BRAD FISHER

GEOTECHNICAL INVESTIGATION

LOT 12 ZENA CLOSE
CAPE TRIBULATION

REPORT NO: GT13-020-001R REV 1

APRIL 2013

REVISION 1

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Document Status							
Revision No.	***Author***	***Reviewer***	***Reason for Issue***	***Approved for Issue***			
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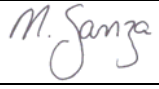
1	C. Ryan	L. Jones	FINAL	M. Ganza		15/04/13	4449

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1.0 INTRODUCTION

ETS Geotechnical (ETS) has conducted a geotechnical investigation at Lot 12 (on RP22757) Zena Close, Cape Tribulation. The works were commissioned by the customer, Brad Fisher.

The scope of the investigation allowed for a geotechnical assessment of slope stability and foundation conditions, for site suitability for residential development purposes only. Assessment and testing was limited to the site area within the property boundary.

It is understood that the proposed development involves the construction of a single storey light weight dwelling. Figure 1, Appendix A presents a locality plan of the subject site.

A geotechnical investigation and slope stability assessment was completed to provide the following:

- Investigation of the subsurface soil and rock profiles across the site including the presence of groundwater;
- Slope stability assessment of the existing topography broadly in accordance with the Australian Geomechanics Society Landslide Risk Management Concepts and Guidelines, 2007[1];
- Engineering assessment and recommendations
- Discussion on further investigation and/or assessment that may be required.

2.0 FIELD WORK

Fieldwork was conducted by ETS on the 5th March 2013 and included a visual assessment of the property and its surrounds. Subsurface investigations using Dynamic Cone Penetrometer (DCP) testing were carried throughout the site and beneath the location in which it was understood the proposed dwelling would be situated. This testing along with hand augured boreholes was undertaken by ETS and was used to evaluate the subsurface conditions across the site. DCP testing

[1] Australian Geomechanics Vol 42 No 1 March 2007.

was carried out to assess the consistency and density of the subsurface materials to a depth of three (3) metres or refusal.

The results of the field work (borehole logs and DCP results) are presented in Appendix B. The locations at which the field work was conducted are displayed in Figure 2, Appendix A.

3.0 LABORATORY TESTING

The following laboratory testing was conducted in ETS's NATA accredited laboratory on samples recovered during fieldwork in order to determine geotechnical parameters to be used in the analysis:

- Atterberg Limits.

3.1 Laboratory Test Results

Results of the laboratory testing is included in Appendix C. Table 1 provides a summary of laboratory test results.

TABLE 1: Laboratory Test Results

Atterberg Limits **Plasticity Test**	**BH1** **0.5-0.6m**
Liquid Limit %	43
Plastic Limit %	29
Plastic Index %	14
Linear Shrinkage %	6.5

4.0 SITE CONDITIONS AND OBSERVATIONS

4.1 Visual Assessment

The allotment is located on the northern side of Zena Close, Cape Tribulation. Cut and fill earthworks had been carried out at the site to create a level building pad and driveway access. To the west of the building pad area was a batter approximately 2.7m high dipping to the east at about 50^{o}. Surrounding the building pad area to the north, south and east were batters dipping away from the site at approximately 35^{o},

about 6m high. The site was surrounded by dense rain forest vegetation and had a creek running to the north and east of the proposed building pad area. Two (2) floating rock outcrops were observed on the building pad.

At the time of the investigation the customers indicated the location of the proposed dwelling.

Appendix D presents photographs of the subject site.

4.2 Subsurface Conditions

Typically the subsurface profile consisted of pale orange mottled yellow, silty CLAY (CL) of low plasticity and of very soft to stiff consistency. Some floating cobbles were encountered in Borehole 2. Fill had been placed in the vicinity of the crest of the building pad area.

At the time of investigation, the ground water table was not encountered at the locations investigated. However, it should be noted, that groundwater levels are affected by climatic conditions and by soil permeability, therefore groundwater levels may vary with time.

The engineering logs of the borehole are available in Appendix B.

5.0 GEOTECHNICAL DESIGN PARAMETERS

Based on the borehole logs, DCP results and Atterberg limits test results, the following geotechnical parameters are recommended for design purposes. These parameters are based on experience with similar materials elsewhere.

TABLE 2: Geotechnical Design Parameters

Material – Description	**Consistency**	φ'	**c'** kPa	γ_d kN/m^3	**R_u**
Silty CLAY	Very Soft to Stiff	30	5	17	0.5
Residual Soil	Stiff to Hard	30	7	17	-

Where:-

φ'	Effective Friction Angle
c'	Effective Cohesion (kPa)
□$_d$	Dry Density (kN/m^3)
R_u	Pore Pressure

6.0 SLOPE STABILITY ASSESSMENT

Using data obtained during the site inspection, slope stability analysis has been completed on an inferred cross section using the software program SLIDE adopting the geotechnical design parameters presented in Table 2. The section that has been investigated is as follows:-

Section	Location
A-A	East – West (Upper Building Pad)

No other cross sections have been considered. The cross section location is shown on Figure 2, Appendix A.

Two (2) cases were considered for the cross section:-

1. Dry (Normal) conditions – no groundwater table within the slope.
2. Saturated (Extreme) conditions as might be developed during periods of prolonged rainfall. For saturated conditions it has been assumed that any soil above the residual soil becomes saturated but that the residual soil remains at natural moisture content.

Where appropriate, surcharge loadings were applied to represent the proposed building.

The results of the stability analysis are summarised in Table 3, the SLIDE output images are displayed in Appendix E.

