August 2013

GEOTECHNICAL INVESTIGATION

Lot 126, Murphy Street

Submitted to:
Lindsay & Robyn Partridge
c/- Charles Wright Architects Pty Ltd
PO Box 492
Port Douglas QLD 4877

Report Number. 137632049-001-R-Rev1

Distribution:

1 Copy - Charles Wright Architects Pty Ltd

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1.0 INTRODUCTION

At the request of Charles Wright Architects (CWA), Golder Associates (Golder) has undertaken a geotechnical investigation for a proposed residence at Lot 126 Murphy Street, Port Douglas. The investigation has been conducted in general accordance with our proposal (Golder Reference P37632116-001-P-Rev0) dated 13 March 2013.

The aim of the investigation was to assess geotechnical and groundwater conditions at the site of the proposed development and to provide the following information:

- Subsurface conditions at the site;
- Stability of the slopes following proposed development and comments on slope stabilisation, if necessary;
- To assess the risk of upslope hazards, including the potential for rockfall and debris flows;
- Comments on foundation options and provide geotechnical design parameters;
- To provide a site classification as per AS2870.

This report presents the results of the geotechnical investigation together with preliminary geotechnical input related to the items outlined above. As final details related to the proposed foundation types and structural loads are not known at this time, all geotechnical comments provided in this report should be considered preliminary in nature and should be reviewed and, if necessary, revised once the final design details are available. This report is based on drawings provided to Golder by CWA and geotechnical investigation and laboratory testing undertaken by Golder.

This report provides supersedes document 137632049-001 Rev0 issued on April 2013.

2.0 REGIONAL GEOLOGY

The Queensland Department of Natural Resources and Mines 1:250 000 Geological Map Mossman, Sheet SE 55-1, indicates that the site is underlain by the late Silurian / Devonian Hodgkinson Formation dominated by arenite rich conglomerates.

Subsurface conditions encountered in the test pits are considered to be consistent with the materials indicated on the geological map.

3.0 FIELDWORK

3.1 Methods

The field investigation was carried out on 19 March 2013 under the full time supervision of a geotechnical engineer from Golder. The fieldwork consisted:

- Site walkover of the site;
- Excavation of two test pits (TP1 and TP2) to a maximum depth of 3.0 m.
- Observation and logging of two cuttings where the soil / rock profile is exposed;
- Performance of a dynamic Cone Penetrometer (DCP) test adjacent to test pit 1 (TP1/ DCP1) and near to the crest of an existing cut batter (DCP2).

The approximate test pit locations are indicated on Figure 1. Ground surface levels were interpolated from contour information presented on the RPS Contour and Detail Surveying drawing (115859-1) dated 26 November 2012 provided by CWA.

3.2 Site Overview

The site slopes down to the southwest at approximately 25 degrees. At the time of investigation, it was undeveloped and predominately covered by dense rainforest vegetation. A near-level platform towards the centre of the Lot has been formed between an old rock retaining wall and a low cut batter where weathered bedrock is exposed. Disused concrete steps are located north of the platform, and an open concrete drain runs along the northeast lot boundary. A second low cutting exposing weathered bedrock is located at the south corner of the Lot near the end of the concrete driveway. Site drainage is toward the west corner.

3.3 Subsurface Conditions

General sub soil conditions comprise localised uncontrolled fill overlying natural topsoil, colluvium and weathered bedrock. The fill deposits are associated with the near-level bench near the centre of the Lot, with minor deposits noted along the western property boundary. The colluvium appears to thicken toward the southwest portion of the Lot. The thickness of colluvium and residual soils was noted to a depth of 2.9 m below ground level in Test Pit 1 before grading to low strength rock. The approximate limits of the uncontrolled fill and the thickened colluvium are illustrated on Figures 1 and 2. Detailed descriptions of the subsurface conditions at investigation locations are presented on the Test Pit Reports in Appendix A.

The conditions encountered were generally as follows:

■	GL to 0.4/1.9m	Topsoil: very loose to loose silty Sand.
■	1.9 to 2.9 m	Colluvium / Residual soil: very dense silty clayey Sand.
■	Deeper than 0.4/2.9	Extremely weathered to highly weathered rock (phyllite), extremely low to low and low to medium strength

Groundwater was not encountered in the test pits to the depths advanced at the time of investigation. It should be noted that groundwater levels may fluctuate seasonally and during heavy rainfall periods.

4.0 LABORATORY TESTING

Laboratory plasticity and particle distribution tests were carried out on samples of the soils encountered to confirm field classifications. Laboratory test result sheets are presented in Appendix B and are summarised in Table 1 below.

Table 1: Summary of Laboratory Testing

ID	Depth (m)	Material	Emerson Class Number	Grading (%)			Plasticity (%)	
				Gravel	Sand	Fines	LL	PI
TP1	0.6-0.9	Silty CLAY	8	7	43	50	41	8
TP1	1.3-1.6	Silty CLAY	5	8	42	50	31	6

LL denotes Liquid Limit, PI denotes Plasticity Index.

Due to the nature of the materials encountered on site, undisturbed samples for shrink/swell testing could not be recovered.

5.0 ENGINEERING COMMENTS

5.1 Preliminary Stability Analyses

Stability analyses were carried out for the site profile indicated on Figure 2 for the existing slope profile. Based on judgement and previous experience with similar materials, the following strength parameters were adopted for the stability analyses:

Table 2: Strength Parameters for Slope Stability Analyses

Material Type	Strength Parameters	
Fill	c' = 3 kPa	ϕ' = 28°
Top Soil	c' = 2 kPa	ϕ' = 28°
Colluvium	c' = 3 kPa	ϕ' = 28°
Residual soils	c' = 5 kPa	ϕ' = 30°
Inferred Weathered Rock	c' = 8 kPa	ϕ' = 34°

Analyses were performed for what were considered to be dry or "normal" conditions and for what were considered to be wet or "extreme" conditions. Dry/ "normal" conditions are considered to represent usual dry season climatic conditions. Wet/ "extreme" conditions are considered to represent adverse wet season climatic conditions, but with standard engineering controls such as effective surface and subsurface drainage, drainage behind retaining walls, etc. A pore water pressure co-efficient, R_u= 0.2 was used to simulate seepage/water infiltration for "extreme" conditions within the soils and R_u= 0.1 within weathered rock zones respectively. The analyses were carried out for a potential failure surfaces using the proprietary computer software SLOPE/W.

The results of the stability analyses are presented in **Appendix C** and are summarised as follows:

Table 3: Results of Stability Analyses

Slope	Profile	Calculated Factor of Safety (FOS)	
		Dry Conditions	Wet Conditions
Upslope	Existing	1.9	1.7
	Proposed	1.7	1.6
Middle Platform	Existing	1.2	1.0
	Proposed	1.2	1.0
Downslope	Existing	2.3	2.0
	Proposed	2.3	2.0

For the purposes of assessing stability at this site we consider that a factor of safety ≥ 1.5 should be achieved for the dry conditions modelled and that a factor of safety ≥1.3 should be achieved for the wet, "extreme" conditions modelled.

The results of the stability analyses indicate that the profile at the location of section A-A has adequate factors of safety for the upslope and downslope conditions modelled. The uncontrolled fill deposit in the middle platform at the location of section A-A is marginally stable under dry conditions and may be unstable under wet conditions for the condition modelled. Please refer to Section 5.4 for discussion of uncontrolled fill.

As is the case for all developments involving cut/fill earthworks in the Cairns area, some minor instability should be expected on batter faces. This instability is expected to be in the form of relatively minor slips and slumps on locally steep slopes or unsupported batters, and to occur during or after prolonged periods of heavy rainfall. Some 'ravelling' may be anticipated in the rock batters. Given the low risk to residential development, this instability is generally accepted in the Cairns area and must be accepted by all parties involved in the proposed development.

5.2 Site Landslide Risk Assessment

The risk assessment procedure adopted herein is in general accordance with AGS 2007c[1]. The AGS Guidelines outline an approach that includes a qualitative risk assessment for risk to property. Implementing the control measures to reduce risk to property will result in an environment with a negligible risk to persons from landslides.

The Qualitative Level of Risk to Property resulting in landslide event is based on a measure of the likelihood of occurrence (

Therefore, from a geotechnical perspective and based on results of preliminary site assessment, there should be no significant implications or difficulties associated with the construction of an engineer-designed development on the proposed lot.

Table 4) combined with the consequence to property (Table 5). Likelihood and consequence are combined in Table 6, resulting in risk level that can range from very low (VL) to very high (VH). The standard definition of the risk levels are presented in Table 7.

The results of the risk to property assessment for each proposed allotment before and after engineering controls are presented in Table 8.

Subject to standard engineering practices described in Table 8, "Good Hillside Practices" (Appendix D, taken from AGS 2007c), and the recommendations contained in this report are adopted, we consider that proposed development on the allotment will have a Low Risk of instability. The risk from upslope hazards including rock fall, slips and debris slides is considered to be Low. This level of risk would normally be considered to be acceptable to local authorities and owners for hillside development.

Therefore, from a geotechnical perspective and based on results of preliminary site assessment, there should be no significant implications or difficulties associated with the construction of an engineer-designed development on the proposed lot.

Table 4: Qualitative Measures of Likelihood

Level	Descriptor	Description	Approximate Annual Probability
A	ALMOST CERTAIN	The event is expected to occur over the design life	10^{-1}
B	LIKELY	The event will probably occur under adverse conditions over the design life	10^{-2}
C	POSSIBLE	The event could occur under adverse conditions over the design life	10^{-3}
D	UNLIKELY	The event might occur under very adverse circumstances over the design life	10^{-4}
E	RARE	The event is conceivable but only under exceptional circumstances over the design life	10^{-5}
F	BARELY CREDIBLE	The event is inconceivable or fanciful over the design life	10^{-6}

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[1] Practice Note Guidelines for Landslide Risk Management 2007, Australian Geomechanics Journal Volume 42 No. 1 March 2007, Australian Geomechanics Society (AGS)

Table 5: Qualitative Measures of Consequences To Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.
2	MAJOR	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.
3	MEDIUM	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one property minor consequence damage.
4	MINOR	Limited damage to part of structure, and/or part of site requiring reinstatement stabilisation works.
5	INSIGNIFICANT	Little damage.

Table 6: Qualitative Risk Analysis Matrix

Likelihood		Consequence to Property				
	Approx. Annual Probability	1: Catastrophic	2: Major	3: Medium	4: Minor	5: Insignificant
A – Almost Certain	10^{-1}	VH	VH	VH	H	M / L
B - Likely	10^{-2}	VH	VH	H	M	L
C - Possible	10^{-3}	VH	H	M	M	L
D - Unlikely	10^{-4}	H	M	L	L	VL
E - Rare	10^{-5}	M	L	L	VL	VL
F - Barely Credible	10^{-6}	L	VL	VL	VL	VL

Table 7: Risk Level Implications

Risk Level		Example Implications
VH	Very High	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work will likely cost more than the value of the property
H	High	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	Moderate	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce risk to Low.
L	Low	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	Very Low	Acceptable. Manage by normal slope maintenance procedures.

Table 8: Results of Qualitative Assessment of Risk to Property

Potential Hazard	Elements at Risk	Without Engineering Controls			Engineering Controls to Reduce Risk	With Engineering Controls		
		Consequence	Likelihood of Occurrence	Qualitative Risk		Consequence	Likelihood of Occurrence	Qualitative Risk
Landslide in soil slope impacting building from above	Elements in Lot 126	Medium	Possible	Moderate	Limit cut/fill heights, and batter to appropriate angles or provide positive retention/support. Provision for good drainage and erosion control measures i.e. surface water interceptor drains and flow spreaders. Found all footings into rock.	Medium	Rare (Dry conditions) to Unlikely (Wet conditions)	Low
Landslide in soil slope undermining buildings	Elements in Lot 126	Medium	Unlikely	Low	Limit cut/fill heights, and batter to appropriate angles or provide positive retention/support. Provision for good drainage and erosion control measures i.e. surface water interceptor drains and flow spreaders. Found all footings into rock.	Medium	Rare (Dry conditions) to Unlikely (Wet conditions)	Low
Earth slides in existing uncontrolled fill batters	Elements in Lot 126	Medium	Possible	Moderate	Remove uncontrolled fill to fill height not more than 0.5 m height.	Medium	Rare (Dry conditions) to Unlikely (Wet conditions)	Low
Earth slides in existing fill batters	Access Driveway in Lot 126	Minor	Possible	Moderate	Maintain vegetation on batters/vegetate bare areas. Prevent surface water discharging directly over batters. Water run-off from collected and discharged in a controlled manner	Medium	Rare (Dry conditions) to Unlikely (Wet conditions)	Low
Earth slides in existing cut batters	Access Driveway in Lot 126	Insignificant	Possible	Low	Trim batters to remove erosion channels and undercutting of topsoils/vegetation Revegetate batters Crest drain	Insignificant	Possible	Low
Earth slide in future cut batters	Property (Future Roads, Houses and Other Structures)	Medium	Likely	High	Minimise cut slope heights to less than 1.5 m. Maximum cut batter angle of 1V:1H Adopt stable batter slopes or provide positive retention. Provision of good drainage and erosion control measures. Surface loads not to surcharge crests of cut batters.	Minor	Unlikely (Wet conditions)	Low
Earth slides in future fill batters.	Property (Future Roads, Houses and Other Structures)	Medium	Likely	High	Minimise batter slope heights to less than 1 m. Maximum fill batter angle 1V:1H Ensure adequate fill compaction (engineered fill). Ensure fill batters are keyed into natural ground. Adopt stable batter slopes or provide positive retention. Provision of good drainage and erosion control measures. Surface loads not to surcharge fill crests.	Minor	Unlikely (Wet conditions)	Low

5.3 Drainage

It is recommended that the existing upslope cut-off drain is maintained (and improved if necessary) to help reduce the amount of surface and subsurface flow through and across the site. The discharge from this drain should be controlled and not allowed to flow across the site surface.

