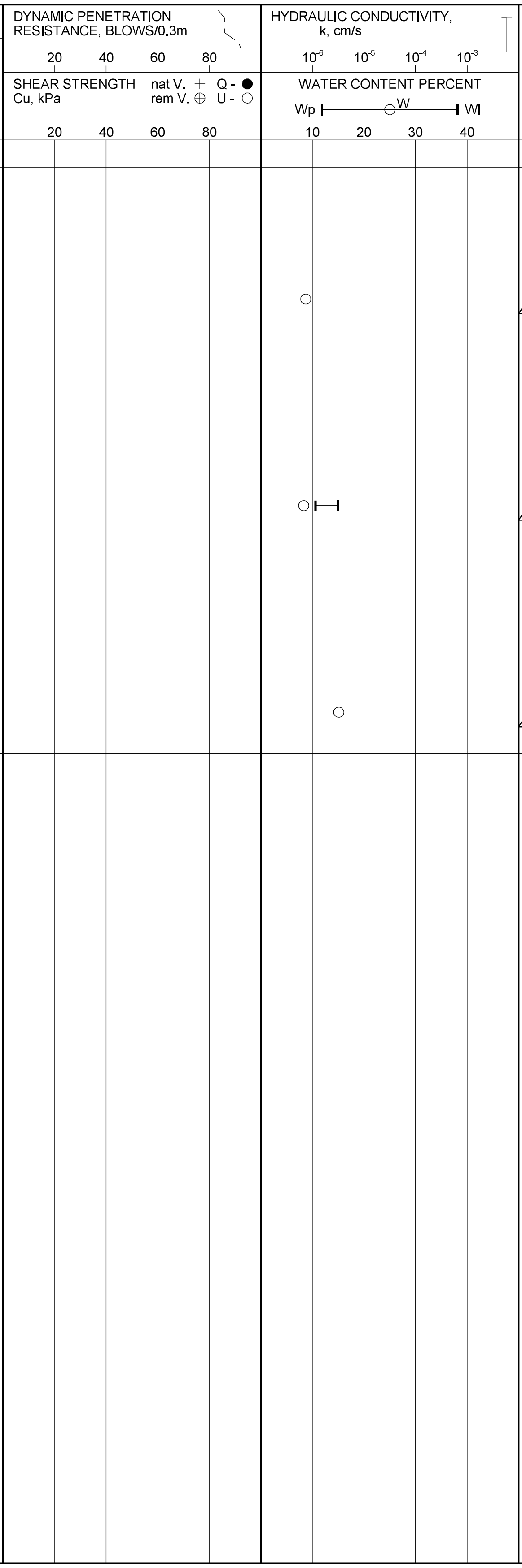
BORING DATE: April 1, 2019

SHEET 2 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
		--- CONTINUED FROM PREVIOUS PAGE ---						
10	CME 75 Track Mount Power Auger 100 mm Solid Stem	(SM) SILTY SAND to SILT, trace to some clay; grey; wet, compact		253.01 10.49				
		(CL-ML) CLAYEY SILT, some sand to sandy, trace gravel; grey, (TILL); cohesive, w<PL, hard						
11					10	SS	45	PP = 440 kPa
12								
		- Increased sand content below 12.5 m depth			11	SS	41	PP = 440 kPa MH
13								
14				249.17 14.33	12	SS	31	PP = 420 kPa
		END OF BOREHOLE.						
15								
16								
17								
18								
19								
20								

Notes:
1. Water level measured at 6.0 mbgs upon completion of drilling.

2. PP= unconfined compressive strength measured with pocket penetrometer in the field.



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

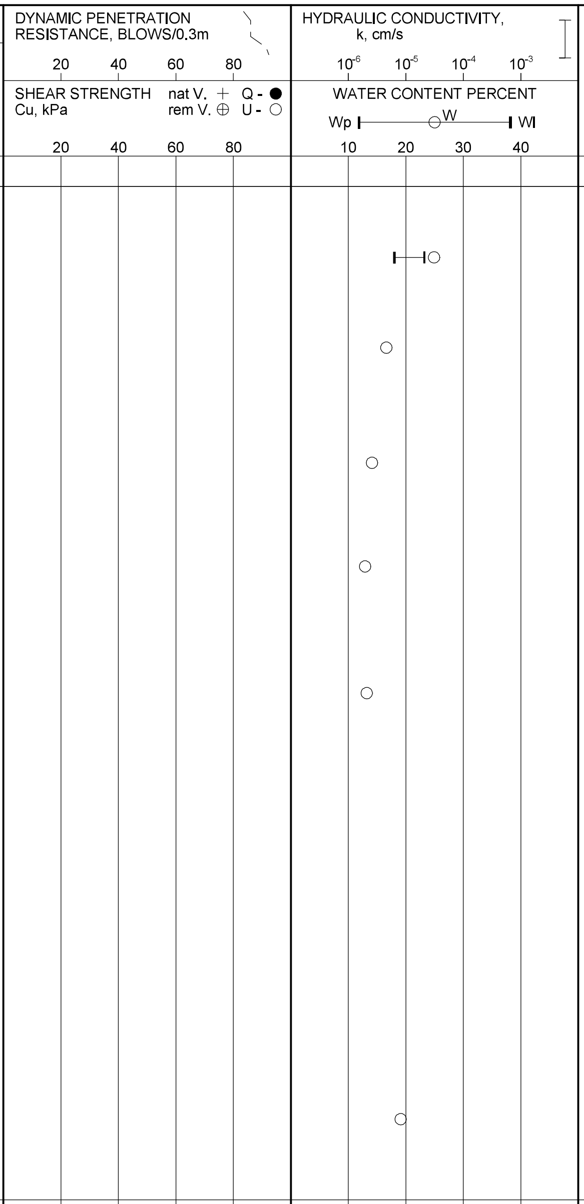
PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.751797 Long. -79.80950
(See Figure 1)

RECORD OF BOREHOLE: BH19-16

BORING DATE: March 26, 2019

SHEET 1 OF 1
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	257.00					
0	CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (330 mm)	0.00	1A	SS	4		
		(CL-ML) sandy CLAYEY SILT, trace to some gravel, trace organics; brown to grey; cohesive, w>PL, soft	256.67 0.33	1B	SS		MH	
1		(CL) sandy SILTY CLAY, trace sand, trace gravel; light brown, (TILL); cohesive, w<PL, stiff to very stiff	256.39 0.61	2	SS	12		∇ 26/03/2019
2				3	SS	25		
				4	SS	21		
3				5	SS	17		
4				6A				
		(CL-ML) CLAYEY SILT, trace gravel; grey, (TILL); cohesive, w<PL, stiff to very stiff - Silt/sand layer at a depth of 4.9 m	252.35 4.65	6B	SS	14		
5								
6		- Silty sand/sandy silt layer at a depth of 6 m - 6.2 m		7A	SS			
				7B	SS	27		
				7C	SS			
7		END OF BOREHOLE Notes: 1. Water level measured at 1.4 mbgs upon completion of drilling.	250.29 6.71					
8								
9								
10								



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.753061 Long. -79.806846
(See Figure 1)

RECORD OF BOREHOLE: BH19-17

BORING DATE: March 28, 2019

SHEET 1 OF 1
DATUM: Geodetic

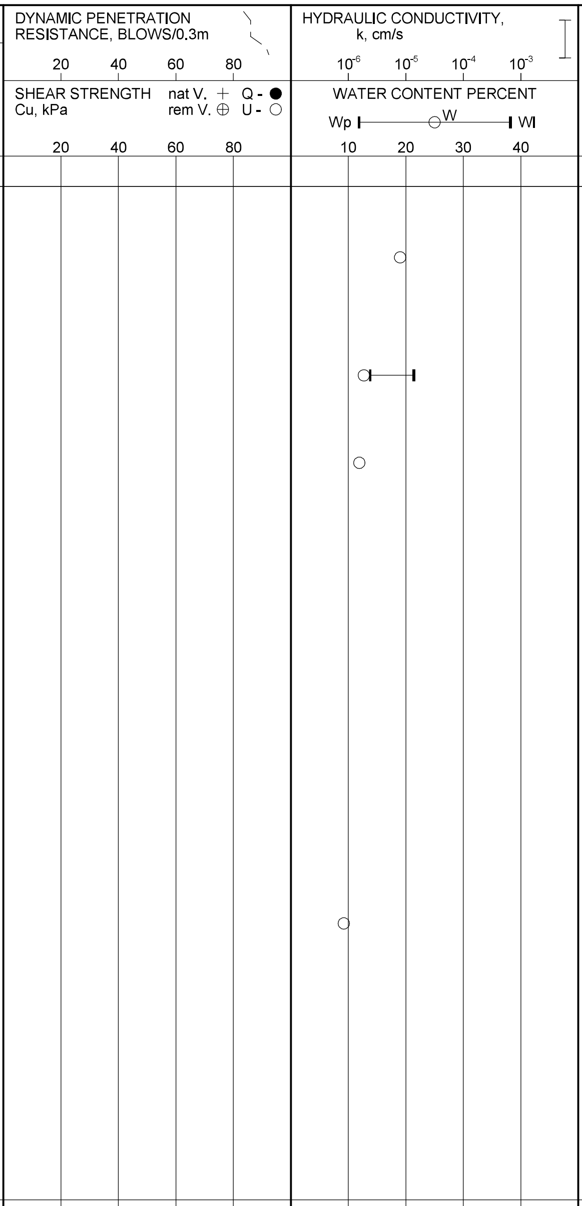
BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	269.50
0	TOPSOIL (330 mm)	0.00
	(CL) SILTY CLAY and SAND to sandy SILTY CLAY, trace gravel; light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to very stiff	269.17 0.33
	(CL-ML) CLAYEY SILT, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	264.93 4.57
	END OF BOREHOLE.	262.79 6.71

Notes:
1. Water level measured at 3.4 mbgs upon completion of drilling.

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	12	
1B	SS		
2A	SS	18	
2B	SS		MH
3	SS	29	
4	SS	14	
5	SS	29	
6	SS	34	
7	SS	46	

PIEZOMETER OR STANDPIPE INSTALLATION: ∇ 28/03/2019



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

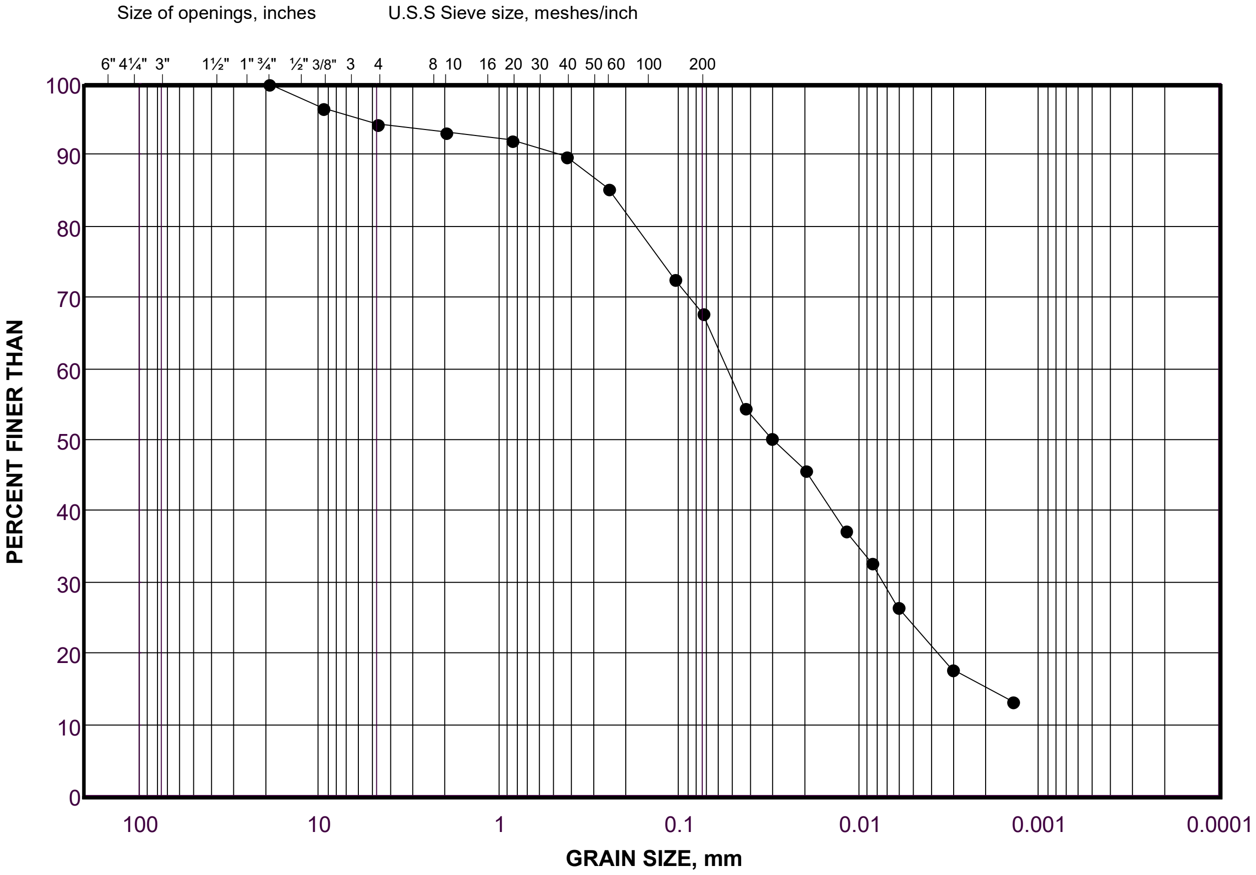
APPENDIX B

Geotechnical Laboratory Figures

GRAIN SIZE DISTRIBUTION

sandy CLAYEY SILT (CL-ML) - Reworked

FIGURE B1



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

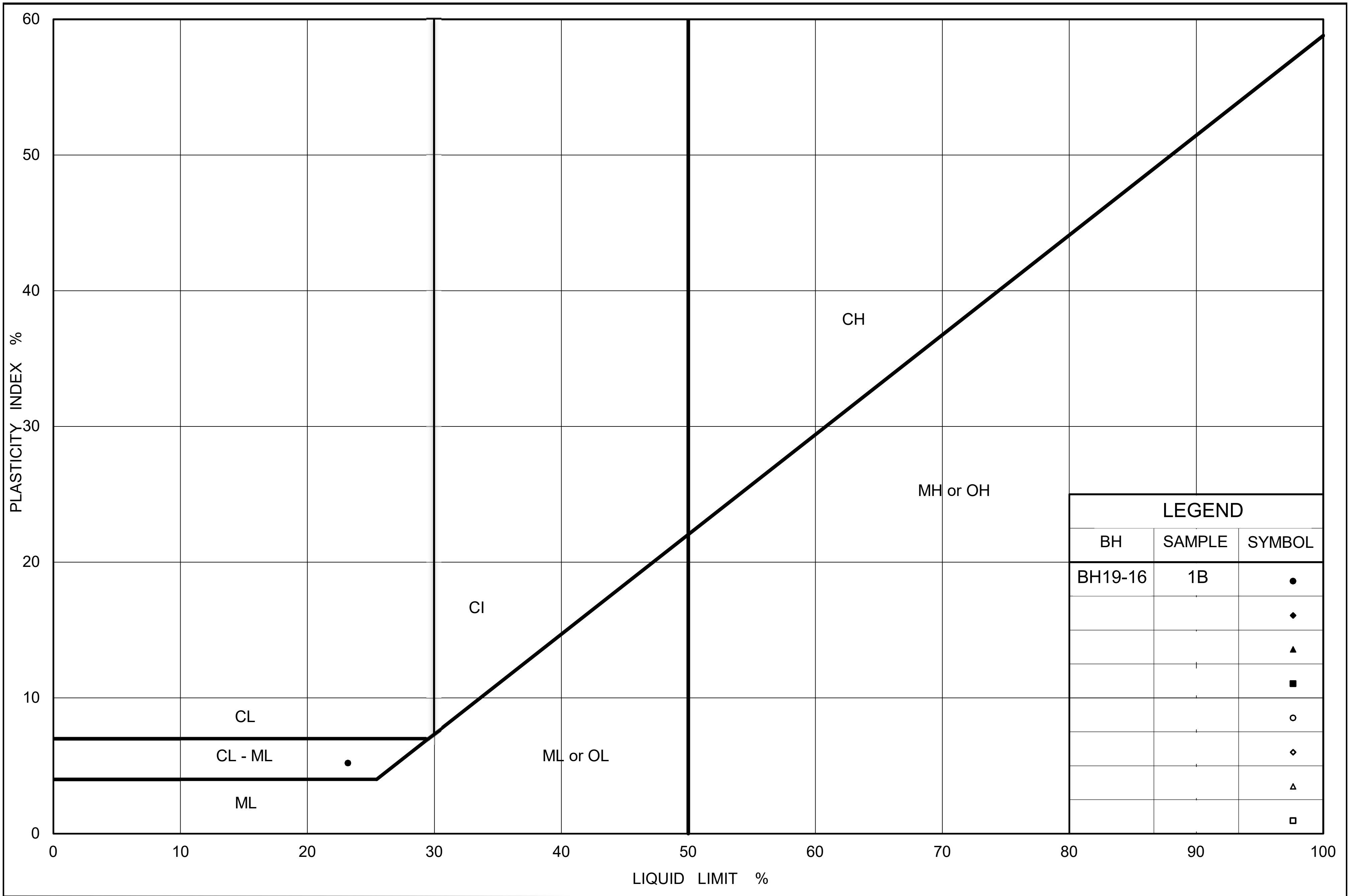
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH 19-16	1B	0.34 - 0.61

Project Number: 19115264 (5000)

Checked By: EM

Golder Associates

Date: 12-Jun-19



GOLDER

PLASTICITY CHART
sandy CLAYEY SILT (CL-ML) - Reworked

Figure No. B2

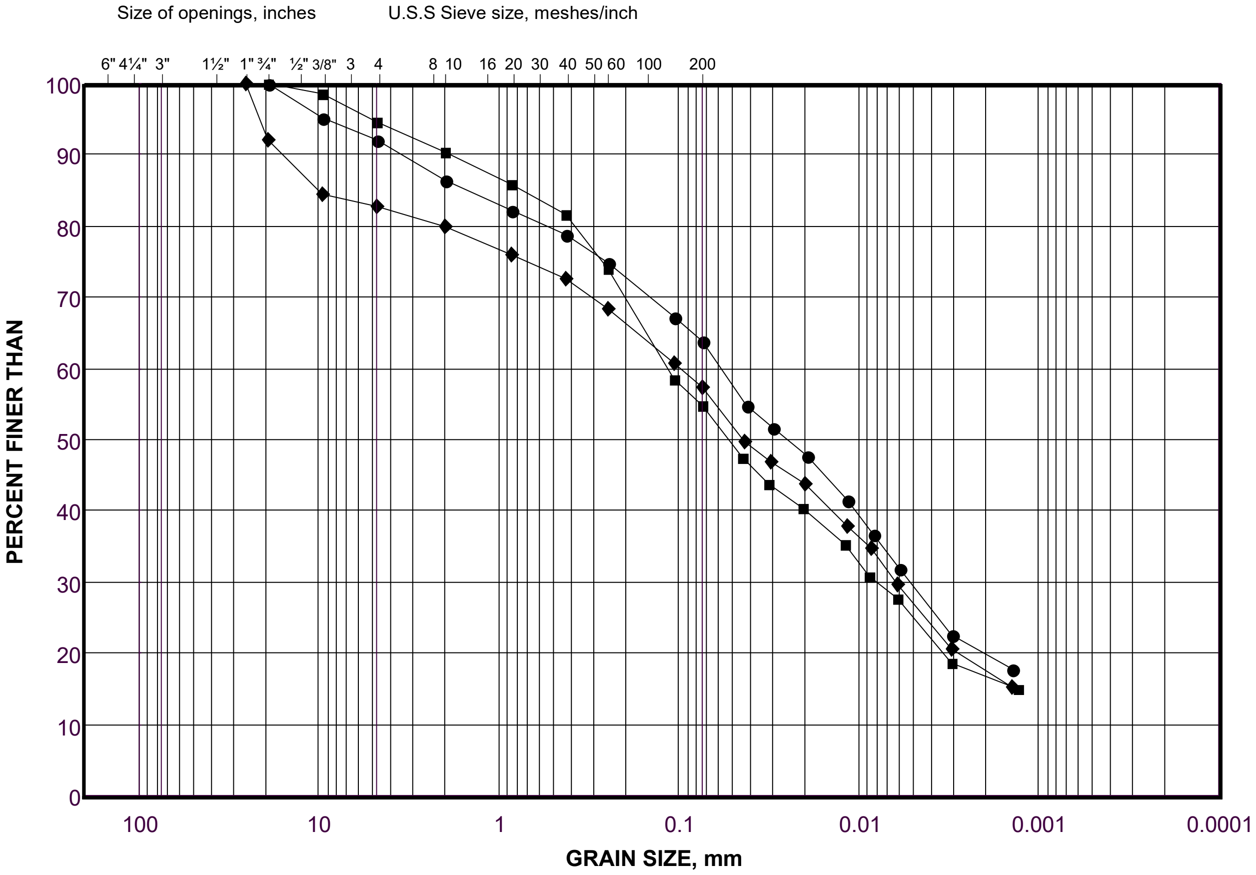
Project No. 19115264 (5000)

Checked By: EM

GRAIN SIZE DISTRIBUTION

sandy SILTY CLAY (CL) - TILL

FIGURE B2



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

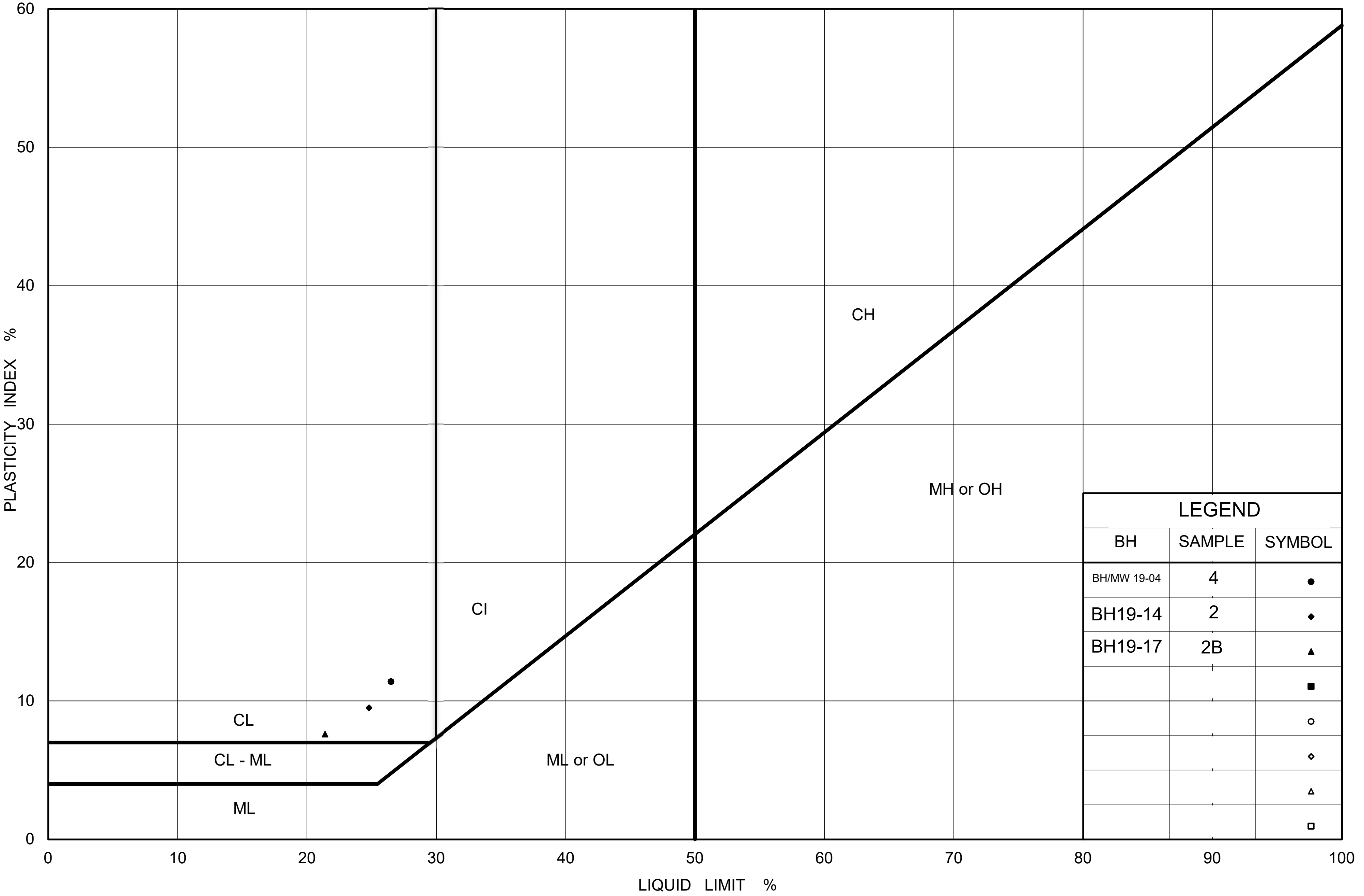
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH 19-14	2	0.76 - 1.37
■	BH 19-17	2B	1.13 - 1.37
◆	BH/MW 19-04	4	2.29 - 2.90

Project Number: 19115264 (5000)

Checked By:

Golder Associates

Date: 21-Jun-19



GOLDER

PLASTICITY CHART
sandy SILTY CLAY (CL) - TILL

Figure No. B3

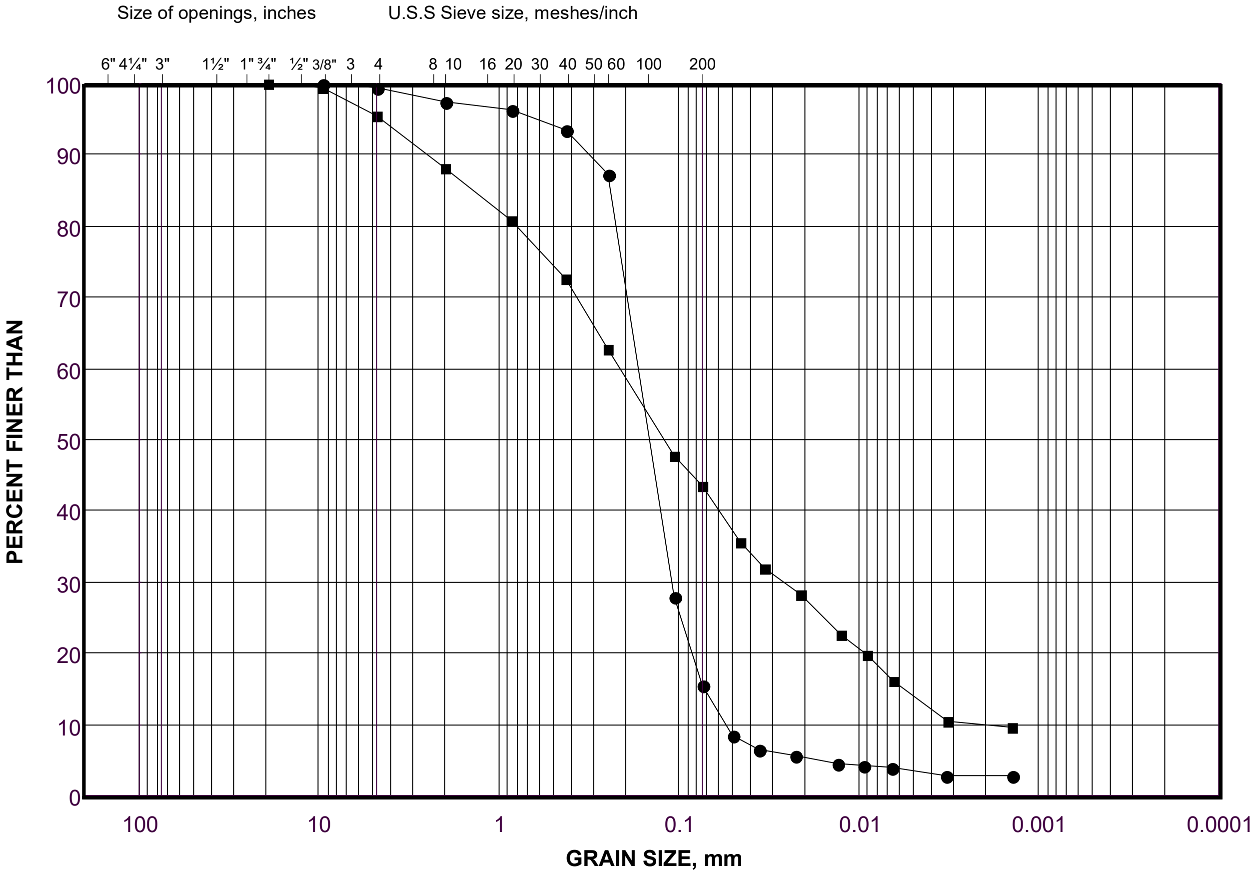
Project No. 19115264 (5000)

Checked By: EM

GRAIN SIZE DISTRIBUTION

SILTY SAND to SILT (SM-ML)

FIGURE B5



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

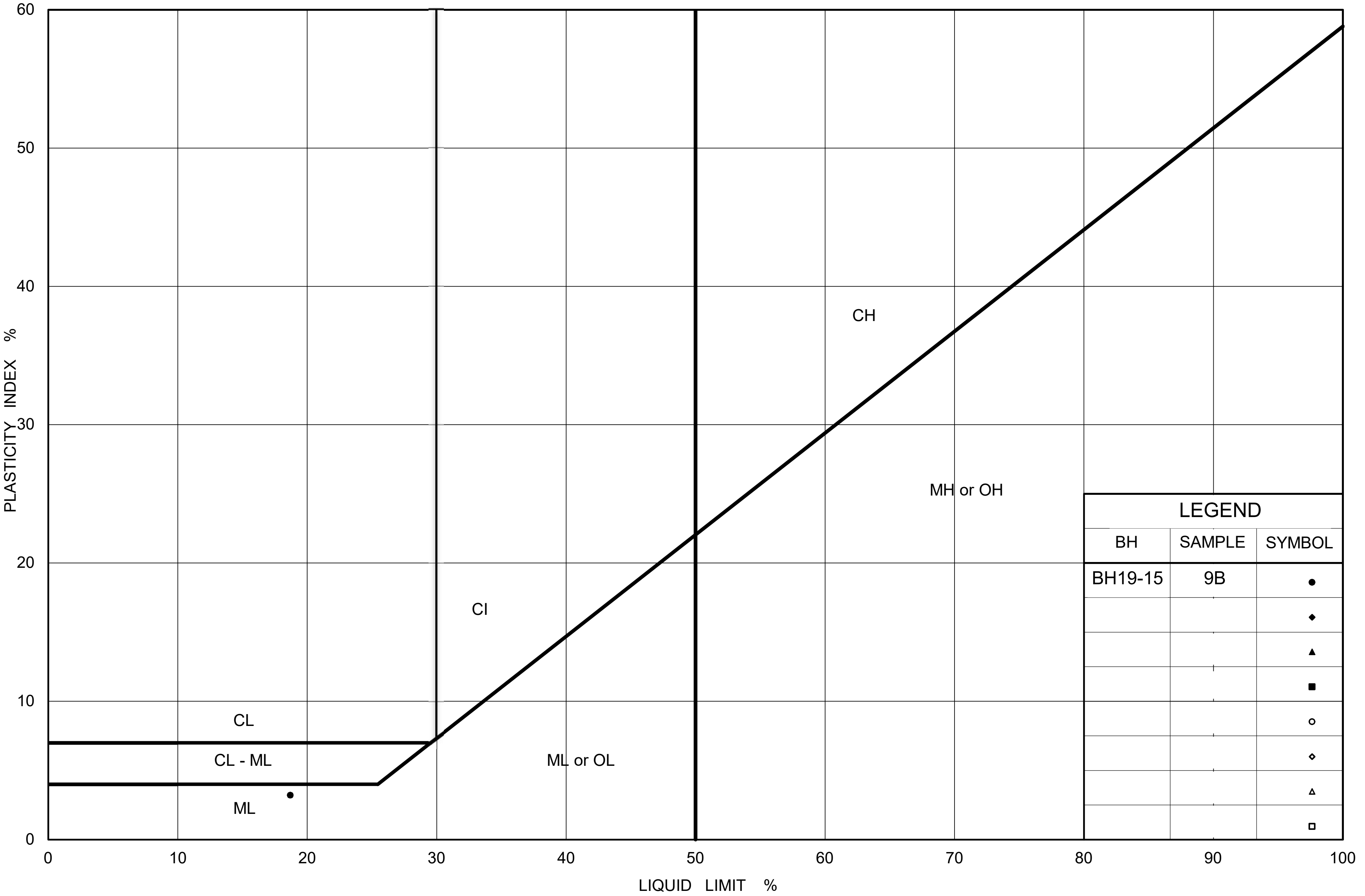
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH 19-14	7	6.10 - 6.71
■	BH 19-15	9B	9.69 - 9.75

Project Number: 19115264 (5000)

Checked By: EM

Golder Associates

Date: 12-Jun-19



GOLDER

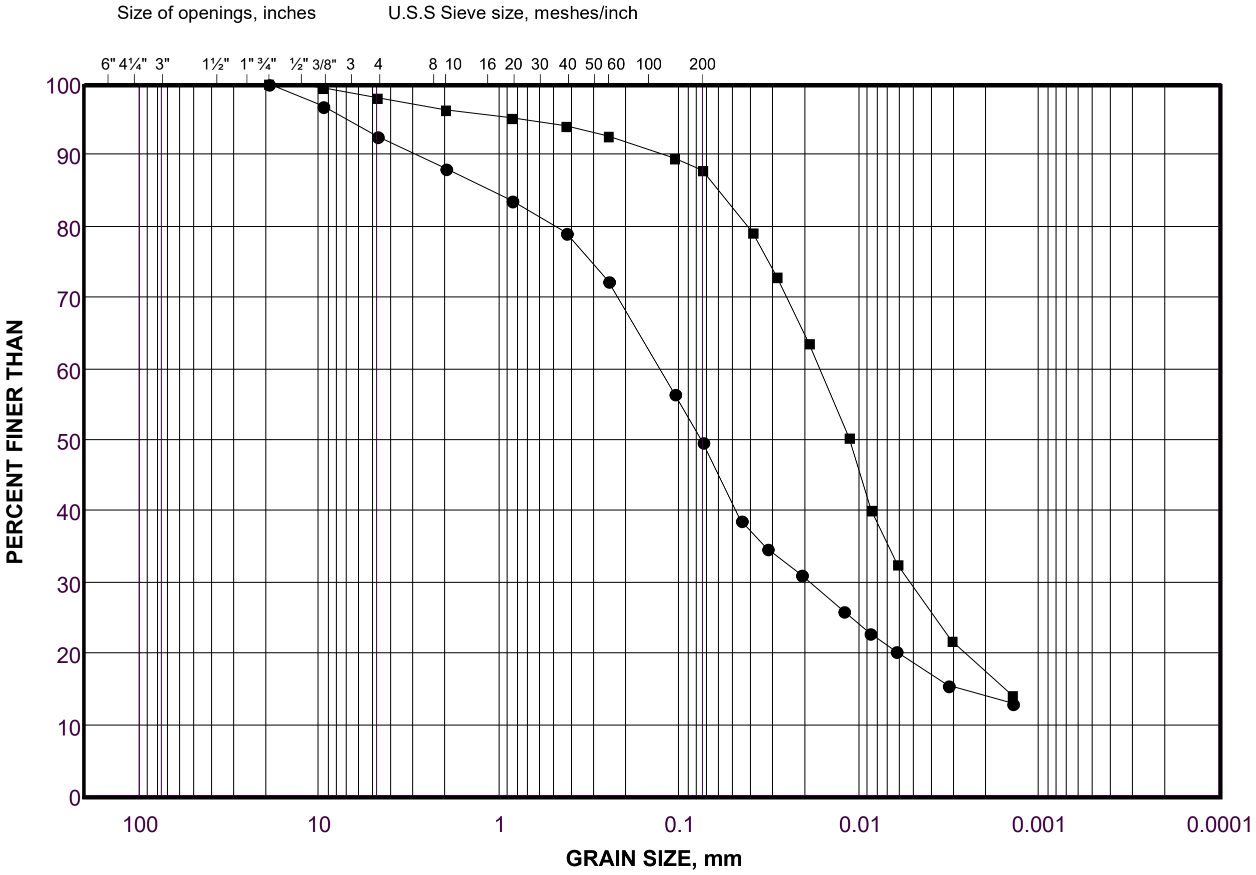
PLASTICITY CHART
SILTY SAND to SILT (SM-ML)

Figure No. B6

Project No. 19115264 (5000)

Checked By: EM

GRAIN SIZE DISTRIBUTION sandy CLAYEY SILT (CL-ML) - TILL	FIGURE B7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

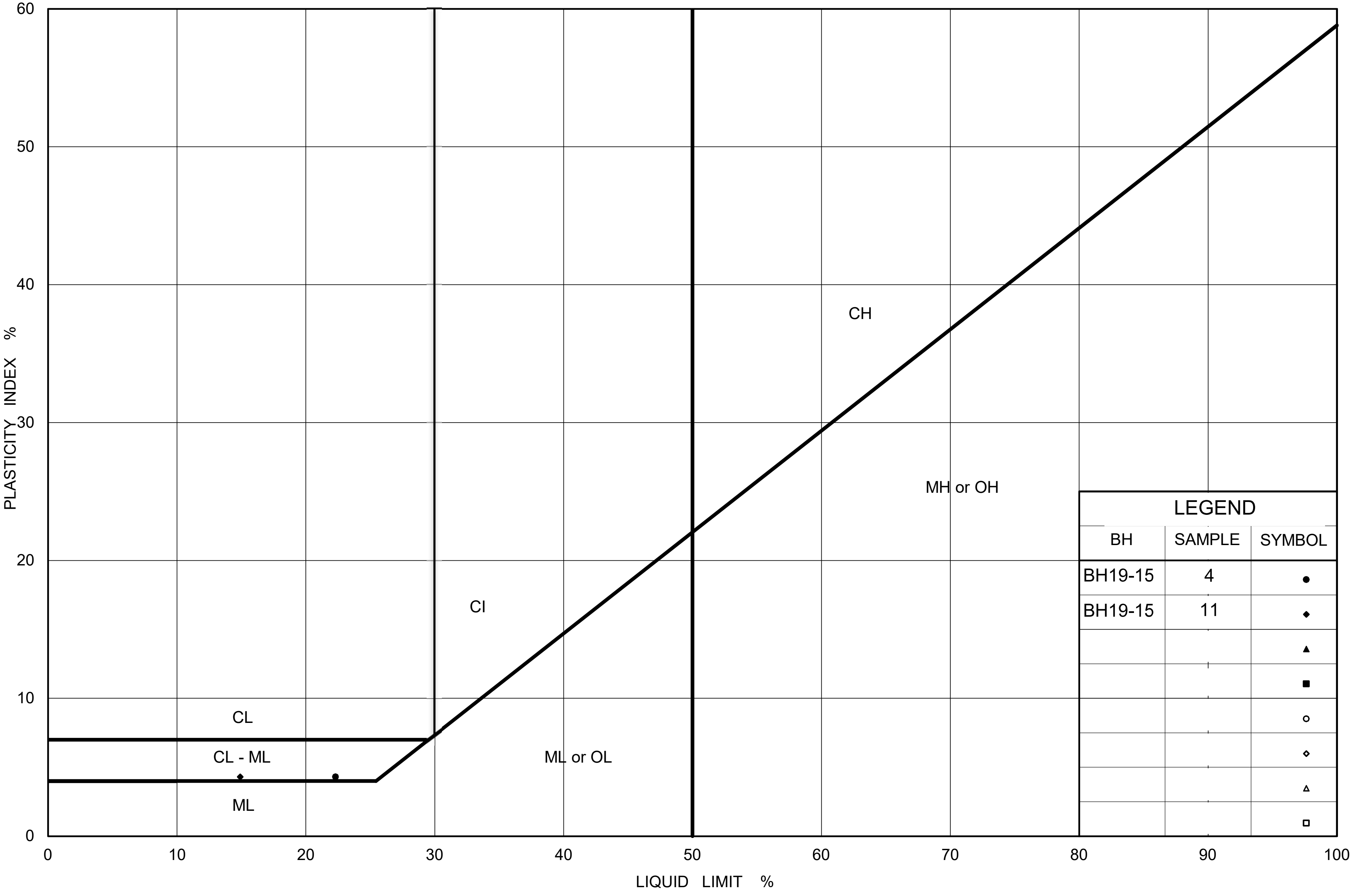
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH 19-15	11	12.19 - 12.80
■	BH 19-15	4	2.29 - 2.90

Project Number: 19115264 (5000)

Checked By: EM

Golder Associates

Date: 21-Jun-19



GOLDER

PLASTICITY CHART
sandy CLAYEY SILT (CL-ML) - TILL

Figure No. B8

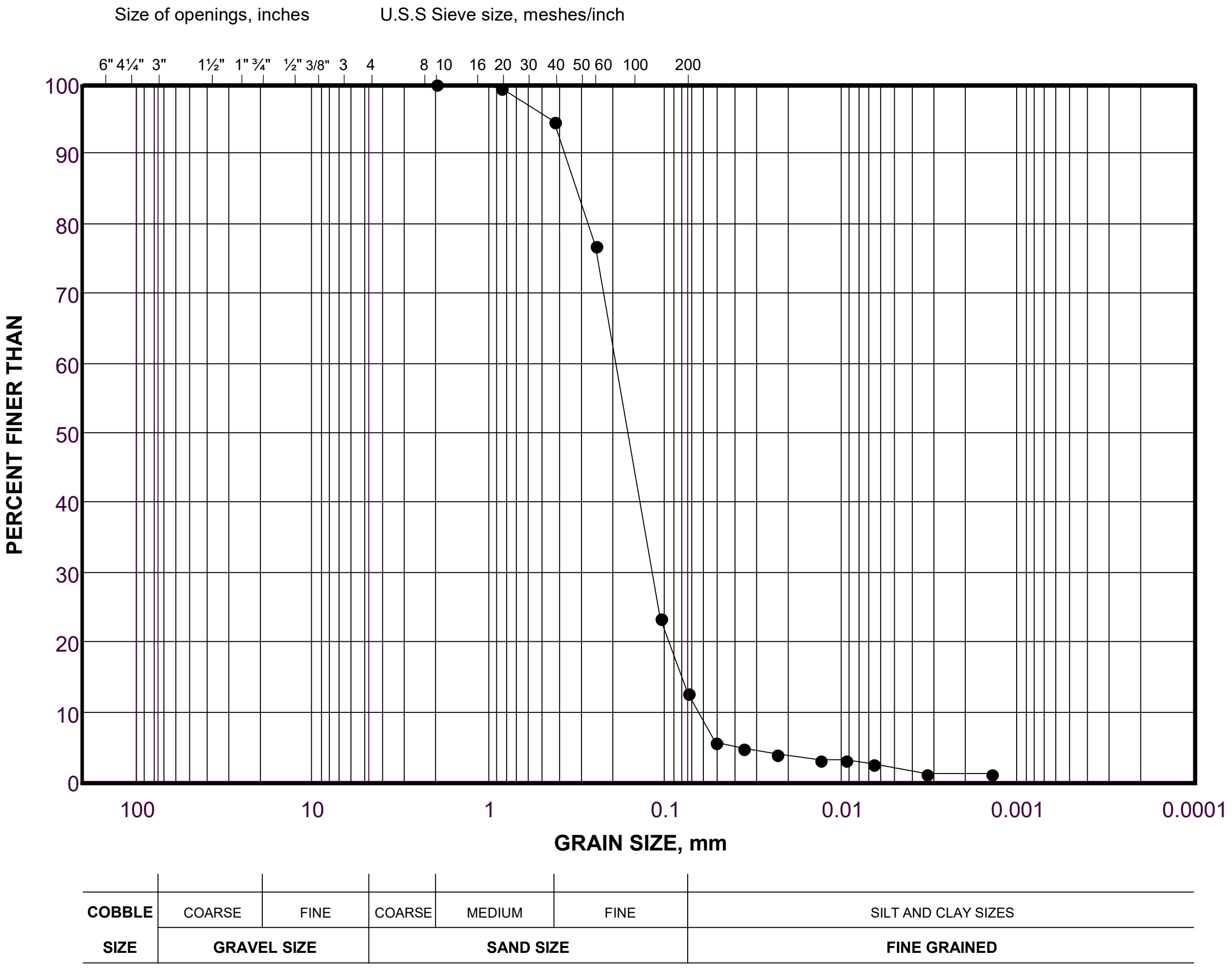
Project No. 19115264 (5000)

Checked By: EM

GRAIN SIZE DISTRIBUTION

SAND (SP)

FIGURE B9



LEGEND

SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH/MW 19-04	14	15.24 - 15.85

Project Number: 19115264

Checked By: EM

Golder Associates

Date: 18-Jun-19

APPENDIX C

Previous Geotechnical Borehole Logs

PROJECT: 19115264-3000

LOCATION: Lat. 43.750098 Long. -79.814418

(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-03

BORING DATE: April 4, 2019

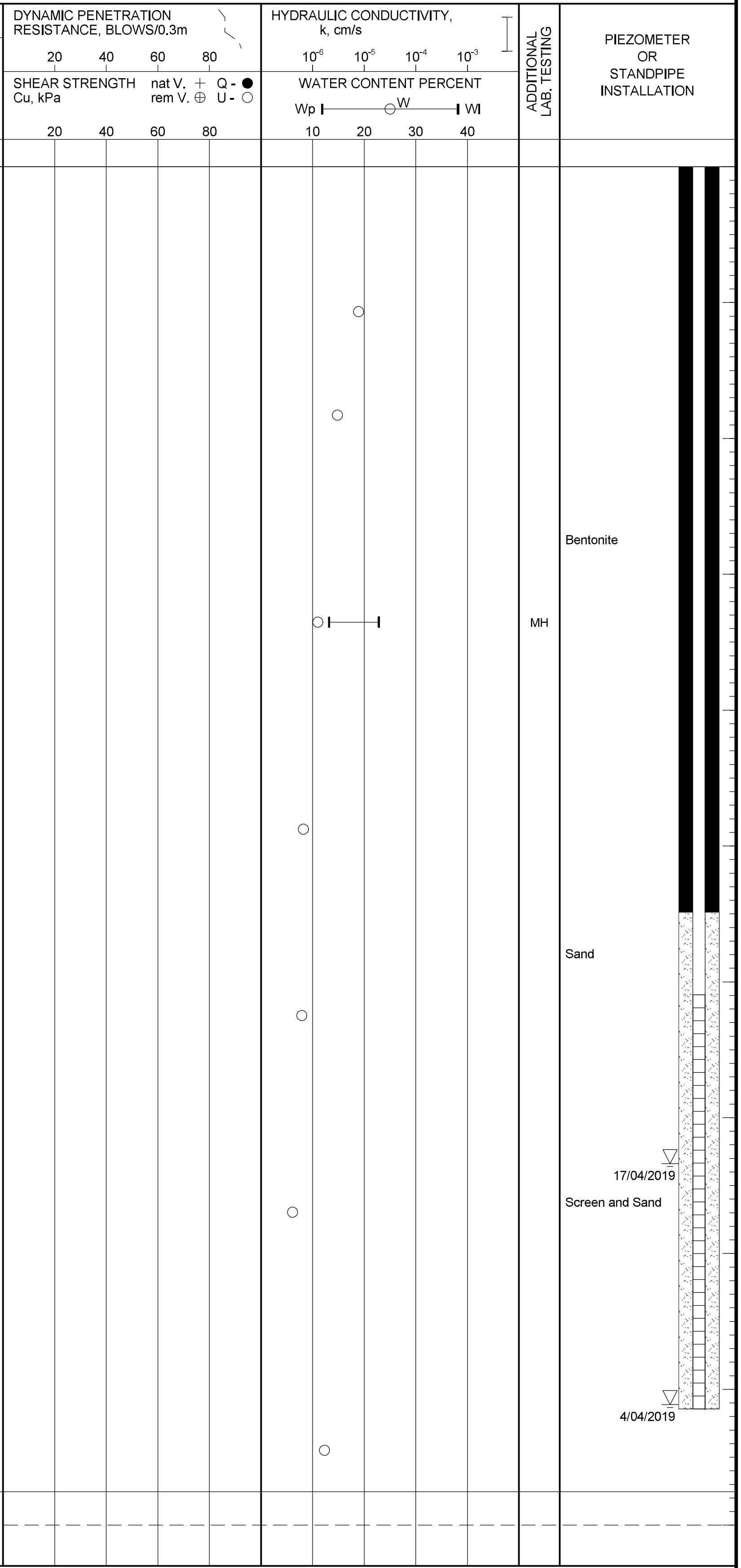
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	266.88
0	TOPSOIL (350 mm)	0.00
	(CL) SILTY CLAY, some sand, trace gravel, trace organics; brown with oxidation staining; cohesive, w<PL, firm	266.53 0.35
1	(CL) sandy SILTY CLAY, trace gravel, contains inferred cobbles; light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to hard	265.51 1.37
4	(ML) gravelly sandy SILT, with slight plasticity, contains inferred cobbles; light brown; non-cohesive, moist, very dense - Inferred cobbles/boulders from auger grindings at a depth of 2 m and 7.3 m	262.89 3.99
7	(CL-ML) CLAYEY SILT, some to trace sand; grey, (TILL); cohesive, w<PL, hard - Cobbles/boulders inferred from auger grinding at a depth of 8.4 m	259.88 7.00
	END OF BOREHOLE.	257.13 9.75
10	*CONTINUED NEXT PAGE*	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	5	
1B	SS		
2	SS	7	
3	SS	11	
4	SS	24	
5	SS	30	MH
6	SS	75	
7	SS	100	
8	SS	100	
9	SS	77	



DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-3000

LOCATION: Lat. 43.750098 Long. -79.814418
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-03

BORING DATE: April 4, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Water level measured at 9.1 mbgs upon completion of drilling. 2. Water level measured in monitoring well as follows: Date Depth Elev. (m) April 17, 2019 7.34 mbgs 259.54 m									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-6000
LOCATION: Lat. 43.755372 Long. -79.802724
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-07

BORING DATE: March 27, 2019

SHEET 1 OF 2

DATUM: Existing Ground Surface

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE				
0	TOPSOIL (230 mm)	0.00	1A	SS	19
	(CL) sandy CLAY, trace gravel, trace organics; dark brown; cohesive, w<PL, very stiff	0.23	1B	SS	
	(CL) SILTY CLAY, some sand to sandy, trace gravel; light brown with oxidation staining, (TILL); cohesive, w<PL, very stiff to hard	0.61			
1			2	SS	11
2			3	SS	11
			4	SS	24
3	- Becoming sandy at a depth of 3 m				
			5	SS	45
4					
5			6	SS	44
6	(SM/ML) sandy SILT to SILT, trace to some clay, slight plasticity; light brown; non-cohesive,wet, dense to very dense	5.90			
			7	SS	36
7	- Cobble/boulder inferred from auger grinding at a depth of 7.3 m		8	SS	100/ 2"
	(SM) SILTY SAND, fine to medium grained, some to trace gravel; light brown; non-cohesive, moist, dense to very dense	7.62			
8					
9			9	SS	131
10					

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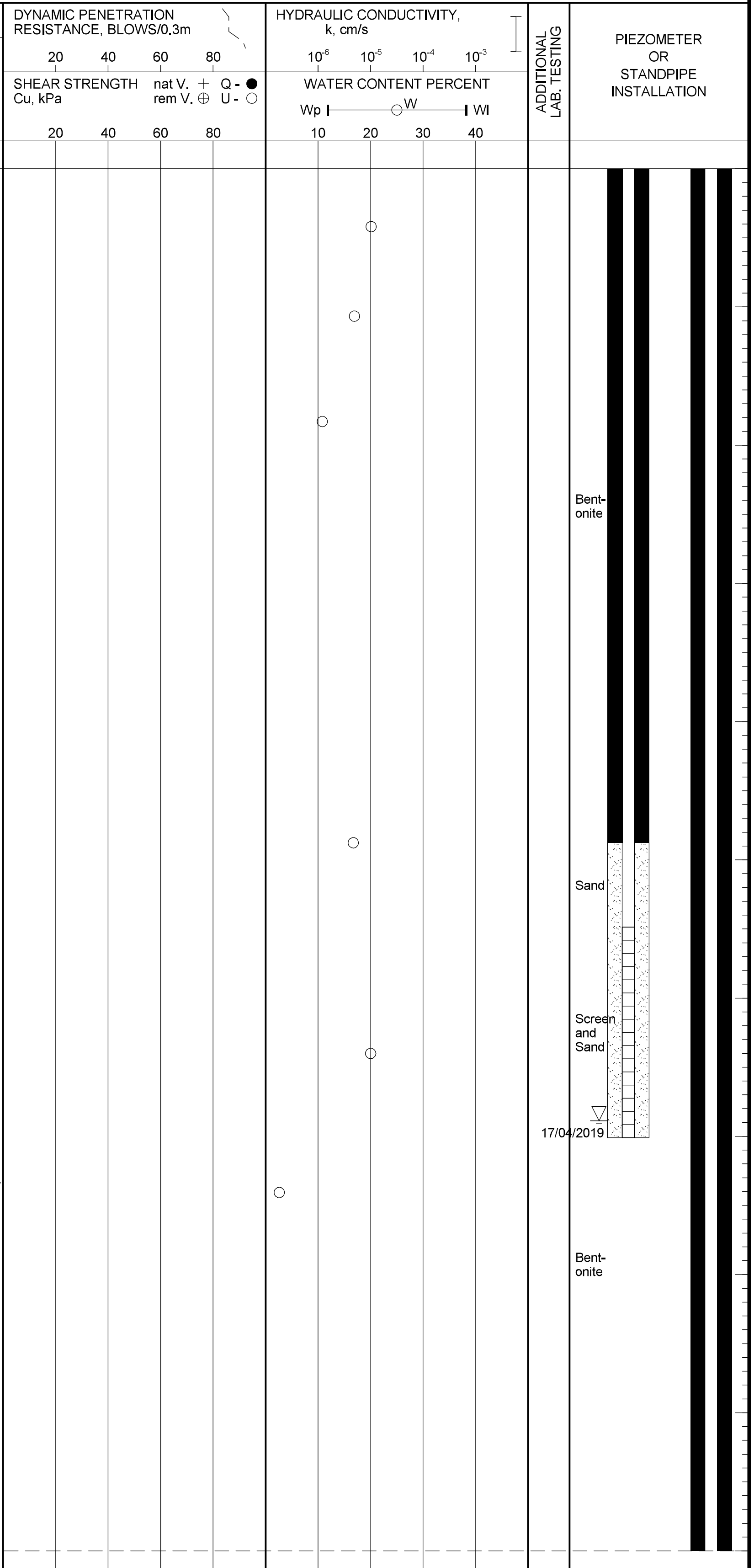


DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-6000
LOCATION: Lat. 43.755372 Long. -79.802724
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-07

BORING DATE: March 27, 2019

SHEET 2 OF 2

DATUM: Existing Ground Surface

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
10	CME 75 Track Mount Power Auger 100 mm Solid Stem	(SM) SILTY SAND, fine to medium grained, some to trace gravel; light brown; non-cohesive, moist, dense to very dense				
11				10	SS	94
12		- Contains wet sandy silt layer at a depth of 12.2 m		11	SS	40
13						
14				12	SS	38
		END OF BOREHOLE.	14.33			
15						
16						
17						
18						
19						
20						

Notes:
1. Water level measured at 12.8 mbgs upon completion of drilling.

