

11 April 2023

Ministry of Culture and Heritage  
C/- The Building Intelligence Group Ltd  
PO Box 930  
Wellington 6140

9(2)(a)

Dear 9(2)(a)

**Addendum to Geotechnical Report Due to Recent Slips - Dove Myer Robinson Park, Parnell**  
**(Our Reference: 16066.000.000\_10)**

## 1 Introduction

During the unprecedented storm events this year (specifically 27 January, 1 February and 12-14 February), three slips occurred along the cliff line within Dove Myer Robinson Park, one of which was in the vicinity of the proposed Erebus Memorial Development. Estimates vary, but the 27 January event is estimated to have been approximately a 1 in 250 year event and the following events were greater than 1 in 100 year events that occurred in already saturated ground conditions.

The Ministry of Culture and Heritage has asked us to carry out a site visit to observe the slips and provide feedback on whether the recommendations given in the ENGEO Geotechnical Investigation Report (ref. 16066.000.000\_07 dated 17 October 2019) remain valid or need to be reviewed due to the slips.

Due to safety concerns accessing the areas, no detailed survey of the slips has been carried out. Accordingly, our assessments have been carried out based on visual interpretations and estimates only.

In light of the recent storm events, the Ministry of Culture and Heritage have also advised they would like the Erebus Memorial and the surrounding land to be "enduring" and have asked that we upgrade the design life of both the structure and surrounding land to at least 100 years in the analysis.

Given the location of the memorial in an Auckland Council reserve, we discussed the slips and our analysis with Auckland Council while preparing this report.

## 2 Site Visits

We visited the site twice following the storm events, once on 9 February 2023 to observe the cliff line at low tide and a second time on 18 February 2023 following the latest event to assess for further damage and to obtain drone footage of the slips.

## 2.1 9 February Visit

We carried out a site walkover and noticed two slips had occurred, marked as Slip 1 and Slip 2 on the attached plan (Appendix 1). We also noted tension cracks above the path further to the north, marked as Slip 3 on the attached plan.

We walked around the base of Slip 1, however due to tides, vegetation growth and safety constraints we could not carry out a detailed assessment of Slip 1 or access the base of Slip 2 at all.

Photos of the slips and tension cracks are attached in Appendix 2.

## 2.2 18 February Visit

We returned to the site following Cyclone Gabrielle to observe for further movement that may have occurred and to obtain drone footage of the slips where possible. For the aforementioned reasons we did not attempt to access the base of any of the slips.

We noted that a third slip (Slip 3) had occurred where the tension cracks had been observed on 9 February.

Photos of the slips and stills from drone footage are attached in Appendix 2.

## 3 Discussion on Slips

Based on our site observations, we believe the failure mechanism for all three slips was saturation of the overburden soil profile leading to shallow soil failure above the rock profile at the top of the cliff. As the failures occurred, they dragged the vegetation (and root systems) off the heavily vegetated rock portion of the cliff.

Specific comments regarding the individual slips are provided below.

### 3.1 Slip 1

This slip appears to be associated with a large tree losing support and toppling from the cliff. It has brought its root system (and associated soil) down the face of the cliff and stripped the vegetation off the cliff face.

Based on visual observations from the base of the cliff:

- The thickness of the upper soil profile couldn't be readily confirmed.
- The rock portion of the cliff face appears to have regressed less than 1 m (horizontally) based on thickness of soil / root mass adjacent to the slip.
- No visual observations could be made regarding the slip within the soil profile due to it being located within the bush area and it being unsafe to access.

### 3.2 Slip 2

This slip was likely the result of excess surface water travelling along the path and concentrated flow onto the cliff.

Based on visual observations from the drone footage:

- The upper soil profile is approximately 2-3 m thick.
- The rock portion of the cliff face appears to have regressed less than 1 m (horizontally) based on thickness of soil / root mass adjacent to the slip.
- The upper soil portion of the cliff face appears to have regressed back approximately 2 m from the pre-slip crest (which is assumed to have been just beyond the path based on the adjacent cliff line).

### 3.3 Slip 3

This slip appeared to have been the result of excess surface water travelling along the path and concentrated flow onto the cliff and into tension cracks (which had likely formed in association with the first storm events).

Based on visual observations from the drone footage:

- The upper soil profile is approximately 2-3 m thick.
- The rock portion of the cliff face appears to have regressed less than 1-2 m (horizontally).
- The upper soil portion of the cliff face appears to have regressed back 2-3 m from the pre-slip crest (which is assumed to have been just beyond the path / handrail based on the adjacent cliff line).

## 4 Reassessment of Stability

### 4.1 Modifications to Original Modelling

We have reassessed the original stability analysis taking into account the following model updates:

- Slip 1 is approximately downslope of the memorial location and we have modified the ground surface to account for this. We have inferred the new profile based on our site observations as no detailed topographical survey information has been collected. The assessment reflects a 1 m horizontal regression of the cliff face and a 1-2 m horizontal regression in the upper overburden soils.
- The transient (highest anticipated) groundwater levels have been raised based on observation of the recent failure mechanisms and the required design life increasing to 100 years.
- We have increased the seismic peak ground acceleration based on the recently updated MBIE guidelines and a 1 in 100 year design life (increased from 0.11 g to 0.19 g).

