

18 May 2021

Attention: Nathan Lee Long
C/o FGF
Unit 5, 2 James Street
Cairns QLD 4870

Project Name: The Outlook Stage 6
Project Number: IH001601

Subject: Stability Assessment As-Constructed Batters

Dear Nathan,

1. Introduction

Jacobs was engaged to provide the batter certification for The Outlook Estate Stage 6 in Bentley Park.

The batter certification comprises the assessment of the long-term stability of batters which are steeper than 1V:2H and higher than 1.5m as per Cairns Council's requirements. Assessment of the slopes adjacent to the creek beds and its associated recommendation provided during design are not included in this assessment.

The batter assessment included a review of available geotechnical information, visual inspection of the batters and geotechnical in-situ testing. The allotment arrangement and batter slopes are presented in Figure 1 and a drawing of the allotments in Stage 6 and 7 is presented in Appendix A.

The following batters which fall within the abovementioned criteria that were assessed included:

- 1V:1H batter, up to 3m high on Lots 609 and 610
- 1V:1H batter, up to 3m high on Lots 611 to 614
- 1V:1H batter, up to 3m high on Lots 615, 616, 618 and 619



Figure 1: Batters Stage 6 The Outlook Estate

2. Available Information

The following information was available for the batter assessment:

- Geotechnical design report "Stage 6 & 7 – The Outlook, Geotechnical investigation", 18113004-001-R-Rev0, dated 26 March 2019 by Golder Associates;
- Detailed design drawings of earthworks, IH001601-CI-DRG-0604 Rev C by Jacobs;
- Level 1 Geotechnical Inspection, Testing and Assessment, The Outlook Stage 6A and 6B by Construction Sciences; and
- The Outlook Stage 6A, 6B & 7, preliminary as-constructed batters, Drawings 9009-117, dated 6 May 2021.

2.1 Available Design Recommendations

Based on the Geotechnical Design Report, the interpreted subsurface conditions based on four (4) boreholes to 2m depth indicated alluvium to be present to maximum 0.9m depth, underlain by residual soil grading to weathered rock. The alluvium was described as a firm to very stiff, low plasticity Silty/Sandy CLAY, while the residual soil was described as a very stiff to hard, low plasticity Sandy CLAY. The extremely weathered (XW) material was described as a metasediment.

Design guidelines for the batter slopes were provided in the Geotechnical Design Report (GDR) and comprised a maximum 1V:1H batter slope for natural silty/clayey soils and controlled fill of up to 3m high. Batters more than 3m high either require a 1.5m bench or a specific assessment. A 1.5V:1H batter slope was recommended in the weathered rock to maximum 3m high. Furthermore, the GDR recommended that an offset between the crest of the batter slopes and the building loads equal to the adjacent batter height should be adopted.

3. Earthworks

The earthworks were a cut and fill operation with Level 1 testing and observation by Construction Sciences. Approximately 9,411m³ of fill was placed and compacted in accordance with AS3798-2007 "Guidelines on earthworks for commercial and residential developments" and available project specifications for the project. The Level 1 report confirms that the areas to be filled were stripped and proof rolled in accordance with the specification requirements. In lieu of specific mention, it is assumed that benching of sloping ground to provide a key for fill material was carried out as per AS3798-2007.

The Level 1 report confirms that the fill was placed and compacted in layers as per AS3798-2007 to a density of not less than 95% of the maximum density as determined by AS1289.5.7.1 (standard compaction). The Level 1 report confirms that a total of 26 tests were carried out at regular intervals throughout the placement of the fill, achieving the minimum density ratio of 95% and that the fill may be deemed to be controlled fill in accordance with AS2870-2011 "Residential Slabs and Footings".

4. Site Inspections

An initial visit was carried out on 23 September 2020. At this stage the construction of the batter on Lots 615, 616, 618 and 619 and Lots 601 to 607 were under construction. Two DCP tests were carried out (see Appendix B). A small weaker area was observed on the cut and fill slope at Lot 618, however it must be noted that the slope was yet to be trimmed back to its final batter.

A second site visit was carried out on 15 March 2021. By this stage, all batters were cut to their final batter shape. DCP tests were carried out along the crest and toe of the 1V:1H batter slopes (see Appendix B).