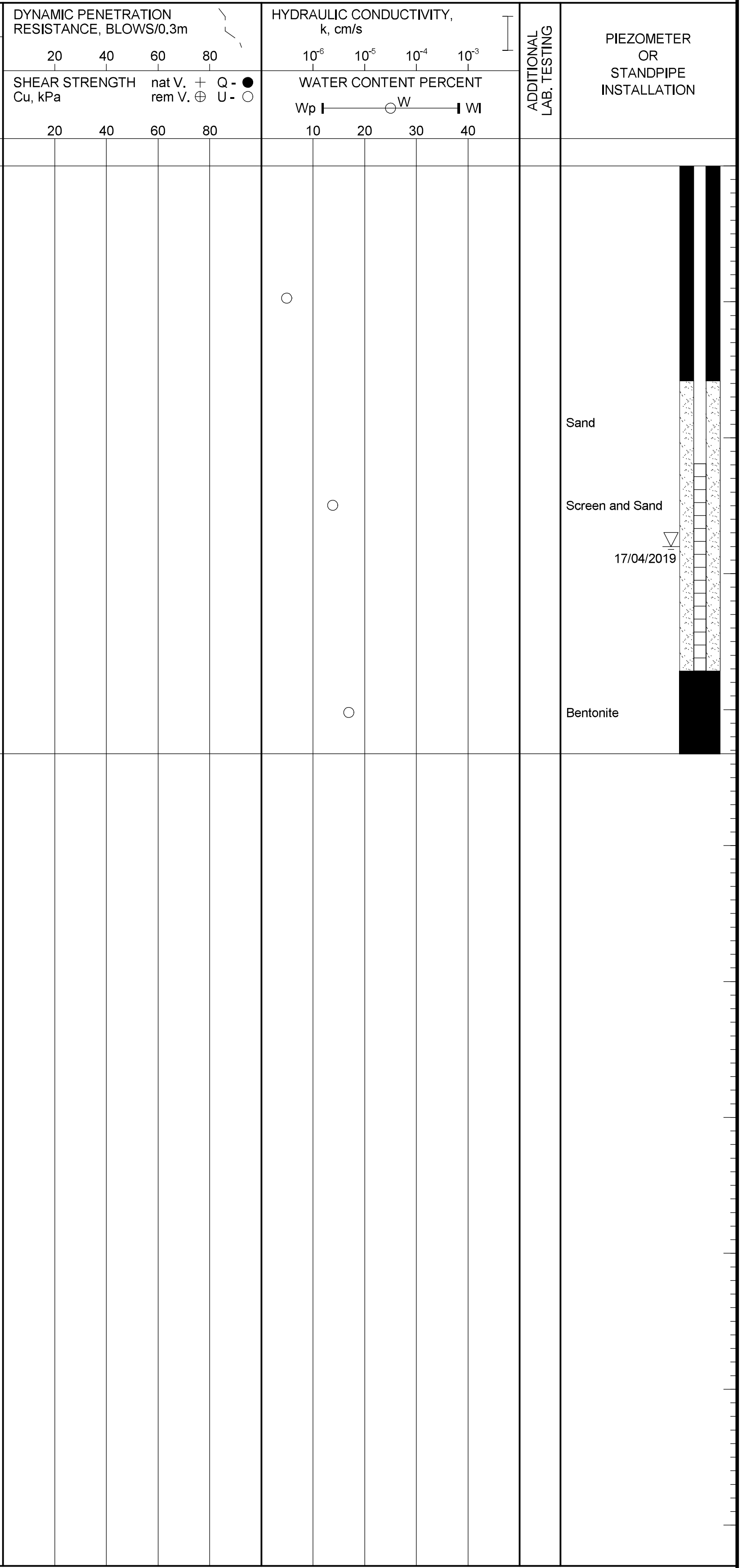
2. Water level measured in monitoring well as follows:

Deep Well

Date	Depth	Elev. (m)
April 17, 2019	12.8 mbgs	N/A

Shallow Well

Date	Depth	Elev. (m)
April 17, 2019	6.9 mbgs	N/A



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.749709 Long. -79.812182

(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-13

BORING DATE: April 4, 2019

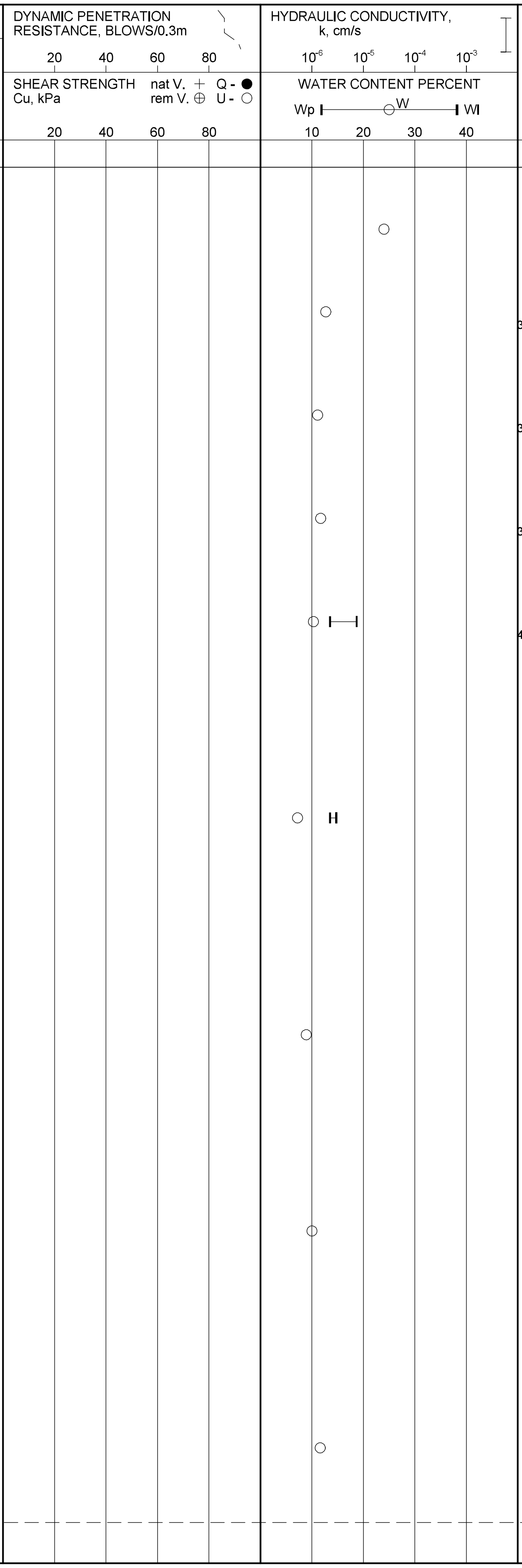
SHEET 1 OF 2

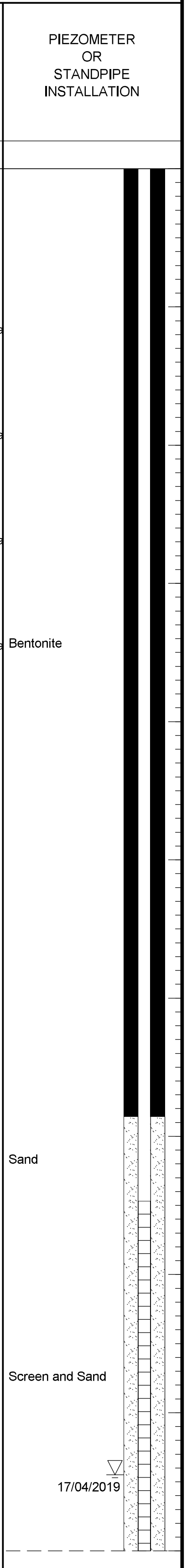
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	267.61
0	TOPSOIL (300 mm)	0.00
	(CL) SILTY CLAY, some sand, trace organics; dark brown; cohesive, w<PL, firm	267.31 0.30
1	(CL) SILTY CLAY and SAND, trace gravel, inferred cobbles/boulders; mottled light brown/brown, (TILL); w<PL, very stiff to hard - Cobbles/boulders inferred from auger grinding at 1.7 m	266.65 0.96
4	(SM) gravelly SILTY SAND, cobbles/boulders inferred from auger grinding; light brown; non-cohesive, dry to moist, very dense - Heavy auger grinding below depth of 5.4 m	263.61 4.00
7.62	(ML) sandy SILT, with slight plasticity, trace gravel; light brown; moist, very dense	259.99 7.62
10	CONTINUED NEXT PAGE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	5	
1B	SS		
2	SS	17	PP = 320 kPa
3	SS	19	PP = 320 kPa
4	SS	22	PP = 340 kPa
5	SS	33	PP = 440 kPa MH
6	SS	154	MH
7	SS	115	
8	SS	138	MH
9	SS	137	
10	SS	146	





DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

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PROJECT: 19115264-1000/2000

LOCATION: Lat. 43.749709 Long. -79.812182

(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-13

BORING DATE: April 4, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(ML) sandy SILT, with slight plasticity, trace gravel; light brown; moist, very dense		257.09	10	SS	146		⦶⊣	MH	Screen and Sand
		END OF BOREHOLE. Notes: 1. Borehole dry upon completion of drilling. 2. Water level measured in monitoring well as follows: Date Depth Elev. (m) April 17, 2019 9.45 mbgs 258.16 m 3. PP= unconfined compressive strength measured with pocket penetrometer in the field.		10.52							
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-6000
LOCATION: Lat. 43.753587 Long. -79.803241
(See Figure 1)

RECORD OF BOREHOLE: BH19-18

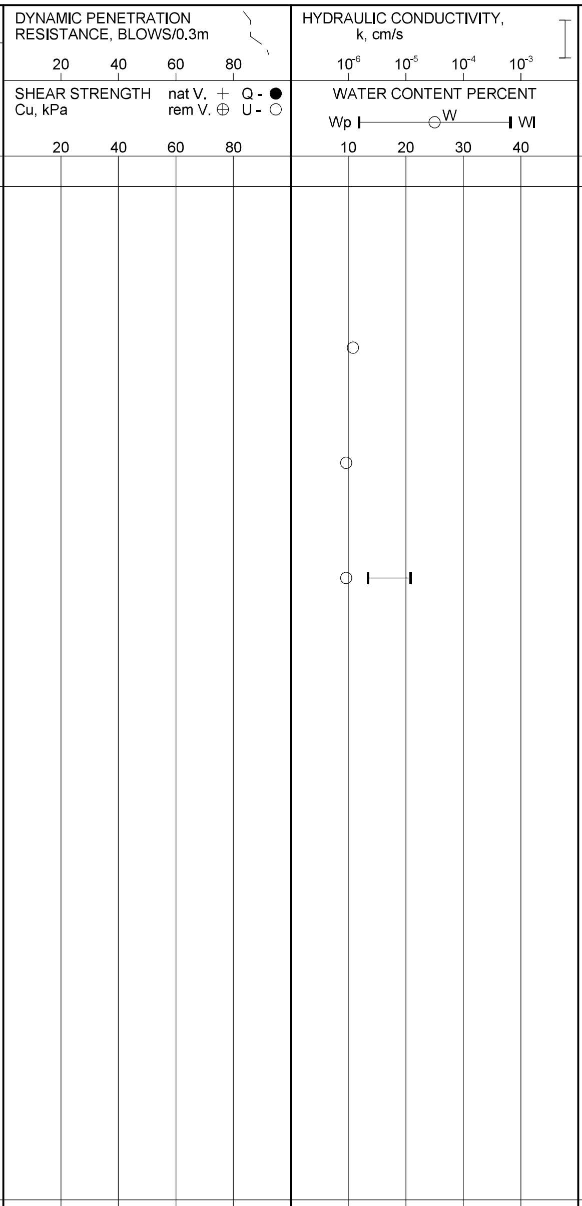
BORING DATE: March 27, 2019

SHEET 1 OF 1

DATUM: Existing Ground Surface

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE						
0	TOPSOIL (200 mm)	0.00	1A	SS	11		
	(CL) sandy SILTY CLAY, trace to some gravel with cobbles/boulders inferred from auger grinding; brown to light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to hard	0.20	1B	SS			
1			2	SS	22		
2			3	SS	38		
			4	SS	35	MH	▽ 27/03/2019
3			5	SS	35		
4							
5			6	SS	52		
6	(CL/ML) CLAYEY SILT, trace sand; grey, (TILL); cohesive, w>PL, hard	6.10	7	SS	33		
	END OF BOREHOLE	6.71					



Notes:
1. Water level measured at 2.7 mbgs upon completion of drilling.

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-6000

LOCATION: Lat. 43.754896 Long. -79.804943

(See Figure 1)

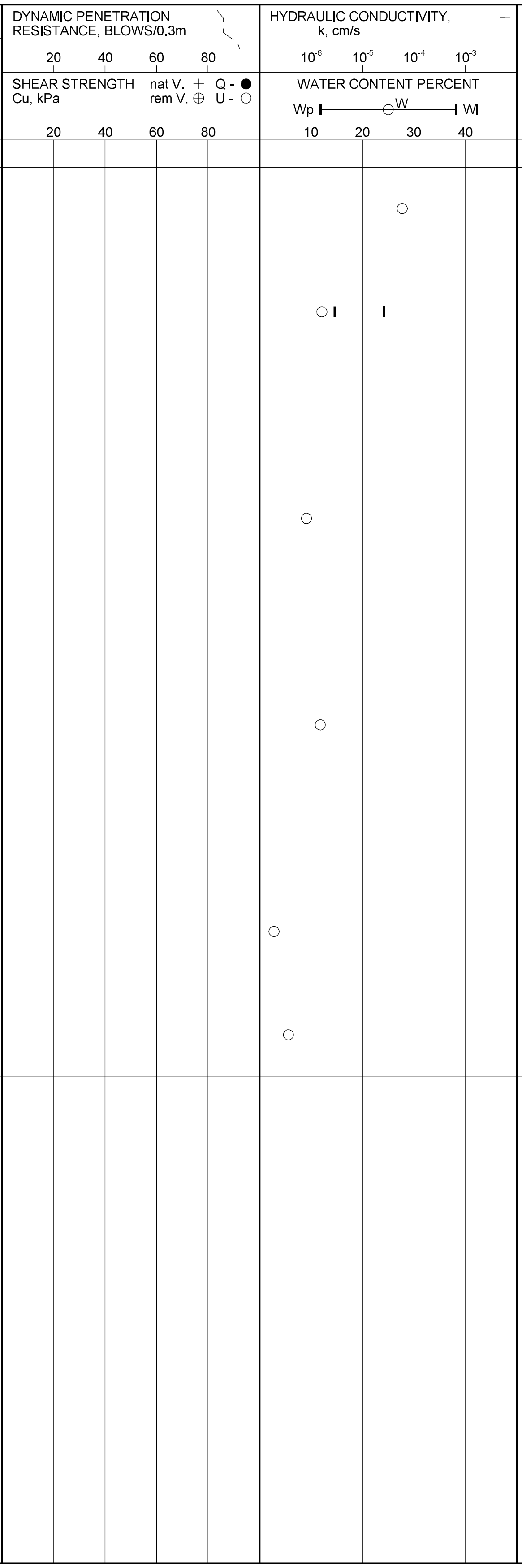
RECORD OF BOREHOLE: BH19-19

BORING DATE: March 26, 2019

SHEET 1 OF 1

DATUM: Existing Ground Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE						
0	CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (610 mm)	0.00	1	SS	4		
1		(CL) sandy SILTY CLAY, some sand, trace gravel with cobbles/boulders inferred from auger grinding; brown with oxidation staining, (TILL); w<PL, very stiff to hard	0.61	2	SS	26	MH	
				3	SS	40		
2				4	SS	49		
3				5	SS	54		
4				6	SS	55		
		- Increased sand content at a depth of 4.6 m		7	SS	86		
5		(SM) SILTY SAND, fine grained, inferred cobbles/boulders; light brown; non-cohesive, moist, very dense	5.18	8	SS	95		
6				9	SS	100		
7		END OF BOREHOLE. Notes: 1. Borehole dry upon completion of drilling.	6.71					
8								
9								
10								



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DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

BORING NUMBER 1

PAGE 1 OF 1

CLIENT Dilip Kumar Jain

PROJECT NAME 3278 Mayfield Road

PROJECT NUMBER Ma002995a

PROJECT LOCATION Town of Caledon

DATE STARTED 10/19/17 **COMPLETED** 10/19/17

GROUND ELEVATION 270 m **HOLE SIZE** 150 mm

DRILLING CONTRACTOR Fadroy Enterprise

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Augers

AT TIME OF DRILLING Dry

LOGGED BY J.J. **CHECKED BY** E.W.

AT END OF DRILLING Dry

NOTES

AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG		MATERIAL DESCRIPTION	
					0.20	**TOPSOIL** - ~200 mm thick.	269.80
	SS 1	3-4-5-7 (9)	MC = 17%			**CLAYEY SILT** - some sand, occasional gravel, brown, very moist, hard.	
1	SS 2	5-6-10 (16)	PP = 400 kPa MC = 17%				
2	SS 3	4-6-10 (16)	PP >450 kPa MC = 15%				
	SS 4	6-10-14 (24)	PP >450 kPa MC = 14%				
3					3.00		267.00
	SS 5	5-10-12 (22)	PP >450 kPa MC = 11%			**SAND TILL** - trace clay, trace gravel, brown, very moist, compact.	
4							
	SS 6	6-16-20 (36)	PP >450 kPa MC = 13%			-becoming dense below ~4.5 m depth	
5							
6							
	SS 7	50-0-0/- 0.15	PP >450 kPa MC = 10%		6.15	-becoming very dense below ~6.0 m depth	263.85
						Bottom of hole at 6.15 m.	

EDWARD WONG

WELL NUMBER 2

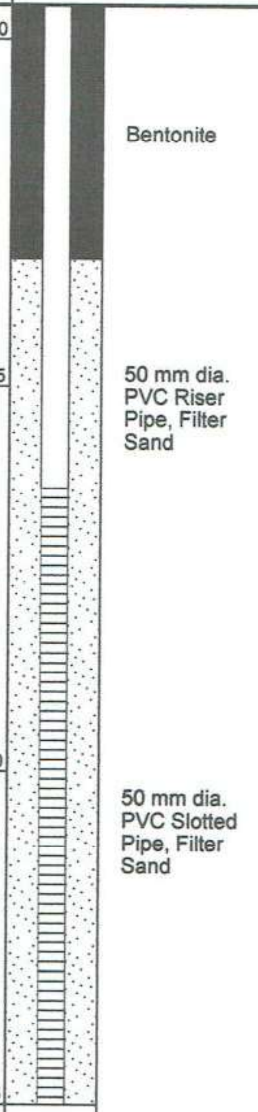
PAGE 1 OF 1

CLIENT Dilip Kumar Jain
PROJECT NUMBER Ma002995a
PROJECT NAME 3278 Mayfield Road
PROJECT LOCATION Town of Caledon

DATE STARTED 10/19/17 **COMPLETED** 10/19/17
DRILLING CONTRACTOR Fadroy Enterprise
DRILLING METHOD Solid Stem Augers
LOGGED BY J.J. **CHECKED BY** E.W.
NOTES
GROUND ELEVATION 270 m **HOLE SIZE** 150 mm
GROUND WATER LEVELS:
AT TIME OF DRILLING Dry
AT END OF DRILLING Dry
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
	SS 1	3-7-10-7 (17)	MC = 15%	0.20	**TOPSOIL** - ~200 mm thick. 269.80 **SILTY SAND** - scattered clay seams, brown, moist, loose.
1	SS 2	2-2-3 (5)	MC = 5%		-becoming loose below ~0.75 m depth
2	SS 3	2-4-5 (9)	MC = 20%		-becoming wet below ~1.5 m depth
	SS 4	8-11-14 (25)	PP >450 kPa MC = 14%	2.25	267.75 **CLAYEY SILT** - trace sand, brown, very moist, hard.
3	SS 5	5-10-15 (25)	PP >450 kPa MC = 14%		
4					
5	SS 6	5-10-11 (21)	PP = 400 kPa MC = 14%	4.50	265.50 **SILTY CLAY** - mottled brown and grey, very moist, hard.
6	SS 7	4-8-11 (19)	PP = 300 kPa MC = 12%		-becoming grey and stiff below ~6.0 m depth
				6.45	263.55 Bottom of hole at 6.30 m.

WELL DIAGRAM



EDWARD WONG

BORING NUMBER 4

PAGE 1 OF 1

CLIENT Dilip Kumar Jain
PROJECT NAME 3278 Mayfield Road
PROJECT NUMBER Ma002995a
PROJECT LOCATION Town of Caledon

DATE STARTED 10/18/17 **COMPLETED** 10/18/17
GROUND ELEVATION 270 m **HOLE SIZE** 150 mm
DRILLING CONTRACTOR Fadroy Enterprise
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Augers
AT TIME OF DRILLING Dry
LOGGED BY J.J. **CHECKED BY** E.W.
AT END OF DRILLING Dry
NOTES
AFTER DRILLING Dry

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
					TOPSOIL - ~200 mm thick.	
	SS 1	3-11-13-12 (24)	MC = 8%	0.20	**FILL** - ~ 1 m of brown sandy silt with rootlets, very moist over ~3,3 m of brown clayey silt, rootlets, organic inclusions, very moist.	269.80
1	SS 2	8-6-6 (12)	MC = 11%			
2	SS 3	4-4-6 (10)	MC = 11%			
	SS 4	4-7-8 (15)	MC = 14%			
3	SS 5	4-7-7 (14)	MC = 17%			
4						
				4.50	**CLAYEY SILT** - some sand, trace gravel, brown, very moist, hard.	265.50
5	SS 6	8-14-20 (34)	PP >450 kPa MC = 10%			
6	SS 7	20-50- 0/0.00	PP >450 kPa MC = 8%	6.30		263.70
					Bottom of hole at 6.30 m.	

APPENDIX D

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

GOLDER

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REPORT

Preliminary Geotechnical Investigation, Coscorp HL Developments Inc.

Proposed Residential Development, Snell's Hollow Secondary Plan, Caledon, Ontario

Submitted to:

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June 24, 2019

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APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Coscorp HL Developments Inc. (Coscorp) to provide preliminary geotechnical consulting services to support a draft plan approval for a future residential subdivision development located north east of Heart Lake Road and Mayfield Road in Caledon, Ontario (the Site), as shown in the Site and Borehole Location Plan, ***Figure 1***.

The terms of reference for the geotechnical consulting services are included in Golder's proposal No. P19115264 Rev 1, dated March 8, 2019.

The purpose of the investigation is to obtain information on the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of boreholes and geotechnical laboratory tests. Based on our interpretation of the factual information collected as part of the preliminary geotechnical investigation carried out at this site, a general description of the subsurface conditions across the site is presented herein. The interpreted subsurface conditions and available project details were used to develop preliminary engineering parameters and recommendations on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

This report provides the results of the preliminary geotechnical investigation and should be read in conjunction with the *"Important Information and Limitations of This Report"* ***Appendix D***. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder should be given an opportunity to confirm that the recommendations in this report are still valid.

2.0 SITE DESCRIPTION AND BACKGROUND

The subject property is located north east of Heart Lake Road and Mayfield Road and is part of the Snell's Hollow Secondary Plan, which is a proposed residential development to be located in the southern part of the Town of Caledon. The site is bounded by Heart Lake Road to the west, Mayfield Road to the south and Highway 410 to the north and east as shown in ***Figure 1.***

The site has a total area of approximately 6.3 hectares (15.6 acres) of predominantly flat land which slightly slopes at the property limit next to Highway 410. The site consists of agricultural land as noted by the presence of previous farming activities (crops). There is one residential dwelling located to the north of the site which has a municipal address of 12109 Heart Lake Road Caledon, Ontario.

Based on our understanding, the Site is to be developed into a residential development, with associated underground services and supporting roads. For the purposes of this report, we have assumed that the future residential houses will be constructed utilizing shallow strip/spread footings, with an interior slab-on-grade, and one-level of underground basement. We have also assumed cuts and/or fills required for site grading purposes will not exceed 2.0 m and that the invert of the site servicing will be no greater than 3.0 m below existing site grades.

3.0 ADJACENT GEOTECHNICAL SITE INFORMATION

An additional geotechnical investigation consisting of sixteen boreholes was also carried out as part of the Snell's Hollow Secondary Plan on the properties adjacent too and west side of Heart Lake Road. The following is a summary of subsurface conditions obtained from boreholes located adjacent to the site (BH/MW19-05, BH/MW19-06, and BH19-17) as shown on the Site and Borehole Location Plan, ***Figure 1***.

In general, the subsurface conditions encountered in Boreholes BH/MW19-05, BH/MW19-06, BH19-17 typically consist of a surficial topsoil ranging in thickness from about 280 mm to over 400 mm overlying a disturbed/reworked dark to light brown silty clay layer, which contains various amounts organics, underlain by glacial till composed of stiff to very stiff brown silty clay to a depth ranging from 0.3 m to 4.86 m below ground surface. A very stiff to hard grey clayey silt till was generally found below the brown silty clay till layer. These subsurface conditions were found to be similar to the subsurface conditions encountered in the boreholes located on Coscorp HL Developments Inc. site (discussed in detail in subsequent sections).

The record of borehole logs from these reports are enclosed in ***Appendix C***. The approximate locations of the boreholes drilled at these sites are shown on the Site and Borehole Location Plan, ***Figure 1.***

Groundwater was encountered in BH/MW19-06 and BH19-17 upon the completion of drilling and ranged from 2.5 m to 3.4 m below existing ground surface, whereas Borehole BH/MW19-05 was found to be dry upon the completion of drilling. Two 50 mm diameter monitoring wells were installed at Boreholes BH/MW19-05 and BH/MW19-06 to permit further monitoring of the groundwater levels. Shallow groundwater levels measured in the 50 mm diameter monitoring wells on April 17, 2019 ranged from 0.34 m (BH/MW19-06) to 8.32 m (BH/MW19-05) below existing ground surface.

4.0 REGIONAL GEOLOGY

The surficial geology aspects of the general site area were reviewed from the following publication:

- Chapman, L.J., and Putnam, D.F., 2007, *"The Physiography of Southern Ontario"*; 4th Edition, Ontario Geological Survey.

Physiographic mapping in the area according to the above noted reference indicates that the site lies within the physiographic region of southern Ontario known as the South Slope. The South Slope region slopes gradually downward towards Lake Ontario. The overburden immediately below ground surface within the South Slope generally consists of clayey silt till and silty clay till and at depth consists of alternating deposits of dense lacustrine sands and silts and overconsolidated lacustrine clays and clay tills overlying the bedrock.

The subsurface conditions encountered during the investigation are generally consistent with the physiographic mapping.

5.0 INVESTIGATION PROCEDURE

The field work for the preliminary geotechnical investigation was carried out between March 26 and March 27, 2019, during which time three boreholes (designated as Boreholes BH19-18, BH19-19 and BH/MW19-07) were advanced at the site to depths between about 6.7 m and 14.4 m below existing ground surface at the approximate locations shown on the Site and Borehole Location Plan, ***Figure 1***, attached. One additional borehole was advanced to about 7.0 m below existing ground surface adjacent to BH/MW19-07 for the purpose of installing a shallow monitoring well, adjacent to the deep monitoring well which was installed in the BH/MW19-07 borehole.

The boreholes were advanced using a track-mounted drill rig supplied and operated by a specialist drilling contractor, subcontracted to Golder. Standard Penetration Testing (SPT) and sampling was carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer, in accordance with ASTM D1586 (99). Two, 50 mm diameter monitoring wells were installed at BH/MW19-07 to permit further monitoring of the groundwater levels. Groundwater level measurements were recorded immediately following drilling procedures for all boreholes and on the monitoring wells on April 17, 2019. The well installation and water level readings are presented on the Record of Borehole sheets in **Appendix A**.

The field work for this investigation was directed by members of our engineering staff who located the boreholes in the field, directed the sampling and in-situ testing operation, logged the boreholes and cared for the samples obtained. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory for further examination and laboratory testing. Index and classification tests, consisting of water content determinations, Atterberg limits and grain size distribution, were carried out on selected soil samples. The results of the geotechnical laboratory tests are included in **Appendix B** and on the Record of Borehole sheets in **Appendix A**.

6.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes and the results of the field and laboratory testing, are shown on the Record of Boreholes sheets, in **Appendix A**. Method of Soil Classification and Symbols and Terms Used on Records of Boreholes are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summary of the subsurface conditions of the boreholes advanced during this investigation followed by a more detailed description of the major soil strata and groundwater conditions.

In general, the subsurface conditions encountered at the boreholes advanced at the site typically consist of a surficial topsoil/silty clay layer underlain by native soil deposits of glacial till composed of silty clay to clayey silt containing varying amounts of sand and gravel, underlain by sandy silt to silty sand deposits.

Details of the observations of the groundwater conditions during and upon completion of drilling are included on the Record of Borehole sheets. Shallow ground water was encountered at depths ranging from 2.7 m to 12.8 m below existing ground surface upon the completion of drilling activities. Shallow groundwater levels measured in the 50 mm diameter monitoring wells installed at the site are also presented below.

6.1 Topsoil and (CL) sandy Silty Clay (possibly re-worked)

Topsoil materials were encountered in all the boreholes and extended to depths ranging from 0.20 m to 0.61 m. A summary of topsoil thickness in each of the boreholes is outlined in the table below.

Table 1: Approximate Topsoil Thickness

Borehole No.	Approximate Topsoil Thickness (m)
BH/MW19-07	0.23
BH19-18	0.20
BH19-19	0.61

Materials identified as topsoil in this report were classified based on visual and textural evidence as no other testing for organic content or other nutrients was carried out. As such, the ability for these materials to support vegetation has not been assessed.

Reworked/disturbed sandy silty clay material was encountered in borehole BH/MW19-07 below the surficial topsoil. Reworked material thickness was observed from 0.23 m to 0.61 m below existing ground surface. The reworked material consisted of sandy silty clay with trace amounts of gravel. SPT 'N' values within cohesive the reworked material was found to be 19 blows per 0.3 m penetration indicating a very stiff consistency.

The natural water content of the reworked material was measured at 20 percent.

6.2 (CL) Silty Clay to sandy Silty Clay (Upper Glacial Till)

A glacial till deposit consisting of cohesive silty clay to sandy silty clay was generally encountered directly underneath the topsoil/reworked till deposits to depths about 6.10 m below existing ground surface. The till deposit is light brown to brown mottled with oxidation staining, about 4.5 m to 6.7 m in thickness, with various amounts of sand and gravel. The silty clay till increases in sand content in borehole BH/MW19-07 at a depth of 3 m below ground surface and in borehole BH19-19 at a depth of 4.6 m below ground surface. The till is believed to contain cobbles and/or possible boulders which have been inferred as a result of auger grinding observed in boreholes BH19-18 and BH19-19.

The SPT 'N' values measured in these till materials range from 11 blows per 0.3 m of penetration to 86 blows per 0.3 m of penetration, but typically greater than 22 blows per 0.3 m of penetration, indicating that the silty clay till is generally stiff to hard in consistency.

The results of grain size distribution tests carried out on selected samples from this deposit are presented in **Figure B1.** Atterberg limits tests that were carried out on the same samples from this deposit measured liquid limit values ranging from about 20 to 24 and plastic limit values ranging from about 13 to 15; yielding corresponding plasticity index values ranging from about 7 to 10. These results are plotted on the plasticity chart as shown in **Figure B2**.

The water content of selected samples ranged from about 9 percent to 17 percent.

6.3 (ML/SM to SM) sandy Silt to Silty Sand

A non-cohesive sandy silt to silty sand deposit was encountered underneath the cohesive silty clay till, in BH/MW19-07 and BH19-19. The sandy silt to silty sand deposit, is light brown, contains various amount of gravel, with cobbles/boulders being inferred from auger grinding. Both boreholes were terminated in the silty sand deposit.

The SPT 'N' values measured in this deposit ranged from 36 blows per 0.3 m to 131 blows per 0.3 m of penetration. These SPT 'N' values indicated a dense to very dense compactness.

The water content of selected samples ranged from about 3 percent and 20 percent.

6.4 (CL/ML) Clayey Silt (Lower Glacial Till)

A clayey silt till deposit was encountered directly underneath the sandy silty clay till in borehole BH19-18 from a depth of 6.10 m below existing ground surface. The borehole was terminated in this layer at a depth of 6.7 m below existing ground surface. The cohesive till deposit contains various amounts of sand and gravel and is grey in colour.

The SPT 'N' values of this till deposit was 33 blows per 0.3 m of penetration indicating hard consistency.

6.5 Groundwater Conditions

Groundwater level measurements were recorded immediately following drilling procedures. Monitoring wells were installed (one deep and one shallow) in borehole BH/MW19-07 to permit monitoring of the groundwater level at the site. Details of the monitoring well installation and the measured groundwater levels are shown on the Records of Borehole in ***Appendix A***. The groundwater level measurements in the drilled boreholes and in the monitoring wells are summarized in Table 2, below.

Table 2: Groundwater Level Measurements

Borehole No.	Measurements Upon Completion of Drilling		Measurements in Monitoring Wells	
	Approximate Groundwater Depth (begs)*	Date	Approximate Groundwater Depth (begs)*	Date
BH/MW19-07 (Shallow Well)	N/A	March 27, 2019	6.9 m	April 17, 2019
BH/MW19-07 (Deep Well)	12.8 m		12.8 m	
BH19-18	2.7 m	March 27, 2019	No monitoring well installed	
BH19-19	Dry	March 26, 2019	No monitoring well installed	

*begs- below existing ground surface.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year.

7.0 GEOTECHNICAL ENGINEERING DISCUSSION

This section of the report provides preliminary geotechnical engineering recommendations on the geotechnical aspects of the proposed development based on our interpretation of the limited borehole information and on our understanding of the project scope and requirements. The information in this portion of the report is provided for the guidance of the design engineers and professionals.

Based on the results of this investigation, the subsurface soil conditions encountered at the site are considered to be generally suitable for the proposed residential development.

As noted above, at the time of this report, proposed design grades (i.e., finished floor slab elevation, pavement subgrade and utility invert levels) were not available for the proposed development. The following engineering recommendations regarding the geotechnical design aspects of the project including underground services, pavements and building foundations should be considered as preliminary only, and should be reviewed when the final design grades and utility invert levels have been finalized.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

This report addresses only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report.

7.1 Site Preparation

7.1.1 Subgrade Preparation

The existing site vegetation, surficial topsoil/organics and other near-surface soils containing significant amounts of organic matter are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grade(s).

Disturbed/reworked materials containing excessive amounts of construction debris or organic material should be disposed of following appropriate environmental procedures. Furthermore; excessively-wet soils should be suitably dried before reuse as engineered fill.

Following the stripping of the surficial topsoil and soils containing significant amounts of organics and/or soft/disturbed surficial soils, the exposed subgrade should be heavily proof-rolled with suitable equipment, in conjunction with inspection by qualified geotechnical personnel to confirm that the exposed soils are competent and have been adequately stripped of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e., further subexcavation and replacement) should be carried out on poorly-performing areas identified during the proof-rolling activities, as directed by Golder.

Any filling carried out at the site in conjunction with regrading should be carried out as under engineered fill procedures. Recommendations for the placement of engineered fill are outlined in Section 7.1.2 of this report.

7.1.2 Engineered Fill Requirements

As described above, the anticipated site grading activities may include both cutting and raising (filling) the original grade to meet the final design site grades. At the time of this report, the design cut and fill depths were not available for review. As such, for the purposes of this report, it has been assumed that cuts will not exceed 2 m and grade raises will not exceed more than 2 m.

In general, the existing native material is considered to be acceptable for reuse as engineered fill. Based on the laboratory test results, the water content of soils present at the site are considered to be generally near or above their optimum water contents for compaction, and therefore may require minor drying prior to placement, in general.

It should be noted that the native materials at the site are silty in nature, and as such are susceptible to over-wetting and subsequent freezing during inclement weather. Therefore, it is recommended that site grading activities not be carried out during late fall, winter, early spring seasons or any periods of inclement weather conditions. All oversized cobbles (i.e., greater than 150 mm in size) and boulders, if present, should be removed from excavated material that will be used as engineered fill material.

If imported material is required for the engineered fill process, the material that is proposed for use as engineered fill should be approved by the geotechnical engineer at its source, prior to importing the material to the site. Suitable soils, free of topsoil, organic matter or other deleterious materials can be used as engineered fill provided that the water content of the soil at the time of placement does not vary by more than 2 percent above or below its optimum water content for compaction. Otherwise, the soils may require treatment (i.e., drying or wetting) prior to placement.

Following the inspection and approval of the subgrade as described previously in this report, engineered fill materials should be placed in maximum 300 mm-thick loose lifts and uniformly compacted to 98 percent of the Standard Proctor maximum dry density (SPMDD). Filling should continue until the design elevations are achieved.

Full-time monitoring and in-situ density testing should be carried out by Golder during placement of engineered fill.

The final surface of the engineered fill should be protected as necessary from construction traffic and should be sloped to provide positive drainage for surface water during the construction period. If the engineered fill materials will be left exposed (i.e. uncovered) during periods of freezing weather, additional soil cover should be placed above final subgrade to provide some level of frost protection. Prior to placing the granular subbase and/or base courses within pavement areas, the surface of the engineered fill/subgrade should be inspected by Golder.

7.2 Installation of Underground Services

7.2.1 Temporary Excavations

Details of the underground servicing for the proposed development are unknown at the time of this investigation; as such, for the purpose of this report, the maximum depth of the underground services was assumed to be about 3 m below the existing ground surface. Once detailed design is completed, review of the underground services should be completed by this office for compliance with the recommendations contained herein.

The founding soils are anticipated to generally consist of the native sandy silty clay or engineered fill. These materials are considered to be suitable for supporting the underground services provided that the integrity of the base of the trench excavations is maintained during construction. Where softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

Care should be taken to direct surface water away from any open excavations and all temporary excavations should be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects.

In general, the groundwater level in the open boreholes, upon completion of drilling, was measured to be at depths ranging from 2.7 m to 12.8 m below existing ground surface. Whereas, the groundwater level in the monitoring wells, one month after drilling, was measured to be at depths ranging from 6.9 m to 12.8 m below existing ground surface. In general, groundwater in the excavations within the native deposits, are likely to be handled by collection via properly constructed and filtered sumps, located within the excavations, and then pumping and discharging the water to a suitable discharge point. However, should excavations deeper than 3 m below existing ground surface be required, some form of active dewatering, such as well points, may have to be implemented.

Excavations for the site servicing would generally extend through the native sandy silty clay deposit. Conventional excavation equipment should be suitable to excavate through these materials.

The hard stiff to very stiff native clayey till soils are classified as a “Type 2” soils under the OH&S Act. As such, all conventional temporary trench excavations should consist of open cuts with side slopes not steeper than 1 horizontal to 1 vertical in the overburden soils to within 1.2 m of the base of the excavation and then may be made vertical to the base. Where engineered fill is used or the native sandy silt/silty clay exhibits signs of water seepage, the soil is classified as a “Type 3”, as such all conventional temporary trench excavations should consist of gradient of 1 horizontal to 1 vertical. Where the side slopes of excavations are required to be steepened to limit the extent of the excavation, then some form of trench support may be required. Some trench excavations could be carried out using a vertically-excavated, unsupported excavation (using a properly-engineered trench liner box for protection, certified by an experienced engineer); or by a supported (sheeted) excavation if conditions warrant so; such as in wet areas and/or in close proximity to adjacent underground services

7.2.2 Pipe Bedding and Cover

The bedding for the sewers and watermains should be compatible with the size, type and class of pipe and the surrounding subsoil and the requirements of the City of Oshawa. If granular bedding is deemed to be acceptable, then Ontario Provincial Standard Specifications (OPSS) Granular A should be used from at least 150 mm below invert to springline. Clear stone should not be used as bedding material. From springline to 300 mm above the obvert of the pipe, sand cover could be used. All bedding and cover material should be placed in 150 mm loose lifts and uniformly compacted to at least 100 percent of SPMDD. Where variable fill materials, softened or disturbed native soils or other deleterious materials are encountered at the base of excavations for settlement-sensitive services, these materials should be subexcavated and replaced with compacted fills approved by the geotechnical engineer.

7.2.3 Trench Backfill

The excavated materials from the site will consist predominantly of silty clay till materials. Based on the measured water contents, in general, the native materials encountered at the site are estimated to be near or above their optimum water contents for compaction, and therefore, will probably require only minor drying prior to placement.

Care should be taken to maintain the water content of the soils close to/at the optimum water content for compaction during the construction operations, as difficulties with compaction and/or backfill performance would be anticipated with fine-grained soils where the water content is significantly above the optimum for compaction purposes. Soils that contain significant quantities of organics or debris are also not suitable for use as trench backfill within settlement-sensitive areas. In addition, all boulders and cobbles greater than 150 mm in size should be removed from the trench backfill materials. If there is a shortage of suitable in-situ material, an approved imported material such as Ontario Provincial Standard Specifications Select Subgrade Material should be used for trench backfill. Again, as noted above, the trench backfill materials are silty in nature and are very susceptible to wetting/freezing temperatures. Backfilling trenches during cold or wet weather is not recommended.

Trench backfill should be placed in maximum 300 mm loose lift thickness and uniformly compacted to at least 98 percent of the SPMDD of the material. Soil that is frozen should not be used as backfill.

Normal post-construction settlement of the compacted trench backfill should be anticipated with the majority of such settlement taking place within about 12 months following the completion of trench backfilling operations. If the trench backfill operations are completed during the winter months, post-construction settlements may increase beyond typical anticipated values. These settlements will be reflected at the ground surface. If the asphalt binder course is laid shortly following the completion of the trench backfilling operations, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding. If possible, the surface course asphalt should not be placed over the binder course asphalt for about 12 months. Where scheduling requires that the surface course be placed over the binder course asphalt before this period, trench backfill settlement would be reflected by subsidence and possible cracking of the finished pavement surface in these areas which, depending upon the extent and magnitude, may require local repairs.

7.3 Building Foundations

As previously indicated, the existing site vegetation, surficial topsoil/organics and other near-surface soils containing significant amounts of organic matter are not considered to be suitable for the subgrade support of engineered fill, building foundations, floor slabs, or other settlement sensitive structures. These materials should be completely stripped prior to placing any engineered fill or construction of foundations or interior or exterior slab-on-grades.

Based on the subsurface conditions encountered in the boreholes, strip and spread footings that may be used, provided that the footings are founded on the native sandy silty clay deposit or on engineered fill (based on existing site soils) placed in accordance with the recommendation outlined in section 7.1, and maintained a minimum depth of soil embedment below finished adjacent ground surface and top of slab of 1.2 m.

For such strip and spread footings, a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa and a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa may be assumed for design purposes, provided that the strip footings dimensions of 0.45 m in width and 10 m in length or spread footings have a minimum width of 0.60 m and a maximum width of 1.2 m.

Where spread footings are constructed at different elevations, the difference in elevation between the individual footings should not be greater than one half the clear distance 650 mm between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with the Ontario Building Code (2012), Section 9.15.3.9.

The maximum total and differential settlements are expected to be less than 25 mm and 20 mm; respectively, for footings designed, constructed and inspected as outlined above.

All exterior footings, and interior footings in unheated areas, should be founded at a minimum depth of 1.2 m below finished grade level in order to provide adequate protection against frost penetration.

The native soils are susceptible to disturbance from construction activity, especially during wet or freezing weather. Care should be taken to preserve the integrity of the materials as bearing strata. It is essential that the founding surface for the footings be inspected by qualified geotechnical personnel prior to placing concrete. If the concrete for the footings cannot be placed immediately after excavation and inspection of the subgrade, it is recommended that a working mat of lean concrete be placed in the excavation to protect the integrity of the bearing stratum.

Resistance to lateral forces/sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the CHBDC. The unfactored coefficient of friction, tan δ, for the interface between the cast-in-place concrete footing and the properly-prepared subgrade can be assumed to be 0.35.

7.3.1 Below Grade Walls

The exterior perimeter of all housing basement walls should be backfilled with an imported free draining, non-frost susceptible granular material approved by a geotechnical engineer, carefully placed and compacted in 200 mm thick loose lifts. The design of the foundation walls for the below-grade walls should take into account the horizontal soil loads as well as surcharge loads that may occur during or after construction and should be designed using a lateral (at-rest) earth pressure coefficient of 0.5 and a unit weight of backfill of 21 kN/m^3.

The wall backfill layers should be compacted to at least 95 per cent of the materials' standard Proctor maximum dry density. Light compaction equipment should be used immediately adjacent to the foundation wall, otherwise compaction stresses on the wall may be greater than that imposed by the backfill material. With the exception of the driveway area, the upper 0.3 m of backfill should consist of clayey material to provide a low permeability cap and the exterior grade should also be shaped to slope away from the building.

Provided that the excavations adjacent to foundation/basement walls are backfilled with free-draining granular materials and a drainage collection system is provided around the perimeter of the building, the design of below-grade walls does not need to take into account hydrostatic forces acting on the walls. However, it is recommended that the exterior of the below-grade walls be damp-proofed.

7.4 Pavement Design within the Proposed Development

Following site grading operations, as noted previously, the proposed pavement subgrade will generally consist of either re-compacted engineered fill or native silty clay till. These materials are considered to be frost susceptible, and as such, the pavement design provided in **Table 3** below has taken this condition into consideration.

Based on the proposed pavement usage, (i.e. residential development type traffic and loads/frequencies) frost susceptibility and strength of the subgrade soils, the following pavement component given are recommended for the proposed development of access roads and streets, however the Town of Caledon and Region of Peel design standards should be followed:

Table 3: Pavement Design

Material		Minimum Thickness of Pavement Components (mm)	
		Local Road (7.9m Road Pavement Width)	9.5 m Neighbourhood Collector (8.9 m Road Pavement Width)
Asphaltic Concrete (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	90
Granular Materials (OPSS.MUNI 1010)	Granular A Base	150	150
	Granular B Type II Subbase	350	500
Total Pavement Thickness (mm)		605	780
		Prepared and Approved Subgrade	

As part of the subgrade preparation, proposed access roads should be stripped of topsoil and other obviously unsuitable fill or organic materials. Fill required to raise the grades to design elevations should conform to the engineered fill requirements outlined previously in the report. Soft or spongy trench backfill areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98 percent SPMDD. Prior to placing pavement subbase and/or base materials, the exposed soil subgrade should be heavily proof-rolled in conjunction with an inspection by Golder. The granular subbase and base materials should be placed in loose layers no thicker than 200 mm and uniformly compacted to 100 percent of their SPMDD. The binder course and surface course asphalt materials should be compacted to minimum at 92.0 of their Marshall Maximum Relative Density according to OPSS 310, as measured in the field using a nuclear density gauge.

Where new pavement abuts existing pavement (e.g. at the development limits), proper longitudinal lap joints should be constructed to key the new asphalt into the existing asphalt surface. The existing asphalt edges should be provided with a proper sawcut edge prior to keying-in the new asphalt. It should be ensured that any undermining or broken edges resulting from the construction activities are removed by the sawcut.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength may not be adequate to support heavy construction loading especially during wet weather or where backfill materials wet of optimum have been placed. In this regard, the design subbase thickness may not be sufficient for a construction haul road and additional subbase (in the order of 450 mm) may be required. In any event, the subgrade should be proofrolled and inspected by Golder prior to placing the subbase and any additional material, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

7.4.1 Subgrade Drainage

In order to preserve the integrity of the pavement, continuous subdrains should be placed at the concrete curb lines along both sides of the proposed streets. The invert of the subdrains should be at least 300 mm below the bottom of the Granular “B” subbase and should be sloped to drain to catchbasins. The subdrains should consist of perforated pipe wrapped in a suitable geotextile and surrounded on all sides with a minimum thickness of 150 mm of OPSS.PROV 1002 Concrete Fine Aggregate (i.e. concrete sand).

8.0 SEISMIC SITE CLASSIFICATION

Seismic hazard is defined in the 2012 Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 second, 0.5 second, 1.0 second and 2.0 seconds and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity, Standard Penetration Test (SPT) resistance, undrained soil shear strength, etc.) in the 30 m below the foundation level. There are six site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain acceleration and velocity-based site coefficients F_a and F_v; respectively, used to modify the UHS to account for the effects of site-specific soil conditions in design.

Based on the results of the preliminary geotechnical investigation and assuming soils below the maximum depth investigated exhibit similar properties / strengths, a **Site Class D** is estimated for planning purposes. The Site Class will need to be verified, and adjusted as necessary, during detail design.

9.0 INSPECTION AND TESTING

During construction, full-time observation should be carried out during engineered fill and site servicing backfill placement, and sufficient foundation inspections, subgrade inspections and in-situ materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.

10.0 CLOSING

We trust that this preliminary report provides enough preliminary geotechnical engineering information to proceed with the detailed design of the proposed development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Signature Page

Golder Associates Ltd.

Erti

Erti Mansaku, P.Eng.
Geotechnical Engineer

Jeff Tolton, C.E.T.
Associate, Senior Geotechnical Technologist

JD/EM/JET/sm

https://golderassociates.sharepoint.com/sites/102461/technical work/phase 6000 - coscorp hl developments inc/19115264 (6000) final georeport coscorp hl developments inc. (jet).docx

LEGEND

⊕	Approximate Borehole Location
⊕	Approximate Borehole and Monitoring Well Location
⊕	Approximate Geotechnical Borehole from Adjacent Properties (Golder 2018, Clearbrook)
—	Watercourse
▨	Wetland
☐	Site Boundary
☐	Coscorp HL Developments Inc. Site Boundary

0 75 150

1:2,500 METRES

REFERENCE(S)

1. IMAGERY: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
© 2019 MICROSOFT CORPORATION © 2019 DIGITALGLOBE ©CNES (2019) DISTRIBUTION AIRBUS DS
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
COSCORP HL DEVELOPMENTS INC.

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, COSCORP HL DEVELOPMENTS INC.

