30% Draft Report

Environmental Study and Stormwater Management Report

Stormwater Management Pond #16 and Leash Free Dog Park

12889 Coleraine Drive, Bolton, ON

Prepared for Town of Caledon
by IBI Group
IBI Project Number 131046 | 2020-0086
February 2022

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February 18, 2022
Reference 131046 | 2020-0086

Cassie Schembri, Senior Project Manager
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6311 Old Church Road
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Attention: Cassie Schembri

Storm Water Pond #16 and Leash Free Dog Park Retrofit Study
Environmental Study and Stormwater Management Report

We are pleased to provide the 30% Draft Environmental Study and Stormwater Management Report for the above noted project. Please review and provide comments in preparation for the 30 day public comment period.

Best Regards,

IBI GROUP LTD.

Roy Johnson, M. A. Sc., P. Eng.
Project Manager, Water Resources Team Lead
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RJ/kjs

Document Control Page

CLIENT:	Town of Caledon
PROJECT NAME:	Storm Water Pond #16 and Leash Free Dog Park Retrofit Study
REPORT TITLE:	Environmental Study and Stormwater Management Report
IBI REFERENCE:	131046 | 2020-0083
VERSION:	Issued for 30% Submission
DIGITAL MASTER:	\\caneast.ibigroup.com\J\TO\2020-0086\400_Tchncl\70_Rprts\WTR_2020-0086_dft_2022-02-18.docx
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CIRCULATION LIST:	
HISTORY:	30% Draft For Review – February 18, 2022

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Executive Summary

IBI Group has been retained by the Town of Caledon (the Town) to provide the detailed design of the retrofit of the Marconi Court Storm Water Management (SWM) Facility #16 (SWMF/Pond 16) located on the west side of Coleraine Drive between Marconi Court and Wheeler Drive in Bolton, and the redesign of the existing dog park adjacent to the SWMF. Refer to **Figure 1-1** Location Plan.

The overall goal of the Work is to retrofit the SWMF to improve the overall function of the facility and, if possible, determine if the facility can be improved to include "enhanced level of protection" (80% SS removal).

The existing SWMF is a dry pond that was designed to provide 100-year quantity control; however, the facility is over 40 years old and has not received required maintenance over its life.

Through further investigation and public consultation, it was determined that the primary objective of the project should be to maximize available detention storage. The project team has completed a Municipal Class Environmental Assessment Schedule A+ to complete a full clean-out and regrading of the SWMF to maximize the available detention storage.

As part of this work, the Town is also looking to complete improvements drainage improvements to the leash free dog park, located next to the Caledon Animal Shelter, having municipal address as 12889 Coleraine Drive, Bolton.

Further discussions determined that a retrofit to maximize available detention storage (without a Permanent Pool) was the new objective.

The Town is also looking for investigation for the drainage issues in the leash free dog park and retrofitting the same, located next to Caledon Animal Shelter, having municipal address as 12889 Coleraine Drive, Bolton.

1 Introduction/Background

IBI Group has been retained by the Town of Caledon [The Town] to provide the detailed design of the retrofit of the Marconi Court Storm Water Management (SWM) Facility #16 (SWMF) located on the west side of Coleraine Drive between Marconi Court and Wheeler Drive in Bolton, and the redesign of the existing dog park adjacent to the SWMF. Refer to **Figure 1-1** Location Plan.

The overall goal of the Work is to retrofit the SWMF to improve the overall function of the facility and, if possible, determine if the facility can be improved to include "enhanced level of protection" (80% SS removal).

The existing SWMF is a dry pond that was designed to provide 100-year quantity control; however, the facility is over 40 years old and has not received required maintenance over its life.

Through further investigation and public consultation, it was determined that the primary objective of the project should be to maximize available detention storage. The project team has completed a Municipal Class Environmental Assessment Schedule A+ to complete a full clean-out and regrading of the SWMF to maximize the available detention storage.

As part of this work, the Town is also looking to complete improvements drainage improvements to the leash free dog park, located next to the Caledon Animal Shelter, having municipal address as 12889 Coleraine Drive, Bolton.

The Work includes completing a Municipal Class Environmental Assessment (“Class EA”), preliminary and detailed design, contract management and inspection services. The scope for redesign of the leash free park would include detailed design of a grading plan, paved and universally accessible path system, planting plan, shade structure, benches, water service (currently at Animal Shelter building), fencing, trash cans and dog waste bag dispensers.

The improvements are categorized as Schedule A+ under the EA Act. Schedule A is a pre-approved activity, which specifically includes works that “establish new or replace or expand existing stormwater detention/retention ponds or tanks and appurtenances including outfall to receiving water body provided all such facilities are in either an existing utility corridor or an existing road allowance where no additional property is required. NOTE – Utility corridors are not always linear, therefore expansion of a stormwater management facility is a Schedule A activity provided no additional property is required.” And A+5 “Modify, retrofit, or improve a retention / detention facility including outfall or infiltration system for the purpose of stormwater quality control.”

One Public Information Centre [PIC] is required and was held on June 23, 2021.

1.1 References

In the preparation of this report, we reviewed the following documents:

- *Development Standards Manual, Town of Caledon, Version 5.0*, 2019 [Caledon Guidelines]1
- *The Erosion and Sediment Control Guideline for Urban Construction,* prepared by the Greater Golden Horseshoe Area Conservation Authorities, dated December 2006 [ESC Guide]
- *Erosion and Sediment Control Design and Submission Requirements,* prepared by TRCA, dated September 2007 [ESC Reqts]

[1] https://www.caledon.ca/en/town-services/resources/Documents/business-planning-development/Development-Standards-Manual.pdf

- *Geotechnical Investigation, Storm Water Pond #16 and Leash Free Dog Park Retrofit, 12889 Colerain Drive, Bolton, ON*, prepared by Terraprobe, dated January 21, 2022 [Geo Report]
- *Town of Caledon Stormwater Management Master Plan, Final Study Report,* prepared by MMM Group Limited, dated June 2016 [SWMMP]
- *Storm Drainage Report for the Proposed Development of the 287187 Ontario Limited Part of Lots 5 & 6, Concession 6, Town of Caledon, prepared by Ander Engineering & Associates Limited,* dated July 1980 [Ander SWM Report]
- *Stormwater Management Criteria, prepared by Toronto and Region Conservation Authority* [TRCA], dated August 2012 [TRCA Criteria]
- *Terrestrial and Fisheries Screening Report – Town of Caledon Stormwater Management Facility and Leash-Free Dog Park Retrofit Study*, prepared by Myler Ecological Consulting, dated January 14, 2022 [Myler Report]

1.2 Existing SWM Pond Design

See **Appendix A** for a copy of the Ander SWM Report which describes the original design of the existing SWM16. Refer to **Figure 1-3** for context.

According to the Ander SWM Report, the existing pond was designed to provide post to pre quantity control for the industrial subdivision. Drainage is conveyed from the subdivision to the pond via 100-year channels. The subject property consists of 50.5ha. The 'watershed' consists of two subcatchment areas; the west catchment being 85.7ha and the east being 65.7ha [total 151.4ha].

Hydrology calculations utilized the Toronto Bloor Street data. The report established pre-development peak design flows of:

- Q10-pre = 132cfs = 3.75m^3/s
- Q100-pre = 340cfs = 9.63m^3/s

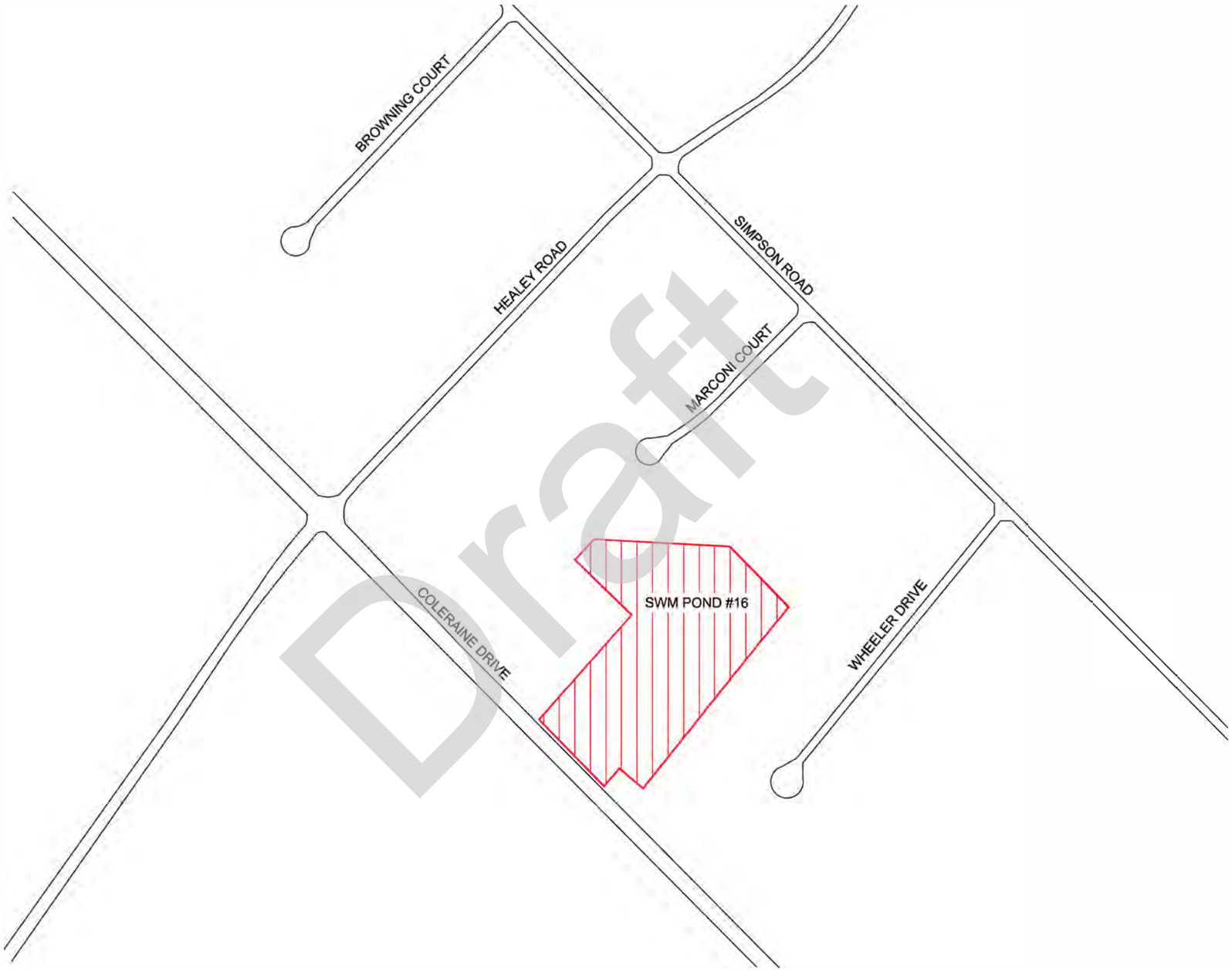
The existing SWMF outlets via two Corrugated Steel Pipes (CSPs) with wingwall and headwall under a foot bridge connecting the two dog park areas.

The pond was constructed using an earth embankment across the existing valley lands, regulated by the operation of the culverts and [then] proposed spillway. The twin 1000mm Ø culverts discharge the 10-year pre-development flow of the upstream area. The 100-year is conveyed over a spillway.

The boardwalk/bridge structure from front area to rear would need to be retained or reconstructed if changed because of SWM needs.

The Ander design assumed that building coverage was 20% of lot area and flat roof system would regulate discharge to 0.87m^3/s/ha. The confirmation of the presence and design of rooftop controls is beyond the scope of this report, therefore we will conservatively assume they are not installed.

A Peel Region sanitary sewer (375mm) bisects the pond, flowing from west to east roughly parallel to Swale 1 (See **Figure 1-2**). Based on information from Peel Region, cover of 1.2m above pipe obvert should be provided.



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LEGEND

STORMWATER MANAGEMENT POND

LOCATION PLAN

STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE:	JULY 2020	PROJECT No.:	2020-0086
SCALE:	N.T.S.	FIGURE No.:	1

Figure 1-2 Region Sanitary Sewer Alignment

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LEGEND

- DRAINAGE AREA BOUNDARY
- SWALES
- TOTAL DRAINAGE AREA
- STUDY AREA
- EXISTING STORMWATER MANAGEMENT POND
- TRCA REGULATION LIMIT

CONTEXT PLAN

STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: OCTOBER 2020	PROJECT No.: 2020-0086
SCALE: 1:6000	FIGURE No.: CON-1

1.3 Problem and Opportunity Statements

The Town has retained IBI Group to develop a retrofit design of Stormwater Management Facility 16 (SWMF16) to achieve the applicable criteria.

The Retrofit Study has been prepared in accordance with the Class EA process and is available for public review.

1.4 Study Objectives

The primary objective of the study is to provide a design for the pond retrofit to achieve SWM objectives.

1.5 Purpose of Project File

The document will be the key deliverable for the project for the implementation of future works. The document will provide the planning rationale and EA documentation required to proceed with detailed design of the recommended works. The Master Plan is expected to contain, at a minimum:

- Problem/Opportunity statement
- Documentation of all public, agency, and First Nations comments and responses
- Rationale for evaluation criteria
- Summary evaluation of alternatives

This draft EA Report is presented to the Town's staff for review and comment. After receipt of the Town's comments on the EA Report, the draft will be finalized and delivered to the Town.

The EA document includes an Executive Summary that provides a clear picture of the recommendations, and a description of how those recommendations were arrived at.

As needed, the final document will be formatted to meet the Town's AODA requirements or policies.

2 EA Planning Context

The following flow chart in **Figure 2-1** illustrates the process for the EA.

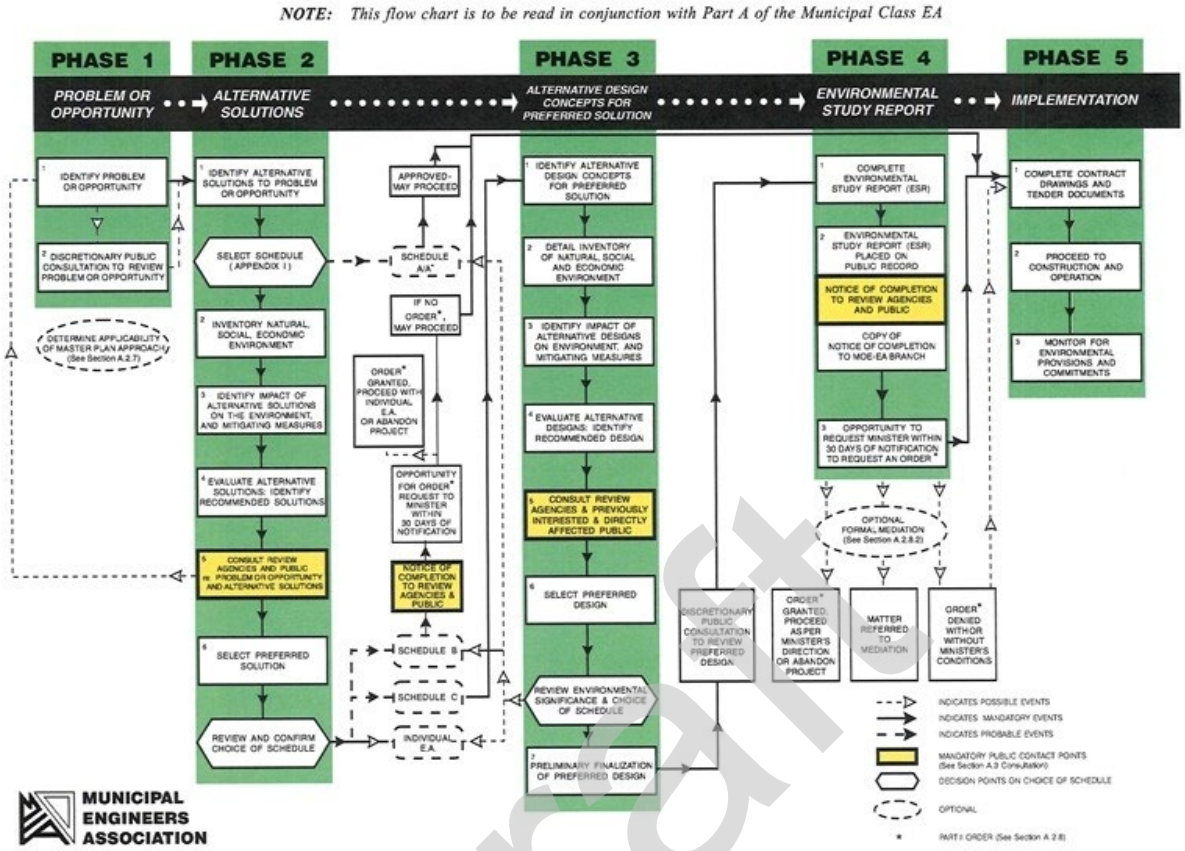


Figure 2-1 Municipal Class EA Process

3 Existing Conditions Summary

3.1 SWMF 15

Located upstream of SWMF 16 is SWMF 15. The capacity of this pond has been conservatively assumed and evaluated in the VO model. SWMF 15 overflows between the 2-year and 5-year events and is therefore not considered in the SWMF 16 design. See **Figure 3-1** for the existing catchment area.

The Town is undertaking a similar study of Pond 15 which includes assessment of its current function, development of a design to complete the necessary maintenance to reinstate full functionality and improve the level of service as best as reasonably possible.

The capacity of the existing Pond 16 has been evaluated and it currently provides minimal flow attenuation; therefore, it is not considered in the quantity control function of SWMF 16.

3.2 SWMF 16

As noted, the existing SWMF exists within an industrial subdivision, adjacent to a community Dog Park.

The surrounding catchment areas (**Table 3.1**) to the pond inlet via two swales:

- Swale 1: Located on the west side of the pond
- Swale 2: Located on the north side of the pond

There is a third swale [Swale 3] adjacent to the east side of the existing Dog Park that bypasses the pond and connects with the channel downstream of the twin 900mm Ø CSP culverts.

Table 3.1 SWMF16 Culverts

CULVERT	U/S INVERT	D/S INVERT	DIAM (MM)	LENGTH	TYPE
1	240.58	240.46	900	9.40	CMP
2	240.65	240.48	900	9.29	CMP

Drainage Areas (**Table 3.2**) can broadly be divided into:

- Catchment 1: Catchment areas that drain to Swale 1
- Catchment 2: Catchment areas that drain to Swale
- Catchment 3: The SWMF itself
- Catchment 4: Dog Park and other Catchment areas that drain to SWMF16

Refer to **Appendix B** for Existing Conditions Calculations, and **Appendix C** for Visual OTTHYMO [VO] modeling.

Table 3.2 Summary of Existing Drainage Areas and Flows

CATCHMENT ID	CATCHMENT AREA (ha)	CATCHMENT IMPERVIOUSNESS (%)	Q100 (m^3/s)
1	60.65	69	11.752
2	39.6	85	8.936
3	4.49	3	0.628
4	7.35	79	1.610
Total to Pond	**112.10**	**70**	**22.926**

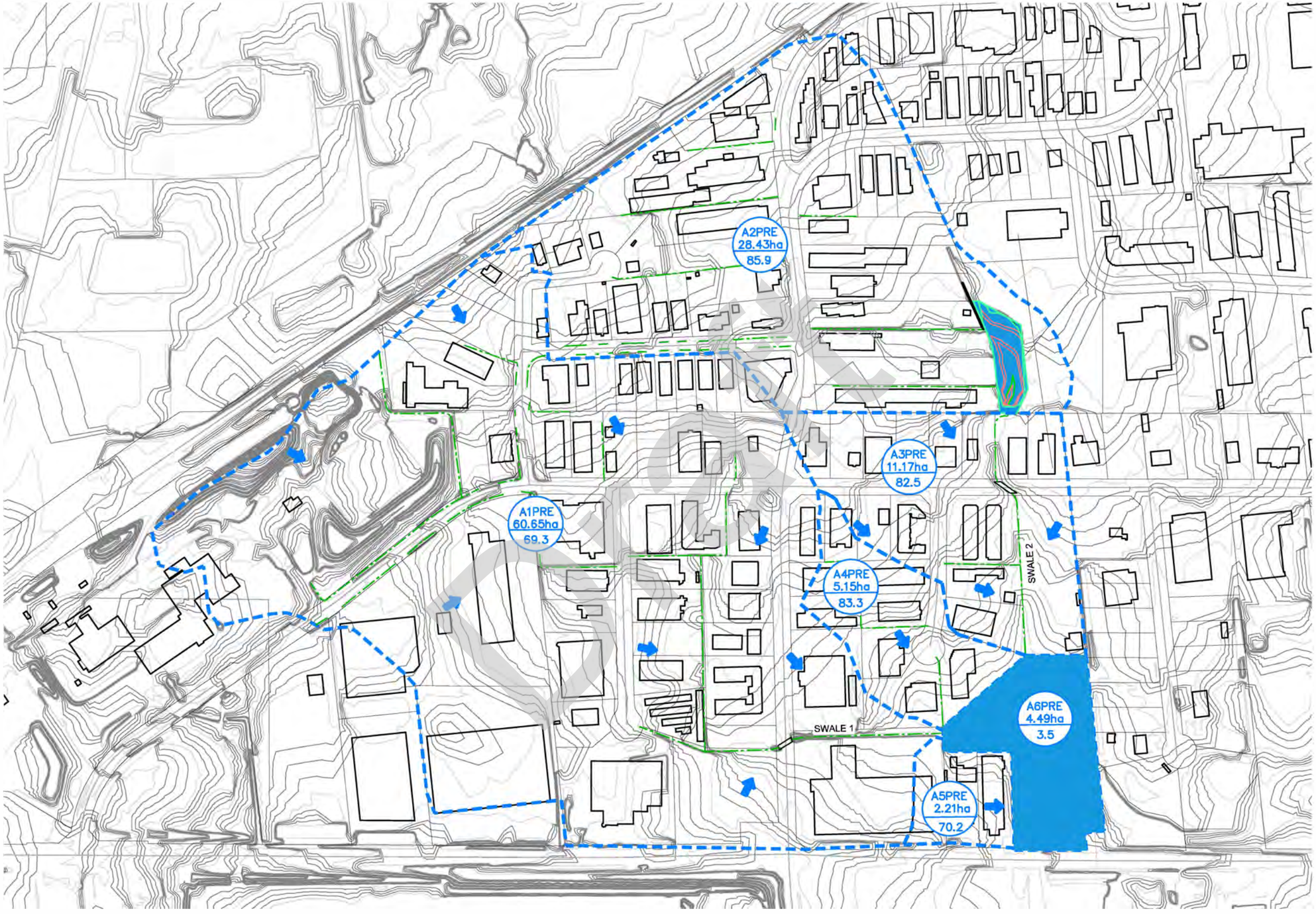
As per Drainage Area Plan and VO Modeling

3.3 SWMF16 Performance

Table 3.3 below illustrates the existing pond hydraulic performance, using the 6-hour AES Storm (See **Section 4**).

Table 3.3 Existing Pond Hydraulics Performance

RETURN PERIOD STORM (YEARS)	INFLOW (M^3/S)	OUTFLOW (M^3/S)	STORAGE USED (HA-M)
2	7.691	4.172	0.8315
5	11.878	7.264	1.4282
10	14.237	9.697	1.6658
25	17.827	14.527	1.9127
50	20.177	17.159	2.0543
100	22.926	19.973	2.2033



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LEGEND

- DRAINAGE AREA BOUNDARIES
- SWALES
- STORMWATER MANAGEMENT POND
- OVERLAND FLOW DIRECTION
- A1PRE / 62.21ha / 69.1 — DRAINAGE AREA ID; DRAINAGE AREA (HECTARES); PERCENT IMPERVIOUS (%)

PRE-DEVELOPMENT DRAINAGE AREA PLAN

STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: SEPTEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:6000	FIGURE No.: DAP-1

4 Stormwater Management Criteria

Based on a review of TRCA Regulation Mapping (**Figure 4-1**), SWMF16 discharges to the Clarkway Drive Tributary of the (West) Humber Watershed and is within a TRCA Regulated Area.

Figure 4-1 TRCA Regulation Mapping

Based on a review of the TRCA Criteria, including **Appendix A**, Table E.1, the Site is located within Sub Basin 36 (Equation F), and the following criteria listed in **Table 4.1** apply:

Table 4.1 Stormwater Management Criteria

COMPONENT	CRITERION	REFERENCES AND NOTES
Quantity Control	Control post-development peak flows to pre-development levels for all storms up to and including the 100-year storm (i.e., 2, 5, 10, 25, 50, and 100-year storms) except for the main branches of the Lower, Main, East, Upper and West Humber where no quantity control is required (see **Appendix A**) Unit flow relationships have been established (see **Appendix A**) and should be used for all other sites located in the Humber River Watershed not discharging to the main channels listed above. Development outside of the approved urban boundary when the hydrology study was finalized may require Regional storm protection, proponents should consult with TRCA staff to confirm	Hydrologic Model - SWMHYMO Return period peak flows based on 6 & 12 hours AES (basin specific - Tributary Based Control Strategy) Hydrology Study: - "Humber River Watershed Hydrology Update" (Aquafor Beech Ltd., Nov. 2002) Using Basin 36, Equation F yields the following Q_{100} = 29.912 – 2.316*ln(A) Q_{50} = 26.566-2.082*ln(A) Q_{25} = 22.639-1.741*ln(A) Q_{10} = 17.957-1.373*ln(A) Q_{5} = 14.652-1.136*ln(A) Q_{2} = 9.506-0.719*ln(A) Where Q – Unit Flow (L/s/ha), A – Area in hectares (ha)

Table 4.1 Stormwater Management Criteria

COMPONENT	CRITERION	REFERENCES AND NOTES
Erosion Control	As a minimum, where conditions do not warrant the detailed analyses described in **Section 4.2**, TRCA requires on-site retention of 5mm. For sites with SWM pond, extended detention of the 25mm event for a period of 48 hours may also be required, depending on the results of the erosion assessment.	Confirmed with RCA
Quality Control	All watercourses and water bodies within TRCA's jurisdiction are classified as requiring an Enhanced level of water quality protection, equivalent to 80% TSS removal.	

[Source: TRCA Criteria]

The Town met with TRCA on March 22, 2021, and the project team subsequently confirmed through written correspondence, that because there are no flooding concerns in the area, TRCA advised that the original design of the facility is grandfathered. All efforts possible are being taken within this project to improve the stormwater level of service.

4.1 TRCA Submission Requirements

In addition, the TRCA requirements below for a complete submission for the Storm Water Pond and Dog Park Retrofit O.Reg. 166/06 permit are:

- A signed application form which can be obtained from the following website: https://trca.ca/app/uploads/2016/11/EA-Permit-Application-Form-October-2016.pdf.
- Please show/state where the access routes and staging areas will be.
- State the duration of work and method of installation.
- Please state/show how the proposed works will mimic or enhance existing conditions as per Jairo Morelli's email dated June 26, 2020.
- If required, please provide a dewatering plan.
- Erosion and sediment controls and details.
- Restoration of disturbed areas (compensation related to removals) - ID vegetation removals.
- Applicable standard notes http://www.trca.on.ca/dotAsset/93458.pdf.
- Landowner authorization on the City/Region letterhead and a copy of all landowner agreements.
- Review fees: Please note that this fee will be confirmed after review of the scope of work and plans.
- Please submit all material in digital format only at this time. Please also ensure that the drawings are stamped by a licensed professional engineer.

4.2 IDF Data

Based on Caledon Guidelines, Section 1.4.7, the Town of Caledon intensity-duration frequency curve equations are set out in **Table 4.2**.

Table 4.2 IDF Parameters

RETURN PERIOD (YEARS)	A	B	C
2	1070	0.8759	7.85
5	1593	0.8789	11
10	2221	0.9080	12
25	3158	0.9335	15
50	3886	0.9495	16
100	4688	0.9624	17

$$I = A/(t+B)^C$$

Where A, B, C as above
I = intensity (mm/hr)
t = storm duration (minutes)

Based on the unitary flow rates, drainage areas, and VO model, the following **Table 4.3** outlines the target flows for the Pond.

Table 4.3 Target Flow Rates and Storage Requirements

RETURN PERIOD	UNIT RELEASE RATE (L/s/HA)	UNIT RELEASE RATE (M^3/S/HA)	TARGET FLOW RATE (M^3/S)	STORAGE REQUIRED (HA-M)
2	6.112758	0.0061	**0.685**	**2.6123**
5	9.290771	0.0093	**1.041**	**3.9298**
10	11.47728	0.0115	**1.287**	**4.6615**
25	14.42254	0.0144	**1.617**	**5.7263**
50	16.74023	0.0167	**1.877**	**6.4383**
100	18.98189	0.0190	**2.128**	**7.2767**

As seen in the table above, approximately **72,767m^3 of detention storage** would be required to meet the original quantity control criteria.

5 Evaluation of Alternatives

5.1 Overview of Alternatives

During the initial investigation, IBI Group evaluated various pond grading options to achieve the original goal of providing a Permanent Pool and the quantity control criteria of the TRCA.

Through the initial analysis of the various options aimed at achieving the original goal, it was determined that an option that investigated providing only quantity control should also be considered.

As noted in **Section 1.2**, a sanitary trunk sewer exists within the pond block (and dog park). The Region confirms that there are no plans to relocate the sanitary sewer, therefore it is a design constraint.

5.2 Pond Grading Options

The following sections describe the grading options evaluated by IBI Group and shown on **Figure 5-1 to 5-8**.

5.2.1 Option 1

This option as shown in **Figure 5-1** provides a forebay and berm above the sanitary sewer. Side slope of 5:1 (H:V) were required as the slopes would be submerged.

Option 1 maximizes the available area, while maintaining some space for the dog park. It accounts for the sanitary sewer with a berm and has 5:1 side slopes. This pond option exceeds the permanent pool target but falls short of the active storage target by 47,414m^3.

5.2.2 Option 2

Option 2 as shown in **Figure 5-2** uses the existing pond block (slightly modified) with 3:1 and 7:1 side slopes. In this option, the sanitary sewer is proposed to be relocated within the access road. This pond option exceeds the permanent pool target but falls short of the active storage target by 45,759m^3.

5.2.3 Option 3

Option 3 as shown in **Figure 5-3** maximizes the available area and has 3:1 and 5:1 side slopes. It ignores the sanitary sewer completely so the active storage is closer to the target. This pond option exceeds the permanent pool target but falls short of the active storage target by 32,565m^3. In addition, the pond footprint encompasses both the existing pond block and the Dog Park.

5.2.4 Option 4

Option 4 as shown in **Figure 5-4** uses the existing pond block (slightly modified) with 1:1 side slopes, accounting for the sanitary sewer with a berm. This pond option exceeds the permanent pool target but falls short of the active storage target by 48,845m^3. The cost of retaining walls would also need to be considered.

5.2.5 Option 5

Option 5 as shown in **Figure 5-5** uses the existing pond block (slightly modified) with 1:1 side slopes, ignoring the sanitary sewer completely so the active storage is closer to the target. This pond option exceeds the permanent pool target but falls short of the active storage target by 43,240m^3.

5.2.6 Option 6

Option 6 as shown in **Figure 5-6** maximizes the available area and has 1:1 side slopes ignoring the sanitary sewer completely so the active storage is closer to the target. This pond option exceeds the permanent pool target but falls short of the active storage target by 30,952m^3.

Like Option 3, the pond footprint encompasses both the existing pond block and the Dog Park.

5.2.7 Option 7

Option 7 as shown in **Figure 5-7** maximizes the dry pond performance given the constraints of the Dog Park to the east while minimizing interference with the Region sanitary sewer, and using standard pond side slopes (i.e. no armorstone retaining walls), and does not include a Permanent Poo..

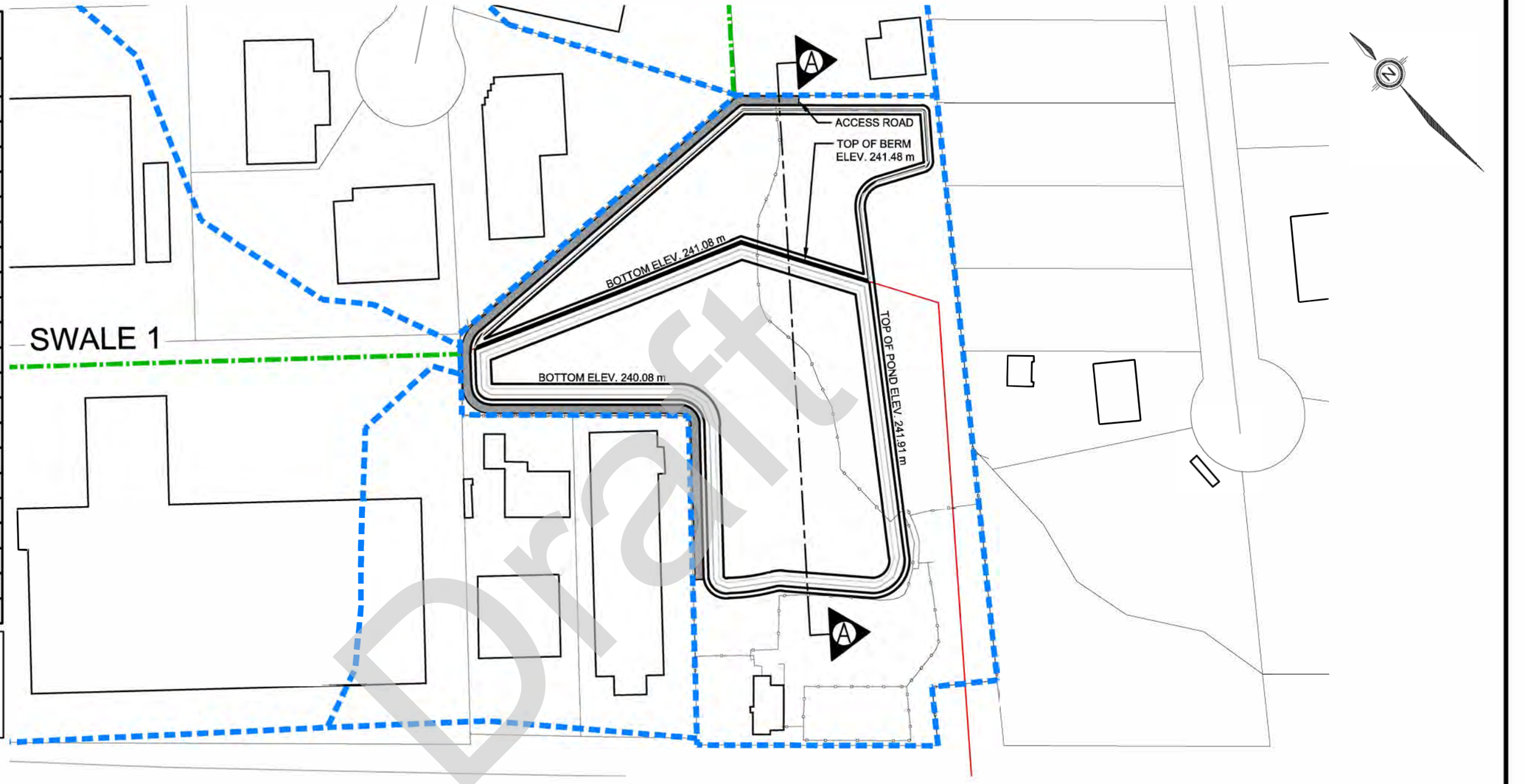
5.2.8 Option 8

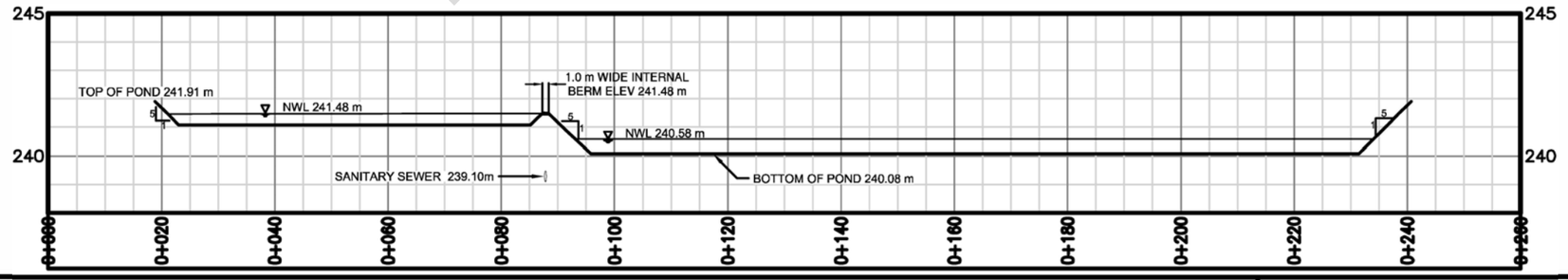
Option 8 as shown in **Figure 5-8** is the “do nothing’ option, which would maintain the existing pond with no improvement to function.

Pond Stage Storage Analysis

Elevation	Permanent Pool Storage	Active Storage
Target	*9,134*	*72,767*
240.08	0	0
240.18	1,285	0
240.28	2,599	0
240.38	3,942	0
240.48	5,314	0
240.58	6,715	0
240.68	6,715	1,431
240.78	6,715	2,891
240.88	6,715	4,381
240.98	6,715	5,901
241.08	6,715	7,451
241.18	6,715	9,782
241.28	8,242	10,641
241.38	9,045	12,282
241.48	9,873	13,954
241.58	9,832	16,562
241.68	9,832	19,168
241.78	9,832	21,813
241.88	9,832	24,495
241.91	9,832	25,353

Option 1 maximizes the available area, while maintaining some space for the dog park. It accounts for the sanitary sewer with a berm, and has 5:1 side slopes. This pond option exceeds the permanent pool target, but falls short of the active storage target by 47,414 m^3.





SECTION A-A
SCALE H-1:1000
V-1:200

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LEGEND
- DRAINAGE AREA BOUNDARIES
- SWALES
- SANITARY SEWER
- FENCE

POND OPTION 1

STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

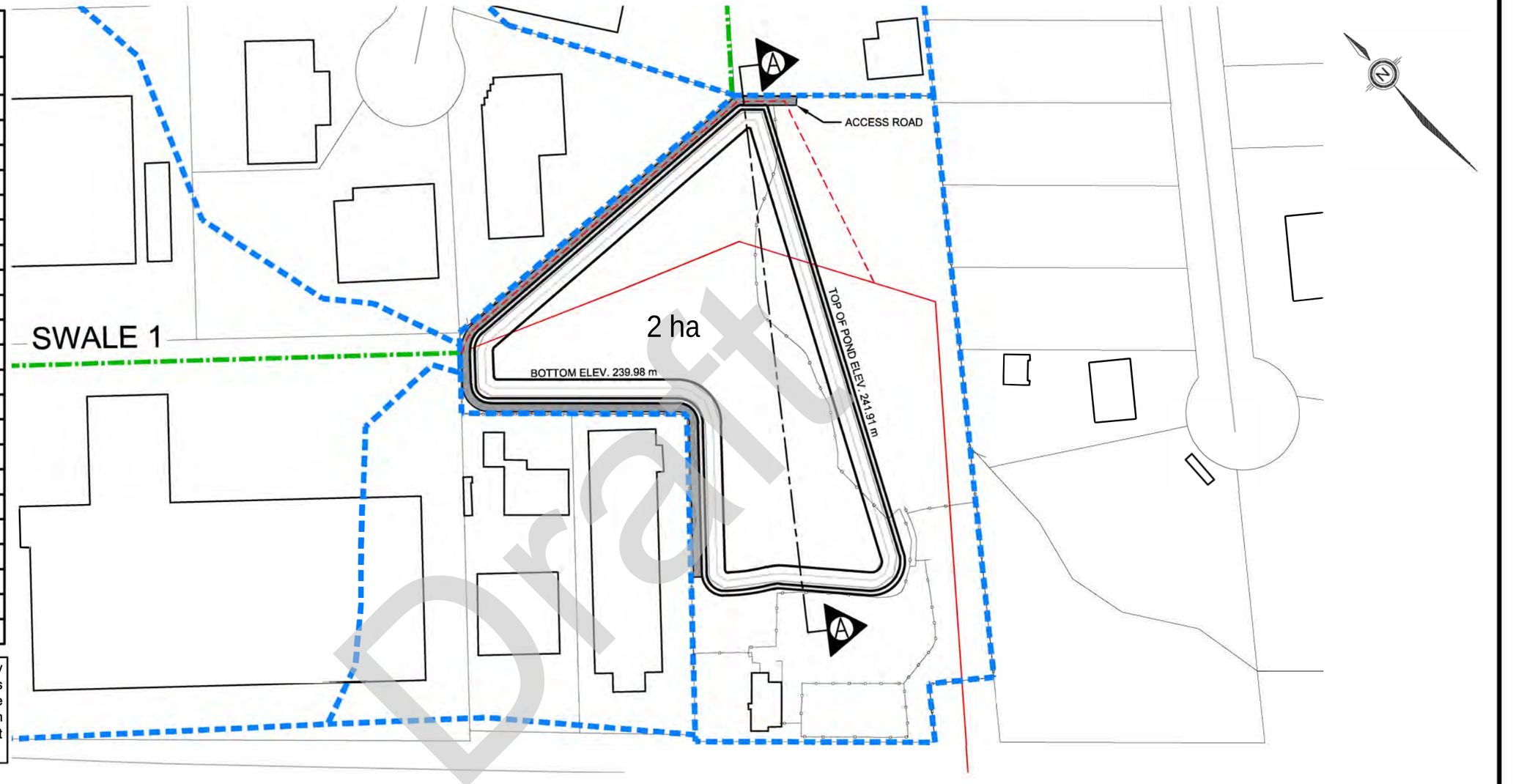
DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 1

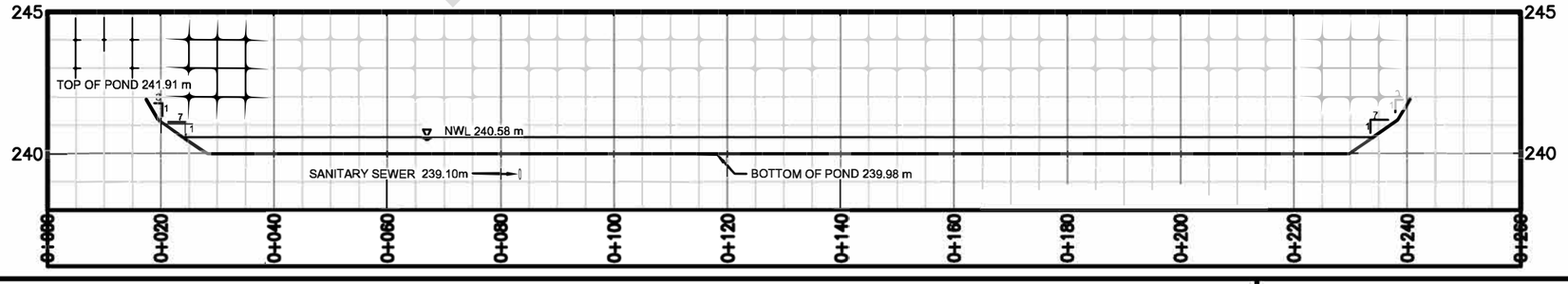
Pond Stage Storage Analysis

Elevation	Permanent Pool Storage	Active Storage
Target	*9,134*	*72,767*
239.98	0	0
240.08	1,524	0
240.18	3,091	0
240.28	4,704	0
240.38	6,362	0
240.48	8,065	0
240.58	9,815	0
240.68	9,815	1,795
240.78	9,815	3,637
240.88	9,815	5,525
240.98	9,815	7,460
241.08	9,815	9,443
241.18	9,815	11,473
241.28	9,815	13,538
241.38	9,815	15,622
241.48	9,815	17,727
241.58	9,815	19,852
241.68	9,815	21,997
241.78	9,815	24,162
241.88	9,815	26,348
241.91	9,815	27,008

Option 2 uses the existing pond block (slightly modified) with 3:1 and 7:1 side slopes. In this option, the sanitary sewer is proposed to be relocated within the access road. This pond option exceeds the permanent pool target, but falls short of the active storage target by 45,759 m^3.

	Inflow (m^3/s)	Existing Outflow (m^3/s)	Target Outflow (m^3/s)	Proposed Outflow (m^3/s)
2-Year	7.69	4.17	0.69	5.09
5-Year	11.88	7.26	1.04	7.83
10-Year	14.24	9.70	1.29	9.38
25-Year	17.83	14.53	1.62	11.65
50-Year	20.18	17.16	1.88	13.18
100-Year	22.93	19.97	2.13	14.97





SECTION A-A
SCALE H-1:1000
V-1:200

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LEGEND

- DRAINAGE AREA BOUNDARIES
- SWALES
- FENCE
- SANITARY SEWER
- PROPOSED SANITARY SEWER

POND OPTION 2

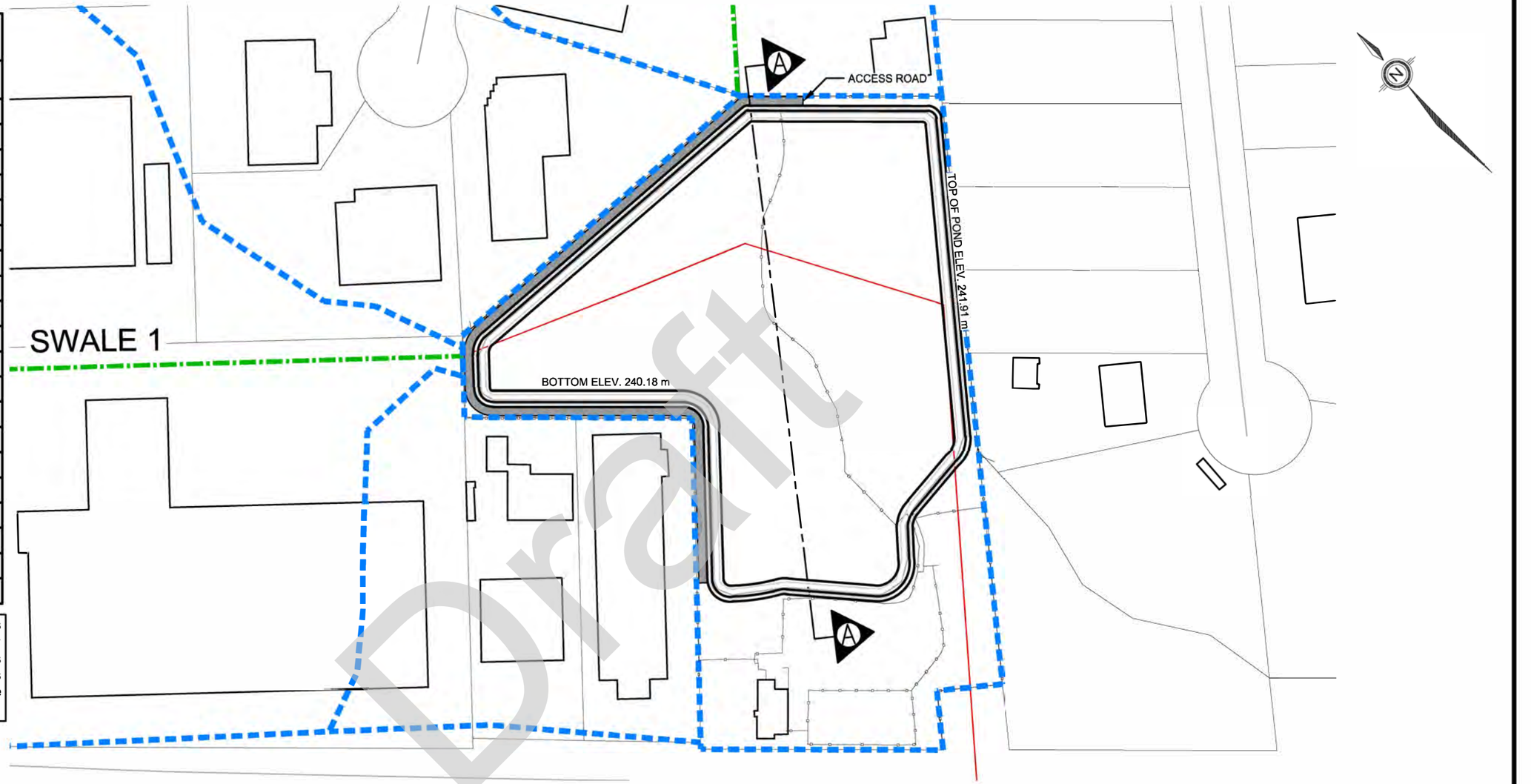
STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

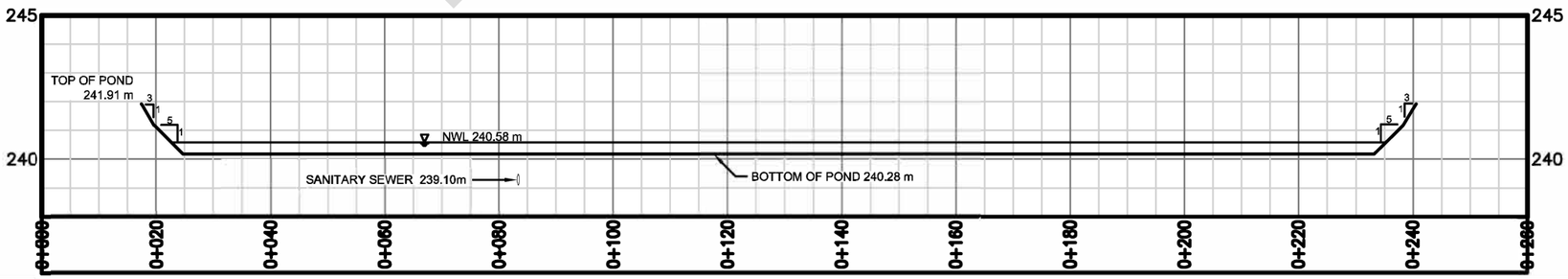
DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 2

Pond Stage Storage Analysis

Elevation	Permanent Pool Storage	Active Storage
Target	*9,134*	*72,767*
240.18	0	0
240.28	2,675	0
240.38	5,387	0
240.48	8,135	0
240.58	10,920	0
240.68	10,920	2,822
240.78	10,920	5,681
240.88	10,920	8,577
240.98	10,920	11,511
241.08	10,920	14,482
241.18	10,920	17,491
241.28	10,920	20,530
241.38	10,920	23,592
241.48	10,920	26,676
241.58	10,920	29,784
241.68	10,920	32,915
241.78	10,920	36,068
241.88	10,920	39,245
241.91	10,920	40,202

Option 3 maximizes the available area and has 3:1 and 5:1 side slopes. It ignores the sanitary sewer completely so the active storage is closer to the target. This pond option exceeds the permanent pool target, but falls short of the active storage target by 32,565 m^3.





SECTION A-A
SCALE H-1:1000
V-1:200

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LEGEND

- DRAINAGE AREA BOUNDARIES
- SWALES
- SANITARY SEWER
- FENCE

POND OPTION 3

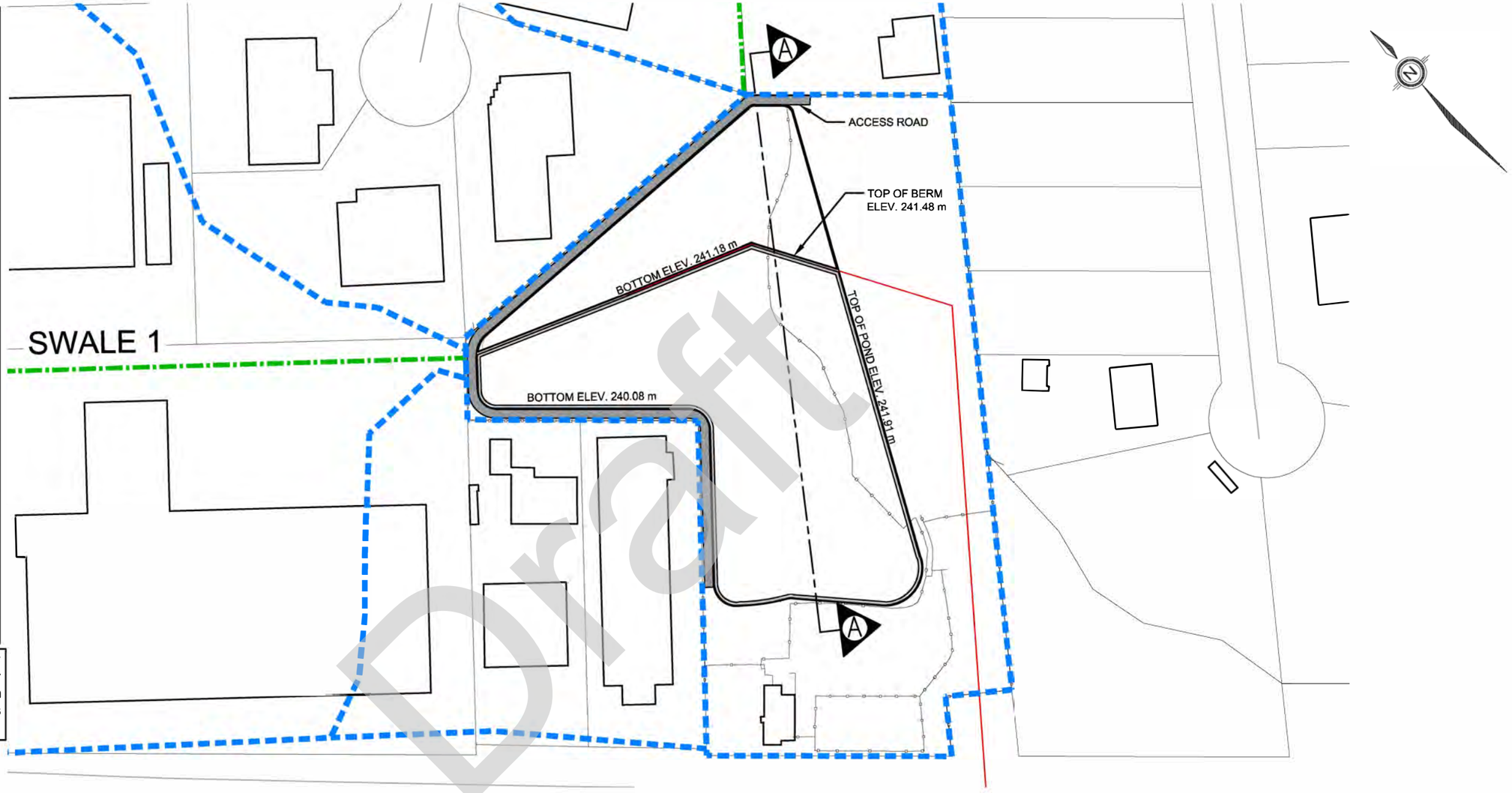
STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

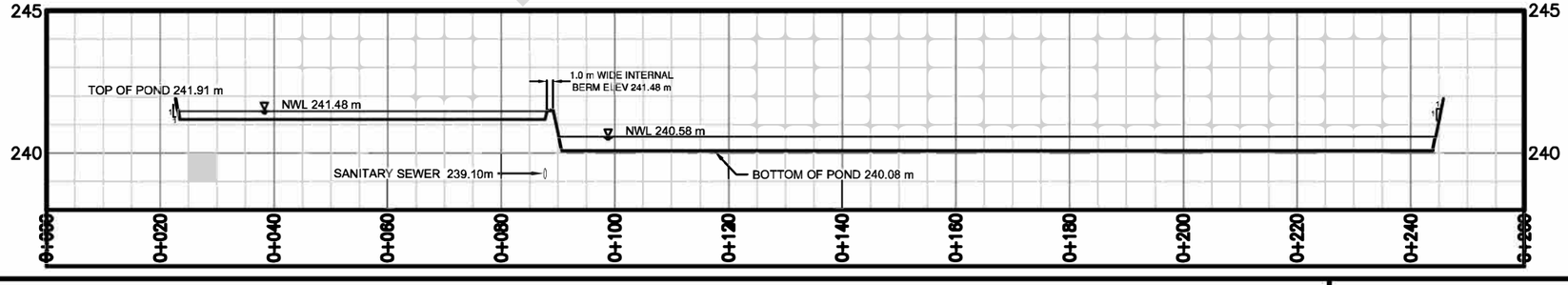
DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 3

Pond Stage Storage Analysis

Elevation	Permanent Pool Volume	Active Storage Volume
Target	*9,134*	*72,767*
240.08	0	0
240.18	1,535	0
240.28	3,076	0
240.38	4,623	0
240.48	6,176	0
240.58	7,735	0
240.68	7,735	1,565
240.78	7,735	3,136
240.88	7,735	4,714
240.98	7,735	6,297
241.08	7,735	7,886
241.18	7,735	9,482
241.28	8,301	11,083
241.38	8,870	12,691
241.48	9,444	14,305
241.58	9,444	16,520
241.68	9,444	18,749
241.78	9,444	20,991
241.88	9,444	23,244
241.91	9,444	23,922

Option 4 uses the existing pond block (slightly modified) with 1:1 side slopes, accounting for the sanitary sewer with a berm. This pond option exceeds the permanent pool target, but falls short of the active storage target by 48,845 m^3.