A third visit was carried out on 27 April 2021 after a period of significant rainfall.

The following was observed during the last two site visits:

- Lots 609 and 610:
 - Design: 1V:1H batter slope, up to 3m high; and
 - As constructed: up to 43 degrees batter slope, up to 3m high; very stiff to hard fill and residual soil.
- Lots 611 to 614:
 - Design: 1V:1H batter slope, up to 3m high; and
 - As constructed: up to 49 degrees batter slope, up to 3.2m high, very stiff to hard fill in batter and hard residual soil below batter.

- Lots 615, 616, 618 and 619:
 - Design: 1V:1H batter slope, up to 3m high;
 - As constructed: up to 45 degrees batter slope, up to 3.4m high, in the 90 degrees corner in Lot 615 batter locally up to 48.5 degrees, very stiff to hard fill and residual soil; and
 - Additional observations: Weak layer previously observed not observed anymore.

We have assumed that the design of the allotment batters in relation to the creek banks, which are locally steep and high (at Lots 618 and 619) have been sufficiently addressed in the Golder Associates design report and that any recommendations associated with the creek banks provided by Golder Associates have been adopted in the design and construction.



Figure 2: Batter in Lots 615, 616, 618 and 619 on 23 September 2020



Figure 3: Batter in Lots 615, 616, 618 and 619 on 15 March 2021



Figure 4: Batter in Lot 612 on 15 March 2021



Figure 5: Batter in Lots 609 and 610 on 15 March 2021

5. Slope Stability Analysis

Where the batter geometry differs from the design recommendations, a slope stability analysis has been carried out. The below batters therefore require a slope stability assessment:

- Lots 611 to 614:
 - Design: 1V:1H batter slope, up to 3m high;
 - As constructed: up to 49 degrees batter slope, up to 3.2m high.
- Lots 615, 616, 618 and 619:
 - Design: 1V:1H batter slope, up to 3m high;
 - As-constructed: up to 45 degrees batter slope, up to 3.4m high.

The slope stability assessment was carried out using the computer software SLIDE. A design load of 20kPa was adopted with crest set-backs equal to the batter height and the slope geometry was based on site measurements. The material design parameters were based on the DCP test results and experience with similar materials. The analyses were carried out for two groundwater scenarios, i.e. "dry conditions" and "wet conditions". For "wet conditions" an R_u of 0.2 was adopted.

The global stability assessment of both cases is presented in Appendix C. For long term dry conditions, a factor of safety (FOS) of 1.5 is to be achieved, while for "wet conditions", i.e. short-term conditions a FOS of 1.3 is acceptable. The slope stability analysis results indicate that a

satisfactory FOS cannot be achieved for the current slope geometry for Lots 611 to 614 and the following measures are required:

- Lots 611 to 614 (Design: 1V:1H batter, up to 3m high): Batter to be cut to 1V:1H.

The slope amendments are confirmed to have been adopted, based on the provided survey data.

6. Conclusion

Based on the available information, the site inspections and the geotechnical investigation, the batters are considered to be constructed in general accordance with the design intent and relevant geotechnical guidelines and are considered satisfactory, providing that:

- The following design load set-back from the batter crest is adopted:
 - Lots 609 to 616, 618 and 619 – minimum 3m.
- A maximum slope batter of 1V:1H is maintained for all specified 1V:1H design batters.
- Engineered measures are adopted and maintained to manage surface water flow and associated erosion of the batters and toe of batters, such as, but not limited to:
 - Hydromulch or alternative erosion measures on batter slopes;
 - Redirection of surface runoff away from crest and toe of batters; and
 - Collection of surface runoff in lined drains or natural drainage paths, which discharge into the stormwater drainage system or natural watercourse.
- Any erosion of batter slopes prior to installation of appropriate surface flow and erosion protection measures are promptly repaired and surface waterflow issues are resolved.
- Batters along the creek banks have not been requested to be assessed as part of this review. We have assumed that any relevant erosion control measures and setback requirements along the creek banks have been implemented based on advice from others.

As is the case for all developments involving cut/fill earthworks in the Cairns area, some minor instability is to be expected on batter slopes. This instability is anticipated to be relatively minor slips and slumps on locally steep slopes or unsupported batters, generally occurring after prolonged periods of heavy rainfall. This instability is generally accepted in the Cairns area and must be accepted by all parties involved in the proposed development.