CONSULTANT
GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	MM
PREPARED	MM
REVIEWED	EM
APPROVED	-

TITLE
SITE AND BOREHOLE LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
19115264	6000	-	1

PATH: S:\Clients\Snells_Hollow_Developer_Group\Mayfield_Rd_Caledon\99_PROJ\19115264\40_PROD\0002_Prelim_Geotechnical_Investigation\19115264-0002-BG-0001.mxd PRINTED ON: 2019-06-04 AT: 2:24:25 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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APPENDIX A

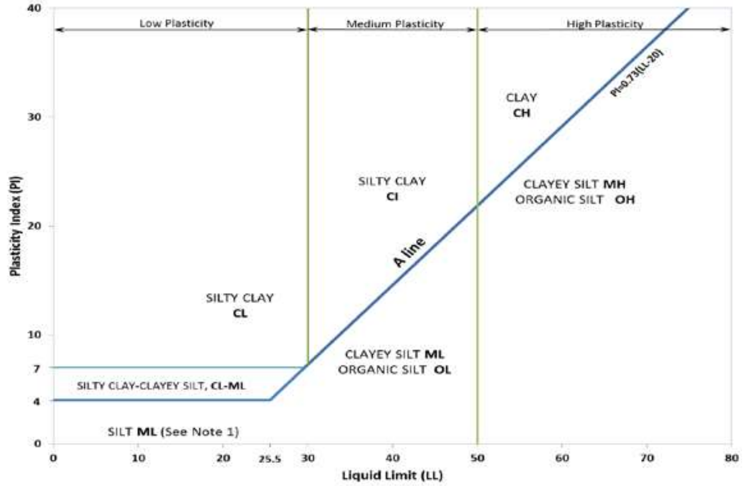
Method of Soil Classification
Abbreviations and Terms used on Record of Borehole
List of Symbols
Record of Boreholes

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% (see Note 2)	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma$ - u)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes:
1 $\tau = c' + \sigma' \tan \phi'$
2 shear strength = (compressive strength)/2

PROJECT: 19115264-6000

LOCATION: Lat. 43.755372 Long. -79.802724

(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-07

BORING DATE: March 27, 2019

SHEET 1 OF 2

DATUM: Existing Ground Surface

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE				
TOPSOIL (230 mm)	0.00	1A	SS	19
(CL) sandy CLAY, trace gravel, trace organics; dark brown; cohesive, w<PL, very stiff	0.23	1B	SS	
(CL) SILTY CLAY, some sand to sandy, trace gravel; light brown with oxidation staining, (TILL); cohesive, w<PL, very stiff to hard	0.61	2	SS	11
		3	SS	11
		4	SS	24
- Becoming sandy at a depth of 3 m				
		5	SS	45
		6	SS	44
(SM/ML) sandy SILT to SILT, trace to some clay, slight plasticity; light brown; non-cohesive,wet, dense to very dense	5.90	7	SS	36
- Cobble/boulder inferred from auger grinding at a depth of 7.3 m		8	SS	100/ 2"
(SM) SILTY SAND, fine to medium grained, some to trace gravel; light brown; non-cohesive, moist, dense to very dense	7.62	9	SS	131

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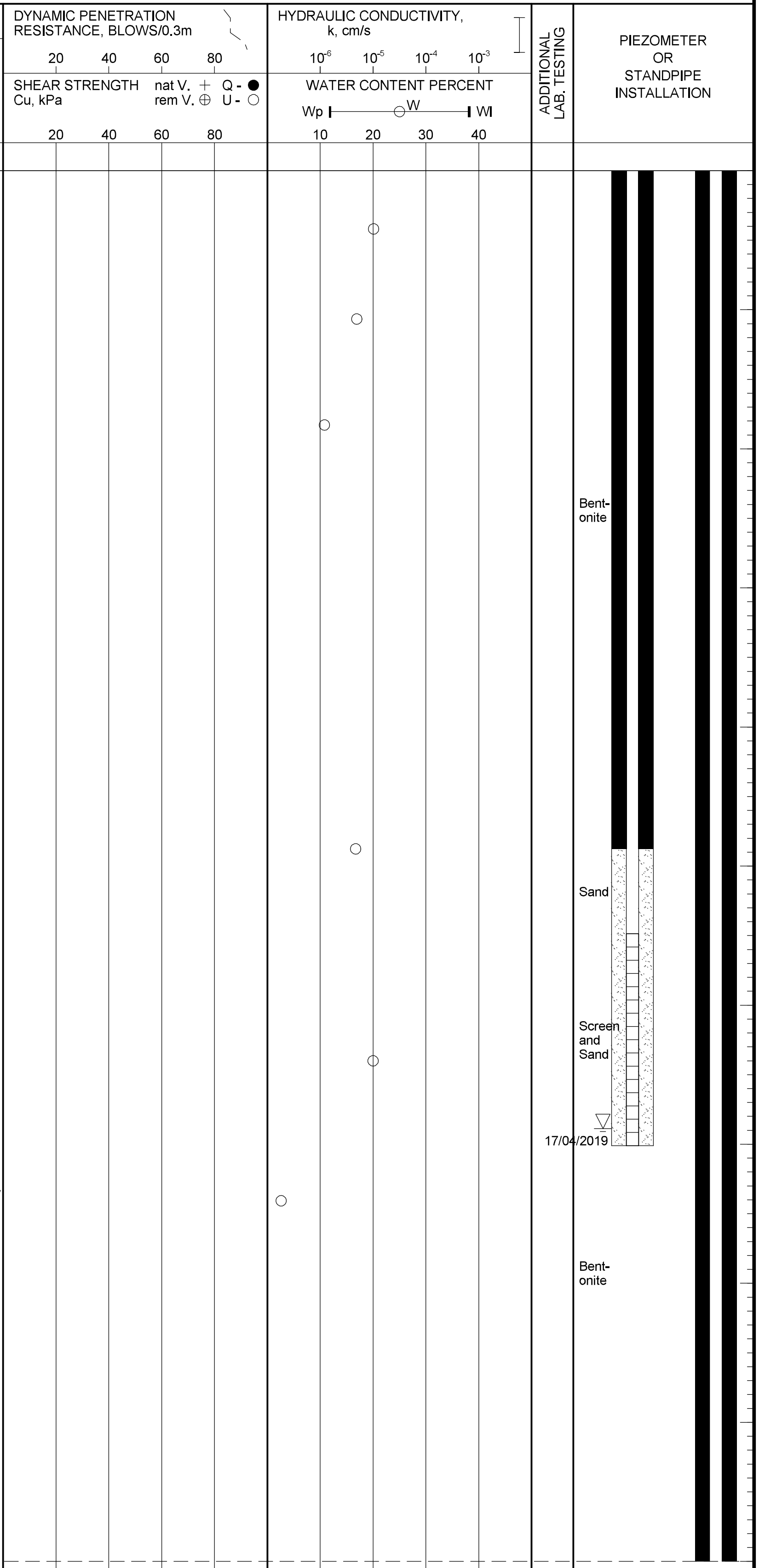


DEPTH SCALE 1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

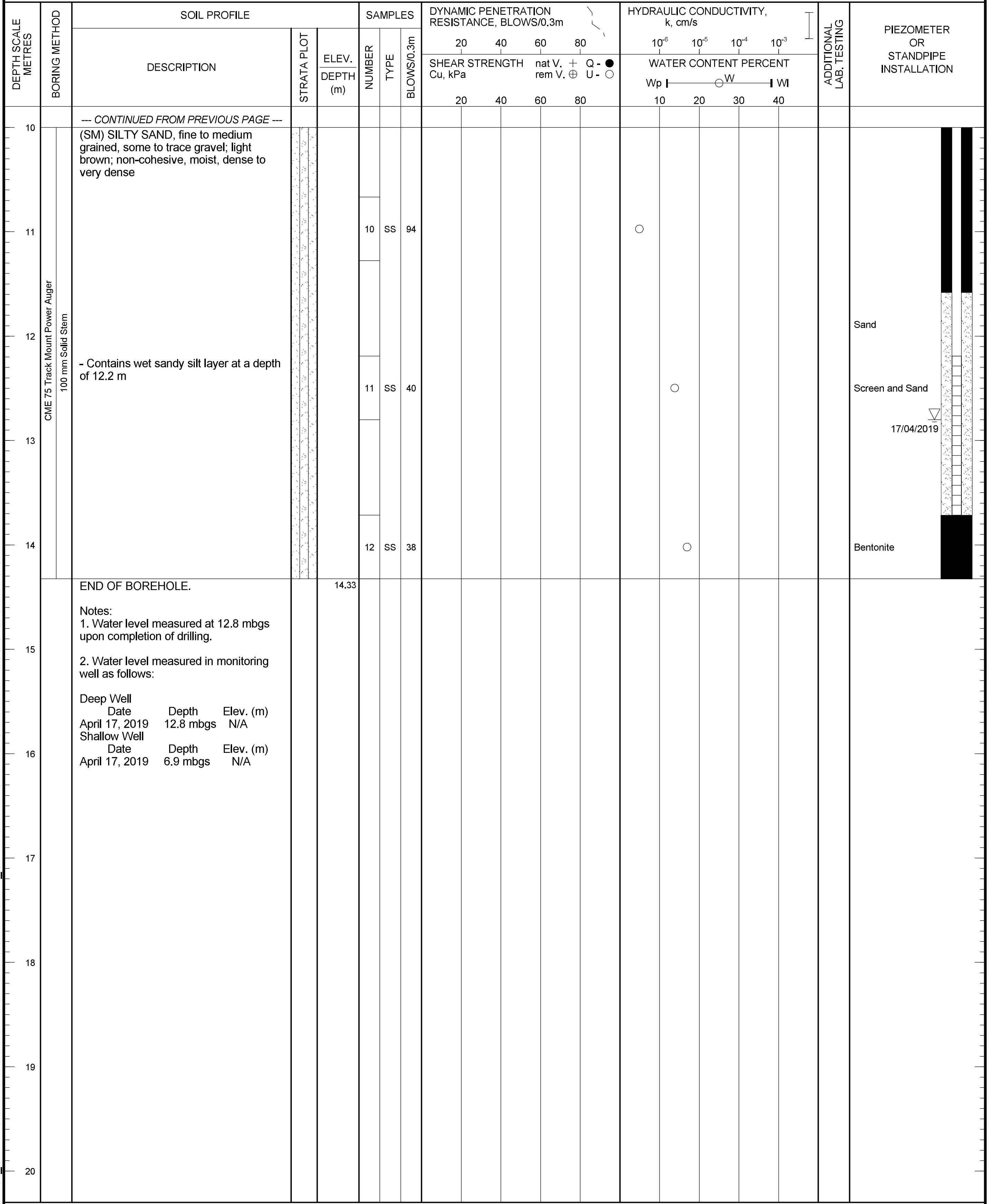
PROJECT: 19115264-6000
LOCATION: Lat. 43.755372 Long. -79.802724
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-07

BORING DATE: March 27, 2019

SHEET 2 OF 2

DATUM: Existing Ground Surface



--- CONTINUED FROM PREVIOUS PAGE ---

(SM) SILTY SAND, fine to medium grained, some to trace gravel; light brown; non-cohesive, moist, dense to very dense

- Contains wet sandy silt layer at a depth of 12.2 m

NUMBER	TYPE	BLOWS/0.3m
10	SS	94
11	SS	40
12	SS	38

END OF BOREHOLE. 14.33

Notes:
1. Water level measured at 12.8 mbgs upon completion of drilling.

2. Water level measured in monitoring well as follows:

Deep Well

Date	Depth	Elev. (m)
April 17, 2019	12.8 mbgs	N/A

Shallow Well

Date	Depth	Elev. (m)
April 17, 2019	6.9 mbgs	N/A

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

PROJECT: 19115264-6000

RECORD OF BOREHOLE: BH19-18

SHEET 1 OF 1

LOCATION: Lat. 43.753587 Long. -79.803241
(See Figure 1)

BORING DATE: March 27, 2019

DATUM: Existing Ground Surface

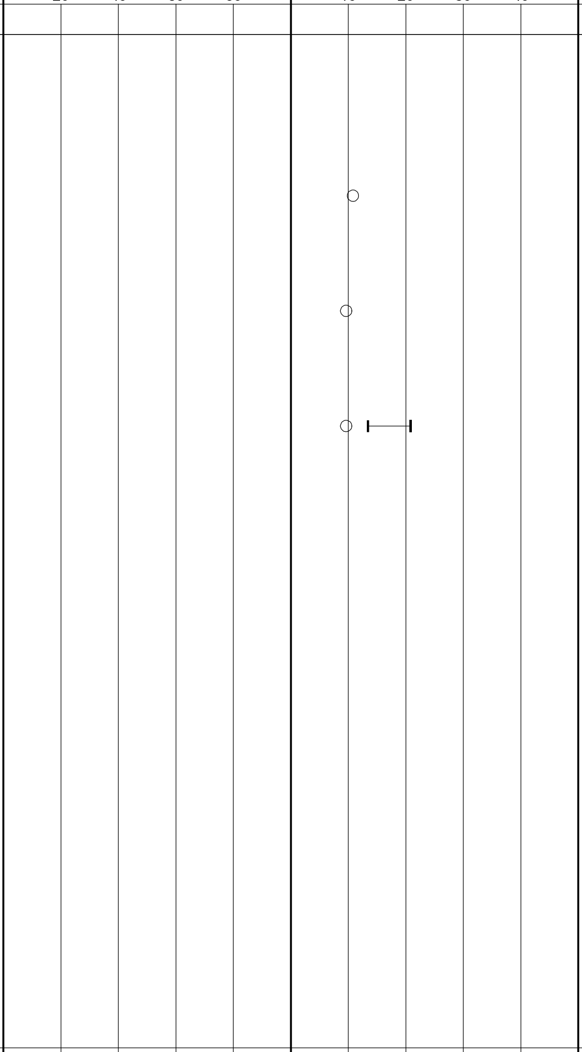
BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE							
CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (200 mm)		0.00	1A	SS			
	(CL) sandy SILTY CLAY, trace to some gravel with cobbles/boulders inferred from auger grinding; brown to light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to hard		0.20	1B	SS	11		
				2	SS	22		
				3	SS	38		
				4	SS	35	MH	∇ 27/03/2019
				5	SS	35		
				6	SS	52		
	(CL/ML) CLAYEY SILT, trace sand; grey, (TILL); cohesive, w>PL, hard		6.10	7	SS	33		
	END OF BOREHOLE		6.71					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m — 20 40 60 80

SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s — 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT — Wp ├──○W──┤ Wl — 10 20 30 40



Notes:
1. Water level measured at 2.7 mbgs upon completion of drilling.

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-6000

LOCATION: Lat. 43.754896 Long. -79.804943
(See Figure 1)

RECORD OF BOREHOLE: BH19-19

BORING DATE: March 26, 2019

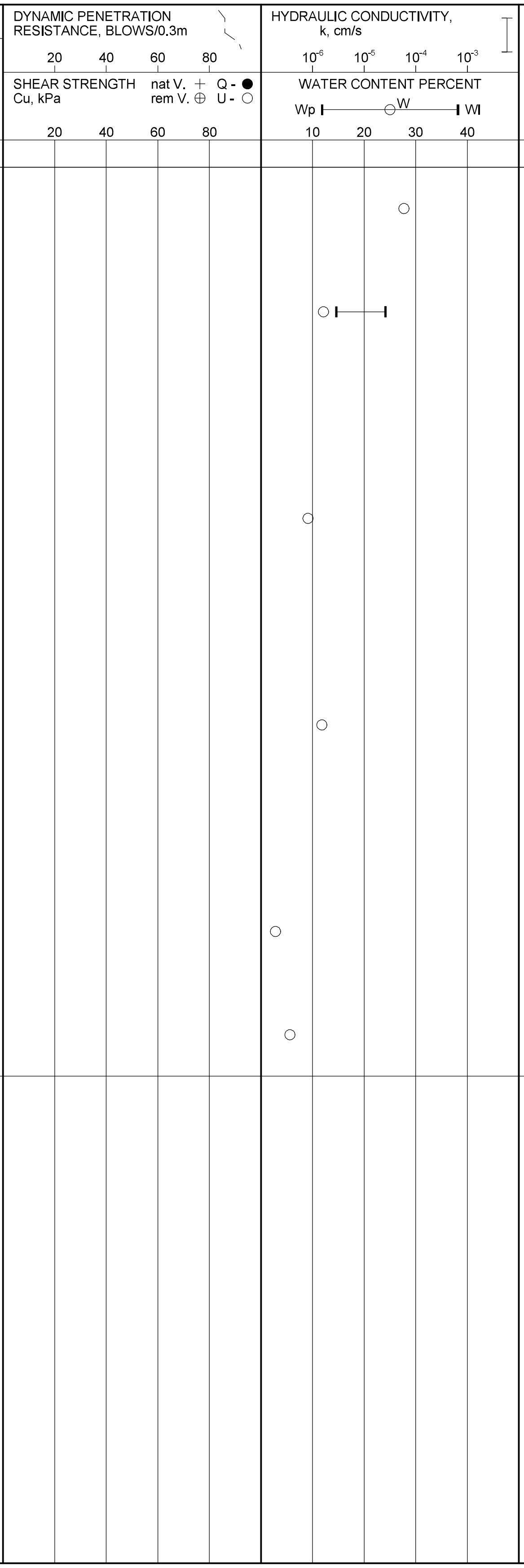
SHEET 1 OF 1

DATUM: Existing Ground Surface

BORING METHOD: CME 75 Track Mount Power Auger
100 mm Solid Stem

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE					
TOPSOIL (610 mm)	0.00	1	SS	4	
(CL) sandy SILTY CLAY, some sand, trace gravel with cobbles/boulders inferred from auger grinding; brown with oxidation staining, (TILL); w<PL, very stiff to hard	0.61	2	SS	26	MH
		3	SS	40	
		4	SS	49	
		5	SS	54	
		6	SS	55	
- Increased sand content at a depth of 4.6 m		7	SS	86	
(SM) SILTY SAND, fine grained, inferred cobbles/boulders; light brown; non-cohesive, moist, very dense	5.18	8	SS	95	
		9	SS	100	
END OF BOREHOLE.	6.71				

Notes:
1. Borehole dry upon completion of drilling.



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

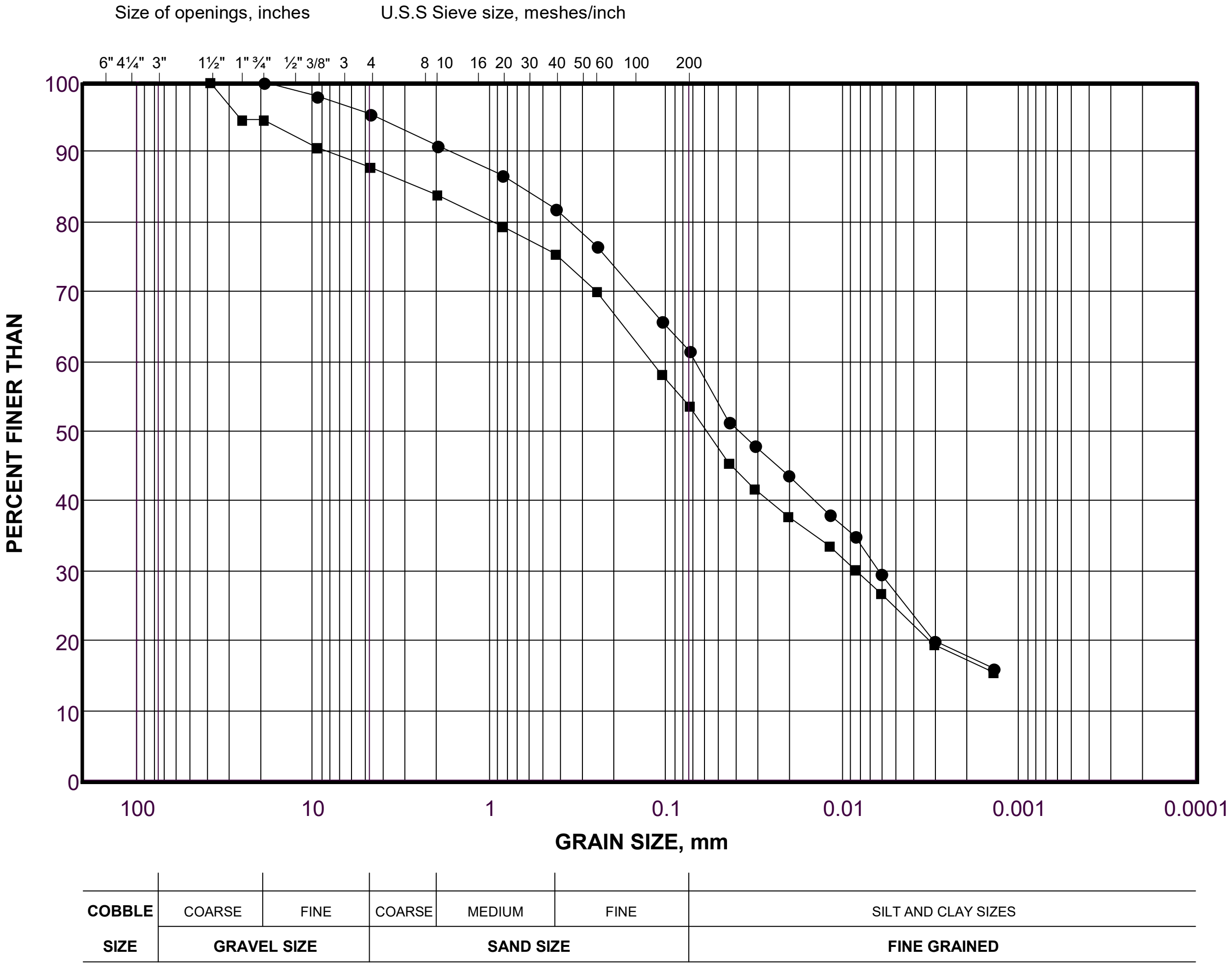
APPENDIX B

Geotechnical Laboratory Figures

GRAIN SIZE DISTRIBUTION

sandy SILTY CLAY to SILTY CLAY (CL) - TILL

FIGURE B1



LEGEND

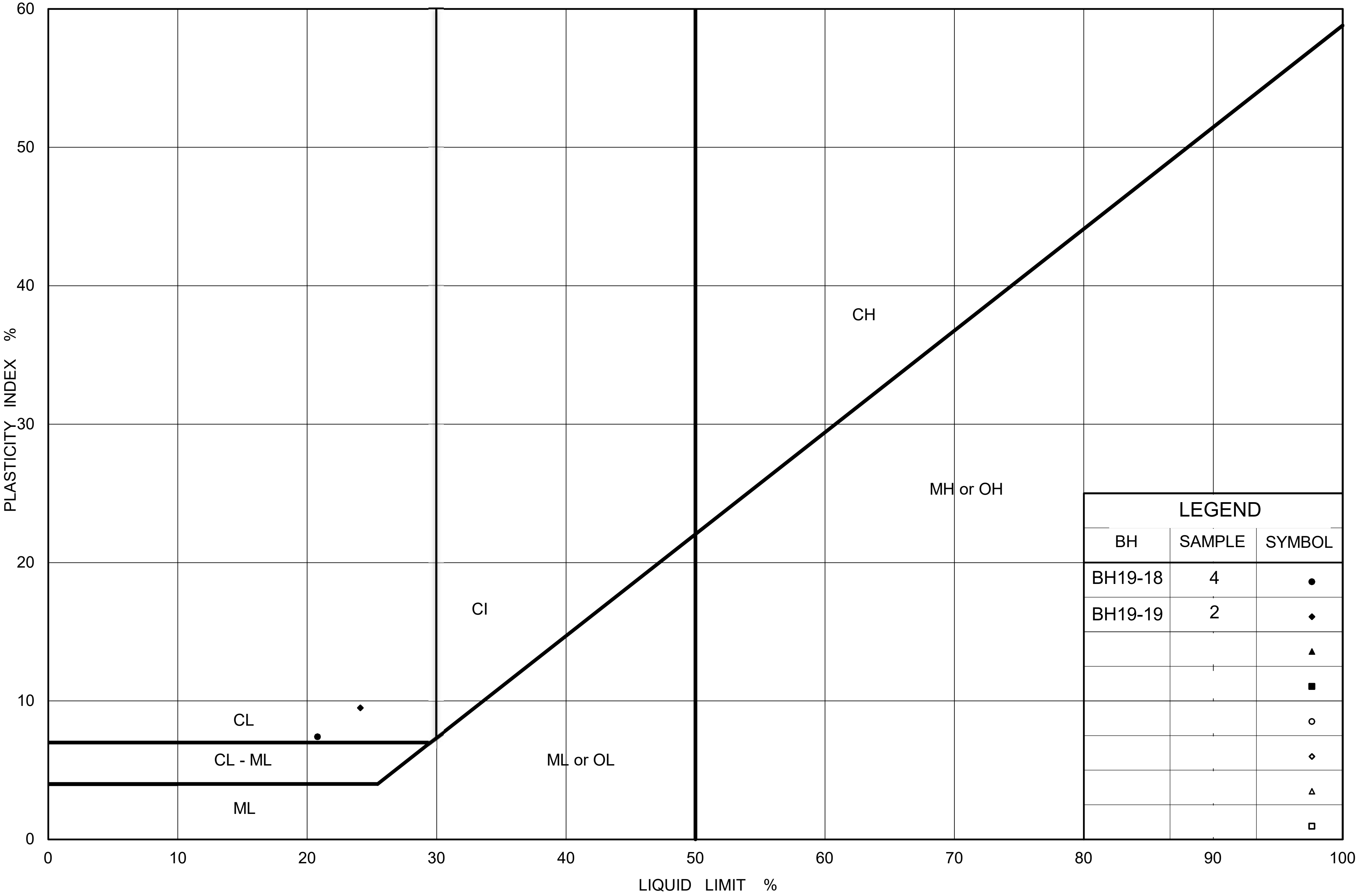
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	BH 19-19	2	0.76 - 1.37
■	BH 19-18	4	2.29 - 2.90

Project Number: 19115264

Checked By: EM

Golder Associates

Date: 30-May-19



GOLDER

PLASTICITY CHART
sandy SILTY CLAY to SILTY CLAY (CL) - TILL

Figure No. B2

Project No. 19115264 (6000)

Checked By: EM

APPENDIX C

Adjacent Properties Borehole Logs

PROJECT: 19115264-1000/5000

LOCATION: Lat. 43.75409 Long. -79.807715

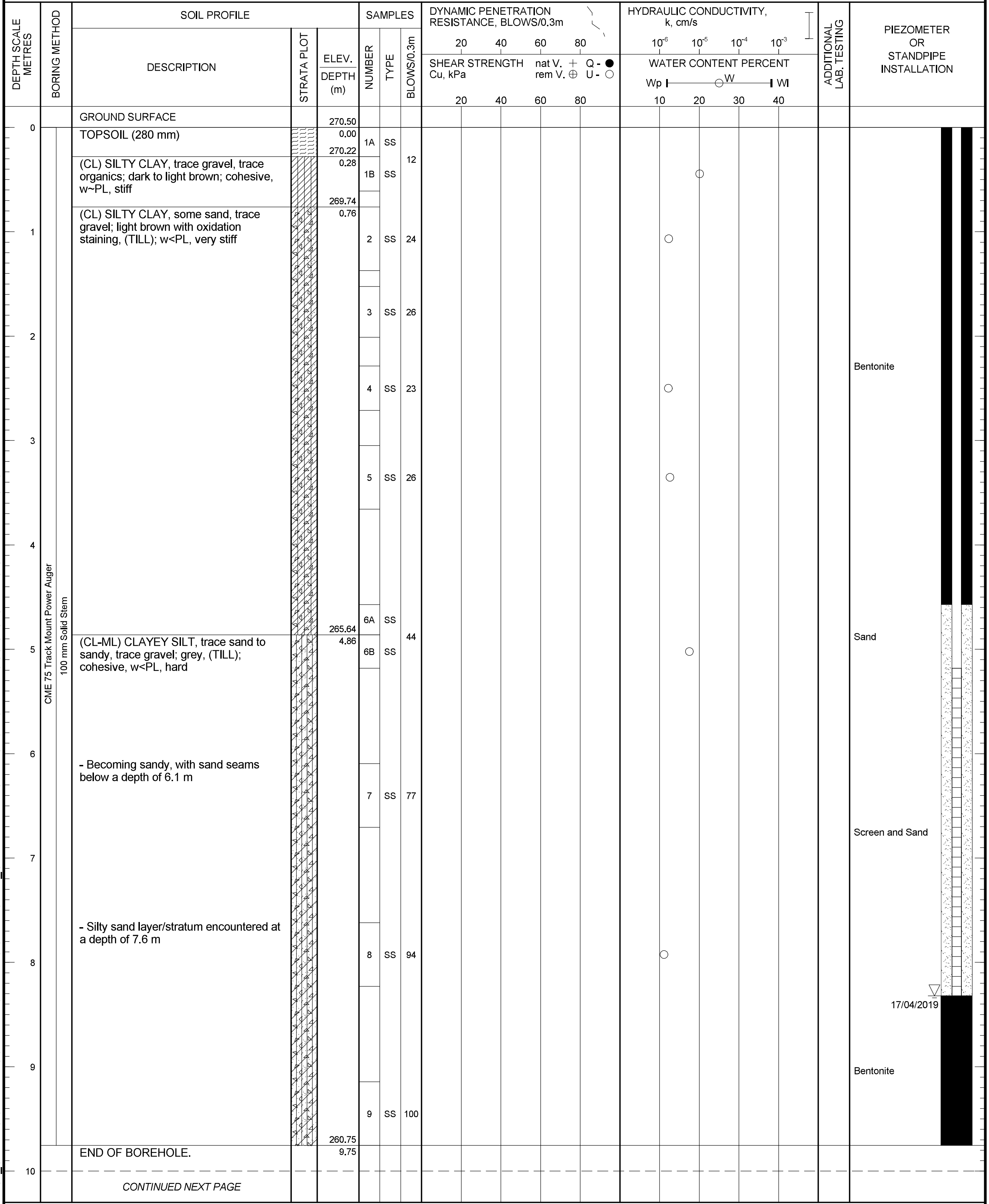
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-05

BORING DATE: March 28, 2019

SHEET 1 OF 2

DATUM: Geodetic



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	270.50
TOPSOIL (280 mm)	0.00
(CL) SILTY CLAY, trace gravel, trace organics; dark to light brown; cohesive, w~PL, stiff	270.22 0.28
(CL) SILTY CLAY, some sand, trace gravel; light brown with oxidation staining, (TILL); w<PL, very stiff	269.74 0.76
(CL-ML) CLAYEY SILT, trace sand to sandy, trace gravel; grey, (TILL); cohesive, w<PL, hard - Becoming sandy, with sand seams below a depth of 6.1 m - Silty sand layer/stratum encountered at a depth of 7.6 m	265.64 4.86
END OF BOREHOLE.	260.75 9.75

NUMBER	TYPE	BLOWS/0.3m
1A	SS	12
1B	SS	
2	SS	24
3	SS	26
4	SS	23
5	SS	26
6A	SS	44
6B	SS	
7	SS	77
8	SS	94
9	SS	100

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: EM

PROJECT: 19115264-1000/5000

LOCATION: Lat. 43.75409 Long. -79.807715
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-05

BORING DATE: March 28, 2019

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Borehole dry upon completion of drilling. 2. Water level measured in monitoring well as follows:									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Date	Depth	Elev. (m)
March 28, 2019	Dry	Dry
April 17, 2019	8.32 mbgs	262.18 m

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.752469 Long. -79.804999
(See Figure 1)

RECORD OF BOREHOLE: BH/MW19-06

BORING DATE: March 2, 2019

SHEET 1 OF 1
DATUM: Geodetic

BORING METHOD: CME 75 Track Mount Power Auger, 100 mm Solid Stem

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	262.00
TOPSOIL (410 mm)	0.00
(CL) SILTY CLAY, trace organics, some to trace sand, trace gravel; dark brown; cohesive, w>PL, firm	261.59 0.41
(CL) SILTY CLAY, some sand to sandy, trace gravel; light brown, (TILL); cohesive, w>PL, stiff to very stiff	260.55 1.45
(CL-ML) CLAYEY SILT, trace sand and gravel; grey, (TILL); cohesive, w>PL, very stiff to hard	258.88 3.12
END OF BOREHOLE.	253.68 8.32

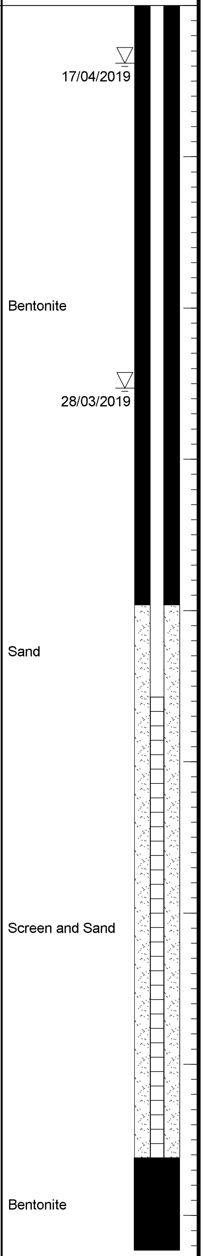
NUMBER	TYPE	BLOWS/0.3m
1A	SS	9
1B	SS	
2	SS	5
3	SS	14
4	SS	28
5A	SS	
5B	SS	39
6	SS	15
7	SS	27
8	SS	36

Notes:
1. Water level measured in monitoring well as follows:

Date	Depth	Elev. (m)
March 28, 2019	2.54 mbgs	259.46 m
April 17, 2019	0.38 mbgs	261.62 m

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl ; 10 20 30 40
ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE 0 1 2 3 4 5 6 7 8 9 10 METRES

GTA-BHS 001 G:_CLIENTS\CLEARBROOKDEVELOPMENTS\CALEDON\12_GINT\19115264-SNELLSHOLLOW BH LOGS.GPJ GAL-MIS.GDT 17/6/19 JMC

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

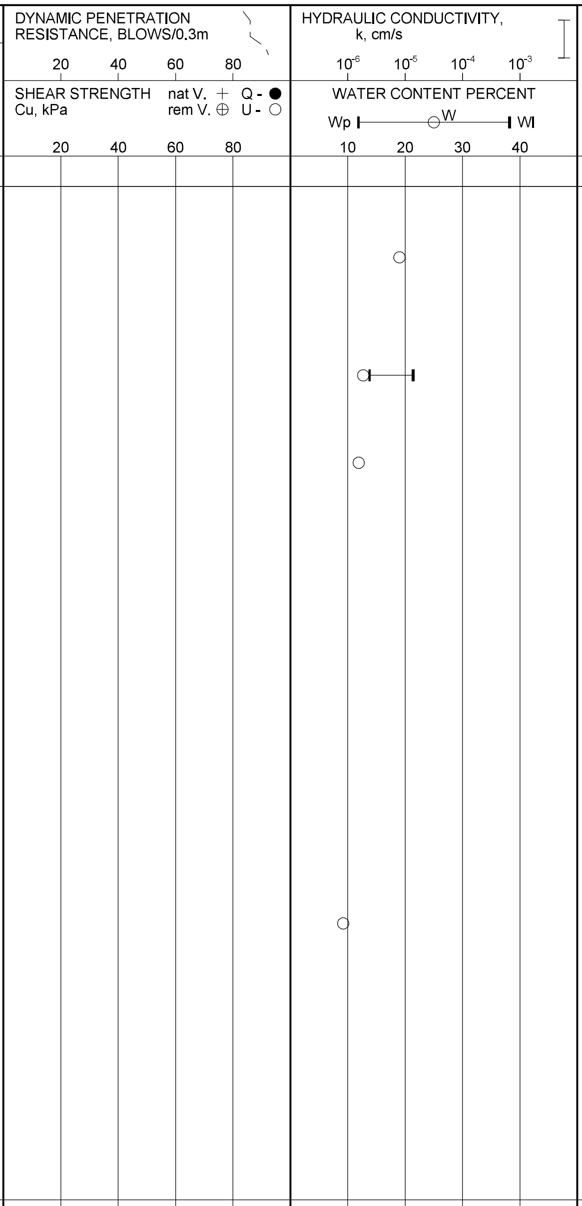
PROJECT: 19115264-1000/5000
LOCATION: Lat. 43.753061 Long. -79.806846
(See Figure 1)

RECORD OF BOREHOLE: BH19-17

BORING DATE: March 28, 2019

SHEET 1 OF 1
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		269.50					
0	CME 75 Track Mount Power Auger 100 mm Solid Stem	TOPSOIL (330 mm)		0.00	1A	SS	12		
		(CL) SILTY CLAY and SAND to sandy SILTY CLAY, trace gravel; light brown with oxidation staining, (TILL); cohesive, w<PL, stiff to very stiff		269.17 0.33	1B	SS			
1					2A	SS	18		
					2B	SS		MH	
					3	SS	29		
2					4	SS	14		
3					5	SS	29		∇ 28/03/2019
4		(CL-ML) CLAYEY SILT, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard		264.93 4.57	6	SS	34		
5									
6					7	SS	46		
		END OF BOREHOLE.		262.79 6.71					
7									
8									
9									
10									



Notes:
1. Water level measured at 3.4 mbgs upon completion of drilling.

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: EM

APPENDIX D

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

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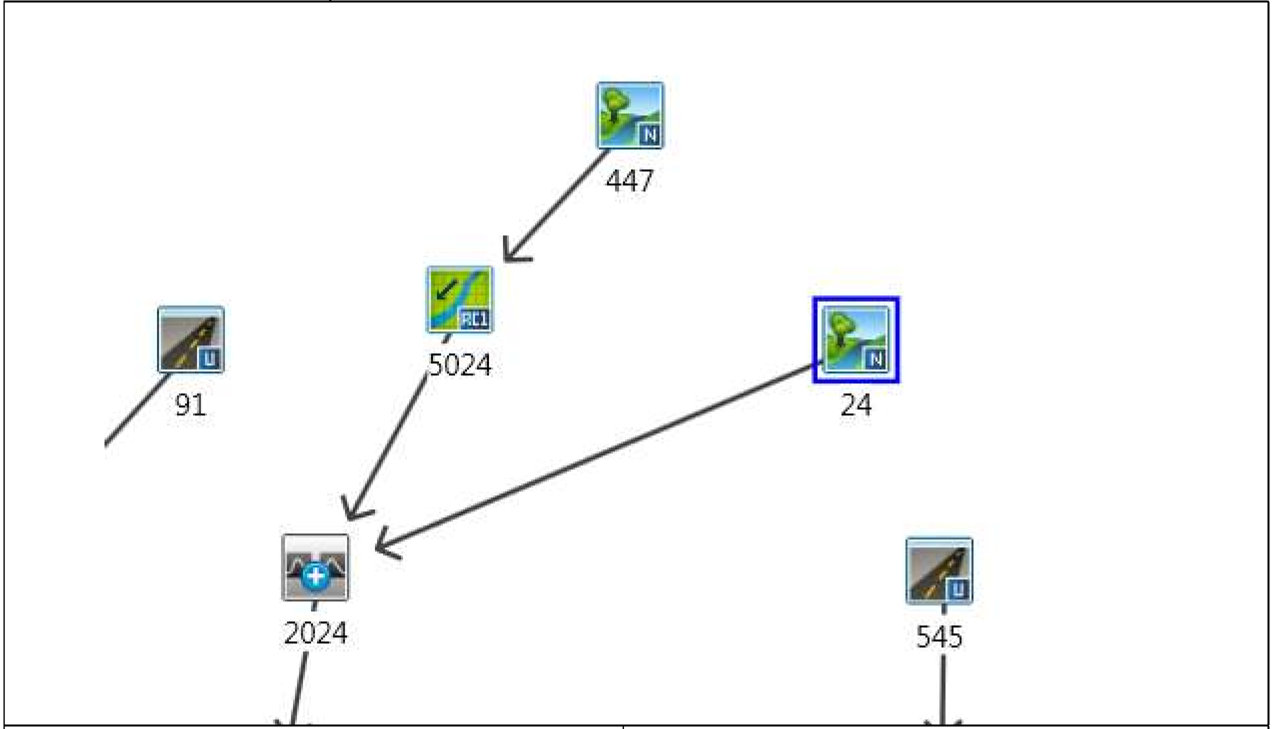
APPENDIX B: PRE-DEVELOPMENT CALCULATIONS



SCHAEFFERS
CONSULTING ENGINEERS

Visual OTTHYMO^{TM} Schematic

TRCA Etobicoke Model

Existing-2to100yr-12AES
12 Hour AES
Catchment 24

Job #: 2019-4851	**Date: August 2020**

```
********************************
** SIMULATION:Run 31          **
********************************

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|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\9bfc2c76
| Ptotal= 42.00 mm |    Comments: 2yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50    7.14 |  6.75    2.94 | 10.00    0.42
                 0.50    0.42 |  3.75    7.14 |  7.00    2.94 | 10.25    0.42
                 0.75    0.42 |  4.00    7.14 |  7.25    2.94 | 10.50    0.42
                 1.00    0.42 |  4.25    7.14 |  7.50    1.68 | 10.75    0.42
                 1.25    0.42 |  4.50   19.32 |  7.75    1.68 | 11.00    0.42
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                 1.75    0.42 |  5.00   19.32 |  8.25    1.68 | 11.50    0.42
                 2.00    0.42 |  5.25   19.32 |  8.50    0.84 | 11.75    0.42
                 2.25    0.42 |  5.50    5.46 |  8.75    0.84 | 12.00    0.42
                 2.50    2.52 |  5.75    5.46 |  9.00    0.84 | 12.25    0.42
                 2.75    2.52 |  6.00    5.46 |  9.25    0.84 |
                 3.00    2.52 |  6.25    5.46 |  9.50    0.42 |
                 3.25    2.52 |  6.50    2.94 |  9.75    0.42 |

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

--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 76.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=   1.554 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  10.045
     TOTAL RAINFALL   (mm)=  42.000
     RUNOFF COEFFICIENT   =   0.239

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 32          **
********************************

--------------------
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|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\8b231e31
| Ptotal= 54.38 mm |    Comments: 5yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50    9.25 |  6.75    3.81 | 10.00    0.54
                 0.50    0.54 |  3.75    9.25 |  7.00    3.81 | 10.25    0.54
                 0.75    0.54 |  4.00    9.25 |  7.25    3.81 | 10.50    0.54
                 1.00    0.54 |  4.25    9.25 |  7.50    2.18 | 10.75    0.54
                 1.25    0.54 |  4.50   25.02 |  7.75    2.18 | 11.00    0.54
                 1.50    0.54 |  4.75   25.02 |  8.00    2.18 | 11.25    0.54
                 1.75    0.54 |  5.00   25.02 |  8.25    2.18 | 11.50    0.54
                 2.00    0.54 |  5.25   25.02 |  8.50    1.09 | 11.75    0.54
                 2.25    0.54 |  5.50    7.07 |  8.75    1.09 | 12.00    0.54
                 2.50    3.26 |  5.75    7.07 |  9.00    1.09 | 12.25    0.54
                 2.75    3.26 |  6.00    7.07 |  9.25    1.09 |
                 3.00    3.26 |  6.25    7.07 |  9.50    0.54 |
                 3.25    3.26 |  6.50    3.81 |  9.75    0.54 |

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

--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 76.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=   2.691 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  16.890
     TOTAL RAINFALL   (mm)=  54.380
     RUNOFF COEFFICIENT   =   0.311

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 33          **
********************************

--------------------
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|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\84fa4c73
| Ptotal= 62.71 mm |    Comments: 10yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   10.66 |  6.75    4.39 | 10.00    0.63
                 0.50    0.63 |  3.75   10.66 |  7.00    4.39 | 10.25    0.63
                 0.75    0.63 |  4.00   10.66 |  7.25    4.39 | 10.50    0.63
                 1.00    0.63 |  4.25   10.66 |  7.50    2.51 | 10.75    0.63
                 1.25    0.63 |  4.50   28.84 |  7.75    2.51 | 11.00    0.63
                 1.50    0.63 |  4.75   28.84 |  8.00    2.51 | 11.25    0.63
                 1.75    0.63 |  5.00   28.84 |  8.25    2.51 | 11.50    0.63
                 2.00    0.63 |  5.25   28.84 |  8.50    1.25 | 11.75    0.63
                 2.25    0.63 |  5.50    8.15 |  8.75    1.25 | 12.00    0.63
                 2.50    3.76 |  5.75    8.15 |  9.00    1.25 | 12.25    0.63
                 2.75    3.76 |  6.00    8.15 |  9.25    1.25 |
                 3.00    3.76 |  6.25    8.15 |  9.50    0.63 |
                 3.25    3.76 |  6.50    4.39 |  9.75    0.63 |

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

--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 76.0
```

```
|ID= 1 DT=15.0 min |   Ia       (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=   3.551 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  22.064
     TOTAL RAINFALL   (mm)=  62.710
     RUNOFF COEFFICIENT   =   0.352

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

--------------------------------------------------------------------------------
********************************
** SIMULATION:Run 34          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\eaee5477
| Ptotal= 73.10 mm |    Comments: 25yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   12.43 |  6.75    5.12 | 10.00    0.73
                 0.50    0.73 |  3.75   12.43 |  7.00    5.12 | 10.25    0.73
                 0.75    0.73 |  4.00   12.43 |  7.25    5.12 | 10.50    0.73
                 1.00    0.73 |  4.25   12.43 |  7.50    2.92 | 10.75    0.73
                 1.25    0.73 |  4.50   33.63 |  7.75    2.92 | 11.00    0.73
                 1.50    0.73 |  4.75   33.63 |  8.00    2.92 | 11.25    0.73
                 1.75    0.73 |  5.00   33.63 |  8.25    2.92 | 11.50    0.73
                 2.00    0.73 |  5.25   33.63 |  8.50    1.46 | 11.75    0.73
                 2.25    0.73 |  5.50    9.50 |  8.75    1.46 | 12.00    0.73
                 2.50    4.39 |  5.75    9.50 |  9.00    1.46 | 12.25    0.73
                 2.75    4.39 |  6.00    9.50 |  9.25    1.46 |
                 3.00    4.39 |  6.25    9.50 |  9.50    0.73 |
                 3.25    4.39 |  6.50    5.12 |  9.75    0.73 |

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

--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 76.0
|ID= 1 DT=15.0 min |   Ia       (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=   4.713 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  29.022
     TOTAL RAINFALL   (mm)=  73.100
     RUNOFF COEFFICIENT   =   0.397

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

--------------------------------------------------------------------------------
********************************
** SIMULATION:Run 35          **
```

```
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\b05838de
| Ptotal= 80.82 mm |    Comments: 50yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   13.74 |  6.75    5.66 | 10.00    0.81
                 0.50    0.81 |  3.75   13.74 |  7.00    5.66 | 10.25    0.81
                 0.75    0.81 |  4.00   13.74 |  7.25    5.66 | 10.50    0.81
                 1.00    0.81 |  4.25   13.74 |  7.50    3.23 | 10.75    0.81
                 1.25    0.81 |  4.50   37.17 |  7.75    3.23 | 11.00    0.81
                 1.50    0.81 |  4.75   37.17 |  8.00    3.23 | 11.25    0.81
                 1.75    0.81 |  5.00   37.17 |  8.25    3.23 | 11.50    0.81
                 2.00    0.81 |  5.25   37.17 |  8.50    1.62 | 11.75    0.81
                 2.25    0.81 |  5.50   10.50 |  8.75    1.62 | 12.00    0.81
                 2.50    4.85 |  5.75   10.50 |  9.00    1.62 | 12.25    0.81
                 2.75    4.85 |  6.00   10.50 |  9.25    1.62 |
                 3.00    4.85 |  6.25   10.50 |  9.50    0.81 |
                 3.25    4.85 |  6.50    5.66 |  9.75    0.81 |

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

--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 76.0
|ID= 1 DT=15.0 min |   Ia       (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=   5.622 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  34.491
     TOTAL RAINFALL   (mm)=  80.820
     RUNOFF COEFFICIENT   =   0.427

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

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********************************
** SIMULATION:Run 36          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\b4d34ed8
| Ptotal= 88.54 mm |    Comments: 100yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   15.05 |  6.75    6.20 | 10.00    0.89
                 0.50    0.89 |  3.75   15.05 |  7.00    6.20 | 10.25    0.89
                 0.75    0.89 |  4.00   15.05 |  7.25    6.20 | 10.50    0.89
                 1.00    0.89 |  4.25   15.05 |  7.50    3.54 | 10.75    0.89
                 1.25    0.89 |  4.50   40.71 |  7.75    3.54 | 11.00    0.89
                 1.50    0.89 |  4.75   40.71 |  8.00    3.54 | 11.25    0.89
```

```
                 1.75    0.89 |  5.00   40.71 |  8.25    3.54 | 11.50    0.89
                 2.00    0.89 |  5.25   40.71 |  8.50    1.77 | 11.75    0.89
                 2.25    0.89 |  5.50   11.51 |  8.75    1.77 | 12.00    0.89
                 2.50    5.31 |  5.75   11.51 |  9.00    1.77 | 12.25    0.89
                 2.75    5.31 |  6.00   11.51 |  9.25    1.77 |
                 3.00    5.31 |  6.25   11.51 |  9.50    0.89 |
                 3.25    5.31 |  6.50    6.20 |  9.75    0.89 |

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--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 76.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=   6.566 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  40.175
     TOTAL RAINFALL   (mm)=  88.540
     RUNOFF COEFFICIENT   =   0.454

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

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```
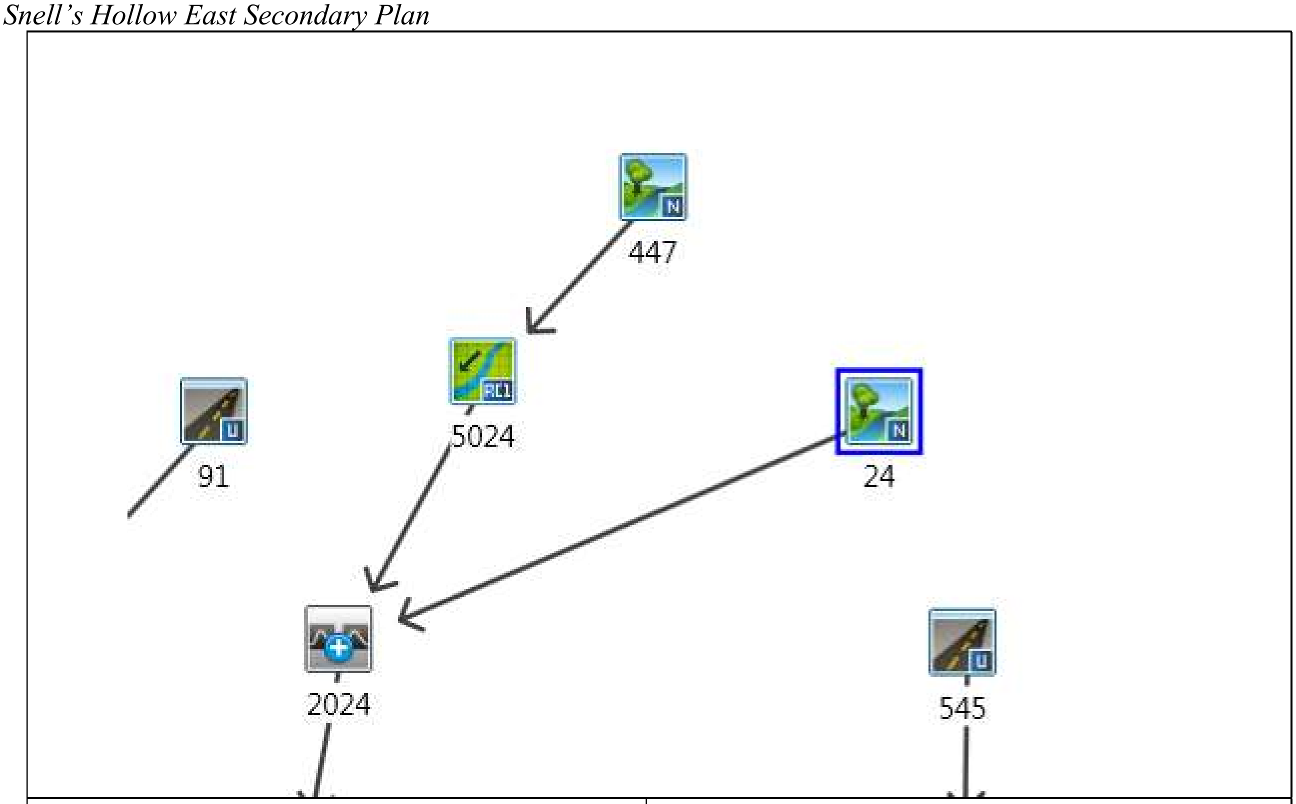



SCHAEFFERS
CONSULTING ENGINEERS

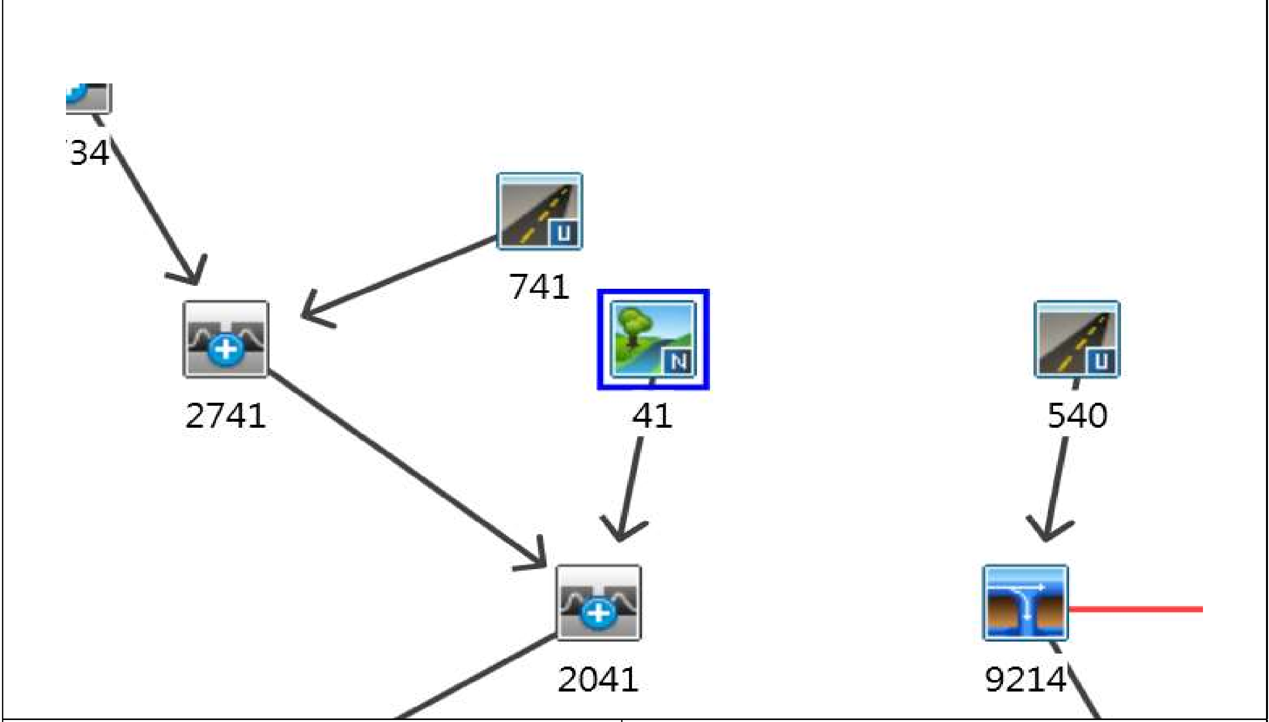
Visual OTTHYMO^{TM} Schematic

TRCA Etobicoke Model

Existing-Regional_12hr_AMCIII
Regional Storm
Catchment 24

Job #: 2019-4851	**Date: August 2020**

```
********************************
** SIMULATION:Run 01          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              166ca339-2260-4565-b289-9f97bf93bb13\296e1377
| Ptotal=212.00 mm |    Comments: * Regional Storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 1.00    6.00 |  4.00   13.00 |  7.00   23.00 | 10.00   53.00
                 2.00    4.00 |  5.00   17.00 |  8.00   13.00 | 11.00   38.00
                 3.00    6.00 |  6.00   13.00 |  9.00   13.00 | 12.00   13.00

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

--------------------
| CALIB            |
| NASHYD   (  0024)|   Area    (ha)= 140.14   Curve Number   (CN)= 89.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Unit Hyd Qpeak  (cms)=   9.610

     PEAK FLOW       (cms)=  17.050 (i)
     TIME TO PEAK    (hrs)=  10.250
     RUNOFF VOLUME    (mm)= 176.247
     TOTAL RAINFALL   (mm)= 212.000
     RUNOFF COEFFICIENT   =   0.831

