Engineering Assessment

Heartwood Residential Precinct Planning Proposal

Endeavour Drive Bellingen

November 2020

George Stulle Engineering
P 0418 219 358
E george.stulle@exemail.com.au

Contents

1 Introduction

1.1 Scope

This Engineering assessment report has been prepared as part of a planning proposal application to Bellingen Shire Council for rezoning of land at Endeavour Drive Bellingen.

The land has an area of 75.07 hectares and is zoned RU1 Primary Production and E3 Environmental Management. The land is an existing holding with one dwelling entitlement. The land has frontage to Endeavour Drive to the north, Hill Street to the west and Nobles Lane to the south east.

The proposal comprises a potential rezoning of the northern part of the land from RU1 Primary Production to E4 Environmental Living.

This report assesses the suitability of the land for rezoning and the impact of the proposed rezoning on the operation of the surrounding infrastructure and services.

2 Existing Conditions

2.1 Location

The planning proposal encompasses Lot 456 DP 755557 shown in Figure 1. The land has frontage to Endeavour Drive to the north, Hill Street to the west and Nobles Lane to the south east.

Primary vehicular access to the land is via Endeavour Drive and Crown Street to the Waterfall Way.

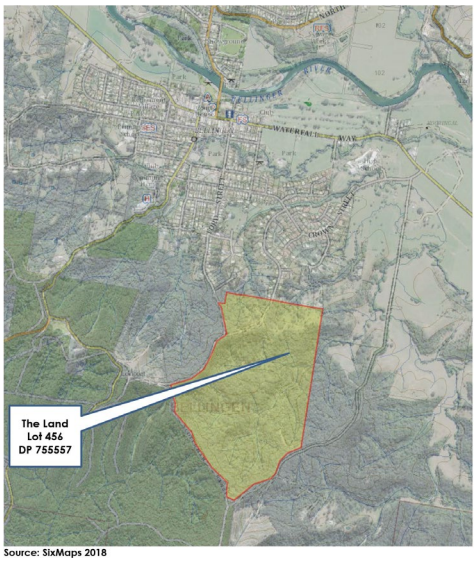

Figure 1 Site location

The site drains naturally to mapped tributaries of Connell Creek. Council water and sewer network services are available close to the subject land. See appendices for relevant mapping.

3 Environmental Considerations

1.1 Slope Stability and Landslip assessment

Regional Geotechnical Solutions Pty Ltd (RGS) have undertaken a preliminary geotechnical assessment of the site and subsurface conditions and provided comments and recommendations regarding slope stability, earthworks, drainage and pavements.

A slope stability risk assessment was carried out using the principles and procedures of the Australian Geomechanics Society publication Practice Note Guidelines for Landslide Risk Management, 2007.

The assessment indicates that there is a Moderate to High risk of slope instability within the natural slopes and within and future cuts and excavations. There is a High risk in areas of fill if not placed appropriately.

The risk of instability for all hazards however can be reduced to low by following good practice in design of earthworks and structures, with recommendations included in the RGS report.

Providing the recommendations detailed in the RGS report are implemented, the risks associated with stope stability can be reduced to Low. A low risk level is normally be considered acceptable for hillside development in Australia.

The complete RGS study is included in Appendix G of this report.

1.2 Sediment

Future development of the site will be subject to controls in Bellingen Shire Council DCP in relation to management of soil and erosion. Construction impacts will be managed through implementation of a Construction Environmental Management Plan prepared in accordance with relevant industry guidelines. Post development impacts will be addressed in a Stormwater Management Plan developed during the development application process.

1.3 Acid Sulfate Soils

The site is partially mapped as Class 5 Acid Sulfate soils. The RGS test pit investigations did not encounter any groundwater. Acid Sulfate soil and contamination are unlikely to pose any significant constraint to development.

Proposed excavations within the low lying portions of the site (gullies) may require further assessment and development of a management plan for treatment for acid sulfate soils if required.

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2 Stormwater Quality

Bellingen Shire Council DCP 2017 Chapter 12 Stormwater nominates the following aims for new development:

a) To maintain the high ecological, recreational and agricultural values of waterways.

b) To ensure stormwater systems are carefully planned, designed and located to prevent the disturbance, redirection, reshaping or modification of watercourses and associated vegetation and to protect the quality of receiving waters.
c) To ensure that stormwater harvesting (source controls) measures are implemented to maximise stormwater reuse and prevent increases in the quantity of stormwater discharge from the development site which can impact on downstream environments.
d) To ensure that any stormwater facilities installed on Council property are appropriate having regard to Council's ongoing ability to manage and maintain those facilities.

A concept design for development of the site in accordance with an E4 Environmental Living zone has been completed and is included in Appendix A.

The concept design shows significant areas available within the existing drainage gullies (on the subject land), for construction of appropriate stormwater detention and water quality treatment facilities to capture and treat stormwater discharge from the developed land.

The development will be able to meet the aims of Bellingen Shire Council DCP 2017 Chapter 12 Stormwater. This will include water quality modelling and design to meet Level 3 Stormwater Quality requirements.

The likely stormwater quality treatment method will include detention/bio-retention basins located generally as shown on the concept development plan.

3 Stormwater Drainage

A major/minor approach for conveyance of stormwater will be used in the management of stormwater on the development site. A piped stormwater system will be designed in accordance with Bellingen Shire Council Development Specifications.

The development will be able to meet peak discharge requirements as specified in Councils DCP within the community title site, including stormwater quality requirements.

Stormwater discharge will be directed appropriately to the existing mapped waterways down stream of the development site.

4 Flooding

The site is partially impacted by Bellingen Shire Council Flood Risk mapping with part of the lower non-developable area mapped as effected by the PMF (Appendix C).

Otherwise the site is not flood effected.

5 Sea Level Rise

The site is well upstream of the coastal plain and has not been identified as being at risk from sea level rise.

6 Infrastructure

Traffic and Transport

A Traffic Impact Assessment has been prepared on the proposed re-zoning assuming development in accordance with the concept for a community title subdivision comprising approximately 80 residential lots.

The Traffic Impact Assessment concludes that:

The concept design proposes and 8.0m wide perimeter road in accordance with Planning for Bushire Protection 2019 (PBP 2019) requirements. All roads within the

proposed community title subdivision are able to meet the requirements of Bellingen Shire Council Development Design Specifications and the Bellingen Shire DCP 2017.

Primary access to the community title subdivision will be from Endeavour Drive. An emergency access road from the development to Hill street is also proposed.

Endeavour Drive is a non through road currently servicing approximately 40 residential dwellings. The rezoning proposal would see an additional 80 residential dwellings with primary vehicular access to Endeavour Drive.

With an 8.0m pavement width, roll over kerb and gutter and wide verges over most of its length, Endeavour Drive can safely cater for increased traffic volumes from the proposed development in a bush fire emergency.

Emergency service vehicles will have two-way all-weather access to the site via Endeavour Drive which will continue to be a Council maintained asset.

Alternative access to the site is proposed from Hill Street which is a Council/Crown Road. The development proposal would see Hill Street between Evans Street and the connection to the development perimeter road upgraded to a 5.5 m wide gravel road. The remainder of the Hill Street connection to Ford Street and the local road network is two way and capable of safely taking emergency service vehicles and if required, evacuation traffic during a bushfire emergency.

All roads within the proposed community title subdivision and providing access to the subdivision are capable of (or can be upgraded to) carrying fully loaded firefighting vehicles (up to 23 tonnes).

Water

The site benefits from a 100mm diameter Bellingen Shire Council water main on Hill Street terminating at Wattle Close and a 200mm diameter Council water main terminating adjacent the property boundary on Endeavour Drive.

The proposed community title subdivision will include a reticulated water supply connected to either or both existing mains with new mains within the community title subdivision accessible and reliable for firefighting operations. Fire hydrant spacing, design and sizing will comply with the relevant clauses of AS 2419.

Maintenance of flows and pressure to the proposed system may require installation of a water reticulation pump and balance tank connecting to an appropriately sized and

located water storage tank to ensure fire hydrant flows and pressures comply with the relevant clauses of AS 2419.

All reticulation mains and supply infrastructure will be maintained as Bellingen Shire Council assets.

Sewer

Options for the discharge of sewer from the proposed rezoning have been developed in consultation with Bellingen Shire Council. Discharge to the existing sewer reticulation on Endeavour Drive is not practicable due to capacity constraints at the Halpin Street Pump Station. Council advises however that the system west of the site has capacity for growth.

Two options have been assessed in concept to achieve sewer discharge connection from the site to the Ford Street pump station catchment.

Concept options are detailed in Appendix E. Option 1A proposes gravity sewer from the site to a new pump station in the vicinity of Red Cedar Place with a rising main transfer to the Ford Street system. Option 1B proposes a conventional pumps station and rising main on Hill Street to the Ford Street connection.

Detailed option assessment and cost/benefit analysis will be carried out in conjunction with Bellingen Shire Council.

Electricity and NBN Services

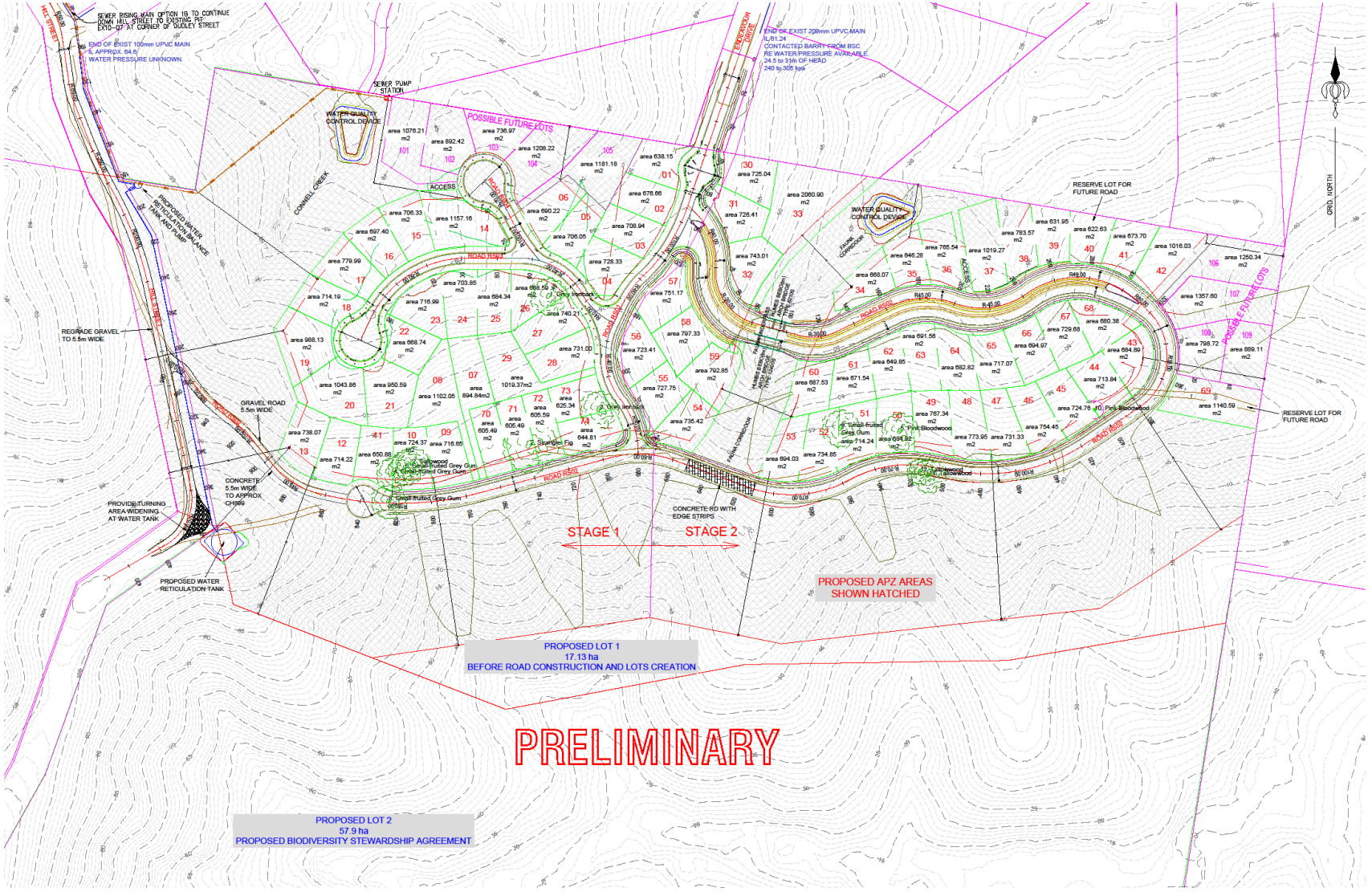
A desktop study has been completed of the existing Essential Energy and NBN local network

The study determined that:

- The community title site will need to cater for the installation (minimum) of a 315kVA Essential Energy padmount transformer.
- This transformer will require a 7 x 4.2M easement incumbent on the community title land.
- Further easements in favour of Essential Energy may be required incumbent on the community title land for extra transformer units and any supply cables, conduits and fittings.
- A HV feeder connection will be required from the nearest Essential Energy HV supply point. The nearest point of supply is the existing Essential Energy padmount transformer on Endeavour Drive asset number 5-33737 which is approximately 240m from the proposed community title development.
- All network from the nearest point of connection will be either Telstar or NBN to the proposed community title boundary.
- It is envisaged the NBN connection works from the nearest point of connection to the site will be minor and include minor conduit and civil works.

