tectonic
geotechnical & environmental engineers

11 July 2018

Project No. 18144-001-Rev1

CQ Soil Testing
Attention: Mr Scott Walton

Email: scott@cqsoiltesting.com.au

SLOPE STABILITY ASSESSMENT FOR PROPOSED RESIDENCE
43 ROSEWOOD DRIVE, NORMAN GARDENS

Dear Scott,

1.0 INTRODUCTION

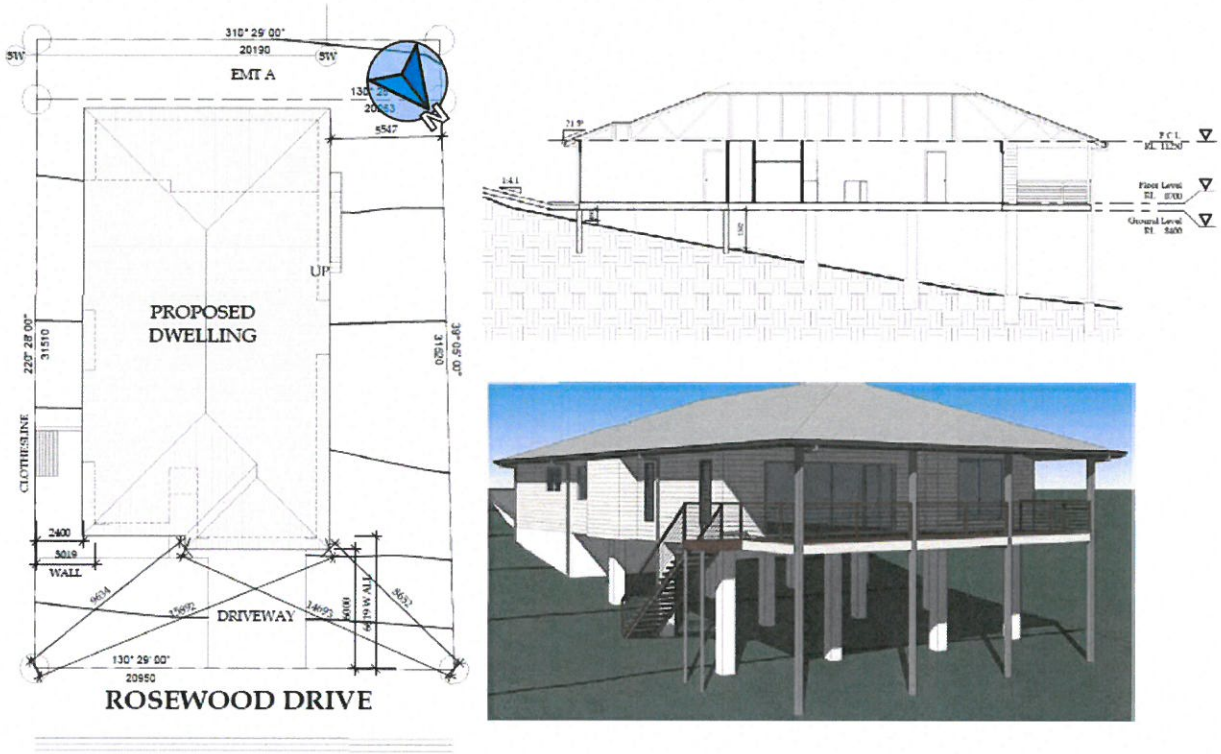
At the request of CQ Soil Testing (CQ), Tectonic has undertaken a slope stability assessment for a proposed residence at 43 Rosewood Drive, Norman Gardens. This report presents the results of our slope stability assessment, together with geotechnical advice for the proposed residence. In summary, subject to implementation of the recommendations made herein, it is assessed that there would be a Low Risk of slope instability affecting the proposed residence in accordance with the Australian Geomechanics Society "*Guidelines for Landslide Risk Management*", dated March 2007 (AGS 2007).

1.1 Details of Site and Development

The property is described as Lot 123 on RP882387 and covers an area of 648 m^2. The allotment has frontage to Rosewood Drive along the north-eastern boundary. Based on Rockhampton Regional Council (RRC) online mapping and aerial images, the allotment appears to be surrounded by similar suburban properties (Ref. Text Figure 1). A more detailed site description is given in Section 2.

Text Figure 1: 2016 image of surrounds (courtesy RRC); and aerial image during soil test 1 May 2018 (courtesy CQ)

We have been provided with proposed construction drawings (Chris Warren Homes [CWH] Dwg No 18-118-R Sheets A02 to A09, Rev. F, dated 4 July 2018) for the proposed residence, extracts of which are shown in Text Figure 2 below. It is understood that the proposed design for the house will include a driveway entry and garage formed approximately level with Rosewood Drive. It appears that the garage will be constructed using a slab on ground, with the remainder of the house being of high-set construction graded to suit the natural falling slope profile. The house is shown on drawings to be constructed using predominantly lightweight cladding to walls and sheet metal roofing, with brick/block piers under the house and posts supporting a rear deck.



Text Figure 2: Extract from proposed construction drawings (courtesy CWH)

1.2 Method and Scope of Investigation

As part of our slope stability assessment, a desk-top study was carried out comprising a review of published geology maps, aerial photographs, ground level contours, a soil test report by CQ dated 9 May 2018 (Job No. CQ15127), and site photographs provided by CQ.

The results of the desk-top study are included in Section 2 below.

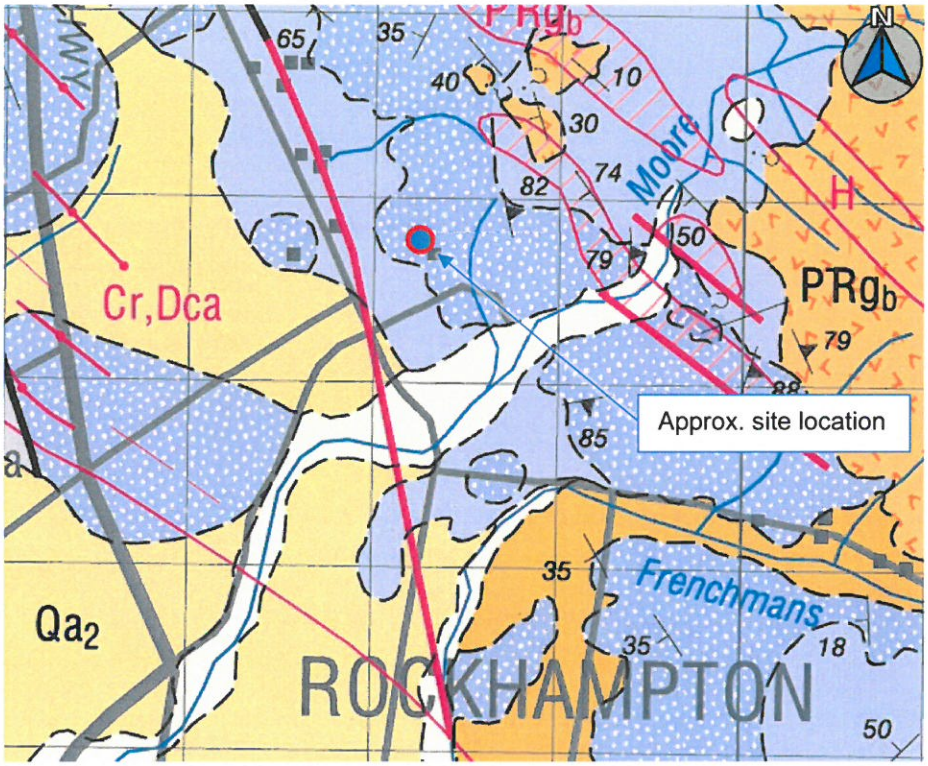
1.3 Qualifications of Responsible Engineer

This report has been reviewed by Mr Ashley Davey, an RPEQ with more than 20 years' experience in geotechnical engineering, including a number of slope stability projects.

2.0 DESCRIPTION OF EXISTING CONDITIONS

2.1 Geology

Available geological information[1] indicates that the site is underlain by Permian age Lakes Creek Formation (stippled blue shading) comprising *"siltstone and lithic sandstone."*



Text Figure 3: Extract from Rockhampton Geology Map

The CQ investigation comprised five boreholes (designated BH1 to BH5) drilled to depths of 0.6 m to 1.4 m below ground level (BGL) spread across the allotment, along with dynamic cone penetrometer (DCP) testing at each borehole location. The locations of these are shown in Text Figure 4 on the following page.

Subsurface conditions encountered in the CQ boreholes show that there is a deepening soil profile towards the downslope (south-western) part of the allotment.

Towards the top of the slope (BH1 and BH2) natural, very stiff, gravelly sandy silt is reported to a maximum depth of 0.6 m BGL, overlying dense to very dense, clayey sandy gravel (inferred as possible extremely weathered material). It was possible to drill in to the dense to very dense gravel for 0.2 m before auger refusal, and inferred weathered rock was encountered between 0.6 m and 0.8 m BGL.