18 May 2021

Subject: Stability Assessment As-Constructed Batters

If you have any queries regarding any of the observations and comments from the site inspection, please do not hesitate to contact me.

Yours sincerely



Ryan Davis

Principal Geotechnical Engineer, RPEQ 20198

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Ryan.Davis@jacobs.com

Copies to: Rob Carman (Jacobs)

Appendices:

- Important Information About Your Report
- Appendix A: Earthworks Design Drawing IH001601-CI-DRG-0604 Rev C
- Appendix B: DCP Test Results
- Appendix C: Slope Stability Analysis Output

Important Information About your Report

The sole purpose of this report is to present the findings of a geotechnical investigation carried out by Jacobs for FGF ('the Client') in connection with the Stage 6 development of The Outlook Estate. This report was produced in accordance with and is limited to the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

All reports and conclusions that deal with sub-surface conditions are based on interpretation and judgement and as a result have uncertainty attached to them. You should be aware that this report contains interpretations and conclusions which are uncertain, due to the nature of the investigations. No study can investigate every risk, and even a rigorous assessment and/or sampling programme may not detect all problem areas within a site.

This report is based on assumptions that the site conditions as revealed through sampling are indicative of conditions throughout the site. The findings are the result of standard assessment techniques used in accordance with normal practices and standards, and (to the best of Jacobs' knowledge) they represent a reasonable interpretation of the current conditions on the site. Sampling techniques, by definition, cannot determine the conditions between the sample points and so this report cannot be taken to be a full representation of the sub-surface conditions. This report only provides an indication of the likely sub surface conditions.

Conditions encountered during site work may be different from those inferred in this report, for the reasons explained in this limitation statement. If site conditions encountered during site works are different from those encountered during Jacobs' site investigation, Jacobs reserves the right to revise any of the findings, observations and conclusions expressed in this report.

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law. Opinions and judgements expressed in the report are based on Jacobs' understanding and interpretation of current regulatory standards and should not be construed as legal opinions.

This report does not address environmental or geo-environmental issues including the presence of any contaminants or hazardous materials at the site unless Jacobs was specifically and expressly retained to do so.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context. This report has been prepared on behalf of, and for the exclusive use of, the Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.



18 May 2021

Subject: Stability Assessment As-Constructed Batters

Appendix A: Earthworks Design Drawing IH001601-CI-DRG-0604 Rev C





18 May 2021

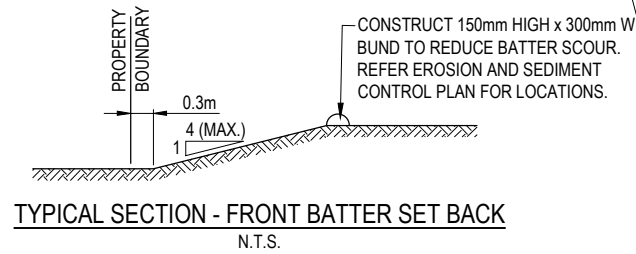
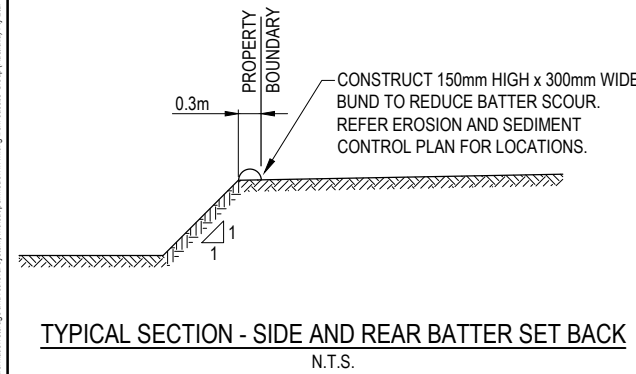
Subject: Stability Assessment As-Constructed Batters

Appendix B: DCP Test Results



NOTE
FOR NOTES REFER TO DRG-0602.

