CQ SOIL TESTING

AS2870 Site Classification, Site-Specific Landslide Susceptibility Risk Assessment and Slope Stability Analysis

SITE ADDRESS:	Lot 57 (SP217337) 24 Reddy Drive, Norman Gardens QLD 4701
Prepared for:	Lyke Homes Pty Ltd
Job Number:	CQ18152
Issue Date:	23/11/2020

CQ SOIL TESTING technical excellence

ABN 477 159 434 84
QBCC License 11 17 681

PO Box 9654
Park Avenue QLD 4701

P (07) 4936 1163
F (07) 4936 1162

info@cqsoiltesting.com.au

Client & Document Information

Client:	Lyke Homes Pty Ltd
Project:	Lot 57 (SP217337) 24 Reddy Drive, Norman Gardens QLD 4701
Investigation Type:	**AS2870 Site Classification, Site-Specific landslide Susceptibility Risk Assessment and Slope Stability Analysis**
Job Number:	CQ18152
Date of Issue:	23/11/2020

Contact Information

CQ SOIL TESTING
ABN 47 715 943 484

PO Box 9654
PARK AVENUE QLD 4701

Telephone: (07) 4936 1163
Facsimile: (07) 4936 1162

Email: info@cqsoiltesting.com.au

Document Control

Version	Date	Author	Design Drawings	Approver	Approver Initials
A	23/11/2020	S Walton/S Jeyan	NA	Scott Walton	SWW

QBCC Subsidence Policy

In accordance with the QBCC "Queensland Building and Construction Commission" the contractor must supply the site classifier with the information in Table 1. The contractor, or the contractor representative (CR), may require the site classifier (SC) gather all or part of this information and the SC must satisfy themselves that all of the "relevant" information has been considered.

If all of the information listed below is not supplied by the contractor or the contractor does not wish the SC to recover said information (at cost) the contractor may be in breach of the no fault provisions of the QBCC's Policy for Rectification of Building Work and may be held responsible for subsidence or settlement of a building.

Table 1

Element	Supplied/Considered	Remarks
Property description and site address	✓	Client Supplied
Plan and/or survey	✓	Supplied
Contour of the site	✓	Supplied
Location of trees, vegetation etc identified	✓	Supplied
Location and identification of potential overland flow	✓	Supplied
The footprint of proposed building and platform levels	✓	Supplied
Location of proposed or existing cut and fill	✓	Supplied
Appropriate land searches	✓	Supplied

The following (Table 2) is a summary of the information required under the QBCC relating specifically to the SC. Information supplied in this summary is to be read in conjunction with the entire report attached. All relevant data taken into account for the classification is documented in the report.

Table 2

Element	Remarks
Total number of excavations	3
Minimum of two excavations in building footprint	✓
Soil samples recovered	Yes
Laboratory test performed	Classification
Predicted Surface Movement	50 - 60 mm
Expected movement potential for "P" sites in the absence of soft soil	NA

1.0 Introduction

The purpose of this report is to classify the subject allotment in accordance with Australian Standard 2870 Residential Slabs and Footings" and provide geotechnical recommendations. From this classification, a footing system can be recommended by an experienced/qualified engineer (designer) to suit the proposed structure. This design shall provide adequate performance of the footings under the soil conditions determined at the site.

This site investigation has been carried out by an experienced/qualified soils technician and in accordance with *AS 2870*. CQ Soil Testing is licensed with Building Services Australia to "Classify Sites".

In addition to the above, this report is also to present the results of site-specific landslide susceptibility risk assessment and slope stability analysis undertaken for the above site.

This report relates exclusively to the proposed new residential development at the address stated on page one of this report and has been prepared for the express purpose stated above. This document does not cover any other elements related to construction on the site.

2.0 Site Description

The subject site is a residential allotment, which fronts a sealed road.

The allotment is grassed and there are no trees within and surrounding the proposed dwelling footprint (see site photographs in the attachment). The allotment falls towards the northeast and is considered to be well drained. Surface water will drain toward the northeast. Surface water from the adjoining allotments may traverse the site. A site/test location plan is attached to this report.

The site falls away from the eastern part of the site towards the western part at approximately from RL 55 m AHD down to RL 47 m AHD which will provide an indication of 8 m vertical drop within the site.

There is an evidence of minor fill having been placed onto the proposed construction site.

3.0 Subsurface Ground Conditions

Boreholes (1-3) were carried using power auger drilling rig on 16/11/2020 at the site (refer attached site/test location plan for approximate localities) indicate **UNCONTROLELD FILL** up to 0.5 m depth and/or natural medium dense silty sand followed by very stiff to hard sandy clay/clay to the borehole termination depth of 3.0 m (see attachment for detailed borehole logs). Tungsten carbide drill bit refusal was not encountered. Laboratory testing was carried out on typical soil sample/s to assess the potential of the underlying soils to exhibit shrink/swell characteristics and any underlying moisture conditions. Details of the laboratory test results are contained in the attachment.

- Groundwater was not encountered during the site investigation.
- Weathered rock was not encountered during the site investigation.

It is possible that the soil profile may vary across the site from those shown in the bore logs which were used for this site classification. CQ Soil Testing are required to be notified if different conditions are encountered during construction. No allowance has been made for any substantial earthworks on the site, or importing building platform material. The classification provided is based on the borehole, which has the highest characteristic surface movement.

4.0 Site Classification

Based on the findings of the site investigation and subsequent laboratory testing, the predicted surface movement for this site in the absence of fill would be 50 – 60 mm which would give a classification of 'H1 – Highly Reactive' in line with AS2870. However, due to the presence of uncontrolled fill, it shall be classified as:

CLASS "P"
(Uncontrolled Fill)

In accordance with Australian Standard 2870, Residential Slabs and Footings. Class P sites require that a footing system be carried out/designed by a qualified engineer using engineering principles and considering the recommendations stated in section C4 of the aforementioned standard.

Any fill placed over the existing ground shall be piered through into the existing suitable material. Further note that the placement of reactive material as fill, or cutting of the site may change the site's classification.

It is noteworthy that soil samples recovered from this site may be tested further to aid in the preparation of a database of Central Queensland soils currently being compiled by CQ Soil Testing. The aim of this database is to further understand the types of soils in the region and their mechanical properties.

"CSIRO – Homeowner's Guide" is attached to this report for further reference on foundation maintenance and footing performance.

5.0 Site Specific Landslide Susceptibility Risk Assessment and Slope Stability Analysis

The following sections outlines the scope of the site-specific landslide susceptibility risk assessment and slope stability analysis for the proposed residential development is to be located at 24 Reddy Drive, Norman Gardens QLD. The aim of the assessment was to:

- Identify the site in accordance with "Rockhampton Regional Council" (RRC) Landslide Hazard and Steep Slope Map Area;
- Carry out site-specific landslide susceptibility risk assessment based on "Geotechnical Stability Assessment Guidelines" published in March 2016 by City of Gold Coast (CGC);
- Carry out slope stability analyses for the proposed residential development and provide advice (where required); and
- Prepare a geotechnical site-specific landslide susceptibility risk and slope stability analysis report together with RPEQ certification in order to demonstrate general compliance with landslide hazard zone codes.

Architectural drawings were available from the client during the preparation of this reporting. Copies of such drawings are attached to this report.

Note that the "Geotechnical Stability Assessment Guidelines" (by CGC) incorporated Australian Geomechanics Society (AGS) guidelines for landslide hazard risk assessment. CGC guidelines are generally accepted guidelines for similar conditions as an appropriate tool to prepare a geotechnical stability assessment and reporting in accordance with landslide hazard planning scheme policy.

5.1 Site Geology and Geotechnical Investigation

On relevant 1:100,000 Geological map, site plots within Early Permian Aged Lakes Creek Sedimentary Rock Formation.

Three boreholes (1–3) were drilled using power auger drilling rig on 16/11/2020 Dynamic Cone Penetrometer (DCP) tests were carried out at adjacent to each borehole in order to assess the strength consistency.

Based on the RRC interacting mapping database, the site is located within the landslide hazard and steep slope map area. A check was made using CGC flowchart of geotechnical stability assessments. Based on this, a site-specific landslide susceptibility risk assessment and slope stability analysis are required for the proposed residential development. A copy of such flowchart is attached at the end of this report for further confirmation.

The following Table 3 summarises the outcome of the site-specific landslide susceptibility risk assessment.

Table 3

Assessment Type	Output	Susceptibility
Existing Site Including the Consideration of the Proposed Residential Development	0.41	Low

NOTE: The landslide susceptibility risk assessment outcome was assessed to be low. However, we have included site-specific and generic recommendations included in Section 5.7 of this report for the consideration of good engineering and hillside construction practices. Such recommendations are highly recommended and should be adopted by the client where appropriate.

Borehole logs, laboratory test results, site photographs and site/test location plan are attached to this report.

5.2 Slope Stability Analysis

Elevation 3 extracted from the client supplied drawings and borehole records were used for slope stability analysis using commercially available Slope/W software. The assumed soil and its parameters adopted in the stability analysis are presented in Table 4 below.

Table 4

Material	Drained Cohesion C' (kPa)	Drained Friction Angle, Φ' (°)	Unit Weight γ (kN/m³)
Very Stiff Sandy Clay Fill	2	24	18
Natural Very Stiff to Hard Sandy Clay/Clay	7	26	19

The slope profiles were modelled using the parameters given in Table 4 in line with the Morgenstern and Price method. Surcharge load of 10 kPa was adopted for residential/maintenence load. Appropriate groundwater level has been incorporated into the modelling.

The analysis has considered a minimum long-term Factor of Safety (FOS) of 1.50 as required by "Geotechnical Stability Assessment Guidelines" by and current industry practice for permanent civil engineering slope works.

Slope Stability Model Set-Up

Model adopted in this stability analysis is presented below.

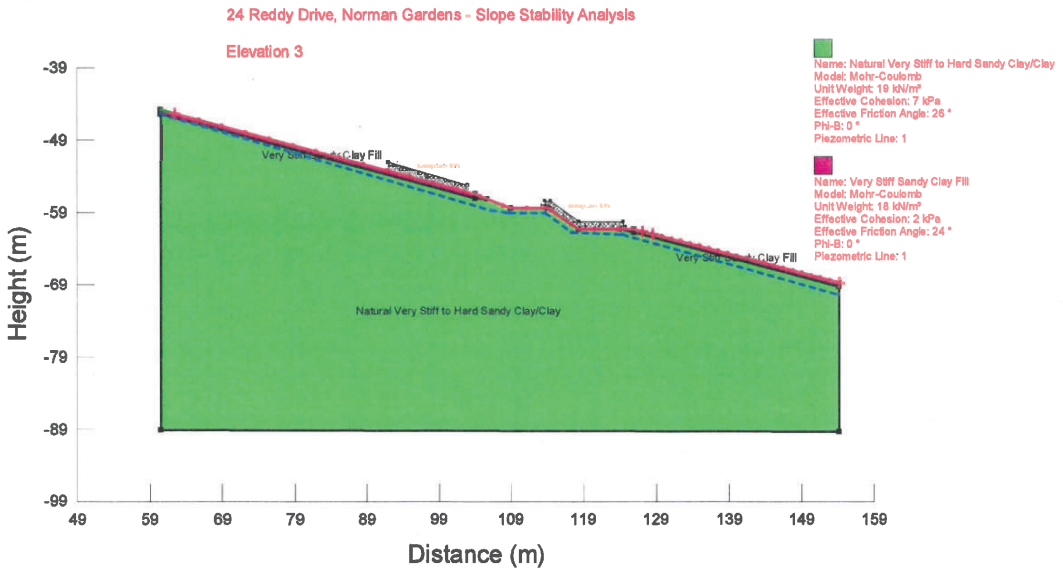


Figure 1: Elevation 3 Model Adopted in this Slope Stability Analysis.

The results of the slope stability analysis with groundwater conditions are presented in Table 5 below.

Table 5

Analysis Area	Analysis Condition	Long Term Factor of Safety (FOS) Achieved	Required Long Term FOS by "Geotechnical Stability Assessment Guidelines"
Elevation 3	Existing/Proposed Slope Geometry with Surcharge Load and Appropriate Groundwater – Global Stability	1.51 (>1.50) (Drawing 1)	1.50

Stability analysis output is attached at the end of this report.

5.3 Safety in Design and Geotechnical Risk

The current industry practice incorporates, and details risks which may be associated with the geotechnical design addressed in this report. This section outlines risks which may have an effect during construction and also outlines relevant risks which may exists in the operation, maintenance and demolition stages of the proposed residential development or design.

We do believe that the following potential geotechnical risks may be associated with this design component and need to be managed by the builder/contractor:

- Ground strata encountered differing from design assumptions – can be managed by engaging a suitably qualified geotechnical engineer during the construction stage.
- Plants and equipment's movements with possible slips and falls – can be managed by safety checks and using an appropriate safe work method statements (SWMS).
- Temporary slope stability of the proposed excavation (if required) – can be managed by safety checks, using appropriate SWMS and by engaging a suitably qualified geotechnical engineer during construction.
- Unexpected groundwater flow or seepage encountered in the sub-surface (if observed) – can be managed by installing drainage pipes and discharge pipes to enhance the drainage system.

As far as practical, we have included appropriate control measures associated with the above-mentioned risks. It is contractor's responsibility to reduce such risks practically low as possible to abide by relevant regulations and standards including safe working practices and methods.

5.4 Foundation Options and Founding Conditions

Given the expected foundation conditions and considering good & hillside construction practices, steel screw, driven and bored pier foundations are expected to be suitable to support the proposed residential development. Any elements (including footings and slabs) that require support at ground level will need to be founded through underlying natural very stiff or stronger clayey soils, generally encountered between the ground level and 0.6 m depths. Allowable end bearing pressures for steel screw pile foundation are given below;

- 250 kPa – Founded minimum 1.0 m and deeper into natural very stiff clayey soils.
- 350 kPa – Founded minimum 1.0 m and deeper into natural hard clayey soils.

Steel screw pile requires specialised design and construction by a suitably qualified consultant and/or contractor.

Allowable pile end bearing pressures for driven/bored pier foundation are given below;

- 450 kPa – Founded minimum three pile diameters and deeper into natural very stiff clayey soils.
- 600 kPa – Founded minimum three pile diameters and deeper into natural hard clayey soils.

The following allowable shaft adhesion values are available in Table 6 below the base of the excavation;

Table 6

Strata	Allowable Shaft Adhesion
Top 1.0 m	Ignore
Natural Very Stiff Clayey Soils	30 kPa
Natural Hard Clayey Soils	40 kPa

Driven/Bored pier foundation settlements are not generally to be expected to exceed 1% to 2% of the pile diameter.

Reference can be made to AS2159-2009 for the detail pile design and construction procedures. The selection of the foundation option is to be at the discussion by the structural engineer.

It is appropriate that footing excavations be inspected by a suitably qualified geotechnician or geotechnical engineer.

5.5 Excavation Conditions

Excavations in the strata encountered within the depth of testing can be carried out using backhoes or tracked excavators. However, should excavations be required in concrete, then provision may be allowed for the use of large excavator fitted with ripping tyne and/or rock hammer.

If bored piles be adopted as the foundation option drilling within the depth of testing should be able to be carried out using medium sized auger drilling rigs (i.e. large excavators fitted with drilling arms or small truck mounted rigs).

5.6 Earthworks, Site Preparation and Trafficability

Earthworks should be carried out in a responsible manner in accordance with the relevant parts of AS3798 – 2007. It is recommended that all earthworks be carried out under Level 1 inspection and testing arrangements as detailed in clause 8.2 of AS3798-2007.

Prior to the placement of any structural fill across the site, any topsoil, unsuitable, deleterious and organically contaminated surface soils should be stripped to depths exposing competent ground. In addition, any tree roots remaining from any clearing operations should be completely removed.