SECTION A-A
SCALE H-1:1000
V-1:200

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LEGEND
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- SWALES
- SANITARY SEWER
- FENCE

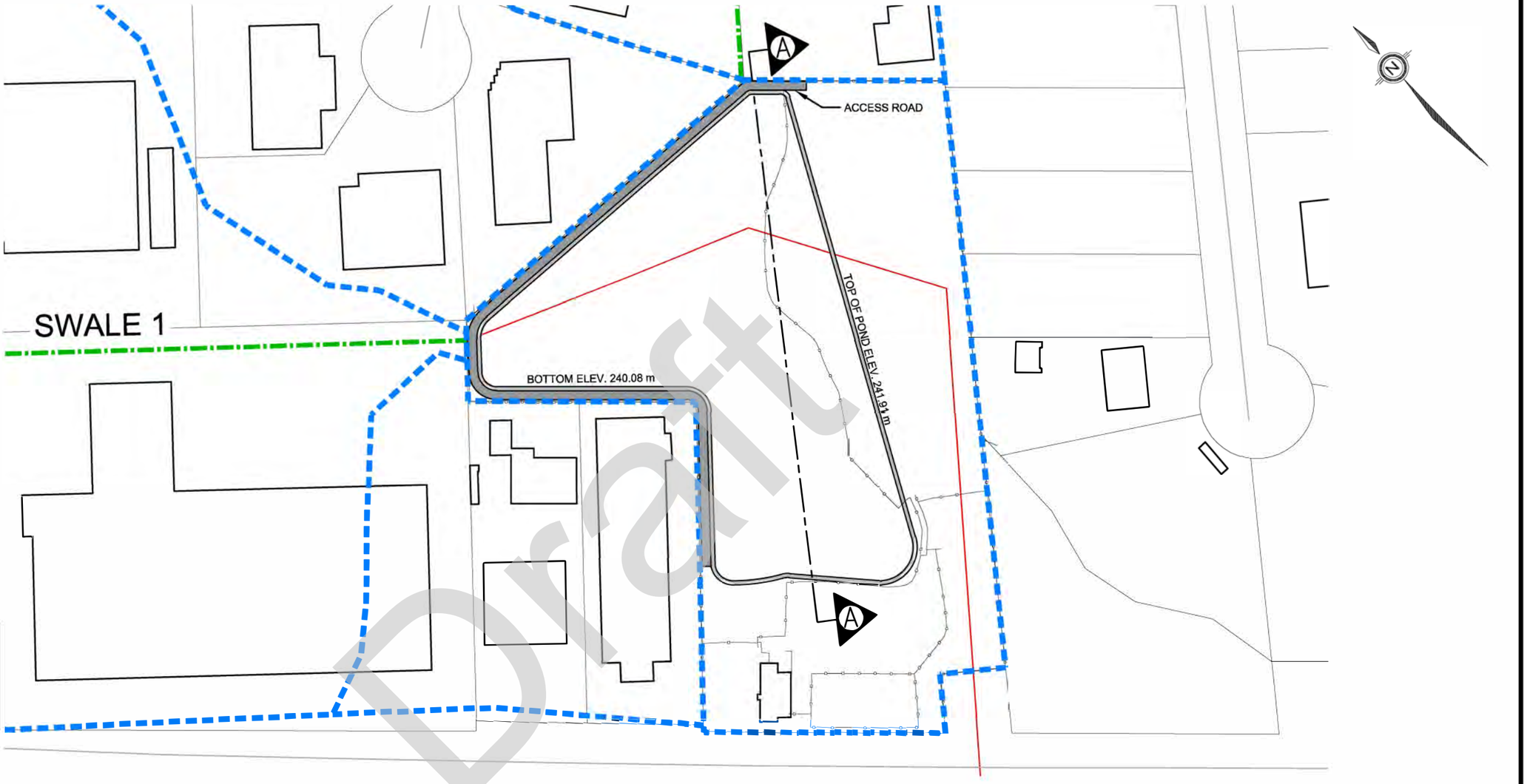
POND OPTION 4

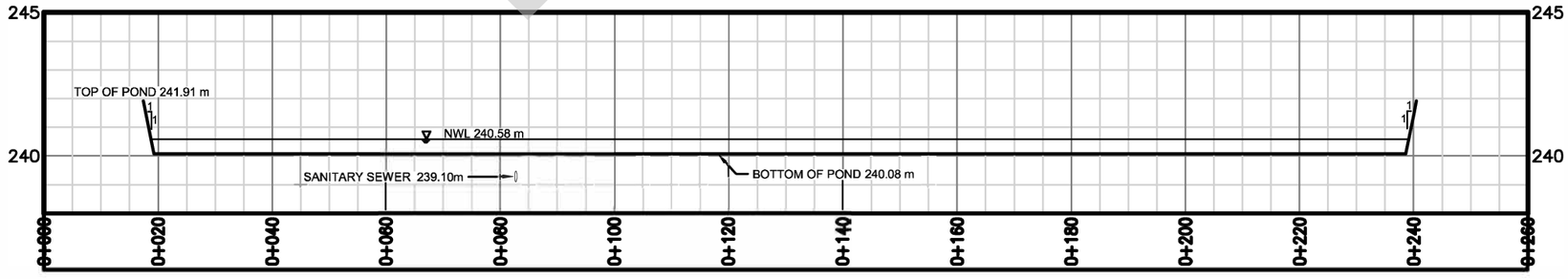
STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 4

Pond Stage Storage Analysis		
Elevation	Permanent Pool Storage	Active Storage
Target	*9,134*	*72,767*
240.08	0	0
240.18	2,143	0
240.28	4,292	0
240.38	6,449	0
240.48	8,612	0
240.58	10,783	0
240.68	10,783	2,177
240.78	10,783	4,362
240.88	10,783	6,553
240.98	10,783	8,751
241.08	10,783	10,956
241.18	10,783	13,168
241.28	10,783	15,387
241.38	10,783	17,613
241.48	10,783	19,846
241.58	10,783	22,086
241.68	10,783	24,333
241.78	10,783	26,587
241.88	10,783	28,848
241.91	10,783	29,527

Option 5 uses the existing pond block (slightly modified) with 1:1 side slopes, ignoring the sanitary sewer completely so the active storage is closer to the target. This pond option exceeds the permanent pool target, but falls short of the active storage target by 43,240 m^3.





SECTION A-A
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V-1:200

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LEGEND
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- SWALES
- SANITARY SEWER
- FENCE

POND OPTION 5

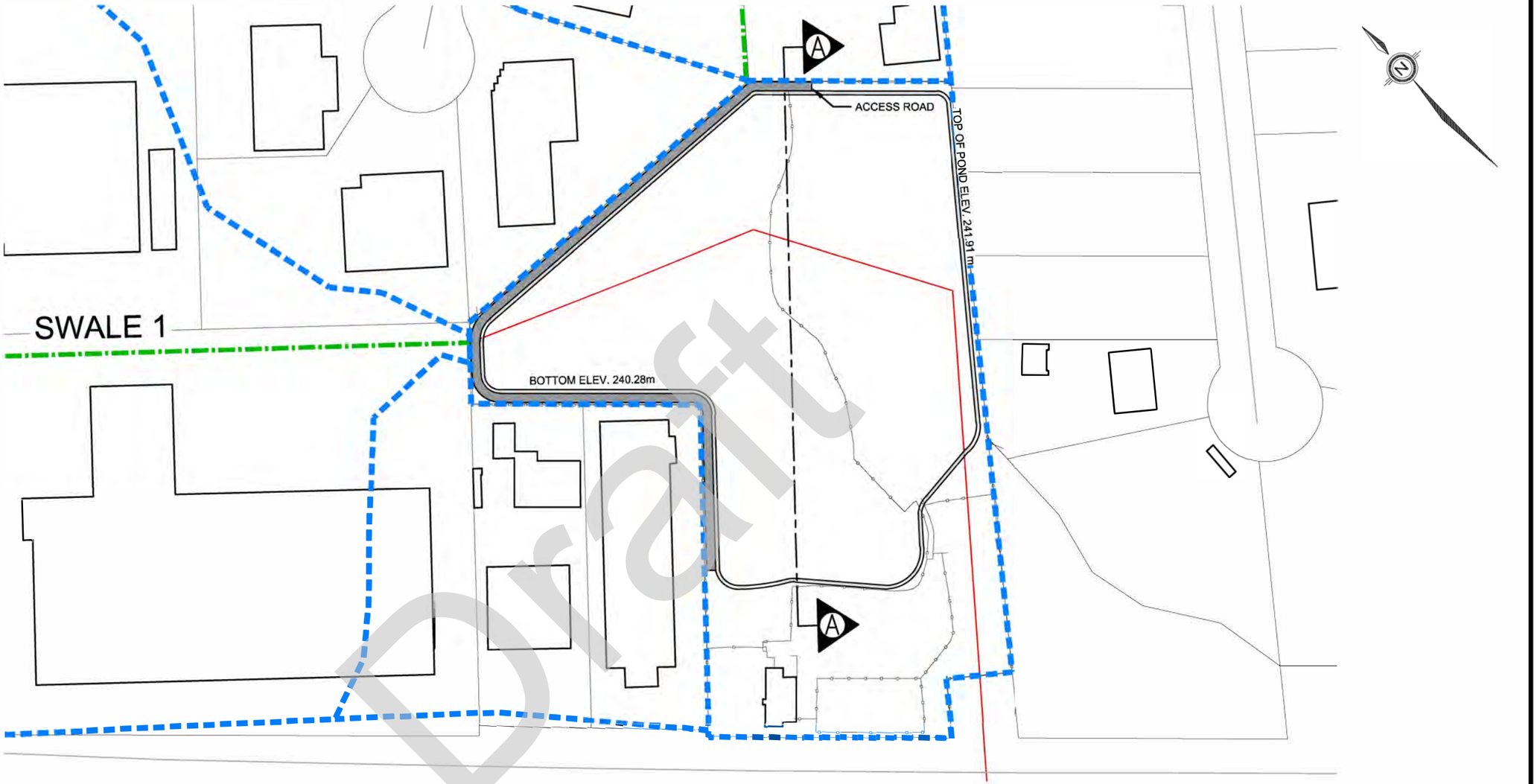
STORMWATER POND #16 & LEASH-FREE DOG PARK RETROFIT STUDY
TOWN OF CALEDON

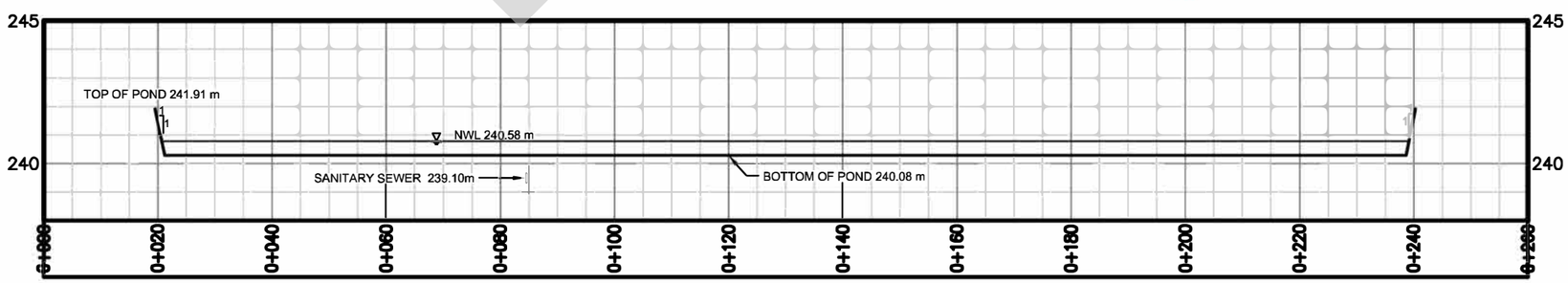
DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 5

Pond Stage Storage Analysis

Elevation	Permanent Pool Storage	Active Storage
Target	*9,134*	*72,767*
240.28	0	0
240.38	3,074	0
240.48	6,155	0
240.58	9,245	0
240.68	9,245	3,097
240.78	9,245	6,201
240.88	9,245	9,314
240.98	9,245	12,433
241.08	9,245	15,561
241.18	9,245	18,696
241.28	9,245	21,839
241.38	9,245	24,989
241.48	9,245	28,148
241.58	9,245	31,313
241.68	9,245	34,487
241.78	9,245	37,668
241.88	9,245	40,857
241.91	9,245	41,815

Option 6 maximizes the available area and has 1:1 side slopes, ignoring the sanitary sewer completely so the active storage is closer to the target. This pond option exceeds the permanent pool target, but falls short of the active storage target by 30,952 m^3.





SECTION A-A
SCALE H-1:1000
V-1:200

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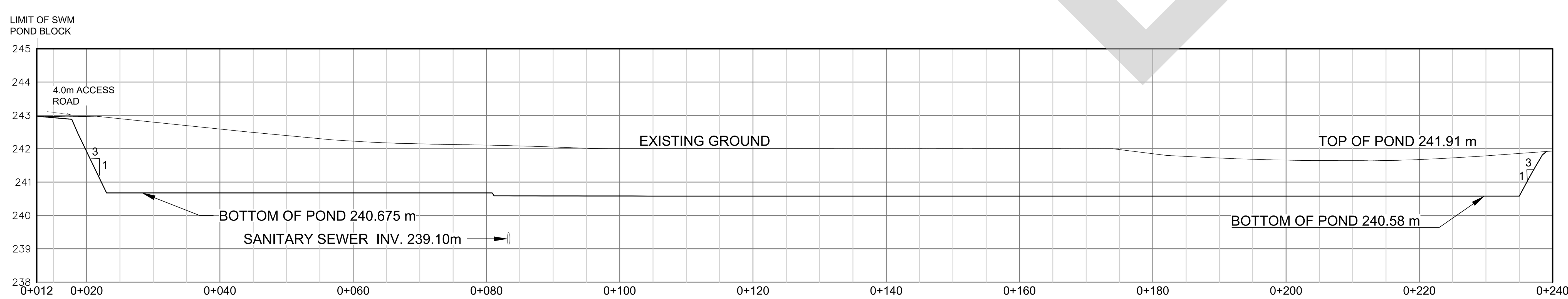
LEGEND
- DRAINAGE AREA BOUNDARIES
- SWALES
- SANITARY SEWER
- FENCE

POND OPTION 6

STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 6



SECTION A-A
SCALE H-1:100
V-1:20

STAGE STORAGE TABLE						
ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
240.580	1,607.30	0.000	0.00	0.00	0.00	0.00
240.680	17,516.41	0.010	153.07	1267.66	152.54	1258.08
240.780	17,740.19	0.010	177.29	3030.49	177.29	3020.90
240.880	17,964.93	0.010	179.54	4815.73	179.54	4806.15
240.980	18,190.60	0.010	181.79	6623.50	181.79	6613.92
241.080	18,417.23	0.010	184.06	8453.89	184.06	8444.30
241.180	18,644.79	0.010	186.33	10306.98	186.33	10297.39
241.280	18,873.31	0.010	188.62	12182.88	188.62	12173.29
241.380	19,102.77	0.010	190.91	14081.67	190.91	14072.09
241.480	19,333.17	0.010	193.22	16003.46	193.22	15993.87
241.580	19,564.52	0.010	195.53	17948.34	195.53	17938.75
241.680	19,796.81	0.010	197.85	19916.40	197.85	19906.81
241.780	20,030.05	0.010	200.18	21907.73	200.18	21898.15
241.880	20,263.80	0.010	202.52	23922.42	202.52	23912.84
241.910	20,333.98	0.010	203.22	24531.39	203.22	24521.80

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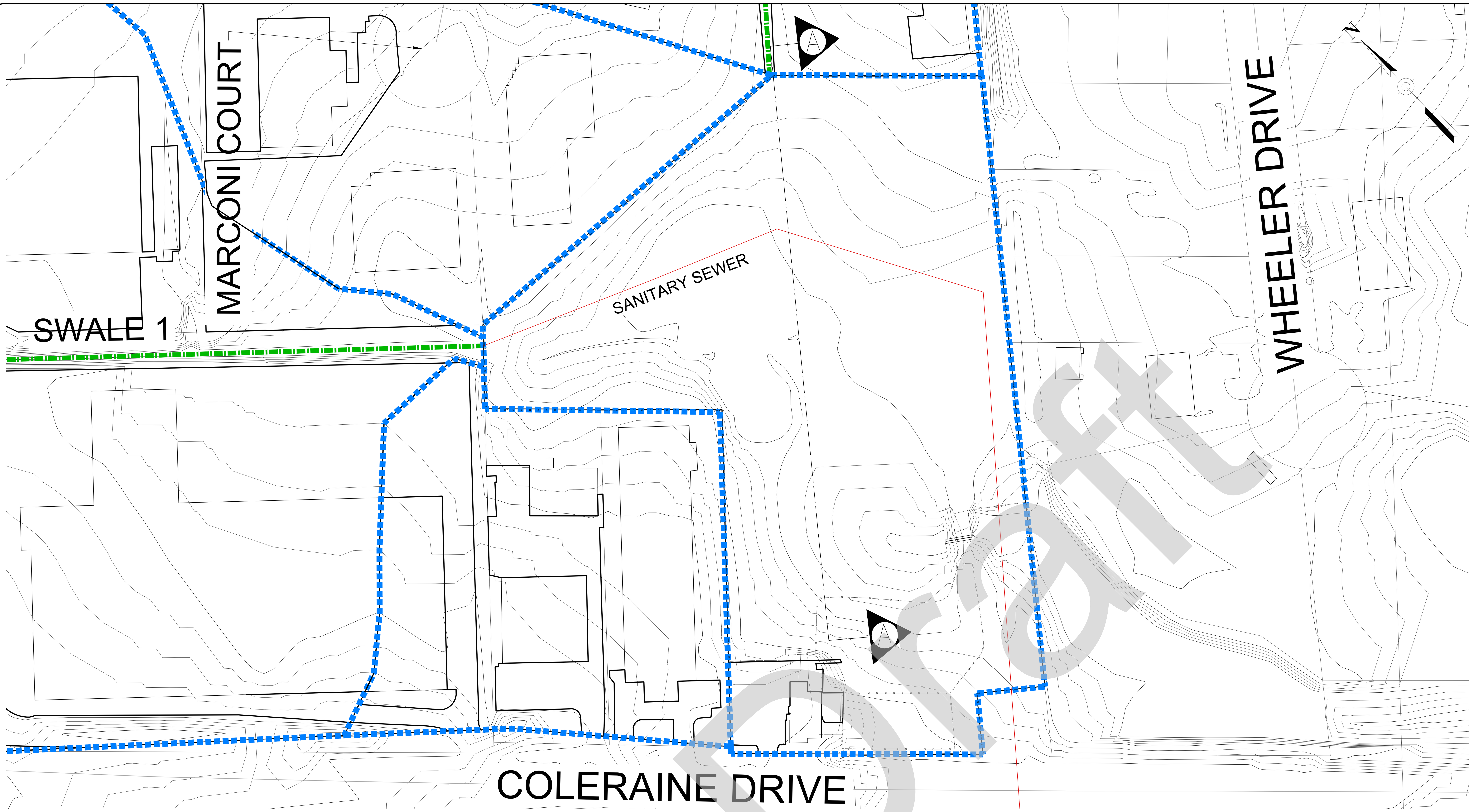
LEGEND

- DRAINAGE AREA BOUNDARIES
- SWALES
- FENCE
- SANITARY SEWER
- ACCESS ROAD

POND OPTION 7

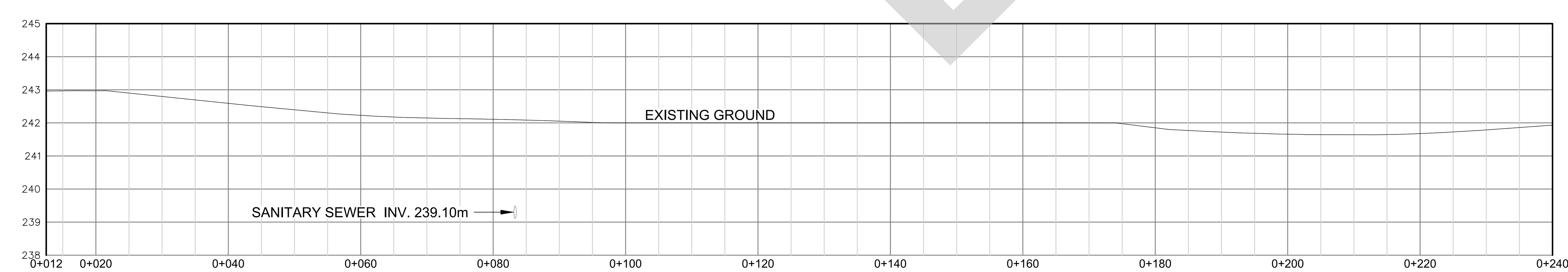
STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 7



STAGE STORAGE TABLE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
240.500	0.18	N/A	N/A	0.00	N/A	0.00
241.000	1.87	0.500	0.51	0.51	0.44	0.44
241.000	0.05	0.000	0.00	0.51	0.00	0.44
241.000	0.07	0.000	0.00	0.51	0.00	0.44
241.000	86.77	0.000	0.00	0.51	0.00	0.44
241.000	0.18	0.000	0.00	0.51	0.00	0.44
241.000	3.03	0.000	0.00	0.51	0.00	0.44
241.000	4.12	0.000	0.00	0.51	0.00	0.44
241.000	2.57	0.000	0.00	0.51	0.00	0.44
241.000	1.13	0.000	0.00	0.51	0.00	0.44
241.000	520.34	0.000	0.00	0.51	0.00	0.44
241.000	39.33	0.000	0.00	0.51	0.00	0.44
241.500	16.43	0.500	13.94	14.45	13.53	13.97
241.500	9.38	0.000	0.00	14.45	0.00	13.97
241.500	4.62	0.000	0.00	14.45	0.00	13.97
241.500	7.22	0.000	0.00	14.45	0.00	13.97
241.500	6.80	0.000	0.00	14.45	0.00	13.97
241.500	19.96	0.000	0.00	14.45	0.00	13.97
241.500	4,379.26	0.000	0.00	14.45	0.00	13.97
242.000	0.73	0.500	1095.00	1109.45	739.41	753.38
242.000	1.81	0.000	0.00	1109.45	0.00	753.38
242.000	1.73	0.000	0.00	1109.45	0.00	753.38
242.000	29.43	0.000	0.00	1109.45	0.00	753.38
242.000	14.15	0.000	0.00	1109.45	0.00	753.38
242.000	6,531.07	0.000	0.00	1109.45	0.00	753.38
242.000	79.16	0.000	0.00	1109.45	0.00	753.38
242.500	1.46	0.500	20.16	1129.61	15.23	768.61
242.500	0.55	0.000	0.00	1129.61	0.00	768.61
242.500	36.88	0.000	0.00	1129.61	0.00	768.61
242.500	0.43	0.000	0.00	1129.61	0.00	768.61
242.500	17.76	0.000	0.00	1129.61	0.00	768.61
242.500	0.07	0.000	0.00	1129.61	0.00	768.61
242.500	1,046.38	0.000	0.00	1129.61	0.00	768.61
242.500	0.40	0.000	0.00	1129.61	0.00	768.61
242.500	8,293.05	0.000	0.00	1129.61	0.00	768.61
243.000	44.77	0.500	2084.46	3214.06	1491.19	2259.80
243.000	9.87	0.000	0.00	3214.06	0.00	2259.80
243.000	26.01	0.000	0.00	3214.06	0.00	2259.80
243.000	734.61	0.000	0.00	3214.06	0.00	2259.80
243.000	630.02	0.000	0.00	3214.06	0.00	2259.80
243.000	203.21	0.000	0.00	3214.06	0.00	2259.80
243.000	1.24	0.000	0.00	3214.06	0.00	2259.80
243.000	113.75	0.000	0.00	3214.06	0.00	2259.80
243.000	0.14	0.000	0.00	3214.06	0.00	2259.80
243.500	14.87	0.500	3.75	3217.81	2.74	2262.54
243.500	41.15	0.000	0.00	3217.81	0.00	2262.54
243.500	123.42	0.000	0.00	3217.81	0.00	2262.54
243.500	9.36	0.000	0.00	3217.81	0.00	2262.54
243.500	5.60	0.000	0.00	3217.81	0.00	2262.54
244.000	3.01	0.500	2.15	3219.97	2.12	2264.66
244.500	0.15	0.500	0.79	3220.76	0.64	2265.30



SECTION A-A
SCALE H-1:100
V-1:20

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LEGEND

DRAINAGE AREA BOUNDARIES	SANITARY SEWER
SWALES	ACCESS ROAD
FENCE	

POND OPTION 8

STORMWATER POND #16 & LEASH-FREE
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: DECEMBER 2020	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 8

5.3 Final SWM Criteria

Based on further discussions with the Town of Caledon and the TRCA, the TRCA advised that unless there is known flooding issues resulting from the current design, they are unable to require anything above the original design. As such the original design is grandfathered for this project.

Based on discussions with the Town, it was determined that the Preferred Alternative was to regrade the pond block to attain the best active storage volume possible in the existing space. Therefore, no Permanent Pool is required.

Based on the foregoing, IBI Group proposes to provide for minimal grading and no change to the existing outlet structure.

5.4 Do Nothing

The existing pond does not provide for any significant quality control, and minimal quantity control.

5.5 Site Controls

Installation of quality or quantity controls on the existing industrial subdivision would likely not be feasible, as it would require landowners to redesign their sites.

5.6 Pond Grading Options

As noted above, various grading options were explored to accommodate Permanent Pool and Active Storage volumes. These options are shown on **Figures 5-1** to **5-8**.

6 Development and Assessment of Alternative Solutions

6.1 Identification/Descriptions of Alternative Solutions

Various grading alternatives were investigated to accommodate Permanent Pool and Active Storage volumes. The existing pond block was determined to be insufficient to accommodate a full retrofit; these alternatives were discussed in **Section 5.2**.

6.1.1 Options Summary

The various options were evaluated per the original criteria and are summarized in the **Table 6.1** below.

Table 6.1 Pond Options Summary

OPTION	MEETS QUALITY OBJECTIVE	MEETS QUANTITY OBJECTIVE	REQUIRES SANITARY RELOCATION	SATISFIES ORIGINAL CRITERIA	COSTS	SOCIAL IMPROVEMENT	ENVIRONMENTAL IMPROVEMENT
1	Y	N	N	N	$	N	Y
2	Y	N	Y	N	$$[1]	N	Y
3	Y	N	Y	N	$	N	Y
4	Y	N	N	N	$$[2]	N	Y
5	Y	N	Y	N	$$[2]	N	Y
6	Y	N	Y	N	$$$[2]	N	Y
7	**N**	**N**	**N**	**N**	**$**	**Y**	**N**
8	N	N	N	N	0	N	N

Notes:
[1] Additional costs due to sanitary sewer relocation
[2] Additional costs due to armorstone retaining walls

Considering the revised criteria, the proposed alternative is Option 7 above. Refer to **Section 7** and **Figure 5-7**.

7 Preferred Alternative Strategy

Based on an evaluation of the options, it was determined that the Preferred Alternative was to regrade the pond block to attain the best active storage volume possible in the existing space. The eastern limit of the pond block (roughly coincident with the fenceline) was shifted easterly roughly 5m to increase the available grading area without significantly affecting the Dog Park limits. This option is as shown on **Figure 5-7**. That option allows for the continued use of the Dog Park and ensures that the primary objective of maintaining flood control is achieved.

7.1 Dog Park

Based upon Town staff review, and comments received from the public information session, including input from the Caledon Dog Park Advisory Committee the following features and objectives have been included in the Conceptual Landscape Plan for this Off Leash Dog Park.

- A new fenced transition zone will be provided, where owners and dogs can enter a fenced zone and then released from their leashes into either the ‘’small dog area or the ‘’large dog area’’.
- There will be a separate fenced area for small dogs with seating for owners. The existing gazebo will likely be placed within the small dog area.
- The larger dog park area which includes the area east of the boardwalk will have a permanent new fence along the pond edge to keep dogs out of the pond.
- There is a proposal for a covered shade structure which will include picnic tables and or benches to be located on the east side of the boardwalk (close to the existing boardwalk).
- There will be additional tree plantings, for shade, throughout the dog park.
- The existing mowed pathways through the meadow on the eastside of the boardwalk are to remain.
- There will be improved accessibility at the boardwalk be making the grades at both ends of the boardwalk flush with the granular path.
- The existing granular path from the parking lot to the boardwalk will also be regraded to improve accessibility, i.e.: lessen the slope and smooth out the grade.
- The park will be provided with a new ‘’In Ground ‘’ waste receptacle.
- The park will have dog poop bag stations provided throughout the park.
- The park will have a new ‘’Off Leash Dog Park Rules Sign’’ located at the entry to the Transition Zone.

8 Stormwater Management Plan

The following Section outlines the proposed Stormwater Management Plan for the SWM Pond retrofit. 30% Design Drawings are provided in **Appendix D**.

Visual OTTHYMO [VO] was used to model the existing and proposed conditions. A 6-hour AES storm distribution produced the highest storage volumes and therefore governs the pond design. VO has been used to calculate the inflow and outflow from the pond.

8.1 SWMF 16

Further, we have evaluated the land required to accommodate the Pond 16 Volume Requirements above and have determined that even extending the Pond limits to encompass the entire Dog Park does not provide enough detention volume to meet the TRCA criteria.

8.2 Future Design Considerations

Given the culvert outlet elevation, any future Normal Water Level cannot be lower than 240.58m. The Swale 1 invert is 242.29m, Swale 2 is 242.36m. Setting the 100-year water level in Pond 15 at 0.30m below 242.29m yields 241.99m. Those physical constraints define the Normal Water Level and Active Storage elevations.

In addition, to provide 60% TSS Removal (Basic) a dry pond would require approximately 240m^3/ha, or roughly 24,000m^3.

IBI Group has conservatively assumed that there are no control flow roof drains installed on existing buildings; however, that could be confirmed in a future study.

9 Geotechnical Investigation

Please refer to **Appendix E** for a copy of the Geo Report.

9.1 Geotechnical Key Findings

- Proposed pond side slopes are stable.
- Pond base is expected to comprise low permeability glacial till deposit. A clay liner may not be required.
- It is recommended that the pond slopes and base must be inspected by a geotechnical engineer to assess the exposed subgrade soil conditions to identify presence of any relatively permeable weathered/disturbed soils, and silt or sand layers/pockets typically found within the till deposit, to provide recommendations
- for possible modification to the geotechnical design of the pond. These modifications may include local sub-excavation of the relatively permeable soil zone(s) and backfilling with approved low permeability clayey soils.
- The emergency spillway must be provided with a significant erosion resistant lining consisting of either rip rap, gabion mattresses, or buried and staked Geoweb/Duramat Concrete Units or equivalent. The lining should extend from the design high water level to over the berm and down to the slope toe.

9.2 Geotechnical Recommendations

- A minimum operating freeboard of 0.3m should be maintained between the high-water level and the pond rim. Overtopping of the pond, as a result of overfilling or flooding, would result in severe damage and possible breaching or failure of the earth berm, spillway and the downstream slope. A provision of an overflow conveyance route/spillway is recommended to prevent pond overtopping.
- The flat surface (maintenance/access road) at the top of the pond/berm must be a minimum of 3.0m wide to facilitate adequate compaction and to accommodate service vehicles for maintenance.
- The pond should be carefully inspected each season for including but not limited to the following:
    - General condition of various pond components to identify areas of erosion, settlement, slump or deterioration.
    - Inspection of pond base and slope surface for discontinuities or holes as a result of burrowing animals, vandalism, settlement, or the like.
    - Removal of unwanted vegetation (tree, seedlings and the like) from within the footprint of the pond area.
    - Any damaged or deteriorated areas must be repaired regularly.

10 Terrestrial and Fisheries Screening

Myler Ecological Consulting (Myler) was retained to prepare a Terrestrial and Fisheries Screening Report to document screening level assessments of wetlands, wildlife, fisheries and aquatic habitat and vegetation per the Request for Proposal (RFP). Myler's screening of potential terrestrial and fisheries and aquatic habitat constraints included desktop review of relevant existing natural heritage mapping and information, consultation with TRCA, and seasonal site visits to observe characteristics of the watercourse, vegetation, and wildlife at the site. Refer to **Appendix F** for a copy of the report. The following sections summarize the key findings of the Myler Report.

10.1 Natural Heritage Constraints

SWMF #16 and the leash-free dog park were determined not to contain natural heritage constraints as follows:

- SWMF #16 is not Unevaluated Wetland, or wetland of any sort, as erroneously depicted on TRCA and provincial mapping.
- As an artificial stormwater management facility, SWMF #16 is neither a watercourse nor is it fish habitat. Fish were not observed within the facility and the likelihood of upstream fish passage to the facility is very low.
- As an artificial stormwater management facility, SWMF #16 cannot be significant wildlife habitat as defined by the Province in the Significant Wildlife Habitat Criteria Schedules For Ecoregion 7E.
- Nevertheless, it does not contain habitat features or wildlife species that could elsewhere indicate candidate significant wildlife habitat.
- SWMF #16 does not contain aquatic SAR, and DFO mapping shows the nearest hydrologically connected aquatic SAR occurrence, of Redside Dace, as more than 7.5 kilometres downstream.
- No terrestrial SAR or SAR habitat were observed at SWMF #16.
- As a fenced, manicured and semi-manicured area of limited extent frequented by dogs and their people, the leash-free dog park lacks natural habitat and is generally unattractive to wildlife, does not contain significant wildlife habitat, and does not contain SAR.

10.2 Recommended Mitigation Measures

Recommended mitigation measures to be employed during conduct of the retrofit works and activities are limited to the following:

- Pre-clearing of trees and other vegetation that are within grading and construction footprints during September – March to avoid the active bird nesting season and ensure compliance with the federal Migratory Birds Convention Act.
- Use, monitoring and maintenance of erosion and sedimentation controls to prevent water quality
- impacts to off-site/downstream fish habitat, including the distant downstream habitat of Redside Dace.
- Post-retrofit restoration of SWMF #16 is recommended to include seeding and planting of native plant species to the extent practicable to avoid proliferation of the invasive Common (Phragmites) Reed, and to stabilize soils, enhance water quality and provide incidental habitat for wildlife.

11 Public Consultation

The following section outlines the overall public consultation process. Agency Correspondence can be found in **Appendix G**.

11.1 Consultation Activities

11.1.1 Notice of Commencement

A Notice of Commencement was published on the Town's website and in local newspapers. The notice will also be directly mailed to the stakeholders list. A draft notice will be developed immediately after contract award and will be provided to the Town for review at the project kick-off meeting. The notice will contain the problem/ opportunity statement for the project and invite the public to comment and/or join the project mailing list.

11.1.2 Notice of Public Information Centre

The RFP requires that two Public Information Centres (PICs) were to be held through the course of this project. Notices of PICs will be published approximately four (4) weeks in advance of the PIC. The notice will also be directly mailed to individuals and organizations on the stakeholder list. IBI Group will prepare draft notices for review by Town staff.

11.1.3 Public Information Centres

Given the scope of the work (Schedule A+ Class EA), IBI Group recommended that only one PIC be held to provide the public with an opportunity to review the problem/opportunity statement, potential alternative solutions, our proposed evaluation criteria and, finally, our recommended preferred solution.

At the time of this writing, the COVID 19 Pandemic makes in-person meetings ill advised; therefore, IBI Group provided materials for the Town to host online in lieu of PICs.

PIC 1 was held virtually on June 23, 2021. The PIC boards and comments can be found in **Appendix H**.

11.2 Stakeholders List

The list of stakeholders is included in **Table 11.1**.

Table 11.1 Stakeholders List

AGENCY	CONTACT NAME	CONTACT EMAIL ADDRESS	CONTACT TELEPHONE NUMBER
Town of Caledon	Cassie Schembri	Cassie.Schembri@Caledon.ca	905-584-2272
Toronto Region Conservation Authority			
Ministry of the Environment, Conservation and Parks	District Office Aziz S. Ahmed, P. Eng. Manager, Municipal Water and Wastewater Permissions Section, Environmental Permissions Branch	Aziz.Ahmed@ontario.ca	416-314-4625 Cell: 416-712-7427
Ministry of Natural Resources and Forestry	Megan Eplett Aurora District Planner	megan.eplett@ontario.ca	(905) 713-7369

Table 11.1 Stakeholders List

AGENCY	CONTACT NAME	CONTACT EMAIL ADDRESS	CONTACT TELEPHONE NUMBER
Peel Region Sanitary and Watermain	Geoff Bowden Supervisor, Support Services and Connections		
Mississaugas of the New Credit First Nation	Fawn Sault Consulting Manager	Fawn.Sault@ newcreditfirstnation.com	905-768-4260
Metis Nation of Ontario	Aly N. Alibhai Director of Land, Resources and Consultation	alya@metisnation.org	(416) 977-9881

11.3 First Nations Consultation

First Nations (Mississaugas of the New Credit First Nation and the Metis Nation of Ontario) will have the opportunity to comment on the SWM Plan.

11.4 Consultation with TRCA

As per IBI Group's email request of June 8, 2020, the Toronto Region Conservation Authority (TRCA) reviewed IBI Group's request to provide background information and input into this study. Refer to **Appendix G** for details.

11.5 Consultation with the Ministry of the Environment, Conservation, and Parks

IBI Group sent a letter via email to the Guelph MECP District Office (Amy Shaw) June 8, 2020, with copy to Aziz Ahmed, MECP Manager, Municipal Water and Wastewater Permissions at the Main Branch. Refer to **Appendix G** for details.

12 Notice of Study Completion

TBD

13 Conclusions

Based on an evaluation of the options, it was determined that the Preferred Alternative was to regrade the pond block to attain the best active storage volume possible in the existing space. The eastern limit of the pond block (roughly coincident with the fenceline) was shifted easterly roughly 5m to increase the available grading area without significantly affecting the Dog Park limits. This option is shown on **Figure 7-1**. That option allows for the continued use of the Dog Park and ensures that the primary objective of maintaining flood control is achieved.

IBI Group has provided a retrofit design of the existing SWM Pond 16 to achieve as much of the Town's goal of Enhanced quality control as is feasible, as well as meeting as much of the TRCA's quantity control criteria as is practical.

The Town and IBI Group have discussed investigating the use of existing roadside ditches for quality control in conjunction with CB Shields (catch basin quality inserts) to provide the required quality control, but that evaluation is outside the scope of the current assignment.

The Town will look for continued improvements within the sewershed from CB shields etc. and the Town is completing a similar initiative with Pond 15 to improve the stormwater function of that facility.

Appendix A

Ander SWM Report

43M 418/419

STORM DRAINAGE REPORT
FOR THE PROPOSED DEVELOPMENT OF
287187 ONTARIO LIMITED
PART OF LOTS 5 & 6, CONCESSION 6
TOWN OF CALEDON

JULY 1980

FOR: 287187 ONTARIO LIMITED

ANDER ENGINEERING & ASSOCIATES LIMITED
CONSULTING ENGINEERS
355 RAYETTE ROAD, P. O. BOX 384
CONCORD, ONTARIO L4K 1C5

Sonny Angotti 1-905-669-3700 M
Caleb Co. Assessed map (probably can't find it)

TABLE OF CONTENTS

STORM DRAINAGE REPORT
FOR THE PROPOSED DEVELOPMENT OF
287187 ONTARIO LIMITED
PART OF LOTS 5 & 6 CONCESSION 6
TOWN OF CALEDON

1.0 INTRODUCTION

1.1 Background:

287187 Ontario Limited has applied to the Regional Municipality of Peel for the approval of two abutting industrial plans of subdivision in the Town of Caledon and the Region has assigned files numbers 21T-79064C and 21T-79065C to the applications. These proposed developments have received draft approval and among the conditions of final plan approval is a requirement of the Town of Caledon and Metropolitan Toronto and Region Conservation Authority to prepare a detailed engineering and drainage report which would indicate the proposed site grading and treatment of storm drainage within the developments.

In fulfillment of this requirement, Ander Engineering & Associates Limited was engaged by 287187 Ontario Limited to prepare the design of the municipal services for the developments to the satisfaction of the Town of Caledon, the Regional Municipality of Peel and Metropolitan Toronto and Region Conservation Authority. Representatives of Ander Engineering & Associates Limited obtained engineering design criteria from the Town of Caledon Engineering Department for the design of the minor storm drainage system. Consistent with the Town of Caledon design criteria, the minor storm drainage system will be designed to convey run-off occurring from a 10-year return frequency design storm.

Although a curb and gutter road cross section is proposed, no road storm sewer system is proposed. Site drainage will be collected in the road system and discharged to swales and/or sodded channels using curb outlets.

Representatives of Ander Engineering & Associates Limited also met with Mr. Don Haley of Metropolitan Toronto and Region Conservation Authority and were advised that the major storm drainage system must be designed to convey the runoff resulting from the occurrance of a 100-year return frequency design storm on the upstream watershed area. Furthermore, there should be no increase in runoff in the water course downstream of the site due to the development of the two sites.

The appendices of this report contain the storm drainage design calculations. The body of the report will serve to provide a discussion on the design calculation and considerations.

1.2 Subject Property:

The subject property of this report consists of some 50.5 ha (124 acres) of land located immediately west of the present industrial area in the community of Bolton as indicated in Figure 1. The property consists of part of the west halves of Lots 5 and 6, Concession 6, of the former Township of Albion, now the Town of Caledon, Regional Municipality of Peel.

1.3 Watershed:

The watershed consists chiefly of two subcatchment areas; the west catchment area being approximately 85.7 ha (211.7 acres) in area and the east catchment area being 65.7 ha (162.2 acres) in area. The extent of the watershed and catchment area has been determined by photogrammetric means and is delineated on drawing 80-112-3A.

The predominent land use of the west catchment area is agricultural. The area is drained by two natural drainage swales, each having several branches. The two swales merge in the northern plan (21T-79064C) and enter the southerly plan (21T-79065C) as one watercourse via a 1140mm x 1850 C.M.P. arch culvert under Fifth Side Road. Approximately 2.81 ha of the existing industrial lands east of the northern plan are tributary to this catchment area. A casual site observation indicates that the yard area of the industrial lots drain westerly as this appears to be the original natural drainage direction.

The land use of the easterly catchment area is a mixture of vacant lands, industrial lands and agricultural lands. Much of the south-westerly portion of the catchment area has been urbanized. The natural drainage courses have been re-aligned into engineered drainage swales or have been enclosed into pipes or conduits. A storm water detention pond has been constructed in the industrial development abutting the east limit of the south plan. A 0.92m dia. C.M.P. discharges low flows from the detention pond and the gabion spillway arrangement would assist in discharging greater flows from the upstream area.

No design data was available from the local municipality or the original designers to determine the capacity or the operation characteristics of the existing detention pond. For the purposes of our evaluation it is considered that the detention pond and outflow system will restrict the outflow entering the subject lands to the pre-development amount of the upstream area. Our discussions with the Town of Caledon and Metropolitan Toronto and Region Conservation Authority indicate that both concur with this design approach.

Times of Concentration for the external drainage areas have been determined by the Kirpich formula.

1.3 Watershed:

$$Tc = 0.00013 \frac{L^{0.77}}{S^{0.385}}$$

Tc = Time of Concentration in hours

L = Greatest distance along the watercourse to the dividing ridge.

S = Hydraulic slope of the watercourse

Note → Times of Concentration for the internal areas have been set equal to 18 min. in accordance with Town design criteria.

The geodetic elevations around the perimeter of the watershed were obtained from a topographic plan prepared by the Department of Energy, Mines and Resources.

The soil classification will be type 'D' of the U.S. Soil Conservation Service soil types due to the soils poor drainage capability.
(Raised tile beds are proposed for the site)

1.4 Site Runoff Co-efficient:

The composite runoff co-efficient "C" used for the subject lands is determined in accordance with the following design rational.

1. Building coverage assumed to be 20% of lot area and flat roof system will permit storage of rainwater. Roof drainage hoppers to regulate discharge to 0.87m³/sec/ha (750 U.S.G.P.M.)

   $C_1 = 0.0867$

2. Landscaped and tile field area comprises 39.5% of lot area 0.25 × .395

   $C_2 = 0.0988$

3. Parking, loading and driveway areas with impervious co-efficient of 0.90 will comprise 40.5% of lot area .9 × .405

   $C_3 = 0.3645$

$$C = C_1 + C_2 + C_3$$
$$= 0.0867 + 0.0988 + 0.3645$$
$$= 0.55$$

Any increase in the building area would reduce the runoff co-efficient since a greater area to provide on site storage of rainwater will be available.

2.0 MINOR STORM DRAINAGE SYSTEM:

A 10 year return frequency design storm has been used in the design of the minor storm drainage system. A summary of the design calculations is contained in Appendix 'A' of this report. With the exception of the 2.81 ha. of industrial lands located north-easterly of the site and a 4.29 ha. of agricultural land located north-west of the site, all remaining tributary areas are internal to the subject lands. The initial time of concentration was set at 18.0 min. and the 10 year return rainfall-indensity curve of the Town of Caledon was used to select rainfall intensities. The rational method of storm runoff determination was used to calculate the runoff quantity. Swales of the minor drainage system are connected with the major drainage system swales and runoff is conveyed to the detention pond area via the major drainage swales and/or in the on site natural watercourses remaining in the blocks reserved for future development. The detention pond and outlet culverts have been appropriately sized to restrict the outflow rate to the pre-development amount of the upstream drainage areas. Further discussion on the operation of the detention pond is contained in Part 4.0 of this report.

3.0 MAJOR STORM DRAINAGE SYSTEM:

The major storm drainage system has been designed to carry runoff determined by the rational method using rainfall intensities for a 100 year return frequency design storm. Discussion with Metropolitan Toronto and Region Conservation Authority suggested that the 100 year Bloor Street rainfall intensity curve would be suitable for use.

The three external watercourses entering the subject lands are intercepted at the limits of the development and the runoff is routed via the major drainage swale system to the detention pond area located in Block 29 of the southern plan.

The design calculations of the major storm drainage system are contained in Appendix 'B' of this report.

The operation of two existing hydraulic structures are also analyzed in the design calculations.

small portion of Block 27 below 245.70 elevation.

The operation of the existing gabion spillway and outlet culvert from the existing storm water detention pond was also investigated. It was found, that based on our design constraints, the spillway discharge is small. It is proposed to use a gabion lined side channel in front of the spillway to intercept the spillway discharge. The purpose of the gabion lining is to check the possible erosion of the channel bottom and side-sloped by the anticipated turbulent flow resulting from the operation of the spillway.

4.0 STORM WATER DETENTION POND:

Synthetic hydrographs of both catchment areas were constructed for the 100 year return frequency design storm and the 10 year return frequency design storm for both pre-development and developed site conditions. Calculations and hydrographs are contained in Appendix 'C' of the report. Hydrographs were constructed in accordance with the methods described in the publication "Design of Small Dams"

4.0 STORM WATER DETENTION POND:

The following is a summary of the results contained in Appendix 'C'

PEAK DESIGN FLOWS

	10 year Pre Devel. c.f.s.	10 year Devel. c.f.s.	100 year Pre Devel. c.f.s.	100 year Devel. c.f.s.
West Watershed	76	147	190	370
East Watershed	58	74	155	187.5
Combined	132	219	340	550

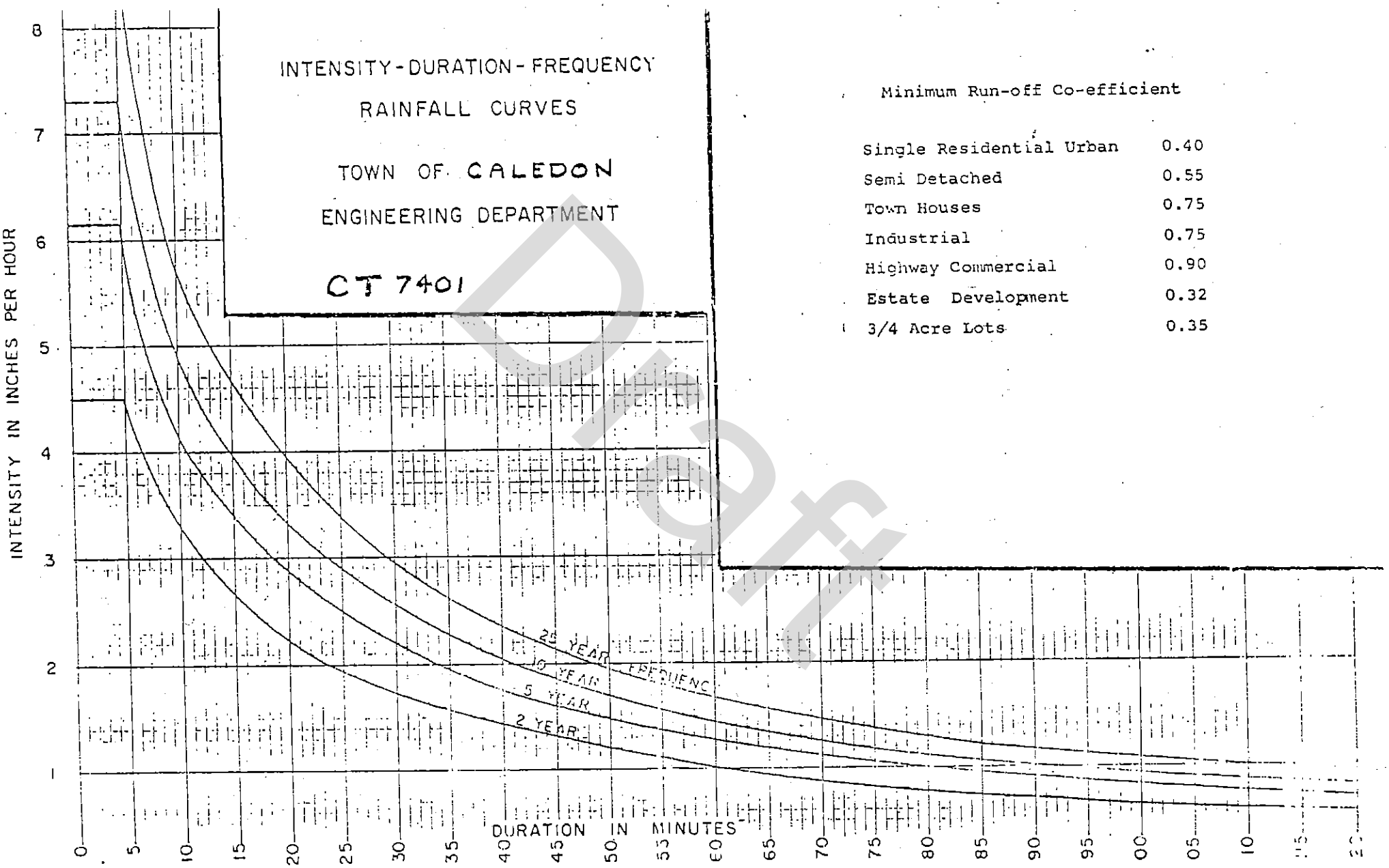
The required storage was obtained by determining the area between the pre-development and post development hydrographs. Pages 8 & 15 of Appendix "C" contain the calculations. The storage volumes required in order that the design runoff from the developed site does not exceed the amount of pre-developed site runoff for the 100 year and 10 year design storms are 11.48 and 6.16 acre-feet respectively.

The detention pond proposed will be created by constructing an earth embankment across the existing valley lands.

The 10 year storm and 100 year storm outflows from the subject lands will be regulated by the operation of the culverts jointly with the proposed spillway. Appendix'D' contains the design calculations for for the spillway and culvert operation.

The twin 1000mm dia. culverts will discharge the 10 year pre-development flow of the upstream area. As the flow enters the detention pond, the water level on the ponds will rise because of the restricted capacity of the culverts, thus creating the necessary storage. The flow condition for the 100 year pre-development flow is similar to the 10 year flow condition only that discharge over the spillway will also occur. The sizing of the spillway and culverts is such that the combined discharge rate will not increase the runoff downstream of the subject lands due to the development of the subject lands.

APPENDIX 'A'



Minimum Run-off Co-efficient

Single Residential Urban	0.40
Semi Detached	0.55
Town Houses	0.75
Industrial	0.75
Highway Commercial	0.90
Estate Development	0.32
3/4 Acre Lots	0.35

JULY 10, 1980

PROJECT: TOWN OF CALEDON
LOTS 5 & 6 CONC. 6
FILES 21T-79064C & 21T-79065C

FILE 80-112

CALC BY V.A.P.

PART I DESIGN OF MINOR STORM DRAINAGE SYSTEM – FILE 21T-79065C - NORTH PLAN

H) SWALE: REAR OF LOTS 21 to 25

AREA = 2.81 ha = 6.95 ac
T_C = (18 MIN) ? should be 10 MIN ∴ I = 3.55 mm/hr R = 0.75

Q_{ACTUAL} = 6.95 x 3.55 x 0.75 = 18.50 CFS

Q_{DESIGN} = 20.0 CFS (0.566 cms)

TYPE 'C' CHANNEL @ 0.50%

$$AR^{2/3}_{REQ} = \frac{Q_D\, n}{1.486\,(S_o)^{1/2}} = \frac{(20)(0.030)}{1.486\,(.005)^{1/2}} = 5.71$$

FOR Y_N = 0.87' $AR^{2/3}$ = 5.80 OK
= 0.265 M

$$\therefore V = \frac{Q}{A} = \frac{20.0}{7.23} = 2.77 \text{ f/sec}$$

DIST = 252 M = 826.7'

TRAVEL TIME = $\frac{826.7}{2.77 \times 60}$ = 5.00 MIN ∴ T_C = 23 MIN

B SWALE LOTS 25/26

ACCUMULATED AR = 5.21

T_c = 23 MIN ∴ I = 3.10 INS/hr

Q_{ACTUAL} = 5.21 x 3.10 = 16.15 CFS

Q_{DESIGN} = 20.0 CFS

TYPE 'C' CHANNEL @ 1.00% & 1.50%

So @ 1.00% $AR^{2/3}_{REQ} = \frac{Qn}{1.486\, So^{1/2}} = \frac{(20)(0.03)}{(1.486)(0.01)^{1/2}} = 4.03$

for Y_N = 0.71' (0.216m) $AR^{2/3}$ = 4.04

$V = \frac{Q}{A} = \frac{20}{5.66} = 3.53$ '/sec

So = 1.50% $AR^{2/3} = \frac{Qn}{1.486\, So^{1/2}} = \frac{(20)(0.03)}{(1.486)(0.015)^{1/2}} = 3.29$

for Y_N = 0.63' (0.192 m) $AR^{2/3}$ = 3.28

$V = \frac{20}{4.93} = 4.05$ '/sec

TRAVEL TIME = $\frac{32 \times 3.28}{60 \times 3.53} + \frac{33 \times 3.28}{4.05 \times 60} + \frac{35 \times 3.28}{3.53 \times 60}$ = 1.50 MIN

T_c = 23.0 + 1.50 = 24.5 MIN I = 2.95 INS/hr

C ROAD CULVERT FRONTING LOTS 25/26 & 5/6

AREA = 3.87ha = 9.55ac $R = 0.55$

$AR = 0.55 \times 9.55 = 5.25$
$AR_{ACCUM} = 5.21$
$AR_{TOTAL} = 10.46$

$T_c = 24.5$MIN $I = 2.95$ITRM/hr

$Q_{ACTUAL} = 10.46 \times 2.95 = 30.86$CFS (0.872cms)

USE 2 CULVERTS Q/CULVERT = 15.43CFS

TRY 910MM x 660MM ARCH CULVERT

i) CHECK INLET CONTROL

- USING HEADWALL & $Q = 15.5$CFS

$\therefore HW_I/D = 0.77$ (FIG 14-10) $\therefore HW_I = 0.77 \times 1.66 = 0.508$M $= 1.67'$

ii) CHECK OUTLET CONTROL — HEADWALL $K_e = 0.5$

$L = 20.00$M $= 65.6'$
$S_o = 0.30\%$ $A = 5.4$sq ft.

$HW_o = H + h_o - LS_o$

Let $h_o = \frac{d_c + .66}{2}$ $d_c = 0.93'$; $0.66M = 2.16'$

$\therefore h_o = \frac{0.93 + 2.16}{2} = 1.55'$

FROM FIG 14-15 $H = 0.47$

$\therefore HW_o = 0.47 + 1.55 - (.650)(.30) = 1.82'$

∴ OUTLET CONTROL WILL PREVAIL

$HW_O > HW_I$

$$V_{AVE} \frac{30.84 \times}{2 \times 5.4 \times} = 2.86'/sec$$

$$\text{TRAVEL TIME} = \frac{65.6'}{2.86 \times 60} = 0.4 \text{ MIN}$$

∴ T_C = 24.9 MIN I = 2.90 INS/HR

D SWALE LOTS 5/6 & 4/6.

