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October 8, 2020

18-027(a).R01

Cobide Engineering Inc.
517 10th Street
Hanover, Ontario
N4N 1R4

Attention: Mr. Travis Burnside, P.Eng.

Dear Sir:

Re: Slope Assessment
Saugeen Cedar Heights West
Hanover, Ontario

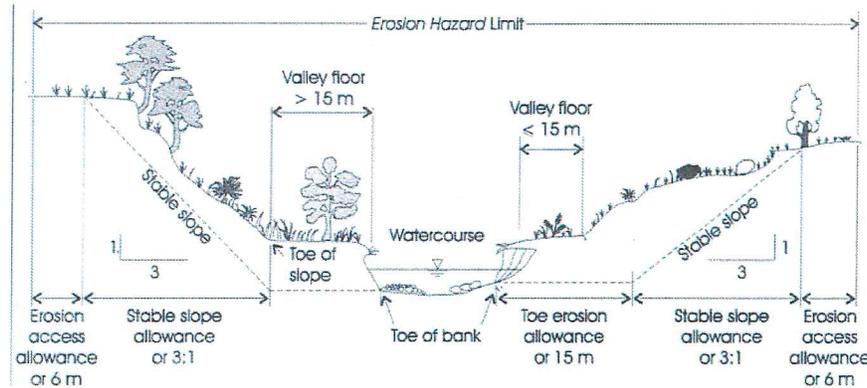
The services of CMT Engineering Inc. (CMT Inc.) were retained by Mr. Travis Burnside, P.Eng. on behalf of the property owner, to carry out a slope assessment at the subject site and we are pleased to present the enclosed letter. It is understood that the slope assessment was requested by the Saugeen Valley Conservation Authority (SVCA) to verify that the previously completed slope stability report by Chung and Vander Doelen (CVD) in January of 2007 remains acceptable regarding the Ontario Ministry of Natural Resources Technical Guide – River and Stream Systems: Erosion Hazard Limit requirement (MNRF Technical Standards) and to the Saugeen Valley Conservation Authority Environmental Planning and Regulations Policies Manual, Amended October 16, 2018 at the subject site. This report should be read in conjunction with all previous geotechnical reports for the subject site (by CMT Inc. or others).

The CVD report utilized five (5) cross-sections throughout the site running south to north perpendicular to the existing slope to determine the geometry of the slope. The topographic survey was provided by Henderson Paddon & Associates Limited, Drawing No. 506030-7 dated November 2007. In general, the site topography slopes from the existing Hanover Community Trail down to the Saugeen River. The location of the site can be seen on Drawing 1.

CMT Inc. personnel conducted a site visit on September 29, 2020 which was comprised of examining the site to visually verify that the existing slope sections are generally consistent with the site plan completed 2007. Photographs were taken during the site visit and the location of the photographs relative to the cross-sections are shown on Drawing 2.

Generally, developments within SVCA regulated areas are required to be outside the Erosion Hazard Limit. The erosion hazard limit is defined by the MNRF technical standards. The Erosion Hazard Limit consists of three aspects: Toe Erosion + Stable Slope Allowance + Erosion

Hazard (access) Allowance and each aspect will be discussed below. The following diagram from Appendix G: Erosion Control Guidelines of the Saugeen Valley Conservation Authority Environmental Planning and Regulations Policies Manual (Amended October 16, 2018) visualizes the Erosion Hazard Limit and the three components the erosion hazard is comprised of:



Toe Erosion Allowance

The bankfull width of the Saugeen River at the project location appeared to be greater than 30.0 m. The bank of the lake at the subject site showed signs of active erosion at the banks (Photographs 8, 9, 10, 20, 21, 22, and 30). CVD reported in 2007 that there were no signs of active bank erosion. However, water levels were higher and access to the bank was not feasible at the time of the CVD report. CVD Reported in Section 7.6.4. that the Toe Erosion Allowance was assessed to be 4.0 m in Cross-section A-A.

Utilizing Table 3 of Appendix G: Erosion Control Guidelines of the Saugeen Valley Conservation Authority Environmental Planning and Regulations Policies Manual (Amended October 16, 2018), CVD laboratory results, and preliminary survey data the 100-year toe erosion allowance was determined to be 5-8 m.