Where medium to high plasticity clays are proposed to be re-used as new structural filling materials in building or pavement areas, it is recommended that the cohesive material be placed at depth and granular material or weathered rock be placed close to the subgrade level. This will reduce the effects of seasonal moisture changes and foundations soil reactivity and improve surface trafficability.

It is appropriate to maintain surface drainage conditions during earthworks and ensure that runoff water is discharged away from the construction area to prevent any water ponding. Generally, clayey and silty materials are susceptible to moisture changes.

If trafficability issues or unfavourable weather is expected, it is appropriate to place "subgrade" material in order to continue with construction.

5.7 Site-Specific and General Recommendations for Good Engineering Practice and Hillside Constructions

The following site-specific and general recommendations are to be followed in line with good engineering practice and hillside constructions where appropriate:

- Reference can be made to "Australian Geomechanics Society's Guidelines" for Good and Bad Hillside Construction Practices and Hillside Constructions. A copy of such extract is attached at the end of this report for further recommendations for hillside constructions.
- In general, ongoing long-term stability will be subject to adequate crest and toe drainages and also slopes be vegetated (or any similar type of available erosion control methods) in order to prevent erosion and associated long term stability concerns.
- Instability is mainly caused by excavation and erosion. Unsupported/erosion prone excavation is not recommended.
- Stormwater, rainwater, wastewater and overflow is to be properly diverted and sewered/piped away from the site and be connected to appropriate council approved drainage arrangements and discharge systems. All drainage is to be maintained in good working condition and regular inspections and maintenance are essential.
- Structural footings are to be engineered and be certified by a suitably qualified structural engineer.
- Retaining walls and excavation generally over 1.0 m high should be engineered and be certified by a suitably qualified structural engineer.
- All site earthworks should be carried out in accordance with AS3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments'.

5.8 Conclusions and Certification

Based on the outcome in the above Sections 5.1, 5.2 & assuming client will adhere to appropriate recommendations included in Section 5.7 of this report, the site-specific landslide susceptibility risk assessment indicated that the existing site and the proposed residential development will have a landslide susceptibility risk of 'low' based on site-specific geotechnical information and landslide susceptibility risk assessment outcome.

Slope stability analysis indicates that the existing/proposed slope geometry (as included in the attached drawing 1) have FOS greater than "Geotechnical Stability Assessment Guidelines" by CGC and current industry practice for permanent civil engineering slope works of 1.50.

Seismic hazard is considered to be very low and not been adopted in this assessment.

Based on the above information, we certify that the existing site and the proposed residential development is appropriate for the sloping nature of the site, and that the risk of landslide adversely affecting the subject site, adjoining properties and the proposed residential development is 'low' which is considered to be acceptable for RRC and current engineering practice for permanent civil engineering slope works.

5.9 Landslide Susceptibility Risk/Slope Stability Report Limitations

The statements presented in this document are intended to advise the reader of recommendations in line with stated assumptions.

This report has been prepared for the sole use of the client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

The comments given in this report and the opinions expressed herein are based on the information received from the client, the conditions encountered during the geotechnical investigation and associated landslide susceptibility & slope stability analysis. However, there may be conditions prevailing at the site which have not been disclosed by the client/geotechnical investigation/landslide susceptibility & slope stability analysis and which have not been taken into account in the report.

This report has been reasonably reviewed to eliminate human errors, inappropriateness, and omissions.

If you should have any queries regarding this report, please do not hesitate to contact the undersigned at your convenience.

Yours faithfully

SAM JEYAN
Senior Geotechnical Engineer
RPEQ – 13339 in Civil, geotechnical and Subdivisional Geotechnics
RPEng – 0969 in Civil
MIEAust – 3439772

SCOTT WALTON
Owner/Laboratory Manager

Attachments:

Site/Soil Characteristics and Classification
Site Photographs
Borehole Logs
CSIRO – A Homeowner's Guide
Site/Test Location Plan
Report Limitations
Extracts from RRC Landslide Hazard Overlay Map
CGC Flowchart of Geotechnical Stability Assessments
Site-Specific Landslide Susceptibility Risk Assessment Report
Architectural Drawings by the Client
Extract from Australian Geomechanics Society's Guidelines for Good and Bad Hillside Construction Practices and Hillside Constructions
Slope Stability Analysis Output
Completed Standard Pro-forma for Geotechnical Certification

5.10 References

The following papers, reports or books have been consulted in preparing this report:

- "Geotechnical Stability Assessment Guidelines" by Gold Coast City Council (CGC) – March 2016.
- SMEC (2011): Landslide Susceptibility Assessment Report for the City of the Gold Coast, August 2011.
- Australian Geomechnics Society (2007): Practice Note Guideline for Landslide Risk Management 2007, Journal of the Australian Geomechnics Society, Vol 42, No. 1, March 2007.
- Australian Standard AS 4678: Earth-Retaining Structures, February 2002.

Site/Soil Characteristics and Classification

A. Classification by characteristic surface movement as per AS2780-2011

Site Classification Symbols	Y's Range Value	Generalised Description (Guide Only)
'S'	0 – 20 mm	Slightly reactive clay sites which may experience only slight ground movement due to moisture changes
'M'	21 – 40 mm	Moderately reactive clay or silt sites which may experience moderate ground movement due to moisture changes
'H1'	41 – 60 mm	Highly reactive clay sites which may experience high ground movement due to moisture changes
'H2'	61 – 75 mm	Highly reactive clay sites which may experience very high ground movement due to moisture changes
'E'	>75 mm	Extremely reactive clay sites which may experience extreme ground movement due to moisture changes
'P'	N/A	Problem sites which generally have soils associated with uncontrolled fill, abnormal moisture conditions (trees), soft or collapsing soils, landslip etc...

B. Laboratory Test Results

Borehole Location	2	Borehole Location	1	Borehole Location
Depth Range of Sample (m)	0.6-0.8	Depth Range of Sample (m)	2.8-3.0	Depth Range of Sample (m)
Natural MC %	20	Natural MC %	19	Natural MC %
% Passing 75 um Sieve	ND	% Passing 75 um Sieve	ND	% Passing 75 um Sieve
Liquid Limit %	ND	Liquid Limit %	ND	Liquid Limit %
Plastic Index %	ND	Plastic Index %	ND	Plastic Index %
Linear Shrinkage %	ND	Linear Shrinkage %	ND	Linear Shrinkage %
Shrink Swell Index	3.1	Shrink Swell Index	3.6	Shrink Swell Index
Pocket Penetrometer kPa	ND	Pocket Penetrometer kPa	ND	Pocket Penetrometer kPa

C. Permeability Test Results AS1547-2000

Test Hole Number	Depth Of Test Hole	Range Tested	Permeability M/Day
NA	500 mm	250 – 500 mm	NA

Site Photographs

Image 1: Proposed construction site

Image 2: Proposed construction site

CQ SOIL TESTING technical excellence

CLIENT: LYKE HOMES Pty Ltd
PROJECT: Slope Stability
ADDRESS: Loy 57 Reddy Drive, Norman Gardens
DRILL RIG: GT10

PROJECT #: CQ18152
LOGGED: F Phelan
EASTING:
NORTHING:

BORE HOLE 1

TEST DATE: 16/11/2020

RL (m)	Depth (m)	Graphic Log	Water	Material Description	Sampling & Testing: Type	Sampling & Testing: Results & Comments	DCP Results (blows per 100 mm) 4 8 12 16
				FILL SANDY CLAY (CI): medium plasticity, fine to medium grained, with fine to medium grained gravel, pale reddish brown, dry, very stiff			
			0.6	NATURAL CLAY (CH): high plasticity, with fine to coarse grained sand and gravel, grayish brown, dry, very stiff.			7, 7, 8, 7, 7, 7, 7, 8, 15
	1		1.7	SANDY CLAY (CI): medium plasticity, fine to coarse grained, with fine to coarse grained gravel, brown, dry, hard.			
	2		2.8	CLAY (CH): high plasticity, trace fine to coarse grained sand, greyish brown, dry, hard.			11, 11, 14, 9, 8, 15
	3		3.0	Bore Terminated at 3 m. Limit of Investigation.			

DRILLING METHOD: Solid Flight Auger.

CASING:

GROUNDWATER: No groundwater seepage observed at time of drilling.

REMARKS:

LEGEND:

D - Disturbed Sample from Auger	SPT - Standard Penetration Test	- Groundwater Seepage Level
B - Bulk Sample from Auger	Is_{50} - Point Load Result (MPa)	- Standing Groundwater Level
C - Rock Core	PP - Pocket Penetrometer (kPa)	- Partial Groundwater Loss
U_{50} - Undisturbed Sample (mm)		- Perched Groundwater Level

CQ SOIL TESTING technical excellence

CLIENT: LYKE HOMES Pty Ltd
PROJECT: Slope Stability
ADDRESS: Loy 57 Reddy Drive, Norman Gardens
DRILL RIG: GT10

PROJECT #: CQ18152
LOGGED: F Phelan
EASTING:
NORTHING:

BORE HOLE 2

TEST DATE: 16/11/2020

RL (m)	Depth (m)	Graphic Log	Water	Material Description	Sampling & Testing: Type	Sampling & Testing: Results & Comments	DCP Results (blows per 100 mm) 4 8 12 16
				SILTY SAND (SM): fine to coarse grained, low plasticity fines, dark grey, dry, medium dense.			
			0.2	SANDY CLAY (CI): medium plasticity, fine to coarse grained, with fine to coarse grained gravel, brown, dry, very stiff to hard.			
				becoming hard			15
	1						15
							11
							11
							12
							13
							15
	2						
							15
							15
	3						
			3.0	Bore Terminated at 3 m. Limit of Investigation.			

DRILLING METHOD: Solid Flight Auger.
CASING:
GROUNDWATER: No groundwater seepage observed at time of drilling.
REMARKS:

LEGEND:

D - Disturbed Sample from Auger
B - Bulk Sample from Auger
C - Rock Core
U_{50} - Undisturbed Sample (mm)
SPT - Standard Penetration Test
Is_{50} - Point Load Result (MPa)
PP - Pocket Penetrometer (kPa)
- Groundwater Seepage Level
- Standing Groundwater Level
- Partial Groundwater Loss
- Perched Groundwater Level

CQ SOIL TESTING technical excellence

CLIENT: LYKE HOMES Pty Ltd
PROJECT: Slope Stability
ADDRESS: Loy 57 Reddy Drive, Norman Gardens
DRILL RIG: GT10

PROJECT #: CQ18152
LOGGED: F Phelan
EASTING:
NORTHING:

BORE HOLE 3

TEST DATE: 16/11/2020

RL (m)	Depth (m)	Graphic Log	Water	Material Description	Sampling & Testing: Type	Sampling & Testing: Results & Comments	DCP Results (blows per 100 mm) 4 8 12 16
				SANDY CLAY (CI): medium plasticity, fine to coarse grained, with fine to coarse grained gravel, brown, dry, very stiff to hard.			6 6 15
	1			becoming hard			14 15
	2						14 15
	3						16 16
			3.0	Bore Terminated at 3 m. Limit of Investigation.			

DRILLING METHOD: Solid Flight Auger.

CASING:

GROUNDWATER: No groundwater seepage observed at time of drilling.

REMARKS:

LEGEND:

D - Disturbed Sample from Auger	SPT - Standard Penetration Test	- Groundwater Seepage Level
B - Bulk Sample from Auger	Is_{50} - Point Load Result (MPa)	- Standing Groundwater Level
C - Rock Core	PP - Pocket Penetrometer (kPa)	- Partial Groundwater Loss
U_{50} - Undisturbed Sample (mm)		- Perched Groundwater Level

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

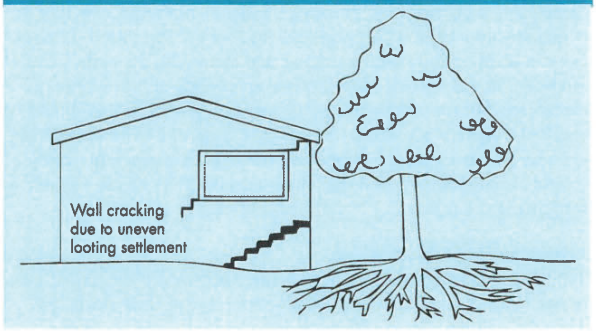
The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Trees can cause shrinkage and damage



Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter

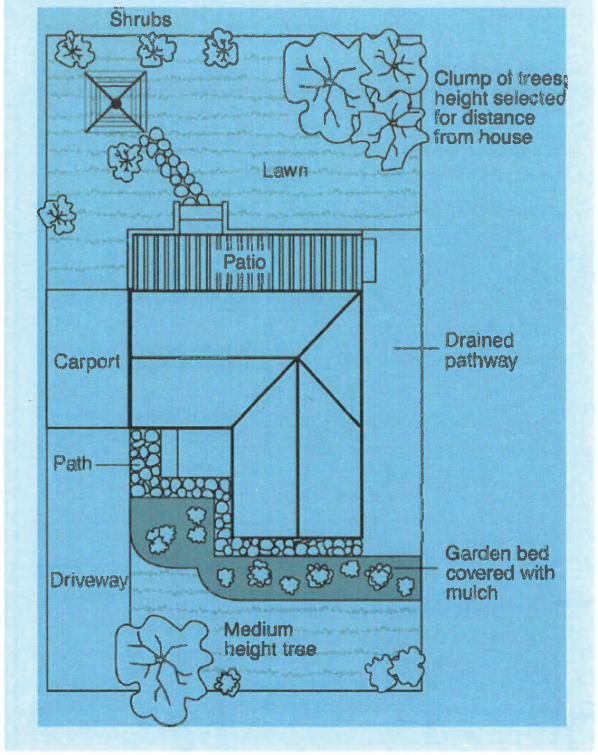
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

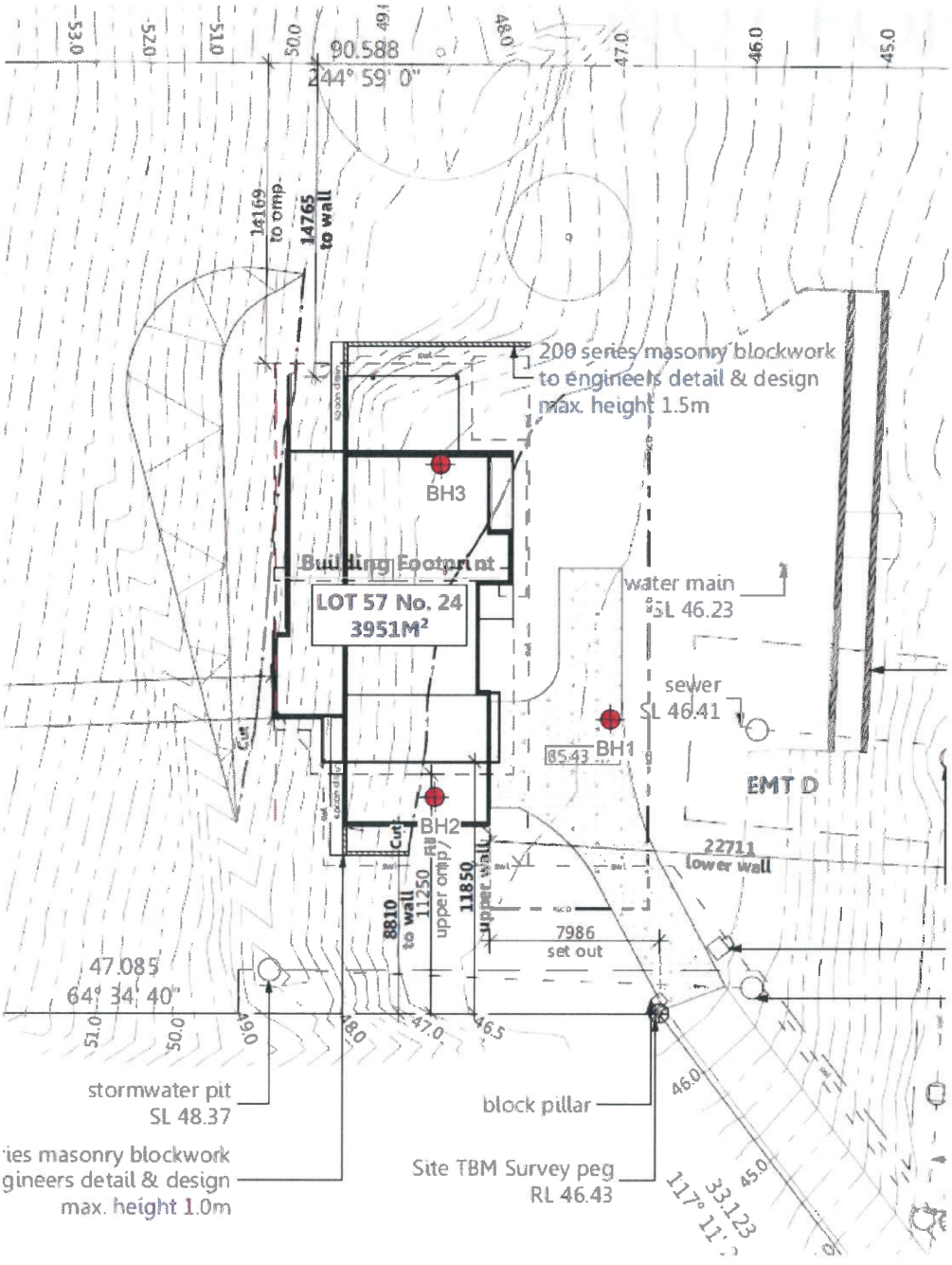
Distributed by

CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

Site/Test Location Plan



- Not to scale
- All measurements are to be used as a guide only

Report Limitations

1. Recommendations given in this report are based on the information supplied by the client regarding the proposed building construction in conjunction with the findings of the investigation. Any change in construction type, building location or omission in the client supplied information, may require additional testing and/or make the recommendations invalid.