All stormwater from rooftops or paved areas should be collected and directed away from the site via pipes or lined drains rather than be allowed to flow across the site and down the slope.

5.4 Uncontrolled Fill

In the absence of an engineer’s certification, existing fill is considered to be uncontrolled.

The uncontrolled fill is localised with relatively minor volumes. The uncontrolled fill is not considered suitable to support structural loads, and the uncontrolled fill has been shown to be marginally stable. It is our understanding that the residential footings are planned to be extended into rock. In addition, it is anticipated that much of the fill will be removed as a result of footing and retaining wall excavation, therefore the uncontrolled fill is not deemed to be detrimental to stability of the residence.

All excavations should be inspected by Golder to confirm that the conditions exposed are consistent with the assumptions on which our design guidelines are made.

All landscape structures including driveways, garden walls, footpaths, etc. should likewise be founded in natural soil/rock beneath the uncontrolled fill, or on engineered fill.

5.5 Site Preparation and Earthworks

It is anticipated that the natural soils and fill at the site should be able to be excavated using “normal” capacity hydraulic earthmoving equipment, while excavation below the level where weathered rock was encountered may require hydraulic rock breaker equipment if excavation is required.

Excavated materials are likely to comprise residual, (silty-sandy clay) soils and small amounts of fill material on the driveway. Some cobbles and boulders may also be encountered.

Should filling be required, site preparation should include the following:

- Removal of vegetation, and stripping of topsoil and soil containing signification amounts of organic material from the footprint of the proposed fill. Earthworks should be conducted with particular attention to trees, if any, that may be considered environmentally significant. Local depressions left by the removal of root boles may need to be filled and these should be backfilled with engineered fill, compacted in layers.
- Excavate and remove uncontrolled fill, where encountered.
- Compact subgrade areas with a heavy roller to reveal soft or loose zones. Soft or loose materials that cannot be improved by compaction should be removed and replaced with engineered fill, or excavated down to rock.
- Fill where required should be placed in layer not exceeding 200 mm loose thickness and compact to the recommended level prior to placing the next layer.

The recommended compaction level is a density ratio of at least 95% using Standard Compaction. If required, additional imported fill materials should preferably have a CBR value greater than 15% and a Plasticity Index of less than 10.

Earthworks should be undertaken in accordance with AS 3798-20011 “*Guidelines on Earthworks for Commercial and Residential Developments*”. It is recommended the Earthworks should be supervised by a suitably qualified person and all filling should be checked by field density testing.

Cuts should be limited to not more than 1.5 m deep, and new fill up to a maximum height of 1 m. Cuts/ fills should be supported by engineered retaining walls or battered to a stable angle. A batter slope of no steeper than 1V:1H is recommended for cuts and fills. Where deeper cuts/ higher fills are proposed, they should be assessed on an individual basis.

Unvegetated areas, or areas stripped to temporarily allow construction, should be revegetated (or otherwise protected from erosion) as soon as possible following construction to maintain the slope instability risk level for the site. Temporary erosion protection and drainage to divert surface runoff away from areas of the site stripped/exposed as part of construction should be considered to reduce the risk of erosion and subsequent instability.

5.6 Footings and Site Classification

Footing design and structural loading for the proposed development have not been reviewed as part of the scope of this report. All geotechnical comments provided in this report should be considered preliminary in nature and should be reviewed and, if necessary, revised once the final design details are available.

All footing excavations should be inspected by Golder to confirm the ground conditions are consistent with those on which these design guidelines are based.

5.6.1 Shallow Footings

Pad and strip footings for the residence supporting vertical loads should be founded at least 0.5 m into low strength (or better) rock based on the parameters in Table 9. Footings for ancillary structures should where possible be founded in bedrock, but may be sized using the parameters presented in the table below. Despite no water table being observed in any test pit, a worst case scenario of the water table being located at the base of the footing has been assumed for this analysis. Design parameters are based on footing excavations being level, clean, dry and free of loose, softened and disturbed materials at the time of pouring concrete.

Allowable bearing pressures and geotechnical design parameters for shallow footings are shown in Table 4.

Table 9: Design Parameters for Shallow Footings

Founding Strata	Unit Weight (ϒ)	Friction Angle (ϕ)	Modulus (E)	Allowable Bearing Pressure (Vertical)
Dense to very dense silty Sand	18 kN/m^3	35 °	15 to 20 MPa	120 kPa
Medium dense to dense silty Sand	18 kN/m^3	30°	10 to 15 MPa	80 kPa
Engineered fill	18 kN/m^3	30°	10 to 20 MPa	100 kPa
Very low strength extremely weathered rock	22 kN/m^3	34 °	100 MPa	600 kPa

5.6.2 Deep Footings

If structure loads cannot be economically supported on high level footings, bored cast *in situ* piles could be considered. Piled footings should penetrate through the residual soil / colluvium and should extend at least three times their diameter into the weathered rock. Design of piles should be in accordance with Australian Standard AS2159-1995 "*Piling – Design and installation*". Preliminary assessment of pile sizes and founding levels using static analyses could be based on the parameters presented in Table 10. For limit state strength design, a geotechnical strength reduction factor of 0.5 applied to the ultimate pressures is suggested. Selection of a design value for base capacity should consider materials four pile diameters below base level.

Table 10: Parameters for Bored Cast *In Situ* Piles

Material	Allowable End Bearing (kPa)	Allowable Shaft Adhesion (kPa)
Dense to very dense silty Sand	-	-
Medium dense to dense silty Sand	-	-
Very low strength extremely weathered rock	600	50

Note: Shaft adhesion and end bearing capacities in Table 5 apply when the pile length (L) is greater than 4 times the pile diameter (d). If L/d<4, use parameters for shallow footings. Design end bearing should consider material capacity within 4 pile diameters below founding level.

Bored pile settlements will depend on footing shape, applied load and pile “cleanliness” on casting concrete, and should be assessed once these characteristics are known. As a preliminary guide, footing settlements under static serviceability loads would not be expected to exceed about 1.5% of pile diameter for properly constructed bored piles using allowable bearing pressures presented in Table 10. Parameters are based on foundation excavations being clean, dry and free of loose, softened and disturbed materials at the time of pouring concrete.

It is recommended that bored pile drilling be observed by a geotechnical engineer to confirm ground conditions present and that geotechnical capacity meets the design loads.

5.6.3 Site Classification

In accordance with AS2870-1996 ‘*Residential slabs and footings – Construction*’, the site is classified as “Class P” due to uncontrolled fill and steep slopes. Footings should be designed in accordance with the parameters outlined above.

Based on site reactivity (shrink-swell potential) only, the soil profile behaviour would be equivalent to a site with an “S” site classification.

It is recommended that footing excavations be inspected by Golder to confirm that founding conditions are consistent with those on which the design guidelines are based. Footing inspections should be scheduled prior to installation of reinforcing steel.

5.7 Retaining Walls

For permanent retaining structures, drainage should be provided behind all retaining structures to help prevent the development of water pressures on the back of the walls. In addition, the drainage will need to be maintained throughout the life of the structure. If the designer is not satisfied that maintenance will be undertaken and the integrity of drainage maintained, then the retaining structure design should allow for the development of water pressures.

Footings for retaining wall structures should be founded in rock or at least 0.5 m into the medium dense to dense or dense to very dense silty sands, the parameters presented in Table 9 should be used for design, along with the earth pressure coefficients presented in Table 11.

Table 11: Geotechnical Design Parameters for Retaining Walls

Material	Active Earth Pressure Coefficient (k_a)	At Rest Earth Pressure Coefficient (k_o)	Passive Earth Pressure Coefficient (k_o)	Unit Weight (kN/m^3)
Engineered fill / Colluvium	0.3*	0.47	3.0	18
Very Low and Low Strength Weathered Rock	0.3	0.5	-	22

** Assumes horizontal backfill behind wall*

Bearing pressures presented in Table 9 reduced by one-third for inclined resultant forces from lateral pressures could be used to size retaining wall footings.

All retaining wall excavations should be inspected by Golder to confirm the ground conditions are consistent with those on which these design guidelines are based.

6.0 LIMITATIONS

Your attention is drawn to the document – “Limitations”, which is included in the appendices of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. We would be pleased to answer any questions about this important information from the reader of this report.

GOLDER ASSOCIATES PTY LTD

Gaozhao Lu Geotechnical Engineer	Russell Jacobsen Senior Geotechnical Engineer, RPEQ

GZL/JJP/JD/dh

A.B.N. 64 006 107 857

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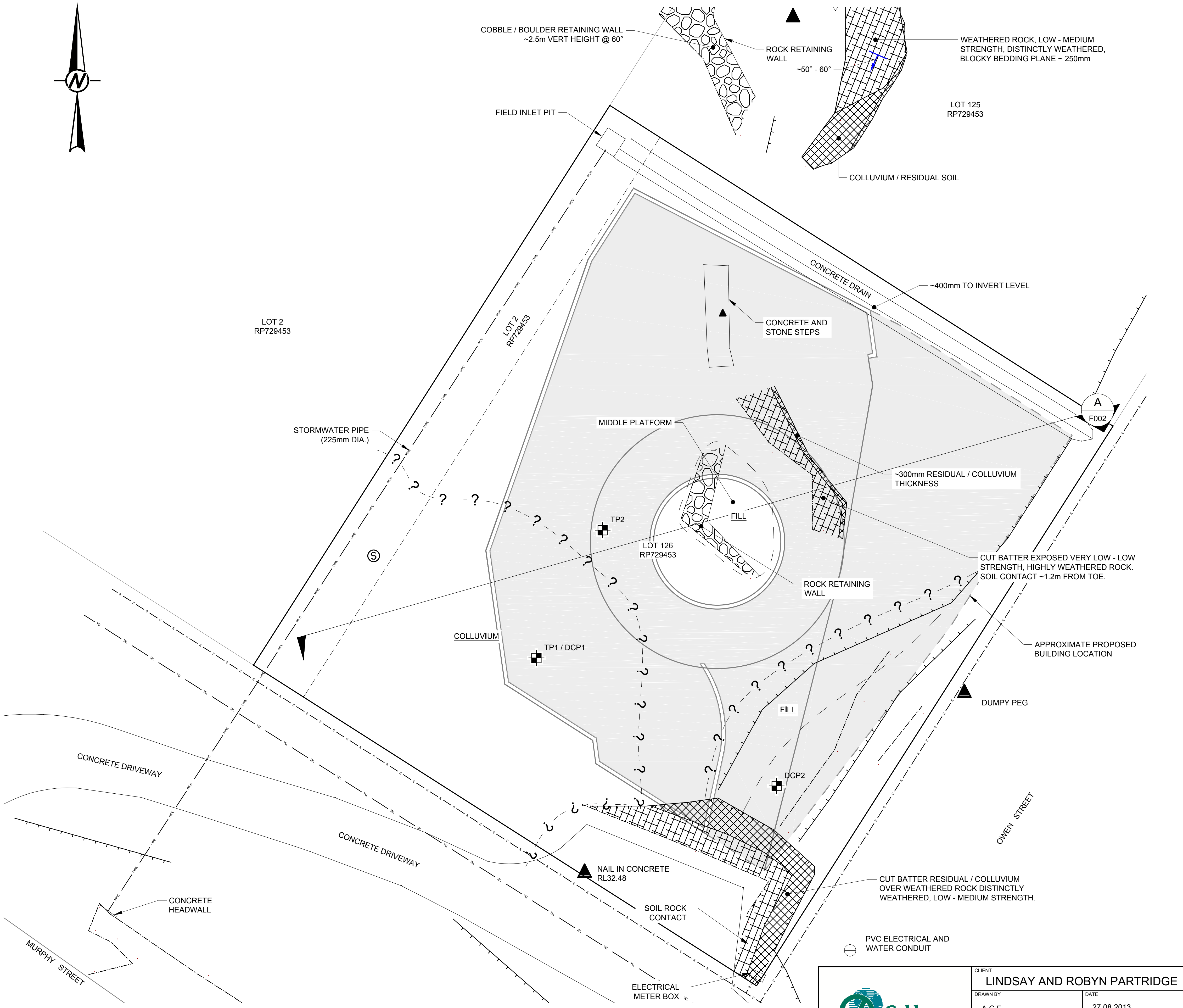

IMAGERY ©BING 2010, ©DigitalGlobe 2010, ©GeoEye 2013, ©Microsoft Corporation
TAKEN FROM RPS 115859-1 Lot 126 on RP729453 model.dwg DATED 26-11-2012