Table 3: Determination of Toe Erosion Allowance

MINIMUM TOE EROSION ALLOWANCE - River Within 15 m of Slope Toe*

Type of Material Native Soil Structure	Evidence of Active Erosion** OR Bankfull Flow Velocity > Competent Flow Velocity*** RANGE OF SUGGESTED TOE EROSION ALLOWANCES	No evidence of Active Erosion** OR Bankfull Flow Velocity <Competent Flow Velocity***		
		Bankfull Width		
		< 5m	5-30m	> 30m
1. Hard Rock (granite) *	0 - 2 m	0 m	0 m	1 m
2. Soft Rock (shale, limestone) Cobbles, Boulders *	2 - 5 m	0 m	1 m	2 m
3. Stiff/Hard Cohesive Soil (clays, clay silt), Coarse Granular (gravels) Tills *	5 - 8 m	1 m	2 m	4 m
4. Soft/Firm Cohesive Soil, loose granular, (sand, silt) Fill *	8 - 15 m	1-2 m	5 m	7 m

*Where a combination of different native soil structures occurs, the greater or largest range of applicable toe erosion allowances for the materials found at the site should be applied

**Active Erosion is defined as: bank material is exposed directly to stream flow under normal or flood flow conditions where undercutting, oversteepening, slumping of a bank or down stream sediment loading is occurring. An area may have erosion but there may not be evidence of 'active erosion' either as a result of well rooted vegetation or as a result of a condition of net sediment deposition. The area may still suffer erosion at some point in the future as a result of shifting of the channel. The toe erosion allowances presented in the right half of Table 3 are suggested for sites with this condition. See Step 3.

***Competent Flow Velocity is the flow velocity that the bed material in the stream can support without resulting in erosion or scour. For bankfull width and bankfull flow velocity, see Section 3.1.2.

CVD reported a toe erosion allowance of 4.0 m in their report for Cross-section A-A but when determining development setbacks, all cross-sections (A-A to E-E) used a conservative toe erosion allowance of 15.0 m. Therefore, the existing toe erosion allowance is within the MNRF technical standards. CMT Inc. believes that the toe erosion allowance can be reduced from 15.0 m through further geotechnical testing, if required.

Stable Slope Allowance

During the site visit conducted by CMT Inc. personnel on September 24, 2020, the slope generally appeared to be well-vegetated with large trees throughout and low-lying vegetation over the remainder of the area. There appeared to be limited active erosion and drainage over the slope noted at the time of the site visit. There appeared to be no signs of slope instability such as slumps or tension cracks, and there appeared to be no significant seepage from the slope face. Based on Table 8.1 - Slope Stability Rating Chart from *Geotechnical Principles for Stable Slopes, 1997*, Ontario Ministry of Natural Resources (MNR) (same as Table 4.2 – Slope Stability Rating Chart from *Technical Guide – River and Stream Systems: Erosion Hazard Limit, 2002* by the MNR), the slope was determined to have a total rating range of 30 and therefore the slope is considered to have a slight potential for slope instability (see attached slope stability rating chart).

CVD reported a stable slope angle of 3H:1V and determined the stable slope allowance by superimposing a 3H:1V stable slope line at the southern extent of the 15.0 m toe erosion. The location where the superimposed 3H:1V stable slope line intersected the existing topography was determined to be the southern extent of the stable slope allowance. Therefore, the existing stable slope allowance is within the MNRF technical standards. CMT Inc. believes that the stable slope allowance may be able to be reduced from what was reported by CVD by increasing the angle of the stable slope line through slope stability modeling for each cross-section and further geotechnical testing, if required.

Erosion Hazard (Access) Allowance

CVD recommended in their 2007 report that a 6.0 m erosion access allowances (no development within this zone) is recommended measured laterally to the south from the southern extent of the stable slope allowance. Therefore, the existing erosion access allowance is within the MNRF technical standards. The CVD report did not address any additional loadings at the top of the slope in their analysis. With the development setbacks outlined by CVD, it is unlikely that additional loading would have a significant affect on long-term global stability. CMT Inc. would be pleased to review plans as they become available to assess the risk for slope failure for new developments near the top of the slope.

The slope of interest is considered an erosion hazard – apparent river or stream valley based on Policy 4.11.2-3 of the Saugeen Valley Conservation Authority Environmental Planning and Regulations Policies Manual, Approved May 16, 2017, Amended October 16, 2018.