- LEGEND
- AREAS OF FILL
 - 18.70 FINISHED SURFACE LEVEL
 - 18.68 NATURAL SURFACE LEVEL
 - FALL OF LOTS
 - CONCRETE PATHWAY (2m WIDE U.N.O.)
 - BATTER
 - STAGE BOUNDARY
 - DESIGN SURFACE CONTOURS (0.25m INTERVAL)
 - EXISTING SURFACE CONTOURS (0.5m INTERVAL)
 - EXISTING STORMWATER
 - EXISTING SEWER
 - EXISTING WATER
 - 34.00 MINIMUM LEVEL OF LOT ABLE TO BE SERVICED BY SEWER
 - DCP TEST LOCATION



SCALE 1:500 (A1)
1:1000 (A3)

REV	DATE	DRAWN	REV'D	APP'D	REVISION	DRAWING NUMBER	REFERENCE DRAWING TITLE
C	07.09.20	SAB	RJB	RJC	STAGE 6 SPLIT INTO 6A AND 6B		
B	22.07.19	PAM	RJB	RJC	EARTHWORKS REVISED IN ACCORDANCE WITH GEOTECH		
A	16.11.18	RC	RJB	RJC	INITIAL ISSUE		

THE OUTLOOK		JACOBS		CLIENT WESTERLY PROJECTS PTY LTD PROJECT THE OUTLOOK - STAGES 6 & 7		TITLE EARTHWORKS	
ABN 37 001 024 095 and ACN 001 024 095 Jacobs Group (Australia) Pty Ltd 2 James Street CAIRNS, QLD 4870 AUSTRALIA		Tel: +61 7 4031 4599 Fax: +61 7 4031 3967 Web: www.jacobs.com		DRAWN RC DESIGNED PAM		DRAWING CHECK RJB DESIGN REVIEW RJC	
				REVIEWED D.McEWAN DATE 16.11.18		APPROVED [Signature] DATE 16.11.18	
				SCALE 1:500 (A1)		DRAWING No. IH001601-CI-DRG-0604	
						REV C	

Project Name: The Outlook - Stage 6		Reported By: CDB	
Project No: IH001601		Checked: RED	
Client: Jacobs		Checked Date: 27/04/2021	
Location: The Outlook Estate - Bentley Park		Test Method: AS1289.6.3.2	

Depth (metres)	Tested: CR / CDB	P1
	Date: 23/09/2020	
	Area: Toe of Batter Lot 616	
	Surface RL:	
	m E m N	
Blows per 100 mm		
0 5 10 15 20 25		

Depth (metres)	Tested: CR / CDB	P2
	Date: 23/09/2020	
	Area: Crest of Batter Lot 615	
	Surface RL:	
	m E m N	
Blows per 100 mm		
0 5 10 15 20 25		

Depth (metres)	Tested:	
	Date:	
	Area:	
	Surface RL:	
	m E m N	
Blows per 100 mm		
0 5 10 15 20 25		

Depth (metres)	Blows per 100 mm
0.5	11
0.6	6
0.7	5
0.8	3
0.9	4
1.0	3
1.1	6
1.2	4
1.3	3
1.4	9
1.5	11
1.6	7
1.7	7

Depth (metres)	Blows per 100 mm
0.5	10
0.6	20
0.7	17
0.8	9
0.9	6
1.0	15
1.1	16
1.2	12
1.3	11
1.4	9
1.5	8
1.6	5
1.7	4
1.8	6
1.9	9
2.0	7
2.1	10
2.2	9
2.3	18
2.4	16

Depth (metres)	Blows per 100 mm
0.5	
0.6	
0.7	
0.8	
0.9	
1.0	
1.1	
1.2	
1.3	
1.4	
1.5	
1.6	
1.7	
1.8	
1.9	
2.0	
2.1	
2.2	
2.3	
2.4	
2.5	
2.6	
2.7	
2.8	
2.9	
3.0	
3.1	
3.2	
3.3	
3.4	
3.5	
3.6	
3.7	
3.8	
3.9	
4.0	
4.1	
4.2	
4.3	
4.4	
4.5	
4.6	
4.7	
4.8	
4.9	
5.0	

This Dynamic Cone Penetration Report must be read with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only.