The complete study is included in Appendix F of this report.

Appendix A – Heartwood Community Concept Design



AMENDMENT	DATE	AMENDMENT DETAILS	AUTHORISED BY
J.C	01/09/20	LOT 69 & 70 ADDED	I.S.
J.D	18/09/20	AMEND LOTS 7,8,29,70 LOT 71–74 ADDED	I.S.

CLIENT: STEPHEN & JENNIFER SMITH

APPROVED ON BEHALF OF COFFS HARBOUR CITY COUNCIL

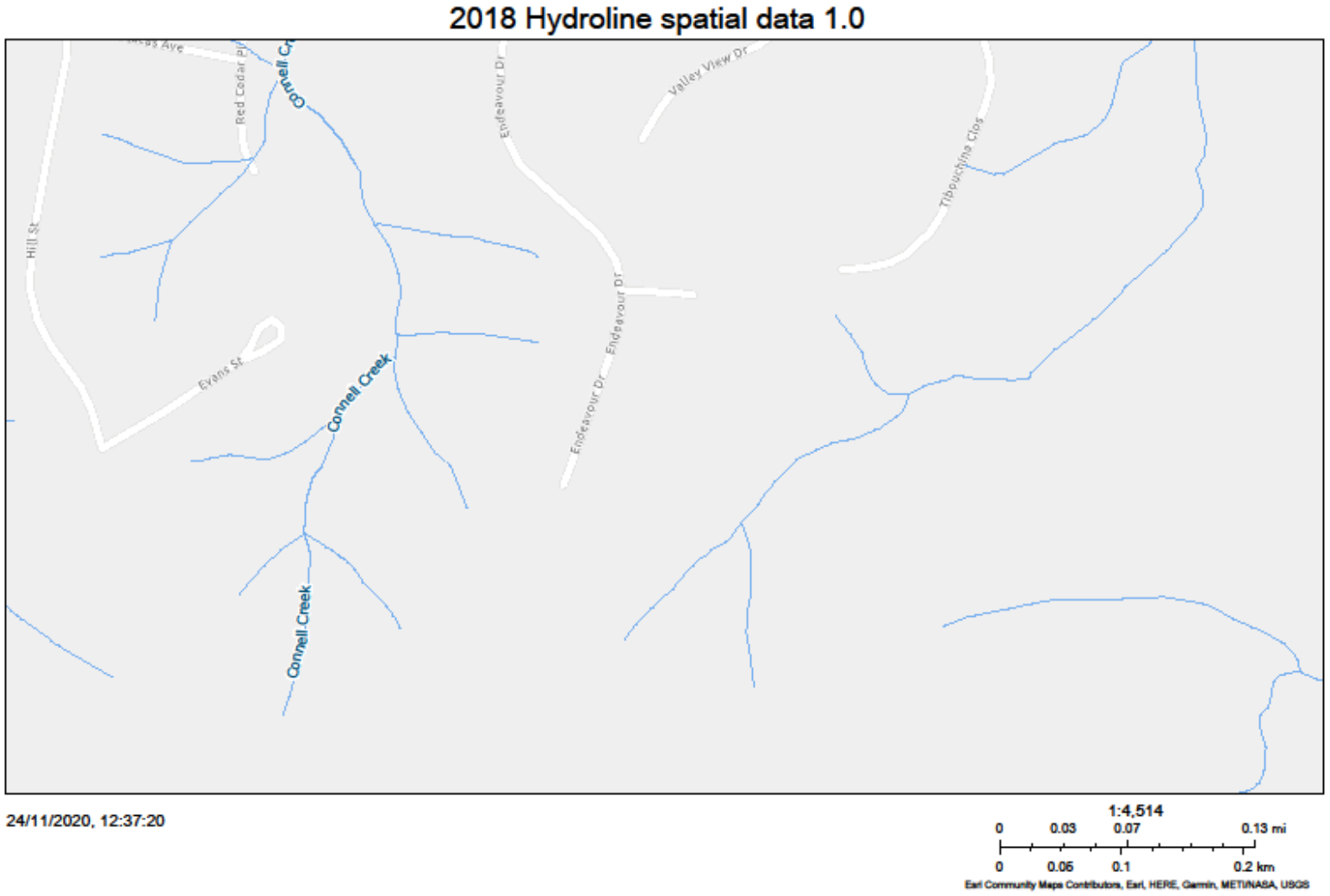
CONSULTING SURVEYORS | URBAN PLANNERS | PROJECT MANAGERS
Newnham Karl Weir and Partners Pty Ltd
5 Murdock Street Coffs Harbour 2450
Phone 02 6652 6630

SCALE: 1:1000 | SHEET SIZE A1 CAUTION DO NOT SCALE
DATE: 18/09/20 | SURVEYED: S.A. | DRAWN: I.S.

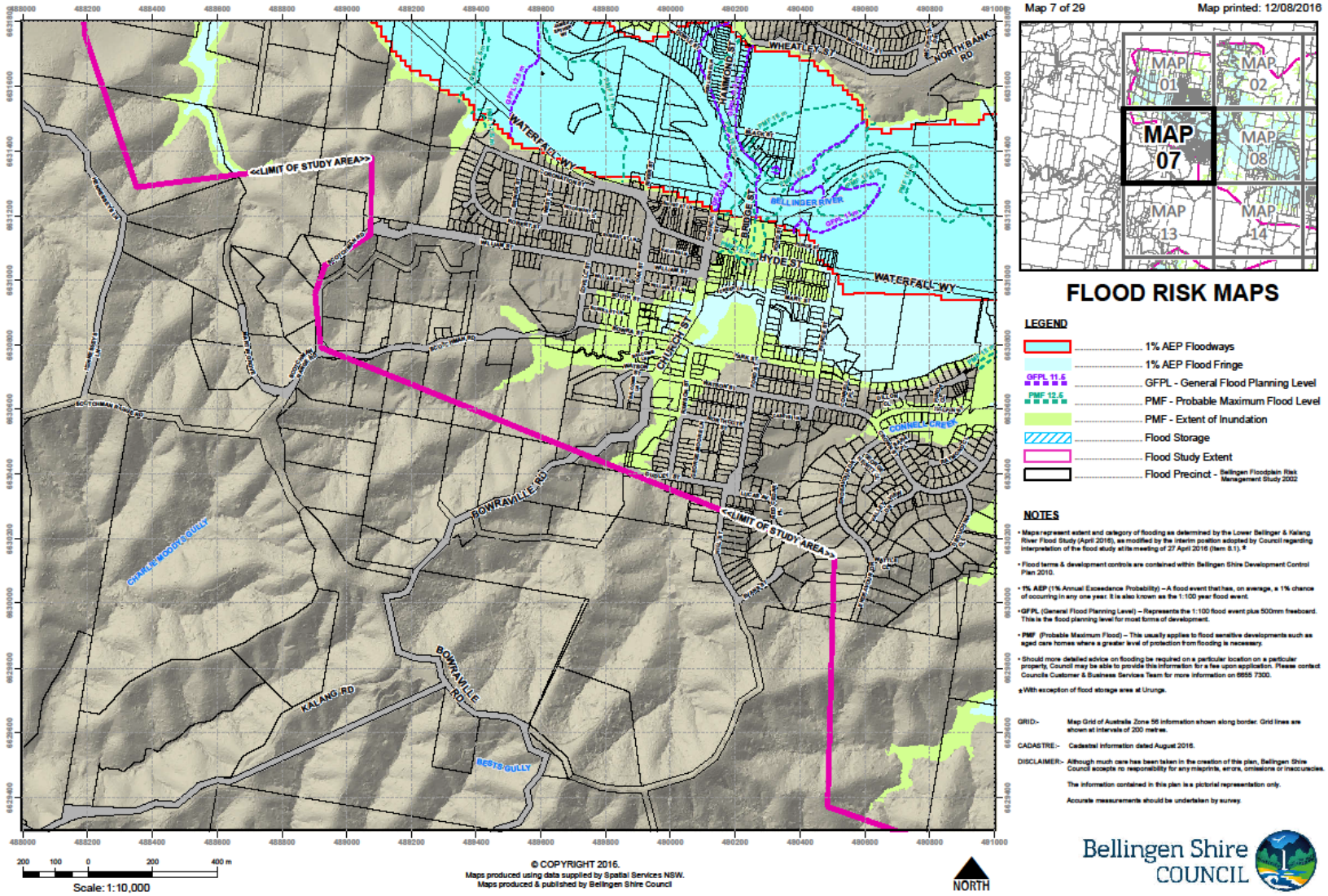
PROJECT: HEARTWOOD COMMUNITY & FOREST
TITLE: DRAFT PROPOSED LOT LAYOUT WITH 1m CONTOURS
LOT 456 D.P. 755557 NOBLES LANE, BELLINGEN, NSW

FILE No. 11875
SHEET 1 OF 2
COUNCIL DRAWING No.

Appendix B – Heartwood Community Stream Map



Appendix C – Heartwood Community Flood Map



Map 7 of 29 Map printed: 12/08/2016

FLOOD RISK MAPS

LEGEND

- 1% AEP Floodways
- 1% AEP Flood Fringe
- GFPL 11.6 – GFPL - General Flood Planning Level
- PMF 12.6 – PMF - Probable Maximum Flood Level
- PMF - Extent of Inundation
- Flood Storage
- Flood Study Extent
- Flood Precinct - Bellingen Floodplain Risk Management Study 2002

NOTES

- Maps represent extent and category of flooding as determined by the Lower Bellinger & Kalang River Flood Study (April 2016), as modified by the interim position adopted by Council regarding interpretation of the flood study at its meeting of 27 April 2016 (Item 8.1). a
- Flood terms & development controls are contained within Bellingen Shire Development Control Plan 2010.
- 1% AEP (1% Annual Exceedance Probability) – A flood event that has, on average, a 1% chance of occurring in any one year. It is also known as the 1:100 year flood event.
- GFPL (General Flood Planning Level) – Represents the 1:100 flood event plus 500mm freeboard. This is the flood planning level for most forms of development.
- PMF (Probable Maximum Flood) – This usually applies to flood sensitive developments such as aged care homes where a greater level of protection from flooding is necessary.
- Should more detailed advice on flooding be required on a particular location on a particular property, Council may be able to provide this information for a fee upon application. Please contact Councils Customer & Business Services Team for more information on 6655 7300.

a With exception of flood storage area at Urunga.

GRID:- Map Grid of Australia Zone 56 information shown along border. Grid lines are shown at intervals of 200 metres.

CADASTRE:- Cadastral information dated August 2016.