SITE INVESTIGATION LOCATIONS

SCALE: 1:200

LOCALITY PLAN - PORT DOUGLAS

NOT TO SCALE

LEGEND

TP2 / DCP2	TEST PIT AND / OR DYNAMIC CONE PENETROMETER LOCATIONS
———	SITE PROPERTY BOUNDARY
———	ADJACENT PROPERTY BOUNDARY
— — —	EASEMENT BOUNDARY
┴┴┴	TOP OF BATTER
—··—··—	BOTTOM OF BATTER
— E — E —	ELECTRICITY CABLE (UNDERGROUND)
— TEL — TEL —	TELEPHONE LINE
—50.0—	MAJOR CONTOUR (@ 1.0m INTERVALS)
———	MINOR CONTOUR (@ 0.5m INTERVALS)

NOT FOR CONSTRUCTION - ISSUED FOR

PRELIMINARY

0 4 8 12m

1:200

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CLIENT LINDSAY AND ROBYN PARTRIDGE			PROJECT GEOTECHNICAL INVESTIGATION				
DRAWN BY A.C.F.	DATE 27.08.2013		DRAWING TITLE SITE INVESTIGATION LOCATIONS AND LOCALITY PLAN - LOT 126 MURPHY STREET, PORT DOUGLAS				
CHECKED BY J.J.P.	DATE 27.08.2013						
SCALE 1:200		SHEET SIZE A3	PROJECT No 137632049	DOC No 001	DOC TYPE R	FIGURE No F001	REVISION 1

FIGURE 1

Plot Date: 27 August 2013 Time:1:30:01 PM By: Farlow, Alan Path: K:\GEO\2013\137632049- CWA - Geo Invest - Lot 126 Murphy Street, Port Douglas\FIGURES - File Name:137632049-001-R-F001-F002-Rev0.dwg
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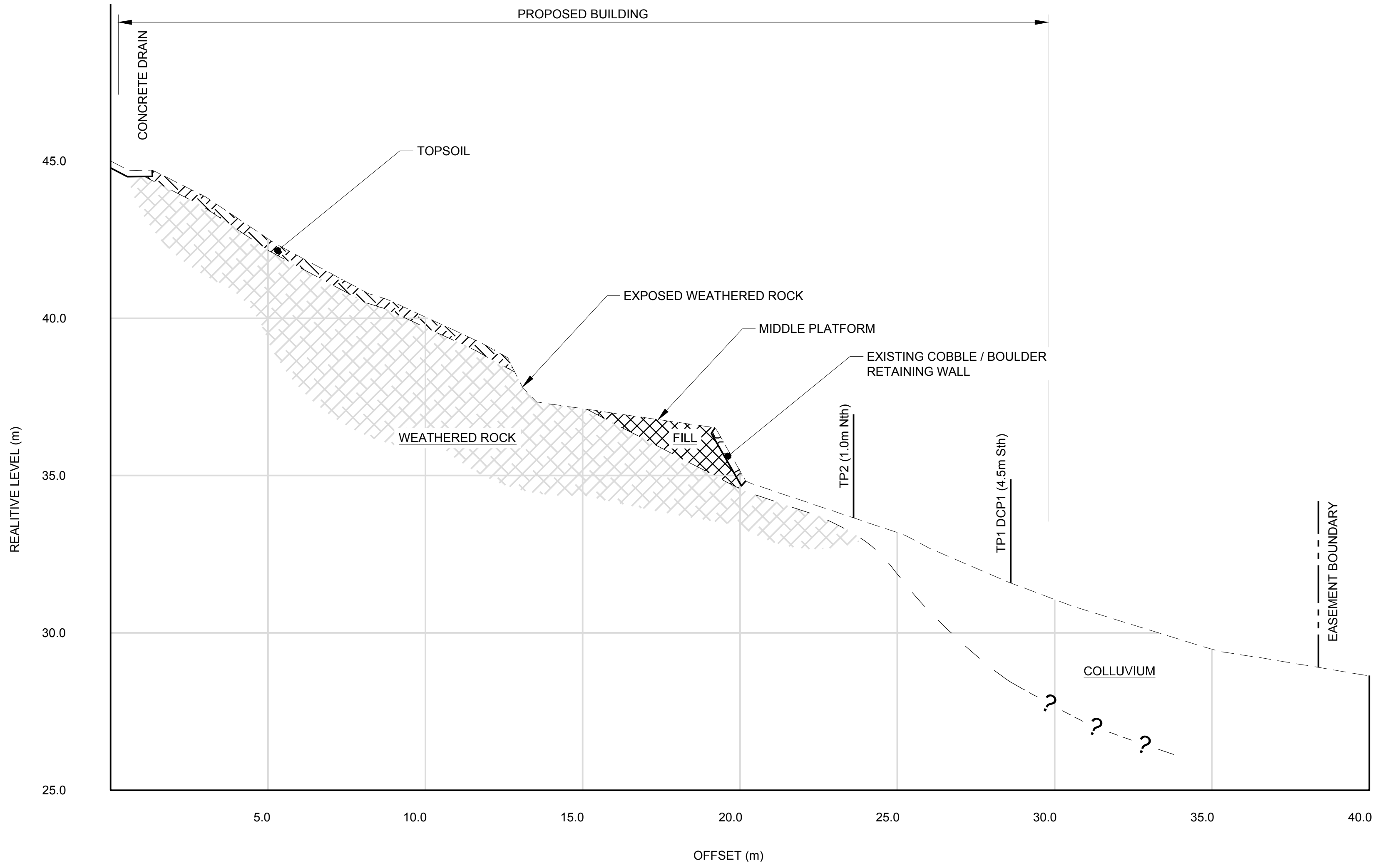

SECTION A
SCALE 1:200 F001

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PRELIMINARY

0 4 8 12m
1:200

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CLIENT: LINDSAY AND ROBYN PARTRIDGE
PROJECT: GEOTECHNICAL INVESTIGATION
DRAWN BY: A.C.F. DATE: 27.08.2013
CHECKED BY: J.J.P. DATE: 27.08.2013
DRAWING TITLE: SECTION A
- LOT 126 MURPHY STREET, PORT DOUGLAS
SCALE: 1:200
SHEET SIZE: A3
PROJECT No: 137632049
DOC No: 001
DOC TYPE: R
FIGURE No: F002
REVISION: 1
FIGURE 2

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APPENDIX A

Results of Field Investigation

REPORT OF TEST PIT: TP1

CLIENT: L & R Partridge
PROJECT: 126 Murphy Street
LOCATION: Port Douglas
JOB NO: 137632049

POSITION:
SURFACE RL: DATUM: AHD
PIT DEPTH: 3.00 m
BUCKET TYPE: 450mm Toothed

SHEET: 1 OF 1
MACHINE: Hyundai 5.5-9
CONTRACTOR: Heath's Backhoe Hire
LOGGED: JJP DATE: 19/3/13
CHECKED: DH DATE: 26/3/13

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					SM	TOPSOIL: Silty SAND fine to medium grained, dark grey brown, trace clay, with some rootlets, trace fine to medium grained gravel	M	VL - L	NATURAL
			0.5	*0.30*	BDS 0.60-0.90 m	■			trace rootlets			
			1.0	*1.10*	BDS 1.30-1.60 m	■		SM	COLLUVIUM: Silty SAND fine to medium grained, dark grey brown, increased low to medium plasticity clay, with some cobbles (<15mm) interbedded orange brown	M	L	
			1.5	*1.60*					becomes orange brown		L - MD	
	L-M		2.0 2.5	*1.90*					RESIDUAL SOIL: Silty Clayey SAND / Clayey Sandy SILT fine to medium grained, CL/ML, fine to coarse grained gravel	M	VD - H	
			3.0	*2.90*					WEATHERED ROCK phyllite, quartzite abundant, orange brown with pale grey brown, extremely weathered to highly weathered, extremely low to very low strength			
									TEST PIT DISCONTINUED @ 3.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED			
			3.5 4.0 4.5 5.0									

REPORT OF TEST PIT: TP2

CLIENT: L & R Partridge
PROJECT: 126 Murphy Street
LOCATION: Port Douglas
JOB NO: 137632049

POSITION:
SURFACE RL: DATUM: AHD
PIT DEPTH: 1.30 m
BUCKET TYPE: 450mm Toothed

SHEET: 1 OF 1
MACHINE: Hyundai 5.5-9
CONTRACTOR: Heath's Backhoe Hire
LOGGED: JJP DATE: 19/3/13
CHECKED: DH DATE: 26/3/13

Excavation					Sampling	Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					SM	TOPSOIL: Silty SAND fine to medium grained, dark grey brown, with some rootlets, trace low plasticity clay, trace fine to medium grained gravel	M	L	NATURAL
			0.5	*0.40*					WEATHERED ROCK orange brown with pale grey, phyllite, quartzite abundant, distinctly weathered, low to medium strength			Excavates as blocky/tabular gravel cobble (<250mm)
	M		1.0									
									TEST PIT DISCONTINUED @ 1.30 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED			
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									

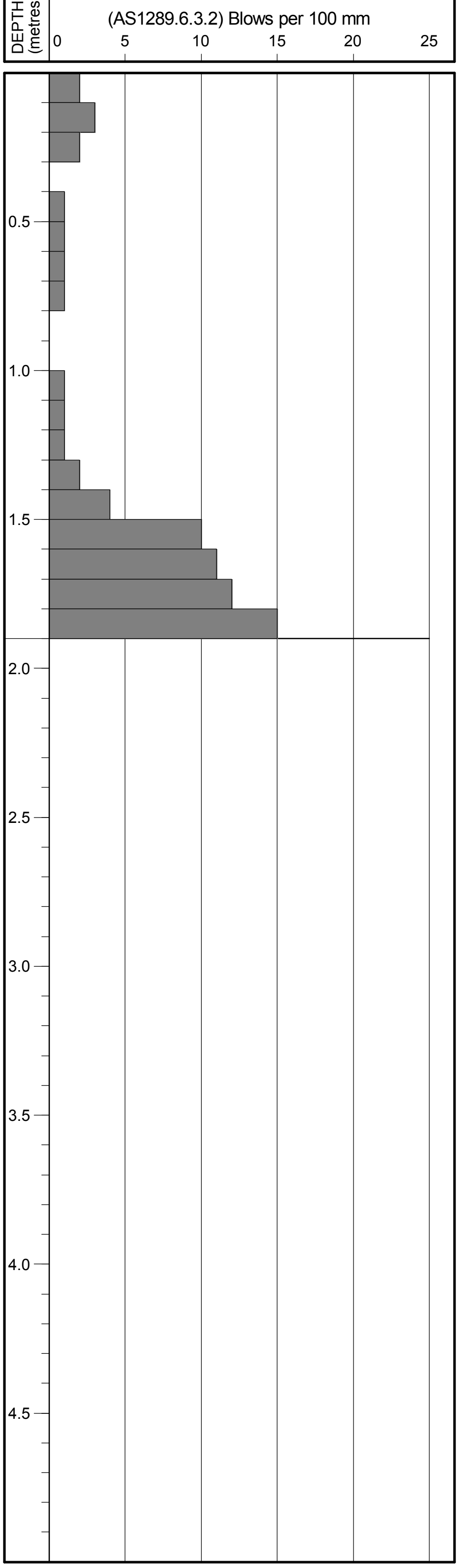
This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF DCP TESTS

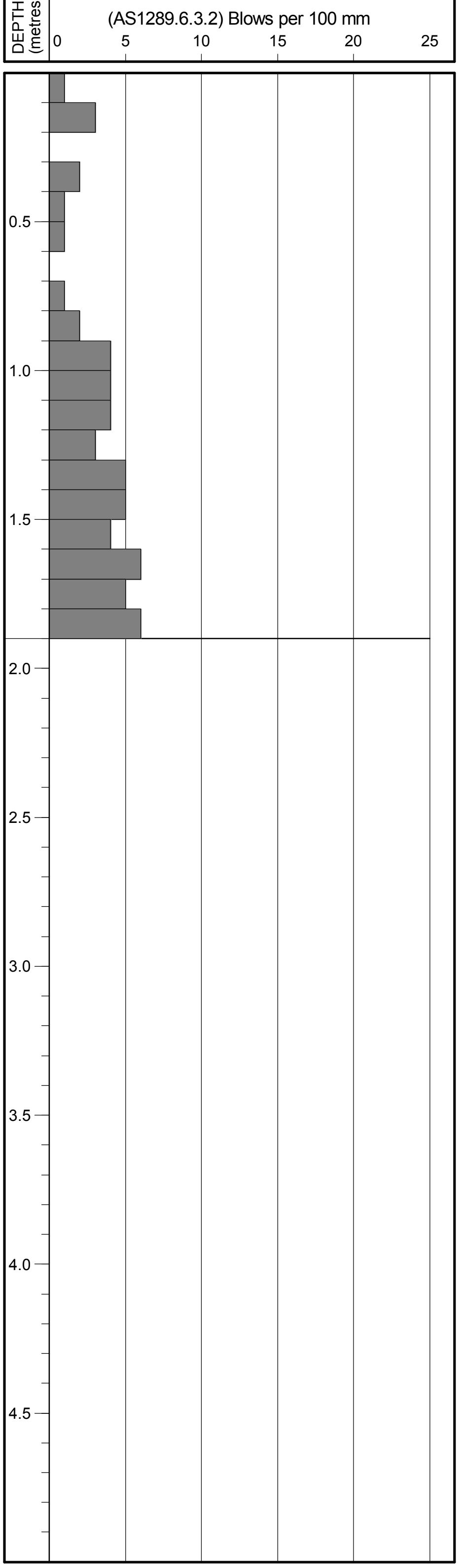
CLIENT: L & R Partridge
PROJECT: 126 Murphy Street
LOCATION: Port Douglas
JOB NO: 137632049