Project Name:		The Outlook - Stage 6		Reported By:		CDB	
Project No:		IH001601		Checked:		RED	
Client:		Jacobs		Checked Date:		27/04/2021	
Location:		The Outlook Estate - Bentley Park		Test Method:		AS1289.6.3.2	

Depth (metres)	Tested:	CR / CDB	P1A
	Date:	15/03/2021	
	Area: Crest of Batter Lot 609		
	Surface RL:		
	<div style="display: flex; justify-content: space-between;"> m E m N </div>		

Blows per 100 mm			
0	5	10	15
20	25		

Depth (metres)	Tested:	CR / CDB	P2A
	Date:	15/03/2021	
	Area: Crest of Batter Lot 610		
	Surface RL:		
	<div style="display: flex; justify-content: space-between;"> m E m N </div>		

Blows per 100 mm			
0	5	10	15
20	25		

Depth (metres)	Tested:	CR / CDB	P3A
	Date:	15/03/2021	
	Area: Toe of Batter Lot 609/610		
	Surface RL:		
	<div style="display: flex; justify-content: space-between;"> m E m N </div>		

Blows per 100 mm			
0	5	10	15
20	25		

Refusal

Refusal

Refusal - Hammer Bouncing

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Project Name:		The Outlook - Stage 6		Reported By:		CDB	
Project No:		IH001601		Checked:		RED	
Client:		Jacobs		Checked Date:		27/04/2021	
Location:		The Outlook Estate - Bentley Park		Test Method:		AS1289.6.3.2	

Depth (metres)	Tested:		CR / CDB		P4A	
	Date:		15/03/2021			
	Area: Crest of Batter Lot 611					
	Surface RL:					
	m E		m N			
Blows per 100 mm						
0 5 10 15 20 25						

Depth (metres)	Tested:		CR / CDB		P5A	
	Date:		15/03/2021			
	Area: Crest of Batter Lot 613					
	Surface RL:					
	m E		m N			
Blows per 100 mm						
0 5 10 15 20 25						

Depth (metres)	Tested:		CR / CDB		P6A	
	Date:		15/03/2021			
	Area: Toe of Batter Lot 612					
	Surface RL:					
	m E		m N			
Blows per 100 mm						
0 5 10 15 20 25						

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Project Name:		The Outlook - Stage 6		Reported By:		CDB	
Project No:		IH001601		Checked:		RED	
Client:		Jacobs		Checked Date:		27/04/2021	
Location:		The Outlook Estate - Bentley Park		Test Method:		AS1289.6.3.2	

Depth (metres)	Tested:		CR / CDB		P7A	
	Date:		15/03/2021			
	Area: Crest of Batter Lot 619					
	Surface RL:					
	m E		m N			
Blows per 100 mm						
0 5 10 15 20 25						

Depth (metres)	Tested:		CR / CDB		P8A	
	Date:		15/03/2021			
	Area: Crest of Batter Lot 618					
	Surface RL:					
	m E		m N			
Blows per 100 mm						
0 5 10 15 20 25						

Depth (metres)	Tested:		CR / CDB		P9A	
	Date:		15/03/2021			
	Area: Toe of Batter Lot 618					
	Surface RL:					
	m E		m N			
Blows per 100 mm						
0 5 10 15 20 25						

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Project Name:		The Outlook - Stage 6		Reported By:		CDB	
Project No:		IH001601		Checked:		RED	
Client:		Jacobs		Checked Date:		27/04/2021	
Location:		The Outlook Estate - Bentley Park		Test Method:		AS1289.6.3.2	

Depth (metres)	Tested:		CR / CDB	P10A
	Date:		15/03/2021	
	Area:		Toe of Batter Lot 618	
	Surface RL:			
			m E m N	
Blows per 100 mm				
0 5 10 15 20 25				

Depth (metres)	Tested:			
	Date:			
	Area:			
	Surface RL:			
			m E m N	
Blows per 100 mm				
0 5 10 15 20 25				

Depth (metres)	Tested:			
	Date:			
	Area:			
	Surface RL:			
			m E m N	
Blows per 100 mm				
0 5 10 15 20 25				

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18 May 2021

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Appendix C: Slope Stability Analysis Output