Development will be permitted within the allowance adjacent to the erosion hazard (6.0 m erosion access allowance) of an apparent river or stream valley if it has been demonstrated to the satisfaction of the SVCA that the control of flooding, erosion, pollution or the conservation of land will not be negatively affected.

The submitted plans should demonstrate that:

- a) *development does not create or aggravate an erosion hazard;*
Determined from slope stability analysis.
- b) *development is set back a sufficient distance from the stable top of bank to avoid increases in loading forces on the top of the slope;*
Determined from slope stability analysis.
- c) *development does not change drainage or vegetation patterns that would compromise slope stability or exacerbate erosion of the slope face;*
Completed by others.
- d) *development does not prevent access to, preserve, maintain or repair the top of the valley slope;*
Completed by others.
- e) *the potential for surficial erosion has been addressed through proper drainage, erosion and sediment control and site stabilization/restoration plans; and*
Completed by others.
- f) *natural features and/or ecological functions contributing to the conservation of land are protected, pollution is prevented, and flood control and erosion hazards have been adequately addressed.*
Completed by others.

In conclusion, the existing development setbacks from the 2007 report from CVD remain acceptable under the MNRF technical standards and SVCA Environmental Planning and Regulation Policies Manual. Based on a visual inspection by CMT Inc. personnel, the topography at the cross-section locations of the site appears to not have significantly changed from 2007 to today. If the owner wishes to move the development setback closer to the river, this may be possible from a geotechnical perspective by reducing any combination of the toe erosion allowance, stable slope allowance, and erosion access allowance. Further geotechnical testing and/or analysis will be required to modify setbacks from what was previously completed by CVD. CMT Engineering Inc. would be pleased to provide a proposal to provide this work. It should be noted that the erosion hazard (slope stability) is not the only technical factor limiting development closer to the Saugeen River. Other technical factors such as setbacks from flood lines should also be considered.

This report is intended for the Client named herein. The letter is written to be read in its entirety, and no portion of this report may be used as a separate entity. Any use which a third party makes of this letter, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

The recommendations made in this letter are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. Soil or water contamination is generally caused by the presence of xenobiotic (human-made) chemicals or other alteration processes in the natural soil and groundwater environment. If necessary, the investigation, assessment and rehabilitation of soil and water contaminants should be undertaken by qualified environmental specialists.

Prepared by:

West Morlock

Weston Morlock, M.Eng., EIT
Project Leader



Reviewed by:

Nathan Chortos, P.Eng.
Senior Geotechnical Engineer

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Enclosures:

- Drawing 1 – Site Location Plan
- Drawing 2 – Plan and Profile View Showing Photograph and Slope Cross-Section Locations
- Table 4.2 – Slope Stability Rating Chart
- Photographs 1-31



NOTES:

1. BASE MAP PROVIDED BY GOOGLE MAPS



NO.	DESCRIPTION	DATE
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REVISIONS



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PROJECT:
**SLOPE STABILITY ASSESSMENT
 20th Street
 Hanover, Ontario**