ACCUM AR = 10.46

AREA = 1.62 ha = 4.01 ac
AR = 4.01 × 0.55 = 2.21

AR_{TOTAL} = 12.67

T_C = 24.9 MIN I = 2.90 INS/HR

Q_{ACTUAL} = 12.67 × 2.90 = 36.47 CFS

Q_{DESIGN} = 38.0 CFS (1.076 cms)

TYPE 'C' CHANNEL @ 0.30%

$$AR^{2/3}_{REQ} = \frac{Qn}{1.486 S_o^{1/2}} = \frac{(38)(.030)}{1.486 (.003)^{1/2}} = 14.0$$

FOR Y_n = 1.41' (0.43M) $AR^{2/3}$ = 13.97

$$V = \frac{Q}{A} = \frac{38}{13.23} = 2.87'/sec$$

DIST = 97M + 38M = 135M = 443'

TRAVEL TIME = $\frac{443}{2.87 \times 60}$ = 2.6 MIN

∴ T_C = 2.6 + 24.9 = 27.5 MIN

E SWALE LOT 12/27

AREA = 2.54 ha = 6.38 ac
T_C = 18 MIN ∴ I = 3.55 ins./hr R = 0.55

Q_{ACTUAL} = 6.38 × 3.55 × 0.55 = 15.97 CFS

Q_{DESIGN} = 16.0 CFS S_o = 1.50%

TYPE 'B' CHANNEL

$AR^{2/3}_{REQ} = \frac{Qn}{1.486 S_o^{1/2}} = \frac{(16)(.030)}{(1.486)(.015)^{1/2}} = 2.63$

FOR Y_N = 0.74' (0.226M) $AR^{2/3}$ = 2.66 OK

$V = \frac{16}{4.07} = 3.93$ '/sec

F SWALE LOT 1/27

$T_C = \frac{0.00013 L^{0.77}}{S^{0.385}}$

(KIRPICH FORMULA)

L = 3010'

ΔH = 840 − 805 = 35'
256.03M − 245.2M

$S = \frac{\Delta H}{L} = \frac{35}{3010} = 0.01163$'/'

∴ T_C = 21 MIN

∴ I = 3.25 ins./hr

Tributary Areas

North Entry	4.29ha	= 10.6ac ; R=0.25	AR= 2.65
Lot 27	5.27ha	= 13.03ac R=0.25	AR= 3.25
Upstream	2.54ha	= 6.38ac R=0.55	AR= 3.51
			AR_{TOTAL}=9.41

Q_{ACTUAL} = 9.41 x 3.25 = 30.58 CFS

Q_{DESIGN} = 31.0 CFS

Type 'B' Channel @ 0.50%

$$AR^{2/3}_{REQ} = \frac{Qn}{(1.486)(.8)^{1/2}} = \frac{(31)(.03)}{(1.486)(.005)^{1/2}} = 8.85$$

for Y_N = 1.34' (0.408m) $AR^{2/3}$ = 8.87

$$V = \frac{Q}{A} = \frac{31}{9.78} = 3.17 \text{ l/sec}$$

Part II Design of Minor Storm Drainage System - File 21T-79064C - South Plan

A) Road Culvert Fronting Lot 25

T_C = 18mins I = 3.55 ins/hr

Area= 2.24ha = 5.54ac ; R= 0.55

AR= 5.54 x 0.55 = 3.05

Q_{ACTUAL} = 3.55 x 3.05 = 10.83 CFS

Q_{DESIGN} = 12 CFS

TRY 600mm dia. C.M.P @ 0.30%
WITH CONC. HEADWALLS L = 57.4'

i) CHECK INLET CONTROL

FOR Q = 12 cms HWI/D = 0.97
FIG 14-9

∴ HWI = 0.97 × 0.6 = 0.582M = 1.91'

ii) CHECK OUTLET CONTROL

- HEADWALL - Ke = 0.50
L = 17.5M = 57.4'
So = 0.30%

HWo = H + ho - Lso

LET $h_o = \frac{d_{ce} + D}{2} = \frac{1.24 + 1.97}{2} = 1.61$

FROM FIG 14-14 H = 1.35'

∴ HWo = 1.35 + 1.61 - (57.4)(.30) = 2.78' = 0.847M

∴ OUTLET CONTROL PREVAILS

$V_{AVE} = \frac{12}{3.04} = 3.95'/sec$

$TRAVEL\ TIME = \frac{57.4}{3.95 \times 60} = 0.3 MIN$

∴ Tc = 18 + 0.3 = 18.3 MIN

B SWALE LOTS 8/9

$AR_{UPSTREAM} = 3.05$

$A = 1.49 ha = 3.67 ac$;

$\therefore AR = 3.67 \times 0.55 = 2.02$

$AR_{TOTAL} \quad 5.07$

$T_c = 18.3 MIN \quad \therefore I = 3.50 ins/hr$

$Q_{ACTUAL} = 5.07 \times 3.50 = 17.75 CFS$

$Q_{DESIGN} = 20 CFS$

TYPE 'D' CHANNEL @ 0.50%

$$AR^{2/3}_{REQ} = \frac{Qn}{1.486(S^{1/2})} = \frac{(20)(.030)}{(1.486)(0.005)^{1/2}} = 5.71$$

for $1/n = 1.42'$ $(0.433M)$; $AR^{2/3} = 5.79$

$$V = \frac{Q}{A} = \frac{20}{6.36} = 3.14'/sec.$$

DIST = $166 M = 544.6'$

$$\text{TRAVEL TIME} = \frac{544.6}{3.14 \times 60} = 2.9 MIN$$

$\therefore Tc = 18.3 + 2.9 = 21.2 MIN$

Culvert Required for Lots 10/9 & 16/17

Area = 0.88 ha = 2.17 ac

AR = 2.17 x 0.55 = 1.19
AR upstream = = 5.07

AR total = 6.26

For Tc = 21.2 min I = 3.20 ins/hr

Q actual = 3.20 x 6.26 = 20.03 cfs

Q design = 22 cfs

Try 800mm dia C.M.P @ 0.30%
c/w Conc Headwalls L = 18.0m = 59'

i) Inlet Control Check

Using Headwall c/w 800mm CMP Area = 5.41 sq ft

HWI/D = 0.90
Fig 14-9 ∴ HWI = 0.9 x .8 = .72m = 2.36'

ii) Outlet Control Check

- Headwall - Ke = 0.5
- L = 18.00m = 59' So = 0.30%

$HW_o = H + h_o - LS_o$

Let $h_o = \frac{d_{cr} + D}{2} = \frac{1.58 + 2.63}{2} = 2.10'$

From Fig 14-19 H = 0.90

∴ HW_o = 0.90 + 2.10 - .59(.30) = 2.82' (.859m)

∴ Outlet Control Prevails

$V_{AVE} = \frac{22}{5.41} = 4.06'/sec$

$TRAVEL\ TIME = \frac{59}{4.06 \times 60} = 0.3\ MIN$

$\therefore\ T_C = 21.2 + 0.3 = 21.5\ MIN$

D SWALE LOTS 16/17 & 16/18

AREA = 0.67ha = 1.65ac ; R = 0.55

$AR = 1.65 \times 0.55 = 0.91$

$AR_{UPSTREAM} = 6.26$

$AR_{TOTAL} = 7.17$

for $T_C = 21.5\ MIN$ $I = 3.17\ ins/hr$

$Q_{ACTUAL} = 7.17 \times 3.17 = 22.72\ CFS$

$Q_{DESIGN} = 25\ CFS$

USE TYPE 'D' CHANNEL @ 0.50%

$AR^{2/3}_{REQ} = \frac{Qn}{1.486(S_0^{1/2})} = \frac{25(.03)}{(1.486)(.005)^{1/2}} = 7.14$

for $Y_{NO} = 1.56'$ (0.475M) $AR^{2/3} = 7.13$

$V = \frac{25}{7.43} = 3.36'/sec$

E Swale Lots 13/14

T_c = 18.0 (MIN) I = 3.55 ins/hr

Tributary Area = 2.44ha = 6.02ac ; R = 0.55

$Q_{ACTUAL} = 0.55 \times 6.02 \times 3.55 = 11.04$ CFS

$Q_{DESIGN} = 14$ CFS

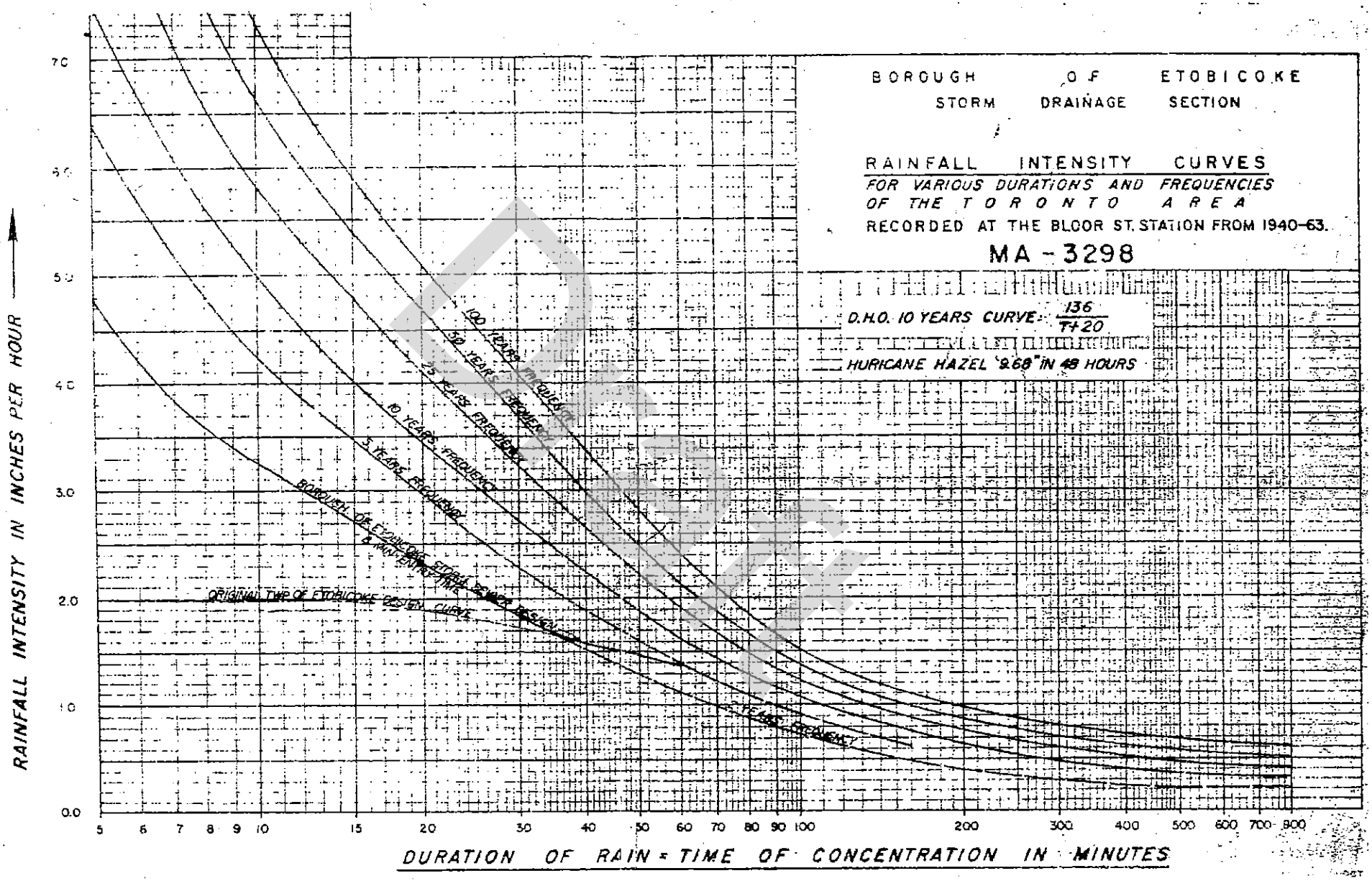
Type 'D' Channel @ 0.70%

$$AR^{2/3}_{REQ} = \frac{Qn}{1.486(S_0)^{1/2}} = \frac{(14)(.03)}{1.486(.007)^{1/2}} = 3.38$$

For Y_N = 1.14' (0.347M) ; $AR^{2/3}$ = 3.40

$$V = \frac{14}{4.47} = 3.13 \text{ l/sec}$$

APPENDIX 'B'


BOROUGH OF ETOBICOKE
STORM DRAINAGE SECTION
RAINFALL INTENSITY CURVES
FOR VARIOUS DURATIONS AND FREQUENCIES
OF THE TORONTO AREA
RECORDED AT THE BLOOR ST. STATION FROM 1940-63.
MA - 3298
D.H.O. 10 YEARS CURVE = 136/(T+20)
HURICANE HAZEL "8.68" IN 48 HOURS
100 YEARS FREQUENCY
50 YEARS FREQUENCY
25 YEARS FREQUENCY
10 YEARS FREQUENCY
5 YEARS FREQUENCY
2 YEARS FREQUENCY
ORIGINAL TYP. OF ETOBICOKE STORM SEWER DESIGN CURVE
RAINFALL INTENSITY IN INCHES PER HOUR
DURATION OF RAIN = TIME OF CONCENTRATION IN MINUTES
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
5 6 7 8 9 10 15 20 30 40 50 60 70 80 90 100 200 300 400 500 600 700 800

PART III DESIGN OF MAJOR STORM DRAINAGE SYSTEM

FILE 21T-79065C - NORTH PLAN

A SWALE REAR LOT 17

- T_c BY KIRPICH FORMULA

$$T_c = 0.00013 \frac{L^{0.77}}{S^{0.385}}$$

$L = 2310'$

$\Delta H = 845' - 812' = 33'$

257.56m - 247.5m

$$S = \frac{\Delta H}{L} = \frac{33}{2310} = 0.01428$$

$\therefore T_c = 15.6$ MIN $I = 5.80$ INS/hr

- AREA = 11.34ha = 28.0ac $R = 0.25$
- $Q_{ACTUAL} = 28 \times 0.25 \times 5.80 = 40.6$ cfs (1.154 cms)
- $Q_{DESIGN} = 45$ CFS
- TYPE 'A' CHANNEL @ 0.40%

$$AR^{2/3}_{REQ} = \frac{(45)(.035)}{(1.486)(0.004)^{1/2}} = 16.76$$

FOR $Y_{NO} =$ 1.49' (0.454m) $AR^{2/3} = 16.73$ & $V = 2.73$'/sec

- DIST = 45.3m = 148.6'
- TRAVEL TIME = $\frac{148.6}{2.73 \times 60} = 0.9$ MIN
- $\therefore T_c = 15.6 + 0.9 = 16.5$ MIN

Type A Channel lots 17/18+19

- $T_c = 0.000013 \frac{L^{0.77}}{S^{0.385}}$ $L = 3080'$ (939m)

$\Delta H = 846 - 814 = 32'$
$257.86m - 248.1m$

$V \approx 0.7 m/s$

$S_o = \frac{\Delta H}{L} = \frac{32}{3080} = 0.01039$

∴ $T_c = 0.366 hrs = 22.0 min$

∴ $I =$ 4.85 ins/hr check this

- Area = 29.36ha = 72.5ac ; R = 0.25
- $Q_{actual} = 72.5 \times 0.25 \times 4.85 =$ 87.9cfs (2.489cms)
- $Q_{design} =$ 95cfs
- Type 'A' Channel @ 0.60%

$$AR^{2/3}_{req} = \frac{(95)(.035)}{1.486(.006)^{1/2}} = 28.88$$

For $Y_N = 1.94'$ (0.591m) $AR^{2/3} = 28.89$

$$V = \frac{95}{24.02} = 3.95' / sec$$

- Dist = 133.0m = 436'
- Travel Time = $\frac{436}{3.95 \times 60} = 1.8$ min
- ∴ $T_c = 22 + 1.8 = 23.8$ min

AREA = 1.53 ha = 3.78 ac

AR =	3.78 x 0.55 =	2.08
AR WEST =	28.0 x 0.25 =	7.00
AR EAST =	72.5 x 0.25 =	18.13
AR TOTAL =		27.21

FOR T_c = 23.8 MIN I = 4.67 INS/HR

Q_{ACTUAL} = 4.67 x 27.21 = 127.07 CFS

Q_{DESIGN} = 130 CFS (3.681 CMS) 100 YEAR

USE TYPE 'A' CHANNEL @ 0.50%

$$AR^{2/3}_{REQ} = \frac{(130)(.035)}{(1.486)(.005)^{1/2}} = 43.3$$

FOR Y_{NO} = 2.39' (0.728M); $AR^{2/3}$ = 43.25

$$V = \frac{130}{32.81} = 3.96 \text{ FT/SEC}$$

DIST = 107M = 351'

$$T_c = 23.8 + \frac{351}{3.96 \times 60} = 25.3 \text{ MIN}$$

- AREA = 1.97ha = 4.87ac

AR	= 4.87 x 0.55 =	2.68
ARUPSTREAM =		27.21
ARTOTAL		29.89

- T_C = 25.3MIN ∴ I = 4.50 INS/HR

- Q_{ACTUAL} = 4.50 x 29.89 = 134.51CFS (3.807 cms)

- USE 2 CULVERTS ∴ Q/CULVERT = 67.25CFS

TRY 2 - 1630 x 1120 CMP ARCH CULVERTS
Q_{DESIGN} = 70CFS A = 1.32M² = 14.20 SQFT

i) CHECK FOR INLET CONTROL

- USING CONC HEADWALLS & Q_{DESIGN} = 70CFS

HW_I/D = 0.88 ∴ HW_I = 0.88 x 1.12 = 0.985M = 3.23'
FIG 14-10

ii) CHECK FOR OUTLET CONTROL

- HEADWALL K_e = 0.5
- L = 20.235M = 66.38' S_o = 0.33%
- $HW_O = H + h_o - LS_o$
- LET $h_o = \frac{d_{cr} + D}{2} = \frac{1.82 + 3.67}{2} = 2.75'$
- FROM FIG 14-15 H = 0.95'

∴ HW_O = 0.95 + 2.75 - (66.38)(.33) = 3.48' = 1.06

OUTLET CONTROL PREVAILS

E SWALE LOTS 7/8 & 6/8

- AREA = 1.67ha = 4.13ac ; R = 0.55

AR = 4.13 x 0.55 = 2.27
$AR_{UPSTREAM}$ = 29.89
AR_{TOTAL} 32.16

- T_C = 25.5 MIN I = 4.50 INS/hr

- Q_{ACTUAL} = 4.5 x 32.16 = 144.7 CFS

- Q_{DESIGN} = 150 CFS

- USE TYPE 'A' CHANNEL @ 0.27%

$$AR^{2/3}_{REQ} = \frac{(150)(.035)}{1.486\ (0.0027)^{1/2}} = 67.99$$

FOR Y_N = 2.96' (0.902 M) $AR^{2/3}$ = 67.82

- $V = \frac{150}{45.70} = 3.28'/sec$

- DIST = 119.3M = 391.4ft.

- $T_C = 25.5 + \frac{391.4}{3.28 \times 60} = 27.5$ MIN

$AR_{UPSTREAM}$ = : 32.16

$AR_{EAST\ MINOR\ SYSTEM}$: 12.67

AR_{TOTAL} 48.49

CONSIDER T_C @ MIDWAY OF SWALE T_o BE 29.0 MIN

@ I = 4.1 ins/hr

Q_{ACTUAL} = 4.1 x 48.49 = 198.8 CFS

Q_{DESIGN} = 200 CFS = 5.67 CMS.

USE TYPE 'A' CHANNEL @ 0.27%

$$\therefore AR^{2/3}_{REQ} = \frac{(200)(.035)}{(1.486)(0.0027)^{1/2}} = 90.66$$

FOR Y_N = 3.38' $AR^{2/3}$ = 90.2
1.03M

$$V = \frac{200}{56.44} = 3.50'/sec$$

DIST = 217.8 M = 714.5 ft

CHECK T_C @ MIDWAY OF SWALE

$$27.5 + \frac{714.5}{2 \times 60 \times 3.5} = 29.2\ MIN \quad \underline{OK}$$

$$T_C = 27.5 + \frac{714.5}{60 \times 3.5} = 30.9\ MIN$$

- AREA = 1.31ha = 2.38ac ; R = 0.55

AR = 2.38 x 0.55 = 1.31
AR UPSTREAM = 48.49
AR TOTAL 49.80

- T_C = 30.9MIN ; I = 4.0INS/hr

- Q_{ACTUAL} = 49.8 x4 = 199.2 CFS

- Q_{DESIGN} = 200CFS

- USE TYPE 'A' CHANNEL @ 0.27%

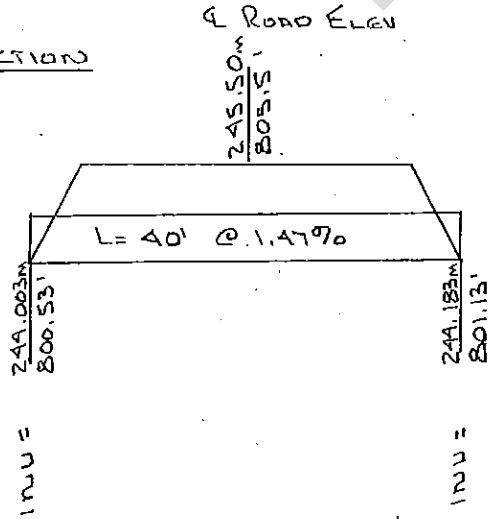
Y_N = 3.38' OR 1.03M V = 3.5'/SEC

- DIST = 108.2 = 355'

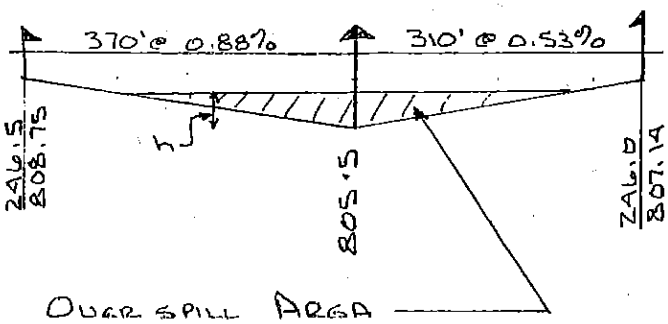
- T_C = $30.9 + \frac{355}{3.5 \times 60}$ = 32.6MIN

H ANALYSIS OF EXISTING 1.14M x 1.85M (44" x 72") ARCH C.M.P CROSSING UNDER FIFTH SIDE ROAD

X-SECTION



PROFILE OF ROAD



OVERSPILL AREA

$= \frac{b}{2}\left[\frac{h}{0.0088} + \frac{h}{0.0053}\right] = 151.16h^2$

- Check For Inlet Control
  - Projecting Entrance Condition

$$HW/D = \frac{4.37'}{\frac{44}{12}} = 1.19$$

From Fig 19-10 $Q = 110$ cfs

- Check For Outlet Control
  - Projecting Entrance Condition $K_e = 0.9$
  - $L = 40'$ @ 1.47%

$$HW_o = H + h_o - LS_o$$

$$4.37 = H + h_o - (0.40)(1.47)$$

$$\therefore H + h_o = 4.96$$

@ $Q = 120$ cfs, $d_c = 2.40'$ $\therefore h_o = \frac{2.40 + 3.67}{2} = 3.03'$

From Fig 19-15 $H = 1.90'$

$$\therefore H + h_o = 4.93'$$

$\therefore$ INLET CONTROL PREVAILS

∴ DISCHARGE PRIOR TO ROAD OVERSPILL = 110CFS

II FLOW OVER ROAD & THROUGH CULVERT

- CONSIDER ROAD ACTING AS A WEIR & DISCHARGE GIVEN BY $Q = CAH^{1/2}$

$C \approx 2.50$; $A = 151.16h^2$

$\therefore Q = 377.9h^{5/2}$

- FOR L.W.L = 806.12 (245.705m) $\therefore h = 0.62'$ (DEPTH OF WATER ON ROAD DURING OVERSPILL)

$Q_{ROAD} = 377.9(0.62)^{5/2} = 114 CFS$

$Q_{CULVERT}$ (FROM FIG 14-18) = 128 CFS

$HW/D = 4.99/3.67$

$= 1.36$

$Q_T =$ 242 CFS

CHECK FOR OUTLET CONTROL

PROJECTING ENTRANCE CONDITION $K_e = 0.9$

$L = 40'$ $S_o = 1.47\%$

FOR 44" x 72" CMP $d_c = 2.50'$ FOR $Q = 128 CFS$

$\therefore h_o = \frac{d_c + d}{2} = \frac{2.5 + 3.67}{2} = 3.09'$

FROM FIG 14-15 $H = 2.15'$

$\therefore HW_o = H + h_o - LS_o = 2.15 + 3.09 - (.4)(1.47)$

$= 4.65'$

$HW_{ACTUAL} = 806.12 - 801.13 \approx 5.00'$

$\therefore$ INLET CONTROL PREVAILS.

EXCEEDING 7½") IT IS PROPOSED TO LEAVE THE CULVERT AS IS

OVER SPILL & CULVERT DISCHARGE WILL BE CONVEYED TO DETENTION POND VIA NATURAL WATERCOURSE IN BLOCK 28. FLOOD LIMITS SHOWN ON DWG BO-112-3 SH 2 of 2 determined BY STANDARD STEP METHOD USING DISCHARGE DETERMINED IN PART OF DESIGN REPOR See PART FOR CALCULATIONS OF FLOOD WATER LIMITS

PART IV DESIGN OF MAJOR STORM DRAINAGE SYSTEM File 21T-79064C - SOUTH PLAN

A SWALE BETWEEN LOTS 21/22

- T_c BY KIRPICH FORMULA

$$T_c = 0.00013 \frac{L^{0.77}}{S^{0.385}} \qquad L = 5250'$$

$\Delta H = 840' - 810' = 30'$
$= 256.03_M - 246.89_M$

$$S = \frac{\Delta H}{L} = \frac{30}{5250} = 0.00571$$

$$\therefore T_c = 0.00013 \frac{(5250)^{0.77}}{(0.00571)^{.385}} = 0.695\,hr = 41.7\,MIN$$

$\therefore I = 3.25\,IN/hr$

- AREA UPSTREAM = 133.7ac $\quad R = 0.25$
- $Q_{ACTUAL} = 3.25 \times 133.7 \times 0.25 = 108.6\,CFS$
- USE TYPE 'D' CHANNEL @ 0.50%
- $Q_{DESIGN} = 120\,CFS$

$$AR^{2/3}_{REQ.} = \frac{(120)(0.035)}{(1.486)(0.005)^{1/2}} = 39.97$$

FOR $Y_N = 2.30'$ $\quad AR^{2/3} = 39.96$
$= 0.701M$

$$V = \frac{120}{30.96} = 3.87\,'/SEC$$

- DIST = 127.0M = 416.67'
- $T_c = 41.7 + \frac{416.67}{60 \times 3.87} = 43.5\,MIN$

B KOAD CULVERT LOTS 21/22 & 18/19

- AREA = 2.04ha = 5.05ac R = 0.55

AR = 5.05 x 0.55 = 2.78
ARUPSTREAM = 33.43
ARTOTAL = 36.21

- TC = 43.5 MIN I = 3.18 INS/HR

- QACTUAL = 36.21 x 3.18 = 115.15 CFS

- QDESIGN = 120 CFS

- TRY 2 CULVERTS 1630MM X 1120MM A = 1.32M²
27.639M @ 0.30% = 14.2SQFT

QDESIGN / CULVERT = 60CFS

i) CHECK FOR INLET CONTROL

- USING CONC HEADWALLS & QDESIGN = 60CFS

- HWI/D = 0.825 ∴ HWI = 0.825 x 1.12 = 0.924M
FIG 14-10 = 3.03'

ii) CHECK FOR OUTLET CONTROL

- HEADWALL ; Ke = 0.5
- L = 27.639M = 90.68' ; So = 0.30%

HWo = H + ho - LSo

LET ho = $\frac{dc+D}{2}$ = $\frac{1.66+3.67}{2}$ = 2.66'

H = 0.82'
FROM FIG 14-15 Q = 60CFS

- HW$_{60}$ = 0.82 + 2.66 − (90.68)(.30) = 3.19

∴ OUTLET CONTROL PREVAILS

- $V_{DUE} = \frac{60}{14.2} = 4.22'/sec$

- $T_C = 43.5 + \frac{90.68}{4.22 \times 60} = 43.9 MIN$

C SWALE BETWEEN LOTS 18/19

- AREA = 1.22 ha = 3.01 ac R = 0.55

AR = 3.01 × 0.55 = 1.65

- $AR_{UPSTREAM} = \frac{36.21}{AR_{TOTAL}} \quad 37.86$

- T_C = 43.9 MIN ∴ I = 3.15 in/hr

- Q_{ACTUAL} = 3.15 × 37.86 = 119.26 CFS

- USE TYPE 'A' CHANNEL @ 0.82%

- Q_{DESIGN} = 125 CFS

$$AR^{2/3}_{REQ} = \frac{(125)(0.035)}{(1.486)(0.0082)^{1/2}} = 32.51$$

for $Y_N = 2.08'$ (0.633M) $AR^{2/3} = 32.52$

- $V = \frac{125}{26.42} = 4.70'/SEC$

- DIST = 112 M = 367'

- $T_C = 43.9 + \frac{367}{4.70 \times 60} = 45.2 MIN$

D SWALE BETWEEN LOTS 16/19

- AREA = 1.80 ha = 4.55ac ; R = 0.55

$AR = 4.55 \times 0.55 = 2.50$

$AR_{EAST} = 37.86$

$AR_{NORTH} = 7.18$

$AR_{TOTAL} = 47.54$

- T_C = 45.2 MIN I = 3.05 INS/HR
- $Q_{ACTUAL} = 3.05 \times 47.54 = 145$ CFS
- USE TYPE 'A' CHANNEL @ 1.00%
- Q_{DESIGN} = 150 CFS

$$AR^{2/3}_{REQ} = \frac{(150)(0.035)}{(1.486)(0.01)^{1/2}} = 35.33$$

FOR Y_N = 2.17' (0.66M) $AR^{2/3}$ = 35.46

$$V = \frac{150}{28.36} = 5.29'$$

- DIST = 61.2M = 200.8'
- $T_C = 45.2 + \frac{200.8}{5.29 \times 60} = 45.8$ MIN

E SWALE BETWEEN LOTS 15/16

- AR_{ACCUM} = 47.54
- Q_{DESIGN} = 150 CFS
- USE TYPE 'A' CHANNEL @ 0.80%

- for $Q_{DESIGN} = 150$ cfs

$$AR^{2/3}_{REQ} = \frac{(150)(0.035)}{(1.486)(0.008)^{1/2}} = 39.5$$

For $Y_N = 2.30'$ (0.701m) $AR^{2/3} = 39.96$

- $V = \frac{150}{30.96} = 4.85'/sec$

- DIST = 96.2m = 315.6ft

- $T_C = 45.8 + \frac{315.6}{4.85 \times 60} = 46.9$ min

- Runoff Conveyed To Detention Pond Via Natural Watercourse

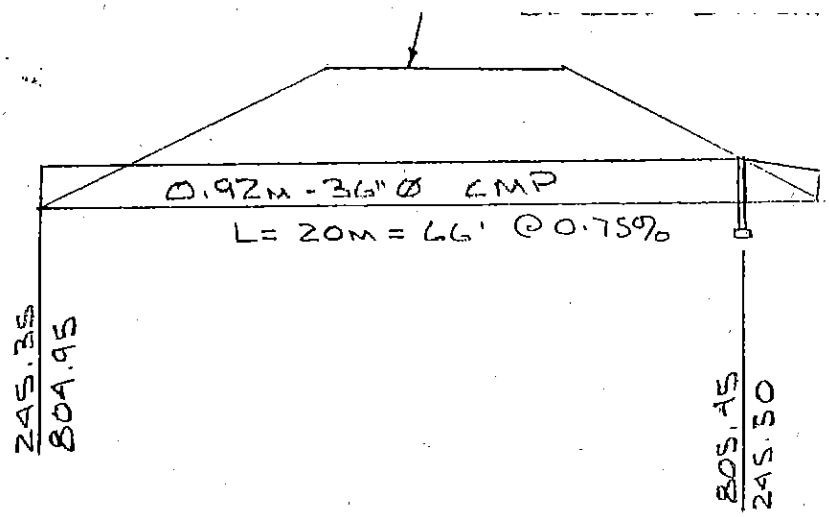
F Investigation Of Gabion Spillway & 0.92m (36"ø) Outlet Pipe From Existing Detention Pond

Design Criteria

- Discharge Based Upon Undeveloped Site Condition Upstream of Spillway and Culvert (Detention Pond). The Runoff In Excess Will Be Detained In Pond

$T_C = 41.7$min (see Part IV Section A) $I = 2.80$ins/hr
Area = 54.15ha = 133.7ac $R = 0.25$

$Q_{ACTUAL} = 133.7 \times 0.25 \times 2.80 = 108.6$cfs



INLET STRUCTURE
(CONC HEADWALL + WINGWALLS)
Ke = 0.25

AVAILABLE HEAD ON CULVERT PRIOR TO OVERSPILL ON SPILLWAY = 811.35 - 805.45 = 5.90' = HW

CHECK FOR INLET CONTROL

$HW_i/D = 5.90/3.0 = 1.97$

FROM FIG 14-9 Q = 70 CFS

CHECK FOR OUTLET CONTROL

$HW_o = H + h - LS_o$

$\therefore H + h_o = HW_o + LS_o = 5.9 + (.66)(0.75) = 6.4$

FOR Q = 70 CFS LET $h_o = \frac{d_{cr} + D}{2} = \frac{2.7 + 3}{2} = 2.85'$

FROM FIG 14-19 H = 4.5'

$\therefore H + h_o = 4.5 + 2.85 = 7.35'$

$\therefore$ OUTLET CONTROL WILL PREVAIL

BASED UPON SYSTEM CONSTRAINTS & BY TRIAL & ERROR SOLUTION
$Q_{CULVERT} = 65$ CFS.

- MAXIMUM OVERSPILL OVER SPILLWAY

  = 108.6 - 65 = 43.6 CFS

- WIDTH OF SPILLWAY = 36'

- SPILLWAY DISCHARGE GIVEN BY

$$Q = 2.7 L H^{3/2}$$

$$\therefore H = \left(\sqrt[3]{\frac{Q}{2.7L}}\right)^2 = \left(\sqrt[3]{\frac{43.6}{2.7(36)}}\right)^2 \approx 0.6'$$

∴ ELEV OF CREST = 811.95' = 247.48M

- CHANNEL TRANSITING SPILLWAY PROPOSED TO INTERCEPT DISCHARGE AS A SIDE CHANNEL

  FOR TYPE 'A' CHANNEL @ 0.50%
  1/N = 2.30' OR 0.701M

∴ WATER SURFACE ELEV = 245.2 + 0.7 = 245.9M
= 806.76 ft

- SIDE CHANNEL TO BE [illegible] FOR EROSION PROTECTION

- SINCE DISCHARGE PER UNIT WIDTH IS SMALL (APPROX 1CFS/LIN FT) IT IS SUGGESTED THAT [illegible] SIDE CHANNEL AND HAVING SUBCRITICAL FLOW WITHIN SIDE CHANNEL EXISTS SUFFICE TO CONTAIN TURBULENCE FLOW RESULTING DISCHARGE OF [illegible] CHANNEL

APPENDIX 'C'

100 YEAR STORM

RAINFALL DISTRIBUTION

TIME MIN	RAINFALL INS	ACCUMULATED RAINFALL INS	TIME MIN	RAINFALL INS	ACCUMULATED RAINFALL INS
0	0	0	160	0.079	2.869
10	0.026	0.026	170	0.066	2.935
20	0.026	0.052	180	0.059	2.994
30	0.033	0.085	190	0.053	3.047
40	0.033	0.118	200	0.046	3.093
50	0.039	0.157	210	0.039	3.132
60	0.046	0.203	220	0.039	3.171
70	0.053	0.256	230	0.033	3.204
80	0.072	0.328	240	0.033	3.237
90	0.112	0.440	250	0.026	3.263
100	0.269	0.709	260	0.026	3.289
110	1.319	2.028	270	0.019	3.308
120	0.354	2.382	280	0.019	3.327
130	0.184	2.566	290	0.019	3.346
140	0.125	2.691	300	0.019	3.365
150	0.099	2.790	310	0.019	3.384

$CN = 78 \quad \therefore S = 2.82$

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

100 YR. PRE DEVELOPMENT

TIME MIN	P IN	P_{ACCUM} IN	WATERSHED I Q_{ACCUM} CFS	WATERSHED I ΔQ CFS	WATERSHED I q_P CFS	WATERSHED II Q_{ACCUM} CFS	WATERSHED II ΔQ CFS	WATERSHED II q_P CFS
100	0.269	0.709	0.0071	0.0014	0.37			.27
110	1.319	2.028	0.5000	0.4929	131.6			94.1
120	0.354	2.382	0.7130	0.213	56.8			40.7
130	0.184	2.566	0.8310	0.118	31.5			22.5
140	0.125	2.691	0.9150	0.084	22.4			16.0
150	0.099	2.790	0.9820	0.067	17.9			12.8
160	0.079	2.869	1.0360	0.054	14.4			10.3

WATERSHED CHARACTERISTICS

I - WEST

DRAINAGE AREA = 211.7ac = 0.33sqmi

$L = 1.23mi = 6510 ft$

$\Delta H = 846. - 794 = 52'$

$S_{ave} = \frac{52}{6510} = 0.00799'/'$

$T_c = \frac{0.00013 L^{0.77}}{S^{0.385}} = 0.72 hrs$

Soil Type D

CN = 78

$q_p = \frac{(484)(0.33)(1)}{0.598} = 267 cfs$

II - EAST

= 162.2ac = 0.253 sqmi

= 1.31 mi = 6930 ft

= 840 - 794 = 46'

$= \frac{46}{6930} = 0.00707'/'$

= 0.793 hrs

= Type D

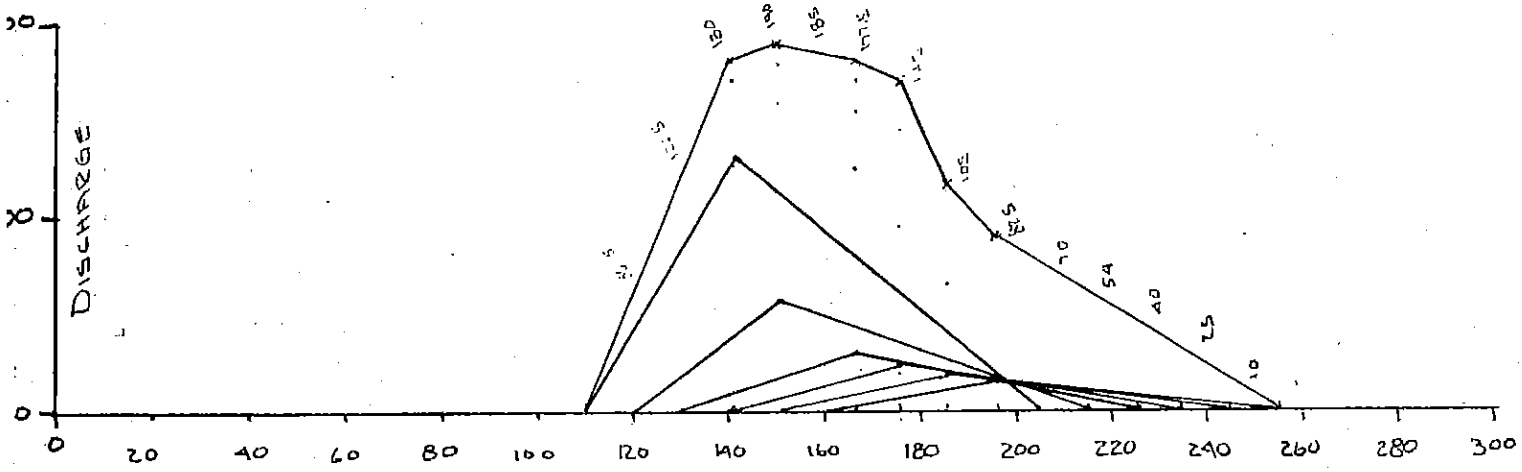
= 78

$q_p = \frac{(484)(0.253)(1)}{0.642} = 191 cfs$

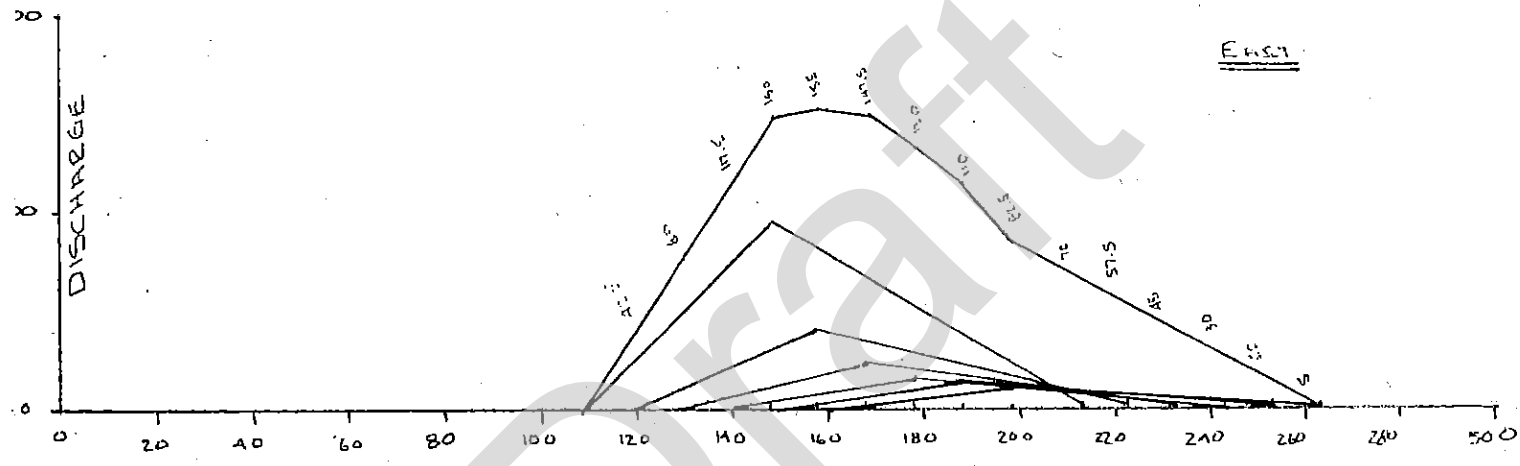
$Q = \frac{(P - 0.25)^2}{P + 0.85} = \frac{(P - 0.564)^2}{P + 2.256}$

PRE. DEVELOPED -100 YR

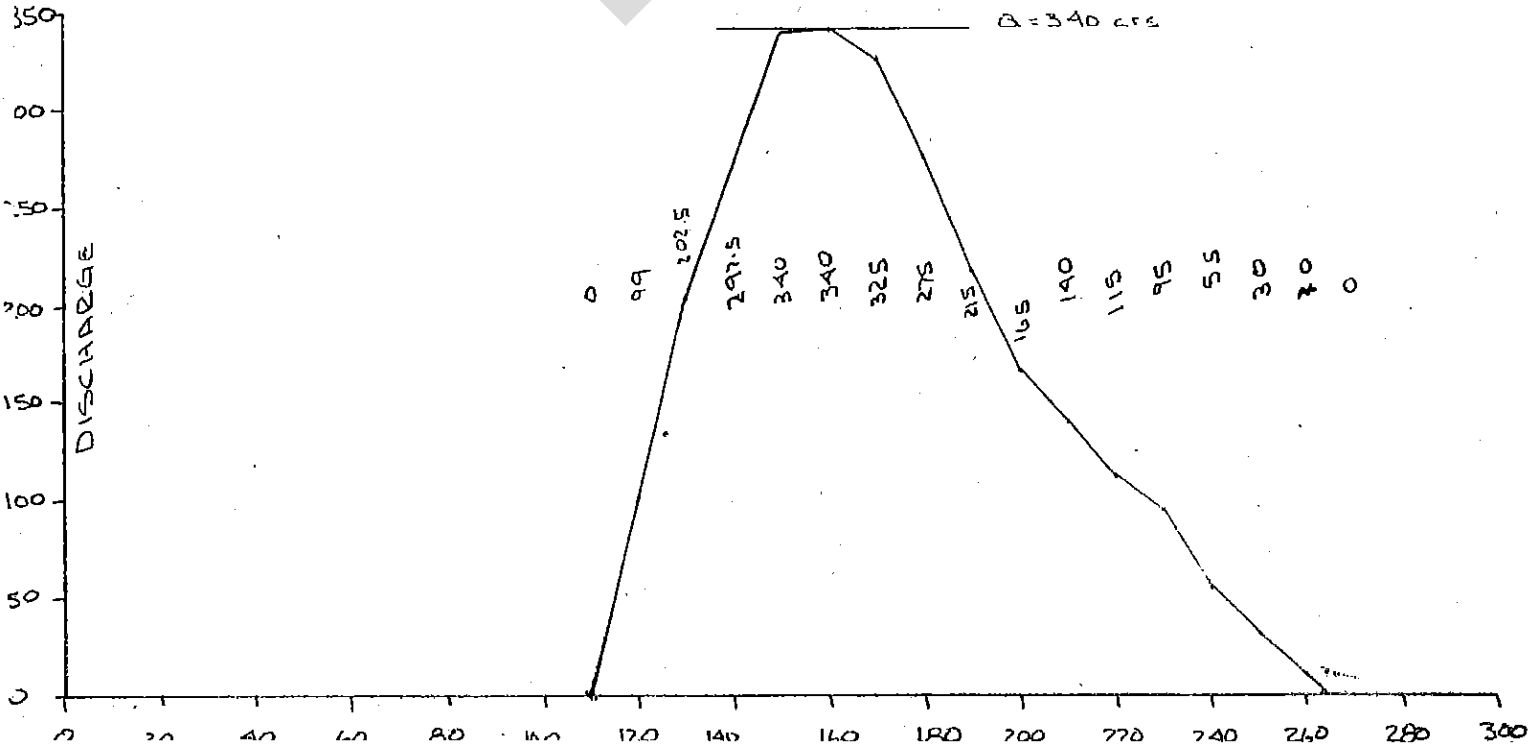
WEST



EAST



COMBINED



DEVELOPED SITE CONDITION

WATER SHED ANALYSIS

	WATERSHED I WEST	WATERSHED II EAST
TAL AREA	211.7 ac	162.2 ac
IGRICULTURAL CN = 78	120.1 ac (56.7%)	133.7 (82.4%)
-NDUSTRIAL CN = 89*	91.6 ac (43.3%)	28.5 (17.6%)

* FROM FIG 2-2 TR-55 URBAN HYDROLOGY FOR SMALL WATERSHEDS S.C.S

CN_I = .567(78) + (.443)(89) = 84 ∴ S = 1.90

CN_{II} = .824(78) + (.176)(89) = 80 ∴ S = 2.50

STIMATION OF Tc. - WATER SHED No 1 - WEST.

FROM ANALYSIS USING RATIONAL METHOD

Tc at CULVERT at 5th SIDE ROAD = 32.4 MIN

- ASSUME V NATURAL WATERCOURSE SOUTH OF 5th SIDEROAD TO BE 2.50 '/sec

L = 360M = 1181'

∴ $T_c = \frac{1181}{2.5 \times 60} + 32.4 =$ 40.27 MIN = 0.67 hrs.

ESTIMATION OF T_c - WATERSHED NO 2 - EAST

- FROM ANALYSIS USING RATIONAL METHOD

T_c @ NW CORNER OF LOT 19 = 46.9 MIN = 0.78 HRS

∴ LET T_c = 0.78 HRS

100 YR POST DEVELOPMENT

TIME MIN	P IN	P_{ACCUM} IN	WATERSHED-I-WEST Q_{ACCUM} CFS	WATERSHED-I-WEST ΔQ CFS	WATERSHED-I-WEST q_P CFS	WATERSHED-II EAST Q_{ACCUM} CFS	WATERSHED-II EAST ΔQ CFS	WATERSHED-II EAST q_P CFS
90	0.112	0.440	0.0018	—		0.00147		
100	0.269	0.709	0.0485	0.0467	15.4	0.01612	0.01465	3.3
110	1.319	2.028	0.7544	0.706	232.0	0.5796	0.56348	125.6
120	0.354	2.382	1.0272	0.273	89.8	0.8083	0.2287	51.0
130	0.184	2.566	1.1695	0.1423	46.8	0.9348	0.1265	28.2
140	0.125	2.691	1.2683	0.0988	32.5	1.0233	0.0885	19.7
150	0.099	2.790	1.3476	0.0793	26.1	1.0948	0.0715	15.9
160	0.079	2.869	1.4115	0.0639	21.0	1.1526	0.0312	6.9
170	0.066	2.935	1.4653	0.0538	17.7	1.2015	0.0489	10.9
180	0.059	2.994	1.5137	0.0484	15.9	1.2455	0.0440	9.8

I

T_c = 0.67 hrs

$T_P = 0.5D + 0.6T_c = 0.485 hr = 29.1 min$

$T_b = 2.67 T_P = 1.29 hrs = 78 min$

$q_P = \frac{484 \Delta Q}{T_P} = \frac{(484)(1.33)(1)}{0.485} = 329 cfs$

$CN_I = 84 \quad S = 1.90$

$Q = \frac{(P - 0.38)^2}{P + 1.52}$

II

T_c = 0.78 hrs

$T_P = 0.55 hrs = 33 min$

$T_b = 1.47 hrs = 88 min$

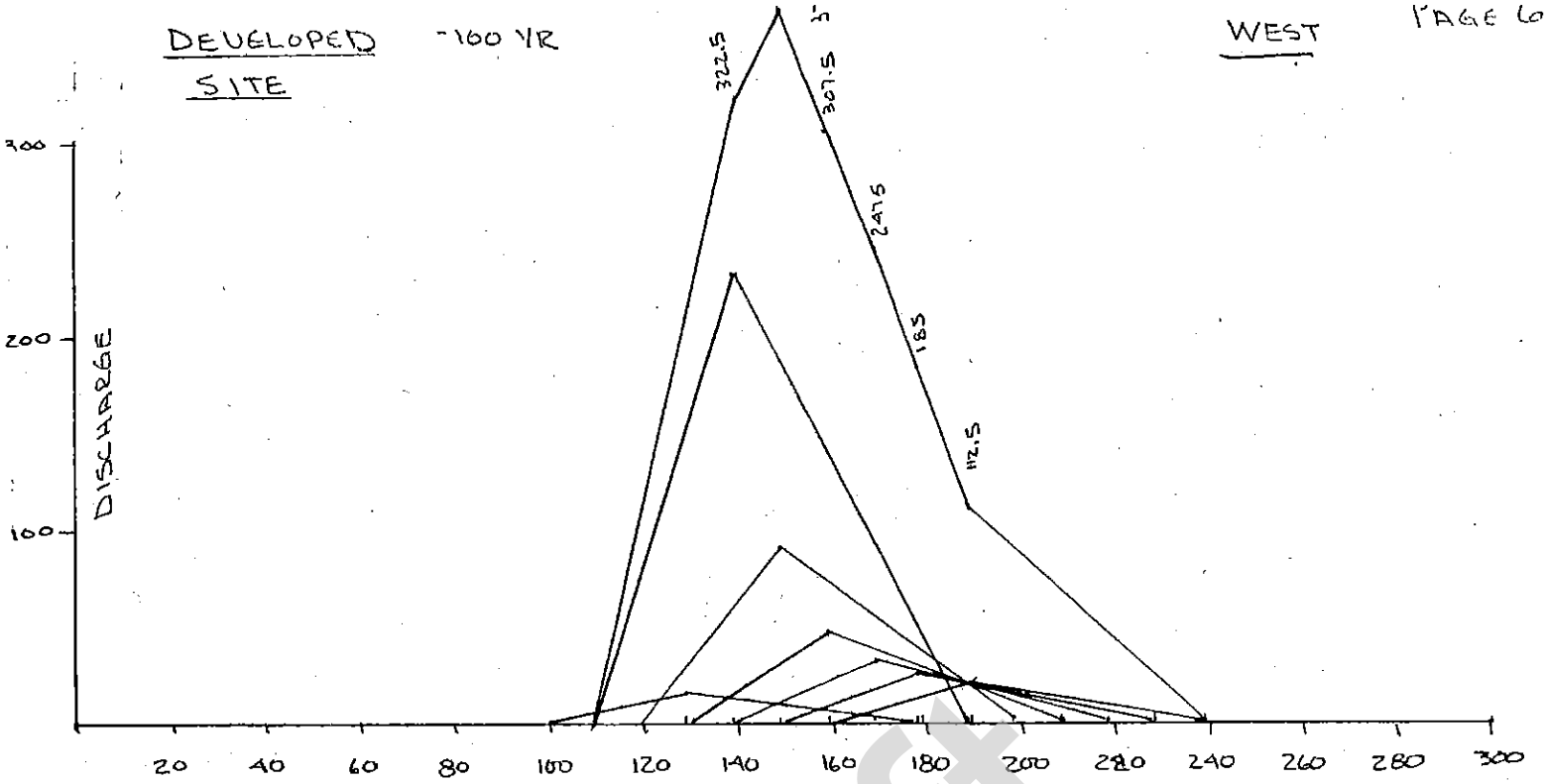
$q_P = \frac{484 (0.253)(1)}{0.55} = 223 cfs$

$CN_{II} = 80 \quad S = 2.50$

$Q = \frac{(P - 0.5)^2}{P + 2.0}$

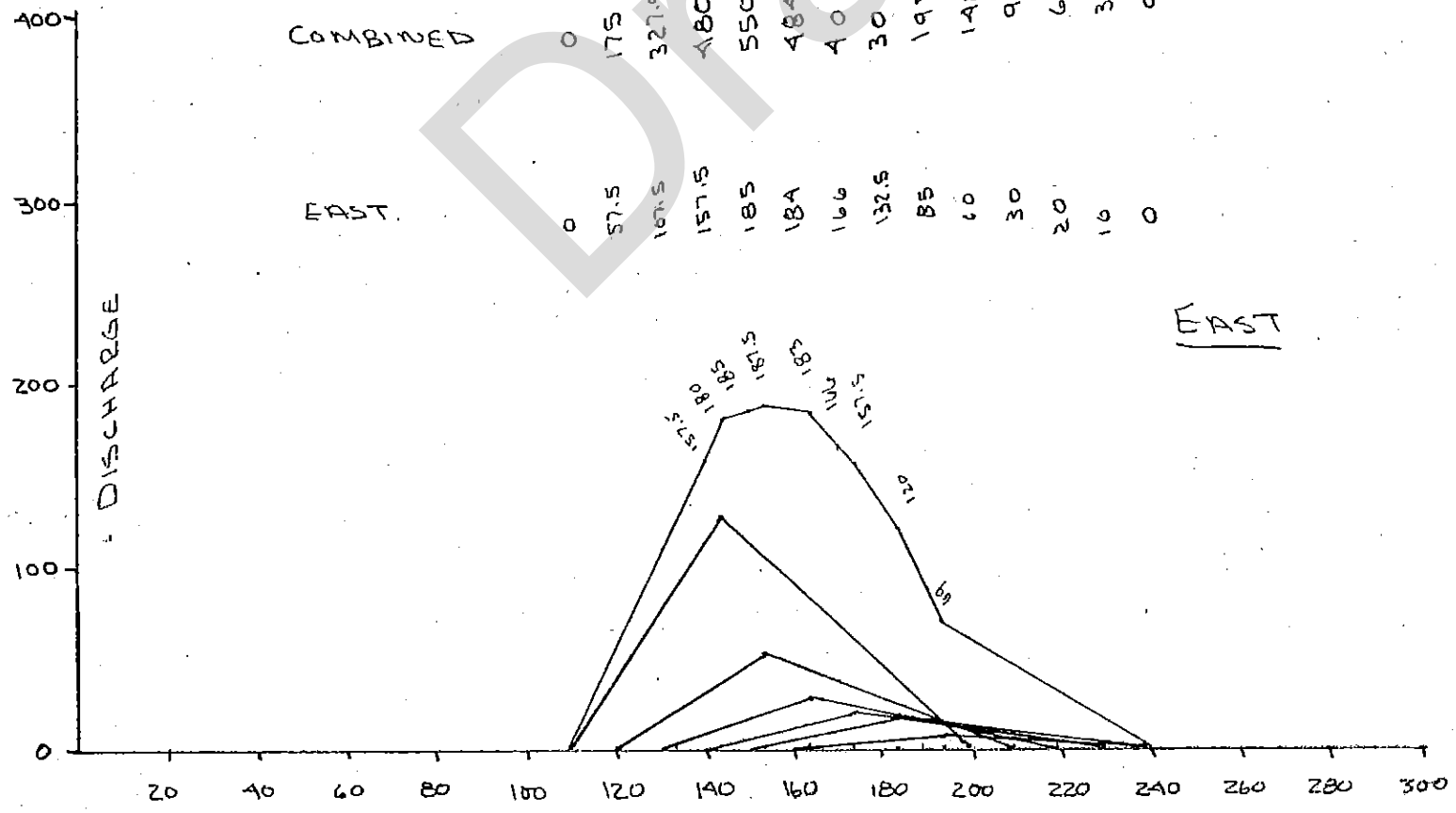
DEVELOPED SITE -100 YR

WEST

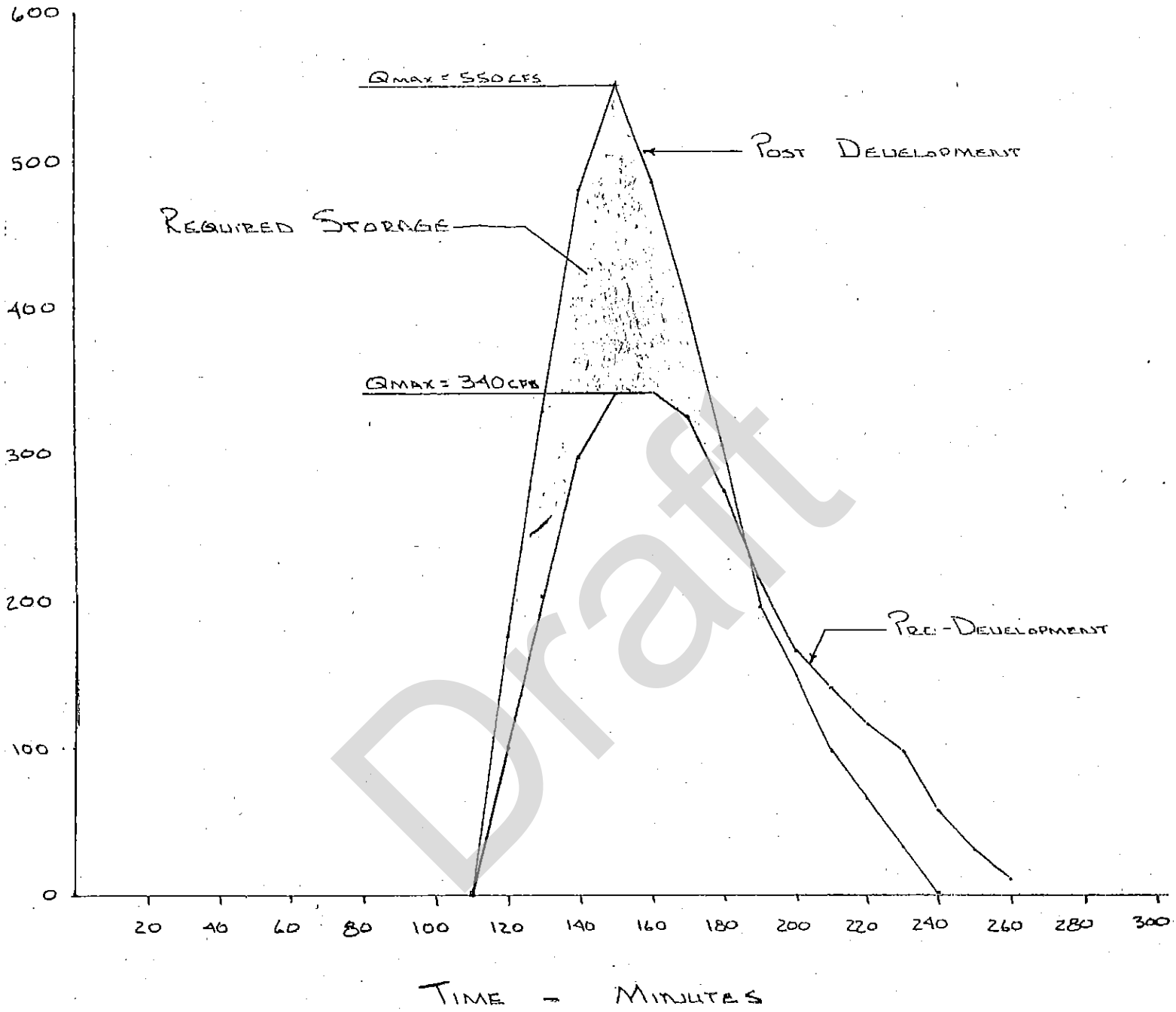


WEST	0	117.5	220	323.5	370	300	245	172.5	110	88	66	44	22	0
COMBINED	0	175	327.5	480	550	484	401	305	195	148	96	64	32	0
EAST	0	57.5	107.5	157.5	185	184	166	132.5	85	60	30	20	10	0

EAST



HYDROGRAPH FOR 100YR STORM



10

100 YR STORM

DETERMINATION OF STORAGE REQUIREMENTS

TIME	ΔT	POST DEVELOPED SITE: Qi	Qi+ΔT	A = (Qi+Qi+ΔT)/2	PRE DEVELOPED SITE: Qi	Qi+ΔT	B = (Qi+Qi+ΔT)/2	C = A-B	STORAGE = CxΔ VOLUME
110	10	0	175.0	87.5	0.0	99.0	49.50	38.0	22,800
120	10	175.0	327.5	251.25	99.0	202.5	150.75	100.5	60,300
130	10	327.5	480.0	403.75	202.5	297.5	250.0	153.75	92,250
140	10	480.0	550.0	515.0	297.5	340.0	318.75	196.25	117,750
150	10	550.0	484.0	517.0	340.0	340.0	340.0	177.0	106,200
160	10	484.0	401.0	442.5	340.0	325.0	332.5	110.3	66,180
170		401.0	305.0	353	325.0	275.0	300.0	53.0	31,800
180		305.0	195.0	250	275.0	215.0	245.0	5	3,000
190		195.0	148.0	171.5	215.0	165.0	190.0	—	
200		148.0	96.0		165.0	140.0			
210		96.0	64.0		140.0	115.0			
220		64.0	32.0		115.0	95.0			500,280
230		32.0	0		95.0	55.0			
240		0			55.0				

TOTAL = 11.48 ac ft.