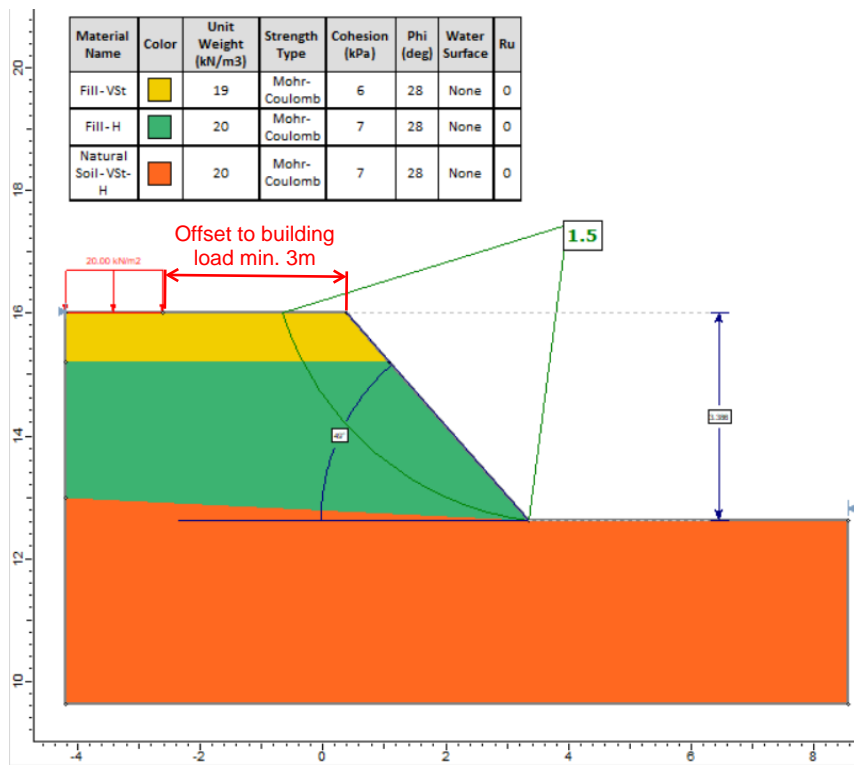


Figure C1: Lots 611 to 614 with 49 degrees batter – Dry Conditions

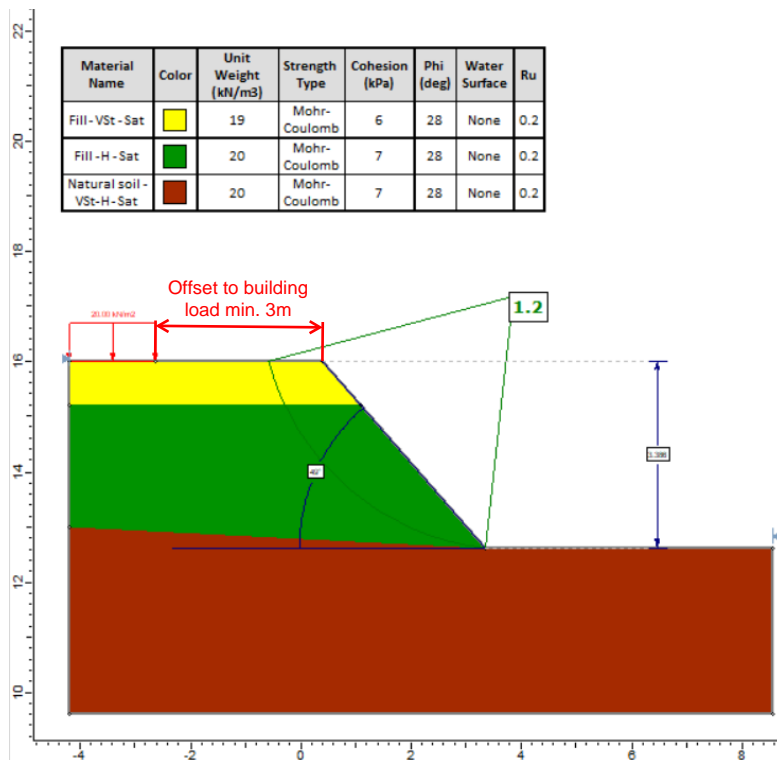


Figure C2: Lots 611 to 614 with 49 degrees batter – Wet Conditions