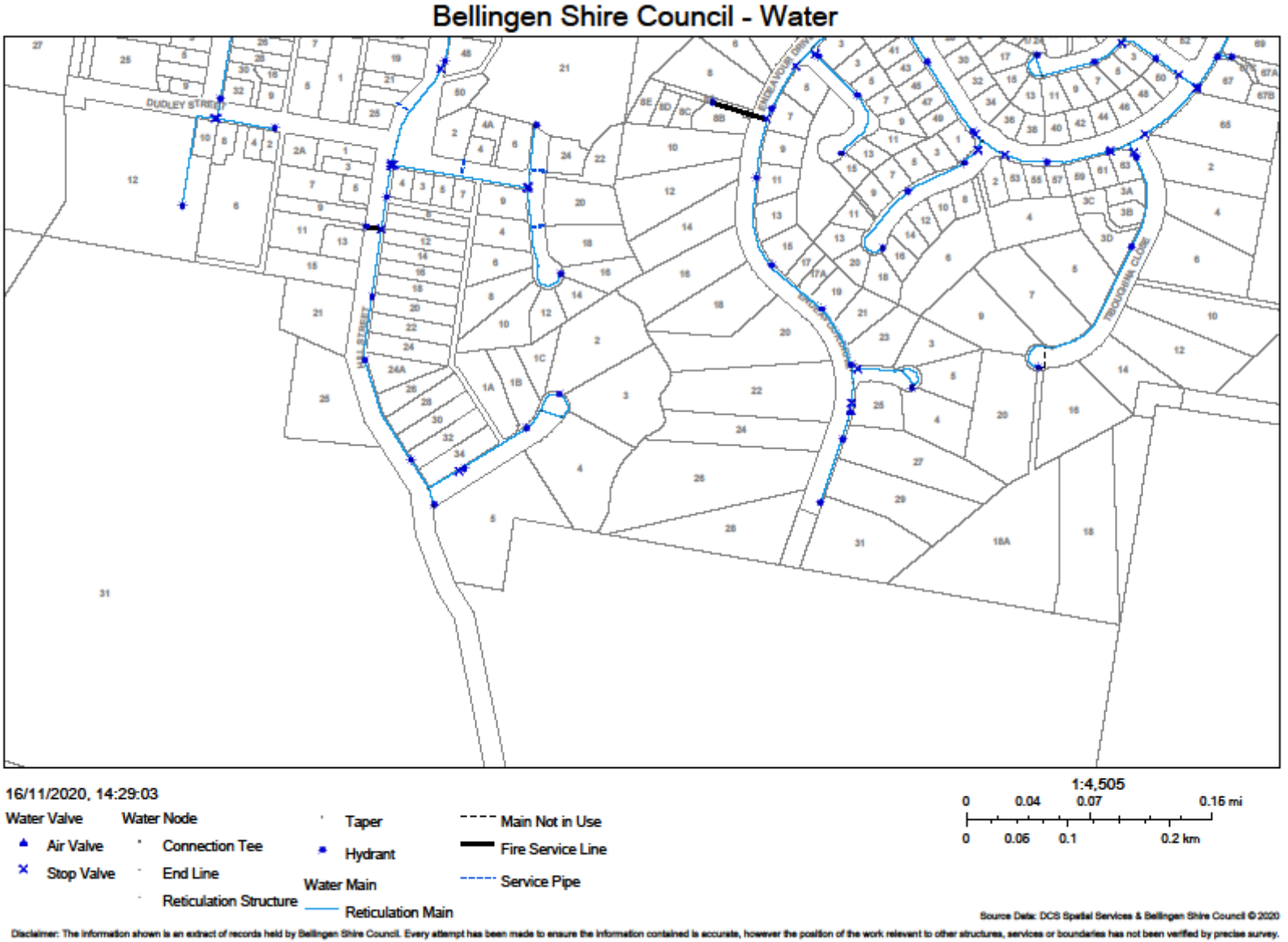
DISCLAIMER:- Although much care has been taken in the creation of this plan, Bellingen Shire Council accepts no responsibility for any misprints, errors, omissions or inaccuracies.

The information contained in this plan is a pictorial representation only.

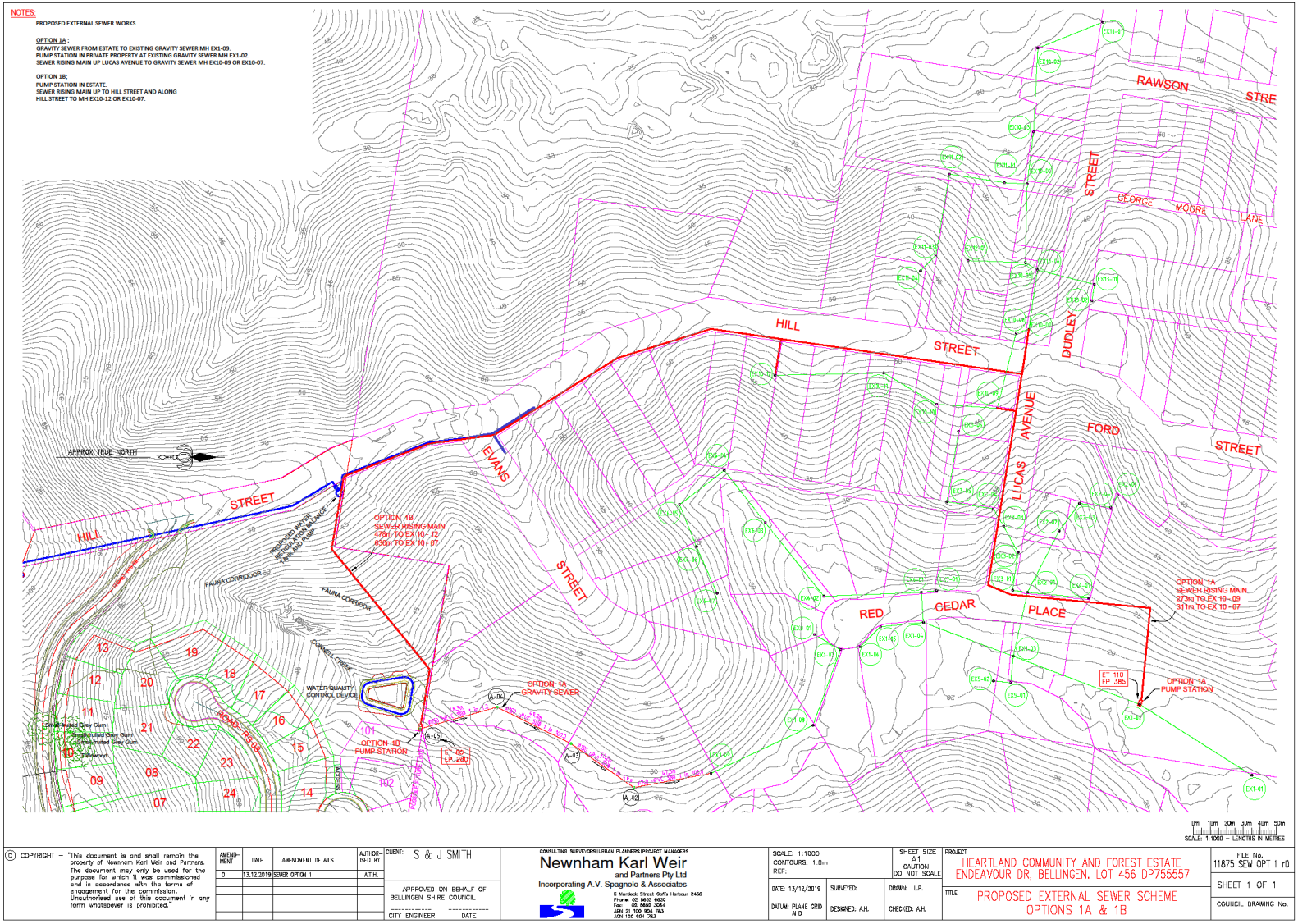
Accurate measurements should be undertaken by survey.

Bellingen Shire COUNCIL

Appendix D – Heartwood Community water supply network



Appendix E – Heartwood Community sewer concepts



Appendix E Heartwood Community electrical and NBN assessment

GOSLING ELECTRICAL

Design LEVEL 3 | Construct LEVEL 1 | Connect LEVEL 2

Report

For Electrical and Comms assessment

Project Address:	Nobles Lane Bellingen
Project Summary:	Electrical and Comms preliminary assessment report.
Prepared For:	George Stulle.
Prepared By:	Tony Freeney
Date Issued:	24/02/2020

Gosling Electrical ABN 56 491 602 668
62 Industrial Drive, North Boambee Valley NSW 2450 | PO Box 8040, Coffs Harbour NSW 2450
02 6652 3283 | admin@goslingelectrical.com.au | **www.goslingelectrical.com.au**

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Assessment Report for Electrical and Communications Design

1 Introduction

Our client has requested a preliminary investigation of the existing Essential Energy and Communications network arrangements to assess what arrangements may be required to provision the development in line with Council conditions.

The following is to assist you the client as part of your DA application and is based on preliminary investigation.

Full and final provision in line with councils' conditions of DA approval will be met at a later date through liaison and detailed design with the relevant authorities.

2 Design Process

2.1 Level 3 ASP Design process (Essential Energy)

- Submission to Essential Energy for the Design Information Package
- Preparation of Level 3 ASP design drawings to Essential Energy Standards in line with the Design Information Package received
- Provision of a concept design for review and/or comment prior to submission to Essential Energy
- Submission to Essential Energy for Certification
- Provision of Certified drawings for Level 1 construction
  Note: This process will only be applicable from the point of connection into the Essential Energy local network to the point of common connection at the community title site. All electrical reticulation within the community title site will be considered private and must meet the minimum AS3000 design and construction standards.
  If embedded generation is to be considered as part of this development, then a separate embedded generation connection application must be submitted to Essential Energy for approval.

2.2 Telstra/NBN Pit and Pipe Design Process (Telstra or NBN)

- Submit application for new project, or administer existing registered project with relevant carrier
- Co-ordination with project manager, architect, builder or electrical contractor to determine locations and routing of Comms infrastructure
- Design and documentation of sections and details in accordance with comms provider requirements.
- Design and documentation of schematics in accordance with Comms provider requirements.
- Documentation of conduit schedule.
- Submission of detailed Comms pathway design to provider for review and approval.
- Coordinate approval process with provider over the design review period.
  Note: This process will only be applicable from the point of connection into the NBN/Telstra local network to the point of common connection at the community title site. All electrical comms reticulation within the community title site will be considered private and must meet the minimum design and construction standards.
  It should also be noted that the actual provider cannot be determined at this stage till an application for comms supply is submitted.

2.3 AS3000 Design Process

- As the development is proposed community title all internal electrical reticulation will be classified as private beyond the Essential Energy point of connection.
- All internal electrical reticulation must meet the minimum AS3000 design and construction standards.

2.4 Lighting Design Process

- All lighting requirements specified by council and within Essential Energy network and outside the boundaries of the community tile will be designed to meet AS1158 standards.
- All lighting within the community title will be private.

3 Existing Essential Energy Network assessment

A desktop study was completed of the existing Essential Energy local network and the following was determined:

- The community title site will need to cater for the installation (minimum) of a 315kVA Essential Energy padmount transformer.
- This transformer will require a 7 x 4.2M easement incumbent on the community title land. Note a larger unit or multiple units may be required to supply the site dependent on AS3000 maximum demand calculations.
- Further easements in favour of Essential Energy may be required incumbent on the community title land for extra transformer units and any supply cables, conduits and fittings.
- A HV feeder connection will be required from the nearest Essential Energy HV supply point. The nearest point of supply is the existing Essential Energy padmount transformer on Endeavour Drive asset number 5-33737 which is approximately 240Mtrs from the proposed community title development. If the existing padmount transformer cannot accommodate an extra HV feed to the site, then Essential Energy will require its replacement with a unit that can.
- Essential Energy's present GIS network does not indicate any spare conduits from the existing padmount transformer to the site boundary thus the supply to the site and any interconnections will need to be made via trenching and or underboring.
-

Note: Refer to appendix A this report.