TABLE 3: Summary of Slope Stability Analyses

Case Analysed	Calculated Factor of Safety	
	Dry Conditions	Saturated Conditions
Section A-A	1.6	1.0
Section A-A with surcharge load at ground surface	1.0	0.8
Section A-A with surcharge load 2.5m below ground surface	0.8*	0.6*

**SLIDE analysis output indicates failure above the depth of the foundation surcharge.*

For the purposes of assessing stability the following is provided which are considered appropriate to the site:-

- A calculated factor of safety > 1.5 indicates the profile is likely to be stable;
- A calculated factor of safety from 1.0 – 1.5 indicates a marginally stable profile
- A calculated factor of safety < 1.0 indicates the profile is likely to be unstable.

In general terms the factor of safety (FOS) is calculated by dividing the forces resisting instability (i.e. the strength of the soil/rock or the strength of discontinuities within the soil/rock) by the forces driving instability (i.e. the weight of the soil/rock, plus groundwater/seepage, plus surcharges/loads on the slope). A calculated FOS of 1.0 indicates the forces are balanced, whereas a calculated factor of safety <1.0 indicates instability will likely occur.

Generally for normal operating conditions a long term FOS of 1.5 is considered to be acceptable. For short term “extreme” conditions it may be acceptable to design for a FOS of about 1.3.

6.1 Review of Factors of Safety

The analysis demonstrates that the site was marginally stable during both dry and saturated conditions. When a surcharge load was modelled at the ground surface the analysis showed failure surfaces around the batter are likely. The surcharge load was

also modelled 2.5m below the current ground surface into the residual soil. The analysis demonstrated that surficial failures are still likely however deep seated failures around the base of the surcharge were not observed.

Recommendations to improve the stability at the site are presented in Section 6.2 of this report.

6.2 Site Specific Recommendations

Due to the potential for surficial failures in the soil profile, the following is recommended:-

- Structures should be founded into the residual soils at least 2.5m below the ground surface level;
- Footings should be designed to accommodate the potential lateral forces due to failure (landslip) of the upper soil profile;
- Unsupported excavations on the slopes including existing batters should be flattened to no steeper than 1V:4H or should be retained by engineer designed walls;
- Lined surface and subsurface drains should be constructed and water collected by these drainage systems, together with run-off from gutters, down-pipes, driveways and paved areas should be directed into the stormwater reticulation system;
- Particular attention should be given to drainage and erosion control measures during site development. Areas where surface groundwater seepage currently exists or becomes apparent during or immediately after periods of heavy rainfall may require sub-soil drains.
- Upon completion of a draft building design, a review of the slope stability should be carried out.

7.0 RISK LEVEL IMPLICATIONS

7.1 Landslide Hazard Assessment for Existing Slopes

A landslide hazard assessment of the existing slopes has been conducted broadly in accordance with the Australian Geomechanics Society Landslide Risk Management

Concepts and Guidelines, 2007[2]. A copy of this document can be found at www.australiangeomechanics.org. Appendix C of the document describes the terminology used.

The process involves determining the likelihood of an event occurring and the consequences to persons and / or property. The risk level implications can then be determined. If is found that the level of risk is greater than "LOW", measures need to be determined to reduce the risk to this level.

7.2 Previous Instability

Indicators of instability within the soil or rock beneath the site can include, but not be limited to:

- Creep – observed by tilting of structures including trees, fences or by soil/rock encroaching on roads or over drains, gutters etc.
- Hummocky disturbed ground in or at the base of slopes.
- Tension cracks in or at the top of slopes.

These indicators were not observed at this site.

7.3 Possible Landslide Hazards

On the basis of the visual and subsoil assessment, potential landslide hazards considered applicable to the existing slopes are as follows:

TABLE 4: General Possible Failure Mechanisms for Landslide

Possible Failure Mechanisms	Description of Failure Mechanism
Rotational/Trans-lational landslide on fill slopes.	This mode of failure is characterised by a curved or relatively flat failure surface. Should rotational/translational failure occur at this site, for shallow soils, the plane of failure would likely be on the contact between fill and residual soil depending on

[2]www.australiangeomechanics.org.

	groundwater conditions prevailing at the time of the failure. For deeper soils, the failure would likely occur within the soil layer.

7.4 Likelihood of Hazard Occurring

The likelihood of failure (landslip) occurring has been assessed in accordance with Appendix C – Qualitative Measures of Likelihood[3]. The anticipated likelihood of these failure mechanisms occurring is based on site observations and local experience. Should the recommendations outlined in Section 6.2 of this report be adopted the likelihood of slope failure occurring is assessed to be **unlikely** with **minor** consequences to property. On this basis the risk level for this site is assessed to be **very low to low**.

8.0 ENGINEERING ASSESSMENT AND RECOMMENDATIONS

8.1 Site Classification

The Atterberg Limits tests indicate the Silty CLAY is slightly reactive to changes in moisture content with an estimated predicted ground surface movement (y_s) within the **Class S** category (less than 20mm).

Due to presence of fill, which is considered to be uncontrolled, and the potential for slope instability the site is classified as **CLASS – P** in accordance with AS2870-2011[4] "Residential Slabs and Footings – Construction". Footing design should be completed in accordance with the recommendations listed in Section 8.2 of this report.

The classification is only valid for the location proposed as displayed in Figure 2, Appendix A.

[3] Australian Geomechanics Vol 42 No 1 March 2000

[4] Australian Standard AS 2870-2011 "Residential Slabs and Footings – Construction", Standards Australia

8.2 Footing Options

The nature of fill at the site in unknown and is therefore assumed to have been placed in an uncontrolled manner. The highly variable DCP results tend to agree with this assumption.

Given the nature of the fill, the potential for soft spots and/or voids and slope stability issues it is recommended footings extend into the natural residual soils a minimum of 2.5m below the current ground surface. This may require the house to be supported on a suspended slab with footings designed to take any lateral load from a landslip in the fill.

It is recommended that the material type is confirmed by an ETS representative once the footings have been excavated.