DRAWING TITLE:
SITE LOCATION MAP

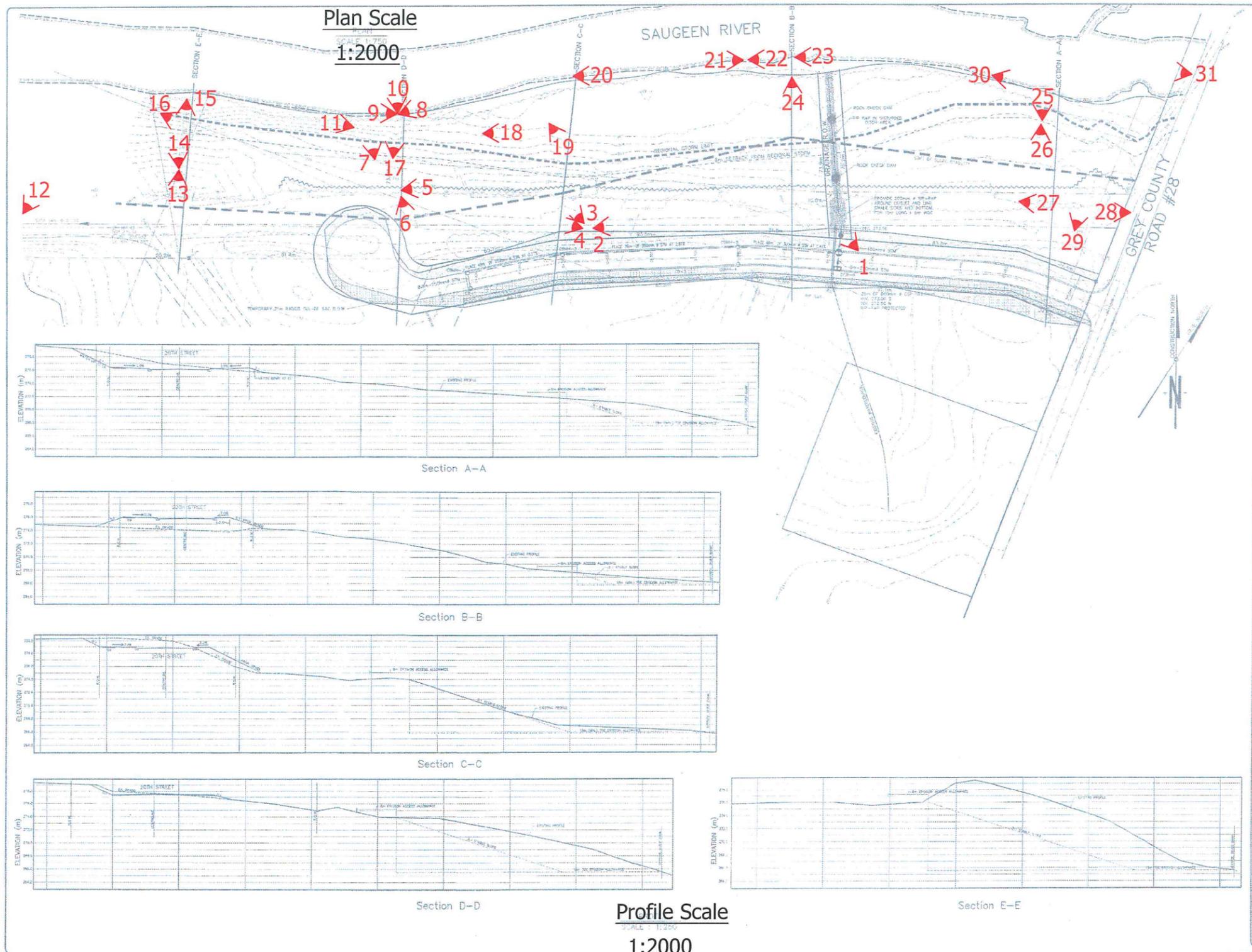
PROJECT NO.:	DATE:
18-027(a)	October 7, 2020
SCALE:	DRAWING NO.
N.T.S.	1

NOTES:

1. This drawing is for information purposes only. Locations and sizes of existing and proposed features are approximate only, and should not be used for construction.

LEGEND

➤ 31 CMT Photograph location, direction and number



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NO.	DESCRIPTION	DATE

REVISIONS

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 St. Clements, Ontario NOB 2M0
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PROJECT:
SLOPE STABILITY ASSESSMENT
 20th Street
 Hanover, Ontario

DRAWING TITLE:
PLAN AND PROFILE VIEW SHOWING PHOTOGRAPH AND SLOPE CROSS-SECTION LOCATIONS

PROJECT NO.:	DATE:
18-027(a)	October 7, 2020
SCALE:	DRAWING NO.:
VARIES	2

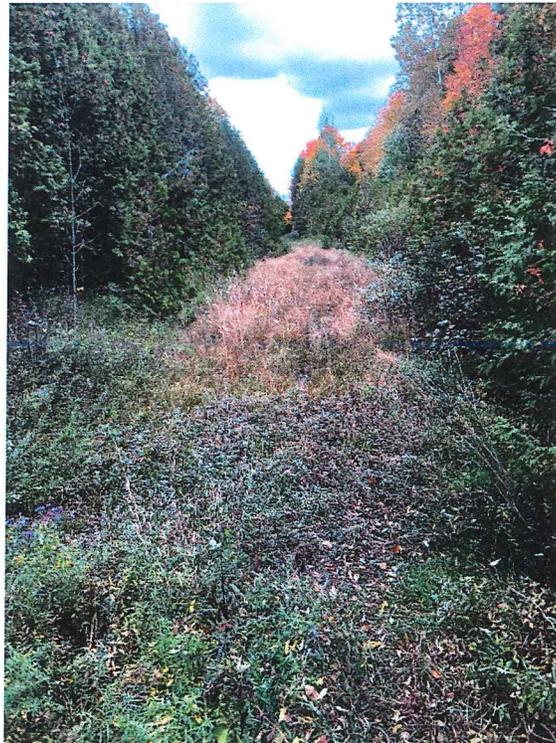
TABLE 4.2 - SLOPE STABILITY RATING CHART