2. The recommendations herein may identify a target soil stratum into which the footings should be founded. The target stratum has been located by the depth in mm of the target stratum's upper horizon boundary below the existing ground surface level at the time of the site investigation. Any cutting or filling works and any surface erosion or deposits subsequent to the site investigation, will alter the measured location of the stratum relative to the surface. Where required, the author should be notified in such cases to confirm the location of the target stratum.

3. The description of the soil given in Section 3.0 of this report is intended as a brief overview of the soil's primary constituents. For a detailed classification of the soil, the reader should refer to the Soil Profile Reports and/or Borehole Reports.

4. Every reasonable effort has been made to locate the test sites so that the borehole profiles are representative of the soil conditions within the area investigated. The client should be made aware however, that exploration is limited by time available and economic restraints. In some cases soil conditions can change dramatically over short distances, therefore, even careful exploration programs may not locate all the variations.

5. If soil conditions different from those shown in this report are encountered or are inferred from other sources, then the author must be notified immediately.

6. This report may not be reproduced except in full, and only then with the permission of the entity trading as CQ Soil Testing. The information and site sketch shall only be used and will only be applicable for the development shown on the client-supplied information provided for this site.

7. All information contained within this report is the intellectual property of the entity trading as CQ Soil Testing. All information contained with can only be used for the express purposes of the commissioned scope of works.

8. Any dimensions, contours, slope directions and magnitudes shown on the site sketch plan shall not be used for any building construction or costing calculations. The purpose of the plan is to show approximate location of field tests only.

9. Any changes made to these recommendations by persons unauthorized by the author will legally be interpreted at that person assuming the responsibility for the long-term performance of the footing system.

10. The recommendations contained in this report have not taken into consideration the long term effects of any previous, current or potential subsurface work by mining companies or potential slope instability problems. At the time of writing this report neither our client (nor his agent) nor the local authority had made the author aware that these problems may be affecting this allotment. If a mining subsidence or slope stability assessment is required for this allotment, the recommendations of a suitably qualified geotechnical engineer should be sought.

11. Removal of trees from a site before an investigation can cause significant swelling of the soil over large areas. The removal of large trees from a construction site during development is rarely picked up during the investigation phase and is generally outside the scope of AS2870. Sites affected by large trees are often classified "P". If, during the footing excavation, it is noticed that there are soils with varying moisture contents or evidence of large trees having been removed CQ Soil Testing should be notified immediately.

12. The following documents are available from the CSIRO and QBCC and shall be read and adhered to in relation to this site:

    - Builder's Guide to Preventing Damage to Dwellings- Part 1 Site Investigation and Preparation
      http://www.publish.csiro.au/nid/22/pid/3621.htm
    - Builder's Guide to Preventing Damage to Dwellings- Part 2 Sound Construction Methods
      http://www.publish.csiro.au/nid/22/pid/3661.htm
    - Foundation Maintenance and Footing Performance- A Homeowner's Guide
      http://www.publish.csiro.au/nid/22/pid/3612.htm
    - BSA Subsidence Fact Sheet
      http://www.bsa.qld.gov.au/NR/rdonlyres/4CA6BA57-3CB5-4B75-B75E-3CA0469D7463/0/SubsidenceFacts.pdf

Subject Site

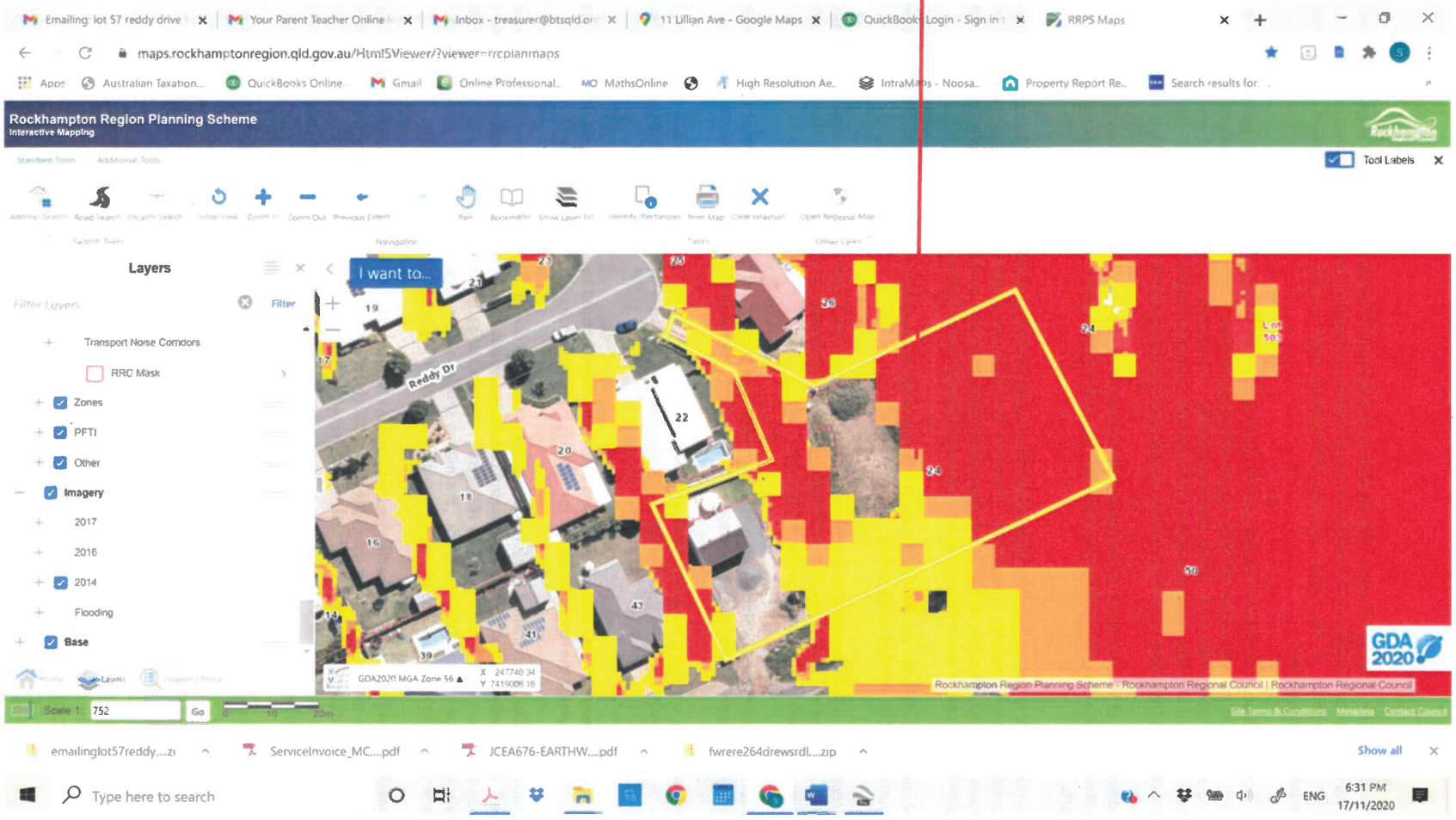
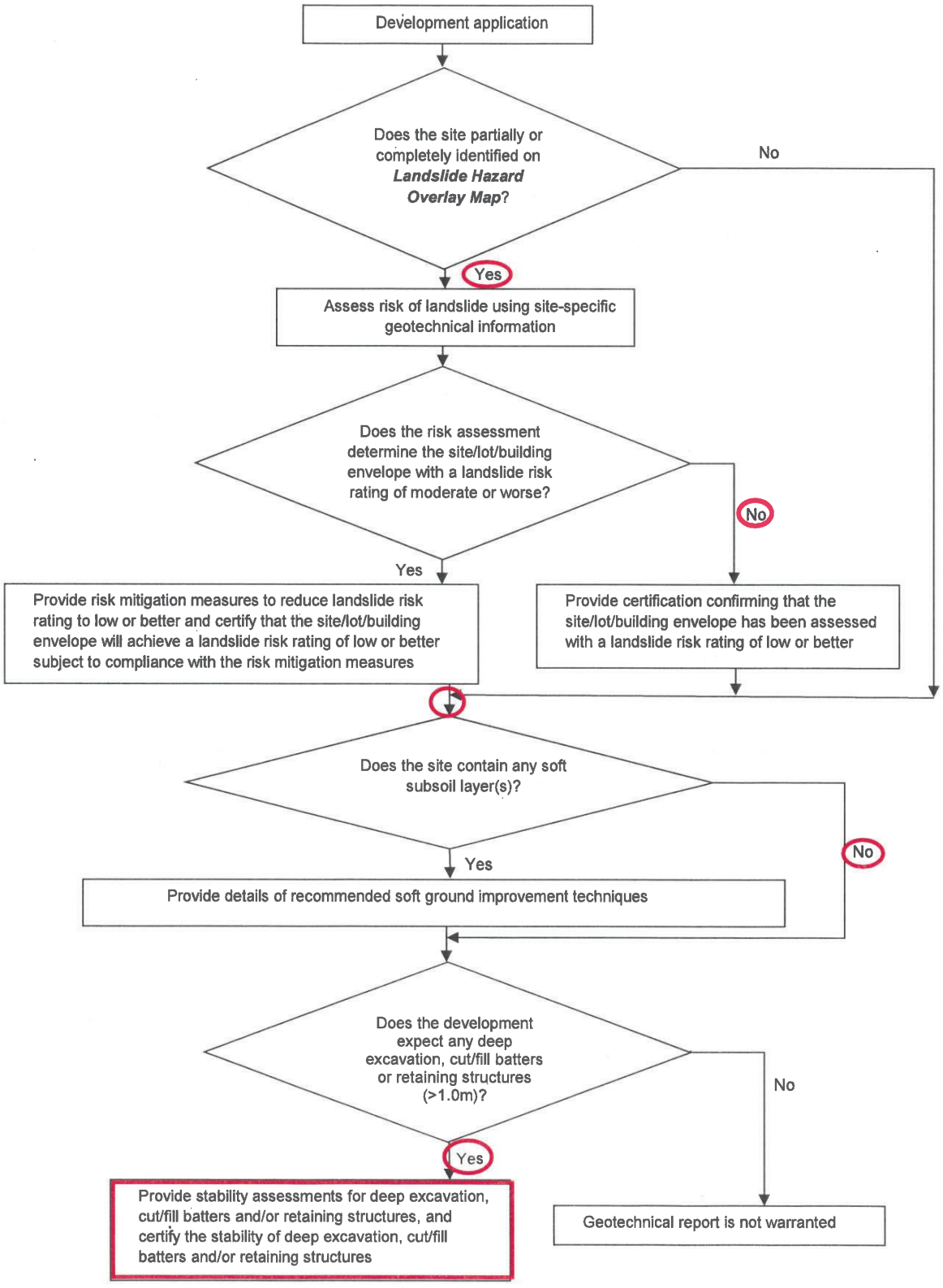


Figure 1 shows a flowchart for various geotechnical stability assessments that should be carried out and include in a *Geotechnical Report.*

Figure 1: Flowchart for geotechnical stability assessment



LANDSLIDE SUSCEPTIBILITY ANALYSIS - EXISTING/PROPOSED

Site Address: 24 Reddy Drive, Norman Gradens QLD 4701.
Geology: Early Permian Aged Lakes Creek Sedimentary Rock Formation.
Landslide Hazard Overlay Map: Located within Rockhampton Regional Council (RRC) Landslide Hazard and Steep Sloping Area.

1 Natural Surface Slope

Site		Level	Factor
	Less than 5 degrees	L	0.1
	Between 5 and 15 degrees	M	**0.5**
	Between 15 and 30 degrees	M	0.8
	Between 30 and 45 degrees	H	1.2
	More than 45 degrees	M	0.8

2 Slope Shape

Site		Level	Factor
	Crest or ridge	L	0.7
	Planar / Convex	M	**0.9**
	Rough / Irregular	H	1.2
	Concave	H	1.5

3 Site geology

Site		Level	Factor
	Volcanic Extrusive rock	H	1.1
	Sedimentary rock	M	**1**
	Low grade metamorphic rock	M	1
	High grade metamorphic rock	L	0.9
	Volcanic Intrusive rock	M	1

4 Soils

Site		Level	Factor
	Rock at surface	VL	0.1
	Residual soil < 1m deep	L	0.5
	Residual soil 1-3m deep	M	**0.9**
	Residual soil > 3m deep	H	1.5
	Colluvial soil < 1m deep	H	1.5
	Colluvial soil 1-3m deep	VH	2
	Colluvial soil > 3m deep	VH	4

5 Fill height - Existing/Assumed

Site		Level	Factor
	None	L	0.9
	Less than 1m	M	**1.1**
	Between 1 and 3m	M	1.3
	Between 3 and 6m	H	1.7
	More than 6m	VH	2.5

6 Evidence of groundwater

Site		Level	Factor
	None apparent	L	**0.7**
	Minor moistness	M	0.9
	Generally wet	H	1.5
	Surface springs	VH	3

7 Cut height - Proposed/Assumed

Site		Level	Factor
	None	L	0.9
	Less than 1m	M	1.1
	Between 1 and 3m	M	**1.3**
	Between 3 and 6m	H	1.7
	More than 6m	VH	2.5

8 Slope of Cut Face

Site		Level	Factor
	Less than 30 degrees	L	**0.5**
	Between 30 and 45 degrees	M	1
	Between 45 and 60 degrees	H	1.5
	More than 60 degrees	VH	3

9 Material in cutting -

Site		Level	Factor
	High strength rock	L	0.5
	Medium strength rock	L	1
	Low strength rock	M	1.2
	Very low strength rock and soil	H	1.5
	Soil	VH	**2**

10 Cut slope support

Site		Level	Factor
	Concrete/Block wall	L	0.5
	Crib wall	M	0.9
	Gabion wall	M	1
	Rock wall	H	1.5
	Unsupported	H	**2**

11 Concentration of surface water

Site		Level	Factor
	Ridge	L	0.7
	Crest	M	0.8
	Upper slope	M	**0.9**
	Mid slope	H	1.2
	Lower slope	H	1.5