The ground model, geotechnical parameters and all other design cases have remained consistent with the original Geotechnical Investigation Report (dated 16 October 2019).



## 4.2 Stability Results

The results of the reassessment are presented in Table 1 below and detailed outputs are included in Appendix 3. The proposed development and surrounding ground (taking into account the recent slip and the increased design life) no longer achieves adequate factors of safety against instability.

We have therefore run a second case which includes a palisade wall along the downslope extent of the proposed development. With this wall installed, the factors of safety increase to above the minimum values currently required by Auckland Council.

We understand that there is no scope to move the memorial back from the cliff face or resize it due to protected trees around the memorial and the size and orientation of the memorial being critical to its overall design / appearance. We therefore haven't considered cases where the memorial is moved.

**Table 1: Slope Stability Summary**

Case	Model	Minimum Required Factor of Safety	Minimum Factor of Safety Achieved
Long Term Groundwater	Proposed Development	1.50	1.32
Word Credible Groundwater	Proposed Development	1.30	0.98
Seismic Loading	Proposed Development	1.00 <sup>1</sup>	0.98
Long Term Groundwater	Proposed Development with Palisade Wall	1.50	1.50
Word Credible Groundwater	Proposed Development with Palisade Wall	1.30	1.31 (1.03) <sup>2</sup>
Seismic Loading	Proposed Development with Palisade Wall	1.00 <sup>1</sup>	1.22

1 – We have adopted the ULS PGA loading as described in the draft Version 2.0 (Dated July 2022) of the Auckland Council Code of Practice.

2 – Factor of safety in brackets is downslope of the palisade wall, indicating that slips may still occur downslope of the wall however the land upslope of the wall will have adequate factors of safety against instability.

The results demonstrate that a palisade wall will be required along the downslope extent of works to achieve adequate factors of safety for both the structure and the surrounding land.

An alternative to the above would be to pile the structure down to rock. This option would provide protection to the structure however it would not prevent slips potentially occurring in the surrounding land.

## 5 Updated Recommendations

Based on our reassessment of the stability analysis, we consider that the recent slip events have compromised the Erebus Memorial development as it is currently proposed. We therefore consider that the recommendations given in the previous Geotechnical Investigation Report are no longer valid.

To achieve adequate factors of safety for the proposed Erebus Memorial and the surrounding land we would recommend that a palisade wall be installed downslope of the structure. The palisade wall will likely involve large diameter reinforced concrete piles extending 5 m to 10 m into rock at close centres. It may also require tie back anchors and a capping beam at the ground surface to limit wall deflections.

It should be noted that the palisade wall would not prevent further slips happening downslope of the wall (or beyond the extents of the wall), however it would provide protection to the proposed structure and the land upslope of the wall.

We would recommend that additional site investigation comprising machine boreholes is carried out to inform the detailed design stage of the proposed palisade wall.

## 6 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Ministry of Culture and Heritage, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by

Report reviewed by

9(2)(a)