10-YEAR STORM

RAINFALL DISTRIBUTION

TIME MIN	RAINFALL INS.	ACCUMULATED RAINFALL INS.	TIME MIN	RAINFALL INS.	ACCUMULATE RAINFALL INS.
0	0	0	160	0.053	1.836
10	0.013	0.013	170	0.046	1.882
20	0.013	0.026	180	0.039	1.921
30	0.019	0.045	190	0.033	1.954
40	0.019	0.064	200	0.033	1.987
50	0.026	0.090			
60	0.026	0.116	210	0.026	2.013
70	0.033	0.149	220	0.026	2.039
80	0.046	0.195	230	0.026	2.065
90	0.072	0.267	240	0.026	2.091
100	0.164	0.431	250	0.026	2.117
110	0.886	1.317	260	0.019	2.136
120	0.216	1.533	270	0.019	2.155
130	0.112	1.645	280	0.013	2.168
140	0.079	1.724	290	0.013	2.181
150	0.059	1.783	300	0.013	2.194

10 YR PRE DEVELOPMENT

TIME	P	Paccum	WATERSHED I Qaccum	ΔQ	qp	WATERSHED II Qaccum	ΔQ	qp
90	.072	.267	.0350	-				
100	.164	.431	.00658	-				
110	.886	1.317	.1587	.15212	40.6			29.0
120	.216	1.533	.2478	.0891	23.8			17.0
130	.112	1.645	.2996	.0518	13.8			9.9
140	.079	1.724	.3381	.0385	10.3			7.4
150	.059	1.783	.3679	.0298	8.0			5.7
160	.053	1.836	.3954	.0275	7.3			5.3
170	.046	1.882	.4198	.0244	6.5			4.7
180	.039	1.921	.4408	.0210	5.6			4.6

WATERSHED CHARACTERISTICS

I

$T_c = 0.72$ hrs

$CN = 78$; $S = 2.82$

$$Q = \frac{(P-0.2S)^2}{P+0.8S} = \frac{(P-.564)^2}{P+2.256}$$

$T_p = 0.598$ hrs $= 36$ MIN

$T_b = 1.597$ hrs $= 95.8$ MIN

$$q_p = \frac{484(.33)(1)}{1.598} = 267 \text{ cfs}$$

II

$T_c = 0.793$ hrs

$CN = 78$; $S = 2.82$

$$Q = \frac{(P-.564)^2}{P+2.256}$$

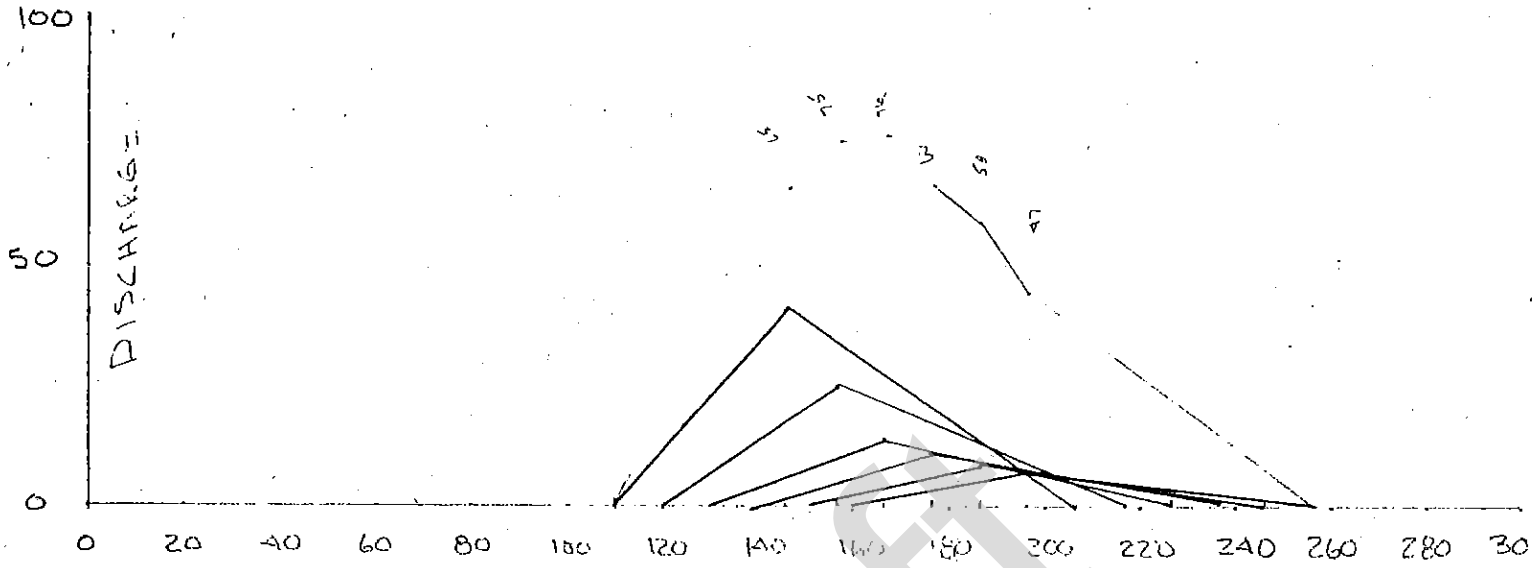
$T_p = 0.642$ hrs $= 38.5$ MIN

$T_b = 1.715$ hrs $= 103$ MIN

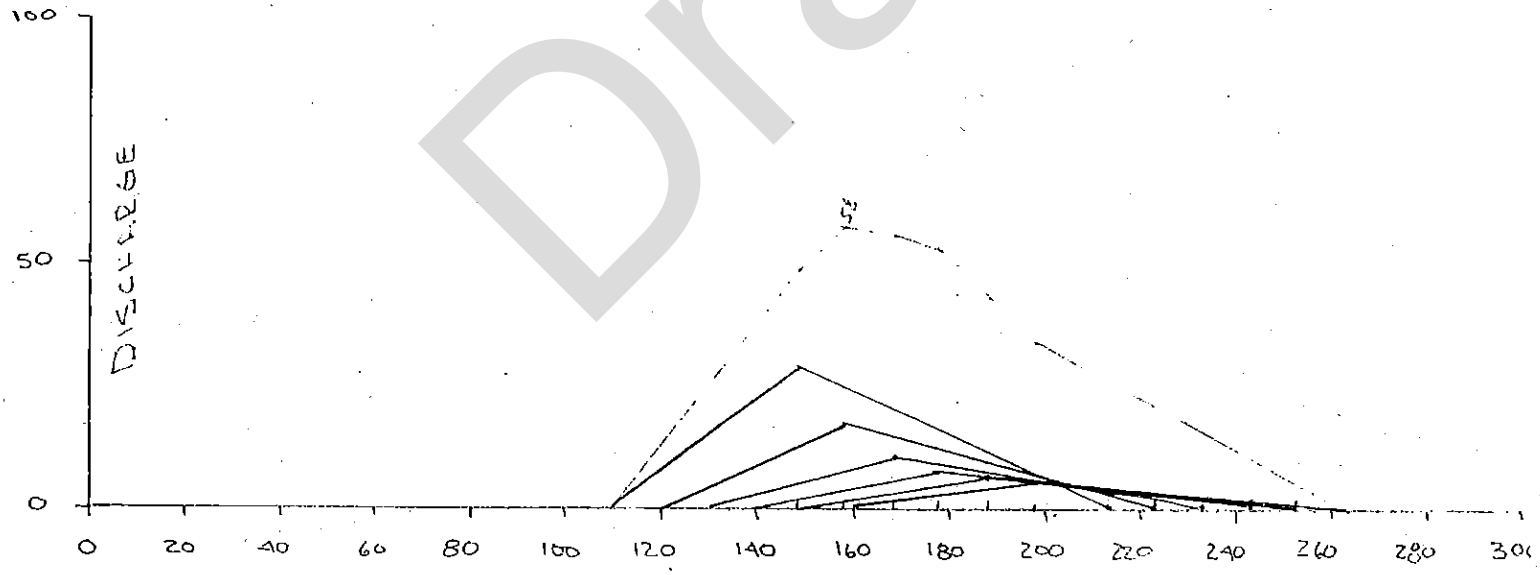
$$q_p = \frac{(484)(.253)(1)}{1.642} = 191$$

PRE-DEVELOPMENT 10 YR STORM

WEST.



EAST



TIME	110	120	140	160	180	200	220	240	260
WEST	0	19	36	55	73	75	73	63	53	42	34	27	19	12	5	0
EAST	0	13	26	39	[illegible]	[illegible]	56	51	42	[illegible]	25	23	18	12	6	0
COMBINED	0	31	62	[illegible]	118	132	129	114	95	75	[illegible]	[illegible]	37	24	11	0

10-YR POST DEVELOPMENT

TIME	P	Paccum	WEST Qaccum	WEST ΔQ	WEST qp	EAST Qaccum	EAST Δq	EAST qp
90	.072	.267	.06714	—				
100	.164	.431	.00133	—		.00195		
110	.886	1.317	.3095	.308	101.4	.20123	.199	44.4
120	.216	1.533	.4354	.126	41.4	.30203	.100	22.5
130	.112	1.645	.5056	.070	23.1	.35967	.057	12.9
140	.079	1.724	.5568	.051	16.9	.40230	.0426	9.5
150	.059	1.783	.5959	.039	12.9	.43512	.032	7.3
160	.053	1.836	.631168	.035	11.8	.46530	.030	6.7
170	.046	1.882	.66314	.031	10.4	.49200	.027	6.0
180	.039	1.921	.69011	.0269	8.9	.51498	.022	5.1

I - WEST

USE T_c FOR 100 YR.
THIS WOULD HAVE GREATEST IMPACT ON HYDROGRAPHS.

T_c = 0.67 hrs

T_p = 29.1 min / 0.485 hrs

T_b = 78 min / 1.29 hr

$$q_p = \frac{(484)(.33)(1)}{.485} = 329 \text{ cfs}$$

$$Q = \frac{(P-0.2S)^2}{P+0.8S} \qquad CN = 84 \qquad S = 1.90$$

$$= \frac{(P-.38)^2}{P+1.52}$$

II - EAST

T_c = 0.78 hrs

T_p = 33 min / 0.55 hr

T_b = 88 min / 1.47 hr

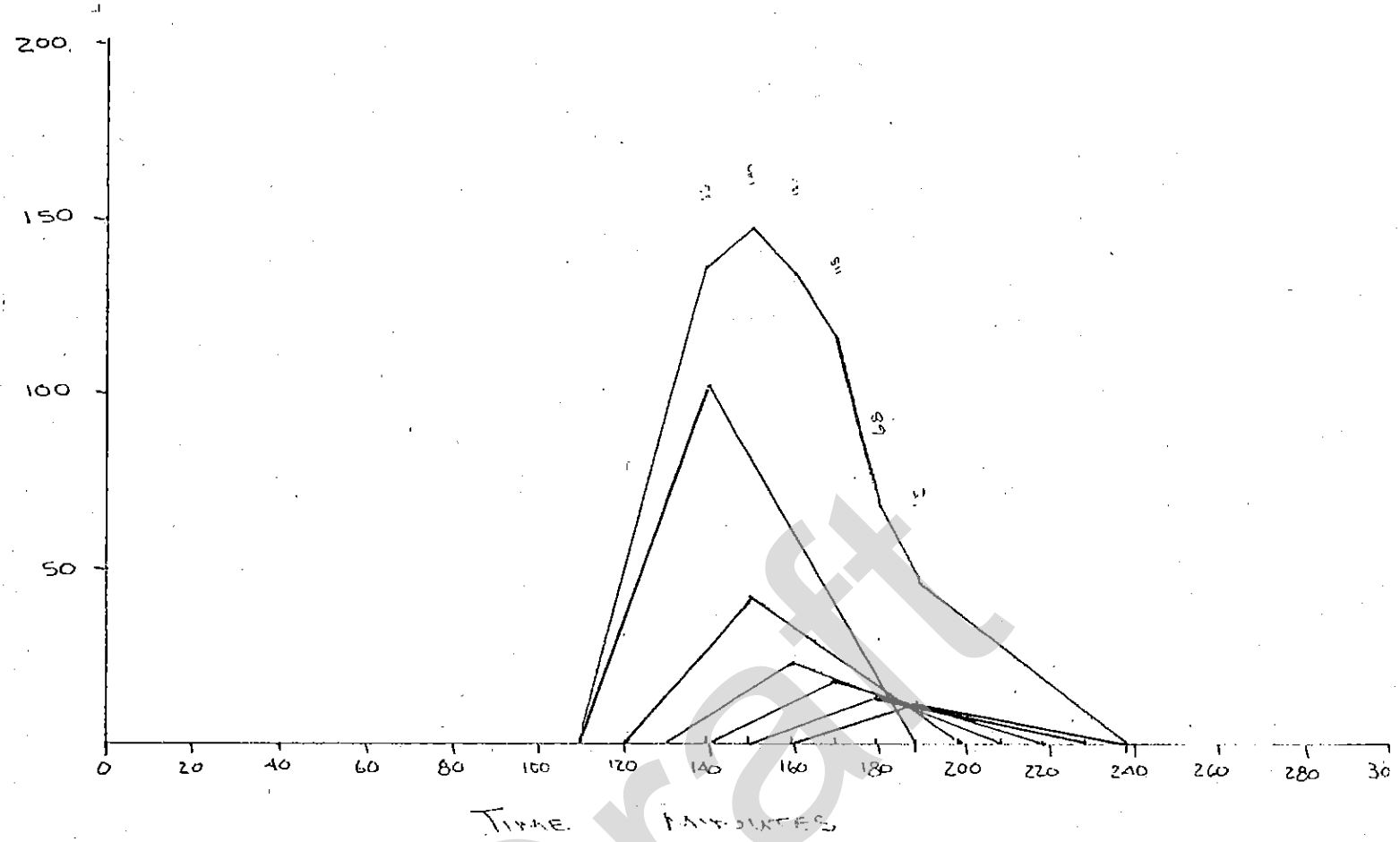
$$q_p = \frac{(484)(.253)(1)}{.55} = 223 \text{ cfs}$$

$$Q = \frac{(P-0.2S)^2}{P+0.8S} \qquad CN = 80 \qquad S = 2.50$$

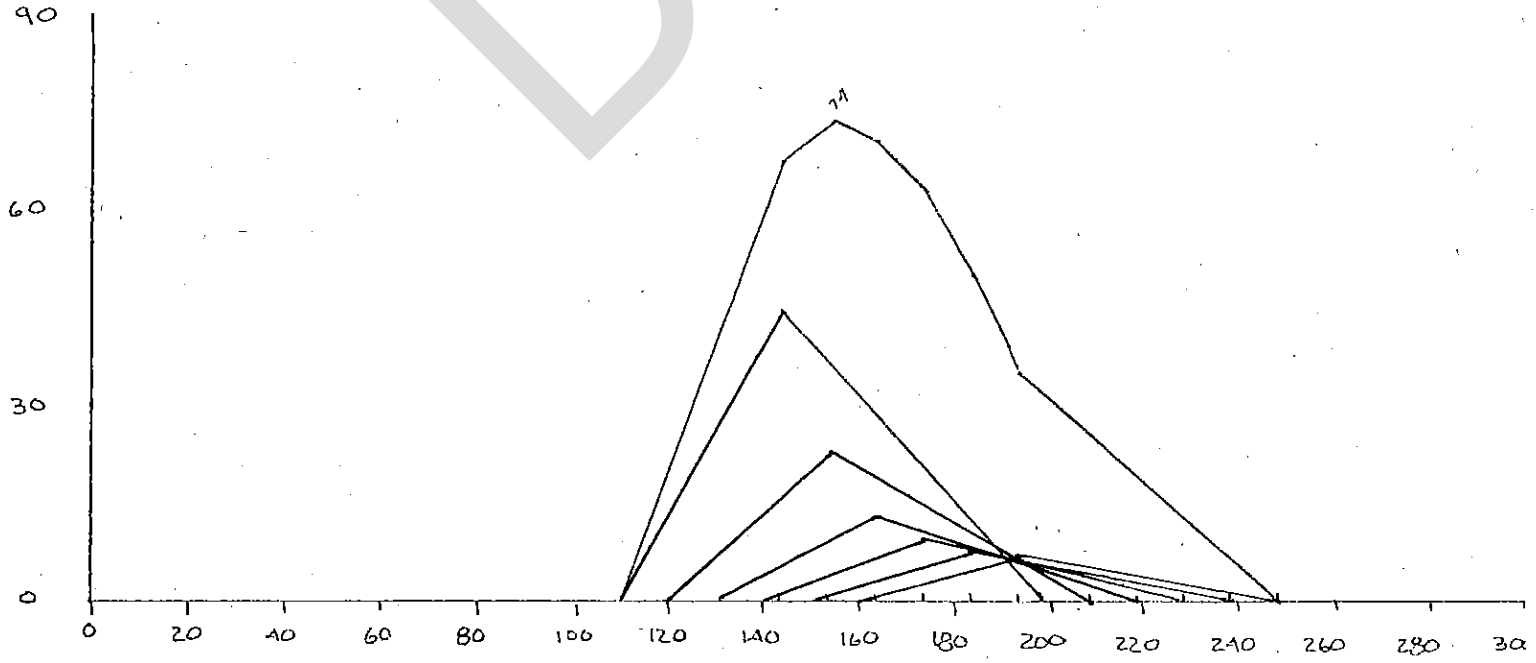
$$= \frac{(P-0.5)^2}{P+2.0}$$

POST DEVELOPMENT 10YR STORM

WEST

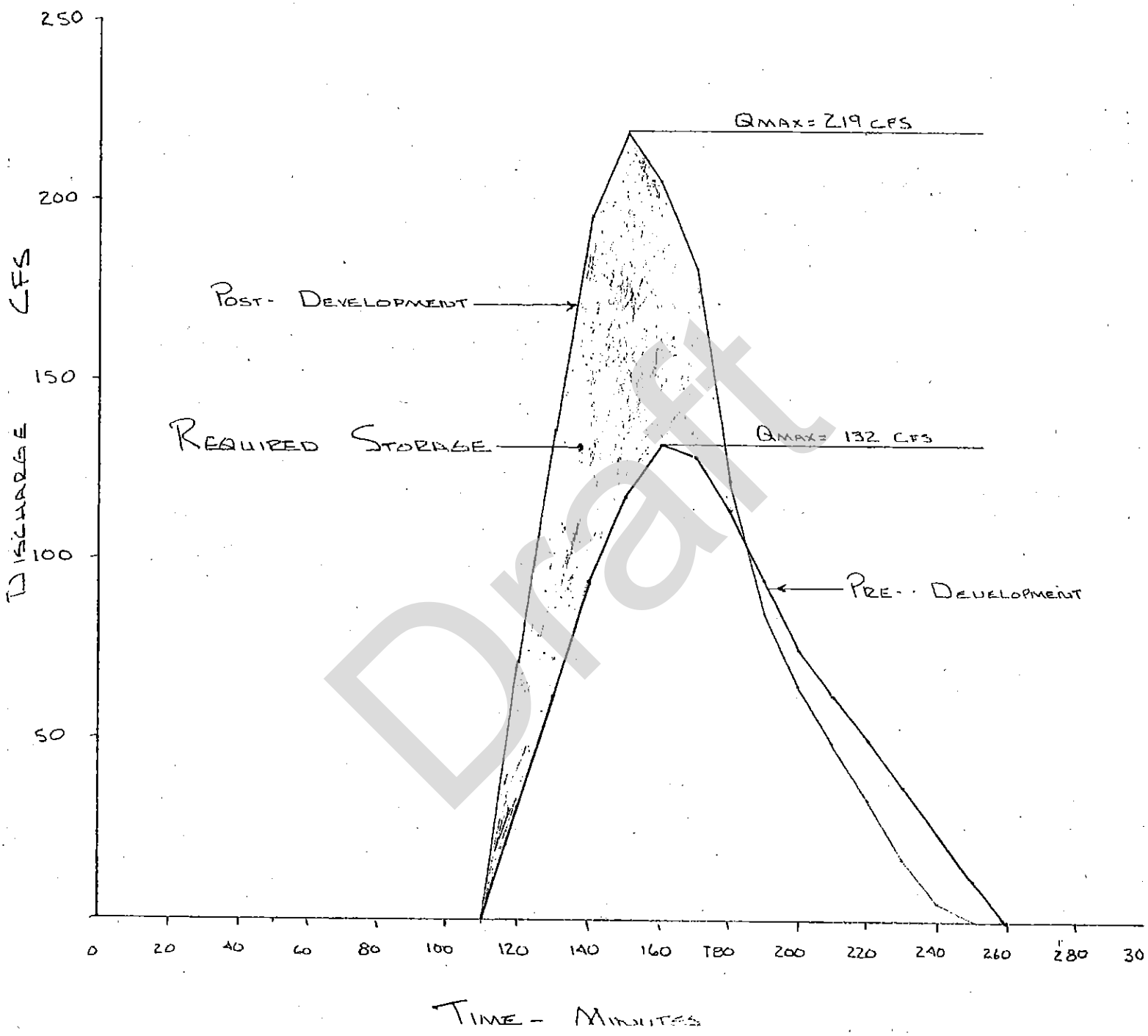


EAST



WEST	0	50	95	136	147	134	115	68	45	35	25	15	5	0
EAST	0	21	41	60	72	72	66	54	40	30	24	18	12	5	0
TOTAL														

WATERSHED HYDROGRAPH FOR 10-YR STORM



STORM

DETERMINATION OF STORAGE REQUIREMENTS

Q_i	$Q_{i+\Delta T}$	$A = \frac{Q_i + Q_{i+\Delta T}}{2}$	Q_i	$Q_{i+\Delta T}$	$B = \frac{Q_i + Q_{i+\Delta T}}{2}$	$C = A - B$	STORAGE = $C \times \Delta T$ VOLUME
POST DEVELOPED SITE			PRE-DEVELOPED SITE				
CFS	CFS	CFS	CFS	CFS	CFS	CFS	CU FT
0	71	35.5	0	31	15.5	20.0	12,000.0
71	136	103.5	31	62	46.5	57.0	34,200.0
136	196	166.0	62	94	78.0	88.0	52,800.0
196	219	207.5	94	118	106.0	101.5	60,900.0
219	206	212.5	118	132	125.0	87.5	52,500.0
206	181	193.5	132	129	130.5	63.0	37,800.0
181	122	151.5	129	114	121.5	30.5	18,300.0
122	85	103.5	114	95	104.5	-	
85	65	75.0	95	75	85.0	-	
65	49		75				
49	33		62				
33	17		50				268,500
17	5		37				
5	0		24				
0			11				
			0				

TOTAL = 6.16 ac-ft.

Part VI Design Of Detention Pond

A Design Criteria

1. Pipe Through Spillway Will Discharge 10 yr Pre-Development Flow As Determined in Part V of Report. Storage will be Provided To Detain Runoff In Excess of Pre Development Amount.

2. 100 Year Pre Development Flow will Discharge over Spillway and Through Pipe. Storage Will Be Provided To Detain Runoff In Excess of 100 yr Pre Development Level

3. Storage Requirements From Hydrograph Analysis

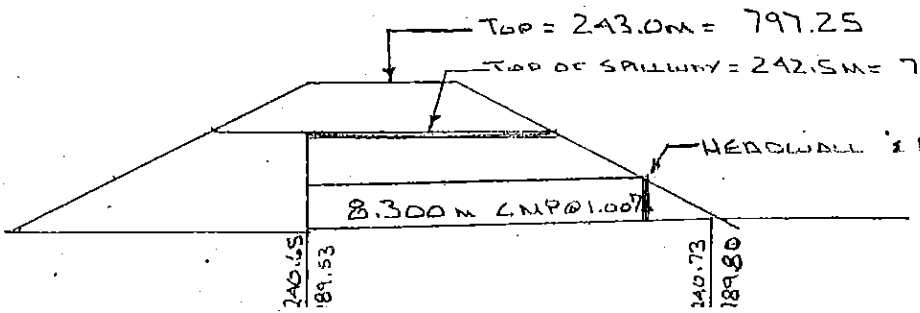
   10 yr 6.16 ac-ft
   100 yr 11.48 ac-ft

4. Discharge Conditions

	Pre Development	Post Development
10 yr	132 cfs	219 cfs
100 yr	340 cfs	550 cfs

5. Attempt To Utilize Storage Capability of Natural Creek Valley In Blk 29

6. Prop. Spillway Arrangement



B 10 YR STORM

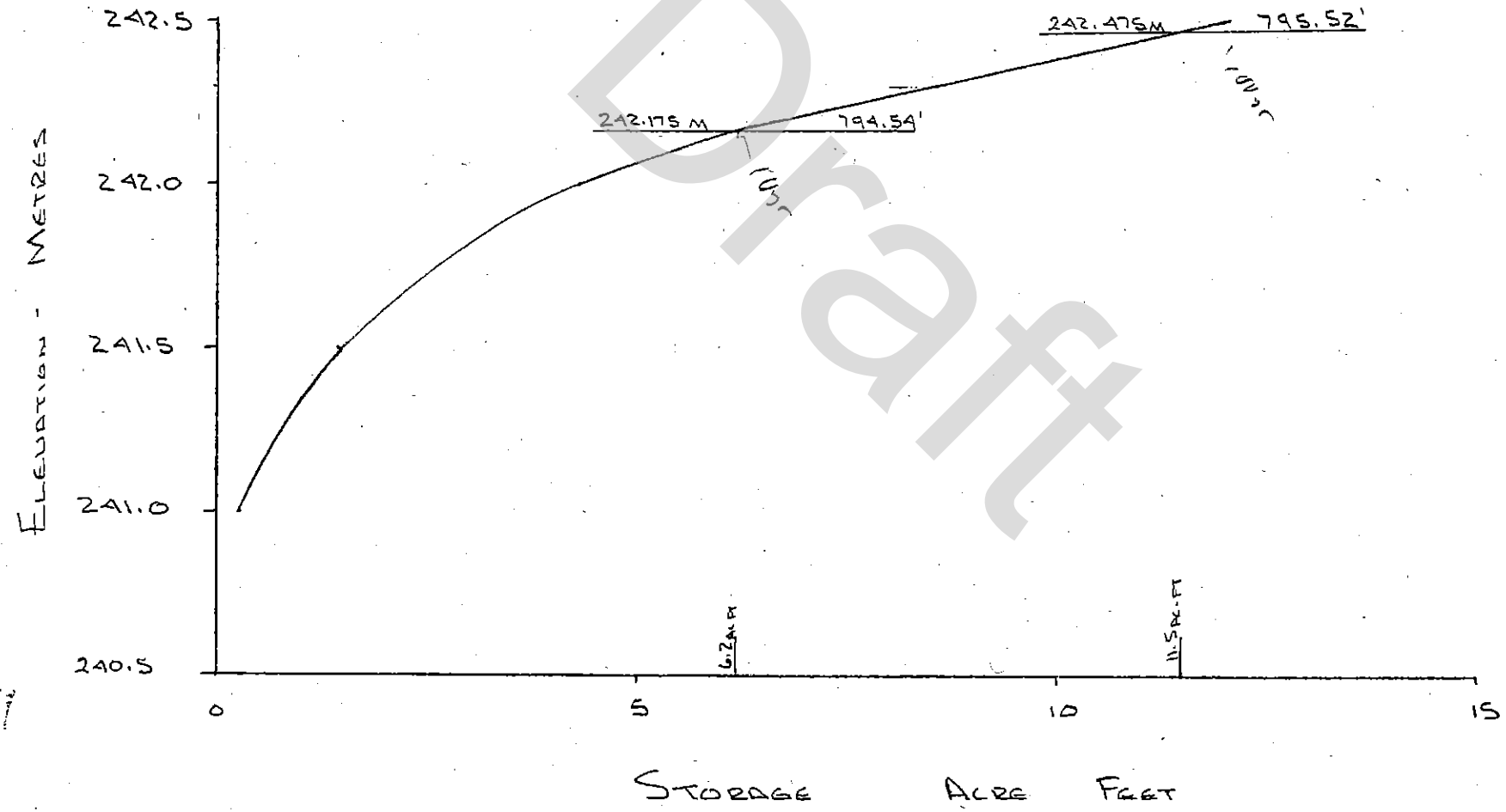
- Q_{ALL} = 132 CFS
- WATER SURFACE ELEVATION (MIN) OF DETENTION POND = 242.175M = 799.54'
- INVERT OF PROP. CULVERT = 240.733M = 789.80 ft
- TRY 2 1000MM dia C.M.P ; D = 1000 = 39.4" = 3.28'
  A = 8.467 SQFT

  $Q/_{CULVERT}$ = 132/2 = 66 CFS
- INLET CONTROL ANALYSIS
  - HEADWALL & WINGWALL PRESENT @ INLET
  - HW_{MIN} = 794.54 - 789.80 = 4.74 ft
  - HW/D = 4.74/3.28 = 1.44
  - FOR Q = 66 CFS ; HW/D = 1.42
- OUTLET CONTROL ANALYSIS:
  - Ke = 0.25 S_o = 1.00% L = 8.3M = 27.2'
  - HW_o = H + h_o - LS_o
  - LET h_o = $\frac{d_{cr}+D}{2}$ = $\frac{2.56+3.28}{2}$ = 2.92'
  - FOR Q = 66 CFS H = 2.5 ft (FIG IV-19)

  ∴ HW_o = 2.5 + 2.92 - 27.2(.01) = 5.15'

∴ OUTLET CONTROL PREVAILS

Stage Storage Curve of Proposed Detention Pond



- Elevation of $HW_o = 5.15 + 789.80 = 794.95$

- From Stage Storage Curve of Detention Pond, the Storage Volume in Detention Pond when HW = 794.95 (242.30m) is 8.5ac ft
  This is Satisfactory!

c 100 yr Storm

- $Q_{allow} = 340$ cfs

- Storage Volume Req = 11.48 Ac Ft
  ∴ Elev of Water surface in Detention Pond Must Be 242.50m = 795.60' MIN

- ∴ Set Top of Spillway @ 242.20m = 794.60'

- Discharge Of Twin 1000 mm dia CMP

$HW = 795.60 - 789.80 = 5.80'$

Check Inlet Control $= 1.77\,m$ $\quad 1m \times \frac{100cm}{1m} \times \frac{1inch}{2.54cm} \times \frac{1ft}{12inch}$

$HW/D = 5.80/3.28 = 1.77$

From Fig 14-9 $\quad Q = 77 cfs$ / pipe

Check Outlet Control

$L = 27.23'$ $\quad S_o = 1.00\%$ $\quad k_e = 0.25$

Let $Q = 75$ cfs ∴ $H = 3.1$ (From Fig 14-14)

Let $h_o = \frac{d_{cr} + d}{2} = \frac{2.72 + 3.28}{2} = 3.0$

∴ $HW_o = 3.1 + 3 - (.27)(1) = 5.83$

∴ Outlet Control Prevails

$HW_{REQ'D} = 5.83 + 789.80 = 795.63$

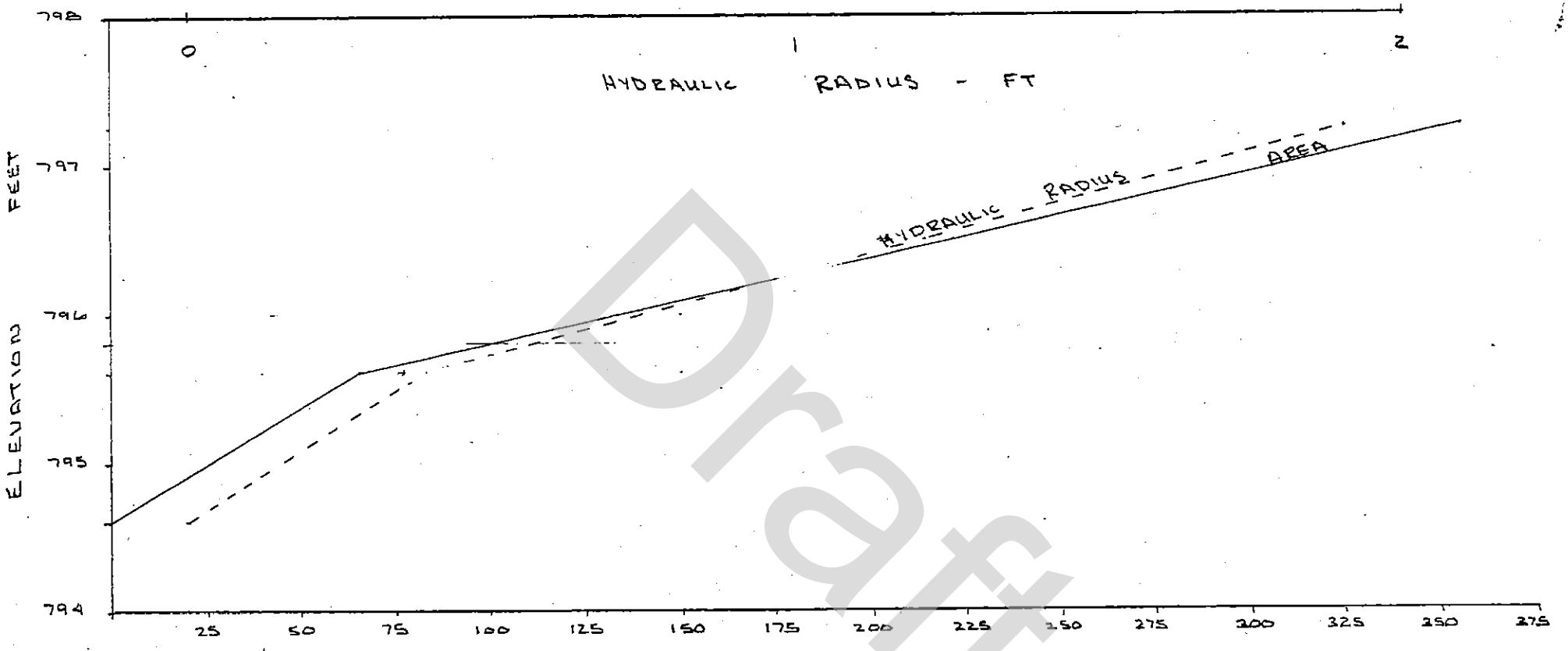
$Q_{WEIR} = 340 - (2)(75) = 190$ cfs

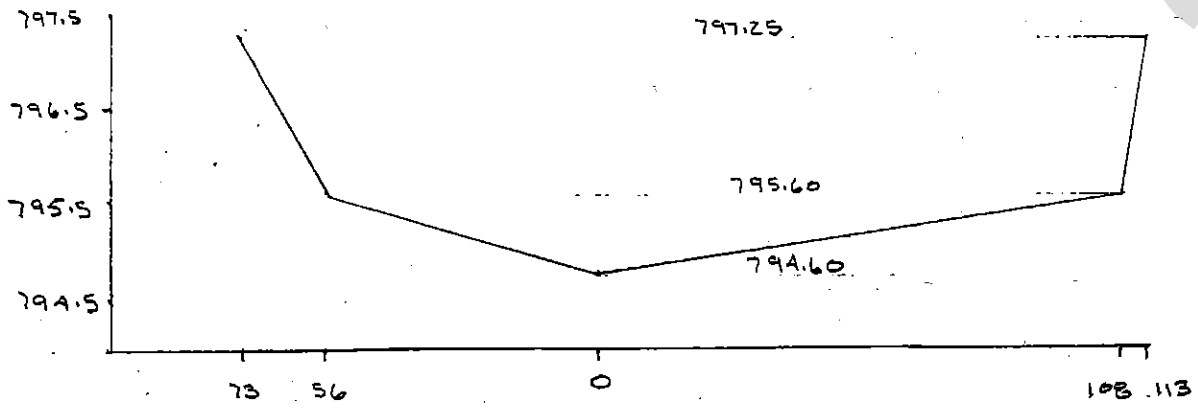
$Q = CLH^{3/2}$ $\quad H = 795.63 - 794.6 = 1.03$

∴ $L_{REQ} = \frac{190}{(1.03)^{3/2} \times 2.7} = 67.32' = 20.5_M$

APPENDIX 'D'

STA 0+095 - SECTION 2

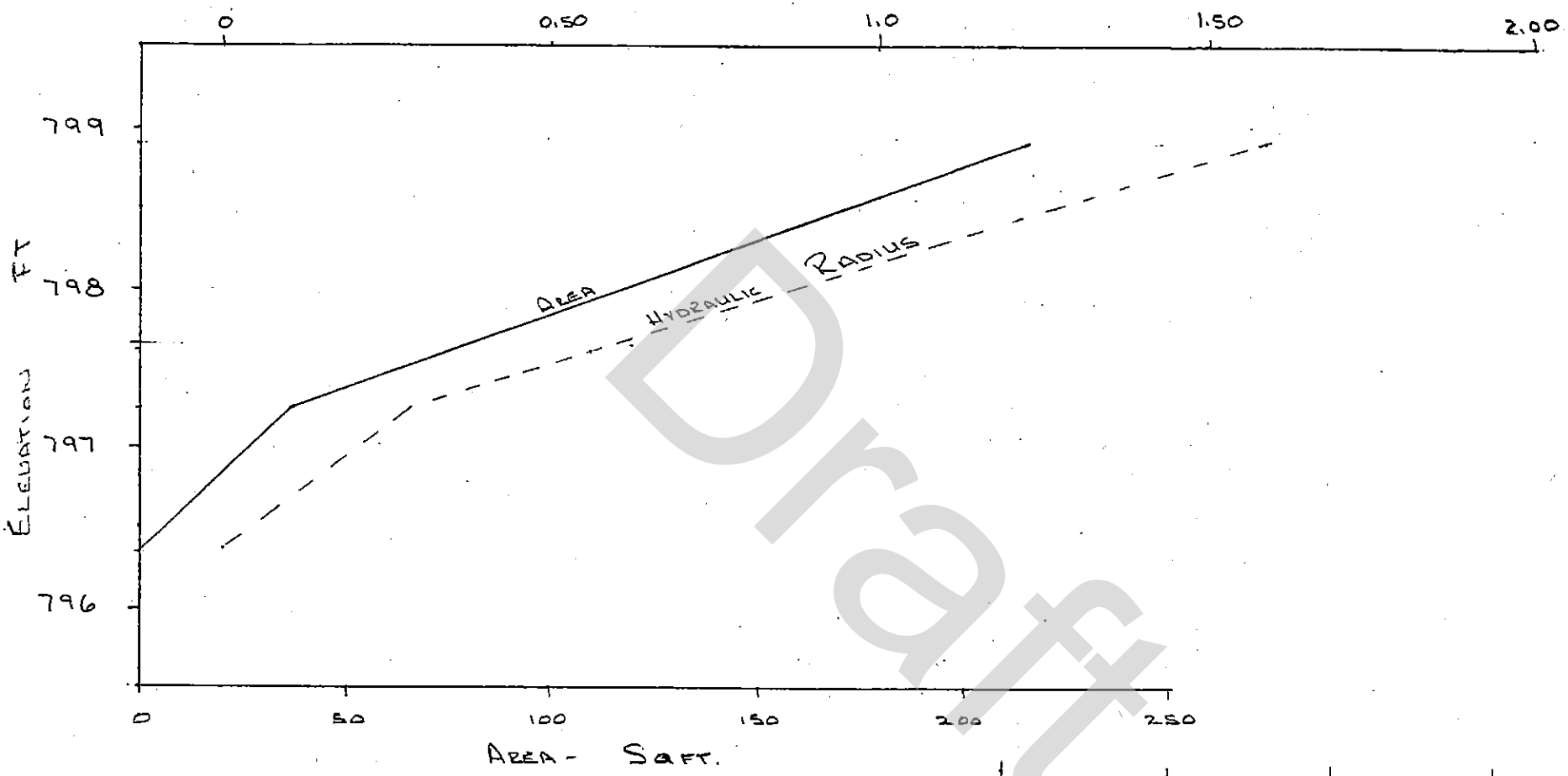


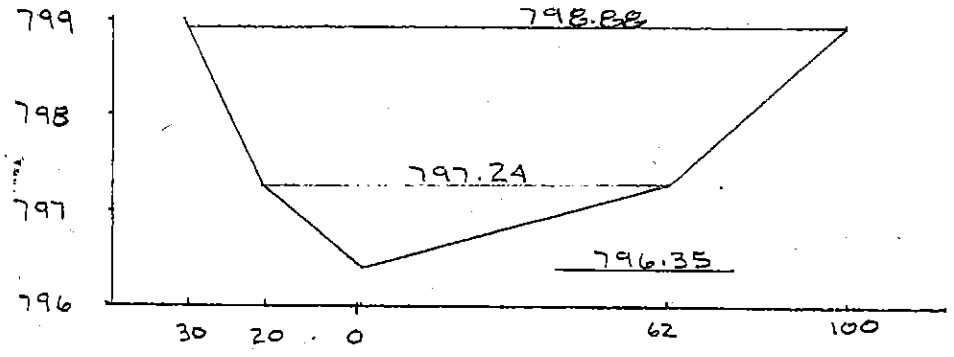


ELEV	AREA	P	R
794.60	0	0	0
795.60	65.6	164	0.40
797.25	354.35	186	1.905

STA 0+140 SECTION 3

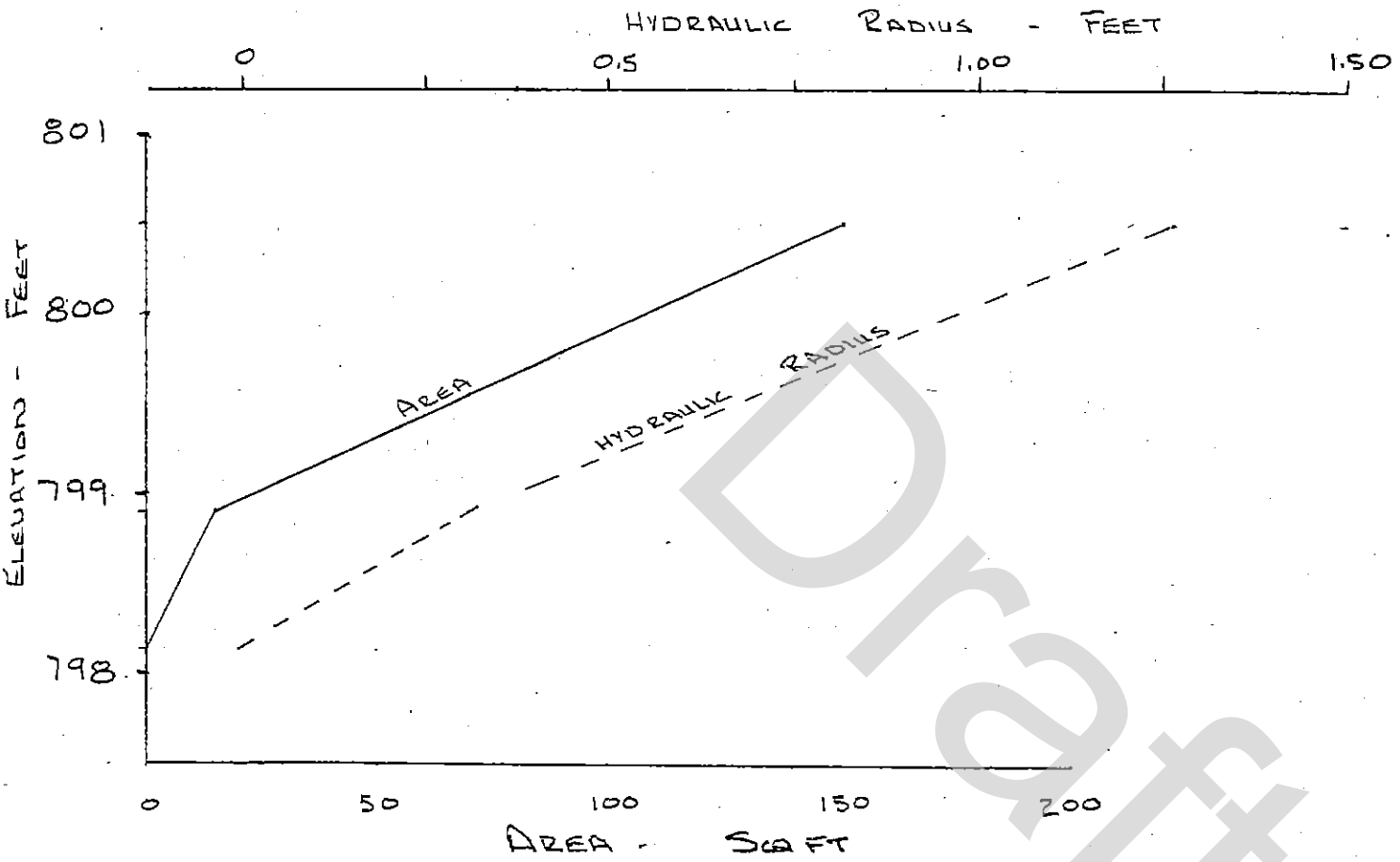
- HYDRAULIC RADIUS - FT

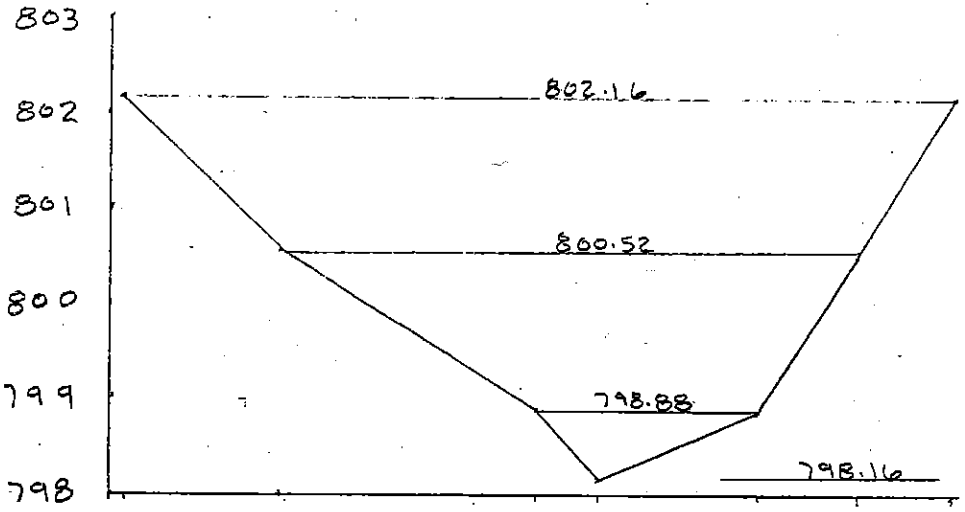




ELEV	AREA	P	R
796.35	0	0	0
797.24	37.31	82	0.455
798.88	216.07	136	1.589

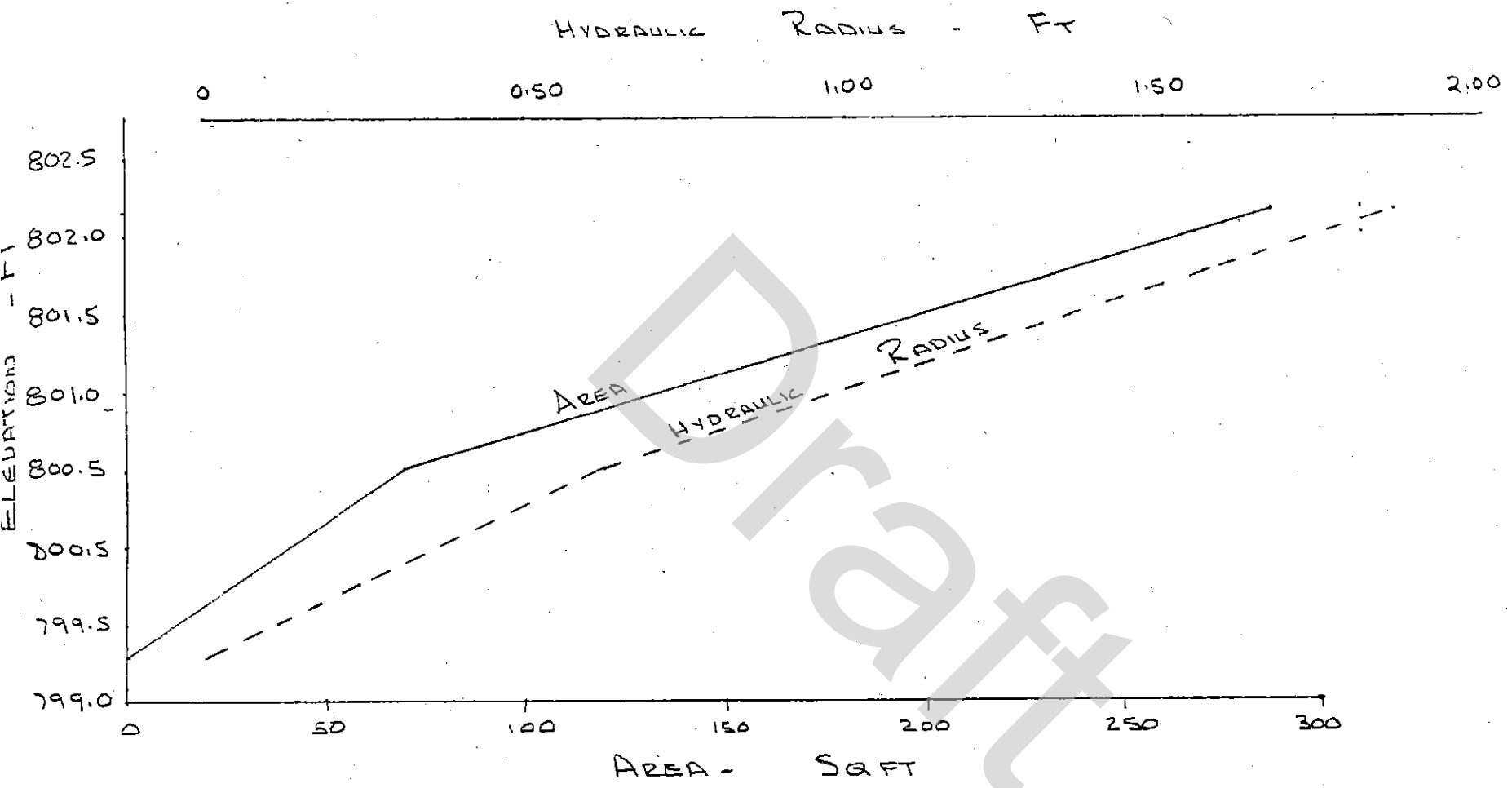
STA 0+245 SECTION 4

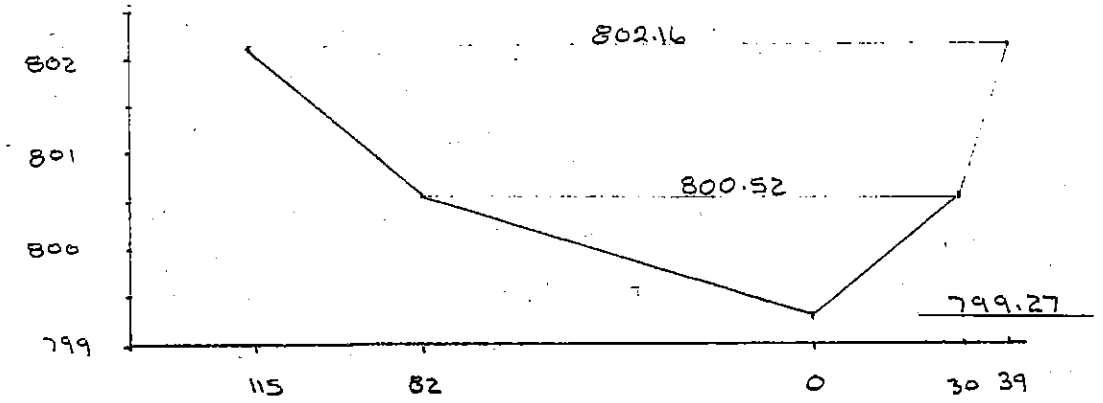




ELEVATION	AREA	P	R
798.16	0	0	0
798.88	14.26	46	0.31
800.52	149.56	119	1.257

STA 0+290 - SECTION 5





ELEV.	AREA	P	R
799.27	0	0	0
800.52	70	112	0.625
802.16	288.12	154	1.87

WATER SURFACE PROFILE CALCULATIONS - WEST TRIBUTARY SOUTH OF FIFTH SIDEROAD

PROJECT : CALEDON FILE 80-112

DATE : JULY /80.

CALC BY V.P.

Q = 240 CFS

C_e = 0.30 C_c = 0.10

CROSS SECTION No	WATER SURFACE ELEV ASSUMED	WATER SURFACE ELEV COMPUTED	AREA A	HYD. RAD. R	$R^{2/3}$	n	$K = \frac{1.486 A R^{2/3}}{n}$	$\bar{K}$	$\bar{S}_f = \left(\frac{Q}{K}\right)^2$	L	h_f	$K^3/A^2 \times 10^9$	α	V	$\frac{\alpha V^2}{2g}$	$\frac{\Delta \alpha V^2}{2g}$	h_o	Δ W.S. ELEV
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1 *	795.6		196	0.82	0.8731	0.03	8505											
2	795.8	795.78	160	0.575	0.6915	0.03	3425	5965	0.001618	148	0.24		1.00	2.40	0.089	$\bar{0}$.09	0.03	0.18
3	797.6	797.76	75	0.5625	0.6814	0.03	2531	2978	0.006495	312	2.03		1.00	3.20	0.16	$\bar{0}$.07	0.02	1.98
4	799.75	799.84	86	0.8125	0.8707	0.03	3709	3120	0.005917	345	2.04		1.00	2.79	0.12	0.09	0.004	2.08
5	800.52	800.67	70	0.625	0.731	0.03	2534	3122	0.005901	148	0.87		1.00	3.43	0.18	$\bar{0}$.06	0.02	0.83

$h_f = L \times \bar{S}_F$ for $\frac{\Delta \alpha V^2}{2g}$ >0 $h_o = \left|0.1 \frac{\Delta \alpha V^2}{2g}\right|$

$\Delta WS = h_f + h_o + \frac{\Delta \alpha V^2}{2g}$ <0 $h_o = \left|0.3 \alpha \frac{\Delta V^2}{2g}\right|$

* POND W.S. ELEV

STA.	FT	M
1	795.6	242.55
2	795.8	242.56
3	797.6	243.11
4	799.75	243.76
5	800.52	244.0

CHARTS AND GRAPHS

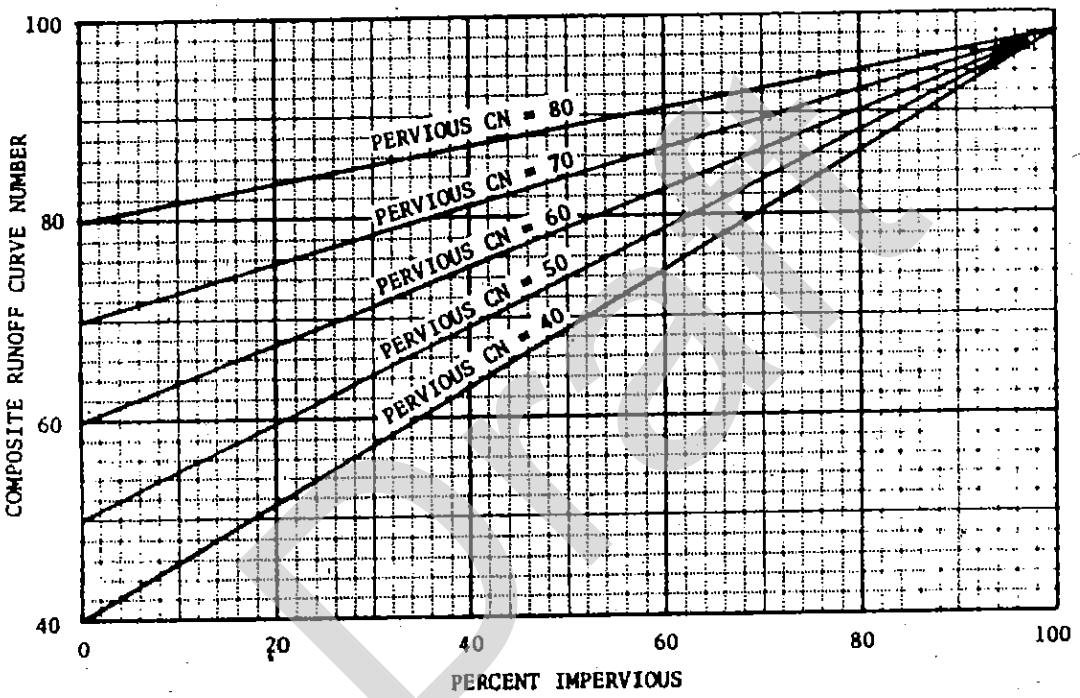


Figure 2-2.--Percentage of impervious areas vs. composite CN's for given pervious area CN's.

Fig. 2-2
TR - 55
Urban Hydrology for
Small Watersheds

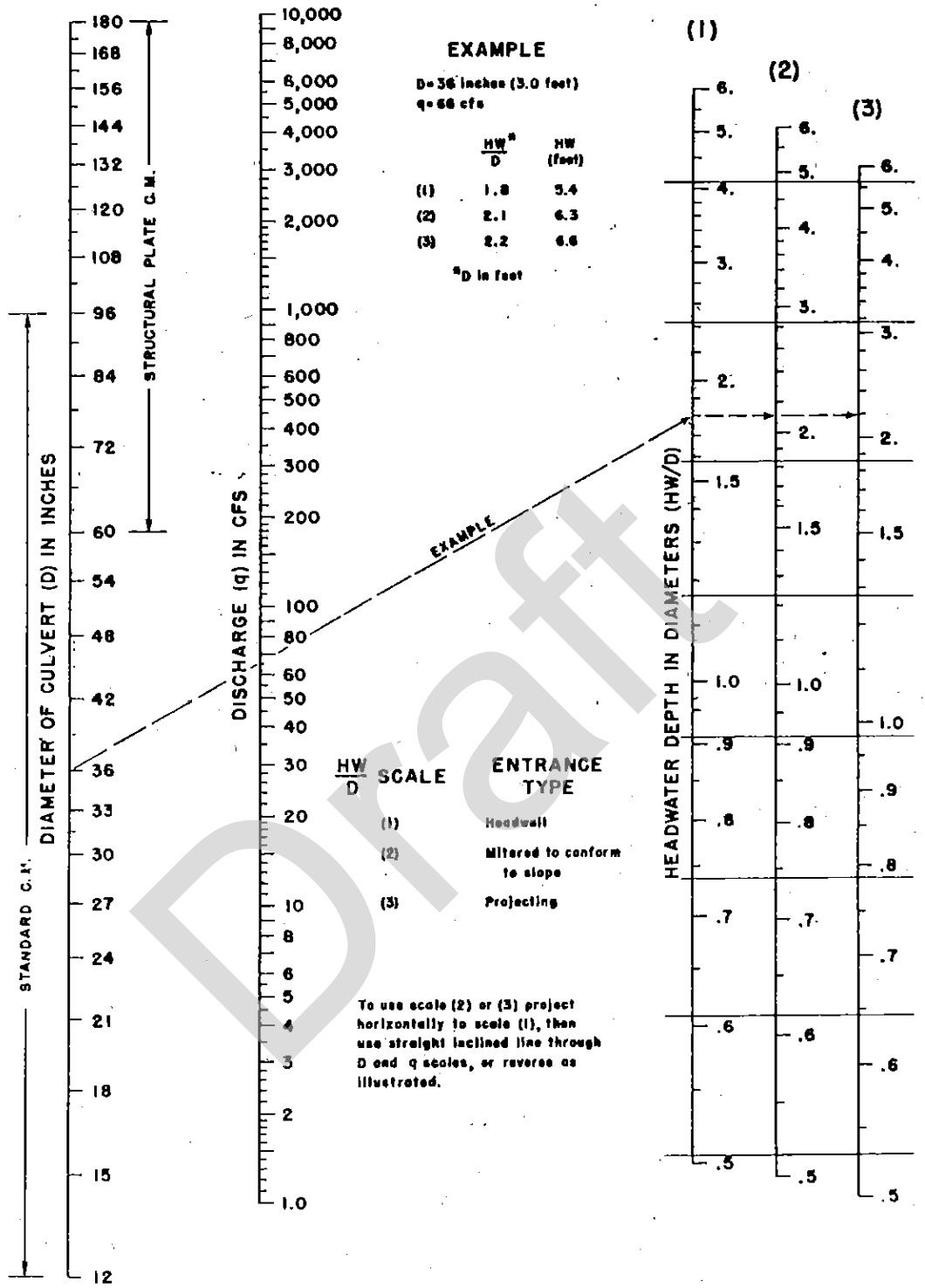


Exhibit 14-9. Headwater depth for C. M. pipe culverts with inlet control.