8.3 Allowable Bearing Capacity

The required bearing capacity will depend on the design and footing options selected. An allowable bearing capacity of 100kPa is readily achievable in the residual soils approximately 2m below the current ground surface level.

In order to ensure the required bearing capacity is achieved it is recommended that a soil technician be present during the excavation of the footings to confirm the allowable bearing capacity.

8.4 Cut and Fill Earthworks

The following general procedures are suggested for any site preparation and earthworks to be performed at the site:

- Strip & remove topsoil, soil containing significant amounts of organic materials, ‘uncontrolled’ filling and also any deleterious soft, wet or highly compressible materials if encountered at footing or pavement formation levels;
- Undertake ‘proof’ rolling of the exposed surface levels across the site with a minimum 12 tonne static weight smooth drum roller or similar. Any soft or

loose material that cannot be improved by compaction should be removed and replaced with approved select fill;

- Any exposed natural foundation soils should be compacted to a minimum dry density ratio of 98% using Standard compaction and moisture treated to a moisture range of -2%(dry) to +2%(wet) of optimum moisture content (OMC);
- Any exposed subgrade soils, at or close to foundation level, should be sealed or covered as soon as practicable, in order to reduce the opportunity for desiccation and cracking (due to drying), or softening and swelling (due to wetting) with moist conditions;
- Where the foundation levels are to be raised or subgrade materials are to be excavated (i.e. remove & replace), the foundation soils should be prepared as detailed below:
    - Approved filling should be undertaken by placing fill in uniform horizontal layers not exceeding 200mm loose thickness and compact to achieve a dry density ratio of at least 98% using Standard compaction for cohesive soil or to at least 75% density index for sand. The moisture content of any cohesive soil fill materials should be maintained at -2% to +2% of OMC, during and after compaction;
    - Filling should be placed at least two (2) metres beyond the design profile and then trimmed to the design profile;
    - Where unsuitable materials are to be excavated it is recommended that all excavated insitu soils are removed from the site and approved select fill is placed and compacted in the excavation. The excavation should be benched to “key in” the select fill material and optimise compaction. The benches should slope back at 1V:5H and be at least 0.5m wide, refer to Figure 1 below;

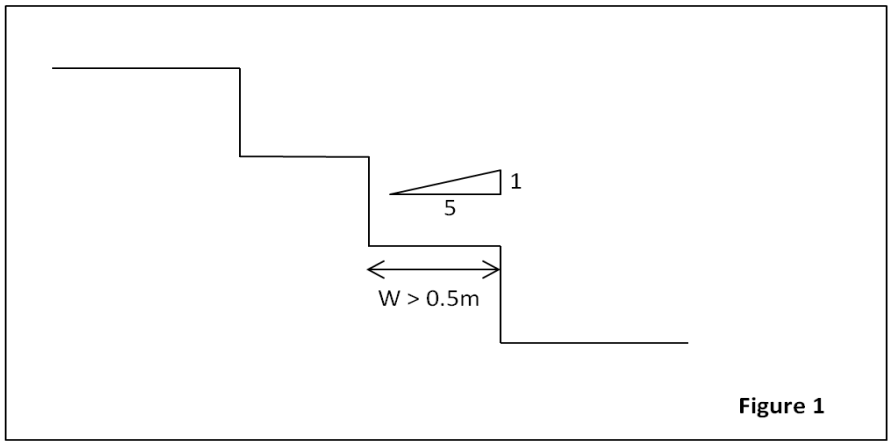


Figure 1

- Approved filling (general fill) should be a well graded material free from organic materials, have a Plasticity Index less than or equal to 15%, and should not contain any individual particles greater than 75mm in size;
- In order for filling to be considered 'controlled' any earthworks that are undertaken beneath any of the proposed structures or pavements are to be performed under full time 'Level 1' inspection and testing as described and in accordance with AS3798:2007.

It should be noted that there may be trafficability issues for rubber wheeled earthmoving equipment if construction activities are undertaken either during, or soon after, wet weather, due to the moistening and softening of the silty clay / clay soils. In order to minimise these issues, the use of tracked equipment is suggested. In addition to this, achieving a satisfactory 'proof' roll under wet weather conditions may also be difficult. Should this situation arise, additional geotechnical advice should be sought.

8.5 Drainage

Drainage measures that should be implemented and/or maintained at this site include:

- Measures should be taken to divert surface water away from the crest of batters to reduce the seepage of water into these slopes.

- Provision of subsurface drainage behind any retaining walls.
- Provision of kerbing and drainage structures on all driveways.
- All stormwater should be collected and discharged from the site via pipes into designated drainage paths and not allowed to flow on to the ground around founding structures.

9.0 CONSTRUCTION INSPECTIONS

Footing excavations, earthworks and stabilisation works are to be inspected by a suitably qualified person to confirm design assumptions.

Instability / erosion may occur at the site during construction activities and result in destabilisation of the slope and localised slips. Any works on the allotment shall minimise disturbance of all surfaces outside of the immediate earthworks zone.

No construction works shall take place during prolonged or heavy rainfall. Any earthworks / stabilisation works should be completed during the dry season.