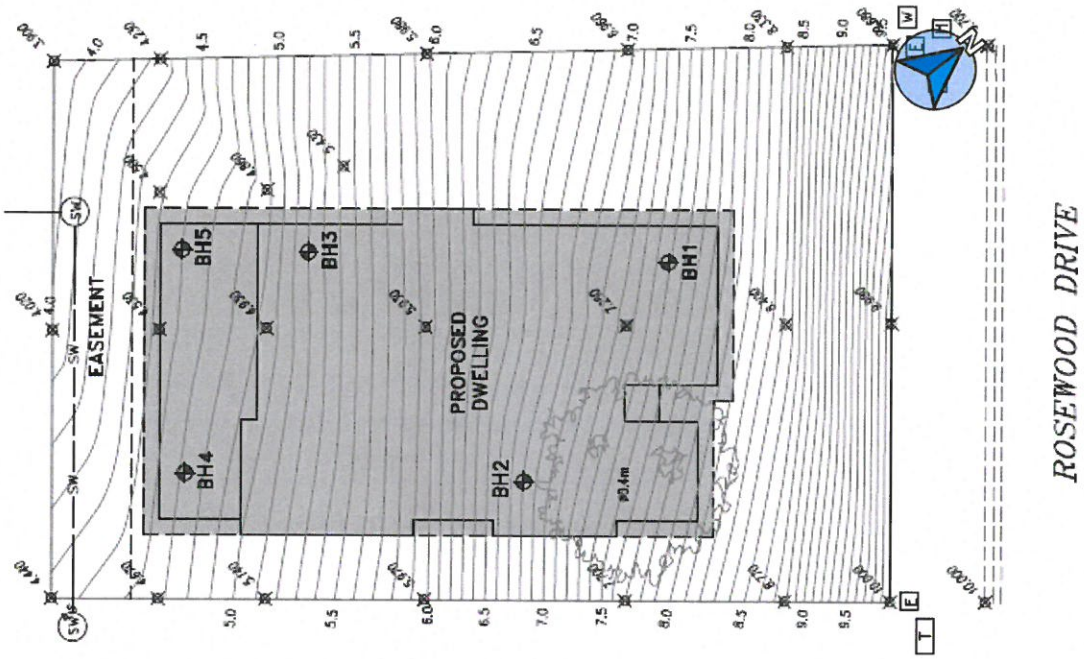
Towards the bottom of the slope (BH3, BH4 & BH5) natural, stiff to very stiff, gravelly sandy silt was logged to around 0.3 m BGL; with very stiff clay/sandy clay below to around 1.2m BGL; then dense to very dense clayey sandy gravel to depths of between 1.2 m and 1.4 m BGL, where auger refusal was encountered and weathered rock inferred.

[1] The State of Queensland, Department of Mines and Energy, Geological Survey of Queensland, 1:100,000 Rockhampton, Sheet 9051, Revised Edition 2006

DCP testing conducted by CQ adjacent to and within each borehole indicates that the natural soils are very dense (or denser) below 0.6 m BGL at the top of the slope; and are very stiff to hard/dense (or denser) below about 0.9 m BGL towards the lower parts of the site.

CQ have classified the site as ***Class M***, in accordance with AS2870-2011 *Residential Slabs & Footings*, with an estimated characteristic surface movement (y_s) therefore of 20 mm to 40 mm.

No groundwater was mentioned in the CQ borehole reports, with the soil generally described as dry.

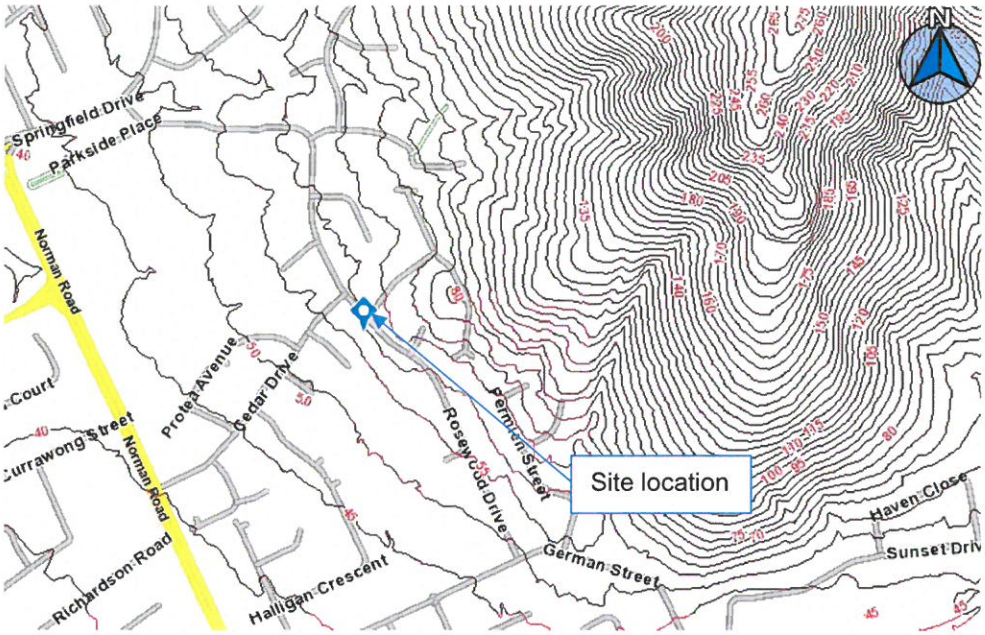


Text Figure 4: Borehole location plan (courtesy CQ)

2.2 Topography

As shown by the ground surface contours in Text Figure 5 on the following page, regionally the site is located on the lower western flanks of relatively steep, high ground to the east. The site is located towards the lower extent of a rounded spur, and slopes down to the south-west, with ground surface contours between about RL 61 m and RL 56 m AHD.

The shape of the ground surface is waning (decreasing) and planar. The contours generally indicate the steeper ground adjacent to Rosewood Drive is inclined at around 15° (27 %) to the south-west, and towards the bottom of the site is more gentle at around 8° (14 %). As shown in Text Figure 7 on the following page, there appears to be a fill embankment associated with the adjacent road construction along the front of the block. Although no boreholes were drilled in this area by CQ, we estimate that the fill ranges up to approximately 1 m high.



Text Figure 5: Image showing ground surface contours (courtesy RRC online mapping)

Text Figure 6: Site conditions at the time of investigation looking southwest from Rosewood Dr (photos by CQ)

Text Figure 7: Site conditions at the time of investigation looking to Rosewood Dr from south of site (photos by CQ)

2.3 Groundwater

No signs of surface groundwater seepage ('springs') were reported by CQ, nor encountered in boreholes.

2.4 Surface Drainage

Site photos and available contour information indicates that the ground surface slope is generally waning (decreasing) and planar, indicating surface water should be spread as sheet flow across the site and not be concentrated by the topography. Surface runoff is expected to follow the ground surface contours towards the south-west, and drain well from the site considering the positive gradients, and only moderately permeable immediate subsurface materials (sandy silt). Although the downslope part of the site is more gently sloping, it is also noted that running along the south-western boundary to the south is a stormwater easement (indicated on RCC mapping, Ref. Text Figure 1), which may aid in removing surface/stormwater.

2.5 Vegetation

The ground surface generally featured short grass, with one large mature tree towards the north-western corner of the site (Ref. Text Figures 6 and 7). Based upon photos provided by CQ, this does not appear to be unusually tilting or distorted in its growth.

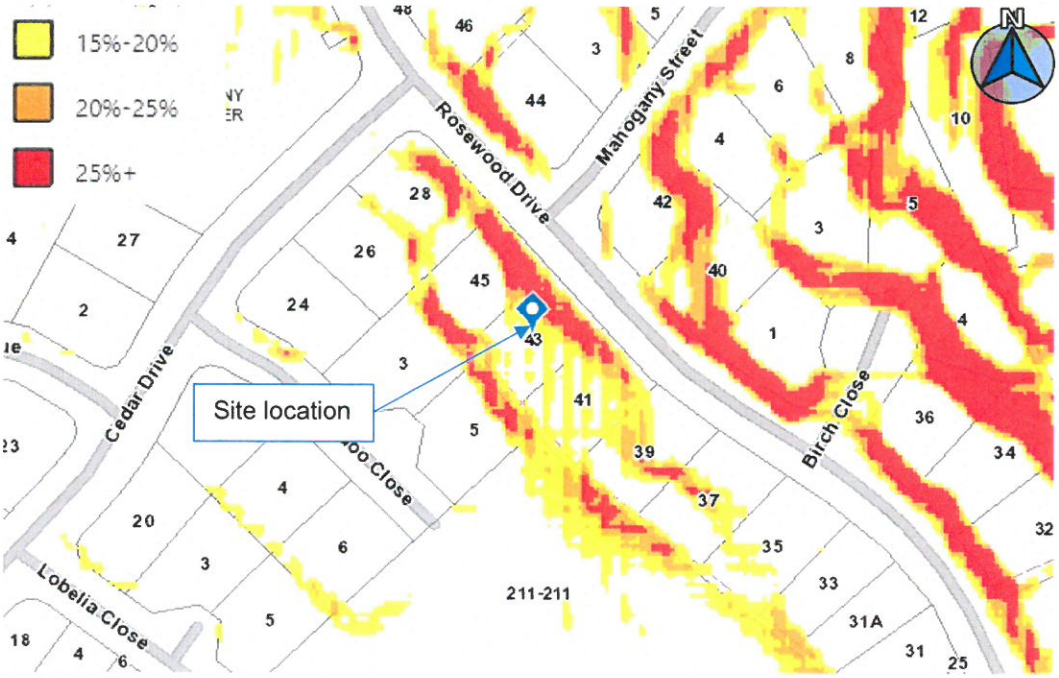
2.6 Buildings and Other Structures

No buildings or structures were located on the lot at the time of the CQ investigation. Notes on the condition of structures on adjacent blocks were not provided prior to this assessment.