SHEET: 1 OF 1
CHECKED: DH
DATE: 26/3/13

TEST: DCP1
TESTED: JJP DATE: 18/03/2013
POSITION:
COORDS: MGA94 56
SURFACE RL: DATUM: AHD



TEST: DCP2
TESTED: JJP DATE: 18/03/2013
POSITION:
COORDS: MGA94 56
SURFACE RL: DATUM: AHD



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EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L	**Low resistance.** Rapid penetration possible with little effort from the equipment used.
M	**Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.
H	**High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.
R	**Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N= 18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$$

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METHOD OF SOIL DESCRIPTION
USED ON BOREHOLE AND TEST PIT REPORTS

- FILL
- GRAVEL (GP or GW)
- SAND (SP or SW)
- SILT (ML or MH)
- CLAY (CL, CI or CH)
- ORGANIC SOILS (OL or OH or Pt)
- COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

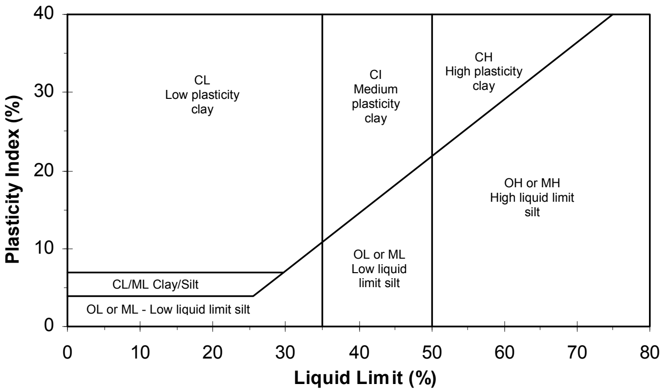
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

APPENDIX B

Laboratory Test Results

Cardno Bowler
Shaping the Future

Cardno Bowler Pty Ltd
ABN: 71 128 806 735

Address:
3/5 Commercial Place,
Earville Cairns QLD 4870

Telephone: 07 4032 3522
Facsimile: 07 4032 4156
Email: paul.shaw@cardno.com.au
Website: www.cardno.com.au

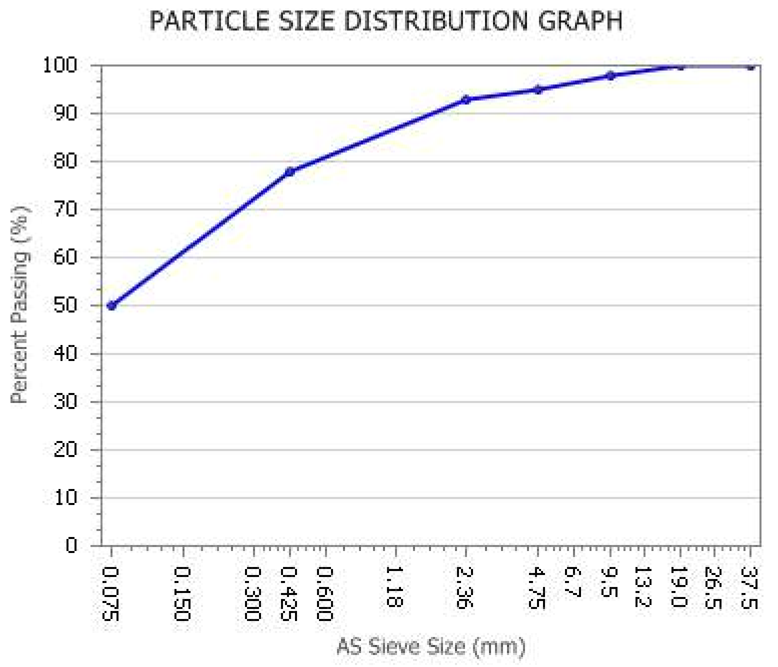
QUALITY OF MATERIALS REPORT

Client:	Golder Associates Pty Ltd	Report Number:	11519/R/2225-1
Client Address:	216, Draper Street, Cairns	Project Number:	11519/P/212
Project:	137632049 - Lot 126 Murphy Street	Lot Number:	126
Location:	Port Douglas	Report Date:	08/04/2013
Component:	Material Classification	Client Reference/s:	Job # 137632049
Area Description:	Port Douglas	Page Number:	Page 1 of 2

Test Procedures AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1

Sample Number	11519/S/6823		TP 1
Sampling Method	Sampled By Client		0.6m - 0.9m
Date Sampled	19/03/2013		
Sampled By	Client		
Date Tested	05/04/2013	Material Source	Existing Material
Att. Drying Method	Oven Dried	Material Type	Existing Material
Atterberg Preparation	Dry Sieved	Material Description	Silty CLAY, Dark Grey

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
37.5		**100**	
19.0		**100**	
9.5		**98**	
4.75		**95**	
2.36		**93**	
0.425		**78**	
0.075		**50**	



Test Result	Specification Minimum	**Result**	Specification Maximum	Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**41**		0.075/0.425 Ratio		**0.64**	
Plastic Limit (%)		**33**		PI x 0.425 Ratio (%)		**624.0**	
Plastic Index (%)		**8**		LS x 0.425 Ratio (%)		**351.0**	
Linear Shrinkage (%)		**4.5**		Linear Shrinkage Defects			

Remarks

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Accredited for compliance with ISO/IEC 17025

Laboratory Accreditation Number: 11519

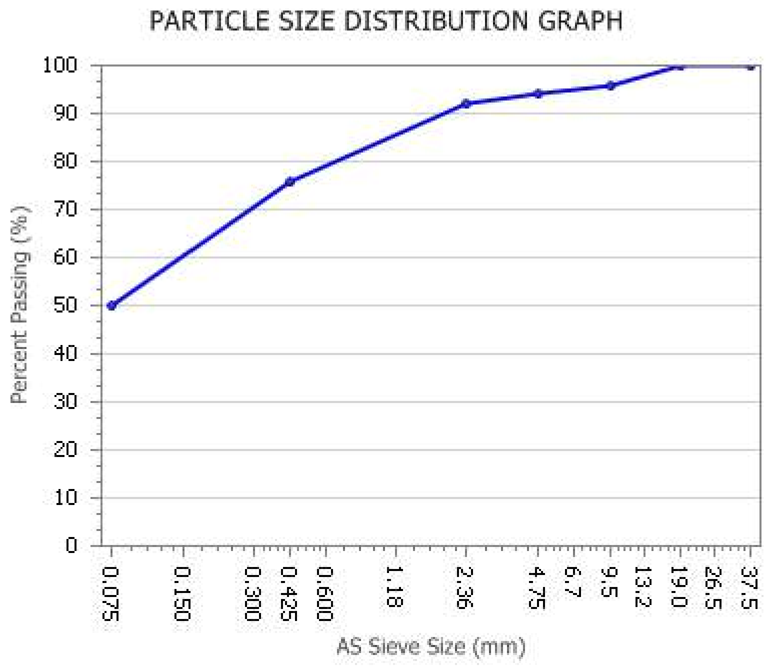
Approved Signatory: Paul Shaw
Form ID: W85Rep Rev 1

QUALITY OF MATERIALS REPORT

Client:	Golder Associates Pty Ltd	Report Number:	11519/R/2225-1
Client Address:	216, Draper Street, Cairns	Project Number:	11519/P/212
Project:	137632049 - Lot 126 Murphy Street	Lot Number:	126
Location:	Port Douglas	Report Date:	08/04/2013
Component:	Material Classification	Client Reference/s:	Job # 137632049
Area Description:	Port Douglas	Page Number:	Page 2 of 2

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	11519/S/6824		TP 1
Sampling Method	Sampled By Client		1.3m - 1.6m
Date Sampled	19/03/2013		
Sampled By	Client		
Date Tested	05/04/2013	Material Source	Existing Material
Att. Drying Method	Oven Dried	Material Type	Existing Material
Atterberg Preparation	Dry Sieved	Material Description	Silty CLAY, Pale Brown

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
37.5		**100**	
19.0		**100**	
9.5		**96**	
4.75		**94**	
2.36		**92**	
0.425		**76**	
0.075		**50**	



Test Result	Specification Minimum	**Result**	Specification Maximum	Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**31**		0.075/0.425 Ratio		**0.66**	
Plastic Limit (%)		**25**		PI x 0.425 Ratio (%)		**456.0**	
Plastic Index (%)		**6**		LS x 0.425 Ratio (%)		**304.0**	
Linear Shrinkage (%)		**4.0**		Linear Shrinkage Defects			

Remarks

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Accredited for compliance with ISO/IEC 17025

Laboratory Accreditation Number: 11519

Approved Signatory: Paul Shaw
Form ID: W85Rep Rev 1

Cardno Bowler
Shaping the Future

Cardno Bowler Pty Ltd
ABN: 71 128 806 735

Address:
3/5 Commercial Place,
Earville Cairns QLD 4870

Telephone: 07 4032 3522
Facsimile: 07 4032 4156
Email: paul.shaw@cardno.com.au
Website: www.cardno.com.au

EMERSON CLASS NUMBER REPORT

Client:	Golder Associates Pty Ltd	Report Number:	11519/R/2226-1
Client Address:	216, Draper Street, Cairns	Project Number:	11519/P/212
Project:	137632049 - Lot 126 Murphy Street	Lot Number:	126
Location:	Port Douglas	Report Date:	08/04/2013
Component:	Material Classification	Client Reference/s:	Job # 137632049
Area Description:	Port Douglas	Page Number:	Page 1 of 1

Test Procedures:	AS1289.3.8.1

Sample Number	11519/S/6823	11519/S/6824		
ID / Client ID	P/O CQ3321	P/O CQ3321		
Lot Number	126	126		
Date / Time Sampled	19/03/2013	19/03/2013		
Material Source	Existing Material	Existing Material		
Material Type	Existing Material	Existing Material		
Water Type	Distilled	Distilled		
Water Temperature (C°)	29	29		
	TP 1	TP 1		
	0.6m - 0.9m	1.3m - 1.6m		
Soil Description	Silty CLAY, Dark grey	Silty CLAY, Pale brown		
Emerson Class Number	**8**	**5**		

Remarks

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Accredited for compliance with ISO/IEC 17025

Laboratory Accreditation Number: 11519

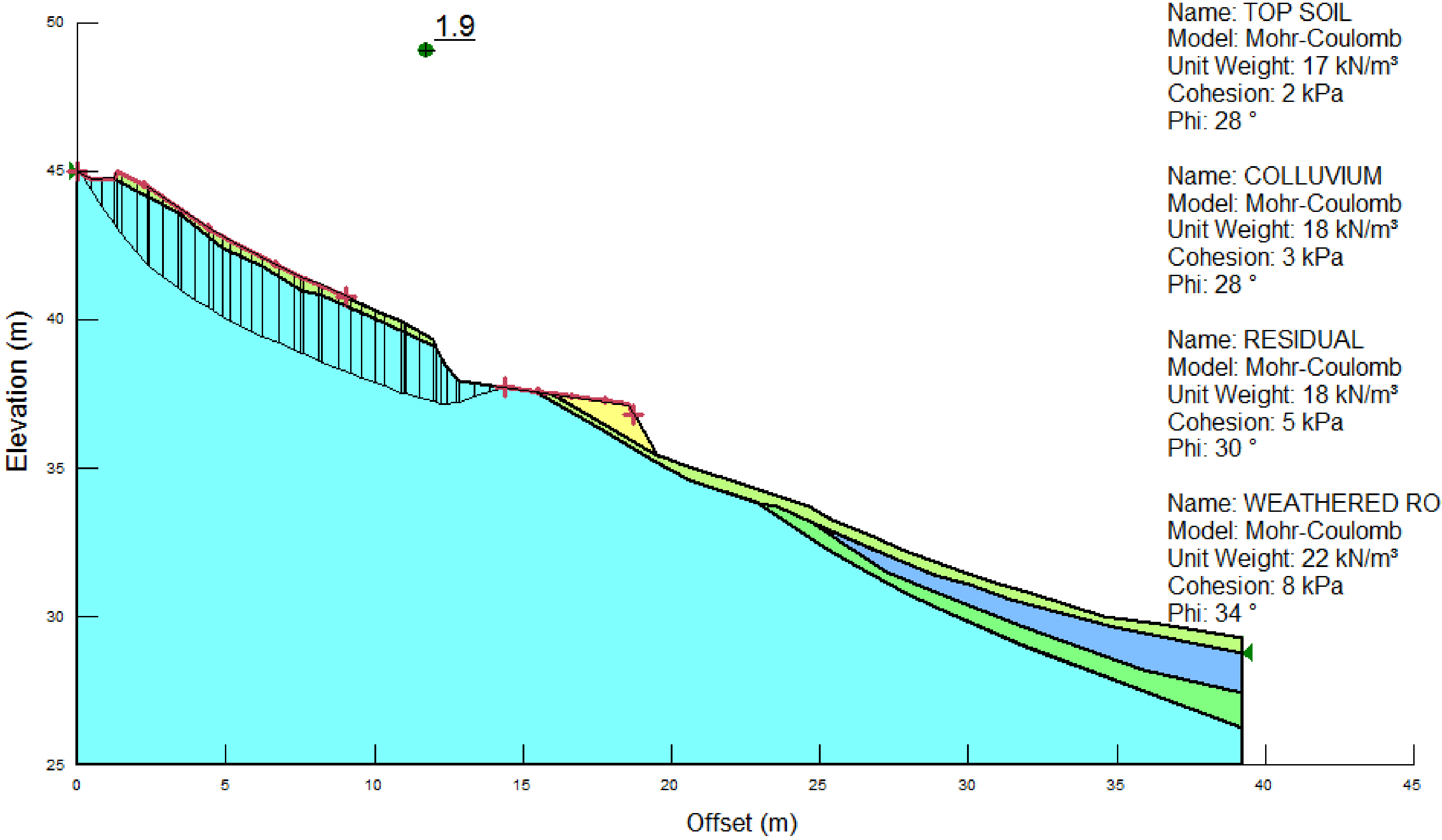
Approved Signatory: Paul Shaw
Form ID: W34Rep Rev 1