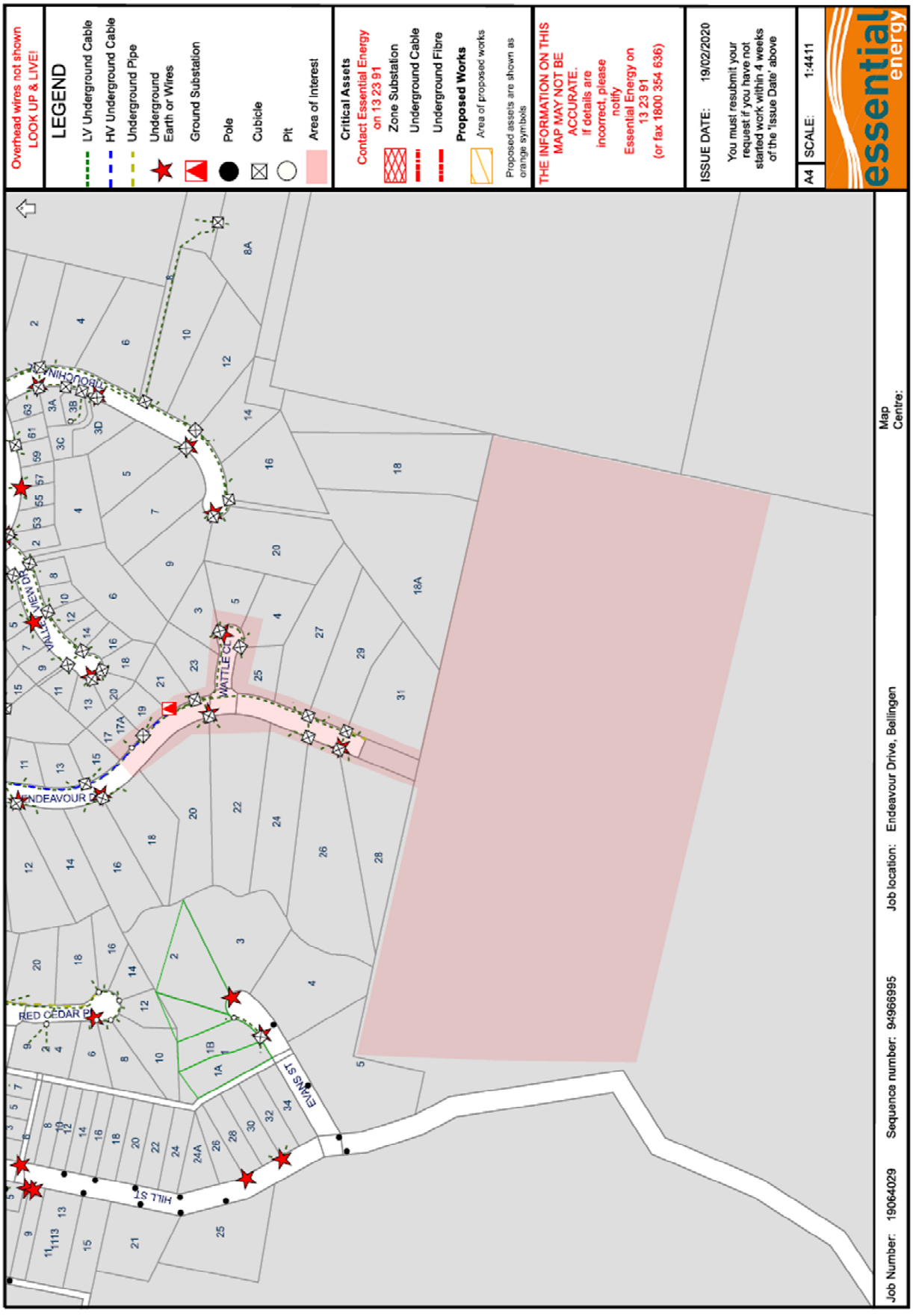
4 Existing NBN/TELSTRA Network assessment

A desktop study was completed of the existing NBN/TELSTRA local network and the following was determined:

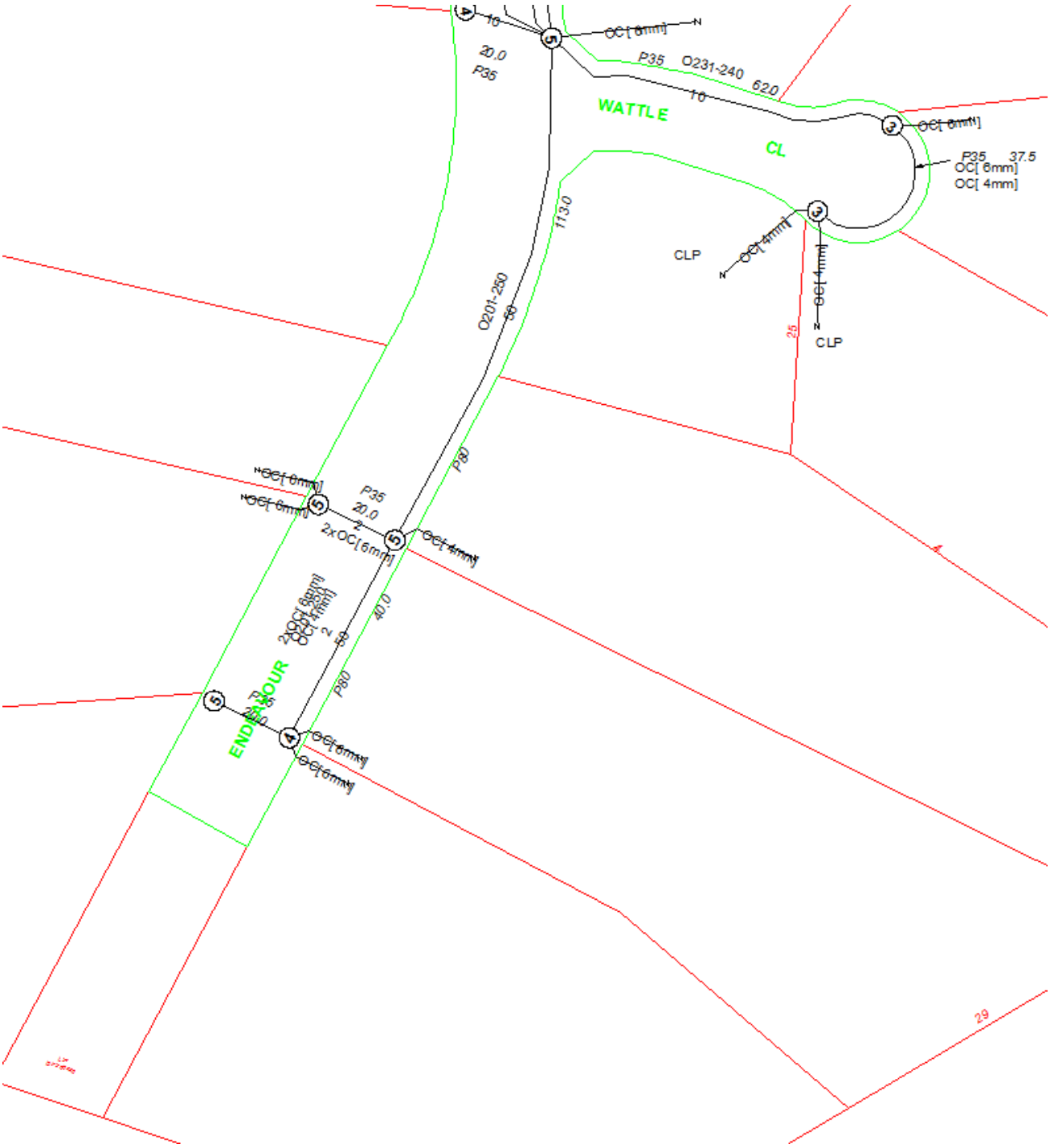
- A dial before you dig request was completed for all services and the response showed both Telstra and NBN connections within reach of the development boundary. (refer to Dial before you digs attached with this report)
- A new application will need to be submitted to the relevant provider for supply to the proposed development.
- All network from the nearest point of connection will be either Telstar or NBN to the proposed community title boundary.
- All internal network reticulation will be private unless otherwise agreed with the primary provider.
- It is envisaged the connection works from the nearest point of connection to the site will be minor and include minor conduit and civil works.
- All comms connections will be required to complete a required design process to produce For Construction Drawings to allow a competent installer to complete the conduit works.
- All cable installation will be completed by the relevant provided post conduit works.