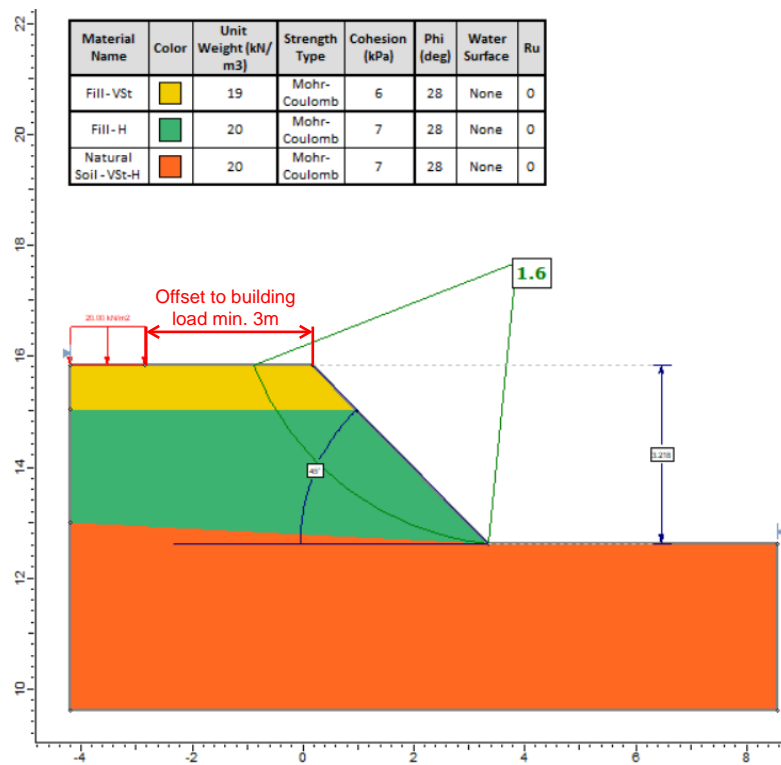


Figure C3: Lots 611 to 614 with 45 degrees batter – Dry Conditions

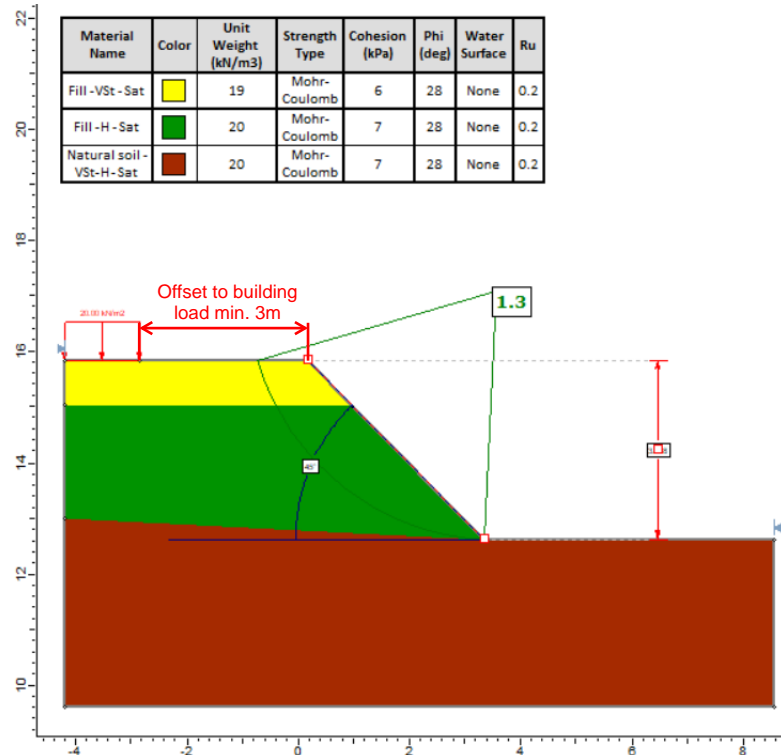


Figure C4: Lots 611 to 614 with 45 degrees batter – Wet Conditions