3.0 ASSESSMENT OF LAND STABILITY

3.1 Existing Conditions

RRC Planning Scheme Steep Land Overlay (Refer extract in Text Figure 8) mapping indicates that, towards the north-eastern and south-western boundaries of the site, land between 20 % and >25 % (11° and >14°) (orange/red shading) exists, with some ground across the middle of the site indicated to be between 15 % and 20 % (8.5° and 11°).



Text Figure 8: Extract from RRC Steep Land Overlay

It should be noted that the RRC mapping is an indication of land slope (land >15%) rather than potential landslide susceptibility. For slopes over 15%, RRC requires a site specific geotechnical report to address stability. Based on available information, the site does not exhibit any indicators of slope instability. No landslide back scarps, tension cracks, or areas of naturally 'hummocky' ground are apparent in photographs supplied by CQ, and slopes are moderate across the site (8° to 15°/14 % to 27 %).

3.2 Stability Assessment

The risk assessment for this project has been carried out following AGS 2007 Practice Note Guidelines for Landslide Risk Management. Relative levels of risk and their implications are given in Table 1 below and the *Qualitative Terminology for Use in Assessing Risk to Property* is also attached.

Table 1: Stability Risk Levels

Risk Level		Example Implications(1)
VH	Very High Risk	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 likely to cost more than value of property.
H	High Risk	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 Risk	May be tolerated in certain circumstances (subject to regulators' approval) but requires investigation, planning and implementation of treatment options to reduce risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	Low Risk	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance required.
VL	Very Low Risk	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

Considering the existing site information provided by CQ (Ref. Section 2), and subject to the implementation of the recommendations given below, it is assessed that there is a **Low (L) Risk** of global slope instability affecting the proposed residence. Regulators (RRC) normally require that a Very Low or Low Risk of landslide affecting property must be demonstrated to enable development approval.

Summarised in Table 2 on the following page is our qualitative assessment of landslide risk for the site. A summary of qualitative terminology for use in assessing risk to property is attached (taken from AGS 2007).

Table 2: Details of Qualitative Risk Assessment for Property (AGS 2007)

Hazard	Likelihood	Consequence	Assessed Risk	Comments
1: Shallow failure through residual soils above foundation depths	**Unlikely**	**Minor**	**Low**	The likelihood of a failure through residual soils in the vicinity of the proposed residence is assessed as **Unlikely** due to the moderate natural gradients, shallow depth to rockhead, apparent lack of groundwater, and subject to our recommendations in Section 4 of this report. The consequence of such a failure would be **Minor** considering the anticipated limited effects of such shallow instability, with the resultant risk being **Low** as per AGS 2007.
2: Deep failure through weathered rock below the foundation depth	**Barely Credible**	**Major**	**Very Low**	The likelihood of a deep failure through the weathered rock is assessed as **Barely Credible** due to the strength and shallow occurrence of this material, moderate ground slopes, lack of evidence of such deep seated instability in the area, and subject to implementation of our recommendations in Section 4 of this report. Although the consequence of such a failure could be **Major**, the resultant risk is **Very Low** as per AGS 2007.

The potential impacts on slope stability of the development components have been assessed, and the measures recommended below in Section 4 have been designed to mitigate those impacts.

4.0 RECOMMENDATIONS

General recommendations to help maintain the stability of the site area also given in the document *"Some Guidelines for Hillside Construction"*, which is attached.

4.1 Site Layout

The proposed building location as shown in drawings provided to us (CWH, Dwg No 18-118-R Sheets A02 to A09, Rev. F, dated 4 July 2018), is considered suitable from a slope stability viewpoint. Should it be proposed to alter the building location, Tectonic must be notified to enable an assessment of the impact on slope stability.

4.2 Earthworks

Based on the drawings provided to us, cutting and filling would be restricted to the garage/driveway area and should not exceed 1.6 m in height. Cut excavations or fill heights greater than 1 m should be retained by engineer designed retaining walls. Should fill earthworks greater than 1.6 m high be proposed Tectonic must be notified to enable an assessment of the impact on slope stability.

Any organic rich topsoil and severely root affected soils must be stripped and removed from the proposed construction area. Tree roots must be grubbed out if they are within the proposed building footprint.

Any fill materials should be compacted at moisture contents within the range of -2% to +2% of optimum moisture content for Standard Compaction. Confirmatory testing must be carried out at regular intervals and further details for control and testing of fill are given in Australian Standard AS 3798-2007 "*Guidelines on Earthworks for Commercial and Residential Developments*". Select fill should have a maximum particle size of 100 mm for an uncompacted layer thickness of 200 mm and shall be compacted by repeated rolling with a small compactor to achieve a dry density ratio of at least 95% of the Standard Maximum Dry Density for cohesive soils, or 70% Dry Density Index for any imported cohesionless soils.

Sloping ground must be benched to 'key in' fill material. Fill batters should be over-filled by 0.5 m (horizontally) and then trimmed back to the well compacted material.

Temporary batter slopes could be constructed at a maximum grade of 1V:1H in soil materials on site; with permanent batters recommended at no steeper than 1V:2H. Permanent soil or fill batters will require erosion protection (e.g. revegetation or surface protection).

4.3 Retaining Structures

Retaining structures greater than 1 m high shall be founded as described in Section 4.4 below, and will require engineer design and certification of construction.

We suggest the parameters given in Table 3 below may be adopted for retaining wall design:

Table 3: Retaining Wall Design Parameters

Retained material	Unit weight (kN/m^3)	Friction angle (Degrees)	Lateral earth pressure coefficients		
			K_a (Cantilever wall)	K_o (Non-yielding wall)	K_p
Stiff to Very Stiff Gravelly Clayey Silts	19	25	0.40	0.57	2.46
Very Stiff Clay/Sandy Clay	19	28	0.36	0.53	2.77
Dense to Very Dense Clayey Sandy Gravel	21	36	0.26	0.41	3.85
Fill	*	*	*	*	*

*Depends on type of fill used, and level/quality of compaction

These parameters do not include allowance for surcharge above the wall, or additional loads imposed by sloping ground.

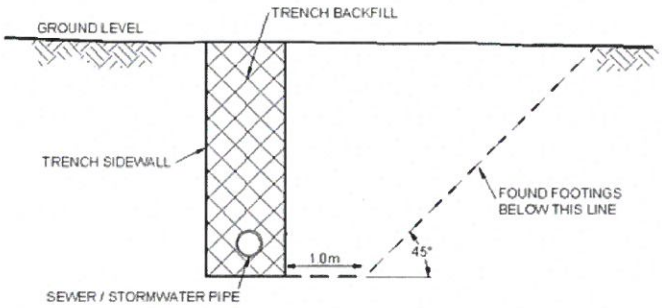
4.4 Footing Design

Footings for the residence and any retaining walls should penetrate through any fill placed on site, to found at least 300 mm into the very dense natural clayey sandy gravel (inferred weathered rock), or at drilling/excavation refusal in such materials. Footings, so founded, could be designed with an allowable bearing capacity of 400 kPa. Nominally this may mean footings at the top of the slope would be founded in the order of 1 m depth; with those furthest downslope being around 1.5 m depth.

Off Rosewood Drive to the north-east of the site, it is possible that following cutting to form a level pad for the garage slab, that normally dimensioned high level footings, or perhaps 'bucket piers' may achieve this requirement. However, with the sloping nature of the site, and high-set construction downslope from Rosewood Drive, bored piles (or similar) should be adopted for design.

CQ Soil Testing has determined that the site classification would be *Class M* in accordance with the definitions given in AS270. Design of the footing system must take the potential site reactivity ($20\ mm < y_s < 40\ mm$) into account.

All footings should found such that they are not adversely affected by any adjacent excavations, batter slopes, trenches, or retaining walls that are not designed to support building loads. Footings should found at least below a plane extending 1 m horizontally from the base of trenches/batter slopes/excavations/retaining walls, then rising up at 1V:1H, as illustrated in Text Figure 9 below.



Text Figure 9: Footing depth required to minimise risk of undermining

If any soil conditions encountered during construction are found to differ from those noted in the geotechnical investigation, CQ and Tectonic should be notified immediately and an inspection carried out to determine if changes to footing design are required.

4.5 Drainage

Temporary construction drainage should be implemented such as perimeter surface drains, and positive grades across building areas.

Surface diversion drainage should be constructed upslope of the residence and above the crest of any cut or fill embankments (e.g. grassed or lined swales or diversion mounds). Adequate site drainage should be installed to ensure that stormwater runoff is directed away from building walls and footings. Grated channel drains should also be constructed across the driveway and adjacent to any other sealed surfaces such as perimeter footpaths where there is sloping ground above.

Subsurface drainage must be installed behind future retaining walls in order to prevent the development of hydrostatic pressure (e.g. slotted 'aggi' pipe wrapped in filter 'sock' placed in gravel backfill).

All excess stormwater collected around the residence and tank overflow water must be directed by pipes or lined channels to the council stormwater system along the southwestern boundary.