### Attachments:

Site Plan

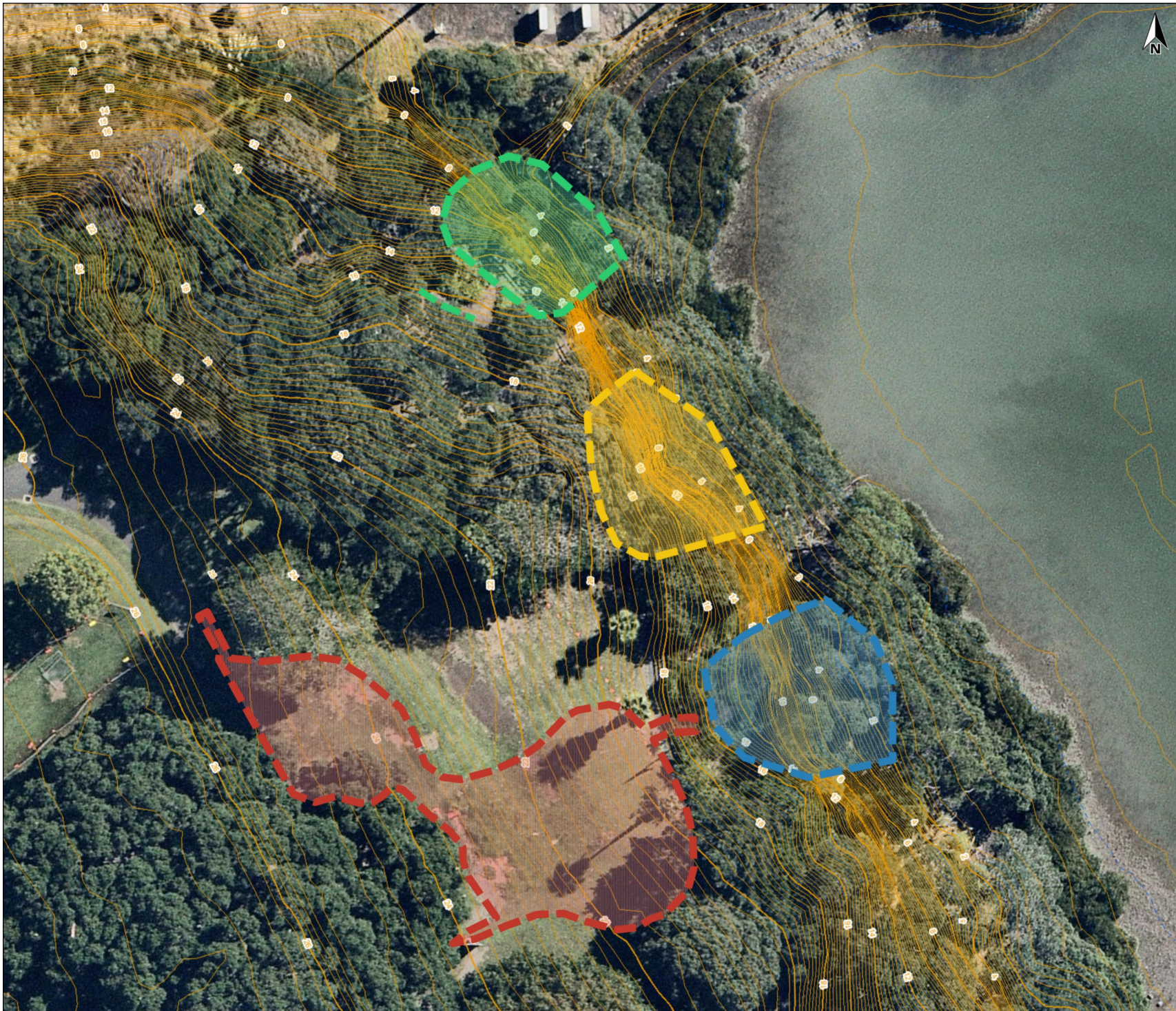
Photos of Slips

Stability Analysis





## APPENDIX 1

Site Plan






**Legend**

-  Slip #1 (Approximate)
-  Slip #2 (Approximate)
-  Slip #3 (Approximate)
-  Slip #3 Tension Cracks (Approximate)
-  Erebus Memorial, Main Construction Site

Contours

-  Contours 2m

0    5 m    10 m  
© Nearmap,

**ENGEO**  
Produced by [Datanest.earth](http://Datanest.earth)

Title: Preliminary Site Walkover		
Client: Ministry of Culture and Heritage		Figure No.: 1 Size: A4
Project: Dove Myer Robinson Park (Parnell Rose Garden)	Drawn: 9(2)(a)	
Date: 12-03-2023	Checked: 9(2)(a)	
Proj No.: 16066.000.000	Scale: 1:500	Version: 1



## APPENDIX 2

Photos of Slips



Slip 1 – Taken from base of slip



Slip 1 – Taken from base of slip





Slip 2 – Taken from top of slip



Slip 2 – Drone Footage showing exposed face





Slip 2 – Drone footage showing adjacent growth (for depth of slip) and debris



Slip 3 – Tension cracks on 9 February (prior to slip)