APPENDIX C

Results of Stability Analysis

File Name: 137632049 Existing Dry Upslope V1.gsz

Directory: C:\Users\GLu\Desktop\Lot 126\Slope Stability\Upslope\



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Unit Weight: 17 kN/m³
Cohesion: 3 kPa
Phi: 28 °

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °

Golder Associates

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	EXISTING UPSLOPE PROFILE - DRY CONDITION

File Name: 137632049 Existing Wet Upslope V1.gsz

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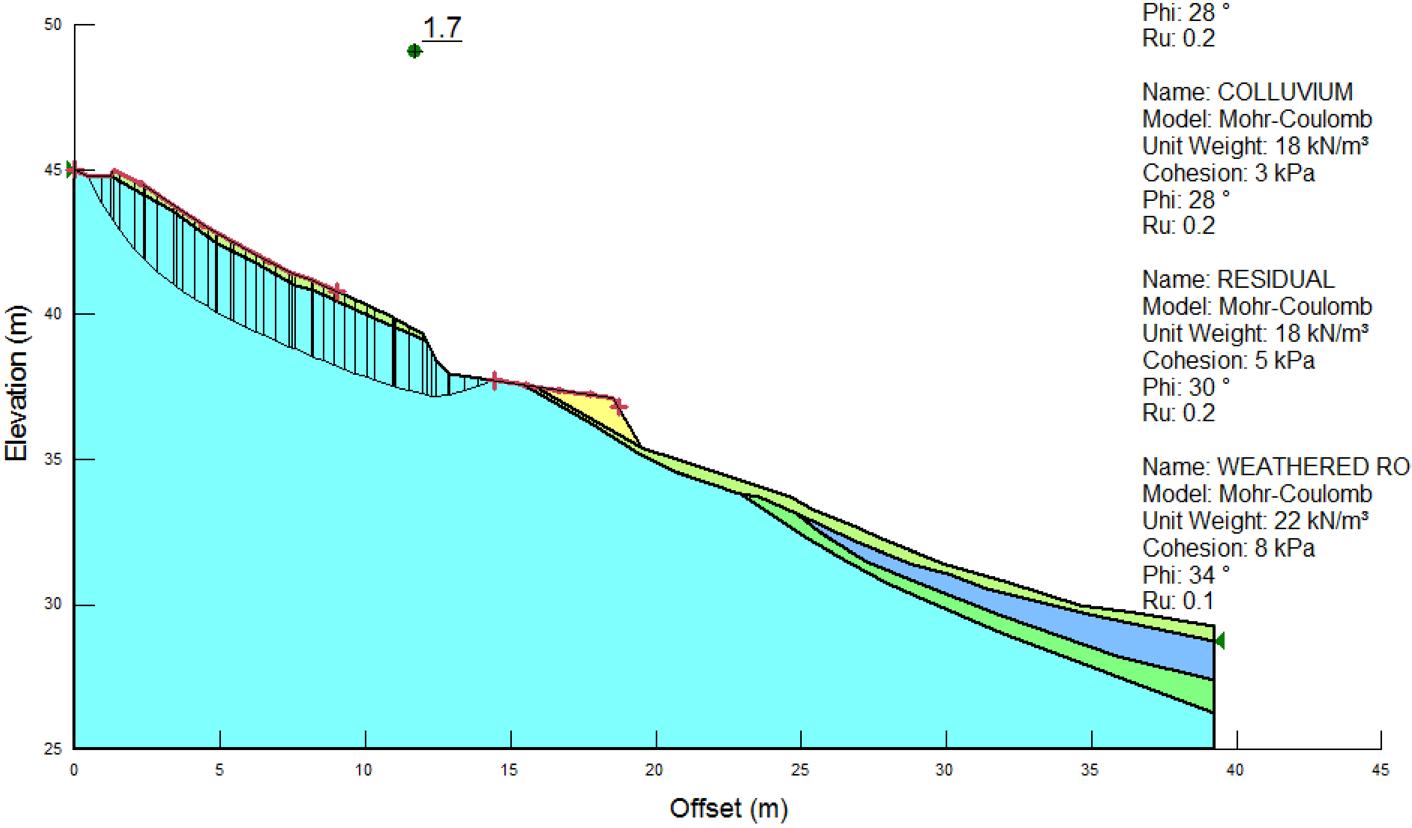

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Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: TOP SOIL
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Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °
Ru: 0.2

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °
Ru: 0.2

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °
Ru: 0.1

Golder Associates

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	EXISTING UPSLOPE PROFILE - WET CONDITION

File Name: 137632049 Proposed Dry Upslope V2.gsz

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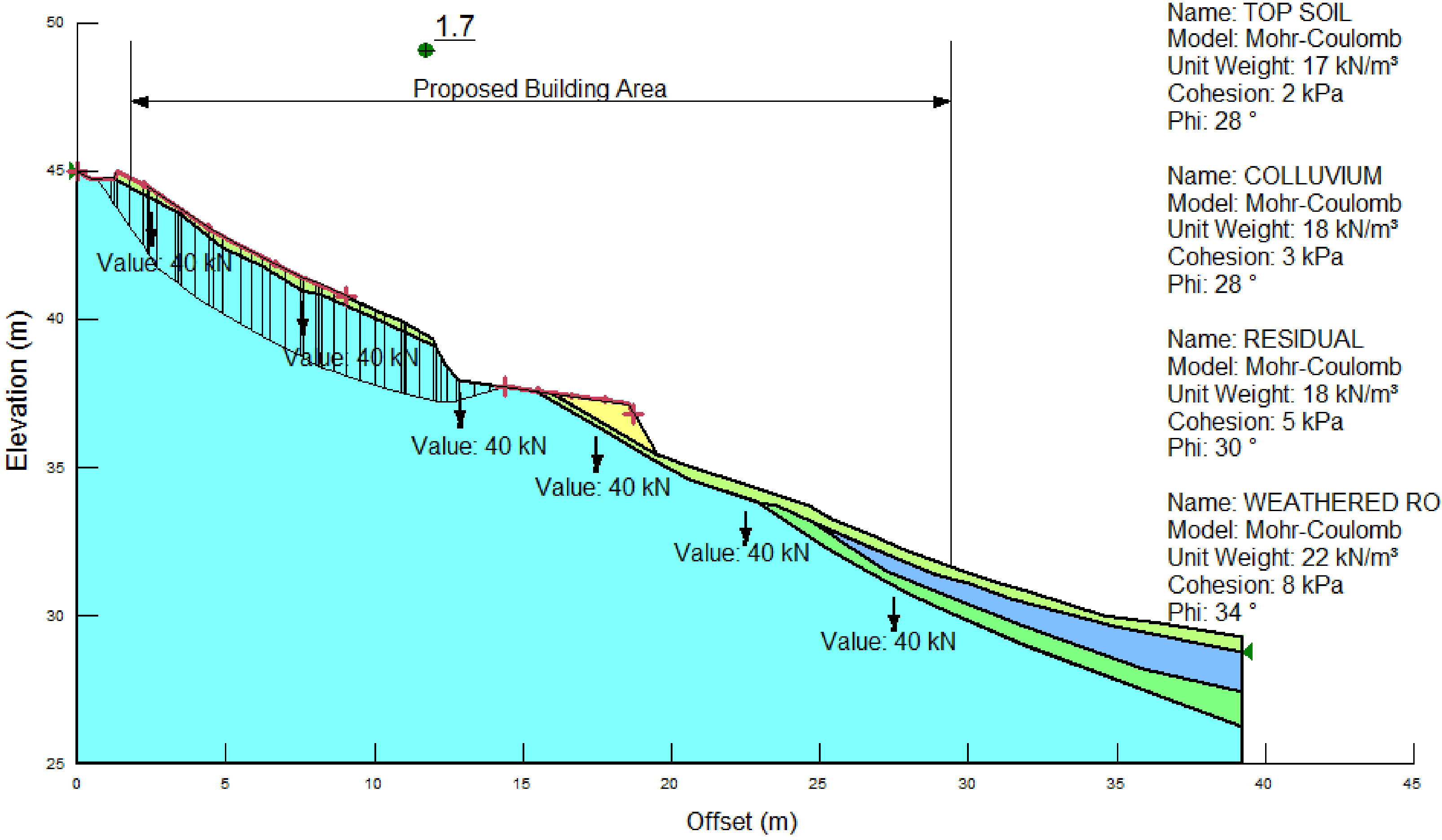

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Cohesion: 3 kPa
Phi: 28 °

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	PROPOSED UPSLOPE PROFILE - DRY CONDITION

File Name: 137632049 Proposed Wet Upslope V2.gsz

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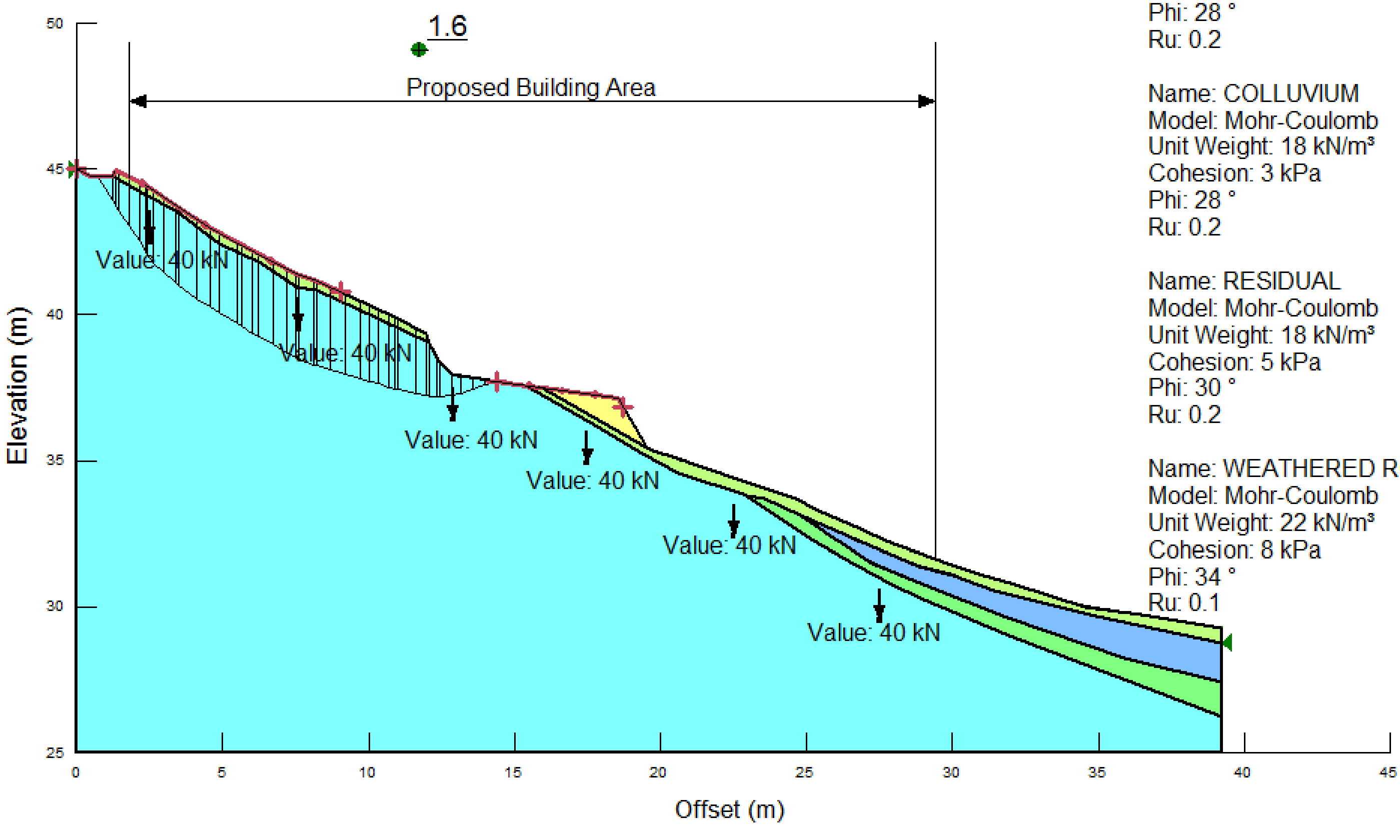