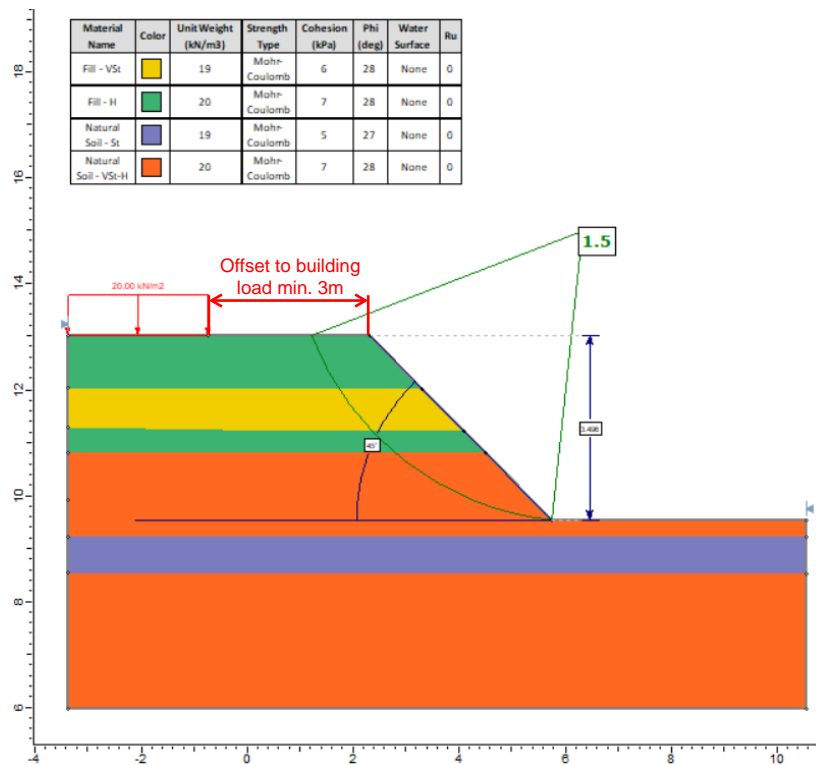


Figure C5: Lots 615, 616, 618 and 619 with 45 degrees batter – Dry Conditions

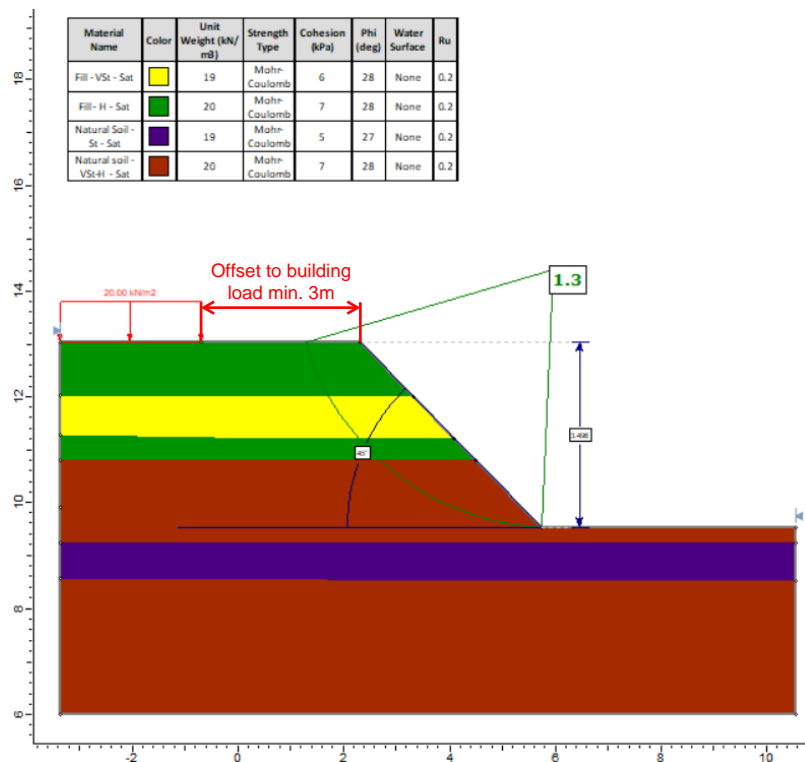


Figure C6: Lots 615, 616, 618 and 619 with 45 degrees batter – Wet Conditions