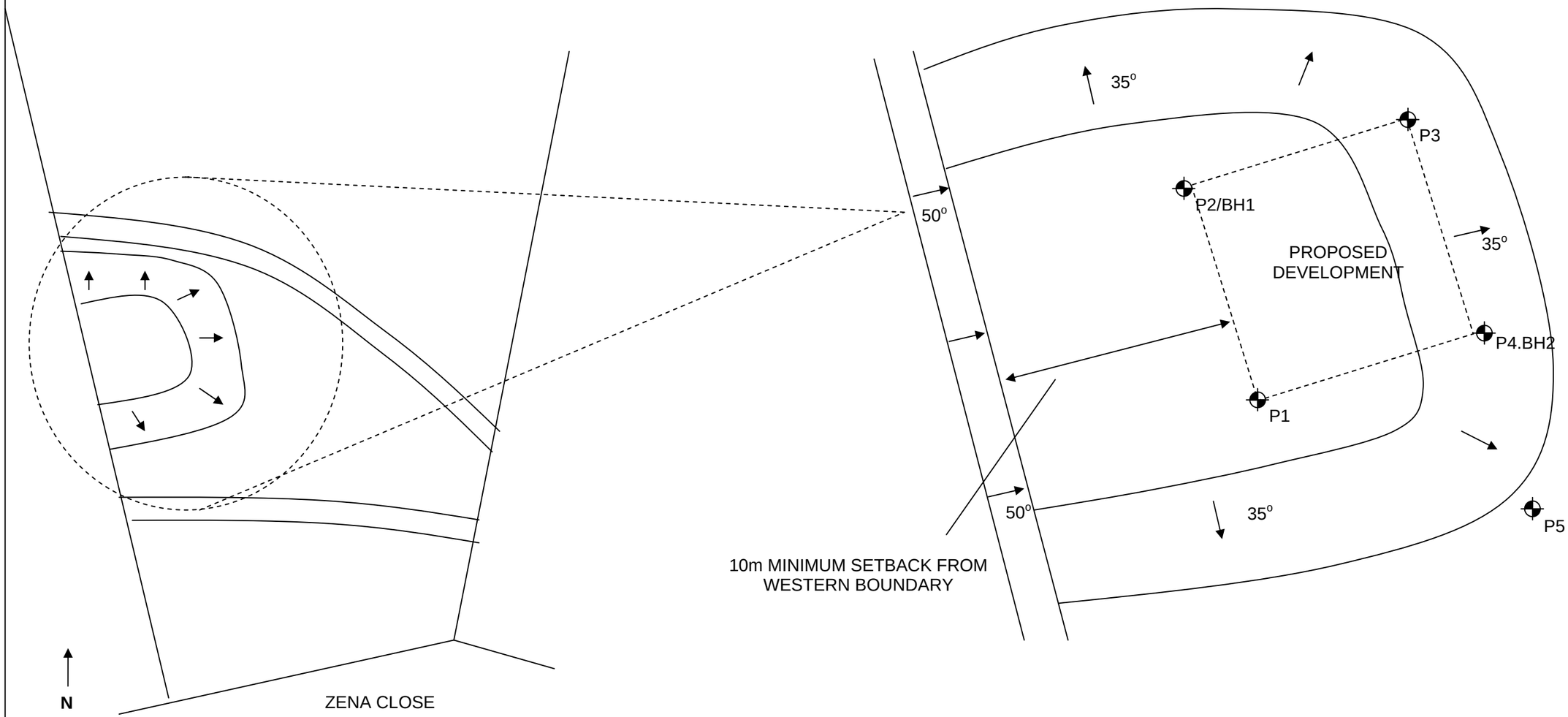
10.0 LIMITATIONS

We have prepared this report for the use of **BRAD FISHER** for design purposes in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **BRAD FISHER** or his design consultants, i.e. Architect & Civil/Structural Engineers. It may not contain sufficient information for purposes of other parties or for other uses.

Your attention is drawn to the document - “Understand the Limitations of Your Geotechnical Report”, which is included in Appendix F of this report. This document has been prepared to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by ETS, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

APPENDIX A – DRAWINGS AND FIGURES

Figure 1. Locality Plan- Cape Tribulation



Legend

Borehole and DCP Locations

GEOTECHNICAL

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E-mail: info@engineeringtesting.com.au

TITLE:
SITE CLASSIFICATION
LOT 12 ZENA CLOSE
CAPE TRIBULATION

PROJECT NO.: GT13-020	**SCALE:** NTS	**DRAWN BY:** CR
DATE: 10/04/13	**OFFICE:** Cairns	**APPROVED BY:** LJ

CLIENT: BRAD FISHER

DRAWING NO.: GT13-020-001 DRW

APPENDIX B – BOREHOLE AND DCP LOGS

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ABN: 89 119 263 366
NATA Accreditation No: 2694

Site Investigation Report

Customer:	Brad Fisher	**Report Number:**	GT13-020 LOG
Job Number:	GT13-020	**Report Date:**	10-Apr-13
Project:	Site Classification	**Order Number:**	*
Location:	Lot 12 Zena Close, Cape Tribulation		**Page 1 of 1**

BOREHOLE NO: 1

Depth (m)	Description of Subsoil	Consistency	Moisture Condition	Ground Water Level (m)	Sample Type & Depth (m)
0.0 - 0.25	Silty CLAY (CL) low plasticity, pale orange mottled yellow, trace roots.	Soft to Firm	Moist	Free Ground Water Not Encountered	Disturbed Sample @ 0.5m
0.25 - 1.5	Silty CLAY (CL) low plasticity, pale orange mottled yellow.	Stiff to Hard	Moist		Disturbed Sample @ 1.4m
1.5	Borehole terminated				

BOREHOLE NO: 2

Depth (m)	Description of Subsoil	Consistency	Moisture Condition	Ground Water Level (m)	Sample Type & Depth (m)
0.0 - 0.6	Silty CLAY (CL) low plasticity, pale orange mottled yellow, trace roots.	Very Soft	Moist	Free Ground Water Not Encountered	Disturbed Sample @ 0.5m
0.6	Borehole terminated on floating rock				

SIGNATURE:

SIGNED BY: C. Ryan
POSITION: Snr Engineering Geologist
DATED: 10-Apr-13
ETS Regional Laboratory: Cairns