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

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



SCHAEFFERS
CONSULTING ENGINEERS

Visual OTTHYMO^{TM} Schematic

TRCA Etobicoke Model

Existing-2to100yr-12AES
12 Hour AES
Catchment 41

Job #: 2019-4851	**Date: August 2020**

```
********************************
** SIMULATION:Run 31          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\9bfc2c76
| Ptotal= 42.00 mm |    Comments: 2yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50    7.14 |  6.75    2.94 | 10.00    0.42
                 0.50    0.42 |  3.75    7.14 |  7.00    2.94 | 10.25    0.42
                 0.75    0.42 |  4.00    7.14 |  7.25    2.94 | 10.50    0.42
                 1.00    0.42 |  4.25    7.14 |  7.50    1.68 | 10.75    0.42
                 1.25    0.42 |  4.50   19.32 |  7.75    1.68 | 11.00    0.42
                 1.50    0.42 |  4.75   19.32 |  8.00    1.68 | 11.25    0.42
                 1.75    0.42 |  5.00   19.32 |  8.25    1.68 | 11.50    0.42
                 2.00    0.42 |  5.25   19.32 |  8.50    0.84 | 11.75    0.42
                 2.25    0.42 |  5.50    5.46 |  8.75    0.84 | 12.00    0.42
                 2.50    2.52 |  5.75    5.46 |  9.00    0.84 | 12.25    0.42
                 2.75    2.52 |  6.00    5.46 |  9.25    0.84 |
                 3.00    2.52 |  6.25    5.46 |  9.50    0.42 |
                 3.25    2.52 |  6.50    2.94 |  9.75    0.42 |

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

--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 74.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=   2.660 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=   8.925
     TOTAL RAINFALL   (mm)=  42.000
     RUNOFF COEFFICIENT   =   0.212

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 32          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\8b231e31
| Ptotal= 54.38 mm |    Comments: 5yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50    9.25 |  6.75    3.81 | 10.00    0.54
                 0.50    0.54 |  3.75    9.25 |  7.00    3.81 | 10.25    0.54
                 0.75    0.54 |  4.00    9.25 |  7.25    3.81 | 10.50    0.54
                 1.00    0.54 |  4.25    9.25 |  7.50    2.18 | 10.75    0.54
                 1.25    0.54 |  4.50   25.02 |  7.75    2.18 | 11.00    0.54
                 1.50    0.54 |  4.75   25.02 |  8.00    2.18 | 11.25    0.54
                 1.75    0.54 |  5.00   25.02 |  8.25    2.18 | 11.50    0.54
                 2.00    0.54 |  5.25   25.02 |  8.50    1.09 | 11.75    0.54
                 2.25    0.54 |  5.50    7.07 |  8.75    1.09 | 12.00    0.54
                 2.50    3.26 |  5.75    7.07 |  9.00    1.09 | 12.25    0.54
                 2.75    3.26 |  6.00    7.07 |  9.25    1.09 |
                 3.00    3.26 |  6.25    7.07 |  9.50    0.54 |
                 3.25    3.26 |  6.50    3.81 |  9.75    0.54 |

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

--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 74.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=   4.694 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  15.301
     TOTAL RAINFALL   (mm)=  54.380
     RUNOFF COEFFICIENT   =   0.281

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 33          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\84fa4c73
| Ptotal= 62.71 mm |    Comments: 10yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   10.66 |  6.75    4.39 | 10.00    0.63
                 0.50    0.63 |  3.75   10.66 |  7.00    4.39 | 10.25    0.63
                 0.75    0.63 |  4.00   10.66 |  7.25    4.39 | 10.50    0.63
                 1.00    0.63 |  4.25   10.66 |  7.50    2.51 | 10.75    0.63
                 1.25    0.63 |  4.50   28.84 |  7.75    2.51 | 11.00    0.63
                 1.50    0.63 |  4.75   28.84 |  8.00    2.51 | 11.25    0.63
                 1.75    0.63 |  5.00   28.84 |  8.25    2.51 | 11.50    0.63
                 2.00    0.63 |  5.25   28.84 |  8.50    1.25 | 11.75    0.63
                 2.25    0.63 |  5.50    8.15 |  8.75    1.25 | 12.00    0.63
                 2.50    3.76 |  5.75    8.15 |  9.00    1.25 | 12.25    0.63
                 2.75    3.76 |  6.00    8.15 |  9.25    1.25 |
                 3.00    3.76 |  6.25    8.15 |  9.50    0.63 |
                 3.25    3.76 |  6.50    4.39 |  9.75    0.63 |

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

--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 74.0
```

```
|ID= 1 DT=15.0 min |   Ia       (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=   6.247 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  20.172
     TOTAL RAINFALL   (mm)=  62.710
     RUNOFF COEFFICIENT   =   0.322

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 34          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\eaee5477
| Ptotal= 73.10 mm |    Comments: 25yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   12.43 |  6.75    5.12 | 10.00    0.73
                 0.50    0.73 |  3.75   12.43 |  7.00    5.12 | 10.25    0.73
                 0.75    0.73 |  4.00   12.43 |  7.25    5.12 | 10.50    0.73
                 1.00    0.73 |  4.25   12.43 |  7.50    2.92 | 10.75    0.73
                 1.25    0.73 |  4.50   33.63 |  7.75    2.92 | 11.00    0.73
                 1.50    0.73 |  4.75   33.63 |  8.00    2.92 | 11.25    0.73
                 1.75    0.73 |  5.00   33.63 |  8.25    2.92 | 11.50    0.73
                 2.00    0.73 |  5.25   33.63 |  8.50    1.46 | 11.75    0.73
                 2.25    0.73 |  5.50    9.50 |  8.75    1.46 | 12.00    0.73
                 2.50    4.39 |  5.75    9.50 |  9.00    1.46 | 12.25    0.73
                 2.75    4.39 |  6.00    9.50 |  9.25    1.46 |
                 3.00    4.39 |  6.25    9.50 |  9.50    0.73 |
                 3.25    4.39 |  6.50    5.12 |  9.75    0.73 |

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

--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 74.0
|ID= 1 DT=15.0 min |   Ia       (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=   8.356 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  26.769
     TOTAL RAINFALL   (mm)=  73.100
     RUNOFF COEFFICIENT   =   0.366

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 35          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\b05838de
| Ptotal= 80.82 mm |    Comments: 50yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   13.74 |  6.75    5.66 | 10.00    0.81
                 0.50    0.81 |  3.75   13.74 |  7.00    5.66 | 10.25    0.81
                 0.75    0.81 |  4.00   13.74 |  7.25    5.66 | 10.50    0.81
                 1.00    0.81 |  4.25   13.74 |  7.50    3.23 | 10.75    0.81
                 1.25    0.81 |  4.50   37.17 |  7.75    3.23 | 11.00    0.81
                 1.50    0.81 |  4.75   37.17 |  8.00    3.23 | 11.25    0.81
                 1.75    0.81 |  5.00   37.17 |  8.25    3.23 | 11.50    0.81
                 2.00    0.81 |  5.25   37.17 |  8.50    1.62 | 11.75    0.81
                 2.25    0.81 |  5.50   10.50 |  8.75    1.62 | 12.00    0.81
                 2.50    4.85 |  5.75   10.50 |  9.00    1.62 | 12.25    0.81
                 2.75    4.85 |  6.00   10.50 |  9.25    1.62 |
                 3.00    4.85 |  6.25   10.50 |  9.50    0.81 |
                 3.25    4.85 |  6.50    5.66 |  9.75    0.81 |

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

--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 74.0
|ID= 1 DT=15.0 min |   Ia       (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=  10.014 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  31.985
     TOTAL RAINFALL   (mm)=  80.820
     RUNOFF COEFFICIENT   =   0.396

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 36          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\b4d34ed8
| Ptotal= 88.54 mm |    Comments: 100yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   15.05 |  6.75    6.20 | 10.00    0.89
                 0.50    0.89 |  3.75   15.05 |  7.00    6.20 | 10.25    0.89
                 0.75    0.89 |  4.00   15.05 |  7.25    6.20 | 10.50    0.89
                 1.00    0.89 |  4.25   15.05 |  7.50    3.54 | 10.75    0.89
                 1.25    0.89 |  4.50   40.71 |  7.75    3.54 | 11.00    0.89
                 1.50    0.89 |  4.75   40.71 |  8.00    3.54 | 11.25    0.89
```

```
                 1.75    0.89 |  5.00   40.71 |  8.25    3.54 | 11.50    0.89
                 2.00    0.89 |  5.25   40.71 |  8.50    1.77 | 11.75    0.89
                 2.25    0.89 |  5.50   11.51 |  8.75    1.77 | 12.00    0.89
                 2.50    5.31 |  5.75   11.51 |  9.00    1.77 | 12.25    0.89
                 2.75    5.31 |  6.00   11.51 |  9.25    1.77 |
                 3.00    5.31 |  6.25   11.51 |  9.50    0.89 |
                 3.25    5.31 |  6.50    6.20 |  9.75    0.89 |

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--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 74.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=  11.742 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  37.428
     TOTAL RAINFALL   (mm)=  88.540
     RUNOFF COEFFICIENT   =   0.423

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

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

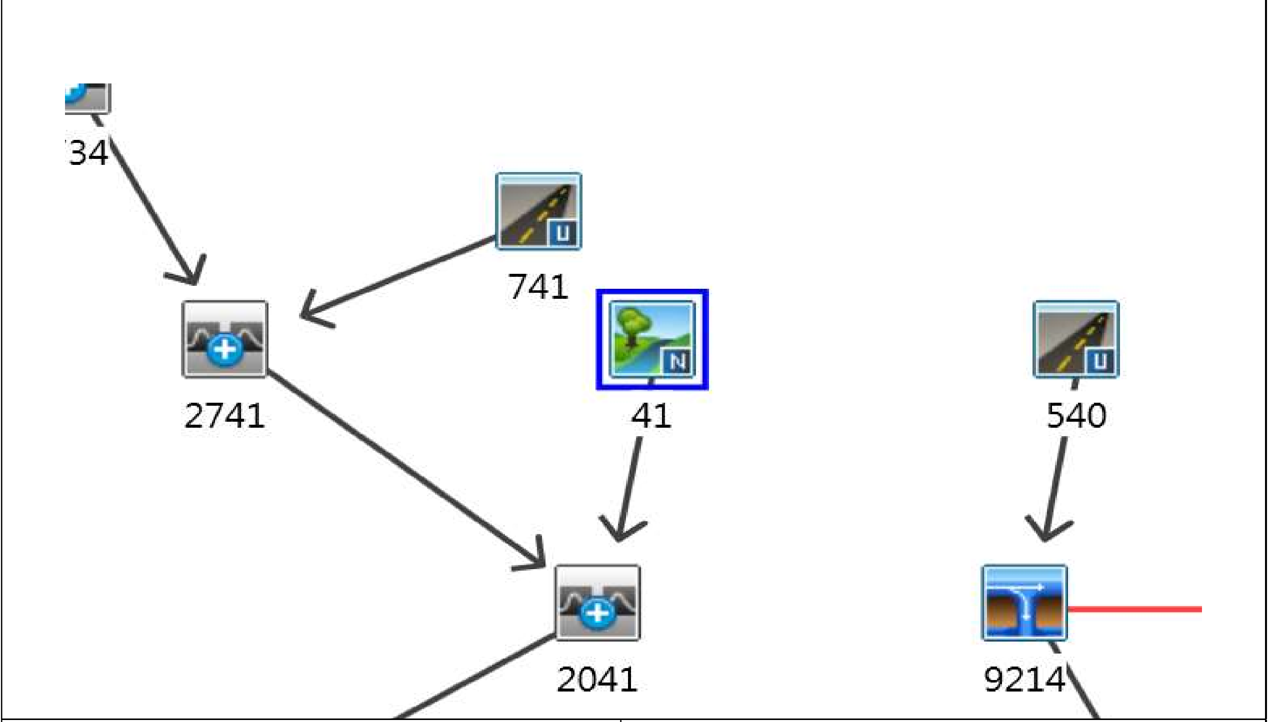

SCHAEFFERS
CONSULTING ENGINEERS

Visual OTTHYMO^{TM} Schematic

TRCA Etobicoke Model

Existing-Regional_12hr_AMCIII
Regional Storm
Catchment 41

Job #: 2019-4851	**Date: August 2020**

```
********************************
** SIMULATION:Run 01          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              853aa2dd-2815-444d-b092-b3bd072042c5\296e1377
| Ptotal=212.00 mm |    Comments: * Regional Storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 1.00    6.00 |  4.00   13.00 |  7.00   23.00 | 10.00   53.00
                 2.00    4.00 |  5.00   17.00 |  8.00   13.00 | 11.00   38.00
                 3.00    6.00 |  6.00   13.00 |  9.00   13.00 | 12.00   13.00

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

--------------------
| CALIB            |
| NASHYD   (  0041)|   Area    (ha)= 263.00   Curve Number   (CN)= 88.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.52

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Unit Hyd Qpeak  (cms)=  19.468

     PEAK FLOW       (cms)=  32.356 (i)
     TIME TO PEAK    (hrs)=  10.250
     RUNOFF VOLUME    (mm)= 172.918
     TOTAL RAINFALL   (mm)= 212.000
     RUNOFF COEFFICIENT   =   0.816

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

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```

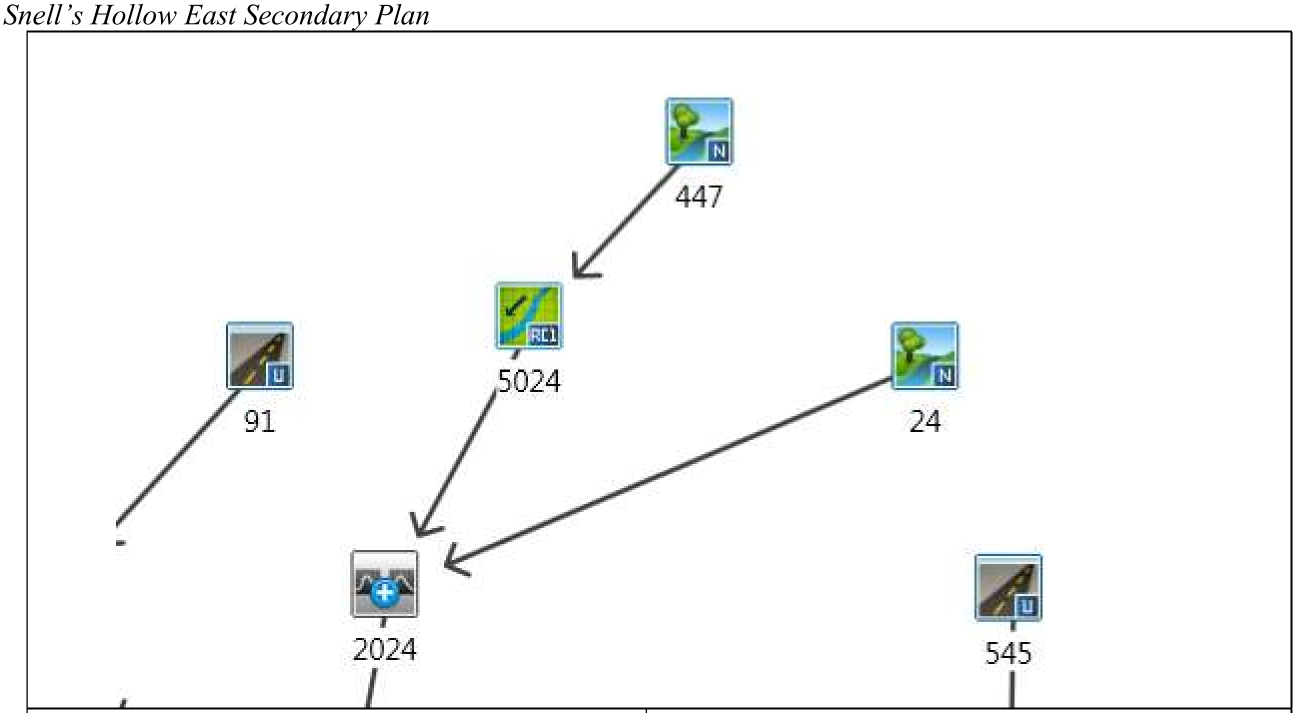

Visual OTTHYMO^{TM} Schematic

TRCA Etobicoke Model

Existing-2to100yr-12AES
12 Hour AES
Catchment 447

Job #: 2019-4851	**Date: August 2020**

```
********************************
** SIMULATION:Run 31          **
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--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\9bfc2c76
| Ptotal= 42.00 mm |    Comments: 2yr/12hr
--------------------
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                  0.25    0.00 |  3.50    7.14 |  6.75    2.94 | 10.00    0.42
                  0.50    0.42 |  3.75    7.14 |  7.00    2.94 | 10.25    0.42
                  0.75    0.42 |  4.00    7.14 |  7.25    2.94 | 10.50    0.42
                  1.00    0.42 |  4.25    7.14 |  7.50    1.68 | 10.75    0.42
                  1.25    0.42 |  4.50   19.32 |  7.75    1.68 | 11.00    0.42
                  1.50    0.42 |  4.75   19.32 |  8.00    1.68 | 11.25    0.42
                  1.75    0.42 |  5.00   19.32 |  8.25    1.68 | 11.50    0.42
                  2.00    0.42 |  5.25   19.32 |  8.50    0.84 | 11.75    0.42
                  2.25    0.42 |  5.50    5.46 |  8.75    0.84 | 12.00    0.42
                  2.50    2.52 |  5.75    5.46 |  9.00    0.84 | 12.25    0.42
                  2.75    2.52 |  6.00    5.46 |  9.25    0.84 |
                  3.00    2.52 |  6.25    5.46 |  9.50    0.42 |
                  3.25    2.52 |  6.50    2.94 |  9.75    0.42 |

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

--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 79.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=   1.410 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  12.037
     TOTAL RAINFALL   (mm)=  42.000
     RUNOFF COEFFICIENT   =   0.287

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 32          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\8b231e31
| Ptotal= 54.38 mm |    Comments: 5yr/12hr
--------------------
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                  0.25    0.00 |  3.50    9.25 |  6.75    3.81 | 10.00    0.54
                  0.50    0.54 |  3.75    9.25 |  7.00    3.81 | 10.25    0.54
                  0.75    0.54 |  4.00    9.25 |  7.25    3.81 | 10.50    0.54
                  1.00    0.54 |  4.25    9.25 |  7.50    2.18 | 10.75    0.54
                  1.25    0.54 |  4.50   25.02 |  7.75    2.18 | 11.00    0.54
                  1.50    0.54 |  4.75   25.02 |  8.00    2.18 | 11.25    0.54
                  1.75    0.54 |  5.00   25.02 |  8.25    2.18 | 11.50    0.54
                  2.00    0.54 |  5.25   25.02 |  8.50    1.09 | 11.75    0.54
                  2.25    0.54 |  5.50    7.07 |  8.75    1.09 | 12.00    0.54
                  2.50    3.26 |  5.75    7.07 |  9.00    1.09 | 12.25    0.54
                  2.75    3.26 |  6.00    7.07 |  9.25    1.09 |
                  3.00    3.26 |  6.25    7.07 |  9.50    0.54 |
                  3.25    3.26 |  6.50    3.81 |  9.75    0.54 |

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

--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 79.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=   2.355 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  19.627
     TOTAL RAINFALL   (mm)=  54.380
     RUNOFF COEFFICIENT   =   0.361

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

-------------------------------------------------------------------------------
********************************
** SIMULATION:Run 33          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\84fa4c73
| Ptotal= 62.71 mm |    Comments: 10yr/12hr
--------------------
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                  0.25    0.00 |  3.50   10.66 |  6.75    4.39 | 10.00    0.63
                  0.50    0.63 |  3.75   10.66 |  7.00    4.39 | 10.25    0.63
                  0.75    0.63 |  4.00   10.66 |  7.25    4.39 | 10.50    0.63
                  1.00    0.63 |  4.25   10.66 |  7.50    2.51 | 10.75    0.63
                  1.25    0.63 |  4.50   28.84 |  7.75    2.51 | 11.00    0.63
                  1.50    0.63 |  4.75   28.84 |  8.00    2.51 | 11.25    0.63
                  1.75    0.63 |  5.00   28.84 |  8.25    2.51 | 11.50    0.63
                  2.00    0.63 |  5.25   28.84 |  8.50    1.25 | 11.75    0.63
                  2.25    0.63 |  5.50    8.15 |  8.75    1.25 | 12.00    0.63
                  2.50    3.76 |  5.75    8.15 |  9.00    1.25 | 12.25    0.63
                  2.75    3.76 |  6.00    8.15 |  9.25    1.25 |
                  3.00    3.76 |  6.25    8.15 |  9.50    0.63 |
                  3.25    3.76 |  6.50    4.39 |  9.75    0.63 |

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

--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 79.0
```

```
|ID= 1 DT=15.0 min |   Ia       (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=   3.058 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  25.273
     TOTAL RAINFALL   (mm)=  62.710
     RUNOFF COEFFICIENT   =   0.403

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

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********************************
** SIMULATION:Run 34          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\eaee5477
| Ptotal= 73.10 mm |    Comments: 25yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   12.43 |  6.75    5.12 | 10.00    0.73
                 0.50    0.73 |  3.75   12.43 |  7.00    5.12 | 10.25    0.73
                 0.75    0.73 |  4.00   12.43 |  7.25    5.12 | 10.50    0.73
                 1.00    0.73 |  4.25   12.43 |  7.50    2.92 | 10.75    0.73
                 1.25    0.73 |  4.50   33.63 |  7.75    2.92 | 11.00    0.73
                 1.50    0.73 |  4.75   33.63 |  8.00    2.92 | 11.25    0.73
                 1.75    0.73 |  5.00   33.63 |  8.25    2.92 | 11.50    0.73
                 2.00    0.73 |  5.25   33.63 |  8.50    1.46 | 11.75    0.73
                 2.25    0.73 |  5.50    9.50 |  8.75    1.46 | 12.00    0.73
                 2.50    4.39 |  5.75    9.50 |  9.00    1.46 | 12.25    0.73
                 2.75    4.39 |  6.00    9.50 |  9.25    1.46 |
                 3.00    4.39 |  6.25    9.50 |  9.50    0.73 |
                 3.25    4.39 |  6.50    5.12 |  9.75    0.73 |

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

--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 79.0
|ID= 1 DT=15.0 min |   Ia       (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=   3.997 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  32.779
     TOTAL RAINFALL   (mm)=  73.100
     RUNOFF COEFFICIENT   =   0.448

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

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********************************
** SIMULATION:Run 35          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\b05838de
| Ptotal= 80.82 mm |    Comments: 50yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   13.74 |  6.75    5.66 | 10.00    0.81
                 0.50    0.81 |  3.75   13.74 |  7.00    5.66 | 10.25    0.81
                 0.75    0.81 |  4.00   13.74 |  7.25    5.66 | 10.50    0.81
                 1.00    0.81 |  4.25   13.74 |  7.50    3.23 | 10.75    0.81
                 1.25    0.81 |  4.50   37.17 |  7.75    3.23 | 11.00    0.81
                 1.50    0.81 |  4.75   37.17 |  8.00    3.23 | 11.25    0.81
                 1.75    0.81 |  5.00   37.17 |  8.25    3.23 | 11.50    0.81
                 2.00    0.81 |  5.25   37.17 |  8.50    1.62 | 11.75    0.81
                 2.25    0.81 |  5.50   10.50 |  8.75    1.62 | 12.00    0.81
                 2.50    4.85 |  5.75   10.50 |  9.00    1.62 | 12.25    0.81
                 2.75    4.85 |  6.00   10.50 |  9.25    1.62 |
                 3.00    4.85 |  6.25   10.50 |  9.50    0.81 |
                 3.25    4.85 |  6.50    5.66 |  9.75    0.81 |

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--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 79.0
|ID= 1 DT=15.0 min |   Ia       (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=   4.726 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  38.629
     TOTAL RAINFALL   (mm)=  80.820
     RUNOFF COEFFICIENT   =   0.478

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

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********************************
** SIMULATION:Run 36          **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              723ccf33-eb30-4ca4-a097-59bcd19a8e77\b4d34ed8
| Ptotal= 88.54 mm |    Comments: 100yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   15.05 |  6.75    6.20 | 10.00    0.89
                 0.50    0.89 |  3.75   15.05 |  7.00    6.20 | 10.25    0.89
                 0.75    0.89 |  4.00   15.05 |  7.25    6.20 | 10.50    0.89
                 1.00    0.89 |  4.25   15.05 |  7.50    3.54 | 10.75    0.89
                 1.25    0.89 |  4.50   40.71 |  7.75    3.54 | 11.00    0.89
                 1.50    0.89 |  4.75   40.71 |  8.00    3.54 | 11.25    0.89
```

```
                 1.75    0.89 |  5.00   40.71 |  8.25    3.54 | 11.50    0.89
                 2.00    0.89 |  5.25   40.71 |  8.50    1.77 | 11.75    0.89
                 2.25    0.89 |  5.50   11.51 |  8.75    1.77 | 12.00    0.89
                 2.50    5.31 |  5.75   11.51 |  9.00    1.77 | 12.25    0.89
                 2.75    5.31 |  6.00   11.51 |  9.25    1.77 |
                 3.00    5.31 |  6.25   11.51 |  9.50    0.89 |
                 3.25    5.31 |  6.50    6.20 |  9.75    0.89 |

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

--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 79.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=   5.478 (i)
     TIME TO PEAK    (hrs)=   5.500
     RUNOFF VOLUME    (mm)=  44.670
     TOTAL RAINFALL   (mm)=  88.540
     RUNOFF COEFFICIENT   =   0.505

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

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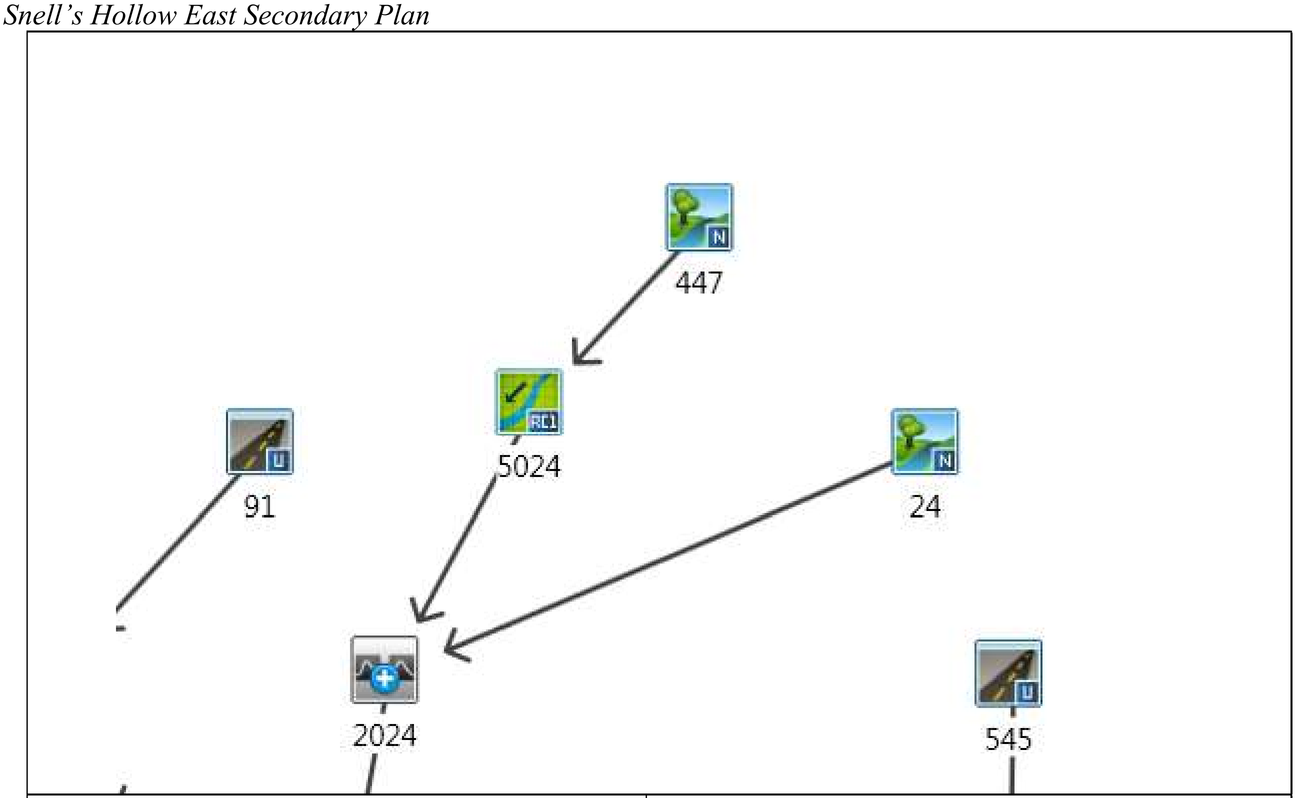

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Visual OTTHYMO^{TM} Schematic

TRCA Etobicoke Model

Existing-Regional_12hr_AMCIII
Regional Storm
Catchment 447

Job #: 2019-4851	**Date: August 2020**

```
********************************
** SIMULATION:Run 01          **
********************************

--------------------
|    READ STORMS    |    Filename: C:\Users\hmilukow\AppD
|                  |              ata\Local\Temp\
|                  |              166ca339-2260-4565-b289-9f97bf93bb13\296e1377
| Ptotal=212.00 mm |    Comments: * Regional Storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 1.00    6.00 |  4.00   13.00 |  7.00   23.00 | 10.00   53.00
                 2.00    4.00 |  5.00   17.00 |  8.00   13.00 | 11.00   38.00
                 3.00    6.00 |  6.00   13.00 |  9.00   13.00 | 12.00   13.00

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

--------------------
| CALIB            |
| NASHYD   (  0447)|   Area    (ha)= 106.74   Curve Number   (CN)= 91.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   6.80   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.58

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Unit Hyd Qpeak  (cms)=   6.969

     PEAK FLOW       (cms)=  12.958 (i)
     TIME TO PEAK    (hrs)=  10.250
     RUNOFF VOLUME    (mm)= 182.435
     TOTAL RAINFALL   (mm)= 212.000
     RUNOFF COEFFICIENT   =   0.861

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

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

Project: 2019-4851

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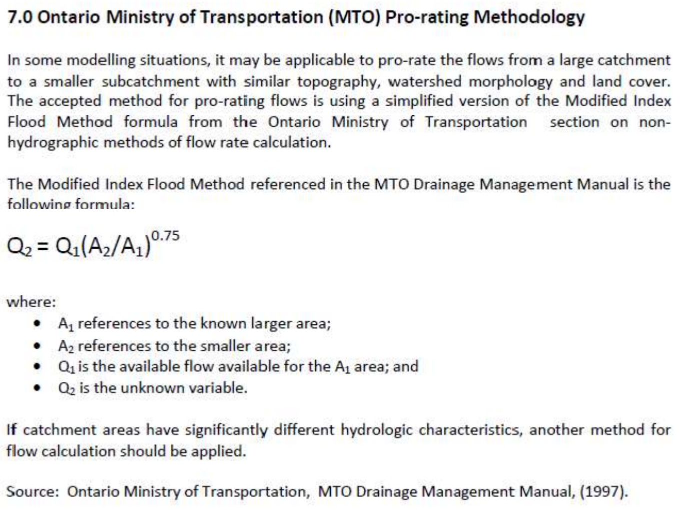
Existing TRCA Flows for catchments 41, 24 and 447 (12 hr AES)

Storm Event	TRCA Catchment ID 41	TRCA Catchment ID 24	TRCA Catchment ID 447
	263.00 ha	**140.14 ha**	**106.74 ha**
2-Year	2.66 cms	1.55 cms	1.41 cms
5-Year	4.69 cms	2.69 cms	2.36 cms
10-Year	6.25 cms	3.55 cms	3.06 cms
25-Year	8.36 cms	4.71 cms	4.00 cms
50-Year	10.01 cms	5.62 cms	4.73 cms
100-Year	11.74 cms	6.57 cms	5.48 cms
Regional Event	32.36 cms	17.05 cms	12.96 cms

Prorating the Flows to establish the existing flows from the Subject site using the Prorating Methodology (12 hr AES)

Storm Event	SCE Catchment ID 1	SCE Catchment ID 2	SCE Catchment ID 3
	46.20 ha	**12.60 ha**	**2.90 ha**
2-Year	0.72 cms	0.26 cms	0.09 cms
5-Year	1.27 cms	0.44 cms	0.16 cms
10-Year	1.70 cms	0.58 cms	0.20 cms
25-Year	2.27 cms	0.77 cms	0.27 cms
50-Year	2.72 cms	0.92 cms	0.32 cms
100-Year	3.19 cms	1.08 cms	0.37 cms
Regional Event	8.78 cms	2.80 cms	0.87 cms



7.0 Ontario Ministry of Transportation (MTO) Pro-rating Methodology

In some modelling situations, it may be applicable to pro-rate the flows from a large catchment to a smaller subcatchment with similar topography, watershed morphology and land cover. The accepted method for pro-rating flows is using a simplified version of the Modified Index Flood Method formula from the Ontario Ministry of Transportation section on non-hydrographic methods of flow rate calculation.

The Modified Index Flood Method referenced in the MTO Drainage Management Manual is the following formula:

$$Q_2 = Q_1(A_2/A_1)^{0.75}$$

where:

- A_1 references to the known larger area;
- A_2 references to the smaller area;
- Q_1 is the available flow available for the A_1 area; and
- Q_2 is the unknown variable.

If catchment areas have significantly different hydrologic characteristics, another method for flow calculation should be applied.

Source: Ontario Ministry of Transportation, MTO Drainage Management Manual, (1997).

APPENDIX C: POST-DEVELOPMENT CALCULATIONS

APPENDIX C.1: POST-DEVELOPMENT CATCHMENTS PARAMETERS

Snell's Hollow
VO Input Parameters

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Area to Pond 1-Catchment 201	Area (ha)	C	TIMP	XIMP	Soil Type	CN	S	Ia
Low Density Area (Yellow)*	5.21	0.65	0.64	0.43	Oneida - D	87	37.95	5.7
Medium Density (Orange & Brown)*	0.88	0.75	0.79	0.79	Oneida - D	92	22.09	4.4
Road Area	4.29	0.65	0.64	0.65	Oneida - D	88	34.64	5.2
Park	1.31	0.25	0.07	0.07	Oneida - D	80	63.50	6.4
Heritage Home	0.10	0.55	0.50	0.50	Oneida - D	80	63.50	6.0
SWM Pond	1.60	0.55	0.50	0.50	Oneida - D	50	254.00	3.8
MTO Corridor	1.12	0.25	0.07	0.07	Oneida - D	80	63.50	6.4
total (weighted averages)	**14.51**	**0.58**	**0.54**	**0.46**		**82.30**		**5.37**

Area to Pond 202 and 204	Area (ha)	C	TIMP	XIMP	Soil Type	CN	S	Ia
Road Area and walkway	4.51	0.65	0.64	0.64	Oneida - D	88	34.64	5.2
Low Density Area (Yellow)*	4.71	0.65	0.64	0.43	Oneida - D	87	37.95	5.7
Medium Density (Orange & Brown)*	1.84	0.75	0.79	0.79	Oneida - D	92	22.09	4.4
High Density Residential (Red)	0.00	0.75	0.79	0.79	Oneida - D	92	22.09	4.4
SWM Pond	1.73	0.55	0.50	0.50	Oneida - D	50	254.00	3.8
MTO Corridor & open space	0.89	0.25	0.07	0.07	Oneida - D	80	63.50	6.4
Catchment 202 subtotal	**13.68**	**0.62**	**0.61**	**0.53**		**82.87**		**5.15**
Road Area (and road widening)	2.30	0.65	0.64	0.65	Oneida - D	88	34.64	5.2
Low Density Area (Yellow)*	0.37	0.65	0.64	0.43	Oneida - D	87	37.95	5.7
Medium Density (Orange & Brown)*	1.70	0.75	0.79	0.79	Oneida - D	92	22.09	4.4
High Density Residential (Red)*	1.27	0.75	0.79	0.79	Oneida - D	92	22.09	4.4
Park and servicing Block (not MTO setback)	0.39	0.25	0.07	0.07	Oneida - D	80	63.50	6.4
MTO Corridor	0.02	0.25	0.07	0.07	Oneida - D	80	63.50	6.4
Catchment 204 subtotal	**6.05**	**0.67**	**0.67**	**0.66**		**89.36**		**4.92**
Total to Pond 2(weighted averages)	**19.73**	**0.64**	**0.63**	**0.57**		**85**		**5.1**

Site Plan Area 1-Catchment 203	Area (ha)	C	TIMP	XIMP	Soil Type	CN	S	Ia
High Density Residential	1.25	0.75	0.79	0.79	Oneida - D	92	22.09	4.4
Commercial	1.47	0.90	1.00	1.00	Oneida - D	95	13.37	2.7
total (weighted averages)	**2.72**	**0.83**	**0.90**			**94**		**3**

Total Area	36.96

** Colors as per the draft plan*

APPENDIX C.2: RELEASE RATES CALCULATIONS

Snell's Hollow

Pond 1 and LID Target Release Rates

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Pre-Development Parameters	
Area 1	46.17 ha
Less Natural Feature Area-to remain in existing	-24.01 ha
Less Site Plan Area 1	-2.72 ha
Total Area	**19.44 ha**

Post Development Area to Pond 1	
Area to Pond 1	14.51 ha

Target Rate Based on TRCA unit flow rates catchment #224

Storm Event	**Unit Flow Rate (m^3/s/ha)**	**Total Target Rate (m^3/s)**
Area (ha)		19.44
Runoff Coefficient C		-
AxC		-
2 Year	0.0075	0.146
5 Year	0.0133	0.259
10 Year	0.0187	0.364
25 Year	0.0270	0.525
50 Year	0.0352	0.684
100 Year	0.0421	0.819
Regional	0.1230	1.785

Unit flow rate based on the TRCA existing model

0.123

Snell's Hollow

Pond 2 Release Rates

Pre-Development Parameters	
Area 2	12.65 ha

Post Development Area to Pond 2	
Area to Pond 2	19.73 ha

Target Rate Based on TRCA unit flow rates catchment #224

Storm Event	**Unit Flow Rate (m^3/s/ha)**	**Total Target Rate (m^3/s)**
Area (ha)		12.645
Runoff Coefficient C		-
AxC		-
2 Year	0.0075	0.095
5 Year	0.0133	0.168
10 Year	0.0187	0.236
25 Year	0.0270	0.341
50 Year	0.0352	0.445
100 Year	0.0421	0.532
Regional	0.122	1.538

Snell's Hollow

South Site Plan Target Release Rates

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Pre-Development Parameters	
Site Plan South Area 1	2.72 ha
Total Area	**2.72 ha**

Post Development Area	
South Plan Area	2.72 ha

Target Rate Based on TRCA unit flow rates catchment #224

Storm Event	**Unit Flow Rate (m^3/s/ha)**	**Total Target Rate (m^3/s)**
Area (ha)		2.72
Runoff Coefficient C		-
AxC		-
2 Year	0.0075	0.020
5 Year	0.0133	0.036
10 Year	0.0187	0.051
25 Year	0.0270	0.073
50 Year	0.0352	0.096
100 Year	0.0421	0.115
Regional	0.1230	0.335

Unit flow rate based on the TRCA existing model

0.123

APPENDIX C.3: EROSION CONTROL CALCULATIONS

Snell's Hollow

SWM Pond 1

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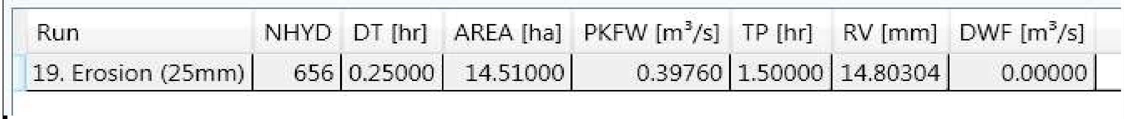
EROSION CONTROL CALCULATIONS-Pond 1



Run	NHYD	DT [hr]	AREA [ha]	PKFW [m³/s]	TP [hr]	RV [mm]	DWF [m³/s]
19. Erosion (25mm)	656	0.25000	14.51000	0.39760	1.50000	14.80304	0.00000

Results of 4 hr 25 mm Design Storm

Input:

Area = 14.51 ha
R.V = 14.8 mm
Draw Down Time = 48 hrs

Calculations:

Storage = 2,147 m^3
Average Outflow = 0.012 m^3/s
Peak Outflow = 0.019 m^3/s

Snell's Hollow

SWM Pond 2

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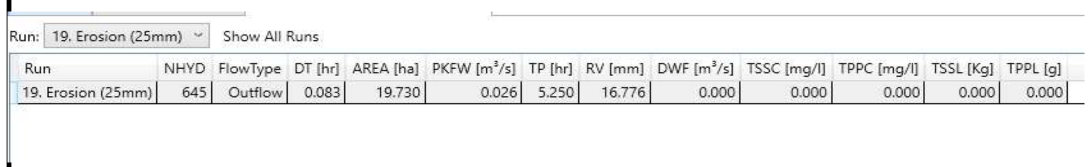
EROSION CONTROL CALCULATIONS-Pond 2



Run: 19. Erosion (25mm) Show All Runs

Run	NHYD	FlowType	DT [hr]	AREA [ha]	PKFW [m³/s]	TP [hr]	RV [mm]	DWF [m³/s]	TSSC [mg/l]	TPPC [mg/l]	TSSL [Kg]	TPPL [g]
19. Erosion (25mm)	645	Outflow	0.083	19.730	0.026	5.250	16.776	0.000	0.000	0.000	0.000	0.000

Results of 4 hr 25 mm Design Storm

Input:

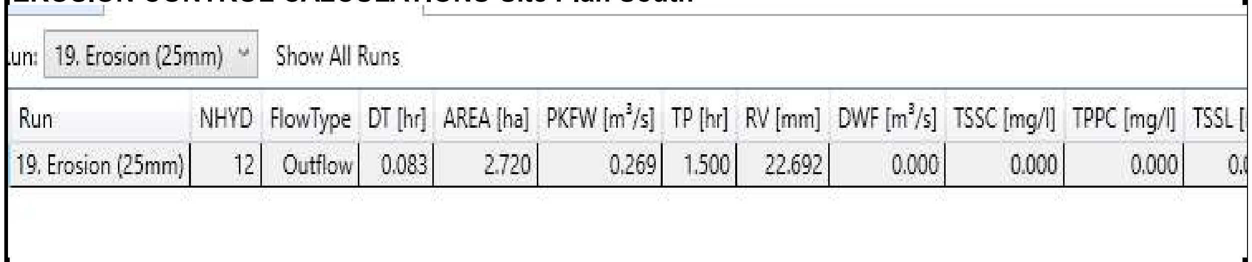
Area = 19.73 ha
R.V = 16.776 mm
Draw Down Time = 48 hrs

Calculations:

Storage = 3,310 m^3
Average Outflow = 0.019 m^3/s
Peak Outflow = 0.029 m^3/s

Snell's Hollow
Site Plan South

EROSION CONTROL CALCULATIONS-Site Plan South



un: 19. Erosion (25mm) Show All Runs

Run	NHYD	FlowType	DT [hr]	AREA [ha]	PKFW [m^3/s]	TP [hr]	RV [mm]	DWF [m^3/s]	TSSC [mg/l]	TPPC [mg/l]	TSSL [
19. Erosion (25mm)	12	Outflow	0.083	2.720	0.269	1.500	22.692	0.000	0.000	0.000	0.0

Results of 4 hr 25 mm Design Storm

Input:

Area = 2.72 ha

R.V = 22.692 mm

Draw Down Time = 48 hrs

Calculations:

Storage = 617 m^3

Average Outflow = 0.004 m^3/s

Peak Outflow = 0.005 m^3/s

APPENDIX C.4: REQUIRED STORAGES

Snell's Hollow

Theoretical Storages for Ponds- 2 to 100year events

Area to Pond 1

Area Draining to Pond 1

Storm Event	**Target Rate Prorated by Area(m^3/s)**	**6 hour AES Release Rate (m^3/s)**	**6 hour AES Required Volume (m^3)**	**12 hour AES Release Rate (m^3/s)**	**12 hour AES Required Volume (m^3)**	**3hr Chicago Release Rate (m^3/s)**	**3hr Chicago Required Volume (m^3)**
Erosion	0.019						
2 Year	0.146	0.117	2304	0.146	2350	0.017	1873
5 Year	0.259	0.248	2486	0.259	2500	0.112	2295
10 Year	0.364	0.362	2594	0.355	2587	0.198	2419
25 Year	0.525	0.522	2723	0.519	2723	0.452	2665
50 Year	0.684	0.677	2789	0.673	2789	0.609	2761
100 Year	0.819	0.815	2863	0.783	2845	0.776	2842
Regional	1.785		2863				

Additional Regional Storage Required 3105 3900

Total Regional Volume Required **5968**

Snell's Hollow

Theoretical Storages for Ponds- 2 to 100year events

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Area to Pond 2 New

Area Draining to Pond 2

Storm Event	Target Rate(m^3/s)	6 hour AES Release Rate (m^3/s)	6 hour AES Required Volume (m^3)	12 hour AES Release Rate (m^3/s)	12 hour AES Required Volume (m^3)	3hr Chicago Release Rate (m^3/s)	3hr Chicago Required Volume (m^3)
2 Year	0.095	0.073	4174	0.095	4594	0.026	2970
5 Year	0.168	0.147	5390	0.168	5719	0.066	4040
10 Year	0.236	0.212	6156	0.236	6392	0.116	4918
25 Year	0.341	0.322	6972	0.341	7099	0.278	6676
50 Year	0.445	0.440	7466	0.445	7484	0.377	7240
100 Year	0.532	0.532	7925	0.528	7905	0.486	7694
Regional	1.538		14815				

Additional Regional Storage Required 4222

Total Regional Volume Required **19037**

Snell's Hollow

Theoretical Storages for Ponds- 2 to 100year events

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South Site Plan Area

On-site Control

Storm Event	**Target Rate Prorated by Area(m^3/s)**	**6 hour AES Release Rate (m^3/s)**	**6 hour AES Required Volume (m^3)**	**12 hour AES Release Rate (m^3/s)**	**12 hour AES Required Volume (m^3)**	**3hr Chicago Release Rate (m^3/s)**	**3hr Chicago Required Volume (m^3)**
Erosion							
2 Year	0.020	0.017	780	0.020	819	0.005	593
5 Year	0.036	0.035	986	0.036	1002	0.016	767
10 Year	0.051	0.050	1116	0.050	1117	0.027	905
25 Year	0.073	0.073	1265	0.069	1242	0.062	1192
50 Year	0.096	0.096	1376	0.088	1338	0.081	1304
100 Year	0.115	0.114	1486	0.107	1440	0.102	1418
Regional	0.335		1968				

Additional Regional Storage Required 582 3900

Total Regional Volume Required **2550**

APPENDIX C.5: QUALITY CONTROL CALCULATIONS

Snell's Hollow
SWM Pond 1
Water Quality Control Requirements

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Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level 1	Storage Volume (m^3/ha) for Impervious Level					
SWMP Type	0%	35%	55%	70%	85%	100%
Wetlands	36	80	105	120	140	160
Wet Pond	53	140	190	225	250	275

* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume. The 40 m3/ha represents extended detention storage.

Source: 2003 SWM Planning & Design Manual

SWM Pond 1

Input:

Weighted Imperviousness = 54%
Area = 14.51 ha
Level of Protection: 1
SWMP Type : Wet Pond

Calculation:

Total Storage Volume = 187 m^3/ha → 2,718 m^3
Permanent Pool Volume = 147 m^3/ha → **2,137 m^3**
Active Storage Volume = 40 m^3/ha → 580 m^3

Snell's Hollow
SWM Pond 2
Water Quality Control Requirements

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CONSULTING ENGINEERS

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level 1	Storage Volume (m^3/ha) for Impervious Level					
SWMP Type	0%	35%	55%	70%	85%	100%
Wetlands	36	80	105	120	140	160
Wet Pond	53	140	190	225	250	275

* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume. The 40 m3/ha represents extended detention storage.