5.0 SUMMARY & CONCLUSIONS

Based on the findings of our assessment we consider, from a geotechnical viewpoint, that the site is suitable for the proposed residential development and that there should be a Low Risk of slope instability. This advice is subject to implementation of the recommendations given in this report, in particular:

- Minimising fill generally to not more than 1 m high and restricting filling to the driveway and garage building area to 1.6 m as noted in construction drawings, unless assessed and approved by Tectonic.
- Cuts/fills in excess of 1 m depth/height are to be supported by engineer designed retaining walls.
- Supporting the residence on footings (likely short piles) taken at least 300 mm into very dense gravel/weathered rock beneath the soil profile.
- Directing stormwater to the existing stormwater infrastructure along the south-western boundary.

6.0 LIMITATIONS

Your attention is drawn to the document Limitations, which is attached to this letter report.

Please contact the undersigned should you wish to discuss any of the above matters.

Yours faithfully

TECTONIC GEOTECHNICAL PTY LTD

Robert Gibb BSc (Hons)
Engineering Geologist

Ashley Davey RPEQ 8159
Principal Geotechnical Engineer/Director

Attachments: CQ Report CQ15127, dated 9 May 2018
Qualitative Terminology for Use in Assessing Risk to Property
Some Guidelines for Hillside Construction
Limitations

CQ SOIL TESTING | Servicing all of Central Queensland

Geotechnical Testing and Borehole Logs

CLIENT: Chris Warren homes

SITE ADDRESS: Lot 123 (RP882387)
43 Rosewood drive, Norman Gardens

JOB NUMBER: CQ15127

ISSUE DATE: 09/05/2018

QBCC Lic. No. 1117681 ABN. 47715943484 Ph: (07) 4936 1163 Fax: (07) 4936 1162 Email: info@cqsoiltesting.com.au

BH1

Project name	Lot 123 Rosewood Drive, Norman Gardens
Client	Chris Warren Homes
Date drilled	01/05/2018
Driller	D Martin
Method	Solid Auger
Logged by	D Martin
Notes	Slope Stability

Depth (m)	Visual Class'n Symbol	Visual Description of Material	Sample
0.0	ML	Gravelly Sandy SILT, low plasticity, fine to medium grained, brown, D-M, VST.	
0.6			
0.6	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD.	
0.8		**Weathered rock**	

Tungsten carbide bit refusal at 0.8 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS

Depth (mm)	DCP Blows/100mm Dynamic Cone	DCP Blows/100mm Perth SAND
100	9	250
200	>15	>300
300	Drill	
400	Drill	
500	Drill	
600	>15	>300
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
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3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		
4100		
4200		
4300		
4400		
4500		
4600		
4700		
4800		
4900		
5000		

BH2

Project name	Lot 123 Rosewood Drive, Norman Gardens
Client	Chris Warren Homes
Date drilled	01/05/2018
Driller	D Martin
Method	Solid Auger
Logged by	D Martin
Notes	Slope Stability

Depth (m)	Visual Class'n Symbol	Visual Description of Material	Sample
0.0	ML	Gravelly Sandy SILT, low plasticity, fine to medium grained, brown, D-M, VST.	
0.4			
0.4	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD.	
0.6		**Weathered rock**	

Tungsten carbide bit refusal at 0.6 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS

Depth (mm)	DCP Blows/100mm Dynamic Cone	DCP Blows/100mm Perth SAND
100	12	250
200	>15	>300
300	Drill	
400	Drill	
500	>15	>300
600		
700		
800		
900		
1000		
1100		
1200		
1300		
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4000		
4100		
4200		
4300		
4400		
4500		
4600		
4700		
4800		
4900		
5000		

BH3

Project name	Lot 123 Rosewood Drive, Norman Gardens
Client	Chris Warren Homes
Date drilled	01/05/2018
Driller	D Martin
Method	Solid Auger
Logged by	D Martin
Notes	Slope Stability

Depth (m)	Visual Class'n Symbol	Visual Description of Material	Sample
0.0 0.3	ML	Gravelly Sandy SILT, low plasticity, fine to medium grained, dark brown, D-M, ST-VST.	
0.3 1.2	CI	Sandy CLAY, medium plasticity, fine to coarse grained, brown, D, VST.	
1.2 1.4	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD. **Weathered rock**	

Tungsten carbide bit refusal at 1.4 m

Classification tests:
0.6 –1.0 m

% Passing 75 um	58
Natural MC%	11
Liquid Limit	46
Plastic Index	18
Iss	ND
Emerson Class	ND

Test Methods:
AS 1289 2.1.1, 3.1.1, 3.1.2, 3.3.1, 3.3.2, 3.4.1, 3.6.1, 3.8.1, 3.9.1, 3.9.2: Moisture content (oven drying); liquid limit (Casagrande); plastic limit; plasticity index; cone plasticity index; linear shrinkage; sieve analysis; Emerson class number

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS

Depth (mm)	DCP Blows/100mm Dynamic Cone	DCP Blows/100mm Perth SAND
100	3	100
200	5	160
300	9	250
400	9	250
500	12	250
600	12	250
700	10	250
800	12	250
900	>15	>300
1000		
1100		
1200		
1300		
1400		
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3400		
3500		
3600		
3700		
3800		
3900		
4000		
4100		
4200		
4300		
4400		
4500		
4600		
4700		
4800		
4900		
5000		

BH4

Project name	Lot 123 Rosewood Drive, Norman Gardens
Client	Chris Warren Homes
Date drilled	01/05/2018
Driller	D Martin
Method	Solid Auger
Logged by	D Martin
Notes	Slope Stability

Depth (m)	Visual Class'n Symbol	Visual Description of Material	Sample
0.0 0.3	ML	Sandy SILT, low plasticity, fine to medium grained, trace fine to coarse grained gravel, dark brown, D-M, ST-VST.	
0.3 0.7	CI	Sandy CLAY, medium plasticity, fine to coarse grained, brown, D, VST.	
0.7 1.1	CH	CLAY, high plasticity, trace fine to coarse grained sand, brown, D, VST.	
1.1 1.2	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD. **Weathered rock**	

Tungsten carbide bit refusal at 1.2 m

Classification tests:
0.7 –1.1 m

% Passing 75 um	ND
Natural MC%	20
Liquid Limit	ND
Plastic Index	ND
Iss	2.9
Emerson Class	ND

Test Methods:
AS 1289 2.1.1, 3.1.1, 3.1.2, 3.3.1, 3.3.2, 3.4.1, 3.6.1, 3.8.1, 3.9.1, 3.9.2: Moisture content (oven drying); liquid limit (Casagrande); plastic limit; plasticity index; cone plasticity index; linear shrinkage; sieve analysis; Emerson class number

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS

Depth (mm)	DCP Blows/100mm Dynamic Cone	DCP Blows/100mm Perth SAND
100	3	100
200	3	100
300	7	200
400	9	250
500	10	250
600	>15	>300
700	Drill	
800	10	250
900	>15	>300
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		
4100		
4200		
4300		
4400		
4500		
4600		
4700		
4800		
4900		
5000		

BH5

Project name	Lot 123 Rosewood Drive, Norman Gardens
Client	Chris Warren Homes
Date drilled	01/05/2018
Driller	D Martin
Method	Solid Auger
Logged by	D Martin
Notes	Slope Stability

Depth (m)	Visual Class'n Symbol	Visual Description of Material	Sample
0.0 0.1	ML	Sandy SILT, low plasticity, fine to medium grained, trace fine to coarse grained gravel, dark brown, D-M, ST-VST.	
0.1 0.8	CI	Sandy CLAY, medium plasticity, fine to coarse grained, brown, D, VST.	
0.8 1.2	CH	CLAY, high plasticity, trace fine to coarse grained sand, brown, D, VST.	
1.2 1.3	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD. **Weathered rock**	

Tungsten carbide bit refusal at 1.3 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS

Depth (mm)	DCP Blows/100mm Dynamic Cone	DCP Blows/100mm Perth SAND
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		
4100		
4200		
4300		
4400		
4500		
4600		
4700		
4800		
4900		
5000		

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years		The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years	200,000 years	The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	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.	CATASTROPHIC	1
60%	40%	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.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or L (5)
B - LIKELY	10^{-2}	VH	VH	H	M	L
C - POSSIBLE	10^{-3}	VH	H	M	M	VL
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

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	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 likely to cost more than value of the property.
H	HIGH RISK	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 RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