Site Location <u>20th Street, Hanover, Ontario</u>	Project No. <u>18-027(a)</u>	
Property Owner _____	Inspection Date <u>2020/09/29</u>	
Inspected By <u>W.Morlock</u>	Weather <u>18°C Cloudy</u>	
1. SLOPE INCLINATION		
degrees	horiz:vert	
a) 18 or less	3:1 or flatter	0
b) 18 - 26	2:1 to more than 3:1	<u>6</u>
c) more than 26	steeper than 2:1	16
2. SOIL STRATIGRAPHY		
a) shale, limestone, granite (bedrock)		0
b) sand, gravel		6
c) glacial till		9
d) clay, silt		<u>12</u>
e) fill		16
f) leda clay		24
3. SEEPAGE FROM SLOPE FACE		
a) none or near bottom only		<u>0</u>
b) near mid-slope only		6
c) near crest only or from several levels		12
4. SLOPE HEIGHT		
a) 2.0 m or less		0
b) 2.1 m to 5.0 m		2
c) 5.1 m to 10.0 m		<u>4</u>
d) more than 10.0 m		8
5. VEGETATION COVER ON SLOPE FACE		
a) well-vegetated, heavy shrubs or forested with mature trees		<u>0</u>
b) light vegetation; mostly grass, weeds, occasional trees, shrubs		4
c) no vegetation, bare		8
6. TABLE LAND DRAINAGE		
a) table land flat, no apparent drainage over slope		0
b) minor drainage over slope, no active erosion		<u>2</u>
c) drainage over slope, active erosion, gullies		4
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE		
a) 15 metres or more from slope toe		0
b) less than 15 metres from slope toe		<u>6</u>
8. PREVIOUS LANDSLIDE ACTIVITY		
a) no		<u>0</u>
b) yes		6
SLOPE STABILITY RATING VALUES INVESTIGATION RATING SUMMARY		TOTAL 30
SUMMARY OF RATING VALUES AND RESULTING INVESTIGATION REQUIREMENTS		
1. Low potential	< 24	- site inspection only, confirmation report letter
2. Slight potential	<u>25-35</u>	- site inspection and surveying, preliminary study, detailed report
3. Moderate potential	>35	- boreholes, piezometers, lab tests, surveying, detailed report
NOTES:		
a) Choose only one from each category; compare total rating value with above requirements.		
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe, the potential for toe erosion and undercutting should be evaluated in detail and protection provided if required.		

Reference: Technical Guide - River and Stream Systems: Erosion Hazard Limit, Ontario Ministry of Natural Resources, 2002.



Photograph 1: Site photo facing north west showing existing culvert and Section B-B. Photograph taken September 29, 2020.



Photograph 2: Site photo facing east near the top of Section C-C. Photograph taken September 29, 2020.



Photograph 3: Site photo facing north west near the top of Section C-C. Photograph taken September 29, 2020.



Photograph 4: Site photo facing west near the top of Section C-C. Photograph taken September 29, 2020.