Slip 3 – Drone Footage

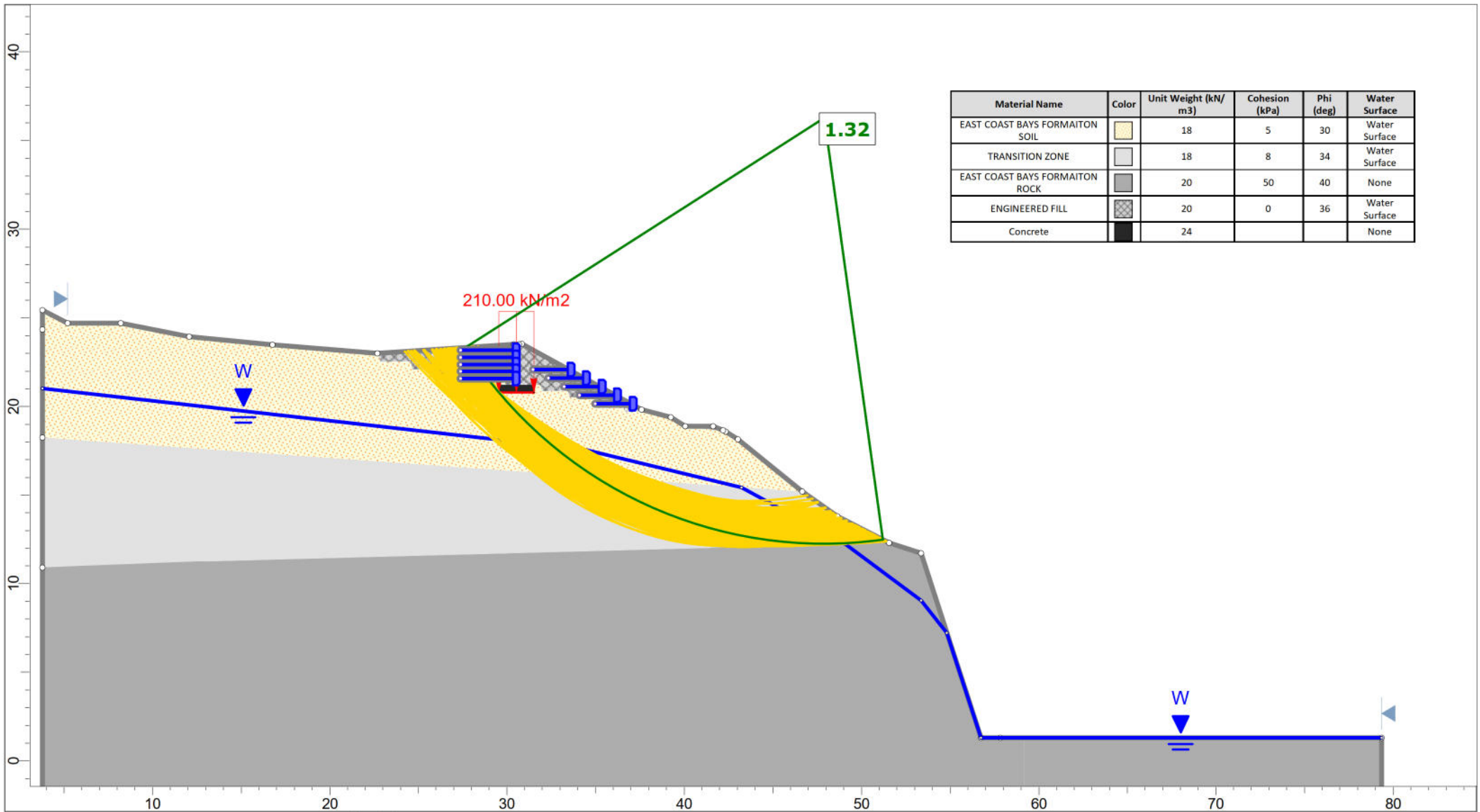


Slip 3 – Drone Birds Eye View

## APPENDIX 3

### Stability Analysis





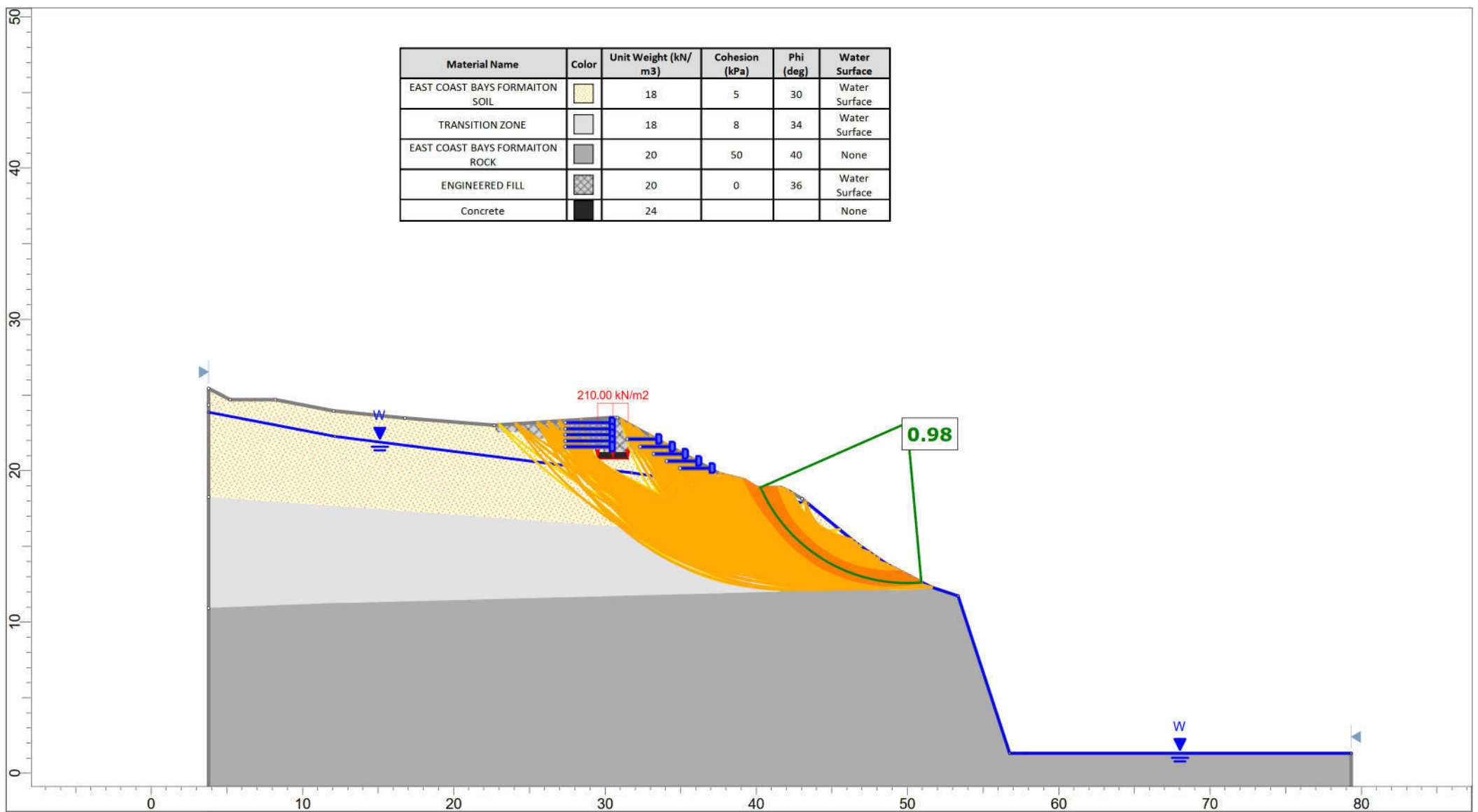
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EAST COAST BAYS FORMAITON SOIL	Yellow dotted	18	5	30	Water Surface
TRANSITION ZONE	Light grey	18	8	34	Water Surface
EAST COAST BAYS FORMAITON ROCK	Dark grey	20	50	40	None
ENGINEERED FILL	Grey cross-hatch	20	0	36	Water Surface
Concrete	Black	24			None