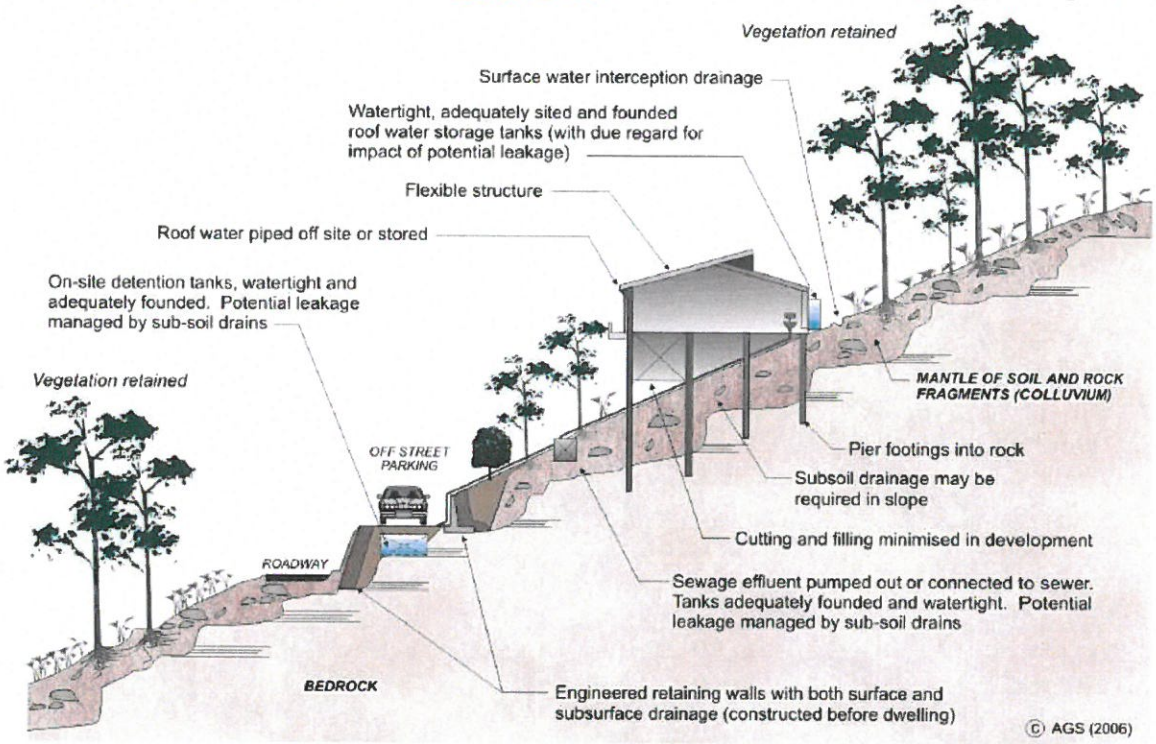
Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

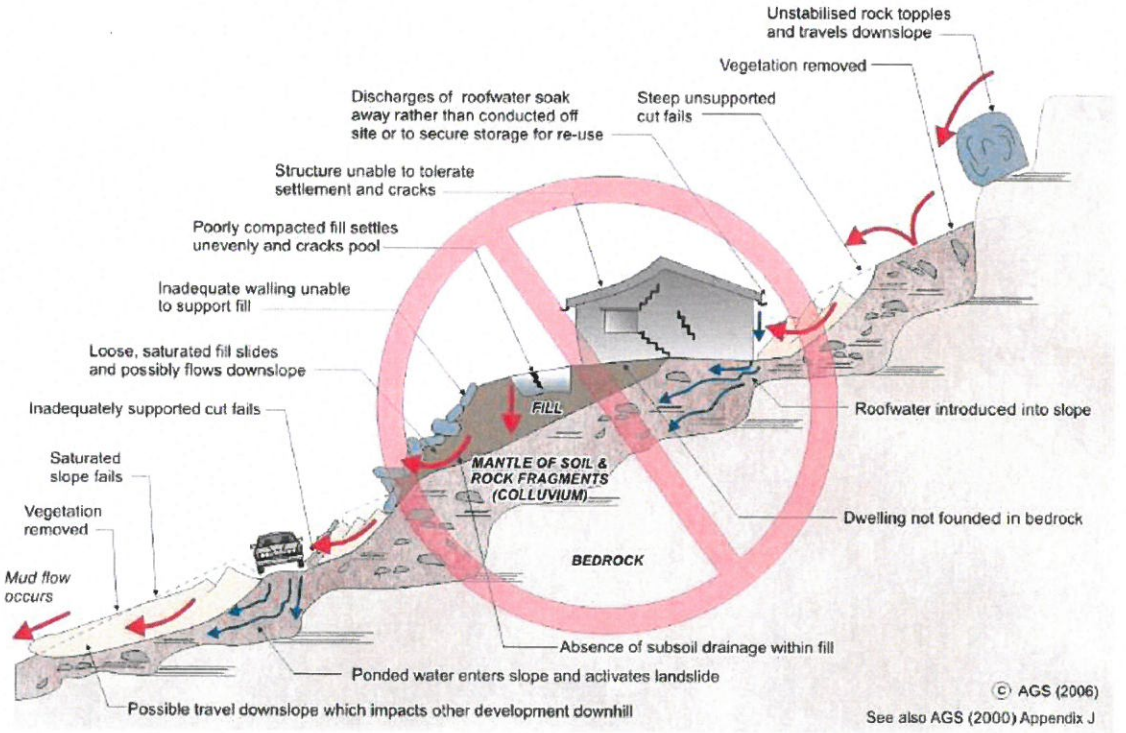
	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminatory bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

Form No. 68029 RL2 August 2010

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



tectonic
geotechnical & environmental engineers

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SITE & TOWN PLANNING INFORMATION

It is the Owner/Builders responsibility to comply to all sections of Decision Notice

DA/MCU Required Y/N & who to complete	Y
DA/MCU Type (if required)	-Steep Land
DA/MCU Decision Notice #	TBA
Boundary Relaxation required Y/N & who to complete	N
Sewer Line Located & marked on Plan Y/N	Y

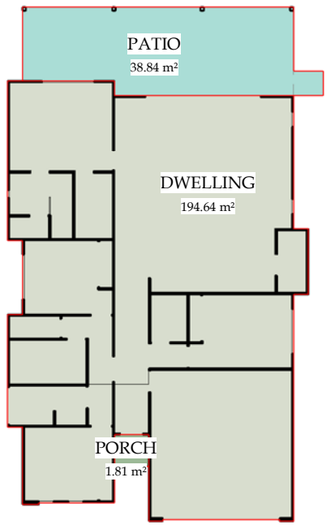
ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

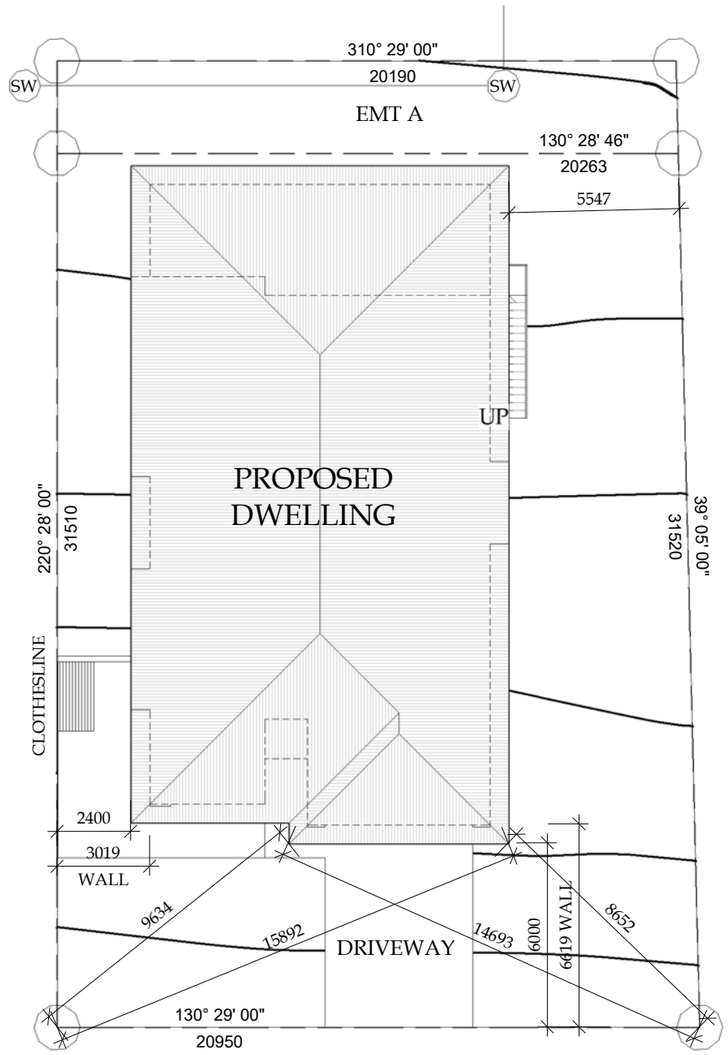
These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/53-2018

Dated: 6 August 2018



4 Area Plan
1 : 250



3 Site Plan
1 : 200

RP Data

Lot Number :	123
RP/SP Number :	RP882387
Parish :	MURCHISON
County :	LIVINGSTONE
Area :	648 m²
Site Cover:	36.3%

SUF	REVISIONS	DATE	INIT
A	PRELIMINARY	17/04/18	JG
B	AMENDED	23/04/18	LMC
C	AMENDED	24/04/18	JG
D	AMENDED	26/04/18	LMC
E	CONSTRUCTION	26/04/18	LMC
F	AMENDED	04/07/18	LMC

JOB DESCRIPTION
NEW DWELLING

DESIGN
MOD PHOBOS 215

CLIENT
CWH

ADDRESS
LOT 123 ROSEWOOD DRIVE, NORMAN GARDENS

CEADS CAPRICORN ENGINEERING AND DRAFTING SERVICES
INDUSTRIAL COMMERCIAL RESIDENTIAL
BSA - 1126594 BSA - 1126593
building designers association of queensland inc.
PO Box 1734, Yeppoon, QLD , 4703
PH: (07) 49250772 Fax: (07) 49395808
Email: info@ceads.com.au
www.ceads.com.au