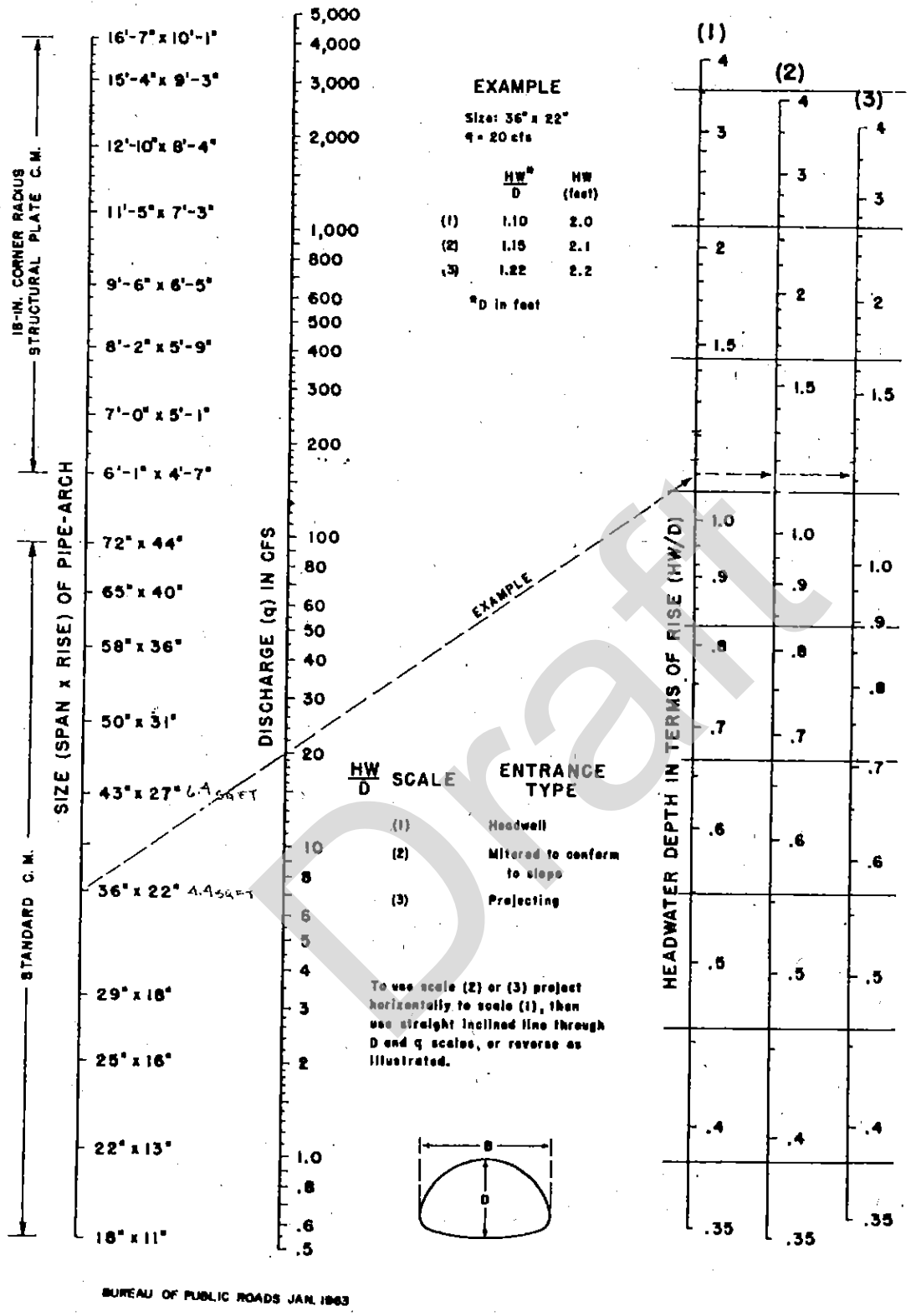


Exhibit 14-10. Headwater depth for C.M. pipe-arch culverts with inlet control.

NEH Notice 4-102, August 1972

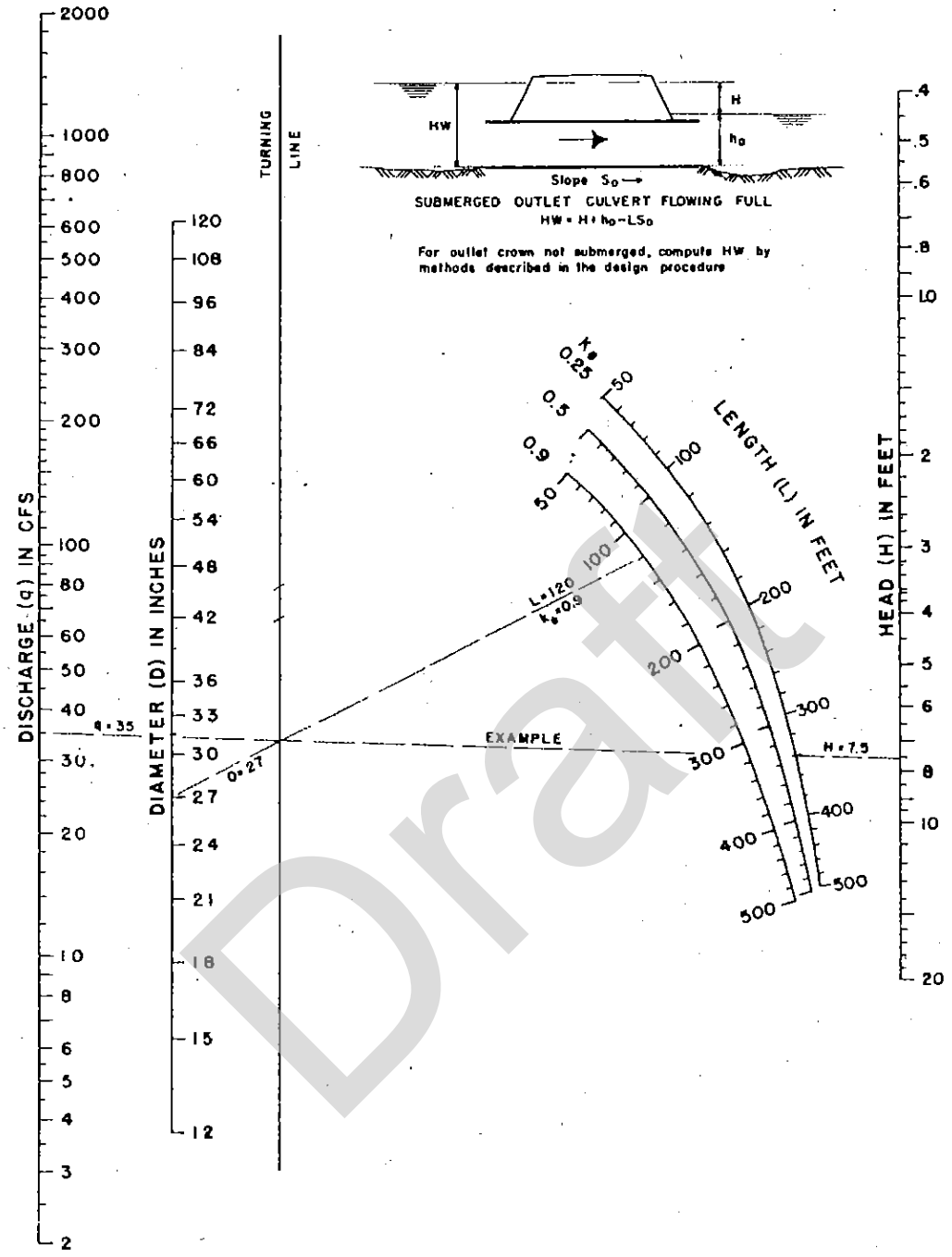
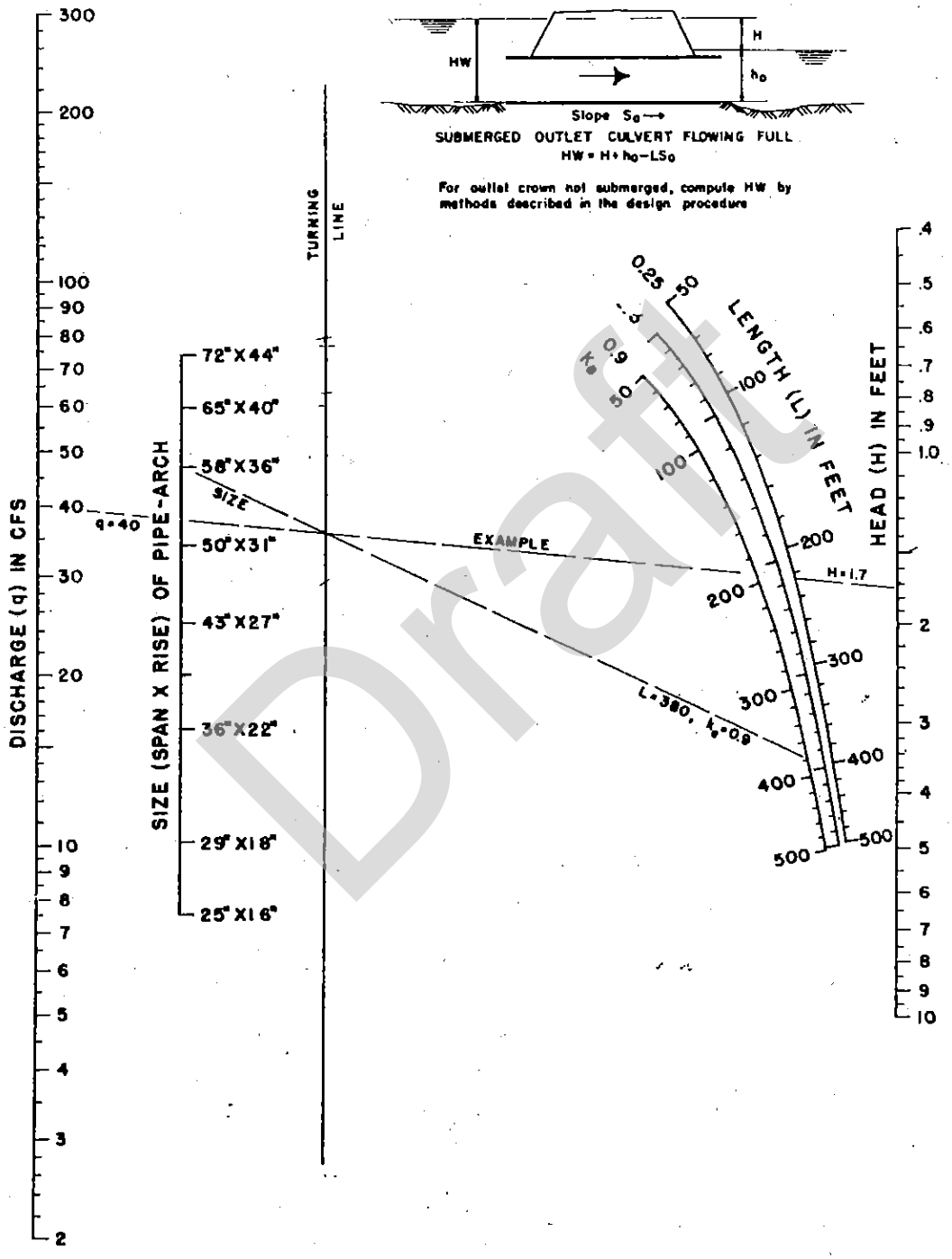


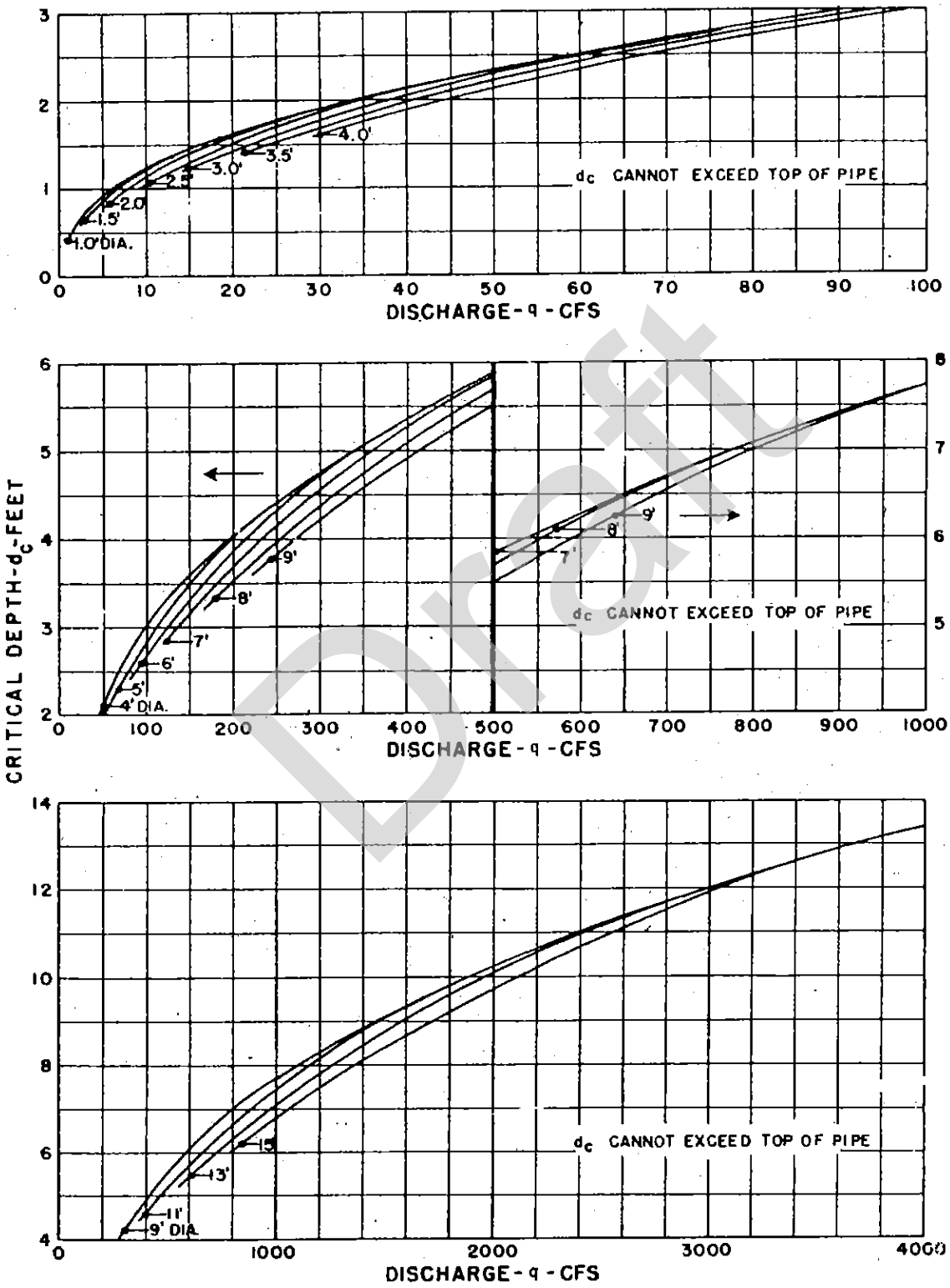
Exhibit 14-14. Head for standard C. M. pipe culverts flowing full n = 0.024.

NEH Notice 4-102, August 1972



BUREAU OF PUBLIC ROADS JAN. 1963

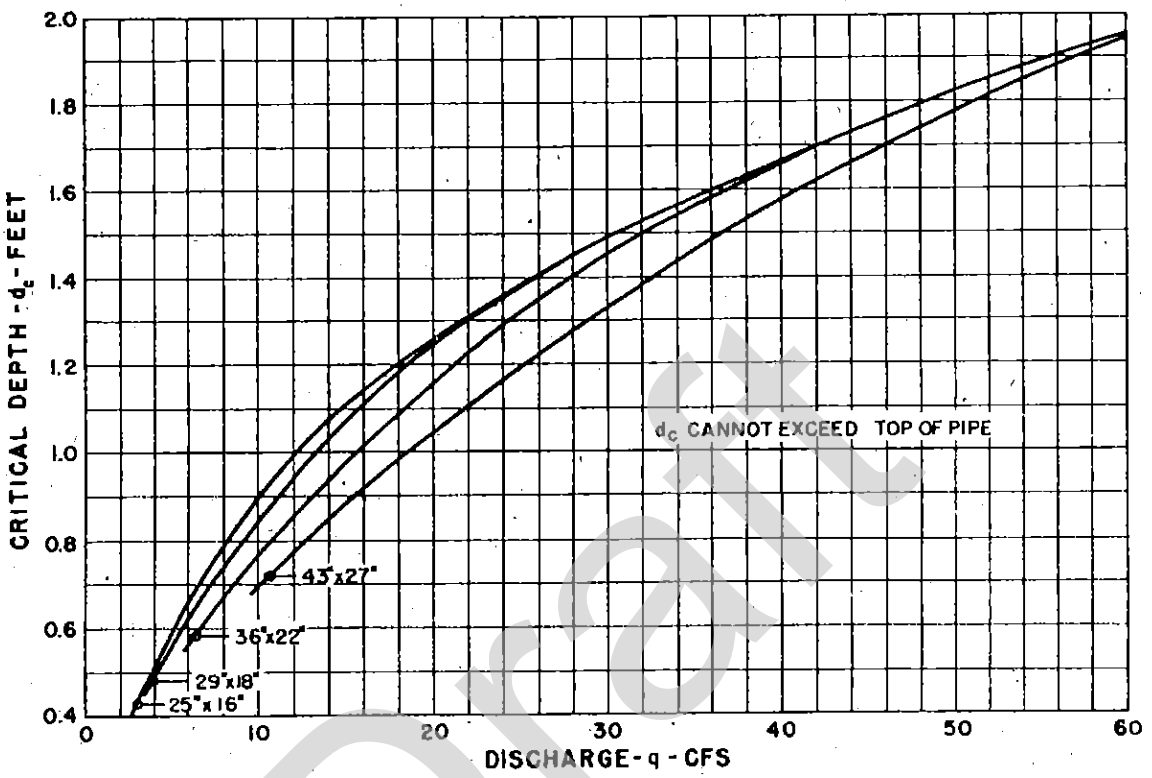
Exhibit 14-15. Head for standard C. M. pipe-arch culverts flowing full n = 0.024.

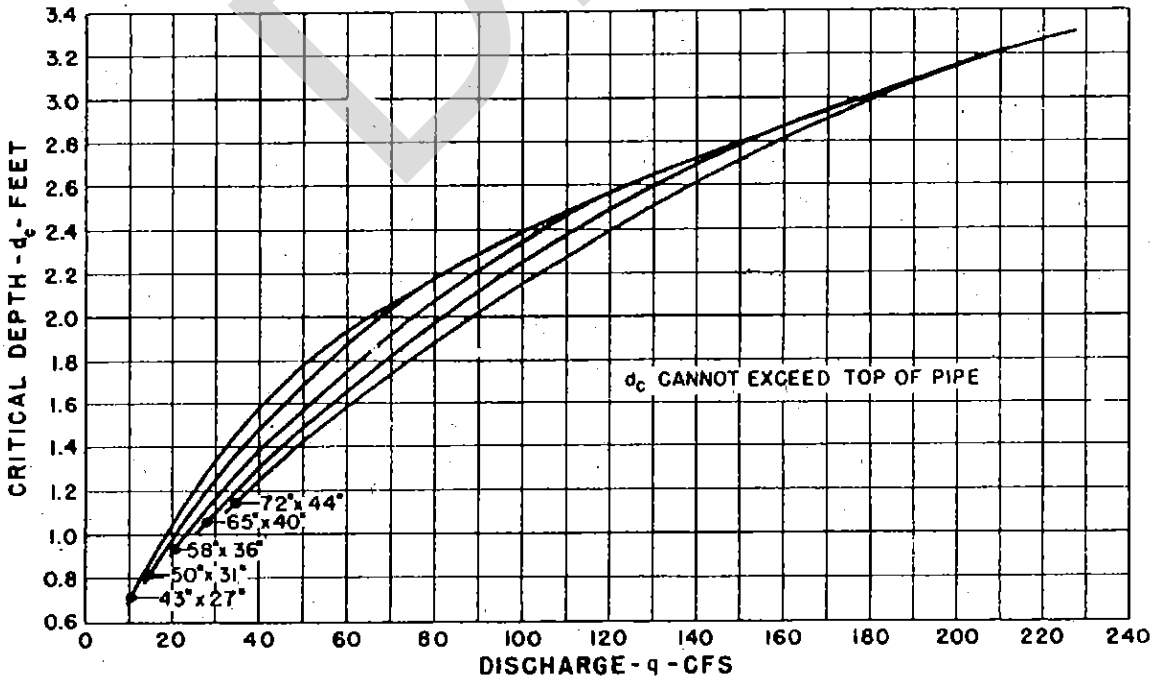


BUREAU OF PUBLIC ROADS

JAN. 1964

Exhibit 14-17. Critical depth. Circular pipe





BUREAU OF PUBLIC ROADS

JAN. 1964

Exhibit 14-19. Critical depth. Standard C.M. pipe-arch.

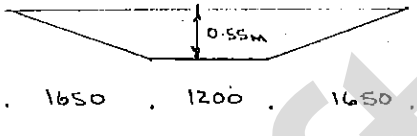
Sept 4/80

Design Revisions:

1 Minor Storm Drainage Syotem

1) - Rear of lots 21 to 25 NORTH PLAN

- SWALE TYPE 'C' REVISED



Q_{ACTUAL} = 18.50 cfs TYPE 'C' @ 0.50%

Q_{DESIGN} = 20.0 cfs ∴ Y/N = 1.12' = 0.34M

V = 2.45' / sec

Travel Time = $\frac{826.7}{2.45 \times 60}$ = 5.6 MIN Tc @ 23 MIN OK

- Swale lots 25/26 - Use Type 'C' revised
- Road Culverts lot 25/26 & 5/6 - OK as designed

2) - Swale lots 5/6 & 4/6 (#4 Holland Drive)

Q_{DESIGN} = 38.0 cfs ; Q_{ACTUAL} = (36.5 cfs (1.033 cms)

for TYPE 'C' channel @ 0.50%

(h) Y/N = 1.54' = 0.468M

V = $\frac{38.0}{13.11}$ = 2.89' / sec

2) Major Storm Drainage System

- Swale lots 7/8 & 6/8

Q_{ACTUAL} = 144.7 cfs

Q_{DESIGN} = 150 cfs - Use Type 'A' @ 0.35%

Y_N = 2.79'

$V = \frac{150}{41.96} = 3.62'/sec$

$T_{c\,revised} = 25.5 + \frac{3914.10}{3.62 \times 60} = 27.3\ min$

- Swale lots 8/A, 9/3, 10/2, 11 & 12

Area = 2.90 ha = 7.16 ac ; R = 0.55

$AR = 7.16 \times 0.55 = 3.94$

$AR_{UPSTREAM} = 32.16$

$AR_{EAST\ MINOR\ SYSTEM} = 12.67$

$AR_{TOTAL} = 48.77$

Consider Tc @ Midway of Swale To Be 29.5 min

∴ I = 4.1 ins/hr

$Q_{ACTUAL} = 4.1 \times 48.77 = 199.96$ cfs

Q_{DESIGN} = 200 cfs - Use Type 'A' swale @ 0.35%

Y_N = 3.18' = 0.97m

$V = \frac{200}{51.20} = 3.90'/sec$

DIST = 287.8m = 944'

Check Tc @ Midway of Swale

$27.5 + \frac{944}{2 \times 3.9 \times 60} = 29.5$ OK

$T_c = 29.5 + 2 = 31.5\ min$

3) Major Drainage Swale Lot 1 / Block 27

$AR_{NORTH} = 6.18 \times 0.55 = 3.40$

$AR_{WEST} = 3.25$

$AR_{EXTERIOR/NORTH} = 2.65$

$AR_{UPSTREAM} = 48.77$

$AR_{TOTAL} = 58.07$

$T_c = 31.5 MIN \quad \therefore I = 3.96 mm/hr.$

$Q_{ACTUAL} = 229.96 cfs$

$Q_{DESIGN} = 240 cfs$

Use Type 'A' Channel @ 0.50%

$\therefore Y_{NO} = 3.19' = 0.97m$

$V = \frac{240}{51.45} = 4.66'/sec$

$T_c = 31.5 + \frac{3444.5}{4.66 \times 60} = 32.7 MIN$

4) Road Culvert Crossing Under Fifth Side Road

1) Road Culvert Crossing Under 5th Sideroad

$Q_{ACTUAL} = 229.96$ cfs

$Q_{DESIGN} = 230$ cfs

- Capacity of existing 1.85m x 1.14m culvert is based upon Inlet control

$Q_{cap} = 86$ cfs (projecting entrance $K_e = 0.9$)
$HW/D = 0.95$

Design Considerations

① Modify existing culvert to convey additional flow

② Provide additional culvert to convey residual flow

① Provide Concrete Headwall at entrance to existing culvert

for $HW/D = 1.10$ & $K_e = 0.25$

$Q_{design} = 115$ cfs

∴ $Q_{required}$ for additional culvert

$= 230$ cfs $- 115$ cfs $= 115$ cfs

Try 1880mm x 1260mm CMP Arch. Culvert
(=72" x 44")

- Use Concrete Headwall $K_e = 0.25$

Inlet Control

HW/D available = (245.50 − 243.935) / 1.26 = 1.24

(245.50 = Road Elev; 243.935 = Pipe Culv Inv)

for HW/D = 1.1 Q = 115 cfs

Outlet Control

L = 17.64m = 58' So = 0.50%

① Discharge to free outlet ∴ T.W ≈< ½ culvert

From Graph Exhibit 14-15 of Drainage Report

H = 1.65 ho = ½ = 2.35'

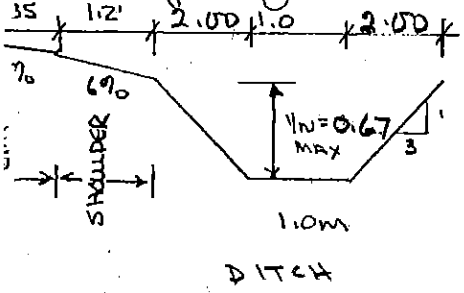
HW = H + ho − L So

= 1.65 + 2.35 − (.58)(.50) = 3.71'

HW/D = 3.71 × .304 / 1.26 = 0.90

∴ Inlet Control Prevails

Design of Roadside Dtch To Convey 115 cfs to Exting Culvert



So = 1.20% Q = 115 cfs

ARreq = (115 × .03) / (1.486)(.012)^½ = 21.19

∴ yn = 2.00' (.62m).

∴ V = 115 / 19.08 = 6.02'/sec.

5 Minor Drainage System

Swale between lots 8/9 south plan

Q_{ACTUAL} = 17.75 cfs
Q_{DESIGN} = 20.0 cfs

Type 'c' mixed @ 0.50%

for Q = 20 cfs y_N = 1.12' & V = 2.45'/sec

6 Swale between lots 16/17 & 16/18

Q_{ACTUAL} = 22.72 cfs

Q_{DESIGN} = 25 cfs

for Type 'c' mixed @ 0.50% y_N = 1.24' & V = 2.63'/sec

7 Swale between lots 13/14

Q_{Actual} = 11.04 cfs

Q_{Design} = 15.0 cfs

for Type 'B' swale @ S = 0.70% y_N = 1.13' & V = 2.64'/s
(0.345m)

THE CORPORATION
OF THE
TOWN OF CALEDON

TOWN OF CALEDON

ENGINEERING DEPARTMENT

STORM WATER MANAGEMENT REQUIREMENTS FOR ALL LOTS WITHIN REGISTERED PLANS 43M-418 AND 43M-419

All lots within the above mentioned plans of subdivision require Storm Water Management in accordance with the following criteria:

- Combined runoff coefficient (c) not to exceed 0.55
- Design storm = 10 years
- Runoff coefficients
  c = 0.9 for roof
  c = 0.9 for asphalt
  c = 0.9 for granular surfaces
  c = 0.25 for landscaped areas
- Allowable discharge from site

$Qa = 0.55 \times A \times I \times 2.778$

Where Qa = allowable discharge from site in litres/second (l/s)

A = total site area in hectares (ha)

I = rainfall intensity in millimetres/hour (mm/hr) for a 10 minute entry time

- All excess flows must be contained on site.
- All granular surfaces to use a runoff coefficient of 0.9 which is equivalent to asphalt.

Revised Jan. 7/87

Appendix B

Existing Conditions Calculations

EXISTING Pond Stage Storage Analysis

Elevation	Storage	Discharge
240.5	0	0.0000
240.75	6.63	0.0622
241	71.52	0.4468
241.25	408.66	1.1149
241.5	1349.54	1.9644
241.75	2927.08	2.8760
242	5127.62	3.5884
242.25	8306.11	4.1728
242.5	12247.61	5.2321
242.75	16821.82	9.9580
243	21764.15	20.0816
243.25	27028.56	33.3952
243.5	32453.33	48.8429

m	m3/s	ha*m
Elevation	**Discharge**	**Storage**
240.50	0.0000	0.0000
240.75	0.0622	0.0007
241.00	0.4468	0.0072
241.25	1.1149	0.0409
241.50	1.9644	0.1350
241.75	2.8760	0.2927
242.00	3.5884	0.5128
242.25	4.1728	0.8306
242.50	5.2321	1.2248
242.75	9.9580	1.6822
243.00	20.0816	2.1764
243.25	33.3952	2.7029
243.50	48.8429	3.2453

Rating Table Report
Pond16_Outlets

Range Data:			
	Minimum	Maximum	Increment
Allowable HW Elevation	240.58	243.00	0.10 m

HW Elev. (m)	Discharge (m³/s)
240.58	0.0000
240.68	0.0159
240.78	0.0797
240.88	0.1938
240.98	0.3539
241.08	0.5558
241.18	0.7949
241.28	1.0662
241.38	1.3637
241.48	1.6793
241.58	2.0036
241.68	2.3269
241.78	2.6567
241.88	2.9599
241.98	3.1808
242.08	3.3839
242.18	3.5784
242.28	3.7649
242.38	3.9443
242.48	4.1171
242.58	4.2839
242.68	4.4453
242.78	4.6016
242.88	4.7532
242.98	4.9005

```
*****************************************
** SIMULATION:100-yr 6hr AES Mass Curve **
*****************************************
--------------------
| RESERVOIR(  0031)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   4.1728      0.8306
                          0.0622     0.0007   |   5.2321      1.2248
                          0.4468     0.0072   |   9.9580      1.6822
                          1.1149     0.0409   |  20.0816      2.1764
                          1.9644     0.1350   |  33.3952      2.7029
                          2.8760     0.2927   |  48.8429      3.2453
                          3.5884     0.5128   |   0.0000      0.0000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0010)    112.100     22.926      2.50      81.14
   OUTFLOW: ID= 1 (  0031)    112.100     19.973      2.58      81.14
   OVERFLOW:ID= 3 (  0003)      0.000      0.000      0.00       0.00

                    TOTAL NUMBER OF SIMULATION OVERFLOW  =     0
                    CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                    PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 87.12
                    TIME SHIFT OF PEAK FLOW         (min)=  5.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  2.2033

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

  --------------------------
  | Junction Command(0029) |
  --------------------------

                             AREA     QPEAK   TPEAK     R.V.
                             (ha)     (cms)    (hrs)    (mm)
  INFLOW : ID= 1(  0031)  112.10    19.97    2.58    81.14
  OUTFLOW: ID= 2(  0029)  112.10    19.97    2.58    81.14

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

  --------------------------
  | Junction Command(0030) |
  --------------------------

                            AREA    QPEAK   TPEAK     R.V.
                            (ha)    (cms)    (hrs)    (mm)
  INFLOW : ID= 3(  0031)    0.00     0.00    0.00     0.00
  OUTFLOW: ID= 2(  0030)    0.00     0.00    0.00     0.00

  --------------------------------------------------------------------------------
*****************************************
** SIMULATION:10-yr 6hr AES Mass Curve **
*****************************************
--------------------
| RESERVOIR(  0031)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   4.1728      0.8306
                          0.0622     0.0007   |   5.2321      1.2248
                          0.4468     0.0072   |   9.9580      1.6822
                          1.1149     0.0409   |  20.0816      2.1764
                          1.9644     0.1350   |  33.3952      2.7029
                          2.8760     0.2927   |  48.8429      3.2453
                          3.5884     0.5128   |   0.0000      0.0000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0010)    112.100     14.237      2.50      51.54
   OUTFLOW: ID= 1 (  0031)    112.100      9.697      2.67      51.54
   OVERFLOW:ID= 3 (  0003)      0.000      0.000      0.00       0.00

                    TOTAL NUMBER OF SIMULATION OVERFLOW  =     0
                    CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                    PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 68.11
                    TIME SHIFT OF PEAK FLOW         (min)= 10.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  1.6658

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

```
  -------------------------
  | Junction Command(0029) |
  -------------------------

                           AREA     QPEAK   TPEAK     R.V.
                           (ha)     (cms)    (hrs)    (mm)
  INFLOW : ID= 1(  0031)  112.10     9.70    2.67    51.54
  OUTFLOW: ID= 2(  0029)  112.10     9.70    2.67    51.54

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

  -------------------------
  | Junction Command(0030) |
  -------------------------

                           AREA     QPEAK   TPEAK     R.V.
                           (ha)     (cms)    (hrs)    (mm)
  INFLOW : ID= 3(  0031)    0.00     0.00    0.00     0.00
  OUTFLOW: ID= 2(  0030)    0.00     0.00    0.00     0.00

  ------------------------------------------------------------------------------
****************************************
** SIMULATION:25-yr 6hr AES Mass Curve **
****************************************
--------------------
| RESERVOIR(  0031)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                         0.0000     0.0000    |   4.1728      0.8306
                         0.0622     0.0007    |   5.2321      1.2248
                         0.4468     0.0072    |   9.9580      1.6822
                         1.1149     0.0409    |  20.0816      2.1764
                         1.9644     0.1350    |  33.3952      2.7029
                         2.8760     0.2927    |  48.8429      3.2453
                         3.5884     0.5128    |   0.0000      0.0000

                              AREA     QPEAK     TPEAK      R.V.
                              (ha)     (cms)     (hrs)      (mm)
   INFLOW : ID= 2 (  0010)    112.100    17.827     2.50      63.53
   OUTFLOW: ID= 1 (  0031)    112.100    14.527     2.58      63.53
   OVERFLOW:ID= 3 (  0003)      0.000     0.000     0.00       0.00

                  TOTAL NUMBER OF SIMULATION OVERFLOW  =      0
                  CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                  PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 81.49
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED      (ha.m.)=  1.9127

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

  -------------------------
  | Junction Command(0029) |
  -------------------------

                           AREA     QPEAK   TPEAK     R.V.
                           (ha)     (cms)    (hrs)    (mm)
  INFLOW : ID= 1(  0031)  112.10    14.53    2.58    63.53
  OUTFLOW: ID= 2(  0029)  112.10    14.53    2.58    63.53

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

  -------------------------
  | Junction Command(0030) |
  -------------------------

                           AREA     QPEAK   TPEAK     R.V.
                           (ha)     (cms)    (hrs)    (mm)
  INFLOW : ID= 3(  0031)    0.00     0.00    0.00     0.00
  OUTFLOW: ID= 2(  0030)    0.00     0.00    0.00     0.00

  ------------------------------------------------------------------------------
****************************************
** SIMULATION:2-yr 6hr AES Mass Curve **
****************************************
--------------------
| RESERVOIR(  0031)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                         0.0000     0.0000    |   4.1728      0.8306
```

0.0622	0.0007	5.2321	1.2248
0.4468	0.0072	9.9580	1.6822
1.1149	0.0409	20.0816	2.1764
1.9644	0.1350	33.3952	2.7029
2.8760	0.2927	48.8429	3.2453
3.5884	0.5128	0.0000	0.0000

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (	0010)	112.100	7.691	2.50	28.68
OUTFLOW: ID= 1 (	0031)	112.100	4.172	2.75	28.68
OVERFLOW:ID= 3 (	0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 54.24
TIME SHIFT OF PEAK FLOW (min)= 15.00
MAXIMUM STORAGE USED (ha.m.)= 0.8315

Junction Command(0029)

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 1(	0031)	112.10	4.17	2.75	28.68
OUTFLOW: ID= 2(	0029)	112.10	4.17	2.75	28.68

Junction Command(0030)

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 3(	0031)	0.00	0.00	0.00	0.00
OUTFLOW: ID= 2(	0030)	0.00	0.00	0.00	0.00

****
** SIMULATION:50-yr 6hr AES Mass Curve **
****

RESERVOIR(0031)|	OVERFLOW IS ON			
IN= 2---> OUT= 1 |				
DT= 5.0 min |	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	4.1728	0.8306
	0.0622	0.0007	5.2321	1.2248
	0.4468	0.0072	9.9580	1.6822
	1.1149	0.0409	20.0816	2.1764
	1.9644	0.1350	33.3952	2.7029
	2.8760	0.2927	48.8429	3.2453
	3.5884	0.5128	0.0000	0.0000

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (	0010)	112.100	20.177	2.50	71.66
OUTFLOW: ID= 1 (	0031)	112.100	17.159	2.58	71.66
OVERFLOW:ID= 3 (	0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 85.04
TIME SHIFT OF PEAK FLOW (min)= 5.00
MAXIMUM STORAGE USED (ha.m.)= 2.0543

Junction Command(0029)

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 1(	0031)	112.10	17.16	2.58	71.66
OUTFLOW: ID= 2(	0029)	112.10	17.16	2.58	71.66

Junction Command(0030)

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 3(0031)	0.00	0.00	0.00	0.00
OUTFLOW: ID= 2(0030)	0.00	0.00	0.00	0.00

****
** SIMULATION:5-yr 6hr AES Mass Curve **
****

RESERVOIR(0031) / IN= 2---> OUT= 1 / DT= 5.0 min	OVERFLOW IS ON			
	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	4.1728	0.8306
	0.0622	0.0007	5.2321	1.2248
	0.4468	0.0072	9.9580	1.6822
	1.1149	0.0409	20.0816	2.1764
	1.9644	0.1350	33.3952	2.7029
	2.8760	0.2927	48.8429	3.2453
	3.5884	0.5128	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	112.100	11.878	2.50	43.30
OUTFLOW: ID= 1 (0031)	112.100	7.264	2.67	43.30
OVERFLOW:ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 61.15
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 1.4282

Junction Command(0029)

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 1(0031)	112.10	7.26	2.67	43.30
OUTFLOW: ID= 2(0029)	112.10	7.26	2.67	43.30

Junction Command(0030)

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 3(0031)	0.00	0.00	0.00	0.00
OUTFLOW: ID= 2(0030)	0.00	0.00	0.00	0.00

Appendix C

Visual OTTHYMO Modeling

```
*****************************************
** SIMULATION:100-yr 6hr AES Mass Curve **
*****************************************
--------------------
| RESERVOIR(  0034)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   1.6170      5.7263
                          0.6850     2.6123   |   1.8770      6.4383
                          1.0410     3.9298   |   2.1280      7.2767
                          1.2870     4.6615   |   0.0000      0.0000

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0010)    112.100     22.926      2.50       81.14
   OUTFLOW: ID= 1 (  0034)    112.100      2.123      4.08       81.13
   OVERFLOW:ID= 3 (  0003)      0.000      0.000      0.00        0.00

                  TOTAL NUMBER OF SIMULATION OVERFLOW  =     0
                  CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                  PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.26
                  TIME SHIFT OF PEAK FLOW          (min)= 95.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  7.2640

--------------------------------------------------------------------------------
*****************************************
** SIMULATION:10-yr 6hr AES Mass Curve **
*****************************************
--------------------
| RESERVOIR(  0034)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   1.6170      5.7263
                          0.6850     2.6123   |   1.8770      6.4383
                          1.0410     3.9298   |   2.1280      7.2767
                          1.2870     4.6615   |   0.0000      0.0000

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0010)    112.100     14.237      2.50       51.54
   OUTFLOW: ID= 1 (  0034)    112.100      1.282      4.08       51.53
   OVERFLOW:ID= 3 (  0003)      0.000      0.000      0.00        0.00

                  TOTAL NUMBER OF SIMULATION OVERFLOW  =     0
                  CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                  PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.01
                  TIME SHIFT OF PEAK FLOW          (min)= 95.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  4.6485

--------------------------------------------------------------------------------
*****************************************
** SIMULATION:25-yr 6hr AES Mass Curve **
*****************************************
--------------------
| RESERVOIR(  0034)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
```

0.0000	0.0000	|	1.6170	5.7263
0.6850	2.6123	|	1.8770	6.4383
1.0410	3.9298	|	2.1280	7.2767
1.2870	4.6615	|	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	112.100	17.827	2.50	63.53
OUTFLOW: ID= 1 (0034)	112.100	1.613	4.08	63.52
OVERFLOW:ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 9.05
TIME SHIFT OF PEAK FLOW (min)= 95.00
MAXIMUM STORAGE USED (ha.m.)= 5.7136

****
** SIMULATION:2-yr 6hr AES Mass Curve **
****

RESERVOIR(0034) | IN= 2---> OUT= 1 | DT= 5.0 min	OVERFLOW IS ON			
	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	1.6170	5.7263
	0.6850	2.6123	1.8770	6.4383
	1.0410	3.9298	2.1280	7.2767
	1.2870	4.6615	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	112.100	7.691	2.50	28.68
OUTFLOW: ID= 1 (0034)	112.100	0.679	4.17	28.67
OVERFLOW:ID= 3 (0003)	0.000	0.000	0.00	0.00

TOTAL NUMBER OF SIMULATION OVERFLOW = 0
CUMULATIVE TIME OF OVERFLOW (HOURS) = 0.00
PERCENTAGE OF TIME OVERFLOWING (%) = 0.00

PEAK FLOW REDUCTION [Qout/Qin](%)= 8.83
TIME SHIFT OF PEAK FLOW (min)=100.00
MAXIMUM STORAGE USED (ha.m.)= 2.5887

****
** SIMULATION:50-yr 6hr AES Mass Curve **
****

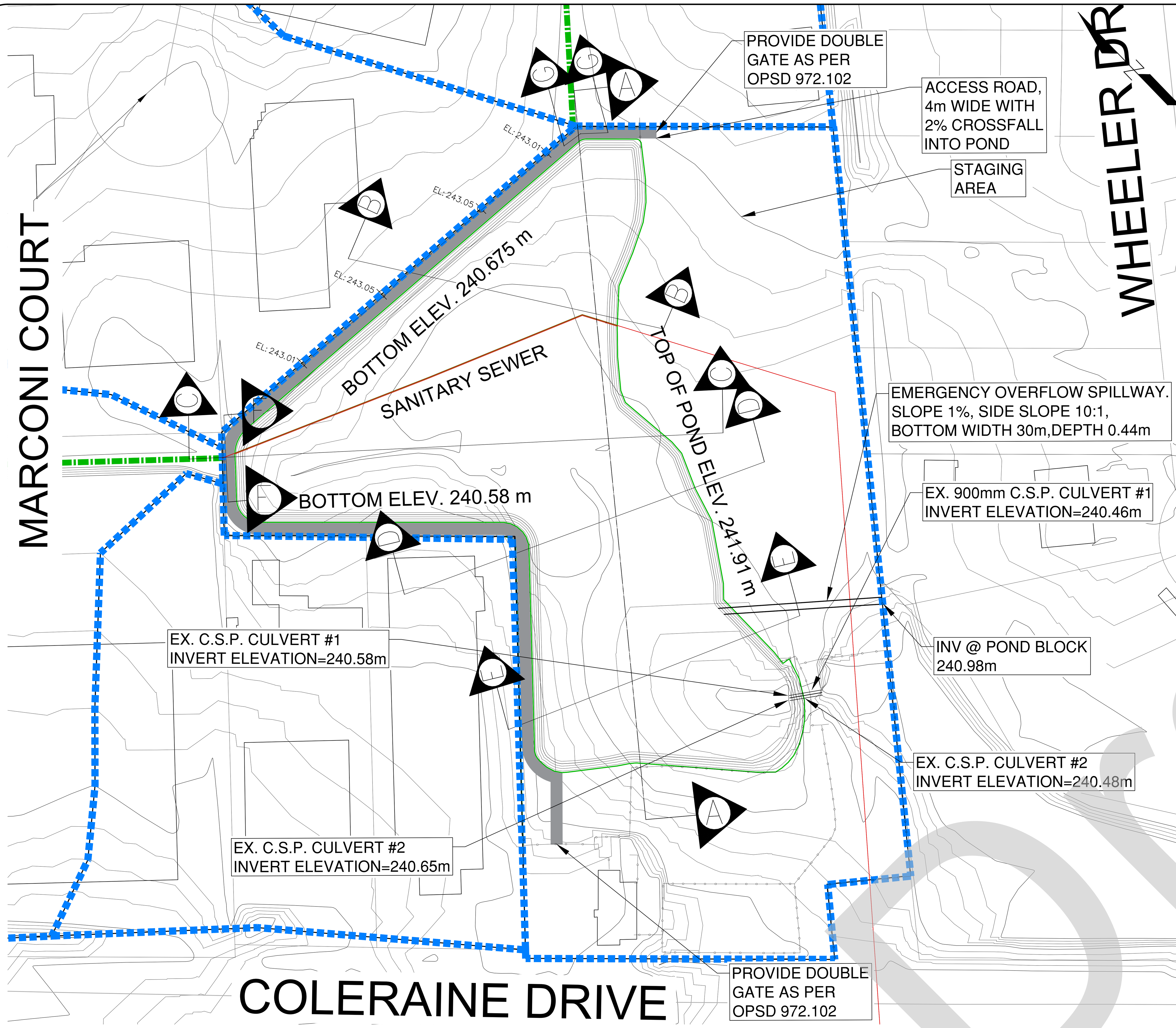
RESERVOIR(0034) | IN= 2---> OUT= 1 | DT= 5.0 min	OVERFLOW IS ON			
	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	1.6170	5.7263
	0.6850	2.6123	1.8770	6.4383
	1.0410	3.9298	2.1280	7.2767
	1.2870	4.6615	0.0000	0.0000

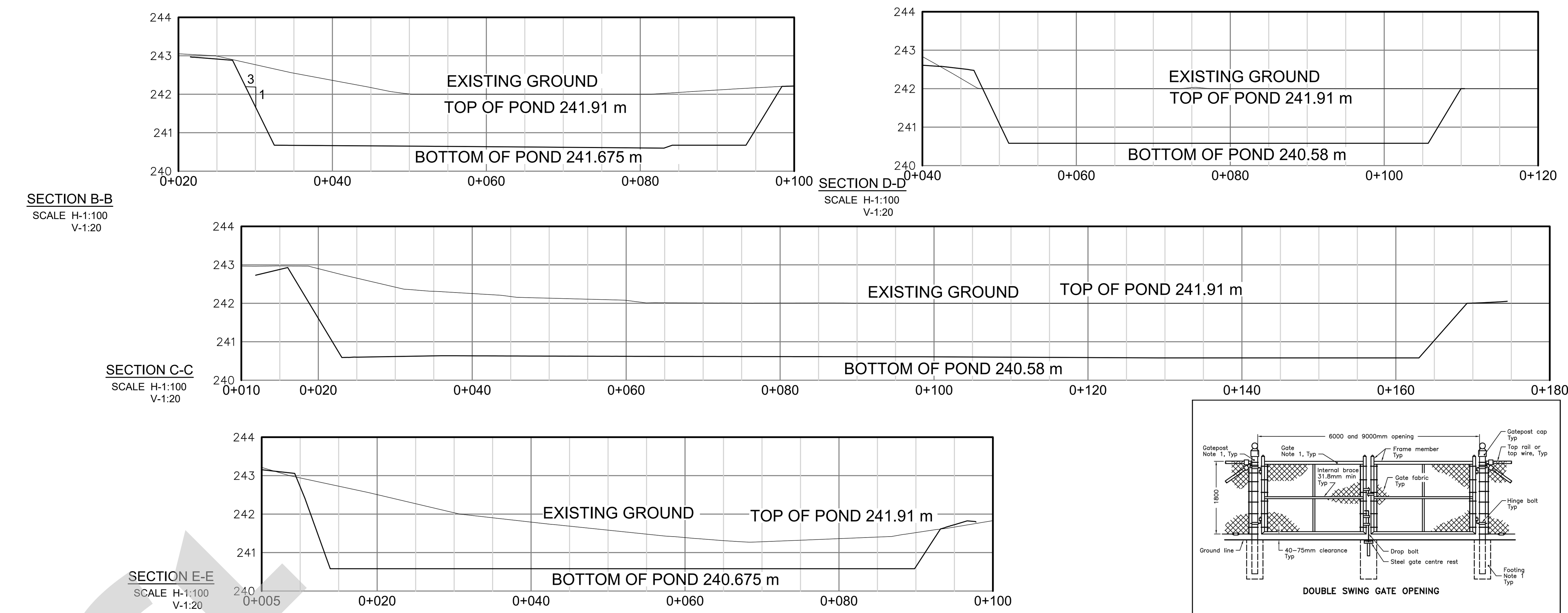
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0010)	112.100	20.177	2.50	71.66

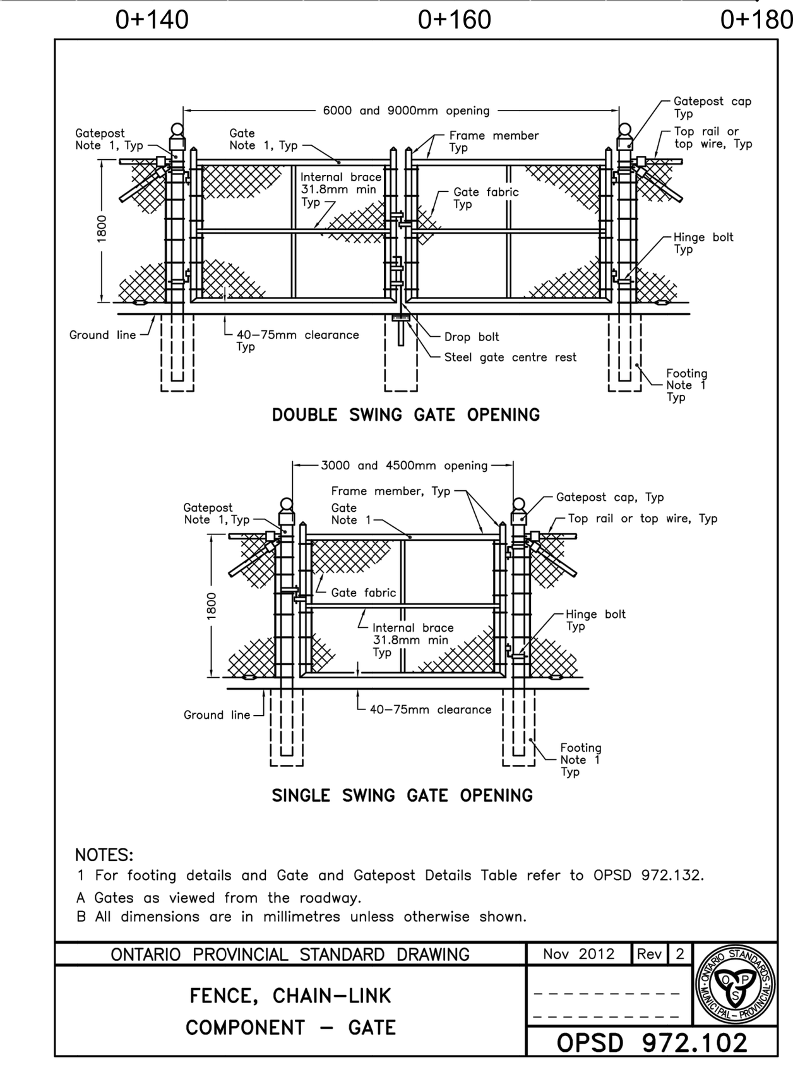
```
   OUTFLOW: ID= 1 (  0034)    112.100      1.872      4.08      71.65
   OVERFLOW:ID= 3 (  0003)      0.000      0.000      0.00       0.00

                    TOTAL NUMBER OF SIMULATION OVERFLOW  =     0
                    CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                    PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.28
                    TIME SHIFT OF PEAK FLOW         (min)= 95.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  6.4257

--------------------------------------------------------------------------------
****************************************
** SIMULATION:5-yr 6hr AES Mass Curve **
****************************************
--------------------
| RESERVOIR(  0034)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                         0.0000     0.0000    |   1.6170      5.7263
                         0.6850     2.6123    |   1.8770      6.4383
                         1.0410     3.9298    |   2.1280      7.2767
                         1.2870     4.6615    |   0.0000      0.0000

                                    AREA      QPEAK     TPEAK       R.V.
                                    (ha)      (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0010)    112.100      11.878      2.50       43.30
   OUTFLOW: ID= 1 (  0034)    112.100       1.037      4.17       43.29
   OVERFLOW:ID= 3 (  0003)      0.000       0.000      0.00        0.00

                    TOTAL NUMBER OF SIMULATION OVERFLOW  =     0
                    CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.00
                    PERCENTAGE OF TIME OVERFLOWING   (%) =  0.00

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.73
                    TIME SHIFT OF PEAK FLOW         (min)=100.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  3.9160

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

Appendix D

Design Drawings







GEOTECH

1. STRIP THE POND SUBGRADE AREA TO REMOVE ALL ORGANICS, TOPSOIL AND VEGETATION.
2. EXPOSED SUBGRADE TO BE PROOF-ROLLED AND INSPECTED BY A QUALIFIED GEOTECHNICAL ENGINEER TO CONFIRM THE FOUNDING SOIL CONDITIONS.
3. LOOSE, SOFT OR OTHERWISE DELETERIOUS MATERIALS MUST BE REMOVED TO THEIR FULL EXTEND AND REPLACED WITH COMPACTED EARTH FILL TO A MAXIMUM OF 98% STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD) UNDER THE DIRECTION OF A QUALIFIED GEOTECHNICAL ENGINEER
4. EARTH FILL MATERIAL USED FOR THE BERM CONSTRUCTION TO BE OF LOW PERMEABILITY AND FREE OF ORGANICS / TOPSOIL. IT SHOULD CONSIST OF AT LEAST 15% CLAY AND 35% SILT SIZED PARTICLES. ANY COBBLES OR BOULDERS GREATER THAN 100mm IN SIZE SHOULD BE EXCLUDED FROM THE EARTH BERM FILL, AS SHOULD ANY EARTH FILL / WEATHERED / DISTURBED SOILS CONTAINING EXCESSIVE AMOUNTS OF SAND OR SILT.
5. EARTH FILL MATERIALS TO BE PLACED IN LIFTS NOT EXCEEDING 150mm AND BE COMPACTED TO A MINIMUM OF 95% OF THE SPMDD. THE MATERIALS SHALL BE PLACED AND COMPACTED AT A WATER CONTENT BETWEEN 2% DRY AND 4% WET OF THE OPTIMUM MOISTURE CONTENT.
6. LOOSE, SOFT OR OTHERWISE DELETERIOUS MATERIALS MUST BE REMOVED TO THEIR FULL EXTENT AND REPLACED WITH COMPACTED EARTH FILL (AS SPECIFIED) UNDER THE DIRECTION OF A QUALIFIED GEOTECHNICAL ENGINEER.
7. POCKETS AND AREAS OF SANDY / SILTY SOILS MUST BE IDENTIFIED, SUB-EXCAVATED AND REPLACED WITH COMPACTED APPROVED LOW PERMEABILITY EARTH FILL SOILS. THE SUBGRADE SHOULD BE COMPACTED TO AT LEAST 95% SPMDD PRIOR TO THE BERM FILL PLACEMENT.
8. THE FINAL SLOPE SURFACE AND ALL BARE OR EXPOSED AREAS (WHERE APPLICABLE) SHOULD BE PROVIDED WITH SUITABLE GROUND COVER OR EROSION PROTECTION.
9. THE SLOPE SURFACE TO BE PROVIDED WITH A THIN LAYER OF TOPSOIL (100mm TO 300mm THICK) AND SHOULD BE HYDRO-SEEDED) WITH A GRASS MIXTURE AND MULCH.
10. IF SEEDED, DURING THE FIRST 2 TO 3 YEARS, THE SURFACE COVER OF TOPSOIL AND SEEDING MAY REQUIRE PERIODIC MAINTENANCE UNTIL VEGETATION BECOMES WELL ESTABLISHED. IT IS RECOMMENDED THAT EROSION NETTING BE STAKED ON THE OUTSIDE SLOPE (WHERE APPLICABLE) FOR EROSION PROTECTION, AND INSIDE SLOPE WHERE ABOVE THE WATER LEVEL.
11. INSIDE SLOPES OF THE SWM PONDS TO BE VEGETATED WITH AQUATIC VEGETATION SPECIES. TO PREVENT MINOR SHEET AND RILL EROSION DUE TO PERIODIC FLUCTUATIONS IN THE POND WATER LEVEL OVER EXTENDED PERIODS OF EXPOSURE
12. OCCASIONAL MAINTENANCE AND REPAIR OF THE INSIDE BARE POND SLOPES (AND REMOVAL OF ACCUMULATED SEDIMENT IN THE BASE) WILL BE REQUIRED.
13. EMERGENCY SPILLWAY MUST BE PROVIDED WITH A SIGNIFICANT EROSION RESISTANT LINING CONSISTING OF EITHER RIP RAP, GABION MATTRESSES OR BURIED AND STAKED GEOWEB / DURAMAT CONCRETE UNITS (OR APPROVED EQUIVALENT).
14. MATERIAL SHOULD CONSIST OF CLEAN MINERAL SOIL. THE GRAIN SIZE DISTRIBUTION OF THE MATERIAL MUST CONFORM TO THE FOLLOWING CRITERIA:
    - NO PARTICLE GREATER THAN 100mm
    - MAXIMUM 15% OF MATERIAL LARGER THAN 4.75mm (NO. 4 SIEVE)
    - MINIMUM OF 35% OF MATERIAL FINER THAN 0.075mm (PASSING NO. 200 SIEVE)
    - MINIMUM 15% FINER THAN 0.002mm (CLAY SIZE)
    - MAXIMUM 5% ORGANIC CONTENT, WITH NO VISIBLE ROOTS OR TOPSOIL

CONSTRUCTION NOTES

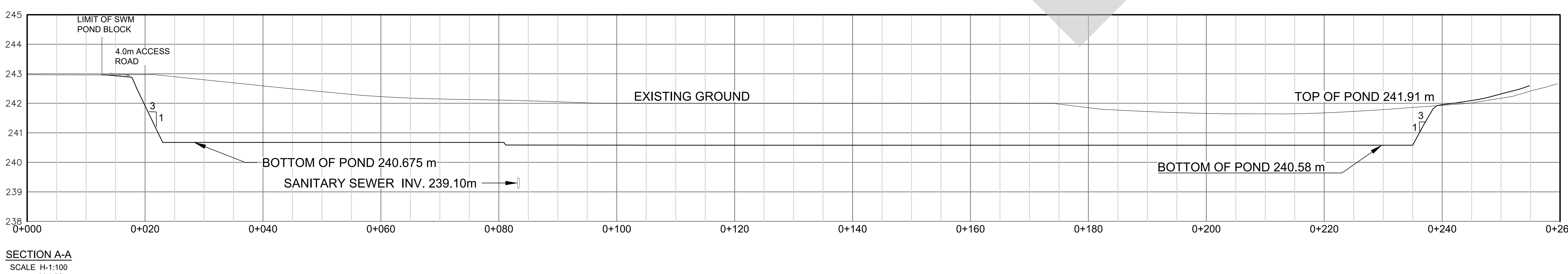
MOBILIZATION
1. OBTAIN REQUIRED PERMITS
2. ENLARGE ACCESS PATH, WHERE REQUIRED, AND INSTALL GRANULAR BASE TO FACILITATE VEHICULAR ACCESS DURING CONSTRUCTION
3. CONDUCT PRE-CONSTRUCTION SURVEY FOR LAYOUT
4. CONTRACTOR TO PROVIDE PROPOSED BYPASS METHODOLOGY AND DEMONSTRATE CAN ADEQUATELY ADDRESS THE ENVIRONMENTAL AND EXISTING SITE CONDITIONS (variable flow conditions, channel capacity, wet weather response)
5. INSTALL SITE TRAILER
6. INSTALL EROSION AND SEDIMENT CONTROL MEASURES. REFER TO ESC DRAWINGS
7. INSTALL TEMPORARY FENCING TO PROTECT UTILITIES AND ISOLATE PUBLIC ACCESS AND SNOW FENCING TO DELINEATE LIMITS OF CONSTRUCTION