GEOTECHNICAL & MATERIALS TESTING

ACCREDITED FOR TECHNICAL COMPETENCE

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DYNAMIC CONE PENETROMETER TEST -- REPORT A.S. 1289 6.3.2

CLIENT	Brad Fisher PMB 10 Mossman Qld 4873	**REPORT NUMBER**	GT13-020 DCP
JOB NO	GT13-020	**REPORT DATE**	10-Apr-13
		TEST DATE	05-Mar-13
PROJECT	Geotechnical Investigation Lot 12 Zena Close Cape Tribulation Qld 4873	**TECHNICIAN**	DK
SAMPLE LOCATION (See Site Plan)		**CLIENT ORDER No.**	*
SAMPLE DESCRIPTION (Soil Profile)		**CLIENT JOB No.**	*

DEPTH (Metres) — *TEST COMMENCED AT 0.00 m BELOW SURFACE LEVEL

	SITE:	P1	SITE:	P2	SITE:	P3	SITE:	P4	SITE:	P5
	No. Blows	Np	No. Blows	Np	No. Blows	Np	No. Blows	Np	No. Blows	Np
0.0 -- -- 0.1	5		4		4		1		1	
0.1 -- -- 0.2	6		2		7				2	
0.2 -- -- 0.3	3	14	2	8	4	15	1	1	3	6
0.3 -- -- 0.4	3		3		4				5	
0.4 -- -- 0.5	3		4		3				4	
0.5 -- -- 0.6	3	9	3	10	2	9		1	3	12
0.6 -- -- 0.7	3		2		2		2		3	
0.7 -- -- 0.8	7		2		3		1		4	
0.8 -- -- 0.9	18	28	1	5	4	9	1	4	5	12
0.9 -- -- 1.0	25		2		4		2		5	
1.0 -- -- 1.1	Refusal		2		6		1		7	
1.1 -- -- 1.2		25	2	6	9	19	1	4	4	16
1.2 -- -- 1.3			3		4		1		5	
1.3 -- -- 1.4			4		4		1		15	
1.4 -- -- 1.5			4	11	8	16	1	3	15	35
1.5 -- -- 1.6			5		4		1		18	
1.6 -- -- 1.7			4		5		1		Refusal	
1.7 -- -- 1.8			4	13	4	13	4	6		18
1.8 -- -- 1.9			4		5		4			
1.9 -- -- 2.0			4		6		2			
2.0 -- -- 2.1			4	12	6	17	8	14		
2.1 -- -- 2.2			11		7		6			
2.2 -- -- 2.3			18		9		5			
2.3 -- -- 2.4			25	54	9	25	6	17		
2.4 -- -- 2.5			Refusal		22		8			
2.5 -- -- 2.6					25		12			
2.6 -- -- 2.7					Refusal		12			
2.7 -- -- 2.8							15			
2.8 -- -- 2.9							18			

WATER TABLE: 'Not encountered' MOISTURE CONDITION Moist

(Np) : Penetration Resistance
= blows per 300 mm

NATA ACCREDITED FOR TECHNICAL COMPETENCE

This Laboratory is accredited by the National Association of Testing Authorities, Australia. The test (s) reported herin have been performed in accordance with its terms of accreditation. This document shall not be reproduced except in full.

SIGNATURE:

SIGNED BY: L. Jones
POSITION: Geotechnical Associate
DATED: 10-Apr-13
ETS Regional Laboratory: Cairns

APPENDIX C – LABORATORY RESULTS

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NATA Accreditation No: 1833

Atterberg Limits Report

Client:	**Brad Fisher**	Report Number:	**GT13-020-001**
Client Address:	**Ferntrees Rainforest Resort PM10 Mossman**		
Job Number:	**GT13-020**	Report Date:	**12/03/2013**
Project:	**Lot 12 Zena Close**	Order Number:	**-**
Location	**Cape Tribulation**		
Lab No:	**GT13-020-001**	Sample Location:	
Date Sampled:	**31/03/2013**	**BH 1**	
Date Tested:	**11/03/2013**	**0.5 - 0.6m**	
Sampled By:	**DK**		
Sample Method:	**AS1289.1.2.1 6.5.2**		
Material Source:	**Insitu Material**	Spec Description:	-
For Use As:	**Site Classification**	Lot Number:	**-**
Remarks:	**-**	Spec Number:	**-**

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289 3.1.2**	**-**	**43**	**-**
Plastic Limit (%)	**AS1289 3.2.1**	**-**	**29**	**-**
Plasticity Index	**AS1289 3.3.1**	**-**	**14**	**-**
Linear Shrinkage (%)	**AS1289 3.4.1**	**-**	**6.5**	**-**