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Ru: 0.2

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °
Ru: 0.2

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °
Ru: 0.2

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °
Ru: 0.1

Golder Associates

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	PROPOSED UPSLOPE PROFILE - WET CONDITION

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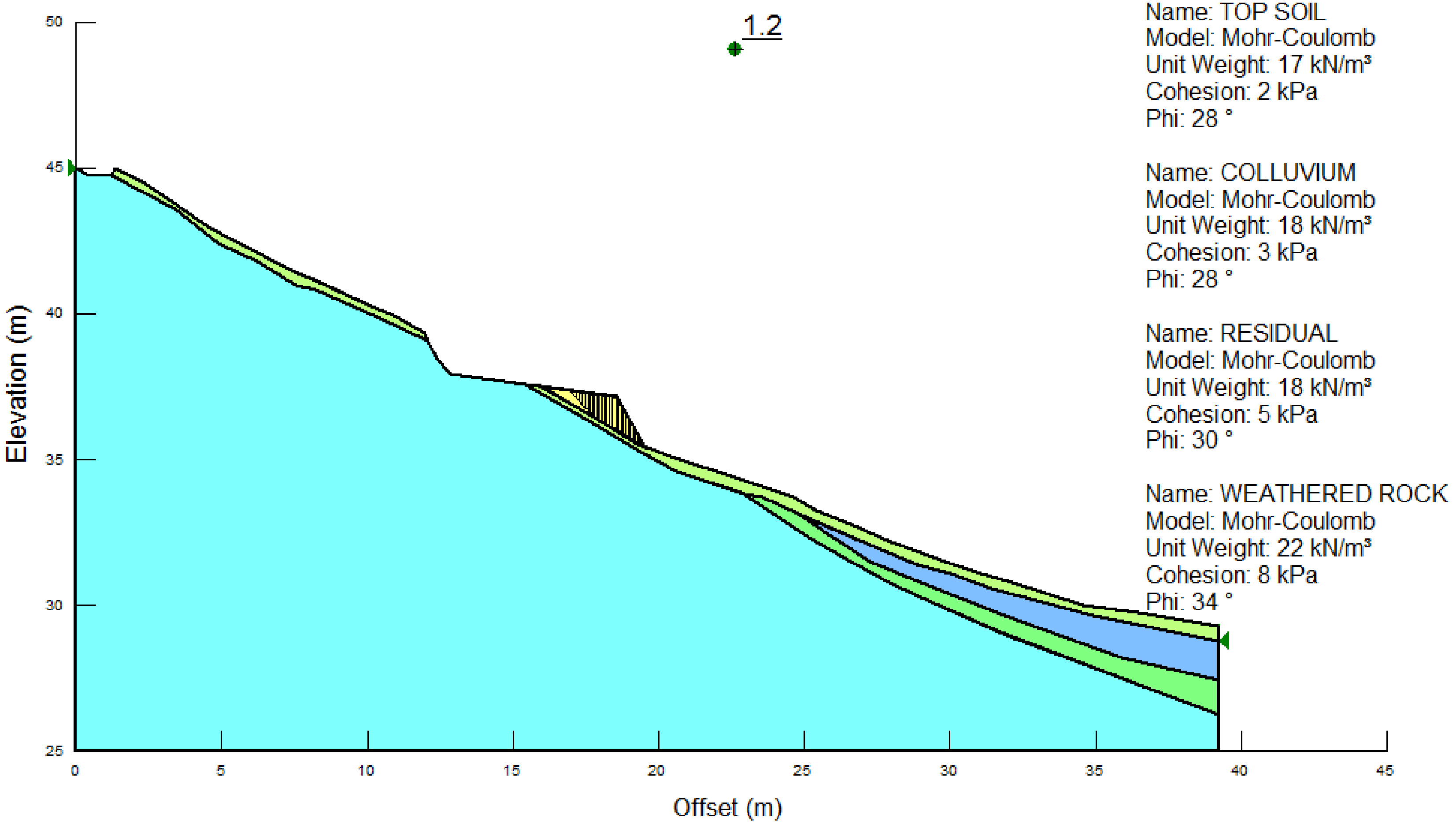

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Phi: 28 °

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Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °

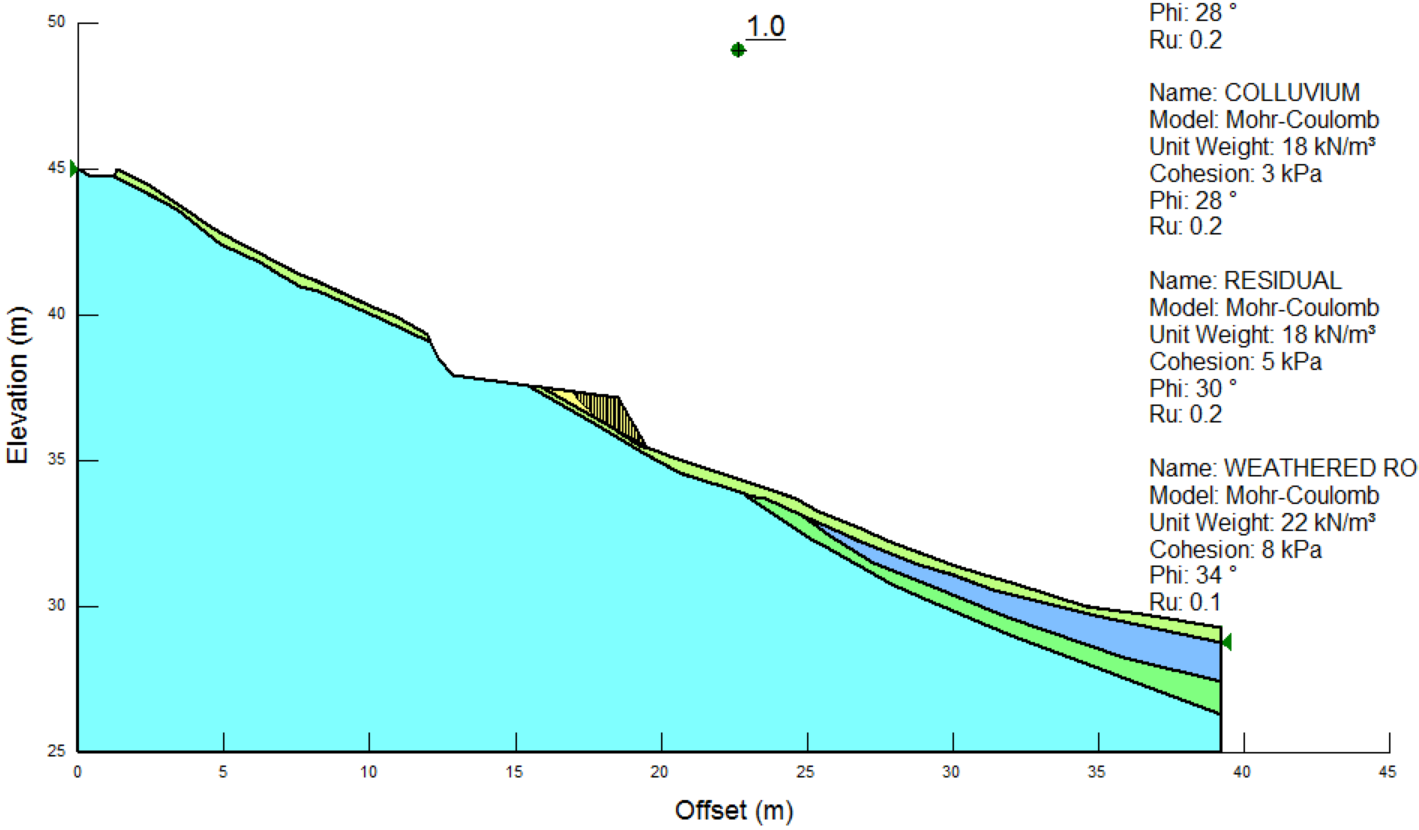
Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °

Golder Associates

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	EXISTING MIDDLE PLATFORM - DRY CONDITION

File Name: 137632049 Existing Wet V1.gsz

Directory: C:\Users\GLu\Desktop\Lot 126\up and down slope\



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Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °
Ru: 0.2

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °
Ru: 0.2

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °
Ru: 0.1

Golder Associates

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	EXISTING MIDDLE PLATFORM - WET CONDITION

File Name: 137632049 Proposed Dry V2.gsz

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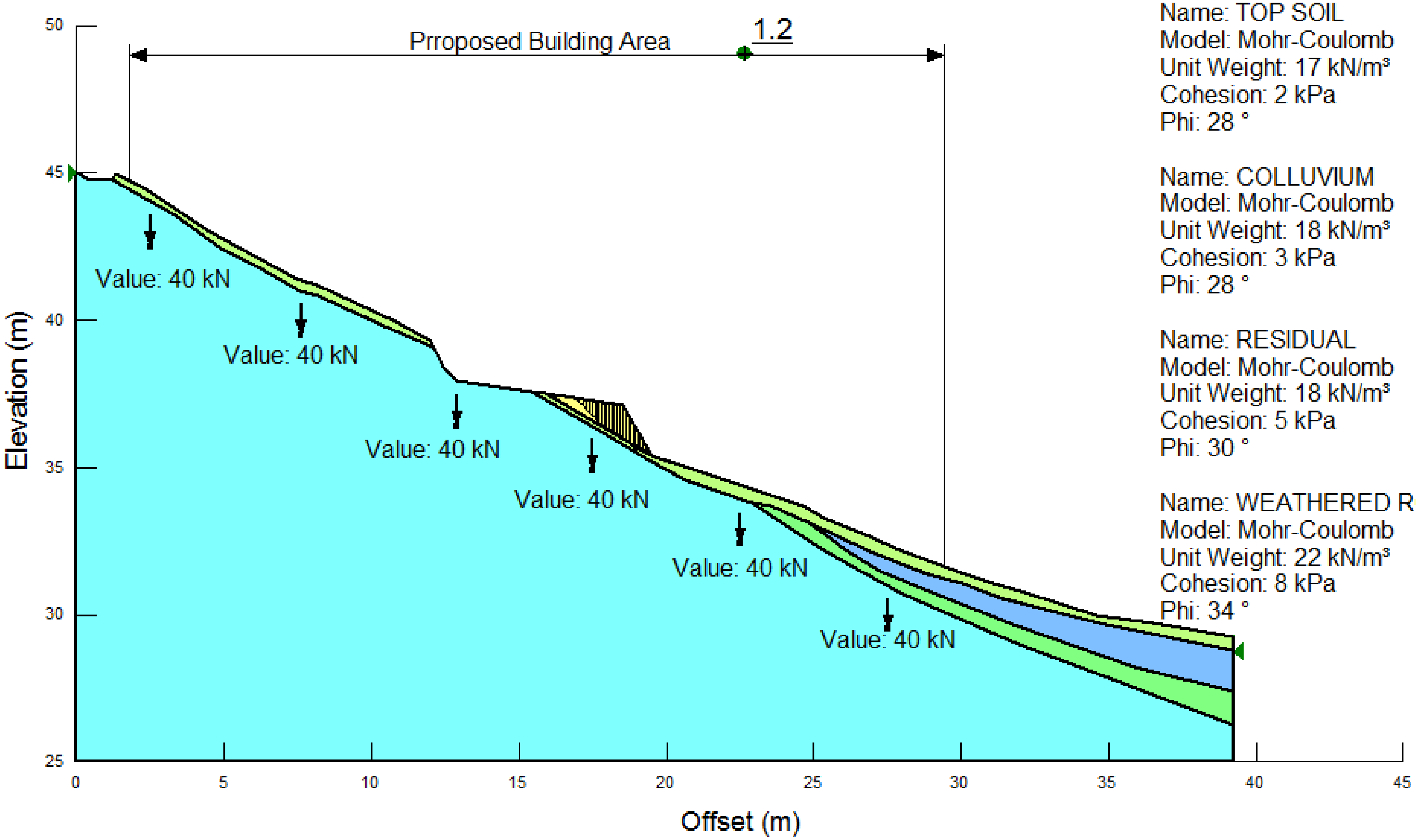

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Cohesion: 3 kPa
Phi: 28 °

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	PROPOSED MIDDLE PLATFORM - DRY CONDITION