12 Wastewater Disposal - Proposed/Assumed

Site		Level	Factor
	Fully Sewered	M	**1**
	Onsite disposal – Surface	M	1.2
	Onsite disposal – Soak Pit/Trenches	H	1.5

13 Stormwater Disposal - Proposed/Assumed

Site		Level	Factor
	All stormwater piped into road drainage	L	**0.7**
	Rain water tank with overflows	M	1
	Stormwater discharge on site	H	1.5

14 Evidence of instability

Site		Level	Factor
	No sign of instability	L	**0.8**
	Soil Creep	H	1.2
	Minor irregularity	VH	2
	Major irregularity	VH	5
	Active instability	VH	10

Summary

			Factor
1	Natural Surface Slope		0.5
2	Slope Shape		0.9
3	Site Geology		1.0
4	Soils		0.9
5	Fill Height		1.1
6	Evidence of Groundwater		0.7
7	Cut height		1.3
8	Slope of Cut Face		0.5
9	Material in Cutting		2.0
10	Cut Slope Support		2.0
11	Concentration of Surface Water		0.9
12	Wastewater Disposal		1.0
13	Stormwater Disposal		0.7
14	Evidence of Instability		0.8
Relative Susceptibility (1x2x3x4x5x6x7x8x9x10x11x12x13x14)			0.41

Low

Correlation between relative susceptibility and susceptibility rating

Relative Susceptibility	Susceptibility Rating
Less than 0.2	Very Low
0.2 – 0.6	Low
0.6 – 2.0	Moderate
2.0 – 6.0	High
Greater than 6.0	Very High

Preliminary Drawings - A

LYKE HOMES

WEB | www.lykehomes.com.au
BEN | 04 03 531 735 TASH | 0410 399 340
QBCC | 1269170 ABN | 98 162 495 105

Sheet Index

PROPOSED RESIDENCE FOR:

Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Rockhampton QLD 4701

LEGEND

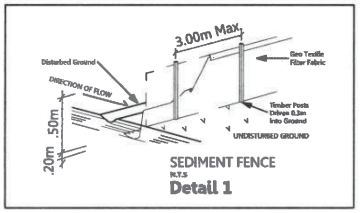
- Rock retaining wall to eng. detail & design
- 200 series masonry block retaining wall to eng. detail & design
- Timber retaining wall maximum height 1m
- 23.5 Contour
- scb Sediment control barrier to local authority policy
- swl Stormwater line
- Timber fence
- G Timber gate
- Batter / slope
- 23.500 Proposed FGL (finished ground level)
- 1.2m sq. on site toilet pad location tbc on site
- 6.65 m² Driveway / Pathway (approx. area)
- 6.65 m² Private Open Space (approx. area)
- 30.715 165°42'00" Boundary distance & coordinates

NOTE:
Not all symbols above may be depicted on this site plan

Site drawn using Detail Survey as supplied by Capricorn Survey Group.

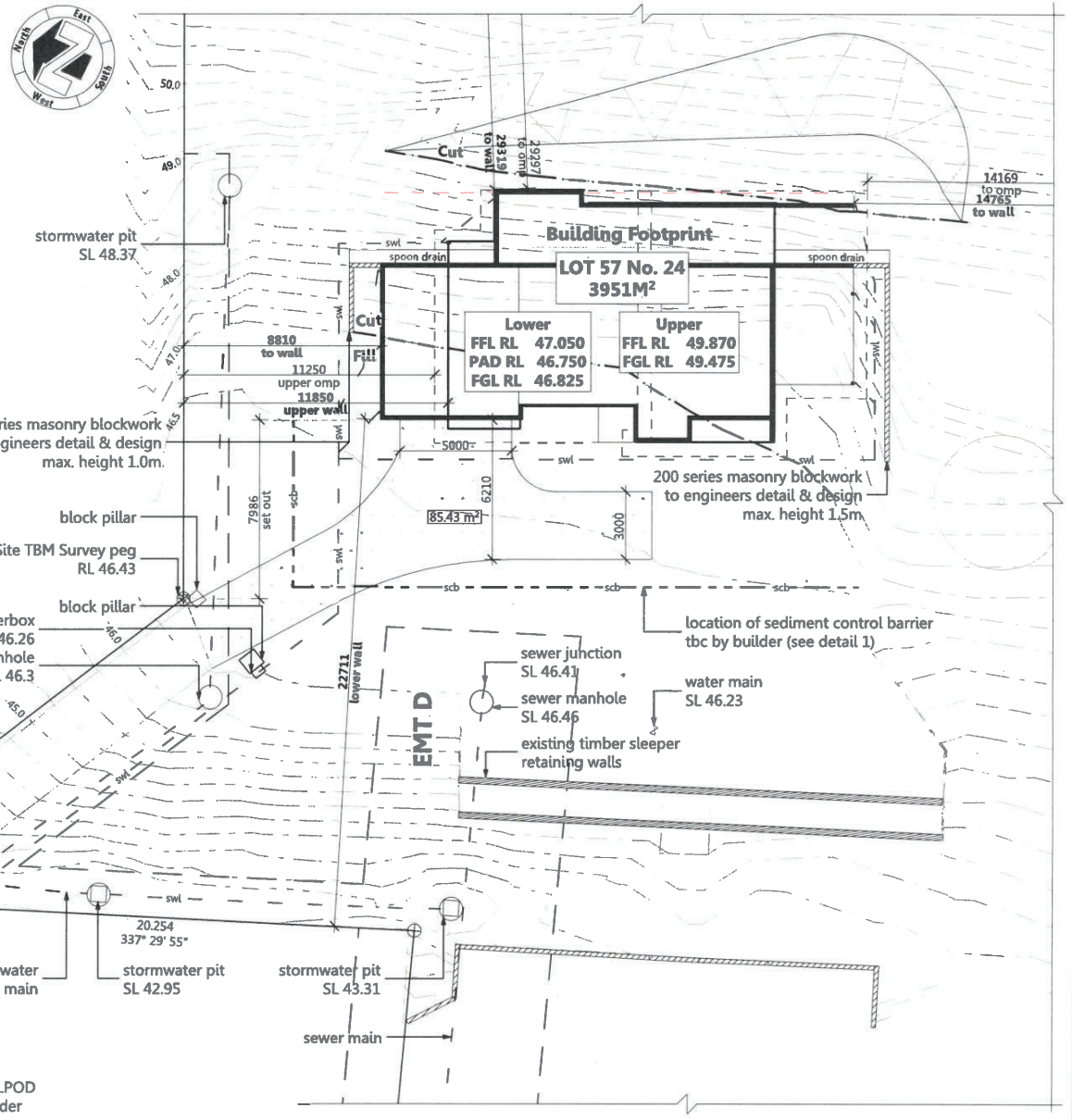
Levels & contours are based on assumed datum. Prior to construction the relevant authority should be contacted for possible minimum floor level requirements & flood information.

This site plan is based on information provided by the builder. The floor level is subject to change.



Stormwater
Legal Point Of Discharge

The builder / owner must confirm the precise location of the point of discharge, prior to any work carried out on site, if the point of discharge cannot be located, Council's Engineering Office should be notified immediately



Real Property Description

Lot Number: 57 No. 24
Registered Plan Number: SP217337
Parish: tba
County: tba
Local Authority: Rockhampton Regional Council

Site Area: 3951M²
Site Coverage: 5.33%
Site Coverage With Shed: 7.76%

I WANT THAT DESIGN
Suite 30503, Level 5, Tower 3 Southport Central Commercial 9 Lawson Street, Southport Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN 89135124775 QBCC 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches.

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Site Plan 1:200

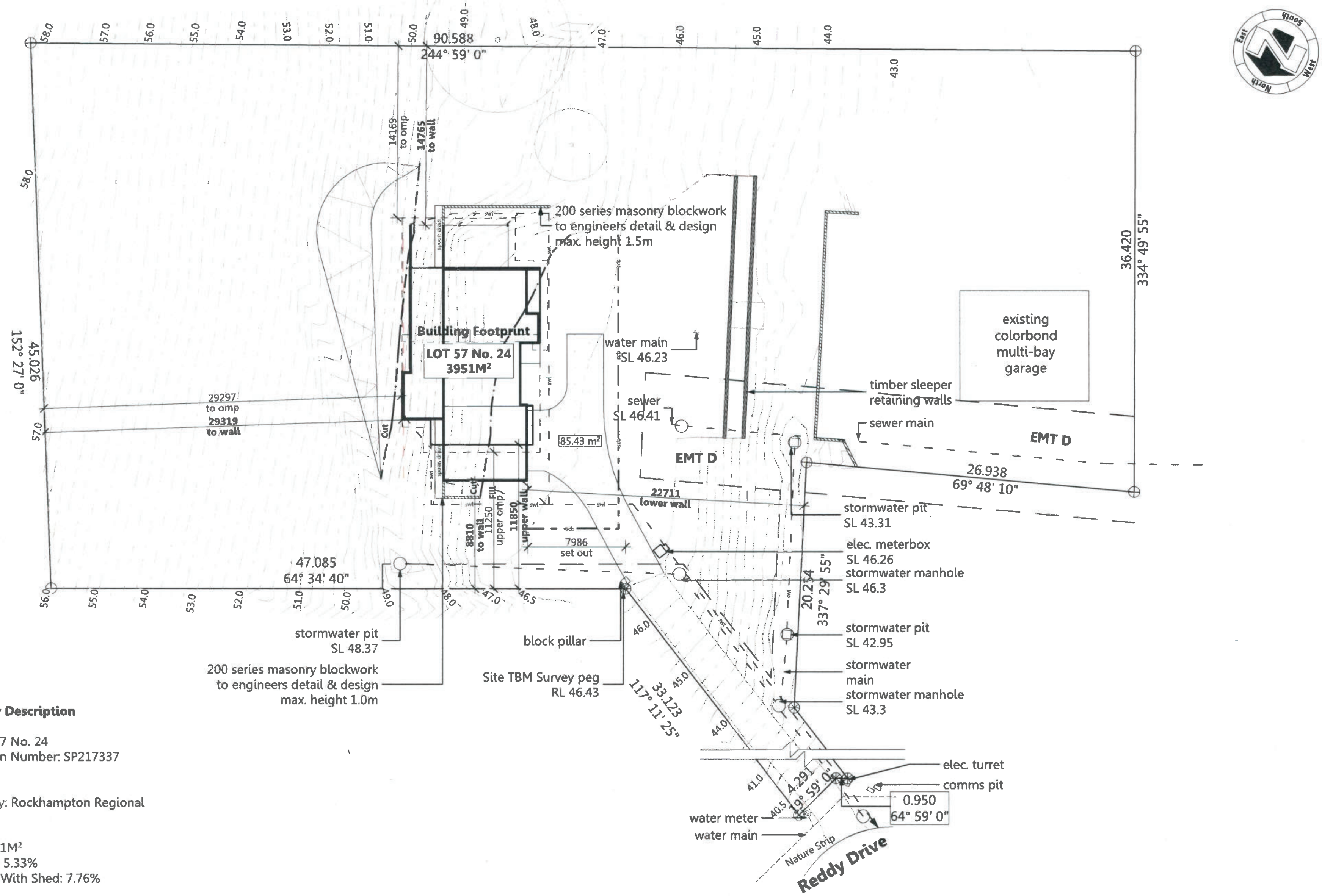
Design Name:
Custom

Area Calculations (m²)

Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	**326.94 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	**Concept** Drawings	PK
CB	13/08/2020	**Amendments** as requested	PK
PA	09/11/2020	**Preliminary Drawings Issued**	LBJ

Drawing No: 2 of 10
Scale: 1:200 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**



Real Property Description

Lot Number: 57 No. 24
Registered Plan Number: SP217337
Parish: tba
County: tba
Local Authority: Rockhampton Regional Council

Site Area: 3951M²
Site Coverage: 5.33%
Site Coverage With Shed: 7.76%

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s .... Date..............

Owner / s .... Date..............

Builder: LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title: **Site Plan 1:300**

Design Name: **Custom**

Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	326.94 m²

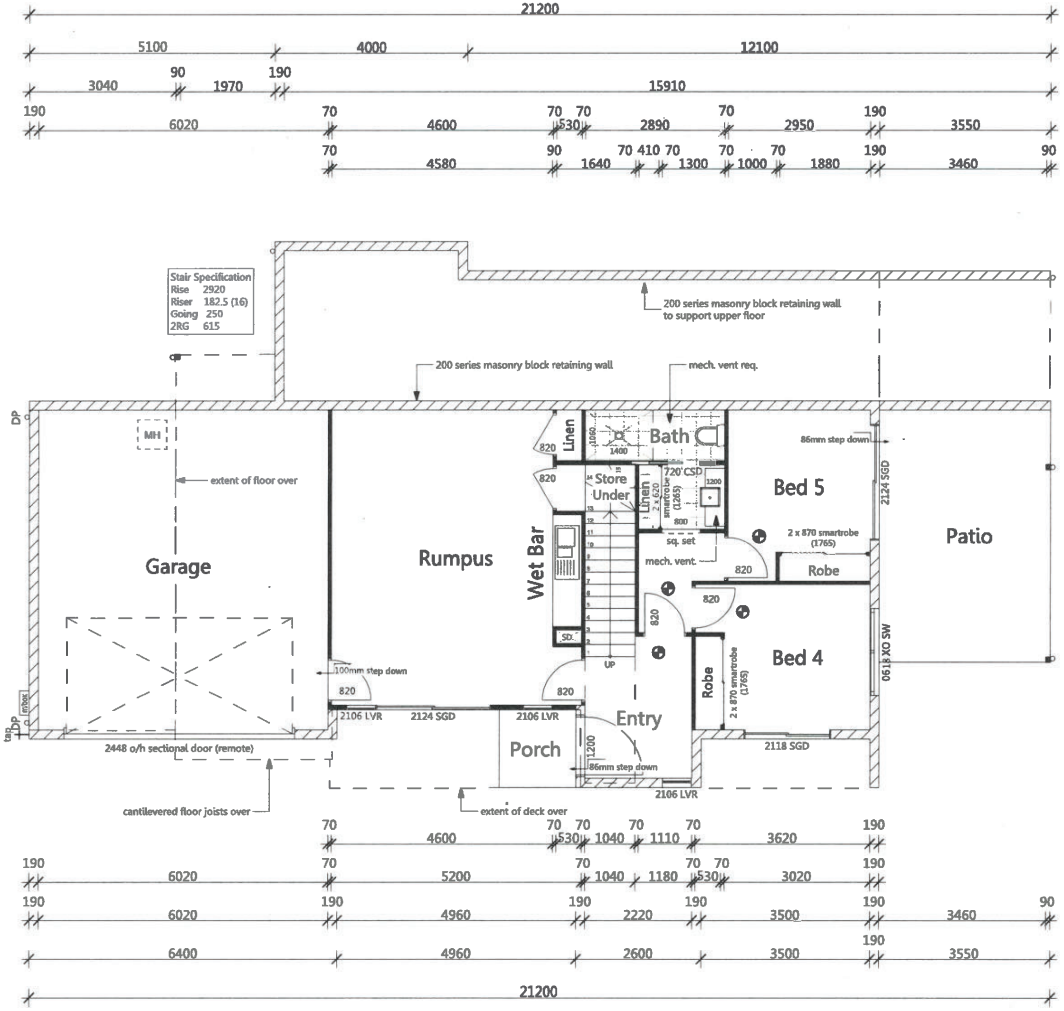
Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

Drawing No: 3 of 10
Scale: 1:300 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**

Important Note

Ventilation to internal wc, bath, ensuite to be an exhaust fan in accordance with BCA 3.8.5 & BCA 3.8.7 & AS - 1668.2

Stair treads are to have a slip resistant/ nosing strip with a classification not less than table 3.9.1.3 of BCA Part 3.9.1



