SOIL-MAT

PROJECT NO.: SM 167182-G

SLOPE STABILITY ASSESSMENT
PROPOSED RESIDENTIAL DEVELOPMENT
EAGLE HEIGHTS
WATERDOWN ROAD
BURLINGTON, ONTARIO

PREPARED FOR:

PENTA PROPERTIES INC.

BY

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
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PROJECT NO.: SM 167182-G

April 10, 2017
Revised: March 23, 2018

PENTA PROPERTIES INC.
4480 Paletta Court
Burlington, Ontario
L7L 5R2

Attention: David Pitblado

SLOPE STABILITY ASSESSMENT
PROPOSED RESIDENTIAL DEVELOPMENT
EAGLE HEIGHTS
WATERDOWN ROAD
BURLINGTON, ONTARIO

Dear Mr. Pitblado,

Further to your authorisation, Soil-Mat Engineers & Consultants Ltd. has completed the fieldwork, laboratory testing and report preparation in connection with the above noted project. The fieldwork and reporting were undertaken in general accordance with our proposal P6454, dated September 30, 2016, and revised November 4, 2016. Our comments and recommendations, based on our findings at seven borehole locations and twenty-one slope cross-sections are presented in the following paragraphs.

1. INTRODUCTION

We understand that a residential development is proposed at the Eagle Heights property, between Waterdown Road and Grindstone Creek, south of Mountainbrow Road in Burlington, Ontario. The area is bound by Grindstone Creek to the west, with a number of tributaries and drainage channels running from north to south through the site. As such the development lands are within the jurisdiction of Conservation Halton [CH] and so are subject to permit approval. In order to support development approval with CH it is necessary to undertake a slope stability assessment of the valley slope to Grindstone Creek, as well as the various tributary ravines through the site.

The purpose of this slope stability assessment was to assess the subsurface soil conditions, evaluate the stability of the existing slopes, and determine the top of stable slope locations along all tributaries as well as Grindstone Creek, in general accordance with the applicable guideline policies of CH. Our comments and recommendations, with

respect to the stability of the existing slope and the proposed construction, from a geotechnical point of view, are presented herein. This work has been conducted in general accordance with the guideline policies of CH, including the *Natural Hazards Technical Guide* by MNRF and the supporting document *Geotechnical Principles for Stable Slopes*.

It is noted that the scope of the current study was established based on a review of previous geotechnical and slope assessment reports for the subject site by Peto MacCallum Ltd., conducted in 2003 and 2006. In addition a meeting was held with members of the project team and Conservation Halton on October 29, 2016 to review the proposed scope and establish the appropriate scope of work at this stage.

2. PROCEDURE

A total of seven [7] sampled boreholes were advanced on January 24 and 25, 2017 at the location illustrated in the attached Drawing No. 1, Slope Profile and Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment under the direction and supervision of a representative of SOIL-MAT ENGINEERS, to termination at depths of approximately of 6.2 to 24.8 metres beneath the existing ground surface. Upon completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903.

Representative samples of the subsoils were recovered from the boring at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples recovered from the borehole were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples.

Separate site visits were conducted on December 2, 5, and 6, 2016, and May 24, 2017, by representatives of SOIL-MAT ENGINEERS. During these site visits, twenty five [25] representative slope profiles were measured along the face of the slopes, both the main slope to the west down to Grindstone Creek and the ravines of Tributaries 4, 5, and 6. The locations are illustrated in the attached Drawing No. 1 and 2, Slope Profile and Borehole Location Plans. These slope profiles can be found on Drawing Nos. 3 to 27, Slope Profiles A-A through Y-Y.

The ground surface elevation at the borehole and start of slope profile locations were staked in the field and surveyed by MCI. These geodetic elevations were provided to our office.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests are presented in Borehole Log Nos. 1 to 7, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact planes of geological change

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The Eagle Heights property is located on the northwest corner of Flatt Road and Waterdown Road in Burlington, Ontario. The property is generally a mixture of wooded and open field areas. The property is vacant, with existing single family dwellings to the northeast, and a residential property to the central west. The topography is generally undulating, following the tributaries, with an overall drop in grade from north to south away from the Escarpment, and east to west towards Grindstone Creek. The subject slopes consist of the main slope towards Grindstone Creek to the west, as well as the smaller ravine slopes along the banks of Tributaries 4, 5, and 6.

The former Taylor property (now part of Eagle Heights) is located on the southwest corner of Flatt Road and Waterdown Road. The property is mostly vacant, with existing single family dwellings to the north and east of the property, and some wooded areas. The slopes consist of the ravine slopes to Tributaries 4 South and 5 South, as well as a smaller unnamed creek at the southern limit of the property.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Topsoil

A surficial layer of topsoil approximately 50 to 100 millimetres in thickness was encountered at all borehole locations. It is noted that the depth of topsoil might vary across the site and from the depths encountered at the borehole locations, especially within areas of heavier vegetation or mature trees. It should also be noted that the term 'topsoil' has been used from a geotechnical point of view, and does not necessarily reflect the material's nutrient content or ability to support plant life.

Silty Sand

Silty sand was encountered beneath the topsoil in Borehole Nos. 1, 2, 4, and 7. This granular soil is fine to medium in gradation, and contains occasional traces of clay and fine gravel. The sandy soils are generally in a very loose condition near the surface, typical of surface disturbance, becoming compact quickly with depth. The silty sand was proven to termination in Borehole No. 1, and to depths of approximately 3.4 to 12.8 metres beneath the existing ground surface in Borehole Nos. 2, 4, and 7.

Silty Clay

Silty clay was encountered beneath the silty sand in Borehole Nos. 2, 4, and 7, and beneath the topsoil in Borehole Nos. 3, 5, and 6. This cohesive soil is brown in colour, transitioning to grey with depth, contains trace fine gravel, and is generally stiff to hard in consistency, with firm upper levels near the surface. The silty clay was proven to termination in Borehole Nos. 3 and 6, and to depths of 4.5 to 24.5 metres in the Borehole Nos. 2, 4, 5, and 7.

Queenston Shale

Queenston shale bedrock was encountered beneath the silty clay in Borehole Nos. 2, 4, 5, and 7, at depths of 4.5 to 24.5 metres. The shale is red, weathered in the upper levels, becoming sounder with depth, and is hard in terms of soil. The Queenston shale bedrock was proven to termination in all boreholes it was encountered. The bedrock was not cored as part of this investigation.

SUMMARY OF INFERRED BEDROCK ELEVATIONS

BH No.	Surface Elevation [m]	Bedrock Depth [m]	Bedrock Elevation [m]
2	158.13	16.8	141.30
4	185.91	24.5	161.40
7	187.28	3.4	183.90

Groundwater Observations

All boreholes were recorded as 'dry' upon completion of drilling. It should be noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes. In cohesive soils the depth of the static groundwater level is typically the point at which the colour of the soil transitions from brown to grey. However, the static groundwater level would be expected to drop quickly in proximity to the slope,

particularly in areas of sand overburden soils, and would be expected to fluctuate significantly depending on the prevailing weather conditions.

4. SLOPE CONDITIONS AND STABILITY ASSESSMENT

The subject slope along Grindstone Creek is approximately 26.7 to 55.1 metres high, as measured across four profiles, and exhibits local inclinations as steep as 1.7 horizontal to 1.0 vertical, with overall inclinations measured at approximately 2.1 to 3.1 horizontal to 1.0 vertical. The slope is well vegetated with mature trees and scrub vegetation.

The slopes along the tributaries are significantly shorter, with measured heights of approximately 4.7 to 16.2 metres. The overall inclinations of the tributary slopes range from as steep as 1.8H:1V to near flat inclinations of 4H:1V and flatter.

A visual evaluation of the subject slopes found them to be in a generally stable condition. Evidence of minor surficial movements were noted along the face of the slopes, as well as occasional bowing and tilting of trees. No active erosion, i.e. gullies, was observed from drainage over the faces of the slopes. No significant slump scars or evidence of landslide activity were noted.

As with all slopes, there is a reduction in surficial shearing resistance attributed to the effects of freezing and thawing, wetting and drying, burrowing animals, etc. With time, the surface of the slope will degenerate and tend to reach equilibrium within its stress and ambient environment, including vegetative cover. It should be noted that this type of degeneration is a very slow process, as is evident by the observed stable condition of the existing slope.

Stability analyses of the subject slope were performed with a computerized modeling program [SLOPE/W 2007] considering appropriate material parameters and elevated groundwater conditions, and considering multiple potential failure planes. Conservative soil parameters were assigned to the soil strata encountered based on our finding in the boreholes, and have been summarised as follows:

Soil	Unit weight, γ	Friction angle, ϕ	Cohesion , c
Silty Sand	19.0 kN/m^3	36°	0 kPa
Silty Clay	19.0 kN/m^3	34°	10 kPa
Queenston Shale	20.0 kN/m^3	50°	10 kPa

Stability analyses were completed considering both typical and elevated groundwater conditions. These analyses yielded approximate minimum factors of safety as outlined in the table below. Sample results of these analyses are appended to this report.

Profile	Minimum Factor of Safety	
	Typical Groundwater	Elevated Groundwater
A-A	3.18	2.58
B-B	3.25	2.71
C-C	1.50	1.50
D-D	2.24	2.21
E-E	3.30	3.03
F-F	2.97	2.50
G-G	1.72	1.72
H-H	2.11	2.11
I-I	3.84	3.22
J-J	5.16	4.13
K-K	4.22	4.03
L-L	3.35	3.07
M-M	1.87	1.71
N-N	2.20	2.10
O-O	1.74	1.50
P-P	1.77	1.65
Q-Q	2.29	2.02
R-R	4.72	3.88
S-S	2.11	1.90
T-T	2.19	2.03
U-U	3.17	2.39
V-V	1.99	1.90
W-W	2.92	2.78
X-X	1.73	1.58
Y-Y	1.35	1.31
Z-Z	2.85	2.40
1-1	3.53	3.18
2-2	2.57	2.04

Table 7.2 of the Geotechnical Principles for Stable Slopes [Ministry of Natural Resources and Forestry] lists a Design Minimum Factor of Safety of between 1.3 and 1.5 for 'Active' land use properties [habitable or unoccupied structures near slope]. The calculated factors of safety for both typical and elevated groundwater conditions were found to exceed 1.5 at all locations, with the exception of Profile Y-Y, which was within this range at 1.35. In addition, when considering failure plains extending sufficiently far uphill to affect the long term top of stable slope, as established below, the minimum factor of

safety for Profile Y-Y increases to 1.70, exceeding the specified range. It is also noted that the majority of profiles measured have calculated factors of safety far exceeding this range, with factors of safety of 2 to 3 or greater. Given the above, the existing slopes along both Grindstone creek and the tributaries are considered to be stable in both the short and long term.

5. TOP OF STABLE SLOPE

The top of stable slope location was determined by the application of an erosion allowance at the toe and a stable slope inclination through the slope. In this case, considering the size and flow rates of the creek and tributaries, conservative erosion allowances were chosen, as outlined in Table 3 of the Ministry of Natural Resources publication *Technical Guide: River and Stream System Erosion Hazard Limit* and presented in the table below. It is noted that in locations where the toe was sufficiently far from the water source (<15m), conservative erosion allowances of 4 metres for Grindstone Creek and 3 meters for the tributaries were used. These erosion allowances are a function of the competent very stiff to hard silty clay overburden soils identified through the tributary ravine in the boreholes, both our recent boreholes and those previously advanced by Peto MacCallum Ltd.

	Silty Clay	Queenston Shale	Toe <15m from Water
MNR suggested range of values [m]	5 - 8	2 - 5	N/A
Allowance for Grindstone Creek [m]	8	5	4
Allowance for Tributaries [m]	4	3	3

Table 4.3 of the Ministry of Natural Resources publication *Geotechnical Principles for Stable Slopes* indicates stable slope inclinations through sands and gravels from 1.5 to 2.0 horizontal to 1.0 vertical, and through the clays and silts as steep as 2.0 to 4.0 horizontal to 1.0 vertical. Table 4.3 also notes shales to exhibit stable slope inclinations from 1.0 horizontal to 1.0 vertical to near vertical inclinations. In this case a conservative stable slope inclination of 2.0 horizontal to 1 vertical has been applied through the sand and 2.3 horizontal to 1.0 vertical through the silty clay soils. From a geotechnical perspective, the Shale bedrock would be competent to support long-term stable inclinations of as much as 1 horizontal to 1 vertical, however considering comments provided by CH staff on the previous investigation by Peto MacCallum Ltd., along with our current investigation and previous experience with the Shale bedrock, a highly conservative stable slope inclination of 1.4 horizontal to 1.0 vertical was used. It is noted that in many of the slopes, especially the main slope down to Grindstone Creek, the

inclination of the lower portions within the Shale are much flatter than the conservative 1.4H:1V stable slope inclination. As such the stable slope inclination at these locations has been applied through the overburden silty clay and silty sand.

Applying the above erosion and stable slope inclinations as outlined above results in a top of stable slope location at each profile. The results of these determinations are outlined as follows:

EAGLE HEIGHTS PROPERTY

- For **Grindstone Creek** [Profiles C-C, D-D, H-H, and G-G], the top of stable slope as determined above is approximately 7.2, 6.8, 5.8, and 7.2 metres uphill of the physical crest at Profiles C-C, D-D, H-H, and G-G, respectively. The top of stable slop line should be interpolated along the length of the slope based on these four points.
- For **Tributary 6 West** [Profiles A-A, B-B, E-E, and F-F], the top of stable slope determined at each location was well downhill of the physical crest. Therefore, the physical crest of the slopes along Tributary 6 may be safely taken as the top of stable slope.
- For **Tributary 6 East** and **Tributary 4**, all slopes examined were significantly flatter than 3:1. The physical crest may be safely taken as the top of stable slope at these locations.
- For **Tributary 5 West** [Profiles I-I, K-K, L-L, R-R, and T-T], the top of stable slope determined at each location was downhill or coincided with the physical crest. Therefore, the physical crest of the slopes may be safely taken as the top of stable slope along Tributary 5 West.
- For **Tributary 5 East** [Profiles M-M, N-N, O-O, P-P, Q-Q, S-S, U-U, and J-J] the top of stable slope at all profile locations north of and including Profile Q-Q may be taken as the physical crest. The area south of Q-Q was noted to have steeper banks. The top of stable slope on the west bank was measured at Profile M-M and determined to be 3.8 metres uphill of the physical crest. The top of stable slope on the east bank as measured at Profiles O-O and P-P, was determined to be approximately 11.2 and 9.8 metres uphill of the physical crest, respectively. The stable slope line for this area of Tributary 6 should be interpolated from these points, linearly approaching the physical crest towards Profile Q-Q to the north.
- For **Tributary 4 South** [Profiles V-V, 2-2, and W-W], the top of stable slope determined at each location was downhill or coincided with the physical crest. Therefore, the physical crest of the slopes may be safely taken as the top of stable slope along Tributary 4 South.

- The slopes along the unnamed tributary creek at the southern end of the former Taylor property were examined visually and were not significant enough to warrant measurement. The physical crest may be safely taken as the top of stable slope at these locations.
- For **Tributary 5 South** [Profiles X-X, Z-Z, 1-1, and Y-Y], the top of stable slope as determined above is approximately 9.4 and 10.0 metres uphill of the physical crest at the extremes of Profiles X-X and Y-Y respectively. Moving inward from both ends, the slope flattens out considerably, as measured at the Profiles Z-Z and 1-1. Thus, the physical crest of the slope may be safely taken as the top of stable slope at these locations. The top of stable slope line should be interpolated along the length of the slope based on these four points, beginning at 9.4 metres and ending at 10.0 metres, and linearly approaching the physical crest at the two profiles in between.

As outlined above many of the tributary slopes are significantly flatter than 3H:1V and/or have theoretical top of stable slope locations that are at or downhill of the exiting physical crest of the slope. In such cases the top of stable slope would typically be taken as coincident with the existing physical crest of slope. However, given the significantly flat inclinations of many of the slopes, they would in fact be considered stable at any point along the face of the slope. As such it would be reasonable for the top of stable slope to be taken anywhere along the slope, as the tributary systems allow considering flood levels and storm water management.

6. CONSTRUCTION CONSIDERATIONS

It is our opinion, based on our assessment, that all existing slopes of both the tributaries and the main creek are considered to be sufficiently stable in both the short and long-term and that the proposed development uphill of the top of stable slope locations, as determined above, would have no negative impact on the stability of the subject slopes, from a geotechnical point of view. The following recommendations should be considered in the proposed development:

- New building foundations where possible should be at sufficient depth to extend below a line drawn up from the toe of the slope at 3 Horizontal to 1 Vertical. In this fashion load transfer from the footings to the slope would be minimised or eliminated, thus limiting any impact on the stability of the slope. In the case of main slope to Grindstone Creek, given the presence of Shale bedrock, it is recommended that the 3H:1V line may be taken from the level of the Shale to establish the required founding level.
- Excavated soil should not be placed on or over the crest of the slope, and heavy construction equipment should not travel near the crest of the slope. In this

regard it is recommended that a silt fence be placed along, or slightly 'uphill' from, the established top of stable slope location for the duration of construction. This will act as a barrier for construction activity and also prevent sediment runoff during construction.

- Drainage towards the slope should be unaltered as much as possible, or directed away from the slope as much as possible. Any surface flows towards the slope should be in a controlled manner, such as through established grass or vegetation, to avoid increased or concentrated flows onto the slope.
- Trees in the vicinity of the slope should be protected from damage. No alterations should be made to trees without retaining the services of an arborist.
- All footings must be provided with 1.2 metres of earth cover or equivalent insulation for frost protection. Foundations for the new dwellings must be designed and constructed in accordance with the requirements of the current Ontario Building Code.

We trust that this slope assessment report is sufficient for your present requirements. Should there be any questions regarding the content or comments within this report please do not hesitate to contact our office.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

LICENSED PROFESSIONAL ENGINEER
Aug 28/18
M. M. LIVECCHI
100189574
ML.
PROVINCE OF ONTARIO

Matt LiVecchi, P.Eng.
Project Engineer

Ian Shaw, P. Eng.
Senior Engineer

Enclosures: Drawing Nos. 1 and 2, Borehole and Slope Location Plans
Borehole Log Nos. 1 to 7, inclusive
Drawing Nos. 3-30, Slope Profiles A-A to Z-Z, and 1-1 to 2-2, inclusive
Slope/W analyses Results
Distribution: Metropolitan Consulting Inc. [2, plus pdf]



LEGEND

BH# Borehole Location

Slope Profile

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 167182-G.

2. Borehole and Slope Profile locations are approximate.

3. Creek Locations superimposed on aerial image.

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Slope Stability Assessment
Proposed Residential Development
Eagle Heights, Waterdown Road
Burlington, Ontario

Borehole and Slope Profile Location Plan

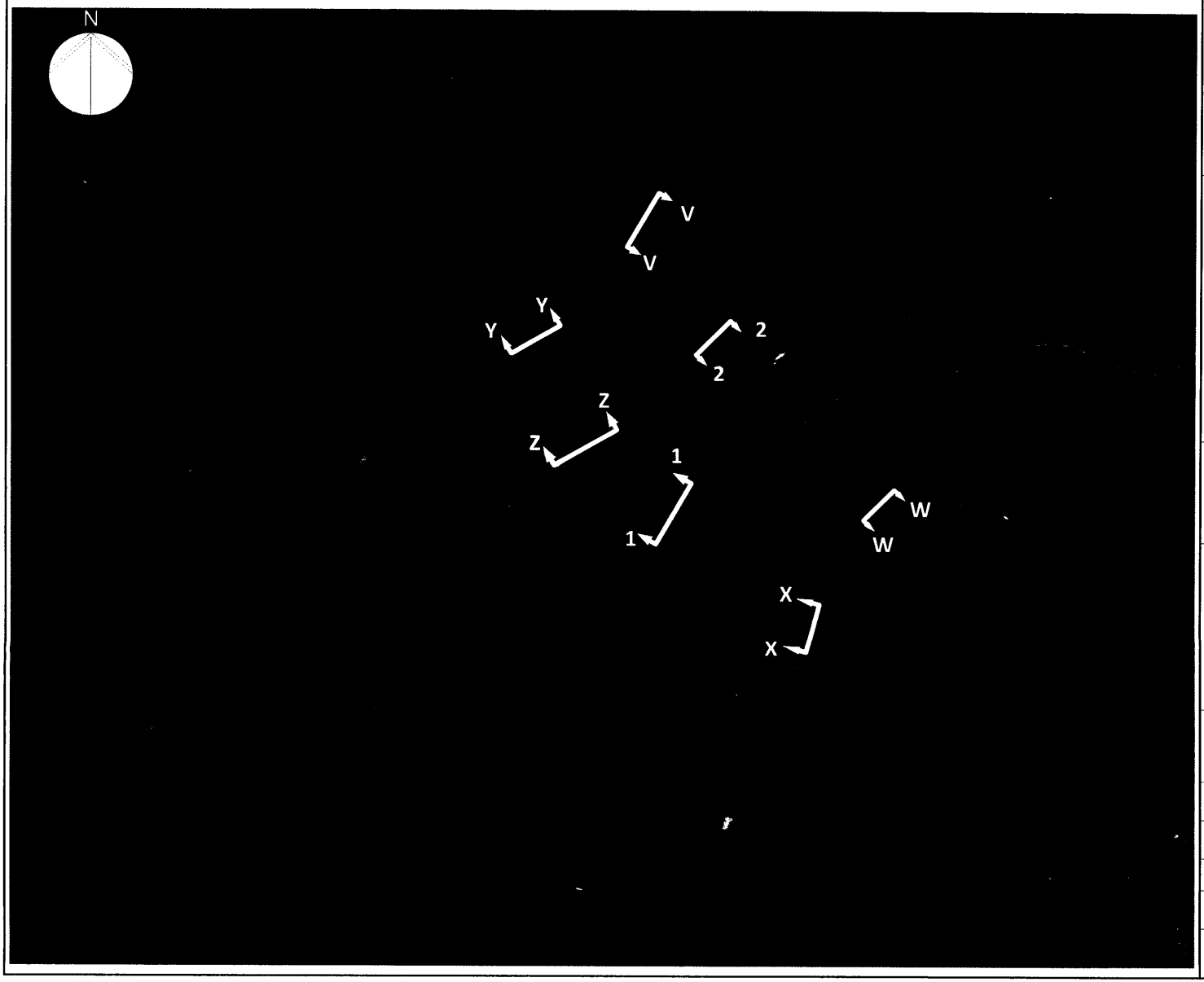
Project No. SM 167182-G

Date: February 2017

Drawn: ML | Checked: IS

SM 167182-G Borehole Location Plan.vsdx

Drawing No. 1



LEGEND

Borehole Location

BH#

Slope Profile

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 167182-G.

2. Borehole and Slope Profile locations are approximate.

3. Creek Locations superimposed on aerial image.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Slope Stability Assessment
Proposed Residential Development
Eagle Heights, Waterdown Road
Burlington, Ontario

Borehole and Slope Profile Location Plan

Project No. SM 167182-G

Date: July 2017

Drawn: ML | Checked: IS

SM 167182-G Borehole Location Plan 2.vsdx

Drawing No. 2

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 1

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

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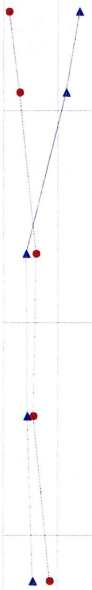
SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	155.44		Ground Surface								
				Topsoil Approximately 50 millimeters of overlying topsoil.								
4				**Silty Sand** Brown, fine to medium in gradation, very loose to compact.		SS	1	2,1,1,1	2			
6	2					SS	2	2,3,3,3	6			
10						SS	3	6,5,7,8	12			
14	4											
16						SS	4	4,5,6,9	11			
20	6											
22		148.70		End of Borehole		SS	5	6,8,9,10	17			
24				NOTES:								
26	8			1. Borehole was advanced using solid stem auger equipment on January 24, 2017 to termination at a depth of 6.7 metres.								
28				2. Borehole was recorded as 'open and dry' upon completion of drilling and backfilled as per Ontario Regulation 903.								
30				3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
32												

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



Drill Method: Solid Stem Augers

Drill Date: January 24, 2017

Hole Size: 150mm

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Datum: Geodetic

Checked by: IS

Sheet: 1 of 1

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 2

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

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SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt. (kN/m3)
0	0	158.13		Ground Surface								
				Topsoil Approximately 50 millimeters of overlying topsoil.								
4				**Silty Sand** Brown, fine to medium in gradation, very loose to compact.		SS	1	3,2,2,3	4			
6	2					SS	2	8,9,10,12	19			
12	4	153.30		**Silty Clay** Grey, trace fine gravel, stiff to hard.		SS	3	5,6,7,4	13			
20	6					SS	4	4,8,6,12	14			
26	8											
30						SS	5	5,9,11,15	20			
32												

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

Drill Method: Hollow Stem Augers

Drill Date: January 24, 2017

Hole Size: 200mm

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Datum: Geodetic

Checked by: IS

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 2

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

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SUBSURFACE PROFILE

SAMPLE

Depth	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
12			NOTES: 1. Borehole was advanced using hollow stem auger equipment on January 24, 2017 to termination at a depth of 18.3 metres. 2. Borehole was recorded as 'dry' upon completion of drilling and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.		SS	6	5,7,9,11	16			
					SS	7	23,41,50	91			
16	141.30		**Queenston Shale** Red, highly weathered in the upper level, becoming more sound with depth, hard in terms of soil.								
18	139.80		End of Borehole		SS	8	50/1"	100			

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

Drill Method: Hollow Stem Augers

Drill Date: January 24, 2017

Hole Size: 200mm

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e-mail: info@soil-mat.on.ca

Datum: Geodetic

Checked by: IS

Sheet: 2 of 2

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 3

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

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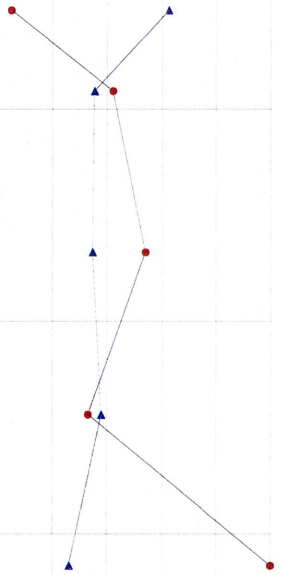
SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt. (kN/m3)
0	0	150.74		Ground Surface								
				Topsoil Approximately 100 millimeters of overlying topsoil.								
				Silty Clay Brown, trace fine gravel,firm to hard.		SS	1	0,2,3,3	5		2.5	
6	2					SS	2	9,20,21,30	42		>4.5	
8		148.10		Transitioning to grey.								
12	4					SS	3	12,20, 34,36	54		>4.5	
16						SS	4	8,13,20,25	33		4.5	
20	6	144.24				SS	5	11,22, 50/3"	100			
22				End of Borehole								

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



NOTES:

1. Borehole was advanced using solid stem auger equipment on January 24, 2017 to termination at a depth of 6.5 metres.

2. Borehole was recorded as 'open and dry' upon completion of drilling and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers

Drill Date: January 24, 2017

Hole Size: 150mm

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Geodetic

Checked by: IS

Sheet: 1 of 1

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 4

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	185.91		Ground Surface								
				Topsoil Approximately 75 millimeters of overlying topsoil.								
2				**Silty Sand** Brown, fine to medium in gradation, very loose to compact.								
4						SS	1	2,1,1,2	2			
6	2					SS	2	5,8,9,10	17			
8												
10						SS	3	10,12,7,12	19			
12	4											
14												
16						SS	4	6,8,11,13	19			
18												
20	6					SS	5	9,14,14,14	28			
22												
24												
26	8											
28												
30						SS	6	9,11,12,14	23			
32												

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

Drill Method: Hollow Stem Augers

Drill Date: January 24, 2017

Hole Size: 200mm

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Datum: Geodetic

Checked by: IS

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 4

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
12	173.40		***Silty Clay*** Grey, trace fine gravel, hard.		SS	7	17,15, 16,19	31			
14					SS	8	8,15,25,26	40			
16											
18					SS	9	32,48, 50/5"	98			

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

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Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Drill Method: Hollow Stem Augers

Drill Date: January 24, 2017

Hole Size: 200mm

Datum: Geodetic

Checked by: IS

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 4

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
67											
69											
71											
73	22										
75											
77					SS	10	6,12,20,27	32			
79	24										
81	161.40										
	161.10		**Queenston Shale** Red, highly weathered, hard in terms of soil.		SS	11	39,46, 50/4"	100			
83			End of Borehole								
85	26										
87											
89											
91											
93	28										
95											
97											

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80

NOTES:

1. Borehole was advanced using hollow stem auger equipment on January 25, 2017 to termination at a depth of 24.8 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Hollow Stem Augers

Drill Date: January 24, 2017

Hole Size: 200mm

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Datum: Geodetic

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Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 5

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	151.54		Ground Surface								
				Topsoil Approximately 50 millimeters of overlying topsoil.								
				Silty Clay Brown, trace fine gravel, hard.		SS	1	18,28, 34,47	62		>4.5	
	2					SS	2	9,18,25,43	43		>4.5	
	4											
		146.70		**Queenston Shale** Red, highly weathered in the upper level, becoming more sound with depth, hard in terms of soil.		SS	3	14,26,46	72		>4.5	
	6	145.20				SS	4	50/5"	100			
				End of Borehole								
	8											

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 24, 2017 to termination at a depth of 6.3 metres.
2. Borehole was recorded as 'open and dry' upon completion of drilling and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers

Drill Date: January 24, 2017

Hole Size: 150mm

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Datum: Geodetic

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Sheet: 1 of 1

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 6

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth ft	Depth m	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	155.65		Ground Surface								
				Topsoil Approximately 50 millimeters of overlying topsoil.								
				Silty Clay Brown, trace fine gravel, hard.		SS	1	8,11,12,13	23		3.0	
						SS	2	7,13,14,15	27		4.0	
		151.20		**Queenston Shale** Red, highly weathered in the upper level, becoming more sound with depth, hard in terms of soil.		SS	3	1016, 21,29	37		>4.5	
		149.45		End of Borehole		SS	4	50/3"	100			

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 25, 2017 to termination at a depth of 6.2 metres.

2. Borehole was recorded as 'open and dry' upon completion of drilling and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers

Drill Date: January 25, 2017

Hole Size: 150mm

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Datum: Geodetic

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Sheet: 1 of 1

Project No: SM 167182-G

Project: Eagle Heights

Location: Waterdown Road, Burlington, ON

Client: Metropolitan Consulting Inc.

Log of Borehole No. 7

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	187.28	Ground Surface								
			Topsoil Approximately 75 millimeters of overlying topsoil.								
4			**Silty Sand** Brown, trace clay and fine gravel, very loose to compact.		SS	1	2,1,2,3	3			
6	2				SS	2	8,10,12,15	22		4.0	
10		183.90			SS	3	10,19, 27,26	46		4.0	
12	4		**Silty Clay** Brown, trace fine gravel, hard.								
16					SS	4	9,18,25,37	43		>4.5	
20	6				SS	5	4,12,23,34	35			
		180.60	End of Borehole								
24	8										

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 25, 2017 to termination at a depth of 6.7 metres.

2. Borehole was recorded as 'open and dry' upon completion of drilling and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers

Drill Date: January 25, 2017

Hole Size: 150mm

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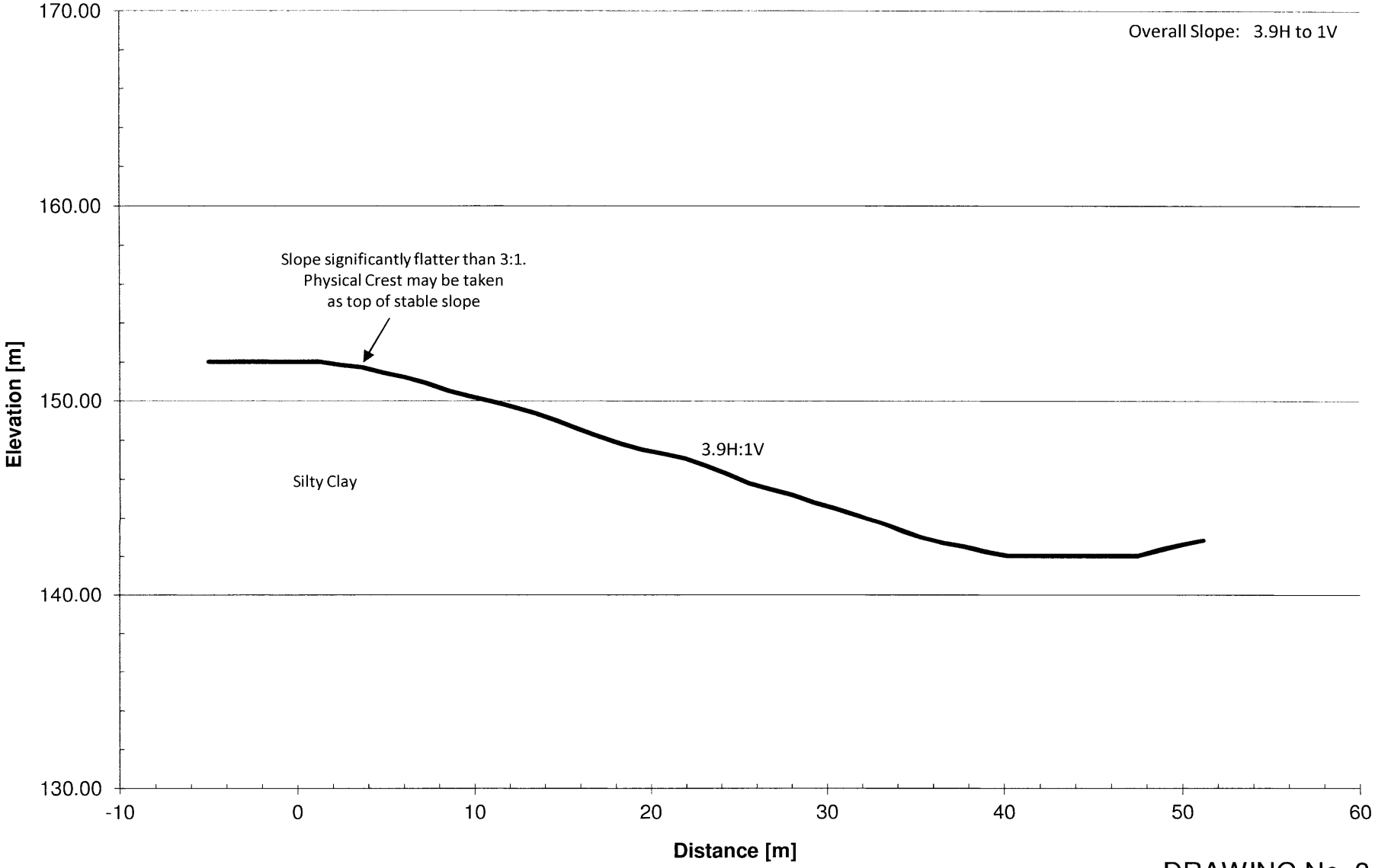
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Checked by: IS

