Soil Investigation Report

Prepared For

Rosewood Green Property Pty Ltd
Locked Bag 800 ROOTY HILL 2766

SITE ADDRESS - Lot 18 NEW ROAD ROSEWOOD 4340

Local Authority - IPSWICH CITY

Date : 16th September, 2020
OUR PROJECT JOB NUMBER: 194854

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Section 1 - Introduction

STA Consulting Engineers have been commissioned by Rosewood Green Property Pty Ltd to undertake a soil test and site investigation in order to determine a site classification in accordance with AS 2870 Residential Slabs and Footings. Unless otherwise stated, the scope of this commission is limited to obtaining sufficient information to enable a site classification to be made, collect information on the natural soil profiles observed, determine the bearing strength of the soils, identify the presence and depth of fill material, determine the soils reactivity and calculate the effects of trees where required

This commission does not extend to the testing of stockpiled materials stored on site, fill certification, or the testing of sub grade materials for pavement design. Whilst some comment may be made regarding foundations, the final design criteria is to be specified by the designing engineer.

1.01 - QBCC Subsidence Policy

NOTE: Under QBCC subsidence policy the following indicates the required information that is to be supplied and the information that has been supplied to the engineer prior to site investigation. :-

YES	Property Description and site address
YES	Evidence to ensure site is correct
NO	The footprint of the proposed building and an indication of platform levels.

NOTE: "Site Classification **- Under the QBCC subsidence policy we the engineers confirm the following :-**

YES	The engineer or a representative of STA Consulting has visited the site
YES	The soil testing has been undertaken by a Registered Professional Engineer in Queensland.
YES	The minimum of two (2) bore holes have been located over the proposed footprint of the building and below the final platform level.
YES	Soil samples have been taken for the purpose of laboratory testing where required.
YES	A laboratory test and a soil report have been obtained for the design engineer.

STA Consulting Engineers confirms from an engineering perspective, compliance with the engineer's obligations in the QBCC Subsidence Policy for the below mentioned items, subject only to:-

1. The below mentioned items were assessed at the time the site investigation.
2. The builder, in accordance with the QBCC Subsidence Policy has met all the requirements and supplied all relevant searches.

NOTE: Abnormal Site Conditions **- Under QBCC subsidence policy we the engineers acknowledge the following :-**

- Soil soil - such as uncontrolled fill or development fill sites including soft clay or silt or loose sand. (Bearing capacity less than 100 kPa);
- Landslip
- Mine Subsidence and collapsing soils
- Soils subject to erosion
- Reactive sites subject to abnormal moisture conditions
- Sites that cannot be classified otherwise

NOTE: Under QBCC subsidence policy we the engineers confirm the following check list for Abnormal Moisture Conditions

- Recent removal of an existing building structure
- Unusual moisture conditions caused by drains, channels, ponds, dams or tanks which are to be maintained or removed from the site. *Canal developments that have deep seated clays are an example where abnormal moisture conditions may prevail over time.*
- Removal of large trees prior to construction
- Trees located to close to footings *(including trees on adjoining sites within the relevant distance of the mature height of the tree from the building depending on site classification).*

1.02 - Site Classification Criteria

This soil test has been prepared by reference to;

Site Classification Criteria :

AS 1289	Methods of testing soils for engineering purposes
AS 1726	Site Investigation Code
AS 2870	Classification of site in accordance with "Residential Slab & Footings"
AS 3798	Guidelines on earthworks for commercial and residential development

Section 2 - Findings

2.01 Site Description

At the time of the investigation the block was vacant. The vegetation consisted of grass, the tested area was flat and the drainage was poor.

2.02 Fieldwork & Laboratory Testing

Two bore holes were undertaken across the site using a power auger drill rig mounted at the rear of a four wheel drive ute to a maximum depth of 2400mm. Dynamic Cone Penetrometer (D.C.P) tests and Pocket Penetrometer (P.P) tests were also undertaken at the time of the site investigation.

The bore holes were drilled using solid flight augers fitted with a steel V shaped bit or tungsten carbide bit

An authorised representative from STA Consulting Engineers set out the bore holes locations from existing site features, directed sampling and logged bore hole profiles. Engineering logs of the bore holes are presented in Section 3 , together with Explanation Sheets defining the terms and symbols used in the preparation of the logs.

Representative samples of residual soil was collected for the purpose of Laboratory testing. These tests include the following :-

- Moisture Contents
- Liquid Limit (LL)
- Linear Shrinkage (LS)
- Shrink /Swell (Iss)

Results of the Laboratory tests are indicated under Section 3.0 Soil Profile and Laboratory Results.

2.03 Subsurface Conditions

The ground conditions encountered were generally existing fill/ natural silty sand over natural silty clay.

Note : There is a danger that by simplifying the geological conditions as described above, small-scale variations that may have significant engineering implications can be overlooked. Where specific information is required, the reader should in all instances refer to the bore hole logs in Section 3 of this report.

2.04 Groundwater

Groundwater was not identified at the time of the subsurface investigation. It must be noted that ground moisture and ground water depths are typically influenced by climatic conditions and the permeability of the soils observed and may vary with season change or tidal influences.

Section 2 - Findings

2.05 Site Classification

After assessing the laboratory test results, on site conditions and surrounding conditions in accordance with AS 2870. This site has been classified: **Class H2**

Approximately 800 mm of fill was encountered in bore hole #2 . STA Consulting Engineers has been presented with documentation to show that it was compacted and certified in accordance with AS 3798 (Level One Supervision) by Protest Engineering, Project No. PTP/03821.

STA Consulting Engineers has been presented with a detailed mining study completed by Moreton Geotechnical Services Pty Ltd, Ref No. 2004/112/07 which outlines the restricted and unrestricted areas of the subdivision. This lot is located within the unrestricted area of the subdivision therefore there are no additional requirements. Refer to page 9 of this report for the restricted and unrestricted zone overlay.

2.06 Comments (Detailed Plans Not Supplied))

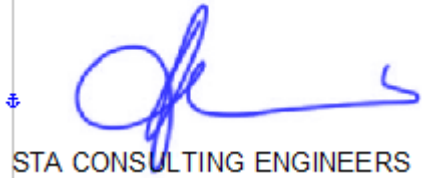
For a residential dwelling as defined under AS 2870 we are of the considered opinion that footings designed to suit a {Class " H2 "} classification, using engineering principles would be suitable on this site.

Complete field and laboratory test results are presented in Section 3 of this report. Please note that the test hole locations, and slope are estimations only and should not be taken as being absolute.

To ensure correct footing and or slab construction it is essential that a copy of this report and any relevant addendums (where applicable) are supplied to the concretor in full prior to their preparation. It is also advisable that such documentation is available on site for reference by the concretors and nominated inspectors.

We would like to thank you for giving us the opportunity to provide this service to you and should you wish to contact us again please do so.

Yours faithfully,



STA CONSULTING ENGINEERS

Bore Log Sheet

Bore Hole # 1

Project Job No. ES194854-B

Client: Rosewood Green Property Pty Ltd
Pty Ltd

Drill Method: Power Auger

Depth (m)	Sample Location	Groundwater	Graphic Log	Extent of Fill	Symbols	SOIL DESCRIPTION	PP Value	D.C.P blows/ 100 mm	N'q (kPa)
0						SILTY SAND (Grey Brown)		6	
						Moist & Medium Dense		7	
						SILTY CLAY		8	220
						(Grey Black)	250	8	
0.5						Moist & Stiff *Some Fine to Medium Sands*		9	
						(Yellow Brown)		9	230
						Moist & Stiff	250	8	
								9	
1.0							250	10	240
								10	
								12	
							250	11	300
1.5								12	
						Moist & Stiff	250		
							250		
2.0									
							240		
2.5						Moist & Stiff			
						END			
3.0									
3.5									
4.0									
4.5									
5.0									

Bore Hole Terminated - 2.4 m

Bore Hole # 2

Drill Method: Power Auger

Depth (m)	Sample Location	Groundwater	Graphic Log	Extent of Fill	Symbols	SOIL DESCRIPTION	PP Value	D.C.P blows/ 100 mm	N'q (kPa)
0						FILL - SILTY SAND (Grey Brown)		5	
						Moist & Medium Dense		6	
						FILL - SANDY CLAY		9	
						(Brown)	250	8	
0.5						Moist & Stiff		10	
						Fine to Medium Sands	240	8	
								9	
								7	
1.0						SILTY CLAY	250	8	
						(Yellow Brown)		8	
						Moist & Stiff		9	230
							250	9	
								9	
1.5							250		
						Moist & Stiff			
							250		
2.0									
							240		
2.5						Moist & Stiff			
						END			
3.0									
3.5									
4.0									
4.5									
5.0									

Bore Hole Terminated - 2.4 m

This line represents the anticipated base level of the recommended founding material nominated on page 1 of this report. This level is to be used as a gauge only.