SLIDEINTERPRET 9.027

Analysis:	Long Term Groundwater - Proposed Development		
Project:	Erebus Memorial, Dove Myer Robinson Park	Analysis By:	9(2)(a)
Client:	Ministry of Culture and Heritage	Date:	09/03/2023
Reference:	16066.000.000	Scale:	1:300
		Reviewed by:	9(2)(a)
		Revision:	1
		Page:	1 of 6

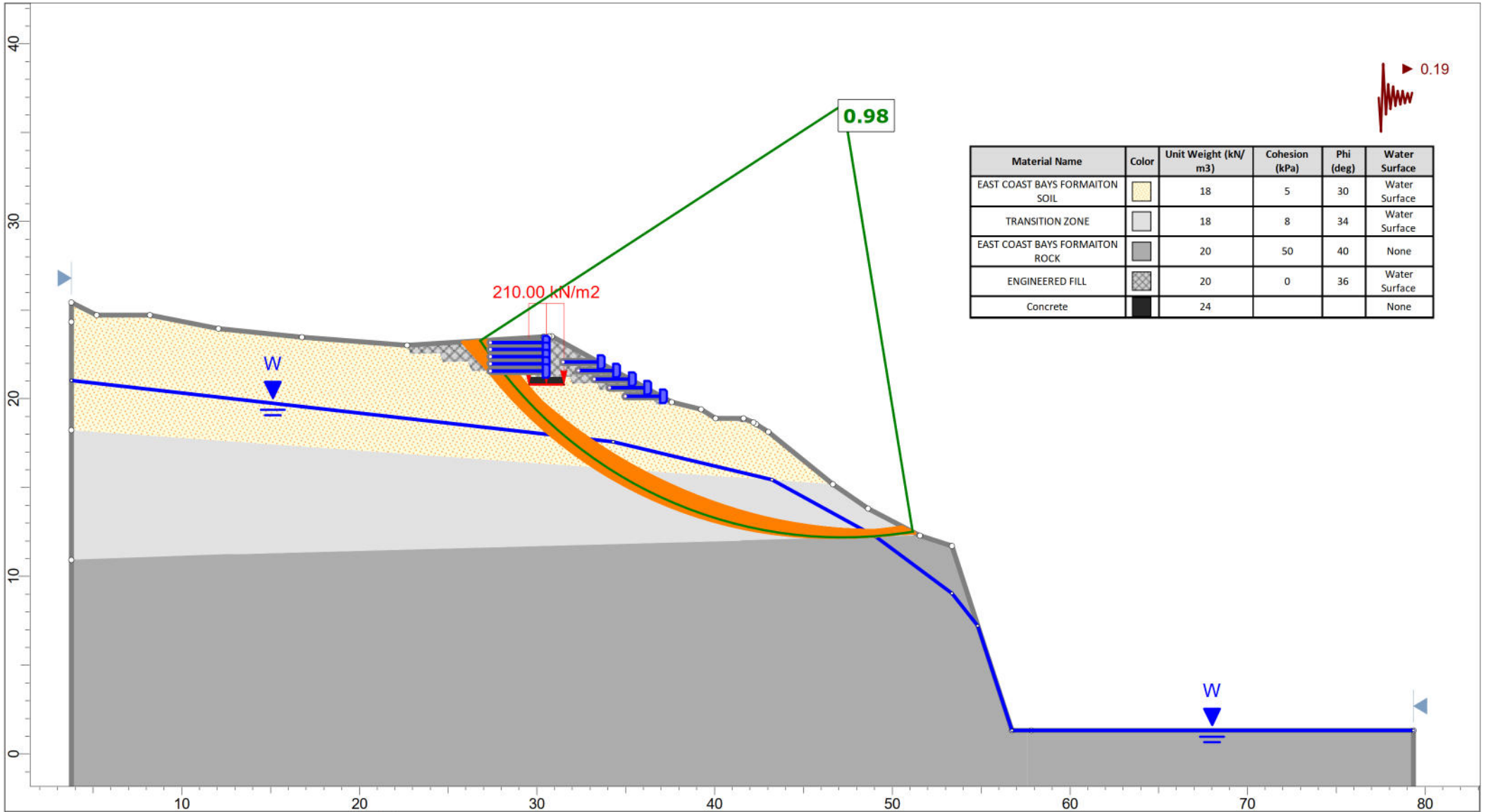
Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Cohesion (kPa)	Phi (deg)	Water Surface
EAST COAST BAYS FORMAITON SOIL		18	5	30	Water Surface
TRANSITION ZONE		18	8	34	Water Surface
EAST COAST BAYS FORMAITON ROCK		20	50	40	None
ENGINEERED FILL		20	0	36	Water Surface
Concrete		24			None