Sheet: 1 of 1

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile A-A

Soil-Mat

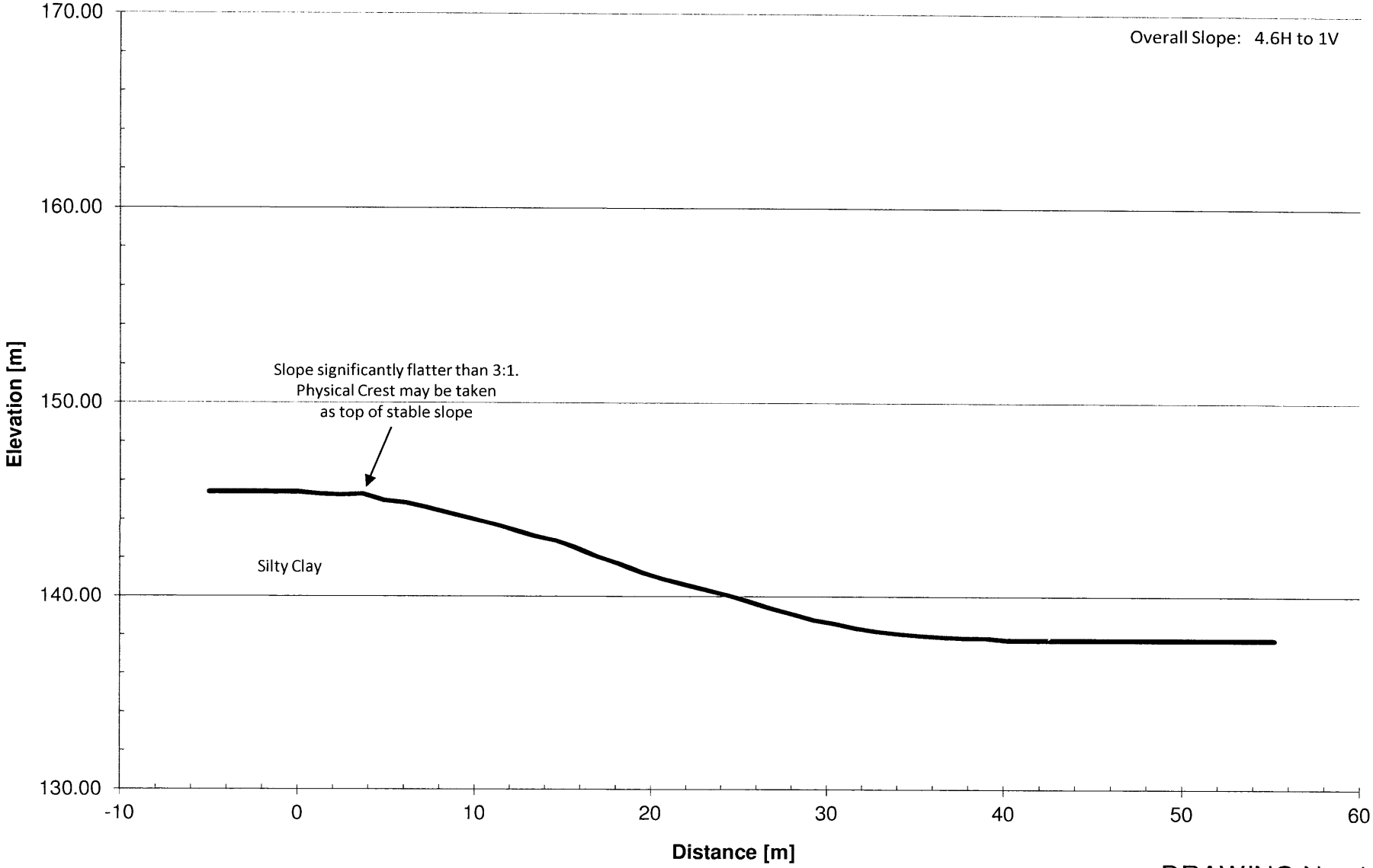


Project No.: SM 167182-G

DRAWING No. 3

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile B-B

Soil-Mat

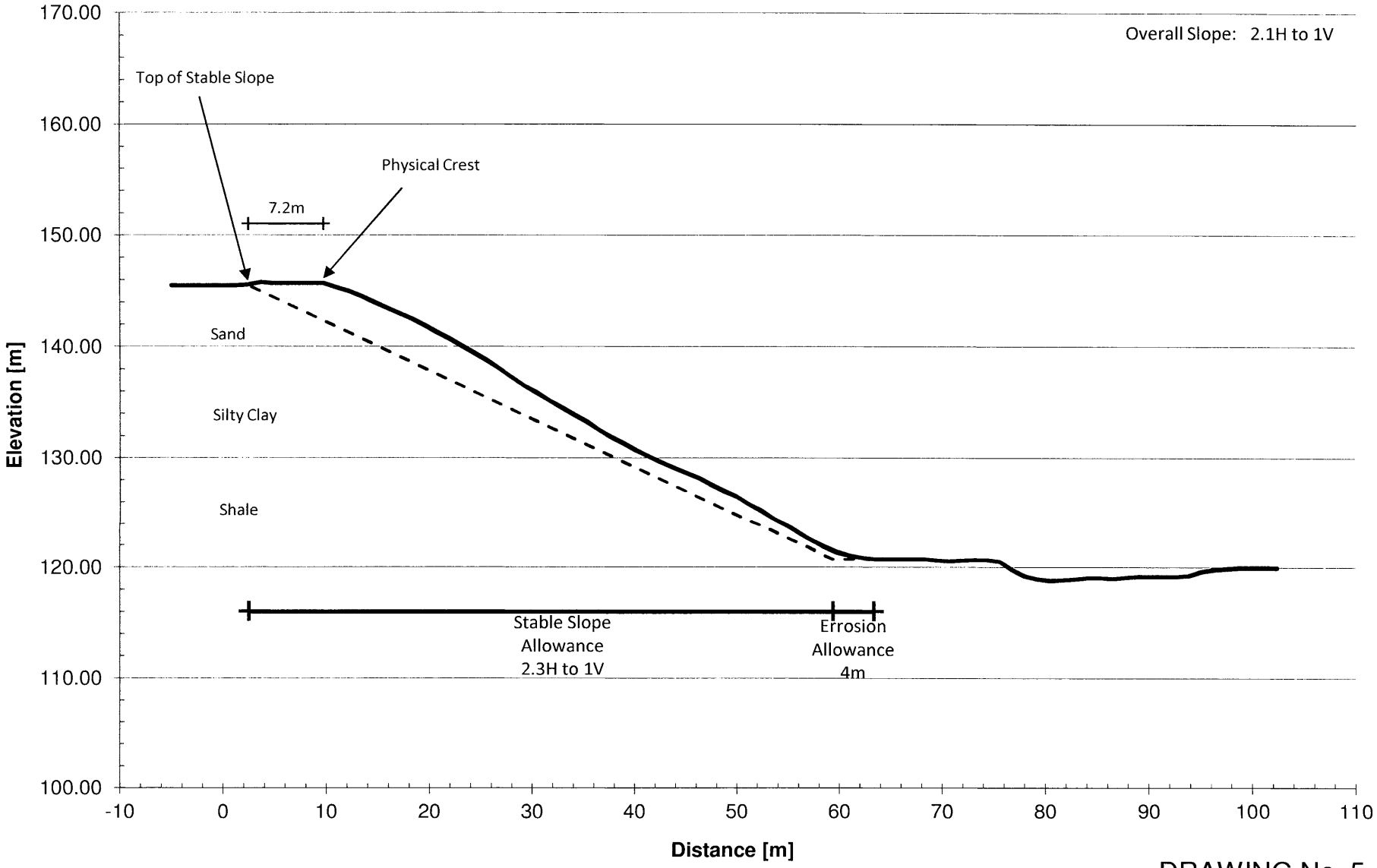


Project No.: SM 167182-G

DRAWING No. 4

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile C-C

Soil-Mat

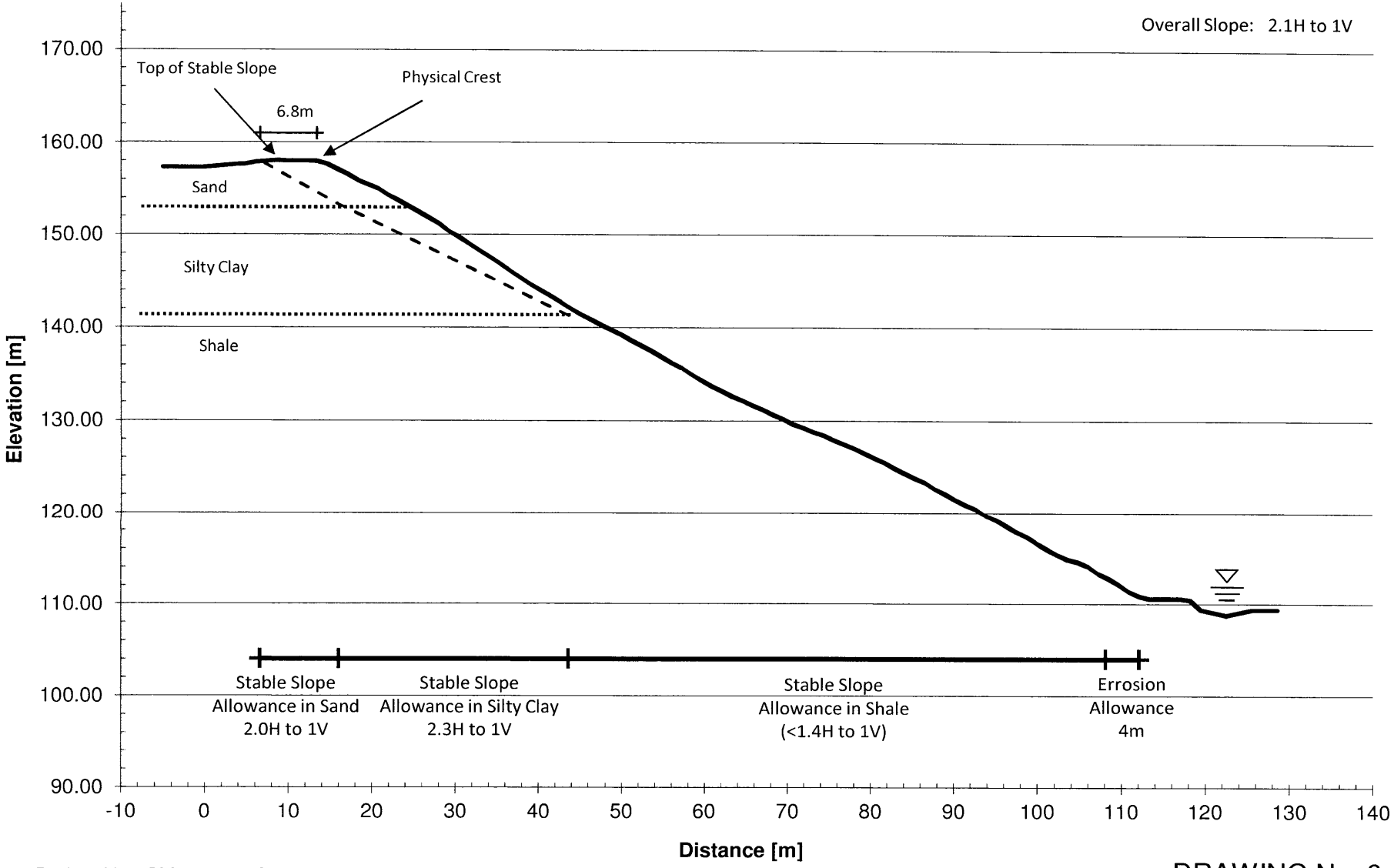


Project No.: SM 167182-G

DRAWING No. 5

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile D-D

Soil-Mat

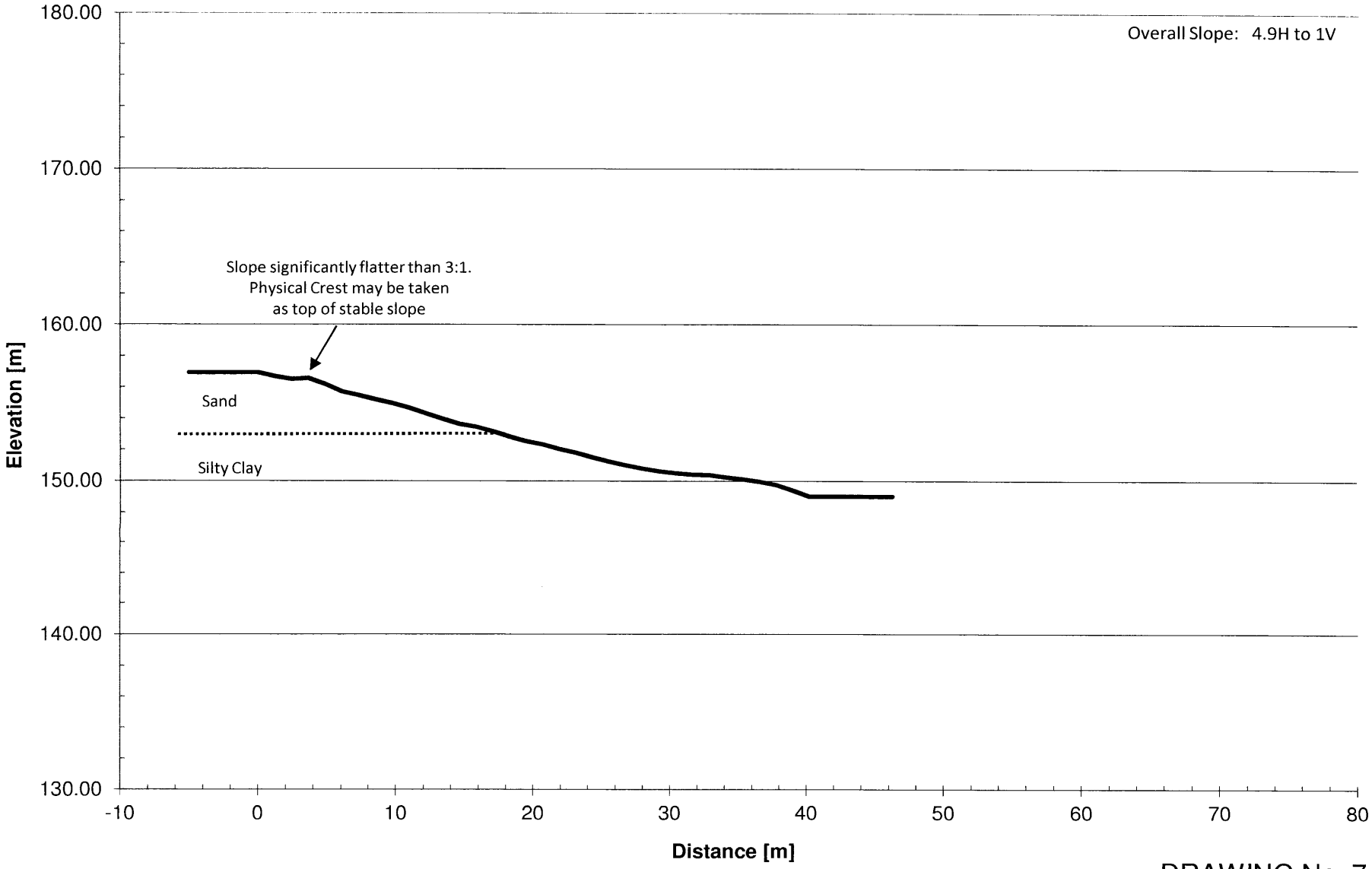


Project No.: SM 167182-G

DRAWING No. 6

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile E-E

Soil-Mat

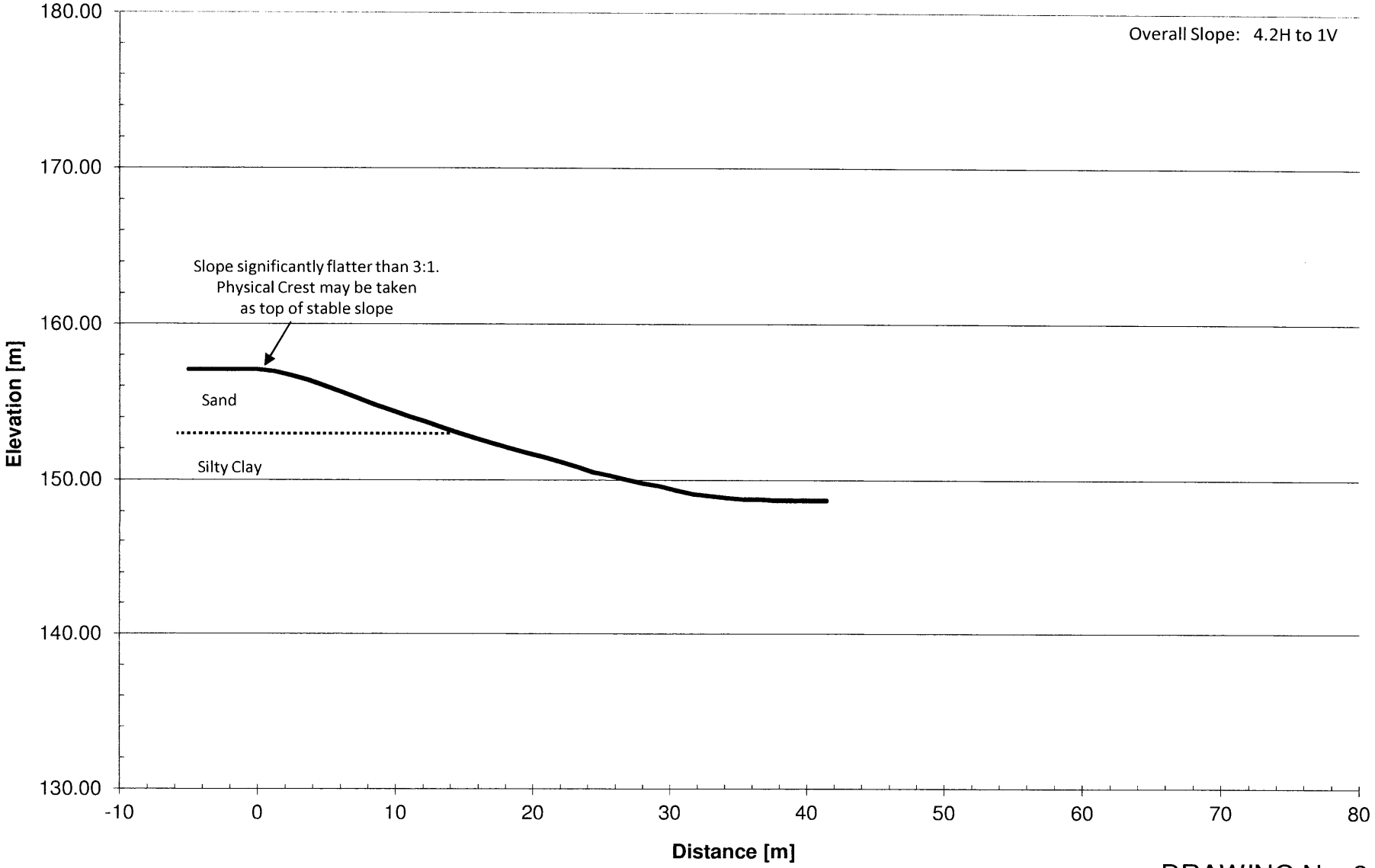


Project No.: SM 167182-G

DRAWING No. 7

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile F-F

Soil-Mat

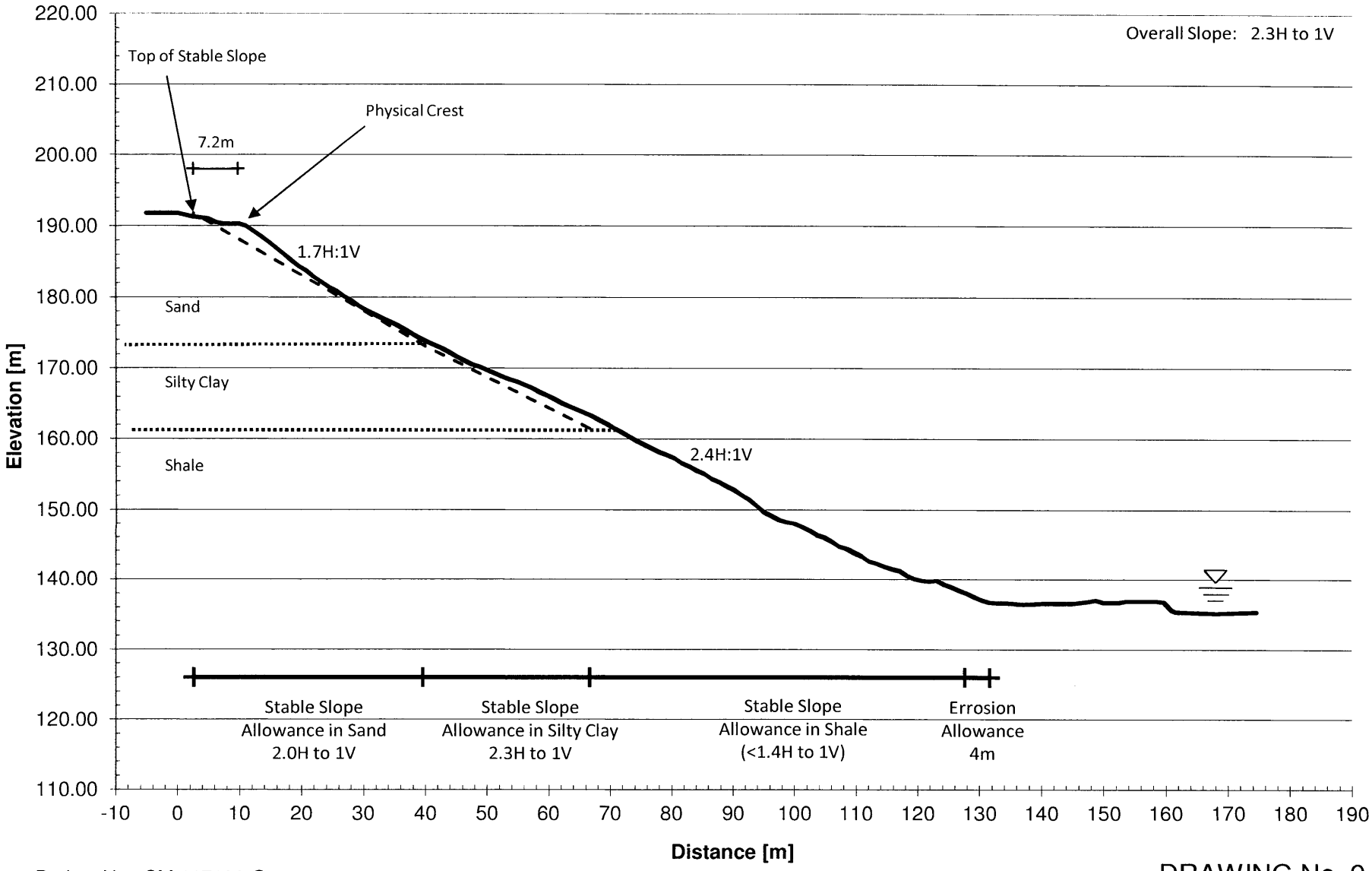


Project No.: SM 167182-G

DRAWING No. 8

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile G-G

Soil-Mat

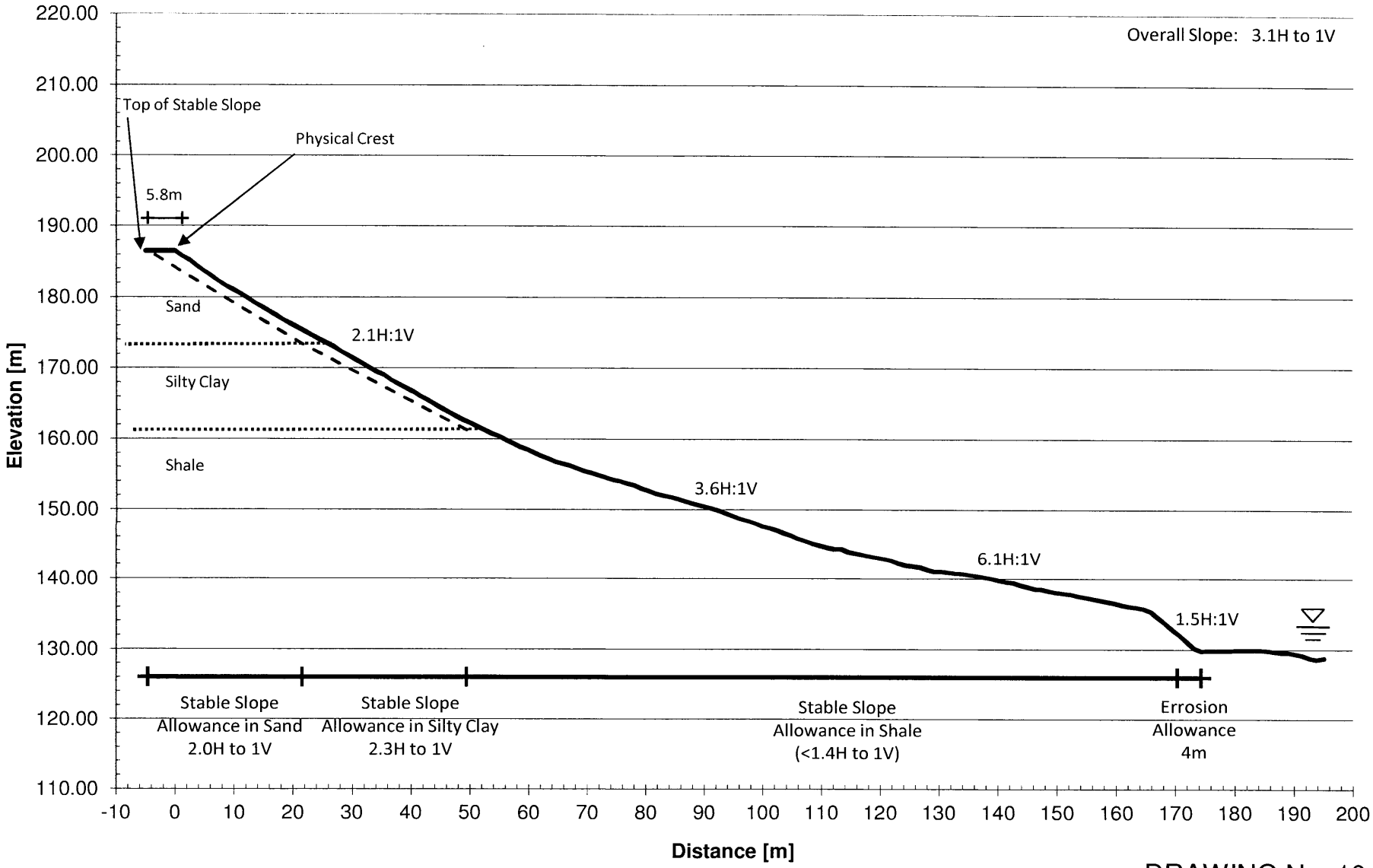


Project No.: SM 167182-G

DRAWING No. 9

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile H-H

Soil-Mat

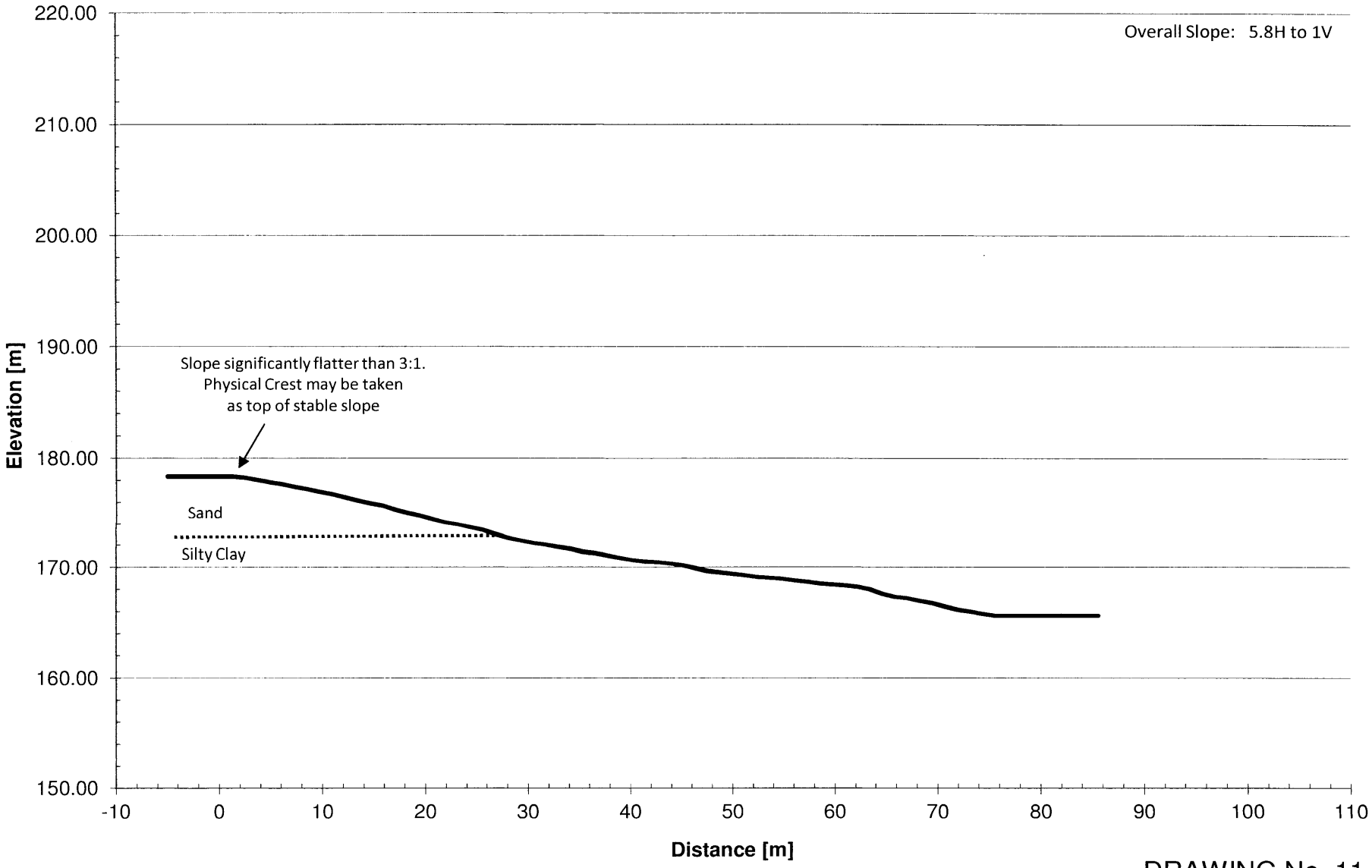


Project No.: SM 167182-G

DRAWING No. 10

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile I-I

Soil-Mat

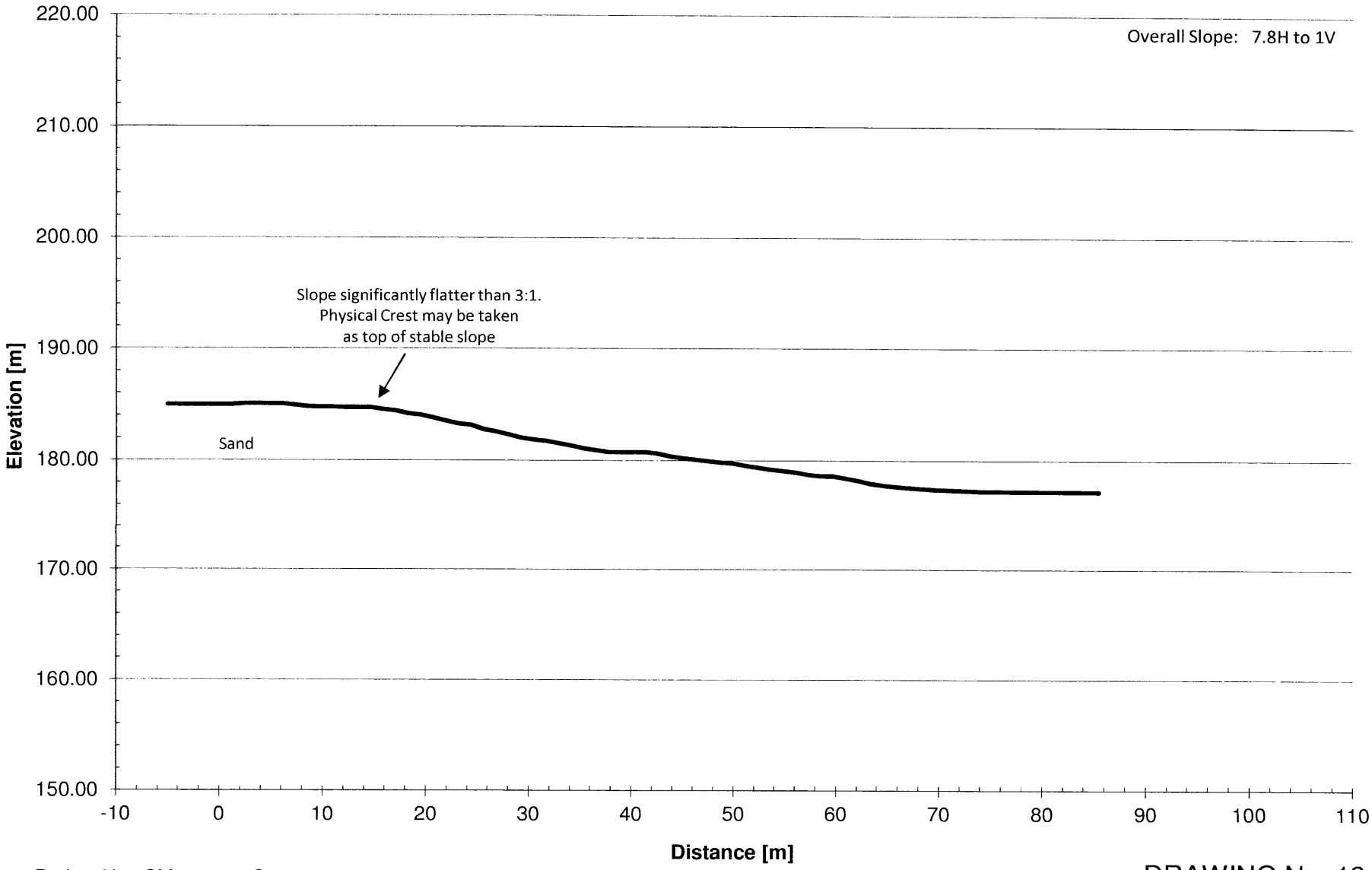


Project No.: SM 167182-G

DRAWING No. 11

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile J-J

Soil-Mat

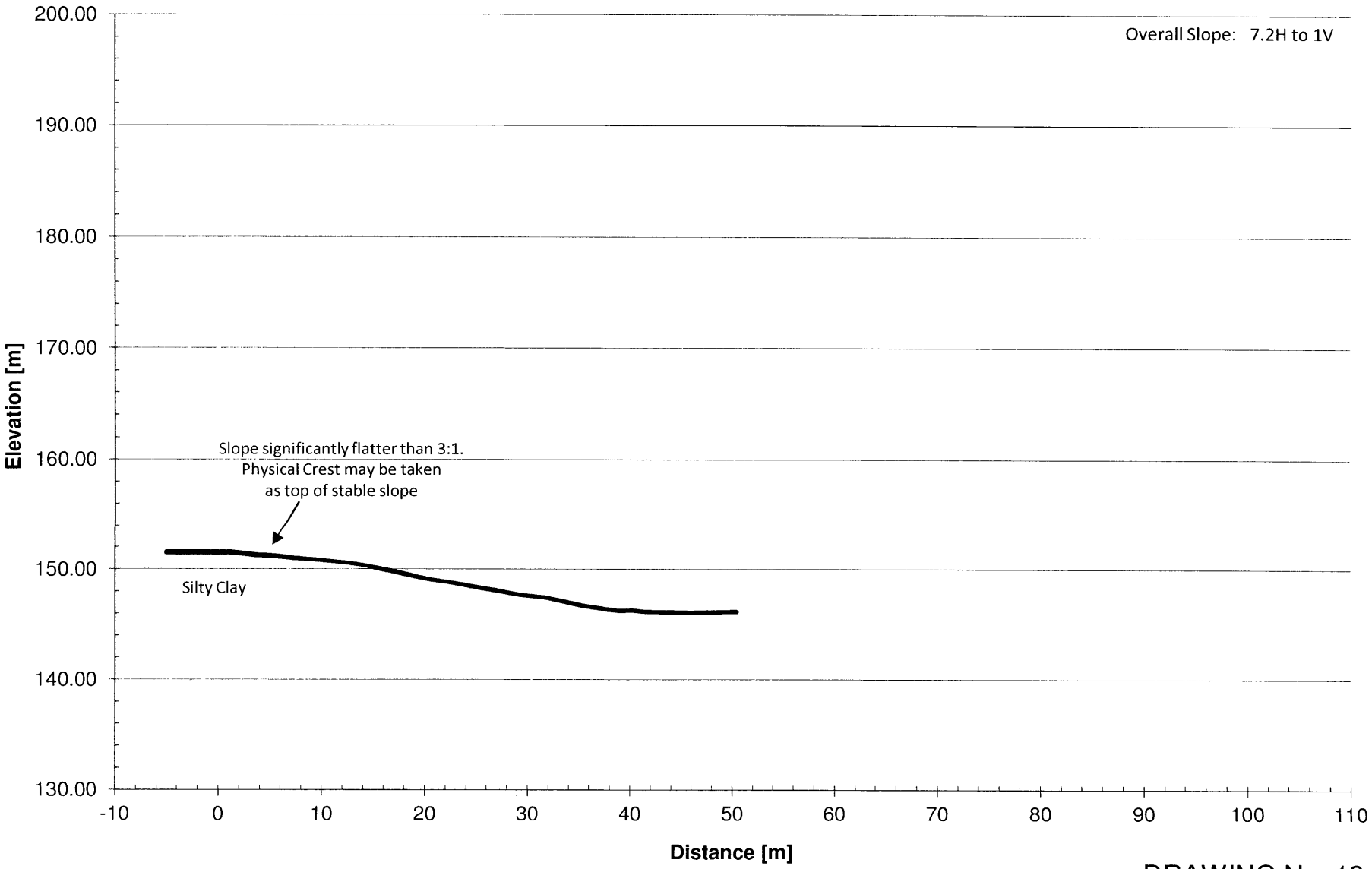


Project No.: SM 167182-G

DRAWING No. 12

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile K-K

Soil-Mat

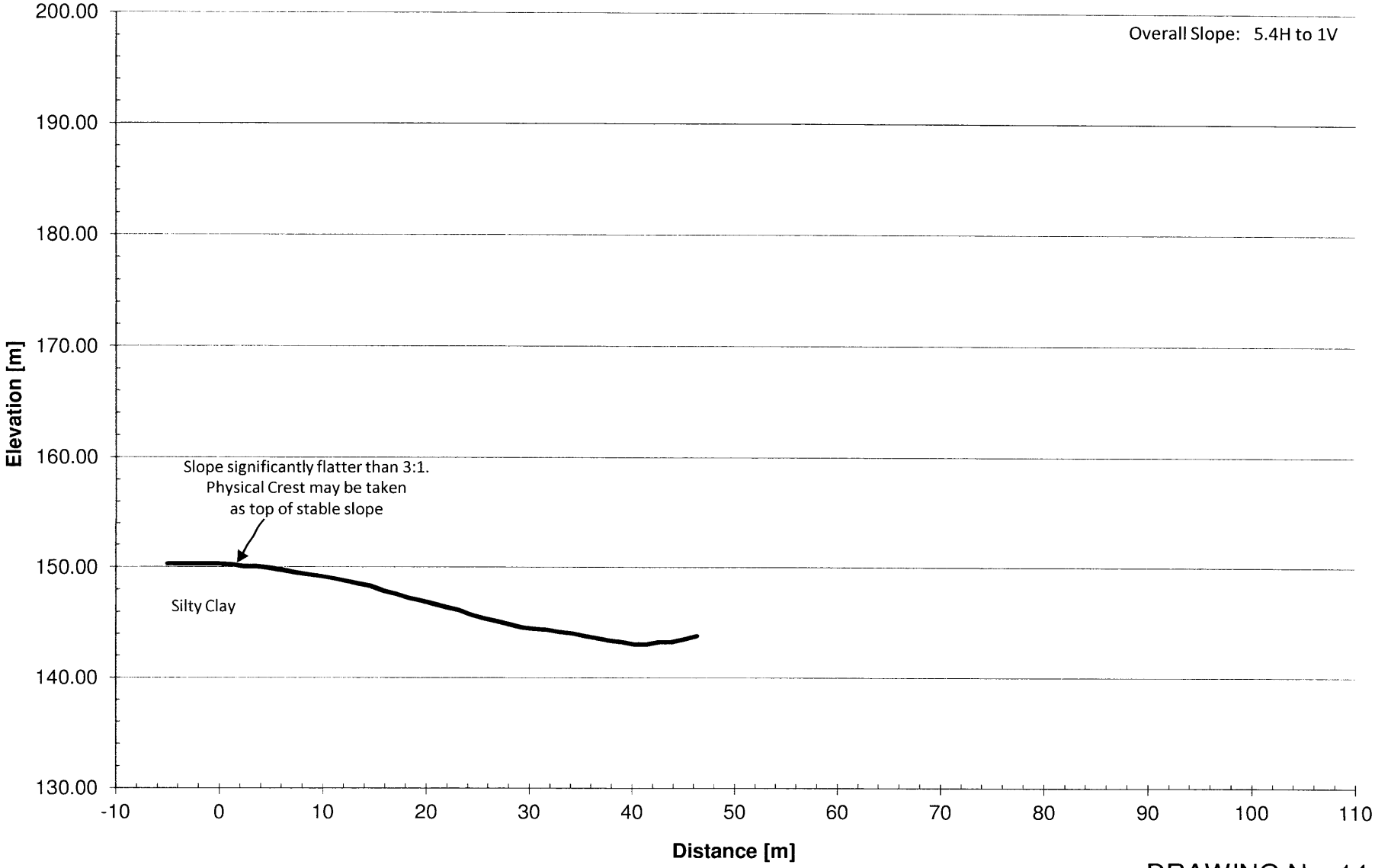


Project No.: SM 167182-G

DRAWING No. 13

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile L-L