File Name: 137632049 Proposed Wet V2.gsz

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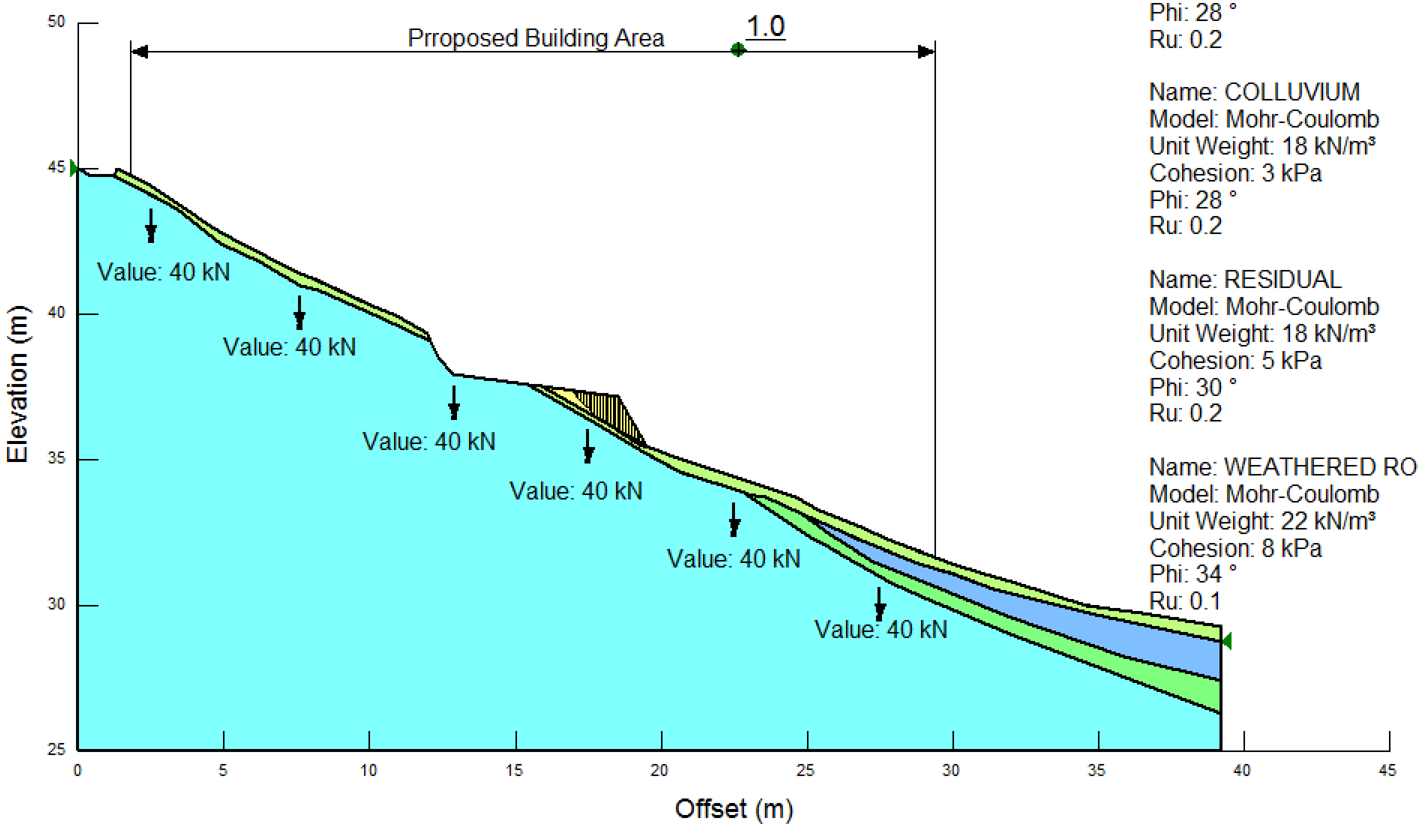

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Unit Weight: 17 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °
Ru: 0.2

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °
Ru: 0.2

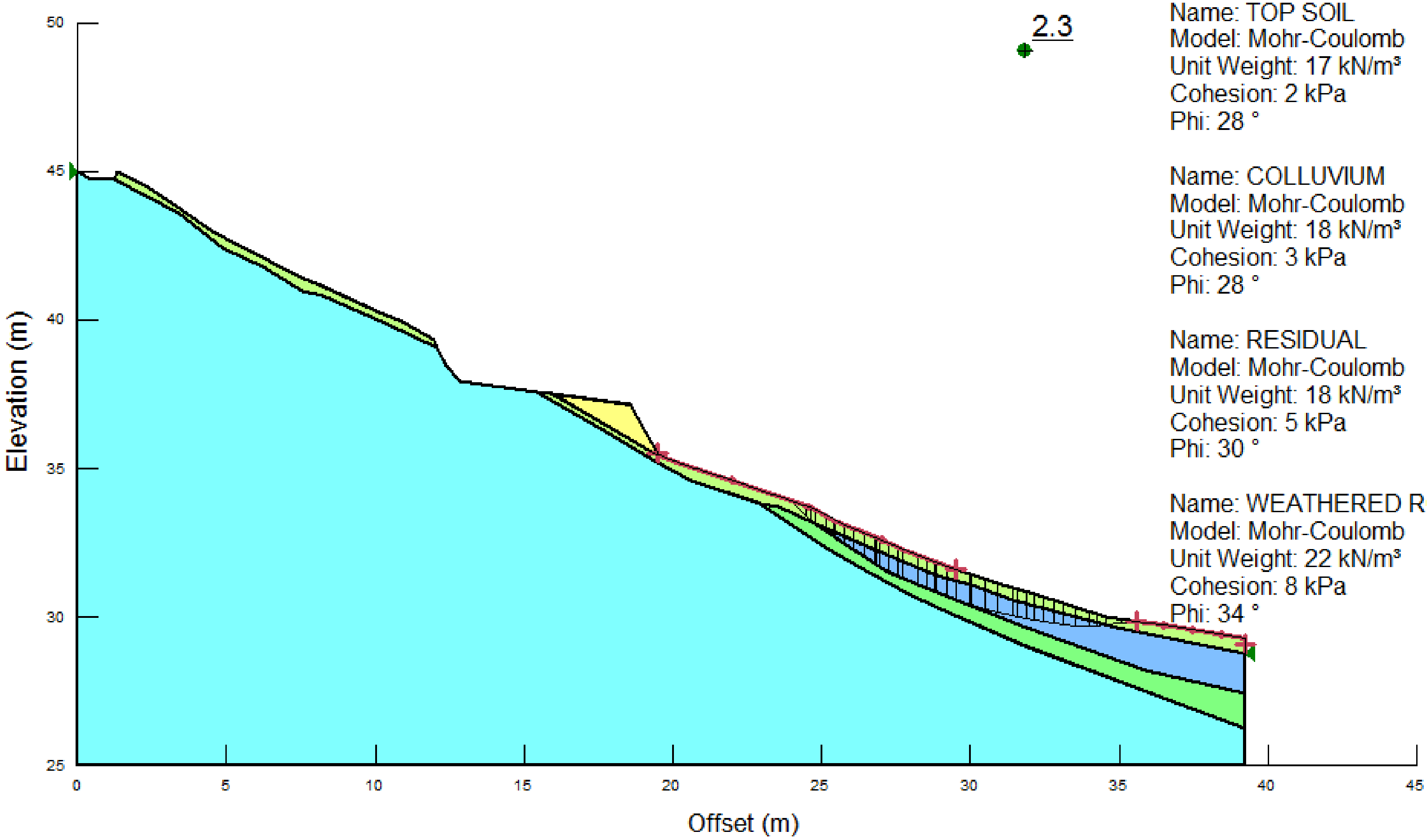
Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °
Ru: 0.1

Golder Associates

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	PROPOSED MIDDLE PLATFORM - WET CONDITION

File Name: 137632049 Existing Dry Downslope V1.gsz

Directory: C:\Users\GLu\Desktop\Lot 126\Slope Stability\Downslope\



Name: FILL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 3 kPa
Phi: 28 °

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °

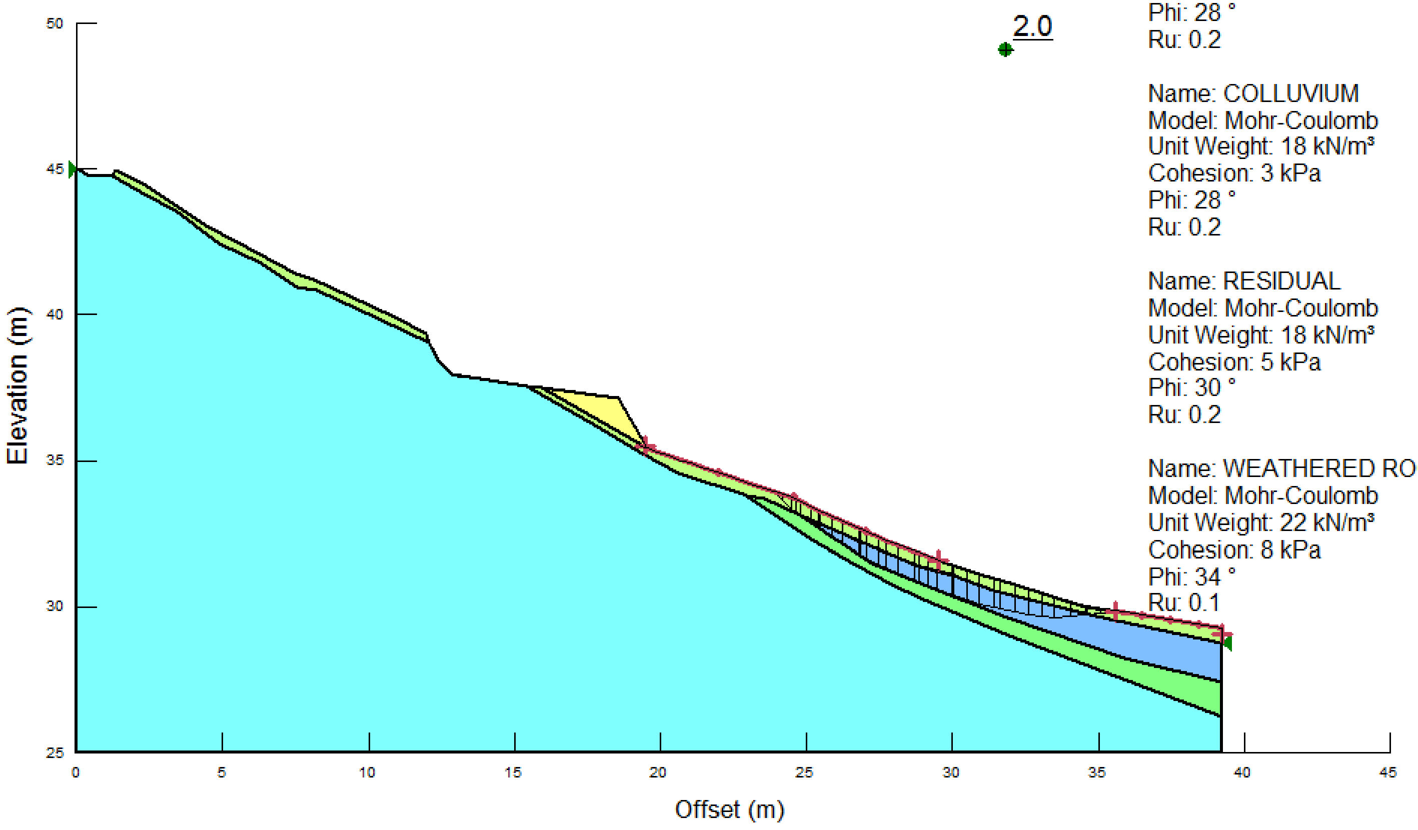
Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °

Project No.:	137632049	Computed In: SLOPE/W		RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	EXISTING DOWNSLOPE PROFILE - DRY CONDITION

File Name: 137632049 Existing Wet Downslope V1.gsz

Directory: C:\Users\GLu\Desktop\Lot 126\Slope Stability\Downslope\



Name: FILL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °
Ru: 0.2

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °
Ru: 0.2

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °
Ru: 0.1

Golder Associates

Project No.:	137632049	Computed In:	SLOPE/W	RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	EXISTING DOWNSLOPE PROFILE - WET CONDITION