ACCREDITED FOR TECHNICAL COMPETENCE

APPROVED SIGNATORY

Darren Koch

NATA Accreditation No. 1833

FORM NUMBER

REP ASATT-1

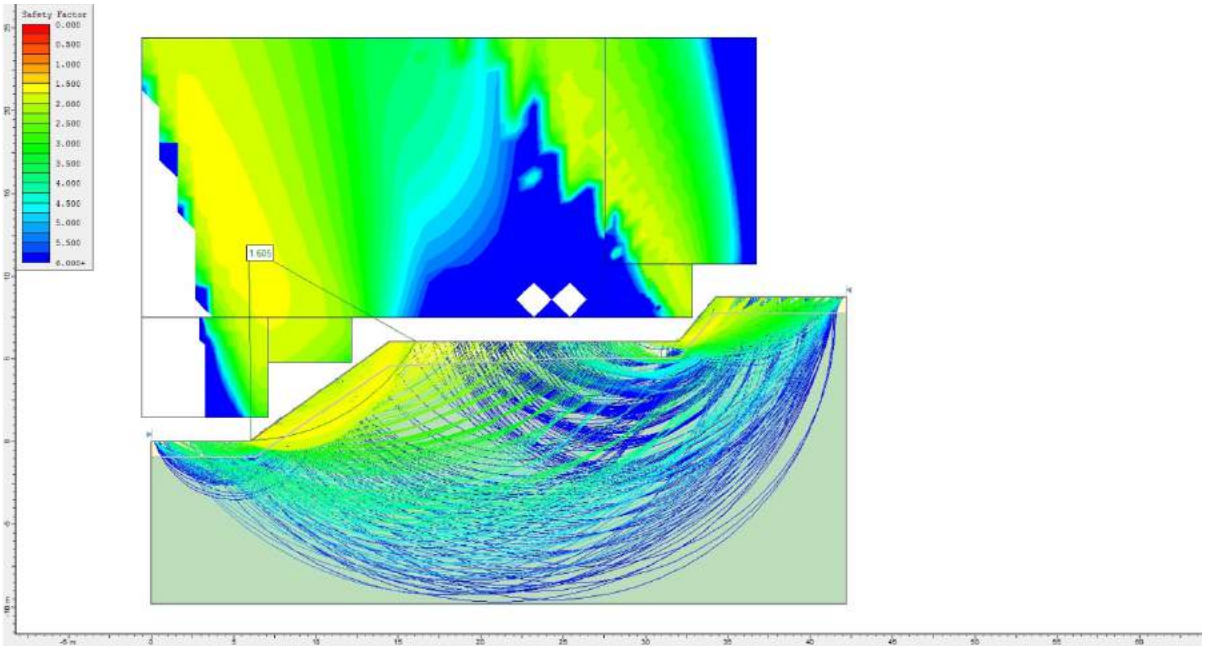
APPENDIX D – PHOTOGRAPHS

Looking north towards benched area

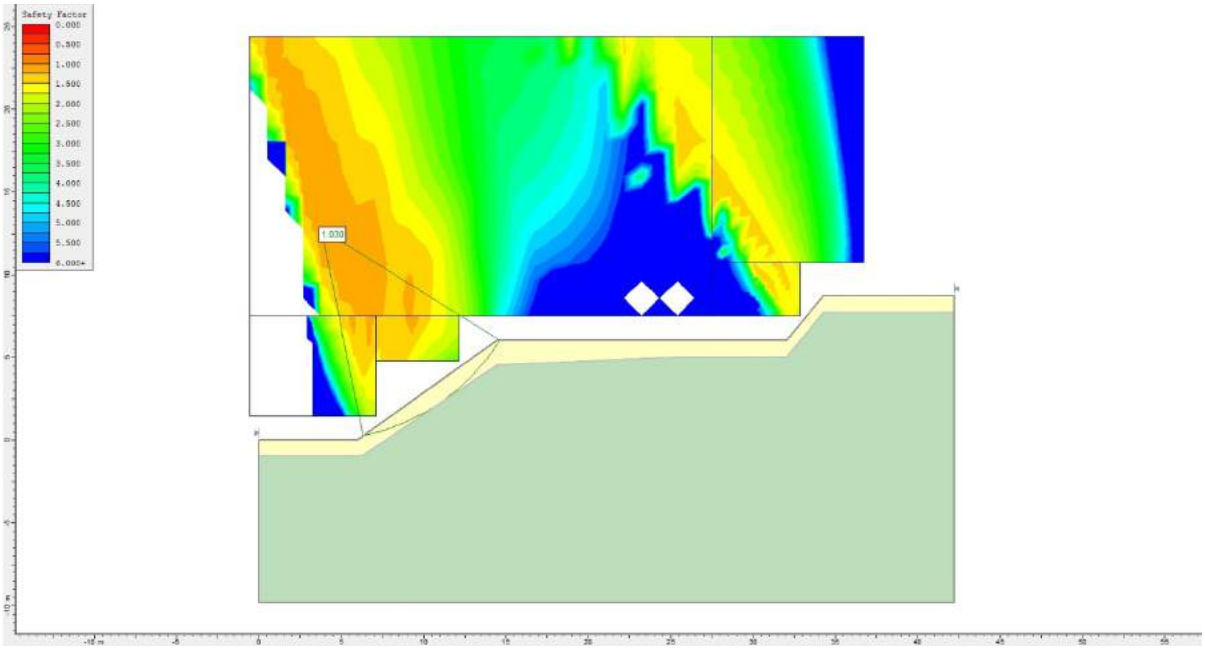