Elevations

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King

Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Lower Floor Plan

Design Name:
Custom

Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	326.94 m²

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

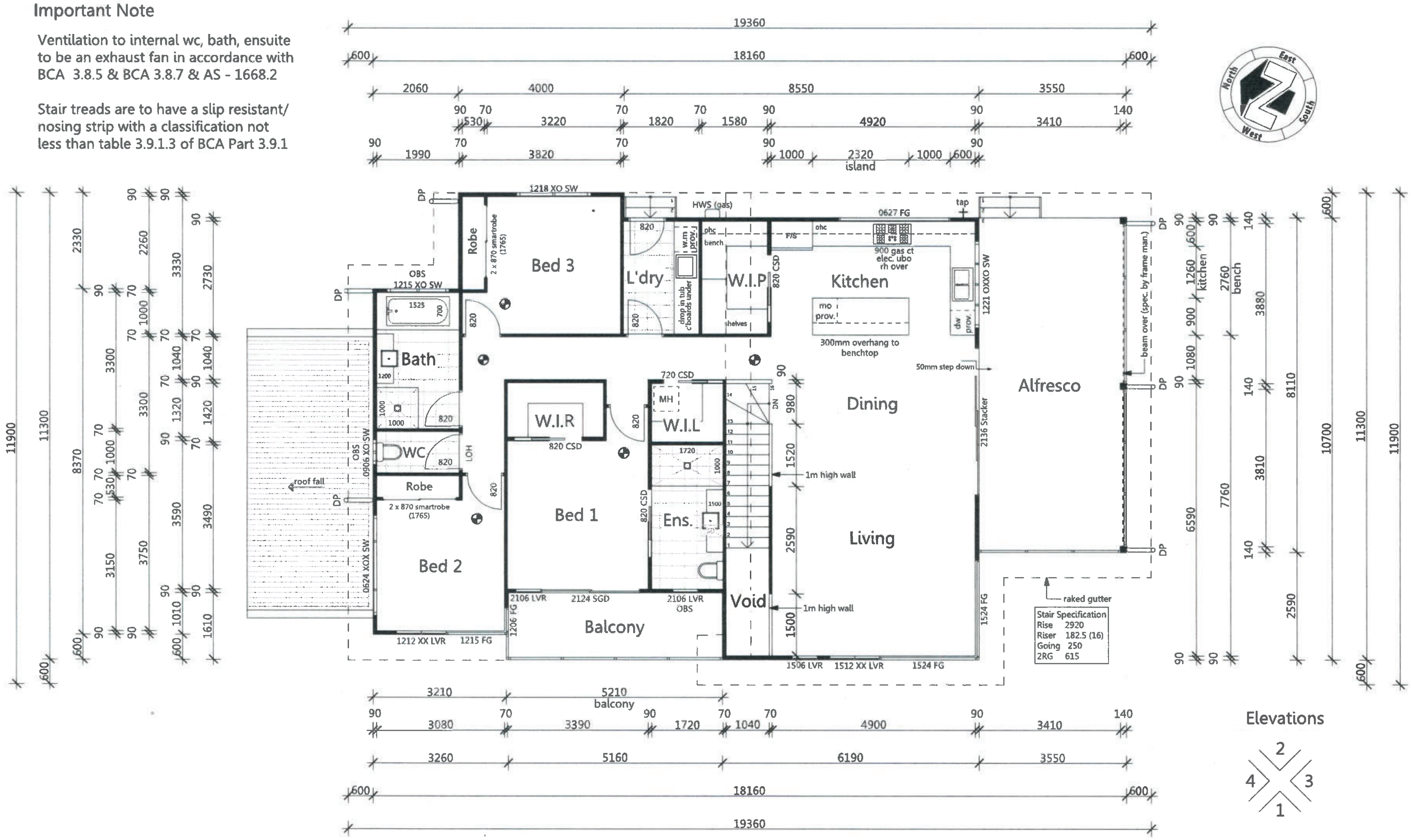
Drawing No: 4 of 10

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: 7699SM

Important Note

Ventilation to internal wc, bath, ensuite to be an exhaust fan in accordance with BCA 3.8.5 & BCA 3.8.7 & AS - 1668.2

Stair treads are to have a slip resistant/ nosing strip with a classification not less than table 3.9.1.3 of BCA Part 3.9.1



Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s .... Date...............

Owner / s .... Date...............

Builder: LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title: **Upper Floor Plan**

Design Name: **Custom**

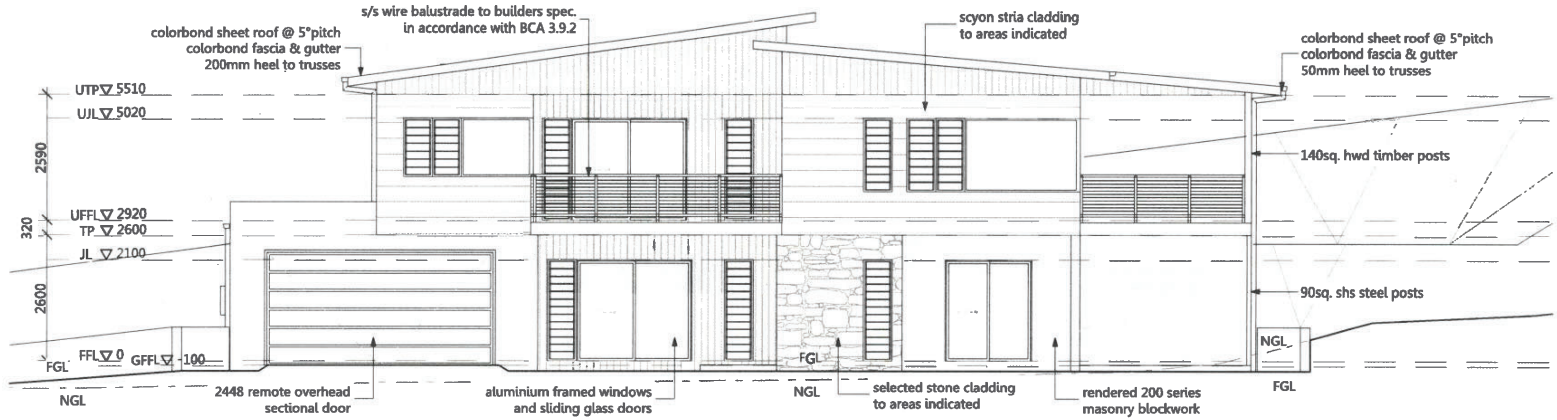
Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	**326.94 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

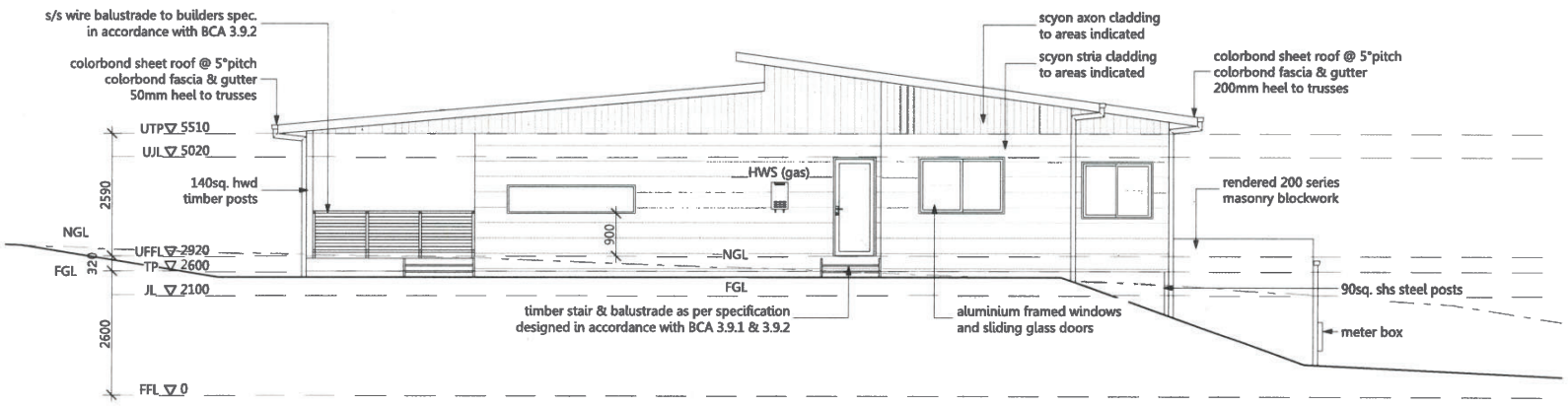
Drawing No: 5 of 10

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK

Job No: **7699SM**



Elevation 1



Elevation 2

I WANT THAT DESIGN
Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181786

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Elevations 1 of 2

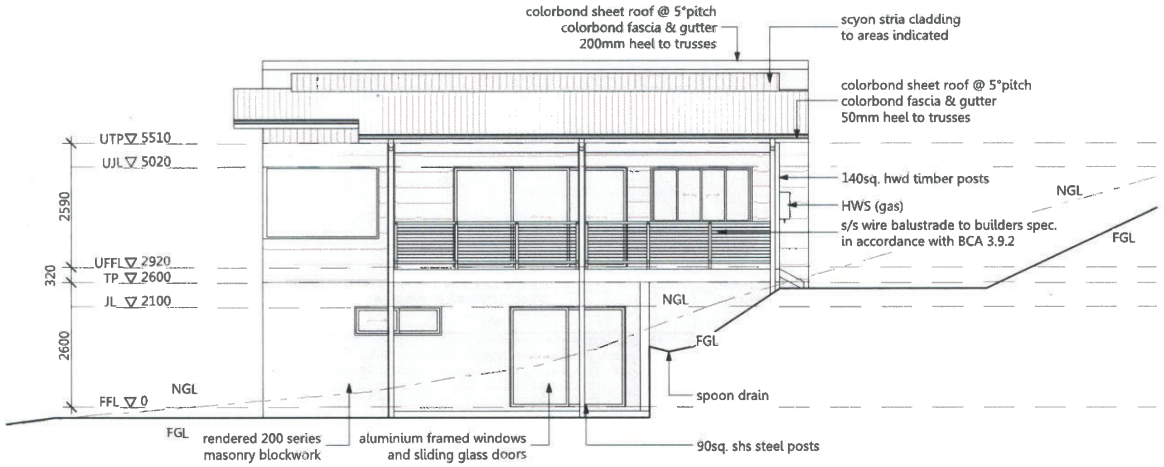
Design Name:
Custom

Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	326.94 m²

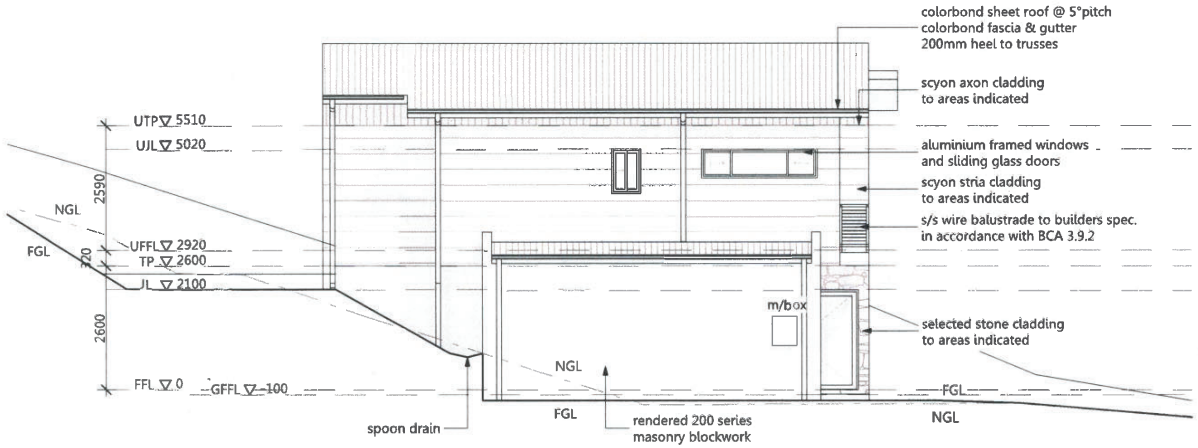
Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

Drawing No: 6 of 10

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**



Elevation 3



Elevation 4

I WANT THAT DESIGN
Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Elevations 2 of 2

Design Name:
Custom

Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	**326.94 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

Drawing No: 7 of 10

Job No: **7699SM**

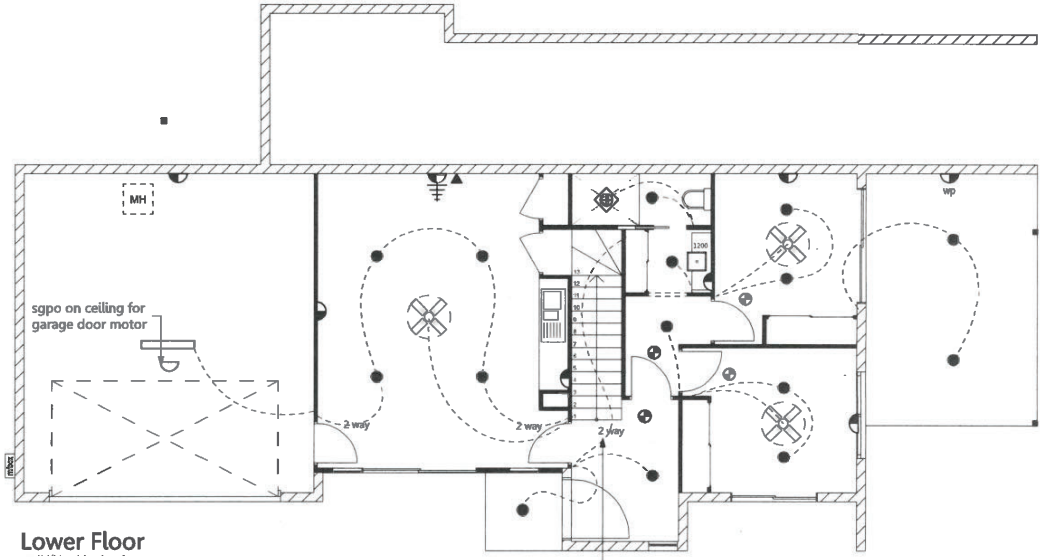
Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK

Electrical Legend

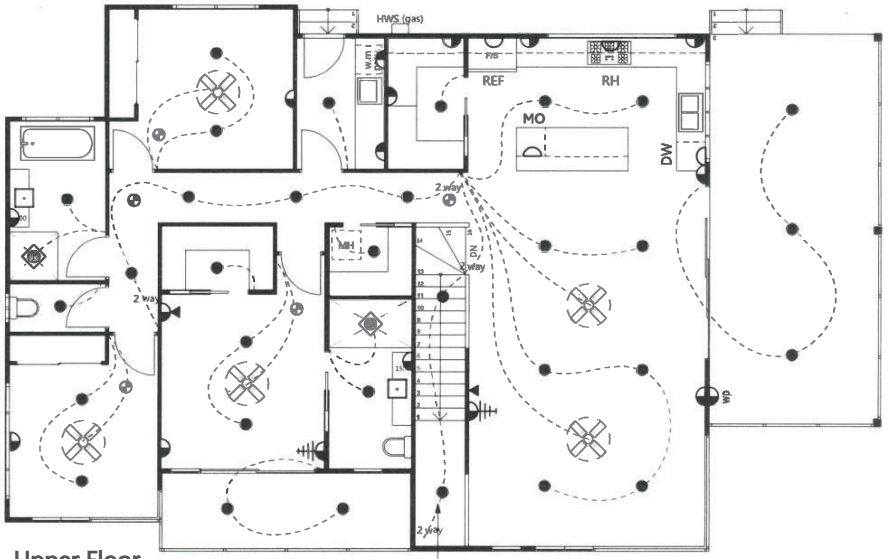
- Single Power Outlet
- Single Power Outlet - Weather Proof
- Double Power Outlet
- Double Power Outlet - Weather Proof
- Ceiling Down Light Point
- Low Voltage Down Light Point
- Pendant Light Point
- Ceiling Circ. Fluro Light Point
- Flood Light Point
- Up & Down Light Point
- Single Fluro Light Point
- Sensor Light Point
- Ceiling Exhaust Fan (vented to ceiling space)
- Ceiling Exhaust Fan (vented externally)
- Heater / Light / Fan
- T.V Point
- Smoke Alarm
- Phone / Data Point
- Skylight
- Ceiling Fan
- Ceiling Fan / Light
- Air Conditioner - Internal Unit
- Air Conditioner - External Unit
- Gas Connection Point
- NBN