Source: 2003 SWM Planning & Design Manual

SWM Pond 2

Input:

Weighted Imperviousness = 63%

Area = 19.73 ha

Level of Protection: 1

SWMP Type : Wet Pond

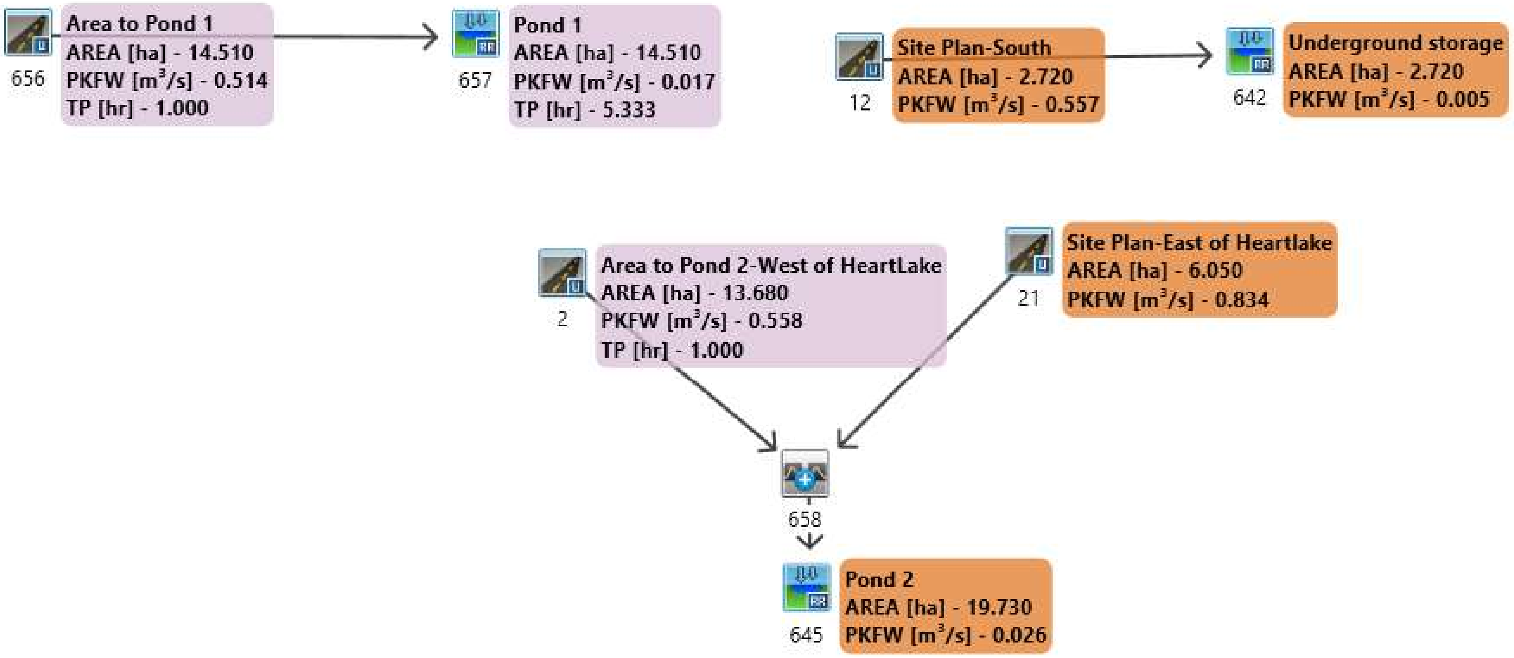
Calculation:

Total Storage Volume = 208 m^3/ha → 4,106 m^3

Permanent Pool Volume = 168 m^3/ha → **3,317 m^3**

Active Storage Volume = 40 m^3/ha → 789 m^3

APPENDIX C.6: VO MODEL RESULTS



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Visual OTTHYMO^{TM} Schematic
Post-Development
6hr AES, 12hr AES & 3hr Chicago Storms

Job #: 2019-4851	**Date: February 2021**

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


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DATE: 02-09-2021                           TIME: 01:20:05

USER:



COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------
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  ************************************************
  ** SIMULATION : 1. Chicago 3hr 2yr           **
  ************************************************


--------------------
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|                  |              8766663e-6d3f-4db9-a962-c49127701f86\c7ad88c2
| Ptotal= 25.36 mm |    Comments: Chicago 5 Min Time Step - 3hr - 2yr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    1.86 |  0.83   10.84 |  1.58    5.33 |  2.33    2.43
                 0.17    2.03 |  0.92   27.01 |  1.67    4.68 |  2.42    2.30
                 0.25    2.24 |  1.00   95.47 |  1.75    4.18 |  2.50    2.18
                 0.33    2.50 |  1.08   35.47 |  1.83    3.78 |  2.58    2.08
                 0.42    2.85 |  1.17   18.58 |  1.92    3.45 |  2.67    1.98
                 0.50    3.31 |  1.25   12.41 |  2.00    3.18 |  2.75    1.90
                 0.58    3.97 |  1.33    9.30 |  2.08    2.95 |  2.83    1.82
```

```
                 0.67    5.00 |  1.42    7.43 |  2.17    2.75 |  2.92    1.75
                 0.75    6.81 |  1.50    6.20 |  2.25    2.58 |  3.00    1.68

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


--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
     Mannings n          =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      95.47         27.76
                over (min)       5.00         10.00
     Storage Coeff.  (min)=       3.11 (ii)     6.10 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.27          0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.55          0.01          0.557 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.08           1.00
     RUNOFF VOLUME    (mm)=      24.36         10.98          23.02
     TOTAL RAINFALL   (mm)=      25.36         25.36          25.36
     RUNOFF COEFFICIENT   =       0.96          0.43           0.91

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     0.557      1.00      23.02
   OUTFLOW: ID= 1 (  0642)      2.720     0.005      3.08      21.86

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  0.86
                  TIME SHIFT OF PEAK FLOW         (min)=125.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0593

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

```
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    2.04 | 1.000   44.44 | 1.750    4.73 |  2.50    2.31
                0.500    2.89 | 1.250   22.16 | 2.000    3.47 |  2.75    1.99
                0.750    5.26 | 1.500    7.64 | 2.250    2.76 |  3.00    1.75

     Max.Eff.Inten.(mm/hr)=      44.44        10.45
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.56         0.04         0.558 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75          1.00
     RUNOFF VOLUME    (mm)=      24.36         7.70         16.52
     TOTAL RAINFALL   (mm)=      25.36        25.36         25.36
     RUNOFF COEFFICIENT   =       0.96         0.30          0.65


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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      95.47        15.47
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       3.95 (ii)   18.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.24         0.06
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.83         0.04         0.834 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.33          1.00
     RUNOFF VOLUME    (mm)=      24.36         7.77         18.71
```

```
     TOTAL RAINFALL   (mm)=      25.36        25.36          25.36
     RUNOFF COEFFICIENT   =       0.96         0.31           0.74

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|  1 +  2 =  3     |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):   13.68   0.558     1.00    16.52
      + ID2= 2 (  0021):    6.05   0.834     1.00    18.71
        ===================================================
        ID = 3 (  0658):   19.73   1.392     1.00    17.20

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730     1.392      1.00      17.20
   OUTFLOW: ID= 1 (  0645)     19.730     0.026      4.33      17.05

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.87
                  TIME SHIFT OF PEAK FLOW         (min)=200.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2970

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
               0.250    2.04 | 1.000   44.44 | 1.750    4.73 |  2.50    2.31
               0.500    2.89 | 1.250   22.16 | 2.000    3.47 |  2.75    1.99
               0.750    5.26 | 1.500    7.64 | 2.250    2.76 |  3.00    1.75

     Max.Eff.Inten.(mm/hr)=      44.44         9.33
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.51         0.05          0.514 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75           1.00
     RUNOFF VOLUME    (mm)=      24.36         7.14          15.06
     TOTAL RAINFALL   (mm)=      25.36        25.36          25.36
     RUNOFF COEFFICIENT   =       0.96         0.28           0.59


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |  0.3640      0.2594
                         0.0190     0.2147   |  0.5250      0.2723
                         0.1460     0.2350   |  0.6840      0.2789
                         0.2590     0.2500   |  0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510     0.514      1.00      15.06
   OUTFLOW: ID= 1 (  0657)     14.510     0.017      5.33      14.86

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.22
                  TIME SHIFT OF PEAK FLOW         (min)=260.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1873

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==================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\ffd53e9e-e0f5-4a8a-894a-2ad4d02d2bb7\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\ffd53e9e-e0f5-4a8a-894a-2ad4d02d2bb7\scen


DATE: 02-09-2021                           TIME: 01:20:06

USER:


COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------
-----------------------
  **************************************************
  ** SIMULATION : 10. AES 6hr 25yr              **
  **************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\a8b5c5a3
| Ptotal= 65.59 mm |    Comments: 25yr/6hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  2.00   22.30 |  3.75    9.18 |  5.50    1.31
                 0.50    1.31 |  2.25   22.30 |  4.00    5.25 |  5.75    1.31
                 0.75    1.31 |  2.50   60.35 |  4.25    5.25 |  6.00    1.31
                 1.00    1.31 |  2.75   60.35 |  4.50    2.62 |  6.25    1.31
                 1.25    1.31 |  3.00   17.06 |  4.75    2.62 |
                 1.50    7.87 |  3.25   17.06 |  5.00    1.31 |
                 1.75    7.87 |  3.50    9.18 |  5.25    1.31 |

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


--------------------
| CALIB            |
| STANDHYD ( 0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n           =      0.013        0.250

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

```
                          ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    7.87 | 3.250   17.06 |  4.83    1.31
                0.167    0.00 | 1.750    7.87 | 3.333    9.18 |  4.92    1.31
                0.250    0.00 | 1.833   22.30 | 3.417    9.18 |  5.00    1.31
                0.333    1.31 | 1.917   22.30 | 3.500    9.18 |  5.08    1.31
                0.417    1.31 | 2.000   22.30 | 3.583    9.18 |  5.17    1.31
                0.500    1.31 | 2.083   22.30 | 3.667    9.18 |  5.25    1.31
                0.583    1.31 | 2.167   22.30 | 3.750    9.18 |  5.33    1.31
                0.667    1.31 | 2.250   22.30 | 3.833    5.25 |  5.42    1.31
                0.750    1.31 | 2.333   60.35 | 3.917    5.25 |  5.50    1.31
                0.833    1.31 | 2.417   60.35 | 4.000    5.25 |  5.58    1.31
                0.917    1.31 | 2.500   60.35 | 4.083    5.25 |  5.67    1.31
                1.000    1.31 | 2.583   60.35 | 4.167    5.25 |  5.75    1.31
                1.083    1.31 | 2.667   60.35 | 4.250    5.25 |  5.83    1.31
                1.167    1.31 | 2.750   60.35 | 4.333    2.62 |  5.92    1.31
                1.250    1.31 | 2.833   17.06 | 4.417    2.62 |  6.00    1.31
                1.333    7.87 | 2.917   17.06 | 4.500    2.62 |  6.08    1.31
                1.417    7.87 | 3.000   17.06 | 4.583    2.62 |  6.17    1.31
                1.500    7.87 | 3.083   17.06 | 4.667    2.62 |  6.25    1.31
                1.583    7.87 | 3.167   17.06 | 4.750    2.62 |

     Max.Eff.Inten.(mm/hr)=      60.35        54.03
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.74 (ii)    7.32 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.25         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.41         0.04         0.449 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.75          2.75
     RUNOFF VOLUME    (mm)=      64.59        47.09         62.84
     TOTAL RAINFALL   (mm)=      65.59        65.59         65.59
     RUNOFF COEFFICIENT   =       0.98         0.72          0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)       2.720     0.449      2.75      62.84
   OUTFLOW: ID= 1 (  0642)       2.720     0.073      3.50      61.68

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 16.22
                   TIME SHIFT OF PEAK FLOW         (min)= 45.00
```

```
                        MAXIMUM  STORAGE   USED       (ha.m.)=  0.1265

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      60.35        53.14
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.08         0.20         1.117 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25          2.75
     RUNOFF VOLUME    (mm)=      64.59        38.27         52.22
     TOTAL RAINFALL   (mm)=      65.59        65.59         65.59
     RUNOFF COEFFICIENT   =       0.98         0.58          0.80


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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                          ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    7.87 | 3.250   17.06 |  4.83    1.31
                0.167    0.00 | 1.750    7.87 | 3.333    9.18 |  4.92    1.31
                0.250    0.00 | 1.833   22.30 | 3.417    9.18 |  5.00    1.31
                0.333    1.31 | 1.917   22.30 | 3.500    9.18 |  5.08    1.31
                0.417    1.31 | 2.000   22.30 | 3.583    9.18 |  5.17    1.31
                0.500    1.31 | 2.083   22.30 | 3.667    9.18 |  5.25    1.31
                0.583    1.31 | 2.167   22.30 | 3.750    9.18 |  5.33    1.31
                0.667    1.31 | 2.250   22.30 | 3.833    5.25 |  5.42    1.31
```

```
               0.750    1.31 | 2.333   60.35 | 3.917    5.25 |  5.50    1.31
               0.833    1.31 | 2.417   60.35 | 4.000    5.25 |  5.58    1.31
               0.917    1.31 | 2.500   60.35 | 4.083    5.25 |  5.67    1.31
               1.000    1.31 | 2.583   60.35 | 4.167    5.25 |  5.75    1.31
               1.083    1.31 | 2.667   60.35 | 4.250    5.25 |  5.83    1.31
               1.167    1.31 | 2.750   60.35 | 4.333    2.62 |  5.92    1.31
               1.250    1.31 | 2.833   17.06 | 4.417    2.62 |  6.00    1.31
               1.333    7.87 | 2.917   17.06 | 4.500    2.62 |  6.08    1.31
               1.417    7.87 | 3.000   17.06 | 4.583    2.62 |  6.17    1.31
               1.500    7.87 | 3.083   17.06 | 4.667    2.62 |  6.25    1.31
               1.583    7.87 | 3.167   17.06 | 4.750    2.62 |

     Max.Eff.Inten.(mm/hr)=      60.35        47.89
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.75 (ii)   14.23 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.22         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.67         0.20         0.866 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.83          2.75
     RUNOFF VOLUME    (mm)=      64.59        39.10         55.92
     TOTAL RAINFALL   (mm)=      65.59        65.59         65.59
     RUNOFF COEFFICIENT   =       0.98         0.60          0.85

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0002):    13.68    1.117     2.75    52.22
     + ID2= 2 (  0021):     6.05    0.866     2.75    55.92
       ==================================================
       ID = 3 (  0658):    19.73    1.983     2.75    53.35

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)      19.730      1.983      2.75      53.35
   OUTFLOW: ID= 1 (  0645)      19.730      0.322      4.58      53.20

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 16.23
```

```
                  TIME SHIFT OF PEAK FLOW         (min)=110.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.6972

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84          6.67
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.30
     Length            (m)=     311.02         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      60.35         49.79
                over (min)       15.00         30.00
     Storage Coeff.  (min)=      16.80 (ii)    97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00        105.00
     Unit Hyd. peak  (cms)=       0.07          0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.99          0.23          1.037 (iii)
     TIME TO PEAK    (hrs)=       2.75          4.25           2.75
     RUNOFF VOLUME    (mm)=      64.59         36.68          49.52
     TOTAL RAINFALL   (mm)=      65.59         65.59          65.59
     RUNOFF COEFFICIENT   =       0.98          0.56           0.75


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)      14.510      1.037      2.75      49.52
   OUTFLOW: ID= 1 (  0657)      14.510      0.522      3.25      49.32

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 50.37
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2723

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

 FINISH
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=======================

       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\189e6ca6-9823-4dd5-811c-ab3078eb04ea\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\189e6ca6-9823-4dd5-811c-ab3078eb04ea\scen


DATE: 02-09-2021                           TIME: 01:20:04

USER:



COMMENTS: ____________________________________________________________

-------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 11. AES 6hr 50yr              **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\71df3a36
| Ptotal= 73.00 mm |    Comments: 50yr/6hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  2.00   24.82 |  3.75   10.22 |  5.50    1.46
                 0.50    1.46 |  2.25   24.82 |  4.00    5.84 |  5.75    1.46
                 0.75    1.46 |  2.50   67.16 |  4.25    5.84 |  6.00    1.46
                 1.00    1.46 |  2.75   67.16 |  4.50    2.92 |  6.25    1.46
                 1.25    1.46 |  3.00   18.98 |  4.75    2.92 |
                 1.50    8.76 |  3.25   18.98 |  5.00    1.46 |
                 1.75    8.76 |  3.50   10.22 |  5.25    1.46 |

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--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

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


                               ---- TRANSFORMED HYETOGRAPH ----
                   TIME    RAIN | TIME    RAIN |' TIME    RAIN |  TIME    RAIN
                    hrs   mm/hr |  hrs   mm/hr |'  hrs   mm/hr |   hrs   mm/hr
                  0.083    0.00 | 1.667    8.76 | 3.250   18.98 |  4.83    1.46
                  0.167    0.00 | 1.750    8.76 | 3.333   10.22 |  4.92    1.46
                  0.250    0.00 | 1.833   24.82 | 3.417   10.22 |  5.00    1.46
                  0.333    1.46 | 1.917   24.82 | 3.500   10.22 |  5.08    1.46
                  0.417    1.46 | 2.000   24.82 | 3.583   10.22 |  5.17    1.46
                  0.500    1.46 | 2.083   24.82 | 3.667   10.22 |  5.25    1.46
                  0.583    1.46 | 2.167   24.82 | 3.750   10.22 |  5.33    1.46
                  0.667    1.46 | 2.250   24.82 | 3.833    5.84 |  5.42    1.46
                  0.750    1.46 | 2.333   67.16 | 3.917    5.84 |  5.50    1.46
                  0.833    1.46 | 2.417   67.16 | 4.000    5.84 |  5.58    1.46
                  0.917    1.46 | 2.500   67.16 | 4.083    5.84 |  5.67    1.46
                  1.000    1.46 | 2.583   67.16 | 4.167    5.84 |  5.75    1.46
                  1.083    1.46 | 2.667   67.16 | 4.250    5.84 |  5.83    1.46
                  1.167    1.46 | 2.750   67.16 | 4.333    2.92 |  5.92    1.46
                  1.250    1.46 | 2.833   18.98 | 4.417    2.92 |  6.00    1.46
                  1.333    8.76 | 2.917   18.98 | 4.500    2.92 |  6.08    1.46
                  1.417    8.76 | 3.000   18.98 | 4.583    2.92 |  6.17    1.46
                  1.500    8.76 | 3.083   18.98 | 4.667    2.92 |  6.25    1.46
                  1.583    8.76 | 3.167   18.98 | 4.750    2.92 |

     Max.Eff.Inten.(mm/hr)=      67.16        61.21
                over (min)       5.00        10.00
     Storage Coeff.  (min)=       3.58 (ii)    7.02 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.14
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.46         0.04         0.501 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.75          2.75
     RUNOFF VOLUME    (mm)=      72.00        54.17         70.22
     TOTAL RAINFALL   (mm)=      73.00        73.00         73.00
     RUNOFF COEFFICIENT   =       0.99         0.74          0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |  0.0510      0.1120
                         0.0050     0.0617    |  0.0730      0.1266
                         0.0200     0.0820    |  0.0960      0.1376
                         0.0360     0.1003    |  0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.501      2.75      70.22
   OUTFLOW: ID= 1 (  0642)      2.720      0.096      3.33      69.06

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 19.14
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1376

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      67.16        61.56
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.20         0.24             1.247 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25              2.75
     RUNOFF VOLUME    (mm)=      72.00        44.70             59.17
     TOTAL RAINFALL   (mm)=      73.00        73.00             73.00
     RUNOFF COEFFICIENT   =       0.99         0.61              0.81


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

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
```

```
     Mannings n           =      0.013        0.250

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


                             ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    0.00 | 1.667    8.76 | 3.250   18.98 |  4.83    1.46
                 0.167    0.00 | 1.750    8.76 | 3.333   10.22 |  4.92    1.46
                 0.250    0.00 | 1.833   24.82 | 3.417   10.22 |  5.00    1.46
                 0.333    1.46 | 1.917   24.82 | 3.500   10.22 |  5.08    1.46
                 0.417    1.46 | 2.000   24.82 | 3.583   10.22 |  5.17    1.46
                 0.500    1.46 | 2.083   24.82 | 3.667   10.22 |  5.25    1.46
                 0.583    1.46 | 2.167   24.82 | 3.750   10.22 |  5.33    1.46
                 0.667    1.46 | 2.250   24.82 | 3.833    5.84 |  5.42    1.46
                 0.750    1.46 | 2.333   67.16 | 3.917    5.84 |  5.50    1.46
                 0.833    1.46 | 2.417   67.16 | 4.000    5.84 |  5.58    1.46
                 0.917    1.46 | 2.500   67.16 | 4.083    5.84 |  5.67    1.46
                 1.000    1.46 | 2.583   67.16 | 4.167    5.84 |  5.75    1.46
                 1.083    1.46 | 2.667   67.16 | 4.250    5.84 |  5.83    1.46
                 1.167    1.46 | 2.750   67.16 | 4.333    2.92 |  5.92    1.46
                 1.250    1.46 | 2.833   18.98 | 4.417    2.92 |  6.00    1.46
                 1.333    8.76 | 2.917   18.98 | 4.500    2.92 |  6.08    1.46
                 1.417    8.76 | 3.000   18.98 | 4.583    2.92 |  6.17    1.46
                 1.500    8.76 | 3.083   18.98 | 4.667    2.92 |  6.25    1.46
                 1.583    8.76 | 3.167   18.98 | 4.750    2.92 |

     Max.Eff.Inten.(mm/hr)=      67.16        55.21
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.55 (ii)   13.50 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.23         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.74         0.24         0.979 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.83          2.75
     RUNOFF VOLUME    (mm)=      72.00        45.63         63.03
     TOTAL RAINFALL   (mm)=      73.00        73.00         73.00
     RUNOFF COEFFICIENT   =       0.99         0.63          0.86

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   1.247     2.75    59.17
      + ID2= 2 (  0021):     6.05   0.979     2.75    63.03
        ===================================================
        ID = 3 (  0658):    19.73   2.226     2.75    60.35

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
```

```
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730     2.226      2.75      60.35
   OUTFLOW: ID= 1 (  0645)     19.730     0.440      4.33      60.20

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 19.75
                  TIME SHIFT OF PEAK FLOW         (min)= 95.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7466

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      67.16        57.89
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.10         0.28          1.158 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25          2.75
     RUNOFF VOLUME    (mm)=      72.00        42.98         56.32
     TOTAL RAINFALL   (mm)=      73.00        73.00         73.00
     RUNOFF COEFFICIENT   =       0.99         0.59          0.77


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863
```

```
                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510     1.158      2.75      56.32
   OUTFLOW: ID= 1 (  0657)     14.510     0.677      3.17      56.12

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 58.46
                  TIME SHIFT OF PEAK FLOW         (min)= 25.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2789

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

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\791534ba-0671-452e-9de6-e5d066fbb528\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\791534ba-0671-452e-9de6-e5d066fbb528\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:


COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 12. AES 6hr 100yr            **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\58f83706
| Ptotal= 80.31 mm |    Comments: 100yr/6hr
--------------------
```

```
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  2.00   27.30 |  3.75   11.24 |  5.50    1.61
                 0.50    1.61 |  2.25   27.30 |  4.00    6.42 |  5.75    1.61
                 0.75    1.61 |  2.50   73.88 |  4.25    6.42 |  6.00    1.61
                 1.00    1.61 |  2.75   73.88 |  4.50    3.21 |  6.25    1.61
                 1.25    1.61 |  3.00   20.88 |  4.75    3.21 |
                 1.50    9.64 |  3.25   20.88 |  5.00    1.61 |
                 1.75    9.64 |  3.50   11.24 |  5.25    1.61 |

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

--------------------
| CALIB              |
| STANDHYD ( 0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      2.45          0.27
     Dep. Storage     (mm)=      1.00          5.00
     Average Slope     (%)=      1.00          2.00
     Length            (m)=    134.66         40.00
     Mannings n           =     0.013         0.250

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


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    9.64 | 3.250   20.88 |  4.83    1.61
                0.167    0.00 | 1.750    9.64 | 3.333   11.24 |  4.92    1.61
                0.250    0.00 | 1.833   27.30 | 3.417   11.24 |  5.00    1.61
                0.333    1.61 | 1.917   27.30 | 3.500   11.24 |  5.08    1.61
                0.417    1.61 | 2.000   27.30 | 3.583   11.24 |  5.17    1.61
                0.500    1.61 | 2.083   27.30 | 3.667   11.24 |  5.25    1.61
                0.583    1.61 | 2.167   27.30 | 3.750   11.24 |  5.33    1.61
                0.667    1.61 | 2.250   27.30 | 3.833    6.42 |  5.42    1.61
                0.750    1.61 | 2.333   73.88 | 3.917    6.42 |  5.50    1.61
                0.833    1.61 | 2.417   73.88 | 4.000    6.42 |  5.58    1.61
                0.917    1.61 | 2.500   73.88 | 4.083    6.42 |  5.67    1.61
                1.000    1.61 | 2.583   73.88 | 4.167    6.42 |  5.75    1.61
                1.083    1.61 | 2.667   73.88 | 4.250    6.42 |  5.83    1.61
                1.167    1.61 | 2.750   73.88 | 4.333    3.21 |  5.92    1.61
                1.250    1.61 | 2.833   20.88 | 4.417    3.21 |  6.00    1.61
                1.333    9.64 | 2.917   20.88 | 4.500    3.21 |  6.08    1.61
                1.417    9.64 | 3.000   20.88 | 4.583    3.21 |  6.17    1.61
                1.500    9.64 | 3.083   20.88 | 4.667    3.21 |  6.25    1.61
                1.583    9.64 | 3.167   20.88 | 4.750    3.21 |

     Max.Eff.Inten.(mm/hr)=     73.88         68.25
                over (min)      5.00         10.00
     Storage Coeff.  (min)=      3.45 (ii)     6.76 (ii)
     Unit Hyd. Tpeak (min)=      5.00         10.00
     Unit Hyd. peak  (cms)=      0.26          0.14
                                                            *TOTALS*
     PEAK FLOW       (cms)=      0.50          0.05          0.552 (iii)
     TIME TO PEAK    (hrs)=      2.75          2.75           2.75
     RUNOFF VOLUME    (mm)=     79.31         61.20          77.50
     TOTAL RAINFALL   (mm)=     80.31         80.31          80.31
     RUNOFF COEFFICIENT   =      0.99          0.76           0.96
```

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510      0.1120
                          0.0050     0.0617   |   0.0730      0.1266
                          0.0200     0.0820   |   0.0960      0.1376
                          0.0360     0.1003   |   0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     0.552      2.75      77.50
   OUTFLOW: ID= 1 (  0642)      2.720     0.114      3.33      76.34

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 20.68
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1486

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD ( 0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      8.34          5.34
     Dep. Storage     (mm)=      1.00          5.00
     Average Slope     (%)=      1.00          2.30
     Length            (m)=    301.99         40.00
     Mannings n           =     0.013         0.250

     Max.Eff.Inten.(mm/hr)=     73.88         69.93
                over (min)     15.00         30.00
     Storage Coeff.  (min)=     16.80 (ii)    97.80 (ii)
     Unit Hyd. Tpeak (min)=     15.00        105.00
     Unit Hyd. peak  (cms)=      0.07          0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=      1.32          0.27          1.375 (iii)
     TIME TO PEAK    (hrs)=      2.75          4.25           2.75
     RUNOFF VOLUME    (mm)=     79.31         51.17          66.08
     TOTAL RAINFALL   (mm)=     80.31         80.31          80.31
     RUNOFF COEFFICIENT   =      0.99          0.64           0.82


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
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--------------------
| CALIB             |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        4.05         2.00
     Dep. Storage     (mm)=        1.00         5.00
     Average Slope     (%)=        1.00         2.00
     Length            (m)=      200.83        40.00
     Mannings n           =       0.013        0.250

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


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    9.64 | 3.250   20.88 |  4.83    1.61
                0.167    0.00 | 1.750    9.64 | 3.333   11.24 |  4.92    1.61
                0.250    0.00 | 1.833   27.30 | 3.417   11.24 |  5.00    1.61
                0.333    1.61 | 1.917   27.30 | 3.500   11.24 |  5.08    1.61
                0.417    1.61 | 2.000   27.30 | 3.583   11.24 |  5.17    1.61
                0.500    1.61 | 2.083   27.30 | 3.667   11.24 |  5.25    1.61
                0.583    1.61 | 2.167   27.30 | 3.750   11.24 |  5.33    1.61
                0.667    1.61 | 2.250   27.30 | 3.833    6.42 |  5.42    1.61
                0.750    1.61 | 2.333   73.88 | 3.917    6.42 |  5.50    1.61
                0.833    1.61 | 2.417   73.88 | 4.000    6.42 |  5.58    1.61
                0.917    1.61 | 2.500   73.88 | 4.083    6.42 |  5.67    1.61
                1.000    1.61 | 2.583   73.88 | 4.167    6.42 |  5.75    1.61
                1.083    1.61 | 2.667   73.88 | 4.250    6.42 |  5.83    1.61
                1.167    1.61 | 2.750   73.88 | 4.333    3.21 |  5.92    1.61
                1.250    1.61 | 2.833   20.88 | 4.417    3.21 |  6.00    1.61
                1.333    9.64 | 2.917   20.88 | 4.500    3.21 |  6.08    1.61
                1.417    9.64 | 3.000   20.88 | 4.583    3.21 |  6.17    1.61
                1.500    9.64 | 3.083   20.88 | 4.667    3.21 |  6.25    1.61
                1.583    9.64 | 3.167   20.88 | 4.750    3.21 |

     Max.Eff.Inten.(mm/hr)=       73.88        62.47
                over (min)        5.00        15.00
     Storage Coeff.  (min)=        4.38 (ii)   12.90 (ii)
     Unit Hyd. Tpeak (min)=        5.00        15.00
     Unit Hyd. peak  (cms)=        0.23         0.08
                                                           *TOTALS*
     PEAK FLOW       (cms)=        0.82         0.28          1.092 (iii)
     TIME TO PEAK    (hrs)=        2.75         2.83           2.75
     RUNOFF VOLUME    (mm)=       79.31        52.20          70.09
     TOTAL RAINFALL   (mm)=       80.31        80.31          80.31
     RUNOFF COEFFICIENT   =        0.99         0.65           0.87

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):     13.68   1.375     2.75    66.08
      + ID2= 2 (  0021):      6.05   1.092     2.75    70.09
        ====================================================
        ID = 3 (  0658):     19.73   2.467     2.75    67.31

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      2.467      2.75      67.31
   OUTFLOW: ID= 1 (  0645)     19.730      0.532      4.25      67.16

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 21.56
                  TIME SHIFT OF PEAK FLOW         (min)= 90.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7925

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        7.84         6.67
     Dep. Storage     (mm)=        1.00         5.00
     Average Slope     (%)=        1.00         2.30
     Length            (m)=      311.02        40.00
     Mannings n           =       0.013        0.250

     Max.Eff.Inten.(mm/hr)=       73.88        65.97
                over (min)       15.00        30.00
     Storage Coeff.  (min)=       16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=       15.00       105.00
     Unit Hyd. peak  (cms)=        0.07         0.01
                                                           *TOTALS*
     PEAK FLOW       (cms)=        1.22         0.32          1.279 (iii)
     TIME TO PEAK    (hrs)=        2.75         4.25           2.75
     RUNOFF VOLUME    (mm)=       79.31        49.32          63.11
     TOTAL RAINFALL   (mm)=       80.31        80.31          80.31
     RUNOFF COEFFICIENT   =        0.99         0.61           0.79


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

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------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.3640      0.2594
                         0.0190     0.2147   |   0.5250      0.2723
                         0.1460     0.2350   |   0.6840      0.2789
                         0.2590     0.2500   |   0.8190      0.2863

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      1.279      2.75      63.11
   OUTFLOW: ID= 1 (  0657)     14.510      0.815      3.00      62.91

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 63.76
                   TIME SHIFT OF PEAK FLOW         (min)= 15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2863

------------------------------------------------------------------------------
==================================================================================
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      V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
      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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\f2f2422e-5afa-42ad-b7a1-6ec56d4ad7f8\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\f2f2422e-5afa-42ad-b7a1-6ec56d4ad7f8\scen


DATE: 02-09-2021                          TIME: 01:20:06

USER:


COMMENTS: ____________________________________________________________

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  ************************************************
  ** SIMULATION : 13. AES 12hr 2yr             **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\155f0ad1
| Ptotal= 42.00 mm |    Comments: 2yr/12hr
--------------------
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                  0.25    0.00 |  3.50    7.14 |  6.75    2.94 | 10.00    0.42
                  0.50    0.42 |  3.75    7.14 |  7.00    2.94 | 10.25    0.42
                  0.75    0.42 |  4.00    7.14 |  7.25    2.94 | 10.50    0.42
                  1.00    0.42 |  4.25    7.14 |  7.50    1.68 | 10.75    0.42
                  1.25    0.42 |  4.50   19.32 |  7.75    1.68 | 11.00    0.42
                  1.50    0.42 |  4.75   19.32 |  8.00    1.68 | 11.25    0.42
                  1.75    0.42 |  5.00   19.32 |  8.25    1.68 | 11.50    0.42
                  2.00    0.42 |  5.25   19.32 |  8.50    0.84 | 11.75    0.42
                  2.25    0.42 |  5.50    5.46 |  8.75    0.84 | 12.00    0.42
                  2.50    2.52 |  5.75    5.46 |  9.00    0.84 | 12.25    0.42
                  2.75    2.52 |  6.00    5.46 |  9.25    0.84 |
                  3.00    2.52 |  6.25    5.46 |  9.50    0.42 |
                  3.25    2.52 |  6.50    2.94 |  9.75    0.42 |

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--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
     Mannings n          =      0.013         0.250

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


                                 ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    0.00 | 3.167    2.52 | 6.250    5.46 |  9.33    0.42
                 0.167    0.00 | 3.250    2.52 | 6.333    2.94 |  9.42    0.42
                 0.250    0.00 | 3.333    7.14 | 6.417    2.94 |  9.50    0.42
                 0.333    0.42 | 3.417    7.14 | 6.500    2.94 |  9.58    0.42
                 0.417    0.42 | 3.500    7.14 | 6.583    2.94 |  9.67    0.42
                 0.500    0.42 | 3.583    7.14 | 6.667    2.94 |  9.75    0.42
                 0.583    0.42 | 3.667    7.14 | 6.750    2.94 |  9.83    0.42
                 0.667    0.42 | 3.750    7.14 | 6.833    2.94 |  9.92    0.42
                 0.750    0.42 | 3.833    7.14 | 6.917    2.94 | 10.00    0.42
                 0.833    0.42 | 3.917    7.14 | 7.000    2.94 | 10.08    0.42
                 0.917    0.42 | 4.000    7.14 | 7.083    2.94 | 10.17    0.42
                 1.000    0.42 | 4.083    7.14 | 7.167    2.94 | 10.25    0.42
                 1.083    0.42 | 4.167    7.14 | 7.250    2.94 | 10.33    0.42
                 1.167    0.42 | 4.250    7.14 | 7.333    1.68 | 10.42    0.42
```

```
                1.250    0.42 | 4.333   19.32 | 7.417    1.68 | 10.50    0.42
                1.333    0.42 | 4.417   19.32 | 7.500    1.68 | 10.58    0.42
                1.417    0.42 | 4.500   19.32 | 7.583    1.68 | 10.67    0.42
                1.500    0.42 | 4.583   19.32 | 7.667    1.68 | 10.75    0.42
                1.583    0.42 | 4.667   19.32 | 7.750    1.68 | 10.83    0.42
                1.667    0.42 | 4.750   19.32 | 7.833    1.68 | 10.92    0.42
                1.750    0.42 | 4.833   19.32 | 7.917    1.68 | 11.00    0.42
                1.833    0.42 | 4.917   19.32 | 8.000    1.68 | 11.08    0.42
                1.917    0.42 | 5.000   19.32 | 8.083    1.68 | 11.17    0.42
                2.000    0.42 | 5.083   19.32 | 8.167    1.68 | 11.25    0.42
                2.083    0.42 | 5.167   19.32 | 8.250    1.68 | 11.33    0.42
                2.167    0.42 | 5.250   19.32 | 8.333    0.84 | 11.42    0.42
                2.250    0.42 | 5.333    5.46 | 8.417    0.84 | 11.50    0.42
                2.333    2.52 | 5.417    5.46 | 8.500    0.84 | 11.58    0.42
                2.417    2.52 | 5.500    5.46 | 8.583    0.84 | 11.67    0.42
                2.500    2.52 | 5.583    5.46 | 8.667    0.84 | 11.75    0.42
                2.583    2.52 | 5.667    5.46 | 8.750    0.84 | 11.83    0.42
                2.667    2.52 | 5.750    5.46 | 8.833    0.84 | 11.92    0.42
                2.750    2.52 | 5.833    5.46 | 8.917    0.84 | 12.00    0.42
                2.833    2.52 | 5.917    5.46 | 9.000    0.84 | 12.08    0.42
                2.917    2.52 | 6.000    5.46 | 9.083    0.84 | 12.17    0.42
                3.000    2.52 | 6.083    5.46 | 9.167    0.84 | 12.25    0.42
                3.083    2.52 | 6.167    5.46 | 9.250    0.84 |

     Max.Eff.Inten.(mm/hr)=      19.32        15.62
                over (min)        5.00        25.00
     Storage Coeff.  (min)=       5.89 (ii)   20.73 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.19         0.05
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.13         0.01         0.141 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.33          5.25
     RUNOFF VOLUME    (mm)=      41.00        25.18         39.41
     TOTAL RAINFALL   (mm)=      42.00        42.00         42.00
     RUNOFF COEFFICIENT   =       0.98         0.60          0.94


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|      OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.141      5.25      39.41
   OUTFLOW: ID= 1 (  0642)      2.720      0.020      7.25      38.26

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 14.14
                TIME SHIFT OF PEAK FLOW         (min)=120.00
```

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                     MAXIMUM  STORAGE   USED       (ha.m.)=  0.0819

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =       0.013        0.250

     Max.Eff.Inten.(mm/hr)=      19.32        14.45
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.38         0.08         0.410 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75          5.25
     RUNOFF VOLUME    (mm)=      41.00        19.09         30.70
     TOTAL RAINFALL   (mm)=      42.00        42.00         42.00
     RUNOFF COEFFICIENT   =       0.98         0.45          0.73


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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n          =       0.013        0.250

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


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 3.167    2.52 | 6.250    5.46 |  9.33    0.42
                0.167    0.00 | 3.250    2.52 | 6.333    2.94 |  9.42    0.42
                0.250    0.00 | 3.333    7.14 | 6.417    2.94 |  9.50    0.42
                0.333    0.42 | 3.417    7.14 | 6.500    2.94 |  9.58    0.42
                0.417    0.42 | 3.500    7.14 | 6.583    2.94 |  9.67    0.42
                0.500    0.42 | 3.583    7.14 | 6.667    2.94 |  9.75    0.42
                0.583    0.42 | 3.667    7.14 | 6.750    2.94 |  9.83    0.42
                0.667    0.42 | 3.750    7.14 | 6.833    2.94 |  9.92    0.42
```

```
                0.750    0.42 | 3.833    7.14 | 6.917    2.94 | 10.00    0.42
                0.833    0.42 | 3.917    7.14 | 7.000    2.94 | 10.08    0.42
                0.917    0.42 | 4.000    7.14 | 7.083    2.94 | 10.17    0.42
                1.000    0.42 | 4.083    7.14 | 7.167    2.94 | 10.25    0.42
                1.083    0.42 | 4.167    7.14 | 7.250    2.94 | 10.33    0.42
                1.167    0.42 | 4.250    7.14 | 7.333    1.68 | 10.42    0.42
                1.250    0.42 | 4.333   19.32 | 7.417    1.68 | 10.50    0.42
                1.333    0.42 | 4.417   19.32 | 7.500    1.68 | 10.58    0.42
                1.417    0.42 | 4.500   19.32 | 7.583    1.68 | 10.67    0.42
                1.500    0.42 | 4.583   19.32 | 7.667    1.68 | 10.75    0.42
                1.583    0.42 | 4.667   19.32 | 7.750    1.68 | 10.83    0.42
                1.667    0.42 | 4.750   19.32 | 7.833    1.68 | 10.92    0.42
                1.750    0.42 | 4.833   19.32 | 7.917    1.68 | 11.00    0.42
                1.833    0.42 | 4.917   19.32 | 8.000    1.68 | 11.08    0.42
                1.917    0.42 | 5.000   19.32 | 8.083    1.68 | 11.17    0.42
                2.000    0.42 | 5.083   19.32 | 8.167    1.68 | 11.25    0.42
                2.083    0.42 | 5.167   19.32 | 8.250    1.68 | 11.33    0.42
                2.167    0.42 | 5.250   19.32 | 8.333    0.84 | 11.42    0.42
                2.250    0.42 | 5.333    5.46 | 8.417    0.84 | 11.50    0.42
                2.333    2.52 | 5.417    5.46 | 8.500    0.84 | 11.58    0.42
                2.417    2.52 | 5.500    5.46 | 8.583    0.84 | 11.67    0.42
                2.500    2.52 | 5.583    5.46 | 8.667    0.84 | 11.75    0.42
                2.583    2.52 | 5.667    5.46 | 8.750    0.84 | 11.83    0.42
                2.667    2.52 | 5.750    5.46 | 8.833    0.84 | 11.92    0.42
                2.750    2.52 | 5.833    5.46 | 8.917    0.84 | 12.00    0.42
                2.833    2.52 | 5.917    5.46 | 9.000    0.84 | 12.08    0.42
                2.917    2.52 | 6.000    5.46 | 9.083    0.84 | 12.17    0.42
                3.000    2.52 | 6.083    5.46 | 9.167    0.84 | 12.25    0.42
                3.083    2.52 | 6.167    5.46 | 9.250    0.84 |

     Max.Eff.Inten.(mm/hr)=      19.32        12.54
                over (min)        5.00        25.00
     Storage Coeff.  (min)=       7.49 (ii)   23.69 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.17         0.05
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.21         0.05           0.266 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.42            5.25
     RUNOFF VOLUME    (mm)=      41.00        19.50           33.69
     TOTAL RAINFALL   (mm)=      42.00        42.00           42.00
     RUNOFF COEFFICIENT   =       0.98         0.46            0.80


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):     13.68   0.410     5.25    30.70
      + ID2= 2 (  0021):      6.05   0.266     5.25    33.69
        ==================================================
        ID = 3 (  0658):     19.73   0.675     5.25    31.62

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

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--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      0.675      5.25      31.62
   OUTFLOW: ID= 1 (  0645)     19.730      0.095      8.50      31.46

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 14.05
                   TIME SHIFT OF PEAK FLOW         (min)=195.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.4594

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      19.32        12.58
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.35         0.09           0.383 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75            5.25
     RUNOFF VOLUME    (mm)=      41.00        18.04           28.60
     TOTAL RAINFALL   (mm)=      42.00        42.00           42.00
     RUNOFF COEFFICIENT   =       0.98         0.43            0.68


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
```

```
                         0.2590     0.2500   |   0.8190      0.2863

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)    14.510     0.383      5.25      28.60
   OUTFLOW: ID= 1 (  0657)    14.510     0.146      7.00      28.40

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 38.10
                   TIME SHIFT OF PEAK FLOW        (min)=105.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2350

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====================================================================================
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      V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
      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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\bff3f53e-29fd-43c8-b1a0-99b54fd426c3\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\bff3f53e-29fd-43c8-b1a0-99b54fd426c3\scen


DATE: 02-09-2021                         TIME: 01:20:05

USER:



COMMENTS: ____________________________________________________________



------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 14. AES 12hr 5yr              **
  ************************************************


--------------------
|    READ STORM    |     Filename: C:\Users\sfanous\AppD
|                  |               ata\Local\Temp\
|                  |               8766663e-6d3f-4db9-a962-c49127701f86\31488919
| Ptotal= 54.38 mm |     Comments: 5yr/12hr
```

```
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50    9.25 |  6.75    3.81 | 10.00    0.54
                 0.50    0.54 |  3.75    9.25 |  7.00    3.81 | 10.25    0.54
                 0.75    0.54 |  4.00    9.25 |  7.25    3.81 | 10.50    0.54
                 1.00    0.54 |  4.25    9.25 |  7.50    2.18 | 10.75    0.54
                 1.25    0.54 |  4.50   25.02 |  7.75    2.18 | 11.00    0.54
                 1.50    0.54 |  4.75   25.02 |  8.00    2.18 | 11.25    0.54
                 1.75    0.54 |  5.00   25.02 |  8.25    2.18 | 11.50    0.54
                 2.00    0.54 |  5.25   25.02 |  8.50    1.09 | 11.75    0.54
                 2.25    0.54 |  5.50    7.07 |  8.75    1.09 | 12.00    0.54
                 2.50    3.26 |  5.75    7.07 |  9.00    1.09 | 12.25    0.54
                 2.75    3.26 |  6.00    7.07 |  9.25    1.09 |
                 3.00    3.26 |  6.25    7.07 |  9.50    0.54 |
                 3.25    3.26 |  6.50    3.81 |  9.75    0.54 |

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--------------------
| CALIB              |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

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


                             ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 3.167    3.26 | 6.250    7.07 |  9.33    0.54
                0.167    0.00 | 3.250    3.26 | 6.333    3.81 |  9.42    0.54
                0.250    0.00 | 3.333    9.25 | 6.417    3.81 |  9.50    0.54
                0.333    0.54 | 3.417    9.25 | 6.500    3.81 |  9.58    0.54
                0.417    0.54 | 3.500    9.25 | 6.583    3.81 |  9.67    0.54
                0.500    0.54 | 3.583    9.25 | 6.667    3.81 |  9.75    0.54
                0.583    0.54 | 3.667    9.25 | 6.750    3.81 |  9.83    0.54
                0.667    0.54 | 3.750    9.25 | 6.833    3.81 |  9.92    0.54
                0.750    0.54 | 3.833    9.25 | 6.917    3.81 | 10.00    0.54
                0.833    0.54 | 3.917    9.25 | 7.000    3.81 | 10.08    0.54
                0.917    0.54 | 4.000    9.25 | 7.083    3.81 | 10.17    0.54
                1.000    0.54 | 4.083    9.25 | 7.167    3.81 | 10.25    0.54
                1.083    0.54 | 4.167    9.25 | 7.250    3.81 | 10.33    0.54
                1.167    0.54 | 4.250    9.25 | 7.333    2.18 | 10.42    0.54
                1.250    0.54 | 4.333   25.02 | 7.417    2.18 | 10.50    0.54
                1.333    0.54 | 4.417   25.02 | 7.500    2.18 | 10.58    0.54
                1.417    0.54 | 4.500   25.02 | 7.583    2.18 | 10.67    0.54
                1.500    0.54 | 4.583   25.02 | 7.667    2.18 | 10.75    0.54
                1.583    0.54 | 4.667   25.02 | 7.750    2.18 | 10.83    0.54
                1.667    0.54 | 4.750   25.02 | 7.833    2.18 | 10.92    0.54
                1.750    0.54 | 4.833   25.02 | 7.917    2.18 | 11.00    0.54
                1.833    0.54 | 4.917   25.02 | 8.000    2.18 | 11.08    0.54
                1.917    0.54 | 5.000   25.02 | 8.083    2.18 | 11.17    0.54
                2.000    0.54 | 5.083   25.02 | 8.167    2.18 | 11.25    0.54
```

```
                 2.083    0.54 | 5.167   25.02 | 8.250    2.18 | 11.33    0.54
                 2.167    0.54 | 5.250   25.02 | 8.333    1.09 | 11.42    0.54
                 2.250    0.54 | 5.333    7.07 | 8.417    1.09 | 11.50    0.54
                 2.333    3.26 | 5.417    7.07 | 8.500    1.09 | 11.58    0.54
                 2.417    3.26 | 5.500    7.07 | 8.583    1.09 | 11.67    0.54
                 2.500    3.26 | 5.583    7.07 | 8.667    1.09 | 11.75    0.54
                 2.583    3.26 | 5.667    7.07 | 8.750    1.09 | 11.83    0.54
                 2.667    3.26 | 5.750    7.07 | 8.833    1.09 | 11.92    0.54
                 2.750    3.26 | 5.833    7.07 | 8.917    1.09 | 12.00    0.54
                 2.833    3.26 | 5.917    7.07 | 9.000    1.09 | 12.08    0.54
                 2.917    3.26 | 6.000    7.07 | 9.083    1.09 | 12.17    0.54
                 3.000    3.26 | 6.083    7.07 | 9.167    1.09 | 12.25    0.54
                 3.083    3.26 | 6.167    7.07 | 9.250    1.09 |

     Max.Eff.Inten.(mm/hr)=      25.02        21.71
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       5.32 (ii)   18.32 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.21         0.06
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.17         0.01          0.185 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.25           5.25
     RUNOFF VOLUME    (mm)=      53.38        36.53          51.69
     TOTAL RAINFALL   (mm)=      54.38        54.38          54.38
     RUNOFF COEFFICIENT   =       0.98         0.67           0.95


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510      0.1120
                          0.0050     0.0617   |   0.0730      0.1266
                          0.0200     0.0820   |   0.0960      0.1376
                          0.0360     0.1003   |   0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.185      5.25      51.69
   OUTFLOW: ID= 1 (  0642)      2.720      0.036      6.42      50.54

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 19.42
                   TIME SHIFT OF PEAK FLOW         (min)= 70.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1002

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
```

```
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      25.02        21.25
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.49         0.12          0.541 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75           5.25
     RUNOFF VOLUME    (mm)=      53.38        28.86          41.85
     TOTAL RAINFALL   (mm)=      54.38        54.38          54.38
     RUNOFF COEFFICIENT   =       0.98         0.53           0.77


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

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                              ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    0.00 | 3.167    3.26 | 6.250    7.07 |  9.33    0.54
                 0.167    0.00 | 3.250    3.26 | 6.333    3.81 |  9.42    0.54
                 0.250    0.00 | 3.333    9.25 | 6.417    3.81 |  9.50    0.54
                 0.333    0.54 | 3.417    9.25 | 6.500    3.81 |  9.58    0.54
                 0.417    0.54 | 3.500    9.25 | 6.583    3.81 |  9.67    0.54
                 0.500    0.54 | 3.583    9.25 | 6.667    3.81 |  9.75    0.54
                 0.583    0.54 | 3.667    9.25 | 6.750    3.81 |  9.83    0.54
                 0.667    0.54 | 3.750    9.25 | 6.833    3.81 |  9.92    0.54
                 0.750    0.54 | 3.833    9.25 | 6.917    3.81 | 10.00    0.54
                 0.833    0.54 | 3.917    9.25 | 7.000    3.81 | 10.08    0.54
                 0.917    0.54 | 4.000    9.25 | 7.083    3.81 | 10.17    0.54
                 1.000    0.54 | 4.083    9.25 | 7.167    3.81 | 10.25    0.54
                 1.083    0.54 | 4.167    9.25 | 7.250    3.81 | 10.33    0.54
                 1.167    0.54 | 4.250    9.25 | 7.333    2.18 | 10.42    0.54
                 1.250    0.54 | 4.333   25.02 | 7.417    2.18 | 10.50    0.54
                 1.333    0.54 | 4.417   25.02 | 7.500    2.18 | 10.58    0.54
                 1.417    0.54 | 4.500   25.02 | 7.583    2.18 | 10.67    0.54
                 1.500    0.54 | 4.583   25.02 | 7.667    2.18 | 10.75    0.54
```

```
              1.583    0.54 | 4.667   25.02 | 7.750    2.18 | 10.83    0.54
              1.667    0.54 | 4.750   25.02 | 7.833    2.18 | 10.92    0.54
              1.750    0.54 | 4.833   25.02 | 7.917    2.18 | 11.00    0.54
              1.833    0.54 | 4.917   25.02 | 8.000    2.18 | 11.08    0.54
              1.917    0.54 | 5.000   25.02 | 8.083    2.18 | 11.17    0.54
              2.000    0.54 | 5.083   25.02 | 8.167    2.18 | 11.25    0.54
              2.083    0.54 | 5.167   25.02 | 8.250    2.18 | 11.33    0.54
              2.167    0.54 | 5.250   25.02 | 8.333    1.09 | 11.42    0.54
              2.250    0.54 | 5.333    7.07 | 8.417    1.09 | 11.50    0.54
              2.333    3.26 | 5.417    7.07 | 8.500    1.09 | 11.58    0.54
              2.417    3.26 | 5.500    7.07 | 8.583    1.09 | 11.67    0.54
              2.500    3.26 | 5.583    7.07 | 8.667    1.09 | 11.75    0.54
              2.583    3.26 | 5.667    7.07 | 8.750    1.09 | 11.83    0.54
              2.667    3.26 | 5.750    7.07 | 8.833    1.09 | 11.92    0.54
              2.750    3.26 | 5.833    7.07 | 8.917    1.09 | 12.00    0.54
              2.833    3.26 | 5.917    7.07 | 9.000    1.09 | 12.08    0.54
              2.917    3.26 | 6.000    7.07 | 9.083    1.09 | 12.17    0.54
              3.000    3.26 | 6.083    7.07 | 9.167    1.09 | 12.25    0.54
              3.083    3.26 | 6.167    7.07 | 9.250    1.09 |

     Max.Eff.Inten.(mm/hr)=      25.02        18.70
               over (min)        5.00        25.00
     Storage Coeff.  (min)=       6.76 (ii)    20.56 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.18         0.05
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.28         0.08          0.360 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.33           5.25
     RUNOFF VOLUME    (mm)=      53.38        29.50          45.26
     TOTAL RAINFALL   (mm)=      54.38        54.38          54.38
     RUNOFF COEFFICIENT   =       0.98         0.54           0.83


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.541     5.25    41.85
      + ID2= 2 (  0021):     6.05   0.360     5.25    45.26
        ==================================================
        ID = 3 (  0658):    19.73   0.901     5.25    42.90

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925
```

```
                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)      19.730      0.901      5.25      42.90
   OUTFLOW: ID= 1 (  0645)      19.730      0.168      8.08      42.73

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 18.65
                  TIME SHIFT OF PEAK FLOW         (min)=170.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.5719

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      25.02        19.85
               over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.46         0.14          0.508 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75           5.25
     RUNOFF VOLUME    (mm)=      53.38        27.50          39.40
     TOTAL RAINFALL   (mm)=      54.38        54.38          54.38
     RUNOFF COEFFICIENT   =       0.98         0.51           0.72


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)      14.510      0.508      5.25      39.40
   OUTFLOW: ID= 1 (  0657)      14.510      0.259      6.33      39.21

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 50.96
                  TIME SHIFT OF PEAK FLOW         (min)= 65.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2500
```

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==================================================================================
=======================

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\453377f5-9ed8-4652-a685-cf063d8575f7\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\453377f5-9ed8-4652-a685-cf063d8575f7\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:



COMMENTS: ____________________________________________________________


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  ************************************************
  ** SIMULATION : 15. AES 12hr 10yr             **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\2f58dc3d
| Ptotal= 62.71 mm |    Comments: 10yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   10.66 |  6.75    4.39 | 10.00    0.63
                 0.50    0.63 |  3.75   10.66 |  7.00    4.39 | 10.25    0.63
                 0.75    0.63 |  4.00   10.66 |  7.25    4.39 | 10.50    0.63
                 1.00    0.63 |  4.25   10.66 |  7.50    2.51 | 10.75    0.63
                 1.25    0.63 |  4.50   28.84 |  7.75    2.51 | 11.00    0.63
                 1.50    0.63 |  4.75   28.84 |  8.00    2.51 | 11.25    0.63
                 1.75    0.63 |  5.00   28.84 |  8.25    2.51 | 11.50    0.63
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                 2.00    0.63 |  5.25   28.84 |  8.50    1.25 | 11.75    0.63
                 2.25    0.63 |  5.50    8.15 |  8.75    1.25 | 12.00    0.63
                 2.50    3.76 |  5.75    8.15 |  9.00    1.25 | 12.25    0.63
                 2.75    3.76 |  6.00    8.15 |  9.25    1.25 |
                 3.00    3.76 |  6.25    8.15 |  9.50    0.63 |
                 3.25    3.76 |  6.50    4.39 |  9.75    0.63 |

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

--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
     Mannings n           =      0.013         0.250

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


                             ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 3.167    3.76 | 6.250    8.15 |  9.33    0.63
                0.167    0.00 | 3.250    3.76 | 6.333    4.39 |  9.42    0.63
                0.250    0.00 | 3.333   10.66 | 6.417    4.39 |  9.50    0.63
                0.333    0.63 | 3.417   10.66 | 6.500    4.39 |  9.58    0.63
                0.417    0.63 | 3.500   10.66 | 6.583    4.39 |  9.67    0.63
                0.500    0.63 | 3.583   10.66 | 6.667    4.39 |  9.75    0.63
                0.583    0.63 | 3.667   10.66 | 6.750    4.39 |  9.83    0.63
                0.667    0.63 | 3.750   10.66 | 6.833    4.39 |  9.92    0.63
                0.750    0.63 | 3.833   10.66 | 6.917    4.39 | 10.00    0.63
                0.833    0.63 | 3.917   10.66 | 7.000    4.39 | 10.08    0.63
                0.917    0.63 | 4.000   10.66 | 7.083    4.39 | 10.17    0.63
                1.000    0.63 | 4.083   10.66 | 7.167    4.39 | 10.25    0.63
                1.083    0.63 | 4.167   10.66 | 7.250    4.39 | 10.33    0.63
                1.167    0.63 | 4.250   10.66 | 7.333    2.51 | 10.42    0.63
                1.250    0.63 | 4.333   28.84 | 7.417    2.51 | 10.50    0.63
                1.333    0.63 | 4.417   28.84 | 7.500    2.51 | 10.58    0.63
                1.417    0.63 | 4.500   28.84 | 7.583    2.51 | 10.67    0.63
                1.500    0.63 | 4.583   28.84 | 7.667    2.51 | 10.75    0.63
                1.583    0.63 | 4.667   28.84 | 7.750    2.51 | 10.83    0.63
                1.667    0.63 | 4.750   28.84 | 7.833    2.51 | 10.92    0.63
                1.750    0.63 | 4.833   28.84 | 7.917    2.51 | 11.00    0.63
                1.833    0.63 | 4.917   28.84 | 8.000    2.51 | 11.08    0.63
                1.917    0.63 | 5.000   28.84 | 8.083    2.51 | 11.17    0.63
                2.000    0.63 | 5.083   28.84 | 8.167    2.51 | 11.25    0.63
                2.083    0.63 | 5.167   28.84 | 8.250    2.51 | 11.33    0.63
                2.167    0.63 | 5.250   28.84 | 8.333    1.25 | 11.42    0.63
                2.250    0.63 | 5.333    8.15 | 8.417    1.25 | 11.50    0.63
                2.333    3.76 | 5.417    8.15 | 8.500    1.25 | 11.58    0.63
                2.417    3.76 | 5.500    8.15 | 8.583    1.25 | 11.67    0.63
                2.500    3.76 | 5.583    8.15 | 8.667    1.25 | 11.75    0.63
                2.583    3.76 | 5.667    8.15 | 8.750    1.25 | 11.83    0.63
                2.667    3.76 | 5.750    8.15 | 8.833    1.25 | 11.92    0.63
                2.750    3.76 | 5.833    8.15 | 8.917    1.25 | 12.00    0.63
                2.833    3.76 | 5.917    8.15 | 9.000    1.25 | 12.08    0.63
```

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                2.917    3.76 | 6.000    8.15 | 9.083    1.25 | 12.17    0.63
                3.000    3.76 | 6.083    8.15 | 9.167    1.25 | 12.25    0.63
                3.083    3.76 | 6.167    8.15 | 9.250    1.25 |

     Max.Eff.Inten.(mm/hr)=      28.84        25.90
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       5.02 (ii)    9.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.21         0.11
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.20         0.02          0.215 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.25           5.25
     RUNOFF VOLUME    (mm)=      61.71        44.36          59.97
     TOTAL RAINFALL   (mm)=      62.71        62.71          62.71
     RUNOFF COEFFICIENT   =       0.98         0.71           0.96