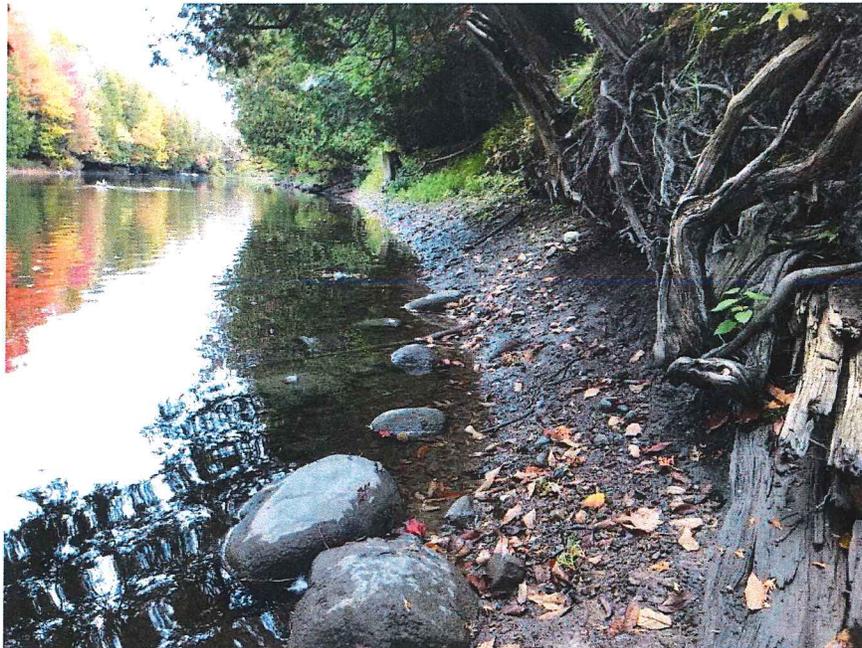
Photograph 5: Site photo facing east near the top of Section D-D. Photograph taken September 29, 2020.



Photograph 6: Site photo facing south east near the top of Section D-D. Photograph taken September 29, 2020.



Photograph 7: Site photo facing north west near the middle of Section D-D. Photograph taken September 29, 2020.



Photograph 8: Site photo facing east near the bank at Section D-D. Photograph taken September 29, 2020.



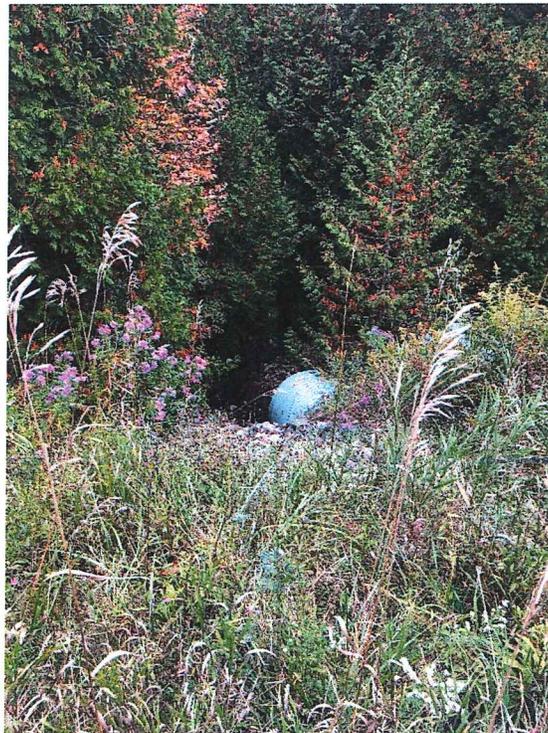
Photograph 9: Site photo facing west near the bank of Section D-D. Photograph taken September 29, 2020.



Photograph 10: Site photo facing north near the base of section D-D showing the north bank of the Saugen River. Photograph taken September 29, 2020.



Photograph 11: Site photo facing west to the west near the base of Section D-D. Photograph taken September 29, 2020.



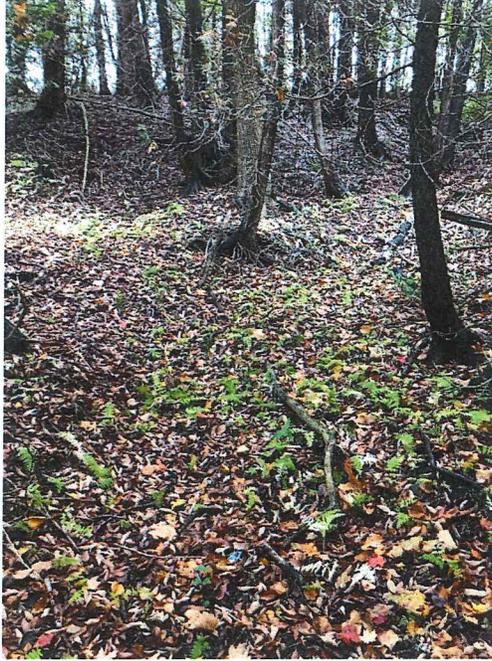
Photograph 12: Site photo facing north east to the west of section E-E near the top of slope showing the existing culvert. Taken on the pedestrian trail located at the western extent of the site, showing the existing culvert. Photograph taken September 29, 2020.



Photograph 13: Site photo facing north near the top of Section E-E. Photograph taken September 29, 2020.