Soil-Mat

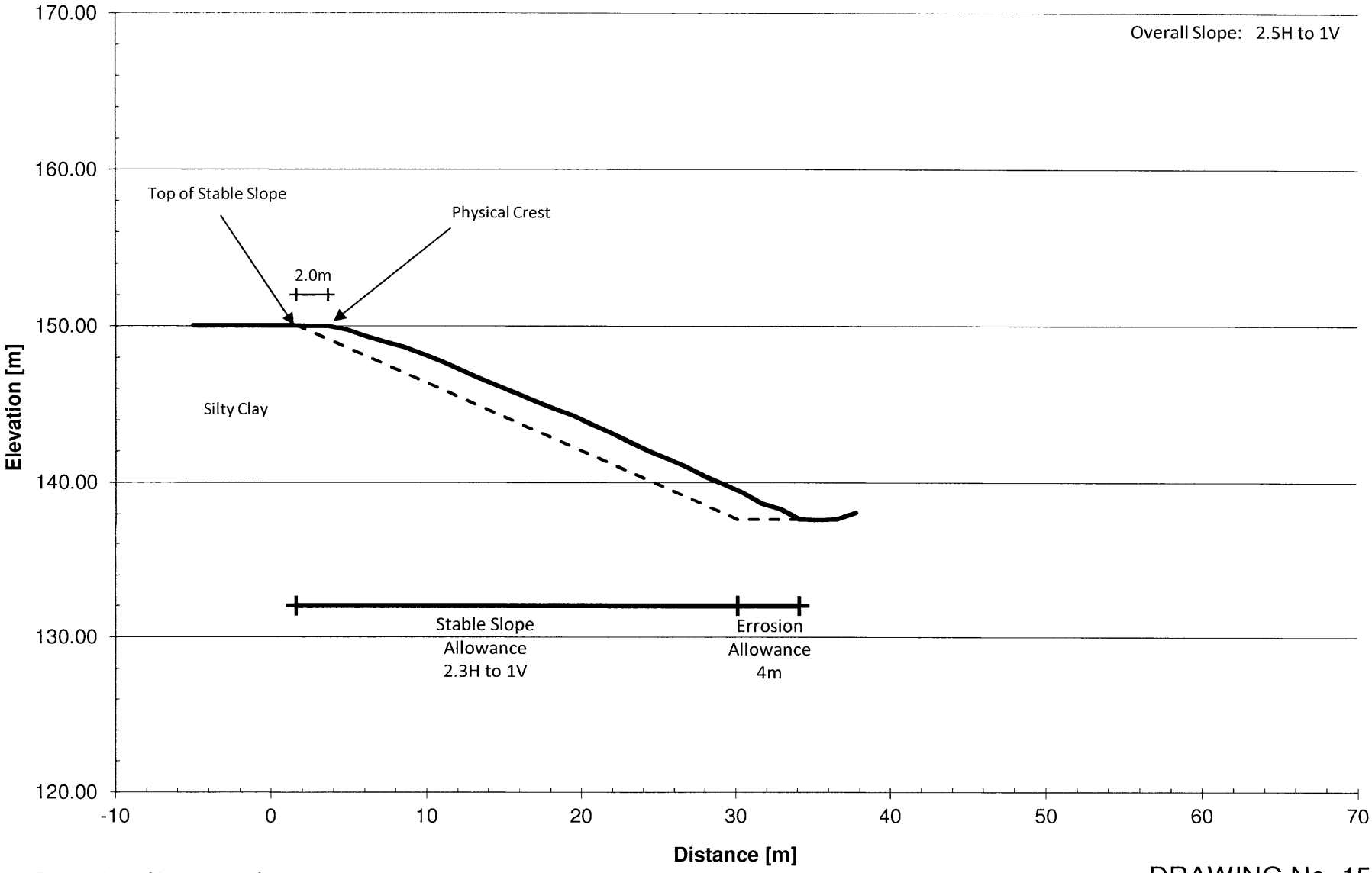


Project No.: SM 167182-G

DRAWING No. 14

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile M-M

Soil-Mat

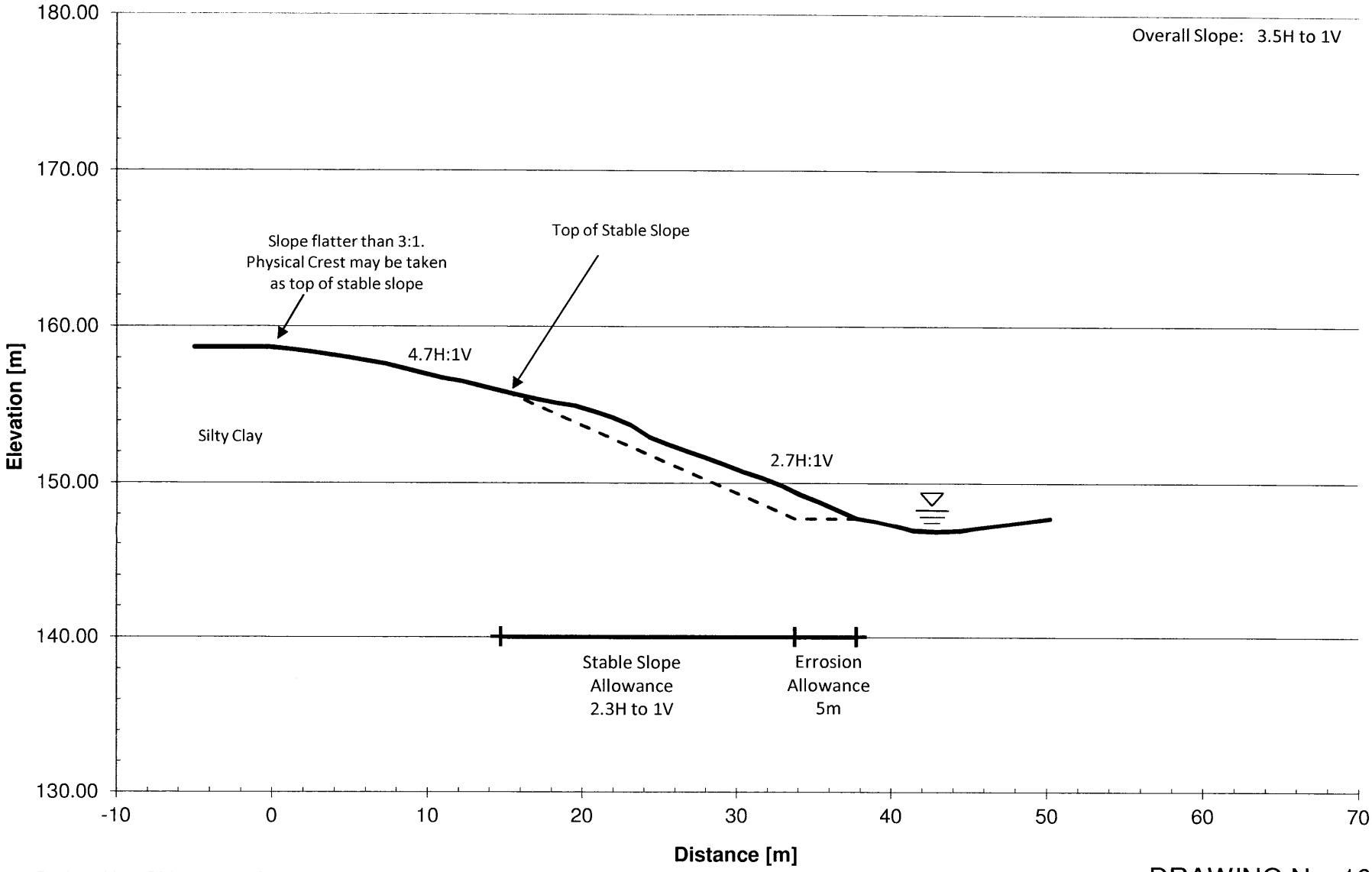


Project No.: SM 167182-G

DRAWING No. 15

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile N-N

Soil-Mat

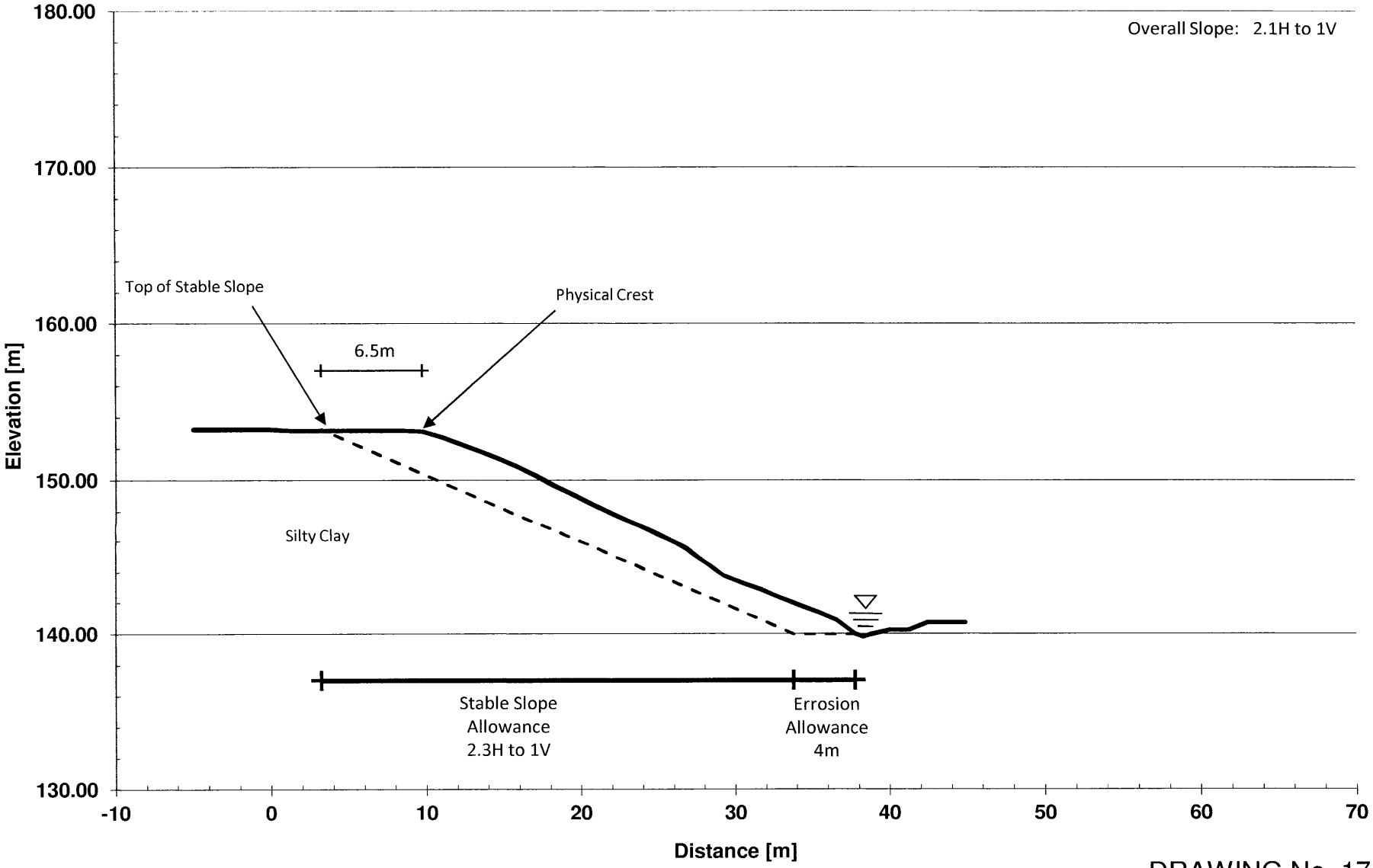


Project No.: SM 167182-G

DRAWING No. 16

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile O-O

Soil-Mat

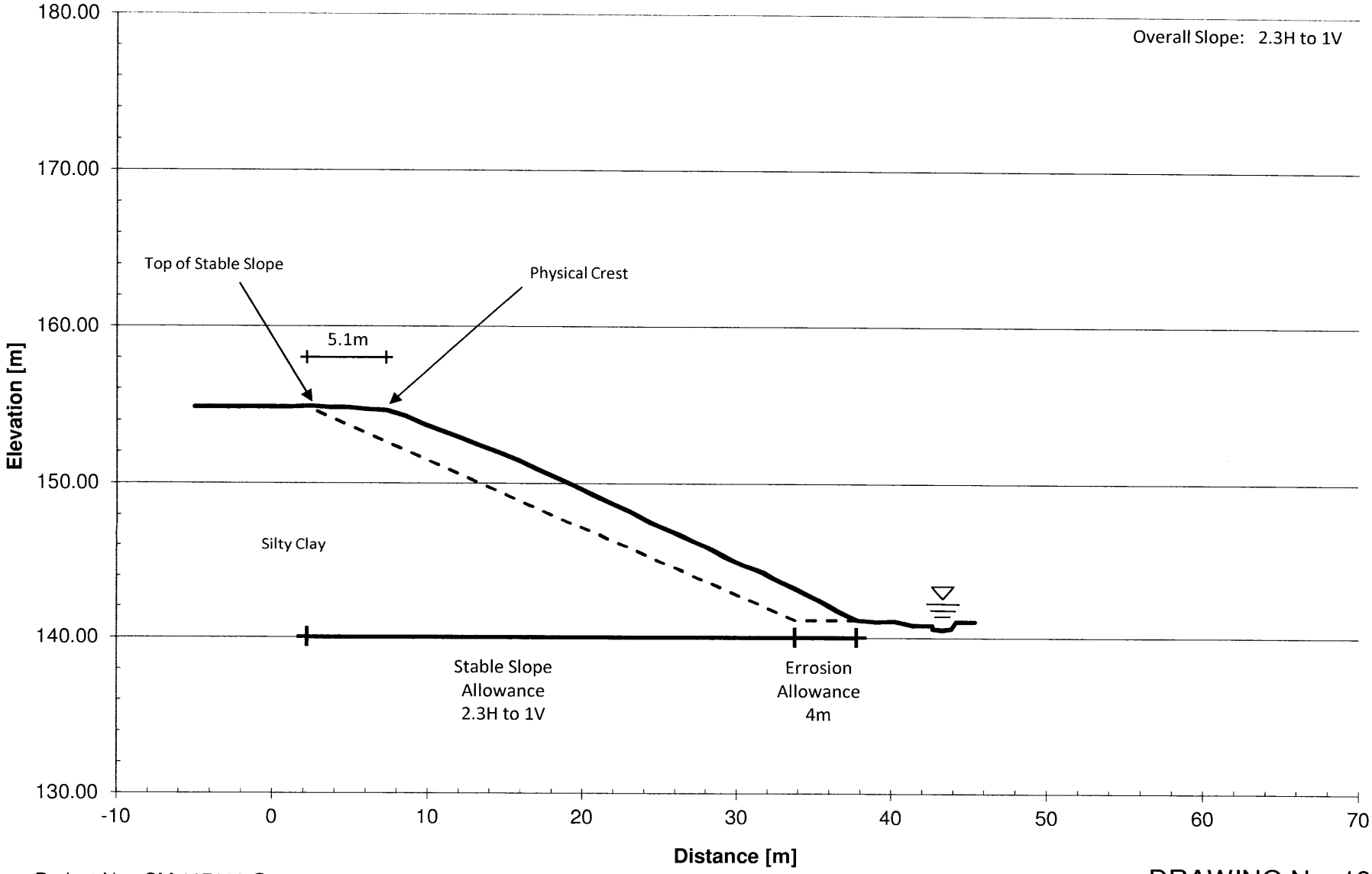


Project No.: SM 167182-G

DRAWING No. 17

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile P-P

Soil-Mat

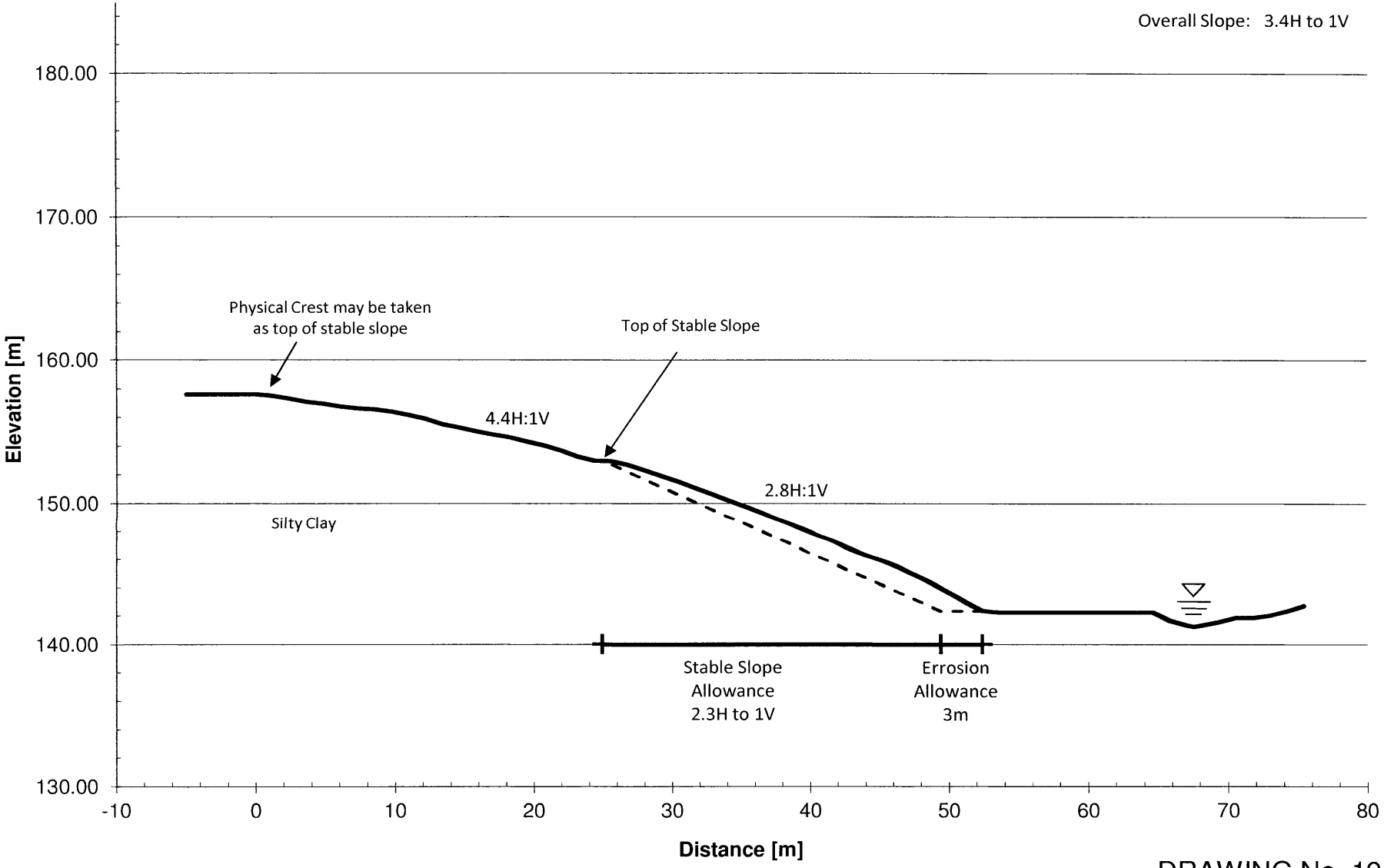


Project No.: SM 167182-G

DRAWING No. 18

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile Q-Q

Soil-Mat

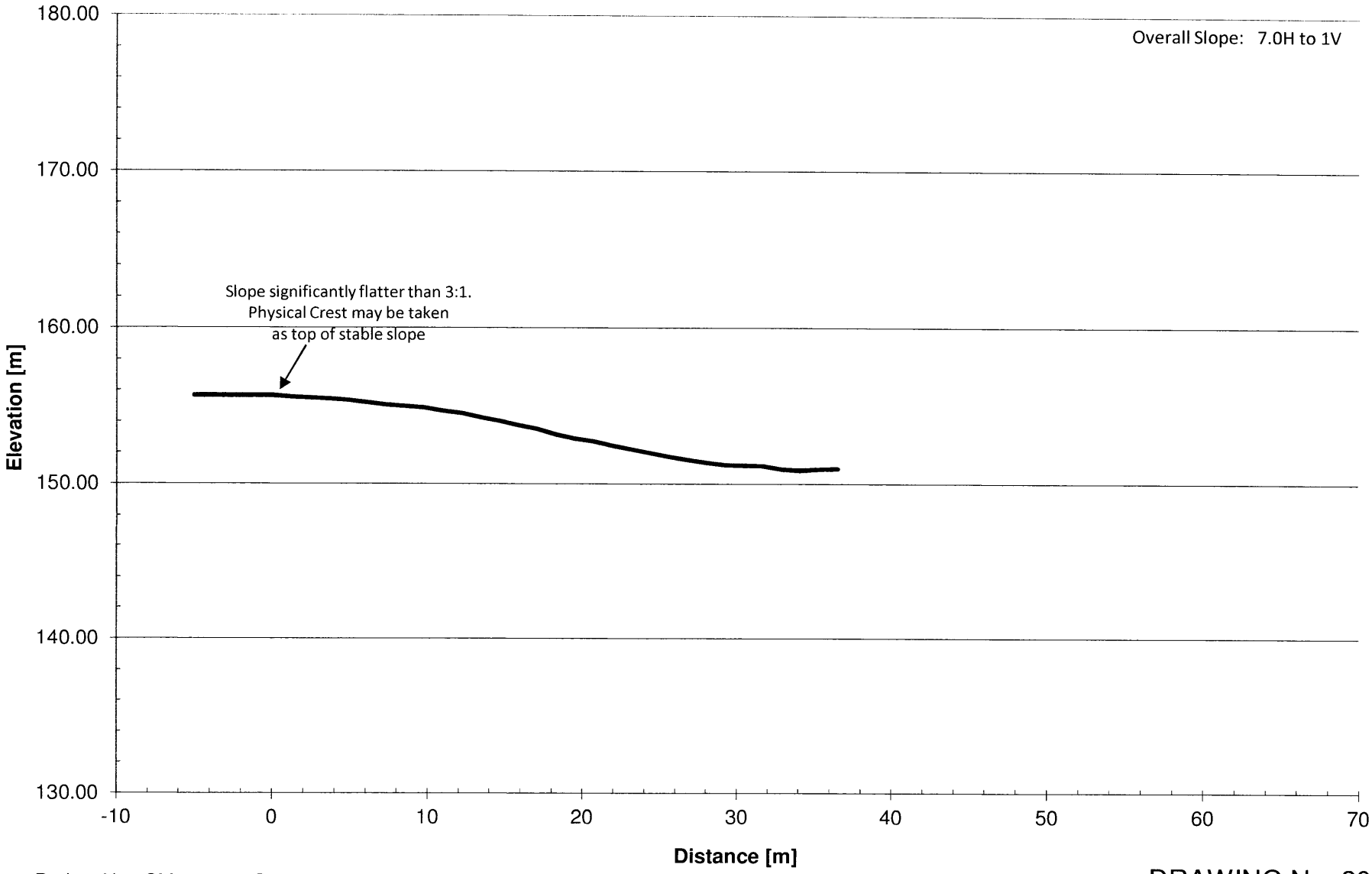


Project No.: SM 167182-G

DRAWING No. 19

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile R-R

Soil-Mat

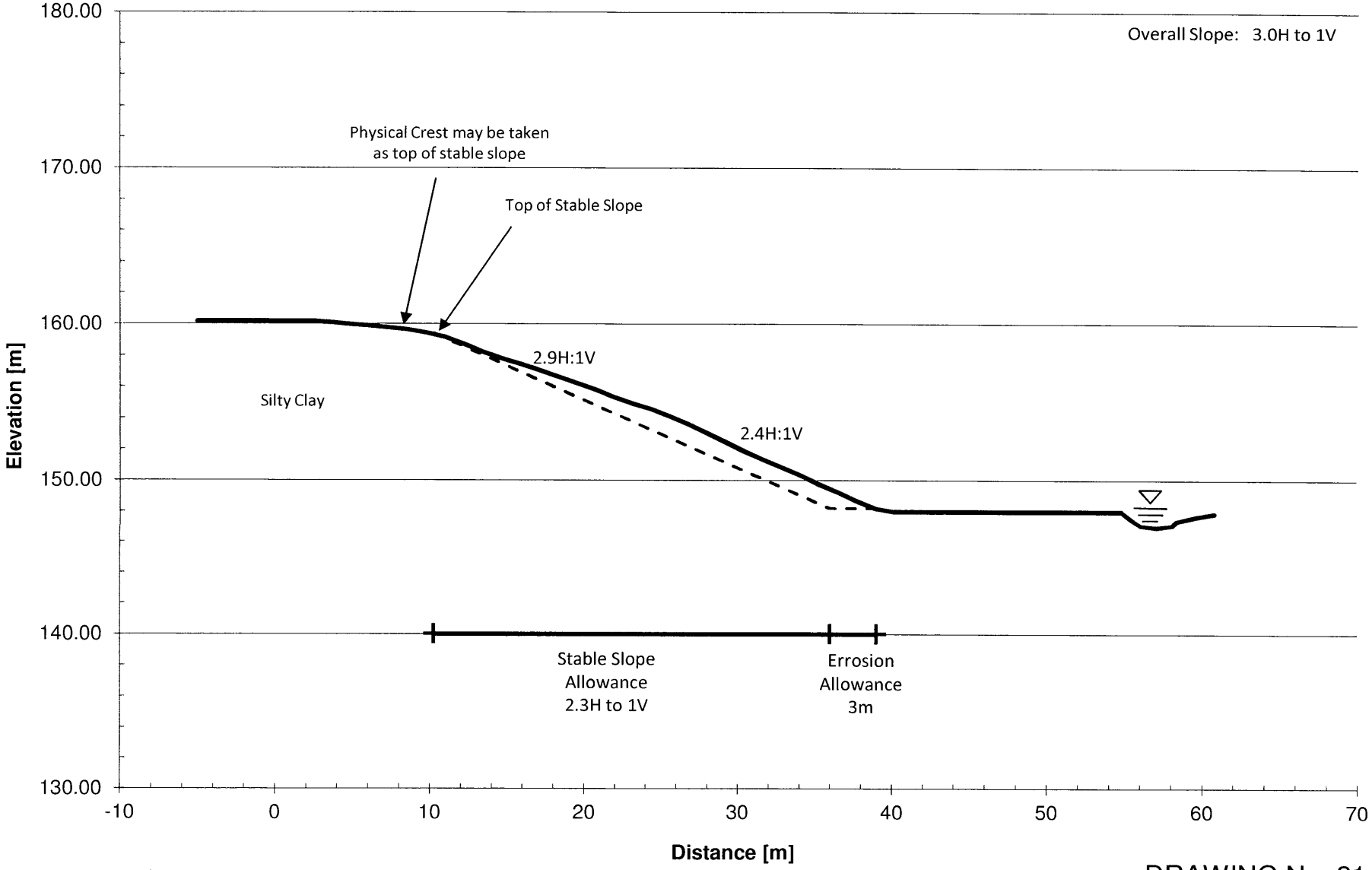


Project No.: SM 167182-G

DRAWING No. 20

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile S-S

Soil-Mat

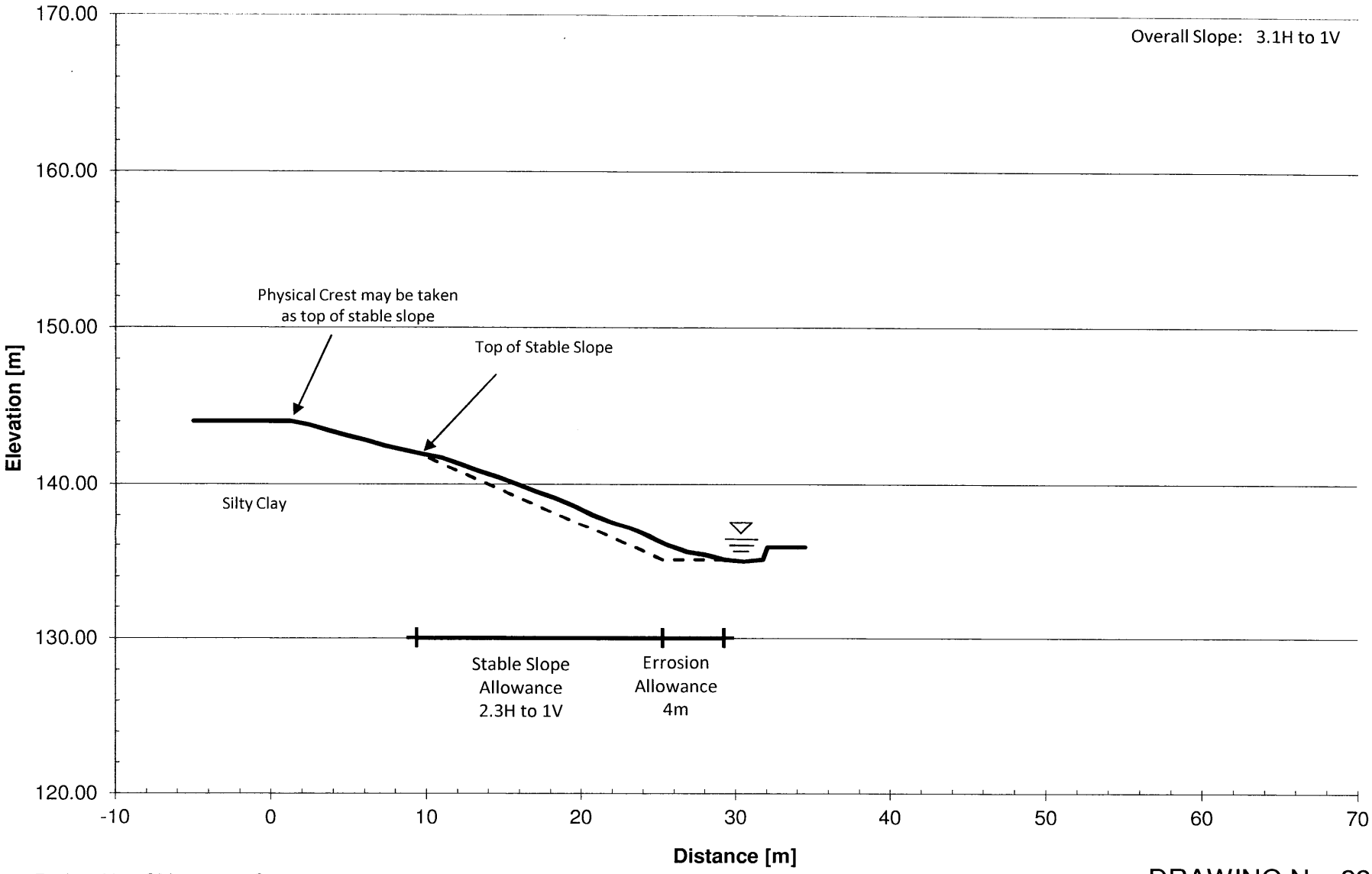


Project No.: SM 167182-G

DRAWING No. 21

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile T-T

Soil-Mat

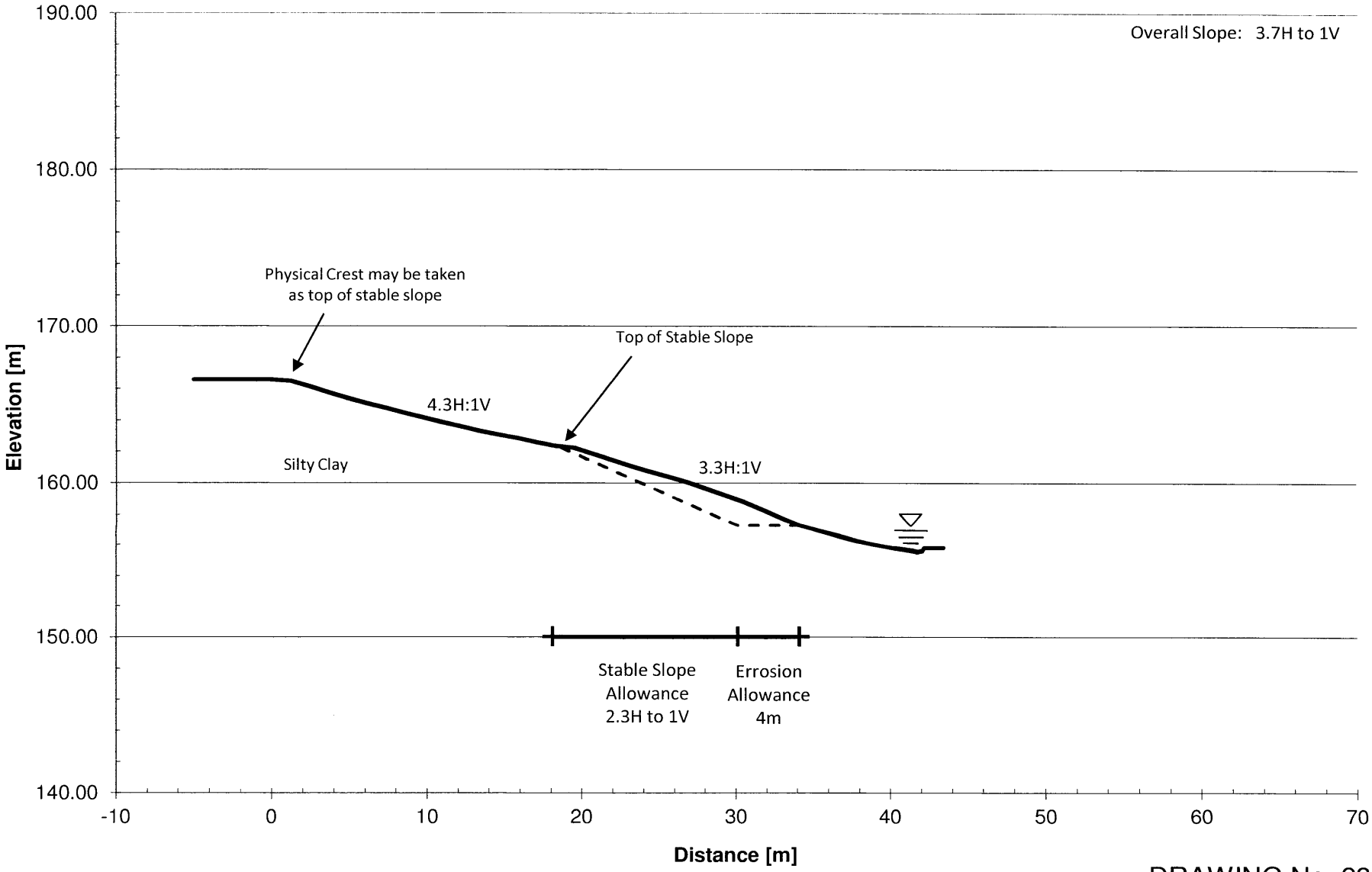


Project No.: SM 167182-G

DRAWING No. 22

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile U-U

Soil-Mat

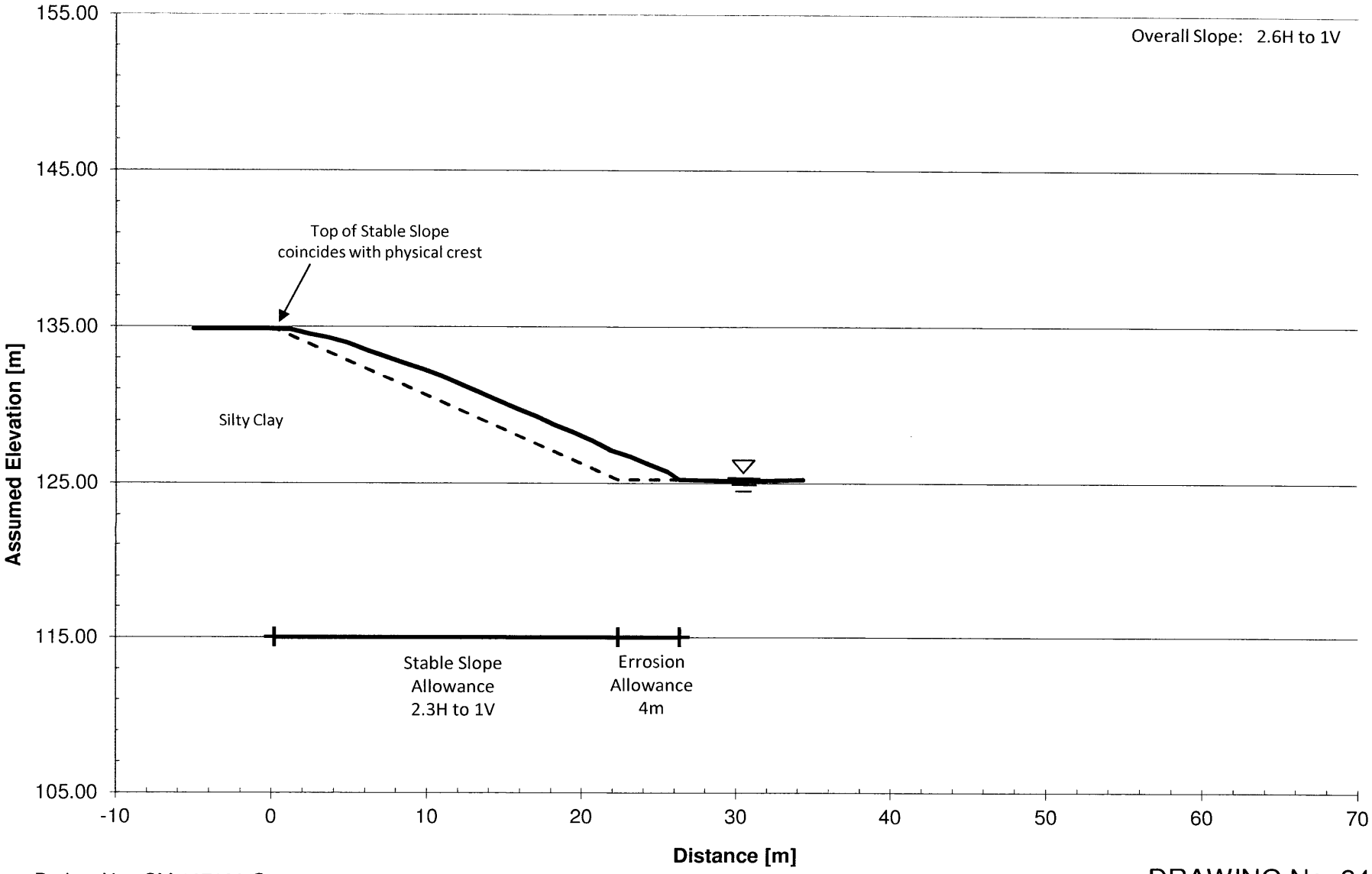


Project No.: SM 167182-G

DRAWING No. 23

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile V-V

Soil-Mat

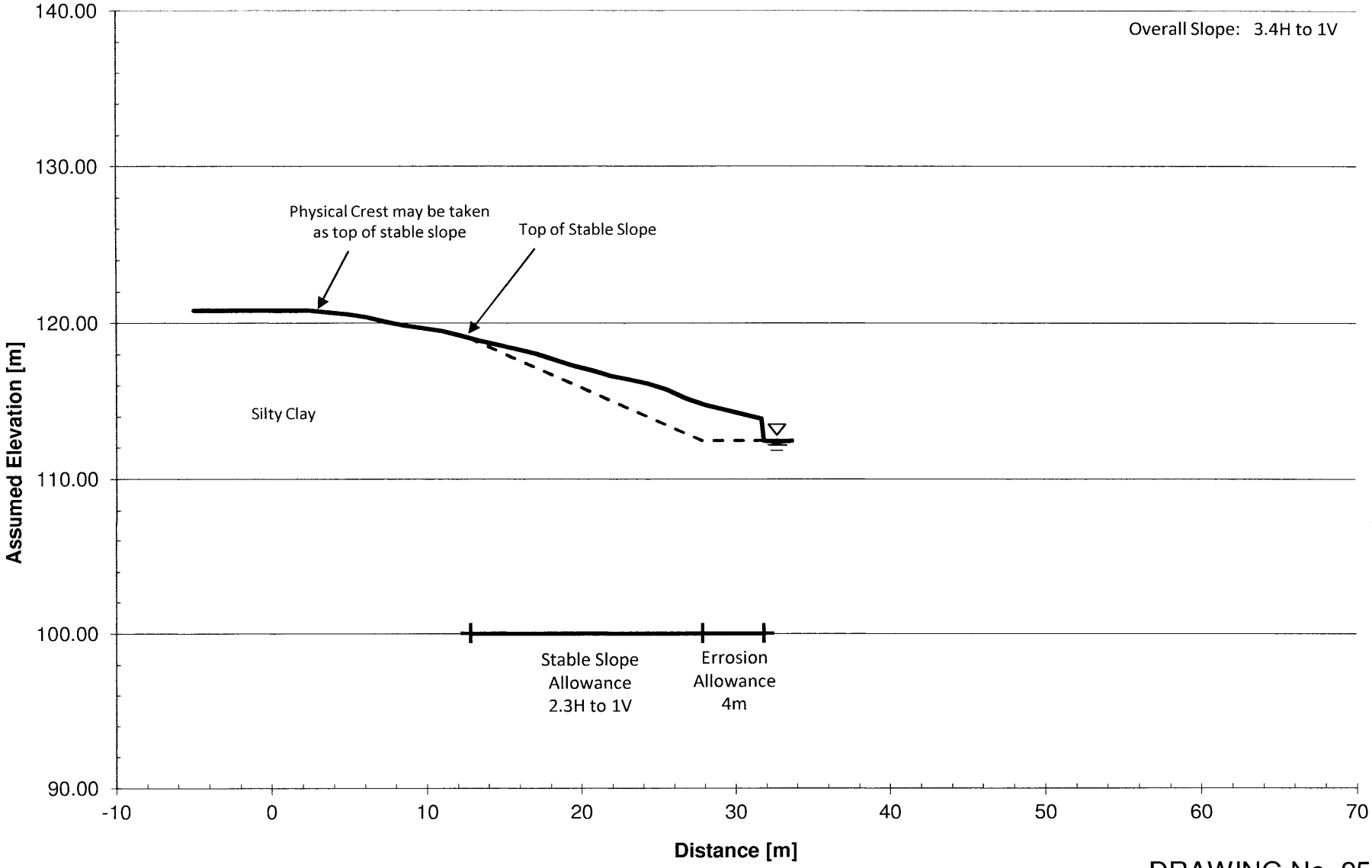


Project No.: SM 167182-G

DRAWING No. 24

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile W-W

Soil-Mat