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |  0.0510      0.1120
                         0.0050     0.0617    |  0.0730      0.1266
                         0.0200     0.0820    |  0.0960      0.1376
                         0.0360     0.1003    |  0.1150      0.1490

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.215      5.25      59.97
   OUTFLOW: ID= 1 (  0642)      2.720      0.050      6.33      58.82

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 23.44
                  TIME SHIFT OF PEAK FLOW         (min)= 65.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1117

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      28.84        25.95
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
```

```
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.57         0.15          0.630 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75           5.25
     RUNOFF VOLUME    (mm)=      61.71        35.81          49.53
     TOTAL RAINFALL   (mm)=      62.71        62.71          62.71
     RUNOFF COEFFICIENT   =       0.98         0.57           0.79


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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                              ---- TRANSFORMED HYETOGRAPH ----
                  TIME     RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs    mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083     0.00 | 3.167    3.76 | 6.250    8.15 |  9.33    0.63
                 0.167     0.00 | 3.250    3.76 | 6.333    4.39 |  9.42    0.63
                 0.250     0.00 | 3.333   10.66 | 6.417    4.39 |  9.50    0.63
                 0.333     0.63 | 3.417   10.66 | 6.500    4.39 |  9.58    0.63
                 0.417     0.63 | 3.500   10.66 | 6.583    4.39 |  9.67    0.63
                 0.500     0.63 | 3.583   10.66 | 6.667    4.39 |  9.75    0.63
                 0.583     0.63 | 3.667   10.66 | 6.750    4.39 |  9.83    0.63
                 0.667     0.63 | 3.750   10.66 | 6.833    4.39 |  9.92    0.63
                 0.750     0.63 | 3.833   10.66 | 6.917    4.39 | 10.00    0.63
                 0.833     0.63 | 3.917   10.66 | 7.000    4.39 | 10.08    0.63
                 0.917     0.63 | 4.000   10.66 | 7.083    4.39 | 10.17    0.63
                 1.000     0.63 | 4.083   10.66 | 7.167    4.39 | 10.25    0.63
                 1.083     0.63 | 4.167   10.66 | 7.250    4.39 | 10.33    0.63
                 1.167     0.63 | 4.250   10.66 | 7.333    2.51 | 10.42    0.63
                 1.250     0.63 | 4.333   28.84 | 7.417    2.51 | 10.50    0.63
                 1.333     0.63 | 4.417   28.84 | 7.500    2.51 | 10.58    0.63
                 1.417     0.63 | 4.500   28.84 | 7.583    2.51 | 10.67    0.63
                 1.500     0.63 | 4.583   28.84 | 7.667    2.51 | 10.75    0.63
                 1.583     0.63 | 4.667   28.84 | 7.750    2.51 | 10.83    0.63
                 1.667     0.63 | 4.750   28.84 | 7.833    2.51 | 10.92    0.63
                 1.750     0.63 | 4.833   28.84 | 7.917    2.51 | 11.00    0.63
                 1.833     0.63 | 4.917   28.84 | 8.000    2.51 | 11.08    0.63
                 1.917     0.63 | 5.000   28.84 | 8.083    2.51 | 11.17    0.63
                 2.000     0.63 | 5.083   28.84 | 8.167    2.51 | 11.25    0.63
                 2.083     0.63 | 5.167   28.84 | 8.250    2.51 | 11.33    0.63
                 2.167     0.63 | 5.250   28.84 | 8.333    1.25 | 11.42    0.63
                 2.250     0.63 | 5.333    8.15 | 8.417    1.25 | 11.50    0.63
                 2.333     3.76 | 5.417    8.15 | 8.500    1.25 | 11.58    0.63
```

```
                2.417    3.76 | 5.500    8.15 | 8.583    1.25 | 11.67    0.63
                2.500    3.76 | 5.583    8.15 | 8.667    1.25 | 11.75    0.63
                2.583    3.76 | 5.667    8.15 | 8.750    1.25 | 11.83    0.63
                2.667    3.76 | 5.750    8.15 | 8.833    1.25 | 11.92    0.63
                2.750    3.76 | 5.833    8.15 | 8.917    1.25 | 12.00    0.63
                2.833    3.76 | 5.917    8.15 | 9.000    1.25 | 12.08    0.63
                2.917    3.76 | 6.000    8.15 | 9.083    1.25 | 12.17    0.63
                3.000    3.76 | 6.083    8.15 | 9.167    1.25 | 12.25    0.63
                3.083    3.76 | 6.167    8.15 | 9.250    1.25 |

     Max.Eff.Inten.(mm/hr)=      28.84        22.78
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       6.38 (ii)   19.14 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.18         0.06
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.32         0.11          0.427 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.33           5.25
     RUNOFF VOLUME    (mm)=      61.71        36.59          53.17
     TOTAL RAINFALL   (mm)=      62.71        62.71          62.71
     RUNOFF COEFFICIENT   =       0.98         0.58           0.85


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

 --------------------
 | ADD HYD  (  0658)|
 |   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
 --------------------          (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (  0002):     13.68   0.630     5.25    49.53
       + ID2= 2 (  0021):      6.05   0.427     5.25    53.17
         ==================================================
         ID = 3 (  0658):     19.73   1.057     5.25    50.65

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
 ------------------------------------------------------------------------------
 --------------------
 | RESERVOIR( 0645)|     OVERFLOW IS OFF
 | IN= 2---> OUT= 1 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000    |   0.2360      0.6393
                          0.0290     0.3310    |   0.3410      0.7100
                          0.0950     0.4595    |   0.4450      0.7485
                          0.1680     0.5720    |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
    INFLOW : ID= 2 (  0658)    19.730     1.057      5.25      50.65
    OUTFLOW: ID= 1 (  0645)    19.730     0.236      7.58      50.48

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 22.30
                   TIME SHIFT OF PEAK FLOW         (min)=140.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.6392
```

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 ------------------------------------------------------------------------------
 --------------------
 | CALIB            |
 | STANDHYD (  0656)|   Area    (ha)=  14.51
 |ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
 --------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       7.84         6.67
      Dep. Storage     (mm)=       1.00         5.00
      Average Slope     (%)=       1.00         2.30
      Length            (m)=     311.02        40.00
      Mannings n           =      0.013        0.250

      Max.Eff.Inten.(mm/hr)=      28.84        24.35
                 over (min)      15.00        30.00
      Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
      Unit Hyd. Tpeak (min)=      15.00       105.00
      Unit Hyd. peak  (cms)=       0.07         0.01
                                                           *TOTALS*
      PEAK FLOW       (cms)=       0.53         0.17          0.593 (iii)
      TIME TO PEAK    (hrs)=       5.25         6.75           5.25
      RUNOFF VOLUME    (mm)=      61.71        34.28          46.89
      TOTAL RAINFALL   (mm)=      62.71        62.71          62.71
      RUNOFF COEFFICIENT   =       0.98         0.55           0.75


        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  84.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 --------------------
 | RESERVOIR( 0657)|     OVERFLOW IS OFF
 | IN= 2---> OUT= 1 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000    |   0.3640      0.2594
                          0.0190     0.2147    |   0.5250      0.2723
                          0.1460     0.2350    |   0.6840      0.2789
                          0.2590     0.2500    |   0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
    INFLOW : ID= 2 (  0656)    14.510     0.593      5.25      46.89
    OUTFLOW: ID= 1 (  0657)    14.510     0.355      5.67      46.70

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 59.90
                   TIME SHIFT OF PEAK FLOW         (min)= 25.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2587

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

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\f2d0c5ba-35e8-42ef-b592-689325161f65\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\f2d0c5ba-35e8-42ef-b592-689325161f65\scen


DATE: 02-09-2021                          TIME: 01:20:06

USER:



COMMENTS: ____________________________________________________________


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-----------------------
  ************************************************
  ** SIMULATION : 16. AES 12hr 25yr             **
  ************************************************



--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\4b1e5c14
| Ptotal= 73.10 mm |    Comments: 25yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   12.43 |  6.75    5.12 | 10.00    0.73
                 0.50    0.73 |  3.75   12.43 |  7.00    5.12 | 10.25    0.73
                 0.75    0.73 |  4.00   12.43 |  7.25    5.12 | 10.50    0.73
                 1.00    0.73 |  4.25   12.43 |  7.50    2.92 | 10.75    0.73
                 1.25    0.73 |  4.50   33.63 |  7.75    2.92 | 11.00    0.73
                 1.50    0.73 |  4.75   33.63 |  8.00    2.92 | 11.25    0.73
                 1.75    0.73 |  5.00   33.63 |  8.25    2.92 | 11.50    0.73
                 2.00    0.73 |  5.25   33.63 |  8.50    1.46 | 11.75    0.73
                 2.25    0.73 |  5.50    9.50 |  8.75    1.46 | 12.00    0.73
                 2.50    4.39 |  5.75    9.50 |  9.00    1.46 | 12.25    0.73
                 2.75    4.39 |  6.00    9.50 |  9.25    1.46 |
                 3.00    4.39 |  6.25    9.50 |  9.50    0.73 |
                 3.25    4.39 |  6.50    5.12 |  9.75    0.73 |

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```
| CALIB                 |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

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


                          ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    0.00 | 3.167    4.39 | 6.250    9.50 |  9.33   0.73
                 0.167    0.00 | 3.250    4.39 | 6.333    5.12 |  9.42   0.73
                 0.250    0.00 | 3.333   12.43 | 6.417    5.12 |  9.50   0.73
                 0.333    0.73 | 3.417   12.43 | 6.500    5.12 |  9.58   0.73
                 0.417    0.73 | 3.500   12.43 | 6.583    5.12 |  9.67   0.73
                 0.500    0.73 | 3.583   12.43 | 6.667    5.12 |  9.75   0.73
                 0.583    0.73 | 3.667   12.43 | 6.750    5.12 |  9.83   0.73
                 0.667    0.73 | 3.750   12.43 | 6.833    5.12 |  9.92   0.73
                 0.750    0.73 | 3.833   12.43 | 6.917    5.12 | 10.00   0.73
                 0.833    0.73 | 3.917   12.43 | 7.000    5.12 | 10.08   0.73
                 0.917    0.73 | 4.000   12.43 | 7.083    5.12 | 10.17   0.73
                 1.000    0.73 | 4.083   12.43 | 7.167    5.12 | 10.25   0.73
                 1.083    0.73 | 4.167   12.43 | 7.250    5.12 | 10.33   0.73
                 1.167    0.73 | 4.250   12.43 | 7.333    2.92 | 10.42   0.73
                 1.250    0.73 | 4.333   33.63 | 7.417    2.92 | 10.50   0.73
                 1.333    0.73 | 4.417   33.63 | 7.500    2.92 | 10.58   0.73
                 1.417    0.73 | 4.500   33.63 | 7.583    2.92 | 10.67   0.73
                 1.500    0.73 | 4.583   33.63 | 7.667    2.92 | 10.75   0.73
                 1.583    0.73 | 4.667   33.63 | 7.750    2.92 | 10.83   0.73
                 1.667    0.73 | 4.750   33.63 | 7.833    2.92 | 10.92   0.73
                 1.750    0.73 | 4.833   33.63 | 7.917    2.92 | 11.00   0.73
                 1.833    0.73 | 4.917   33.63 | 8.000    2.92 | 11.08   0.73
                 1.917    0.73 | 5.000   33.63 | 8.083    2.92 | 11.17   0.73
                 2.000    0.73 | 5.083   33.63 | 8.167    2.92 | 11.25   0.73
                 2.083    0.73 | 5.167   33.63 | 8.250    2.92 | 11.33   0.73
                 2.167    0.73 | 5.250   33.63 | 8.333    1.46 | 11.42   0.73
                 2.250    0.73 | 5.333    9.50 | 8.417    1.46 | 11.50   0.73
                 2.333    4.39 | 5.417    9.50 | 8.500    1.46 | 11.58   0.73
                 2.417    4.39 | 5.500    9.50 | 8.583    1.46 | 11.67   0.73
                 2.500    4.39 | 5.583    9.50 | 8.667    1.46 | 11.75   0.73
                 2.583    4.39 | 5.667    9.50 | 8.750    1.46 | 11.83   0.73
                 2.667    4.39 | 5.750    9.50 | 8.833    1.46 | 11.92   0.73
                 2.750    4.39 | 5.833    9.50 | 8.917    1.46 | 12.00   0.73
                 2.833    4.39 | 5.917    9.50 | 9.000    1.46 | 12.08   0.73
                 2.917    4.39 | 6.000    9.50 | 9.083    1.46 | 12.17   0.73
                 3.000    4.39 | 6.083    9.50 | 9.167    1.46 | 12.25   0.73
                 3.083    4.39 | 6.167    9.50 | 9.250    1.46 |

     Max.Eff.Inten.(mm/hr)=      33.63        30.94
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.72 (ii)    9.25 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.22         0.12
                                                        *TOTALS*
```

```
     PEAK FLOW       (cms)=       0.23         0.02          0.252 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.25           5.25
     RUNOFF VOLUME    (mm)=      72.10        54.26          70.31
     TOTAL RAINFALL   (mm)=      73.10        73.10          73.10
     RUNOFF COEFFICIENT   =       0.99         0.74           0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510      0.1120
                          0.0050     0.0617   |   0.0730      0.1266
                          0.0200     0.0820   |   0.0960      0.1376
                          0.0360     0.1003   |   0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.252      5.25      70.31
   OUTFLOW: ID= 1 (  0642)      2.720      0.069      6.25      69.16

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 27.58
                   TIME SHIFT OF PEAK FLOW         (min)= 60.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1242

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.63        31.91
                over (min)      15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.67         0.19          0.743 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75           5.25
     RUNOFF VOLUME    (mm)=      72.10        44.79          59.26
     TOTAL RAINFALL   (mm)=      73.10        73.10          73.10
     RUNOFF COEFFICIENT   =       0.99         0.61           0.81


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

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

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                            ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 3.167    4.39 | 6.250    9.50 |  9.33    0.73
                0.167    0.00 | 3.250    4.39 | 6.333    5.12 |  9.42    0.73
                0.250    0.00 | 3.333   12.43 | 6.417    5.12 |  9.50    0.73
                0.333    0.73 | 3.417   12.43 | 6.500    5.12 |  9.58    0.73
                0.417    0.73 | 3.500   12.43 | 6.583    5.12 |  9.67    0.73
                0.500    0.73 | 3.583   12.43 | 6.667    5.12 |  9.75    0.73
                0.583    0.73 | 3.667   12.43 | 6.750    5.12 |  9.83    0.73
                0.667    0.73 | 3.750   12.43 | 6.833    5.12 |  9.92    0.73
                0.750    0.73 | 3.833   12.43 | 6.917    5.12 | 10.00    0.73
                0.833    0.73 | 3.917   12.43 | 7.000    5.12 | 10.08    0.73
                0.917    0.73 | 4.000   12.43 | 7.083    5.12 | 10.17    0.73
                1.000    0.73 | 4.083   12.43 | 7.167    5.12 | 10.25    0.73
                1.083    0.73 | 4.167   12.43 | 7.250    5.12 | 10.33    0.73
                1.167    0.73 | 4.250   12.43 | 7.333    2.92 | 10.42    0.73
                1.250    0.73 | 4.333   33.63 | 7.417    2.92 | 10.50    0.73
                1.333    0.73 | 4.417   33.63 | 7.500    2.92 | 10.58    0.73
                1.417    0.73 | 4.500   33.63 | 7.583    2.92 | 10.67    0.73
                1.500    0.73 | 4.583   33.63 | 7.667    2.92 | 10.75    0.73
                1.583    0.73 | 4.667   33.63 | 7.750    2.92 | 10.83    0.73
                1.667    0.73 | 4.750   33.63 | 7.833    2.92 | 10.92    0.73
                1.750    0.73 | 4.833   33.63 | 7.917    2.92 | 11.00    0.73
                1.833    0.73 | 4.917   33.63 | 8.000    2.92 | 11.08    0.73
                1.917    0.73 | 5.000   33.63 | 8.083    2.92 | 11.17    0.73
                2.000    0.73 | 5.083   33.63 | 8.167    2.92 | 11.25    0.73
                2.083    0.73 | 5.167   33.63 | 8.250    2.92 | 11.33    0.73
                2.167    0.73 | 5.250   33.63 | 8.333    1.46 | 11.42    0.73
                2.250    0.73 | 5.333    9.50 | 8.417    1.46 | 11.50    0.73
                2.333    4.39 | 5.417    9.50 | 8.500    1.46 | 11.58    0.73
                2.417    4.39 | 5.500    9.50 | 8.583    1.46 | 11.67    0.73
                2.500    4.39 | 5.583    9.50 | 8.667    1.46 | 11.75    0.73
                2.583    4.39 | 5.667    9.50 | 8.750    1.46 | 11.83    0.73
                2.667    4.39 | 5.750    9.50 | 8.833    1.46 | 11.92    0.73
                2.750    4.39 | 5.833    9.50 | 8.917    1.46 | 12.00    0.73
                2.833    4.39 | 5.917    9.50 | 9.000    1.46 | 12.08    0.73
                2.917    4.39 | 6.000    9.50 | 9.083    1.46 | 12.17    0.73
                3.000    4.39 | 6.083    9.50 | 9.167    1.46 | 12.25    0.73
                3.083    4.39 | 6.167    9.50 | 9.250    1.46 |
```

```
     Max.Eff.Inten.(mm/hr)=      33.63        27.93
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       6.00 (ii)   17.76 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.19         0.06
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.37         0.14           0.509 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.25            5.25
     RUNOFF VOLUME    (mm)=      72.10        45.72           63.13
     TOTAL RAINFALL   (mm)=      73.10        73.10           73.10
     RUNOFF COEFFICIENT   =       0.99         0.63            0.86


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.743     5.25    59.26
      + ID2= 2 (  0021):     6.05   0.509     5.25    63.13
        ===================================================
        ID = 3 (  0658):    19.73   1.252     5.25    60.45

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |  0.2360      0.6393
                         0.0290     0.3310    |  0.3410      0.7100
                         0.0950     0.4595    |  0.4450      0.7485
                         0.1680     0.5720    |  0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730     1.252      5.25      60.45
   OUTFLOW: ID= 1 (  0645)     19.730     0.341      7.33      60.28

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 27.20
                   TIME SHIFT OF PEAK FLOW         (min)=125.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.7099

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
```

```
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.63        30.10
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.61         0.22           0.702 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75            5.25
     RUNOFF VOLUME    (mm)=      72.10        43.06           56.42
     TOTAL RAINFALL   (mm)=      73.10        73.10           73.10
     RUNOFF COEFFICIENT   =       0.99         0.59            0.77


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |  0.3640      0.2594
                         0.0190     0.2147    |  0.5250      0.2723
                         0.1460     0.2350    |  0.6840      0.2789
                         0.2590     0.2500    |  0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510     0.702      5.25      56.42
   OUTFLOW: ID= 1 (  0657)     14.510     0.519      5.42      56.22

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 73.96
                   TIME SHIFT OF PEAK FLOW         (min)= 10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2723

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       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\88947e14-a655-438e-8b03-2f4b16a6137e\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\88947e14-a655-438e-8b03-2f4b16a6137e\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:



COMMENTS: ____________________________________________________________


--------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 17. AES 12hr 50yr             **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\b7dba7b0
| Ptotal= 80.82 mm |    Comments: 50yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   13.74 |  6.75    5.66 | 10.00    0.81
                 0.50    0.81 |  3.75   13.74 |  7.00    5.66 | 10.25    0.81
                 0.75    0.81 |  4.00   13.74 |  7.25    5.66 | 10.50    0.81
                 1.00    0.81 |  4.25   13.74 |  7.50    3.23 | 10.75    0.81
                 1.25    0.81 |  4.50   37.17 |  7.75    3.23 | 11.00    0.81
                 1.50    0.81 |  4.75   37.17 |  8.00    3.23 | 11.25    0.81
                 1.75    0.81 |  5.00   37.17 |  8.25    3.23 | 11.50    0.81
                 2.00    0.81 |  5.25   37.17 |  8.50    1.62 | 11.75    0.81
                 2.25    0.81 |  5.50   10.50 |  8.75    1.62 | 12.00    0.81
                 2.50    4.85 |  5.75   10.50 |  9.00    1.62 | 12.25    0.81
                 2.75    4.85 |  6.00   10.50 |  9.25    1.62 |
                 3.00    4.85 |  6.25   10.50 |  9.50    0.81 |
                 3.25    4.85 |  6.50    5.66 |  9.75    0.81 |

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

--------------------
| CALIB            |
| STANDHYD ( 0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
```

```
    Mannings n            =      0.013        0.250

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


                          ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 3.167    4.85 | 6.250   10.50 |  9.33    0.81
                0.167    0.00 | 3.250    4.85 | 6.333    5.66 |  9.42    0.81
                0.250    0.00 | 3.333   13.74 | 6.417    5.66 |  9.50    0.81
                0.333    0.81 | 3.417   13.74 | 6.500    5.66 |  9.58    0.81
                0.417    0.81 | 3.500   13.74 | 6.583    5.66 |  9.67    0.81
                0.500    0.81 | 3.583   13.74 | 6.667    5.66 |  9.75    0.81
                0.583    0.81 | 3.667   13.74 | 6.750    5.66 |  9.83    0.81
                0.667    0.81 | 3.750   13.74 | 6.833    5.66 |  9.92    0.81
                0.750    0.81 | 3.833   13.74 | 6.917    5.66 | 10.00    0.81
                0.833    0.81 | 3.917   13.74 | 7.000    5.66 | 10.08    0.81
                0.917    0.81 | 4.000   13.74 | 7.083    5.66 | 10.17    0.81
                1.000    0.81 | 4.083   13.74 | 7.167    5.66 | 10.25    0.81
                1.083    0.81 | 4.167   13.74 | 7.250    5.66 | 10.33    0.81
                1.167    0.81 | 4.250   13.74 | 7.333    3.23 | 10.42    0.81
                1.250    0.81 | 4.333   37.17 | 7.417    3.23 | 10.50    0.81
                1.333    0.81 | 4.417   37.17 | 7.500    3.23 | 10.58    0.81
                1.417    0.81 | 4.500   37.17 | 7.583    3.23 | 10.67    0.81
                1.500    0.81 | 4.583   37.17 | 7.667    3.23 | 10.75    0.81
                1.583    0.81 | 4.667   37.17 | 7.750    3.23 | 10.83    0.81
                1.667    0.81 | 4.750   37.17 | 7.833    3.23 | 10.92    0.81
                1.750    0.81 | 4.833   37.17 | 7.917    3.23 | 11.00    0.81
                1.833    0.81 | 4.917   37.17 | 8.000    3.23 | 11.08    0.81
                1.917    0.81 | 5.000   37.17 | 8.083    3.23 | 11.17    0.81
                2.000    0.81 | 5.083   37.17 | 8.167    3.23 | 11.25    0.81
                2.083    0.81 | 5.167   37.17 | 8.250    3.23 | 11.33    0.81
                2.167    0.81 | 5.250   37.17 | 8.333    1.62 | 11.42    0.81
                2.250    0.81 | 5.333   10.50 | 8.417    1.62 | 11.50    0.81
                2.333    4.85 | 5.417   10.50 | 8.500    1.62 | 11.58    0.81
                2.417    4.85 | 5.500   10.50 | 8.583    1.62 | 11.67    0.81
                2.500    4.85 | 5.583   10.50 | 8.667    1.62 | 11.75    0.81
                2.583    4.85 | 5.667   10.50 | 8.750    1.62 | 11.83    0.81
                2.667    4.85 | 5.750   10.50 | 8.833    1.62 | 11.92    0.81
                2.750    4.85 | 5.833   10.50 | 8.917    1.62 | 12.00    0.81
                2.833    4.85 | 5.917   10.50 | 9.000    1.62 | 12.08    0.81
                2.917    4.85 | 6.000   10.50 | 9.083    1.62 | 12.17    0.81
                3.000    4.85 | 6.083   10.50 | 9.167    1.62 | 12.25    0.81
                3.083    4.85 | 6.167   10.50 | 9.250    1.62 |

    Max.Eff.Inten.(mm/hr)=      37.17        34.64
               over (min)        5.00        10.00
    Storage Coeff.  (min)=       4.54 (ii)    8.89 (ii)
    Unit Hyd. Tpeak (min)=       5.00        10.00
    Unit Hyd. peak  (cms)=       0.23         0.12
                                                          *TOTALS*
    PEAK FLOW       (cms)=       0.25         0.03         0.279 (iii)
    TIME TO PEAK    (hrs)=       5.25         5.25          5.25
    RUNOFF VOLUME    (mm)=      79.82        61.69         78.01
    TOTAL RAINFALL   (mm)=      80.82        80.82         80.82
    RUNOFF COEFFICIENT   =       0.99         0.76          0.97

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

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

```
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |  0.0510      0.1120
                         0.0050     0.0617   |  0.0730      0.1266
                         0.0200     0.0820   |  0.0960      0.1376
                         0.0360     0.1003   |  0.1150      0.1490

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.279      5.25      78.01
   OUTFLOW: ID= 1 (  0642)      2.720      0.088      5.50      76.85

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 31.56
                   TIME SHIFT OF PEAK FLOW         (min)= 15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1338

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      37.17        36.35
                over (min)      15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.74         0.22          0.828 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.50          5.25
     RUNOFF VOLUME    (mm)=      79.82        51.63         66.56
     TOTAL RAINFALL   (mm)=      80.82        80.82         80.82
     RUNOFF COEFFICIENT   =       0.99         0.64          0.82


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

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0021)|   Area    (ha)=   6.05
```

```
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n          =      0.013        0.250

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


                           ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME     RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs    mm/hr
                0.083    0.00 | 3.167    4.85 | 6.250   10.50 |  9.33     0.81
                0.167    0.00 | 3.250    4.85 | 6.333    5.66 |  9.42     0.81
                0.250    0.00 | 3.333   13.74 | 6.417    5.66 |  9.50     0.81
                0.333    0.81 | 3.417   13.74 | 6.500    5.66 |  9.58     0.81
                0.417    0.81 | 3.500   13.74 | 6.583    5.66 |  9.67     0.81
                0.500    0.81 | 3.583   13.74 | 6.667    5.66 |  9.75     0.81
                0.583    0.81 | 3.667   13.74 | 6.750    5.66 |  9.83     0.81
                0.667    0.81 | 3.750   13.74 | 6.833    5.66 |  9.92     0.81
                0.750    0.81 | 3.833   13.74 | 6.917    5.66 | 10.00     0.81
                0.833    0.81 | 3.917   13.74 | 7.000    5.66 | 10.08     0.81
                0.917    0.81 | 4.000   13.74 | 7.083    5.66 | 10.17     0.81
                1.000    0.81 | 4.083   13.74 | 7.167    5.66 | 10.25     0.81
                1.083    0.81 | 4.167   13.74 | 7.250    5.66 | 10.33     0.81
                1.167    0.81 | 4.250   13.74 | 7.333    3.23 | 10.42     0.81
                1.250    0.81 | 4.333   37.17 | 7.417    3.23 | 10.50     0.81
                1.333    0.81 | 4.417   37.17 | 7.500    3.23 | 10.58     0.81
                1.417    0.81 | 4.500   37.17 | 7.583    3.23 | 10.67     0.81
                1.500    0.81 | 4.583   37.17 | 7.667    3.23 | 10.75     0.81
                1.583    0.81 | 4.667   37.17 | 7.750    3.23 | 10.83     0.81
                1.667    0.81 | 4.750   37.17 | 7.833    3.23 | 10.92     0.81
                1.750    0.81 | 4.833   37.17 | 7.917    3.23 | 11.00     0.81
                1.833    0.81 | 4.917   37.17 | 8.000    3.23 | 11.08     0.81
                1.917    0.81 | 5.000   37.17 | 8.083    3.23 | 11.17     0.81
                2.000    0.81 | 5.083   37.17 | 8.167    3.23 | 11.25     0.81
                2.083    0.81 | 5.167   37.17 | 8.250    3.23 | 11.33     0.81
                2.167    0.81 | 5.250   37.17 | 8.333    1.62 | 11.42     0.81
                2.250    0.81 | 5.333   10.50 | 8.417    1.62 | 11.50     0.81
                2.333    4.85 | 5.417   10.50 | 8.500    1.62 | 11.58     0.81
                2.417    4.85 | 5.500   10.50 | 8.583    1.62 | 11.67     0.81
                2.500    4.85 | 5.583   10.50 | 8.667    1.62 | 11.75     0.81
                2.583    4.85 | 5.667   10.50 | 8.750    1.62 | 11.83     0.81
                2.667    4.85 | 5.750   10.50 | 8.833    1.62 | 11.92     0.81
                2.750    4.85 | 5.833   10.50 | 8.917    1.62 | 12.00     0.81
                2.833    4.85 | 5.917   10.50 | 9.000    1.62 | 12.08     0.81
                2.917    4.85 | 6.000   10.50 | 9.083    1.62 | 12.17     0.81
                3.000    4.85 | 6.083   10.50 | 9.167    1.62 | 12.25     0.81
                3.083    4.85 | 6.167   10.50 | 9.250    1.62 |

     Max.Eff.Inten.(mm/hr)=      37.17        31.76
                over (min)       5.00        20.00
     Storage Coeff.  (min)=       5.77 (ii)   16.93 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.20         0.06
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.41         0.16          0.570 (iii)
     TIME TO PEAK    (hrs)=       5.25         5.25          5.25
```

```
     RUNOFF VOLUME    (mm)=      79.82        52.66          70.58
     TOTAL RAINFALL   (mm)=      80.82        80.82          80.82
     RUNOFF COEFFICIENT   =       0.99         0.65           0.87


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.828     5.25    66.56
      + ID2= 2 (  0021):     6.05   0.570     5.25    70.58
        ===================================================
        ID = 3 (  0658):    19.73   1.397     5.25    67.80

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
  INFLOW : ID= 2 (  0658)     19.730      1.397      5.25      67.80
  OUTFLOW: ID= 1 (  0645)     19.730      0.445      6.75      67.63

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 31.81
                TIME SHIFT OF PEAK FLOW         (min)= 90.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.7484

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      7.84         6.67
     Dep. Storage     (mm)=      1.00         5.00
     Average Slope     (%)=      1.00         2.30
     Length            (m)=    311.02        40.00
     Mannings n           =     0.013        0.250

     Max.Eff.Inten.(mm/hr)=     37.17        34.40
                over (min)     15.00        30.00
     Storage Coeff.  (min)=     16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=     15.00       105.00
     Unit Hyd. peak  (cms)=      0.07         0.01
```

```
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.68         0.25          0.783 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.75           5.25
     RUNOFF VOLUME    (mm)=      79.82        49.77          63.59
     TOTAL RAINFALL   (mm)=      80.82        80.82          80.82
     RUNOFF COEFFICIENT   =       0.99         0.62           0.79


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
  INFLOW : ID= 2 (  0656)     14.510      0.783      5.25      63.59
  OUTFLOW: ID= 1 (  0657)     14.510      0.673      5.33      63.39

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 85.92
                TIME SHIFT OF PEAK FLOW         (min)=  5.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.2789

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


       V    V   I   SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
 Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\49eef634-74ce-475f-a8c9-71fc17a18461\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\49eef634-74ce-475f-a8c9-71fc17a18461\scen
```

```
DATE: 02-09-2021                          TIME: 01:20:05

USER:



COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 18. AES 12hr 100yr           **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\eeb5780e
| Ptotal= 88.54 mm |    Comments: 100yr/12hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  3.50   15.05 |  6.75    6.20 | 10.00    0.89
                 0.50    0.89 |  3.75   15.05 |  7.00    6.20 | 10.25    0.89
                 0.75    0.89 |  4.00   15.05 |  7.25    6.20 | 10.50    0.89
                 1.00    0.89 |  4.25   15.05 |  7.50    3.54 | 10.75    0.89
                 1.25    0.89 |  4.50   40.71 |  7.75    3.54 | 11.00    0.89
                 1.50    0.89 |  4.75   40.71 |  8.00    3.54 | 11.25    0.89
                 1.75    0.89 |  5.00   40.71 |  8.25    3.54 | 11.50    0.89
                 2.00    0.89 |  5.25   40.71 |  8.50    1.77 | 11.75    0.89
                 2.25    0.89 |  5.50   11.51 |  8.75    1.77 | 12.00    0.89
                 2.50    5.31 |  5.75   11.51 |  9.00    1.77 | 12.25    0.89
                 2.75    5.31 |  6.00   11.51 |  9.25    1.77 |
                 3.00    5.31 |  6.25   11.51 |  9.50    0.89 |
                 3.25    5.31 |  6.50    6.20 |  9.75    0.89 |

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

--------------------
| CALIB            |
| STANDHYD ( 0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n           =      0.013        0.250

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


                            ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 3.167    5.31 | 6.250   11.51 |  9.33    0.89
                0.167    0.00 | 3.250    5.31 | 6.333    6.20 |  9.42    0.89
                0.250    0.00 | 3.333   15.05 | 6.417    6.20 |  9.50    0.89
                0.333    0.89 | 3.417   15.05 | 6.500    6.20 |  9.58    0.89
                0.417    0.89 | 3.500   15.05 | 6.583    6.20 |  9.67    0.89
                0.500    0.89 | 3.583   15.05 | 6.667    6.20 |  9.75    0.89
                0.583    0.89 | 3.667   15.05 | 6.750    6.20 |  9.83    0.89
                0.667    0.89 | 3.750   15.05 | 6.833    6.20 |  9.92    0.89
                0.750    0.89 | 3.833   15.05 | 6.917    6.20 | 10.00    0.89
                0.833    0.89 | 3.917   15.05 | 7.000    6.20 | 10.08    0.89
                0.917    0.89 | 4.000   15.05 | 7.083    6.20 | 10.17    0.89
                1.000    0.89 | 4.083   15.05 | 7.167    6.20 | 10.25    0.89
                1.083    0.89 | 4.167   15.05 | 7.250    6.20 | 10.33    0.89
                1.167    0.89 | 4.250   15.05 | 7.333    3.54 | 10.42    0.89
                1.250    0.89 | 4.333   40.71 | 7.417    3.54 | 10.50    0.89
                1.333    0.89 | 4.417   40.71 | 7.500    3.54 | 10.58    0.89
                1.417    0.89 | 4.500   40.71 | 7.583    3.54 | 10.67    0.89
                1.500    0.89 | 4.583   40.71 | 7.667    3.54 | 10.75    0.89
                1.583    0.89 | 4.667   40.71 | 7.750    3.54 | 10.83    0.89
                1.667    0.89 | 4.750   40.71 | 7.833    3.54 | 10.92    0.89
                1.750    0.89 | 4.833   40.71 | 7.917    3.54 | 11.00    0.89
                1.833    0.89 | 4.917   40.71 | 8.000    3.54 | 11.08    0.89
                1.917    0.89 | 5.000   40.71 | 8.083    3.54 | 11.17    0.89
                2.000    0.89 | 5.083   40.71 | 8.167    3.54 | 11.25    0.89
                2.083    0.89 | 5.167   40.71 | 8.250    3.54 | 11.33    0.89
                2.167    0.89 | 5.250   40.71 | 8.333    1.77 | 11.42    0.89
                2.250    0.89 | 5.333   11.51 | 8.417    1.77 | 11.50    0.89
                2.333    5.31 | 5.417   11.51 | 8.500    1.77 | 11.58    0.89
                2.417    5.31 | 5.500   11.51 | 8.583    1.77 | 11.67    0.89
                2.500    5.31 | 5.583   11.51 | 8.667    1.77 | 11.75    0.89
                2.583    5.31 | 5.667   11.51 | 8.750    1.77 | 11.83    0.89
                2.667    5.31 | 5.750   11.51 | 8.833    1.77 | 11.92    0.89
                2.750    5.31 | 5.833   11.51 | 8.917    1.77 | 12.00    0.89
                2.833    5.31 | 5.917   11.51 | 9.000    1.77 | 12.08    0.89
                2.917    5.31 | 6.000   11.51 | 9.083    1.77 | 12.17    0.89
                3.000    5.31 | 6.083   11.51 | 9.167    1.77 | 12.25    0.89
                3.083    5.31 | 6.167   11.51 | 9.250    1.77 |

     Max.Eff.Inten.(mm/hr)=      40.71         38.32
                over (min)        5.00         10.00
     Storage Coeff.  (min)=       4.38 (ii)     8.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.23          0.12
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.28          0.03       0.305 (iii)
     TIME TO PEAK    (hrs)=       5.17          5.25        5.25
     RUNOFF VOLUME    (mm)=      87.54         69.16       85.70
     TOTAL RAINFALL   (mm)=      88.54         88.54       88.54
     RUNOFF COEFFICIENT   =       0.99          0.78        0.97

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  93.6     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
```

```
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)      (ha.m.)   |   (cms)      (ha.m.)
                          0.0000     0.0000   |   0.0510      0.1120
                          0.0050     0.0617   |   0.0730      0.1266
                          0.0200     0.0820   |   0.0960      0.1376
                          0.0360     0.1003   |   0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     0.305      5.25      85.70
   OUTFLOW: ID= 1 (  0642)      2.720     0.107      5.50      84.55

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 34.87
                   TIME SHIFT OF PEAK FLOW         (min)= 15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1440

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      40.71        40.80
                over (min)      15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.81         0.25          0.913 (iii)
     TIME TO PEAK    (hrs)=       5.25         6.50           5.25
     RUNOFF VOLUME    (mm)=      87.54        58.57          73.92
     TOTAL RAINFALL   (mm)=      88.54        88.54          88.54
     RUNOFF COEFFICIENT   =       0.99         0.66           0.83


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

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250
```

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


                         ---- TRANSFORMED HYETOGRAPH ----
         TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
          hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
        0.083     0.00 | 3.167     5.31 | 6.250    11.51 |  9.33     0.89
        0.167     0.00 | 3.250     5.31 | 6.333     6.20 |  9.42     0.89
        0.250     0.00 | 3.333    15.05 | 6.417     6.20 |  9.50     0.89
        0.333     0.89 | 3.417    15.05 | 6.500     6.20 |  9.58     0.89
        0.417     0.89 | 3.500    15.05 | 6.583     6.20 |  9.67     0.89
        0.500     0.89 | 3.583    15.05 | 6.667     6.20 |  9.75     0.89
        0.583     0.89 | 3.667    15.05 | 6.750     6.20 |  9.83     0.89
        0.667     0.89 | 3.750    15.05 | 6.833     6.20 |  9.92     0.89
        0.750     0.89 | 3.833    15.05 | 6.917     6.20 | 10.00     0.89
        0.833     0.89 | 3.917    15.05 | 7.000     6.20 | 10.08     0.89
        0.917     0.89 | 4.000    15.05 | 7.083     6.20 | 10.17     0.89
        1.000     0.89 | 4.083    15.05 | 7.167     6.20 | 10.25     0.89
        1.083     0.89 | 4.167    15.05 | 7.250     6.20 | 10.33     0.89
        1.167     0.89 | 4.250    15.05 | 7.333     3.54 | 10.42     0.89
        1.250     0.89 | 4.333    40.71 | 7.417     3.54 | 10.50     0.89
        1.333     0.89 | 4.417    40.71 | 7.500     3.54 | 10.58     0.89
        1.417     0.89 | 4.500    40.71 | 7.583     3.54 | 10.67     0.89
        1.500     0.89 | 4.583    40.71 | 7.667     3.54 | 10.75     0.89
        1.583     0.89 | 4.667    40.71 | 7.750     3.54 | 10.83     0.89
        1.667     0.89 | 4.750    40.71 | 7.833     3.54 | 10.92     0.89
        1.750     0.89 | 4.833    40.71 | 7.917     3.54 | 11.00     0.89
        1.833     0.89 | 4.917    40.71 | 8.000     3.54 | 11.08     0.89
        1.917     0.89 | 5.000    40.71 | 8.083     3.54 | 11.17     0.89
        2.000     0.89 | 5.083    40.71 | 8.167     3.54 | 11.25     0.89
        2.083     0.89 | 5.167    40.71 | 8.250     3.54 | 11.33     0.89
        2.167     0.89 | 5.250    40.71 | 8.333     1.77 | 11.42     0.89
        2.250     0.89 | 5.333    11.51 | 8.417     1.77 | 11.50     0.89
        2.333     5.31 | 5.417    11.51 | 8.500     1.77 | 11.58     0.89
        2.417     5.31 | 5.500    11.51 | 8.583     1.77 | 11.67     0.89
        2.500     5.31 | 5.583    11.51 | 8.667     1.77 | 11.75     0.89
        2.583     5.31 | 5.667    11.51 | 8.750     1.77 | 11.83     0.89
        2.667     5.31 | 5.750    11.51 | 8.833     1.77 | 11.92     0.89
        2.750     5.31 | 5.833    11.51 | 8.917     1.77 | 12.00     0.89
        2.833     5.31 | 5.917    11.51 | 9.000     1.77 | 12.08     0.89
        2.917     5.31 | 6.000    11.51 | 9.083     1.77 | 12.17     0.89
        3.000     5.31 | 6.083    11.51 | 9.167     1.77 | 12.25     0.89
        3.083     5.31 | 6.167    11.51 | 9.250     1.77 |

Max.Eff.Inten.(mm/hr)=      40.71        35.59
           over (min)       5.00        20.00
Storage Coeff.  (min)=       5.56 (ii)   16.23 (ii)
Unit Hyd. Tpeak (min)=       5.00        20.00
Unit Hyd. peak  (cms)=       0.20         0.06
                                                      *TOTALS*
PEAK FLOW       (cms)=       0.45         0.18          0.630 (iii)
TIME TO PEAK    (hrs)=       5.25         5.25           5.25
RUNOFF VOLUME    (mm)=      87.54        59.70          78.07
TOTAL RAINFALL   (mm)=      88.54        88.54          88.54
RUNOFF COEFFICIENT   =       0.99         0.67           0.88


  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
       CN*  =  88.0    Ia = Dep. Storage  (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
      THAN THE STORAGE COEFFICIENT.
```

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

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.913     5.25    73.92
      + ID2= 2 (  0021):     6.05   0.630     5.25    78.07
        ==================================================
        ID = 3 (  0658):    19.73   1.543     5.25    75.20

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      1.543      5.25      75.20
   OUTFLOW: ID= 1 (  0645)     19.730      0.528      6.58      75.02

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 34.22
                  TIME SHIFT OF PEAK FLOW         (min)= 80.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7905

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84          6.67
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.30
     Length            (m)=     311.02         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      40.71         38.72
               over (min)       15.00         30.00
     Storage Coeff.  (min)=      16.80 (ii)    97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00        105.00
     Unit Hyd. peak  (cms)=       0.07          0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.74          0.29          0.866 (iii)
     TIME TO PEAK    (hrs)=       5.25          6.50           5.25
     RUNOFF VOLUME    (mm)=      87.54         56.60          70.83
     TOTAL RAINFALL   (mm)=      88.54         88.54          88.54
     RUNOFF COEFFICIENT   =       0.99          0.64           0.80


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

```
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      0.866      5.25      70.83
   OUTFLOW: ID= 1 (  0657)     14.510      0.783      5.33      70.63

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 90.51
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2845

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


       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\243ef2e3-c612-48ff-abfb-bc605eaa5626\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\243ef2e3-c612-48ff-abfb-bc605eaa5626\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:


COMMENTS: ____________________________________________________________
```

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--------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 19. Erosion (25mm)            **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\fc8e445a
| Ptotal= 25.02 mm |    Comments: 25mmchi
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.17    2.17 |  1.17    6.20 |  2.17    5.62 |  3.17    2.95
                 0.33    2.38 |  1.33   12.18 |  2.33    4.80 |  3.33    2.76
                 0.50    2.66 |  1.50   41.67 |  2.50    4.21 |  3.50    2.62
                 0.67    3.03 |  1.67   15.28 |  2.67    3.78 |  3.67    2.47
                 0.83    3.58 |  1.83    9.22 |  2.83    3.45 |  3.83    2.35
                 1.00    4.47 |  2.00    6.88 |  3.00    3.18 |  4.00    2.23

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

--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

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


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    2.17 | 1.083    6.20 | 2.083    5.62 |  3.08    2.95
                0.167    2.17 | 1.167    6.20 | 2.167    5.62 |  3.17    2.95
                0.250    2.38 | 1.250   12.18 | 2.250    4.80 |  3.25    2.76
                0.333    2.38 | 1.333   12.18 | 2.333    4.80 |  3.33    2.76
                0.417    2.66 | 1.417   41.67 | 2.417    4.21 |  3.42    2.62
                0.500    2.66 | 1.500   41.67 | 2.500    4.21 |  3.50    2.62
                0.583    3.03 | 1.583   15.28 | 2.583    3.78 |  3.58    2.47
                0.667    3.03 | 1.667   15.28 | 2.667    3.78 |  3.67    2.47
                0.750    3.58 | 1.750    9.22 | 2.750    3.45 |  3.75    2.35
                0.833    3.58 | 1.833    9.22 | 2.833    3.45 |  3.83    2.35
                0.917    4.47 | 1.917    6.88 | 2.917    3.18 |  3.92    2.23
                1.000    4.47 | 2.000    6.88 | 3.000    3.18 |  4.00    2.23

     Max.Eff.Inten.(mm/hr)=      41.67        14.92
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.33 (ii)    8.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
```

```
     Unit Hyd. peak  (cms)=       0.23         0.12
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.26         0.01          0.269 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.58           1.50
     RUNOFF VOLUME    (mm)=      24.02        10.72          22.69
     TOTAL RAINFALL   (mm)=      25.02        25.02          25.02
     RUNOFF COEFFICIENT   =       0.96         0.43           0.91

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                          0.0000     0.0000    |   0.0510      0.1120
                          0.0050     0.0617    |   0.0730      0.1266
                          0.0200     0.0820    |   0.0960      0.1376
                          0.0360     0.1003    |   0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.269      1.50      22.69
   OUTFLOW: ID= 1 (  0642)      2.720      0.005      4.08      21.54

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.74
                  TIME SHIFT OF PEAK FLOW         (min)=155.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0577

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    2.24 | 1.250    8.19 | 2.250    5.35 |  3.25    2.89
                0.500    2.57 | 1.500   31.84 | 2.500    4.41 |  3.50    2.67
                0.750    3.21 | 1.750   13.26 | 2.750    3.67 |  3.75    2.43
                1.000    4.17 | 2.000    7.66 | 3.000    3.27 |  4.00    2.27

     Max.Eff.Inten.(mm/hr)=      31.84         7.23
```

```
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.43         0.03          0.432 (iii)
     TIME TO PEAK    (hrs)=       1.50         3.75           1.50
     RUNOFF VOLUME    (mm)=      24.02         7.50          16.26
     TOTAL RAINFALL   (mm)=      25.02        25.02          25.02
     RUNOFF COEFFICIENT   =       0.96         0.30           0.65


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

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD ( 0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                              ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    2.17 | 1.083    6.20 | 2.083    5.62 |  3.08    2.95
                 0.167    2.17 | 1.167    6.20 | 2.167    5.62 |  3.17    2.95
                 0.250    2.38 | 1.250   12.18 | 2.250    4.80 |  3.25    2.76
                 0.333    2.38 | 1.333   12.18 | 2.333    4.80 |  3.33    2.76
                 0.417    2.66 | 1.417   41.67 | 2.417    4.21 |  3.42    2.62
                 0.500    2.66 | 1.500   41.67 | 2.500    4.21 |  3.50    2.62
                 0.583    3.03 | 1.583   15.28 | 2.583    3.78 |  3.58    2.47
                 0.667    3.03 | 1.667   15.28 | 2.667    3.78 |  3.67    2.47
                 0.750    3.58 | 1.750    9.22 | 2.750    3.45 |  3.75    2.35
                 0.833    3.58 | 1.833    9.22 | 2.833    3.45 |  3.83    2.35
                 0.917    4.47 | 1.917    6.88 | 2.917    3.18 |  3.92    2.23
                 1.000    4.47 | 2.000    6.88 | 3.000    3.18 |  4.00    2.23

     Max.Eff.Inten.(mm/hr)=      41.67         7.91
                over (min)        5.00        25.00
     Storage Coeff.  (min)=       5.51 (ii)   24.98 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.20         0.05
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.41         0.02          0.411 (iii)
     TIME TO PEAK    (hrs)=       1.50         2.00           1.50
     RUNOFF VOLUME    (mm)=      24.02         7.56          18.42
     TOTAL RAINFALL   (mm)=      25.02        25.02          25.02
     RUNOFF COEFFICIENT   =       0.96         0.30           0.74
```

```
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):     13.68   0.432     1.50    16.26
      + ID2= 2 (  0021):      6.05   0.411     1.50    18.42
        ===================================================
        ID = 3 (  0658):     19.73   0.843     1.50    16.92

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)      19.730      0.843      1.50      16.92
   OUTFLOW: ID= 1 (  0645)      19.730      0.025      5.25      16.77

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.02
                    TIME SHIFT OF PEAK FLOW         (min)=225.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.2901

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                 0.250    2.24 | 1.250    8.19 | 2.250    5.35 |  3.25    2.89
                 0.500    2.57 | 1.500   31.84 | 2.500    4.41 |  3.50    2.67
```

```
                0.750    3.21 | 1.750   13.26 | 2.750    3.67 |  3.75    2.43
                1.000    4.17 | 2.000    7.66 | 3.000    3.27 |  4.00    2.27

     Max.Eff.Inten.(mm/hr)=      31.84         6.42
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.40         0.04           0.398 (iii)
     TIME TO PEAK    (hrs)=       1.50         3.75            1.50
     RUNOFF VOLUME    (mm)=      24.02         6.96           14.80
     TOTAL RAINFALL   (mm)=      25.02        25.02           25.02
     RUNOFF COEFFICIENT   =       0.96         0.28            0.59


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640     0.2594
                          0.0190     0.2147   |   0.5250     0.2723
                          0.1460     0.2350   |   0.6840     0.2789
                          0.2590     0.2500   |   0.8190     0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 ( 0656)     14.510     0.398      1.50      14.80
   OUTFLOW: ID= 1 ( 0657)     14.510     0.016      6.17      14.60

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.07
                   TIME SHIFT OF PEAK FLOW         (min)=280.00
                   MAXIMUM  STORAGE   USED        (ha.m.)=  0.1828

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=====================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\e67c8224-0e01-4e52-90ee-f2fdb2a04b71\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\e67c8224-0e01-4e52-90ee-f2fdb2a04b71\scen


DATE: 02-09-2021                           TIME: 01:20:06

USER:



COMMENTS: _____________________________________________________________


-------------------------------------------------------------------------------------
-----------------------
  **********************************************
  ** SIMULATION : 2. Chicago 3hr 5yr           **
  **********************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\83c52d41
| Ptotal= 34.09 mm |    Comments: Chicago 5 Min Time Step - 3hr - 5yr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    2.50 |  0.83   14.57 |  1.58    7.16 |  2.33    3.27
                 0.17    2.73 |  0.92   36.31 |  1.67    6.29 |  2.42    3.09
                 0.25    3.01 |  1.00  128.34 |  1.75    5.61 |  2.50    2.94
                 0.33    3.36 |  1.08   47.68 |  1.83    5.07 |  2.58    2.79
                 0.42    3.82 |  1.17   24.98 |  1.92    4.64 |  2.67    2.67
                 0.50    4.45 |  1.25   16.69 |  2.00    4.27 |  2.75    2.55
                 0.58    5.34 |  1.33   12.50 |  2.08    3.96 |  2.83    2.45
                 0.67    6.72 |  1.42    9.99 |  2.17    3.70 |  2.92    2.35
                 0.75    9.15 |  1.50    8.34 |  2.25    3.47 |  3.00    2.26

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--------------------
| CALIB            |
| STANDHYD ( 0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     128.34         49.82
                over (min)        5.00         10.00
     Storage Coeff.  (min)=       2.76 (ii)     5.42 (ii)
```

```
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.28         0.16
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.77         0.03          0.779 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      33.09        18.21          31.60
     TOTAL RAINFALL   (mm)=      34.09        34.09          34.09
     RUNOFF COEFFICIENT   =       0.97         0.53           0.93

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |  0.0510      0.1120
                         0.0050     0.0617   |  0.0730      0.1266
                         0.0200     0.0820   |  0.0960      0.1376
                         0.0360     0.1003   |  0.1150      0.1490

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)     2.720     0.779      1.00      31.60
   OUTFLOW: ID= 1 (  0642)     2.720     0.016      3.00      30.44

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.06
                  TIME SHIFT OF PEAK FLOW         (min)=120.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0767

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    2.74 | 1.000   59.74 | 1.750    6.36 |  2.50    3.10
                0.500    3.88 | 1.250   29.78 | 2.000    4.66 |  2.75    2.67
                0.750    7.07 | 1.500   10.27 | 2.250    3.71 |  3.00    2.36

     Max.Eff.Inten.(mm/hr)=      59.74        19.48
```

```
                 over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.75         0.07          0.754 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75           1.00
     RUNOFF VOLUME    (mm)=      33.09        13.35          23.81
     TOTAL RAINFALL   (mm)=      34.09        34.09          34.09
     RUNOFF COEFFICIENT   =       0.97         0.39           0.70


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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     128.34        35.62
                 over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.51 (ii)    8.35 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.12
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.16         0.12          1.214 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      33.09        13.60          26.46
     TOTAL RAINFALL   (mm)=      34.09        34.09          34.09
     RUNOFF COEFFICIENT   =       0.97         0.40           0.78

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.754     1.00    23.81
      + ID2= 2 (  0021):     6.05   1.214     1.00    26.46
        ===================================================
        ID = 3 (  0658):    19.73   1.968     1.00    24.62
```

```
     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      1.968      1.00      24.62
   OUTFLOW: ID= 1 (  0645)     19.730      0.066      3.67      24.47

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.38
                   TIME SHIFT OF PEAK FLOW         (min)=160.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.4040

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD ( 0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
               0.250    2.74 | 1.000   59.74 | 1.750    6.36 |  2.50    3.10
               0.500    3.88 | 1.250   29.78 | 2.000    4.66 |  2.75    2.67
               0.750    7.07 | 1.500   10.27 | 2.250    3.71 |  3.00    2.36