Looking south over building pad

Looking west and benched area

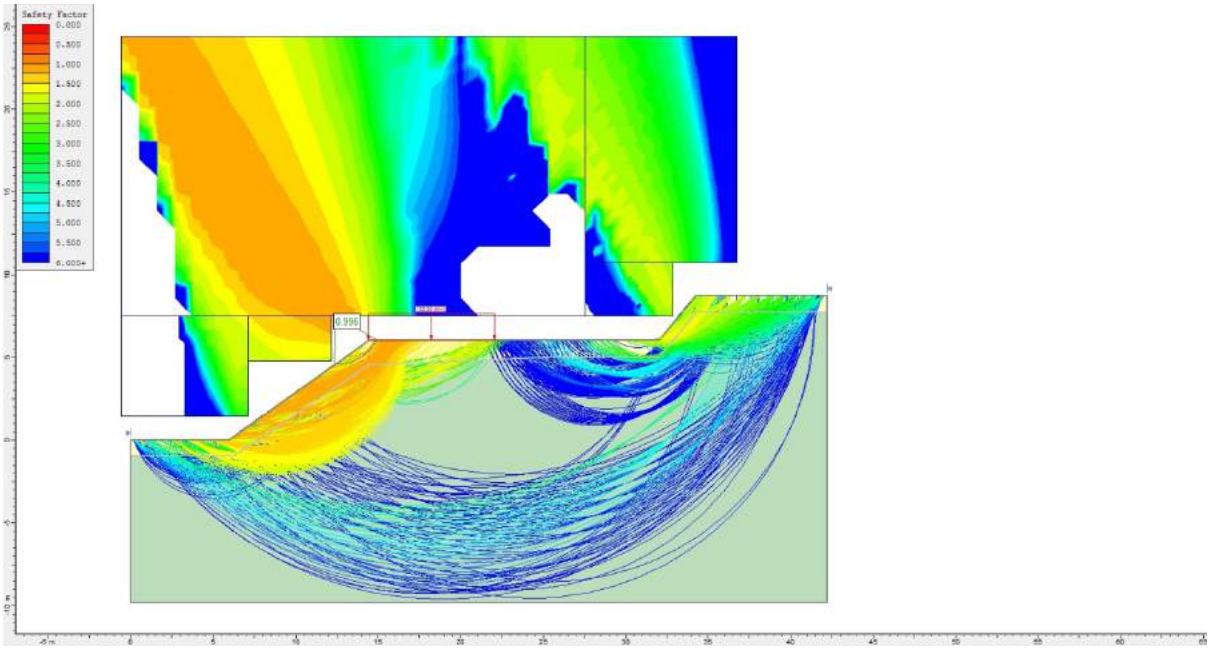
APPENDIX E – SLIDE



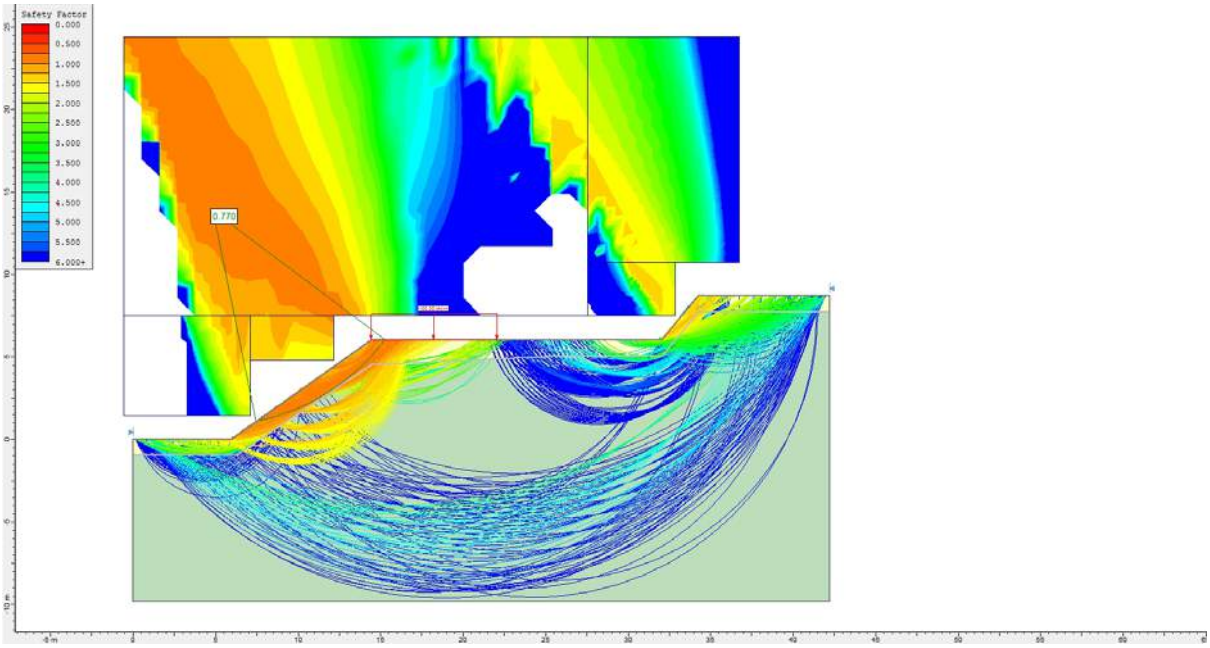
Current (Dry)



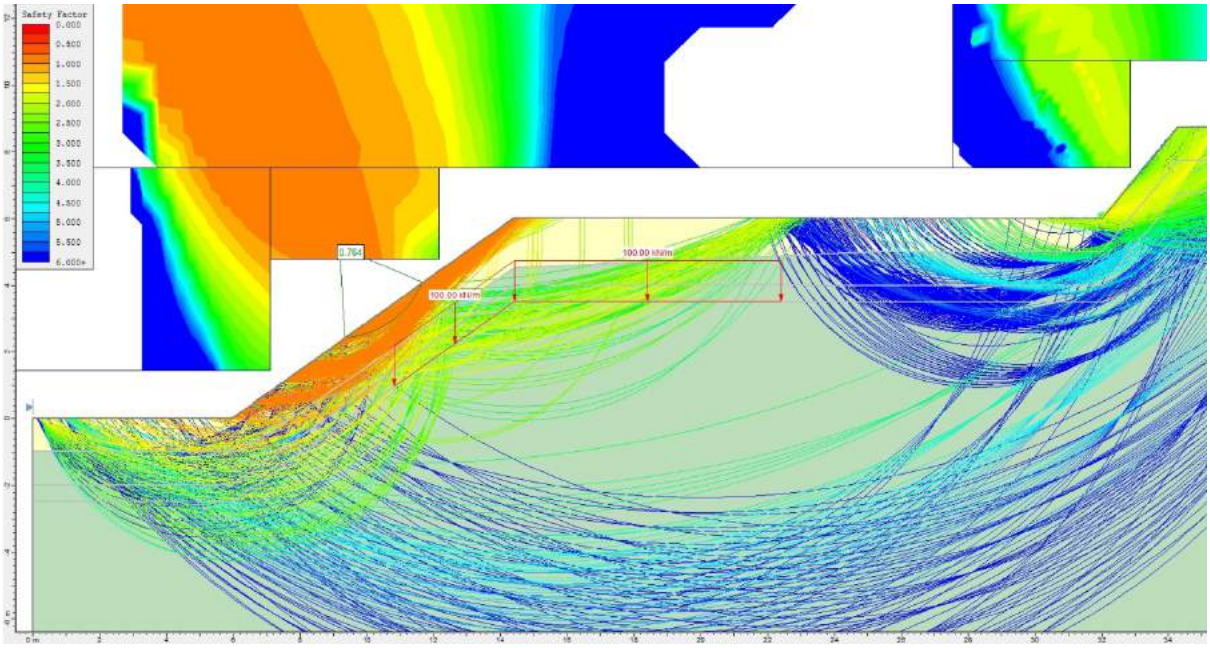
Current (Saturated)



