



Environmental

Geotechnical

Building Sciences

Construction
Monitoring

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Locations

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November 23, 2021

Carveth's Marina
426 Carveth's Marina Rd.
Lakefield, ON. K0L 2H0

Attn: Randy Hawth

Re: Slope Stability Study – 426 Carveth's Marina Road, Lakefield
Cambium Reference: 12908-002

Dear Mr. Hawth,

As requested, Cambium Inc. (Cambium) has completed a survey and visual slope stability inspection at 426 Carveth's Marina Road near Lakefield, Ontario (Site). The slope study was required in order to satisfy Otonabee Conservation's (ORCA's) request to better define the slope and calculate the top of the 3 horizontal to 1 vertical (3H:1V) stable slope, based on the Ontario Ministry of Natural Resources and Forestry (MNRF) "Geotechnical Principles For Stable Slopes" (June 1998). It is understood that the two proposed lots, outlined in Figure 1, are to be severed from the existing parcel for the purpose of residential development.

SLOPE STABILITY

An assessment of the slope was completed on November 3, 2021. The inspection included a visual assessment of the site, completion of a slope inspection record and slope rating chart, and surveying, using both a one-person RTK unit as well as a two-person total station unit due to lack of signal in the dense hardwood bush, to assess slope extents including height and inclination. The field investigation work is summarized below with the Inspection Record and Rating Chart provided in Appendix A and site photographs presented in Appendix B.

SLOPE INSPECTION

The slope at the Site is defined as the inclination that extends landward from the marina below to the table flat land lakeward of the Birchview Road. The Site is



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currently vacant with no development other than a satellite dish mounted on a concrete pad, on bedrock, near the west end of the lots. The slope is made up of a lower slope, multiple escarpments of exposed limestone bedrock, and an upper slope. The lower slope ranges from slightly dipping to greater than 3 horizontal to 1 vertical (3H:1V). The escarpments are vertical in places and the upper slope ranges from steeper than 3H:1V to relatively flat in places. Survey data obtained from the site defines the overall slope as being 14 m to 20 m in height, from west to east, with vertical exposures within the escarpments in places. The average overall slope varies from 1.3H:1V to 2.1H:1V over the Site.

The Site, including the slope, has dense hardwood tree growth, significant shrub growth and considerable grass and weed throughout. Only areas where the near-vertical escarpment was exposed did vegetation not exist.

Outcropped bedrock was observed throughout the slope, including within the lower slope, in the escarpment, at the top of slope, over the table flat land atop the slope, and adjacent to the road on north side and south sides of Birchview Road. The bedrock in the area is known to be limestone of the Shadow Lake Formation. The limestone in outcrops near the road was massive intact limestone. The limestone exposed within the escarpments was also massive limestone however, considerable weathering of the bedrock along the face has occurred over years of exposure. Evidence of spalling bedrock exists, as both small and large limestone blocks have fallen off the escarpment over the years. Thin layers of topsoil were observed over the bedrock, above and below the escarpment.

As per the appended Slope Inspection Record and Slope Stability Rating Chart, found in Appendix A, the total ratings value sums to 32 for the slope. This deems the slope has a slight potential for instability. Specific items of interest that contribute to this rating are outlined below:

1. Slope Inclination – There slope includes and escarpment which is vertical or near-vertical in places, giving a rating value of 16.
2. Soil Stratigraphy –The slope consists mainly of limestone with minimal soil and rock debris cover, giving a rating of 0.



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3. Seepage from Slope Face – At the time of the investigation, there was no apparent seepage from the slope face giving a best-case rating of 0.
4. Slope Height – The slope height for the site, ranges from 15 m to 20m across the site, resulting in a rating of 8.
5. Vegetation Cover on Slope Face – vegetation on the slope consists of dense mature hardwood forest with frequent brush, grasses and weeds, giving a rating of 0.
6. Table Land Drainage – There is a slight dip towards the slope in places, resulting in minor drainage over the slope, giving a rating of 2.
7. Proximity of Watercourse to Slope Toe – Stoney Lake is located well beyond (>15 m) the toe of the slope and therefore carries a rating of 0.
8. Previous Landslide Activity – Large limestone boulders at the base of the escarpment and smaller limestone blocks further down the slope provide evidence of previous slope failure, giving a rating of 6.

Based on the visual inspection, the presence of exposed bedrock on site, and the specific site conditions present, the slope at the site is considered to be unstable in its current condition, however the instability is related to surface spalling of rock, particularly in the near vertical sections, and there is not risk of deep seated slope failure. Many of these features can be seen in the site photos presented in Appendix B.

SLOPE SURVEY

The purpose of the survey, as per ORCA's request in their letter dated October 8, 2021, was to better define the following slope characteristics:

- Toe of slope
- Height of slope
- Calculate 3H:1V stable slope

In order to obtain the data to support ORCA's request over the dense hardwood bush that is present throughout the site, Cambium utilized both one and two-



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person survey equipment and spent 14 hours of time surveying on site. The Site was challenging to survey due to the dense hardwood bush throughout most of the site, the cedar grove in the northeast of the site, and the steep escarpment along the north side of the proposed lots. Each of these conditions inhibited the ability to achieve satellite signal and limited lateral sight lines, preventing all areas of the slope from being shot in great detail. Cambium's team was able to define the toe of slope, top of escarpment and top of slope with the data we collected. While data points were collected along the road edge elevations were not obtained over the developable portion of the lots themselves, as this was not required to achieve the 3H:1V slope.

DEVELOPMENT RECOMMENDATIONS

The top of 3H:1V stable slope falls within the proposed lots to be severed and is illustrated in Figure 1 and outlined in the cross sections in Figure 2. The 3H:1V stable slope represents a conservative estimate of the southern limit for the erosion hazard limit and may be further reduced through more detailed mapping escarpment. It is Cambium's opinion that residential development proposed south of the top of 3H:1V stable slope as illustrated in Figure1, is safe and will have no impact on the slope and vice versa.





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November 23, 2021

CLOSING

We trust the information in this report is sufficient for your current needs. If you have questions or comments regarding this document, please do not hesitate to contact Mr. Baird at (705) 742-7900 ext. 332 or Mr. Peterkin at ext. 301.

Respectfully submitted,

Cambium Inc.

Stuart Baird, P.Eng.
General Manager -
Geotechnical

Brian Peterkin, M.Eng., P.Geo
Senior Project Manager.

SEB/bjp

Encl.

Standard Limitations

Figure 1: Site Plan with Top of 3H:1V Stable Slope

Figure 2: Site Cross Sections

Appendix A: Slope Stability Inspection Record and Rating Chart

Appendix B: Site Photographs

P:\12900 to 12999\12908-002 Carveth's Marina - 426 Carveth's Marina Rd., Slope Stability\Deliverables\2021-11-23 - LTR RPT - 426 Carveth's Marina Rd Slope Stability.docx



November 23, 2021

STANDARD LIMITATIONS

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

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Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

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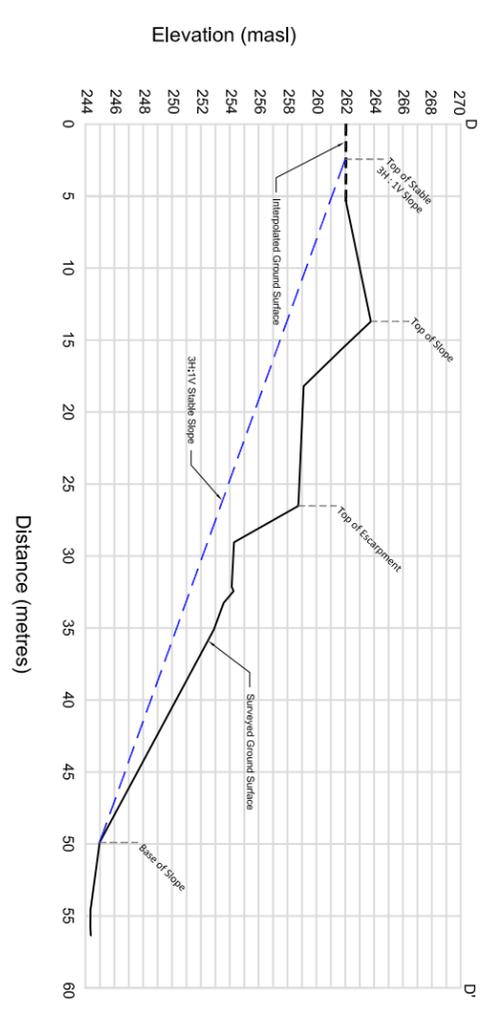
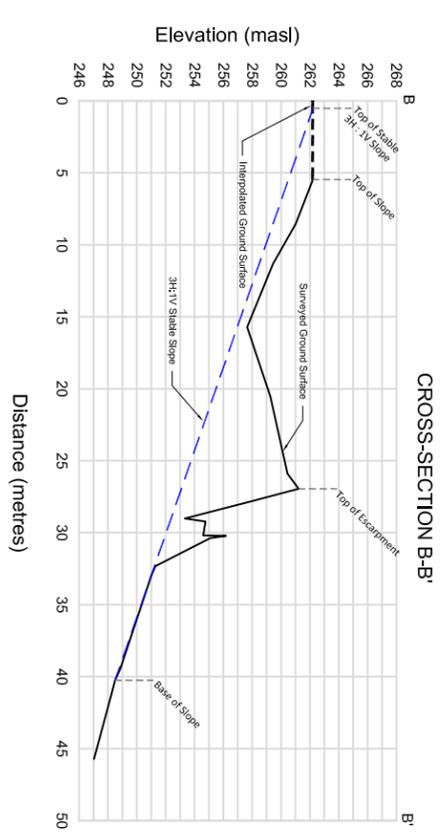
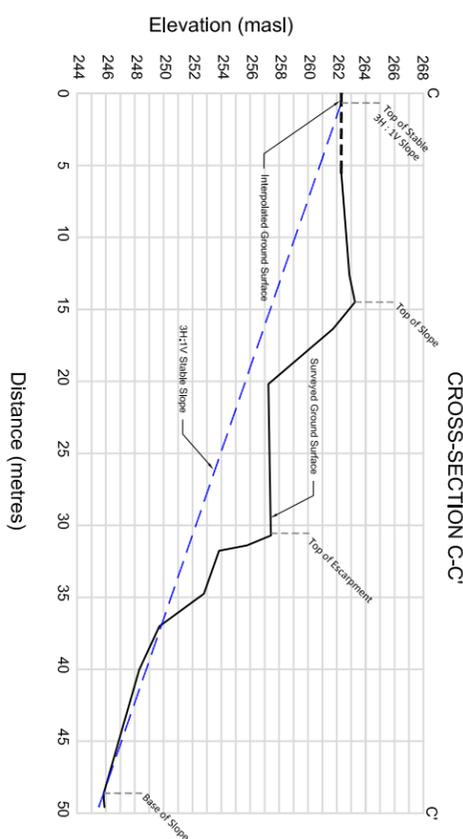
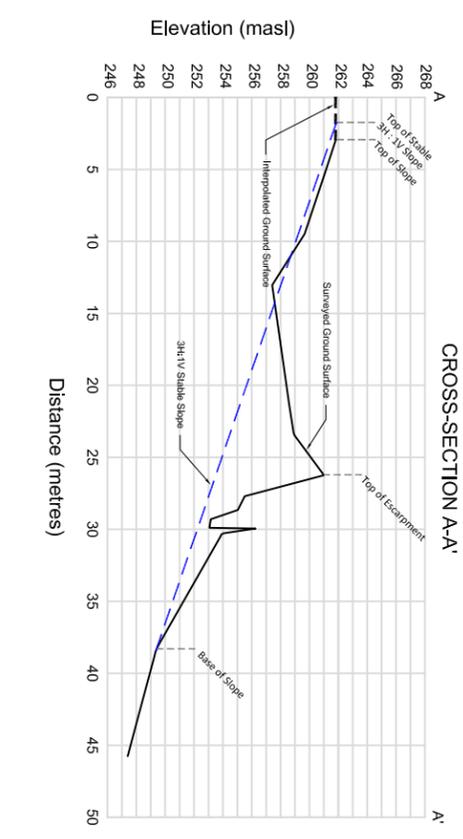
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LEGEND



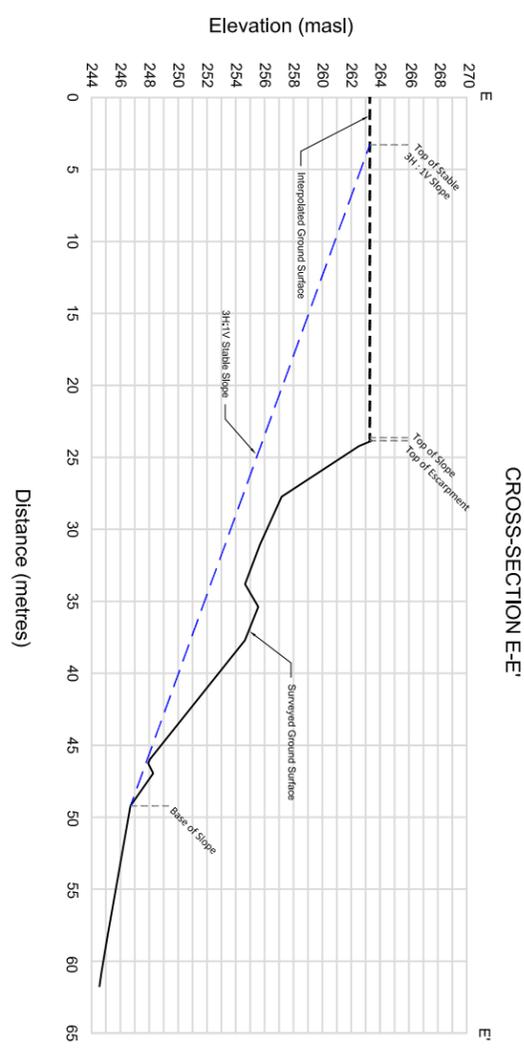
Notes:
 1. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.



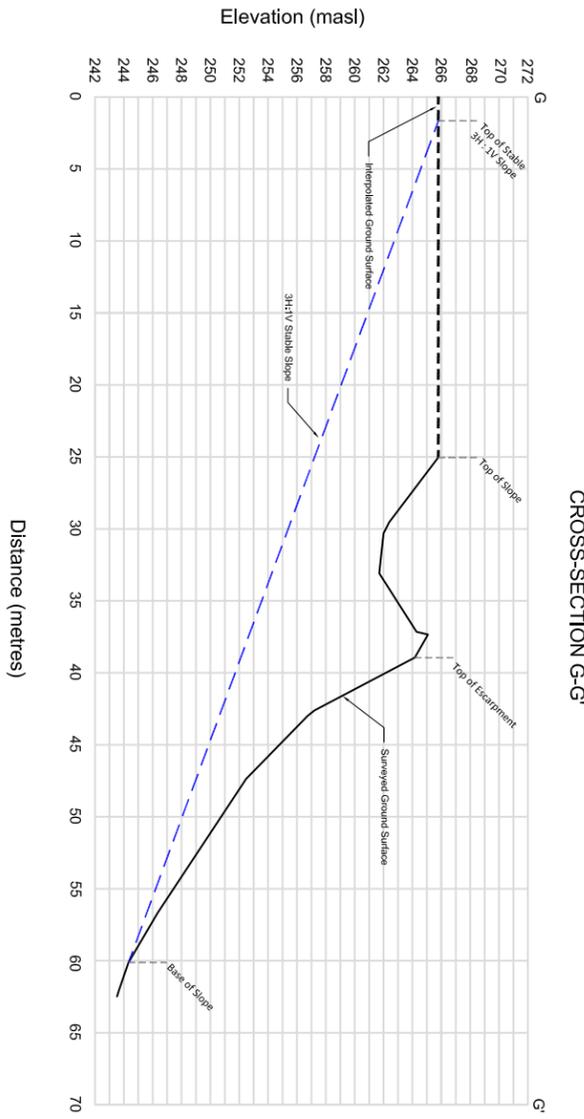
CROSS-SECTIONS A-A' TO D-D'

Project No.:	12908-002	Date:	November 2021
Horizontal Scale:	1:500	Vertical Scale:	1:1
Drawn By:	TLC	Checked By:	BP
Figure:	2		

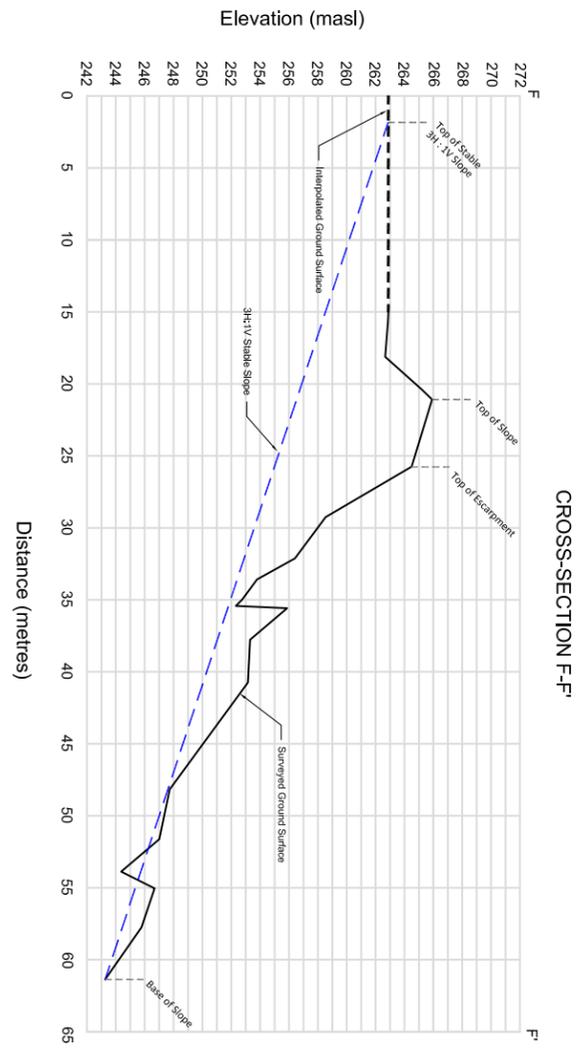
LEGEND



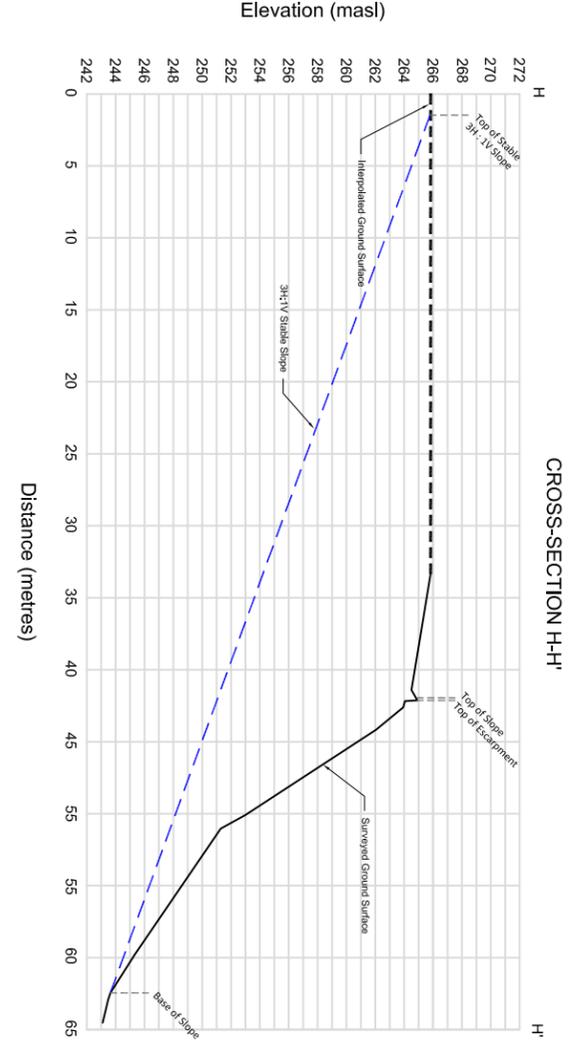
CROSS-SECTION E-E'



CROSS-SECTION G-G'



CROSS-SECTION F-F'



CROSS-SECTION H-H'

Notes:
 1. Distances on this plan are in metres and can be converted to feet by multiplying by 3.2808.



CROSS-SECTIONS E-E' TO H-H'

Project No.:	12908-002	Date:	November 2021
Horizontal Scale:	1:500	Vertical Scale:	1:1
Drawn By:	TLC	Checked By:	BP
Figure:	3		

SLOPE INSPECTION RECORD

TABLE 4.1 - Slope Inspection Record																																		
1. FILE NAME/NO. 12908-002 INSPECTION DATE: November 3, 2021 WEATHER (circle): <table style="display: inline-table; vertical-align: middle; margin-left: 20px;"> <tr> <td style="padding: 2px 10px;">sunny</td> <td style="padding: 2px 10px;">partly cloudy</td> <td style="padding: 2px 10px;">cloudy</td> </tr> <tr> <td style="padding: 2px 10px;">calm</td> <td style="padding: 2px 10px;">breeze</td> <td style="padding: 2px 10px;">windy</td> </tr> <tr> <td style="padding: 2px 10px;">clear</td> <td style="padding: 2px 10px;">fog</td> <td style="padding: 2px 10px;">rain</td> </tr> <tr> <td style="padding: 2px 10px;">cold</td> <td style="padding: 2px 10px;">cool</td> <td style="padding: 2px 10px;">warm</td> </tr> </table> estimated air temperature: 5°C INSPECTED BY: Brian Peterkin					sunny	partly cloudy	cloudy	calm	breeze	windy	clear	fog	rain	cold	cool	warm																		
sunny	partly cloudy	cloudy																																
calm	breeze	windy																																
clear	fog	rain																																
cold	cool	warm																																
2. SITE LOCATION (describe, main roads, features) SKETCH See attache Documents -Site located at 426 Carveth's Marina Road, Lakefield. The two lots in question are situate on the north side of Birchview Rd, atop the large escarpment immediately south of the Marina Stoney Lake to the north is not within 15 m of the base of the slope.																																		
3. WATERSHED																																		
4. PROPERTY OWNERSHIP (name, address, phone Carveths Marina, 426 Carveth's Road, Lakefield Randy Hauth 647-444-0503 LEGAL DESCRIPTION Lot Concession Township County CURRENT LAND USE (circle and describe) - vacant: field, bush, woods, forest, wilderness, tundra -> site has dense hardwood forrest with cedar grove to the northeast. An escarpment borders the north side of the two lots and Birchview Road borders the south side of the - passive: recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools - active: habitable structures, residential, commercial, industrial, warehousing and storage - infrastructure or public use: stadiums, hospitals, schools, bridges, high voltage power lines, waste management sites																																		
5. SLOPE DATA: <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">HEIGHT</td> <td style="width: 20%;">- 3-6 m</td> <td style="width: 20%;">- 6-10 m</td> <td style="width: 20%;">- 10-15 m</td> <td style="width: 10%; background-color: #cccccc;">- 15-20 m</td> </tr> <tr> <td></td> <td>- 20-25 m</td> <td>- 25-30 m</td> <td>- >30 m</td> <td></td> </tr> <tr> <td>estimated height (m):</td> <td colspan="4" style="text-align: center;">5.32 m</td> </tr> <tr> <td colspan="5" style="padding: 5px 0 0 0;">INCLINATION AND SHAPE</td> </tr> <tr> <td></td> <td>4:1 or flatter 25% 14°</td> <td>up to 3:1 33% 18°</td> <td>up to 2:1 50% 26°</td> <td></td> </tr> <tr> <td></td> <td>up to 1:1 100% 45°</td> <td>up to :1 200% 63°</td> <td style="background-color: #cccccc;">steeper than :1 >63°</td> <td></td> </tr> </table>					HEIGHT	- 3-6 m	- 6-10 m	- 10-15 m	- 15-20 m		- 20-25 m	- 25-30 m	- >30 m		estimated height (m):	5.32 m				INCLINATION AND SHAPE						4:1 or flatter 25% 14°	up to 3:1 33% 18°	up to 2:1 50% 26°			up to 1:1 100% 45°	up to :1 200% 63°	steeper than :1 >63°	
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	up to 1:1 100% 45°	up to :1 200% 63°	steeper than :1 >63°																															

SLOPE INSPECTION RECORD

6. SLOPE DRAINAGE (describe):

TOP Top of slope variable. Table flat land in places while there is minor drainage over the slope in other places.

FACE Exposed bedrock escarpment and this soil over bedrock, no sign of excessive drainage over

BOTTOM No sign of excessive drainage on site

7. SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types)

TOP Thin cover of topsoil over limestone bedrock, where not exposed

FACE Exposed bedrock in escarpment and thin soil over bedrock in places

BOTTOM Thin cover of topsoil over limestone bedrock, where not exposed

8. WATER COURSE FEATURES (circle and describe)

SWALE, CHANNEL

GULLY No watercourse features observed on site.

STREAM, CREEK, RIVER:

POND, BAY, LAKE

SPRINGS

MARSHY GROUND

9. VEGETATION COVER (grasses, weeds, shrubs, saplings, trees)

TOP Dense hardwood forest with significant shrub growth, grasses and weed. Cedar Grove to the northeast.

FACE Dense hardwood forest with significant shrub growth, grasses and weed. Cedar Grove to the northeast.

BOTTOM Dense hardwood forest with significant shrub growth, grasses and weed. Cedar Grove to

10. STRUCTURES (buildings, walls, fences, sewers, roads, stairs, decks, towers)

TOP N/A

FACE N/A

BOTTOM N/A

11. EROSION FEATURES (scour, undercutting, bare areas, piping, rills, gully)

TOP None observed

FACE None observed

BOTTOM None observed

SLOPE INSPECTION RECORD

12. SLOPE SLIDE FEATURES (tension cracks, scarps, bulges, grabens, ridges, bent trees)

TOP Cracks observed in bedrock near top of escarpment

FACE Large blocks of limestone fallen from escarpment face

BOTTOM Small blocks of limestone that have tumbled down the slope from escarpment face.

13. PLAN SKETCH OF SLOPE

See attached Figure

13. PROFILE SKETCH OF SLOPE

See attached Cross Sections

SLOPE STABILITY RATING CHART

Site Location: 426 Carveths Marina Road, Lakefield	File No. 12908-002
Property Owner: Carveths Marina	Inspection Date: November 3, 2021
Inspected By: Brian Peterkin	Weather: Sunny, cool
Inspection Task	Rating Value
1. SLOPE INCLINATION	
Degrees Horizontal:Vertical	
a) 18 or less 3:1 or flatter	0
b) 18 to 26 2:1 to more than 3:1	6
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	12
e) Fill	16
f) Leda Clay	24
3. SEEPAGE FROM SLOPE FACE	
a) None or near bottom only	0
b) Near mid-slope only	6
c) Near crest only or from several levels	12
4. SLOPE HEIGHT	
a) 2 m or less	0
b) 2.1 to 5 m	2
c) 5.1 to 10 m	4
d) more than 10 m	8
5. VEGETATION COVER ON SLOPE FACE	
a) Well vegetated, heavy shrubs or forested with mature trees	0
b) Light Vegetation; Mostly grass, weeds, occasional trees, shrubs	4
c) No vegetaion, bare	8
6. TABLE LAND DRAINAGE	
a) Table land flat, no apparent drainage over slope	0
b) Minor drainage over slope, no active erosion	2
c) Drainage over slope, active erosion, gullies	4
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE	
a) 15 m or more from slope toe	0
b) Less than 15 m from slope toe	6
8. PREVIOUS LANDSLIDE ACTIVITY	
a) No	0
b) Yes	6
RATING VALUES TOTAL	32
SLOPE INSTABILITY RATING	INVESTIGATION REQUIREMENTS
1. Low Potential <24	Site inspection only, confirmation, report letter
2. Slight Potential 25 - 35	Site inspection and surveying, preliminary study, detailed report
3. Moderate Potential >35	Boreholes, piezometers, lab tests, surveying detailed report
Notes:	
a) Choose only one rating value from each category; compare total rating value with above requirements	
b) If there is a waterbody (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.	
c) For leda clay and rock slopes, additional evaluation must be carried out	

Site Photographs



Photo 1: Exposed limestone on the south side of the property – north side of Birchview Road. Dense trees and brush immediately north of the road.



Photo 2: Exposed limestone on the south side of the property – north side of Birchview Road. Slight incline from the road north into the proposed lots.



Photo 3: Dense hardwood forest in table flat land atop the slope, within the proposed lots. Grasses and weeds present throughout



Photo 4: Another view of dense hardwood forest on table flat land. Some brush within the forest along with grass and weeds. Roots of tree in bottom right of photo are growing on bedrock and exposed bedrock is visible immediately behind the tree.



Photo 5: Limestone escarpment on the north side of the west lot, looking up from below.



Photo 6: View of slope from base. The escarpment protrudes to the south in the right of the of the photo and in the middle of the photo. The escarpment is less significant between the two and the slope is more constant.



Photo 7: Exposed limestone escarpment on the north side of the west lot looking east to the cut in the escarpment with more constant slope.



Photo 8: Up-close view of limestone with erosion between bedding planes.



Photo 9: Significant vertical escarpment on the north side of the east lot. Near vertical exposed limestone of greater than 3m in height atop a steep slope. Cedar trees visible at the base of the escarpment growing at an angle to vertical.

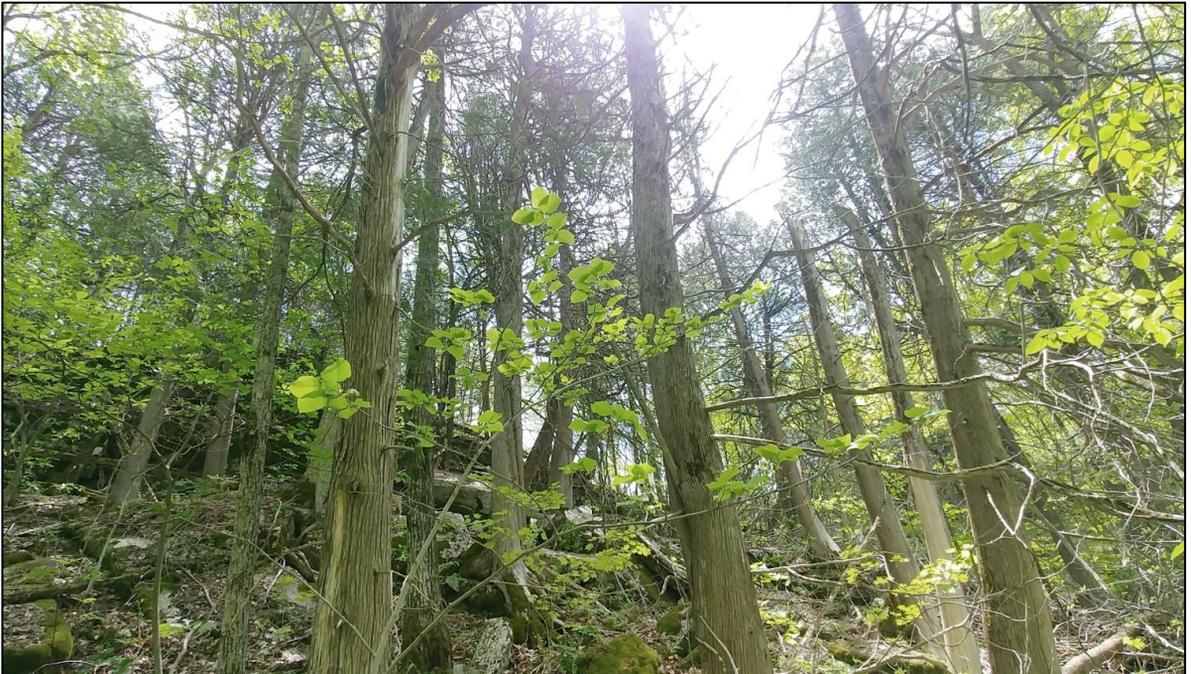


Photo 10: Small limestone blocks that have fallen/tumbled down the slope in the area of the cedar grove on the north side of the east lot.



Photo 11: General greater than 3H:1V slope below the escarpment leveling out to the north (right in the photo). Exposed limestone bedrock within the 3H:1V slope and below the base of the slope.



Photo 12: View of the slope and escarpment from the base of the slope, looking north.