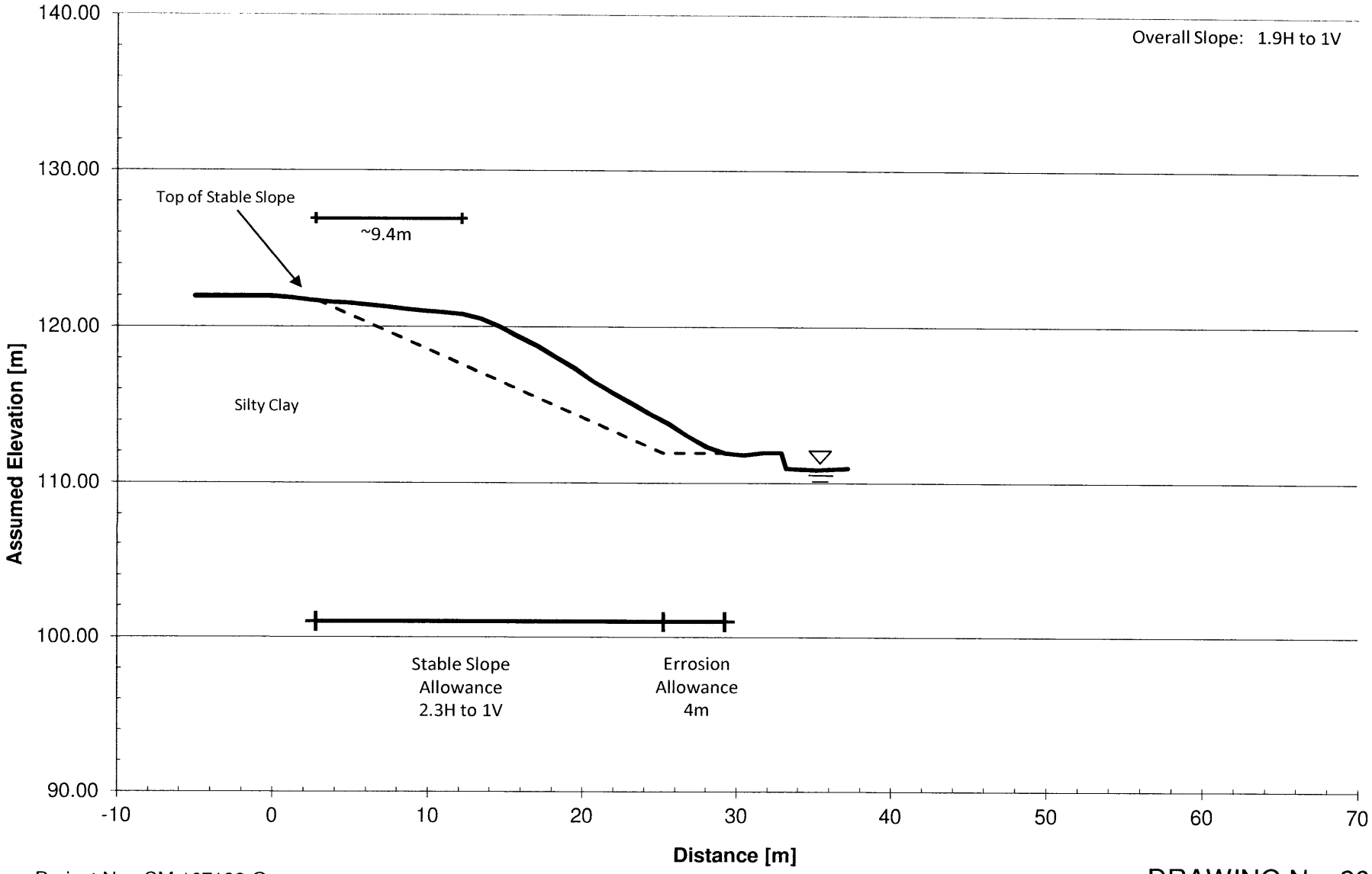


Project No.: SM 167182-G

DRAWING No. 25

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile X-X

Soil-Mat

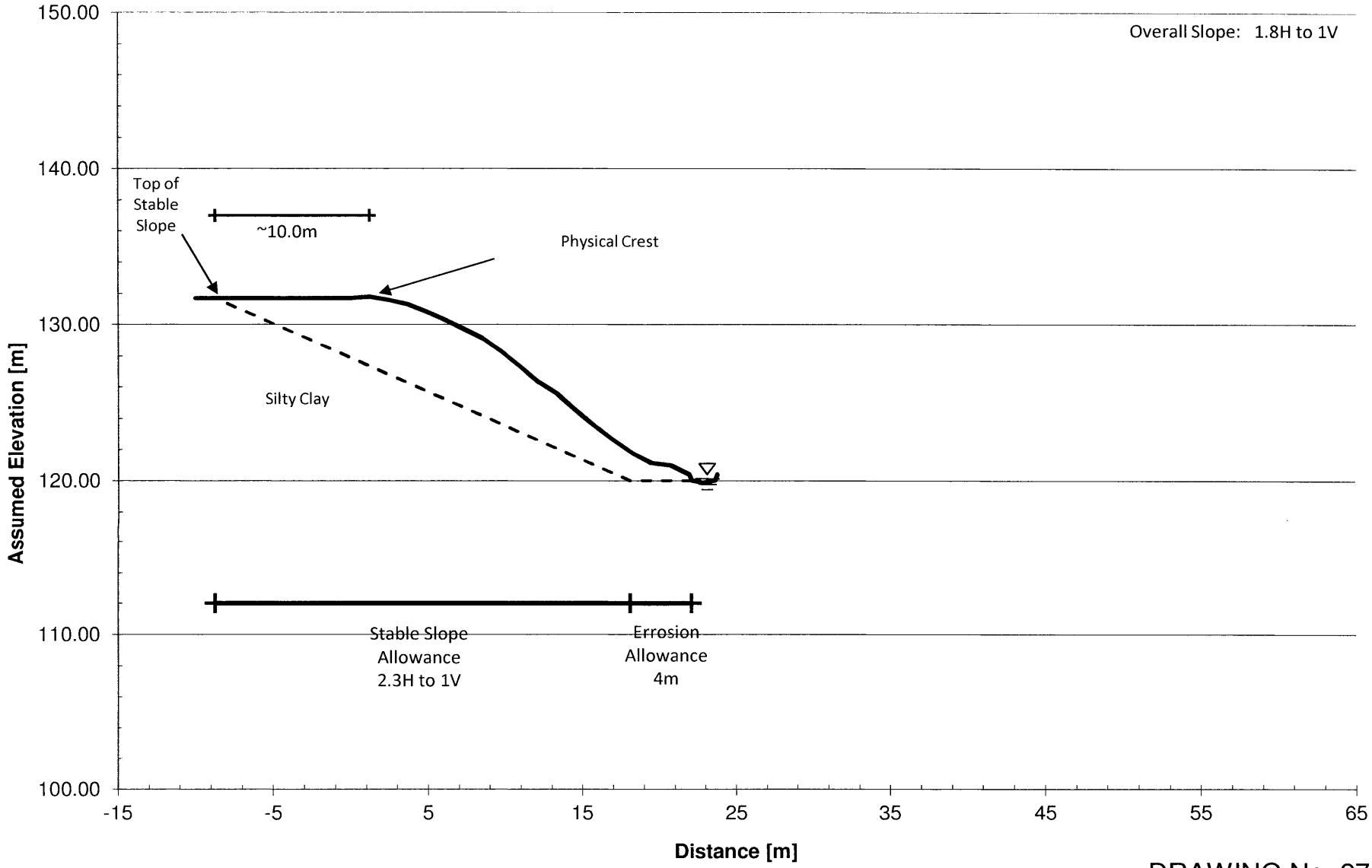


Project No.: SM 167182-G

DRAWING No. 26

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile Y-Y

Soil-Mat

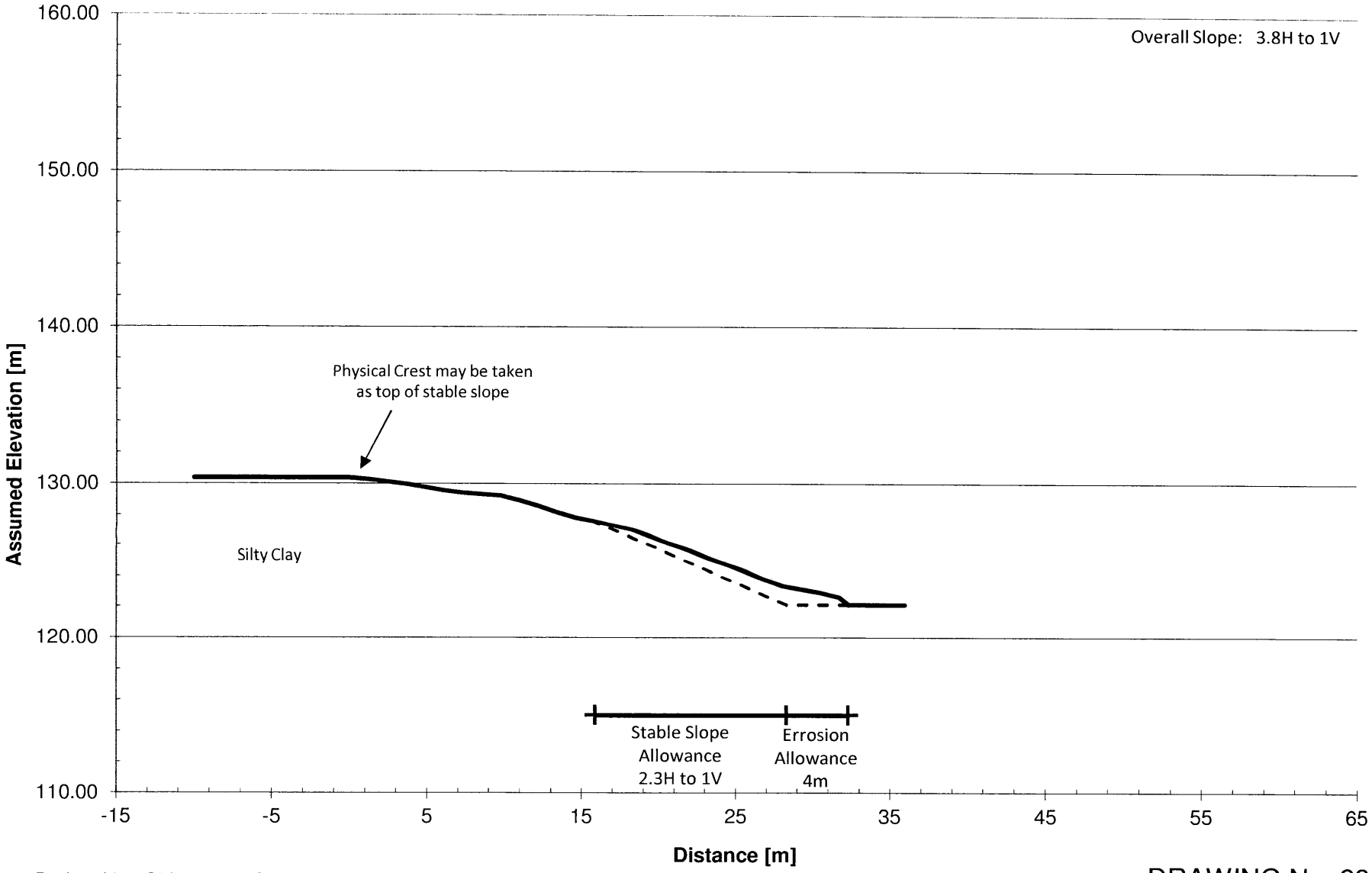


Project No.: SM 167182-G

DRAWING No. 27

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile Z-Z

Soil-Mat

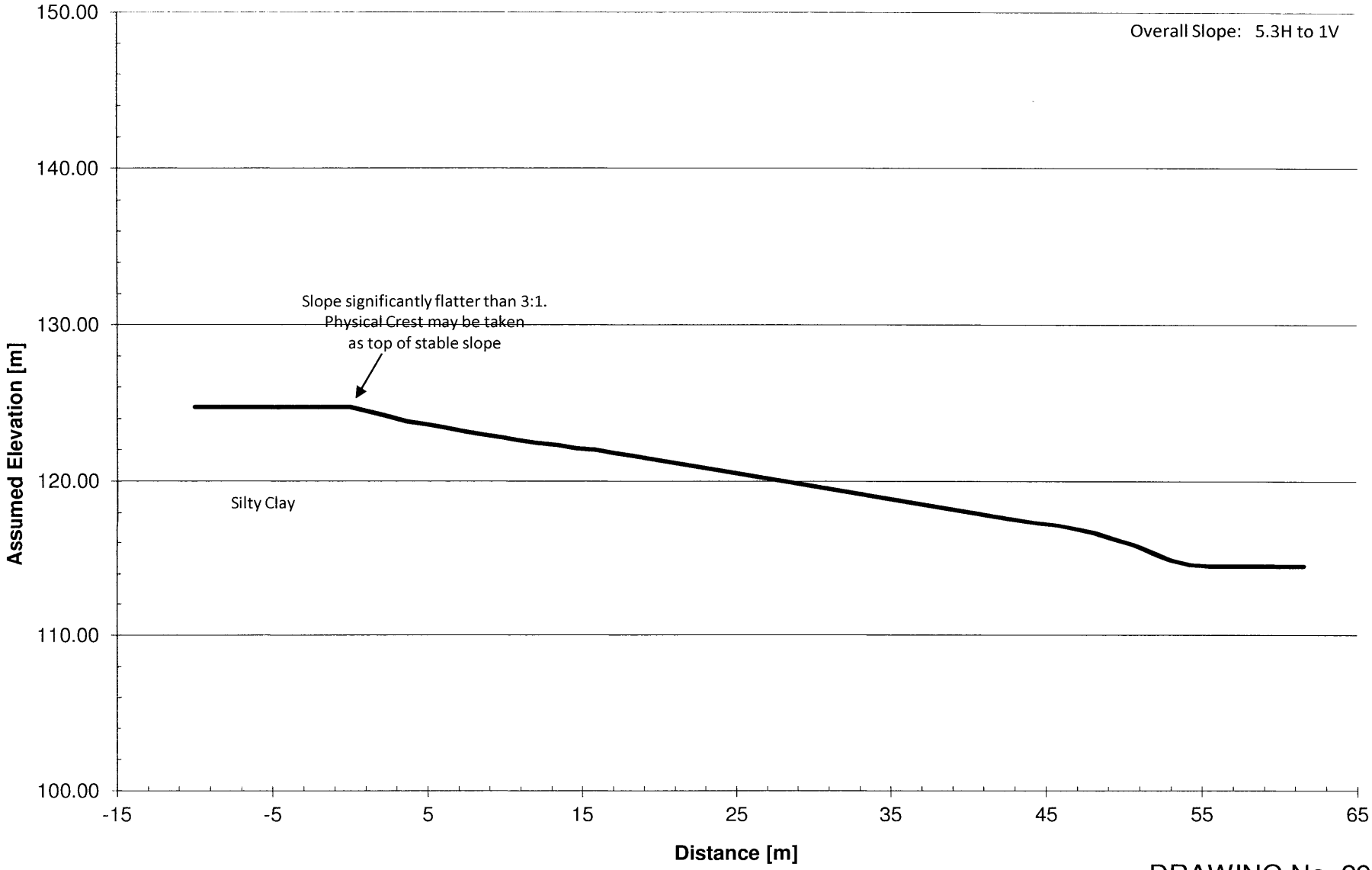


Project No.: SM 167182-G

DRAWING No. 28

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile 1-1

Soil-Mat

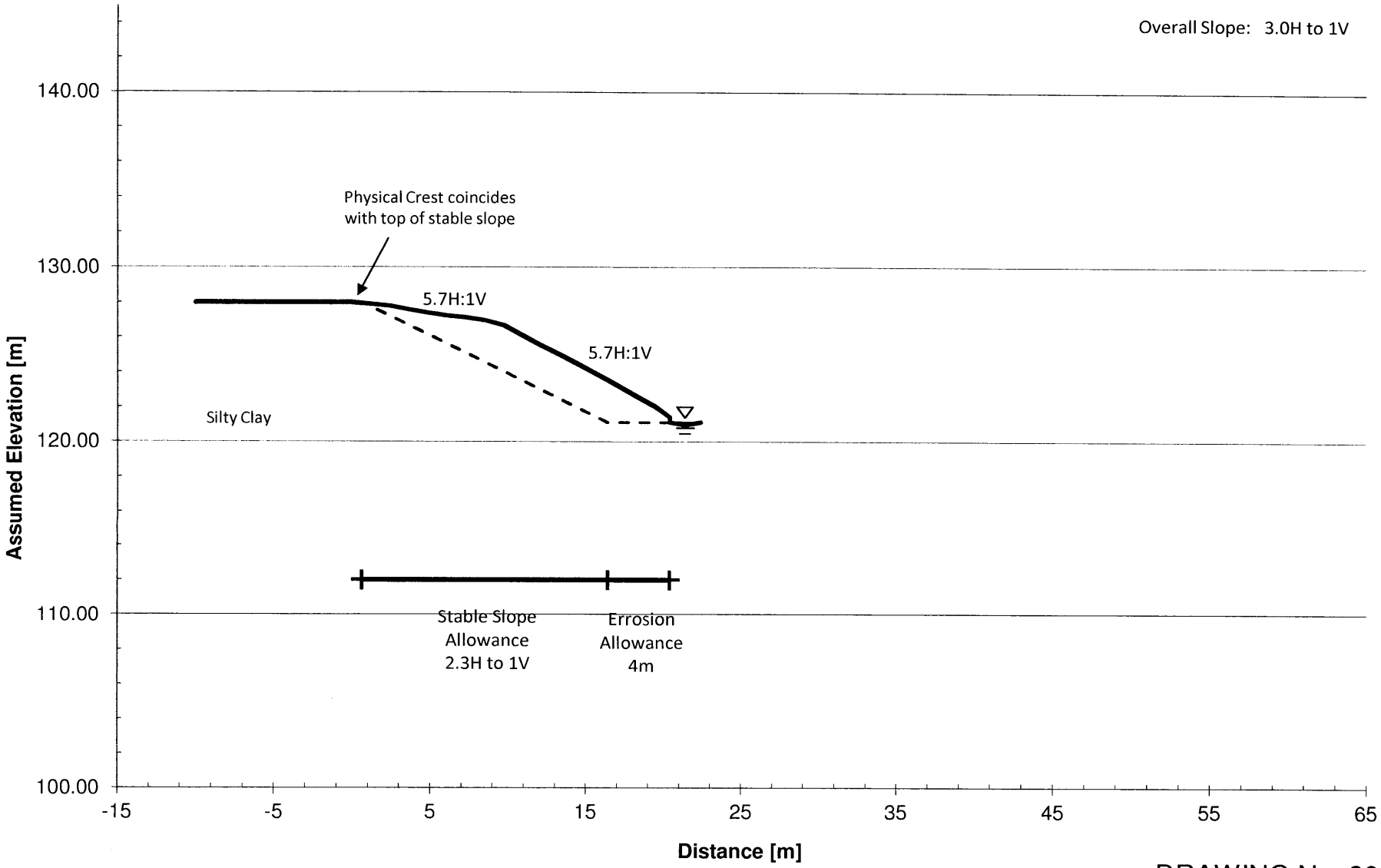


Project No.: SM 167182-G

DRAWING No. 29

Slope Stability Analysis
Eagle Heights
Waterdown Road - Burlington, Ontario
Slope Profile 2-2

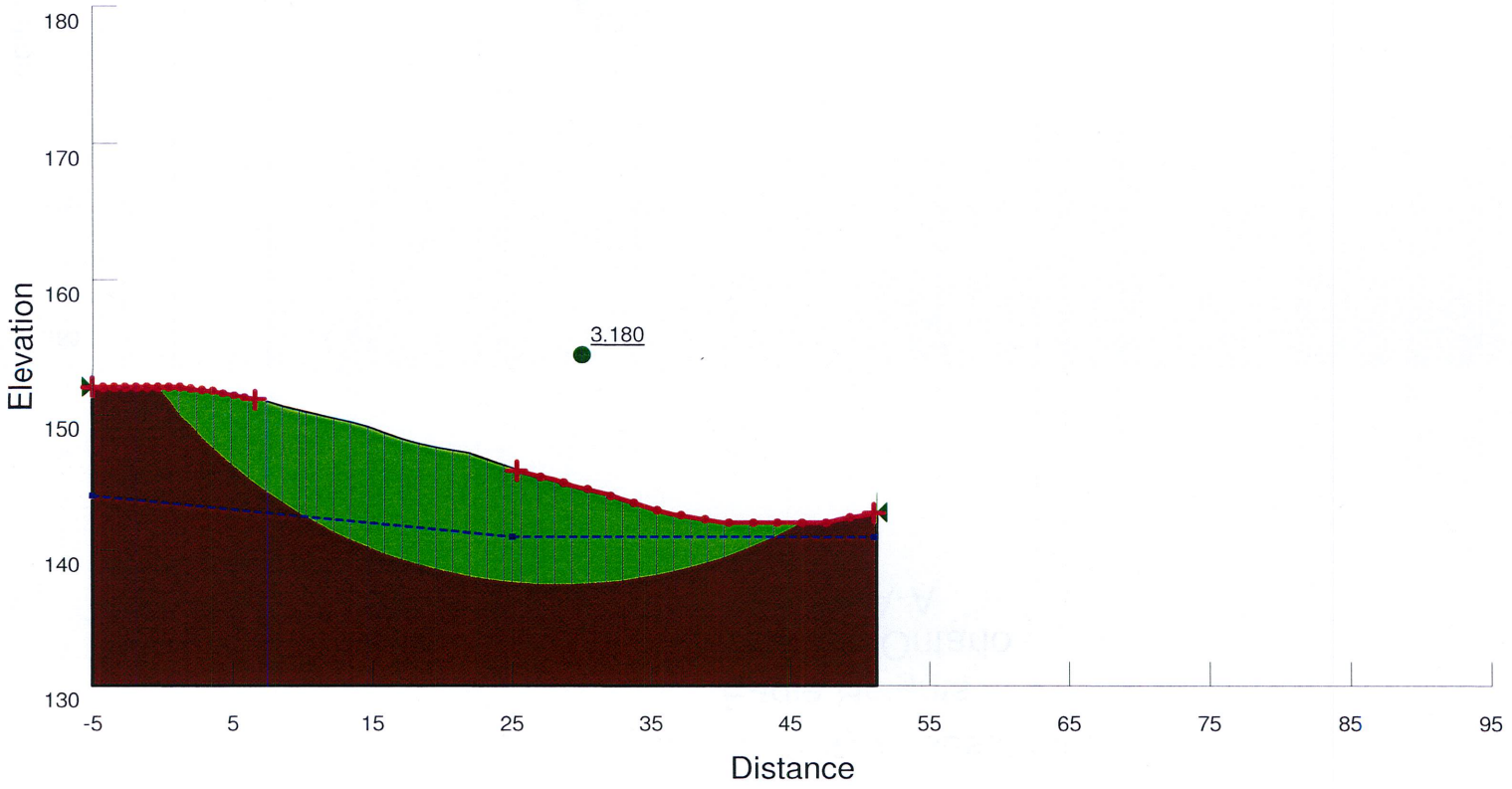
Soil-Mat



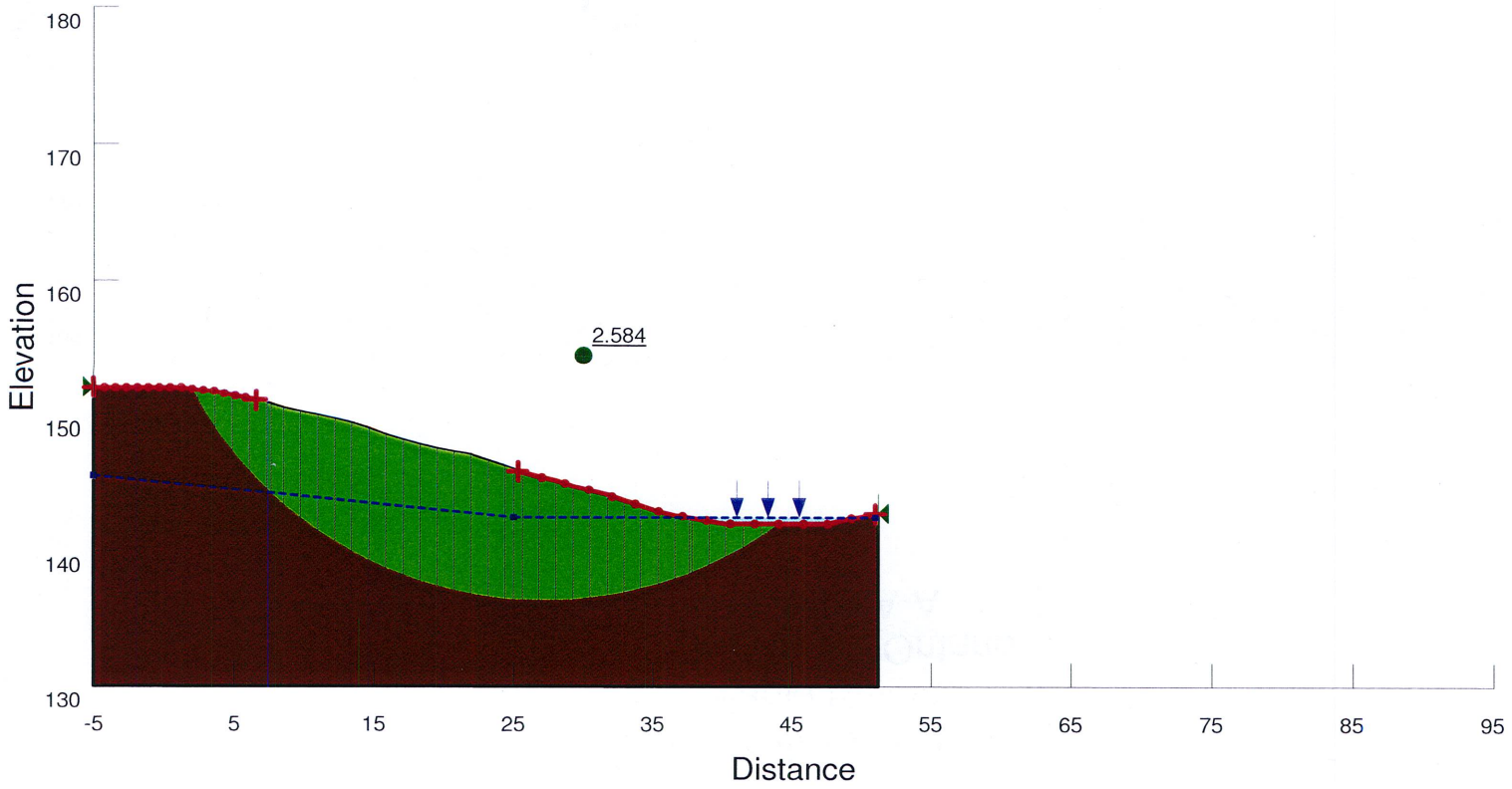
Project No.: SM 167182-G

DRAWING No. 30

Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile A-A

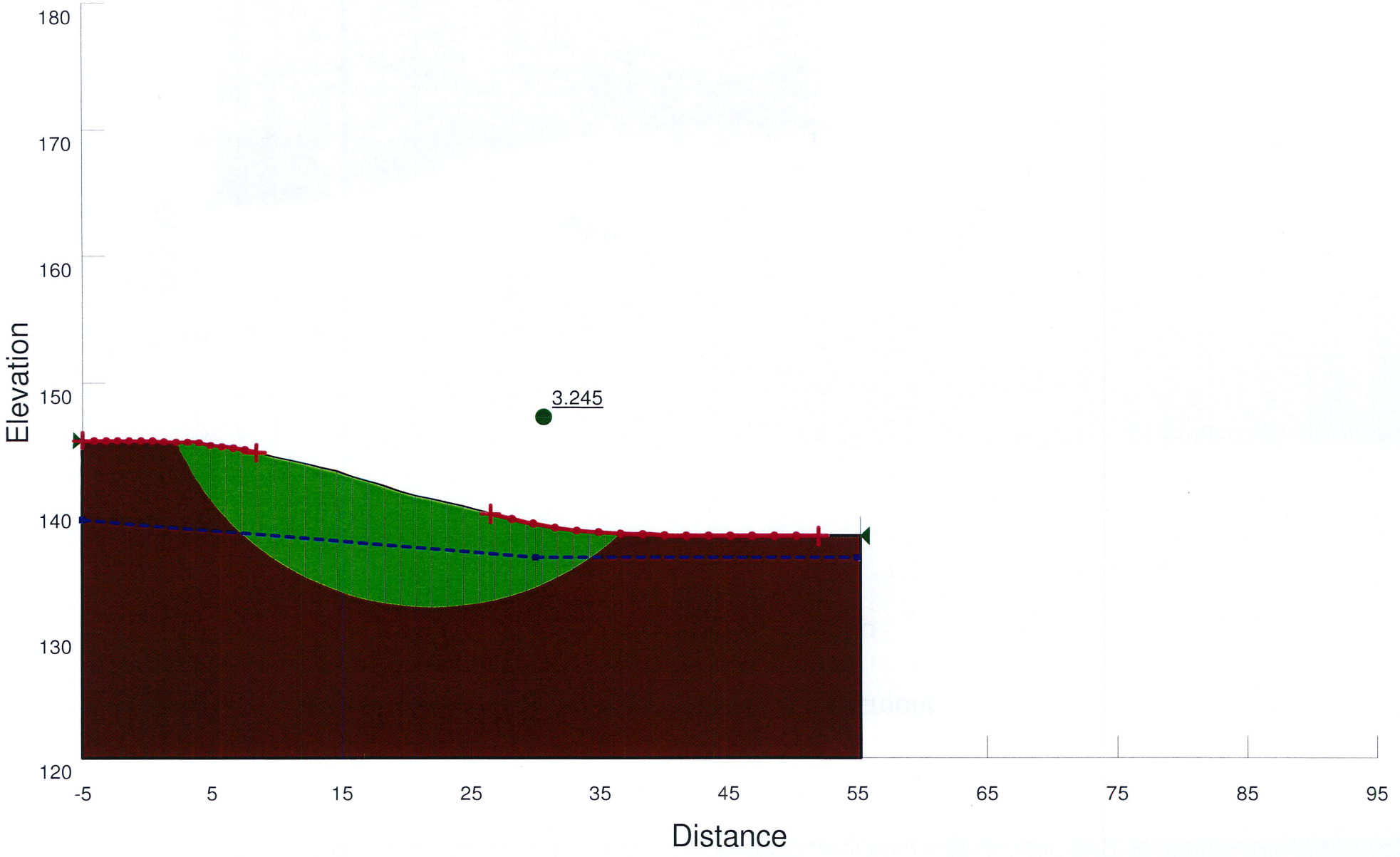


Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile A-A

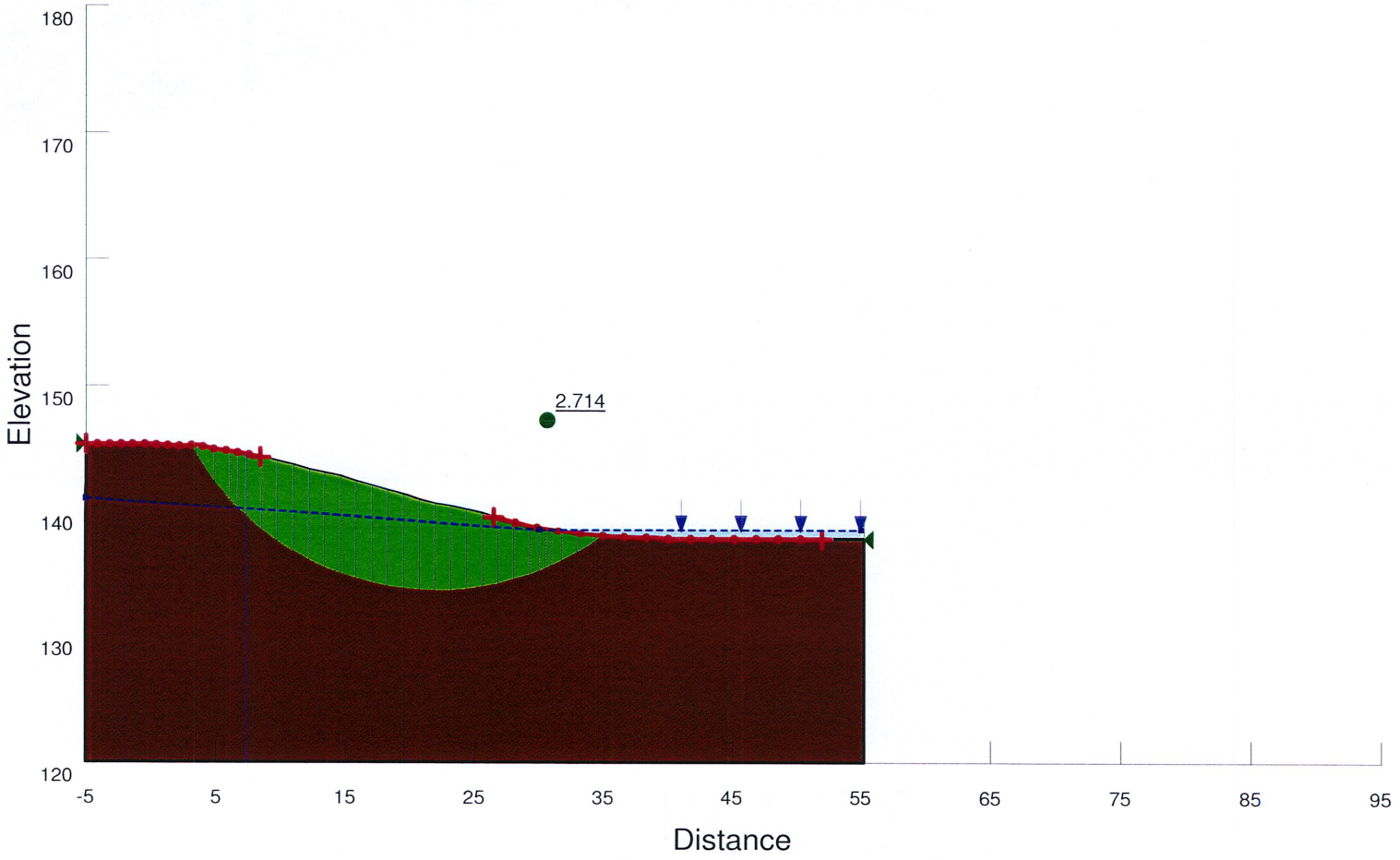


Slope Stability Assessment

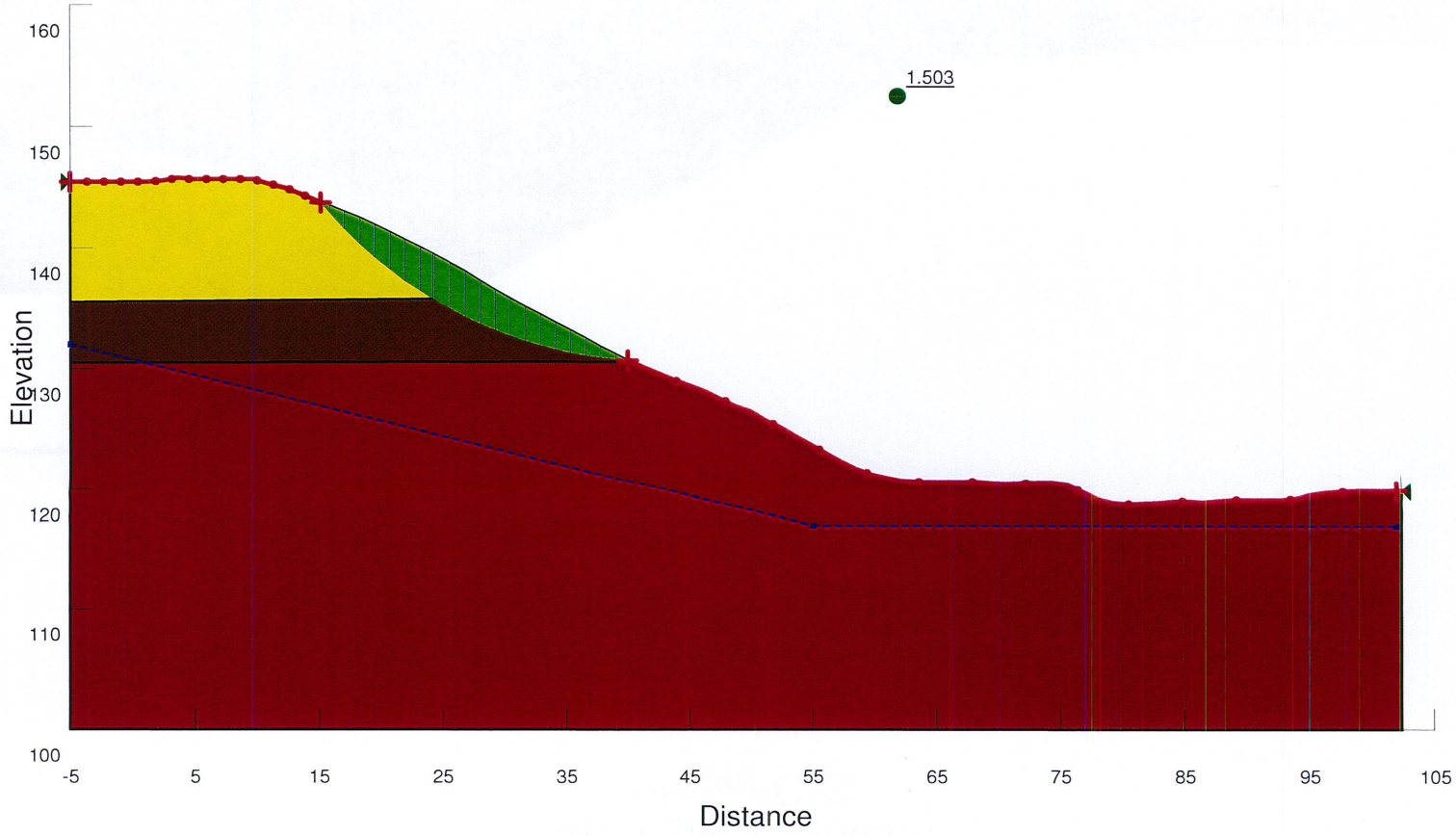
Eagle Heights
Burlington, Ontario
Profile B-B



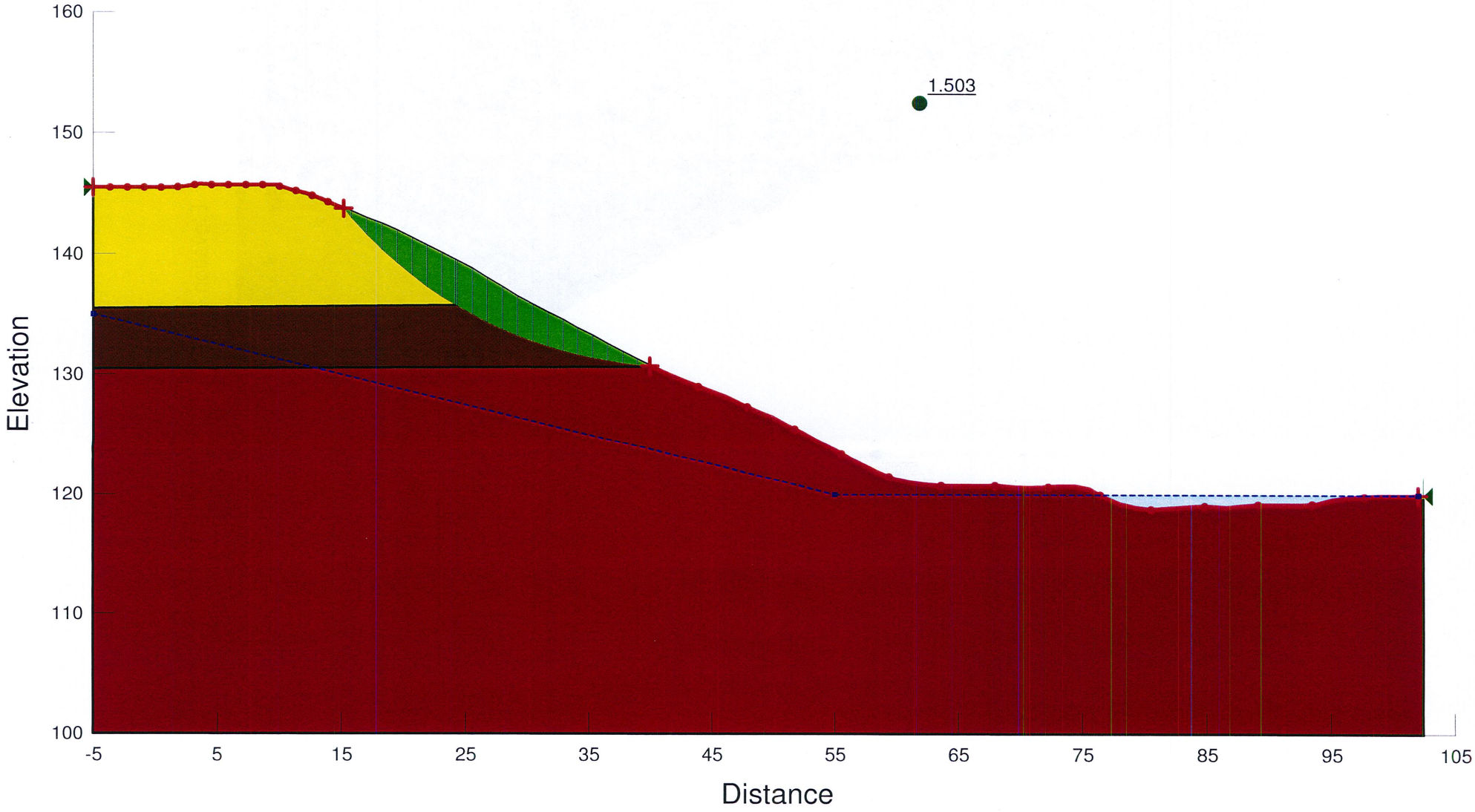
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile B-B



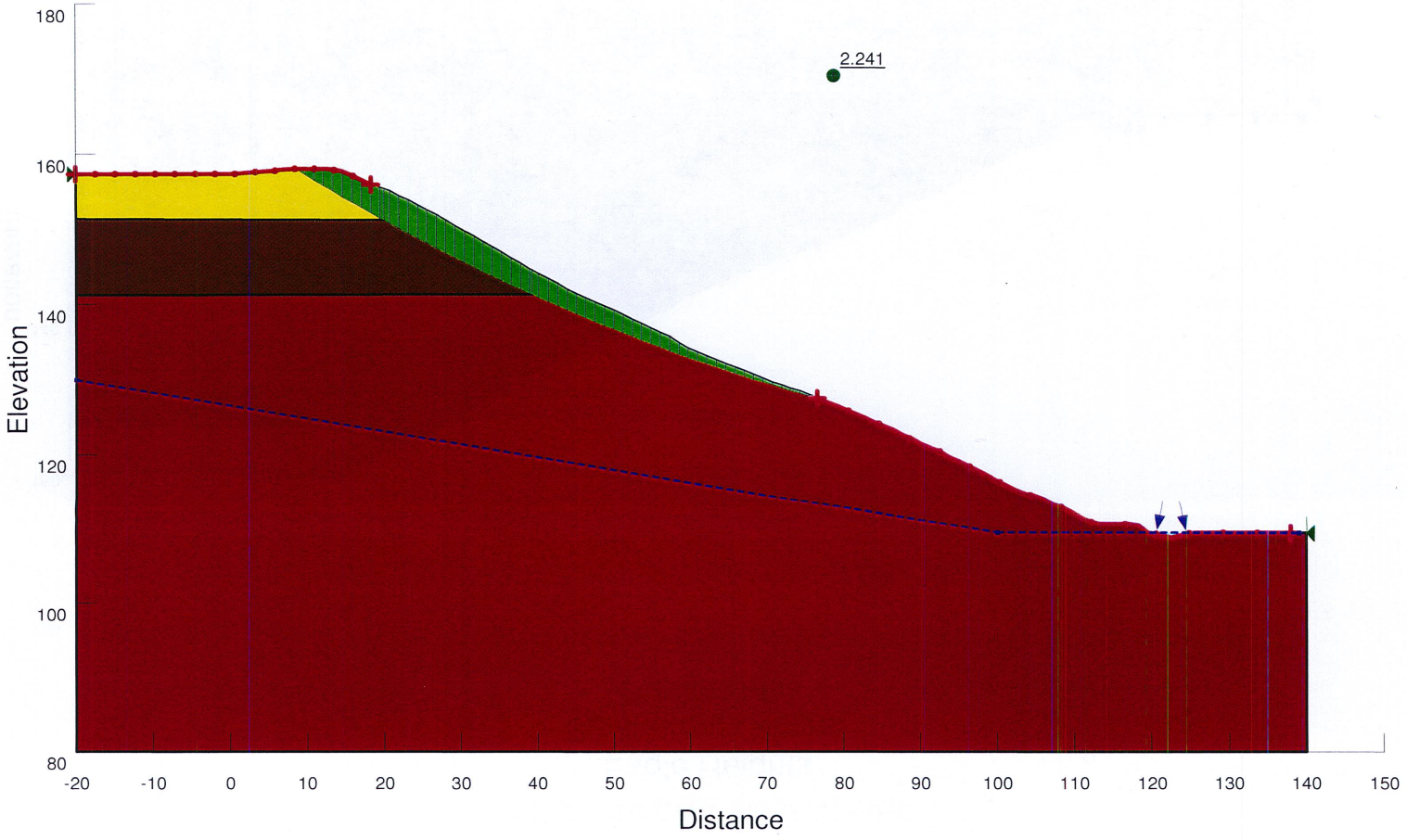
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile C-C



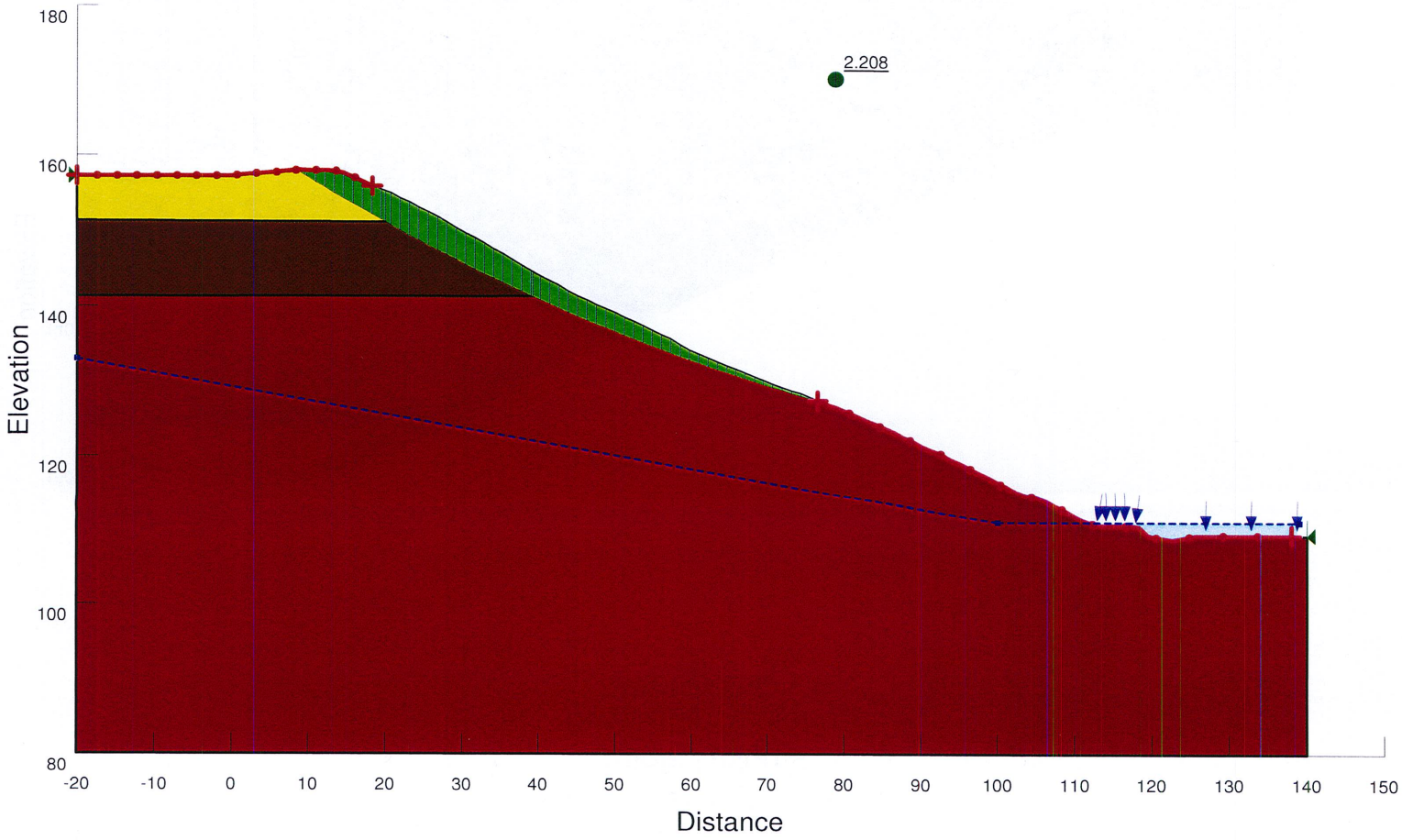
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile C-C



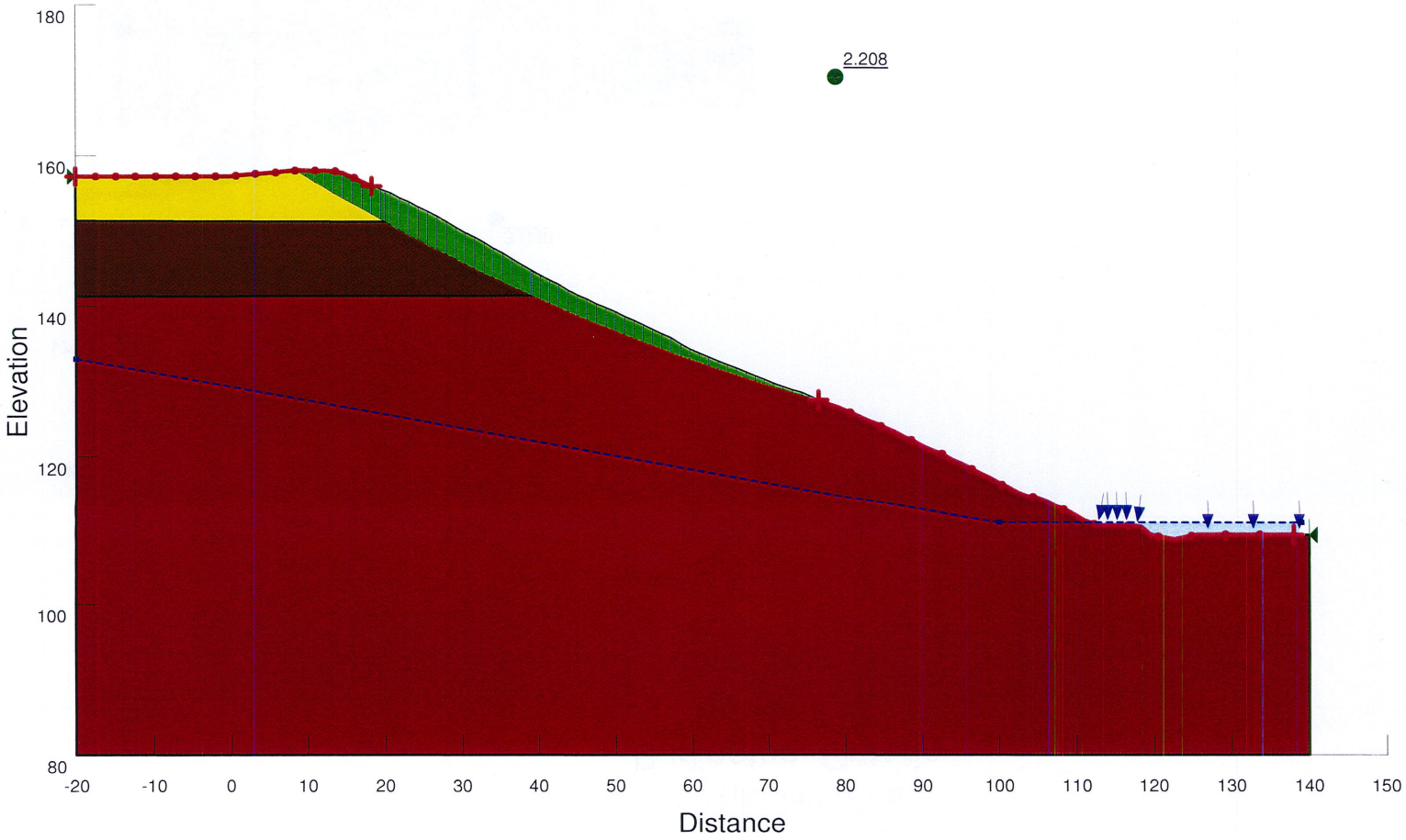
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile D-D



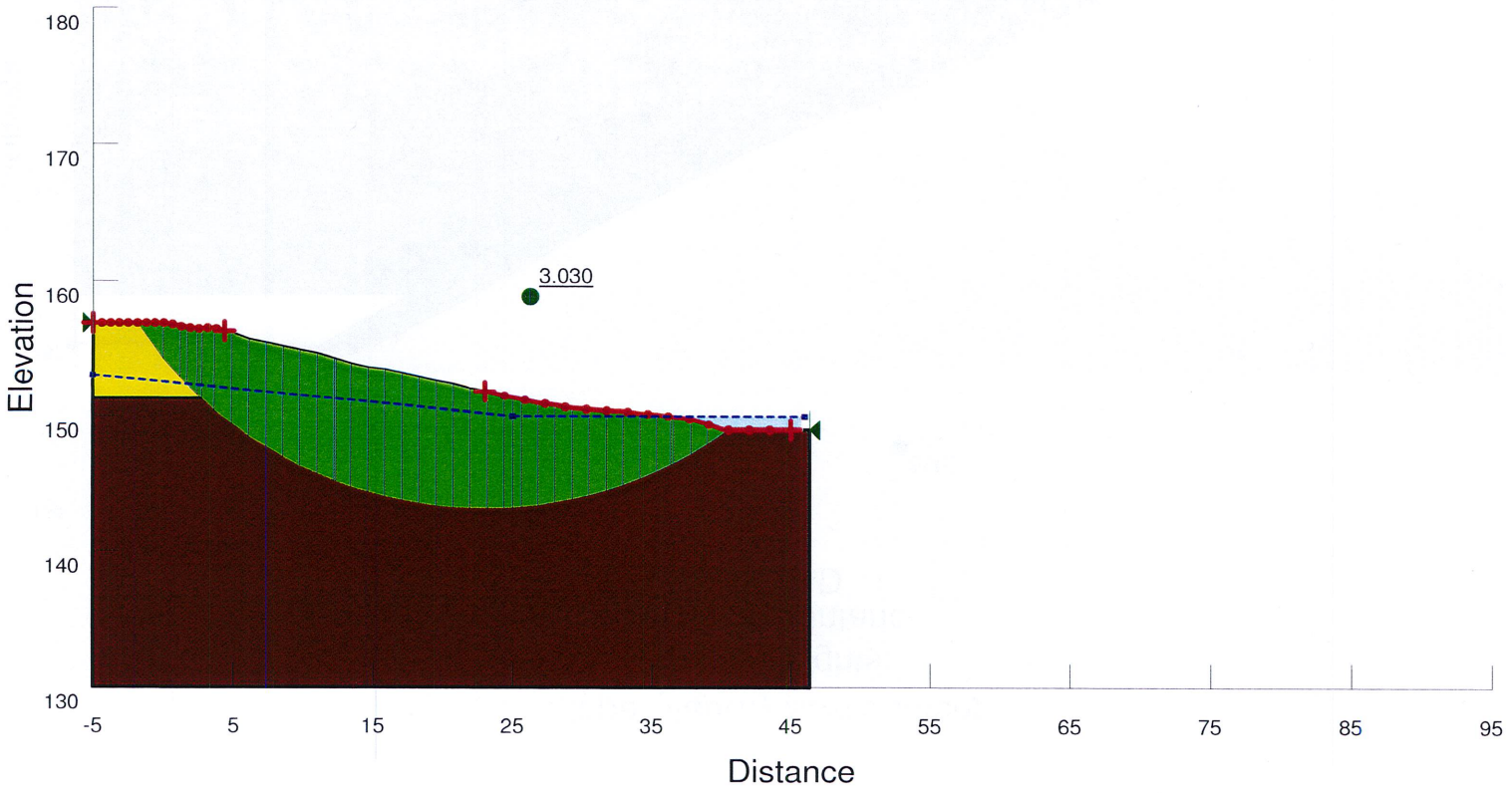
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile D-D