Electrical Notes

Light Switches	@ 1150 AFL
Wall Mounted Lights	@ 2000 AFL
Power Outlets (Standard)	@ 300 AFL
Power Outlets (Other)	
Microwave Oven (Oven Tower)	@ 1800 AFL
Microwave Oven (Under Bench)	@ 300 AFL
Kitchen Bench	@ 1000 AFL
Refrigerator	@ 1500 AFL
Rangehood	@ 1800 AFL
Dishwasher	@ 300 AFL
Vantiy Basins	@ 1000 AFL
Laundry Bench	@ 1000 AFL
Washing Machine	@ 1500 AFL



Lower Floor



Upper Floor

Important Note

Ventilation to internal wc, bath, ensuite to be an exhaust fan in accordance with BCA 3.8.5 & BCA 3.8.7 & AS - 1668.2

Smoke alarms to be hard-wire installed & inter-connected in accordance with BCA 3.7.5

Smoke alarms to be positioned as per Part 5A Smoke Alarms for Domestic Dwellings from the Building Fire Safety Regulation 2008

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN 89135124775 QBCC 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King

Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Electrical Plans

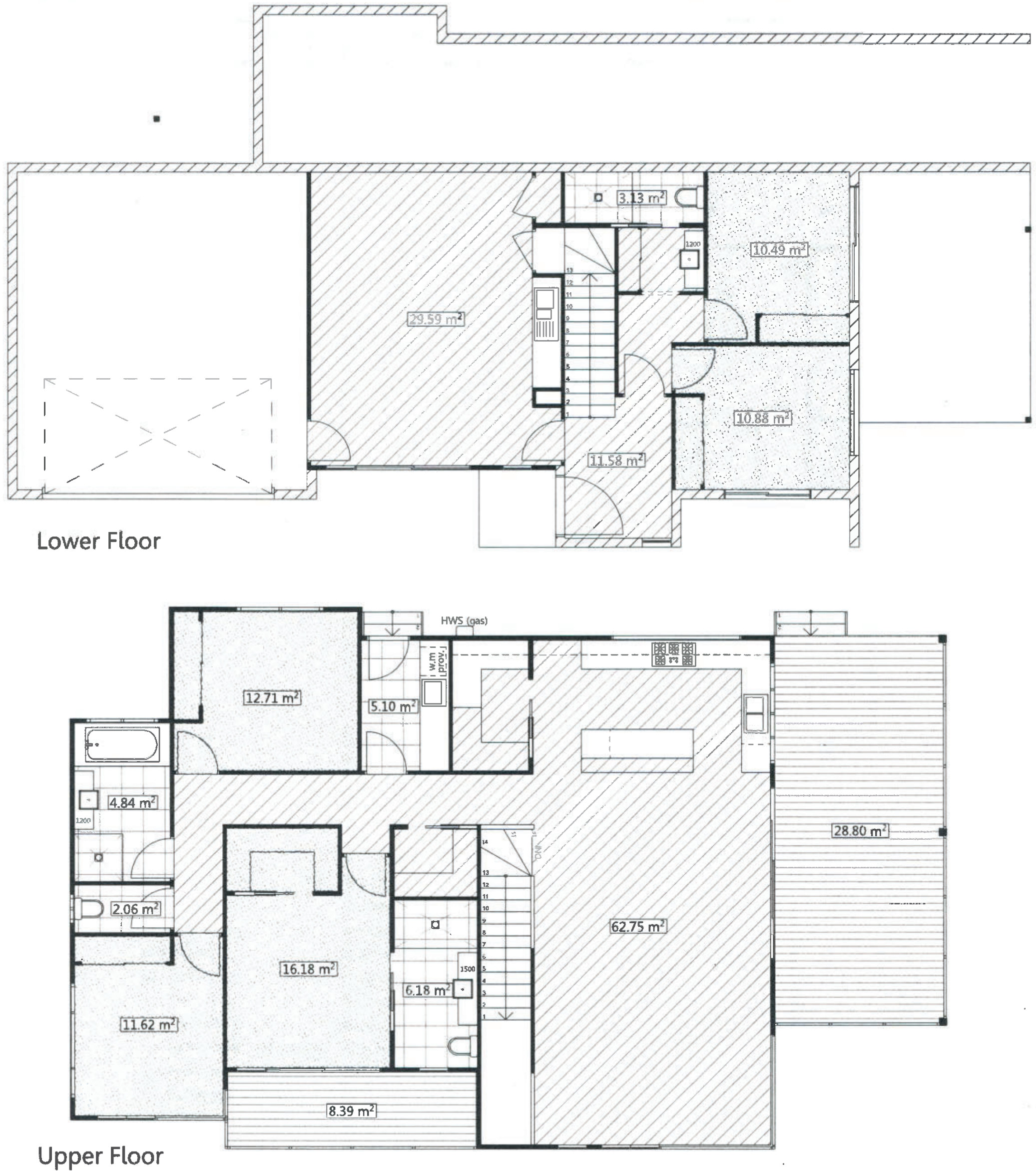
Design Name:
Custom

Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	326.94 m²

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

Drawing No: 8 of 10

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**



Tiling Note:
Floor tile hatching shown indicates areas to be tiled only and not the finished tile layout

Main floor covering as per builders specification

Wet area ceramic tile as per builders specification

Carpet areas as per builders specification

Timber decking as per builders specification

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s .... Date..............

Owner / s .... Date..............

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Floor Covering Plans

Design Name:
Custom

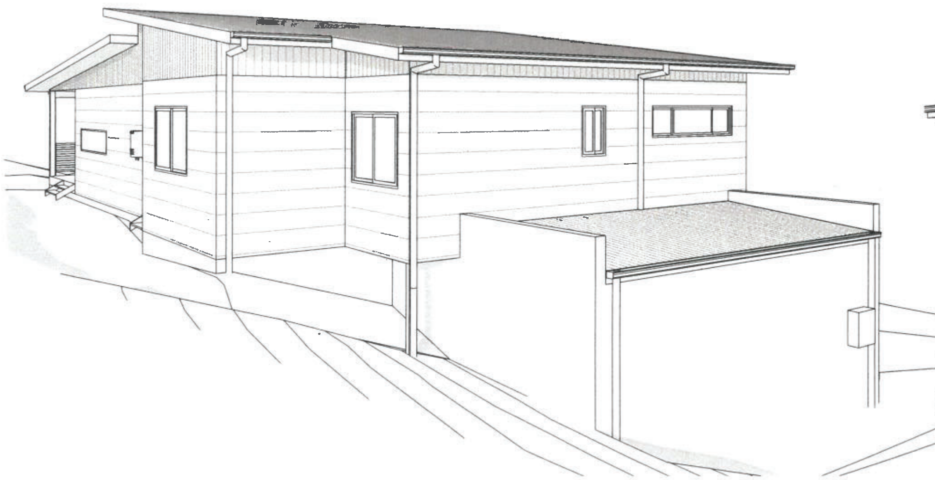
Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	**326.94 m²**

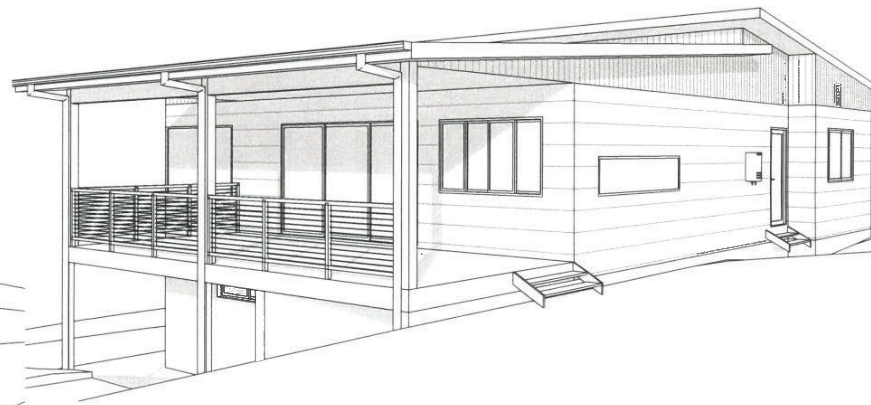
Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

Drawing No: 9 of 10

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK

Job No: **7699SM**





Images Are Diagramatic Only Refer
To Elevations For Details

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215

(07) 5591 7658

orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au

ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches.

Owner / s .... Date..............

Owner / s .... Date..............

Builder: LYKE HOMES

BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title: **3D Perspectives**

Design Name: **Custom**

Area Calculations (m²)	
Upper Living	144.90
Lower Living	79.54
Garage	43.59
Alfresco	28.79
Patio	19.21
Balcony	8.35
Porch	2.56
Total	**326.94 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ

Drawing No: 10 of 10

Scale: N/A

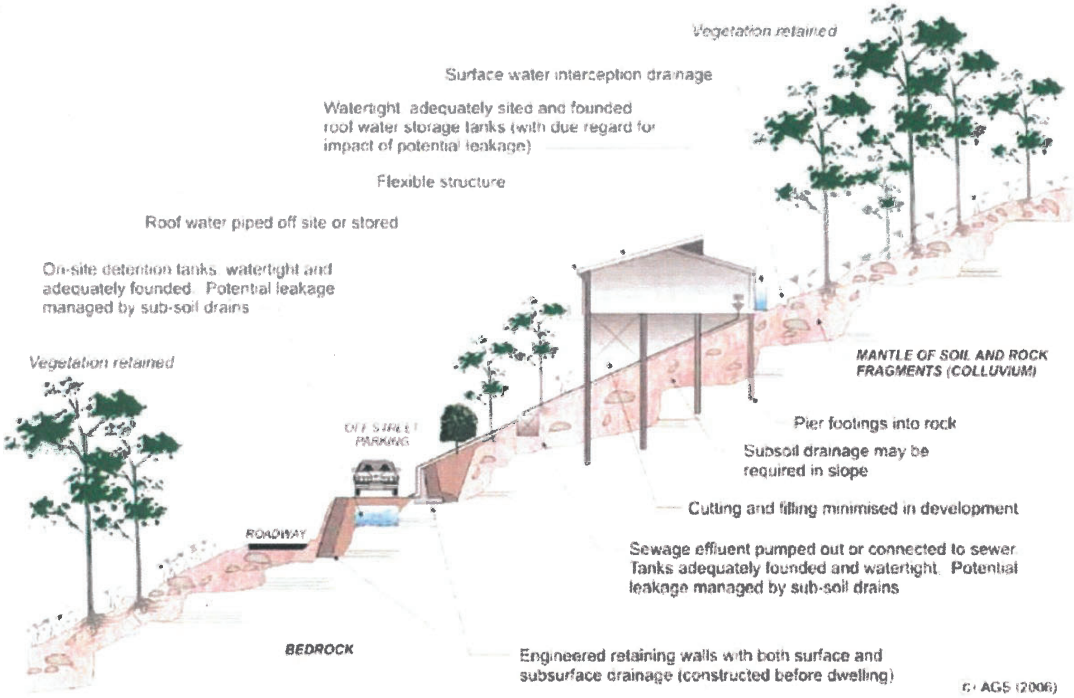
Designed By: Client

Drawn By: KJ

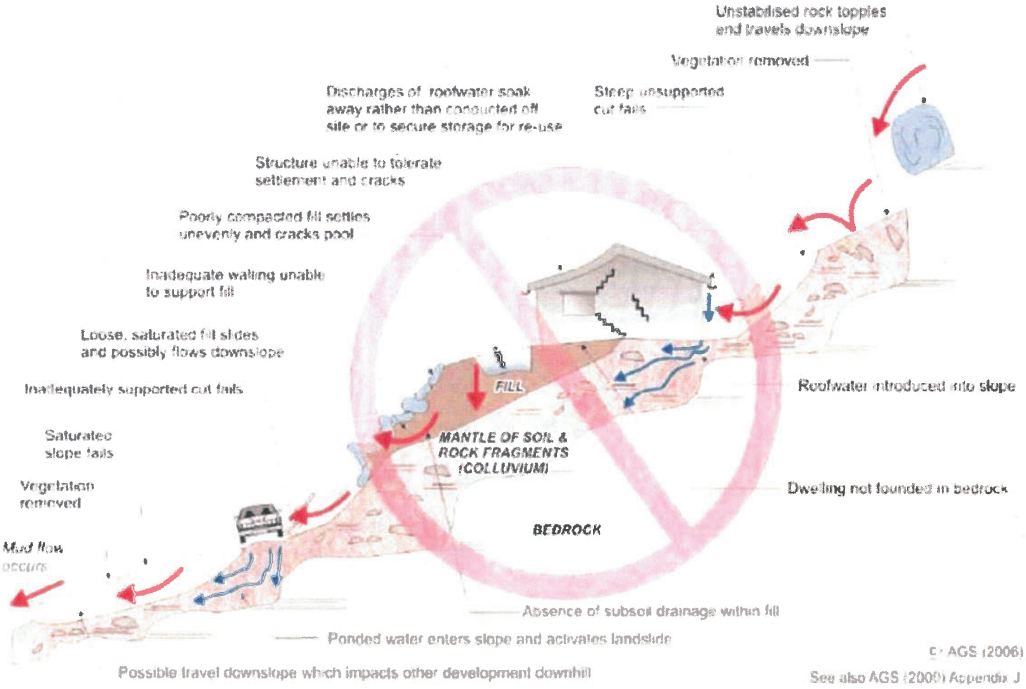
Checked By: PK

Job No: **7699SM**

EXAMPLES OF GOOD HILLSIDE PRACTICE

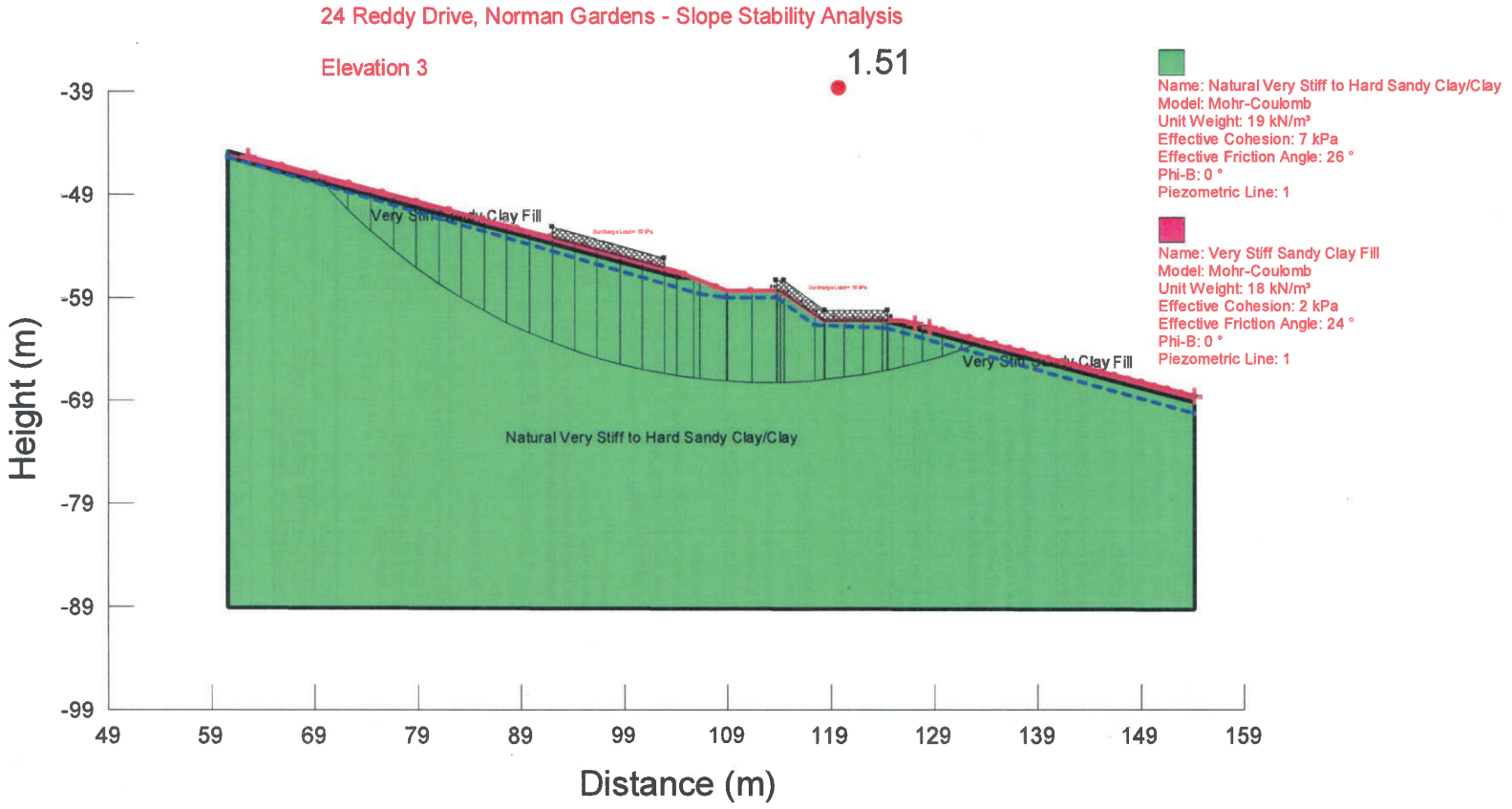


EXAMPLES OF POOR HILLSIDE PRACTICE



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.	