5 Dial Before you Dig Results

5.1 Essential Energy



5.2 Telstra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ENDEAVOUR
CLP
CLP
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113.0
O201-250
58
P80
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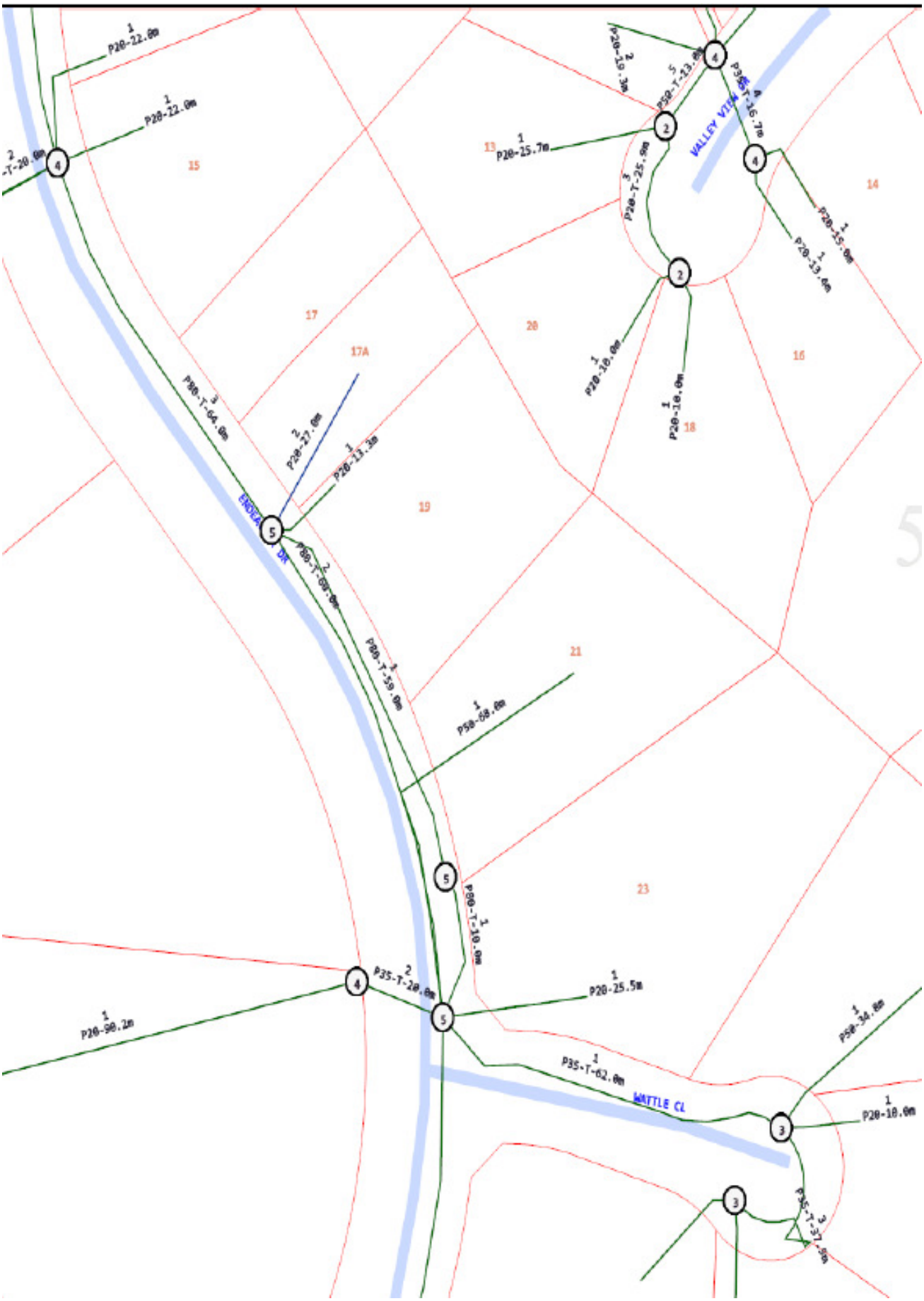
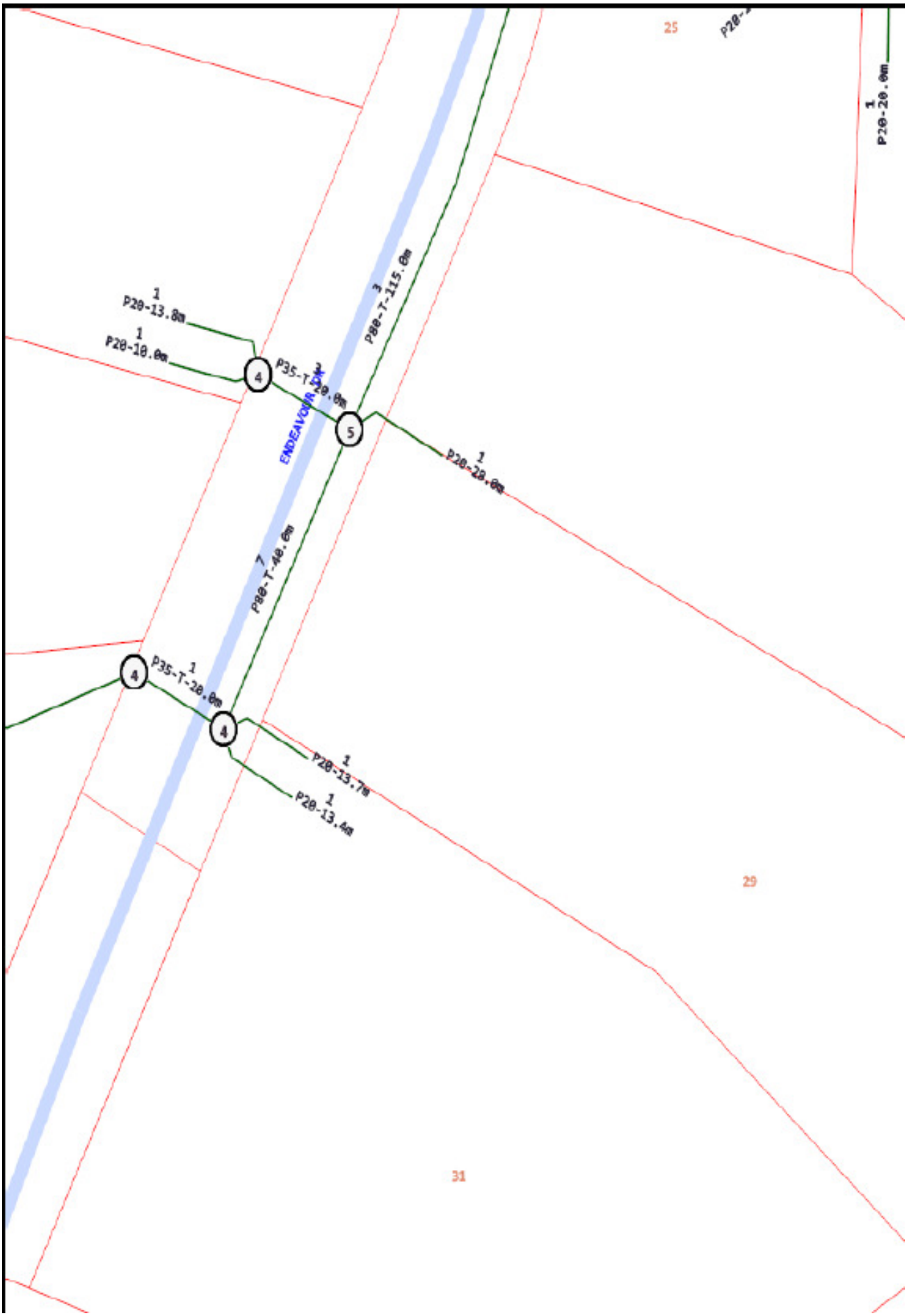
4
29

5.3 NBN




25
1
P20-20.0m
1
P20-13.8m
1
P20-10.0m
4
P35-T-29.0m
3
P80-T-115.0m
ENDEAVOUR DR
5
1
P20-28.0m
7
P80-T-40.6m
4
P35-T-20.0m
1
1
P20-13.7m
1
P20-13.4m
29
31

5.4 Dial Before you dig registration

DIAL BEFORE YOU DIG www.1100.com.au

Job No 19064029

Phone: 1100
www.1100.com.au

Caller Details

Contact:	Mr Tony Freeney	**Caller Id:**	1593034	**Phone:**	02 6652 3283
Company:	Gosling Electrical	**Mobile:**	Not Supplied	**Fax:**	Not Supplied
Address:	2/45 Industrial Drive North Boambee Valley NSW 2450	**Email:**	design@goslingelectrical.com.au		

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.

User Reference: Heartwood Bellingen
Working on Behalf of: Private

Enquiry Date:	Start Date:	End Date:
19/02/2020	01/04/2020	30/04/2020

Address:
Endeavour Drive
Bellingen NSW 2454

Job Purpose: Excavation
Onsite Activity: Mechanical Excavation
Location of Workplace: Both
Location in Road: CarriageWay,Footpath,Nature Strip

- Check the location of the dig site is correct. If not submit a new enquiry.
- If the scope of works change, or plan validity dates expire, resubmit your enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

Notes/Description of Works:

Your Responsibilities and Duty of Care

- The lodgement of an enquiry does not authorise the project to commence. You must obtain all necessary information from any and all likely impacted asset owners prior to excavation.
- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at **www.1100.com.au**
- **For more information on safe excavation practices, visit www.1100.com.au**

Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.

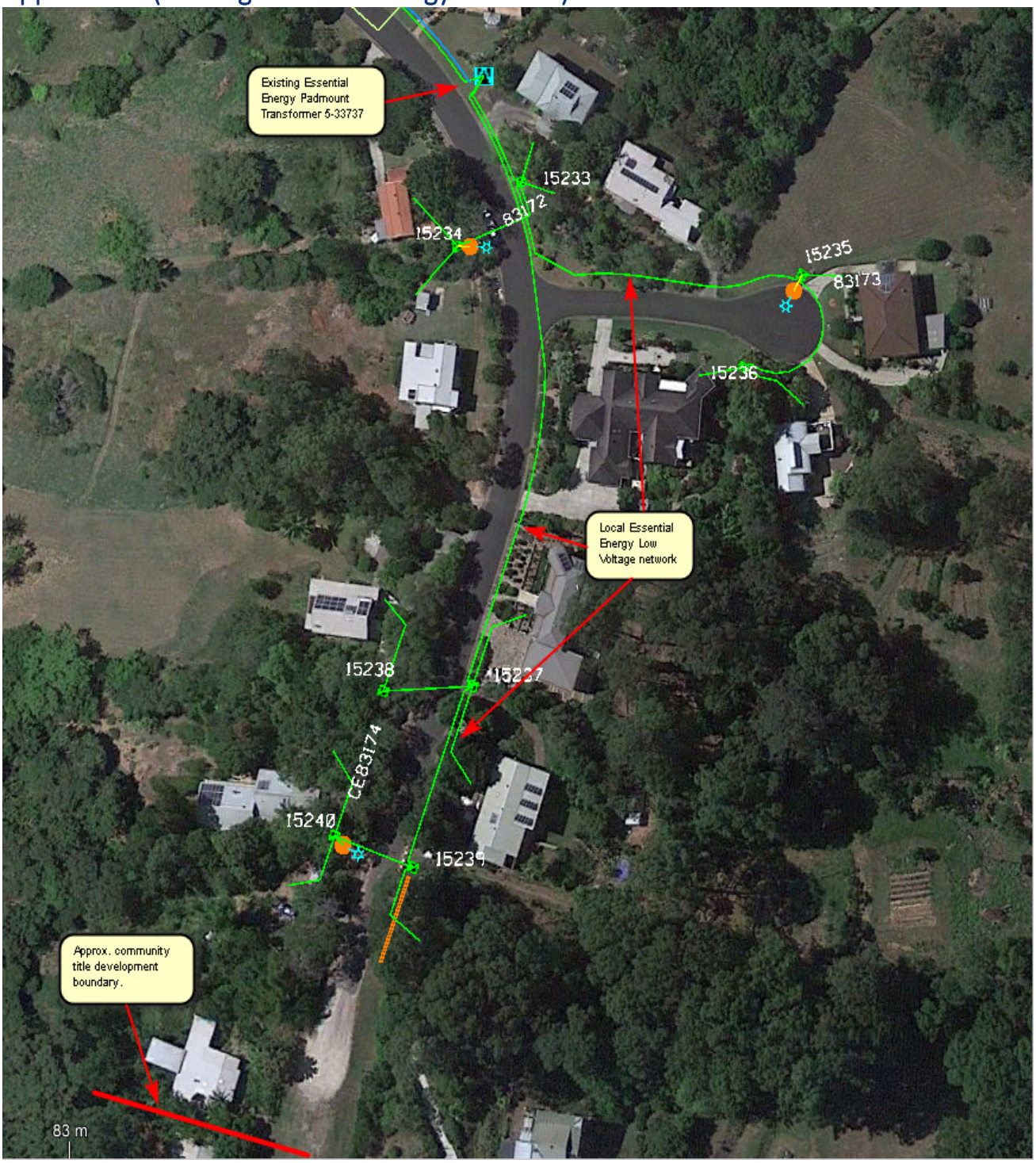
** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.
# Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
94966995	Essential Energy	132391	NOTIFIED
94966997	NBN Co, NswAct	1800626329	NOTIFIED
94966996	Telstra NSW, North	1800653935	NOTIFIED

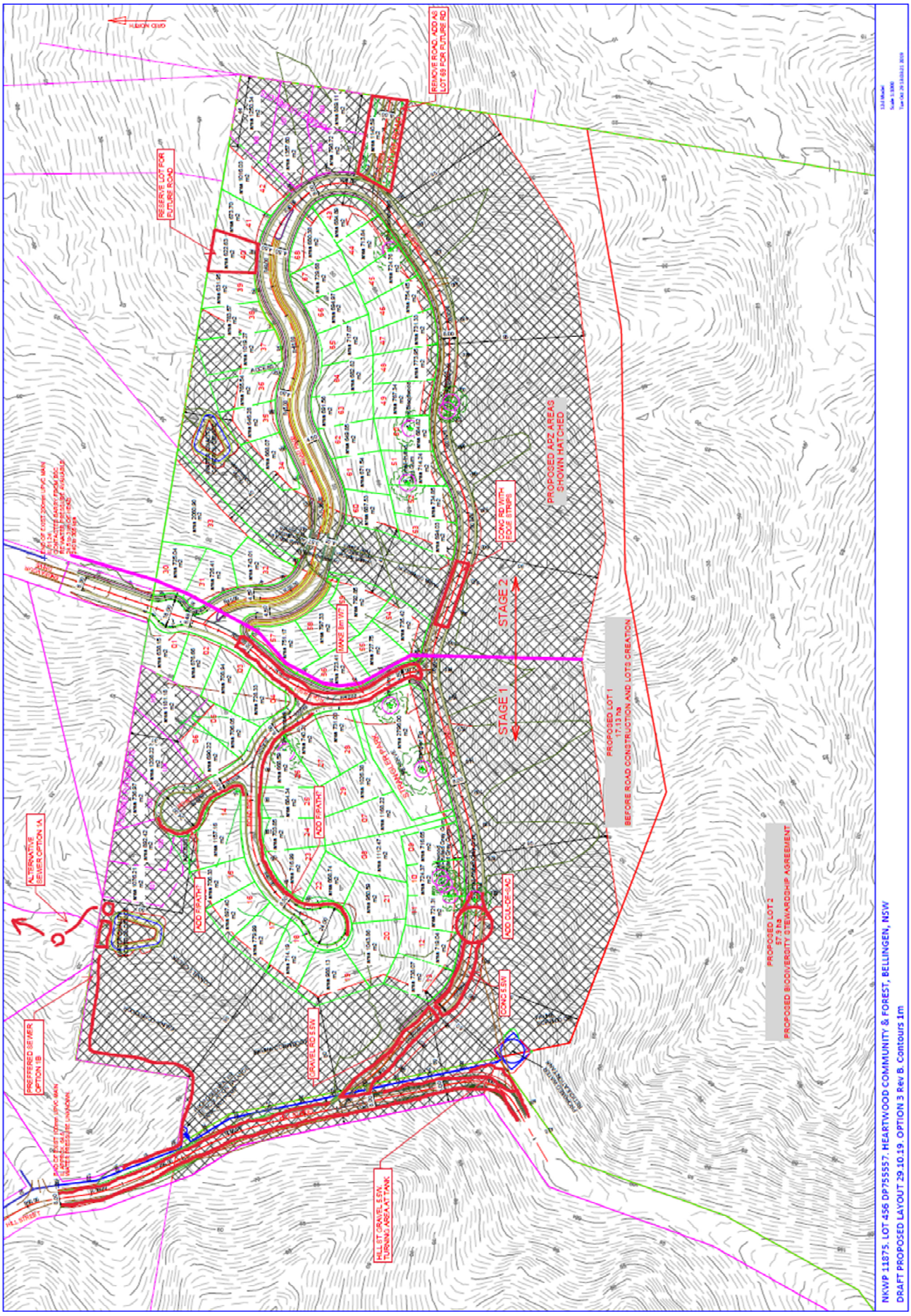
END OF UTILITIES LIST

Lodge Your Free Enquiry Online – 24 Hours a Day, Seven Days a Week [NSW]