DATE: 26/04/18

DRAWN	CHECKED
LMC	DEL

SCALE: As indicated — SHOWN AT A3

DWG NAME. SITE PLAN

DWG No. 18-118-R SHT No. A02

CWH CHRIS WARREN HOMES Today's Builder Yesterday's Values

Area Schedule	
Name	Area
DWELLING	194.64 m²
PORCH	1.81 m²
PATIO	38.84 m²
	235.29 m²

Structural Column Schedule			
Mark	Post Size	Post Type	Count
C1	150x150x4.0	SHS	4
C2	400x400	Block Pier	12
C3	75x75x4.0	SHS	2

ROCKHAMPTON REGIONAL COUNCIL

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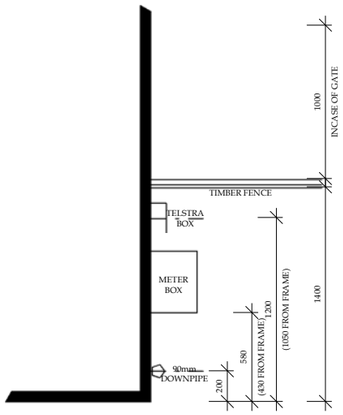
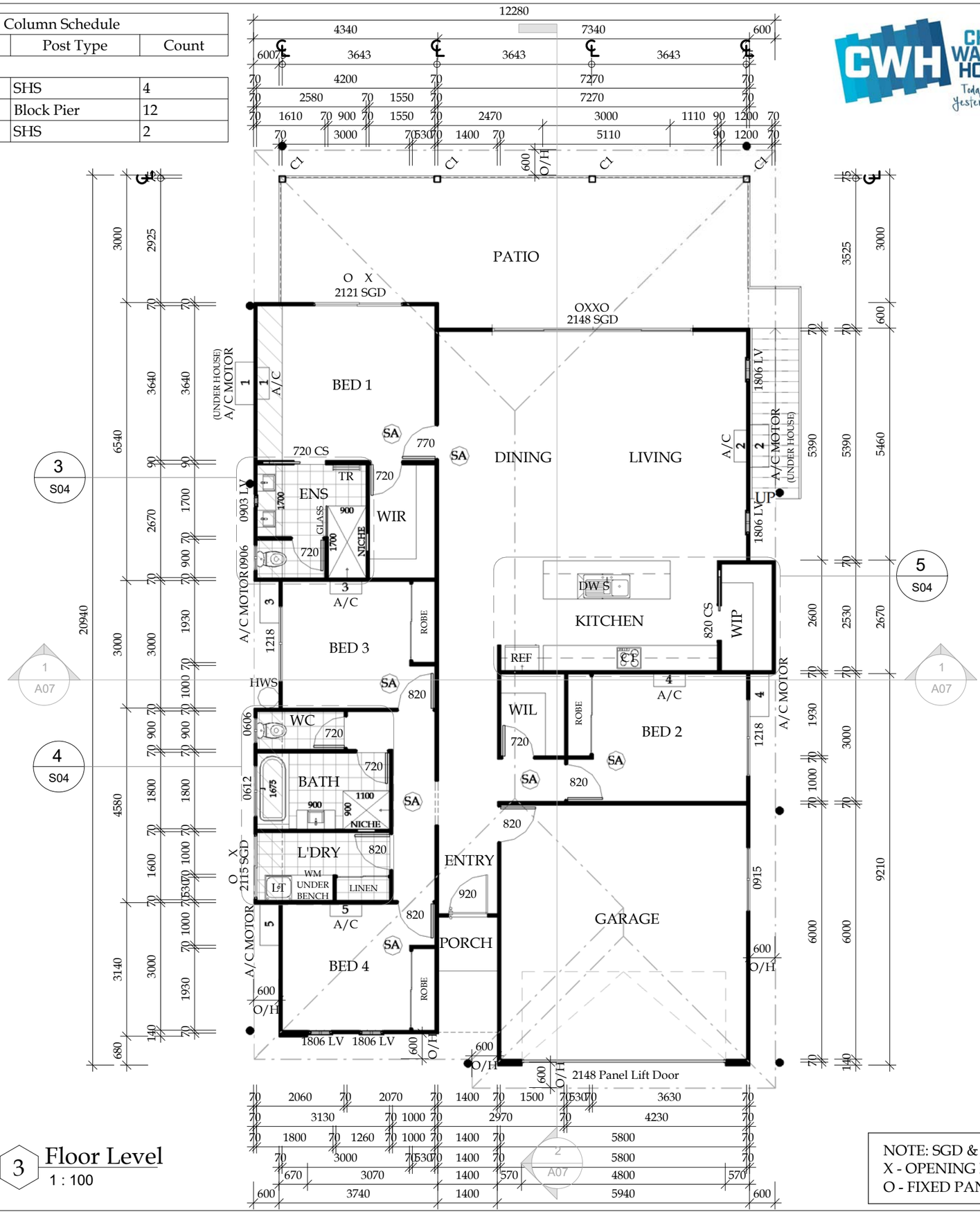


1 Services Details
1 : 40



3 Floor Level
1 : 100

SYMBOL	DESCRIPTION
●	DOWNPIPE (Refer Roof Drainage Plan for type)
⊗	VENTED SKYLIGHT
▨	DROPPED CEILING
SA	SMOKE DETECTOR (in accordance with part 3.7.2 B.C.A vol 2. Smoke Alarms must comply with AS3786-2014)

NOTE: SGD & SGW
X - OPENING PANEL
O - FIXED PANEL

SUF	REVISIONS	DATE	INIT
A	PRELIMINARY	17/04/18	JG
B	AMENDED	23/04/18	LMC
C	AMENDED	24/04/18	JG
D	AMENDED	26/04/18	LMC
E	CONSTRUCTION	26/04/18	LMC

JOB DESCRIPTION
NEW DWELLING

DESIGN
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DATE: 26/04/18

DRAWN	CHECKED
LMC	DEL

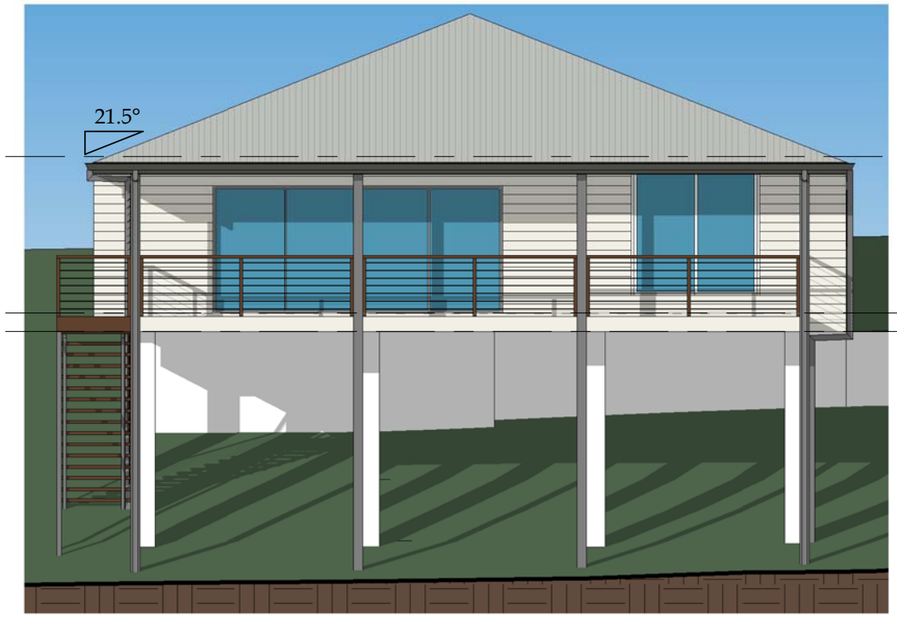
SCALE: As indicated — SHOWN AT A3

DWG NAME. GROUND FLOOR PLAN

DWG No. 18-118-R SHT No. A03

LOCATION	MATERIAL	COLOR
ROOF		
FASCIA		
GUTTER		

ELEVATION NOTES
SELECTED COLORBOND ROOF SHEETING FIXED TO MANUFACTURER'S SPEC
SELECTED FASCIAS & GUTTERS TO MANUFACTURER'S SPEC.
SELECTED ALUMINIUM FRAMED GLASS DOORS & WINDOWS FIXED TO MANUFACTURER'S SPEC.
FC SHEETING TO EAVES
SELECTED CLADDING
SELECTED BALUSTRADING TO AUSTRALIAN STANDARDS.
190 BLOCKWORK RENDER AND PAINT FINISH
SHS POST
400sq BLOCK COLUMN



1 Elevation 1
1 : 100

2 Elevation 2
1 : 100

LOCATION	MATERIAL	COLOR
A		
B		
C		
D		
E		

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Dated: 6 August 2018

SUF	REVISIONS	DATE	INIT
A	CONSTRUCTION	26/04/18	LMC
B	AMENDED	04/07/18	LMC

JOB DESCRIPTION
NEW DWELLING

DESIGN
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Email: info@ceads.com.au
www.ceads.com.au