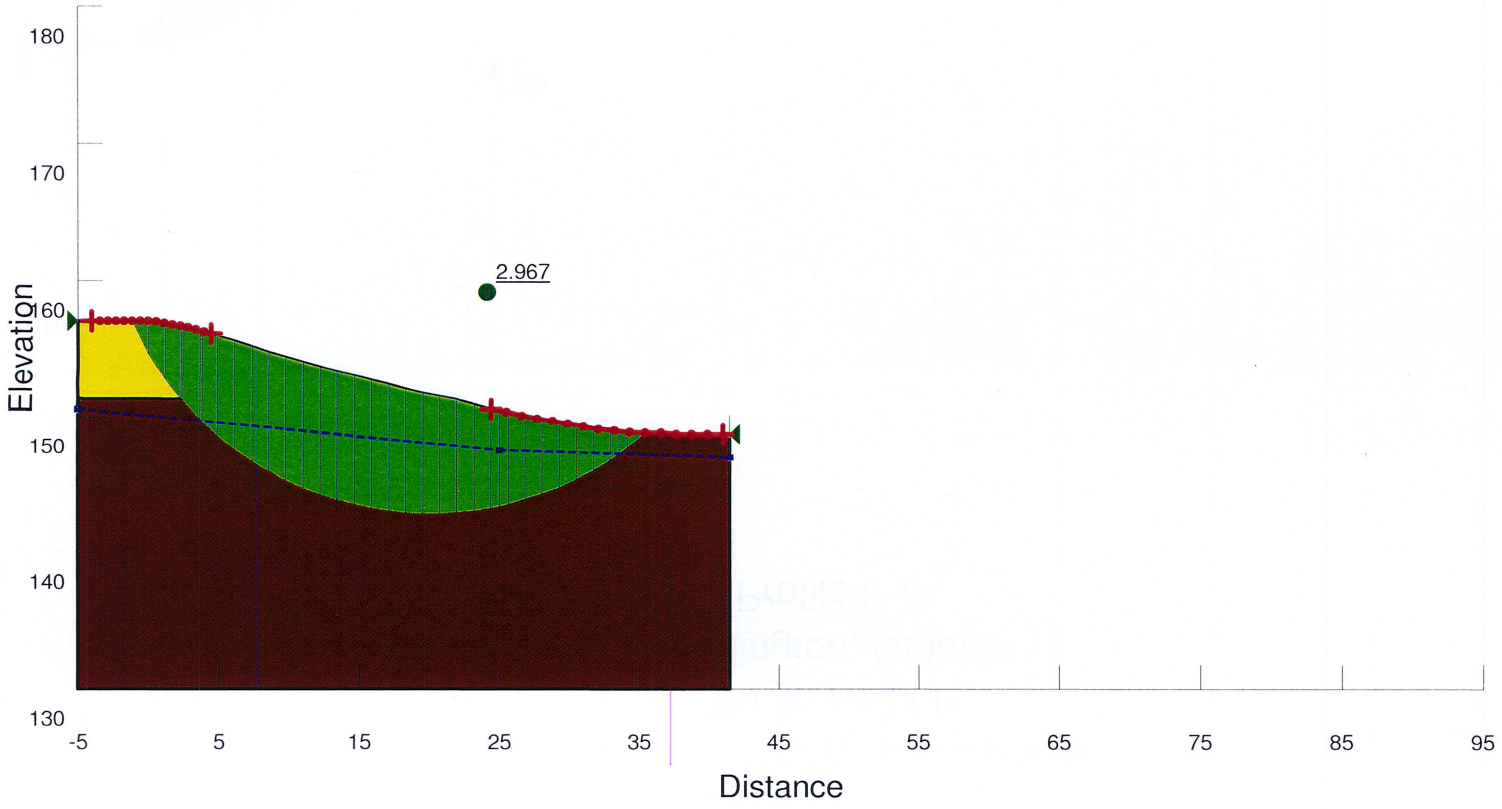
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile D-D



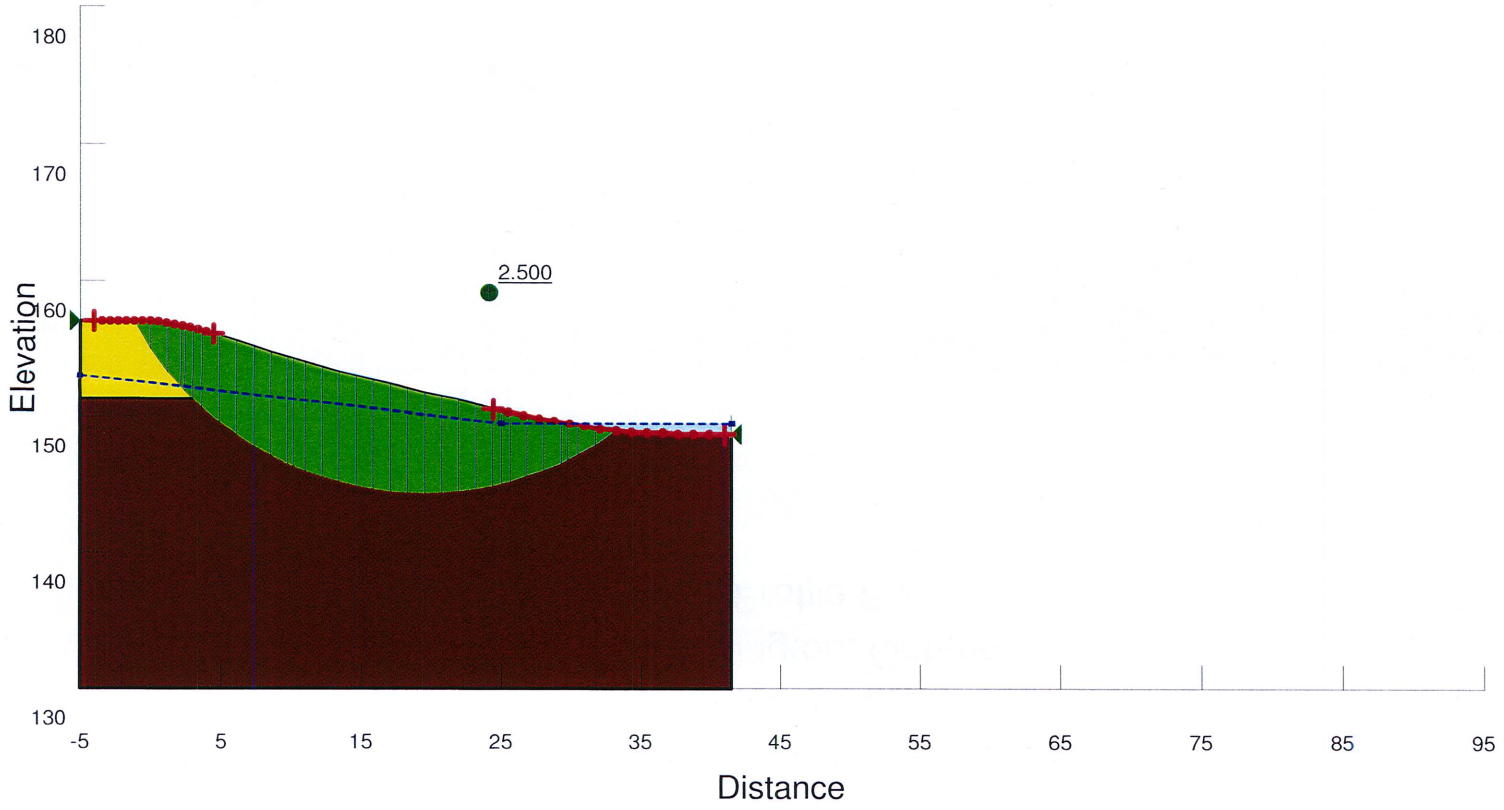
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile E-E



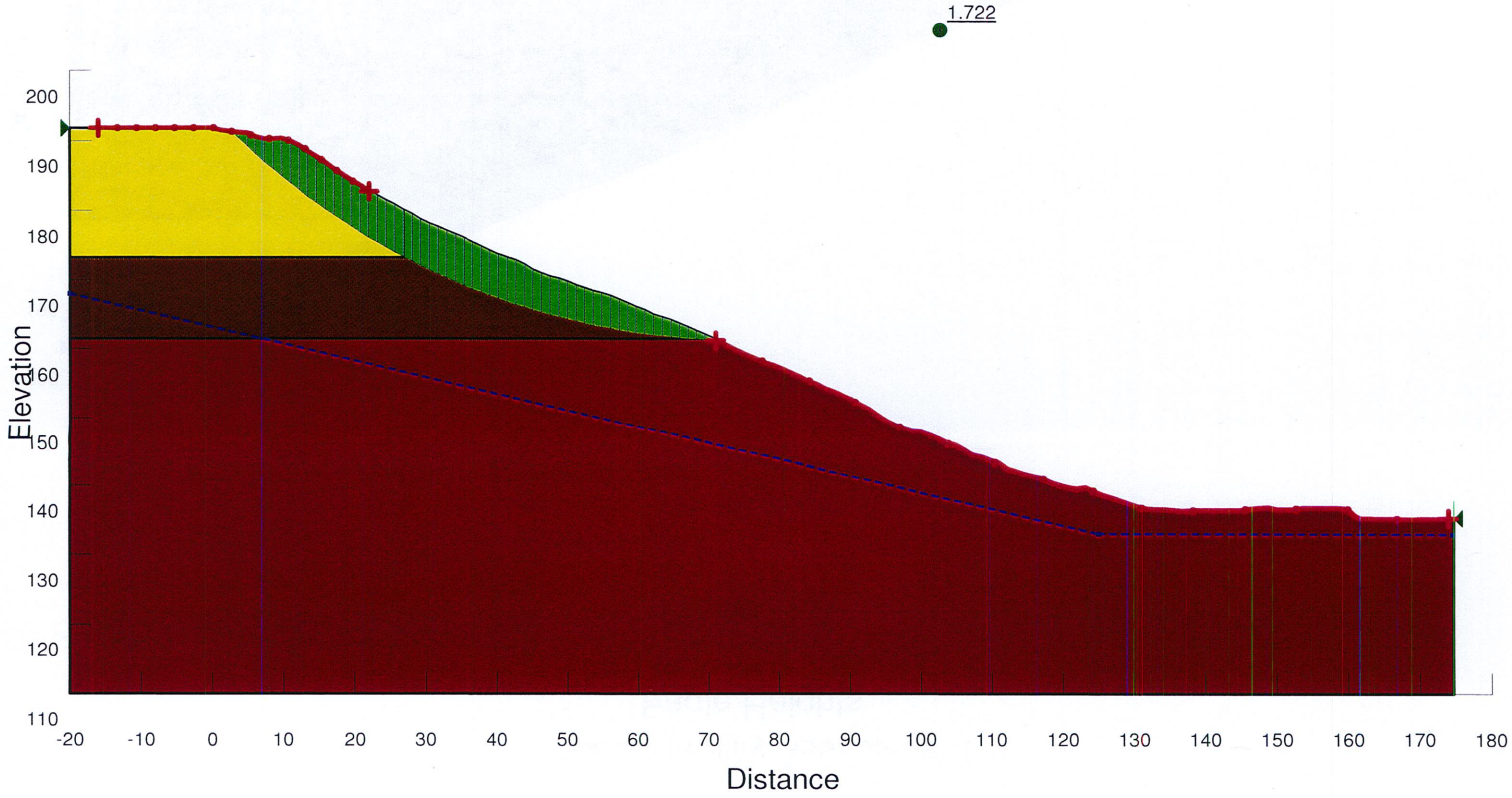
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile F-F



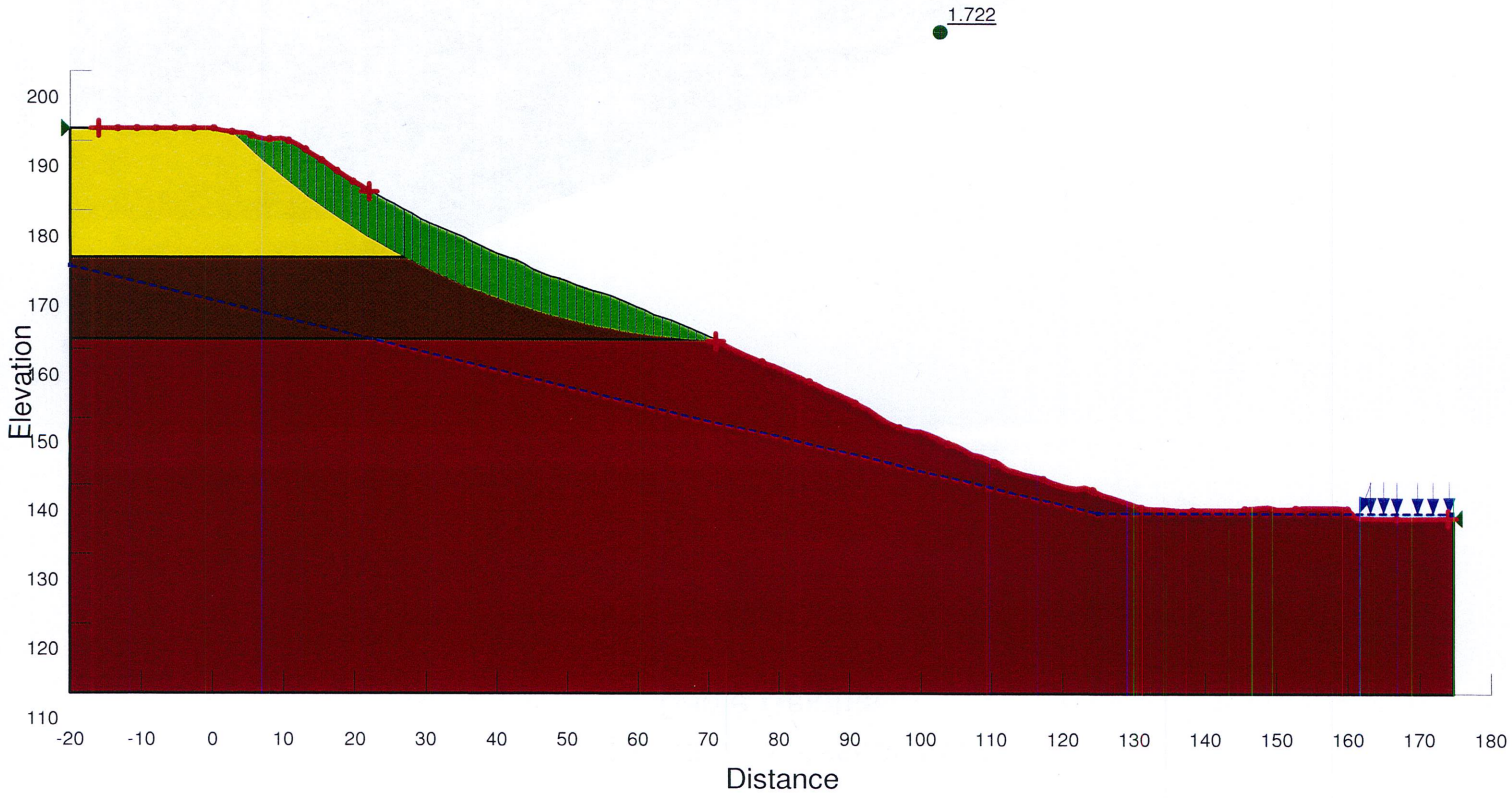
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile F-F



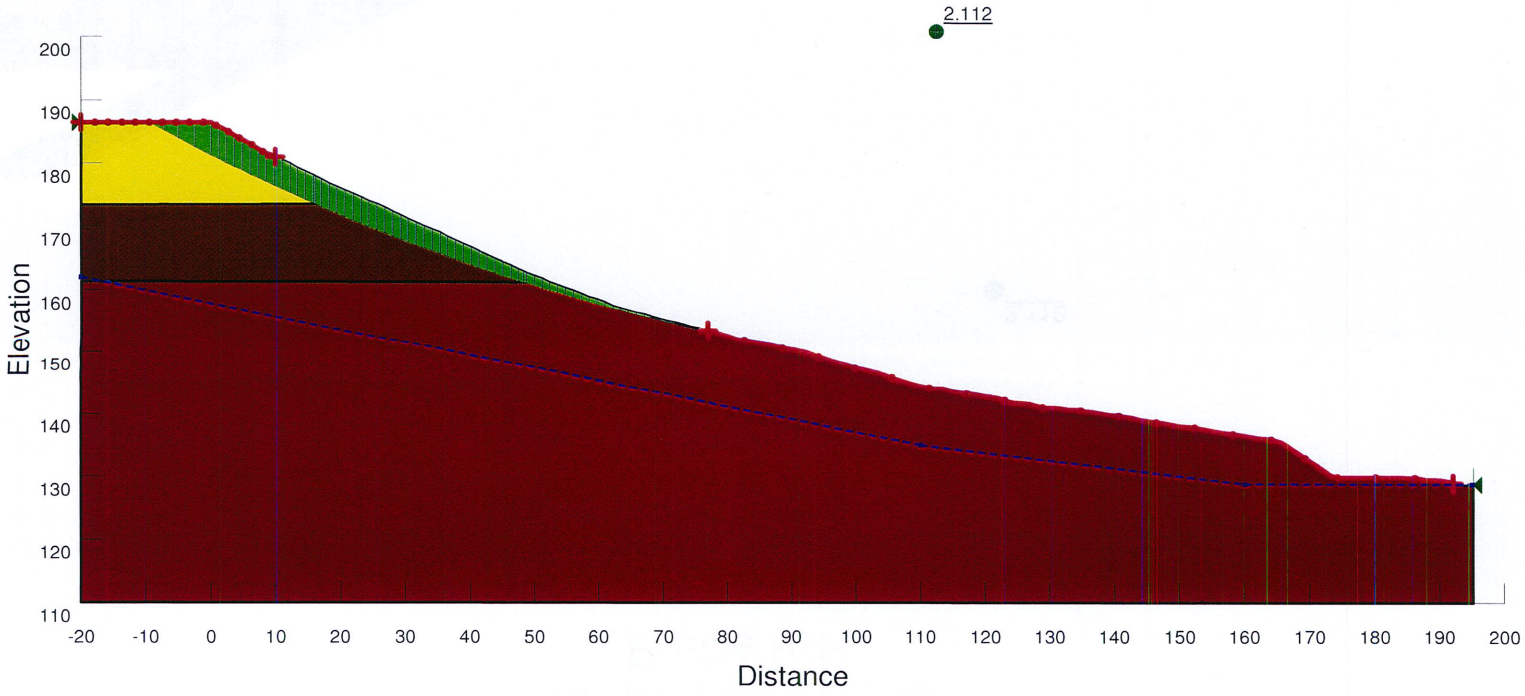
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile G-G



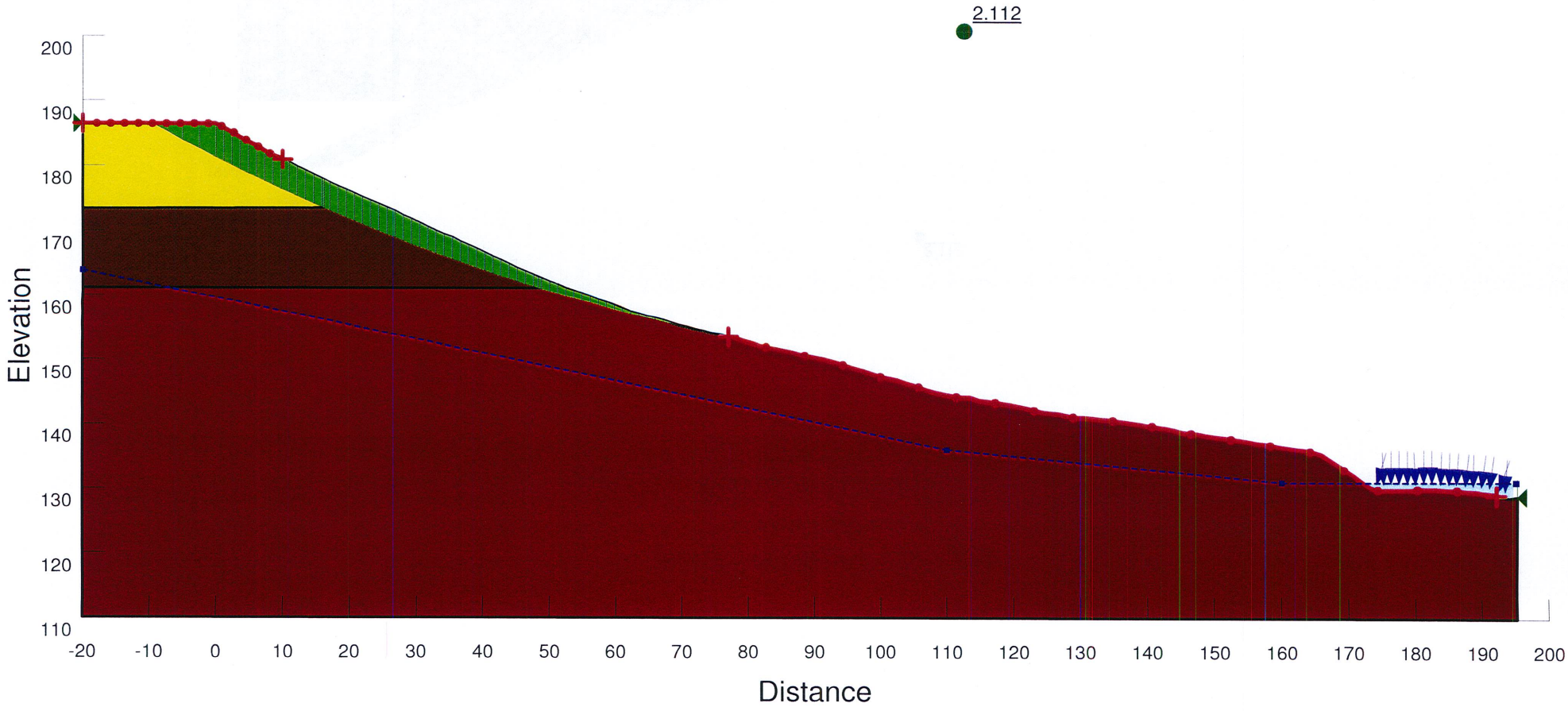
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile G-G



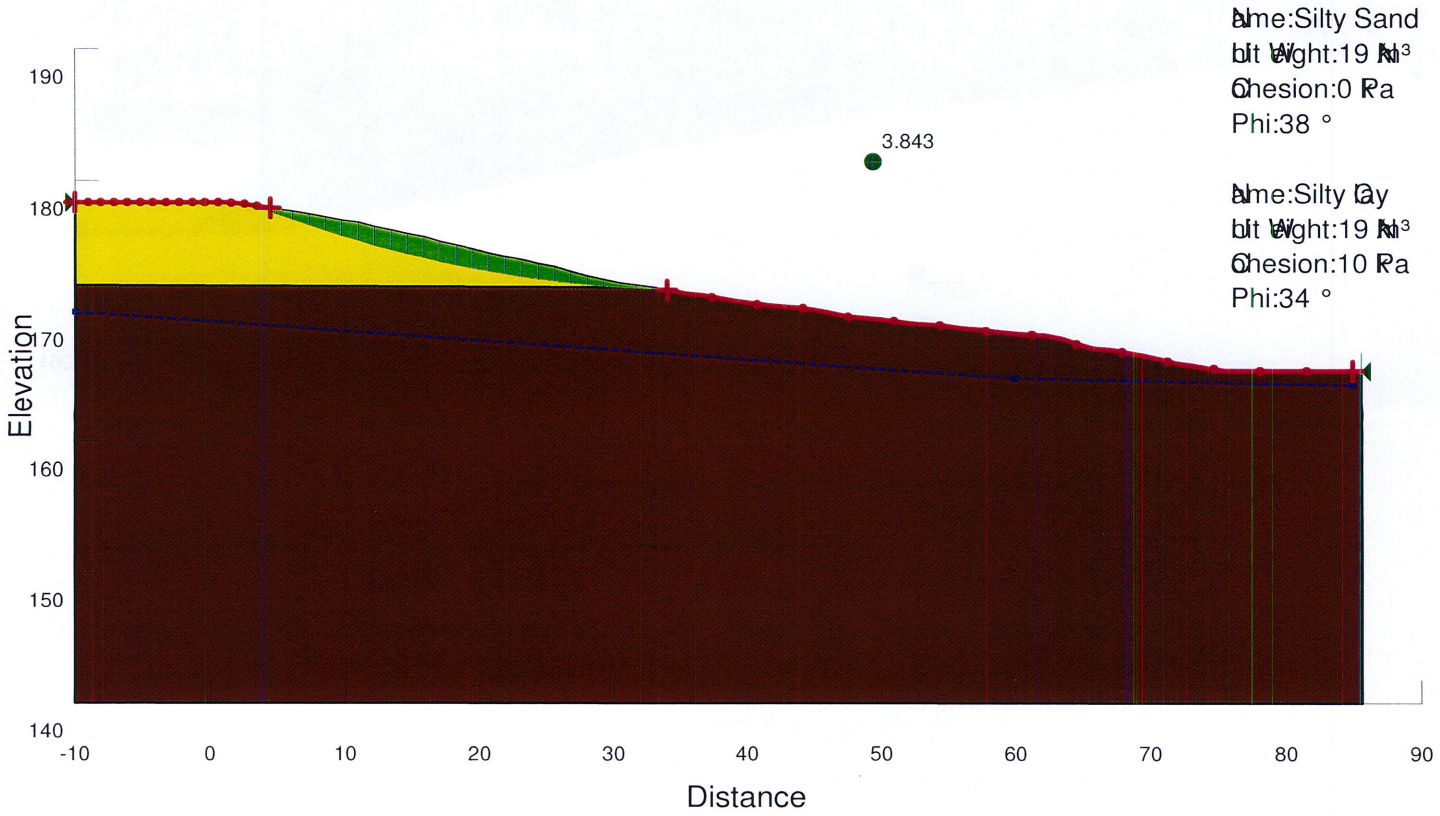
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile H-H



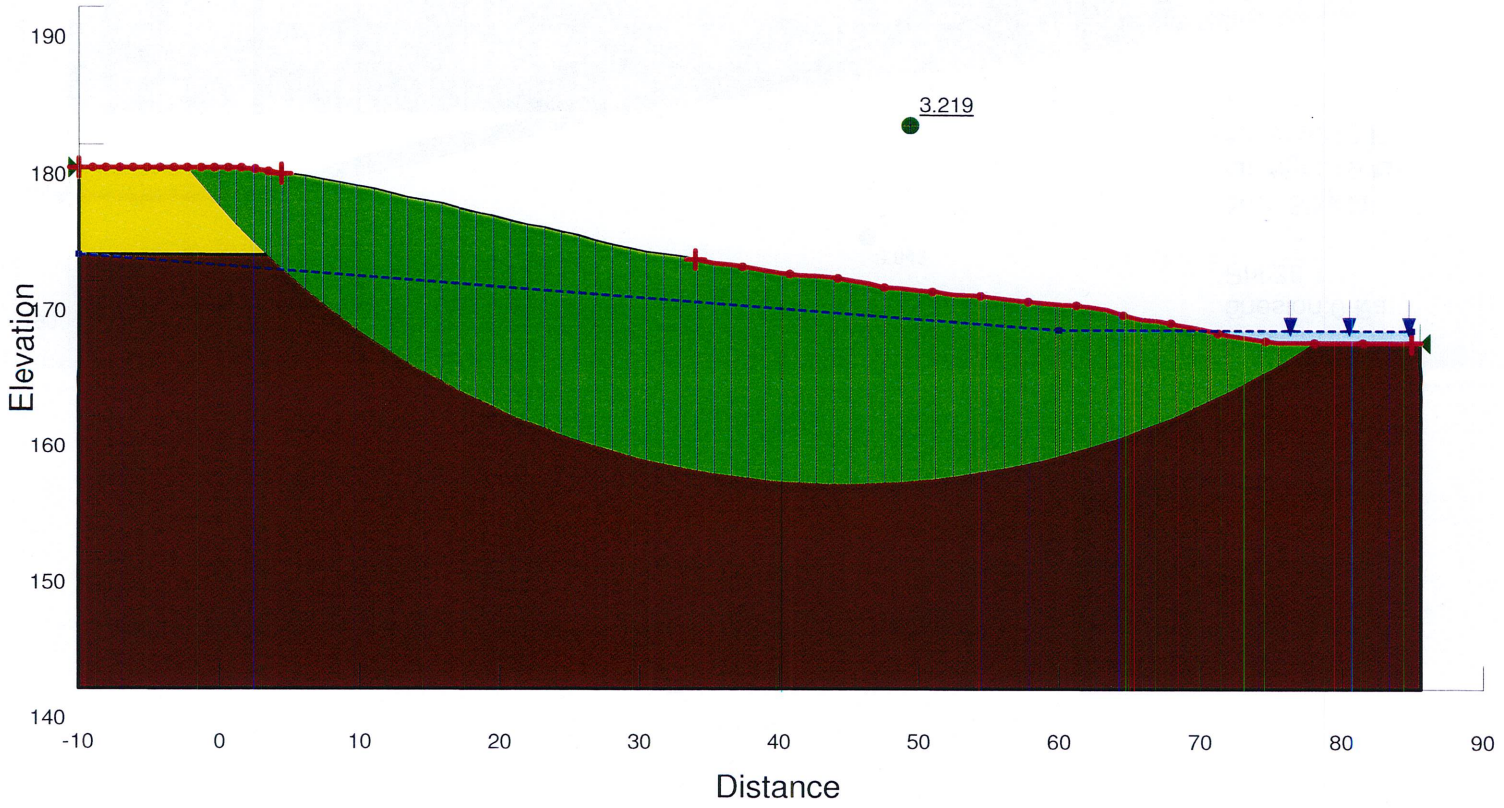
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile H-H



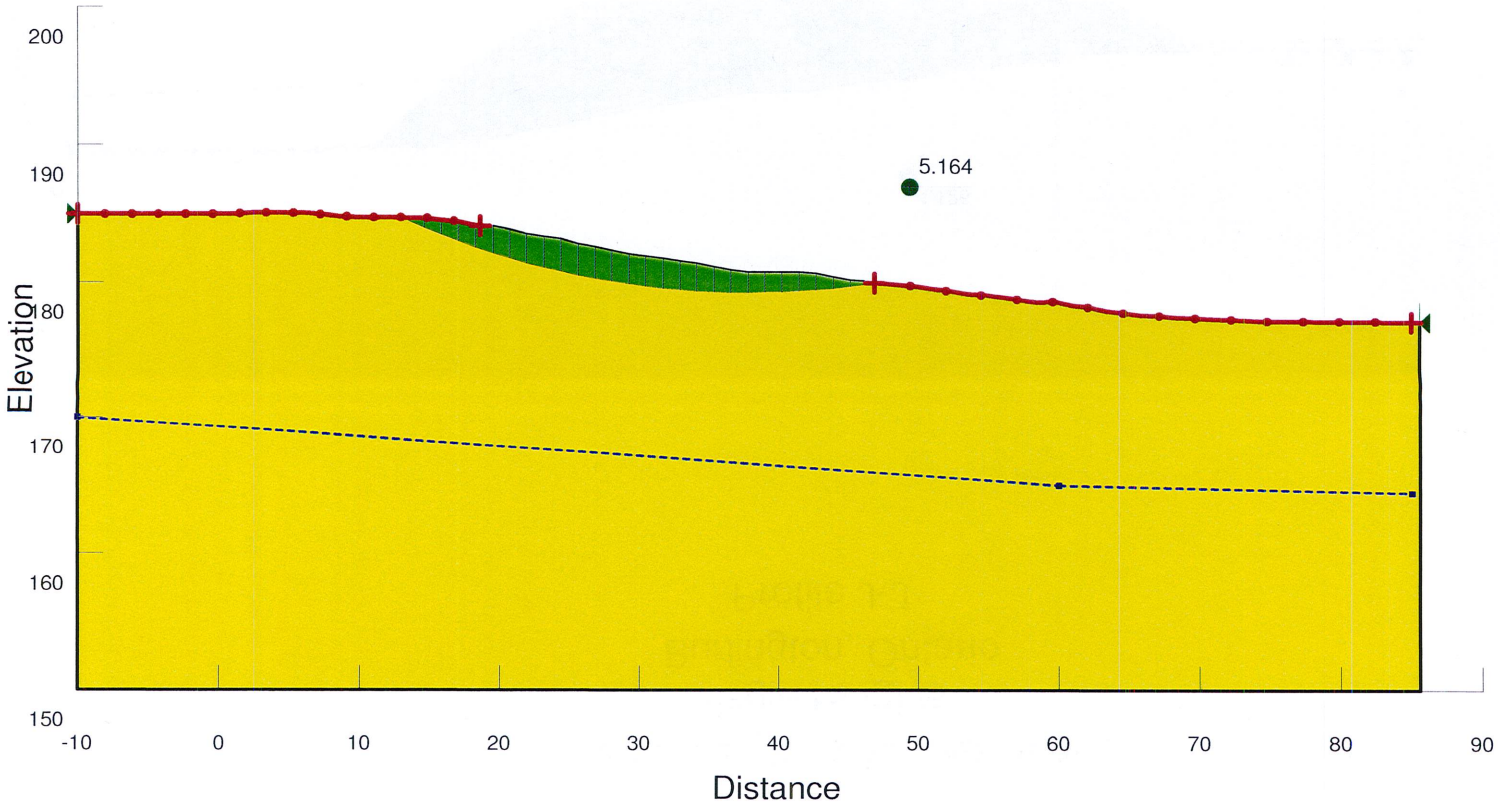
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile I-I



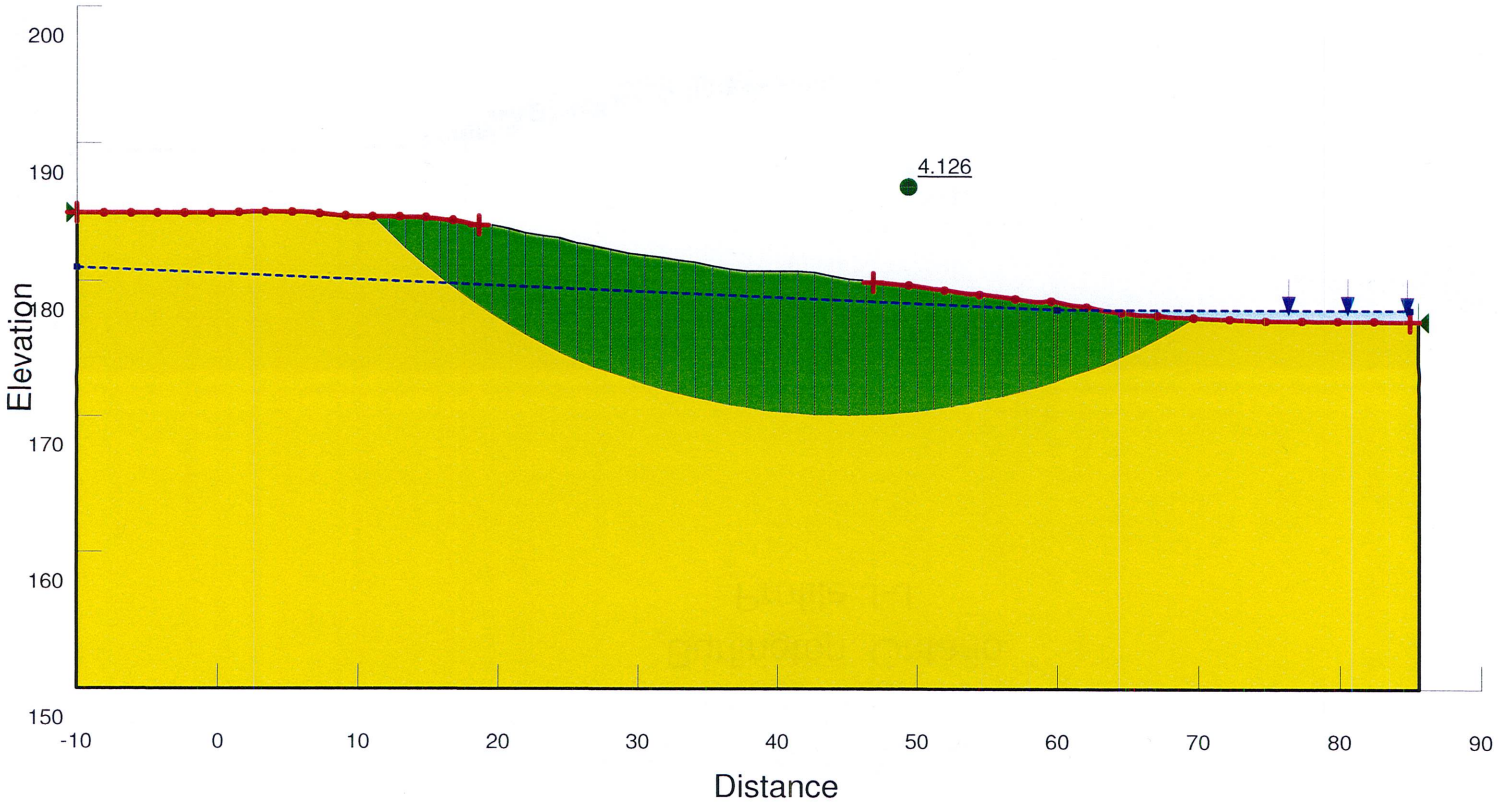
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile I-I



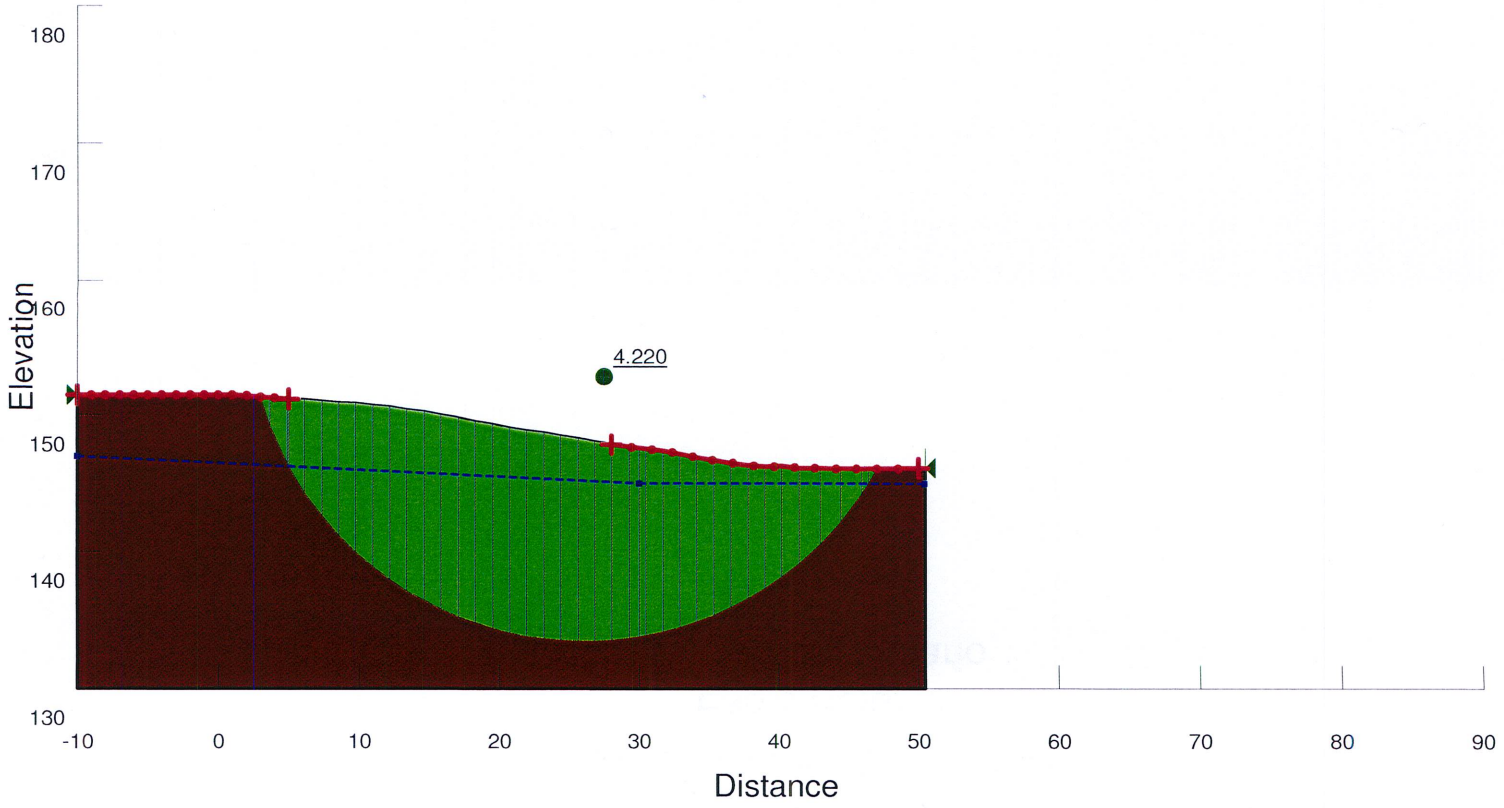
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile J-J