Appendix A: (Existing Essential Energy Network)



Appendix B: (Site Plan)



Appendix G Heartwood Community Geotechnical assessment

Steve & Jen Smith Adventure Moto Australia

Geotechnical Assessment

Proposed Heartwood Community Residential Development

Lot 456 DP755557, Bellingen

Report No. RGS32154.1-AB

27 November 2020

REGIONAL GEOTECHNICAL SOLUTIONS

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS32154.1-AB

27 November 2020

Steve & Jen Smith Adventure Moto Australia
C/o: George Stulle
3 Montgomery Close
SAFETY BEACH NSW 2456

Dear George

RE: Proposed Heartwood Community Residential Development
Lot 456 DP755557, Bellingen
Geotechnical Assessment

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment at Lot 456 DP755557, Bellingen, where it is proposed to construct a 76 lot residential subdivision.

Presented herein is an assessment on the feasibility of the proposed development from a geotechnical perspective along with preliminary comments and recommendations regarding slope stability, earthworks and pavements.

If you have any questions regarding this project, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Simon Keen

Senior Geotechnical Engineer

Reviewed by

Adam Holzhauser

Associate Geotechnical Engineer

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Figures

Appendices

1 INTRODUCTION

Regional Geotechnical Solutions Pty Ltd (RGS) have undertaken a geotechnical assessment for a proposed residential development that is to be constructed at Lot 456 DP755557, Bellingen NSW.

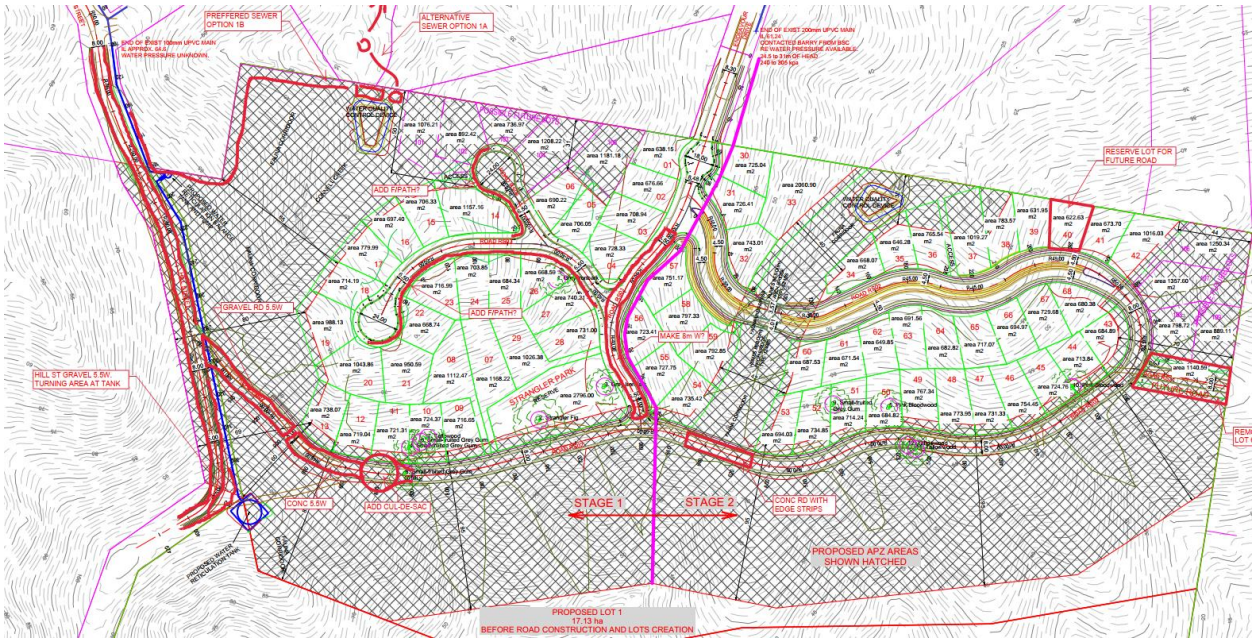
The purpose of the assessment, which was undertaken in accordance with RGS Proposal No. RGS32154.1-AA, was to provide comments and recommendations on the following:

- Subsurface conditions including the presence of fill, depth to weathered rock and groundwater (if encountered);
- The feasibility of the site to support the proposed development from a geotechnical perspective;
- Slope stability;
- General construction requirements and recommended construction types;
- Road subgrades and pavements; and
- Bioretention basins.

2 PROPOSED DEVELOPMENT

It is understood that the proposed development is to include subdividing the northern 17.54ha of the 75.07ha site into 76 residential lots that range between about 620m^2 and 2,060m^2. Four roads are proposed within the development. The southern portion of the site is to be conserved under a Biodiversity Stewardship Agreement. The extent of cut or fill earthworks has not yet been provided.

The proposed development layout is presented below.



The proposed lot and road layout

3 METHODOLOGY

Field work for the assessment was undertaken by a Geotechnical Engineer from RGS on 25 November 2020 and included the following:

- Observation of site features and surrounding features relevant to the geotechnical conditions of the site; and
- The excavation of seven test pits (TP2 to TP8) to depths of between 1.2m and 2.0m with a 4 tonne excavator.

Engineering logs of the test pits are presented in Appendix A. Test locations are shown on the attached Figure 1 and were obtained with a hand held GPS.

4 SITE CONDITIONS

4.1 Surface Conditions

The 75.07ha site is bound by the Hill Street trail to the west, bushland to the south and west, and by large lot residential lots to the north that are accessed by Endeavour Drive. Site access is currently from Endeavour Drive. A satellite photograph that shows the location of the site and the site setting is reproduced below.

Satellite photograph obtained from the NSW Government 'Six Maps' (dated 2009) that illustrates the site location and setting. The site boundaries are shown by a yellow shaded red box. The approximate extent of the proposed residential development is shown by a blue box.

The site is situated within a region characterised by moderately to steeply sloping terrain. The northern portion of the site where development is proposed is dominated by an east-west trending ridgeline in the south of the development footprint (i.e. blue box above). A north plunging ridgeline spur bisects the development and grades down towards Endeavour Drive.

The crest of the east-west trending ridgeline contains slopes of generally up to about 5°, with sections to the east and west being up to about 15-20°. The northern face of the ridgeline and either side of the north plunging ridgeline spur grade down to the north, east and west at grades of between 10 and 30°, with some localised steeper sections being up to about 35°. On the southern side of the ridgeline (i.e. to the south of the proposed residential development) the site initially grades down to the south, southeast and southwest at between about 15 and 35°.

The site is vegetated with sparsely scattered mature trees, grasses and weeds including lantana. Thicker vegetation is present within the lower lying gullies in the northeast and northwest of the site which limited detailed site observations within these areas.

Residual silty clay and extremely to highly weathered extremely low to low strength phyllite is exposed across the site with distinct quartz veins being present. Minor scour/erosion of surface soils is present on steeper sections of the site and is more prominent within the existing 4WD tracks that are void of vegetation.

Typical site photographs are presented below.

Looking south along the ridgeline spur from near the existing end of Endeavor Drive at TP4

Looking west across the northern face of the east-west trending ridgeline towards sparse vegetation

Looking east along the crest of the ridgeline in the west of the site

Looking east from along the crest of the ridgeline in the east of the site

Looking west from the eastern end of the proposed development towards the ridgeline spur

Highly to moderately weathered phyllite was encountered in TP6

4.2 Subsurface Conditions

The NSW Government '*MinView*' Geological Survey of NSW indicates that the site is underlain by Bellingen Slate that comprises dark micaceous slate, lithofeldspathic sandstone, minor conglomerate.

The materials encountered within the test pits undertaken during the investigation are summarised in Table 1. Further details are presented on the attached engineering logs.

Table 1: Summary of Subsurface Materials

Material Name	Material Description	Depth to Base of Material Layer (m)						
		TP2	TP3	TP4	TP5	TP6	TP7	TP8
Topsoil	Clayey SILT, low plasticity, friable	0.25	0.15	0.3	0.3	0.15	0.25	0.25
Residual Soil	Clayey SILT, low plasticity, hard and friable	0.7	0.6	0.8	--	0.3	0.7	0.7
E-HW Phyllite	Extremely to highly weathered, extremely low to low strength	1.5	1.5	1.5	0.6	0.6	1.1	1.5
H-MW Phyllite	Highly to moderately weathered, very low to medium strength, some quartz veins	≥ 1.6*	≥ 2.0*	≥ 1.9*	≥ 1.3*	≥ 1.2*	≥ 1.8*	≥2.0*

Note: ≥ Indicates that base of material layer was not encountered
* indicates that the test was terminated due to practical excavator (toothed) bucket refusal
-- Indicates that the material was not encountered at the test location

Groundwater was not encountered within any of the test pits. Groundwater levels do fluctuate due to inclement weather, seasonal variations, or due to reasons that may not have been apparent at the time of the site investigation.

5 GEOTECHNICAL CONSIDERATIONS

The site is situated within steep terrain and contains grades up to the order of about 35° and the site topography will have significant implications on future developments. Whilst evidence of instability was not identified at the site, the lower lying areas in the northeast and northwest (i.e. within and around gullies) area heavily vegetated and detailed observations were not possible.

From a geotechnical perspective, development of the site for residential purposes is not necessarily precluded, but future development should be undertaken in strict accordance with good hillside practice and the recommendations of this report.

A conceptual development layout has been provided for this assessment, however, detailed design such as cut and fill batters have not yet been provided. The following general recommendations are provided regarding the future development of the site:

- Limit the requirement for cut to fill earthworks as much as practicable. The construction of level cut to fill platforms for the construction of houses is not recommended;
- Slab on ground style buildings should be avoided. Construction methods that minimise excavation and filling should be adopted. Options could include elevated floors (pier and beam), split level development or pole frame construction;
- Maintain or establish new vegetation over the slopes both during and following construction to reduce surface water flows;
- All surface runoff (roof, road and driveway) should be appropriately discharged well below structures and assets, and away from slopes to a reticulated stormwater system where appropriate;
- Where cut and fill must be undertaken it should be supported by appropriately engineered retaining walls. Regular and ongoing maintenance of drainage and retaining structures including the cleaning out of drainage holes and removal of debris should be undertaken; and
- All footings should be founded in Weathered Phyllite and outside the zone of influence of slopes, future services or adjacent structures.

Further comments and recommendations on the above are discussed in the following sections.

Once details of the proposed developments are known it is recommended that RGS are contacted to provide further advice as required.

6 SLOPE STABILITY ASSESSMENT

6.1 Risk Assessment

The risk of slope instability has been assessed using the principles and procedures of the Australian Geomechanics Society publication *Practice Note Guidelines for Landslide Risk Management, 2007*. This methodology represents the currently accepted state of practice for landslide risk assessment.