File Name: 137632049 Proposed Dry Downslope V2.gsz

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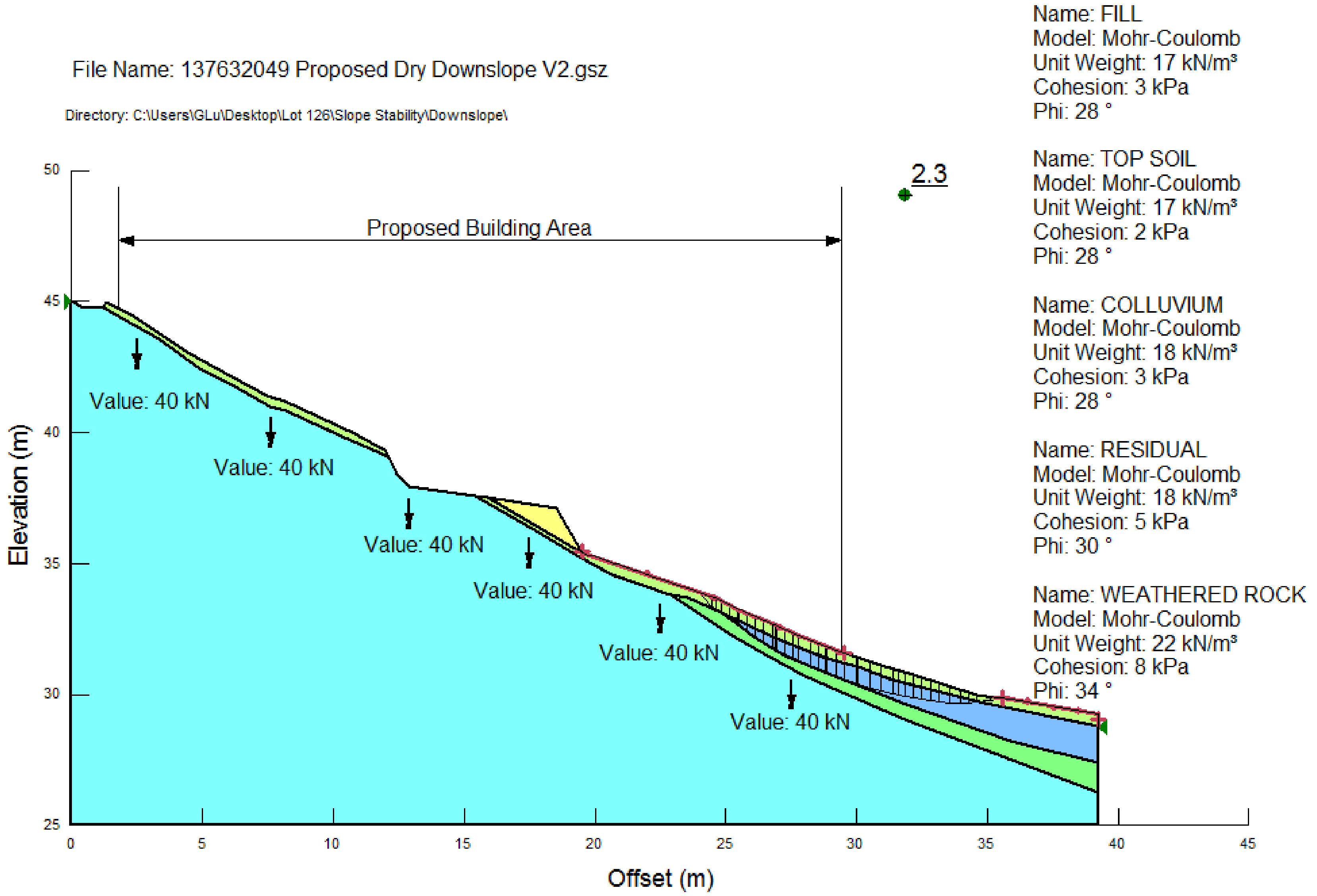


Name: FILL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m^3
Cohesion: 3 kPa
Phi: 28 °

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m^3
Cohesion: 2 kPa
Phi: 28 °

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m^3
Cohesion: 3 kPa
Phi: 28 °

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m^3
Cohesion: 5 kPa
Phi: 30 °

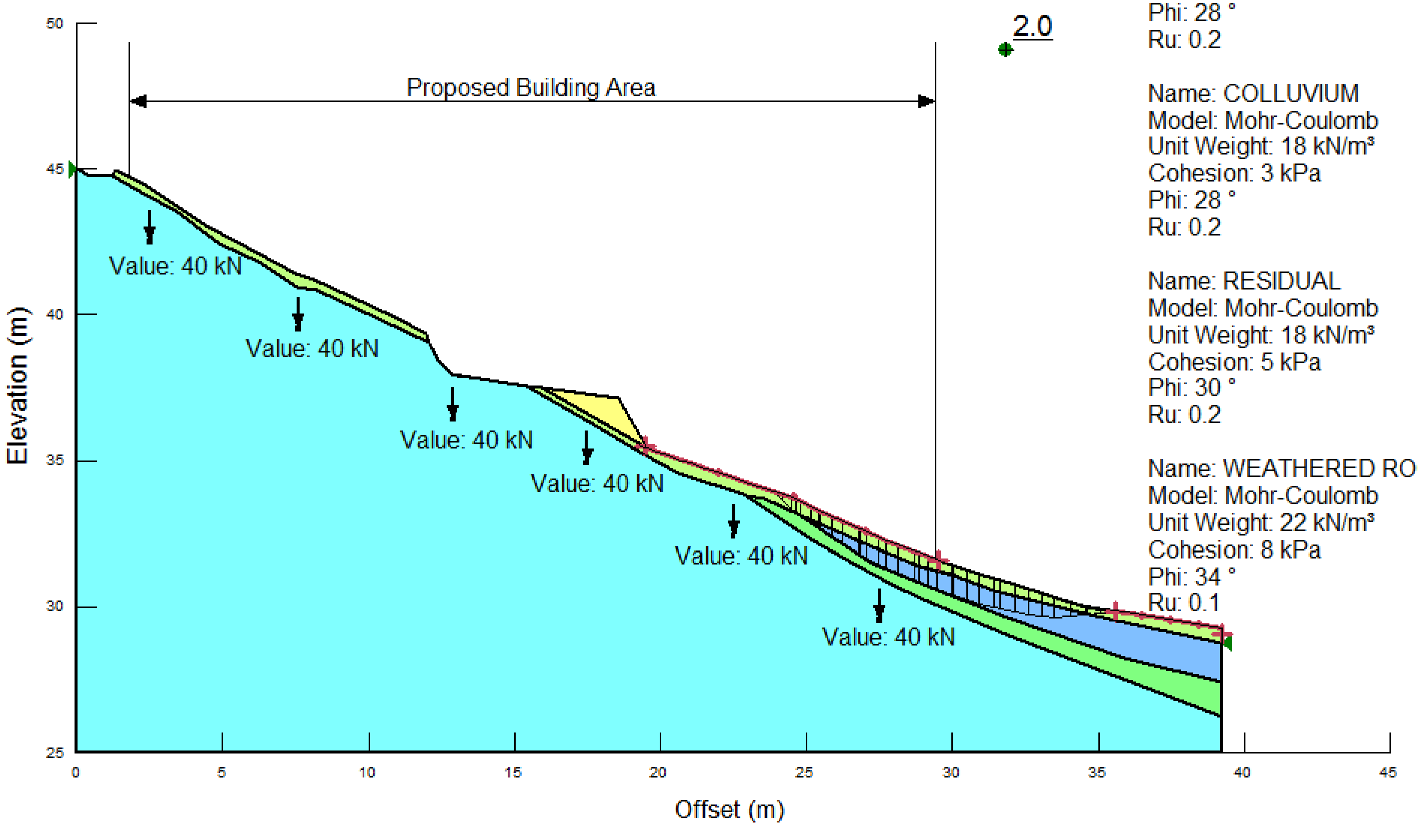
Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m^3
Cohesion: 8 kPa
Phi: 34 °

Golder Associates

Project No.:	137632049	Computed In:	SLOPE/W	RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	PROPOSED DOWNSLOPE PROFILE - DRY CONDITION

File Name: 137632049 Proposed Wet Downslope V2.gsz

Directory: C:\Users\GLu\Desktop\Lot 126\Slope Stability\Downslope\



Name: FILL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: TOP SOIL
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion: 2 kPa
Phi: 28 °
Ru: 0.2

Name: COLLUVIUM
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 3 kPa
Phi: 28 °
Ru: 0.2

Name: RESIDUAL
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 5 kPa
Phi: 30 °
Ru: 0.2

Name: WEATHERED ROCK
Model: Mohr-Coulomb
Unit Weight: 22 kN/m³
Cohesion: 8 kPa
Phi: 34 °
Ru: 0.1

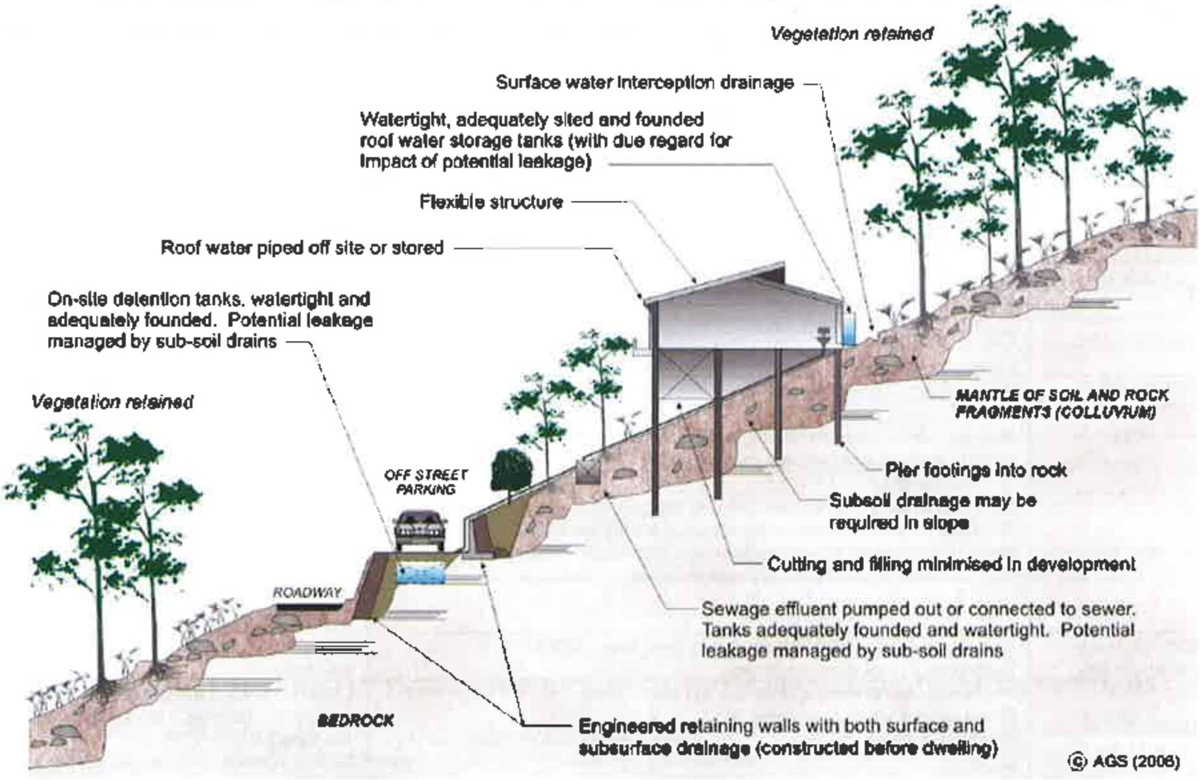
Golder Associates

Project No.:	137632049	Computed In:	SLOPE/W	RESULTS OF STABILITY ANALYSES – SECTION A
Computed By:	GZL	Checked By:	JD	LOT 126, MURPHY STREET, PORT DOUGLAS
Date:	04-04-2013	Date:	04-04-2013	PROPOSED DOWNSLOPE PROFILE - WET CONDITION

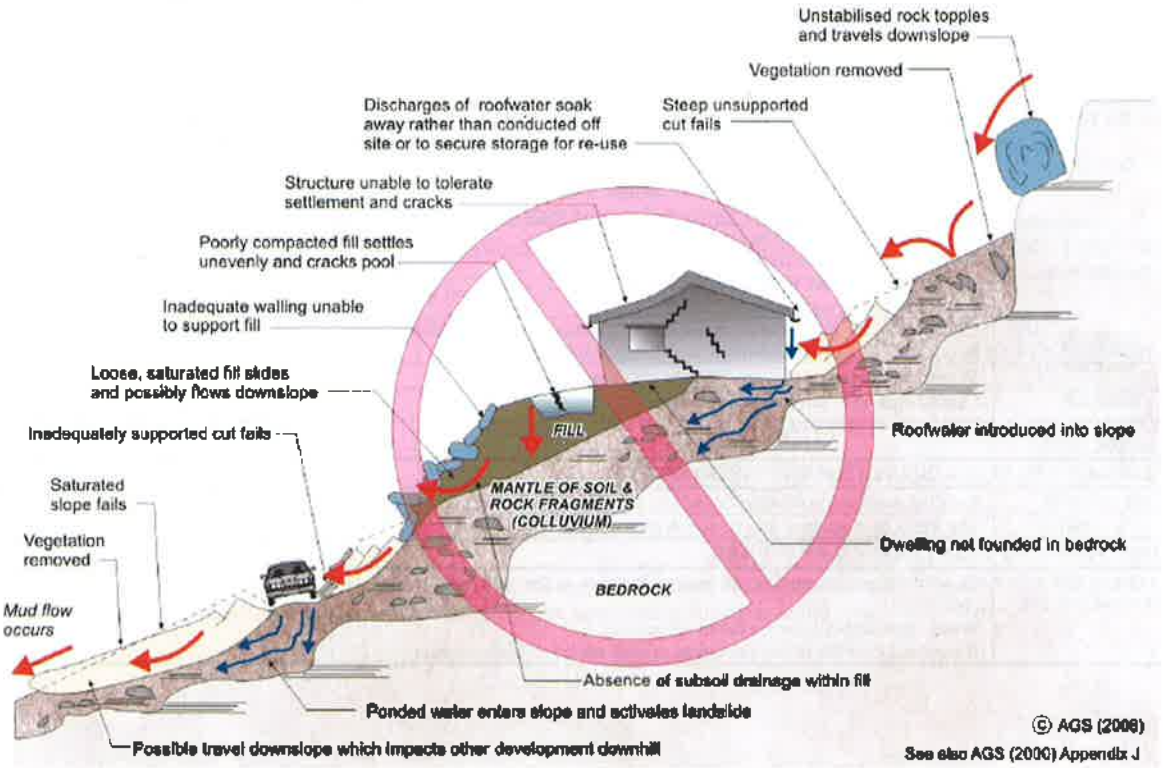
APPENDIX D

Good Hillside Practice (AGS)

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



APPENDIX E

Limitations

LIMITATIONS

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