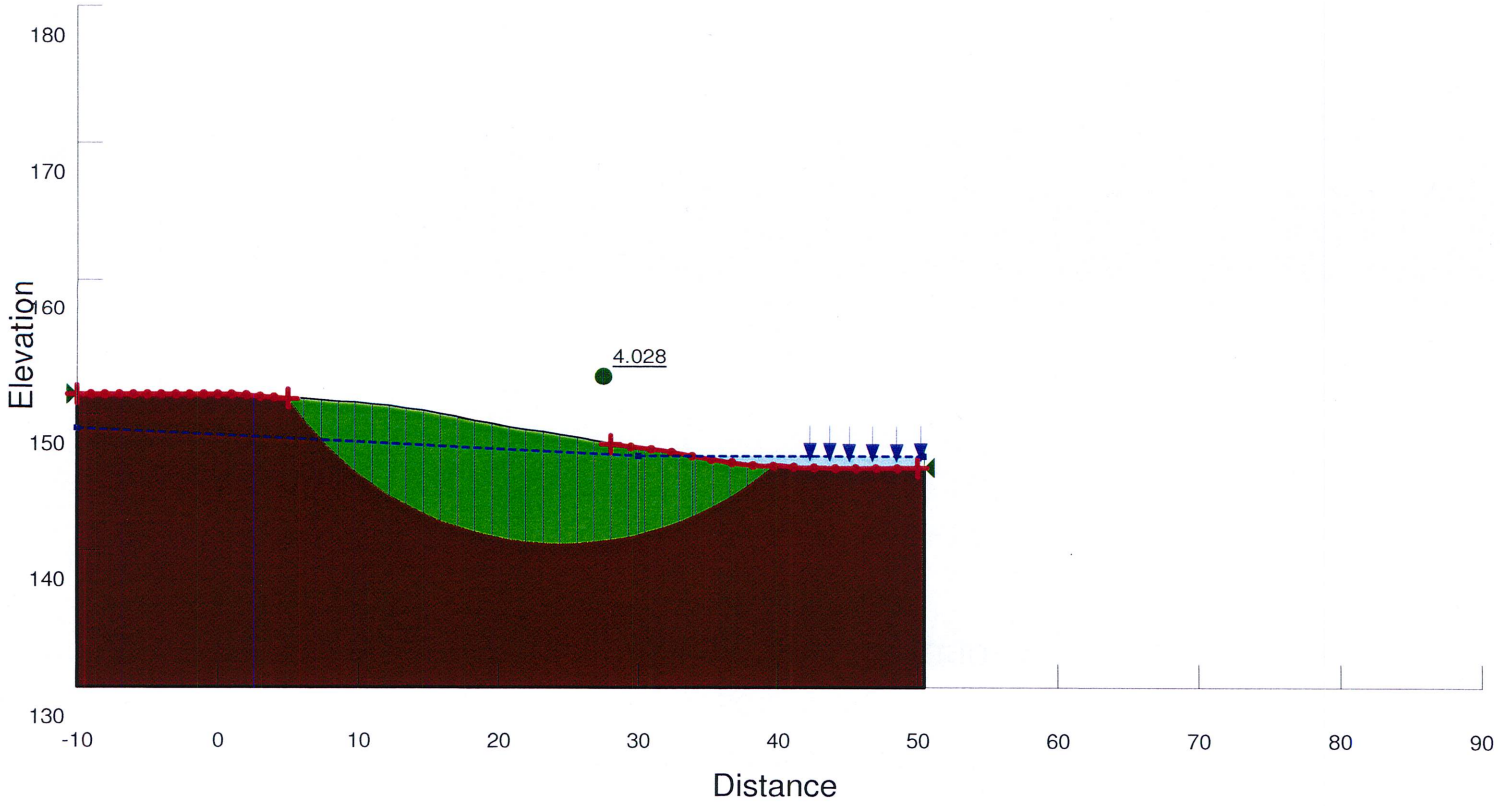
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile J-J



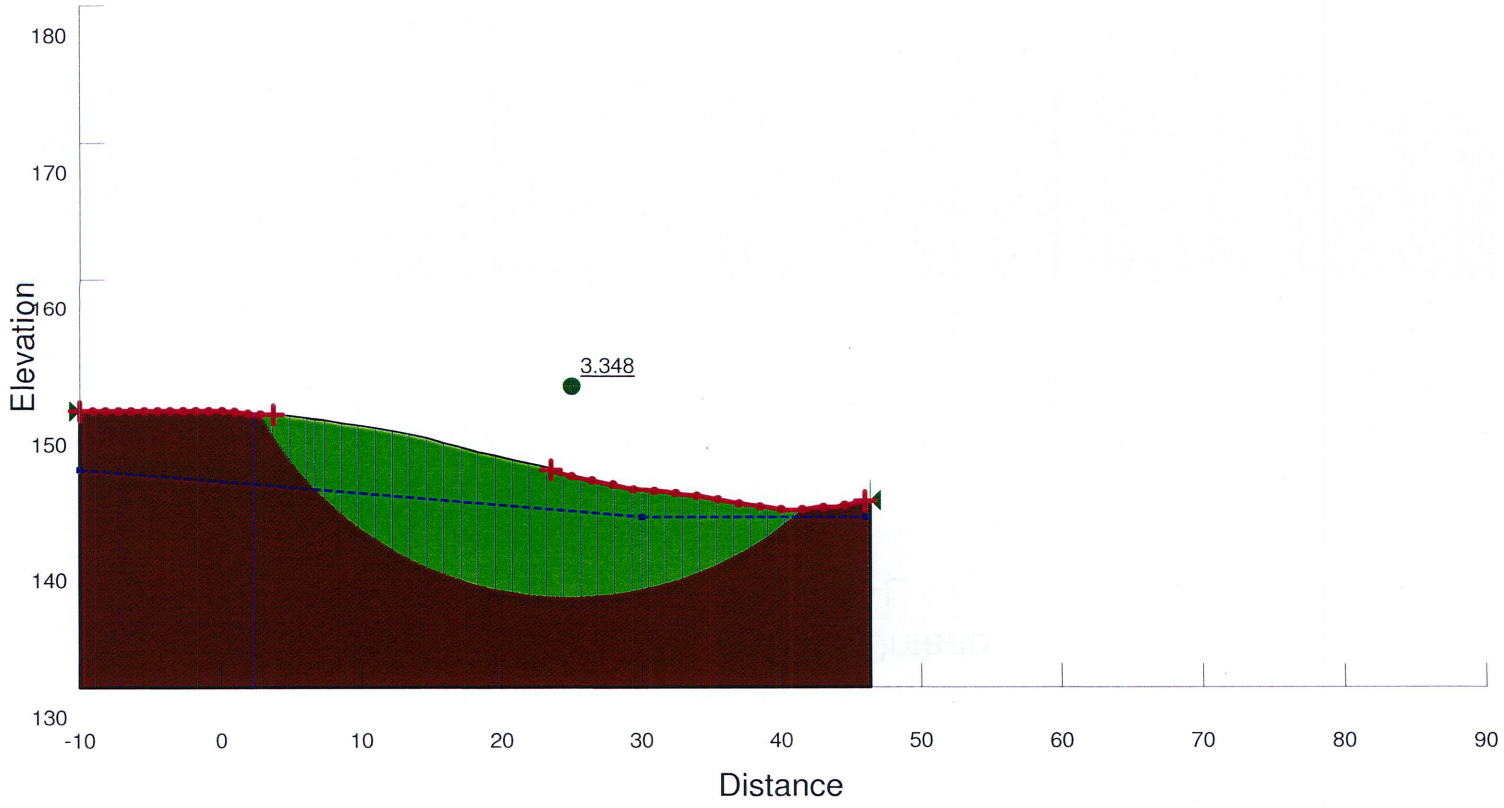
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile K-K



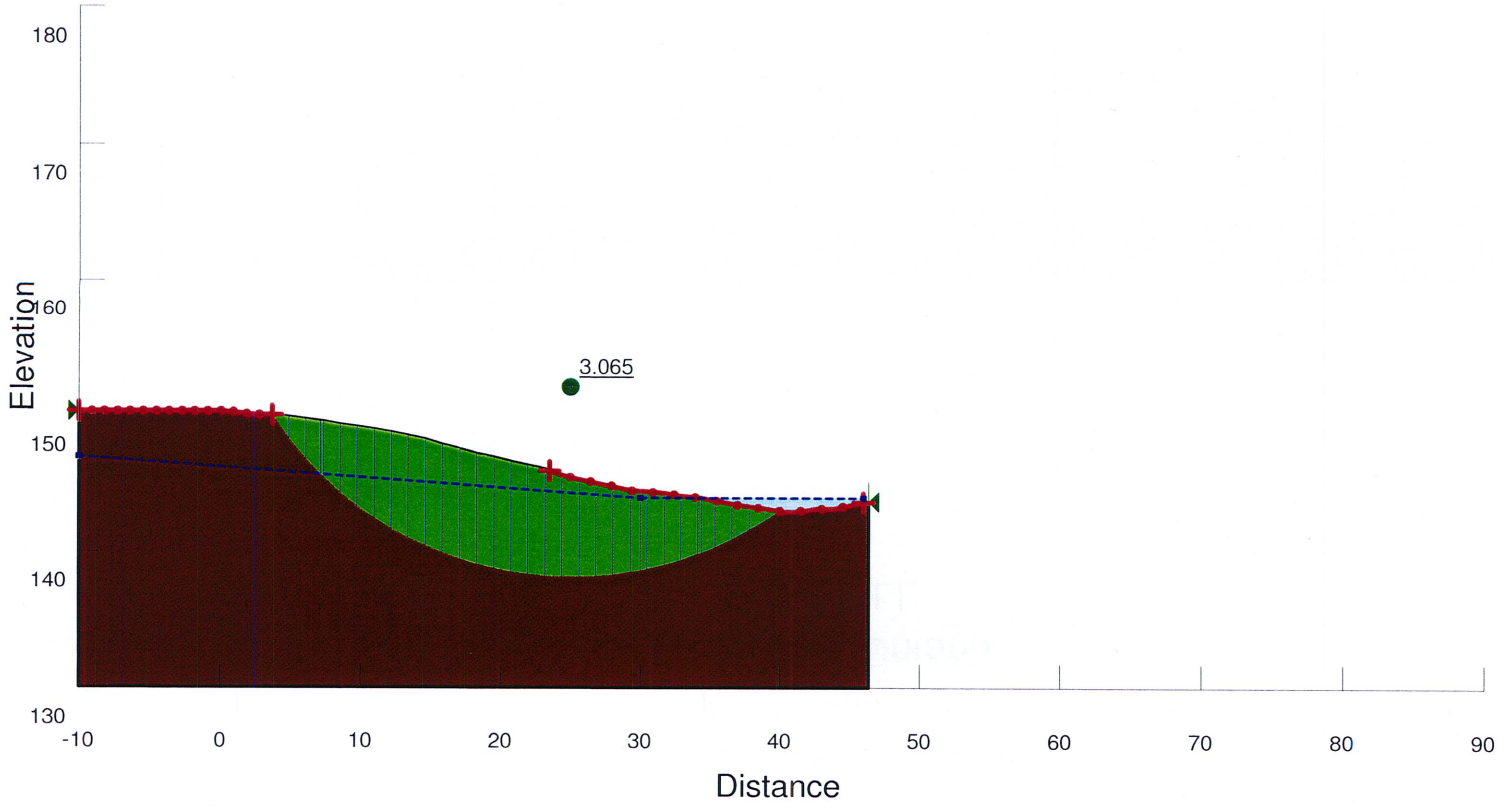
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile K-K



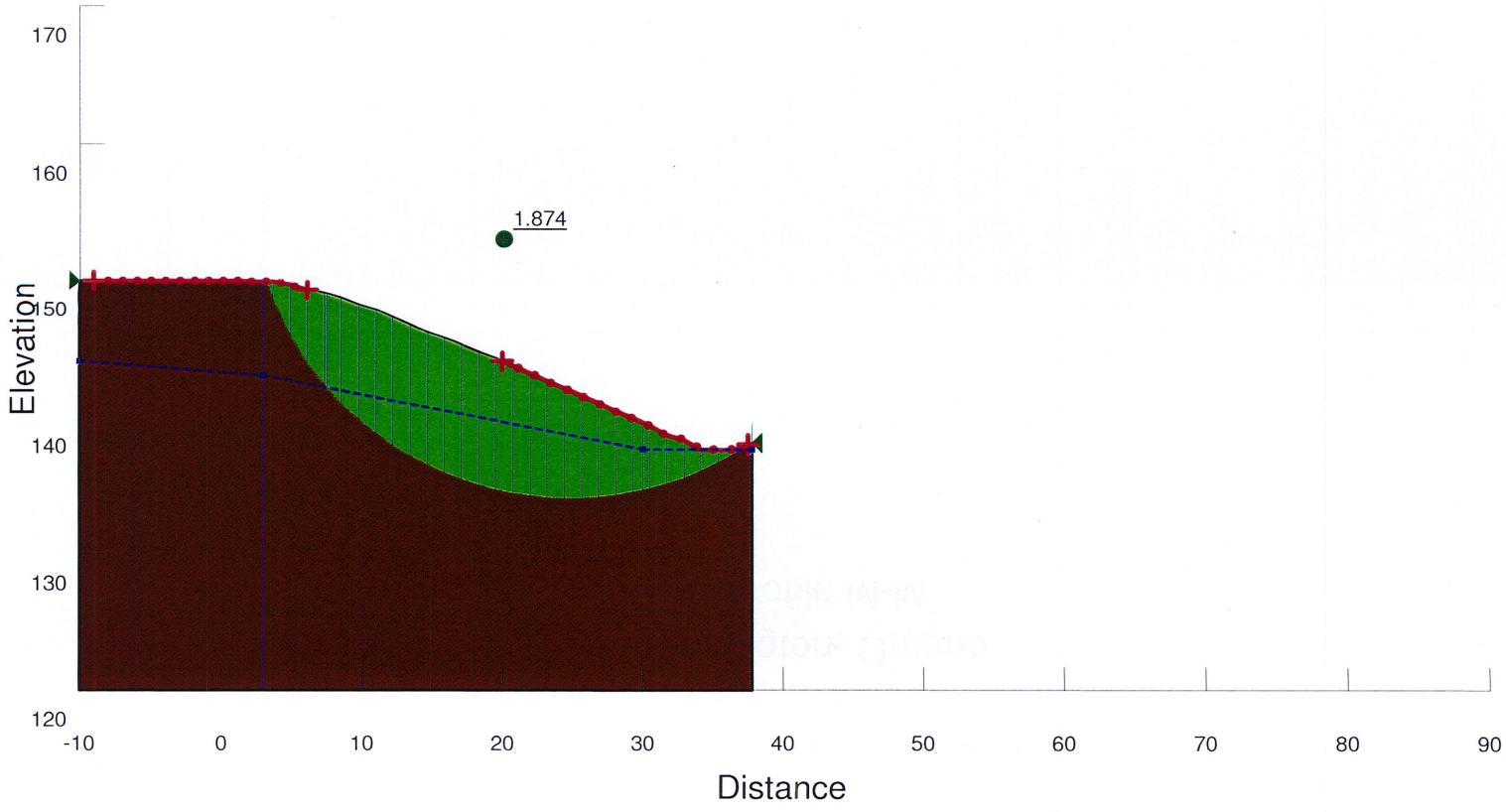
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
ProfileL-LL



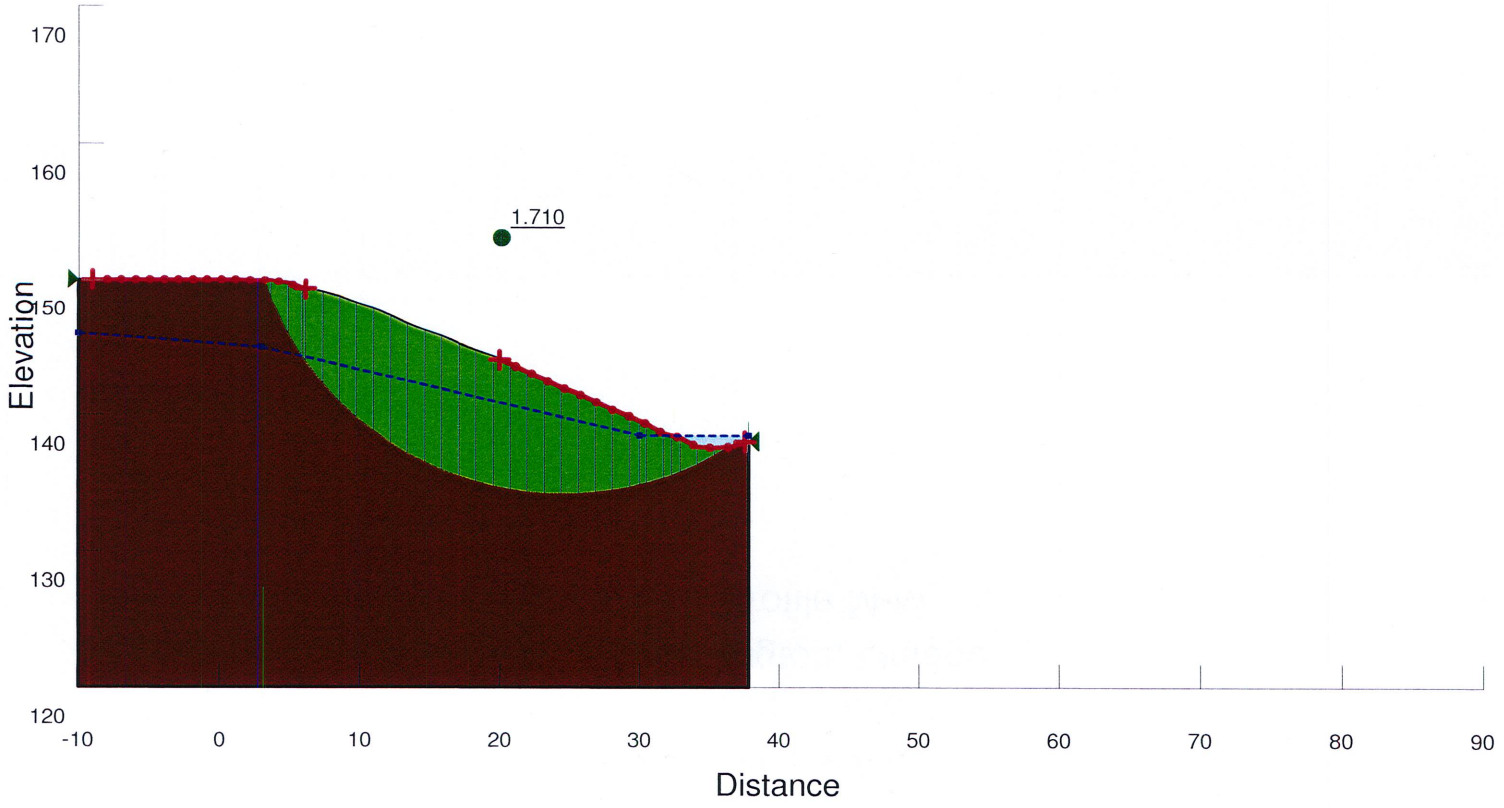
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile L-L



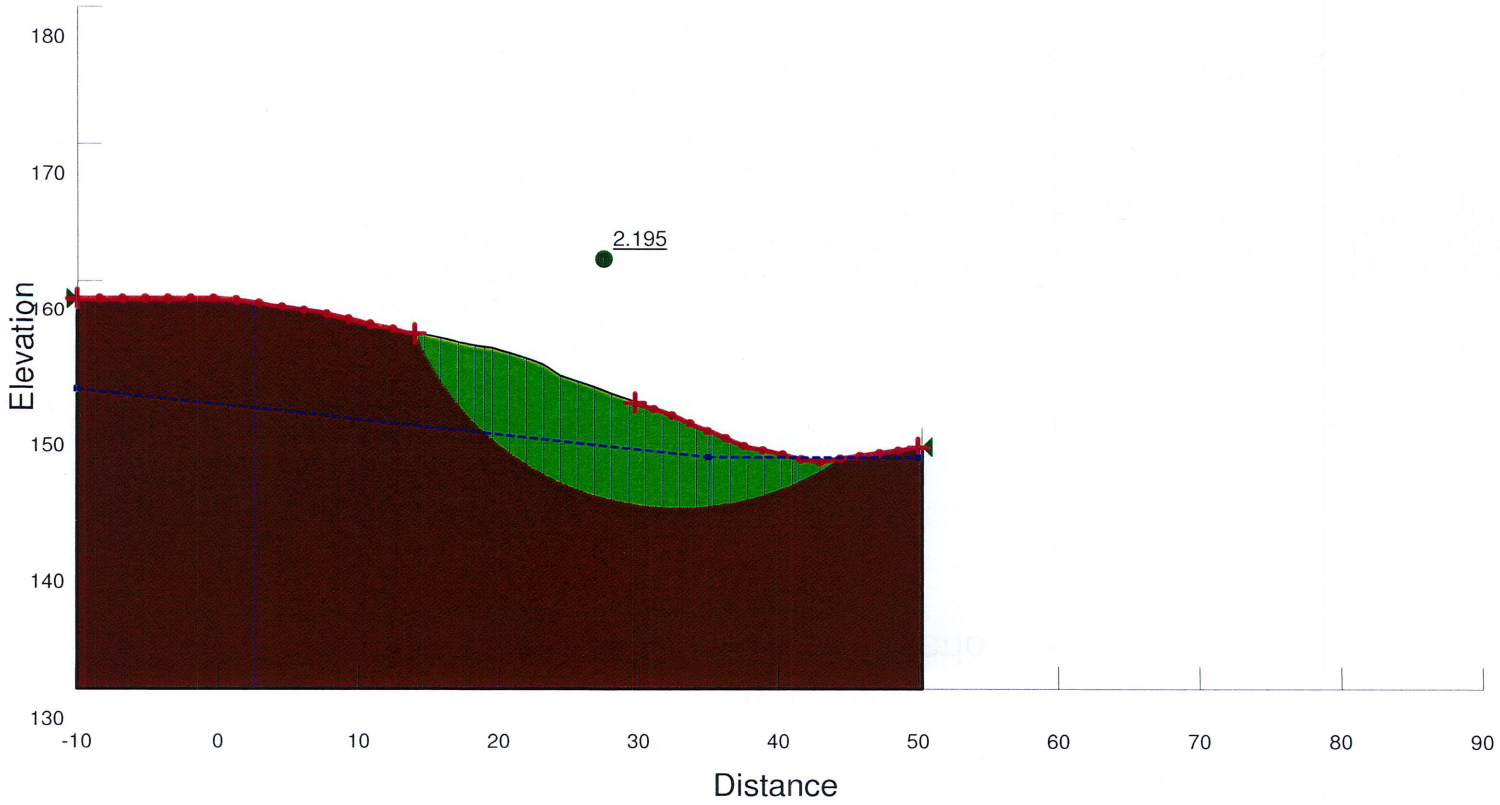
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile M-M



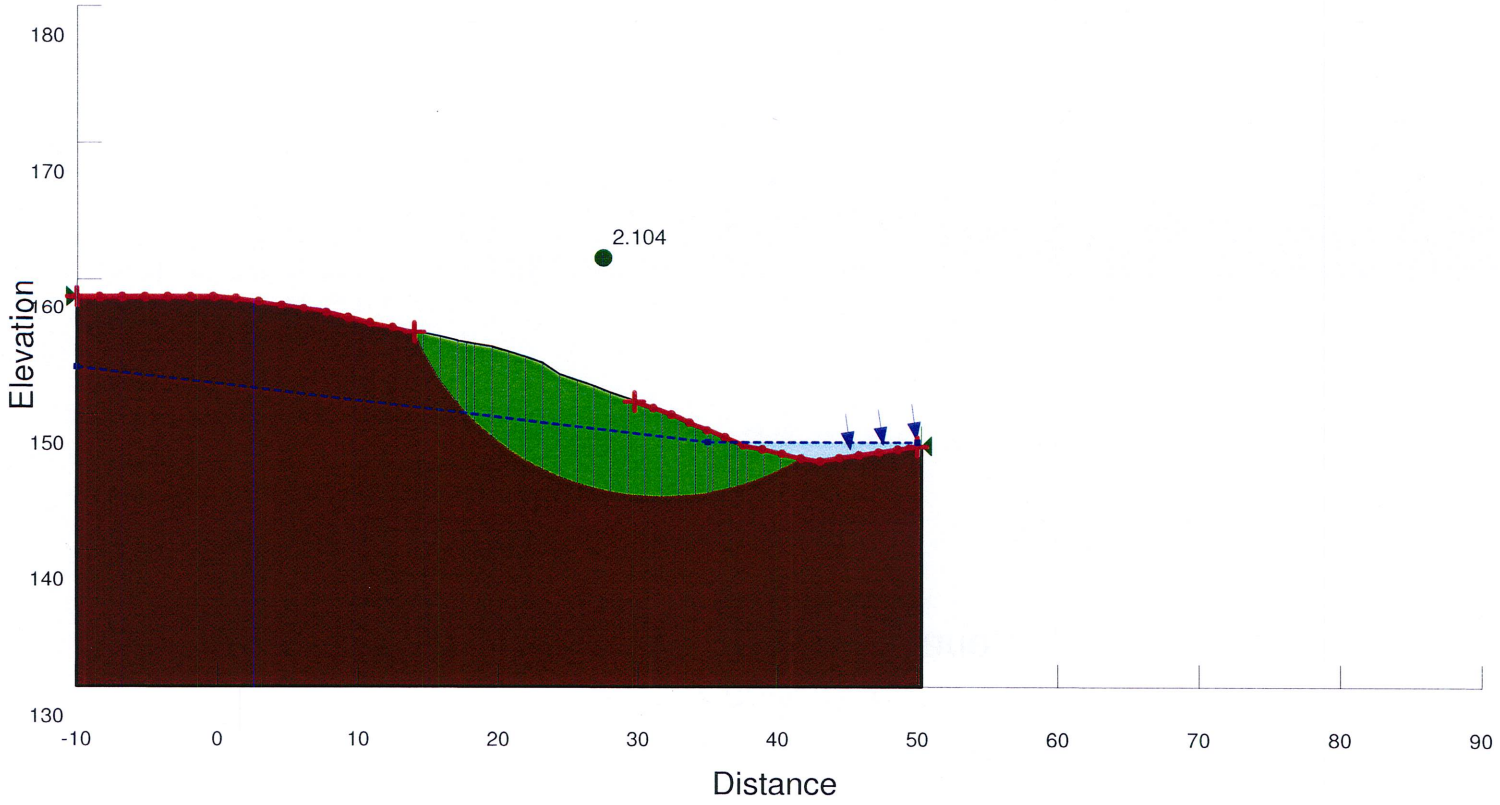
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile M-M



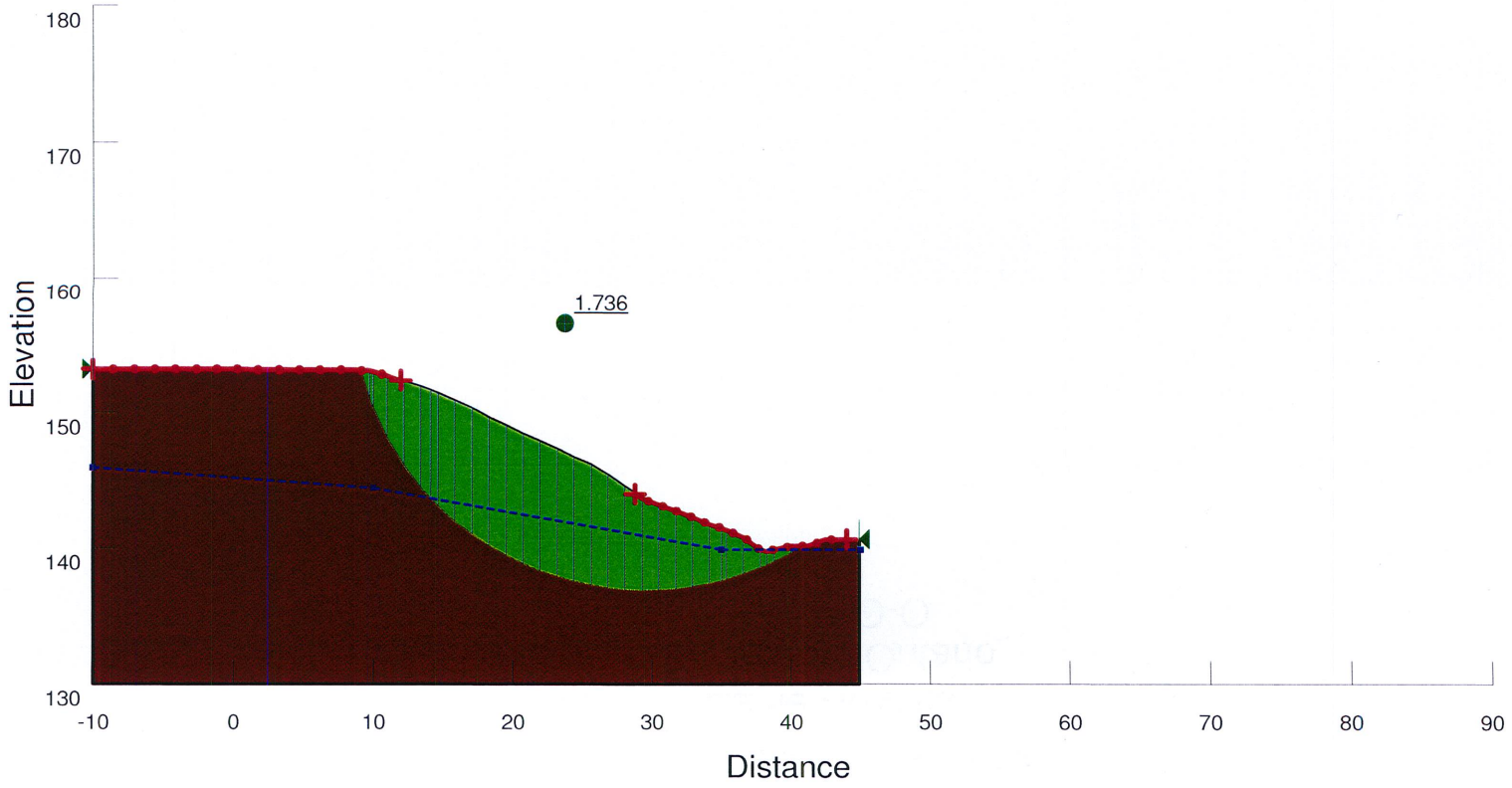
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile N-N



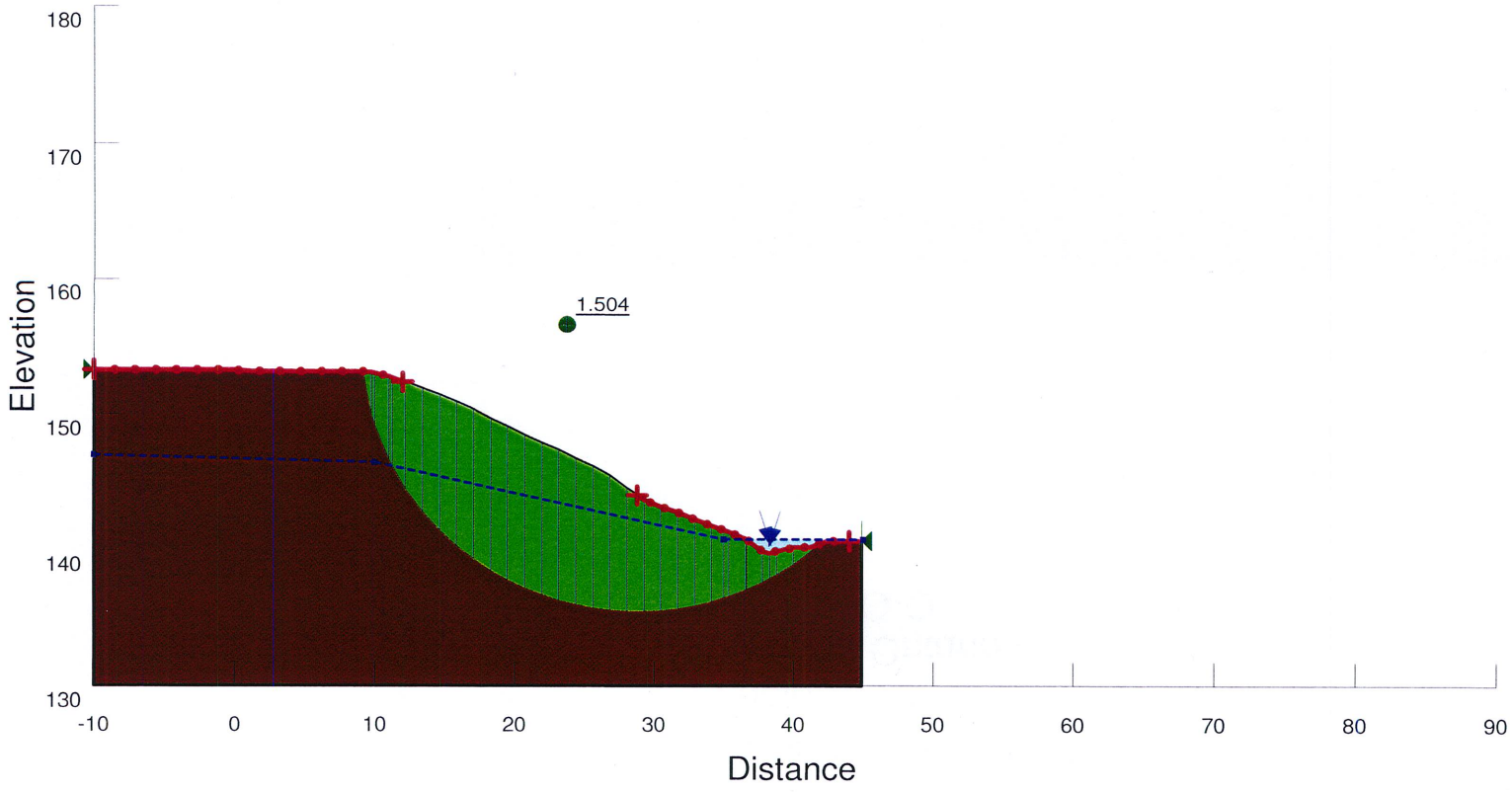
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile N--N



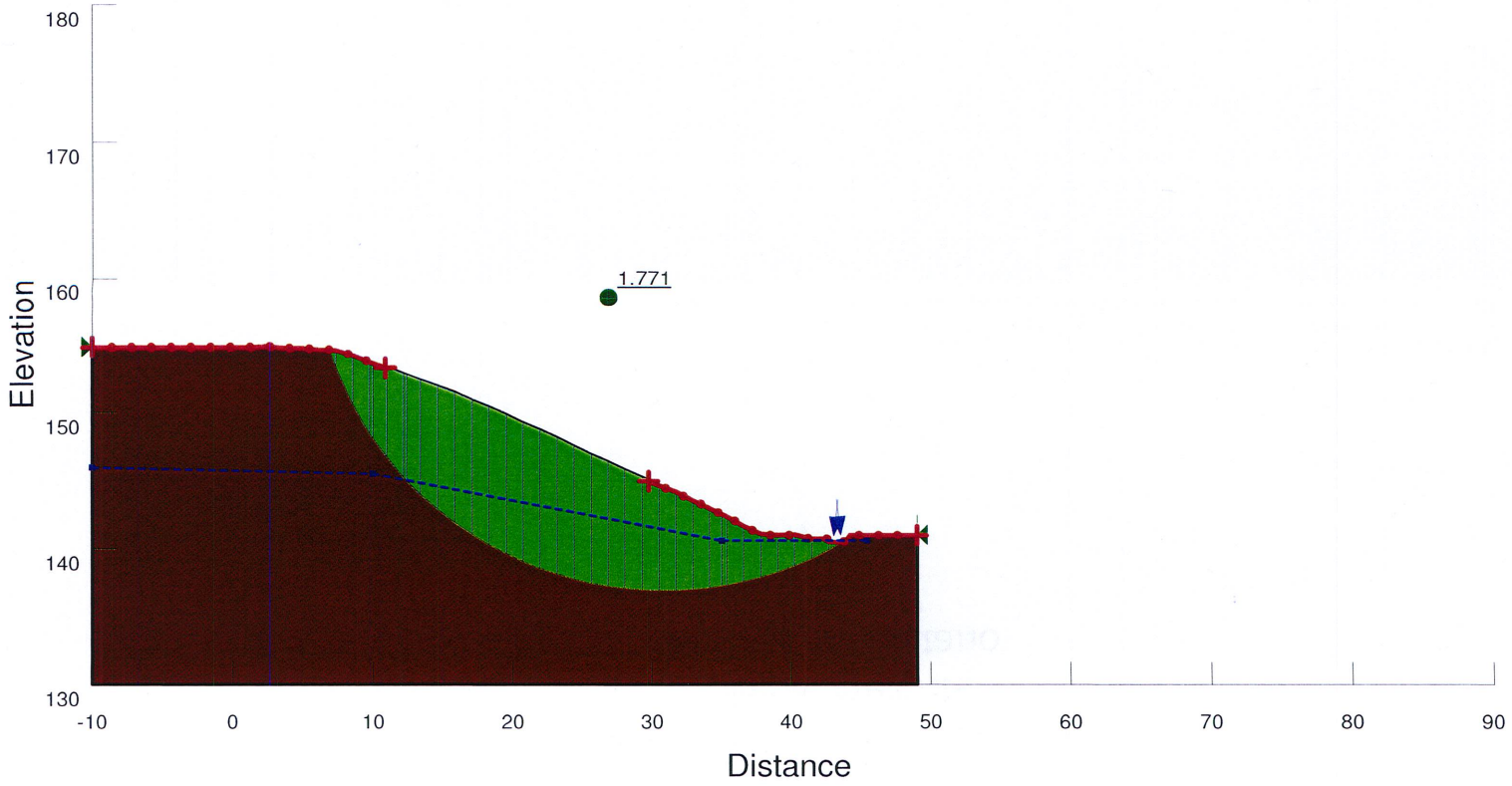
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile O-O



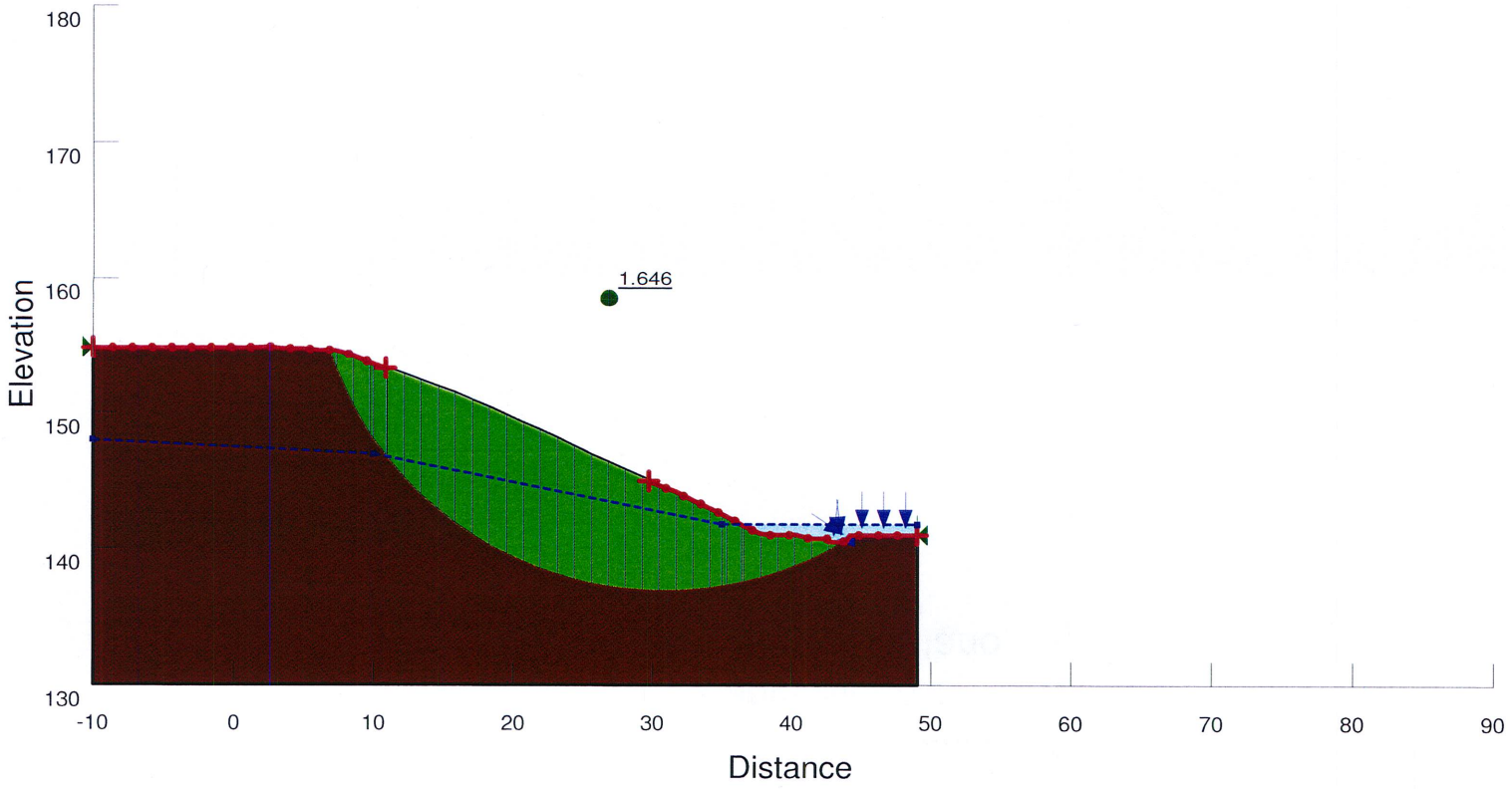
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile O-O



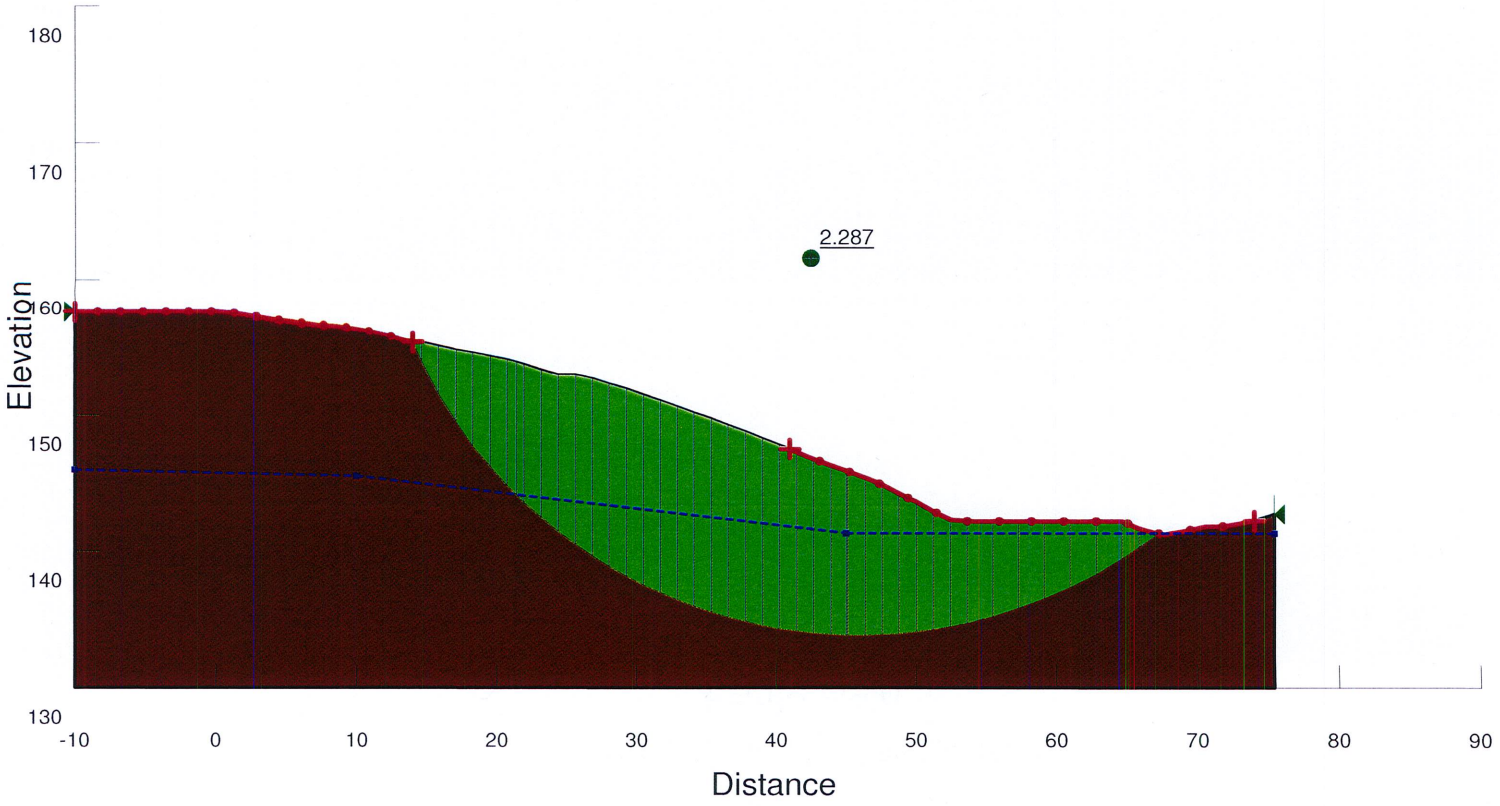
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile P-P