The slope risk assessment process involves identification of a potential slope failure event, or hazard, followed by an estimation of the likelihood of the event occurring, and the potential consequences should the event occur.

The terms used in the risk assessment process are defined below:

Hazard: A condition with the potential for causing an undesirable consequence.

Likelihood: The estimated probability that the hazardous event will occur.

Consequence: Loss or damage resulting from a hazard event.

Risk: A term combining the likelihood and consequence of an event in terms of adverse effects to property or the environment.

6.2 Hazard Identification

The following potential slope stability hazards were assessed in relation to the site and the anticipated development.

Hazard 1: Soil creep. Creep is an imperceptibly slow movement that takes place on sloping soil sites. It is an ongoing, natural slope process involving the progressive downslope movement of soils over the underlying rock profile.

Hazard 2: Failure within the natural slopes (rotational, translational or debris / earthflow).

Hazard 3: Rotational / translational failure within fill over the underlying natural soil profile.

Hazard 4: Rotational, wedge or toppling failure within unsupported excavations.

6.3 Risk Evaluation for Existing Site Conditions

Table 2 summarises the factors affecting slope stability in relation to each of the hazards identified and assesses the risk of slope instability for each using the risk assessment matrix provided in Appendix C of the Australian Geomechanics Society (AGS) publication *Practice Note Guidelines for Landslide Risk Management, 2007*.

Table 2: Assessed Risk of Slope Instability

Hazard	H1 Soil Creep	H2 Failure Within Natural Slope	H3 Instability in Fill	H4 Unsupported Excavations
Slope Height	N/A	Approx. 30m	Estimated up to 3m	Estimated up to 3m
Cause or Trigger	Ongoing process of imperceptibly slow soil movement	Leaking underground services, poor drainage, Extreme rain event (e.g. 1 in 10yr event)	Poorly constructed fill platforms. Surface water flows. Adverse weather (1 in 10yr event)	Unsupported excavations. Surface water flows. Adverse weather (1 in 10yr event)
Proportion of Slope Affected	1	0.1	0.1	0.1
Estimated Annual Probability	10^{-1}	10^{-2}	10^{-2}	10^{-2}
Likelihood	Almost Certain	Likely	Likely	Likely
Consequence	Insignificant	Minor to Medium	Medium	Minor to Medium
Risk	**Low**	**Moderate to High**	**High**	**Moderate to High**

6.4 Evaluation of Risk Level

The assessment presented in Table 2 indicates that there is a **Moderate to High** risk of slope instability within the natural slopes (H2) and cuts and excavations (H4). There is a **High** risk in fill (H3) if not placed appropriately. The risk of instability for hazard H3 and H4 can be reduced to **Low** by adhering to the advice provided herein.

Instability within the natural slopes (H2) is considered a **Moderate to High** risk. This can be reduced to low provided general good hillside practice (refer to attachment) and the recommendations of this report are adhered to.

Providing the recommendations as detailed in the subsequent sections of this report are implemented, the risks associated with stope stability can be reduced to **Low**. A low risk level is normally be considered acceptable for hillside development in Australia.

Site specific assessments are recommended once final details of the proposed developments are known.

The Australian Geomechanics Society published a series of documents providing guidelines for Landslide Risk Management in 2007. The documents included recommendations on Good Hillside Practice, a copy of which is included in Appendix B. The proposed development should proceed in consideration of this documentation and the comments and recommendations provided in the following sections of this report.

7 EARTHWORKS

Specific details of the proposed future developments are unknown, but it is anticipated that single to double storey dwellings will be constructed within the proposed lots. Earthworks will be required for the construction of the proposed roads.

Given the steep nature of the site, earthworks should be limited as much as practicable. Cut to fill platforms should be avoided and alternative construction methods that minimise excavation and filling should be adopted. Options could include elevated floors (pier and beam), split level development or pole frame construction.

Site Drainage

One of the key factors contributing to slope instability is inadequate and/or inappropriate drainage. Therefore, a key factor in reducing the potential for slope instability on any site is adequate site drainage. The site is currently generally well drained and appropriate measures should be incorporated both during construction and post construction to maintain good site drainage.

All surface water runoff (including from further upslope where appropriate) should be appropriately collected on the up-slope side of any works and diverted downslope to the site stormwater system, or nominated designed drainage reserves.

Excavation and Retention

Excavations should be limited to maximum depths of 3m, however, deeper excavations are possible but will require site specific geotechnical assessment during the design stage. Excavations will generally encounter residual soil and weathered phyllite. Excavation of the weathered phyllite will be achievable with medium to large excavators.

Temporary batters through the existing soils should be cut no steeper than 1.5V:1H for heights up to 3m. Temporary batters should be trimmed smooth to reduce moisture ingress and protected from erosion. Surface runoff from above should be collected and diverted away from the face of the batters.

Permanent support of cut and fill should be provided by engineered retaining walls. Permanent cut and fill batters are not recommended. As a preliminary guide gravity or cantilever retaining walls can be adopted for the support of batters and can be designed based on a triangular lateral earth pressure distribution using the subsoil parameters provided in Table 3.

Table 3: Preliminary Earth Retention Design Parameters

Material	Unit Weight, γ	Friction Angle, Φ'	Effective Cohesion, c'	Active Earth Pressure Coefficient, k_a	At Rest Earth Pressure Coefficient, k_o	Passive Earth Pressure Coefficient, k_p
Level 1 Controlled Fill (won from onsite)	19kN/m^3	26°	5kPa	0.40	0.90	2.55
Residual Soil	19 kN/m^3	26°	5kPa	0.40	0.90	2.55
Weathered Phyllite	20 kN/m^3	35°	10kPa	0.27	1.05	3.7

The earth pressure coefficients detailed in Table 3 have been calculated using Rankine's Theory assuming level backfill. The retaining wall designer should ensure that the use of this method is appropriate for the individual retaining wall.

Any surcharge affecting the walls should be allowed for in the design. Appropriate drainage should be installed behind the walls that provide complete and permanent drainage. The wall backfill should comprise free draining granular material. Subsoil drains should comprise a recomposite drain or geotextile (Bidim A34 or similar) wrapped gravel drain at the toe of the back of the wall. The drains should discharge to the stormwater system.

8 FOOTINGS

Shallow footings founded within the upper soil profile are not recommended due to the steep slopes. All footings should be socketed well into weathered phyllite at a depth of at least 1m below finished surface level. Footings should not be located within 2m of the crest of slopes in excess of 45° unless they are extended to found at a depth below the toe level of the slope.

Bored piles founded within weathered phyllite would be suitable and may be proportioned based on a preliminary allowable base bearing pressure of **200kPa**. High bearing capacities may be achievable but require site specific assessment.

Due to the steep slopes the site is classified as Class 'P' in accordance with AS2870-2011 - *Residential slabs and footings*. Footings must therefore be designed based on engineering principles and the recommendations provided above.

Based on the soil profile encountered, previous experience on nearby sites and the presence of large trees, preliminary foundation design can be undertaken based on shrink-swell related ground

movements (y_s) of up to 40mm. Individual lot classifications will be required in accordance with AS2870-2011.

Site maintenance must comply with the recommendations and advice provided in CSIRO Sheet BTF18 "*Foundation Maintenance and Footing Performance: A Homeowners Guide*" a copy of which can be obtained at www.csiro.au.

All footings should be assessed by a Geotechnical Engineer prior to placement of reinforcement and pouring of concrete. Footings must be founded outside or below the zone of influence of steep slopes existing or future footings and service trenches. All footings must be free of loose and softened material prior to the placement of concrete. Concrete should be placed as soon as possible after excavation assessment and cleaning to reduce the potential for the softening of the footing base.

9 LIMITATIONS

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the document. The report should not be used by other parties or for purposes or projects other than those assumed and stated within the report, as it may not contain adequate or appropriate information for applications other than those assumed or advised at the time of its preparation. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. The report should not be reproduced either in part or in full, without the express permission of Regional Geotechnical Solutions Pty Ltd.

Geotechnical site investigation is based on data collection, judgment, experience, and opinion. By its nature, it is less exact than other engineering disciplines. The findings presented in this report and used as the basis for the recommendations presented herein were obtained using normal, industry accepted geotechnical design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

The recommended depth and properties of any soil, rock, groundwater, or other material referred to in this report is an engineering estimate based on the information available at the time of its writing. The estimate is influenced and limited by the fieldwork method and testing carried out in the site investigation, and other relevant information as has been made available. In cases where information has been provided to Regional Geotechnical Solutions for the purposes of preparing this report it has been assumed that the information is accurate and appropriate for such use. No responsibility is accepted by Regional Geotechnical Solutions for inaccuracies within any data supplied by others.

If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Simon Keen

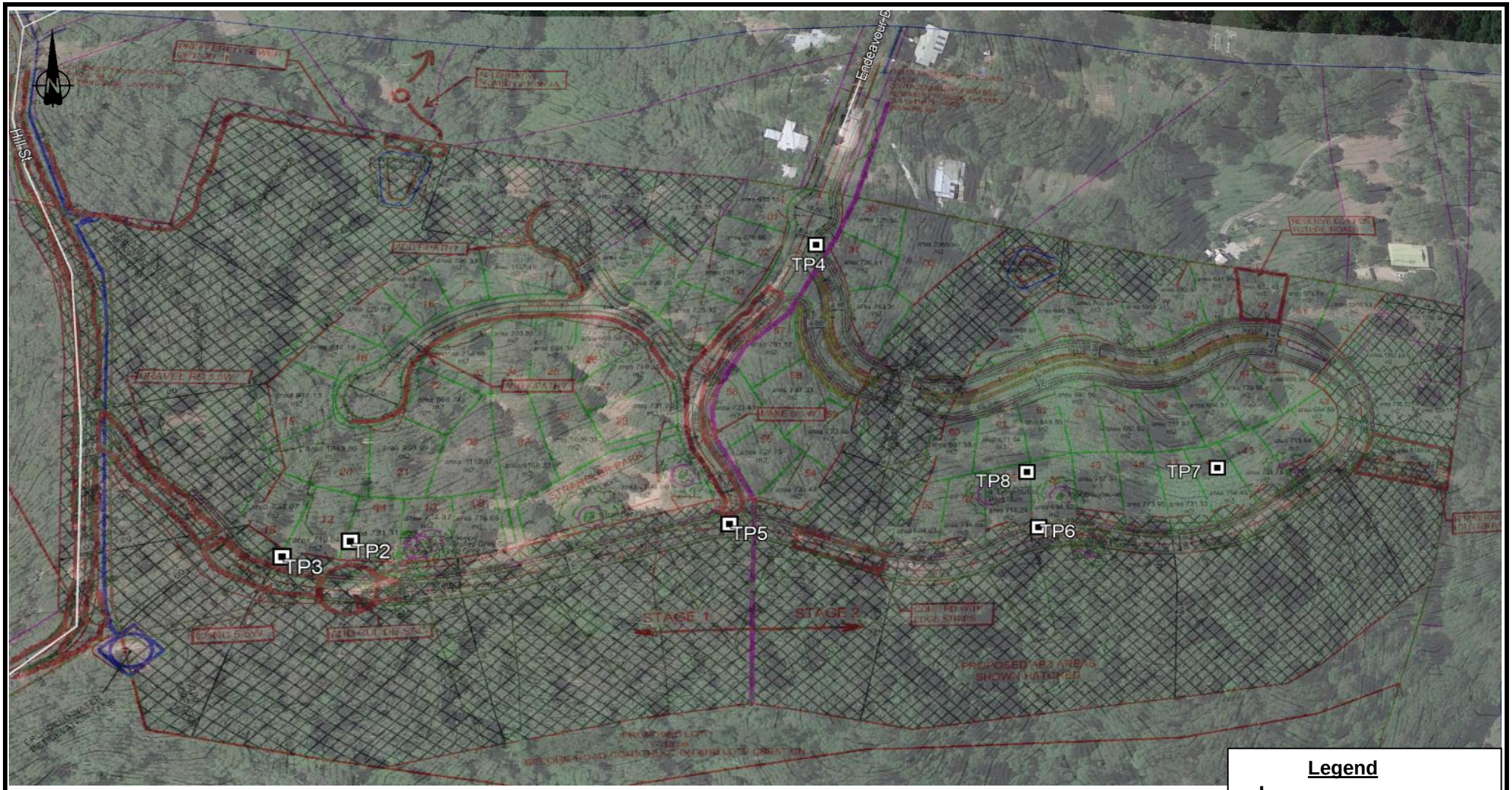
Senior Geotechnical Engineer

Reviewed by

Adam Holzhauser

Associate Geotechnical Engineer

Figures



REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	Steve & Jen Smith Adventure Moto Australia	Job No.	RGS32154.1
	Project:	Proposed Heartwood Community Residential Development Lot 456 DP755557	Drawn By:	SK
			Scale:	NTS
			Date:	25-Nov-20
	Title:	Test Pit Location Plan	Drawing No.	**Figure 1**