Photograph 14: Site photo facing south near the top of Section E-E. Photograph taken September 29, 2020.



Photograph 15: Site photo facing south near the bottom of Section E-E. Photograph taken September 29, 2020.



Photograph 16: Site photo facing south east near the bottom to the west of Section E-E. Photograph taken September 29, 2020.



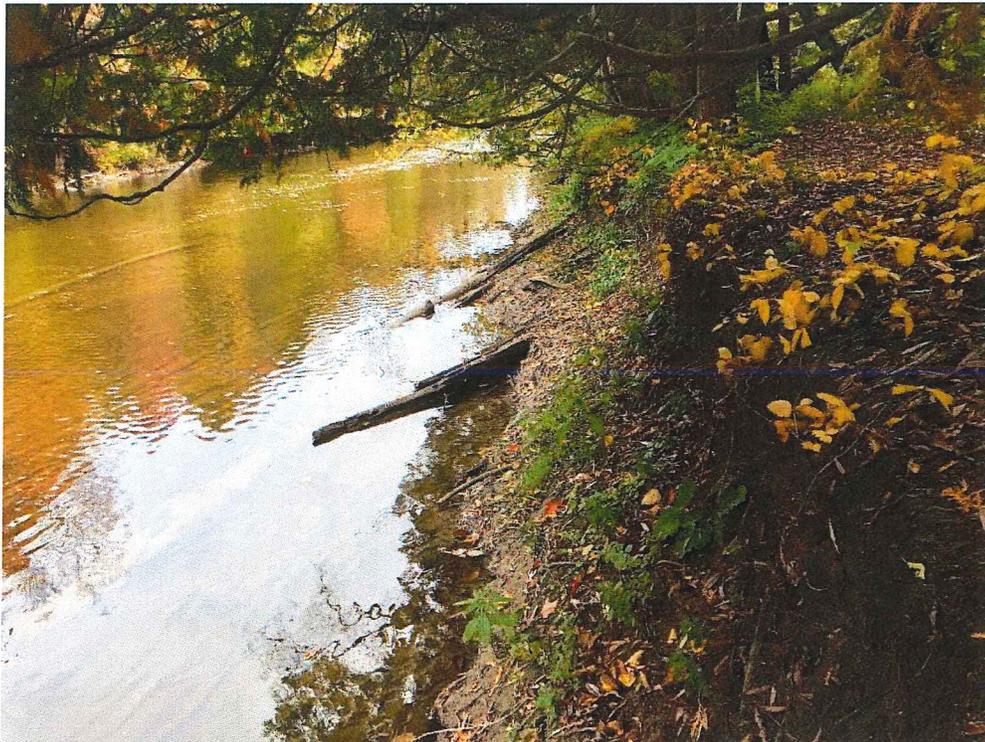
Photograph 17: Site photo facing north near the middle of Section D-D. Photograph taken September 29, 2020.



Photograph 18: Site photo facing east to the west of Section C-C. Photograph taken September 29, 2020.



Photograph 19: Site photo facing south east near the middle of Section C-C. Photograph taken September 29, 2020.



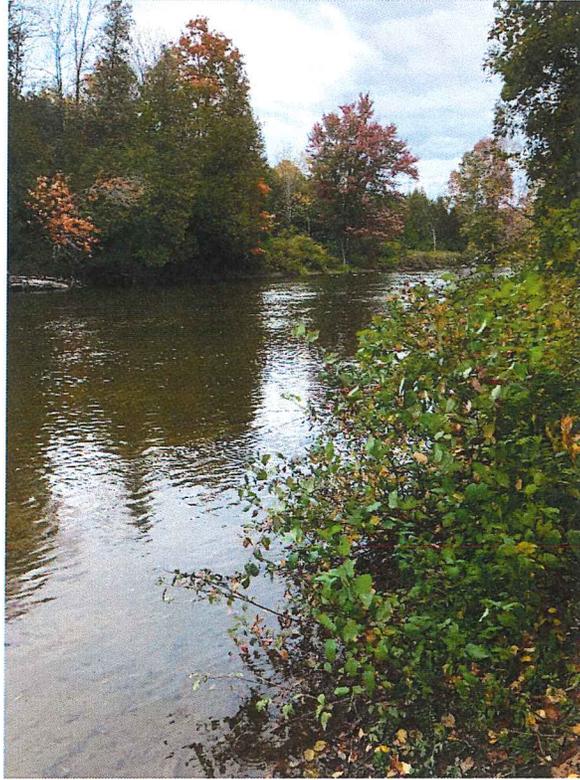
Photograph 20: Site photo facing east near the bank of Section C-C. Photograph taken September 29, 2020.