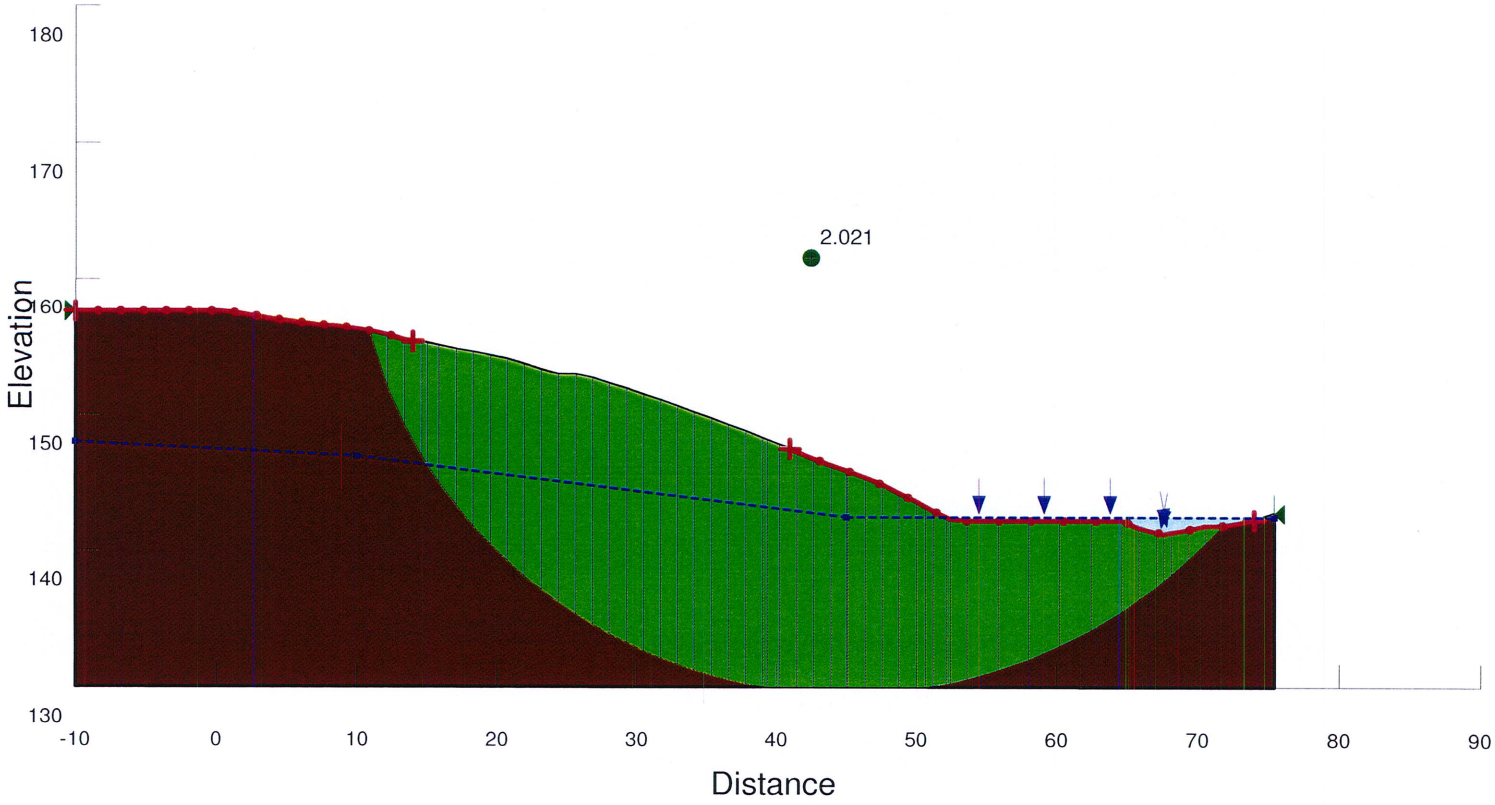
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile P-P



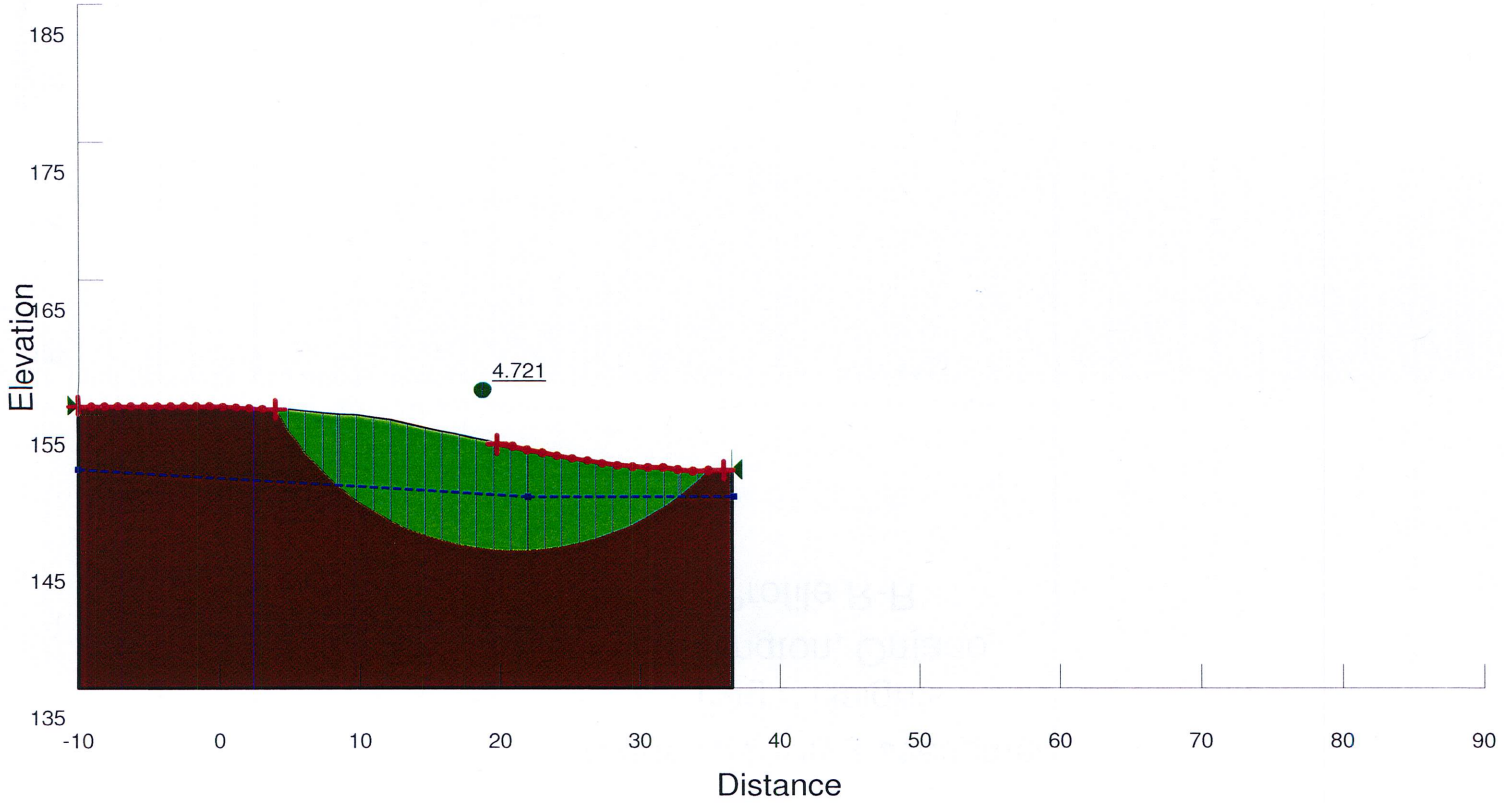
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Q-Q



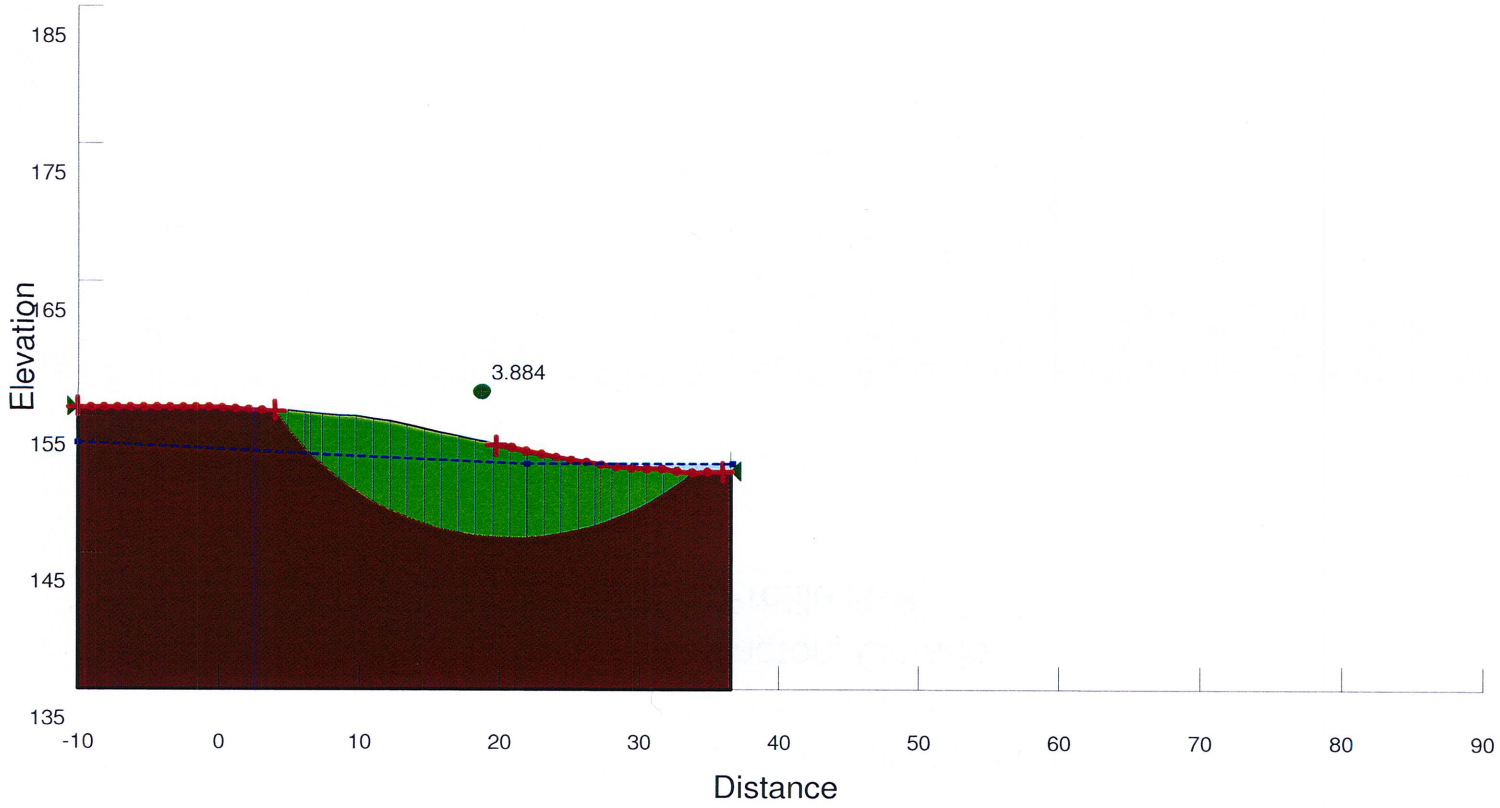
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Q-Q



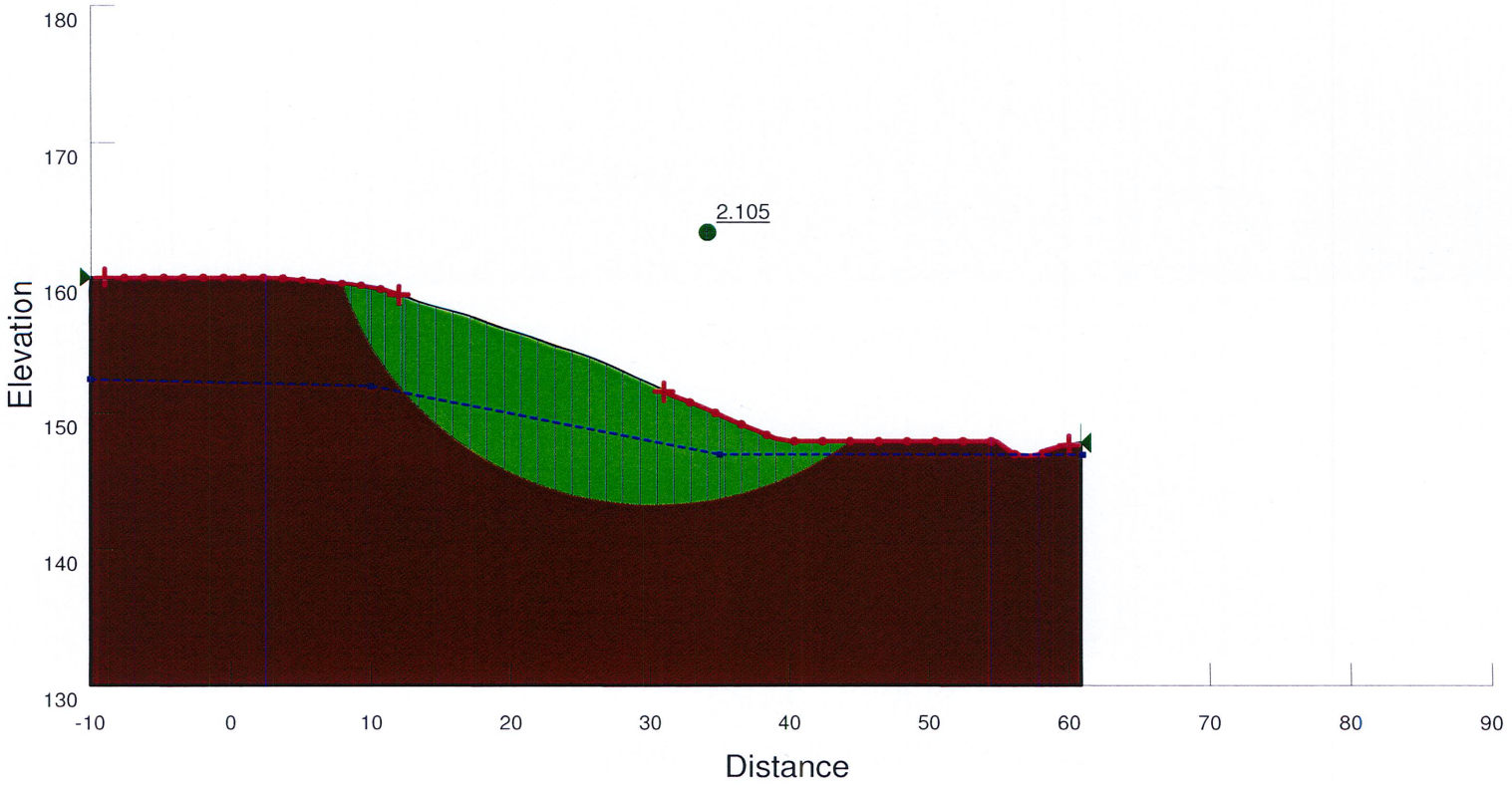
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile R-R



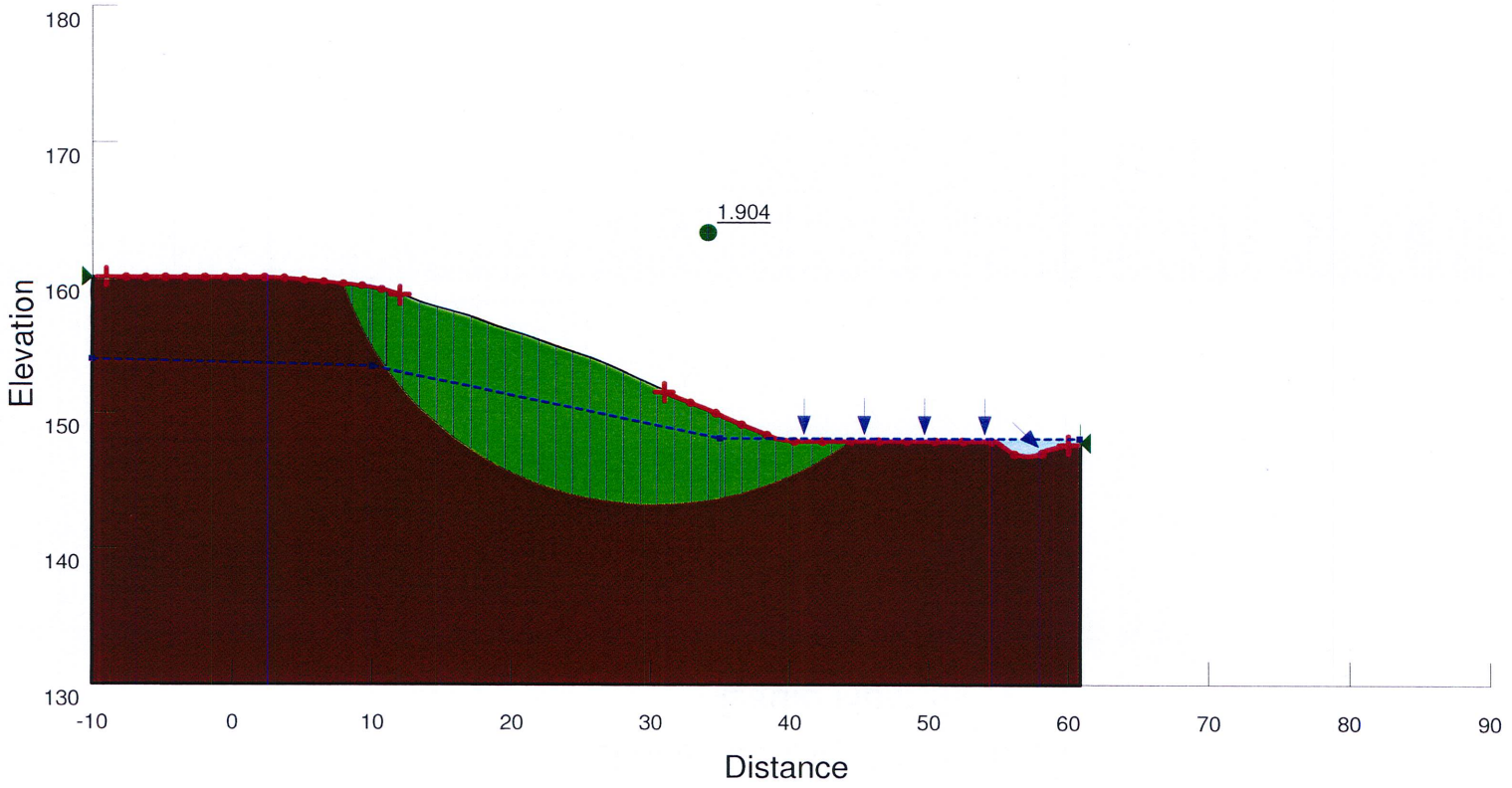
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile R-R



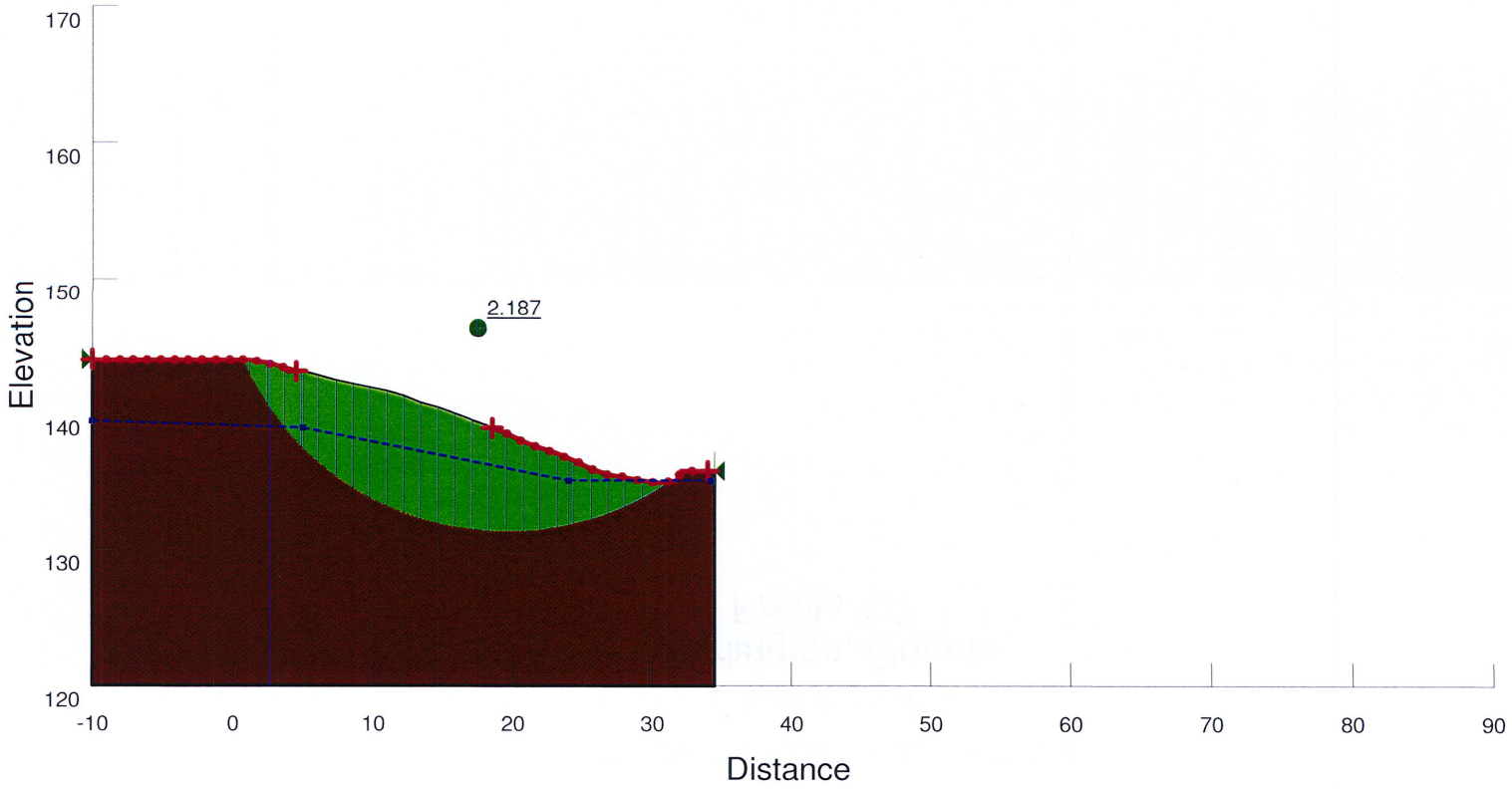
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile S-S



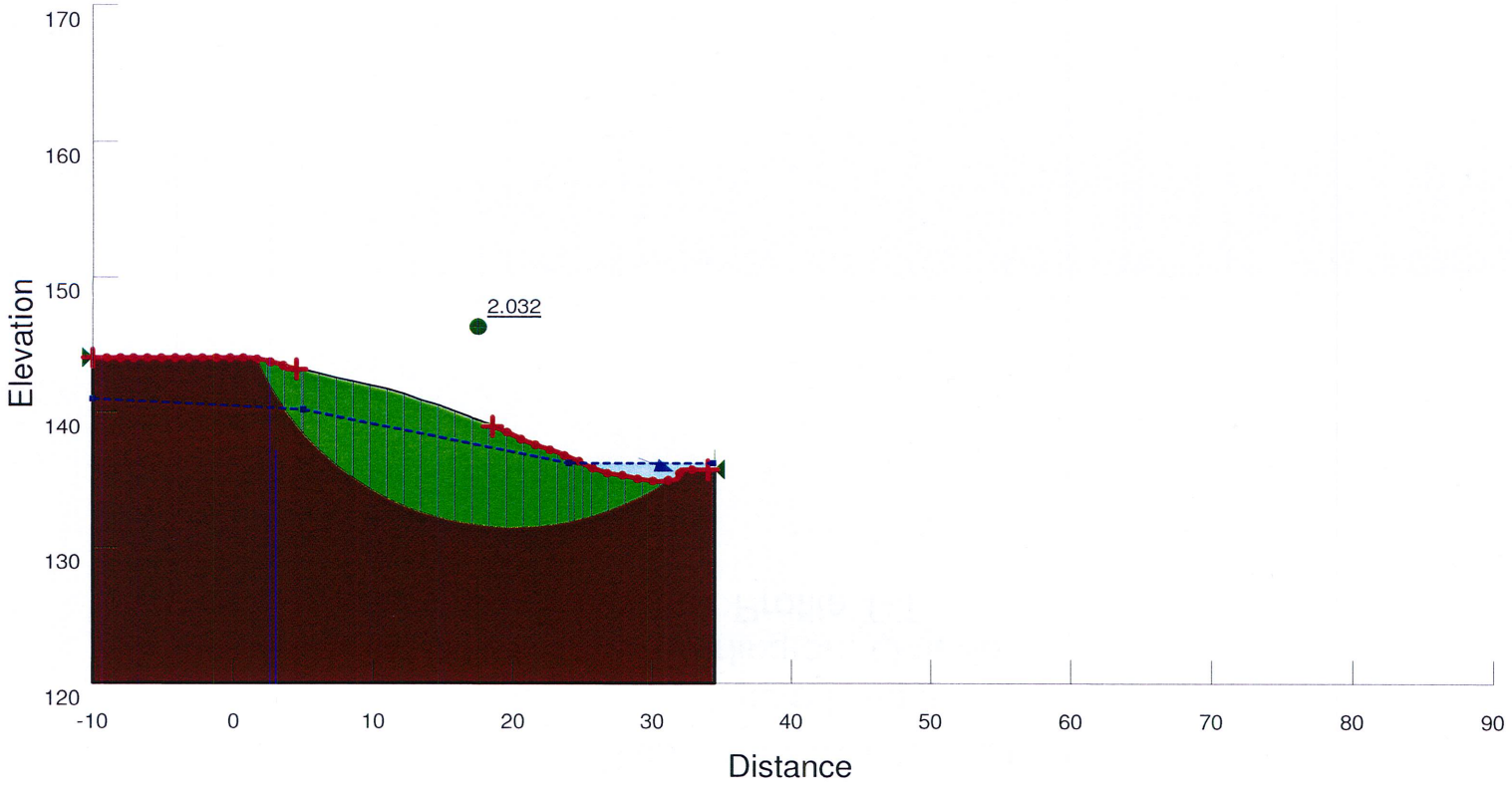
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile S-S



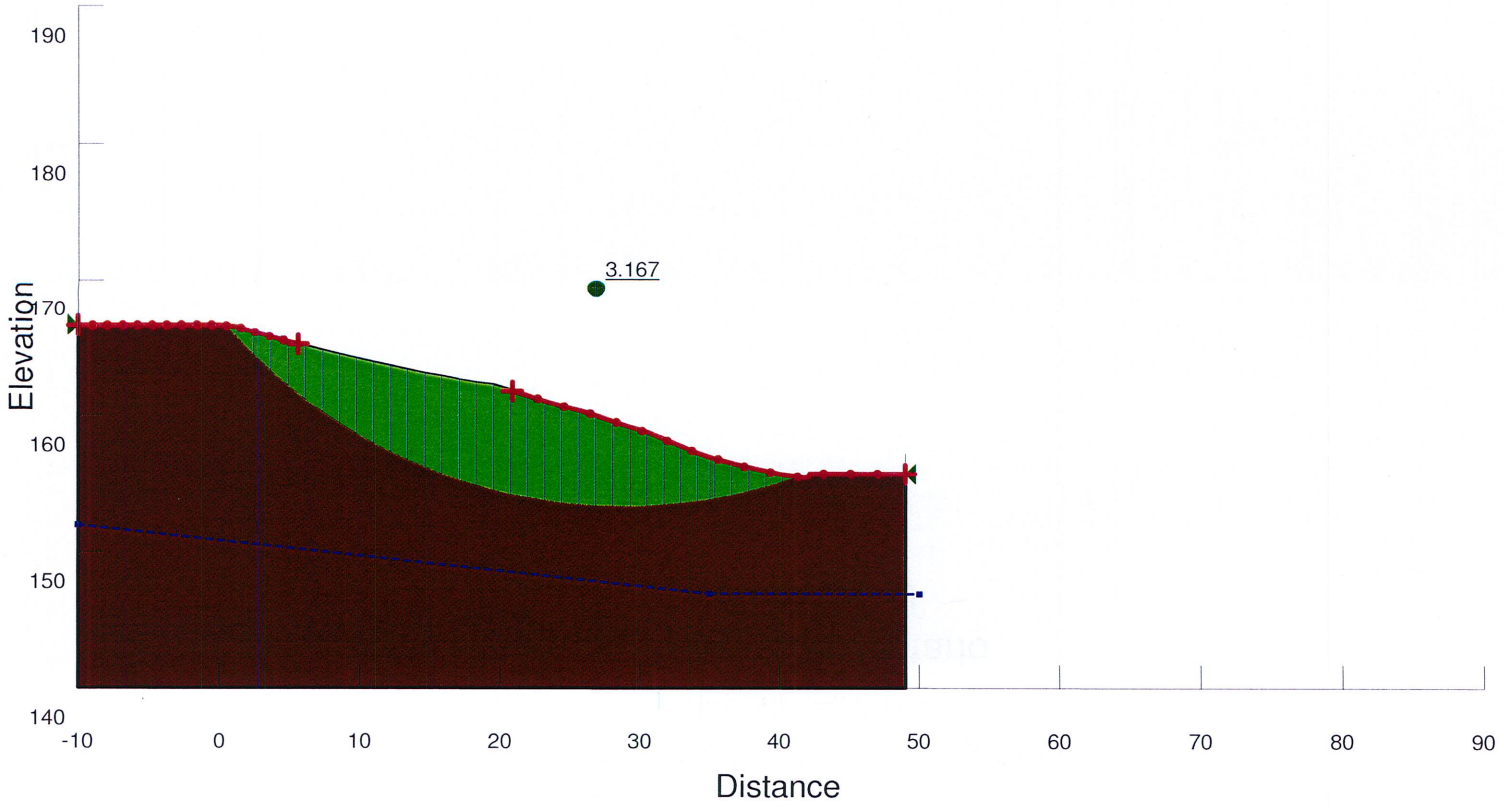
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile T-T



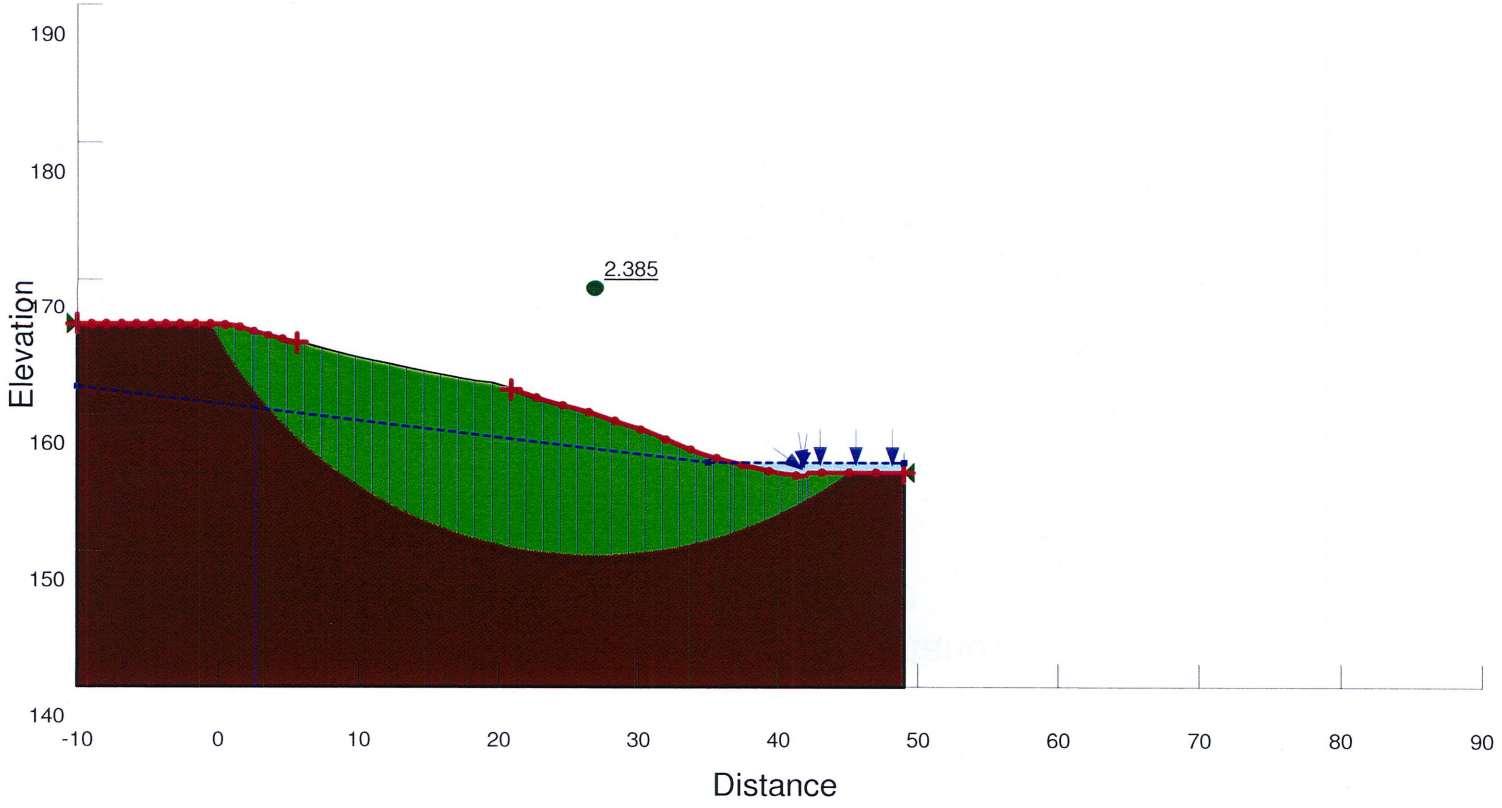
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile T-T



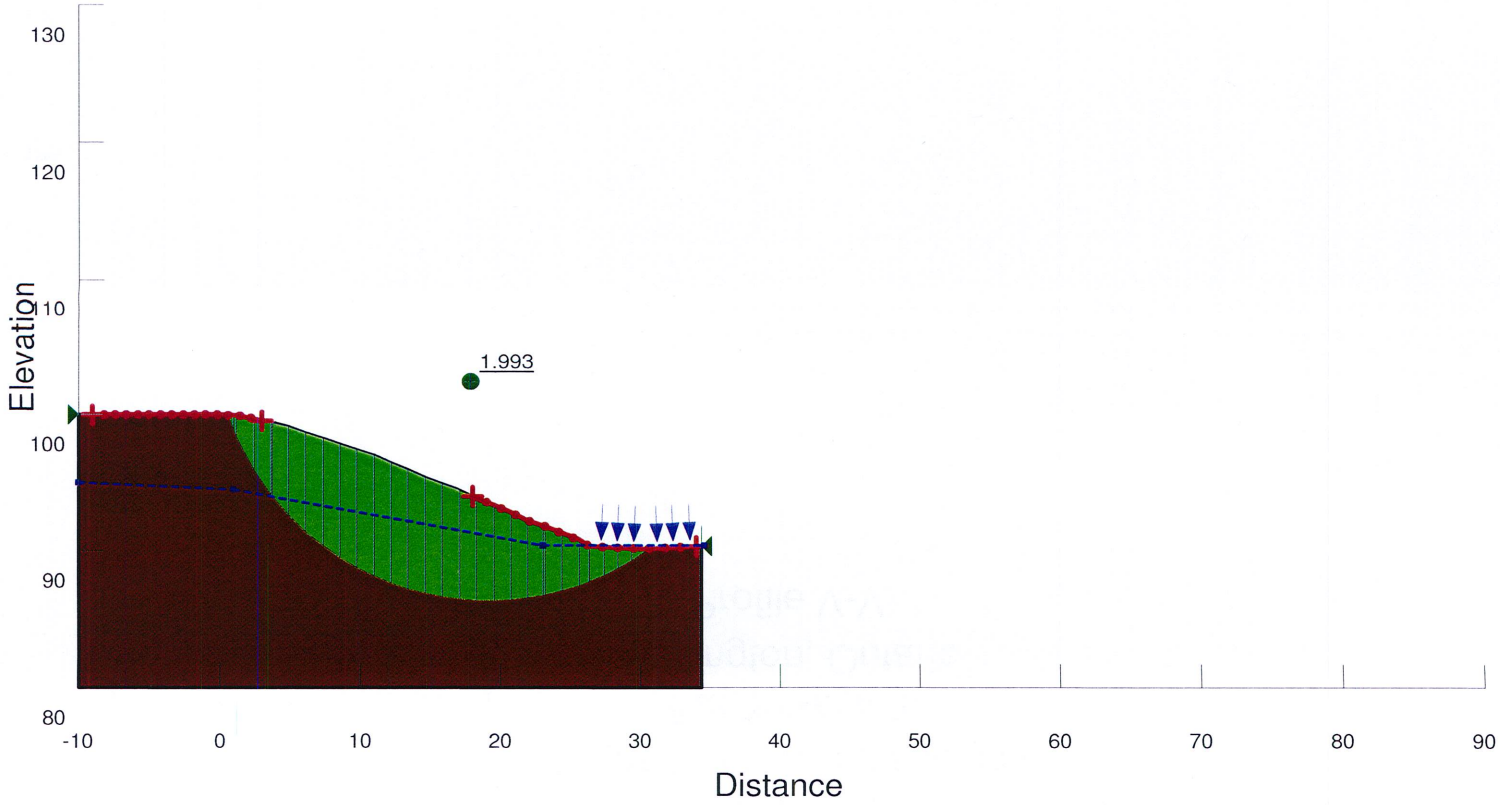
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile U-U



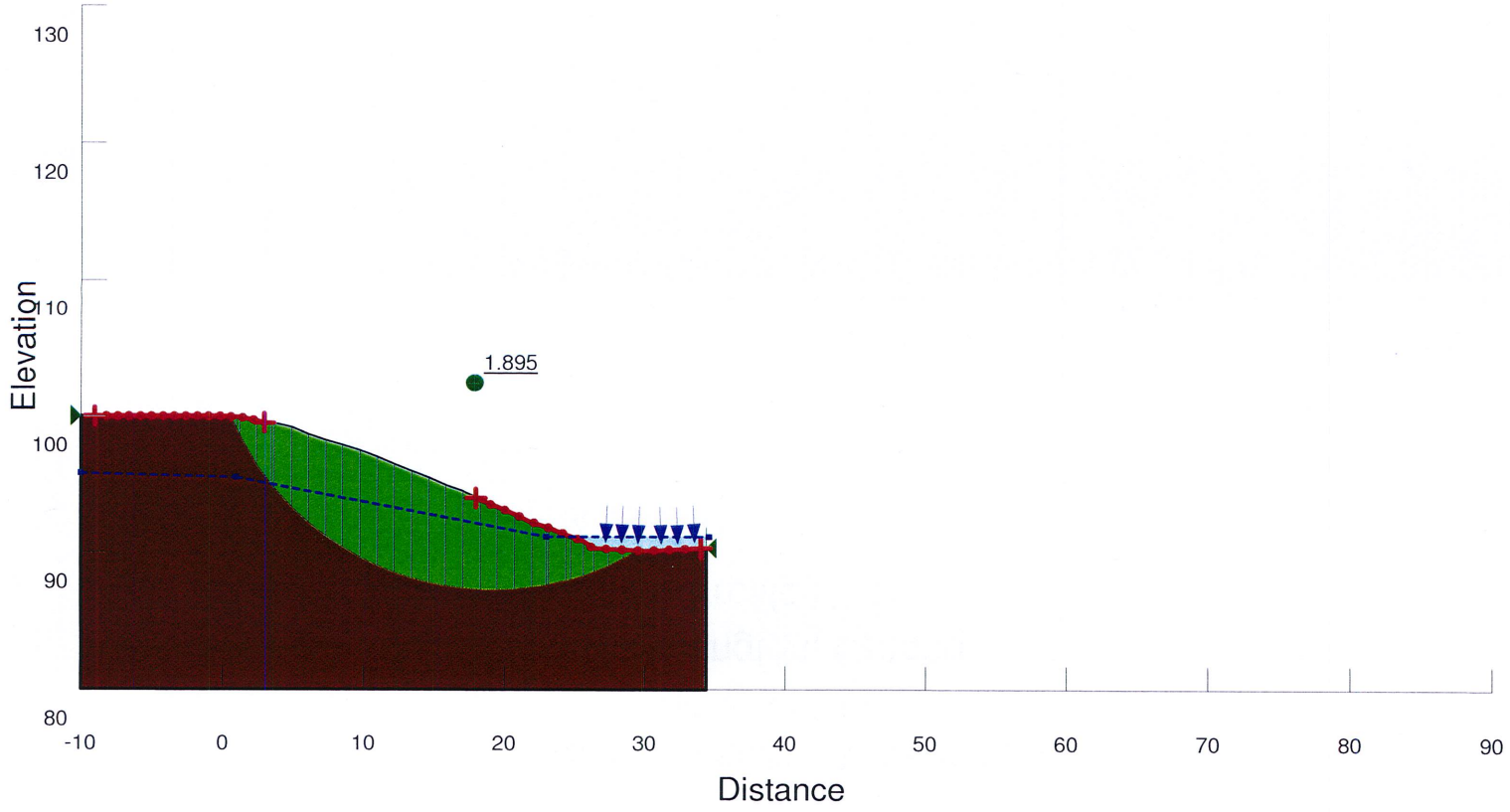
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile U-U



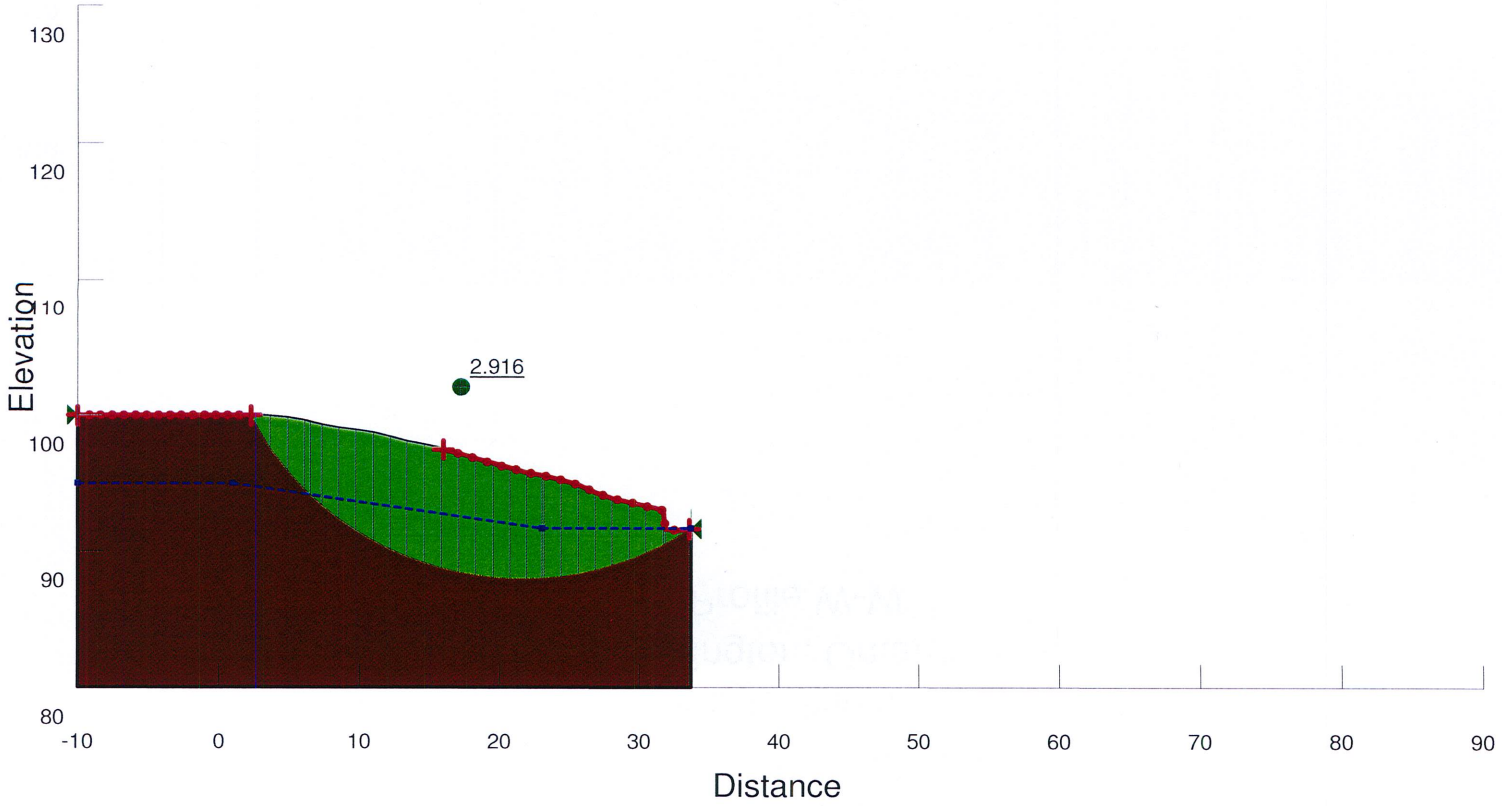
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile V-V



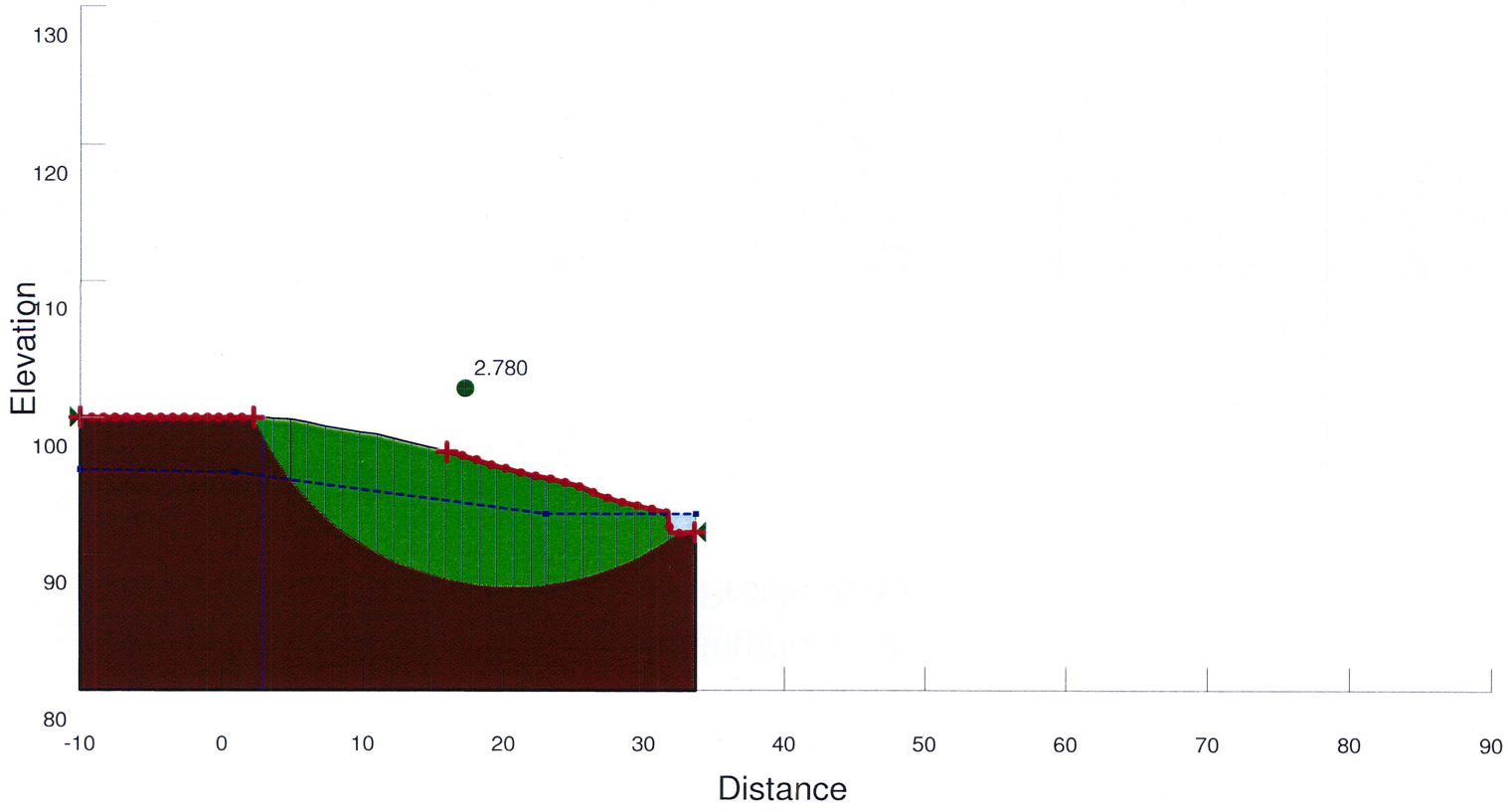
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile V-V



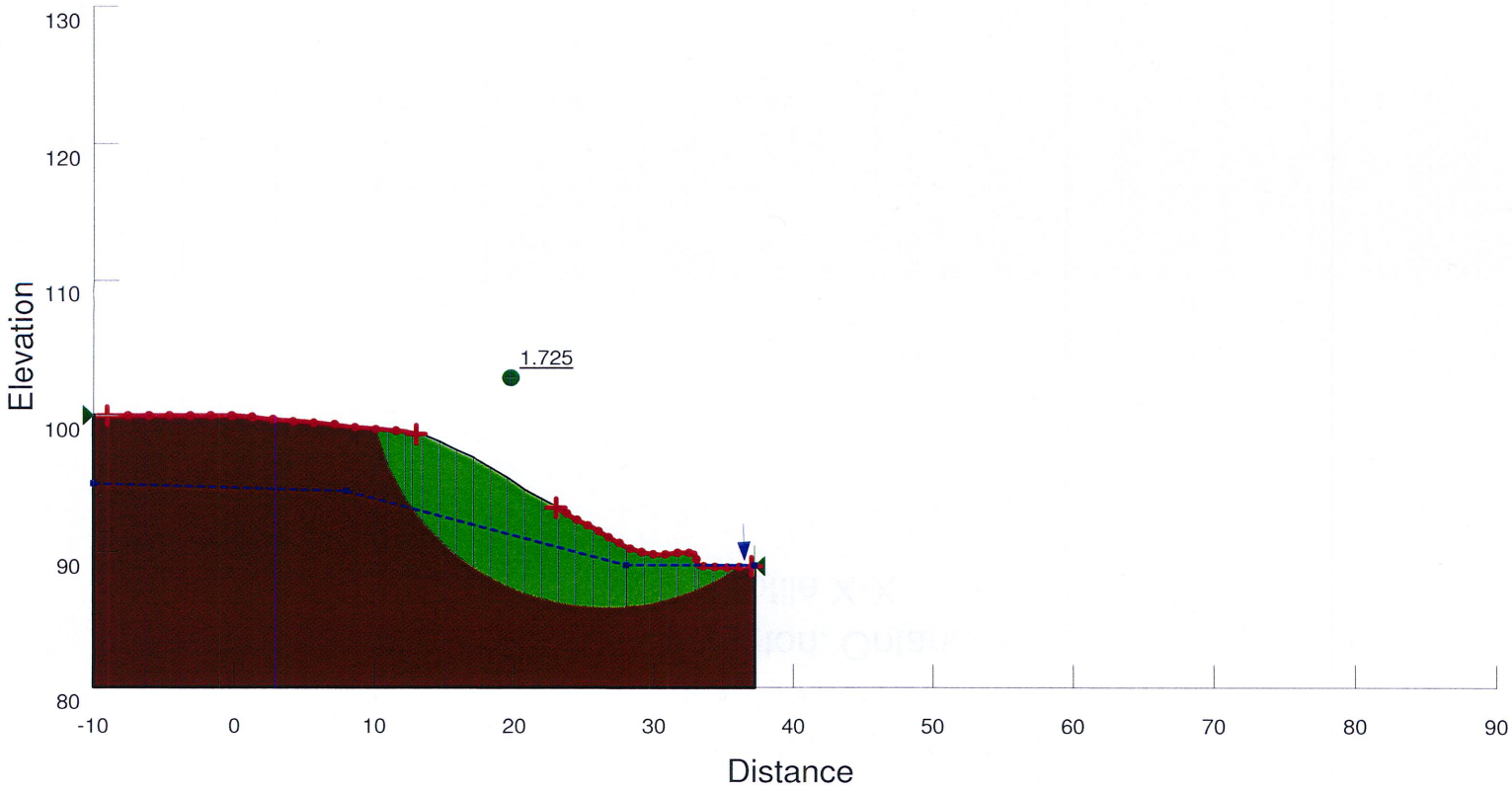
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile W-W



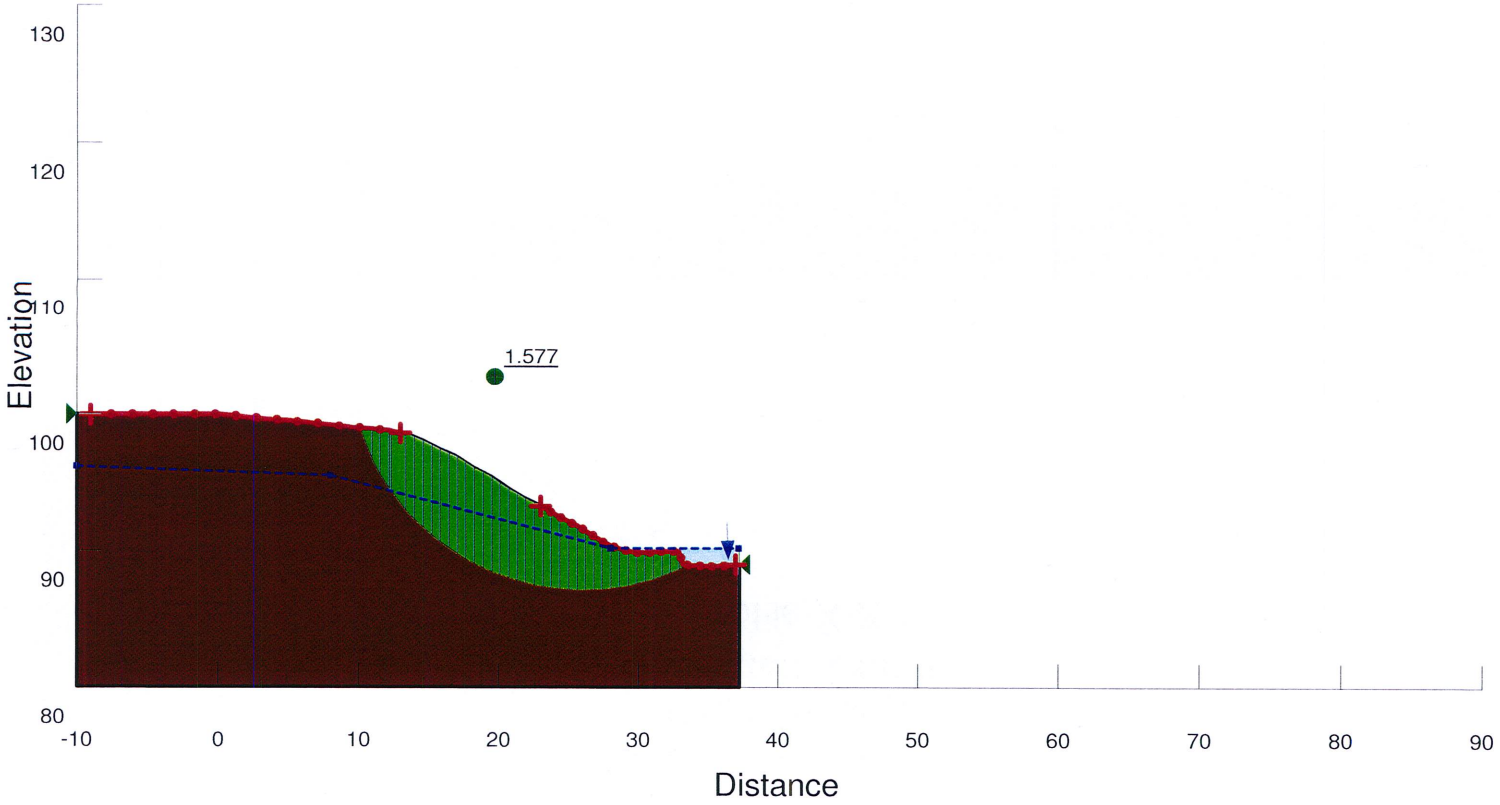
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile W-W



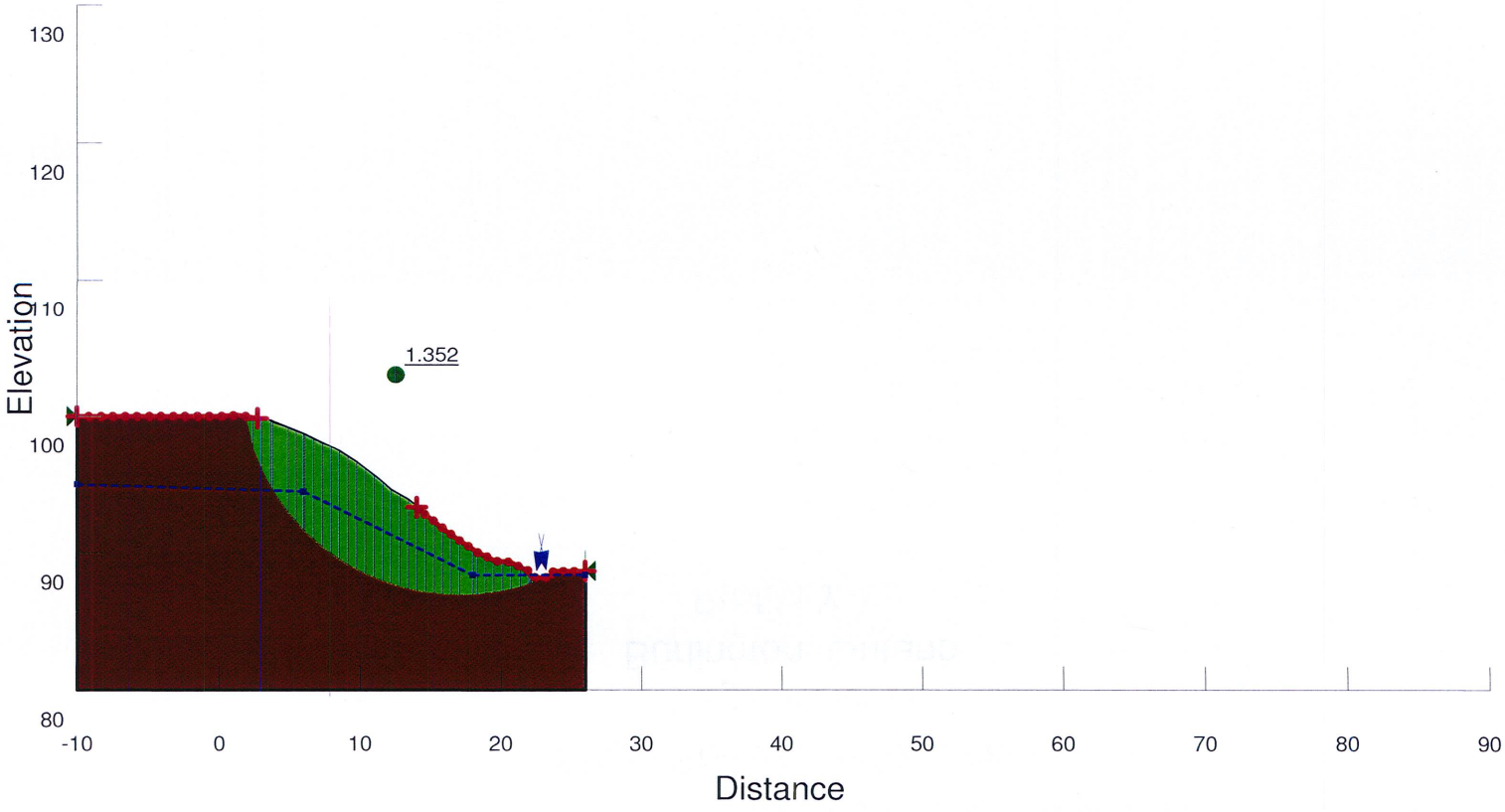
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile X-X



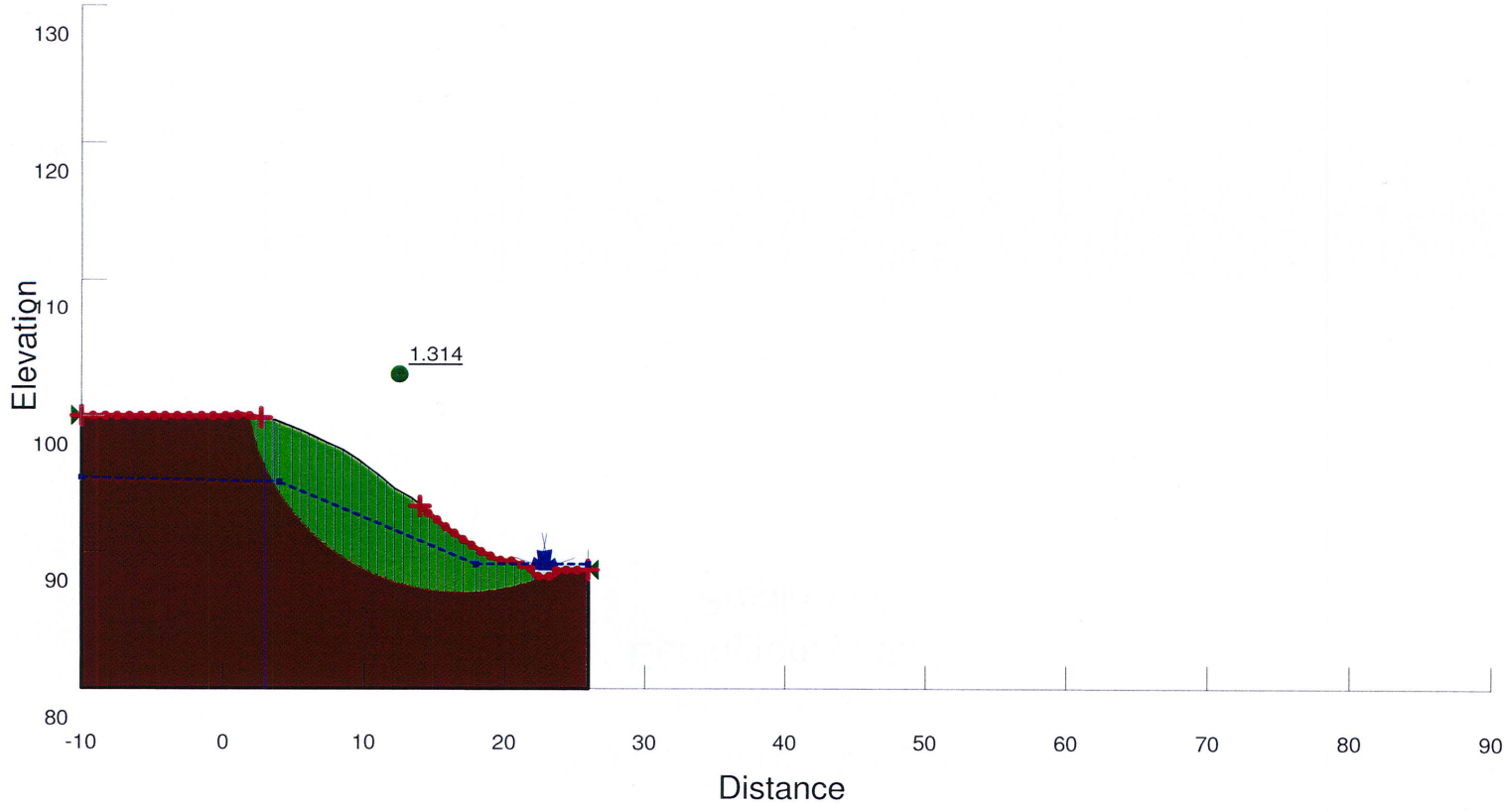
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile X-X



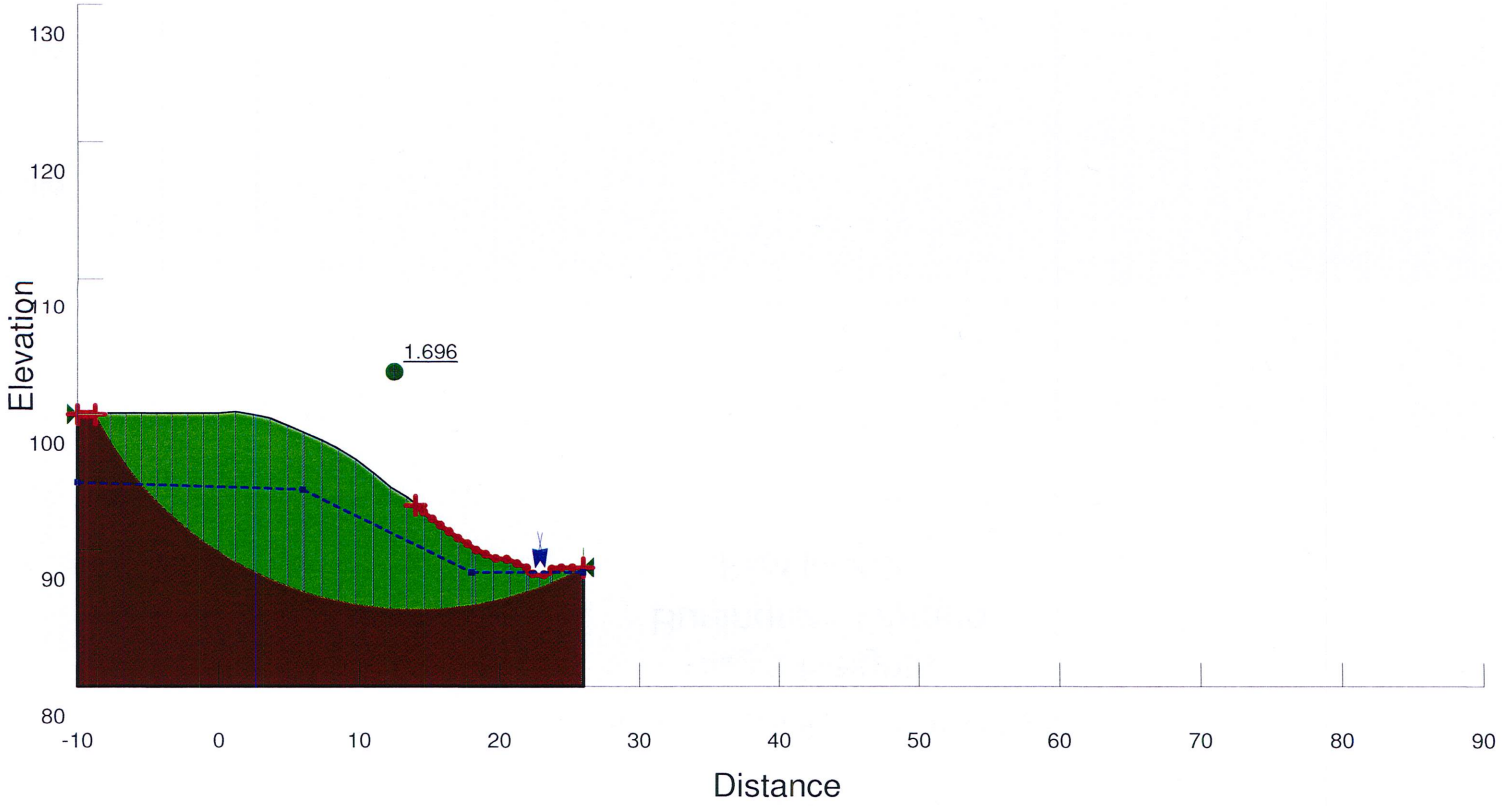
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Y-Y



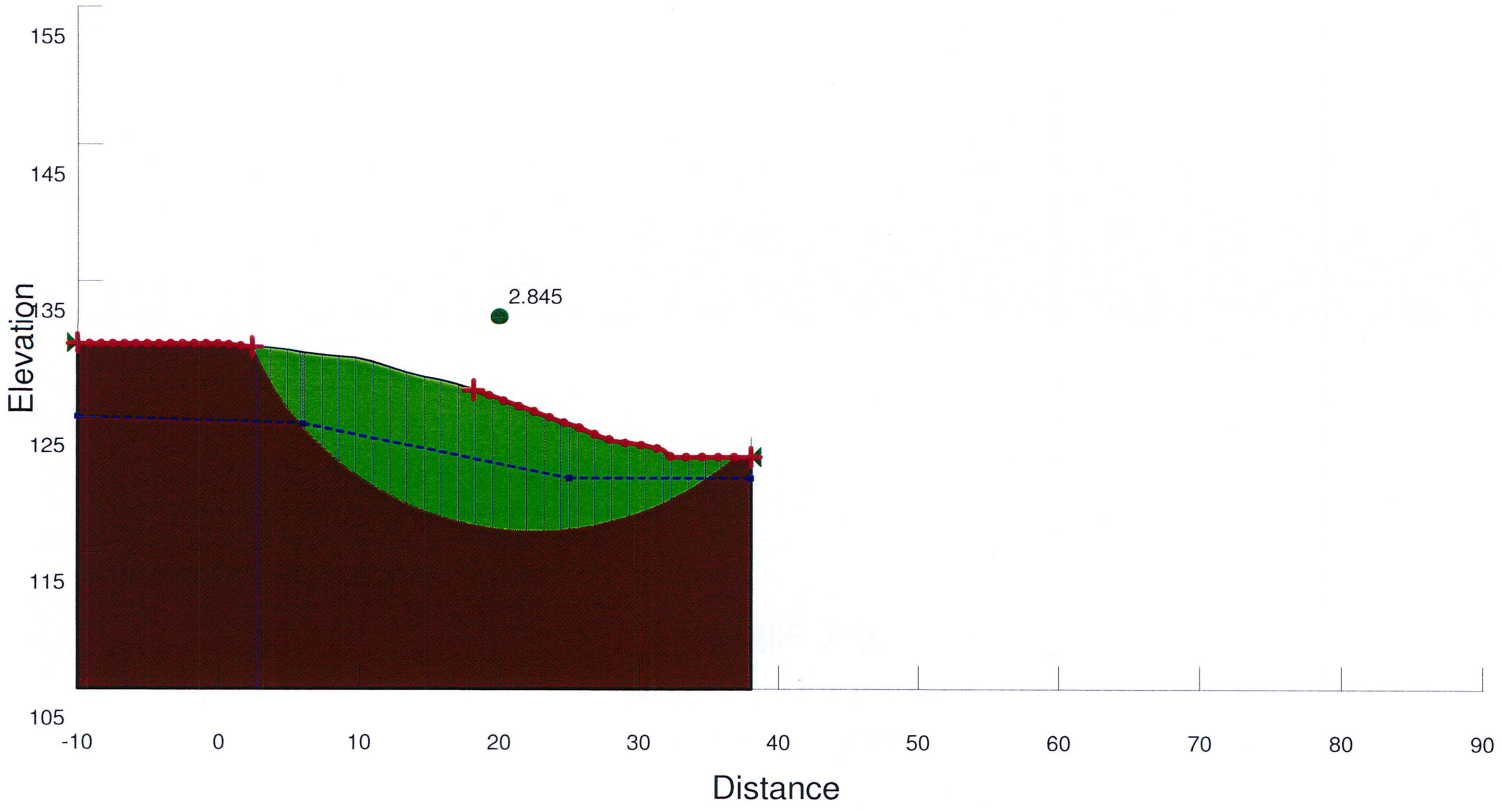
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Y-Y



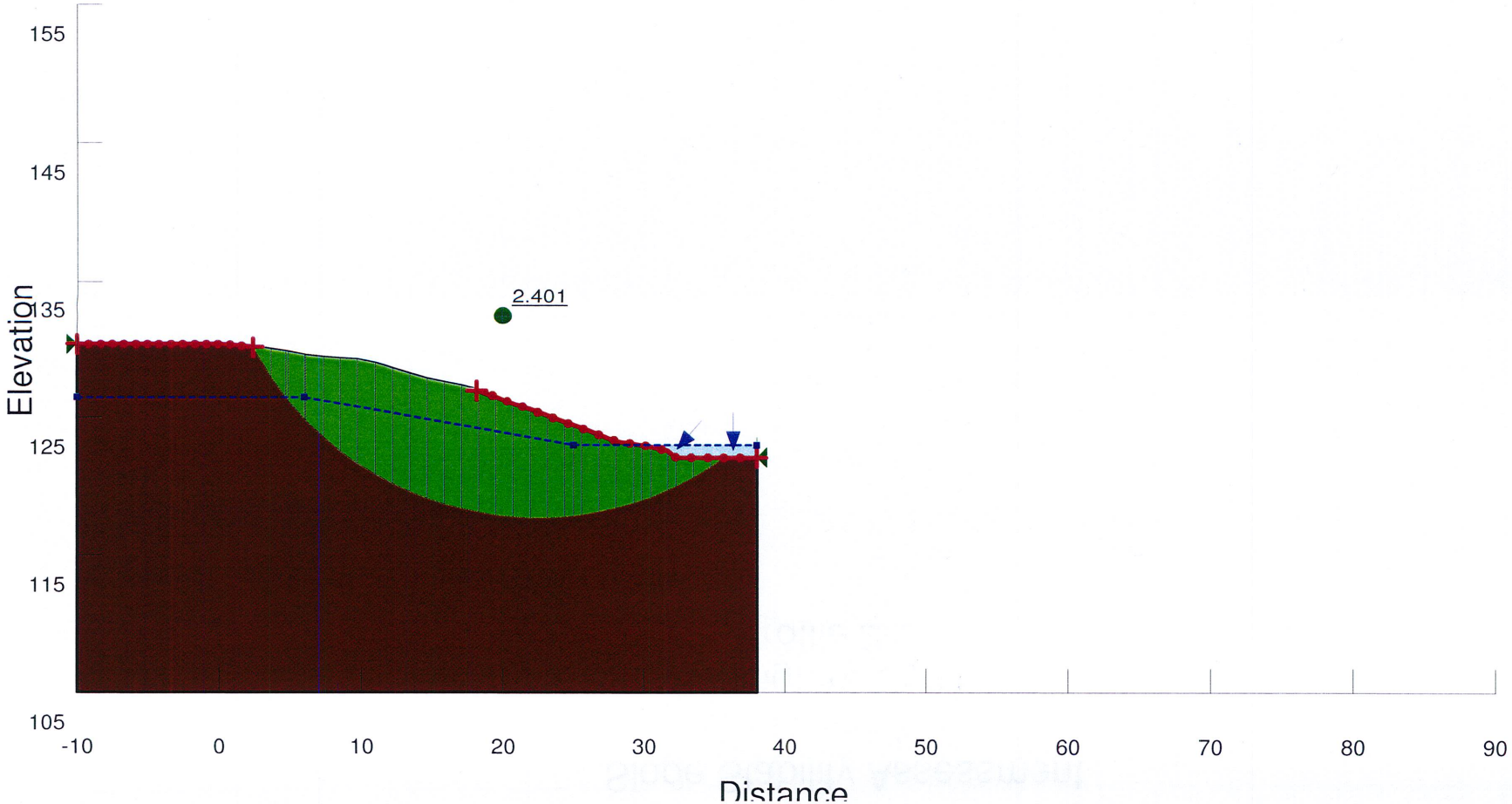
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Y-Y



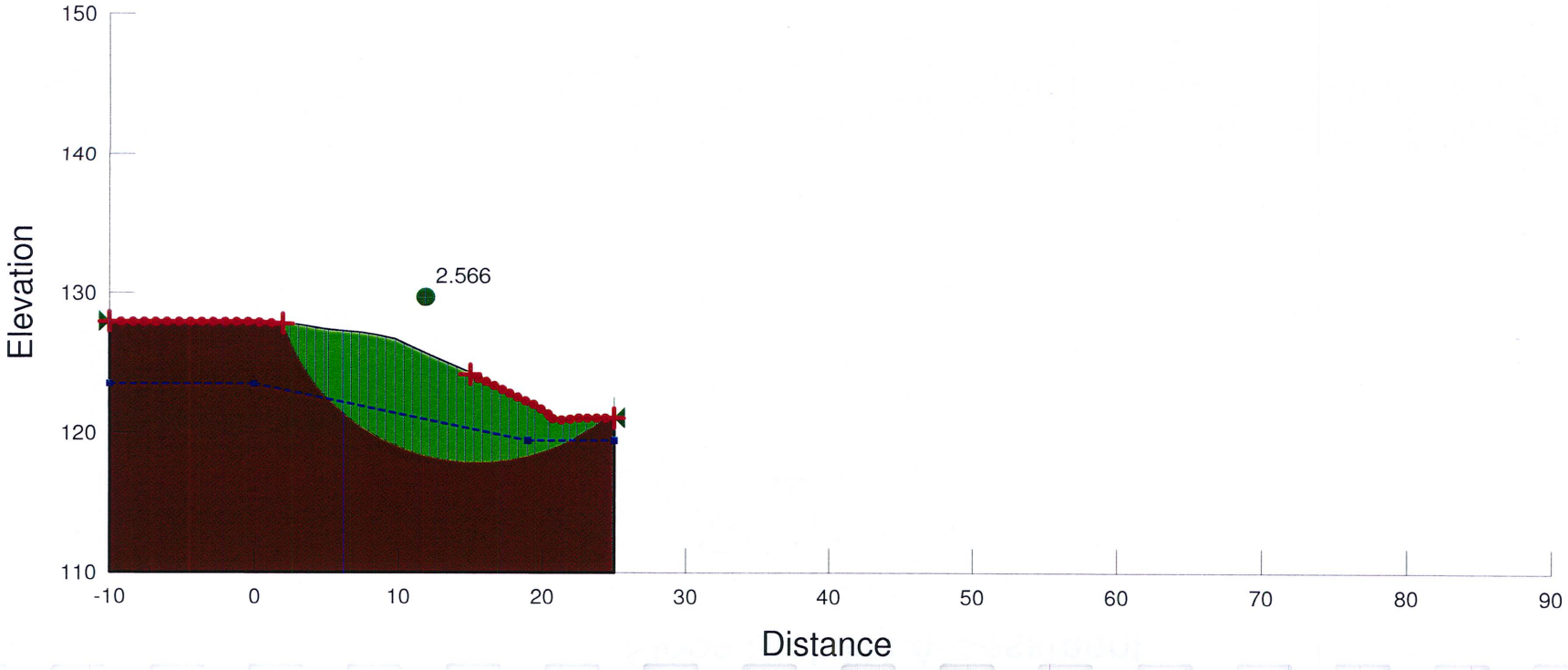
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Z-Z



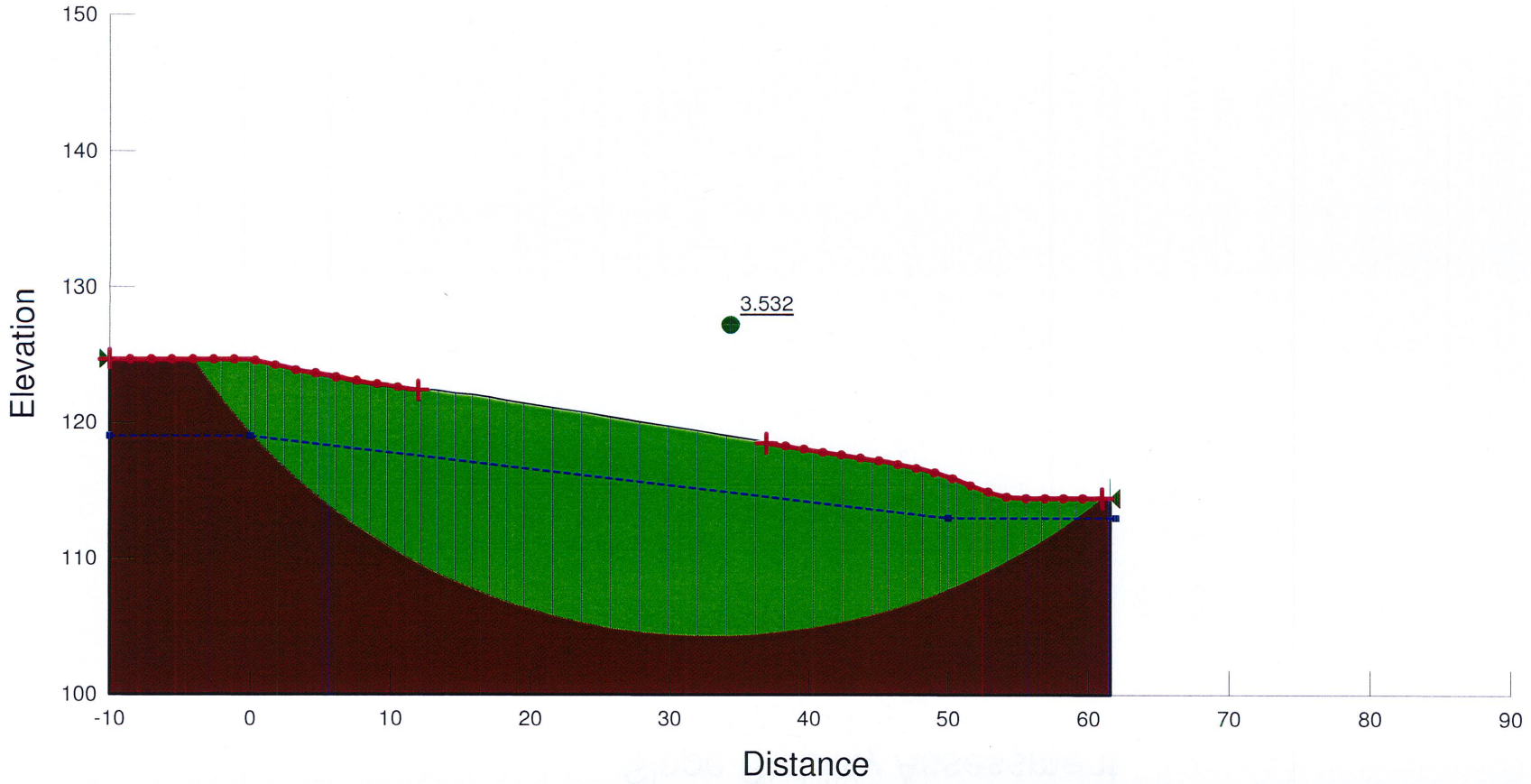
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile Z-Z



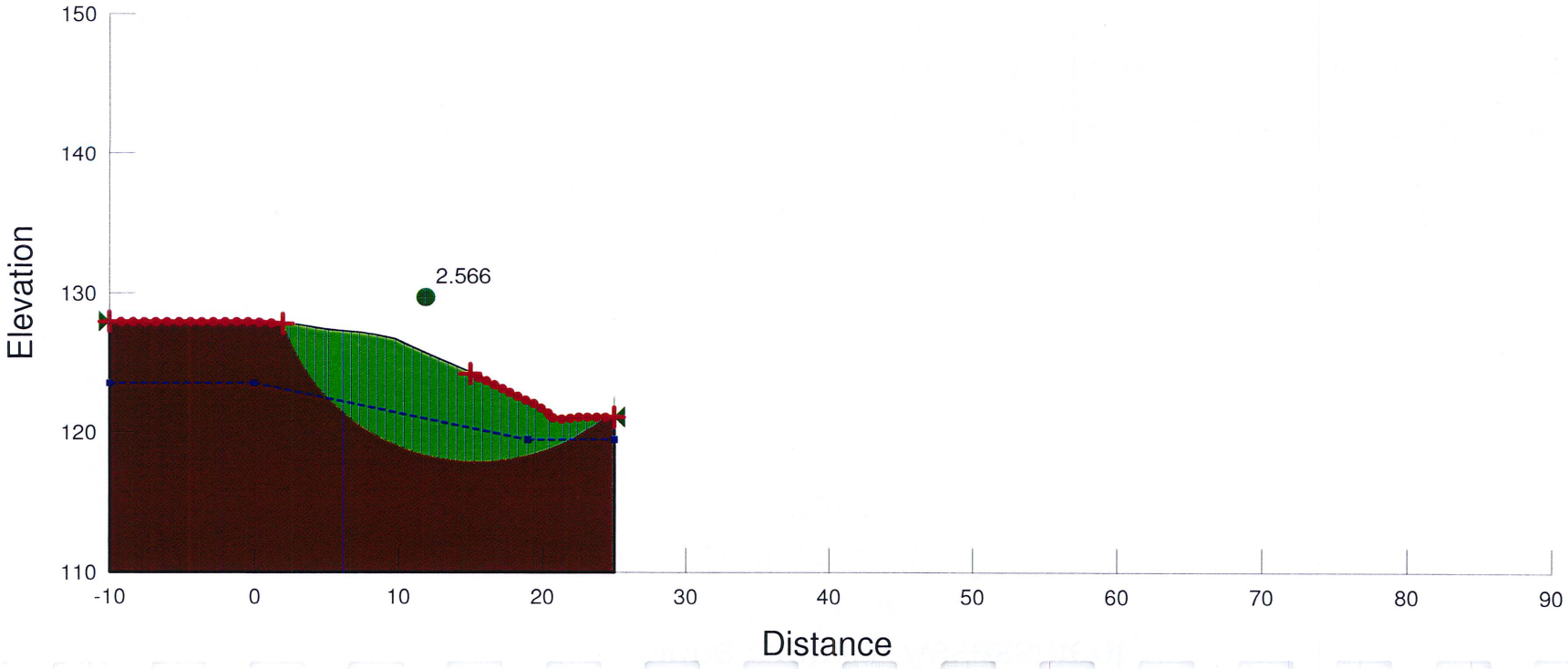
Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile 2-2



Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile 1-1



Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile 2-2



Slope Stability Assessment
Eagle Heights
Burlington, Ontario
Profile 2-2