CQ SOIL TESTING technical excellence	**Client:**	Lyke Homes Pty Ltd	**Global Stability Analysis – Existing/Proposed Slope Geometry with Surcharge Load and Appropriate Groundwater**	
	Consultant:	CQ Soil Testing	**Slope Stability Analysis – Elevation 3**	**Drawing No:** 1
	Date:	November 2020	**24 Reddy Drive, Norman Gardens LD 4701**	**Revision:** 0

Appendix D – Standard pro-forma for geotechnical certification

Property details	
Lot Number If Applicable	Lot 57
Registered Plan Number	SP 217337
Site Address	24 Reddy Drive, Norman Gardens QLD 4701

Proposed works	
Description	Proposed Residential Development

Proposed development	
Description	Proposed Residential Development

Declaration

I,	Sam Jeyan	Registered Professional Engineer of Queensland (RPEQ) number	13339
of	CQ Soil Testing Pty Ltd		(Consulting engineer's firm)

being duly authorised on this behalf, do certify that:

the proposed residential development is appropriate for the sloping nature of the site, and the risk of landslide adversely affecting the subject site, adjoining properties and the proposed development is 'low' (as detailed in Sections 5.1, 5.2, 5.7 & 5.8 of the report).

I am aware that Rockhampton Regional Council (RRC) will rely upon this certificate and any associated maps, structural & drainage plans, drawings, tables and attachments etc. produced as a consequence of commissioning this development proposal.

Accredited Slope Risk Assessor - RMS Guide to Slope Risk Assessment - Version 4

Signature		**Designation**	Senior Geotechnical Engineer		
Certified this	23	**Day of**	November	**Year**	2020

LEGEND

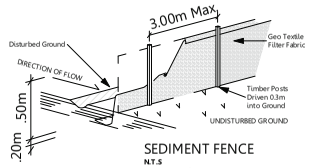
- Rock retaining wall to eng. detail & design
- 200 series masonry block retaining wall to eng. detail & design
- Timber retaining wall maximum height 1m
- 23.5 Contour
- scb Sediment control barrier to local authority policy
- swl Stormwater line
- Timber fence
- G Timber gate
- Batter / slope
- 23.500 Proposed FGL (finished ground level)
- 1.2m sq. on site toilet pad location tbc on site
- 6.65 m² Driveway / Pathway (approx. area)
- 6.65 m² Private Open Space (approx. area)
- 30.715 165°42'00" Boundary distance & coordinates

NOTE:
Not all symbols above may be depicted on this site plan

Site drawn using Detail Survey as supplied by Capricorn Survey Group.

Levels & contours are based on assumed datum. Prior to construction the relevant authority should be contacted for possible minimum floor level requirements & flood information.

This site plan is based on information provided by the builder. The floor level is subject to change.



SEDIMENT FENCE
N.T.S
Detail 1

Stormwater
Legal Point Of Discharge

The builder / owner must confirm the precise location of the point of discharge, prior to any work carried out on site, if the point of discharge cannot be located, Council's Engineering Office should be notified immediately

ROCKHAMPTON REGIONAL COUNCIL
APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with
Development Permit No.: D/127-2021
Dated: 10 November 2021

Real Property Description

Lot Number: 57 No. 24
Registered Plan Number: SP217337
Parish: tba
County: tba
Local Authority: Rockhampton Regional Council

Site Area: 3951M²
Site Coverage: 5.33%
Site Coverage With Shed: 7.76%

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Site Plan 1:200

Design Name:
Custom

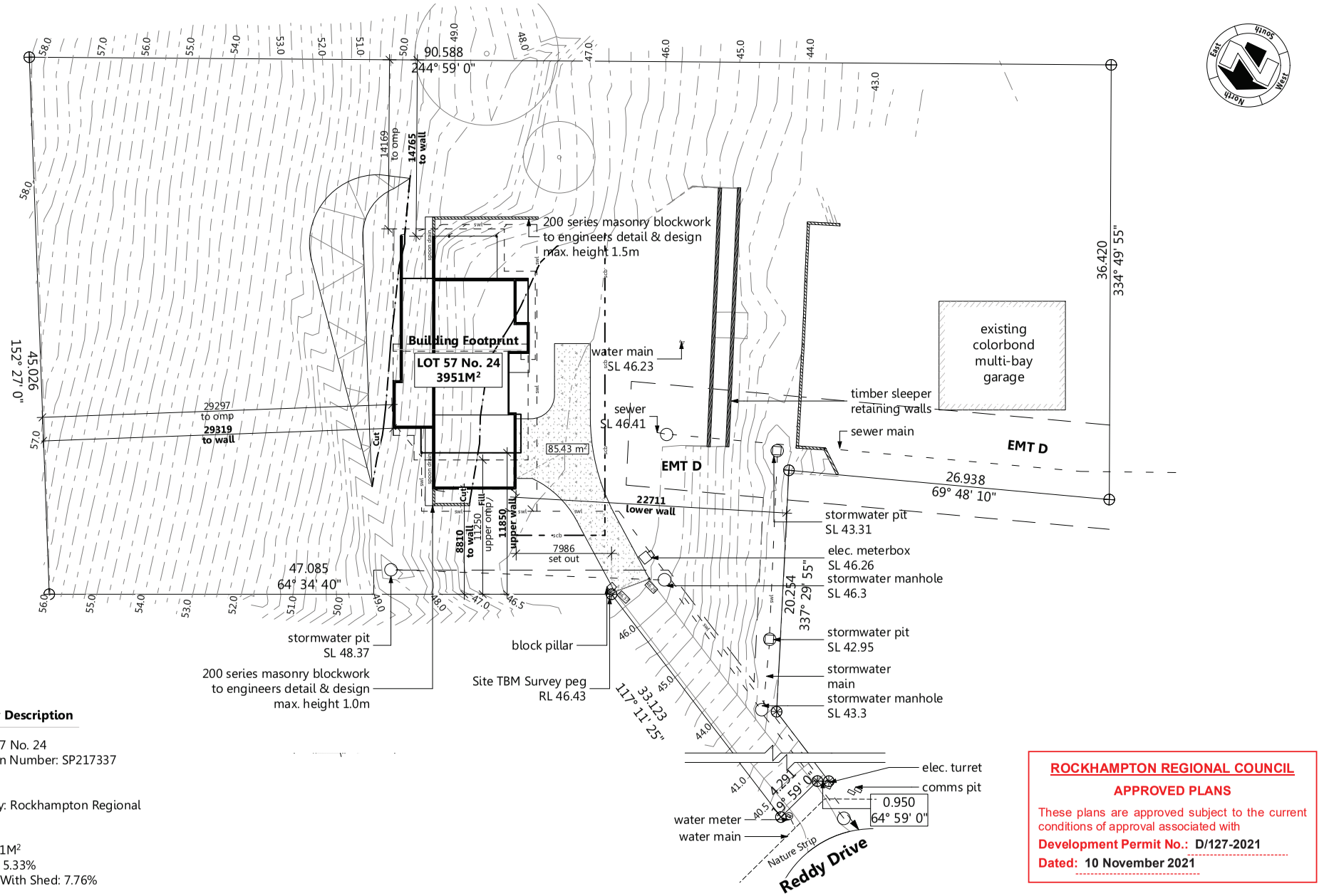
Area Calculations (m²)

Upper Living	144.95
Lower Living	80.04
Garage	43.58
Alfresco	28.79
Patio	19.21
Balcony	8.30
Porch	2.70
Total	**327.57 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ
A	04/12/2020	Working Drawings Issed	LBJ

Drawing No: 4 of 19
Scale: 1:200 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**

Z:\1. B2B\Lyke Homes (Yeppoon, QLD)\Specific Lots\57 No 24 Reddy Drive, Norman Garden Custo Two Storey\/. plans\Current Archicad Drawings\57 No. 24 Reddy Drive - A.pln



Real Property Description

Lot Number: 57 No. 24
Registered Plan Number: SP217337
Parish: tba
County: tba
Local Authority: Rockhampton Regional Council

Site Area: 3951M²
Site Coverage: 5.33%
Site Coverage With Shed: 7.76%

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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

Development Permit No.: D/127-2021

Dated: 10 November 2021

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215
(07) 5591 7658
orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au
ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King
Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Site Plan 1:300

Design Name:
Custom

Area Calculations (m²)

Upper Living	144.95
Lower Living	80.04
Garage	43.58
Alfresco	28.79
Patio	19.21
Balcony	8.30
Porch	2.70
Total	**327.57 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ
A	04/12/2020	Working Drawings Issed	LBJ

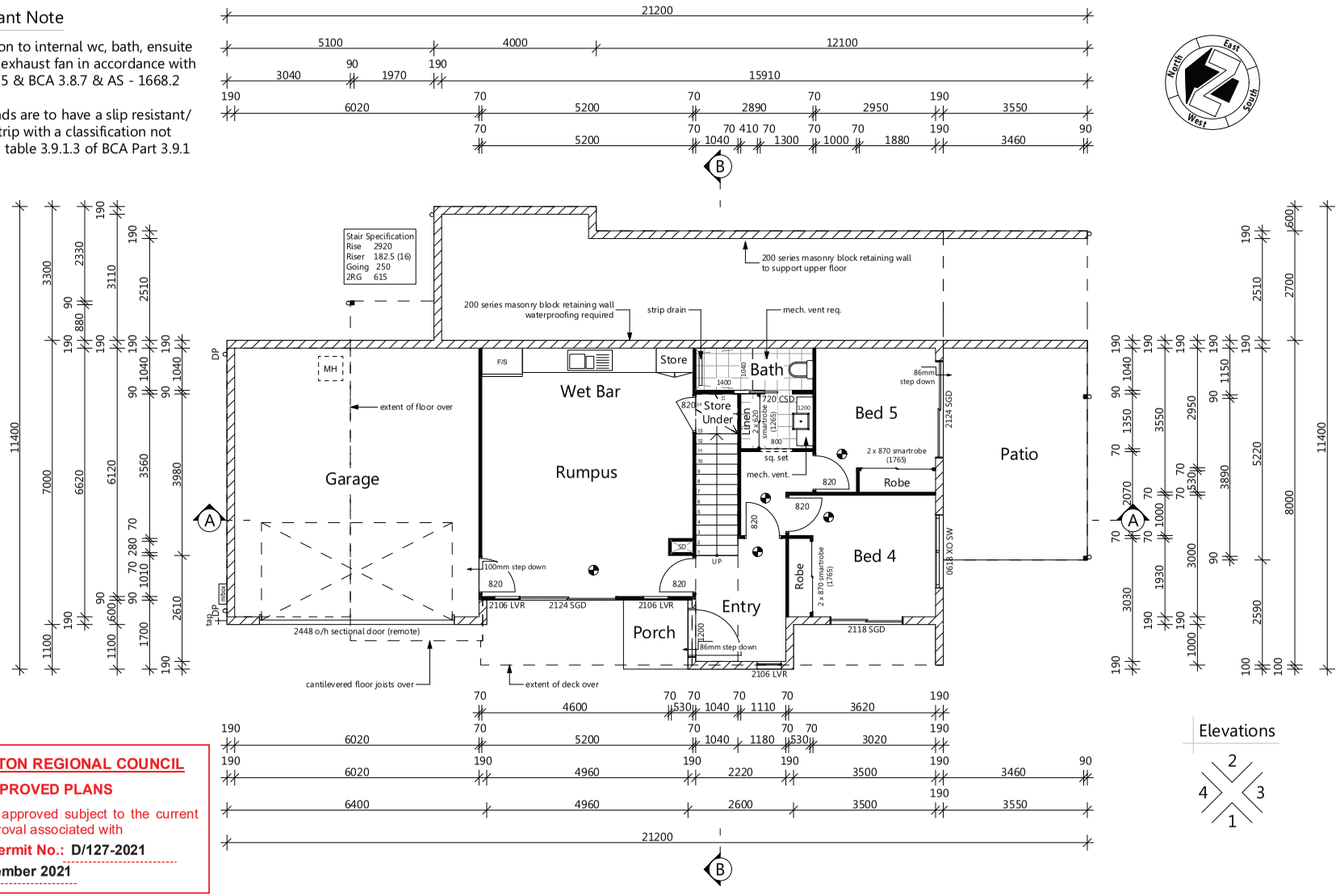
Drawing No: 5 of 19
Scale: 1:300 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**

Z:\1. B2B\Lyke Homes (Yeppoon, QLD)\Specific Lots\57 No 24 Reddy Drive, Norman Garden Custo Two Storey\7. plans\Current Archicad Drawings\57 No. 24 Reddy Drive - A.pln

Important Note

Ventilation to internal wc, bath, ensuite to be an exhaust fan in accordance with BCA 3.8.5 & BCA 3.8.7 & AS - 1668.2

Stair treads are to have a slip resistant/ nosing strip with a classification not less than table 3.9.1.3 of BCA Part 3.9.1



Elevations

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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

Development Permit No.: D/127-2021

Dated: 10 November 2021

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215

(07) 5591 7658

orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au

ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King

Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Lower Floor Plan

Design Name:
Custom

Area Calculations (m²)

Upper Living	144.95
Lower Living	80.04
Garage	43.58
Alfresco	28.79
Patio	19.21
Balcony	8.30
Porch	2.70
Total	**327.57 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ
A	04/12/2020	Working Drawings Issed	LBJ

