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February 9, 2017

Reference No. 1512-S086

Related Reference No. 0210-S044

Page 1 of 6

2512461 Ontario Limited
3751 Victoria Park Avenue
Toronto, Ontario
M1W 3Z4

Attention: Mr. Shaun Joffe

**Re: Slope Stability Study Addendum
Proposed Residential Development
6611 Harmony Hill
City of Mississauga**

Dear Sir:

Further to our Soil Investigation and Slope Stability Study Report Update issued on January 26, 2016, we have reviewed the comments from the Credit Valley Conservation (CVC) dated May 5, 2016, requesting additional slope analysis to be performed for the slope. We herein present the revised results of the slope stability analysis performed using the detailed topographic information updated in 2016 and 2017.

Slope Stability Study

The slope stability study focuses on the valley slope of a drainage ditch along the northern border of the site. At the time of inspection, the drainage ditch was dry.



Four sections, Cross-Sections A-A to D-D, were selected for the analysis where the slope is the tallest and steepest. The locations of the cross-sections are shown on Drawing No. 1. These sections have an overall slope height of $3.0\pm$ to $6.0\pm$ m, measured from the tableland to the toe of slope or ditch, with an overall gradient of $1V:1.5\pm$ to $2.0\pm$ H. The surface profiles of the cross-sections were interpreted from the contours on the topographic plan prepared by Young & Young Surveying Inc.; the subsurface profiles are interpreted from the borehole logs. Cross-Sections A-A to D-D are shown on Drawing Nos. 2A to 5C, inclusive.

The borehole findings revealed that the site is generally underlain by a layer of silty clay till. A layer of earth fill, $4\pm$ m thick, was found in Borehole 2. Normal groundwater condition (NGC) was modeled after the dry condition observed upon completion of the field work. In considering the high seasonal groundwater condition, an assumed elevated groundwater condition (EGC) was added at approximately 1.5 m below surface grade in this study.

The valley feature is well defined in the eastern half of the studied area and gradually opens up and flattens at its entrance in the western half. Visual inspection revealed that the slope is vegetated with shrubs and some young to tall mature trees, most of which stand erect in a vertical orientation. Occasional garbage and debris such as cinder blocks was noted in the valley. While deep-seated failure and active erosion was not evident along the valley, bare slope surfaces and surface sloughing were observed in oversteepened areas.

The slope stability was analyzed using force-moment-equilibrium criteria of the Bishop Method with the soil strength parameters shown in the table below.



Strength Parameters For Slope Stability Analysis

	γ (kN/m ³)	c (kPa)	ϕ (degrees)
Earth Fill (Silty Clay)	21.0	0	26
Granular Fill	20.0	0	28
Silty Clay Till	22.0	5	30

The required minimum Factor of Safety (FOS) for active residential land use under NGC is 1.5, and the FOS under EGC is 1.3. The resulting FOS and corresponding setbacks for the various cross-sections are presented in the following table.

Cross-Section	FOS under Existing Slope Condition		FOS under Geotechnically Stable Condition		Geotechnically Stable Gradient	LTSSL Setback from TOB or TOS ^c (m)
	Normal ^a	Elevated ^b	Normal ^a	Elevated ^b		
A-A	1.80	1.60	-	-	-	-
B-B	1.54	1.19	-	1.38	1V:2H	2.8
C-C	0.93	-	1.52	1.36	1V:3H	4.9
D-D	1.24	-	1.64	1.51	1V:3H	3.9

^a Normal groundwater condition

^b Elevated groundwater condition

^c Long-term stable slope (LTSSL) setback is shown from the Top of Bank as staked January 12, 2016, with MNRF or from the physical top of slope, whichever is closer to the tableland.

The result from the analysis indicates that the slope at Cross-Sections A-A has FOS of 1.5+ under both NGC and EGC, which satisfies the CVC's Slope Stability Definition and Determination Guideline, 2011. The result of analyses is presented on Drawing Nos. 2A and 2B. The slope is therefore considered geotechnically stable at Cross-Section A-A.



For Cross-Sections B-B, C-C and D-D, the results show that the existing slopes have FOS of 0.93 to 1.24, which fails to meet the CVC requirements under either NGC or EGC except for Cross-Section B-B under the NGC where a FOS of 1.54 is achieved. The results of analyses are presented on Drawing Nos. 3A, 3B, 4A, and 5A. Therefore, the existing valley slope at these locations is considered to be geotechnically unacceptable for the proposed residential development. A stable gradient of 1V:2.0H and 1V:3.0H is recommended for use in sound native soils and earth fill, respectively. The remodelled slopes, yielding a FOS of 1.5+ or 1.3+ under NGC or EGC, respectively, which meets the CVC requirements, are presented on Drawing Nos. 3C, 4B, 4C, 5B and 5C.

In the absence of a watercourse at the bottom of slope, toe erosion allowance is thus not required. The long-term stable slope line (LTSSL), incorporating the geotechnically stable gradients is established on the Borehole and Cross-Section Location Plan, Drawing No. 1.

Lastly, a development setback buffer for man-made and environmental degradation of the bank will be required. The distance of the buffer is subject to the discretion and approval of CVC.

In future development, should any alteration be carried out in the slope areas, it should either be restored to its original condition or better than its original condition. In order to prevent the occurrence of localized surface slides in the future and to enhance the stability of the slope, the following geotechnical constraints should be stipulated:

1. The prevailing vegetative cover must be maintained, since its extraction would deprive the rooting system that is reinforcement against soil erosion by weathering. If for any reason the vegetation cover is stripped, it must be reinstated to its original, or better than its original, protective condition.



- Restoration with selective native plantings including deep rooting systems which would penetrate the original buried topsoil shall be carried out to ensure bank stability.
2. Grading of the land adjacent to the slope must be such that concentrated runoff is not allowed to drain onto the slope face. Landscaping features which may cause runoff to pond at the top of the slope, as well as saturation of the crown of the slope must not be permitted.
 3. The leafy topsoil cover on the bank face should not be disturbed, since this provides an insulation and screen against frost wedging and rainwash erosion.
 4. Where development is carried out near the top of the slope, there are other factors to be considered related to possible human environmental abuse. Soil saturation from maintenance of landscaping features, stripping of topsoil or vegetation, and dumping of loose fill over the bank must not be allowed.

The above recommendations are subject to the approval of the CVC.

All other recommendations stated in the original soil report and the update letter remain applicable without revision.



We trust this letter satisfies your present requirements; however, should any queries arise, please feel free to contact this office.

Yours truly,
SOIL ENGINEERS LTD.

Hui Wing Yang, B.A.Sc.

Bernard Lee, P.Eng.
HWY/BL:dd

ENCLOSURES

Borehole and Cross-Section Location Plan Drawing No. 1

Cross-Sections

Cross-Section A-A (Existing/Normal Groundwater Condition) Drawing No. 2A

Cross-Section A-A (Existing/Elevated Groundwater Condition)..... Drawing No. 2B

Cross-Section B-B (Existing/Normal Groundwater Condition)..... Drawing No. 3A

Cross-Section B-B (Existing/Elevated Groundwater Condition) Drawing No. 3B

Cross-Section B-B (Stable/Elevated Groundwater Condition) Drawing No. 3C

Cross-Section C-C (Existing/Normal Groundwater Condition)..... Drawing No. 4A

Cross-Section C-C (Stable/Normal Groundwater Condition) Drawing No. 4B

Cross-Section C-C (Stable/Elevated Groundwater Condition) Drawing No. 4C

Cross-Section D-D (Existing/Normal Groundwater Condition) Drawing No. 5A

Cross-Section D-D (Stable/Normal Groundwater Condition)..... Drawing No. 5B

Cross-Section D-D (Stable/Elevated Groundwater Condition) Drawing No. 5C

c. Soil Engineers Ltd. (Mississauga)
Attn.: Mr. Benjamin Lee

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We trust this letter satisfies your present requirements; however, should any queries arise, please feel free to contact this office.