SLIDEINTERPRET 9.027

Analysis: Worst Credible Groundwater - Proposed Development			
Project:	Erebus Memorial, Dove Myer Robinson Park	Analysis By:	9(2)(a)
Client:	Ministry of Culture and Heritage	Date:	09/03/2023
Reference:	16066.000.000	Scale:	1:350
		Reviewed by:	9(2)(a)
		Revision:	1
		Page:	2 of 6



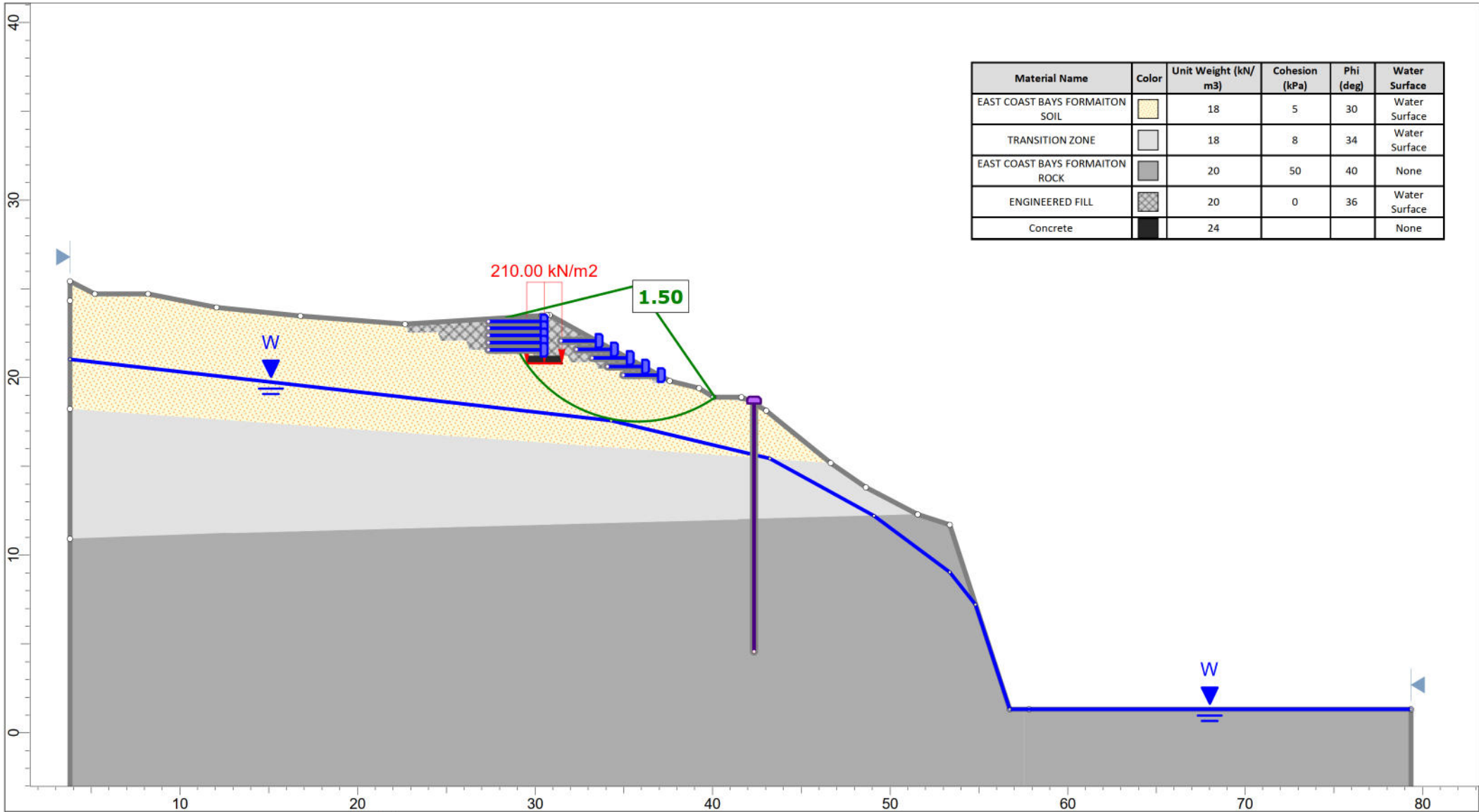


Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Cohesion (kPa)	Phi (deg)	Water Surface
EAST COAST BAYS FORMAITON SOIL		18	5	30	Water Surface
TRANSITION ZONE		18	8	34	Water Surface
EAST COAST BAYS FORMAITON ROCK		20	50	40	None
ENGINEERED FILL		20	0	36	Water Surface
Concrete		24			None