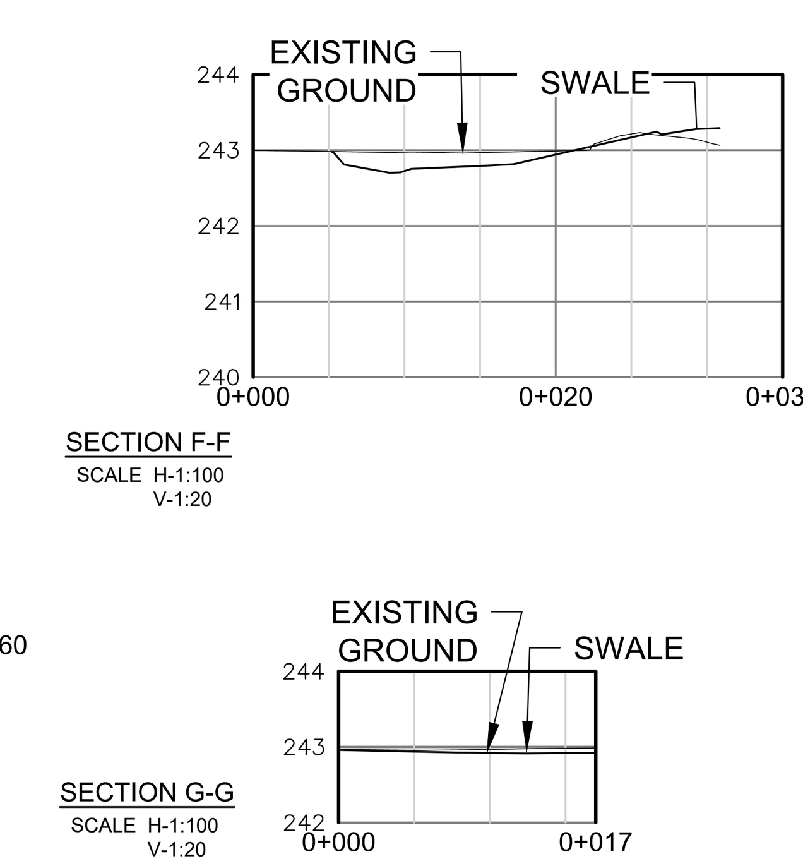
SITE PREP
8. INSTALL TREE PROTECTION FENCING
9. REMOVE DESIGNATED TREES AND VEGETATION AND HAUL OFFSITE
10. PLACE DAM & PUMP CONTROLS IN DESIGNATED AREA (need to consider 5A outlet and creek)

CONSTRUCTION OF POND
11. EXCAVATE TOPSOIL AND REMOVE FROM SITE OR STOCKPILE SUITABLE MATERIAL FOR CONSTRUCTION OF BERMS AND OTHER APPLICATIONS.
12. FINE GRADE EACH POND AS PER ELEVATIONS SHOWN IN CONTRACT DRAWINGS. APPLY INSTALL AND STAKE SPECIFIED EROSION CONTROL MATS TO STABILIZE THE EMBANKMENTS

PLANTING
13. PLANT SPECIES FOR THE WHOLE SITE DURING APPROPRIATE WEATHER CONDITIONS AS CONFIRMED BY LANDSCAPE ARCHITECT FOR ALL THE ITEMS SHOWN IN THE LANDSCAPE DRAWINGS
14. SEED/SOD AREAS SOD AREAS AS DESIGNATED IN THE LANDSCAPE DRAWINGS

DEMOBILIZATION
15. REMOVE ALL TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES
16. REMOVE TRAILER, MACHINERY AND MATERIAL
17. REMOVE CHAIN-LINK FENCE AND SNOW FENCE WHERE APPLICABLE
18. CLEAN SITE OF ACCUMULATED DEBRIS





STAGE STORAGE TABLE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
240.580	1,607.30	0.000	0.00	0.00	0.00	0.00
240.680	17,516.41	0.010	153.07	1267.66	152.54	1258.08
240.780	17,740.19	0.010	177.29	3030.49	177.29	3020.90
240.880	17,964.93	0.010	179.54	4815.73	179.54	4806.15
240.980	18,190.60	0.010	181.79	6623.50	181.79	6613.92
241.080	18,417.23	0.010	184.06	8453.89	184.06	8444.30
241.180	18,644.79	0.010	186.33	10306.98	186.33	10297.39
241.280	18,873.31	0.010	188.62	12182.88	188.62	12173.29
241.380	19,102.77	0.010	190.91	14081.67	190.91	14072.09
241.480	19,333.17	0.010	193.22	16003.46	193.22	15993.87
241.580	19,564.52	0.010	195.53	17948.34	195.53	17938.75
241.680	19,796.81	0.010	197.85	19916.40	197.85	19906.81
241.780	20,030.05	0.010	200.18	21907.73	200.18	21898.15
241.880	20,263.80	0.010	202.52	23922.42	202.52	23912.84
241.910	20,333.98	0.010	203.22	24531.39	203.22	24521.80

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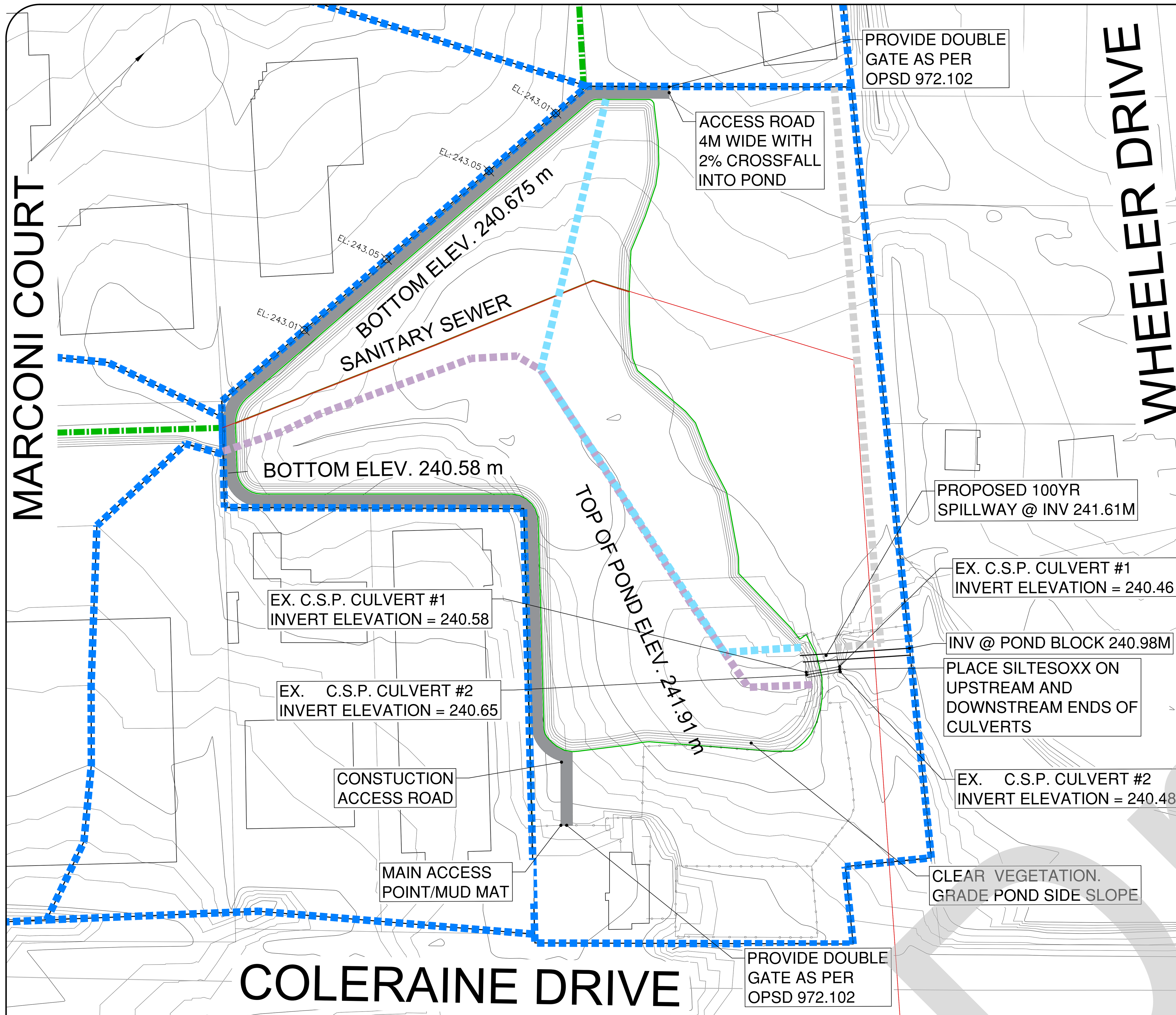
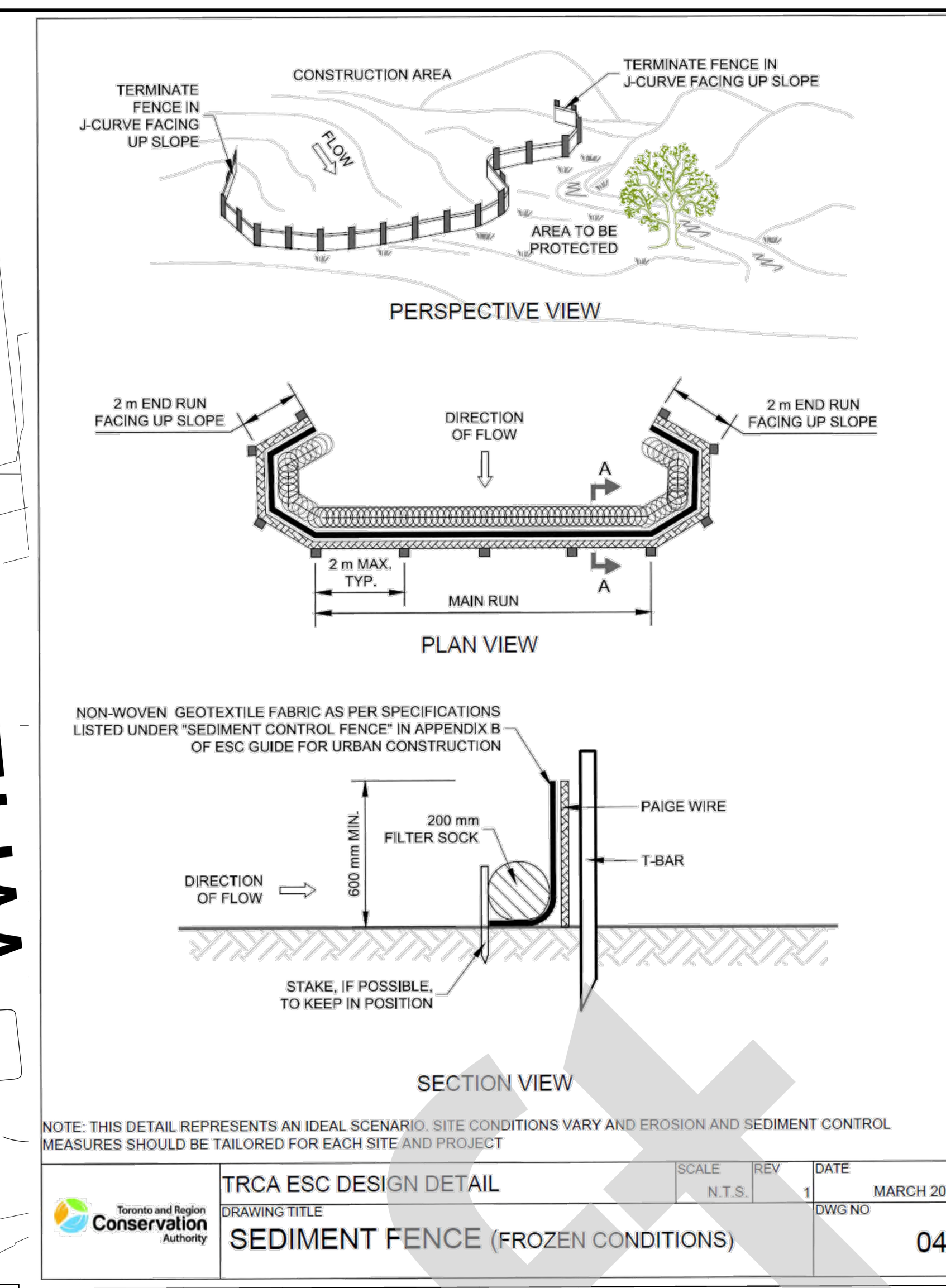
LEGEND
- DRAINAGE AREA BOUNDARIES
- SWALES
- FENCE
- SANITARY SEWER
- ACCESS ROAD

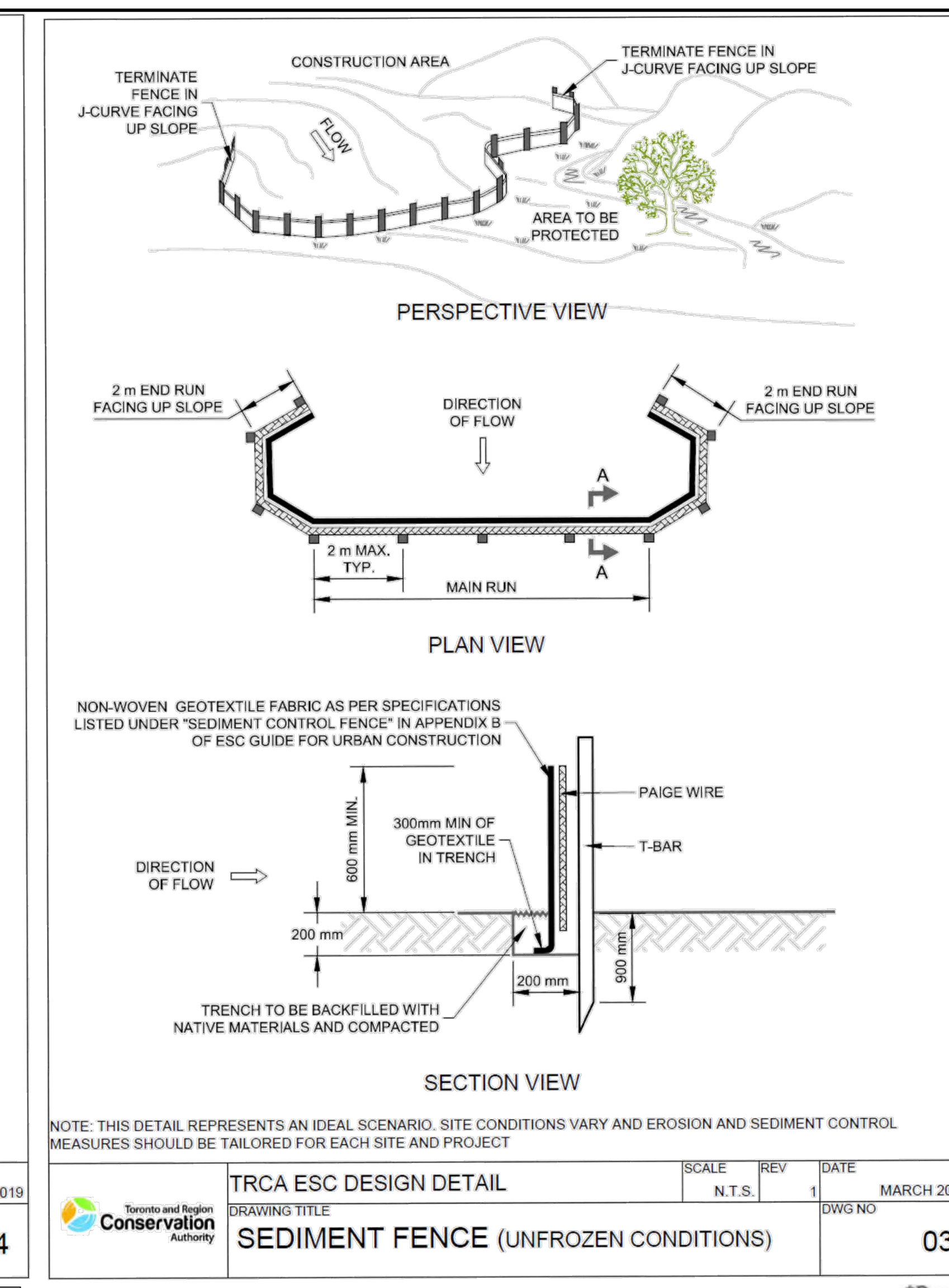
STORMWATER MANAGEMENT POND PLAN/SECTIONS/DETAILS

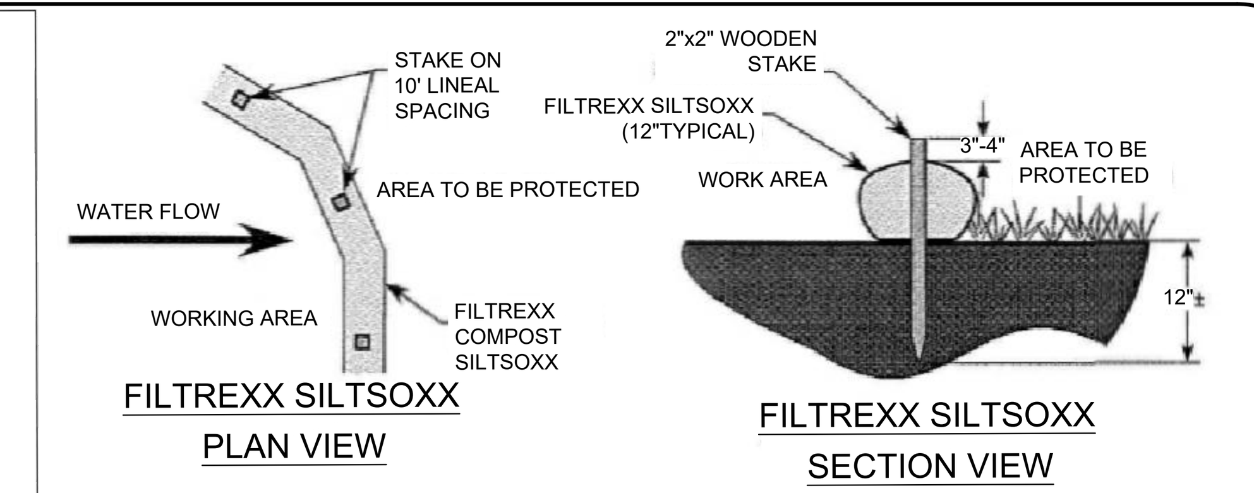
DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: SEPTEMBER 2021	PROJECT No.: 2020-0086
SCALE: 1:2000	FIGURE No.: 2







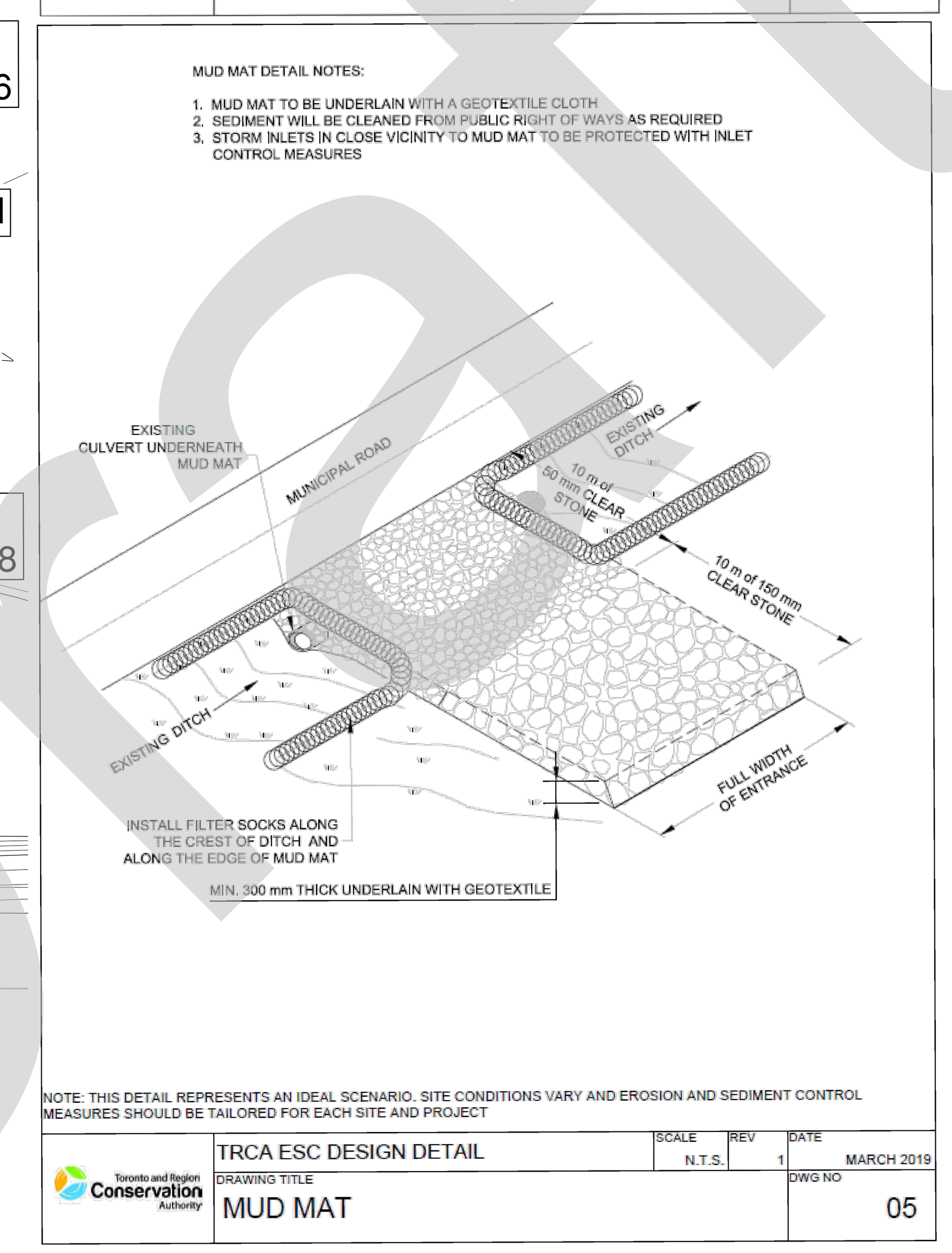


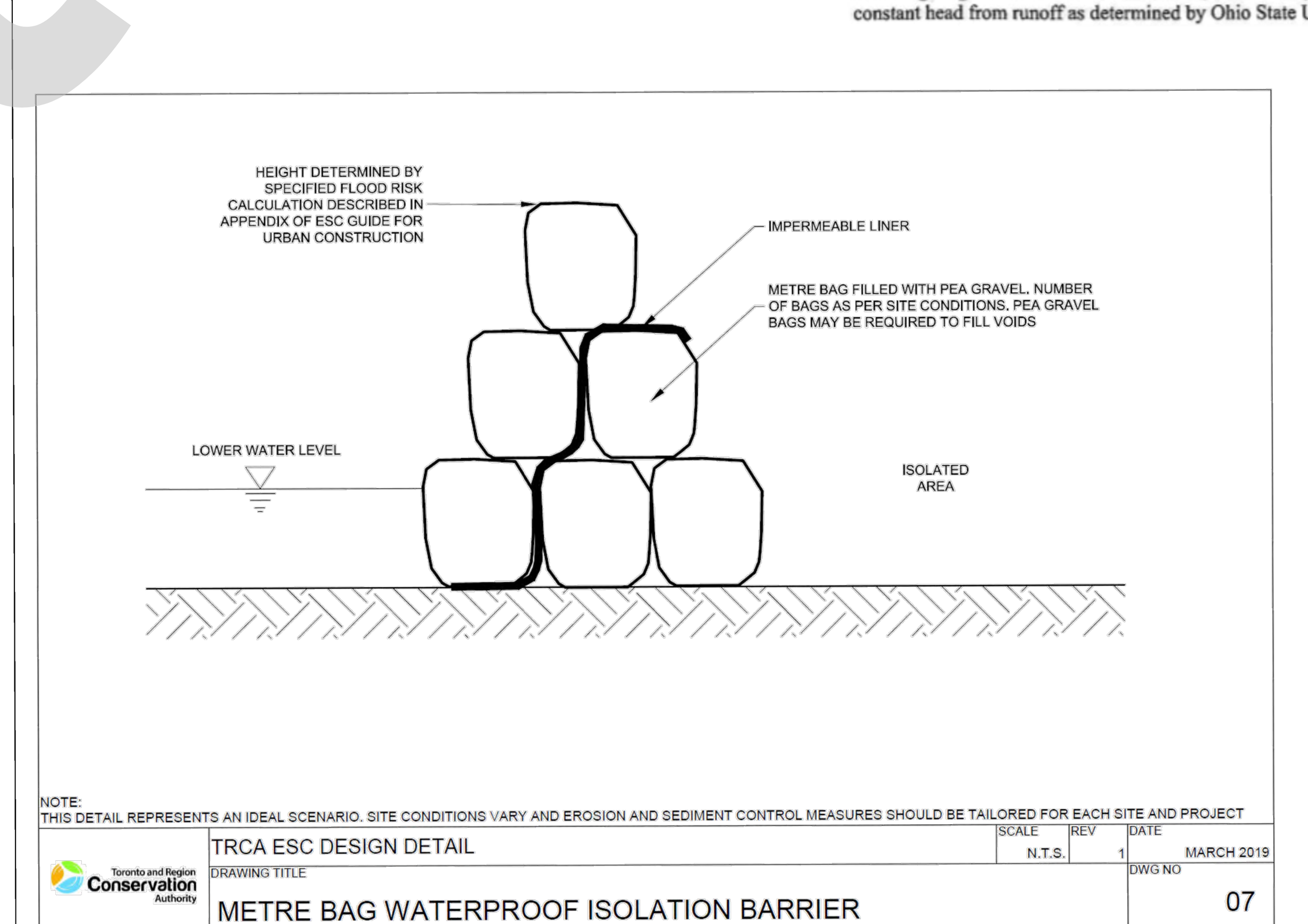
NOTES:

1. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
2. SILTSOXX COMPOST/JSOIL/ROCK/SEED FILL TO MEET APPLICATION REQUIREMENTS.
3. SILTSOXX DEPICTED IS FOR MINIMUM SLOPES. GREATER SLOPES MAY REQUIRE LARGER SOCKS PER THE ENGINEER.
4. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

Slope Percent	Maximum Slope Length Above SiltSoxx™ in Feet (meters)*				
	8 in (200 mm) SiltSoxx™	12 in (300 mm) SiltSoxx™	18 in (450 mm) SiltSoxx™	24 in (600mm) SiltSoxx™	32 in (800mm) SiltSoxx™
	7 in (175 mm)**	10 in (250 mm) **	15 in (375 mm) **	20 in (500 mm) **	26 in (650 mm) **
2 (or less)	600 (180)	750 (225)	1000 (300)	1300 (400)	1650 (500)
5	400 (120)	500 (150)	550 (165)	650 (200)	750 (225)
10	200 (60)	250 (75)	300 (90)	400 (120)	500 (150)
15	140 (40)	170 (50)	200 (60)	325 (100)	450 (140)
20	100 (30)	125 (38)	140 (42)	260 (80)	400 (120)
25	80 (24)	100 (30)	110 (33)	200 (60)	275 (85)
30	60 (18)	75 (23)	90 (27)	130 (40)	200 (60)
35	60 (18)	75 (23)	80 (24)	115 (35)	150 (45)
40	60 (18)	75 (23)	80 (24)	100 (30)	125 (38)
45	40 (12)	50 (15)	60 (18)	80 (24)	100 (30)
50	40 (12)	50 (15)	55 (17)	65 (20)	75 (23)

*Based on a failure point of 36 in (0.9 m) super silt fence (wire reinforced) at 1000 ft (303 m) of slope, watershed width equivalent to receiving length of sediment control device, 1 in/ 24 hr (25 mm/24 hr) rain event. **Effective height of Silt Soxx™ after installation and with constant head from runoff as determined by Ohio State University.





SCHEDULE C - PERMIT CONDITIONS OF THE FILL BY-LAW

1. ALL PERMITS HOLDERS SHALL:
   A. NOTIFY THE DIRECTOR OR HIS/HER DESIGNATE A MINIMUM OF TWO BUSINESS DAYS PRIOR TO THE COMMENCEMENT OR RECOMMENCEMENT OF ANY LAND DISTURBING ACTIVITY;
   B. OBTAIN PERMISSION IN WRITING FROM THE DIRECTOR OR HIS/HER DESIGNATE PRIOR TO MODIFY ANY ELEMENTS OF THE EROSION AND SEDIMENT CONTROL PLAN;
   C. INSTALL ALL CONTROL MEASURES AS IDENTIFIED IN THE APPROVED EROSION AND SEDIMENT CONTROL PLAN;
   D. MAINTAIN ALL ROAD DRAINAGE SYSTEMS, STORMWATER DRAINAGE SYSTEMS, CONTROL MEASURES AND OTHER FACILITIES IDENTIFIED IN THE EROSION AND SEDIMENT CONTROL PLAN;
   E. PROMPTLY REPAIR ANY SILTATION OR EROSION DAMAGE TO ADJOINING SURFACES AND DRAINAGE WAYS RESULTING FROM LAND DEVELOPING OR DISTURBING ACTIVITIES;
   F. INSPECT THE SEDIMENTATION CONTROL MEASURES AT LEAST ONCE PER WEEK AND AFTER EACH RAINFALL OF AT LEAST ONE CENTIMETER AND MAKE NEEDED REPAIRS;
   G. ALLOW TOWN OFFICERS OR AGENTS OF THE TOWN TO ENTER THE SITE FOR THE PURPOSE OF INSPECTING FOR COMPLIANCE WITH EROSION AND SEDIMENT CONTROL PLAN OR FOR PERFORMING ANY WORK NECESSARY TO BRING THE SITE INTO COMPLIANCE WITH THE EROSION AND SEDIMENT CONTROL PLAN;
   H. MAINTAIN A COPY OF THE PERMIT ON THE SITE;
   I. NOTIFY ALL THE SUB CONTRACTORS AND SUPPLIERS OF APPROVED ACCESS ROUTES TO THE SITE AND ENSURE COMPLIANCE WITH THESE INSTRUCTIONS.;
   J. MAINTAIN ALL ROADS IN SAME OR BETTER CONDITION THAT EXISTED PRIOR TO THE COMMENCEMENT OF THE WORK AND KEEP ALL ROADS FREE FROM ANY MATERIALS OR EQUIPMENT ARISING FROM THE WORK SET OUT IN THE PERMIT;
   K. ENSURE THAT NO CONSTRUCTION MACHINERY IS OPERATED OF BY LAW NO. 3821, AS AMENDED, (NOISE BY LAW) OR ANY SUCCESSOR THERETO.

SITE CONTACT:

COMPANY NAME:
CONTACT NAME:
PHONE NUMBER:
MOBILE NUMBER:

TRCA STANDARD NOTES FOR ENVIRONMENTAL ASSESSMENT/INFRASTRACTURE PERMIT APPLICATIONS:

SECTION 1: SITE MANAGEMENT

A. "EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER. ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND/OR REPLACED WITHIN 48 HOURS OF THE INSPECTION."

B. "DISTURBED AREAS WILL BE MINIMIZED TO THE EXTEND POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES."

C. "THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED/AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF A DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. TRCA ENFORCEMENT OFFICER SHOULD BE IMMEDIATELY CONTACTED. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY."

D. "AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN/SNOWMELT EVENT, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DEWATERING OR UNWATERING, RESTORATION AND IN- OR NEAR- WATER WORKS. SHOULD CONCERNS ARISE ON SITE THE ENVIRONMENTAL MONITOR WILL CONTACT THE TRCA ENFORCEMENT OFFICER AS WELL AS THE PROPONENT."

E. "ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER."

F. "THE PROPONENT/CONTRACTOR SHALL MONITOR THE WEATHER SEVERAL DAYS IN ADVANCE OF THE ONSET OF THE PROJECT TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVOURABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE REGIONAL STORM FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC."

G. 'ALL DEWATERING/UNWATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 30 METERS FROM A WATERCOURS OR WETLAND AND ALLOWED TO DRAIN THROUGH A WELL-VEGETATED AREA. NO DEWATERING OR WETLAND AND ALLOWED TO DRAIN THROUGH A WELL-VEGETATED AREA. NO DEWATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, WETLAND OR FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAIN OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT LADEN WATER."

H. ALL ACCESS TO THE WORK SITE SHALL BE FROM EITHER SIDE OF THE WATERCOURSE. NO EQUIPMENT OR VEHICLES ARE PERMITTED TO CROSS THROUGH THE WATERCOURSE UNLESS APPROVED BY TRCA."

SECTION 2: CONSTRUCTION TIMING

I. "IN ORDER TO COMPLY WITH THE MIGRATORY BIRDS CONVECTION ACT, TRCA RECOMMENDS THAT TREE REMOVALS BE COMPLETED BETWEEN AUGUST 1 AND APRIL 1."

SECTION 4: ENVIRONMENTAL COMPLIANCE

J. "PLEASE NOTIFY TRCA ENFORCEMENT OFFICER AND TRCA PROJECT MANAGER 48 HOURS PRIOR TO COMMENCING CONSTRUCTION."
24 HOUR EMERGENCY CONTACT:

K. "AN ENVIRONMENTAL MONITOR WILL BE ON SITE, AND PROVIDE ADVICE, TO ENSURE THAT ACTIVITIES THAT COULD HAVE A NEGATIVE IMPACT TO THE NATURAL ENVIRONMENT ARE EFFECTIVELY MITIGATED AS CONSTRUCTION PROCEEDS. THE ENVIRONMENTAL MONITOR SHALL NOTIFY THE TRCA ENFORCEMENT OFFICER AND PROJECT MANAGER IF AN ISSUE ARISES."

SEEDING REQUIREMENTS

1. POND SLOPES AND SLOPES ADJACENT TO NHS REQUIRE A MINIMUM OF 100MM OF TOPSOIL PRIOR TO SEEDING.
2. SEED MIX TO BE COMPRISED OF NATIVE SEEDS AND RYEGRASS ('LOLIUM MULTIFLORUM').

CONSTRUCTION STAGING

1. ESTABLISH MUD MAT.
2. OPEN AREA IN CHAIN LINK FENCE TO ACCESS POND.
3. CLEAR VEGETATION.
4. ESTABLISH EROSION AND SEDIMENT CONTROL MEASURES.

STAGE 1:
INSTALL METERBAGS AND GRADE POND.
STAGE 2:
MOVE METERBAGS TO LOCATIONS SHOWN TO CONTINUE PONG GRADING.

TOWN OF CALEDONE/BOLTON EROSION & SEDIMENT CONTROL NOTES

1. PRIOR TO COMMENCEMENT OF ANY ON-SITE WORK/TOPSOIL STRIPPING, EROSION AND SEDIMENT CONTROL (ESC) MEASURES, AS PER APPROVED EROSION & SEDIMENT CONTROL PLAN, MAST BE INSTALLED TO PREVENT SURFACE RUNOFF FROM LEAVING THE SITE "UNTREATED". ALL ESC MEASURES ARE TO BE MAINTAINED UNTIL THE SITE HAS BEEN STABILIZED.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER INSTALLATION, MAINTENANCE AND REMOVAL OF ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES DURING CONSTRUCTION, AS DIRECTED BY THE ENGINEER OR THE TOWN OF CALEDONE/BOLTON.
3. SEDIMENT CONTROL FENCE TO USE GEOTEXTILE WITH WEAVE DENSITY OF 270R TERRAFIX OR EQUIVALENT.
4. ALL EXPOSED SOILS SHALL BE IMMEDIATELY STABILIZED AS DIRECTED BY THE ENGINEER OR THE TOWN OF CALEDONE/BOLTON.
5. CHECK DAMS ARE TO BE USED IN ANY TEMPORARY DRAINAGE SWALES REQUIRED DURING THE CONSTRUCTION PERIOD.
6. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED AND SHALL BE DETERMINED BE THE ENGINEER OR THE TOWN OF CALEDONE/BOLTON.
7. ALL SWALES ARE TO BE STABILIZED PRIOR TO USE.
8. INSPECTION OF THE PROPOSED EROSION AND SEDIMENT CONTROL MEASURES WILL OCCUR ON A WEEKLY BASIS, AFTER RAINFALL EVENTS EXCEEDING 10MM OR AFTER RAPID SNOW MELT EVENTS AND DAILY DURING EXTENDED RAIN OR SNOW MELT PERIODS. THE SILT CONTROL FENCE MAST BE INSPECTED FOR RIPS OR TEARS, BROKEN STAKES, BLOW OUTS AND ACCUMULATION OF SEDIMENT. THE SILT CONTROL FENCE MUST BE FIXED AND/OR REPLACED IMMEDIATELY WHEN DAMAGED. ACCUMULATED SEDIMENT MUST BE REMOVED FROM THE SILT CONTROL FENCE WHEN ACCUMULATION REACHES 50% OF THE HEIGHT OF THE FENCE.
9. ROCK CHECK DAMS ARE TO BE CLEANED OF ALL ACCUMULATED SEDIMENT AS SOON AS SEDIMENT HAS ACCUMULATED TO A DEPTH GREATER THAN 50% OF ALL THE UPSTREAM CHECK DAMS.
10. CLEANING AND REPAIR OF MUD MATS AND ANY OTHER TEMPORARY SEDIMENT CONTROL MEASURES SHALL BE DONE AS NECESSARY THROUGH REGULAR INSPECTION OR AS DIRECTED BY THE ENGINEER OR THE TOWN OF CALEDONE/BOLTON. ALL DAMAGED ESC MEASURES SHALL BE REPAIRED AND/OR REPLACED WITHIN 48 HOURS OF THE INSPECTION.
11. MATERIALS TO REPAIR DAMAGED ESC MEASURES MUST BE KEPT ON-SITE AT ALL TIMES.
12. THE ESC STRATEGIES ON THESE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED/AMENDED AS SITE CONDITIONS CHANGE TO PREVENT SEDIMENT RELEASES. FAILED ESC MEASURES MUST BE REPAIRED IMMEDIATELY.
13. NO CONSTRUCTION ACTIVITY OR MACHINERY SHALL INTRUDE BEYOND THE SILT CONTROL FENCE OR LIMIT OF DEVELOPMENT. ALL CONSTRUCTION VEHICLES SHALL LEAVE THE SITE AT DESIGNATED LOCATIONS AS SHOWN ON THE PLANS. ALL MATERIALS AND EQUIPMENT SHALL BE STORED ON SITE IN A DESIGNATED AREA. NO MATERIALS OR EQUIPMENT SHALL BE STORED ON THE MUNICIPAL RIGHT OF WAY, NO CONSTRUCTION VEHICLES WILL PARK ON MUNICIPAL ROADS.
14. SERVICING OF CONSTRUCTION EQUIPMENT ON SITE IS PROHIBITED.
15. THE CONTRACTOR MUST CLEAN ADJACENT ROADS ON A REGULAR BASIS. THE ROAD SHALL BE AT A MINIMUM SCRAPED DAILY AND FLUSHED(IF NECESSARY) ON FRIDAY EVENINGS OR SATURDAY MORNINGS.
16. DUST CONTROL TO BE REVIEWED DAILY. WATER TRUCK OR CALCIUM CHLORIDE IS TO BE PROVIDED ON-SITE AND HAUL ROADS/WORKING AREAS ARE TO BE TREATED AS REQUIRED TO ENSURE THAT DUST IS CONTROLLED ON-SITE.
17. AT THE END OF CONSTRUCTION PERIOD, ACCUMULATED SEDIMENT IS TO BE REMOVED OFF SITE PRIOR TO THE REMOVAL OF THE SILT FENCE.
18. ALL LITTER AND DEBRIS SHALL BE MONITORED AND DISPOSED OF DAILY OR AS NECESSARY THROUGH REGULAR INSPECTION.
19. ALL TOPSOIL STOCKPILES SHALL BE SURROUNDED WITH SEDIMENT CONTROL FENCE AND STABILIZED WITH SEED MIX AS PER THIS DRAWING.
20. DISTURBED AREAS ARE TO BE MINIMIZED TO THE EXTENT POSSIBLE AND STABILIZED AS THE WORK PROGRESSES. ANY AREAS EXPOSED FOR MORE THAT 30 DAYS WILL BE STABILIZED.

EXPECTED WORK SCHEDULE

CONSTRUCTION TO OCCUR DURING HOURS OF DAYLIGHT (TYPICALLY 7AM - 7PM) MONDAY THROUGH SATURDAY. NO CONSTRUCTION TO OCCUR ON SUNDAYS AND STATUTORY HOLIDAYS. CONSTRUCTION IS ESTIMATED TO OCCUR BETWEEN NOVEMBER 2021 TO NOVEMBER 2022.

WINTER ESC MAINTENANCE AND INSPECTION NOTES

1. INSPECTION OF ESC MEASURES FOR DAMAGES TO OCCUR PERIODICALLY (MINIMUM ONCE PER MONTH) DURING WINTER MONTHS (TYPICALLY JANUARY THRU MARCH) AND FOLLOWING ANY FREEZE-THAW EVENTS.
2. ESC MEASURES TO BE INSPECTED DURING SPRING THAWING.
3. ALL DAMAGED ESC MEASURES MUST BE REPAIRED TO RESUMPTION OF CONSTRUCTION.

IBI GROUP
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tel 905 754 8060 fax 905 940 2064
ibigroup.com

LEGEND

- DRAINAGE AREA BOUNDARIES
- SWALES
- FENCE
- SILT FENCE
- METERBAGS (STAGE 1)
- METERBAGS (STAGE 2)
- SANITARY SEWER
- ACCESS ROAD

NO.	REVISIONS	DATE	BY

REVIEWED BY:

DATE:

ENGINEER'S SEAL

STORMWATER MANAGEMENT EROSION AND SEDIMENT CONTROL PLAN

STORMWATER POND #16 & LEASH-FREE DOG PARK RETROFIT STUDY
TOWN OF CALEDON

DATE: SEPTEMBER 2021 | PROJECT No.: 2020-0086
SCALE: 1:2000 | FIGURE No.: ESC-1

Drawing: J:\2020-0086\500_CAD\30_SHT\01_CIV\H_SBDV\2020-0086_SWM_POND-BASE-ESCD.DWG
Layout Tab: ESC-1
Date: 11/12/2021 Time: 10:44:41 AM

Appendix E

Geotechnical Report

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
STORM WATER POND # 16 AND LEASH FREE DOG PARK RETROFIT
12889 COLERAINE DRIVE
BOLTON, ONTARIO

Prepared for: IBI Group
8133 Warden Ave, Unit 300
Markham Ontario
L6G 1B3

Attention: Mr. Roy Johnson

File No. 1-20-0201-01
Issued: January 21, 2022

Distribution

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1 Copy	-	Terraprobe Inc., Brampton

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1 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by IBI Group to conduct a geotechnical investigation for Storm Water Pond # 16 and leash free dog park retrofit located at 12889 Coleraine Drive, in the Bolton Community of the Town of Caledon, Ontario.

This report encompasses the geotechnical investigation of the subject site to determine the prevailing subsurface soil and ground water conditions, and on the basis of this information, carries out a detailed slope stability analysis of the pond slopes for Storm Water Pond # 16 and provide the geotechnical design recommendations for the proposed pond.

2 SITE AND PROJECT DESCRIPTION

The project site is located on the southeast quadrant of the intersection of Coleraine Drive and Healey Road in the Bolton Community of the Town of Caledon, Ontario. The site comprises the Caledon Animal Shelter with a municipal address of 12889 Coleraine Drive, a leash-free dog park, and a 40-year-old open-air stormwater management dry pond that is identified by the Town of Caledon as Stormwater Management Facility No. 16 (SWMF #16). The approximate location of the site is shown in the attached Figure 1.

3 INVESTIGATION PROCEDURE

The field investigation of the site was conducted on July 2 and 3, 2020, and consisted of drilling and sampling a total of six (6) exploratory boreholes extending to 5.2 m to 11 m depths below existing grades.

The boreholes were staked out by Terraprobe based on the existing site features. The approximate borehole locations are shown on enclosed Borehole Location Plan (Figure 2A) and Borehole and Section Location Plan (Figure 2B).

Boreholes 1, 2, 3 and 4 were advanced in the footprint of the proposed Stormwater Management Facility No. 16 (SWMF #16) and Boreholes 5 and 6 were advanced in the dog park.

The boreholes were drilled by a specialist drilling contractor using a track-mounted drill rig power auger and were sampled at 0.75 m (up to 3.0 m depth) and 1.5 m (below 3.0 m depth) intervals with a conventional 50 mm diameter split barrel sampler when the Standard Penetration Test (SPT) was carried out (ASTM D1586). The field work (drilling, sampling and testing) was observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into clean plastic jars, and transported to our geotechnical testing laboratory for detailed inspection and testing. All borehole samples were examined (tactile) in detail by a geotechnical engineer, and classified according to visual and index properties.

Laboratory tests consisted of water content determination on all samples; and a Sieve and Hydrometer analysis as well as Atterberg Limit tests on selected native soil samples. The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analysis are plotted on the enclosed Borehole Logs at respective sampling depths. The results of Sieve and Hydrometer analysis and Atterberg Limit tests are also summarized in Section 4.2 of this report and appended.

Water levels were measured in open boreholes upon completion of drilling. Monitoring wells comprising 50 mm diameter PVC pipes were installed in selected boreholes (Boreholes 2 and 6) to facilitate ground water monitoring. The PVC tubing was fitted with a bentonite clay seal as shown on the accompanying Borehole Logs. Water levels in the monitoring wells were measured on July 21, 2021. The results of ground water monitoring are presented in Section 4.3 of this report.

The borehole ground surface elevations were surveyed by Terraprobe using a Trimble R10 GNSS System. The Trimble R10 system uses the Global Navigation Satellite System and the Can-Net reference system to determine target location and elevation. The Trimble R10 system is reported to have an accuracy of up to 10 mm horizontally and up to 30 mm vertically.

It should be noted that the elevations provided on the Borehole Logs are approximate only, for the purpose of relating soil stratigraphy and should not be used or relied on for other purposes.

4 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a brief summary of the general subsurface soil conditions provided below. This summary is intended to correlate this information to assist in the interpretation of the subsurface conditions encountered at the site.

It should be noted that the subsurface conditions are confirmed at the borehole locations only, and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs represent an inferred transition between the various strata, rather than a precise plane of geologic change.

4.1 Stratigraphy

The boreholes encountered the topsoil layer at ground surface underlain by the earth fill zone, extending to 0.8 m to 1.5 m depth below grade, which is in turn underlain by clayey silt to clay and silt till deposit extending to the full depth of investigation below grade. A brief description of each soil stratigraphy is provided the following sections.

4.1.1 Topsoil

A topsoil layer was encountered at the ground surface in Borehole 3 and 4. The topsoil thicknesses at Boreholes 3 and 4 locations were 180 mm to 250 mm, respectively.

4.1.2 Earth Fill

Earth fill materials, consisting of clayey silt with trace amounts of sand, gravels and organics was encountered beneath the topsoil layer at borehole 3 and 4 locations and at ground surface in all other boreholes and extended to about 0.8 m to 1.5 m depth below grade.

The Standard Penetration Test results ('N' Values) obtained within the earth fill zone varied from 1 to 8 blows per 300 mm of penetration, indicating very soft to firm consistency.

Measured moisture contents for the samples obtained from the earth fill materials ranged between 8 to 25 percent by mass, indicating a moist condition.

4.1.3 Glacial Till

Glacial till deposits were encountered underlying the fill zone in all boreholes. The undisturbed glacial till soils predominantly consisted of clayey silt to clay and silt, with trace amount of sand and gravel and extended to the full depth of investigation.

The results of the Standard Penetration Test (N-Values) from the glacial till ranged from 11 to 44 blows per 300 mm of penetration to 50 blows per 75 to 125 mm of penetration, indicating a stiff to hard consistency.

The measured moisture content for the samples obtained from these soils ranged from 9 percent to 22 percent by mass, indicating a moist condition.

4.2 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural water content determination for all samples, while a Sieve and Hydrometer analysis and Atterberg test were conducted on selected soil sample. The test results are plotted on the enclosed Borehole Logs at respective sampling depths. The results (graphs) of the sieve and hydrometer (grain size) analysis are appended and a summary of these test results is presented as follows:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 5, Sample 6	4.9	0	4	41	55	SILT AND CLAY trace sand
Borehole 6, Sample 10	10.9	3	24	47	26	CLAYEY SILT sandy, trace gravel

Atterberg Limits test was also carried out on selected sample. The results are plotted on A-Line Graph (refer to enclosed figures, Atterberg Limits Chart), and are summarized below:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Liquid Limit (W_L)	Plastic Limit (W_P)	Plasticity Index (I_P)	Natural Water Content (W_N)	Plasticity
Borehole 5, Sample 6	4.9	41	21	20	23	Medium Plastic

4.3 Ground Water

Observations pertaining to the depth of water level and borehole caving were made in the boreholes immediately after the completion of drilling, and are noted on the enclosed Borehole Logs. Monitoring wells comprising 50 mm PVC was installed in borehole 2 and 6 to facilitate groundwater level monitoring. Groundwater level in the wells were measured on July 21, 2020, about two weeks following the installation, and is noted on the enclosed Borehole Logs. A summary of the ground water level observations is provided as follows:

Borehole No.	Depth of Boring below Grade	Depth to Cave below Grade	Water Level Depth below Grade at the Time of Drilling	Water Level Depth below Grade/Elevation in Monitoring well on July 21, 2020
2	10.8 m	10.5	10.4	6.7 m/235.8 m
6	11.0 m	10.1	10.1	8.4 m/234.6 m

The water levels noted above may fluctuate seasonally depending upon the precipitation and surface runoff.

5 DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the basis of these terms of reference and on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice. If there are any changes to the site development features relevant to the interpretations made of the subsurface information, with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Slope Stability Analysis

The preliminary grading plan including the SWM pond locations is presented on Figures 2 and 3. A total of two (2) cross sections (Sections C-C' and E-E') were selected for the slope stability analysis. The slope cross-sections were selected from the design drawings provided by IBI Group (*Stormwater Management Pond Plan/Section/Details, Dog Park Retrofit* Study, Town of Caledon, Project No.: 2020-0086, Dated: September 2021). The locations of the selected slope cross sections and the details of the respective slope profiles are presented on Figures 2 and 3.

Based on the proposed pond grading, the pond side slopes will primarily comprise cut slopes. The subsurface information obtained from the boreholes, advanced in the proposed SWM pond suggests a presence of an earth fill layer ranging from 0.8 m to 1.5 m below grade generally underlain by undisturbed native glacial till deposit extending to the full depth of investigation (up to 11.0 m below grade).

A detailed engineering analysis of slope stability was carried out for two (2) cross-sections (Sections C-C' and E-E') utilizing computer software (Slide 7.031, developed by Rocscience Inc.), and several standard methods of limit equilibrium analysis (Bishop's, Janbu and Spencer). These methods of analysis allow the calculation of Factors of Safety for hypothetical or assumed failure surfaces through the slope. The analysis method is used to assess potential for movements of large masses of soil over a specific failure surface which is often curved or circular. The analysis involves dividing the sliding mass into many thin slices and calculating the forces on each slice. The normal and shear forces acting on the sides and base of each slice are calculated. It is an iterative process that converges on to a solution.

For a specific failure surface, the Factor of Safety is defined as the ratio of the available soil strength resisting movement, divided by the gravitational forces tending to cause movement. The Factor of Safety of 1.0 represents a "limiting equilibrium" condition where the slope is at a point of pending failure since the soil resistance is equal to the forces tending to cause movement. It is usual to require a Factor of Safety greater than one (1) to ensure stability of the slope.

The analysis was carried out by preparing a model of the slope geometry and subsurface conditions, and analyzing numerous different failure surfaces through the slope in search of the minimum or critical Factor of Safety for specific slope conditions.

The analysis included various short and long-term scenarios, including normal water level (long term) and pseudo static analysis, for the native cut and fill slope as well as different water levels including permanent high-water level and rapid drawdown conditions.

The pertinent data obtained from topographic mapping, slope profiles, slope mapping and the borehole information, were input for the slope stability analysis. Many calculations were carried out to examine the Factor of Safety for varying depths of potential failure surfaces. Based on the borehole results, the following average soil properties were utilized for the soil strata in the slope stability analysis:

Stratum	Unit Weight (kN/m^3)	Angle of internal friction	Cohesion (kPa)
Earth Fill	19.0	28°	0
Clayey Silt (Till)	21.0	30°	4

The above soil strength parameters are based on effective stress analysis for long-term slope stability. It is considered that these soil properties are relatively conservative, and the site soils are actually stronger.

This analysis included the overall stability analysis for the pond slopes generally native cut. The results of these analyses are presented on enclosed figures, and are summarized as follows:

Section	Slope Inclination (horizontal to vertical)	Minimum Factor of Safety
Section C-C'	3.0 to 1	3.62 (long term normal groundwater level) 4.27 (100-year water groundwater level) 2.34 (rapid drawdown condition) 3.23 (Pseudo-Static)
Section E-E'	3.0 to 1	2.15 (long term normal groundwater level) 1.95 (100-year water groundwater level) 1.51 (rapid drawdown condition) 1.95 (Pseudo-Static)

A minimum factor of safety of 1.5 is recommended for planning and development under normal groundwater conditions, while a minimum factor of safety of 1.3 is considered satisfactory for the temporary and infrequent conditions such as elevated groundwater level and rapid drawdown; and a factor of safety of greater than 1.0 is considered to be adequate for a Pseudo-Static condition. The minimum factors of safety obtained for analyzed sections are greater than the required factor of safety for various conditions and therefore considered satisfactory against potential slope slides. Thus, the proposed pond slopes are considered to be stable.

5.2 Pond Base

As noted above, the borehole encountered a surficial layer of topsoil underlain by earth fill zone extending to about 1.5 m depth below grade, which was in turn underlain by clayey silt to clay and silt glacial till deposit, extending to the full depth of investigation.

The groundwater level measurement taken on July 21, 2020, in the monitoring well installed in Borehole 2 indicated that the groundwater level was at Elev. 235.8 m. The design drawing indicates that the top and bottom elevations of the proposed pond are at Elev. 241.91 m and Elev. 240.58 m, respectively.

The results of the grain size distribution test indicate that the clayey silt to clay and silt till deposit comprise 26 and 55 percent clay and 41 and 47 percent silt size particles. The estimated permeability of the glacial till deposit (based on the grain size distribution) is on the order of 10^{-7} cm/sec. Based on the above information, the pond base is expected to comprise low permeability clayey silt to silt and clay glacial till deposit. Therefore, a clay liner may not be required.

It is recommended that the pond slopes and base must be inspected by a geotechnical engineer to assess the exposed subgrade soil conditions to identify presence of any relatively permeable weathered/disturbed soils, and silt or sand layers/pockets typically found within the till deposit, to provide recommendations for possible modification to the geotechnical design of the pond. These modifications may include local subexcavation of the relatively permeable soil zone(s) and backfilling with approved low permeability clayey soils.

5.3 Pond Slope Surface Treatment

It is understood that no berm is proposed for the pond and the dog park area will used as an overland spillway. The final slope surface and all bare or exposed areas (where applicable) should be provided with suitable ground cover or erosion protection. The slope surface should be provided with a thin layer of topsoil (100 mm to 300 mm thick) and should be hydro-seeded with a grass mixture and mulch. If seeded, during the first 2 to 3 years, the surface cover of topsoil and seeding may require periodic maintenance until the vegetation becomes well established. It is recommended that erosion netting be

staked on the outside slope (where applicable) for erosion protection (and inside slope where above the water level).

It is understood that the inside slopes of the pond will likely be vegetated with aquatic vegetation species. Periodic fluctuations in the pond water level will make inside slopes susceptible to minor sheet and rill erosion over extended periods of exposure if these slopes remain bare and without vegetation. Occasional maintenance and repair of the inside bare pond slopes (and removal of accumulated sediment in the base) will be required.

The emergency spillway must be provided with a significant erosion resistant lining consisting of either rip rap, gabion mattresses, or buried and staked Geoweb/Duramat Concrete Units or equivalent. The lining should extend from the design high water level to over the pond top and down to the slope toe.

5.4 Operational Considerations

The following general considerations are recommended with respect to the long-term operation and maintenance of the pond:

- A minimum operating freeboard of 0.3 m should be maintained between the high-water level and the pond rim. Overtopping of the pond, as a result of overfilling or flooding, would result in severe damage and possible breaching or failure of the spillway and the downstream slope. A provision of an overflow conveyance route/spillway is recommended to prevent pond overtopping.
- The flat surface (maintenance/access road) at the top of the pond must be a minimum of 3.0 m wide to facilitate adequate compaction and to accommodate service vehicles for maintenance.
- The pond should be carefully inspected each season for including but not limited to the following:
    - ► General condition of various pond components to identify areas of erosion, settlement, slump or deterioration.
    - ► Inspection of pond base and slope surface for discontinuities or holes as a result of burrowing animals, vandalism, settlement, or the like.
    - ► Removal of unwanted vegetation (tree, seedlings and the like) from within the footprint of the pond area.

Any damaged or deteriorated areas must be repaired regularly.

It must be noted that regulatory agencies stipulate pond slope inclinations and other requirements for storm water management pond design. These specifications may have requirements above and beyond the geotechnical recommendations provided in this report and must be followed.

6 LIMITATIONS AND RISK

6.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Terraprobe.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

6.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Ground water levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation conducted at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

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by any means, in any form, without the prior written permission of Terraprobe Inc. and IBI Group who are authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,

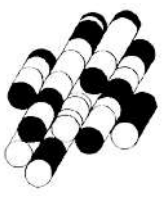
Terraprobe Inc.