     Max.Eff.Inten.(mm/hr)=      59.74        17.86
                over (min)       15.00        45.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.69         0.08           0.695 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75            1.00
     RUNOFF VOLUME    (mm)=      33.09        12.52           21.98
     TOTAL RAINFALL   (mm)=      34.09        34.09           34.09
     RUNOFF COEFFICIENT   =       0.97         0.37            0.64


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      0.695      1.00      21.98
   OUTFLOW: ID= 1 (  0657)     14.510      0.112      3.17      21.78

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 16.06
                   TIME SHIFT OF PEAK FLOW         (min)=130.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2295

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

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\2e3c3dc5-4c64-49f4-9e53-6ff42cf556f4\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\2e3c3dc5-4c64-49f4-9e53-6ff42cf556f4\scen


DATE: 02-09-2021                            TIME: 01:20:05

USER:


COMMENTS: ____________________________________________________________
```

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-----------------------
  ************************************************
  ** SIMULATION : 3. Chicago 3hr 10yr           **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\77778385
| Ptotal= 41.98 mm |    Comments: Chicago 5 Min Time Step - 3hr - 10yr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    3.08 |  0.83   17.95 |  1.58    8.82 |  2.33    4.03
                 0.17    3.36 |  0.92   44.72 |  1.67    7.75 |  2.42    3.81
                 0.25    3.71 |  1.00  158.07 |  1.75    6.91 |  2.50    3.62
                 0.33    4.14 |  1.08   58.73 |  1.83    6.25 |  2.58    3.44
                 0.42    4.71 |  1.17   30.77 |  1.92    5.71 |  2.67    3.29
                 0.50    5.48 |  1.25   20.55 |  2.00    5.26 |  2.75    3.14
                 0.58    6.57 |  1.33   15.39 |  2.08    4.88 |  2.83    3.02
                 0.67    8.27 |  1.42   12.31 |  2.17    4.55 |  2.92    2.90
                 0.75   11.27 |  1.50   10.27 |  2.25    4.27 |  3.00    2.79

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

--------------------
| CALIB            |
| STANDHYD ( 0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     158.07        70.80
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       2.54 (ii)    4.98 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.29         0.22
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.96         0.05         1.011 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00          1.00
     RUNOFF VOLUME    (mm)=      40.98        25.17         39.40
     TOTAL RAINFALL   (mm)=      41.98        41.98         41.98
     RUNOFF COEFFICIENT  =        0.98         0.60          0.94

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)         2.720      1.011      1.00      39.40
   OUTFLOW: ID= 1 (  0642)         2.720      0.027      2.50      38.25

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.72
                  TIME SHIFT OF PEAK FLOW         (min)= 90.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0905

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
               0.250    3.38 | 1.000   73.58 | 1.750    7.83 |  2.50    3.82
               0.500    4.78 | 1.250   36.68 | 2.000    5.74 |  2.75    3.29
               0.750    8.71 | 1.500   12.66 | 2.250    4.57 |  3.00    2.90

     Max.Eff.Inten.(mm/hr)=      73.58        29.52
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.93         0.11         0.932 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75          1.00
     RUNOFF VOLUME    (mm)=      40.98        19.08         30.68
     TOTAL RAINFALL   (mm)=      41.98        41.98         41.98
     RUNOFF COEFFICIENT  =        0.98         0.45          0.73


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

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

```
--------------------
| CALIB              |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     158.07        52.97
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.23 (ii)    7.69 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.27         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.47         0.19         1.560 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08          1.00
     RUNOFF VOLUME    (mm)=      40.98        19.49         33.67
     TOTAL RAINFALL   (mm)=      41.98        41.98         41.98
     RUNOFF COEFFICIENT   =       0.98         0.46          0.80

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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


--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.932     1.00    30.68
      + ID2= 2 (  0021):     6.05   1.560     1.00    33.67
        ==================================================
        ID = 3 (  0658):    19.73   2.492     1.00    31.60

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                 AREA     QPEAK      TPEAK       R.V.
                                 (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  0658)      19.730      2.492       1.00      31.60
   OUTFLOW: ID= 1 (  0645)      19.730      0.116       3.33      31.45

                PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.65
```

```
                    TIME SHIFT OF PEAK FLOW         (min)=140.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.4918

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
               0.250    3.38 | 1.000   73.58 | 1.750    7.83 |  2.50    3.82
               0.500    4.78 | 1.250   36.68 | 2.000    5.74 |  2.75    3.29
               0.750    8.71 | 1.500   12.66 | 2.250    4.57 |  3.00    2.90

     Max.Eff.Inten.(mm/hr)=      73.58        26.55
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.85         0.12         0.859 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75          1.00
     RUNOFF VOLUME    (mm)=      40.98        18.03         28.58
     TOTAL RAINFALL   (mm)=      41.98        41.98         41.98
     RUNOFF COEFFICIENT   =       0.98         0.43          0.68


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                 AREA     QPEAK      TPEAK       R.V.
                                 (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  0656)      14.510      0.859       1.00      28.58
   OUTFLOW: ID= 1 (  0657)      14.510      0.198       2.75      28.39
```

```
                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 23.00
                   TIME SHIFT OF PEAK FLOW         (min)=105.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2419

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

       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\bec09bba-3d18-4f11-8ab1-5e97d24653ae\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\bec09bba-3d18-4f11-8ab1-5e97d24653ae\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:



COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 4. Chicago 3hr 25yr           **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\79190208
| Ptotal= 59.41 mm |    Comments: Chicago 5 Min Time Step - 3hr - 25yr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    5.17 |  0.83   26.33 |  1.58   13.72 |  2.33    6.64
                 0.17    5.61 |  0.92   60.92 |  1.67   12.17 |  2.42    6.31
                 0.25    6.15 |  1.00  198.74 |  1.75   10.96 |  2.50    6.01
                 0.33    6.82 |  1.08   78.66 |  1.83    9.98 |  2.58    5.74
```

```
                 0.42    7.68 |  1.17   43.26 |  1.92    9.18 |  2.67    5.50
                 0.50    8.83 |  1.25   29.84 |  2.00    8.51 |  2.75    5.28
                 0.58   10.46 |  1.33   22.88 |  2.08    7.94 |  2.83    5.07
                 0.67   12.93 |  1.42   18.63 |  2.17    7.45 |  2.92    4.89
                 0.75   17.18 |  1.50   15.77 |  2.25    7.02 |  3.00    4.72

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

--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
     Mannings n          =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     198.74        106.65
                over (min)        5.00          5.00
     Storage Coeff.  (min)=       2.32 (ii)     4.55 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.30          0.23
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.24          0.08          1.318 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.00           1.00
     RUNOFF VOLUME    (mm)=      58.41         41.24          56.69
     TOTAL RAINFALL   (mm)=      59.41         59.41          59.41
     RUNOFF COEFFICIENT   =       0.98          0.69           0.95

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  93.6    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510      0.1120
                          0.0050     0.0617   |   0.0730      0.1266
                          0.0200     0.0820   |   0.0960      0.1376
                          0.0360     0.1003   |   0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     1.318     1.00      56.69
   OUTFLOW: ID= 1 (  0642)      2.720     0.062     2.08      55.54

                PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.69
                TIME SHIFT OF PEAK FLOW         (min)= 65.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.1192

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

```
--------------------
| CALIB             |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
               0.250    5.64 | 1.000   95.33 | 1.750   12.28 |  2.50    6.32
               0.500    7.78 | 1.250   50.59 | 2.000    9.22 |  2.75    5.50
               0.750   13.52 | 1.500   19.09 | 2.250    7.47 |  3.00    4.89

     Max.Eff.Inten.(mm/hr)=      95.33        52.08
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.22         0.18          1.228 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75           1.00
     RUNOFF VOLUME    (mm)=      58.41        33.03          46.48
     TOTAL RAINFALL   (mm)=      59.41        59.41          59.41
     RUNOFF COEFFICIENT   =       0.98         0.56           0.78


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

-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     198.74        85.59
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.95 (ii)    7.01 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.28         0.14
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.91         0.34          2.086 (iii)
```

```
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      58.41        33.76          50.03
     TOTAL RAINFALL   (mm)=      59.41        59.41          59.41
     RUNOFF COEFFICIENT   =       0.98         0.57           0.84

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   1.228     1.00    46.48
      + ID2= 2 (  0021):     6.05   2.086     1.00    50.03
        ==================================================
        ID = 3 (  0658):    19.73   3.314     1.00    47.56

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)      19.730      3.314      1.00      47.56
   OUTFLOW: ID= 1 (  0645)      19.730      0.278      3.08      47.42

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.38
                  TIME SHIFT OF PEAK FLOW         (min)=125.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.6676

-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
             0.250    5.64 | 1.000   95.33 | 1.750   12.28 |  2.50    6.32
             0.500    7.78 | 1.250   50.59 | 2.000    9.22 |  2.75    5.50
             0.750   13.52 | 1.500   19.09 | 2.250    7.47 |  3.00    4.89

     Max.Eff.Inten.(mm/hr)=      95.33        47.47
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                           *TOTALS*
     PEAK FLOW       (cms)=       1.12         0.21          1.133 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75           1.00
     RUNOFF VOLUME    (mm)=      58.41        31.56          43.91
     TOTAL RAINFALL   (mm)=      59.41        59.41          59.41
     RUNOFF COEFFICIENT   =       0.98         0.53           0.74


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |  0.3640      0.2594
                          0.0190     0.2147   |  0.5250      0.2723
                          0.1460     0.2350   |  0.6840      0.2789
                          0.2590     0.2500   |  0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510     1.133      1.00      43.91
   OUTFLOW: ID= 1 (  0657)     14.510     0.452      1.83      43.71

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 39.90
                    TIME SHIFT OF PEAK FLOW         (min)= 50.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=  0.2665

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       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\aa397637-0a47-4238-89ce-bdcb7e18b59a\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\aa397637-0a47-4238-89ce-bdcb7e18b59a\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:


COMMENTS: ____________________________________________________________

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-----------------------
  **********************************************
  ** SIMULATION : 5. Chicago 3hr 50yr          **
  **********************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\9ecc3658
| Ptotal= 66.55 mm |    Comments: Chicago 5 Min Time Step - 3hr - 50yr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    5.80 |  0.83   29.62 |  1.58   15.42 |  2.33    7.46
                 0.17    6.30 |  0.92   68.42 |  1.67   13.67 |  2.42    7.08
                 0.25    6.90 |  1.00  220.93 |  1.75   12.31 |  2.50    6.74
                 0.33    7.66 |  1.08   88.27 |  1.83   11.21 |  2.58    6.44
                 0.42    8.63 |  1.17   48.66 |  1.92   10.31 |  2.67    6.17
                 0.50    9.92 |  1.25   33.57 |  2.00    9.56 |  2.75    5.92
                 0.58   11.75 |  1.33   25.73 |  2.08    8.91 |  2.83    5.69
                 0.67   14.53 |  1.42   20.95 |  2.17    8.36 |  2.92    5.49
                 0.75   19.32 |  1.50   17.73 |  2.25    7.88 |  3.00    5.29

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


--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45          0.27
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     134.66         40.00
     Mannings n          =       0.013         0.250
```

```
     Max.Eff.Inten.(mm/hr)=     220.93       123.80
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       2.22 (ii)    4.36 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.30         0.23
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.39         0.09         1.484 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00          1.00
     RUNOFF VOLUME    (mm)=      65.55        48.01         63.80
     TOTAL RAINFALL   (mm)=      66.55        66.55         66.55
     RUNOFF COEFFICIENT   =       0.98         0.72          0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |  0.0510      0.1120
                          0.0050     0.0617   |  0.0730      0.1266
                          0.0200     0.0820   |  0.0960      0.1376
                          0.0360     0.1003   |  0.1150      0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      1.484      1.00      63.80
   OUTFLOW: ID= 1 (  0642)      2.720      0.081      1.92      62.64

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.45
                   TIME SHIFT OF PEAK FLOW         (min)= 55.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1304

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    6.33 | 1.000  106.32 | 1.750   13.80 |  2.50    7.09
                0.500    8.74 | 1.250   56.83 | 2.000   10.36 |  2.75    6.18
                0.750   15.20 | 1.500   21.47 | 2.250    8.39 |  3.00    5.49

     Max.Eff.Inten.(mm/hr)=     106.32        63.18
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.36         0.22         1.372 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75          1.00
     RUNOFF VOLUME    (mm)=      65.55        39.10         53.11
     TOTAL RAINFALL   (mm)=      66.55        66.55         66.55
     RUNOFF COEFFICIENT   =       0.98         0.59          0.80


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

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     220.93       101.72
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.83 (ii)    6.72 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.28         0.14
                                                        *TOTALS*
     PEAK FLOW       (cms)=       2.15         0.42         2.369 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08          1.00
     RUNOFF VOLUME    (mm)=      65.55        39.94         56.84
     TOTAL RAINFALL   (mm)=      66.55        66.55         66.55
     RUNOFF COEFFICIENT   =       0.98         0.60          0.85

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
```

```
        ID1= 1 (  0002):    13.68   1.372     1.00    53.11
      + ID2= 2 (  0021):     6.05   2.369     1.00    56.84
        ====================================================
        ID = 3 (  0658):    19.73   3.741     1.00    54.26

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      3.741      1.00      54.26
   OUTFLOW: ID= 1 (  0645)     19.730      0.377      3.08      54.11

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.09
                  TIME SHIFT OF PEAK FLOW         (min)=125.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7240

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84          6.67
     Dep. Storage     (mm)=       1.00          5.00
     Average Slope     (%)=       1.00          2.30
     Length            (m)=     311.02         40.00
     Mannings n          =      0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                 0.250    6.33 | 1.000  106.32 | 1.750   13.80 |  2.50    7.09
                 0.500    8.74 | 1.250   56.83 | 2.000   10.36 |  2.75    6.18
                 0.750   15.20 | 1.500   21.47 | 2.250    8.39 |  3.00    5.49

     Max.Eff.Inten.(mm/hr)=     106.32        57.84
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.25         0.25        1.266 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75         1.00
     RUNOFF VOLUME    (mm)=      65.55        37.49        50.39
     TOTAL RAINFALL   (mm)=      66.55        66.55        66.55
     RUNOFF COEFFICIENT   =       0.98         0.56         0.76
```

```
       (i)  CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
                CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii)  TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
               THAN THE STORAGE COEFFICIENT.
     (iii)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      1.266      1.00      50.39
   OUTFLOW: ID= 1 (  0657)     14.510      0.609      1.67      50.20

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 48.13
                  TIME SHIFT OF PEAK FLOW         (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2761

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


       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\4aa15be0-83b8-4b24-85a4-db5642493933\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\4aa15be0-83b8-4b24-85a4-db5642493933\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:
```

COMMENTS: ____

```
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----------------------
  ************************************************
  ** SIMULATION : 6. Chicago 3hr 100yr          **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\7eb7ce48
| Ptotal= 74.17 mm |    Comments: Chicago 5 Min Time Step - 3hr - 100yr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.08    6.49 |  0.83   33.28 |  1.58   17.30 |  2.33    8.35
                 0.17    7.05 |  0.92   76.62 |  1.67   15.34 |  2.42    7.92
                 0.25    7.72 |  1.00  242.53 |  1.75   13.80 |  2.50    7.55
                 0.33    8.57 |  1.08   98.69 |  1.83   12.57 |  2.58    7.21
                 0.42    9.66 |  1.17   54.64 |  1.92   11.55 |  2.67    6.90
                 0.50   11.12 |  1.25   37.73 |  2.00   10.71 |  2.75    6.62
                 0.58   13.17 |  1.33   28.91 |  2.08    9.98 |  2.83    6.37
                 0.67   16.30 |  1.42   23.53 |  2.17    9.36 |  2.92    6.13
                 0.75   21.69 |  1.50   19.90 |  2.25    8.82 |  3.00    5.92

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

--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     242.53       141.27
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       2.14 (ii)    4.20 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.31         0.24
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.54         0.11         1.647 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00          1.00
     RUNOFF VOLUME    (mm)=      73.17        55.29         71.38
     TOTAL RAINFALL   (mm)=      74.17        74.17         74.17
     RUNOFF COEFFICIENT   =       0.99         0.75          0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
```

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

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     1.647     1.00      71.38
   OUTFLOW: ID= 1 (  0642)      2.720     0.103     1.75      70.22

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.25
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1418

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
               0.250    7.09 | 1.000  117.48 | 1.750   15.48 |  2.50    7.94
               0.500    9.78 | 1.250   63.69 | 2.000   11.61 |  2.75    6.91
               0.750   17.05 | 1.500   24.11 | 2.250    9.39 |  3.00    6.14

     Max.Eff.Inten.(mm/hr)=     117.48        75.05
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.50         0.25         1.519 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75          1.00
     RUNOFF VOLUME    (mm)=      73.17        45.73         60.27
     TOTAL RAINFALL   (mm)=      74.17        74.17         74.17
     RUNOFF COEFFICIENT   =       0.99         0.62          0.81


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     242.53       118.58
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.72 (ii)    6.48 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.29         0.14
                                                              *TOTALS*
     PEAK FLOW       (cms)=       2.38         0.50          2.654 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      73.17        46.68          64.16
     TOTAL RAINFALL   (mm)=      74.17        74.17          74.17
     RUNOFF COEFFICIENT   =       0.99         0.63           0.87

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   1.519     1.00    60.27
      + ID2= 2 (  0021):     6.05   2.654     1.00    64.16
        ==================================================
        ID = 3 (  0658):    19.73   4.173     1.00    61.46

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
```

```
  INFLOW : ID= 2 (  0658)     19.730      4.173      1.00      61.46
  OUTFLOW: ID= 1 (  0645)     19.730      0.486      3.00      61.31

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.65
                  TIME SHIFT OF PEAK FLOW         (min)=120.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.7694

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    7.09 | 1.000  117.48 | 1.750   15.48 |  2.50    7.94
                0.500    9.78 | 1.250   63.69 | 2.000   11.61 |  2.75    6.91
                0.750   17.05 | 1.500   24.11 | 2.250    9.39 |  3.00    6.14

     Max.Eff.Inten.(mm/hr)=     117.48        68.99
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.38         0.30          1.402 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.75           1.00
     RUNOFF VOLUME    (mm)=      73.17        43.98          57.40
     TOTAL RAINFALL   (mm)=      74.17        74.17          74.17
     RUNOFF COEFFICIENT   =       0.99         0.59           0.77


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                AREA     QPEAK     TPEAK       R.V.
```

```
                              (ha)      (cms)      (hrs)        (mm)
   INFLOW : ID= 2 (  0656)     14.510      1.402      1.00       57.40
   OUTFLOW: ID= 1 (  0657)     14.510      0.776      1.58       57.20

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)= 55.33
                 TIME SHIFT OF PEAK FLOW         (min)= 35.00
                 MAXIMUM  STORAGE   USED       (ha.m.)=  0.2842

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

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\f14a78eb-5ada-4479-821d-47d1091e03fe\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\f14a78eb-5ada-4479-821d-47d1091e03fe\scen


DATE: 02-09-2021                           TIME: 01:20:06

USER:



COMMENTS: ____________________________________________________________


----------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 7. AES 6hr 2yr                **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\77df6b23
| Ptotal= 36.00 mm |    Comments: 2yr/6hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
```

```
                 0.25    0.00 |  2.00   12.24 |  3.75    5.04 |  5.50    0.72
                 0.50    0.72 |  2.25   12.24 |  4.00    2.88 |  5.75    0.72
                 0.75    0.72 |  2.50   33.12 |  4.25    2.88 |  6.00    0.72
                 1.00    0.72 |  2.75   33.12 |  4.50    1.44 |  6.25    0.72
                 1.25    0.72 |  3.00    9.36 |  4.75    1.44 |
                 1.50    4.32 |  3.25    9.36 |  5.00    0.72 |
                 1.75    4.32 |  3.50    5.04 |  5.25    0.72 |

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

--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

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


                            ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    4.32 | 3.250    9.36 |  4.83    0.72
                0.167    0.00 | 1.750    4.32 | 3.333    5.04 |  4.92    0.72
                0.250    0.00 | 1.833   12.24 | 3.417    5.04 |  5.00    0.72
                0.333    0.72 | 1.917   12.24 | 3.500    5.04 |  5.08    0.72
                0.417    0.72 | 2.000   12.24 | 3.583    5.04 |  5.17    0.72
                0.500    0.72 | 2.083   12.24 | 3.667    5.04 |  5.25    0.72
                0.583    0.72 | 2.167   12.24 | 3.750    5.04 |  5.33    0.72
                0.667    0.72 | 2.250   12.24 | 3.833    2.88 |  5.42    0.72
                0.750    0.72 | 2.333   33.12 | 3.917    2.88 |  5.50    0.72
                0.833    0.72 | 2.417   33.12 | 4.000    2.88 |  5.58    0.72
                0.917    0.72 | 2.500   33.12 | 4.083    2.88 |  5.67    0.72
                1.000    0.72 | 2.583   33.12 | 4.167    2.88 |  5.75    0.72
                1.083    0.72 | 2.667   33.12 | 4.250    2.88 |  5.83    0.72
                1.167    0.72 | 2.750   33.12 | 4.333    1.44 |  5.92    0.72
                1.250    0.72 | 2.833    9.36 | 4.417    1.44 |  6.00    0.72
                1.333    4.32 | 2.917    9.36 | 4.500    1.44 |  6.08    0.72
                1.417    4.32 | 3.000    9.36 | 4.583    1.44 |  6.17    0.72
                1.500    4.32 | 3.083    9.36 | 4.667    1.44 |  6.25    0.72
                1.583    4.32 | 3.167    9.36 | 4.750    1.44 |

     Max.Eff.Inten.(mm/hr)=      33.12        24.99
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       4.75 (ii)    9.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.22         0.12
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.22         0.02       0.241 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.75        2.75
     RUNOFF VOLUME    (mm)=      35.00        19.87       33.49
     TOTAL RAINFALL   (mm)=      36.00        36.00       36.00
     RUNOFF COEFFICIENT   =       0.97         0.55        0.93

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

```
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510      0.1120
                          0.0050     0.0617   |   0.0730      0.1266
                          0.0200     0.0820   |   0.0960      0.1376
                          0.0360     0.1003   |   0.1150      0.1490

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720      0.241      2.75      33.49
   OUTFLOW: ID= 1 (  0642)      2.720      0.017      4.33      32.33

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.04
                   TIME SHIFT OF PEAK FLOW         (min)= 95.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0780

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|  Area    (ha)=  13.68
|ID= 1 DT=15.0 min |  Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.12        21.19
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.59         0.08          0.604 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25           2.75
     RUNOFF VOLUME    (mm)=      35.00        14.69          25.45
     TOTAL RAINFALL   (mm)=      36.00        36.00          36.00
     RUNOFF COEFFICIENT   =       0.97         0.41           0.71


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

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

```
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                                ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    0.00 | 1.667    4.32 | 3.250    9.36 | 4.83    0.72
                 0.167    0.00 | 1.750    4.32 | 3.333    5.04 | 4.92    0.72
                 0.250    0.00 | 1.833   12.24 | 3.417    5.04 | 5.00    0.72
                 0.333    0.72 | 1.917   12.24 | 3.500    5.04 | 5.08    0.72
                 0.417    0.72 | 2.000   12.24 | 3.583    5.04 | 5.17    0.72
                 0.500    0.72 | 2.083   12.24 | 3.667    5.04 | 5.25    0.72
                 0.583    0.72 | 2.167   12.24 | 3.750    5.04 | 5.33    0.72
                 0.667    0.72 | 2.250   12.24 | 3.833    2.88 | 5.42    0.72
                 0.750    0.72 | 2.333   33.12 | 3.917    2.88 | 5.50    0.72
                 0.833    0.72 | 2.417   33.12 | 4.000    2.88 | 5.58    0.72
                 0.917    0.72 | 2.500   33.12 | 4.083    2.88 | 5.67    0.72
                 1.000    0.72 | 2.583   33.12 | 4.167    2.88 | 5.75    0.72
                 1.083    0.72 | 2.667   33.12 | 4.250    2.88 | 5.83    0.72
                 1.167    0.72 | 2.750   33.12 | 4.333    1.44 | 5.92    0.72
                 1.250    0.72 | 2.833    9.36 | 4.417    1.44 | 6.00    0.72
                 1.333    4.32 | 2.917    9.36 | 4.500    1.44 | 6.08    0.72
                 1.417    4.32 | 3.000    9.36 | 4.583    1.44 | 6.17    0.72
                 1.500    4.32 | 3.083    9.36 | 4.667    1.44 | 6.25    0.72
                 1.583    4.32 | 3.167    9.36 | 4.750    1.44 |

     Max.Eff.Inten.(mm/hr)=      33.12        18.71
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       6.04 (ii)   19.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.19         0.06
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.37         0.07          0.420 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.92           2.75
     RUNOFF VOLUME    (mm)=      35.00        14.98          28.19
     TOTAL RAINFALL   (mm)=      36.00        36.00          36.00
     RUNOFF COEFFICIENT   =       0.97         0.42           0.78


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|  1 +  2 =  3     |        AREA    QPEAK    TPEAK     R.V.
```

```
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.604     2.75    25.45
      + ID2= 2 (  0021):     6.05   0.420     2.75    28.19
        ==================================================
        ID = 3 (  0658):    19.73   1.024     2.75    26.29

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      1.024      2.75      26.29
   OUTFLOW: ID= 1 (  0645)     19.730      0.073      5.92      26.14

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.16
                   TIME SHIFT OF PEAK FLOW         (min)=190.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.4174

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.12        19.40
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.54         0.09         0.558 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25          2.75
     RUNOFF VOLUME    (mm)=      35.00        13.81         23.55
     TOTAL RAINFALL   (mm)=      36.00        36.00         36.00
     RUNOFF COEFFICIENT   =       0.97         0.38          0.65


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

```
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3640      0.2594
                          0.0190     0.2147   |   0.5250      0.2723
                          0.1460     0.2350   |   0.6840      0.2789
                          0.2590     0.2500   |   0.8190      0.2863

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      0.558      2.75      23.55
   OUTFLOW: ID= 1 (  0657)     14.510      0.117      4.67      23.36

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 20.93
                   TIME SHIFT OF PEAK FLOW         (min)=115.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2304

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=======================

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\dee187a0-cfd3-4695-94f4-c29e544625fd\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\dee187a0-cfd3-4695-94f4-c29e544625fd\scen


DATE: 02-09-2021                           TIME: 01:20:06

USER:


COMMENTS: ____________________________________________________________


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  ************************************************
  ** SIMULATION : 8. AES 6hr 5yr                **
  ************************************************
```

```
--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\e1d4db76
| Ptotal= 47.81 mm |    Comments: 5yr/6hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  2.00   16.25 |  3.75    6.69 |  5.50    0.96
                 0.50    0.96 |  2.25   16.25 |  4.00    3.82 |  5.75    0.96
                 0.75    0.96 |  2.50   43.98 |  4.25    3.82 |  6.00    0.96
                 1.00    0.96 |  2.75   43.98 |  4.50    1.91 |  6.25    0.96
                 1.25    0.96 |  3.00   12.43 |  4.75    1.91 |
                 1.50    5.74 |  3.25   12.43 |  5.00    0.96 |
                 1.75    5.74 |  3.50    6.69 |  5.25    0.96 |

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--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n           =      0.013        0.250

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


                             ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    5.74 | 3.250   12.43 |  4.83    0.96
                0.167    0.00 | 1.750    5.74 | 3.333    6.69 |  4.92    0.96
                0.250    0.00 | 1.833   16.25 | 3.417    6.69 |  5.00    0.96
                0.333    0.96 | 1.917   16.25 | 3.500    6.69 |  5.08    0.96
                0.417    0.96 | 2.000   16.25 | 3.583    6.69 |  5.17    0.96
                0.500    0.96 | 2.083   16.25 | 3.667    6.69 |  5.25    0.96
                0.583    0.96 | 2.167   16.25 | 3.750    6.69 |  5.33    0.96
                0.667    0.96 | 2.250   16.25 | 3.833    3.82 |  5.42    0.96
                0.750    0.96 | 2.333   43.98 | 3.917    3.82 |  5.50    0.96
                0.833    0.96 | 2.417   43.98 | 4.000    3.82 |  5.58    0.96
                0.917    0.96 | 2.500   43.98 | 4.083    3.82 |  5.67    0.96
                1.000    0.96 | 2.583   43.98 | 4.167    3.82 |  5.75    0.96
                1.083    0.96 | 2.667   43.98 | 4.250    3.82 |  5.83    0.96
                1.167    0.96 | 2.750   43.98 | 4.333    1.91 |  5.92    0.96
                1.250    0.96 | 2.833   12.43 | 4.417    1.91 |  6.00    0.96
                1.333    5.74 | 2.917   12.43 | 4.500    1.91 |  6.08    0.96
                1.417    5.74 | 3.000   12.43 | 4.583    1.91 |  6.17    0.96
                1.500    5.74 | 3.083   12.43 | 4.667    1.91 |  6.25    0.96
                1.583    5.74 | 3.167   12.43 | 4.750    1.91 |

     Max.Eff.Inten.(mm/hr)=      43.98        36.63
                over (min)       5.00        10.00
     Storage Coeff.  (min)=       4.24 (ii)    8.31 (ii)
```

```
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.24         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.30         0.03         0.324 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.75          2.75
     RUNOFF VOLUME    (mm)=      46.81        30.45         45.17
     TOTAL RAINFALL   (mm)=      47.81        47.81         47.81
     RUNOFF COEFFICIENT   =       0.98         0.64          0.94

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     0.324      2.75      45.17
   OUTFLOW: ID= 1 (  0642)      2.720     0.035      3.83      44.02

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.64
                    TIME SHIFT OF PEAK FLOW          (min)= 65.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.0986

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      43.98        33.45
                over (min)      15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.79         0.12         0.807 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25          2.75
     RUNOFF VOLUME    (mm)=      46.81        23.58         35.89
     TOTAL RAINFALL   (mm)=      47.81        47.81         47.81
     RUNOFF COEFFICIENT   =       0.98         0.49          0.75
```

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

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      4.05         2.00
     Dep. Storage     (mm)=      1.00         5.00
     Average Slope     (%)=      1.00         2.00
     Length            (m)=    200.83        40.00
     Mannings n           =     0.013        0.250

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


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    5.74 | 3.250   12.43 |  4.83    0.96
                0.167    0.00 | 1.750    5.74 | 3.333    6.69 |  4.92    0.96
                0.250    0.00 | 1.833   16.25 | 3.417    6.69 |  5.00    0.96
                0.333    0.96 | 1.917   16.25 | 3.500    6.69 |  5.08    0.96
                0.417    0.96 | 2.000   16.25 | 3.583    6.69 |  5.17    0.96
                0.500    0.96 | 2.083   16.25 | 3.667    6.69 |  5.25    0.96
                0.583    0.96 | 2.167   16.25 | 3.750    6.69 |  5.33    0.96
                0.667    0.96 | 2.250   16.25 | 3.833    3.82 |  5.42    0.96
                0.750    0.96 | 2.333   43.98 | 3.917    3.82 |  5.50    0.96
                0.833    0.96 | 2.417   43.98 | 4.000    3.82 |  5.58    0.96
                0.917    0.96 | 2.500   43.98 | 4.083    3.82 |  5.67    0.96
                1.000    0.96 | 2.583   43.98 | 4.167    3.82 |  5.75    0.96
                1.083    0.96 | 2.667   43.98 | 4.250    3.82 |  5.83    0.96
                1.167    0.96 | 2.750   43.98 | 4.333    1.91 |  5.92    0.96
                1.250    0.96 | 2.833   12.43 | 4.417    1.91 |  6.00    0.96
                1.333    5.74 | 2.917   12.43 | 4.500    1.91 |  6.08    0.96
                1.417    5.74 | 3.000   12.43 | 4.583    1.91 |  6.17    0.96
                1.500    5.74 | 3.083   12.43 | 4.667    1.91 |  6.25    0.96
                1.583    5.74 | 3.167   12.43 | 4.750    1.91 |

     Max.Eff.Inten.(mm/hr)=      43.98        29.52
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       5.39 (ii)   16.89 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.21         0.06
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.49         0.11          0.587 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.92           2.75
     RUNOFF VOLUME    (mm)=      46.81        24.10          39.09
     TOTAL RAINFALL   (mm)=      47.81        47.81          47.81
     RUNOFF COEFFICIENT   =       0.98         0.50           0.82


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

```
          CN*  =  88.0    Ia = Dep. Storage  (Above)
    (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
         THAN THE STORAGE COEFFICIENT.
   (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.807     2.75    35.89
      + ID2= 2 (  0021):     6.05   0.587     2.75    39.09
        ===================================================
        ID = 3 (  0658):    19.73   1.394     2.75    36.87

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2360      0.6393
                          0.0290     0.3310   |   0.3410      0.7100
                          0.0950     0.4595   |   0.4450      0.7485
                          0.1680     0.5720   |   0.5320      0.7925

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      1.394      2.75      36.87
   OUTFLOW: ID= 1 (  0645)     19.730      0.147      5.17      36.72

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.51
                 TIME SHIFT OF PEAK FLOW         (min)=145.00
                 MAXIMUM  STORAGE   USED       (ha.m.)=  0.5390

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      7.84         6.67
     Dep. Storage     (mm)=      1.00         5.00
     Average Slope     (%)=      1.00         2.30
     Length            (m)=    311.02        40.00
     Mannings n           =     0.013        0.250

     Max.Eff.Inten.(mm/hr)=      43.98        30.98
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.72         0.14          0.748 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25           2.75
     RUNOFF VOLUME    (mm)=      46.81        22.38          33.61
     TOTAL RAINFALL   (mm)=      47.81        47.81          47.81
     RUNOFF COEFFICIENT   =       0.98         0.47           0.70
```

```
      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  84.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |  0.3640      0.2594
                          0.0190     0.2147   |  0.5250      0.2723
                          0.1460     0.2350   |  0.6840      0.2789
                          0.2590     0.2500   |  0.8190      0.2863

                                AREA     QPEAK      TPEAK       R.V.
                                (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      0.748      2.75      33.61
   OUTFLOW: ID= 1 (  0657)     14.510      0.248      3.92      33.41

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 33.23
                   TIME SHIFT OF PEAK FLOW         (min)= 70.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2486

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

       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\335bbde2-1ad2-40c0-b9b7-1b5ffa8a121d\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\335bbde2-1ad2-40c0-b9b7-1b5ffa8a121d\scen


DATE: 02-09-2021                           TIME: 01:20:05

USER:
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COMMENTS: ____________________________________________________________


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  **********************************************
  ** SIMULATION : 9. AES 6hr 10yr             **
  **********************************************


--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              8766663e-6d3f-4db9-a962-c49127701f86\ce5cfdff
| Ptotal= 55.69 mm |    Comments: 10yr/6hr
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.00 |  2.00   18.94 |  3.75    7.80 |  5.50    1.11
                 0.50    1.11 |  2.25   18.94 |  4.00    4.46 |  5.75    1.11
                 0.75    1.11 |  2.50   51.24 |  4.25    4.46 |  6.00    1.11
                 1.00    1.11 |  2.75   51.24 |  4.50    2.23 |  6.25    1.11
                 1.25    1.11 |  3.00   14.48 |  4.75    2.23 |
                 1.50    6.68 |  3.25   14.48 |  5.00    1.11 |
                 1.75    6.68 |  3.50    7.80 |  5.25    1.11 |

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


--------------------
| CALIB            |
| STANDHYD (  0012)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n          =      0.013        0.250

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


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    6.68 | 3.250   14.48 |  4.83    1.11
                0.167    0.00 | 1.750    6.68 | 3.333    7.80 |  4.92    1.11
                0.250    0.00 | 1.833   18.94 | 3.417    7.80 |  5.00    1.11
                0.333    1.11 | 1.917   18.94 | 3.500    7.80 |  5.08    1.11
                0.417    1.11 | 2.000   18.94 | 3.583    7.80 |  5.17    1.11
                0.500    1.11 | 2.083   18.94 | 3.667    7.80 |  5.25    1.11
                0.583    1.11 | 2.167   18.94 | 3.750    7.80 |  5.33    1.11
                0.667    1.11 | 2.250   18.94 | 3.833    4.46 |  5.42    1.11
                0.750    1.11 | 2.333   51.24 | 3.917    4.46 |  5.50    1.11
                0.833    1.11 | 2.417   51.24 | 4.000    4.46 |  5.58    1.11
                0.917    1.11 | 2.500   51.24 | 4.083    4.46 |  5.67    1.11
                1.000    1.11 | 2.583   51.24 | 4.167    4.46 |  5.75    1.11
                1.083    1.11 | 2.667   51.24 | 4.250    4.46 |  5.83    1.11
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                1.167    1.11 | 2.750   51.24 | 4.333    2.23 |  5.92    1.11
                1.250    1.11 | 2.833   14.48 | 4.417    2.23 |  6.00    1.11
                1.333    6.68 | 2.917   14.48 | 4.500    2.23 |  6.08    1.11
                1.417    6.68 | 3.000   14.48 | 4.583    2.23 |  6.17    1.11
                1.500    6.68 | 3.083   14.48 | 4.667    2.23 |  6.25    1.11
                1.583    6.68 | 3.167   14.48 | 4.750    2.23 |

     Max.Eff.Inten.(mm/hr)=      51.24        44.37
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.99 (ii)    7.82 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.24         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.35         0.03         0.380 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.75          2.75
     RUNOFF VOLUME    (mm)=      54.69        37.75         53.00
     TOTAL RAINFALL   (mm)=      55.69        55.69         55.69
     RUNOFF COEFFICIENT   =       0.98         0.68          0.95

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.6    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR( 0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0510     0.1120
                          0.0050     0.0617   |   0.0730     0.1266
                          0.0200     0.0820   |   0.0960     0.1376
                          0.0360     0.1003   |   0.1150     0.1490

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0012)      2.720     0.380      2.75      53.00
   OUTFLOW: ID= 1 (  0642)      2.720     0.050      3.75      51.84

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 13.27
                  TIME SHIFT OF PEAK FLOW         (min)= 60.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1116

-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0002)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      51.24        42.06
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                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.92         0.16         0.944 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25          2.75
     RUNOFF VOLUME    (mm)=      54.69        29.94         43.05
     TOTAL RAINFALL   (mm)=      55.69        55.69         55.69
     RUNOFF COEFFICIENT   =       0.98         0.54          0.77


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

-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0021)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                             ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN | TIME    RAIN |' TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |  hrs   mm/hr |'  hrs   mm/hr |   hrs   mm/hr
               0.083    0.00 | 1.667    6.68 | 3.250   14.48 |  4.83    1.11
               0.167    0.00 | 1.750    6.68 | 3.333    7.80 |  4.92    1.11
               0.250    0.00 | 1.833   18.94 | 3.417    7.80 |  5.00    1.11
               0.333    1.11 | 1.917   18.94 | 3.500    7.80 |  5.08    1.11
               0.417    1.11 | 2.000   18.94 | 3.583    7.80 |  5.17    1.11
               0.500    1.11 | 2.083   18.94 | 3.667    7.80 |  5.25    1.11
               0.583    1.11 | 2.167   18.94 | 3.750    7.80 |  5.33    1.11
               0.667    1.11 | 2.250   18.94 | 3.833    4.46 |  5.42    1.11
               0.750    1.11 | 2.333   51.24 | 3.917    4.46 |  5.50    1.11
               0.833    1.11 | 2.417   51.24 | 4.000    4.46 |  5.58    1.11
               0.917    1.11 | 2.500   51.24 | 4.083    4.46 |  5.67    1.11
               1.000    1.11 | 2.583   51.24 | 4.167    4.46 |  5.75    1.11
               1.083    1.11 | 2.667   51.24 | 4.250    4.46 |  5.83    1.11
               1.167    1.11 | 2.750   51.24 | 4.333    2.23 |  5.92    1.11
               1.250    1.11 | 2.833   14.48 | 4.417    2.23 |  6.00    1.11
               1.333    6.68 | 2.917   14.48 | 4.500    2.23 |  6.08    1.11
               1.417    6.68 | 3.000   14.48 | 4.583    2.23 |  6.17    1.11
               1.500    6.68 | 3.083   14.48 | 4.667    2.23 |  6.25    1.11
               1.583    6.68 | 3.167   14.48 | 4.750    2.23 |

     Max.Eff.Inten.(mm/hr)=      51.24        37.05
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       5.07 (ii)   15.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
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```
     Unit Hyd. peak  (cms)=       0.21         0.07
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.57         0.15          0.702 (iii)
     TIME TO PEAK    (hrs)=       2.75         2.92           2.75
     RUNOFF VOLUME    (mm)=      54.69        30.60          46.50
     TOTAL RAINFALL   (mm)=      55.69        55.69          55.69
     RUNOFF COEFFICIENT   =       0.98         0.55           0.83


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0658)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):    13.68   0.944     2.75    43.05
      + ID2= 2 (  0021):     6.05   0.702     2.75    46.50
        ==================================================
        ID = 3 (  0658):    19.73   1.646     2.75    44.11

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |  0.2360      0.6393
                         0.0290     0.3310    |  0.3410      0.7100
                         0.0950     0.4595    |  0.4450      0.7485
                         0.1680     0.5720    |  0.5320      0.7925

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0658)     19.730      1.646      2.75      44.11
   OUTFLOW: ID= 1 (  0645)     19.730      0.212      4.92      43.96

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 12.88
                   TIME SHIFT OF PEAK FLOW         (min)=130.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.6156

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--------------------
| CALIB            |
| STANDHYD (  0656)|   Area    (ha)=  14.51
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      51.24        39.18
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```
                 over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.84         0.18          0.876 (iii)
     TIME TO PEAK    (hrs)=       2.75         4.25           2.75
     RUNOFF VOLUME    (mm)=      54.69        28.55          40.57
     TOTAL RAINFALL   (mm)=      55.69        55.69          55.69
     RUNOFF COEFFICIENT   =       0.98         0.51           0.73

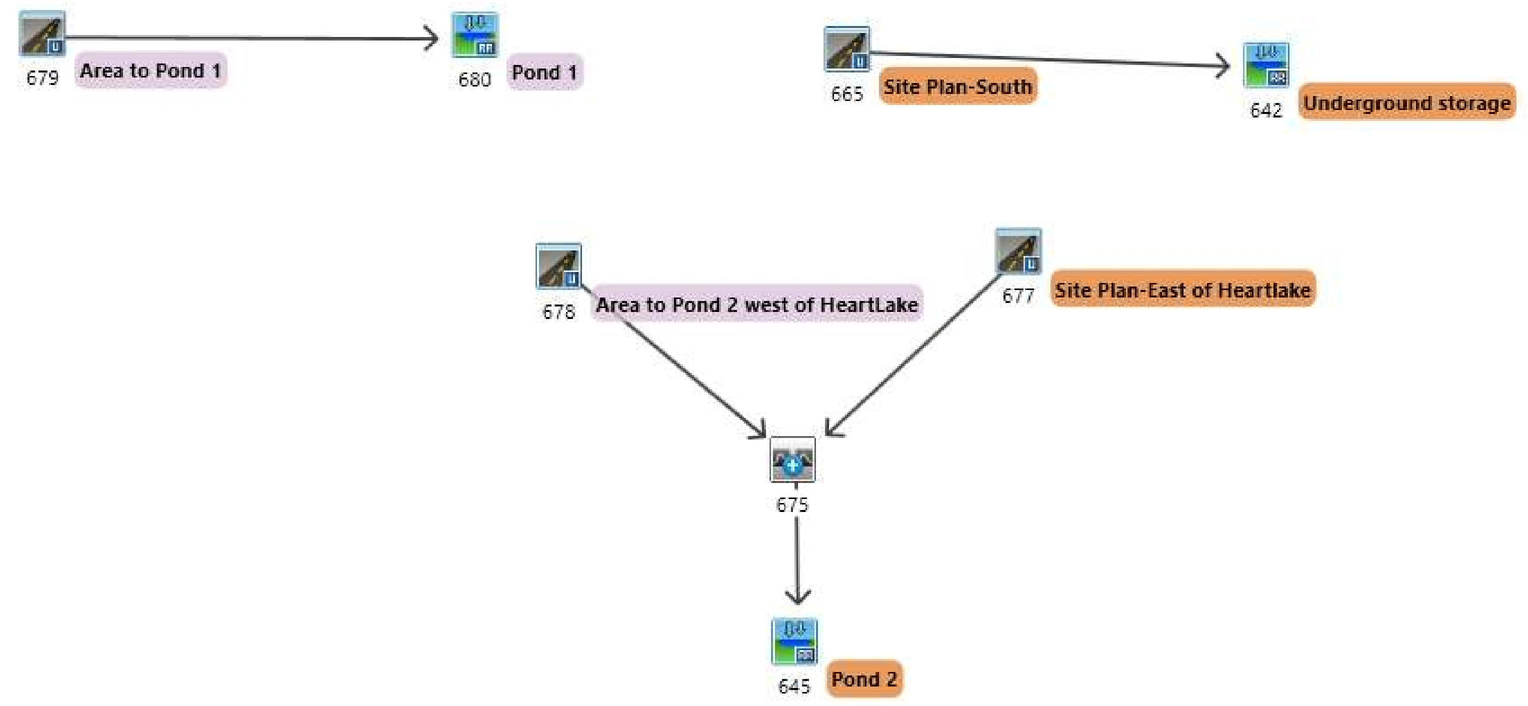

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  84.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0657)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |  0.3640      0.2594
                         0.0190     0.2147    |  0.5250      0.2723
                         0.1460     0.2350    |  0.6840      0.2789
                         0.2590     0.2500    |  0.8190      0.2863

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0656)     14.510      0.876      2.75      40.57
   OUTFLOW: ID= 1 (  0657)     14.510      0.362      3.50      40.37

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 41.34
                   TIME SHIFT OF PEAK FLOW         (min)= 45.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2594

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



SCHAEFFERS
CONSULTING ENGINEERS

Visual OTTHYMO^{TM} Schematic
Post-Development
Regional

Job #: 2019-4851	**Date: February 2021**

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====================================================================================
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       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\bcb80c80-1592-44f4-8f20-039a9462c807\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\bcb80c80-1592-44f4-8f20-039a9462c807\scen


DATE: 02-09-2021                           TIME: 01:53:18

USER:



COMMENTS: ____________________________________________________________


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  ************************************************
  ** SIMULATION : Run 62                         **
  ************************************************



--------------------
|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              bd9e8b95-ead9-4ba2-b13c-50e102ab6333\3fdc4478
| Ptotal=212.00 mm |    Comments: HAZEL
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 1.00    6.00 |  4.00   13.00 |  7.00   23.00 | 10.00   53.00
                 2.00    4.00 |  5.00   17.00 |  8.00   13.00 | 11.00   38.00
                 3.00    6.00 |  6.00   13.00 |  9.00   13.00 | 12.00   13.00

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--------------------
| CALIB            |
| STANDHYD (  0679)|   Area    (ha)=  14.51
```

```
|ID= 1 DT=15.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  46.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.84         6.67
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     311.02        40.00
     Mannings n          =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        61.44
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.96         0.70            1.378 (iii)
     TIME TO PEAK    (hrs)=      10.00        11.50           10.00
     RUNOFF VOLUME    (mm)=     211.00       190.49          199.92
     TOTAL RAINFALL   (mm)=     212.00       212.00          212.00
     RUNOFF COEFFICIENT   =       1.00         0.90            0.94


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  92.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| RESERVOIR( 0680)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.5250      0.2723
                          0.0190     0.2147   |   0.6840      0.2789
                          0.1460     0.2350   |   0.8190      0.2863
                          0.2590     0.2500   |   1.7850      0.2864
                          0.3640     0.2594   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK        R.V.
                                (ha)     (cms)     (hrs)        (mm)
```

```
   INFLOW : ID= 2 (  0679)     14.510      1.378     10.00     199.92
   OUTFLOW: ID= 1 (  0680)     14.510      1.470     10.00     199.72

                PEAK   FLOW   REDUCTION [Qout/Qin](%)=106.64
                TIME SHIFT OF PEAK FLOW         (min)=  0.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.2850

     **** WARNING : HYDROGRAPH PEAK WAS NOT REDUCED.
                  CHECK OUTFLOW/STORAGE TABLE  OR REDUCE DT.
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0677)|   Area    (ha)=   6.05
|ID= 1 DT= 5.0 min |   Total Imp(%)=  67.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.05         2.00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     200.83        40.00
     Mannings n           =      0.013        0.250

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


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
              0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
              0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
              0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
              0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
              0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
              0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
              0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
              0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
              0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
              0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
              1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
              1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
              1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
              1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
              1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
              1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
              1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
              1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
              1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
              1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
              1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
              1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
              2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
              2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
              2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
              2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
              2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
              2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
              2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
              2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
              2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
              2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
```

```
              2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
              2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
              3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        54.12
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       5.00 (ii)   14.03 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.21         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.59         0.29         0.883 (iii)
     TIME TO PEAK    (hrs)=      10.00        10.00         10.00
     RUNOFF VOLUME    (mm)=     211.00       192.52        204.72
     TOTAL RAINFALL   (mm)=     212.00       212.00        212.00
     RUNOFF COEFFICIENT   =       1.00         0.91          0.97


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0678)|   Area    (ha)=  13.68
|ID= 1 DT=15.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.34         5.34
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.30
     Length            (m)=     301.99        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
              0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
              0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
              0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
              1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
              1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
              1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
              1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
              2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
              2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
              2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
              2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
              3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        63.29
                over (min)       15.00        30.00
     Storage Coeff.  (min)=      16.80 (ii)   97.80 (ii)
     Unit Hyd. Tpeak (min)=      15.00       105.00
     Unit Hyd. peak  (cms)=       0.07         0.01
                                                          *TOTALS*
```

```
     PEAK FLOW       (cms)=       1.04         0.58          1.390 (iii)
     TIME TO PEAK    (hrs)=      10.00        11.50         10.00
     RUNOFF VOLUME    (mm)=     211.00       193.11        202.59
     TOTAL RAINFALL   (mm)=     212.00       212.00        212.00
     RUNOFF COEFFICIENT   =       1.00         0.91          0.96


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  93.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0675)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0677):     6.05   0.883    10.00   204.72
      + ID2= 2 (  0678):    13.68   1.390    10.00   202.59
        ==================================================
        ID = 3 (  0675):    19.73   2.272    10.00   203.24

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0645)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.3410      0.7100
                          0.0290     0.3310   |   0.4450      0.7485
                          0.0950     0.4595   |   0.5320      0.7925
                          0.1680     0.5720   |   1.5380      1.4815
                          0.2360     0.6393   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0675)     19.730     2.272     10.00     203.24
   OUTFLOW: ID= 1 (  0645)     19.730     1.537     11.17     203.04

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 67.65
                  TIME SHIFT OF PEAK FLOW         (min)= 70.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.4815

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--------------------
| CALIB            |
| STANDHYD (  0665)|   Area    (ha)=   2.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.45         0.27
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     134.66        40.00
     Mannings n           =      0.013        0.250

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

```
                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
              0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
              0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
              0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
              0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
              0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
              0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
              0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
              0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
              0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
              0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
              1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
              1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
              1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
              1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
              1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
              1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
              1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
              1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
              1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
              1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
              1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
              1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
              2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
              2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
              2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
              2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
              2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
              2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
              2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
              2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
              2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
              2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
              2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
              2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
              3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        52.87
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.94 (ii)    7.72 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.24         0.13
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.36         0.04          0.400 (iii)
     TIME TO PEAK    (hrs)=      10.00        10.00         10.00
     RUNOFF VOLUME    (mm)=     211.00       199.43        209.84
     TOTAL RAINFALL   (mm)=     212.00       212.00        212.00
     RUNOFF COEFFICIENT   =       1.00         0.94          0.99

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  97.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

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------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0642)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0730     0.1266
                          0.0050     0.0617   |   0.0960     0.1376
                          0.0200     0.0820   |   0.1150     0.1490
                          0.0360     0.1003   |   0.3350     0.1968
                          0.0510     0.1120   |   0.0000     0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0665)      2.720      0.400     10.00     209.84
   OUTFLOW: ID= 1 (  0642)      2.720      0.334     10.08     208.69

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 83.53
                   TIME SHIFT OF PEAK FLOW         (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1968

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 FINISH
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APPENDIX D: WATER BALANCE CALCULATIONS