Drawing No: 6 of 19

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK

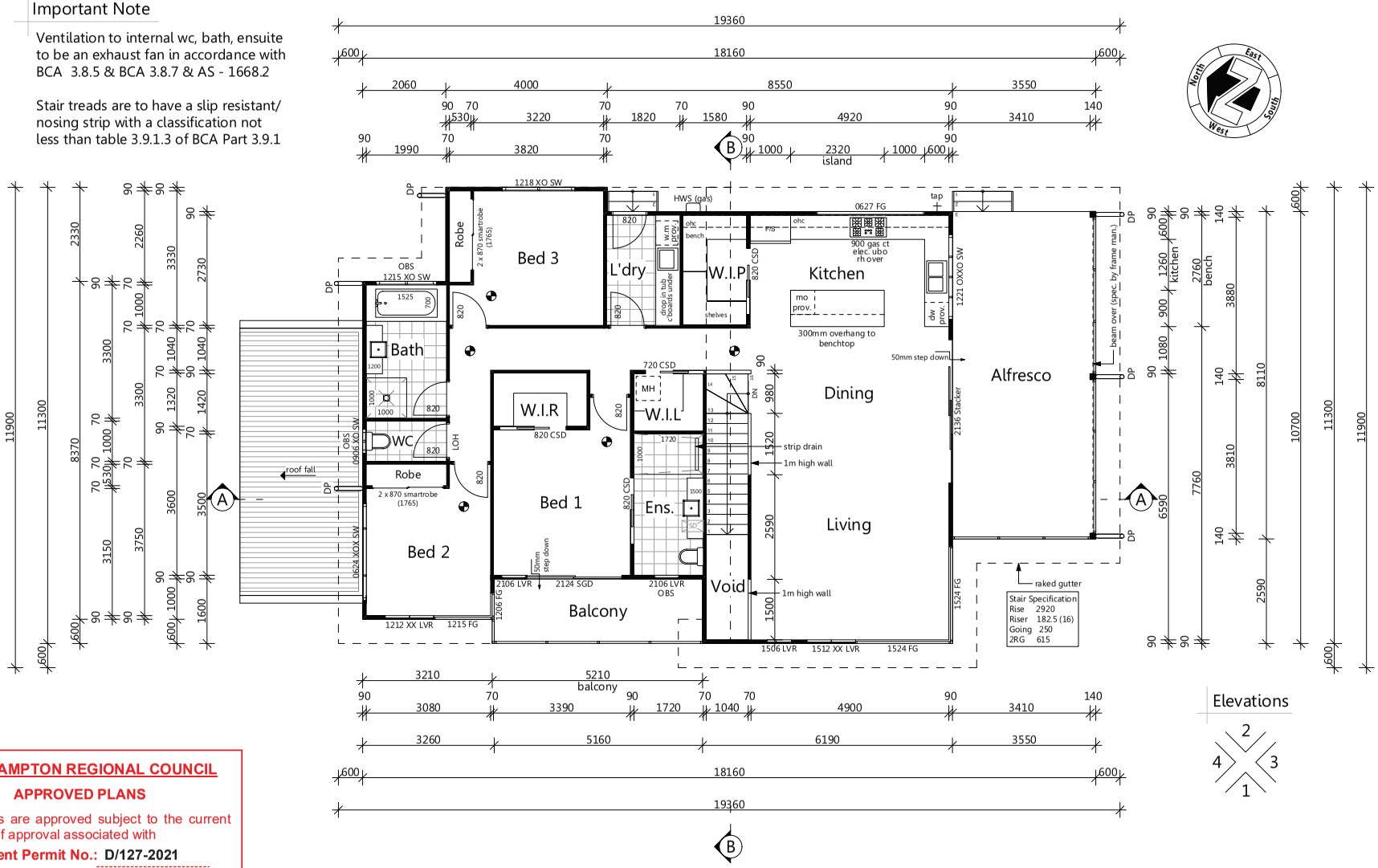
Job No: **7699SM**

Z:\1. B2B\Lyke Homes (Yeppoon, QLD)\Specific Lots\57 No 24 Reddy Drive, Norman Garden Custo Two Storey\/. plans\Current Archicad Drawings\57 No. 24 Reddy Drive - A.pln

Important Note

Ventilation to internal wc, bath, ensuite to be an exhaust fan in accordance with BCA 3.8.5 & BCA 3.8.7 & AS - 1668.2

Stair treads are to have a slip resistant/ nosing strip with a classification not less than table 3.9.1.3 of BCA Part 3.9.1



Elevations

2 4 3 1

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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

Development Permit No.: D/127-2021

Dated: 10 November 2021

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215

(07) 5591 7658

orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au

ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King

Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Upper Floor Plan

Design Name:
Custom

Area Calculations (m²)

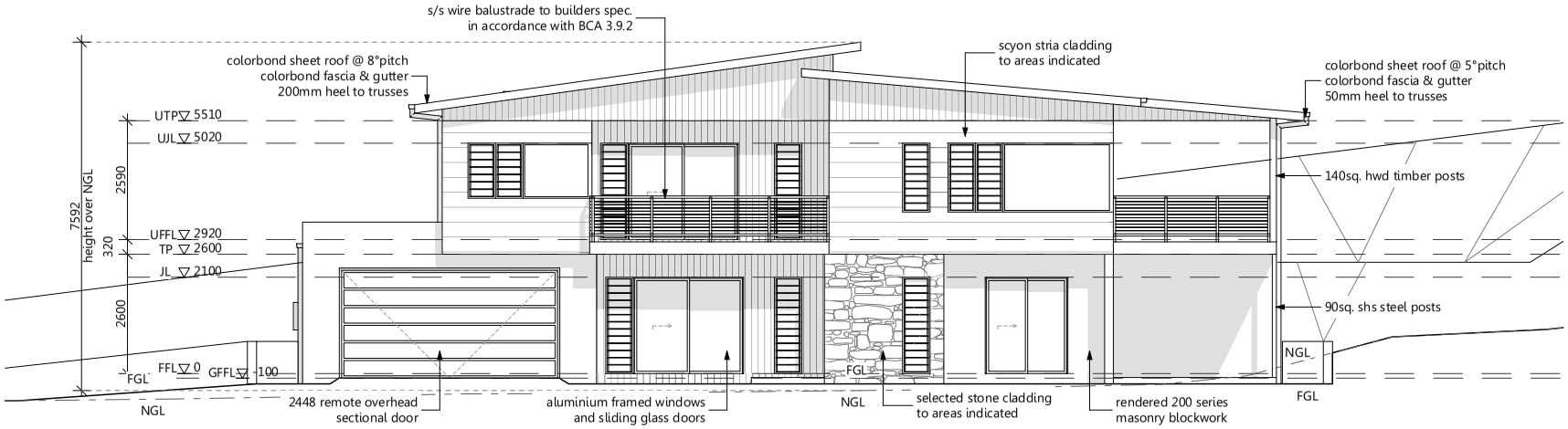
Upper Living	144.95
Lower Living	80.04
Garage	43.58
Alfresco	28.79
Patio	19.21
Balcony	8.30
Porch	2.70
Total	**327.57 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ
A	04/12/2020	Working Drawings Issed	LBJ

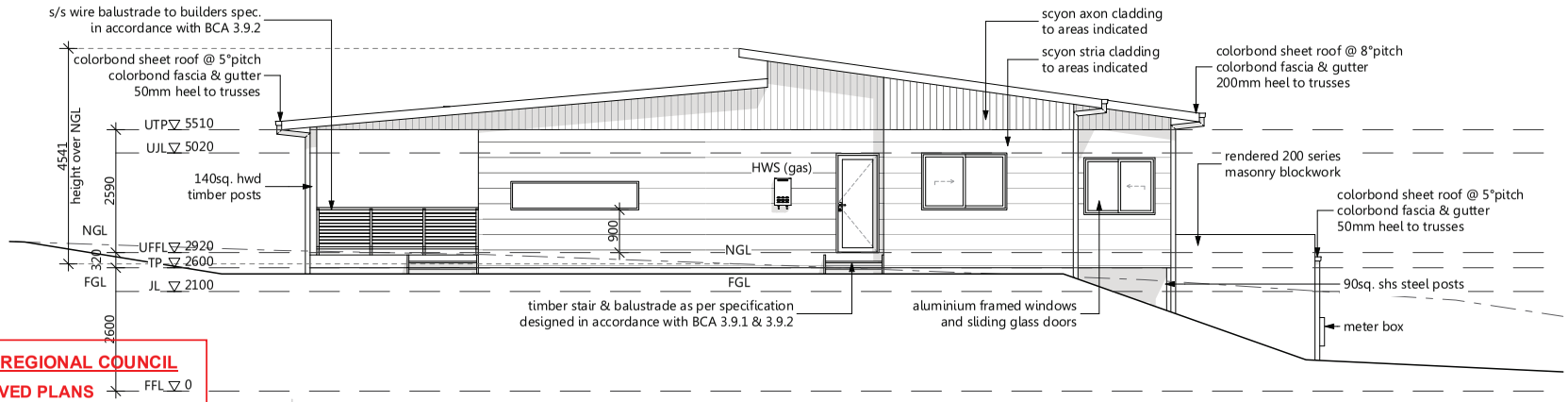
Drawing No: 7 of 19

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**

Z:\1. B2B\Lyke Homes (Yeppoon, QLD)\Specific Lots\57 No 24 Reddy Drive, Norman Garden Custo Two Storey\1. plans\Current Archicad Drawings\57 No. 24 Reddy Drive - A.pln



Elevation 1



Elevation 2

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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

Development Permit No.: D/127-2021

Dated: 10 November 2021

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215

(07) 5591 7658

orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au

ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:

LYKE HOMES

BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King

Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Elevations 1 of 2

Design Name:
Custom

Area Calculations (m²)

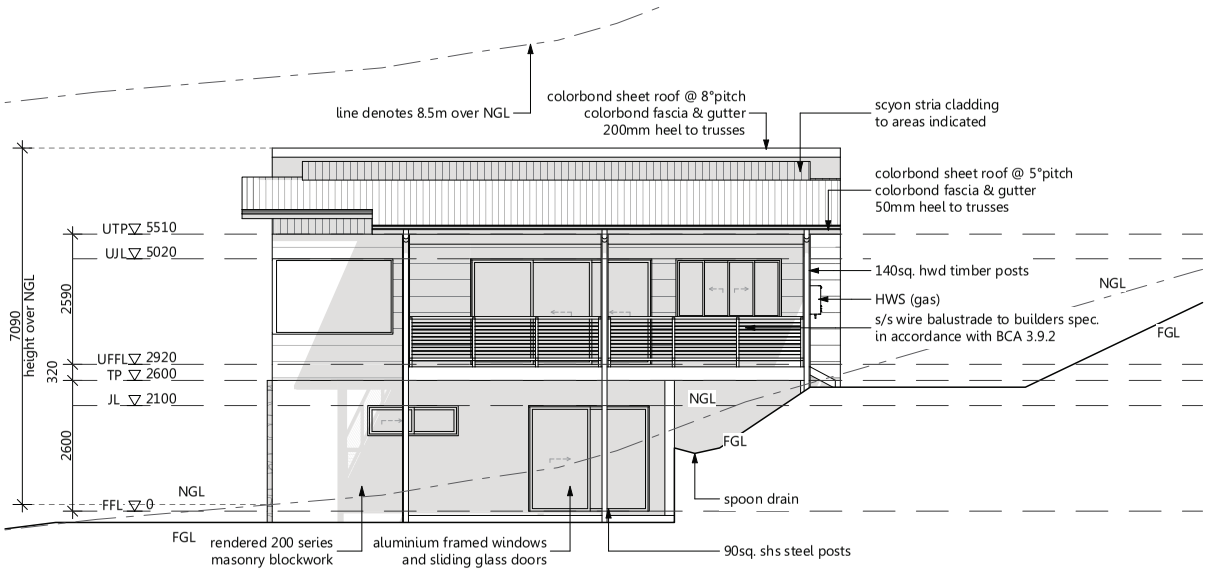
Upper Living	144.95
Lower Living	80.04
Garage	43.58
Alfresco	28.79
Patio	19.21
Balcony	8.30
Porch	2.70
Total	**327.57 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ
A	04/12/2020	Working Drawings Issed	LBJ

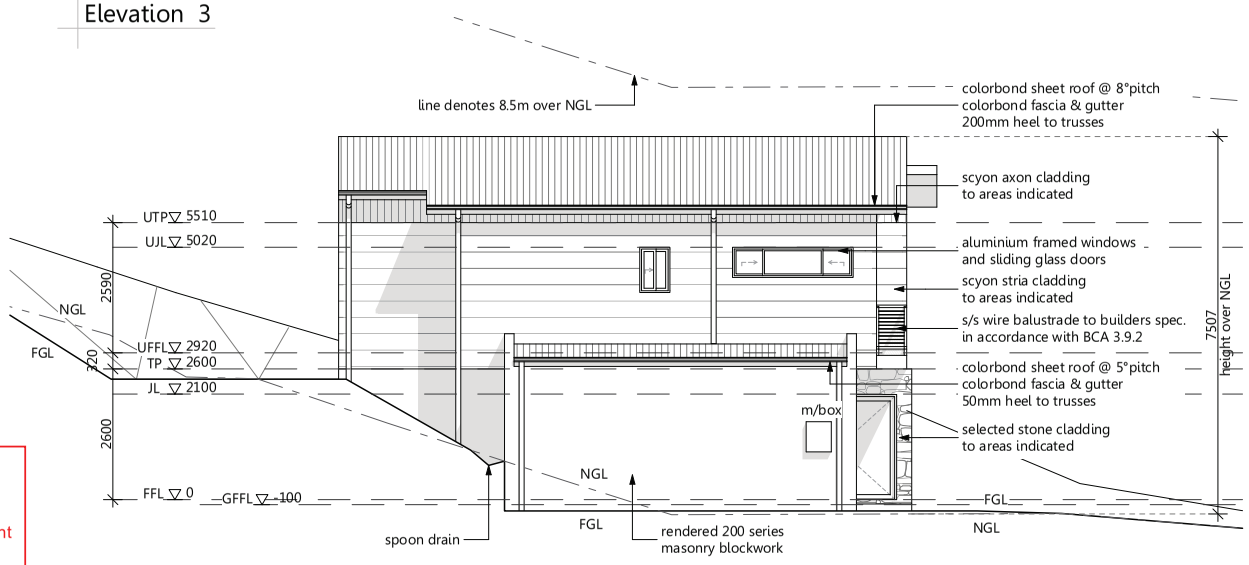
Drawing No: 9 of 19

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK
Job No: **7699SM**

Z:\1. B2B\Lyke Homes (Yeppoon, QLD)\Specific Lots\57 No 24 Reddy Drive, Norman Garden Custo Two Storey\7. plans\Current Archicad Drawings\57 No. 24 Reddy Drive - A.pln



Elevation 3



Elevation 4

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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

Development Permit No.: D/127-2021

Dated: 10 November 2021

I WANT THAT DESIGN

Suite 30503, Level 5, Tower 3
Southport Central Commercial
9 Lawson Street, Southport
Queensland Australia 4215

(07) 5591 7658

orders@iwantthatdesign.com.au
www.iwantthatdesign.com.au

ABN: 89135124775 QBCC: 1181286

PLEASE READ CAREFULLY

This plan certified correct is the one referred to in the contract & specifications and I understand change hereafter may not be possible. These plans supercede all other previous plans or sketches

Owner / s ..... Date.....

Owner / s ..... Date.....

Builder:
LYKE HOMES
BEN | 04 03 531 735
TASH | 0410 399 340
QBCC | 1269170
ABN | 98 162 495 105

Client:
Chris & Leanne King

Lot 57 No. 24 Reddy Drive
Norman Gardens
Rockhampton QLD 4701

Title:
Elevations 2 of 2

Design Name:
Custom

Area Calculations (m²)

Upper Living	144.95
Lower Living	80.04
Garage	43.58
Alfresco	28.79
Patio	19.21
Balcony	8.30
Porch	2.70
Total	**327.57 m²**

Issue/Rev.	Plot Date	Description	
CA	27/07/2020	Concept Drawings	PK
CB	13/08/2020	Amendments as requested	PK
PA	09/11/2020	Preliminary Drawings Issued	LBJ
A	04/12/2020	Working Drawings Issed	LBJ

Drawing No: 10 of 19

Scale: 1:100 @ A3
Designed By: Client
Drawn By: KJ
Checked By: PK

Job No: **7699SM**

Z:\1. B2B\Lyke Homes (Yeppoon, QLD)\Specific Lots\57 No 24 Reddy Drive, Norman Garden Custo Two Storey\1. plans\Current Archicad Drawings\57 No. 24 Reddy Drive - A.pln