Yours truly,
SOIL ENGINEERS LTD.

P.P. Hui Wing Yang, B.A.Sc.

Bernard Lee, P.Eng.
HWY/BL:dd



ENCLOSURES

Borehole and Cross-Section Location Plan..... Drawing No. 1

Cross-Sections

Cross-Section A-A (Existing/Normal Groundwater Condition)..... Drawing No. 2A

Cross-Section A-A (Existing/Elevated Groundwater Condition)..... Drawing No. 2B

Cross-Section B-B (Existing/Normal Groundwater Condition)..... Drawing No. 3A

Cross-Section B-B (Existing/Elevated Groundwater Condition)..... Drawing No. 3B

Cross-Section B-B (Stable/Elevated Groundwater Condition)..... Drawing No. 3C

Cross-Section C-C (Existing/Normal Groundwater Condition)..... Drawing No. 4A

Cross-Section C-C (Stable/Normal Groundwater Condition)..... Drawing No. 4B

Cross-Section C-C (Stable/Elevated Groundwater Condition)..... Drawing No. 4C

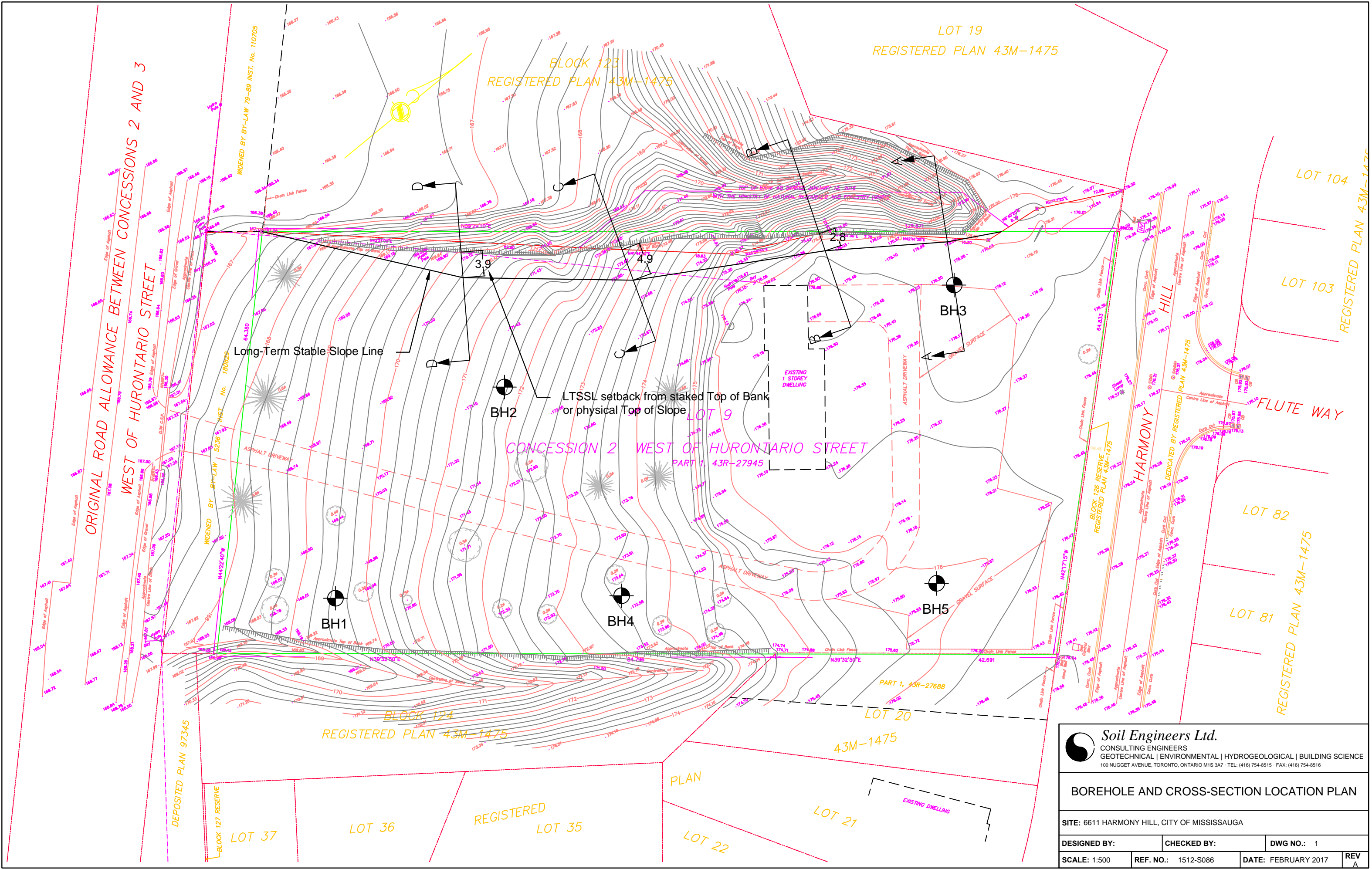
Cross-Section D-D (Existing/Normal Groundwater Condition)..... Drawing No. 5A


Cross-Section D-D (Stable/Normal Groundwater Condition)..... Drawing No. 5B

Cross-Section D-D (Stable/Elevated Groundwater Condition)..... Drawing No. 5C

c. Soil Engineers Ltd. (Mississauga)
Attn.: Mr. Benjamin Lee

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BOREHOLE AND CROSS-SECTION LOCATION PLAN

SITE: 6611 HARMONY HILL, CITY OF MISSISSAUGA

DESIGNED BY:

CHECKED BY:

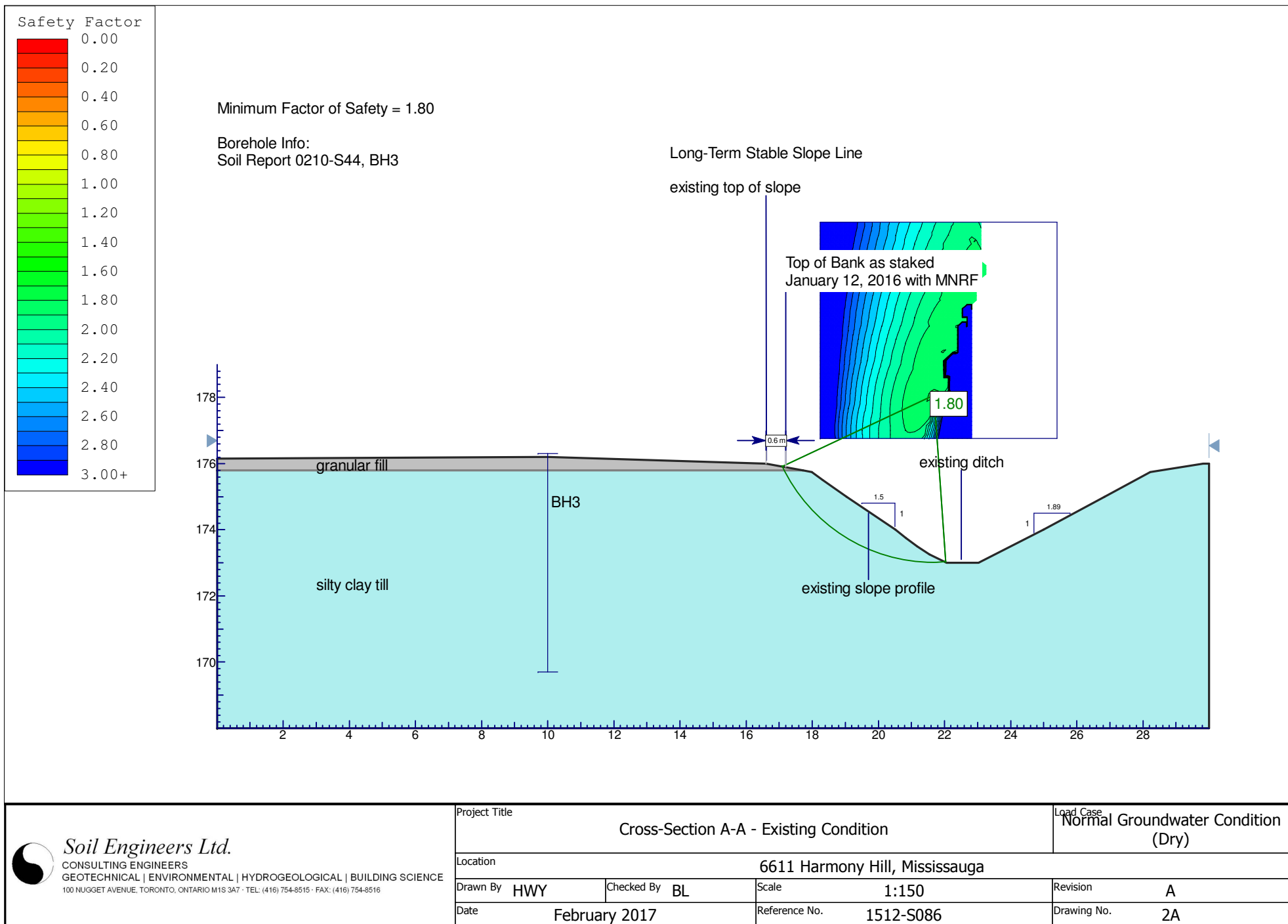
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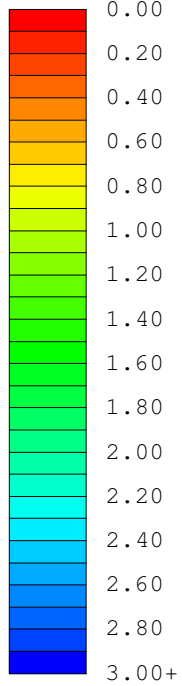
REF. NO.: 1512-S086

DATE: FEBRUARY 2017

REV A

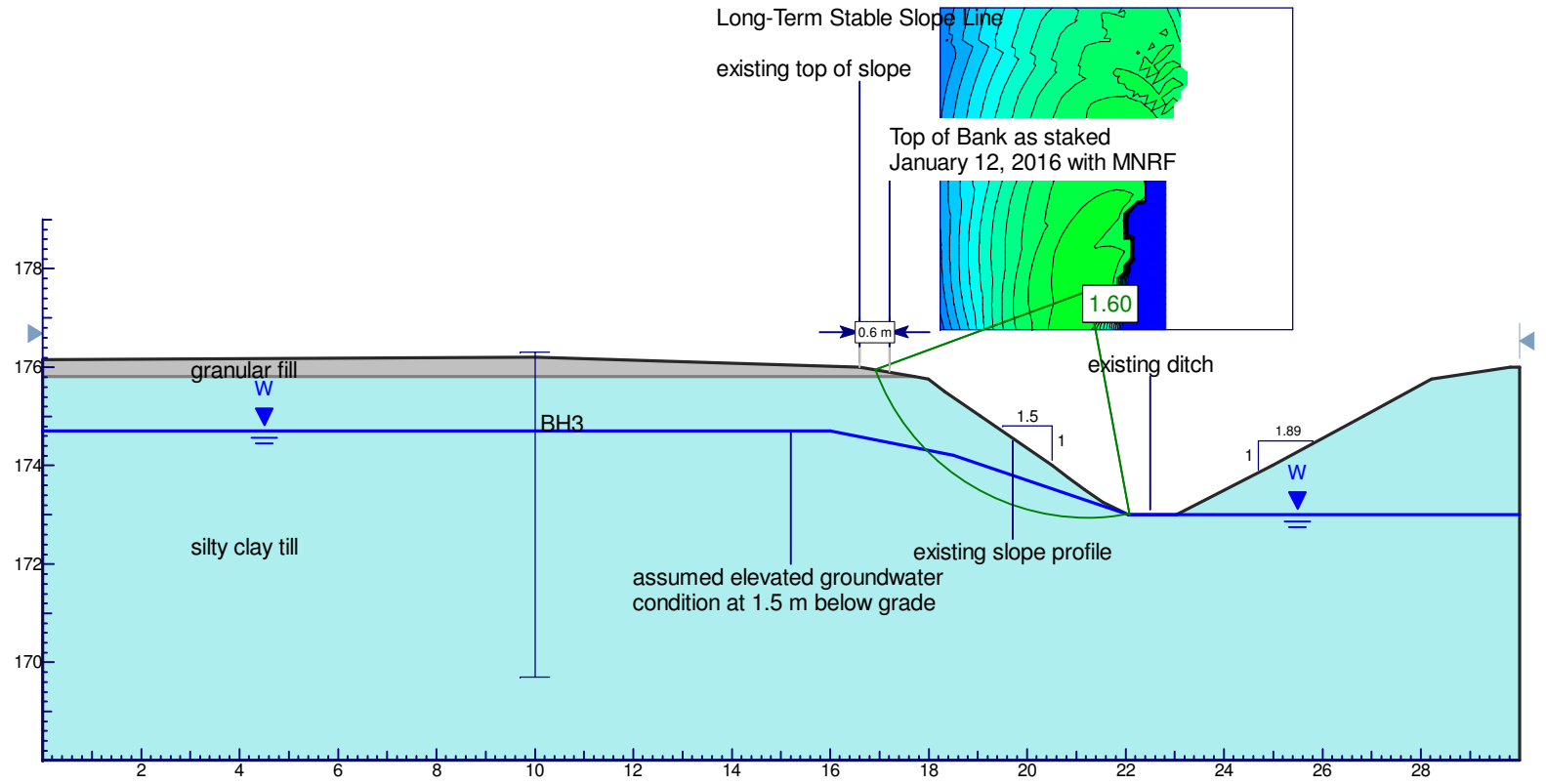


Safety Factor



Minimum Factor of Safety = 1.60

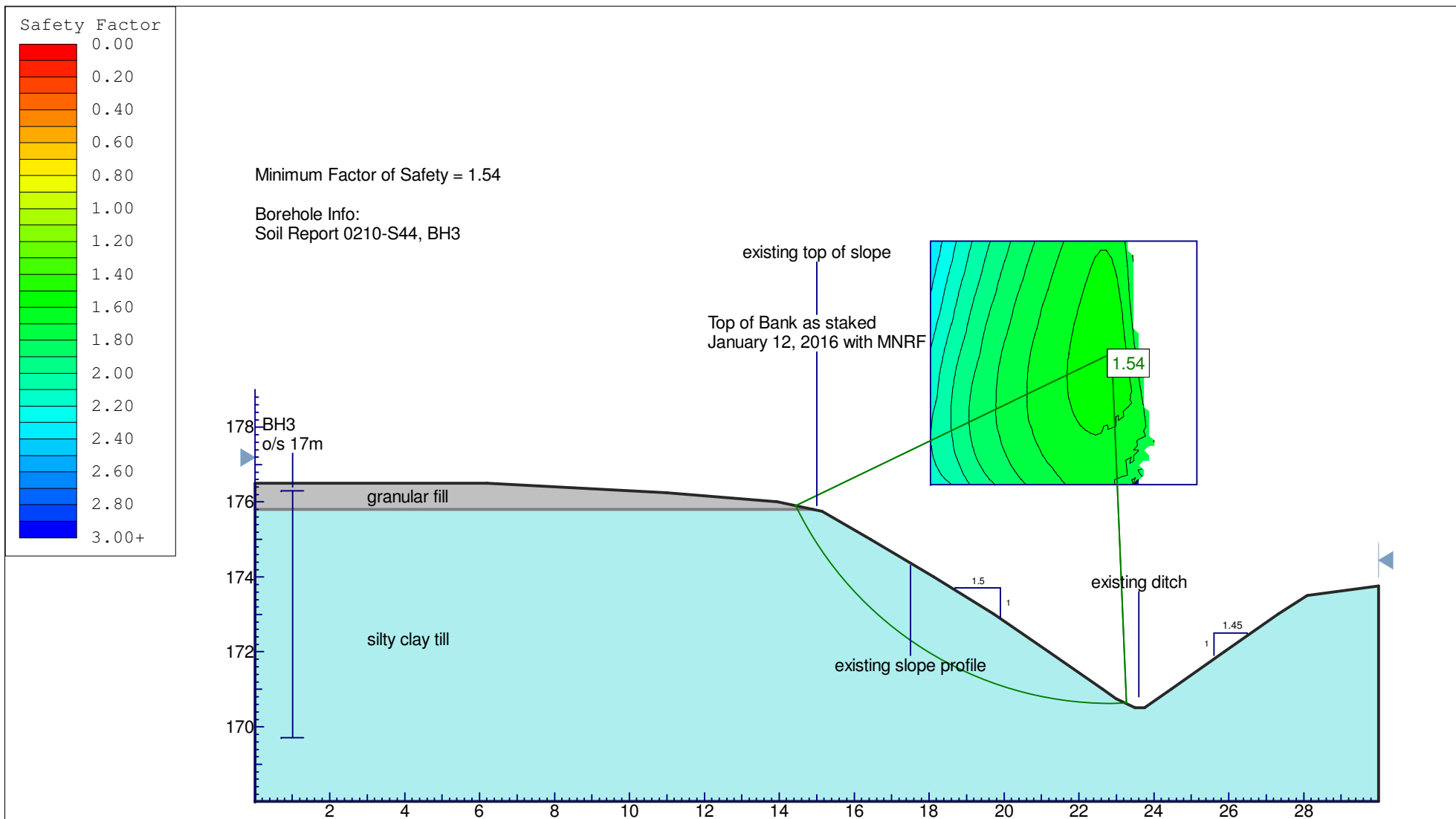
Borehole Info:
Soil Report 0210-S44, BH3




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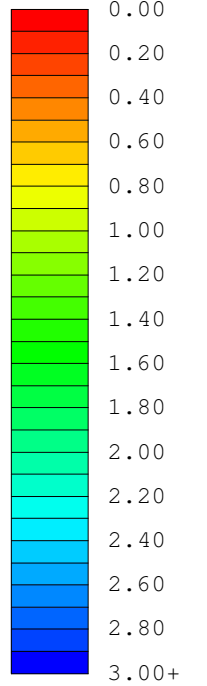
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Project Title			Cross-Section A-A - Existing Condition		Load Case	
					Elevated Groundwater Condition	
Location			6611 Harmony Hill, Mississauga			
Drawn By		HWY	Checked By		BL	Scale
						1:150
Date			February 2017		Reference No.	
					1512-S086	
					Revision	
					A	
					Drawing No.	
					2B	



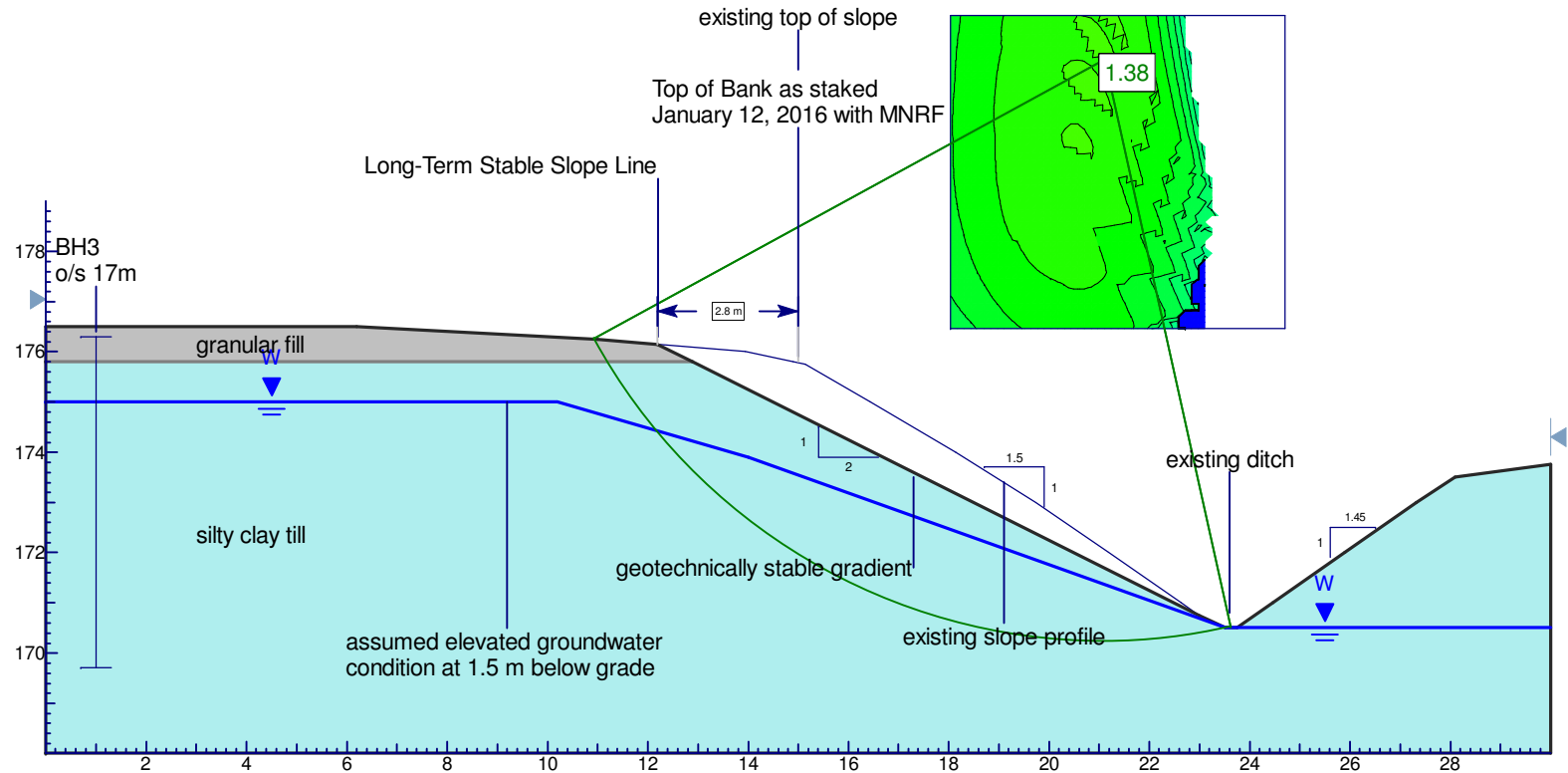
 <div>Soil Engineers Ltd.</div> <div>CONSULTING ENGINEERS GEOTECHNICAL ENVIRONMENTAL HYDROGEOLOGICAL BUILDING SCIENCE 100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 • TEL: (416) 754-8515 • FAX: (416) 754-8516</div>	Project Title			Cross-Section B-B - Existing Condition		Load Case		Normal Groundwater Condition (Dry)								
	Location			6611 Harmony Hill, Mississauga												
	Drawn By		HWY		Checked By		BL		Scale		1:150		Revision		A	
	Date		February 2017				Reference No.		1512-S086				Drawing No.		3A	

Safety Factor



Minimum Factor of Safety = 1.38

Borehole Info:
Soil Report 0210-S44, BH3

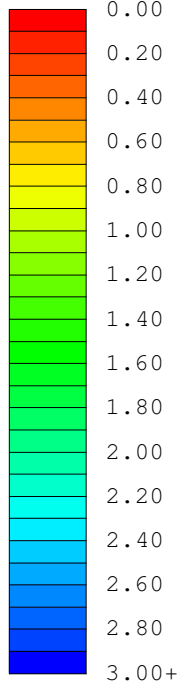


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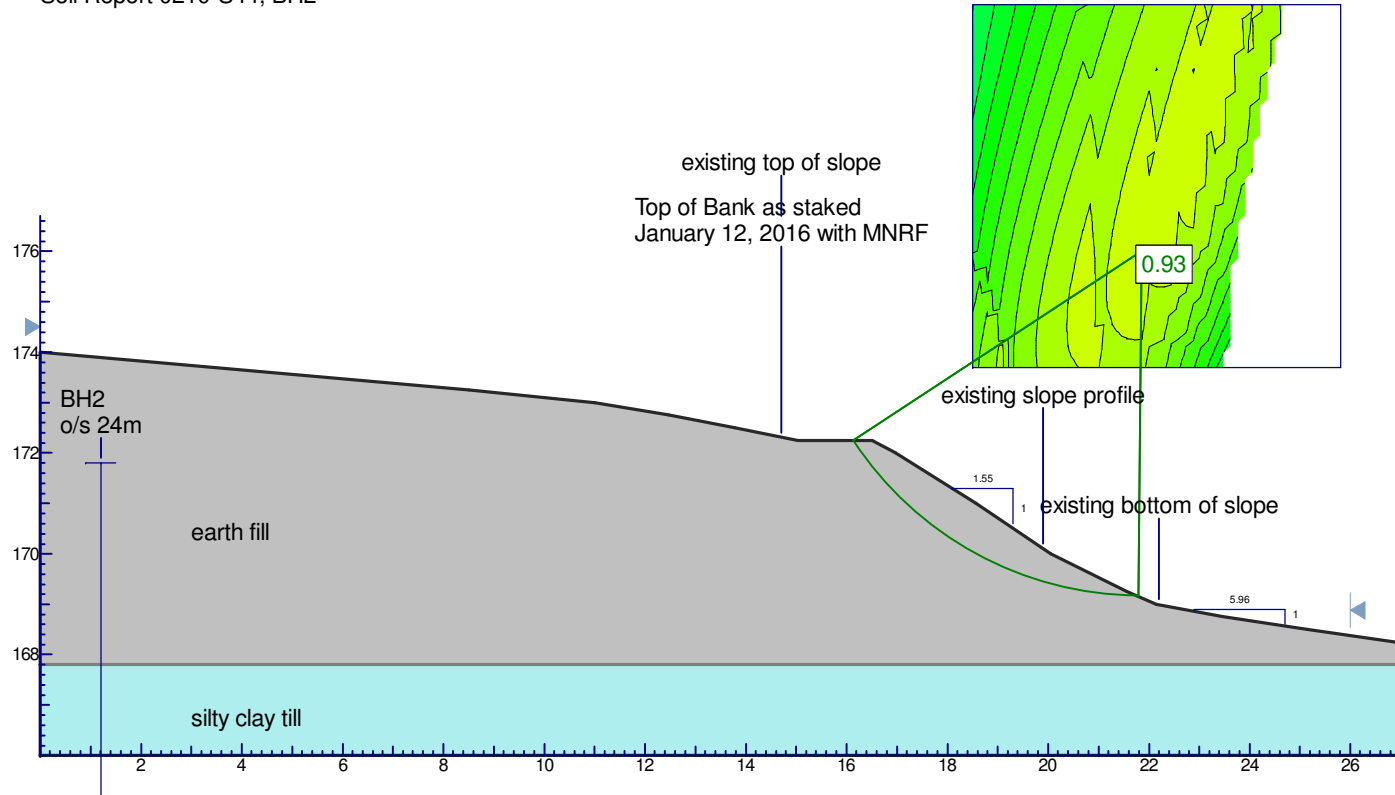
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				Elevated Groundwater Condition
Location		6611 Harmony Hill, Mississauga		
Drawn By	HWY	Checked By	BL	Revision
Date		February 2017		A
		Reference No.	1512-S086	Drawing No.
				3C

Safety Factor



Minimum Factor of Safety = 0.93

Borehole Info:
Soil Report 0210-S44, BH2



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Project Title

Cross-Section C-C - Existing Condition

Load Case

Normal Groundwater Condition
(Dry)

Location

6611 Harmony Hill, Mississauga

Drawn By HWY

Checked By BL

Scale

1:150

Revision

A

Date

February 2017

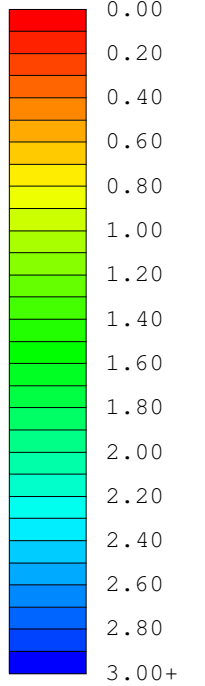
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1512-S086

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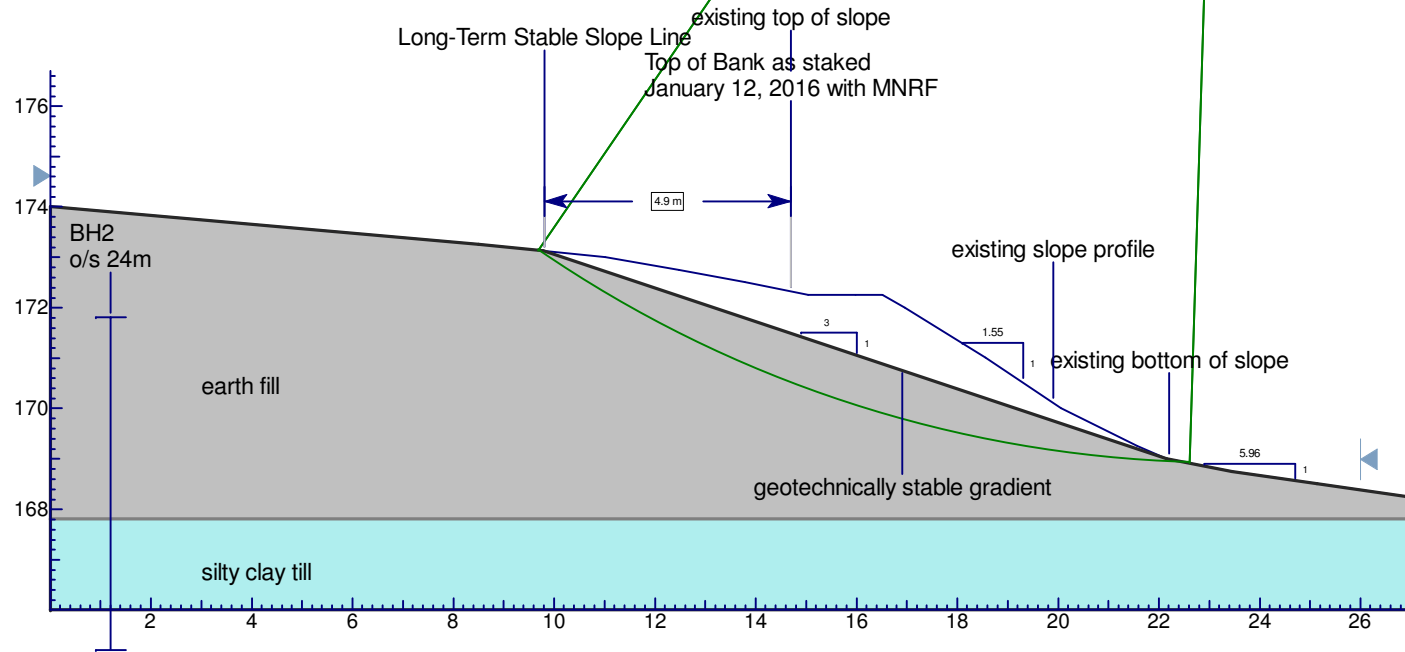
4A

Safety Factor



Minimum Factor of Safety = 1.52

Borehole Info:
Soil Report 0210-S44, BH2



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Project Title

Cross-Section C-C - Geotechnically Stable Condition

Load Case

Normal Groundwater Condition
(Dry)

Location

6611 Harmony Hill, Mississauga

Drawn By

HWY

Checked By

BL

Scale

1:150

Revision

A

Date

February 2017

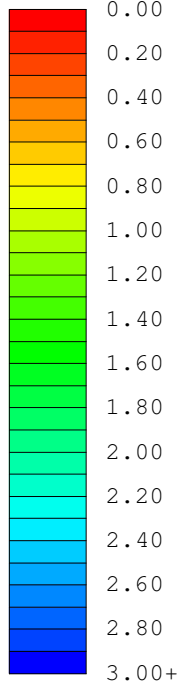
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1512-S086

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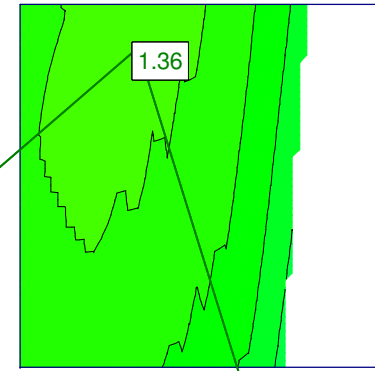
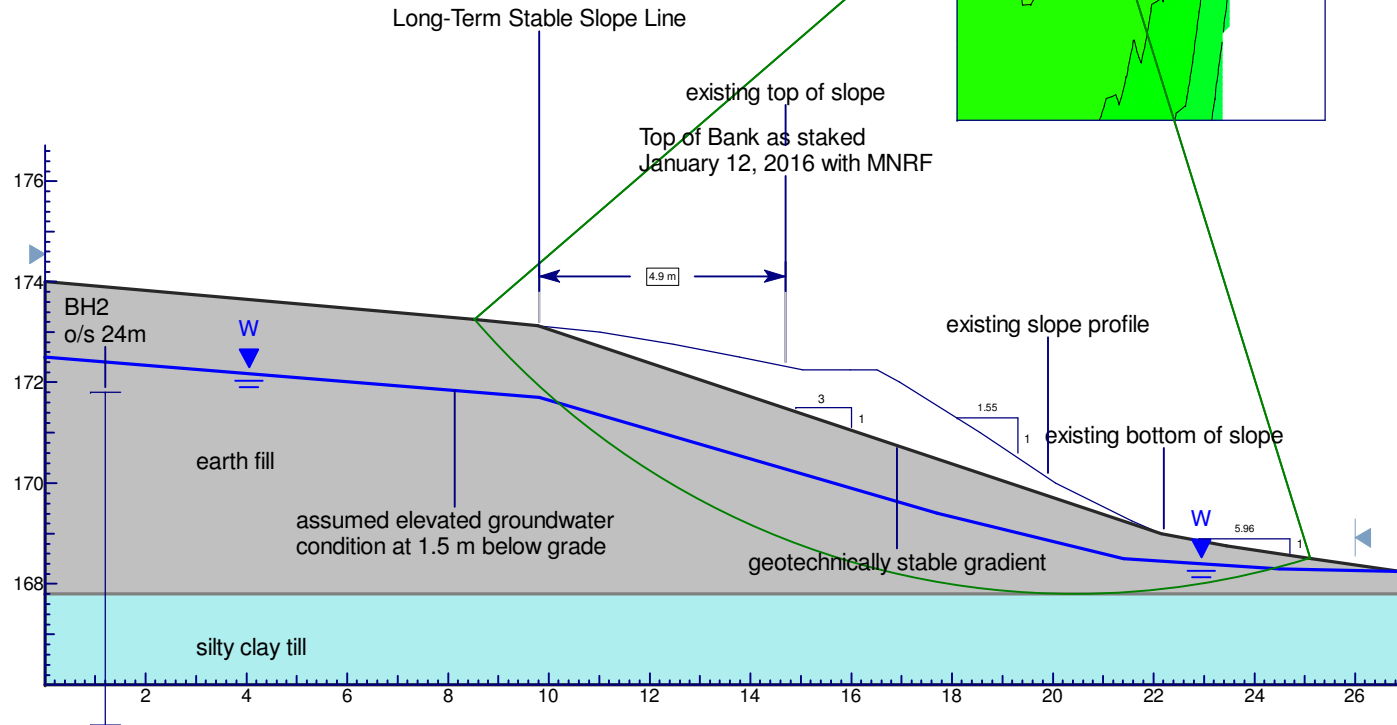
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Safety Factor



Minimum Factor of Safety = 1.36

Borehole Info:
Soil Report 0210-S44, BH2

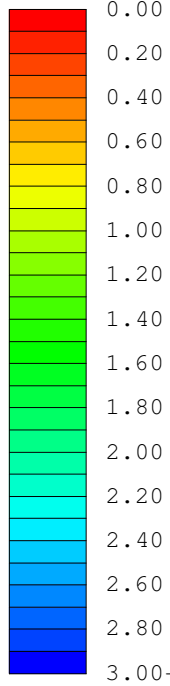


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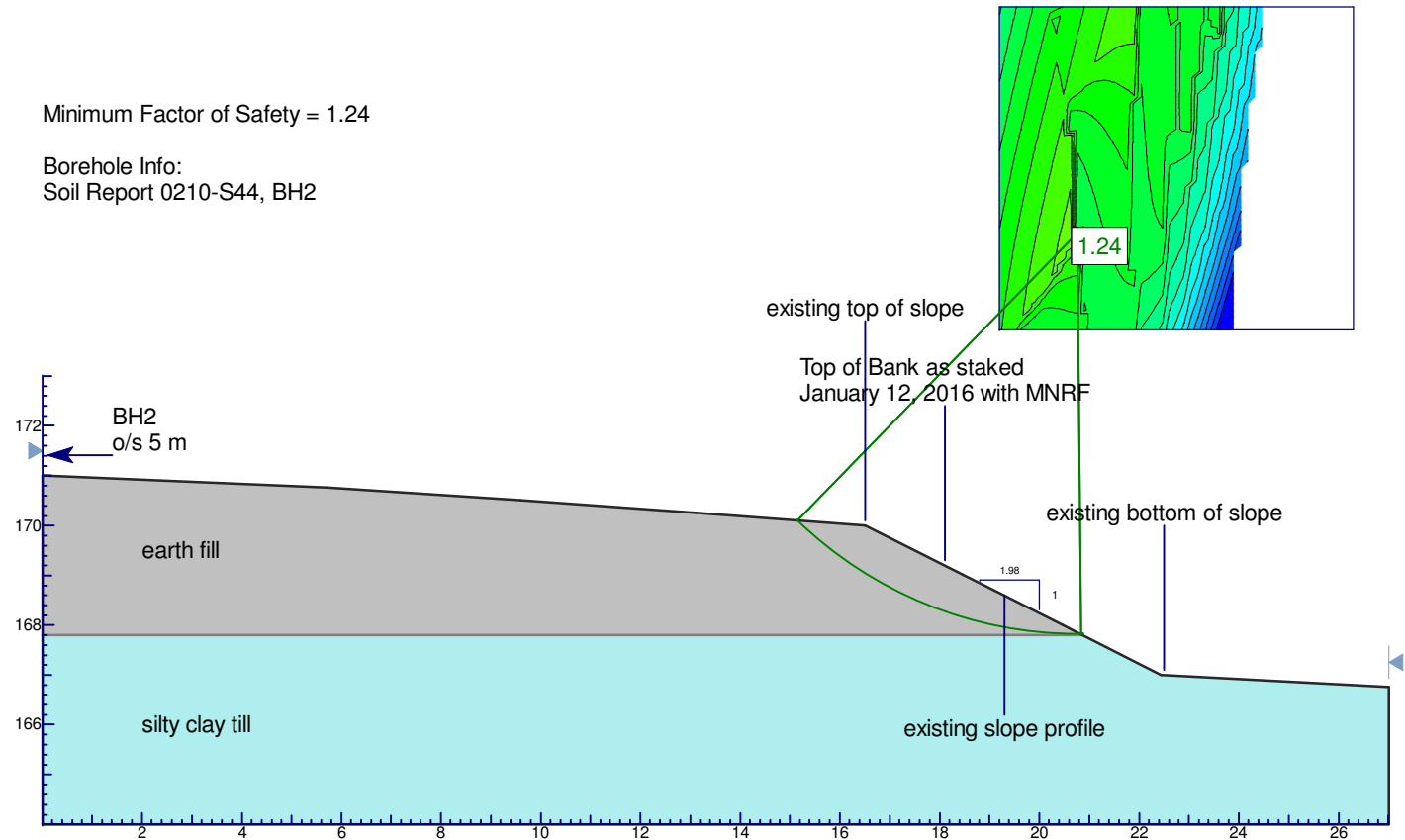
Project Title		Cross-Section C-C - Geotechnically Stable Condition		Load Case
Location		6611 Harmony Hill, Mississauga		Elevated Groundwater Condition
Drawn By	HWY	Checked By	BL	Revision
Date	February 2017	Reference No.	1512-S086	A
				Drawing No.
				4C

Safety Factor



Minimum Factor of Safety = 1.24

Borehole Info:
Soil Report 0210-S44, BH2

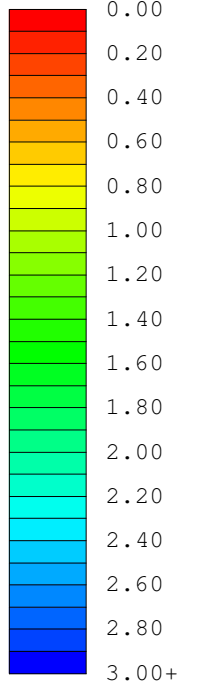


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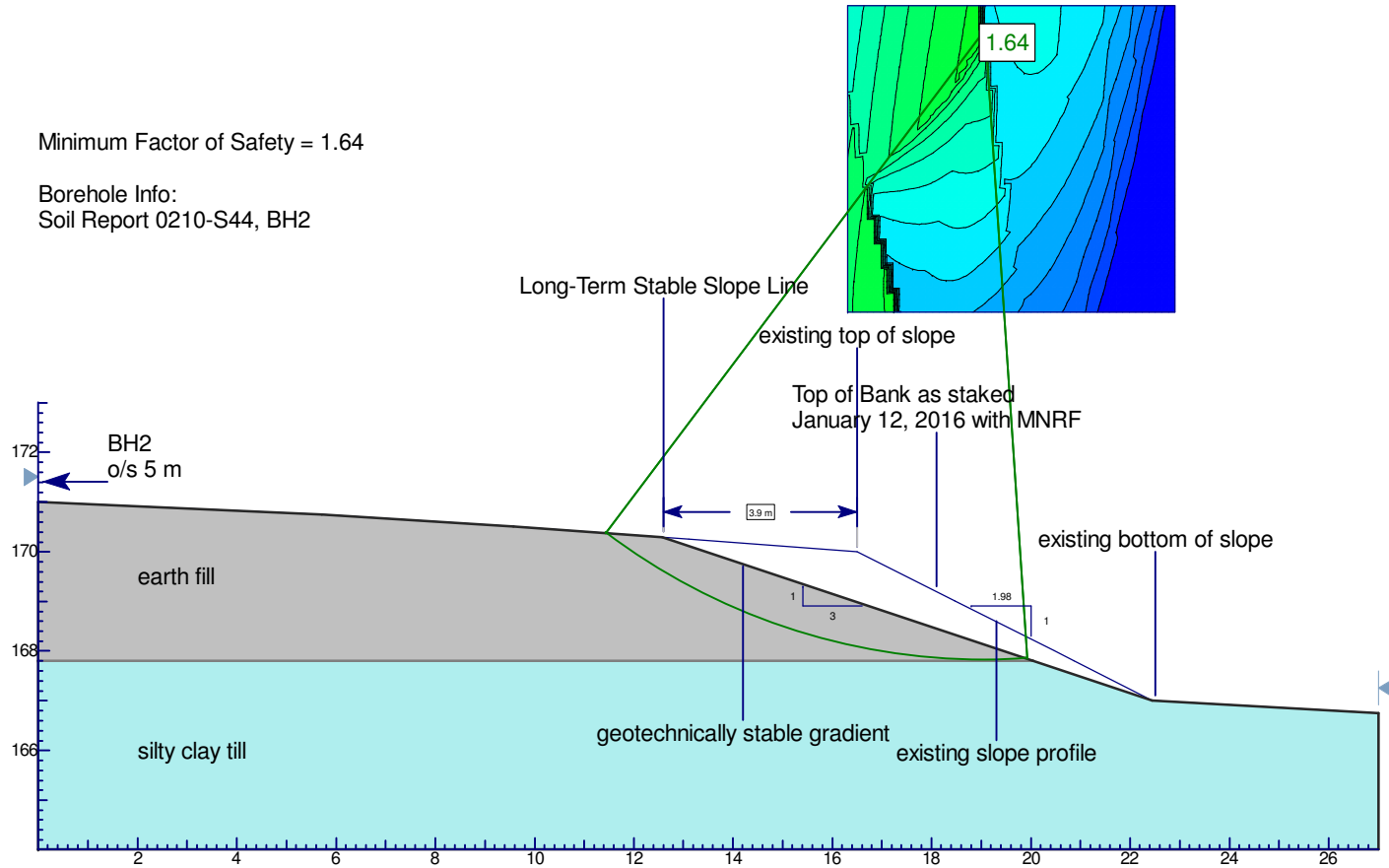
Project Title		Cross-Section D-D - Existing Condition		Load Case	Normal Groundwater Condition (Dry)
Location		6611 Harmony Hill, Mississauga			
Drawn By	HWY	Checked By	BL	Scale	1:150
Date	February 2017	Reference No.	1512-S086	Revision	-
				Drawing No.	5A

Safety Factor



Minimum Factor of Safety = 1.64

Borehole Info:
Soil Report 0210-S44, BH2

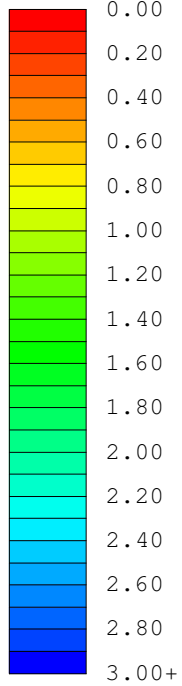


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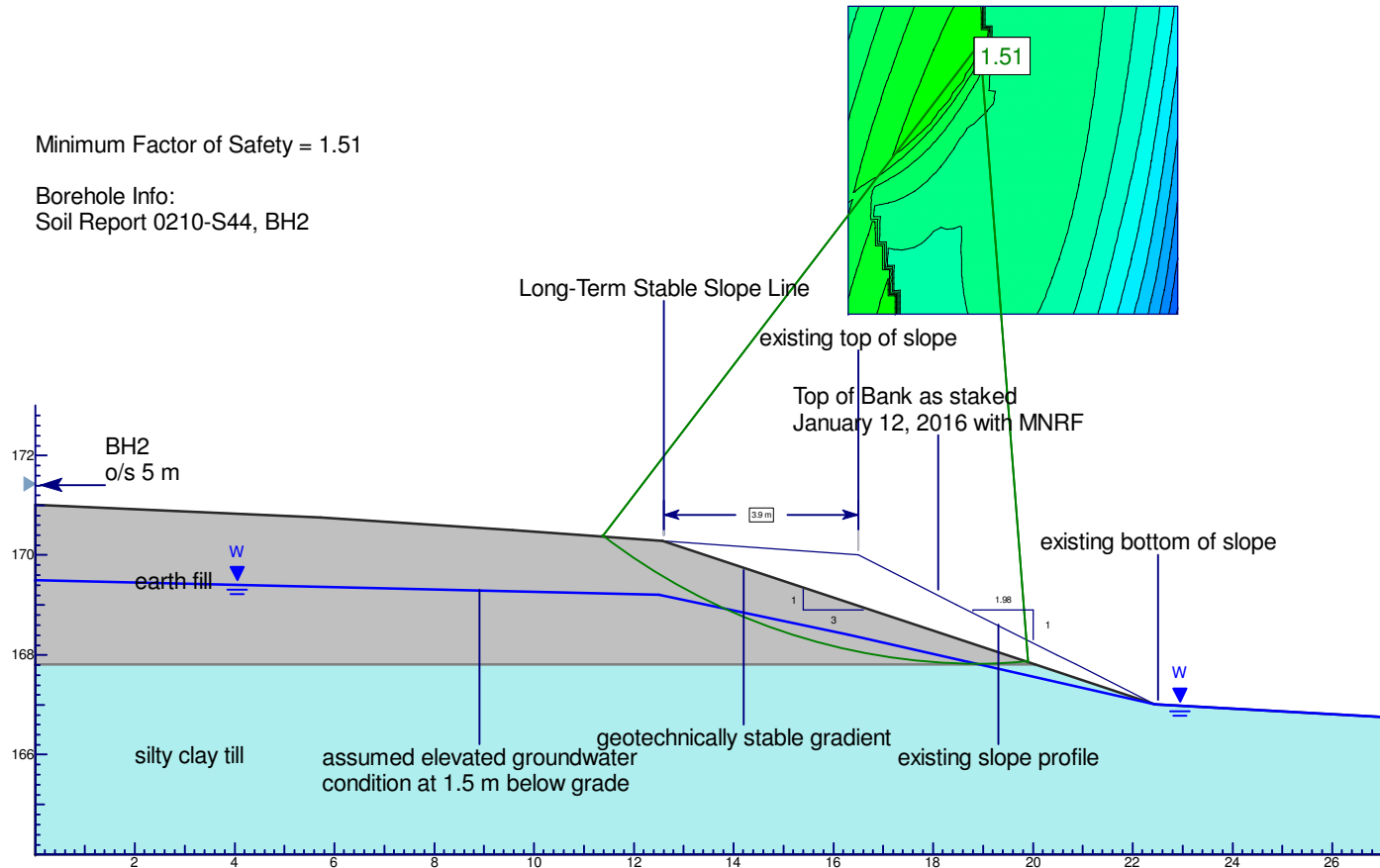
Project Title		Cross-Section D-D - Geotechnically Stable Condition		Load Case	Normal Groundwater Condition (Dry)
Location		6611 Harmony Hill, Mississauga			
Drawn By	HWY	Checked By	BL	Scale	1:150
Date	February 2017	Reference No.	1512-S086	Revision	-
				Drawing No.	5B

Safety Factor



Minimum Factor of Safety = 1.51

Borehole Info:
Soil Report 0210-S44, BH2



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Project Title		Cross-Section D-D - Geotechnically Stable Condition		Load Case	Elevated Groundwater Condition
Location		6611 Harmony Hill, Mississauga			
Drawn By	HWY	Checked By	BL	Scale	1:150
Date	February 2017	Reference No.	1512-S086	Revision	-
				Drawing No.	5C