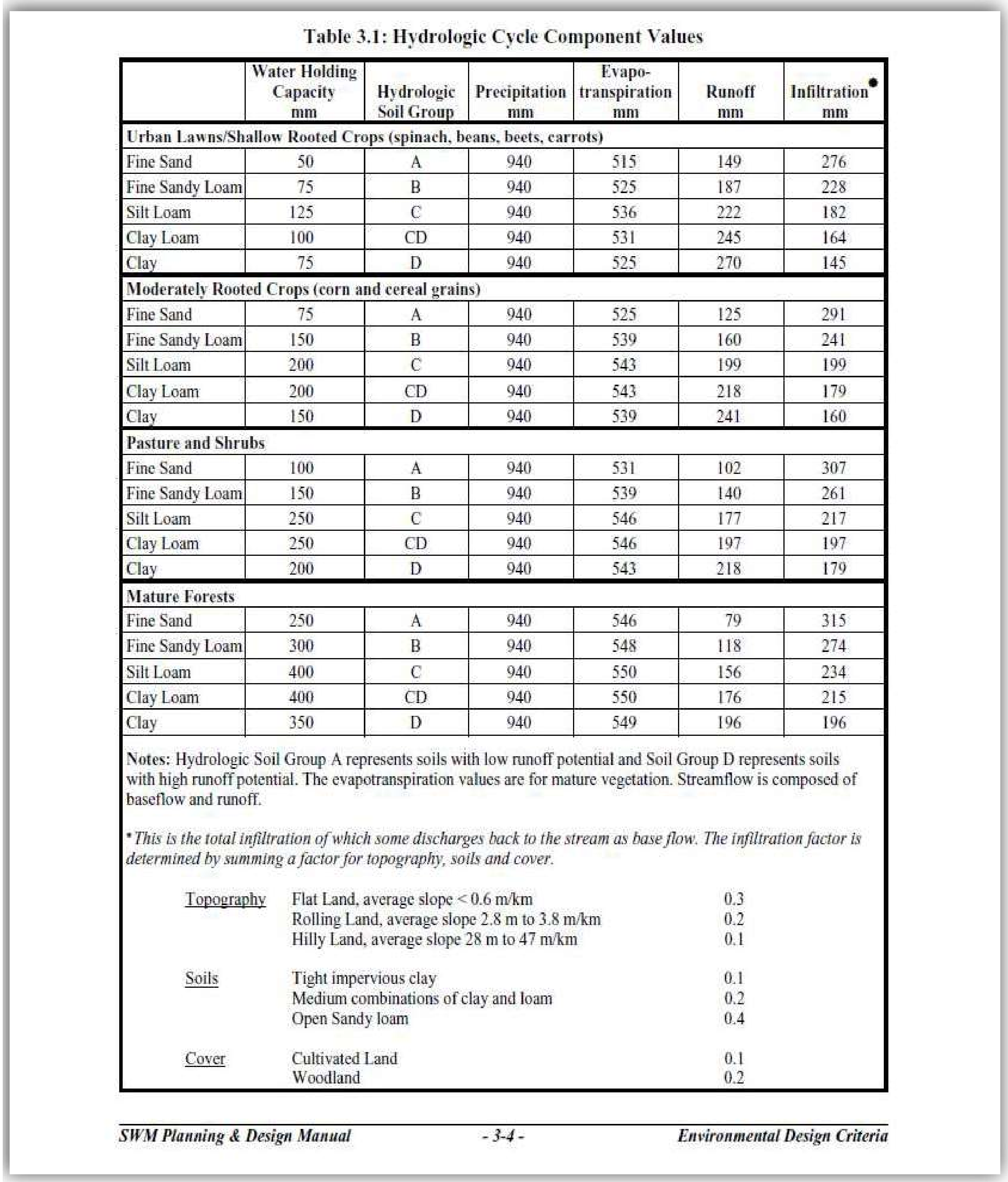


Table 3.1: Hydrologic Cycle Component Values

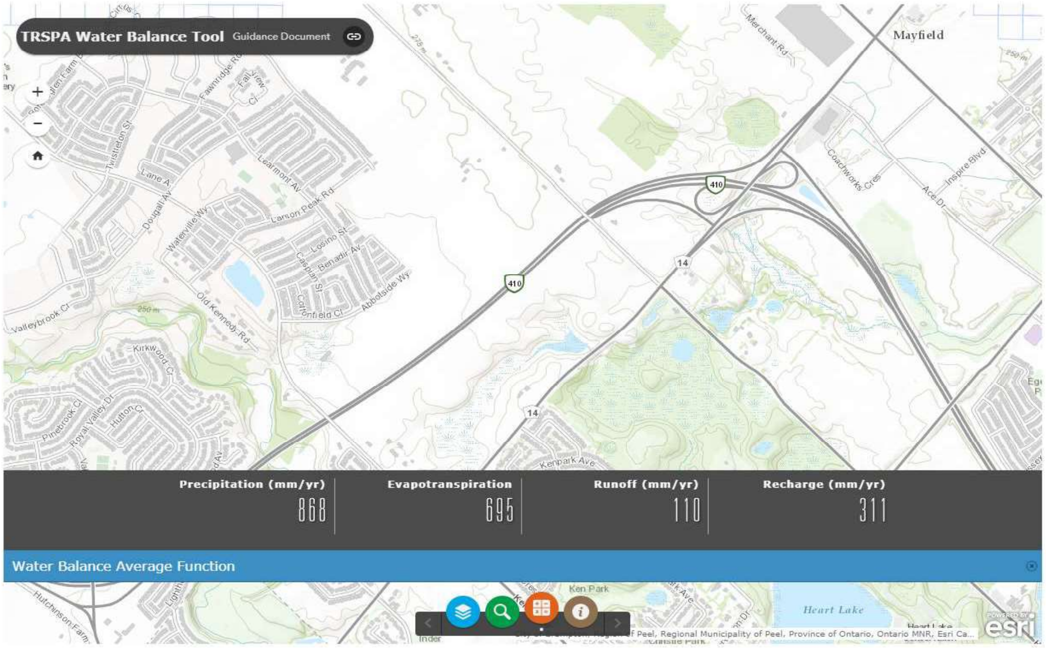
	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration• mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

• *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

TRSPA WATER BALANCE TOOL



Precipitation (mm/yr) 868

Evapotranspiration 695

Runoff (mm/yr) 110

Recharge (mm/yr) 311

Water Balance Average Function

	mm/year	%
Input:		
Precip	868	100%
Output:		
Evavp	695	62%
Runoff	110	10%
Recharge	311	28%
Total Output	1116	100%

	mm/year	%
Input:		
Precip	868	100%
Output:		
Evavp	541	62%
Runoff	86	10%
Recharge	242	28%
Total Output	868	100%

TABLE 1: WATER BUDGET - PRE DEVELOPMENT
WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	Drainage Area 1			Drainage Area 2	Drainage Area 3	
	Natural Feature Area	Imperviousness	Agricultural and Meadow	Agricultural and Meadow	Agricultural and Meadow	Total
Area (m^2)	241000	1980	219020	126000	29000	617000
Pervious Area (m^2)	241000	0	219020	126000	29000	615020
Impervious Area (m^2)	0	1980	0	0	0	1980
Infiltration Factors						
Topography Infiltration Factor (Rolling Land)	0.2	N/A	0.2	0.2	0.2	
Soil Infiltration Factor (Soil Type D)	0.1	N/A	0.1	0.1	0.1	
Land Cover Infiltration Factor	0.2	N/A	0.1	0.1	0.1	
MOE Infiltration Factor	0.5	N/A	0.4	0.4	0.4	
Inputs (per unit area)						
Precipitation (mm/year)	868	868	868	868	868	868
Total Inputs (mm/year)	868	868	868	868	868	868
Outputs (per unit area)						
Precipitation Surplus (mm/year)	418	781	418	418	418	419
Net Surplus (mm/year)	418	781	418	418	418	419
Downspout Disconnection Retention*	0	0	0	0	0	0
Evapotranpiration (mm/year)	450	87	450	450	450	449
Roof Evapotranspiration (mm/year)**	0	0	0	0	0	0
Rooftop Runoff Lawn Evaporation (mm/year)	0	0	0	0	0	0
Total Evapotranspiration (mm/yr)	**450**	**87**	**450**	**450**	**450**	**449**
Infiltration (mm/year)	209	0	167	167	167	183
Rooftop Infiltration (mm/year)**	0	0	0	0	0	0
Total Infiltration (mm/year)	**209**	**0**	**167**	**167**	**167**	**183**
Runoff Pervious Area (mm/year)	209	781	251	251	251	236
Runoff Impervious Area (mm/year)	0	0	0	0	0	0
Total Runoff (mm/year)	**209**	**781**	**251**	**251**	**251**	**236**
Total Outputs (mm/year)	**868**	**868**	**868**	**868**	**868**	**868**
Difference (Inputs - Outputs)	0	0	0	0	0	0
Input Volumes						
Precipitation (m^3/year)	209188	1719	190109	109368	25172	535556
Total Inputs (m^3/year)	**209188**	**1719**	**190109**	**109368**	**25172**	**535556**
Outputs (Volumes)						
Precipitation Surplus (m^3/year)	100738	1547	91550	52668	12122	258625
Net Surplus (m^3/year)	100738	1547	91550	52668	12122	258625
Downspout Disconnection Retention* (m^3/year)	0	0	0	0	0	0
Evapotranpiration (m^3/year)	108450	172	98559	56700	13050	276931
Roof Evapotranspiration (m^3/year)	0	0	0	0	0	0
Rooftop Runoff Lawn Evaporation (m^3/year)	0	0	0	0	0	0
Total Evapotranspiration (m^3/year)	**108450**	**172**	**98559**	**56700**	**13050**	**276931**
Infiltration (m^3/year)	50369	0	36620	21067	4849	112905
Rooftop Infiltration (m^3/year)	0	0	0	0	0	0
Total Infiltration (m^3/year)	**50369**	**0**	**36620**	**21067**	**4849**	**112905**
Runoff Pervious Area (m^3/year)	50369	1547	54930	31601	7273	145720
Runoff Impervious Area (m^3/year)	0	0	0	0	0	0
Total Runoff (m^3/year)	**50369**	**1547**	**54930**	**31601**	**7273**	**145720**
Total Outputs (m^3/year)	**209188**	**1719**	**190109**	**109368**	**25172**	**535556**
Difference (Inputs - Outputs)	0	0	0	0	0	0

TABLE 2: WATER BUDGET - POST DEVELOPMENT
WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation		**Area draining to Pond 1**		**Area draining to pond 2**		**Southern Area**		**Eastern Area Draining to Pond 2**		
	Natural Feature Area	Pervious Area	Impervious Area	Pervious Area	Impervious Area	Pervious Area	Impervious Area	Pervious Area	Impervious Area	Total
Area (m^2)	247400	66864	78237	53783	83017	2680	24520	19702	40798	617000
Pervious Area (m^2)	247400	66863.5	0	53782.86	0	2680	0	19702	0	390428
Impervious Area (m^2)	0	0	78236.5	0	83017.14	0	24520	0	40798	226572
Infiltration Factors										
Topography Infiltration Factor (Rolling Land)	0.2	0.2	N/A	0.2	N/A	0.2	N/A	0.2	N/A	
Soil Infiltration Factor (Soil Type D)	0.1	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	
Land Cover Infiltration Factor	0.2	0.1	N/A	0.1	N/A	0.1	N/A	0.1	N/A	
MOE Infiltration Factor	0.5	0.4	N/A	0.4	N/A	0.4	N/A	0.4	N/A	
Inputs (per unit area)										
Precipitation (mm/year	868	868	868	868	868	868	868	868	868	868
Total Inputs (mm/year)	868	868	868	868	868	868	868	868	868	868
Outputs (per unit area)										
Precipitation Surplus (mm/year)	418	418	781	418	781	418	781	418	781	551
Net Surplus (mm/year)	418	418	781	418	781	418	781	418	781	551
Downspout Disconnection Retention*	0	0	0	0	0	0	0	0	0	0
Evapotranpiration (mm/year)	450	450	87	450	87	450	87	450	87	317
Roof Evapotranspiration (mm/year)**	0	0	0	0	0	0	0	0	0	0
Rooftop Runoff Lawn Evaporation (mm/year)	0	0	0	0	0	0	0	0	0	0
Total Evapotranspiration (mm/yr)	**450**	**450**	**87**	**450**	**87**	**450**	**87**	**450**	**87**	317
Infiltration (mm/year)	209	167	0	167	0	167	0	167	0	123
Rooftop Infiltration (mm/year)**	0	0	0	0	0	0	0	0	0	0
Total Infiltration (mm/year)	**209**	**167**	**0**	**167**	**0**	**167**	**0**	**167**	**0**	123
Runoff Pervious Area (mm/year)	209	251	0	251	0	251	0	251	0	142
Runoff Impervious Area (mm/year)	0	0	781	0	781	0	781	0	781	287
Total Runoff (mm/year)	**209**	**251**	**781**	**251**	**781**	**251**	**781**	**251**	**781**	429
Total Outputs (mm/year)	**868**	**868**	**868**	**868**	**868**	**868**	**868**	**868**	**868**	868
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	0
Input Volumes										
Precipitation (m^3/year)	214743	58038	67909	46684	72059	2326	21283	17101	35413	535556
Total Inputs (m^3/year)	**214743**	**58038**	**67909**	**46684**	**72059**	**2326**	**21283**	**17101**	**35413**	**535556**
Outputs (Volumes)										
Precipitation Surplus (m^3/year)	103413	27949	61118	22481	64853	1120	19155	8235	31871	340197
Net Surplus (m^3/year)	103413	27949	61118	22481	64853	1120	19155	8235	31871	340197
Downspout Disconnection Retention* (m^3/year)	0	0	0	0	0	0	0	0	0	0
Evapotranpiration (m^3/year)	111330	30089	6791	24202	7206	1206	2128	8866	3541	195359
Roof Evapotranspiration (m^3/year)	0	0	0	0	0	0	0	0	0	0
Rooftop Runoff Lawn Evaporation (m^3/year)	0	0	0	0	0	0	0	0	0	0
Total Evapotranspiration (m^3/year)	**111330**	**30089**	**6791**	**24202**	**7206**	**1206**	**2128**	**8866**	**3541**	195359
Infiltration (m^3/year)	51707	11180	0	8992	0	448	0	3294	0	75621
Rooftop Infiltration (m^3/year)	0	0	0	0	0	0	0	0	0	0
Total Infiltration (m^3/year)	**51707**	**11180**	**0**	**8992**	**0**	**448**	**0**	**3294**	**0**	75621
Runoff Pervious Area (m^3/year)	51707	16769	0	13489	0	672	0	4941	0	87578
Runoff Impervious Area (m^3/year)	0	0	61118	0	64853	0	19155	0	31871	176998
Total Runoff (m^3/year)	**51707**	**16769**	**61118**	**13489**	**64853**	**672**	**19155**	**4941**	**31871**	264576
Total Outputs (m^3/year)	**214743**	**58038**	**67909**	**46684**	**72059**	**2326**	**21283**	**17101**	**35413**	**535556**
Difference (Inputs - Outputs)	0	0	0	0	0	0	0	0	0	**0**

Water Balance Mitigation Calculations - OPTION 1

Pre Development Infintration = 112,905 m^3/y
Post Development Infiltration = 75,621 m^3/y

Post to Pre Deficit = 37,284 m^3/y

Overall Required mitigation

36.96 ha x Annual Precipitation Depth = 37,284 m^3/year
Required Annual Precpitation Depth to meet deficit = 101 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *2.68 mm* 990.53 m^3/event
will produce an annual amount of precipitation equal to 101 mm/yr

OPTION 1 Catchment 203 will provide own site plan controls to achieve post to pre infiltration (5mm)
Infiltration trenches proposed on Low density development west of Heart lake Road
Infiltration trenches at park area

Mitigation Measures
Catchment 203 on-site controls 5,200 m^3/y
Topsoil Amendment = 0 m^3/y
Infiltration Trenches= 29,620 m^3/y

Mitgation Voulme Provided = 34,820 m^3/y
Deficit = 2,464 m^3/y 98%

Site Plan Mitigation

2.72 ha x Annual Precipitation Depth = 5,200 m^3/year
Required Annual Precpitation Depth to meet deficit = 191 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *5.00 mm* 136.00 m^3/event
will produce an annual amount of precipitation equal to 191 mm/yr

Infiltration Trenches=
Considering half the roof area

2.23 ha x Annual Precipitation Depth = 17,380 m^3/year
Required Annual Precpitation Depth to meet deficit = 781 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *27.35 mm* 608.54 m^3/event
will produce an annual amount of precipitation equal to 781 mm/yr

	8.9
Roof	4.45
Backyards	3.56
Front	0.89

Backyards

3.56 ha x Annual Precipitation Depth = 8,950 m^3/year
Required Annual Precpitation Depth to meet deficit = 251 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *6.60 mm* 234.96 m^3/event making runoff 0
will produce an annual amount of precipitation equal to 251 mm/yr

In the park area

1.31 ha x Annual Precipitation Depth = 3,290 m^3/year
Required Annual Precpitation Depth to meet deficit = 251 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *6.60 mm* 86.46 m^3/event making runoff 0
will produce an annual amount of precipitation equal to 251 mm/yr

Job: 4851

Feb-21

Infiltration Sizing Calculations for backyards - Option 1

Required Infiltration System Footprint Area

Infiltration Volume	843.50	m^3	
drawdown time	48	hours	(Based on Hydro-Geologic report- hydraulic conductivity = 10^{-6})
infiltration rate	15	mm/h	
Safety Factor	2.5		
Design Infiltration Rate	6	mm/h	MOE Eqn 4.3
Required Footprint Area	7322	m^2	

Proposed Infiltration Details - Trenches

Length=	2000	m	
Width=	1.5	m	**(2000m x 1.5m x 0.72 m)**
Trench Volume Provided=	864.00	m^3	
Required Storage Depth =	0.72	m	
Drawdown time=	48.00	hours	
Volume retained per site =	864.00	m^3	

Therefore the proposed system has the required footprint area to drain within 48 hours and will provide a retention volume that exceeds the required volume for mitigation

* Soils with Satutrated Hydraulic Conductivity = 1(10^{-6}) cm/s correlates to an infiltration rate of 15mm/h
Low Impact Development Design Manual (TRCA and CVC, 2010)

Job: 4851

Feb-21

Infiltration Sizing Calculations for Park - Option 1

Required Infiltration System Footprint Area

Infiltration Volume	86.46	m^3	
drawdown time	48	hours	(Based on Hydro-Geologic report- hydraulic conductivity = 10^{-6})
infiltration rate	15	mm/h	
Safety Factor	2.5		
Design Infiltration Rate	6	mm/h	MOE Eqn 4.3
Required Footprint Area	751	m^2	

Proposed Infiltration Details - Trenches

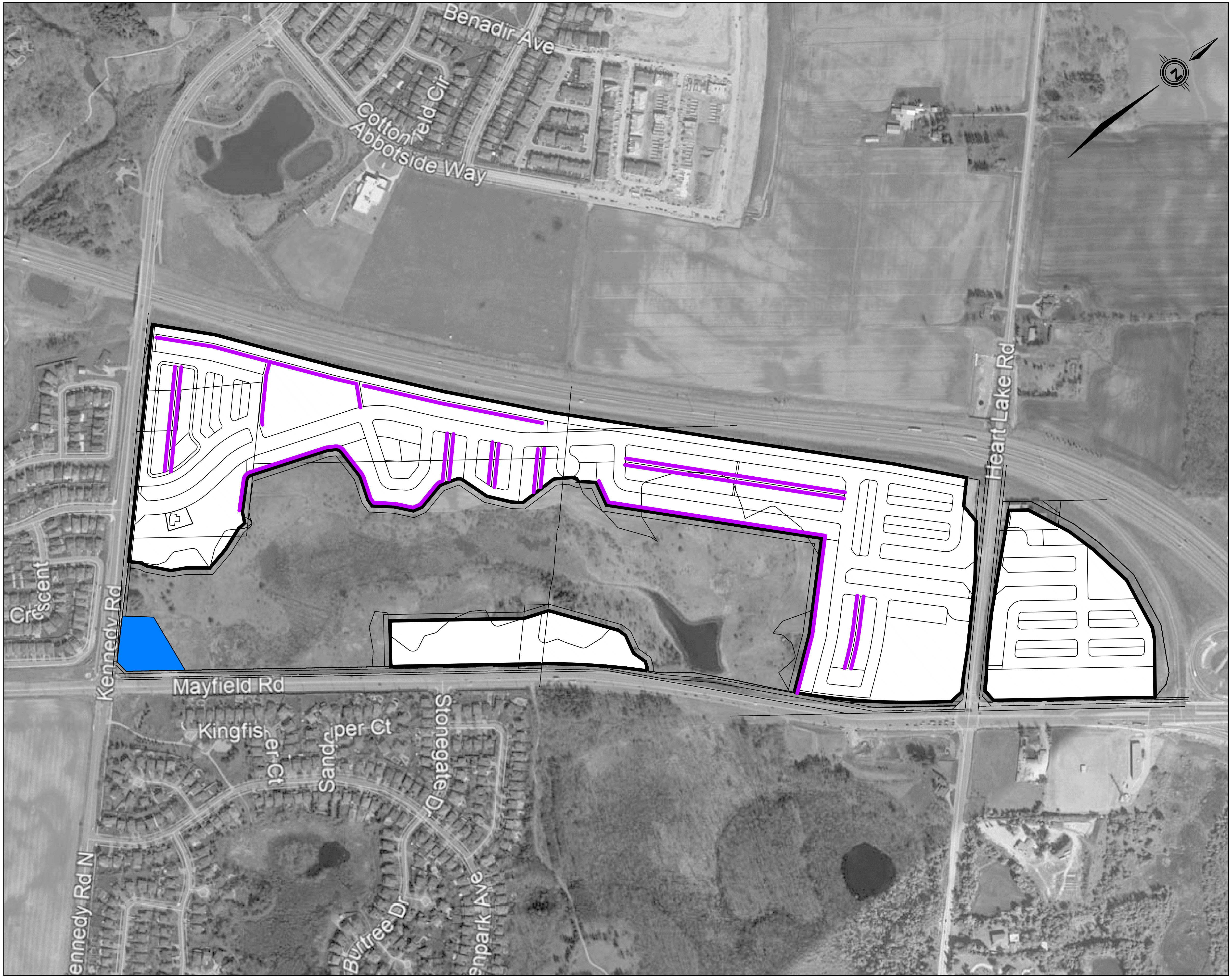
Length=	201	m	
Width=	1.5	m	**(201m x 1.5m x 0.72 m)**
Trench Volume Provided=	86.83	m^3	
Required Storage Depth =	0.72	m	
Drawdown time=	48.00	hours	
Volume retained per site =	86.83	m^3	

Therefore the proposed system has the required footprint area to drain within 48 hours and will provide a retention volume that exceeds the required volume for mitigation

* Soils with Satutrated Hydraulic Conductivity = 1(10^{-6}) cm/s correlates to an infiltration rate of 15mm/h
Low Impact Development Design Manual (TRCA and CVC, 2010)

Phil Gotfried

W:\4800's\4851 - Snells Hollow\Drawings\Servicing\2021-04-01-4851-Servicing.dwg



SNELL'S HOLLOW SECONDARY PLAN
TOWN OF CALEDON

LEGEND

☐	DEVELOPMENT BOUNDARY
—	POTENTIAL INFILTRATION TRENCH LOCATIONS

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
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FIGURE A5.1
POTENTIAL INFILTRATION LOCATION
MEASURES

2019-4851	APRIL 2021	SCALE: N.T.S.

Water Balance Mitigation Calculations - OPTION 2

Pre Development Infintration =	**112,905**	**m^3/y**
Post Development Infiltration =	**75,621**	**m^3/y**
Post to Pre Deficit =	**37,284**	**m^3/y**

Overall Required mitigation

36.96 ha x Annual Precipitation Depth = 37,284 m^3/year

Required Annual Precpitation Depth to meet deficit = 101 mm/yr

Based on this analysis, it is concluded that precipitation events of depth less than or equal to *2.68 mm* 990.53 m^3/event

will produce an annual amount of precipitation equal to 101 mm/yr

OPTION 2 Catchment 203 will provide own site plan controls to achieve post to pre infiltration

Infiltration trenches proposed on Low density development west of Heart lake Road (only for areas draining to SWM Pond 2)

Infiltration facillity proposed at the park facility

Mitigation Measures			
Catchment 203 on-site controls	**5,200**	**m^3/y**	
Infiltration Facility	**22,150**	**m^3/y**	
Infiltration Trenches=	**12,590**	**m^3/y**	
Mitgation Voulme Provided =	**39,940**	**m^3/y**	
Deficit =	**-2,656**	**m^3/y**	102%

Site Plan Mitigation

2.72 ha x Annual Precipitation Depth = 5,200 m^3/year

Required Annual Precpitation Depth to meet deficit = 191 mm/yr

Based on this analysis, it is concluded that precipitation events of depth less than or equal to *5.00 mm* 136.00 m^3/event

will produce an annual amount of precipitation equal to 191 mm/yr

Infiltration facility at the proposed park on the west

2.84 ha x Annual Precipitation Depth = 22,150 m^3/year

Required Annual Precpitation Depth to meet deficit = 781 mm/yr

Based on this analysis, it is concluded that precipitation events of depth less than or equal to *27.35 mm* 775.37 m^3/event

will produce an annual amount of precipitation equal to 781 mm/yr

	5.67
Roof	2.835
Backyards	2.268
Front	0.567

Infiltration Trenches=
For areas draining to SWM Pond 2
Considering half the roof area

1.06 ha x Annual Precipitation Depth = 8,320 m^3/year

Required Annual Precpitation Depth to meet deficit = 781 mm/yr

Based on this analysis, it is concluded that precipitation events of depth less than or equal to *27.35 mm* 291.25 m^3/event

will produce an annual amount of precipitation equal to 781 mm/yr

	4.2596
Roof	2.1298
Backyards	1.70384
Front	0.42596

Backayds

1.70 ha x Annual Precipitation Depth = 4,270 m^3/year

Required Annual Precpitation Depth to meet deficit = 251 mm/yr

Based on this analysis, it is concluded that precipitation events of depth less than or equal to *6.60 mm* 112.45 m^3/event making runoff 0

will produce an annual amount of precipitation equal to 251 mm/yr

Job: 4851
Feb-21

Infiltration Sizing Calculations for backyards - Option 2

Required Infiltration System Footprint Area

Infiltration Volume	403.70	m^3	
Number of Lots	1		
Inillftration Volume Per lot	403.70	m^3	
drawdown time	48	hours	(Based on Hydro-Geologic report- hydraulic conductivity = 10^{-6})
infiltration rate	15	mm/h	
Safety Factor	2.5		
Design Infiltration Rate	6	mm/h	MOE Eqn 4.3
Required Footprint Area	3504	m^2	

Proposed Infiltration Details - Trenches

Length=	935	m	
Width=	1.5	m	**(935m x 1.5m x 0.72 m)**
Trench Volume Provided=	403.92	m^3	
Required Storage Depth =	0.72	m	
Drawdown time=	48.00	hours	
Volume retained per site =	403.92	m^3	

Therefore the proposed system has the required footprint area to drain within 48 hours and will provide a retention volume that exceeds the required volume for mitigation

* Soils with Satutrated Hydraulic Conductivity = 1(10^{-6}) cm/s correlates to an infiltration rate of 15mm/h
Low Impact Development Design Manual (TRCA and CVC, 2010)

Job: 4851
Feb-21

Infiltration Gallery - Option 2

Required Infiltration System Footprint Area

Infiltration Volume	775.37	m^3	
drawdown time	48	hours	(Based on Hydro-Geologic report- hydraulic conductivity = 10^{-6})
infiltration rate	15	mm/h	
Safety Factor	2.5		
Design Infiltration Rate	6	mm/h	MOE Eqn 4.3
Required Footprint Area	6731	m^2	

Proposed Infiltration Details - Trenches

Area	3000	m2
Trench Volume Provided=	864.00	m^3
Required Storage Depth =	0.72	m
Drawdown time=	48.00	hours
Volume retained per site =	864.00	m^3

Therefore the proposed system has the required footprint area to drain within 48 hours and will provide a retention volume that exceeds the required volume for mitigation

* Soils with Satutrated Hydraulic Conductivity = 1(10^{-6}) cm/s correlates to an infiltration rate of 15mm/h
Low Impact Development Design Manual (TRCA and CVC, 2010)

Water Balance Mitigation Calculations - OPTION 3

Pre Development Infintration = 112,905 m^3/y
Post Development Infiltration = 75,621 m^3/y

Post to Pre Deficit = 37,284 m^3/y

Overall Required mitigation

36.96 ha x Annual Precipitation Depth = 37,284 m^3/year 0.01
Required Annual Precpitation Depth to meet deficit = 101 mm/yr 100
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *2.68 mm* 990.53 m^3/event
will produce an annual amount of precipitation equal to 101 mm/yr

OPTION 2 Catchment 203 will provide own site plan controls to achieve post to pre infiltration
Perforated CWC'S (ONLY ROOF AREAS)

Mitigation Measures
Catchment 203 on-site controls 5,200 m^3/y
Perforated CWC 32,084 m^3/y

Mitgation Voulme Provided = 37,284 m^3/y
Deficit = 0 m^3/y 100%

Site Plan Mitigation

2.72 ha x Annual Precipitation Depth = 5,200 m^3/year
Required Annual Precpitation Depth to meet deficit = 191 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *5.00 mm* 136.00 m^3/event
will produce an annual amount of precipitation equal to 191 mm/yr

Perforated CWC's (Only roofs) west of Heartlake road 12.64

Roof	6.32
Backyards	5.056
Front	1.264

6.32 ha x Annual Precipitation Depth = 32,084 m^3/year
Required Annual Precpitation Depth to meet deficit = 508 mm/yr
Based on this analysis, it is concluded that precipitation events of depth less than or equal to *14.62 mm* 923.98 m^3/event
will produce an annual amount of precipitation equal to 508 mm/yr

Job: 4851

Infiltration Sizing Calculations for CWC - Option 3

Feb-21

Required Infiltration System Footprint Area

Infiltration Volume	923.98	m^3	
drawdown time	48	hours	
infiltration rate	15	mm/h	
Safety Factor	2.5		
Design Infiltration Rate	6	mm/h	MOE Eqn 4.3
Required Footprint Area	8021	m^2	

Proposed Infiltration Details - Trenches

Dia=	300	mm		
Length=	1950	m		
Width=	1.5	m	**(1950m x 1.5m x 0.72m)**	
Porosity=	40	%		
Total Trench Volume Provided =	925	m^3		
Minimum Required Storage Depth =	0.72	m	Approx Depth of Infiltration Sy	**0.72**
Drawdown time=	48.00	hours		
Total Volume retained =	925	m^3		

Therefore the proposed system has the required footprint area to drain within 48 hours and will provide a retention volume that exceeds the required volume for mitigation

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* Soils with Satutrated Hydraulic Conductivity = $1(10^{-6})$ cm/s correlates to an infiltration rate of 15mm/h
Low Impact Development Design Manual (TRCA and CVC, 2010)

TABLE 6: WATER BUDGET -SUMMARY TABLE

Characteristics	Site				
	Total Pre-development	Post-development	Percent Change (Pre to Post)	Post-development with mitigation (OPTION 1)	Change (pre to post with mitigation) (OPTION1)
Inputs (Volumes)					
Precipitation (m^3/year)	535,556	535,556	0%	535556	0%
Total Inputs (m^3/year)	535,556	535,556	0%	535556	0%
Outputs (Volumes)					
Precipitation surplus (m^3/year)	258,625	340,197	24%	340197	24%
Net Surplus (m^3/year	258,625	340,197	24%	340197	24%
Total Evapotranspiration (m^3/year)	276,931	195,359	-42%	195359	-42%
Total Infiltration (m^3/year)	112,905	75,621	-49%	110441	-2%
Total Runoff (m^3/year)	145,720	264,576	45%	229756	37%
Total Outputs (m^3/year)	535,556	535,556	0%	535556	0%

Infiltration Deficit (Without mitigation)	37284	m^3/year
Infiltration Deficit (Withmitigation)	2464	m^3/year

TABLE 7: WATER BUDGET -PRE SUMMARY TABLE

Characteristics	Pre-Development Drainage Area 1	Pre-Development Drainage Area 2	Pre-Development Drainage Area 3	Site Total Pre-development
Inputs (Volumes)				
Precipitation (m^3/year)	401,016	109,368	25,172	535,556
Total Inputs (m^3/year)	401,016	109,368	25,172	535,556
Outputs (Volumes)				
Precipitation surplus (m^3/year)	193,835	52,668	12,122	258,625
Net Surplus (m^3/year	193,835	52,668	12,122	258,625
Total Evapotranspiration (m^3/year)	207,181	56,700	13,050	276,931
Total Infiltration (m^3/year)	86,989	21,067	4,849	112,905
Total Runoff (m^3/year)	106,846	31,601	7,273	145,720
Total Outputs (m^3/year)	401,016	109,368	25,172	535,556

Sarah Fanous

Subject: FW: Snell's Hollow - Site-wide Water Balance RESULTS

From: Travis Mikel [mailto:Travis.Mikel@rjburnside.com]
Sent: May 13, 2021 5:03 PM
To: Sarah Fanous <sfanous@schaeffers.com>
Cc: Koryun Shahbikian <kshahbikian@schaeffers.com>; Hannah Maciver <Hannah.Maciver@rjburnside.com>; Yashaswy Gollamudi <ygollamudi@schaeffers.com>; Sadh Katukurunde <skatukurunde@schaeffers.com>
Subject: RE: Snell's Hollow - Site-wide Water Balance RESULTS

Hi Sarah,

I decided to update the water balance calcs to include the infiltration of the 5 mm storm event from Area 203 as per your notes.

Text highlighted in blue below are the edits.

Regards,

Travis

Travis Mikel, P.Geo.
Senior Hydrogeologist
R.J. Burnside & Associates Limited | www.rjburnside.com
Office: +1 800-265-9662 Direct: +1 905-821-5944

From: Travis Mikel
Sent: Friday, May 07, 2021 3:33 PM
To: Sarah Fanous <sfanous@schaeffers.com>
Cc: Koryun Shahbikian <kshahbikian@schaeffers.com>; Hannah Maciver <Hannah.Maciver@rjburnside.com>; Yashaswy Gollamudi <ygollamudi@schaeffers.com>; Sadh Katukurunde <skatukurunde@schaeffers.com>
Subject: RE: Snell's Hollow - Site-wide Water Balance RESULTS

Thanks Sarah.

The results of our water balance calculations are presented below. It is noted that we used the climate normals (1981-2010) from The Toronto Lester B. Pearson International Airport. The data suggests an annual average precipitation volume of 786 mm and an annual average rain volume of 682 mm.

The pre-development infiltration volume is about 42,100 m^3/year.
The post-development infiltration volume without mitigation is about 28,700 m^3/year.
This suggests an infiltration target of about 13,400 m^3/year.

The proposed mitigation strategy is presented below:

Proposed Mitigation Strategy

- additional 300 mm of topsoil will be added across the developable area which reduces runoff and increases infiltration.

Catchment 201

- 1.14 ha of rear roof areas from the Detached/Semi-detached/St. Townhouses are directed to pervious areas (rear/side yards). Our calcs assume 25% of runoff volume infiltrates based on the estimation presented in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D
- Remaining rear roof runoff from above directed to rear yard trenches designed to accommodate the 27 mm storm event. The 27 mm storm event accounts for approximately 95% of all rain (i.e., 82% of all precipitation).
- Runoff from 1.82 ha of rear yards is directed to rear yard trenches designed to accommodate the 7 mm storm event. The 7 mm storm event accounts for approximately 58% of all rain (i.e., 50% of all precipitation).
- Runoff from 1.31 ha of park directed to infiltration trenches designed to accommodate the 7 mm storm event. The 7 mm storm event accounts for approximately 58% of all rain (i.e., 50% of all precipitation).

Catchment 202

- 1.09 ha of rear roof areas from the Detached/Semi-detached/St. Townhouses are directed to pervious areas (rear/side yards). Our calcs assume 25% of runoff volume infiltrates based on the estimation presented in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D
- Remaining rear roof runoff from above directed to rear yard trenches designed to accommodate the 27 mm storm event. The 27 mm storm event accounts for approximately 95% of all rain (i.e., 82% of all precipitation).
- Runoff from 1.74 ha of rear yards is directed to rear yard trenches designed to accommodate the 7 mm storm event. The 7 mm storm event accounts for approximately 58% of all rain (i.e., 50% of all precipitation).

Catchment 203

- On-site measures to infiltrate 5mm storm event from impervious surfaces. The 5 mm storm event accounts for approximately 48% of all rain (i.e., 43% of all precipitation).

Implementing the above noted strategy suggests that the post-development infiltration volume with mitigation (with LIDs) is about 52,900 m^3/year. This is an increase of about 26% over existing conditions (~10,900 m^3/year).

If you have any questions, comments or require clarification……please let me know.

Regards,

Travis

APPENDIX E: FLOODPLAIN ANALYSIS

Area Breakdown for Future Drainage Conditions

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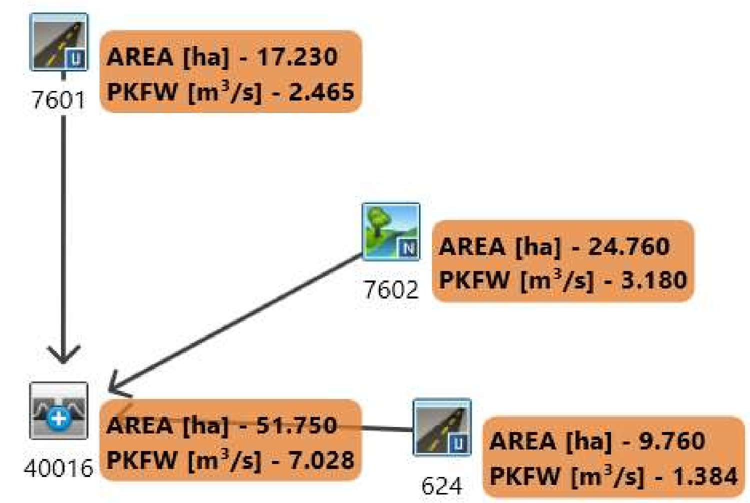
CONSULTING ENGINEERS

	Area	TIMP	XIMP	A x TIMP
Mayfield Pond	9.76	0.45	0.45	4.39
Subdivision	17.23	0.60	0.53	10.28
Open Area	24.76	0.07	0.07	1.73
	51.75	0.32	0.32	16.41

	Area	TIMP	XIMP	A x TIMP	A x XIMP
Subdivision Residential	14.51	0.54	0.46	7.84	6.67
Subdivision Commercial	2.72	0.90	0.90	2.45	2.45
Total Subdivision	17.23	0.60	0.53	10.28	9.12



SCHAEFFERS
CONSULTING ENGINEERS

Visual OTTHYMO™ Schematic

FUTURE CONDITIONS

HAZEL STORM

Job #: 2019-4851

Date: February 2021

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       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 6.1\VO2\voin.dat
  Output  filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\a2e50908-c03d-44ce-b170-a5734344bb03\scen
  Summary filename: C:\Users\sfanous\AppData\Local\Civica\VH5\4a4b2b43-29c0-4f4e-
a930-3446e1ae5bfa\a2e50908-c03d-44ce-b170-a5734344bb03\scen


DATE: 02-12-2021                           TIME: 03:04:27

USER:



COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------
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  ************************************************
  ** SIMULATION : Run 01                        **
  ************************************************


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|    READ STORM    |    Filename: C:\Users\sfanous\AppD
|                  |              ata\Local\Temp\
|                  |              1e295dad-7e03-4676-aa3a-084fecfb41c1\ef422a33
| Ptotal=212.00 mm |    Comments: * Regional Storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 1.00    6.00 |  4.00   13.00 |  7.00   23.00 | 10.00   53.00
                 2.00    4.00 |  5.00   17.00 |  8.00   13.00 | 11.00   38.00
                 3.00    6.00 |  6.00   13.00 |  9.00   13.00 | 12.00   13.00

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| CALIB            |
| NASHYD   (  7602)|   Area    (ha)=  24.76   Curve Number   (CN)= 88.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   8.90   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.43

         NOTE:  RAINFALL WAS TRANSFORMED TO  15.0 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
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Unit Hyd Qpeak  (cms)=   2.199

     PEAK FLOW       (cms)=   3.180 (i)
     TIME TO PEAK    (hrs)=  10.000
     RUNOFF VOLUME    (mm)= 172.321
     TOTAL RAINFALL   (mm)= 212.000
     RUNOFF COEFFICIENT   =   0.813

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

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| CALIB            |
| STANDHYD (  7601)|   Area    (ha)=  17.23
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      10.34         6.89
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     338.92        40.00
     Mannings n          =      0.013        0.250

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


                             ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
                0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
                0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
                0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
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                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
                0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
                1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
                1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
                1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
                1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
                2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
                2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
                2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
                2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        60.64
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       6.85 (ii)   15.47 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.18         0.07
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.34         1.12          2.465 (iii)
     TIME TO PEAK    (hrs)=      10.00        10.00         10.00
     RUNOFF VOLUME    (mm)=     211.00       181.93        197.34
     TOTAL RAINFALL   (mm)=     212.00       212.00        212.00
     RUNOFF COEFFICIENT   =       1.00         0.86          0.93


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| STANDHYD (  0624)|   Area    (ha)=   9.76
|ID= 1 DT= 5.0 min |   Total Imp(%)=  45.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.39         5.37
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     255.08        40.00
     Mannings n          =      0.013        0.250
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         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    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
               0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
               0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
               0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
               0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
               0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
               0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
               0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
               0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
               0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
               0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
               1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
               1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
               1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
               1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
               1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
               1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
               1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
               1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
               1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
               1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
               1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
               1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
               2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
               2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
               2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
               2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
               2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
               2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
               2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
               2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
               2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
               2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
               2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
               2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
               3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        51.17
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       5.78 (ii)   15.00 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.20         0.07
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.65         0.74          1.384 (iii)
     TIME TO PEAK    (hrs)=      10.00        10.00         10.00
     RUNOFF VOLUME    (mm)=     211.00       177.33        192.48
     TOTAL RAINFALL   (mm)=     212.00       212.00        212.00
     RUNOFF COEFFICIENT   =       1.00         0.84          0.91


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  88.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
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--------------------
| ADD HYD  ( 40016)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0624):     9.76   1.384    10.00   192.48
      + ID2= 2 (  7601):    17.23   2.465    10.00   197.34
        ==================================================
        ID = 3 ( 40016):    26.99   3.849    10.00   195.58

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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--------------------
| ADD HYD  ( 40016)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 ( 40016):    26.99   3.849    10.00   195.58
      + ID2= 2 (  7602):    24.76   3.180    10.00   172.32
        ==================================================
        ID = 1 ( 40016):    51.75   7.028    10.00   184.45

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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 FINISH
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HEC-RAS Plan: Existing Floodplain River: Sells Trib-Etob Reach: Snells Trib

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)	
Snells Trib	1082.8	100 Year 6hr AES	5.30	257.03	263.31	256.29	263.31	0.000000	0.01	1062.43	201.73	0.00
Snells Trib	1082.8	Regional	12.87	257.03	263.43	256.41	263.43	0.000000	0.02	1086.88	203.66	0.00
Snells Trib	1061.1	100 Year 6hr AES	5.30	256.09	263.31	256.39	263.31	0.000000	0.01	1089.12	195.27	0.00
Snells Trib	1061.1	Regional	12.87	256.09	263.43	256.51	263.43	0.000000	0.02	1112.73	196.73	0.00
Snells Trib	1012	100 Year 6hr AES	5.30	256.13	263.31	256.76	263.31	0.000000	0.01	761.28	146.60	0.00
Snells Trib	1012	Regional	12.87	256.13	263.43	256.95	263.43	0.000000	0.02	779.82	157.44	0.00
Snells Trib	1011	100 Year 6hr AES	5.30	256.03	263.31	256.26	263.31	0.000000	0.01	1103.19	255.01	0.00
Snells Trib	1011	Regional	12.87	256.03	263.43	256.39	263.43	0.000000	0.02	1134.00	255.71	0.00
Snells Trib	1010	100 Year 6hr AES	5.30	256.24	263.31	256.35	263.31	0.000000	0.01	1434.40	282.89	0.00
Snells Trib	1010	Regional	12.87	256.24	263.43	256.43	263.43	0.000000	0.01	1468.64	284.63	0.00
Snells Trib	1009	100 Year 6hr AES	5.30	256.06	263.31		263.31	0.000000	0.01	770.23	197.44	0.00
Snells Trib	1009	Regional	12.87	256.06	263.43		263.43	0.000000	0.02	794.19	199.71	0.00
Snells Trib	1008	100 Year 6hr AES	5.30	256.06	263.31		263.31	0.000000	0.01	783.29	164.06	0.00
Snells Trib	1008	Regional	12.87	256.06	263.43		263.43	0.000000	0.02	803.16	165.46	0.00
Snells Trib	1007	100 Year 6hr AES	5.30	256.06	263.31		263.31	0.000000	0.01	571.06	107.26	0.00
Snells Trib	1007	Regional	12.87	256.06	263.43		263.43	0.000000	0.03	584.09	108.95	0.00
Snells Trib	1006	100 Year 6hr AES	5.30	255.93	263.31		263.31	0.000000	0.01	646.85	118.85	0.00
Snells Trib	1006	Regional	12.87	255.93	263.43		263.43	0.000000	0.02	661.26	120.16	0.00
Snells Trib	1005	100 Year 6hr AES	5.30	255.93	263.31		263.31	0.000000	0.02	511.46	117.63	0.00
Snells Trib	1005	Regional	12.87	255.93	263.43		263.43	0.000000	0.04	525.74	119.41	0.00
Snells Trib	1004	100 Year 6hr AES	5.30	255.90	263.31		263.31	0.000000	0.02	355.48	78.98	0.00
Snells Trib	1004	Regional	12.87	255.90	263.43		263.43	0.000001	0.05	365.20	82.15	0.01
Snells Trib	1003	100 Year 6hr AES	5.30	255.58	263.31		263.31	0.000000	0.02	424.92	80.04	0.00
Snells Trib	1003	Regional	12.87	255.58	263.43		263.43	0.000000	0.04	434.62	80.94	0.00
Snells Trib	1002	100 Year 6hr AES	5.30	255.58	263.31	255.70	263.31	0.000000	0.01	1077.19	196.23	0.00
Snells Trib	1002	Regional	12.87	255.58	263.43	255.80	263.43	0.000000	0.02	1100.89	197.19	0.00
Snells Trib	1001.5	100 Year 6hr AES	5.30	255.15	263.31		263.31	0.000000	0.01	801.53	131.78	0.00
Snells Trib	1001.5	Regional	12.87	255.15	263.43		263.43	0.000000	0.02	817.46	132.60	0.00
Snells Trib	1001.2	100 Year 6hr AES	5.30	255.45	263.31		263.31	0.000000	0.01	744.48	133.92	0.00
Snells Trib	1001.2	Regional	12.87	255.45	263.43		263.43	0.000000	0.02	760.88	137.47	0.00
Snells Trib	1001	100 Year 6hr AES	5.30	255.48	263.31	256.21	263.31	0.000000	0.03	329.65	146.11	0.00
Snells Trib	1001	Regional	12.87	255.48	263.43	256.59	263.43	0.000001	0.06	338.24	147.52	0.01
Snells Trib	1000.6		Culvert									
Snells Trib	1000	100 Year 6hr AES	5.30	254.35	255.19	255.19	255.37	0.140352	1.90	2.79	52.54	1.01
Snells Trib	1000	Regional	12.87	254.35	255.48	255.48	255.81	0.113133	2.54	5.06	63.50	1.00
Snells Trib	999.46	100 Year 6hr AES	5.30	253.49	254.05	253.76	254.07	0.007301	0.48	11.03	26.10	0.24
Snells Trib	999.46	Regional	12.87	253.49	254.59	253.91	254.60	0.003305	0.45	29.18	49.81	0.17
Snells Trib	999.05	100 Year 6hr AES	13.34	253.05	254.05	253.22	254.05	0.000082	0.08	175.31	229.59	0.03
Snells Trib	999.05	Regional	32.36	253.05	254.59	253.32	254.59	0.000083	0.11	299.41	233.21	0.03
Snells Trib	998	100 Year 6hr AES	13.34	253.05	254.05	253.12	254.05	0.000033	0.06	237.71	248.01	0.02
Snells Trib	998	Regional	32.36	253.05	254.59	253.18	254.59	0.000045	0.09	372.86	256.97	0.02
Snells Trib	997	100 Year 6hr AES	13.34	253.05	254.05		254.05	0.000020	0.04	310.40	334.69	0.01
Snells Trib	997	Regional	32.36	253.05	254.58		254.58	0.000026	0.07	492.03	345.01	0.02
Snells Trib	995.76	100 Year 6hr AES	13.34	253.05	254.04		254.04	0.000123	0.11	123.69	132.74	0.04
Snells Trib	995.76	Regional	32.36	253.05	254.57		254.57	0.000165	0.17	196.44	140.85	0.04
Snells Trib	995.05	100 Year 6hr AES	13.34	253.05	254.03		254.03	0.000233	0.15	92.80	105.49	0.05
Snells Trib	995.05	Regional	32.36	253.05	254.55		254.56	0.000299	0.23	150.92	113.78	0.06
Snells Trib	994	100 Year 6hr AES	13.34	252.72	254.02		254.02	0.000024	0.05	267.07	258.34	0.02
Snells Trib	994	Regional	32.36	252.72	254.54		254.54	0.000036	0.08	403.50	262.53	0.02
Snells Trib	993.45	100 Year 6hr AES	13.34	253.02	253.99	253.37	254.00	0.003906	0.57	23.66	28.52	0.19
Snells Trib	993.45	Regional	32.36	253.02	254.47	253.63	254.51	0.005055	0.87	38.41	32.09	0.24
Snells Trib	993	100 Year 6hr AES	13.34	252.90	253.68	253.27	253.70	0.006257	0.56	24.01	40.71	0.23
Snells Trib	993	Regional	32.36	252.90	254.14	253.48	254.17	0.005447	0.73	44.29	46.49	0.23

HEC-RAS Plan: Existing Floodplain River: Sells Trib-Etob Reach: Snells Trib (Continued)

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)	
Snells Trib	992	100 Year 6hr AES	13.34	251.66	252.93	252.33	252.94	0.004976	0.60	22.60	31.99	0.22
Snells Trib	992	Regional	32.36	251.66	253.55	252.63	253.58	0.003641	0.76	46.76	50.50	0.20
Snells Trib	991	100 Year 6hr AES	13.34	250.79	252.62		252.63	0.002648	0.51	26.57	29.09	0.16
Snells Trib	991	Regional	32.36	250.79	253.28		253.30	0.002595	0.69	49.23	38.20	0.17
Snells Trib	990.7	100 Year 6hr AES	13.34	250.71	252.42		252.43	0.001964	0.55	29.38	34.16	0.15
Snells Trib	990.7	Regional	32.36	250.71	253.07		253.09	0.002147	0.74	55.98	46.49	0.17
Snells Trib	990.2	100 Year 6hr AES	13.34	250.38	251.43	251.42	251.70	0.094368	2.34	6.05	11.28	0.91
Snells Trib	990.2	Regional	32.36	250.38	251.90	251.90	252.31	0.077224	3.00	12.35	15.86	0.90
Snells Trib	990	100 Year 6hr AES	13.34	249.72	250.25	250.02	250.26	0.008794	0.41	32.90	116.99	0.24
Snells Trib	990	Regional	32.36	249.72	250.59	250.14	250.60	0.003333	0.34	95.17	211.48	0.16

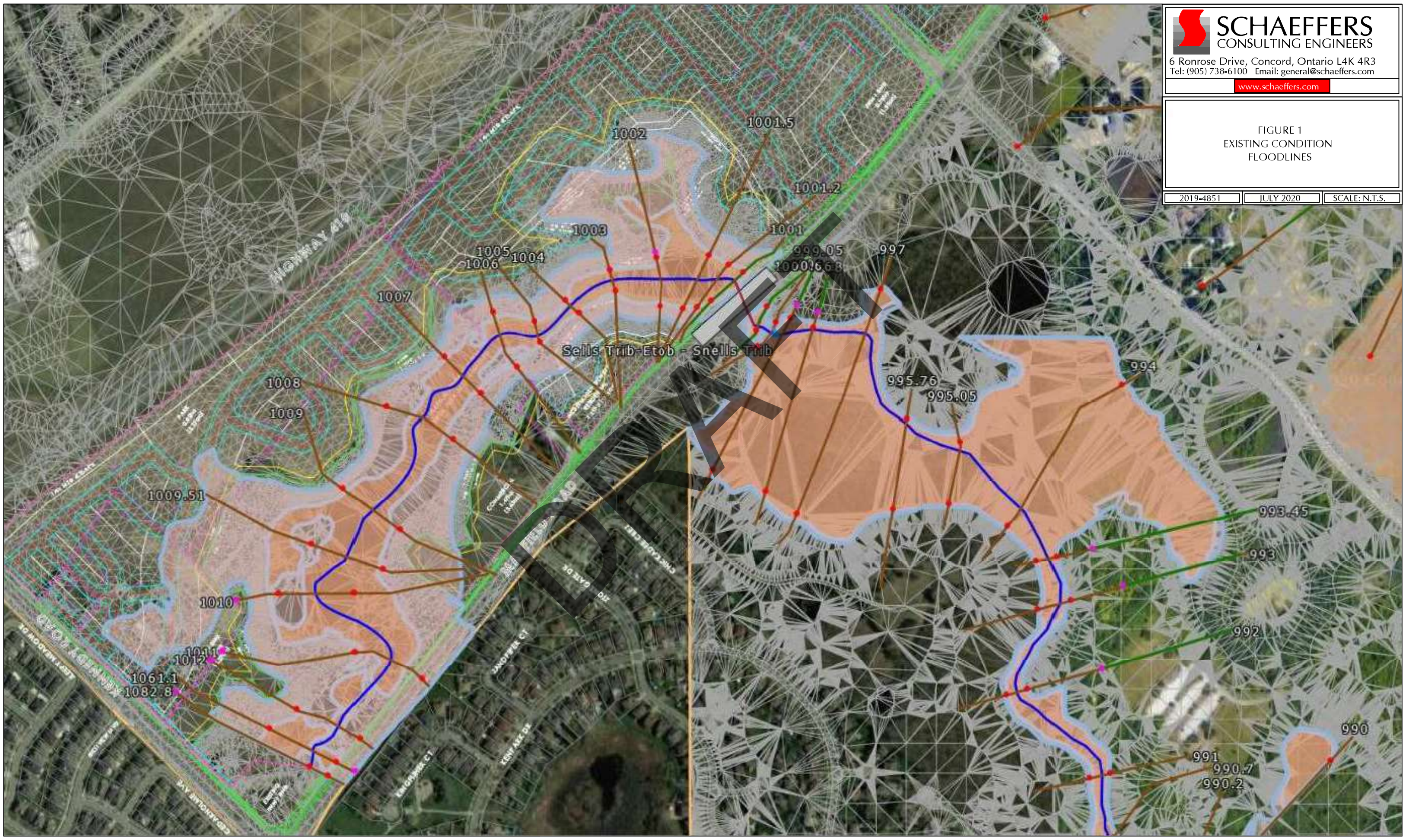

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FIGURE 1
EXISTING CONDITION
FLOODLINES

2019-4851	JULY 2020	SCALE: N.T.S.

APPENDIX F: ADDITIONAL BACKGROUND INFORMATION

See Attached CD for the following Reports:

- Kennedy Pond-Stormwater Management Facility Retrofit, Mayfield Road and Kennedy Road, dated May 2017, by GHD
- Snell's Hollow East Secondary Plan Baseline Conditions Report-2019, dated August 2020, by RJ Burnside

APPENDIX G: ENGINEERING DRAWINGS