Photograph 21: Site photo facing west near the bank of Section B-B. Photograph taken September 29, 2020.



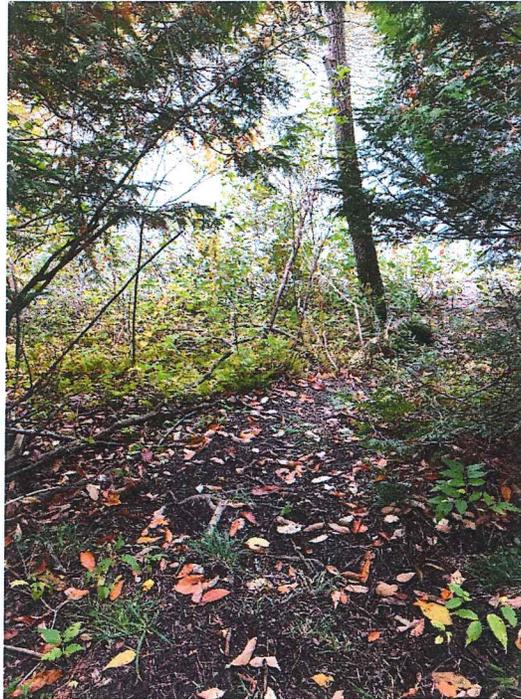
Photograph 22: Site photo facing east near the bottom of Section B-B. Photograph taken September 29, 2020.



Photograph 23: Site photo facing east near the base of Section B-B. Photograph taken September 29, 2020.



Photograph 24: Site photo facing south near the base of Section B-B. Photograph taken September 29, 2020.



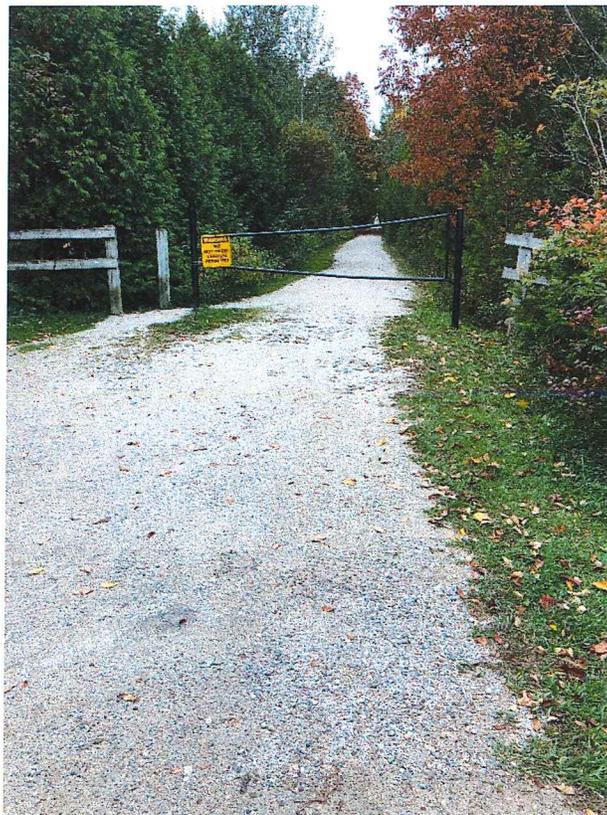
Photograph 25: Site photo facing north near the bottom of Section A-A. Photograph taken September 29, 2020.



Photograph 26: Site photo facing north near the bottom of Section A-A. Photograph taken September 29, 2020.



Photograph 27: Site photo facing east near the top of Section A-A. Photograph taken September 29, 2020.



Photograph 28: Site photo facing west near the top of Section A-A. Photograph taken September 29, 2020.



Photograph 29: Site photo near the top of Section A-A showing the existing well and well tag. Photograph taken September 29, 2020.



Photograph 30: Site photo facing east near the bottom of Section A-A. Photograph taken September 29, 2020.



Photograph 31: Site photo facing west, taken on the bridge located at the eastern extent of the site. Photograph taken September 29, 2020.