Appendix A

Results of Field Investigations

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP2

CLIENT: Steve & Jen Smith Adventure Moto Australia
PAGE: 1 of 1
PROJECT NAME: Heartwood Community Residential Development
JOB NO: RGS32154.1
SITE LOCATION: Lot 456 DP755557, Bellingen NSW
LOGGED BY: JB
TEST LOCATION: Refer to Figure 1
DATE: 25/11/20

EQUIPMENT TYPE: 4T Hitachi Excavator
EASTING:
SURFACE RL:
TEST PIT LENGTH: 2.7 m
WIDTH: 0.6 m
NORTHING:
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**TOPSOIL:** Clayey SILT, low plasticity, brown, root affected	M < w_P				TOPSOIL
							0.25m					
				0.5		ML	**Clayey SILT:** Low plasticity, orange-brown		H / Fb			RESIDUAL/SLOPEWASH
							0.70m					
				1.0			**PHYLLITE:** Extremely to highly weathered, extremely low to low strength, Grey-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
				1.5			1.50m					
							PHYLLITE: Highly to moderately weathered, very low to medium strength, pale grey, with quartz veins					HIGHLY TO MODERATELY WEATHERED PHYLLITE
							1.60m					
							Hole Terminated at 1.60 m Refusal					
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP3

CLIENT: Steve & Jen Smith Adventure Moto Australia
PAGE: 1 of 1
PROJECT NAME: Heartwood Community Residential Development
JOB NO: RGS32154.1
SITE LOCATION: Lot 456 DP755557, Bellingen NSW
LOGGED BY: JB
TEST LOCATION: Refer to Figure 1
DATE: 25/11/20

EQUIPMENT TYPE: 4T Hitachi Excavator
EASTING:
SURFACE RL:
TEST PIT LENGTH: 2.6 m
WIDTH: 0.6 m
NORTHING:
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**TOPSOIL:** Clayey SILT, low plasticity, brown, root affected	M < w_P				TOPSOIL
							0.15m					
						ML	**Clayey SILT:** Low plasticity, orange-brown		H / Fb			RESIDUAL SOIL
				0.5								
							0.60m					
							PHYLLITE: Extremely to highly weathered, extremely low to low strength, Grey orange-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
				1.0								
				1.5			1.50m					
							PHYLLITE: Highly to moderately weathered, very low to medium strength, pale grey mottled red-brown					HIGHLY TO MODERATELY WEATHERED PHYLLITE
							Becoming medium strength					
				2.0			2.00m					
							Hole Terminated at 2.00 m Refusal					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

CLIENT:	Steve & Jen Smith Adventure Moto Australia	**TEST PIT NO:**	**TP4**
PROJECT NAME:	Heartwood Community Residential Development	**PAGE:**	1 of 1
SITE LOCATION:	Lot 456 DP755557, Bellingen NSW	**JOB NO:**	RGS32154.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	JB
		DATE:	25/11/20

EQUIPMENT TYPE:	4T Hitachi Excavator			**EASTING:**	**SURFACE RL:**
TEST PIT LENGTH:	2.7 m	**WIDTH:**	0.6 m	**NORTHING:**	**DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**TOPSOIL/FILL:** Clayey SILT, low plasticity, grey-brown, with fine to medium grained gravel	M < w_P				FILL/TOPSOIL
							0.30m					
						ML	**Clayey SILT:** Low plasticity, orange-brown		H / Fb			RESIDUAL SOIL
				0.5								
							0.80m					
							PHYLLITE: Extremely to highly weathered, extremely low to low strength, pale grey mottled red-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
				1.0								
				1.5			1.50m					
							PHYLLITE: Highly to moderately weathered, very low to medium strength, pale grey-brown					HIGHLY TO MODERATELY WEATHERED PHYLLITE
							Becoming low to medium strength					
							1.90m					
							Hole Terminated at 1.90 m Refusal					
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP5

CLIENT: Steve & Jen Smith Adventure Moto Australia
PAGE: 1 of 1
PROJECT NAME: Heartwood Community Residential Development
JOB NO: RGS32154.1
SITE LOCATION: Lot 456 DP755557, Bellingen NSW
LOGGED BY: JB
TEST LOCATION: Refer to Figure 1
DATE: 25/11/20

EQUIPMENT TYPE: 4T Hitachi Excavator
EASTING:
SURFACE RL:
TEST PIT LENGTH: 2.7 m
WIDTH: 0.6 m
NORTHING:
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**TOPSOIL/FILL:** Clayey SILT, low plasticity, brown, with fine to coarse grained gravel	M < w_P	H / Fb			FILL/TOPSOIL
							0.30m					
				0.5			**PHYLLITE:** Extremely to highly weathered, extremely low to low strength, Grey-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
							0.60m					
				1.0			**PHYLLITE:** Highly to moderately weathered, very low to medium strength, grey					HIGHLY TO MODERATELY WEATHERED PHYLLITE
							1.30m					
				1.5			Hole Terminated at 1.30 m Refusal					
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

CLIENT:	Steve & Jen Smith Adventure Moto Australia	**TEST PIT NO:**	**TP6**
PROJECT NAME:	Heartwood Community Residential Development	**PAGE:**	1 of 1
SITE LOCATION:	Lot 456 DP755557, Bellingen NSW	**JOB NO:**	RGS32154.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	JB
		DATE:	25/11/20

EQUIPMENT TYPE:	4T Hitachi Excavator			**EASTING:**	**SURFACE RL:**
TEST PIT LENGTH:	2.6 m	**WIDTH:**	0.6 m	**NORTHING:**	**DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**FILL/TOPSOIL:** Clayey SILT, low plasticity, brown, with fine to coarse grained gravel	M < w_P	H / Fb			TOPSOIL
							0.15m					
						ML	**Clayey SILT:** Low plasticity, orange-brown					RESIDUAL SOIL
							0.30m					
				0.5			**PHYLLITE:** Extremely to highly weathered, extremely low to low strength, Grey-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
							0.60m					
				1.0			**PHYLLITE:** Highly to moderately weathered, very low to medium strength, pale grey-brown					HIGHLY TO MODERATELY WEATHERED PHYLLITE
							1.20m					
							Hole Terminated at 1.20 m Refusal					
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Steve & Jen Smith Adventure Moto Australia	**TEST PIT NO:**	**TP7**
PROJECT NAME:	Heartwood Community Residential Development	**PAGE:**	1 of 1
SITE LOCATION:	Lot 456 DP755557, Bellingen NSW	**JOB NO:**	RGS32154.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	JB
		DATE:	25/11/20

EQUIPMENT TYPE:	4T Hitachi Excavator			**EASTING:**	**SURFACE RL:**
TEST PIT LENGTH:	2.6 m	**WIDTH:**	0.6 m	**NORTHING:**	**DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**TOPSOIL:** Clayey SILT, low plasticity, brown, root affected	M < w_P				TOPSOIL
							0.25m					
				0.5		ML	**Clayey SILT:** Low plasticity, orange-brown, with coarse grained phyllite gravel		H / Fb			RESIDUAL/SLOPEWASH
							0.70m					
							PHYLLITE: Extremely to highly weathered, extremely low to low strength, Grey-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
				1.0								
							1.10m					
							PHYLLITE: Highly to moderately weathered, very low to medium strength, pale grey and red-brown, with quartz veins					HIGHLY TO MODERATELY WEATHERED PHYLLITE
				1.5								
							1.80m					
							Hole Terminated at 1.80 m Refusal					
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

CLIENT:	Steve & Jen Smith Adventure Moto Australia	**TEST PIT NO:**	**TP8**
PROJECT NAME:	Heartwood Community Residential Development	**PAGE:**	1 of 1
SITE LOCATION:	Lot 456 DP755557, Bellingen NSW	**JOB NO:**	RGS32154.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	JB
		DATE:	25/11/20

EQUIPMENT TYPE:	4T Hitachi Excavator			**EASTING:**	**SURFACE RL:**
TEST PIT LENGTH:	2.5 m	**WIDTH:**	0.6 m	**NORTHING:**	**DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm Bucket	Not Encountered					ML	**TOPSOIL:** Clayey SILT, low plasticity, brown, root affected	M < w_P				TOPSOIL
							0.25m					
				0.5		ML	**Clayey SILT:** Low plasticity, orange-brown, trace coarse grained phyllite gravel		H / Fb			RESIDUAL/SLOPEWASH
							0.70m					
				1.0			**PHYLLITE:** Extremely to highly weathered, extremely low to low strength, Grey-brown					EXTREMELY TO HIGHLY WEATHERED PHYLLITE
				1.5			1.50m					
							PHYLLITE: Highly to moderately weathered, very low to medium strength, pale grey mottled red-brown					HIGHLY TO MODERATELY WEATHERED PHYLLITE
				2.0			2.00m					
							Hole Terminated at 2.00 m Refusal					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

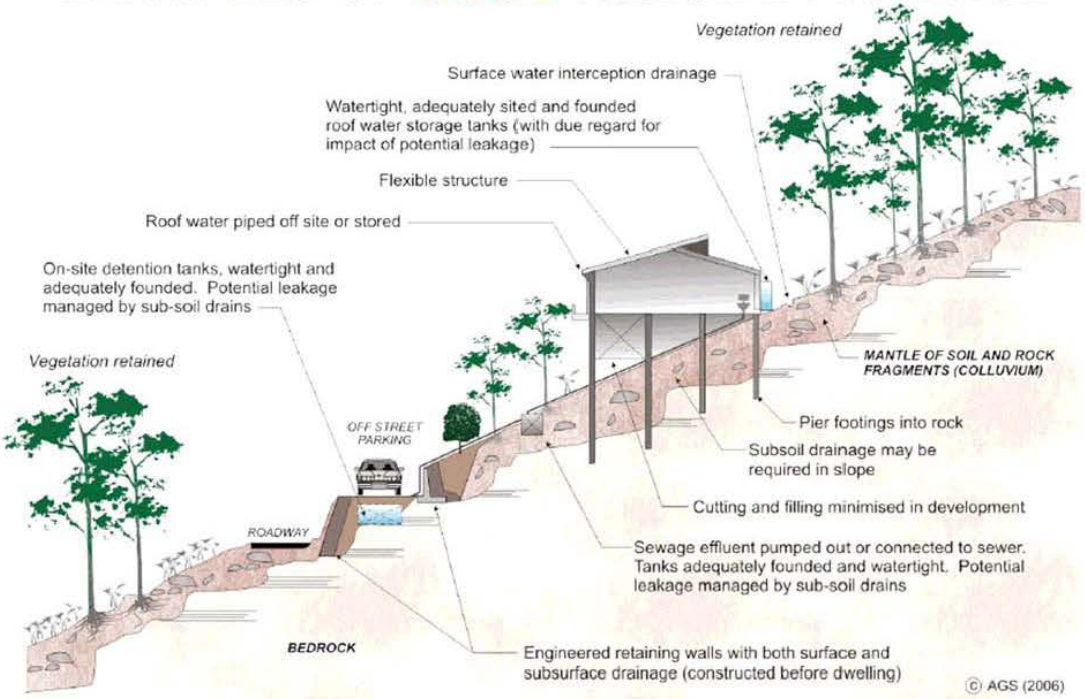
Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Appendix B

Good Hillside Practice

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE