CAMBIUM

Environmental

Geotechnical

Building Sciences

Community Development

Construction Testing & Inspection

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Locations
Peterborough
Kingston
Barrie
Oshawa

Laboratory
Peterborough

September 26, 2022

Yvette Johnston
74 Edwards Drive,
Keene, ON.

Re: Letter Report - Slope Stability Study
74 Edwards Drive, Keene, ON
Cambium Reference Number: 15831-001

Dear Yvette Johnston,

As requested, Cambium Inc. (Cambium) has completed a Slope Stability Study at the above-noted site to determine the stability of the native slope and the potential for building near the crest of the existing slope. It is understood that a qualified assessment of the stability of the slope is required by Peterborough County, in order to properly assess the potential for erosion and or failure that may result from the proposed development on the site.

SLOPE INSPECTION RECORD

The west half of the existing site consists of undeveloped land, that is sloped downward towards the east, with the slope in question ending at the existing gravel laneway. The east portion of the site (east of the laneway that runs north-south) is generally flat, well vegetated with a mixture of coniferous and deciduous trees, shrubs and grasses, and has some wetland areas. Based on the identified top of slope, and a survey conducted by a Cambium technician, the slope is deemed to range from 4 m to 5.5 m in height from the toe (bottom) of slope to the crest (top) of slope, with an overall slope ranging between 1.6H:1V and 4H:1V. Based on nearby borehole data, our experience in the area, observations on site, and hand auger boreholes completed at the time of the inspection, the soils are inferred to be glacial till. The slope was found to have no apparent seepage from anywhere along the slope face and no previous landslide activity. The slope was found to be well vegetated with the natural cover of mature trees and some shrubs. No watercourse is present with 15 m of the base of the slope, which for the purpose of this report is considered the laneway that runs through the site.

SLOPE STABILITY RATING CHART

The stability of the slope was assessed on-site, in accordance with the Ontario Ministry of Natural Resources ‘Table 8.1 - Geotechnical Principles for Stable Slopes’ (June 1998). As per the appended Slope Stability Rating Chart, the total ratings value sums to 21 for this slope, indicating a low potential for slope instability. Specific items of interest that contribute to this rating are outlined below as well as in the Slope Inspection Record in appended to this letter report:

1. Slope Inclination – the average inclination of the slope (from bottom of slope to top of slope) ranges from 2H:1V to 3H:1V, giving a moderate slope inclination rating of 6.
2. Soil Stratigraphy – based on nearby borehole data, our experience in the area, and completing hand auger holes, for the purposes of Table 8.1, the slope is considered to consist glacial till, giving a rating of 9.
3. Seepage from Slope Face – at the time of the investigation there was little to no seepage from the slope face, giving a best-case rating of 0.
4. Slope Height – the height of the slope, from bottom of slope (laneway) to the identified top of slope, ranges from 4.0 m to 5.5 m, giving a rating of 4. Any slope beyond the identified top of slope westward or southward is considered stable and not of concern for erosion since this area has an inclination no steeper than 3H:1V
5. Vegetation Cover on Slope Face – the slope was well vegetated with mature trees, shrubs and grasses. With this understanding we are able to give a rating of 0.
6. Table Land Drainage – the table land has some slope to it beyond the top of slope, with potential drainage over the slope, giving a rating of 2.
7. Proximity of Watercourse to Slope Toe – there is no watercourse within 15 m of the slope toe, giving a rating of 0.
8. Previous Landslide Activity – no apparent previous landslide activity was seen at the time of the investigation, giving a rating of 0.

SLOPE SURVEY

As part of the inspection, and in conjunction with the topographic survey completed by Cambium, six (6) cross sections (A-A' through to F-F') were surveyed at the Site and analyzed, as illustrated in on Figure 1 and presented in Figures 2, 3 and 4. The purpose of the survey was to obtain the slope height and inclination, top of slope and bottom of slope.

SLOPE ASSESSMENT AND GEOTECHNICAL DISCUSSION

Based on the information presented within this study, and the stability rating of 21, the native slope is considered to have low potential for instability as per the Ontario Ministry of Natural Resources 'Table 8.1 - Geotechnical Principles for Stable Slopes' (June 1998). Based on visual inspections, the low potential for instability and no present watercourse, the suggested toe erosion allowance for this site is deemed to be 0 m.

The crest/top of slope has been identified as the top of any slope that is steeper than an inclination of 3H:1V. The identified top of slope is demonstrated in Figure 1. Any slope beyond the top of slope westward (gradual incline to the west) or southward is considered stable and of no concern for erosion, and any development in these areas will not impact the stability of the slope, with the

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exception of the Development Setback line described below. As seen in Figure 1, the identified top of slope culminates at cross section D-D', as any slope beyond this point to the west or south becomes a non-hazard area (no steeper than 3H:1V).

Since the overall slope has a low potential for instability, the top of the existing slope can be considered the long-term stable top of slope, as long as no structures are developed within the slope height horizontal distance from the identified crest (top) of slope. This Development Setback limit is shown in Figures 1, 2 and 3. If development is proposed to be within this limit from the top of slope, then further investigations/studies will be required such as modelling, advancing boreholes/piezometer(s) or test pits, physical laboratory tests of the soil samples and a detailed report to support development through the slope and/or closer to the top of slope. This development limit does not apply for any "slope" beyond cross section D-D' to the south.

During construction, care should be taken to retain as much of the vegetation as possible and erosion control measures should be put in place to maintain the stable slope, including revegetation of the slope if any bushes or trees are removed and ensuring that there is no concentration of runoff from downspouts down the slope.

CLOSING

Cambium trusts that this slope stability study meets with the needs of the landowner and Municipality at this time. Please do not hesitate to contact the undersigned with any questions or comments.

Best regards,

Cambium Inc.

Juan Monroy, P.Eng.
Project Coordinator

Stuart Baird, M.Eng., P.Eng.
Director – Geotechnical Engineering

SEB/jdm

Figure 1: Site Plan
Figure 2: Cross Sections A and B
Figure 3: Cross Sections C and D
Figure 4: Cross Sections E and F
Appendix A: Slope Inspection Record & Slope Stability Rating Chart
Appendix B: Site Photographs

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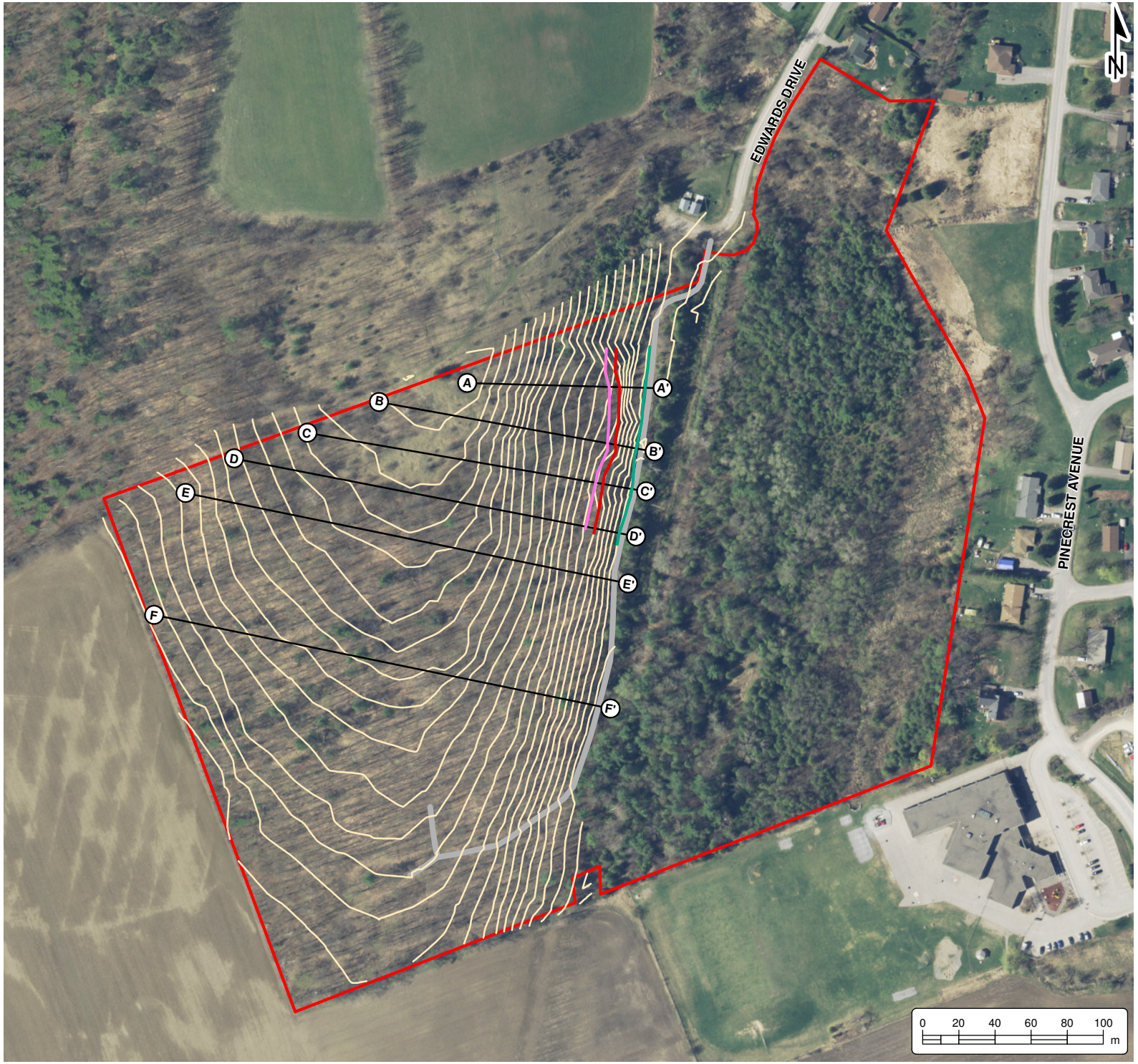

GEOTECHNICAL INVESTIGATION - SLOPE STABILITY

YVETTE JOHNSTON
74 Edwards Drive,
Keene, Ontario

LEGEND

- Development Setback
- Surveyed Bottom of Slope
- Surveyed Top of Slope
- Cross Section
- Contour (1m intervals)
- Gravel Road
- Site (approximate)

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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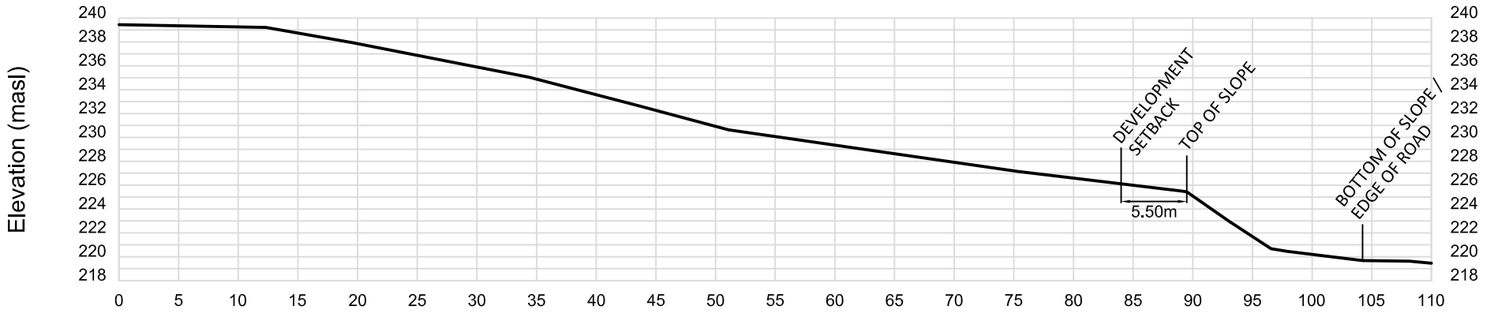
SITE PLAN

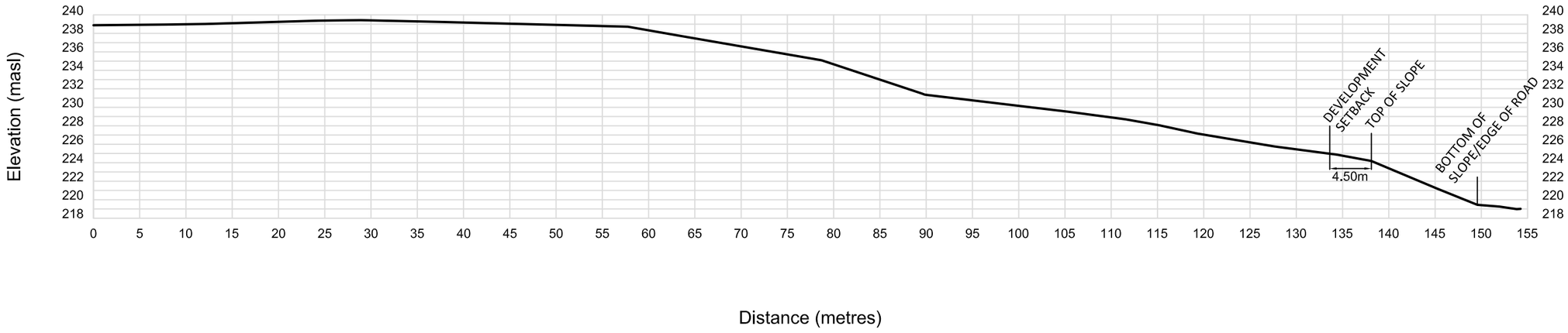
Project No.: 15831-001		Date: September 2022	Rev.:
Scale: 1:3,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: JM	Figure: 1	

O:\GIS\MXDs\15800-15899\15831-P - Yvette Johnston - EIS - 74 Edwards Drive, Keene\2022-08-10 FIG 1 - Site Plan.mxd

Cross Section A-A'



Cross Section B-B'



GEOTECHNICAL INVESTIGATION - SLOPE STABILITY
YVETTE JOHNSTON

74 Edwards Drive,
Keene, Ontario

LEGEND

Notes:
1. Survey completed by Cambium Inc. July 26, 2022.
2. Elevations are based on an MTO vertical elevation benchmark Cosine #00131960U3238, with an elevation of 206.595 (CGVD2013)
3. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

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CROSS SECTIONS
A-A' AND B-B'

Project No.:	Date:
15831-001	September 2022
	Rev.:
Horizontal Scale:	Vertical Scale:
N/A	N/A
Drawn By: MAT	Checked By: JM
	Figure: 2

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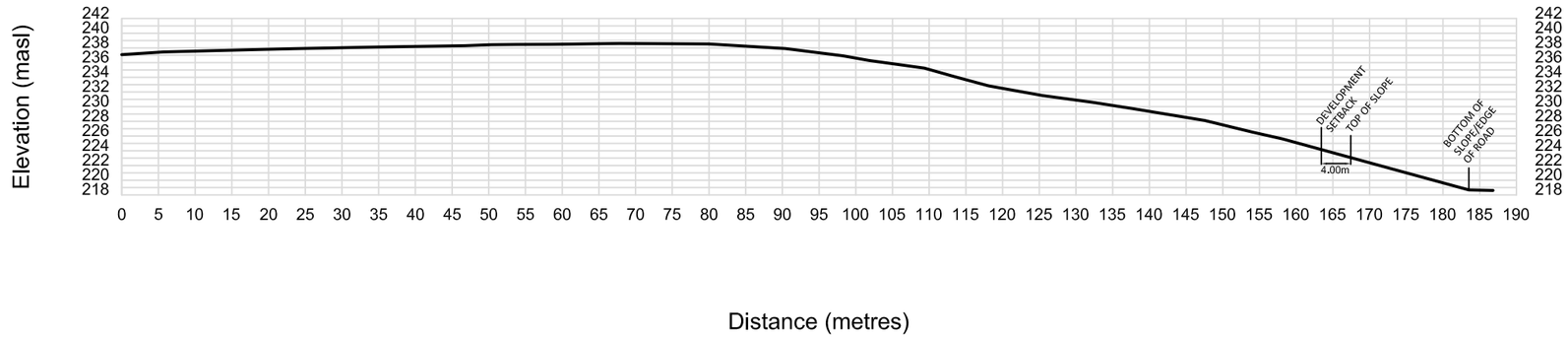
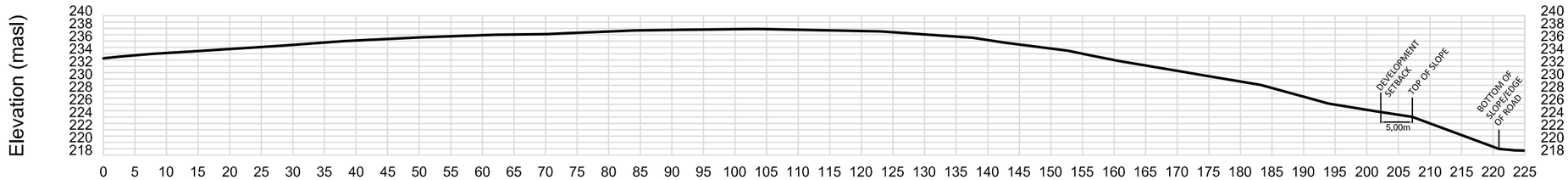
Cross Section C-C'



Distance (metres)

Cross Section D-D'



Distance (metres)

GEOTECHNICAL INVESTIGATION - SLOPE STABILITY
YVETTE JOHNSTON

74 Edwards Drive,
Keene, Ontario

LEGEND

Notes:
1. Survey completed by Cambium Inc. July 26, 2022.
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CROSS SECTIONS
C-C' AND D-D'

Project No.:	Date:
15831-001	September 2022
	Rev.:
Horizontal Scale:	Vertical Scale:
N/A	N/A

Drawn By:	Checked By:	Figure:
MAT	JM	3

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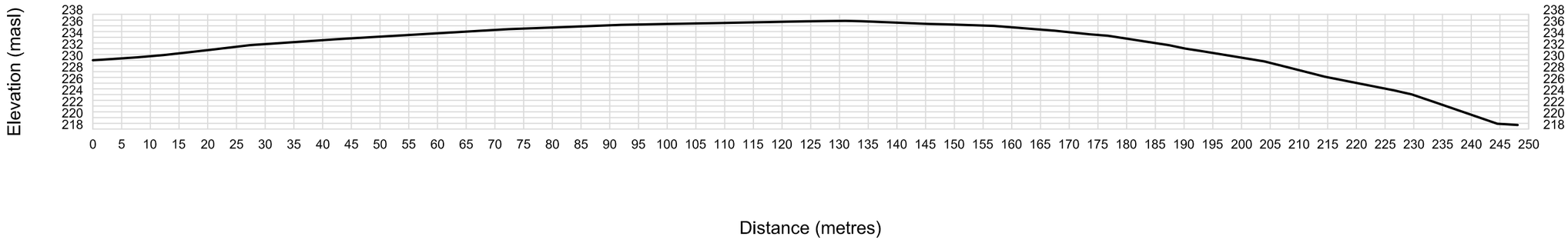
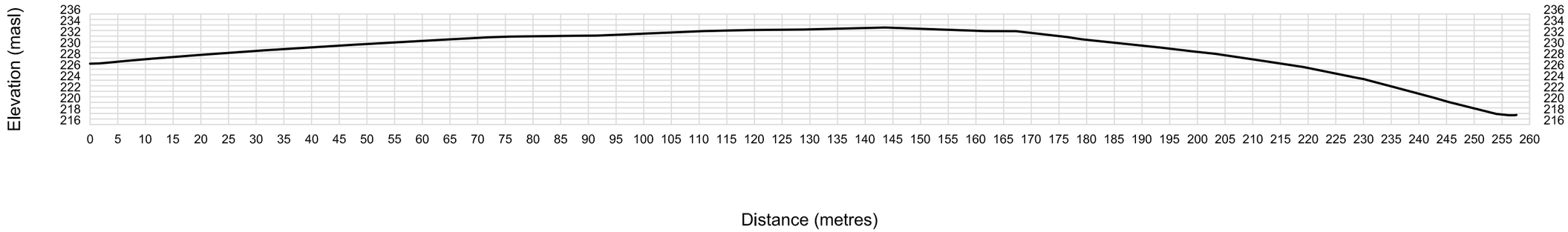
Cross Section E-E'



Cross Section F-F'



GEOTECHNICAL INVESTIGATION - SLOPE STABILITY
YVETTE JOHNSTON

74 Edwards Drive,
Keene, Ontario

LEGEND

Notes:
1. Survey completed by Cambium Inc. July 26, 2022.
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3. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

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CROSS SECTIONS
E-E' AND F-F'

Project No.:	Date:
15831-001	August 2022
	Rev.:
Horizontal Scale:	Vertical Scale:
N/A	N/A

Drawn By:	Checked By:	Figure:
MAT	JM	4

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SLOPE INSPECTION RECORD

TABLE 4.1 - Slope Inspection Record - Location for proposed Gazebo

1. FILE NAME/NO. 15831-001

INSPECTION DATE: 07/21/22

WEATHER (circle):

sunny	partly cloudy			cloudy
calm	breeze			windy
clear	fog		rain	snow
cold	cool		warm	hot

estimated air temperature: 28°C

INSPECTED BY: James Goodwin

2. SITE LOCATION (describe, main roads, features)

SKETCH

- Site located at 74 Edwards Drive, Keene, Ontario with closest major intersection at Heritage Line and Edwards Drive
- Some stagnant marshy areas observed on site. No major water features observed

3. WATERSHED

4. PROPERTY OWNERSHIP (name, address, phone):

LEGAL DESCRIPTION
- Lot
- Concession
- Township
- County

CURRENT LAND USE (circle and describe)

- vacant: field, bush, woods, forest, wilderness, tundra
  Vacant, heavily forested land.
- 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:

HEIGHT

- 3-6 m	- 6-10 m	- 10-15 m	- 15-20 m
- 20-25 m	- 25-30 m	- >30 m	

estimated height (m): 4 - 5 m from bottom of slope (gravel laneway to indentified top of slope)

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°

SLOPE INSPECTION RECORD

6. SLOPE DRAINAGE (describe):

TOP Property is mostly hilly with water draining in all directions. No major water is expected to drain over any slopes from adjacent properties.

FACE Some minor drainage potential through site during rainfall along small gullies.

BOTTOM Some minor drainage potential through site. Some stagnant water pools observed.

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

TOP Till: brown gravely sand some sand, occasional cobble, dry to moist.

FACE Till: brown gravely sand, some silt, occasional cobble, dry to moist.

BOTTOM 0-0.1 mbgs: Brown sand, some silt, moist, 0.1 - 0.7 mbgs, ranges from gravelly silty sand till, moist to wet to grey sandy silt till, moist to wet. 0.7 mbgs - 1.0 mbgs: grey clayey silt till, moist. 1.0 mbgs to 1.5 mbgs: grey coarse sand, some silt, trace to some gravel, moist to wet

8. WATER COURSE FEATURES (circle and describe)

SWALE, CHANNEL

GULLY

STREAM, CREEK, RIVER:

SPRINGS

MARSHY GROUND: Small patches of marshy ground observed ranging from 300mm in width to approximately 3m in width, more than 15 m from bottom of slope

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

TOP Heavily forested with lots of trees and foliage

FACE Heavily forested with lots of trees and foliage

BOTTOM Heavily forested with lots of trees and foliage

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 Minimal noted.

FACE Minimal observed. Some small gullies on slope

BOTTOM Minimal observed. Some gullies and wetland areas

SLOPE INSPECTION RECORD

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

TOP None Observed

FACE None Observed

BOTTOM None Observed

13. PLAN SKETCH OF SLOPE

See additional report appendices

13. PROFILE SKETCH OF SLOPE

See additional report appendices

SLOPE STABILITY RATING CHART

Site Location:	74 Edwards Drive, Keene, Ontario	File No.	15831-001
Property Owner:	Yvette Johnston	Inspection Date:	7/21/2022
Inspected By:	James Goodwin	Weather:	Overcast

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 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		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	**21**

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

Source: Table 8.1 Geotechnical Principles for Stable Slopes (June 1998), Ontario Ministry of Natural Resources

Site Photographs

Photo 1: View from near the top of slope, looking east. Mix of trees, shrubs, grasses.

Photo 2: View from near the top of slope, looking south. Mix of vegetation; trees, shrubs and grasses.

Photo 3: Image of middle of slope, looking north. Mix of vegetation on mid-slope.

Photo 4: Image of middle of slope, looking east towards bottom of slope

Photo 5: View of bottom of slope, with a mix of vegetation right up to the gravel road/bottom of slope.

Photo 6: Portion of marsh area, near the bottom of slope/gravel road.