Md Hasanur Rashid, M.Eng., EIT
Geotechnical Engineering

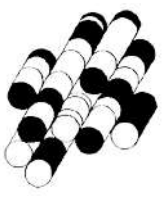
Seth Zhang, P. Eng., M.Eng., M.Sc.
Associate

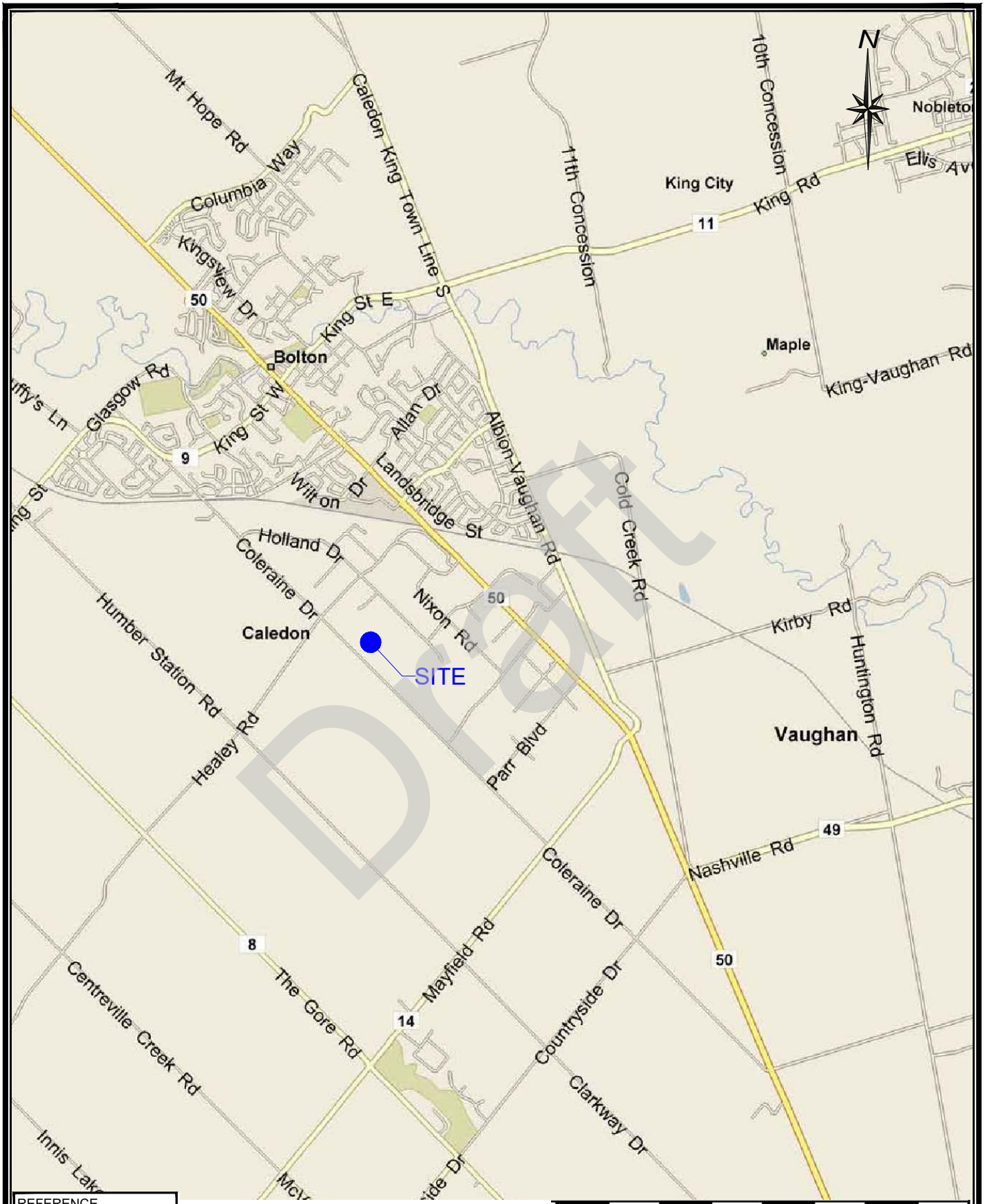
ENCLOSURES

TERRAPROBE INC.



FIGURES





Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SITE LOCATION PLAN

File. No.: 1-20-0201-01

FIGURE : 1

REFERENCE
Image © 2021 Google Earth

LEGEND
Approximate Borehole Location

SCALE 8 0 20m

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11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **BOREHOLE LOCATION PLAN**
Existing Conditions

File No. 1-20-0201-01

FIGURE : 2A

Z:\1-Project Files\2020\1-20-0201 - 12889 Coleraine Drive, Bolton\01-Geotechnical Investigation\A. Dwgs, Logs\AutoCAD\1-20-0201-01 FIG 1 & 2.dwg
DWG To PDF.pc3, Kamal, Kamal

MARCONI COURT

Access Road

ACCESS ROAD, 4m WIDE WITH 2% CROSSFALL INTO POND

STAGING AREA

WHEELER DRIVE

BH2

BH5

BOTTOM ELEV. 240.675 m

Pond Location

Drainage Area Boundaries

SANITARY SEWER

TOP OF POND ELEV. 241.91 m

EMERGENCY OVERFLOW SPILLWAY. SLOPE 1%, SIDE SLOPE 10:1, BOTTOM WIDTH 30m,DEPTH 0.44m

BH1

BH6

SWALE 1

BOTTOM ELEV. 240.58 m

EX. 900mm C.S.P. CULVERT #1 INVERT ELEVATION=240.46m

BH3

Access Road

EX. C.S.P. CULVERT #1 INVERT ELEVATION=240.58m

INV @ POND BLOCK 240.98m

BH4

EX. C.S.P. CULVERT #2 INVERT ELEVATION=240.48m

Fence

EX. C.S.P. CULVERT #2 INVERT ELEVATION=240.65m

COLERAINE DRIVE

PROVIDE DOUBLE GATE AS PER

REFERENCE
Borehole and Section Location Plan
Stormwater Pond #16 & Leash-Free Dog Park
Retrofit Study, Town of Caledon
Project No.: 2020-0086 Figure No.: 2 B
Date: September 2021 By: IBI Group

LEGEND
Borehole Location

16 8 0 40m
SCALE

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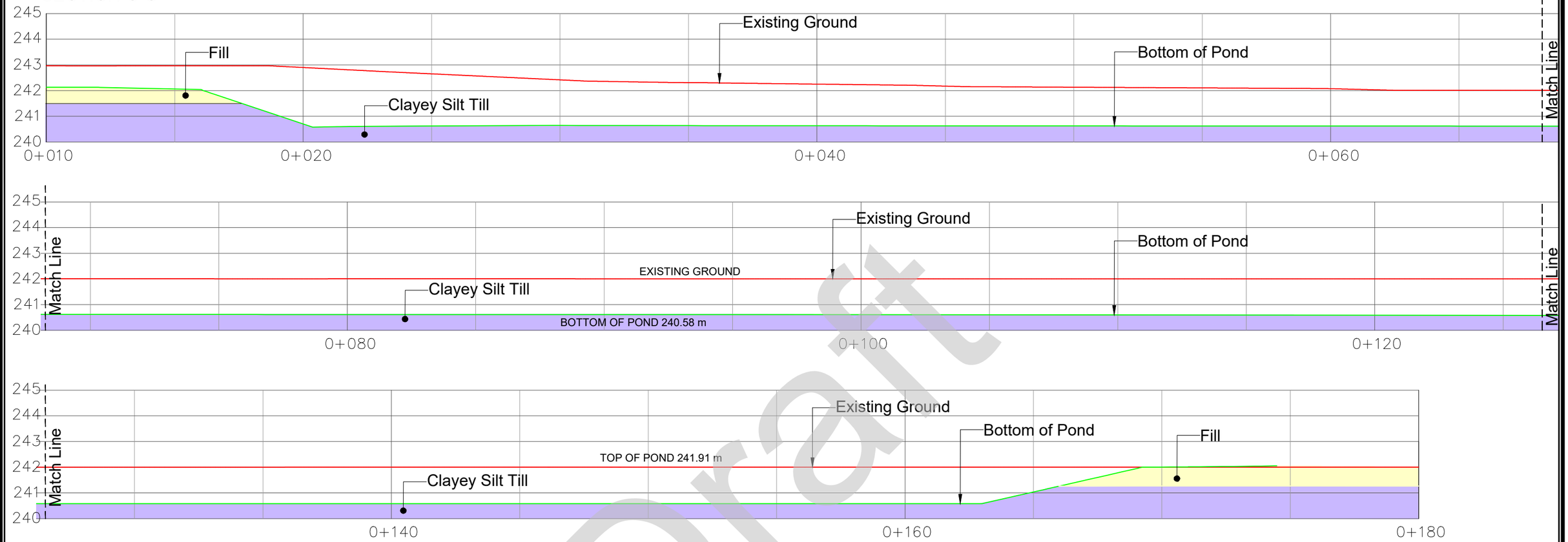
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **BOREHOLE AND SECTION LOCATION PLAN**

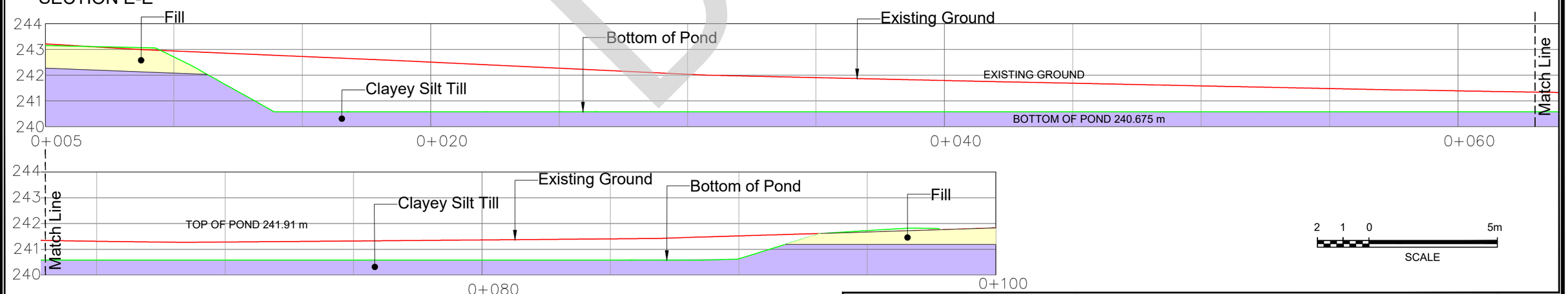
File No. 1-20-0201-01

FIGURE : 2B

SECTION C-C'



SECTION E-E'



2 1 0 5m

SCALE

REFERENCE
Stormwater Management Pond Plan/Sections/Details
Dog Park Retrofit Study, Town of Caledon
Project No.: 2020-0086 Figure No.: 2
Date: September 2021 By: IBI Group

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
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Title: **SECTION C-C' AND SECTION E-E'**

File No. 1-20-0201-01

FIGURE : 3

APPENDIX A

TERRAPROBE INC.

Terraprobe

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silt*y*	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▽	1st water level measurement
▽	2nd water level measurement
▽	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at or close to plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

LOG OF BOREHOLE 1

Terraprobe

Project No. : 1-20-0201-01	Client : Cole Engineering Group Ltd	Originated by : BR
Date started : July 3, 2020	Project : 12889 Coleraine Drive	Compiled by : MYB
Sheet No. : 1 of 1	Location : Bolton, Ontario	Checked by : AR

Position : E: 602139, N: 4856915 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	242.2	**GROUND SURFACE**				
		FILL, clayey silt, trace sand, trace gravel, trace organics, soft to firm, dark brown, moist		1	SS	3
1				2	SS	6
	240.7 / 1.5	**CLAYEY SILT to CLAY AND SILT**, trace sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)		3	SS	14
2				4	SS	24
3				5	SS	20
4		...grey		6	SS	24
5	237.0 / 5.2	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 242, 241, 240, 239, 238

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) 10, Natural Water Content (MC) 20, Liquid Limit (LL) 30

Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
PID: 0.3		SS1 Analysis: M&I, PHC
PID: 0		SS2 Analysis: VOC
PID: 0		SS3 Analysis: M&I, VOC, PHC
PID: 0.3		
PID: 0.1		
PID: 0.1		

Unstabilized Water Level

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

LOG OF BOREHOLE 2

Terraprobe

Project No. : 1-20-0201-01	Client : Cole Engineering Group Ltd	Originated by : BR
Date started : July 2, 2020	Project : 12889 Coleraine Drive	Compiled by : MYB
Sheet No. : 1 of 1	Location : Bolton, Ontario	Checked by : AR

Position : E: 602249, N: 4856926 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	242.5	**GROUND SURFACE**				
0		**FILL**, clayey silt, trace sand, trace gravel, trace organics, very soft, dark brown, moist		1	SS	1
	241.7 / 0.8					
1		**CLAYEY SILT to CLAY AND SILT**, trace sand, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	13
2				3	SS	24
				4	SS	23
3				5	SS	26
4						
5				6	SS	29
6		...grey below		7	SS	17
7						
8				8	SS	34
9				9	SS	33
10						
	231.7 / 10.8	...sandy		10	SS	50 / 125mm

Elevation Scale (m): 242, 241, 240, 239, 238, 237, 236, 235, 234, 233, 232

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm): PID: 0.5, PID: 0.9, PID: 1.1, PID: 1.1, PID: 3, PID: 0.6, PID: 1.1, PID: 0.9, PID: 0.8, PID: 0.3

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 10.4 m below ground surface; borehole caved to 10.5 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jul 21, 2020	6.7	235.8

LOG OF BOREHOLE 3

Terraprobe

Project No. : 1-20-0201-01	Client : Cole Engineering Group Ltd	Originated by : BR
Date started : July 3, 2020	Project : 12889 Coleraine Drive	Compiled by : MYB
Sheet No. : 1 of 1	Location : Bolton, Ontario	Checked by : AR

Position : E: 602145, N: 4856861 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	242.8	**GROUND SURFACE**										
	242.6 / 0.2	180mm **TOPSOIL**		1	SS	8				PID: 4.7		
	242.0 / 0.8	**FILL**, clayey silt, trace sand, trace gravel, trace organics, firm, dark brown, moist		2	SS	23	242			PID: 3		
1		**CLAYEY SILT to CLAY AND SILT**, trace sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		3	SS	26	241			PID: 1.4		
2				4	SS	28				PID: 0.8		
3				5	SS	27	240			PID: 0.7		
4							239					
		...grey		6	SS	20	238			PID: 0.3		
5	237.6 / 5.2											

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

LOG OF BOREHOLE 4

Terraprobe

Project No. : 1-20-0201-01	Client : Cole Engineering Group Ltd	Originated by : BR
Date started : July 3, 2020	Project : 12889 Coleraine Drive	Compiled by : MYB
Sheet No. : 1 of 1	Location : Bolton, Ontario	Checked by : AR

Position : E: 602174, N: 4856765 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	**241.0**	**GROUND SURFACE**					241	Dynamic Cone 10 20 30 40; Unconfined / Pocket Penetrometer / Field Vane / Lab Vane 40 80 120 160	Plastic Limit / Natural Water Content / Liquid Limit PL MC LL 10 20 30			Unstabilized Water Level; GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
	240.7	250mm **TOPSOIL**		1	SS	2				PID: 0.3		
	0.3	**FILL**, clayey silt, trace sand, trace gravel, trace organics, very soft, dark brown, moist										
1	240.2 / 0.8	**CLAYEY SILT to CLAY AND SILT**, trace sand, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	13	240			PID: 0.7		
				3	SS	24	239			PID: 1		
2				4	SS	44				PID: 0.4		
3		...grey below		5	SS	30	238			PID: 0.8		
4							237					
				6	SS	25				PID: 0.2		
5	235.8 / 5.2	**END OF BOREHOLE**					236					

Borehole was dry and open upon completion of drilling.

LOG OF BOREHOLE 5

Terraprobe

Project No. : 1-20-0201-01	Client : Cole Engineering Group Ltd	Originated by : BR
Date started : July 3, 2020	Project : 12889 Coleraine Drive	Compiled by : MYB
Sheet No. : 1 of 1	Location : Bolton, Ontario	Checked by : AR

Position : E: 602271, N: 4856900 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	**243.0**	**GROUND SURFACE**										
	242.2 / 0.8	**FILL**, clayey silt, trace sand, trace gravel, trace organics, firm, dark brown, moist		1	SS	8				PID: 3.2		SS1 Analysis: M&I, VOC, PHC
1		**CLAYEY SILT to CLAY AND SILT**, trace sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	16	242			PID: 1.8		SS2 Analysis: M&I, PHC
2				3	SS	22	241			PID: 0.7		
				4	SS	34				PID: 0.5		
3				5	SS	41	240			PID: 0.7		
4							239					
		...grey		6	SS	16	238			PID: 0.6		0 4 41 55
5	237.8 / 5.2											
		END OF BOREHOLE										

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

LOG OF BOREHOLE 6

Terraprobe

Project No. : 1-20-0201-01	Client : Cole Engineering Group Ltd	Originated by : BR
Date started : July 2, 2020	Project : 12889 Coleraine Drive	Compiled by : MYB
Sheet No. : 1 of 1	Location : Bolton, Ontario	Checked by : AR

Position : E: 602236, N: 4856810 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	243.0	**GROUND SURFACE**					
0	242.2 / 0.8	**FILL**, clayey silt, trace sand, trace gravel, trace organics, firm, dark brown, moist		1	SS	6	
1		**CLAYEY SILT to CLAY AND SILT**, trace sand, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	21	242
2				3	SS	21	241
				4	SS	41	
3				5	SS	11	240
4							239
		...grey below		6	SS	17	
5							238
6				7	SS	25	237
7							236
8				8	SS	37	235
9		...sandy below		9	SS	86 / 250mm	234
10							233
				10	SS	83 / 225mm	
11	232.0 / 11.0						232

Penetration Test Values (Blows / 0.3m): Dynamic Cone (10, 20, 30, 40)

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane (40, 80, 120, 160)

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) (10, 20, 30)

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

3 24 47 26

END OF BOREHOLE

Unstabilized water level measured at 10.1 m below ground surface; borehole caved to 10.1 m below ground surface upon completion of drilling.

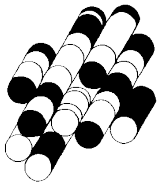
WATER LEVEL READINGS

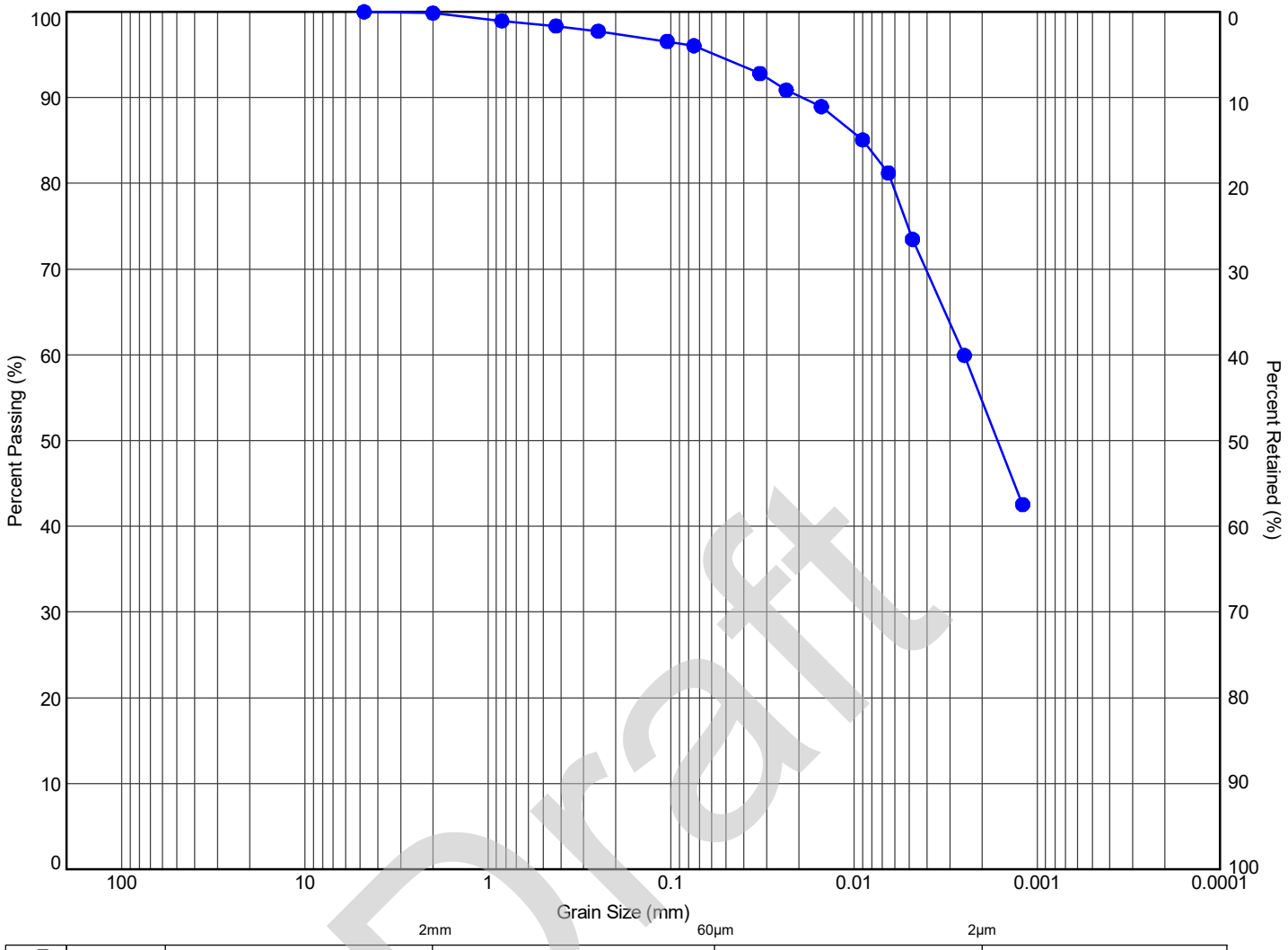
Date	Water Depth (m)	Elevation (m)
Jul 21, 2020	8.4	234.6

file: 1-20-0201 bh logs.gpj

APPENDIX B

TERRAPROBE INC.





MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

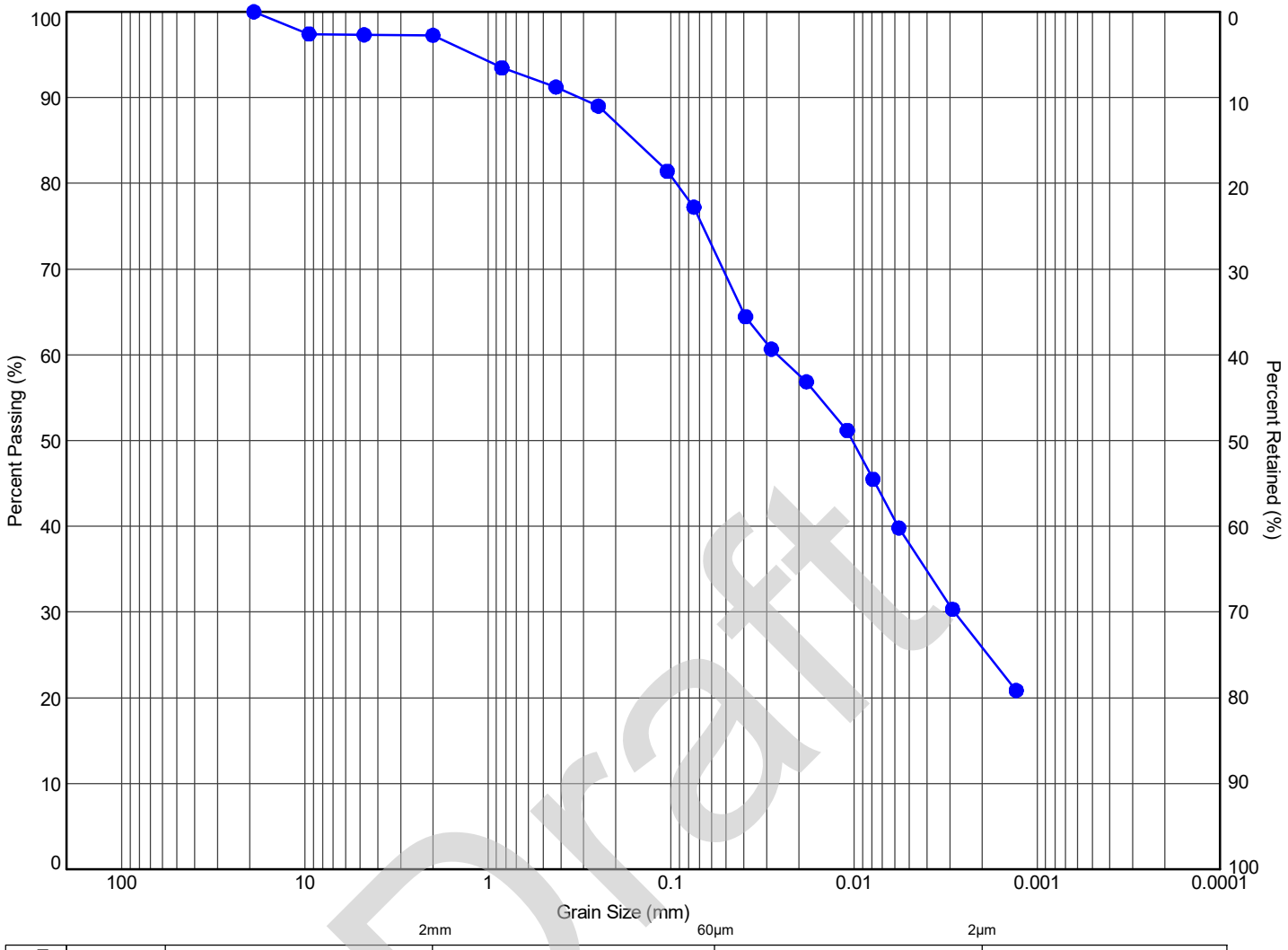
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**5**	SS6	4.9	238.1	0	4	41	55	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT AND CLAY, TRACE SAND

File No.: **1-20-0201-01**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**6**	SS10	10.9	232.1	3	24	47	26	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
CLAYEY SILT, SANDY, TRACE GRAVEL

File No.: **1-20-0201-01**

Terraprobe

ATTERBERG LIMITS REPORT FORM

PROJECT: 12889 Coleraine Drive, Bolton, Ontario
LOCATION: Greater Toronto Area, On.
CLIENT: Cole Engineering Group Ltd.
BOREHOLE: 5
SAMPLE NUMBER: 6
SAMPLE DEPTH:
SAMPLE DESCRIPTION: SILTY CLAY, trace sand

FILE NO.: 1-20-0201
SAMPLE DATE: Jul 3, 2021
SAMPLED BY: B.R.
TEST DATE: Oct 14, 2021
TESTED BY: S.R.
LAB NO.: 1310

ASTM D4318 (LS-703/704)	LIQUID LIMIT DETERMINATION				PLASTIC LIMIT	
	1	2	3	4	1	2
Tare number	1	2	3	4	1	2
Number of blows (N)	34	24	16			
Weight of wet soil and tare (g)	24.86	24.46	27.09		23.64	22.99
Weight of dry soil and tare (g)	22.40	21.87	23.77		22.33	21.78
Weight of water (g)	2.46	2.59	3.32		1.31	1.21
Weight of tare (g)	16.06	15.53	16.03		16.06	16.00
Weight of dry soil (g)	6.3	6.3	7.7		6.27	5.78
Water content (%)	38.80%	40.85%	42.89%		20.89%	20.93%
					20.91%	

RESULT CALCULATIONS

PI at "A" Line = 0.73(LL-20)

One Point Liquid Limit Calculation:

$LL = w_n (N/25)^{0.12}$

W_L = w% at 25 blows

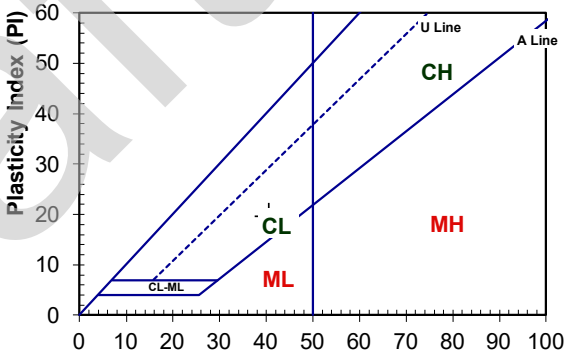
W_P = w% when rolled to $^1/_8$ diameter

$I_L = (W_N - W_P) / I_P$

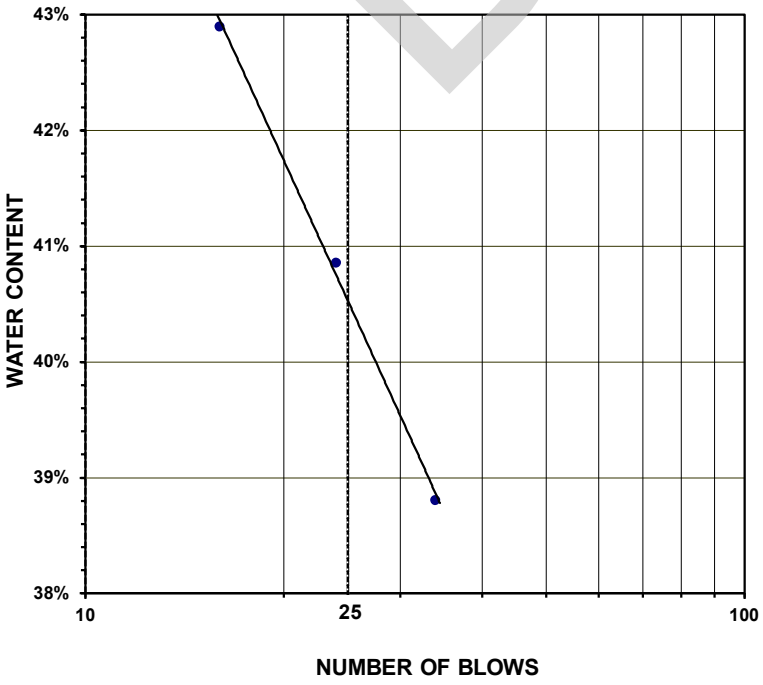
$I_P = W_L - W_P$

$A = I_P / (\%\ clay)$

Plasticity Chart



Flow Curve



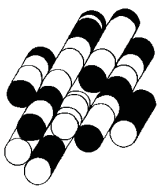
Liquid Limit (W_L)	**41**
Plastic Limit (W_P)	**21**
Natural Water Content (W_N)	**23.38**
Liquidity Index (I_L)	**0.13**
Plasticity Index (I_P)	**20**
Activity (A)	

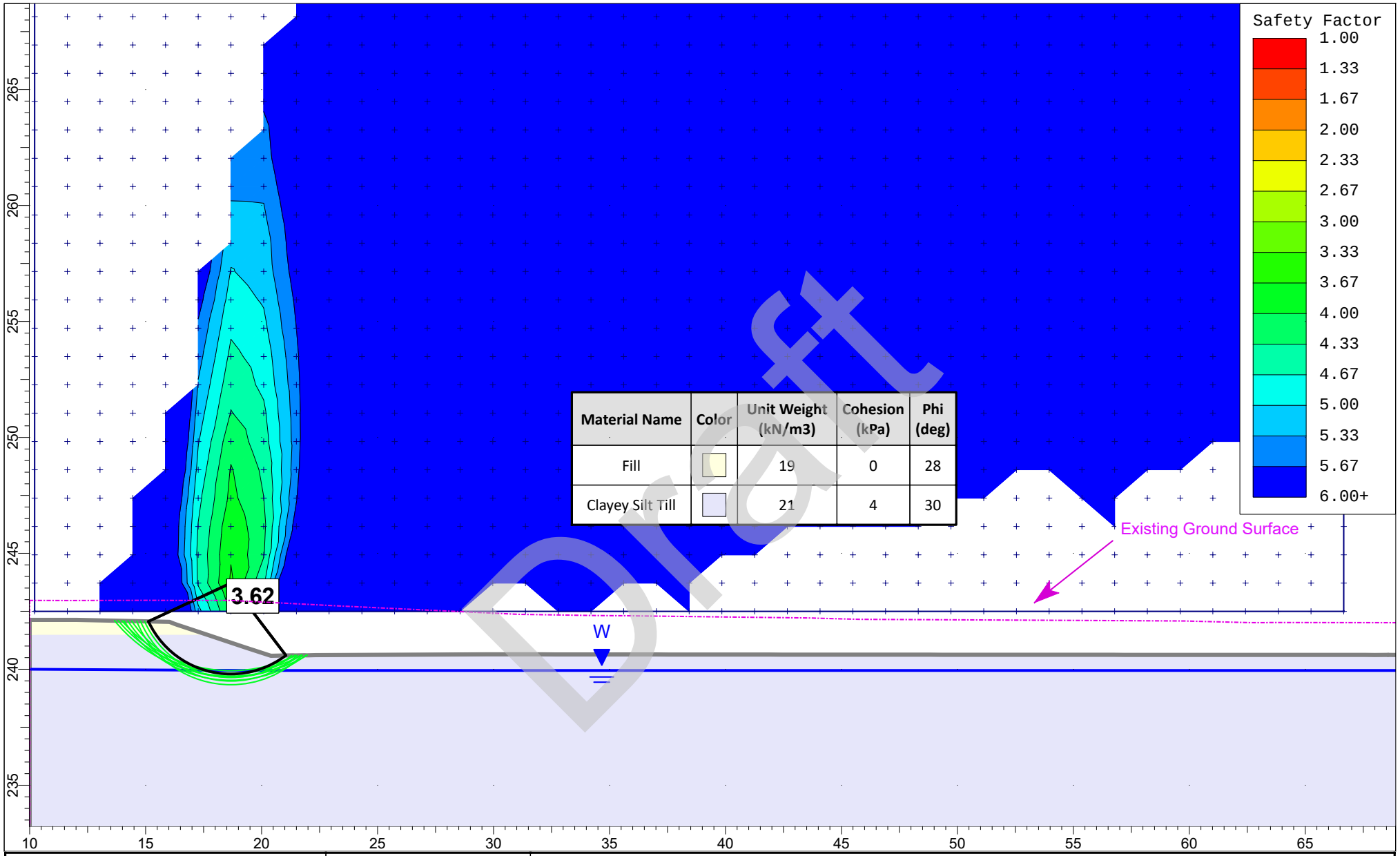
CLASSIFICATION

I_P	PLASTICITY
0-3	Non Plastic
4-15	Slightly Plastic
16-30	Medium Plastic
> 30	Highly Plastic
W_L	**COMPRESSIBILITY**
0-30	Slight or Low
31-50	Moderate or Intermediate
> 50	High

APPENDIX C

TERRAPROBE INC.





Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

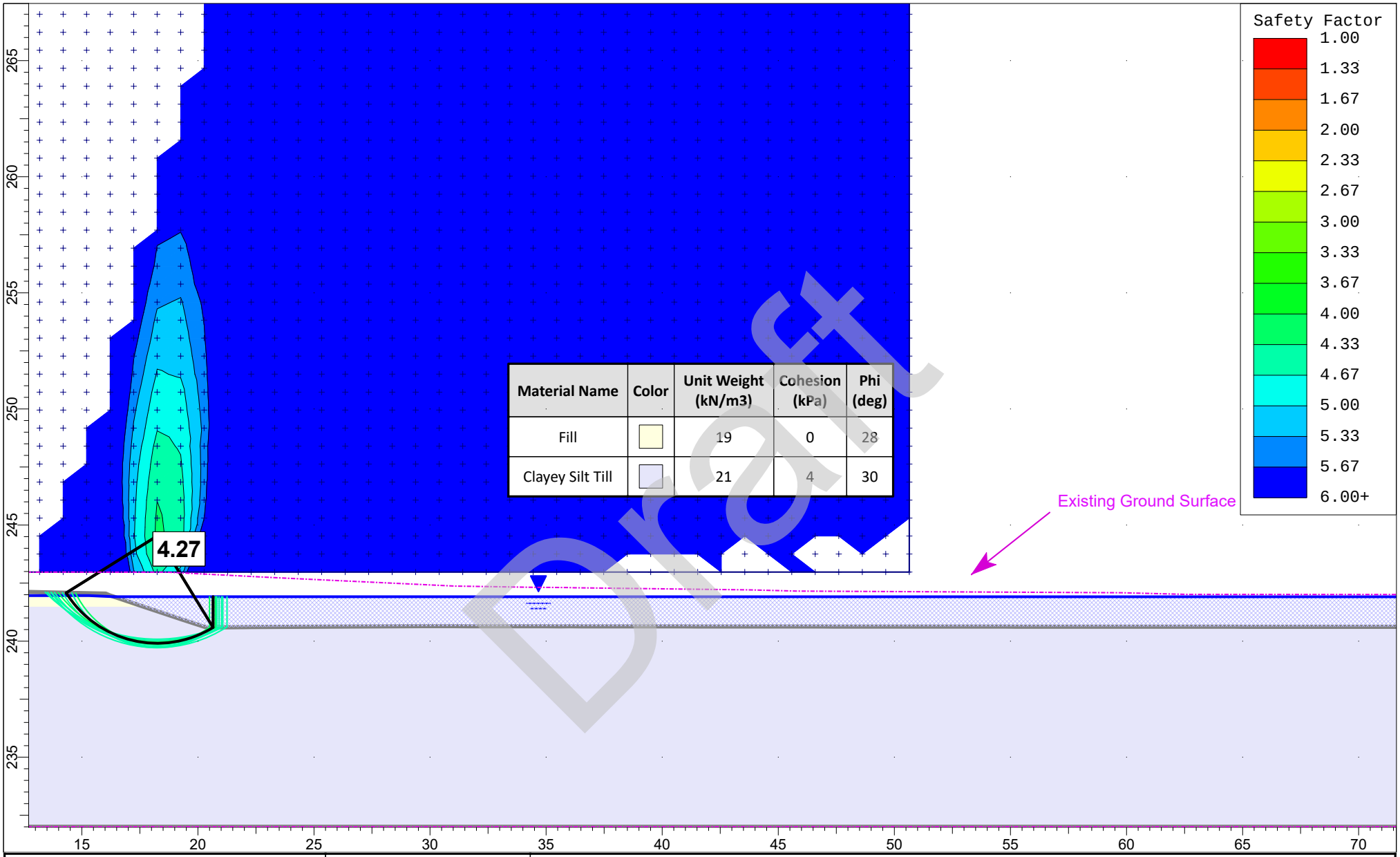
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project: **1-20-0201 - 12889 Coleraine Drive, Bolton**

Analysis Description: Section C-C' - Normal WL

Date: 11/11/2021 | Scale: 1:225 | File: 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By: Ali Rajaei | Survey Ref.: *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



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Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

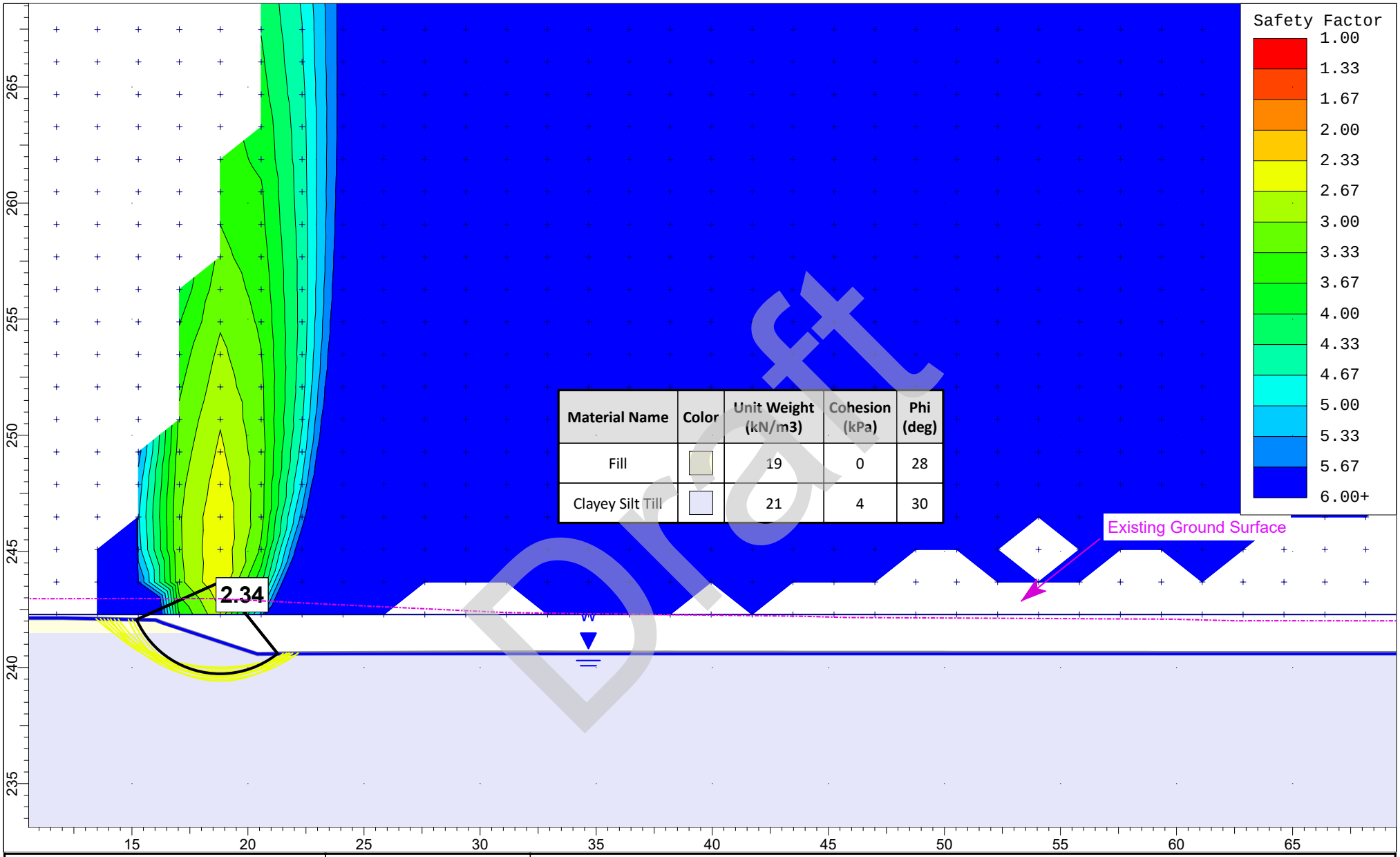
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project: **1-20-0201 - 12889 Coleraine Drive, Bolton**

Analysis Description: Section C-C' - 100 Yr. Water Level

Date: 11/11/2021 | Scale: 1:225 | File: 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By: Ali Rajaei | Survey Ref.: *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



Terraprobe
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Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

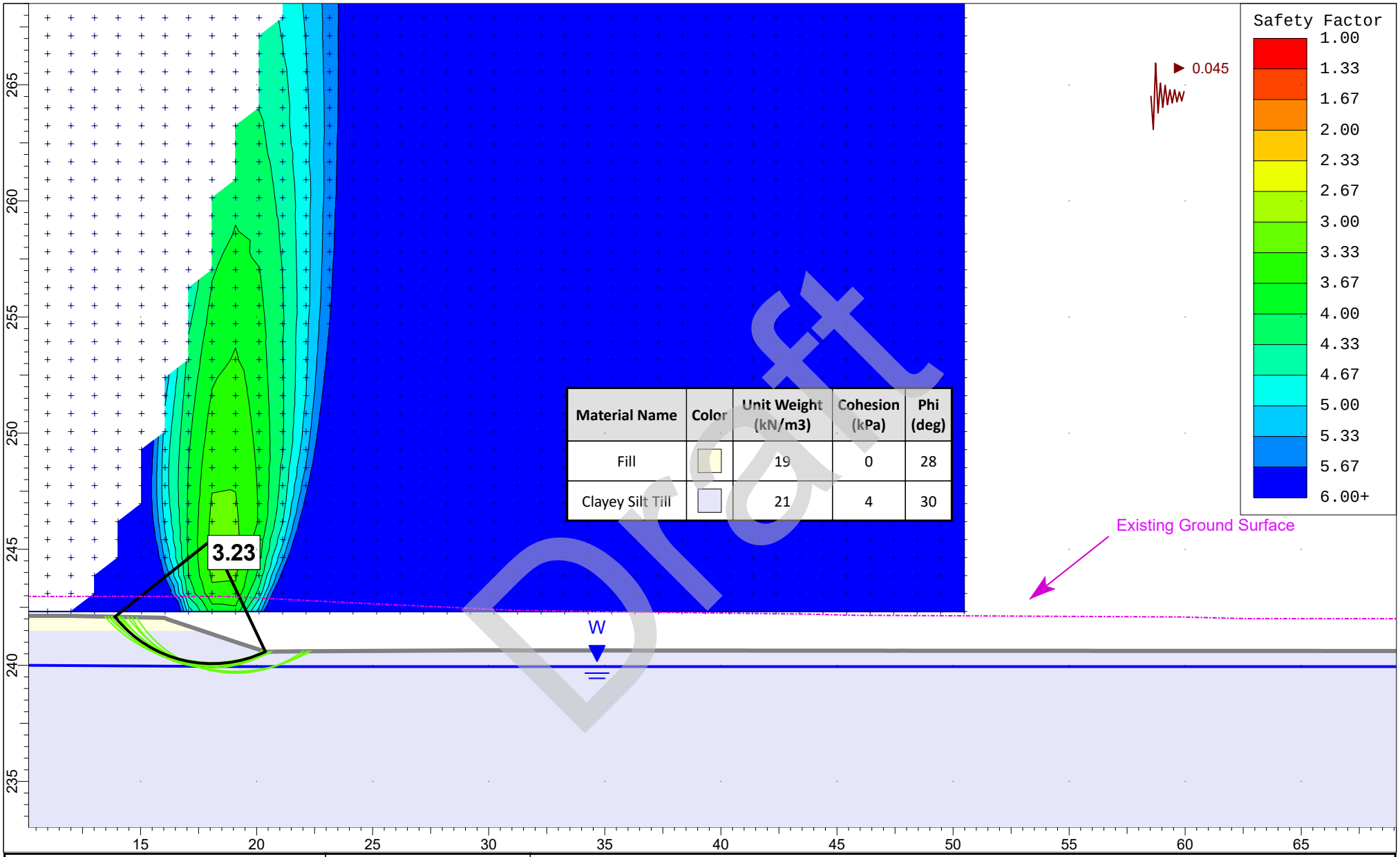
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project: **1-20-0201 - 12889 Coleraine Drive, Bolton**

Analysis Description: Section C-C' - Rapid Draw Down

Date: 11/11/2021 | Scale: 1:225 | File: 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By: Ali Rajaei | Survey Ref.: *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



Terraprobe
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Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

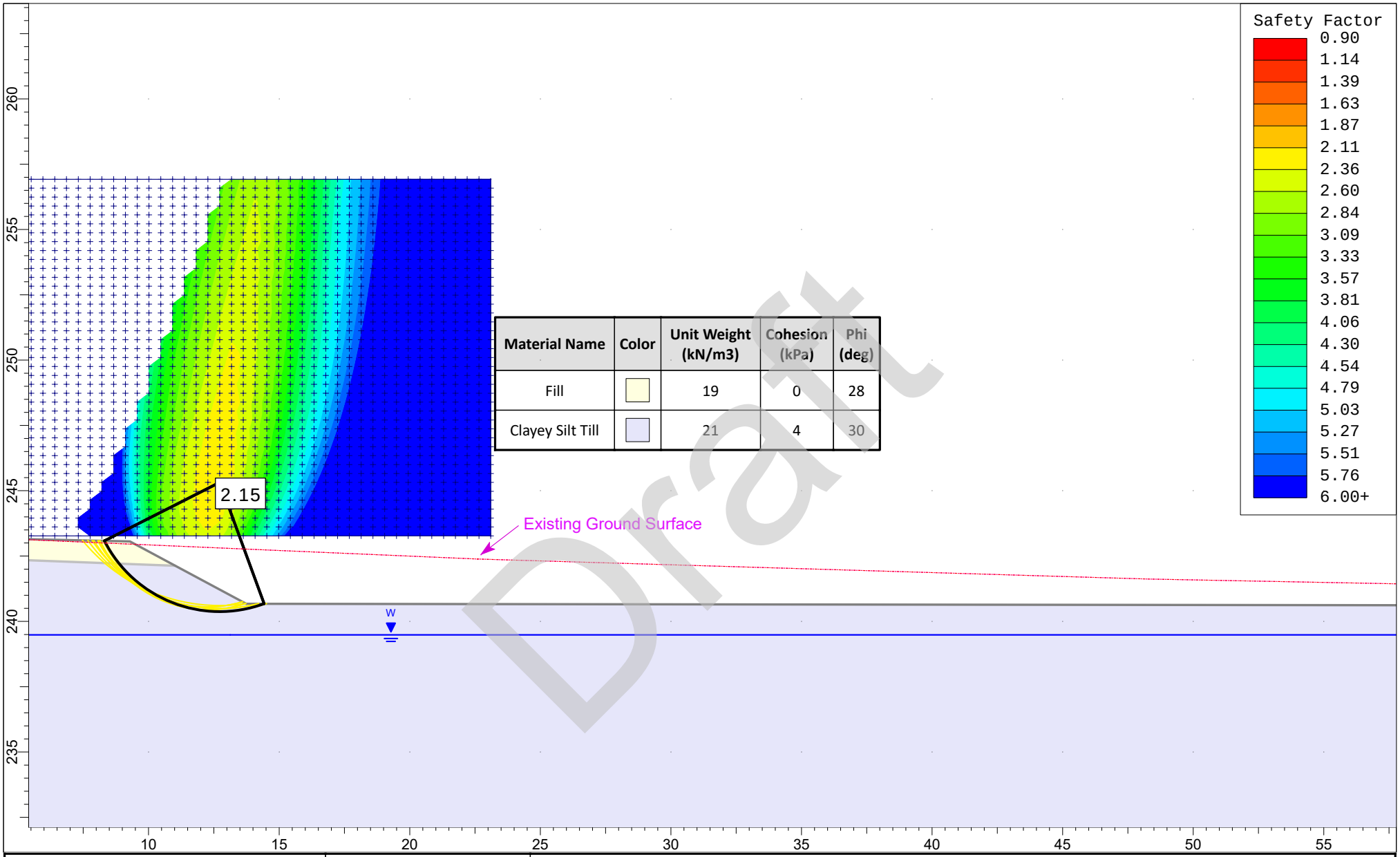
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project: **1-20-0201 - 12889 Coleraine Drive, Bolton**

Analysis Description: Section C-C' - Pseudo Static

Date: 11/11/2021 | Scale: 1:225 | File: 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By: Ali Rajaei | Survey Ref.: *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Fill		19	0	28
Clayey Silt Till		21	4	30

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

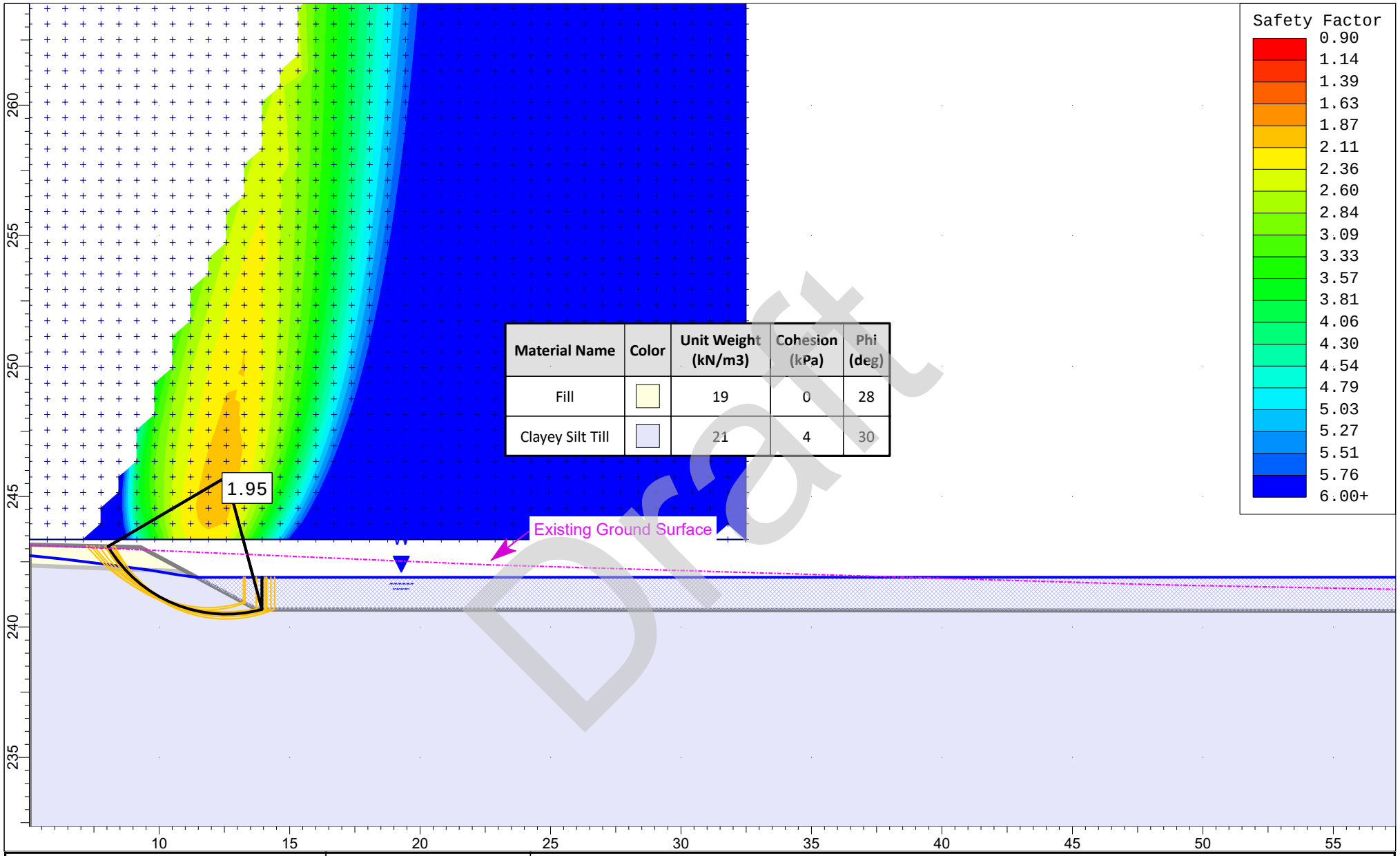
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project
1-20-0201 - 12889 Coleraine Drive, Bolton

Analysis Description
Section E-E' - Normal WL

Date 11/11/2021 | Scale 1:200 | File 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By Ali Rajaei | Survey Ref. *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Fill		19	0	28
Clayey Silt Till		21	4	30

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

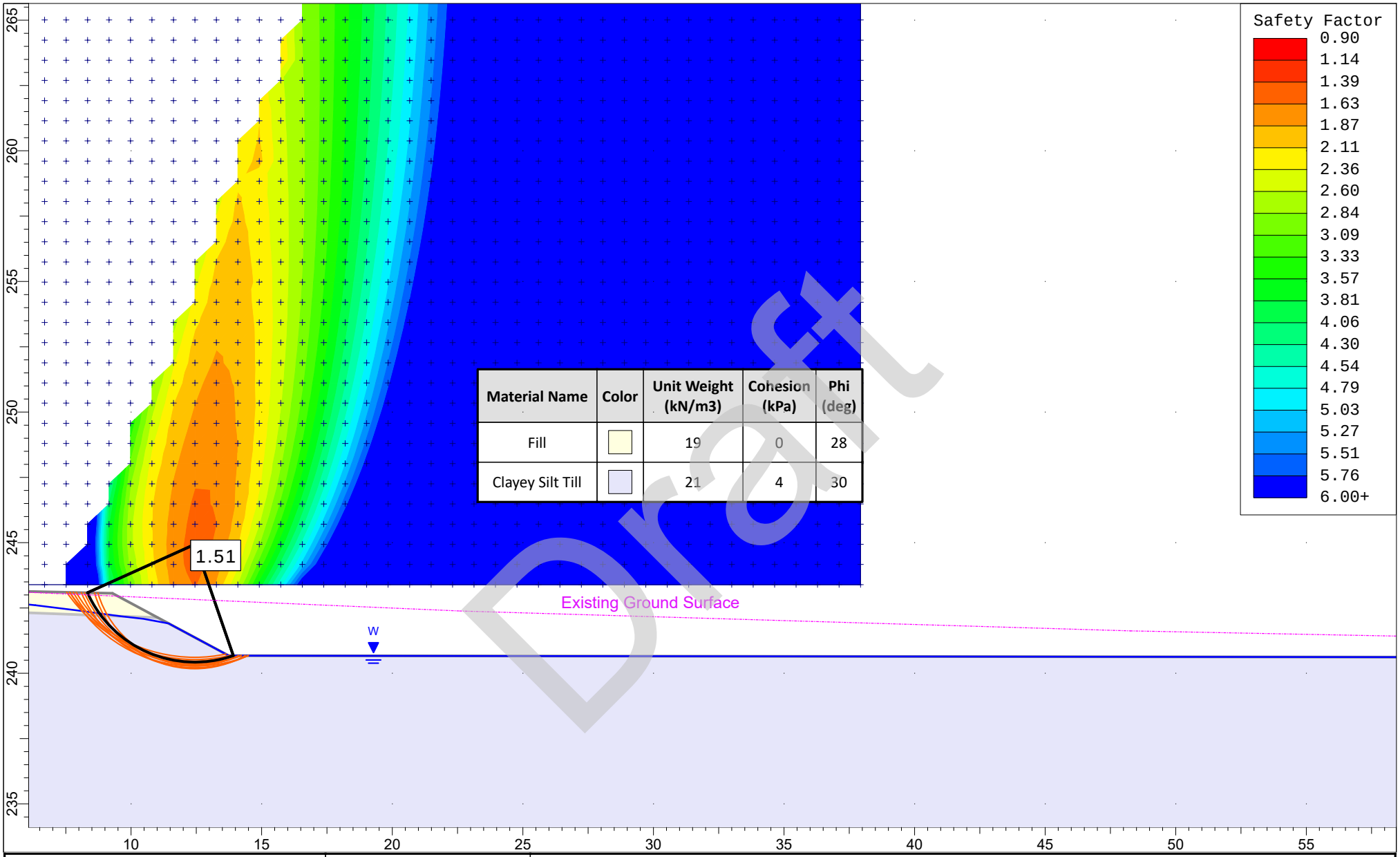
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project: **1-20-0201 - 12889 Coleraine Drive, Bolton**

Analysis Description: Section E-E' - 100 Yr. Water Level

Date: 11/11/2021 | Scale: 1:200 | File: 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By: Ali Rajaei | Survey Ref.: *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



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Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

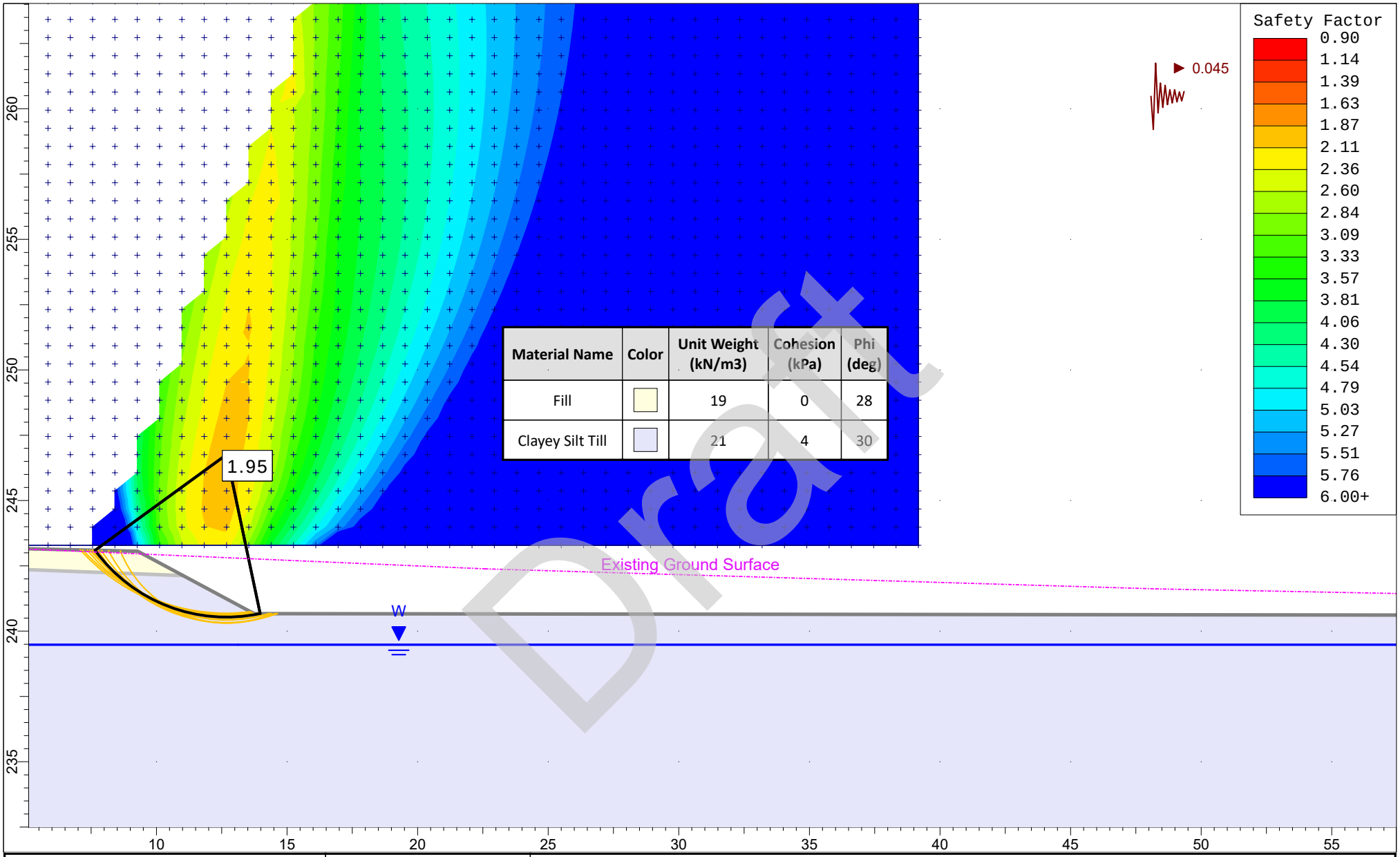
Project
1-20-0201 - 12889 Coleraine Drive, Bolton

Analysis Description
Section E-E' - Rapid Draw Down

Date	Scale	File
11/11/2021	1:200	1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By Ali Rajaei

Survey Ref. *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Fill		19	0	28
Clayey Silt Till		21	4	30

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.037

Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project: **1-20-0201 - 12889 Coleraine Drive, Bolton**

Analysis Description: Section E-E' - Pseudo Static

Date: 11/11/2021 | Scale: 1:200 | File: 1-20-0201 - 12889 Coleraine Drive, Bolton.slmd

By: Ali Rajaei | Survey Ref.: *stormwater Management Pond Plan/Section/Details, Dog Park Retrofit Study, Town of Caledon, Project No.: 2020-0086, Dated: Aug 2021, By: IBI Group*

Appendix F

Ecological Report

Myler Ecological Consulting

7 Olive Crescent, Stoney Creek, ON L8G 2T2 | (289)700-3038 | bmyler@cogeco.ca

14 January 2022

IBI Group Inc.
8133 Warden Avenue, Unit 300
Markham ON L6G 1B3

Att'n: Roy Johnson, Team Lead, Water Resources Engineering

RE: Terrestrial and Fisheries Screening Report – Town of Caledon Stormwater Management Facility #16 and Leash-Free Dog Park Retrofit Study.