SLIDEINTERPRET 9.027

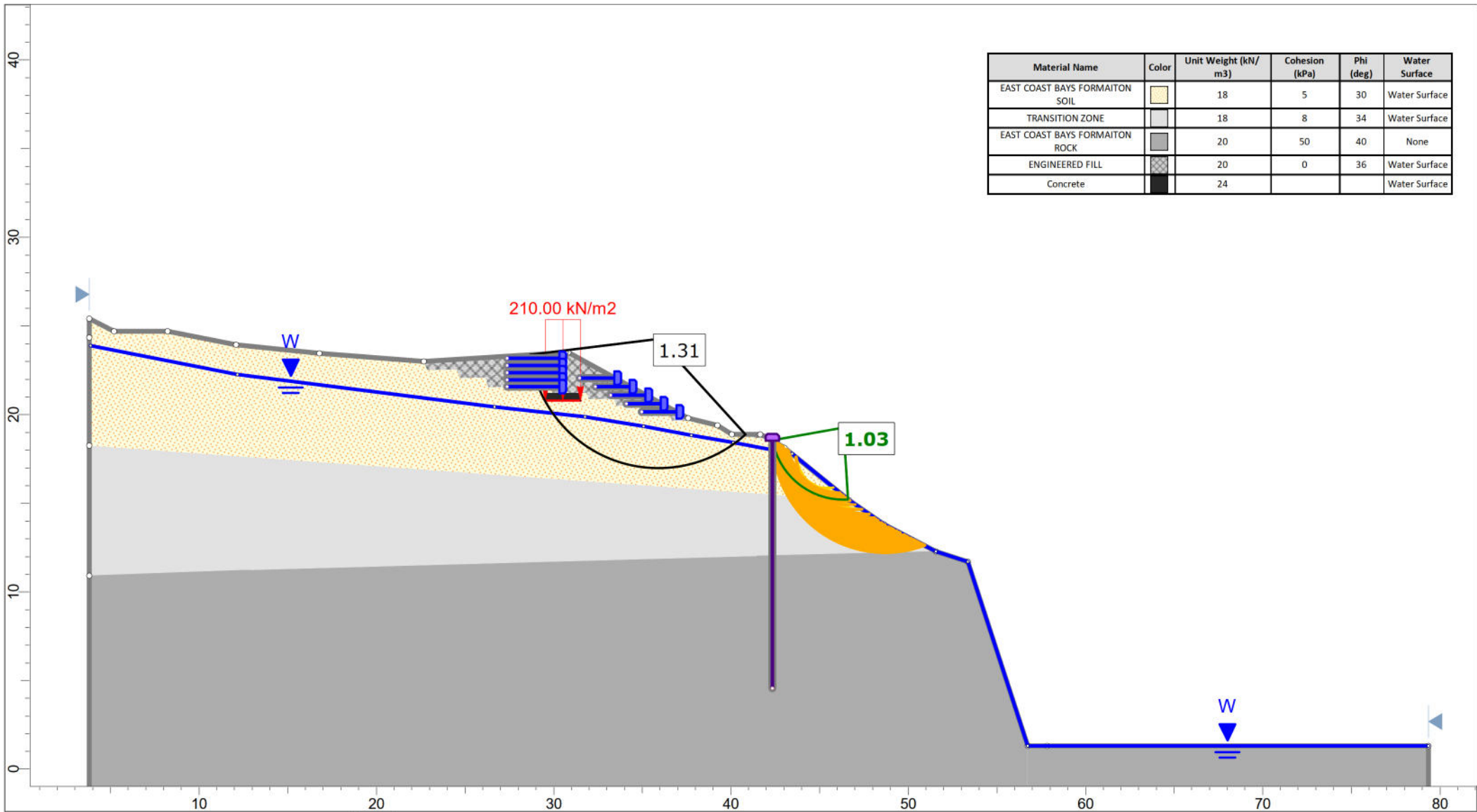
Analysis: ULS Seismic Loading - Proposed Development			
Project:	Erebus Memorial	Analysis By:	9(2)(a)
Client:	Ministry of Culture and Heritage	Date:	09/03/2023
Reference:	16066.000.000	Scale:	1:300
		Reviewed by:	9(2)(a)
		Revision:	1
		Page:	3 of 6



Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Cohesion (kPa)	Phi (deg)	Water Surface
EAST COAST BAYS FORMAITON SOIL		18	5	30	Water Surface
TRANSITION ZONE		18	8	34	Water Surface
EAST COAST BAYS FORMAITON ROCK		20	50	40	None
ENGINEERED FILL		20	0	36	Water Surface
Concrete		24			None