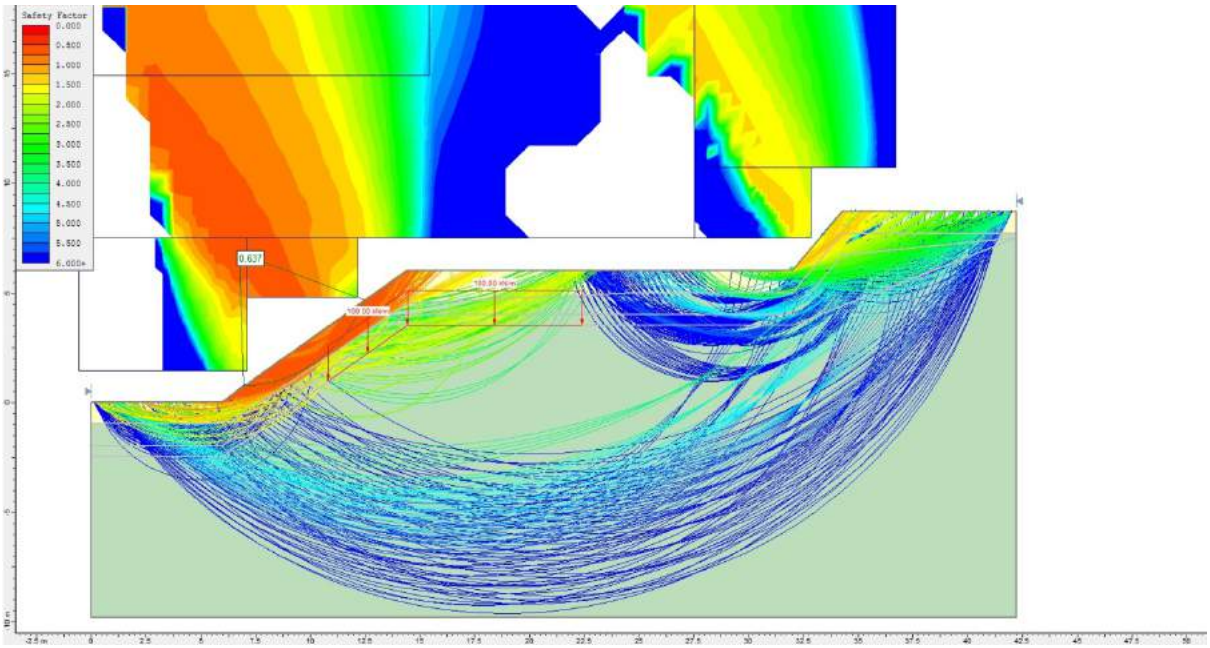
Load at surface level (Dry)



Load at surface level (Saturated)



Load at 2.5m below ground surface level (Dry)



Load at 2.5m below ground surface level (Saturated)

APPENDIX F – UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT

GEOTECHNICAL & MATERIALS TESTING

UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT

This report has been based on project details as provided to us at the time of the commission. It therefore applies only to the site investigated and to a specific set of project requirements as understood by Engineering Testing Services.

If there are changes to the project, you need to advise us in order that the effect of the changes on the report recommendations can be adequately assessed. Engineering Testing Services cannot take responsibility for problems that may occur due to project changes if they are not consulted.

It is important to remember that the subsurface conditions described in the report represent the state of the site at the time of investigation. Natural processes and the activities of man can result in changes to site conditions. For example, ground water levels can change or fill can be placed on a site after the investigation is completed. If there is a possibility that conditions may have changed with time, Engineering Testing Services should be consulted to assess the impact on the recommendations of the report.

The site investigation only identifies the actual subsurface conditions at the location and time when the samples were taken. Geologists and engineers then extrapolate between the investigation points to provide an assumed three-dimensional picture of the site conditions. The report is based on the assumption that the site conditions as identified at the investigation locations are representative of the actual conditions throughout an area. This may not be the case and actual conditions may differ from those inferred to exist. This will not be known until construction has commenced. Your geotechnical report and the recommendations contained within it can therefore only be regarded as preliminary.

In the event that conditions encountered during construction are different to those described in the report, Engineering Testing Services should be consulted immediately. Nothing can be done to change the actual site conditions which exist but steps can be taken to reduce the impact of unexpected conditions. For this reason, the services of Engineering Testing Services should be retained through the development stage of a project.

Problems can occur when other design professionals misinterpret a report. To help avoid this, Engineering Testing Services should be retained for work with other design professionals to explain the implications of the report.

This report should be retained as a complete document and should not be copied in part, divided or altered in any way.

It is recommended that Engineering Testing Services is retained during the construction phase to confirm that conditions encountered are consistent with design assumptions. For example, this may involve assessment of bearing capacity for footings, stability of natural slopes or excavations or advice on temporary construction conditions.

This document has been produced to help all parties involve recognise their individual responsibilities.