INTRODUCTION

The Town of Caledon Stormwater Management Facility (SWMF) #16 and Leash-Free Dog Park Retrofit Study involves the lands northeast of the Caledon Animal Shelter located at 12889 Coleraine Drive in Bolton, Ontario (see site map excerpt, **Figure 1**, below).

Figure 1: Site map excerpt from the Town of Caledon RFP showing the extent of SWMF #16 and of the adjacent Dog Park.

Myler Ecological Consulting (Myler) was retained as a subconsultant to Cole Engineering Group (Cole), since become part of IBI Group (IBI), to prepare a Terrestrial and Fisheries Screening Report to document screening level assessments of wetlands, wildlife, fisheries and aquatic habitat and vegetation per the Request for Proposal (RFP). Myler's screening of potential terrestrial and fisheries and aquatic habitat constraints included desktop review of relevant existing natural heritage mapping and information, consultation with TRCA, and seasonal site visits to observe characteristics of the watercourse, vegetation, and wildlife at the site.

EXISTING INFORMATION REVIEW – DESIGNATED NATURAL HERITAGE FEATURES

Desktop screening of terrestrial and aquatic/fish habitat began with review of Peel Region and Town of Caledon Official Plan schedules, with the following results:

- The site is neither within nor adjacent to Core Areas of the Greenlands System in Peel on the Peel Region Official Plan Schedule A.
- The site is neither within nor adjacent to Environmental Policy Areas on the Town of Caledon Official Plan Schedule C (Bolton Land Use Plan) and Schedule C7 (Coleraine West Employment Area Land Use Plan). However, the receiving tributary watercourse is mapped as Environmental Policy Area beginning more than 300 metres downstream of the SWMF #16 outlet.

Toronto Region Conservation Authority (TRCA) regulated area mapping (see excerpt, **Figure 2**, below) depicts a watercourse at the site and crossing through SWMF #16 as a branch of the "Clarkway Drive Tributary". SWMF #16 is mapped by TRCA as an "Unevaluated Wetland" and associated "Area of Interference".

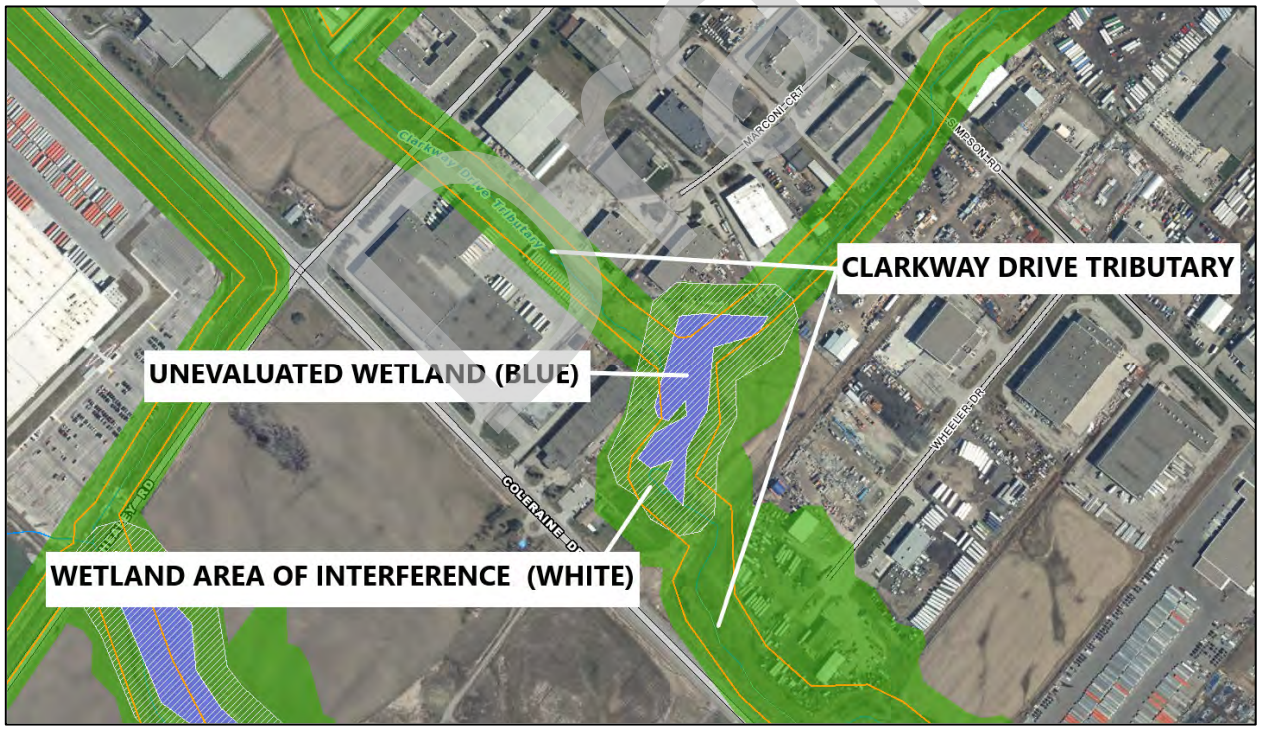


Figure 2: Excerpt of TRCA regulated area mapping showing regulated area (green shading), Clarkway Drive Tributary (thin blue line), Meander Belt (orange line), Unevaluated Wetland (blue shading) and Wetland Area of Interference (white hatching).

Consultation with TRCA's Emma Benko subsequently confirmed that the mapping of Unevaluated Wetland at the site, and the corresponding mapping of same on the provincial Natural Heritage Information Centre (NHIC) mapping, was an error, given that SWMF #16 is a stormwater management facility and not a wetland habitat.

Aerial imagery confirmed that SWMF #16 is vegetated, but that vegetation does not make the constructed facility a wetland.

Review of the aerial imagery (and subsequent site reconnaissance) revealed the Clarkway Drive Tributary upstream of SWMF #16 to be an artificial drainage ditch and not a natural watercourse. And SWMF #16 itself is an artificial stormwater detention facility and not a natural watercourse feature. Aerial imagery confirmed that the Clarkway Drive Tributary only occurs in something like a natural watercourse planform downstream of SWMF #16. Further, the application of Meander Belt to SWMF #16 and its tributary artificial ditches to the northeast and northwest is inappropriate, as none of those artificial features are truly subject to natural channel processes that occur within a meander belt adjacent to a natural watercourse.

Additionally, review of aerial imagery showed the leash-free dog park to be a manicured park-like area, and not a naturally vegetated greenspace.

Desktop review of the potential for fish habitat within the Clarkway Drive Tributary included consultation with TRCA to obtain fish community monitoring data collected in 2004. Additionally, the review included the more recently collected 2013, 2014 and 2015 fisheries and aquatic information presented in BioLogic's 08 February 2016 Environmental Impact Study Report that was prepared in support of industrial development in lands across Coleraine Road that contained the furthest downstream segment of the Clarkway Drive Tributary.

The Clarkway Drive Tributary is within the West Humber River watershed. Being located upstream of the Claireville Dam and Reservoir, the Clarkway Drive Tributary is inaccessible to migratory fish from Lake Ontario that can ascend other parts of the Humber River system. The Clarkway Drive Tributary's resident fish community is comprised of warmwater, most small-bodied, fish species, as revealed in the list of species captured in the 2004 fish community monitoring at Mayfield Road and in BioLogic's 2015 electrofishing catches further upstream on the Coleraine West lands:

- White Sucker
- Bluntnose Minnow
- Fathead Minnow
- Blacknose Dace
- Common Shiner
- Creek Chub
- Brook Stickleback
- Pumpkinseed
- Johnny Darter

It is worth noting that those fish species were captured in the "Main Branch" of the Clarkway Drive Tributary and not in the Tributary branch on which SWMF #16 is situated. BioLogic concluded that SWMF #16's branch does not contain fish based on barriers to upstream migration and on low/intermittent flow and referred to the tributary branch as a headwater drainage feature. Subsequent alterations to SWMF #16's Tributary branch included a substantial enclosure of more than 300 metres length at Coleraine Drive and construction of a realigned channel downstream of the enclosure to facilitate industrial development. The lengthy enclosure at Coleraine Drive is likely sufficient to prevent upstream migration of fish towards SWMF #16.

Screening for the potential occurrence of Species at Risk (SAR), including aquatic and terrestrial species listed as Threatened, Endangered or Special Concern under the provincial Endangered Species Act or the federal Species at Risk Act, involved review of Department of Fisheries and Oceans (DFO) on-line aquatic SAR mapping and NHIC on-line mapping and database.

DFO aquatic SAR mapping confirmed no aquatic SAR and no critical habitat of aquatic SAR within the Clarkway Drive Tributary near the site. The nearest hydrologically connected mapped occurrence of aquatic SAR is more than 7.5 kilometres downstream, on the Clarkway Drive Tributary below Castlemore Road, where DFO mapping indicates the potential occurrence of Redside Dace, an endangered minnow species.

Provincial Natural Heritage Information Centre mapping indicates records or "element occurrences" of three bird SAR. The threatened Bobolink and Eastern Meadowlark are ground-nesting songbirds that require large open areas of prairie, meadow, pasture, or hayfield during the nesting season. Eastern Wood Pewee, designated special concern, is a songbird that nests in forests. Desktop review of aerial imagery confirmed that the site neither contains nor is adjacent to habitats suitable for these bird SAR.

The existing information review therefore confirmed the following regarding SWMF #16:

- It does not contain, nor is it adjacent to, designated natural heritage features.
- As an artificial stormwater management facility, it is not an Unevaluated Wetland or a wetland of any sort.
- As an artificial stormwater management facility, it is neither a watercourse nor is it fish habitat.
- As an artificial stormwater management facility, it cannot be significant wildlife habitat as defined by the Province in the Significant Wildlife Habitat Criteria Schedules For Ecoregion 7E.
- It does not contain aquatic SAR, and DFO mapping shows the nearest hydrologically connected aquatic SAR occurrence, of Redside Dace, as more than 7.5 kilometres downstream.
- There is no indication, and very low expectation, of the occurrence of terrestrial SAR.

Additionally, the existing information review confirmed the following regarding the leash-free dog park portion of the site:

- It does not contain, nor is it adjacent to, designated natural heritage features.
- It is a manicured park-like area without natural features.
- There is no indication, and very low expectation, of the occurrence of terrestrial SAR.

Nevertheless, the scope of the RFP and comments received from TRCA during consultation called for site visits to conduct observations to investigate whether the site contains sensitive terrestrial or fisheries/aquatic features or wildlife species that could trigger measures of avoidance, mitigation, or restoration as part of the retrofit project.

SITE VISIT OBSERVATIONS

Four site visits were conducted by Myler. The site setting, watercourse and vegetation community characteristics, and wildlife observations were completed during the first two site visits in July 2020. Two focused follow-up site visits were conducted in the spring of 2021 to address some of TRCA's specific questions regarding wildlife presence/absence. The date and purpose of each of the site visits is summarized as follows:

- **23 July 2020** – morning site reconnaissance, watercourse and vegetation community characteristics, breeding bird and incidental wildlife observations.
- **29 July 2020** – morning breeding bird observations, supplementary reconnaissance of the watercourse, vegetation community, and wildlife observations.
- **06 April 2021** – dusk/evening breeding frog observations, confirm muskrat presence/absence.
- **15 May 2021** – daytime follow-up observations for muskrat, frogs and to confirm occupation of a burrow observed first on 2021 04 06.

Site Description

Site visit observations revealed that SWMF #16 and the leash-free dog park are surrounded by industrial properties and are separated from them by chain-link fence.

The dog park portion of the site was confirmed to include manicured mowed lawn areas, mowed trails, and semi-manicured areas of tall grass that appeared to be mowed only periodically (**Photos 1** and **2**, below). The dog park contained only a very few and scattered small, planted trees and some large shrubs, principally Common Buckthorn.

Photo 1: Manicured amenity area within the leash-free dog park.

Photo 2: Semi-manicured portion of the leash-free dog park, with regularly mowed trails and periodically mowed tall grass areas.

SWMF #16 was observed to be an unmanicured area, with no sign of vegetation management. It is unknown whether some pre-existing vegetation was retained within the detention basin when it was originally constructed or if the area was completely stripped and subsequently seeded and planted. The existing vegetation is a mix of wetland and upland plant species, with the stands of wetland vegetation occurring along tiny low-flow channels that traverse the basin, with weedy meadow and patches of shrubby thicket upland vegetation on the basin's banks and flanking area (**Photos 3**, below).

The basin was observed to be mostly dry on each of the site visits, with water flowing through it within the tiny low-flow channels (**Photo 4**, below) that convey drainage from the two off-site artificial drainage ditches located northeast and northwest of SWMF #16.

The basin's outlet structure is comprised of a gabion-reinforced dam or bank with two corrugated steel pipe culverts (**Photo 5**, below) the inverts of which allow the basin to drain completely and do not cause permanent ponding within the basin. A fenced and gated boardwalk is situated over the SWMF #16 outlet and connects the manicured and semi-manicured portions of the leash-free dog park (**Photo 6**, below).

Off-site and downstream of the SWMF #16 outlet a cattail-filled channel was observed (**Photo 7**, below). That channel extends in what appears to be a semi-natural meandering planform on the east side of Coleraine Drive for a distance of more than 500 metres and discharges into an underground enclosed piped section of more than 300 metres length that conveys drainage to the recently constructed realigned channel on the west side of Coleraine Drive (**Photos 8** and **9**, below).

Photo 3: SWMF #16 viewed northward from within the manicured dog park area. Note the core of Cattail growth in the basin's centre and flanking areas of meadow and scattered shrubs and individual trees.

Photo 4: Tiny low-flow channel (foreground) within the Cattail stand in the centre of the SWMF #16 basin, made temporarily visible in this location where traverse of a tracked drill rig had knocked down a trail through the Cattail stand vegetation.

Photo 5: Upstream end of the double culvert outlet of SWMF #16. The culvert inverts drain the basin completely, with no permanent retention of ponded area within the basin.

Photo 6: The fenced boardwalk over the SWMF #16 "dam" and outlet connects the manicured and semi-manicured portions of the leash-free dog park.

Photo 7: The receiving channel off-site and downstream of the SWMF #16 outlet. As in the SWMF #16 basin, the receiving channel contains a tiny low-flow channel within a stand of Cattail.

Photo 8: A galvanized steel grate reveals a portion of the lengthy underground piped watercourse enclosure that crosses and runs along the west side of Coleraine Drive.

Photo 9: The outlet of the piped watercourse enclosure more than 800 metres downstream of the SWMF #16 outlet.

Watercourse / Fish Habitat

As a stormwater management facility, SWMF #16 and the two-branched low-flow channel that it contains is neither a watercourse nor is it fish habitat. The artificial drainage ditches that convey drainage from the surrounding industrial neighbourhood are likewise not fish habitat.

BioLogic concluded based on its studies of the furthest downstream reaches of SWMF #16 receiving tributary branch that the watercourse is a headwater drainage feature that does not contain fish and is limited to indirect contributions to downstream fish habitat. The new enclosure of the tributary beneath and along Coleraine Drive further reduced the likelihood of fish ascending the tributary branch towards SWMF #16. As such, SWMF #16 discharges to the downstream channel containing indirect or contributing fish habitat, with the nearest occurrence of direct or occupied fish habitat more than 800 metres downstream on the other side of Coleraine Drive.

Observations of the two-branched tiny low-flow channel within SWMF #16 confirmed it to be both narrow (i.e., wetted width ranging from ~0.3 to ~1 metre) and shallow (i.e., observed water depth generally on the order of ~0.1 metre or less). The water was very clear during each of the site visits, revealing the channel bottom and banks to be comprised of fine-grained silty substrates and although there was generally an abundance of adjacent vegetation there was little by way of instream cover (see **Photos 10** and **11**, below).

Photo 10: The low-flow channel in SWMF #16 within an open herbaceous marshy area of the facility.

Photo 11: The low-flow channel in SWMF #16 within willow shrub thicket area of the facility.

During the second site visit, on 29 July 2020, a fleeting glimpse of movement was observed twice within the watercourse that may have been very small fish. However, despite repeated careful observations within the

clear waters of the low-flow channel on that date and during all site visits, no fish were definitively observed and confirmed to be present within SWMF #16.

As such, neither fish salvage nor fish habitat restoration are indicated as measures required for retrofit of SWMF #16.

Vegetation Communities and Tree Resources

As a stormwater management facility, SWMF #16 is not a wetland or other designated terrestrial natural heritage feature. However, as noted above, vegetation within SWMF #16 does not appear to have been managed, at least in recent times, and includes stands of wetland plant species in central low areas and upland plant species on flanking higher ground.

The wetland plant stands include areas dominated by common native and non-native plant species such as Narrow-leaved Cattail, Purple Loosestrife, Common (Phragmites) Reed, Reed Canary Grass, and a thicket of Willow shrubs.

The upland area is weedy cultural meadow, occupied by a mix of common native Goldenrod and Asters along with non-native weeds and grasses. Isolated shrubs, clumps or small thickets of shrubs, and isolated trees, mostly Manitoba Maple, occur within the cultural meadow.

No substantial or significant tree resources, and certainly no woodland, was observed on or adjacent to the SWMF #16 basin.

The leash-free dog park is comprised of a manicured lawn portion and a separate semi-manicured portion and cannot be characterized as naturally vegetated. Trees within the dog park are mostly small, planted specimens. Scattered large shrubs, mostly non-native Common Buckthorn, occur within the semi-manicured part of the dog park. Like SWMF #16, the dog park neither contains nor is adjacent to significant tree resources or woodland area.

As such, there were no trees or significant plant species observed on or adjacent to the site that would represent potential constraints to the retrofit works.

Amphibians and Reptiles

Given the lack of ponding within the SWMF #16 basin, the miniscule dimensions of the basin's low-flow channel, and the developed industrial surroundings, it was not surprising that no amphibians were observed or heard on site.

No frogs or tadpoles were visually observed despite extensive traverse and observation of the SWMF #16 basin and its two-branched low-flow channel. No toads or salamanders were observed despite searching beneath the scattered pieces of rubbish that were encountered within the site.

A site visit was conducted during the dusk and evening period on 06 April 2021 to check for early season frog species, principally Western Chorus Frog and Spring Peeper, that often occur in marginal breeding habitats, but none were heard calling on or near the site despite that the weather conditions were suitable, and those species were heard calling elsewhere.

Only a single Common Gartersnake was observed on site, beneath an old vehicle tire and rim that had been thrown over the perimeter chain link fence into the SWMF #16's fringe of upland cultural meadow. No specialized snake habitat (e.g., potential hibernaculum) was observed on the site.

Like the case with amphibians, the lack of substantial open water or pond habitat precludes the occurrence of turtles. Although Common Snapping Turtle can sometimes occur in marginal habitats, SWMF #16 is very poorly connected to the downstream areas within the watershed where turtle populations could occur, and no Common Snapping Turtle specimens or turtle tracks were observed during extensive observations of the low-flow channel.

As such, measures to protect and salvage amphibians and reptiles are not required for the retrofit works. In consideration of the incidental occurrence of the single Common Gartersnake, it is recommended that any such individual specimens incidentally encountered during the retrofit activities be gently relocated out of the way of grading and construction and released to the head of the channel immediately downstream of the SWMF #16 outlet.

Birds

Myler visited the site twice during the 2020 bird breeding season in the mornings of 23 and 29 July 2020. Those observations were a little bit after the breeding bird survey protocol period, but still well within the active nesting season. Birds heard and seen within SWMF #16 and the leash-free dog park comprised 12 species in total:

- American Goldfinch
- American Robin
- Cedar Waxwing
- Common Grackle
- European Starling
- House Sparrow
- Mourning Dove
- Northern Cardinal
- Red-winged Blackbird
- Song Sparrow
- Swamp Sparrow
- Willow Flycatcher

The Red-winged Blackbird, Willow Flycatcher and Swamp Sparrow were associated with the Cattails and a Willow shrub thicket within the SWMF #16. However, as there is no permanent pool in the dry detention basin and the aquatic habitat is limited to the very narrow and shallow low-flow channel, there was no sign of ducks, geese, sandpipers, or other waterfowl.

Neither of the ground-nesting Bobolink and Eastern Meadowlark were heard or observed at the site. This is unsurprising as the site lacks the extensive open areas required by these threatened species for nesting. The special concern Eastern Wood Pewee was neither heard nor observed, which is unsurprising as the site neither contains nor is adjacent to the Pewee's woodland habitat. Despite the occurrence of buildings on adjacent industrial properties that could be potentially suitable nesting habitat for threatened Barn Swallow, including a repurposed historical wooden barn, no Barn Swallow were observed at or over SWMF #16 or the dog park.

As such, there are no SAR bird constraints to the retrofit works. However, compliance with the federal Migratory Birds Convention Act requires measures to avoid harm to migratory birds, their active nests, eggs and young (termed "incidental take" in the Act) that may nest within the site. The most practical measure involves

preclearing of the site during the September to March period, outside of the active nesting season (approximately end of March to the beginning of September) to remove trees and strip other vegetation to ensure, to the extent possible, that the common birds that were observed at the site in 2020 do not establish nests that will be disturbed or destroyed by retrofit activities.

Mammals

Screening activities also included observations to confirm the presence of mammalian wildlife on site.

The site lacks substantial tree specimens likely to provide seasonal Bat maternal roosting sites. Pre-clearing of trees and vegetation to ensure Migratory Birds Convention Act compliance will simultaneously avoid potential harm to foliage-roosting Bats that could incidentally occur on tree foliage during the spring and summer active season.

Related to the lack of substantial aquatic habitat, no individuals and no sign of Muskrat was observed within or adjacent to SWMF #16. Muskrats are capable of exploiting rather marginal circumstances, but no huts, burrows, feeding platforms, or signs of Muskrat herbivory on cattail and other vegetation were observed. There are few places even in the low flow channel where a Muskrat could be fully submerged.

Small mammal trails were evident within SWMF #16 and were observed to be coming under the perimeter chain-link fence from surrounding commercial sites and leading to the low-flow channel where tracks in the mud confirmed visits by Raccoons. SWMF #16 lacks substantial trees and other cover for denning by Raccoons, and the trails beneath the fence indicate that the Raccoons reside primarily within the neighbouring industrial properties. Unsurprisingly, the Raccoon trails were not observed to extend into the leash-free dog park portions of the site.

A burrow was observed during the April 2021 evening site visit on a constructed berm in the centre of SWMF #16. It appeared to be a Groundhog burrow, the entrance of which appeared to have been enlarged, either for use as a den by a pair of red fox or by a dog or coyote attempting to reach the Groundhogs. The 15 May 2021 follow-up site visit discovered undisturbed new growth of vegetation at the burrow entrance which confirmed that the burrow was unoccupied.

As such, no mammalian wildlife constraints to the retrofit works were observed.

SIGNIFICANT WILDLIFE HABITAT SCREENING

As a stormwater management facility, SWMF #16 and its existing vegetation would not satisfy criteria to be considered provincially defined significant wildlife habitat per the Significant Wildlife Habitat Criteria Schedules For Ecoregion 7E. And the leash-free dog park is generally unattractive to wildlife, being manicured and semi-manicured and frequented by dogs and their people.

Nevertheless, the investigation of SWMF #16 and the adjacent leash-free dog park area confirmed a complete lack of features that could otherwise be candidate significant wildlife habitat in each of the significant wildlife habitat categories of:

- Seasonal concentration areas of animals.
- Rare vegetation communities or specialized habitat for wildlife.
- Habitat for species of conservation concern.
- Amphibian Movement Corridors.

As such, no measures are required to protect significant wildlife habitat during completion of the SWMF #16

SPECIES AT RISK SCREENING

Observations conducted on site to complement the desktop SAR screening confirmed the absence of both aquatic and terrestrial SAR and their respective habitats at the site. The nearest potentially relevant location of SAR is the potential occurrence of Redside Dace in the Clarkway Drive Tributary more than 7.5 kilometres downstream of the SWMF #16 outlet. Standard erosion and sedimentation controls during conduct of the retrofit activities will prevent off-site impacts to water quality sufficient to protect that distant SAR occurrence.

As such, no specific measures are required to protect SAR and SAR habitat, to maintain provincial Endangered Species Act or federal Species at Risk Act compliance.

CONCLUSIONS AND RECOMMENDATIONS

Natural Heritage Constraints

SWMF #16 and the leash-free dog park were determined not to contain natural heritage constraints as follows:

- SWMF #16 is not Unevaluated Wetland, or wetland of any sort, as erroneously depicted on TRCA and provincial mapping.
- As an artificial stormwater management facility, SWMF #16 is neither a watercourse nor is it fish habitat. Fish were not observed within the facility and the likelihood of upstream fish passage to the facility is very low.
- As an artificial stormwater management facility, SWMF #16 cannot be significant wildlife habitat as defined by the Province in the Significant Wildlife Habitat Criteria Schedules For Ecoregion 7E. Nevertheless, it does not contain habitat features or wildlife species that could elsewhere indicate candidate significant wildlife habitat.
- SWMF #16 does not contain aquatic SAR, and DFO mapping shows the nearest hydrologically connected aquatic SAR occurrence, of Redside Dace, as more than 7.5 kilometres downstream.
- No terrestrial SAR or SAR habitat were observed at SWMF #16.
- As a fenced, manicured and semi-manicured area of limited extent frequented by dogs and their people, the leash-free dog park lacks natural habitat and is generally unattractive to wildlife, does not contain significant wildlife habitat, and does not contain SAR.

Recommended Mitigation Measures

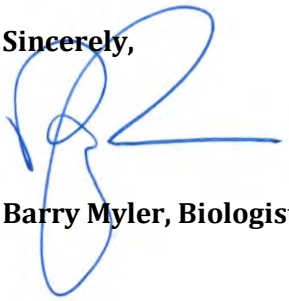
Recommended mitigation measures to be employed during conduct of the retrofit works and activities are limited to the following:

- Pre-clearing of trees and other vegetation that are within grading and construction footprints during September – March to avoid the active bird nesting season and ensure compliance with the federal Migratory Birds Convention Act.
- Use, monitoring and maintenance of erosion and sedimentation controls to prevent water quality impacts to off-site/downstream fish habitat, including the distant downstream habitat of Redside Dace.

Post-retrofit restoration of SWMF #16 is recommended to include seeding and planting of native plant species to the extent practicable to avoid proliferation of the invasive Common (Phragmites) Reed, and to stabilize soils, enhance water quality and provide incidental habitat for wildlife.

Please contact the undersigned should you have any questions.

Sincerely,



Barry Myler, Biologist

Appendix G

Agency Correspondence

Meeting Minutes

MEETING:	Project Kickoff	DATE:	June 11, 2020
LOCATION:	Teleconference	TIME:	9:00 am -
PROJECT NAME:	Caledon SWM Pond	PROJECT #:	2020-0086
PURPOSE:	Kickoff		

PRESENT:	REGRETS:
Roy Johnson, COLE	n/a
Mark Setter, Landscape Architect	
Margi Sheth, Town Project Manager	
Jordan Vander Kloch, Town Landscape Architect	

ITEM	DESCRIPTION	ACTION BY
1.	Staff Introductions	
2.	Project Overview – The project started with dog park complaints of users over drainage, and SWMF16 identified for retrofit in study. The park is old and want new amenities. Town is flexible on pond boundary. Currently believed to be insufficient for 100 volume. Part 1 = CLass EA/ Prelim design GW, ESA (prov) Part 2 = Design to 100% (prov) Part 3 = CA (prov) for 2021 Construction should start next summer or spring	
3.	Stakeholders List Required: • Contact list for dog park • Confirm MNRF District Office contact	
4.	COLE is requesting the following data: • GIS data (parcel fabric, legal boundaries, impervious cover, build form) • SWM reports and associated pond design figures and drawings. Appears the 1980 report was revised in 1987. • Plans of Subdivision. • Invoicing Requirements	Margi to send GIS agreements, invoicing requirements, etc.

COLE ENGINEERING GROUP LTD.
HEAD OFFICE
70 Valleywood Drive, Markham, ON Canada L3R 4T5
T. 905 940 6161 | 416 987 6161 F. 905 940 2064
www.coleengineering.ca

ITEM	DESCRIPTION	ACTION BY
5.	Wrap-Up	

Summary of Actions

ITEM	ACTION	LEAD	DUE DATE
	A passive dog zone for smaller dogs should be considered in design	Mark/Jordan	
	PICs will not be in person but online where people can review and comment from Town website. COLE/Setter to provide relevant information to Town.		
	Drinking water likely not to be included in dog park design, but there is an existing water connection at the shelter	Mark/Roy to review	
	Double gate for leashing/unleashing to be included with signage	Mark	
	Include Margi on TRCA meeting. Annette Lister is the usual Town contact at TRCA.		
	Mark/Jordan to meet Thursday, June 18th at 9 am for site walk	Mark/Jordan	June 18th
	If bridge is determined to be submerged during 100-year event, replacement will need to be considered.		
	Send Margi list of required data.		
	Dog Park education/agility equipment has not been request to Town's knowledge.		

Minutes Recorded By: Roy Johnson
Distribution: All Invitees (email)

Meeting Minutes

MEETING:	Project Kickoff Meeting	DATE:	June 26, 2020
LOCATION:	Microsoft Teams Meeting	TIME:	10:00 a.m. -10: 45 a.m.
PROJECT NAME:	Caledon SWM Pond and Dog Park	PROJECT #:	2020-0086
PURPOSE:	Determine SWM Criteria and EA Process		

PRESENT:	REGRETS:
Roy Johnson, COLE Project Manager	n/a
Margi Sheth, Town of Caledon Project Manager	
Aziz Ahmed, MECP	
Jairo Morelli, TRCA Water Resources Engineer	
Evan Bearss, TRCA Planning Ecologist	
Caroline Mugo, TRCA Planner	
Emma Benko, TRCA Project Manager	

ITEM	DESCRIPTION	ACTION BY
1.	Introductions	
2.	Project Overview Retrofit of existing quantity control SWM Pond (SWMF 16 Marconi Court) to provide quality control for industrial subdivision draining to pond. Currently, an ecologist is evaluating species at risk, construction timing windows, etc. Mark Setter providing Dog Park grading design. EA for pond is Schedule A+ (pre approved activity), but Will be presented at two Public Information Centres (PICs).	INFO
3.	SWM Criteria TRCA and MECP confirmed that applicable criteria were as per TRCA criteria, **Appendix A**, Table E.1 Quantity Control: Using unit flow rate targets per Table E.1 Quality Control: 80% TSS Removal Erosion Control: 48 extended detention of 25 mm event	INFO

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www.coleengineering.ca

ITEM	DESCRIPTION	ACTION BY
	External areas draining to pond that are undeveloped do not require control. TRCA notes that "In retrofitting projects we expect the proposed works to mimic or enhance existing conditions. If some external areas (undeveloped or not) are currently controlled by the existing pond, the TRCA expect the retrofitted pond operates in the same fashion, otherwise no control would be required." (email) TRCA notes the site within estimated flood plain area. Changes to outlet may require an update of model to confirm no adverse impact. Permit under O. Reg. 166/06 will be required.	
4.	EA Process: MECP indicates that if going through a public process (PICs) then no additional posting required.	INFO
5.	Additional: Drinking water impacts of the dog park must be assessed and ensure that there is now backflow into water supply. Dog park may increase impervious level; COLE will assess and coordinate with SWMF design.	INFO

Next Meeting: Enter Next Meeting Information (Date / Time)
Minutes Recorded By: Roy Johnson, COLE
Distribution: All Invitees

Stormwater management pond retrofit and dog park drainage repairs

Posted on Wednesday, August 26, 2020

Back to Search

Stormwater Management Pond

A consultant has been retained by the Town of Caledon to provide a detailed design for a retrofit

“enhanced level of pprotection” which includes sediment control and preventing sediment buildup.

Leash-Free Dog Park

The Town is also investigating drainage issues and upgrading the leash free dog park, located next to Caledon Animal Shelter.

The work includes completing a Municipal Class Environmental Assessment (“Class EA”) and preliminary design services. The scope for redesign of the leash free park may include detailed design of a grading plan, paved and accessible paths, planting plan, shade structure, benches, water service (currently at Animal Shelter building), fencing, trash cans and dog waste bag dispensers.

Two Public Information Centres [PICs] are required. Dates are yet to be determined.

Process

The SWMF improvements are categorized as Schedule A+ under the Municipal Engineers Association document "Municipal Class Environmental Assessment,” (October 2000, amended 2007). Schedule A is a pre-approved activity, which specifically includes works that “establish new or replace or expand existing stormwater detention/retention ponds or tanks and appurtenances including outfall to receiving water body provided all such facilities are in either an existing utility corridor or an existing road allowance where no additional property is required.

NOTE – Utility corridors are not always linear, therefore expansion of a stormwater management facility is a

Schedule A activity provided no additional property is required.” And A+5 “Modify, retrofit, or improve a retention / detention facility including outfall or infiltration system for the purpose of stormwater quality control.”

Comments

These comments will be maintained for reference throughout the project and will become part of public record. Under the Freedom of Information and Protection of Privacy Act and the Environmental Assessment Act, unless otherwise stated in the submission, any personal information such as name, address, telephone number and property location included in a submission will become part of the public record files for this matter and will be released, if requested, to any person.

Information requests or questions may be directed to:

Margi Sheth, M. Eng., EIT
Senior Project Manager – Stormwater,
Town of Caledon
905-584-2272 X.4258
margi.sheth@caledon.ca

Roy Johnson, P. Eng.
Senior Water Resources Engineer
COLE Engineering Ltd.
416-346-3875
rjohnson@coleengineering.ca

Contact Us

Service Caledon
6311 Old Church Road
Caledon ON
L7C 1J6
T: **905-584-2272 x. 7750**
E-Mail
Website
Map this Location

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TOWN OF CALEDON

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Caledon ON L7C 1J6

Phone
905-584-2272

Toll Free
1-888-225-3366

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TOWNSHIP OF CALEDON

CLASS ENVIRONMENTAL ASSESSMENT STORMWATER MANAGEMENT POND RETROFIT AND DOG PARK REDESIGN

THE STUDY

COLE has been retained by the Town of Caledon [The Town] to provide the detailed design of the retrofit of the Marconi Court Storm Water Management (SWM) Facility #16 (SWMF) located on the west side of Coleraine Drive between Marconi Court and Wheeler Drive in Bolton, and the redesign of the existing dog park adjacent to the SWMF. Refer to Figure 1 Location Plan.

The overall goal of the Work is to retrofit the SWMF to meet, as much as can be achieved, current standards for a SWM facility providing an "enhanced level of protection" (i.e. 80% Total Suspended Solids [TSS] removal [Quality Control]).

The Town is also looking for investigation for the drainage issues in the leash free dog park and retrofitting the same, located next to Caledon Animal Shelter, having municipal address as 12889 Coleraine Drive, Bolton.

The Work includes completing a Municipal Class Environmental Assessment ("Class EA"), preliminary and detailed design, contract management and inspection services. The scope for redesign of the leash free park would include detailed design of a grading plan, paved and universally accessible path system, planting plan, shade structure, benches, water service (currently at Animal Shelter building), fencing, trash cans and dog waste bag dispensers.

Two Public Information Centres [PICs] are required.

THE PROCESS

The pond improvements are categorized as Schedule A+ under the Municipal Engineers Association document "Municipal Class Environmental Assessment," (October 2000, amended 2007). Schedule A is a pre-approved activity, which specifically includes works that "establish new or replace or expand existing stormwater detention/retention ponds or tanks and appurtenances including outfall to receiving water body provided all such facilities are in either an existing utility corridor or an existing road allowance where no additional property is required. NOTE – Utility corridors are not always linear, therefore expansion of a stormwater management facility is a Schedule A activity provided no additional property is required." And A+5 "Modify, retrofit, or improve a retention / detention facility including outfall or infiltration system for the purpose of stormwater quality control."

COMMENTS

We are interested in hearing any comments or input that you may have about this Study. Comments and information regarding the study will be collected to assist the Town in meeting the requirements of the Environmental Assessment Act.

These comments will be maintained for reference throughout the project and will become part of the public record. Under the Freedom of Information and Protection of Privacy Act and the Environmental Assessment Act, unless otherwise stated in the submission, any personal information such as name, address, telephone number and property location included in a submission will become part of the public record files for this matter and will be released, if requested, to any person.

Information requests or questions may be directed to:

Margi Sheth, M. Eng., EIT
Senior Project Manager – Stormwater,
Engineering Services
Town of Caledon
6311 Old Church Road
Caledon, ON L7C 1J6
Phone: (905) 584-2272 x4258
Email: margi.sheth@caledon.ca

Roy Johnson, P. Eng.
Senior Water Resources Engineer
COLE Engineering Ltd.
70 Valleywood Drive
Markham, Ontario
Phone: (416) 346-3875
Email: rjohnson@coleengineering.ca

This Notice first issued on INSERT DATE

From:	Roy Johnson
To:	"toomaj.haghshenas@trca.ca"
Cc:	"tina.dufresne@ontario.ca"; "steven.allingham@ontario.ca"; "Ahmed, Aziz (MECP)"
Subject:	TRCA Meeting Request: NRFP 2020-43 Storm Water Pond #16 and Leash Free Dog Park Retrofit Study
Date:	Monday, June 8, 2020 10:21:44 AM
Attachments:	NRFP 2020-43 Storm Water Pond #16 and Leash Free Dog Park Retrofit Study .pdf Appendix E - Project Site Location Map.pdf 2020-43_Section4-Approach&Methodology_COLE Submission.pdf image002.jpg

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Hi

COLE has been retained by the Town of Caledon to provide a retrofit design for an existing quantity pond to provide Enhanced quality control. The SWM Facility is located on the west side of Coleraine Drive between Marconi Court and Wheeler Drive in Bolton. In addition to SWMF #16, Town is also looking for investigation for the drainage issues in the leash free dog park and retrofitting the same, located next to Caledon Animal Shelter, having municipal address as **12889 Coleraine Drive, Bolton**. No new development is planned, only a retrofit of the facility itself.

I would like to arrange a teleconference/Skype call to discuss the TRCA's criteria for the project. For your convenience, I have attached both the RFP and COLE's text response.

By way of cc'ing the MECP I would like to arrange either a combined or separate conference call to discuss the agency's requirements.

We have reviewed the location on the TRCA Regulation Mapping tool and it appears to be within the TRCA's jurisdiction, specifically draining to the Clarkway Drive Tributary of the (West) Humber Watershed. I was unable to see any floodplain mapping on First Base Solutions.

The improvements are categorized as Schedule A+ under the EA Act. Schedule A is a pre-approved activity, which specifically includes works that "establish new or replace or expand existing stormwater detention/retention ponds or tanks and appurtenances including outfall to receiving water body provided all such facilities are in either an existing utility corridor or an existing road allowance where no additional property is required. NOTE – Utility corridors are not always linear, therefore expansion of a stormwater management facility is a Schedule A activity provided no additional property is required." And A+5 "Modify, retrofit, or improve a retention / detention facility including outfall or infiltration system for the purpose of stormwater quality control."

The overall goal of the Work is to retrofit this Storm Water Management (SWM) Facility to meet, as much as can be achieved, current standards for a SWM facility providing an "enhanced level of protection".

This Deliverables is intended to describe the "Work" for retrofitting of the Marconi Court Stormwater Management Facility that is identified as #16 in the Town's Stormwater Management Inventory dated June 2008 ("SWM Facility"). The Work includes, without limitation; Completing Municipal Class Environmental Assessment ("Class EA"), preliminary and detailed design as well as contract management and inspection services during construction in future.

The Town of Caledon Stormwater Retrofit Study, prepared by the Toronto and Region Conservation Authority ("TRCA") and released in March 2001 identified a number of facilities to be upgraded from quantity control facilities to provide quantity and quality control for storm runoff. The study identified the Marconi Court Stormwater Management Facility - Town Facility #16 as a candidate for retrofitting.

This SWM Facility was originally designed approximately 40 years ago. It is a dry pond that is supposed to provide 100-year quantity control for the storm runoff from a drainage area that is mainly industrial with a some other urban and/or rural contribution. The pond has a potential to be upgraded to a level 1 wet pond. This retrofit is intended to achieve a net improvement for the stormwater quality as this pond has a varied pervious catchment area. The land area surrounding the stormwater management facility serves as a leash free park. Changes to the stormwater management facility will require a redesign of

the leash free park area.

Based on a review of the 2012 TRCA SWM Criteria, facilities draining to the Humber:

Regards;
Roy Johnson
Senior Water Resources Engineer - Team Lead
Cole Engineering Group Ltd.
70 Valleywood Dr., Markham, ON L3R 4T5
Tor. Line: 416-987-6161 Ext 261, T. 905-940-6161
F: 905-940-2064
Email: rjohnson@coleengineering.ca
Website: www.ColeEngineering.ca

Appendix H

EA Materials

TOWN OF CALEDON

Stormwater Pond #16 and Dog Park Public Information Centre

IBI GROUP
Town of Caledon
June 24, 2021

PROJECT DESCRIPTION

IBI Group Ltd. and MSA were retained by the Town of Caledon to provide the detailed design of the retrofit of the Marconi Court Storm Water Management (SWM) Facility #16 located on the west side of Coleraine Drive between Marconi Court and Wheeler Drive in Bolton, and the redesign of the existing dog park adjacent to the SWMF.

MUNICIPAL CLASS EA (SCHEDULE A/A+)

The Work includes completing a Municipal Class Environmental Assessment (“Class EA”), preliminary design. Schedule A is a pre-approved activity, which specifically includes works that “establish new or replace or expand existing stormwater detention/ retention ponds.

DOG PARK

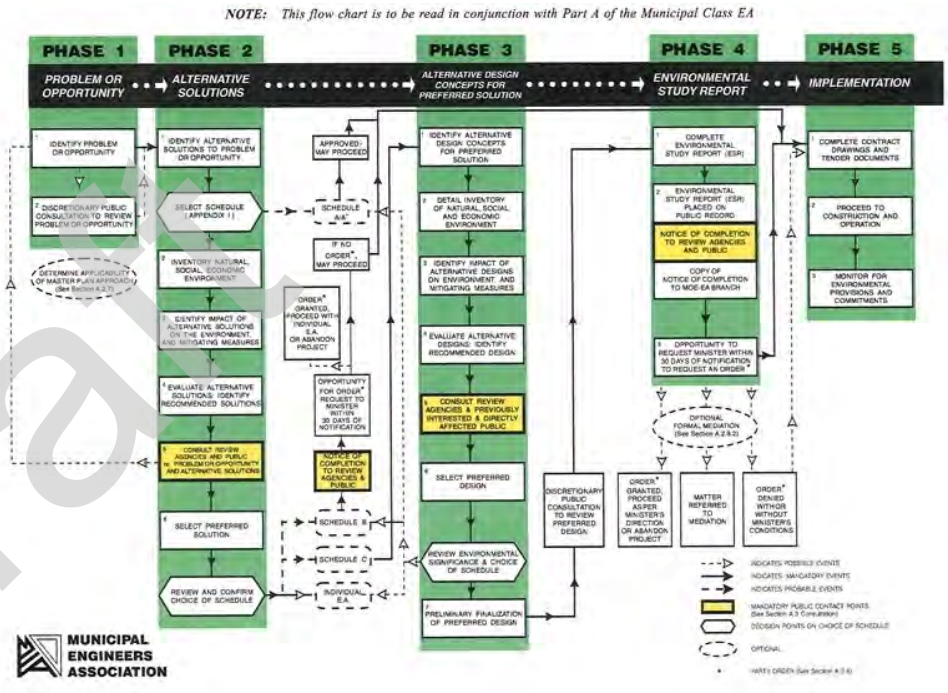
The Town is also looking for investigation for the drainage issues in the leash free dog park and retrofitting the same, located next to Caledon Animal Shelter, having municipal address as 12889 Coleraine Drive, Bolton.

STORMWATER MANAGEMENT POND #16

The overall goal of the Work is to re-establish the original design of the dry detention facility and as much as possible to maximize the detention capacity of the facility, within the approximate limits of the existing pond block.

ENVIRONMENTAL ASSESSMENT PROCESS

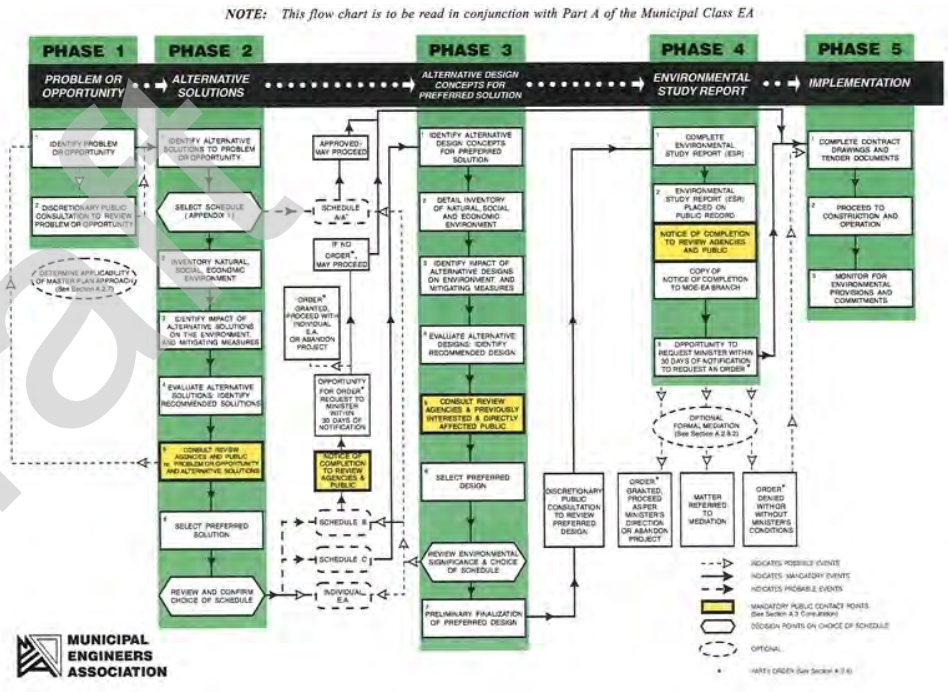
The improvements are categorized as Schedule A+ under the EA Act. Schedule A is a pre-approved activity, which specifically includes works that "establish new or replace or expand existing stormwater detention/retention ponds or tanks and appurtenances including outfall to receiving water body provided all such facilities are in either an existing utility corridor or an existing road allowance where no additional property is required.



Municipal Class EA Process

ENVIRONMENTAL ASSESSMENT PROCESS CONTINUED

NOTE – Utility corridors are not always linear, therefore expansion of a stormwater management facility is a Schedule A activity provided no additional property is required.” And A+5 “Modify, retrofit, or improve a retention / detention facility including outfall or infiltration system for the purpose of stormwater quality control.”

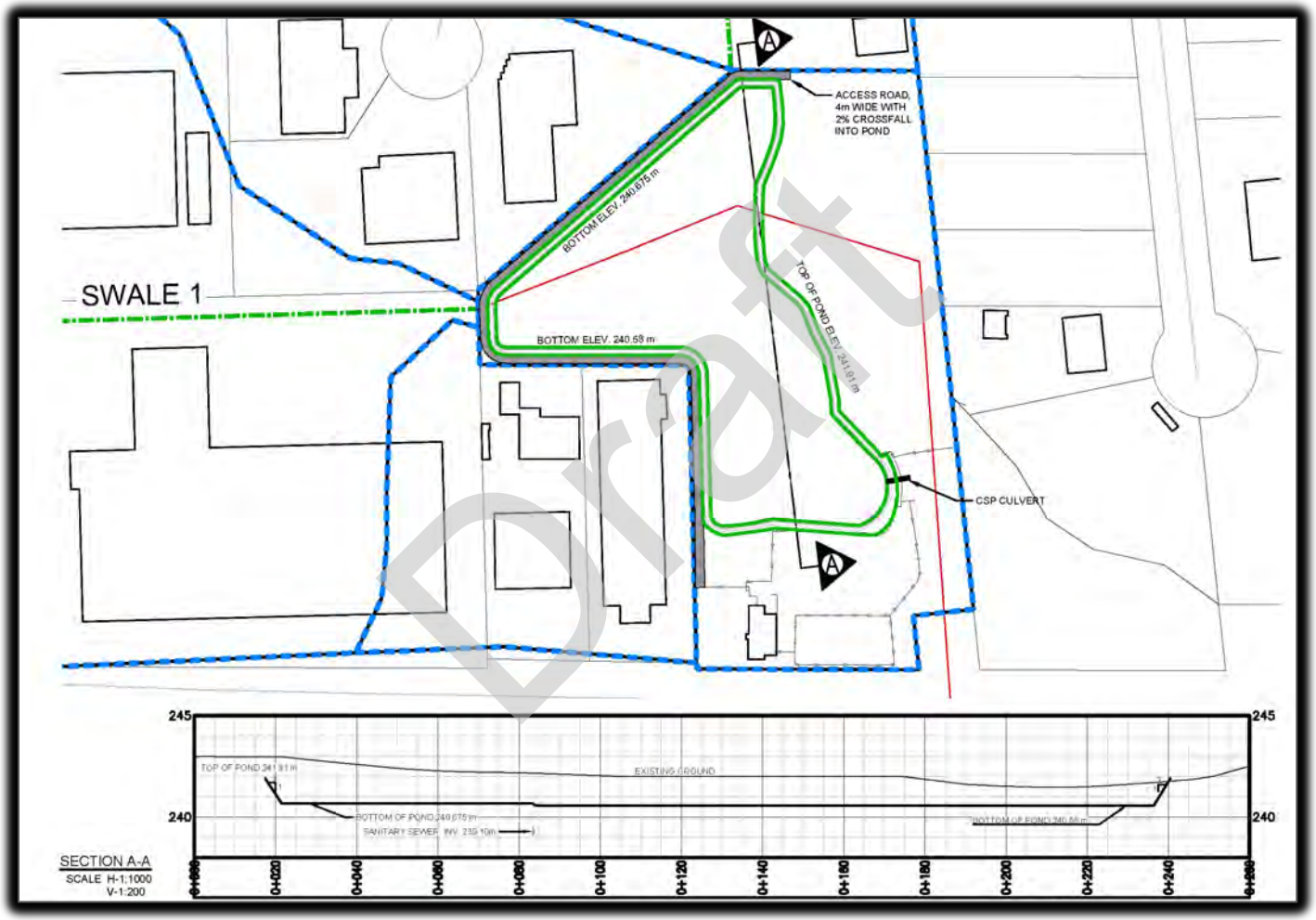


Municipal Class EA Process

STORMWATER POND OPTIONS

IBI Group investigated various grading options to achieve the project goals and opted to maintain the western boundary of the pond block (+/- 5m) and provide for the maximum storage available within that area.

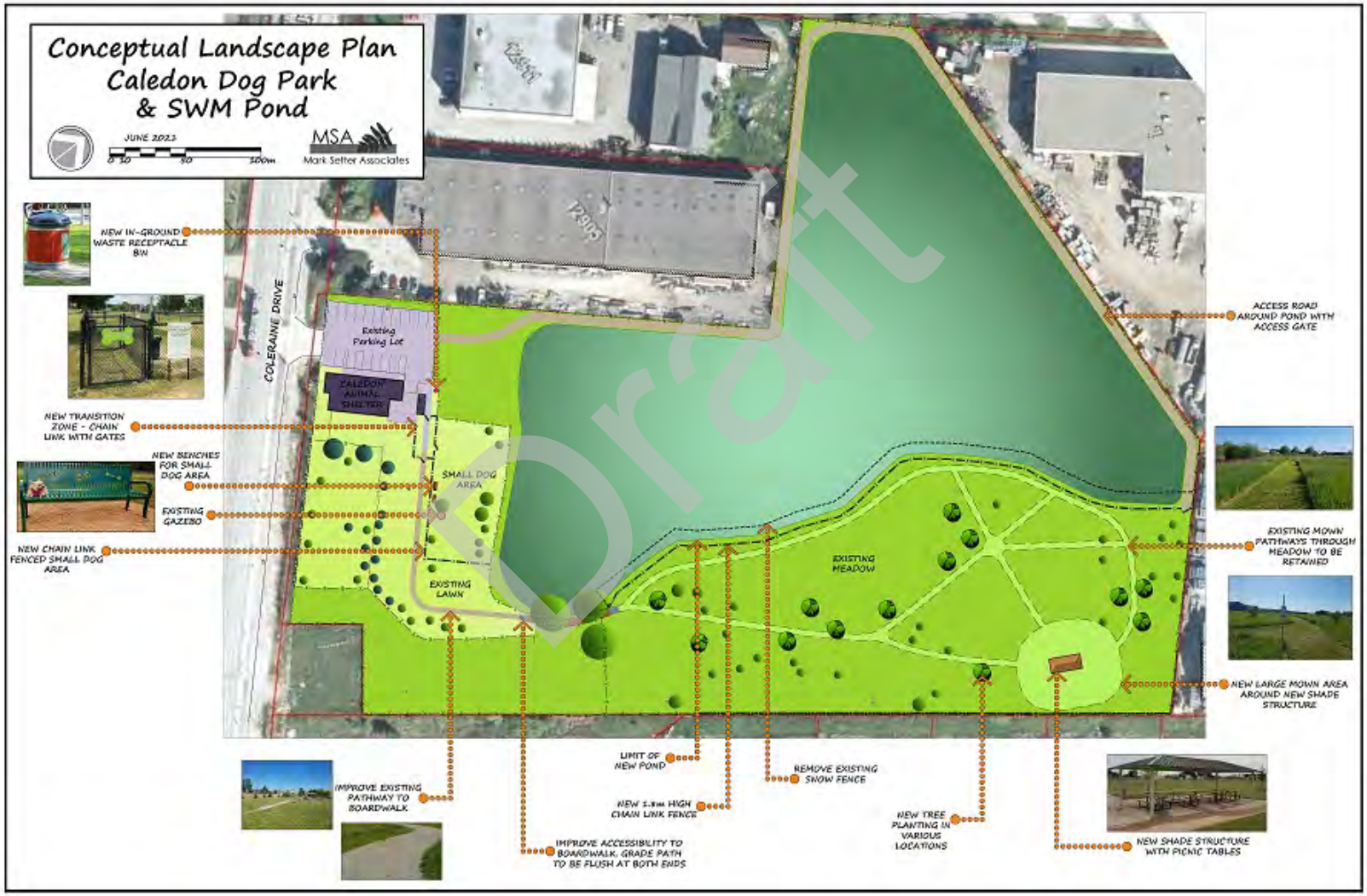
STORMWATER MANAGEMENT POND CONCEPT



DOG PARK CONCEPTUAL LANDSCAPE PLAN

Mark Setter Associates has developed a conceptual Landscape Plan for the Dog Park improvements, as outlined on the following slide.

CONCEPTUAL LANDSCAPE PLAN



THANK YOU

Please direct any questions:

Cassie.Schembri@caledon.ca

Roy.Johnson@ibigroup.com – Stormwater Pond

Msetter@rogers.com – Dog Park

Stormwater Management Pond #16 and Dog Park Design Comment Feedback Form

Class Environmental Assessment Schedule A/A+

Comment Form

Please note: Information collected will be used in accordance with the Freedom of Information and Protection Privacy Act. With the exception of personal information, all comments will become part of the public record.

Please send the comment form to Cassie Schembri at cassie.schembri@caledon.ca by July 30, 2021.

Your Name: John Paton

Email (optional): john.paton@quantech.ca

Mailing Address (optional): Click or tap here to enter text.

Please add me to the study mailing list ☒

1. Please all that apply to you:
   ☒ Caledon Resident
   ☒ Dog Park Patron
   ☐ Technical Agency/interest Group Representative, please identify: Click or tap here to enter text.
   ☐ Other, please identify: Click or tap here to enter text.
2. Please provide your comments as they pertain to the study and/or the material presented:

   a. Study Objective and Goals

   b. Existing Conditions

   Access in winter is an issue. Please consider an extended and easier slope angle with hand rail. This would allow wheelchair access in good weather and support for older users in slippery conditions. Remove the park benches from back park. This park has traditionally been for those wishing to exercise their dogs. Since moving the benches, people are sitting and allowing their dogs to dig resulting in injury to other dogs and

people. Since this has happened, regular users are now avoiding the park and taking their dogs elsewhere.

c. SWM Pond Design

Design with access to park users with possible bench half way would be an improvement. It would attract those wanting a longer walk and those that allow their dogs access to water. Fencing the existing stream has been a divisive issue with regular park users.

d. Dog Park Design

Please consider moving half of the small dog area North to beside the parking lot, allowing the existing park to remain as large as possible. Older people use the park but cannot walk to the back exercise field. Removing much of the space will limit their ability to exercise their dogs. This would also allow for access to the small dog park from the car park, reducing stress to owners and dogs of going through the regular park. Allow access for park users to walk around storm water pond.

Please locate the new shade structure to the first park area. Again older residents cannot walk to the far end, especially in winter months and need some shelter.

3. Do you have any other comments regarding the project or materials presented?

Click or tap here to enter text.

THANK YOU FOR YOUR TIME AND EFFORT

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