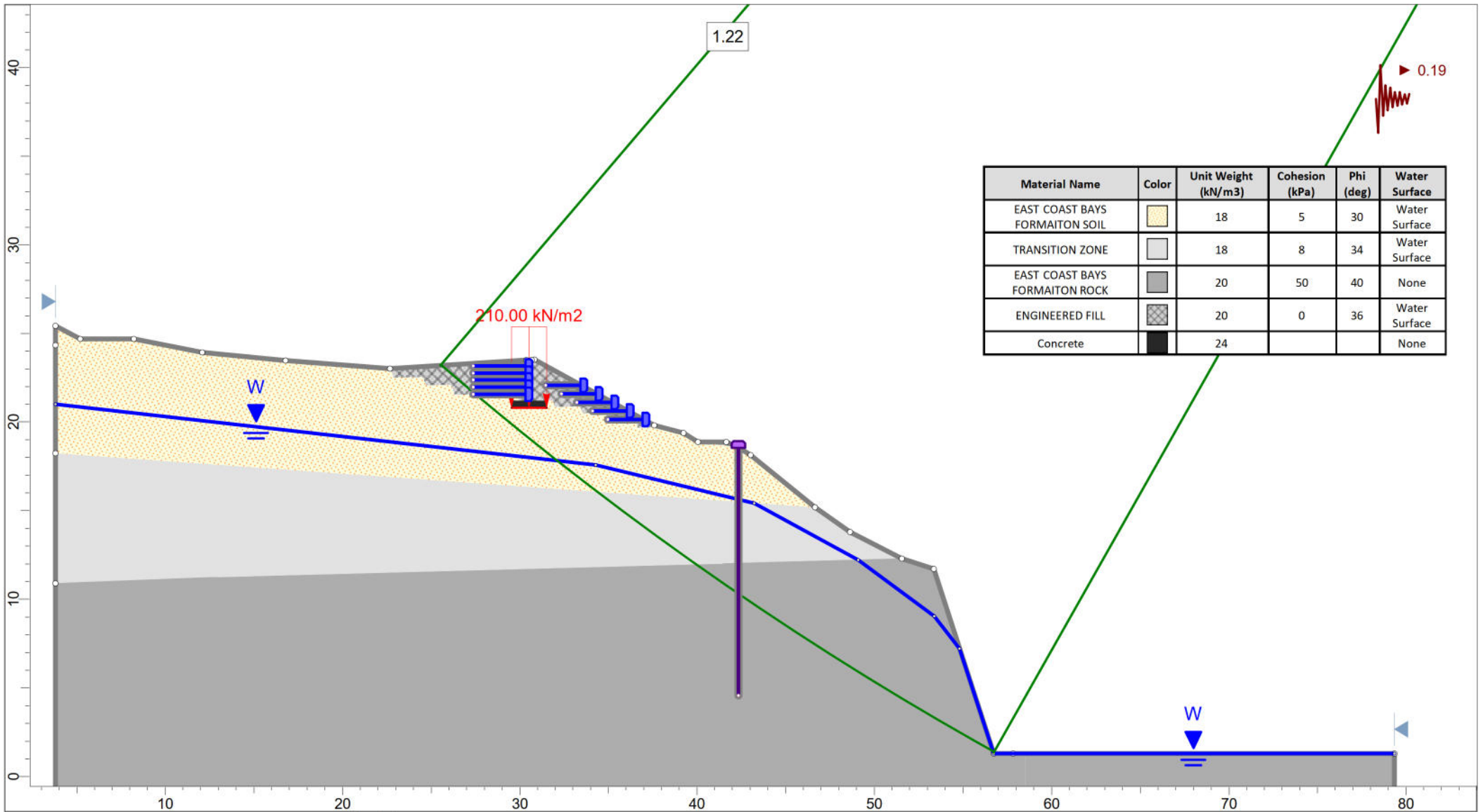
	Analysis: Long Term Groundwater - Palisade Wall		
	Project: Erebus Memorial	Analysis By: 9(2)(a)	Reviewed by: 9(2)(a)
	Client: Ministry of Culture and Heritage	Date: 09/03/2023	Revision: 1
	Reference: 16066.000.000	Scale: 1:300	Page: 4 of 6





Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Cohesion (kPa)	Phi (deg)	Water Surface
EAST COAST BAYS FORMAITON SOIL	Yellow Dotted	18	5	30	Water Surface
TRANSITION ZONE	Grey	18	8	34	Water Surface
EAST COAST BAYS FORMAITON ROCK	Dark Grey	20	50	40	None
ENGINEERED FILL	Cross-hatched	20	0	36	Water Surface
Concrete	Black	24			Water Surface

	<b>Analysis:</b> Worst Credible Groundwater - Palisade Wall		
	<b>Project:</b> Erebus Memorial	<b>Analysis By:</b> 9(2)(a)	<b>Reviewed by:</b> 9(2)(a)
	<b>Client:</b> Ministry of Culture and Heritage	<b>Date:</b> 09/03/2023	<b>Revision:</b> 1
	<b>Reference:</b> 16066.000.000	<b>Scale:</b> 1:300	<b>Page:</b> 5 of 6



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Water Surface
EAST COAST BAYS FORMAITON SOIL		18	5	30	Water Surface
TRANSITION ZONE		18	8	34	Water Surface
EAST COAST BAYS FORMAITON ROCK		20	50	40	None
ENGINEERED FILL		20	0	36	Water Surface
Concrete		24			None

	Analysis: ULS Seismic Loading - Palisade Wall		
	Project: Erebus Memorial	Analysis By: 9(2)(a)	Reviewed by: 9(2)(a)
	Client: Ministry of Culture and Heritage	Date: 09/03/2023	Revision: 1
	Reference: 16066.000.000	Scale: 1:300	Page: 6 of 6