DATE: 26/04/18

DRAWN	CHECKED
LMC	DEL

SCALE: 1 : 100 SHOWN AT A3

DWG NAME. ELEVATIONS

DWG No. 18-118-R SHT No. A04

LOCATION	MATERIAL	COLOR
ROOF		
FASCIA		
GUTTER		

ELEVATION NOTES
SELECTED COLORBOND ROOF SHEETING FIXED TO MANUFACTURER'S SPEC
SELECTED FASCIAS & GUTTERS TO MANUFACTURER'S SPEC.
SELECTED ALUMINIUM FRAMED GLASS DOORS & WINDOWS FIXED TO MANUFACTURER'S SPEC.
FC SHEETING TO EAVES
SELECTED CLADDING
SELECTED BALUSTRADING TO AUSTRALIAN STANDARDS.
190 BLOCKWORK RENDER AND PAINT FINISH
SHS POST
400sq BLOCK COLUMN

3 Elevation 3
1 : 100

4 Elevation 4
1 : 100

LOCATION	MATERIAL	COLOR
A		
B		
C		
D		
E		

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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Development Permit No.: D/53-2018

Dated: 6 August 2018

SUF	REVISIONS	DATE	INIT
A	CONSTRUCTION	26/04/18	LMC
B	AMENDED	04/07/18	LMC

JOB DESCRIPTION
NEW DWELLING

DESIGN
MOD PHOBOS 215

CLIENT
CWH

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Email: info@ceads.com.au
www.ceads.com.au

DATE: 26/04/18

DRAWN: LMC | CHECKED: DEL

SCALE: 1 : 100 SHOWN AT A3

DWG NAME. ELEVATIONS

DWG No. 18-118-R SHT No. A05

ELEVATION NOTES
SELECTED COLORBOND ROOF SHEETING FIXED TO MANUFACTURER'S SPEC
SELECTED FASCIAS & GUTTERS TO MANUFACTURER'S SPEC.
SELECTED ALUMINIUM FRAMED GLASS DOORS & WINDOWS FIXED TO MANUFACTURER'S SPEC.
FC SHEETING TO EAVES
SELECTED CLADDING
SELECTED BALUSTRADING TO AUSTRALIAN STANDARDS.
190 BLOCKWORK RENDER AND PAINT FINISH
SHS POST
400sq BLOCK COLUMN

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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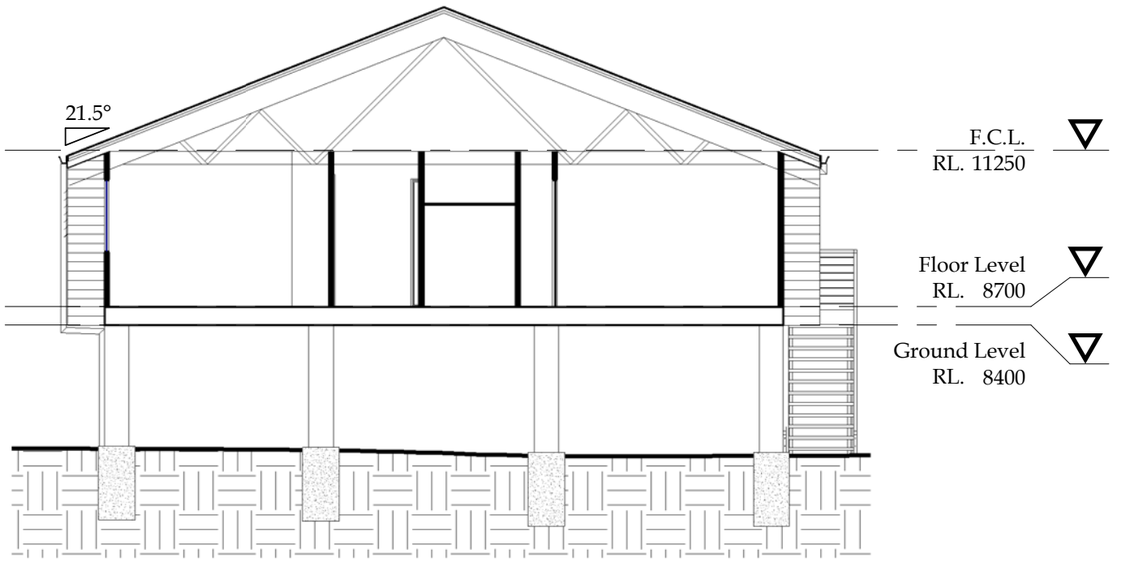
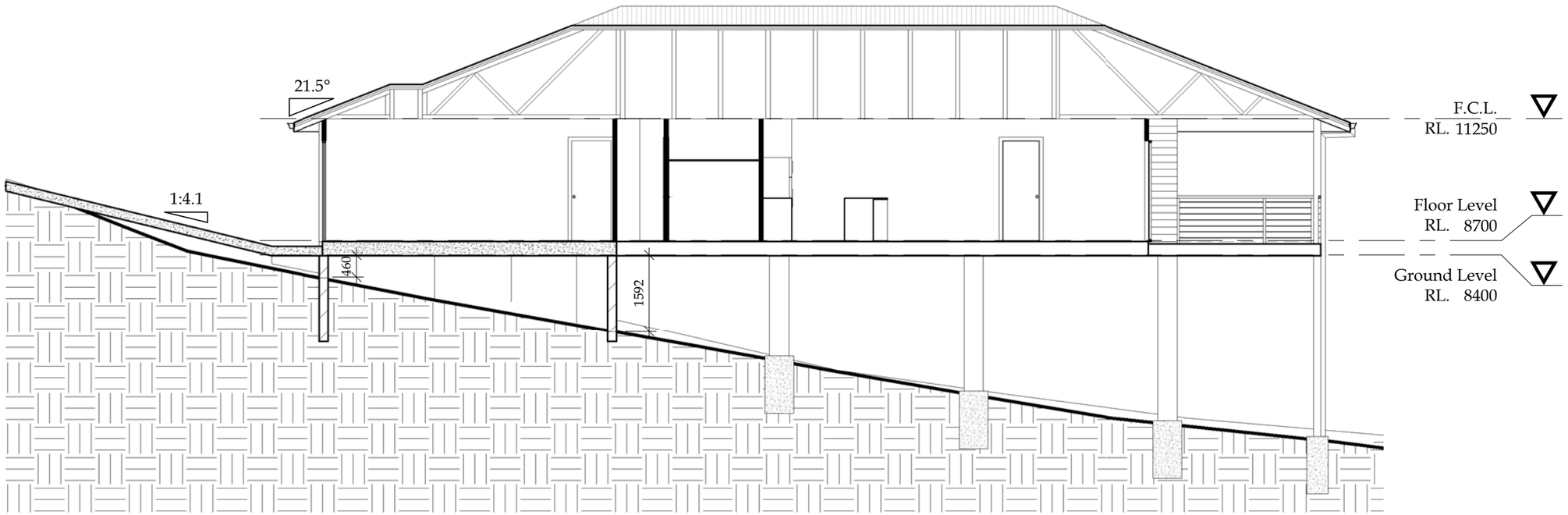
Development Permit No.: D/53-2018

Dated: 6 August 2018



1 Section 1
1 : 100



2 Section 2
1 : 100

SUF	REVISIONS	DATE	INIT
A	CONSTRUCTION	26/04/18	LMC
B	AMENDED	04/07/18	LMC

JOB DESCRIPTION

NEW DWELLING

DESIGN

MOD PHOBOS 215

CLIENT

CWH

ADDRESS

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Email: info@ceads.com.au
www.ceads.com.au

DATE: 26/04/18

DRAWN: LMC

CHECKED: DEL

SCALE: 1 : 100 SHOWN AT A3

DWG NAME. SECTIONS

DWG No. 18-118-R SHT No. A07

Structural Column Schedule			
Mark	Post Size	Post Type	Count
C1	150x150x4.0	SHS	4
C2	400x400	Block Pier	12
C3	75x75x4.0	SHS	2

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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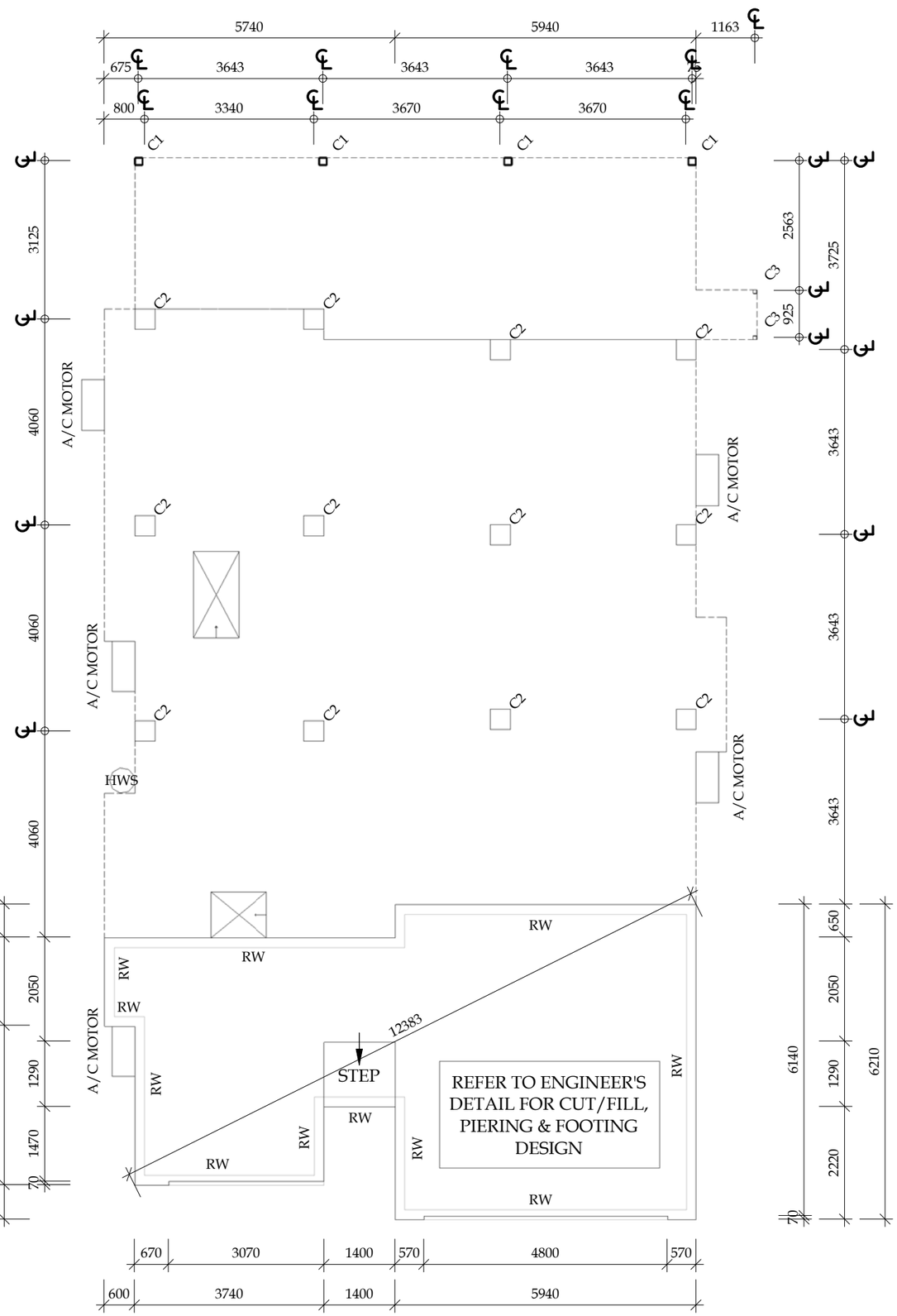
Development Permit No.: D/53-2018

Dated: 6 August 2018



2 Slab Layout Plan
1 : 100

SUF	REVISIONS	DATE	INIT
A	CONSTRUCTION	26/04/18	LMC

JOB DESCRIPTION
NEW DWELLING

DESIGN
MOD PHOBOS 215

CLIENT
CWH

ADDRESS
LOT 123 ROSEWOOD DRIVE, NORMAN GARDENS

CEADS CAPRICORN ENGINEERING AND DRAFTING SERVICES
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DATE: 26/04/18

DRAWN: LMC
CHECKED: DEL

SCALE: As indicated
SHOWN AT A3

DWG NAME: FOUNDATION PLAN

DWG No. 18-118-R SHT No. A09

TABLE B. GUTTER SIZES FOR VARIOUS RAINFALL INTENSITIES		
GUTTER TYPE (AS PER TABLE A)	GUTTER DESCRIPTION	MINIMUM CROSS SECTIONAL AREA mm²
A	MEDIUM RECTANGULAR GUTTER	6500
B	LARGE RECTANGULAR GUTTER	7900
C	115mm D GUTTER	5200
D	125mm D GUTTER	6300
E	150mm D GUTTER	9000
F	GUTTER MUST BE DESIGNED IN ACCORDANCE WITH AS/NZS 3500.3 OR SECTION 5 OF AS NZS 3500.5	

3.5.2.4 INSTALLATION OF GUTTERS
(a) GUTTERS MUST BE INSTALLED WITH A FALL OF NOT LESS THAN -
i) 1:500 FOR EAVES GUTTERS, UNLESS FIXED TO METAL FASCIAS; AND
ii) 1:100 FOR BOX GUTTERS.

(b) EAVES GUTTERS MUST BE SUPPORTED BY BRACKETS SECURELY FIXED AT STOP ENDS AND AT NOT MORE THAN 1.2m CENTRES.

(c) VALLEY GUTTERS ON A ROOF WITH A PITCH -
i) MORE THAN 12.5 DEGREES - MUST HAVE WIDTH OF NOT LESS THAN 400mm AND BE WIDE ENOUGH TO ALLOW THE ROOF COVERING TO OVERHANG NOT LESS THAN 150mm EACH SIDE OF THE GUTTER; OR
ii) NOT MORE THAN 12.5 DEGREES - MUST BE DESIGNED AS A BOX BUTTER

(d) WHERE HIGH-FRONTED GUTTERS ARE INSTALLED, PROVISION MUST BE MADE TO AVOID ANY OVERFLOW BACK INTO THE ROOF OR BUILDING STRUCTURE BY INCORPORATING OVERFLOW MEASURE OR THE LIKE.

LOCALITY	5 MINUTE DURATION RAINFALL INTENSITY (mm/h)	
	AVERAGE RECURRENCE INTERVAL, ONCE IN -	
	20 YEARS	100 YEARS
VICTORIA POINT	245	320
NOOSA HEADS	258	331
ROCKHAMPTON	229	300

ROOF DRAINAGE SPECIFICATION

GUTTER TYPE	- 150 HI FRONT QUAD GUTTER - SLOTTED
ROOF AREA TOTAL	- 267.53m²
DOWN PIPE TYPE	- 90mm PVC ROUND
LONGEST GUTTER RUN	- 6m
OVERFLOW VOLUME (L/s/m)	- 0.5 L/s/m
MAX CATCHEMENT PER DOWNPIPE	- 40m²

Downpipe Schedule	
Type	Count
Downpipe	9

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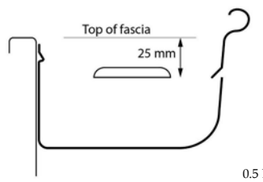
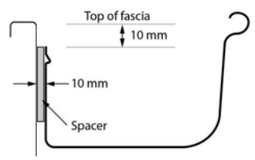
CONTINUOUS OVERFLOW MEASURES

FRONT FACE SLOTTED GUTTER



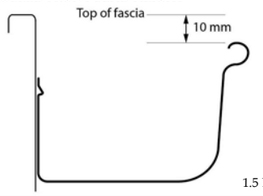
0.5 L/s/m

CONTROLLED BACK GAP



1.5 L/s/m

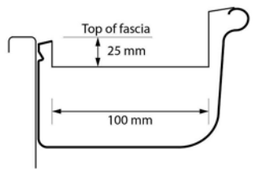
CONTROLLED FRONT BEAD HEIGHT



1.5 L/s/m

DEDICATED OVERFLOW MEASURES

END-STOP WEIR

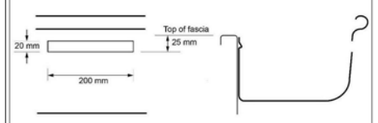


0.15 L/s/m

INVERTED NOZZLE

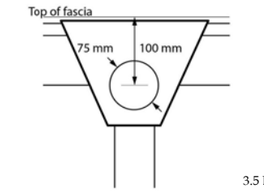
1.2 L/s/m

FRONT FACE WEIR

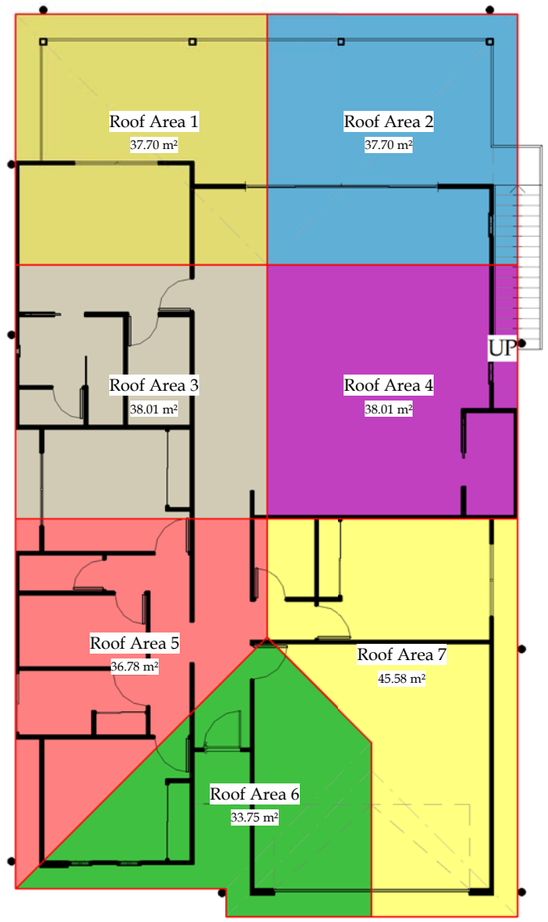


1.0 L/s/m

RAINHEAD



3.5 L/s/m



1 Roof Drainage Plan
1 : 150

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DATE: 26/04/18

DRAWN	CHECKED
LMC	DEL

SCALE: As indicated — SHOWN AT A3

DWG NAME. ROOF DRAINAGE PLAN

DWG No. 18-118-R SHT No. A11