Terms :-

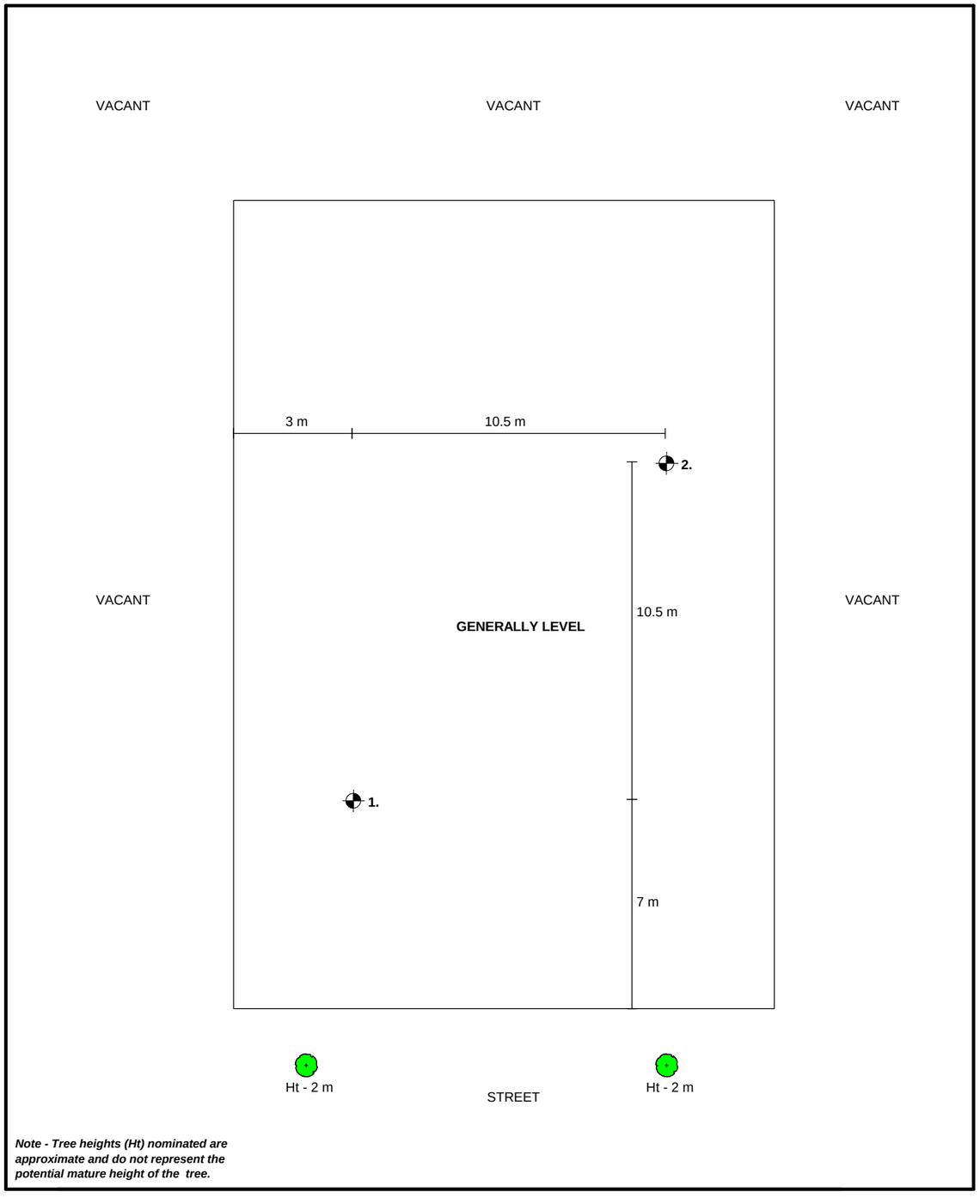
D.C.P.:- Dynamic Cone Penetrometer
N'q:- Allowable Bearing Capacity (kPa)
PP:- Pocket Penetrometer Strength (kPa)
U.T.P:- Unable to Penetrate
→ Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)

Section 3 - Bore Logs & Site Identification

Site Sketch (Not to Scale)

(All Dimensions Shown are Approximate Only)



Note - Tree heights (Ht) nominated are approximate and do not represent the potential mature height of the tree.

Site Identification

Laboratory Test Results

Sample Location:-	B.H. # 2	B.H. # 2
Depth of Sample:-	500 mm	1000 mm
Liquid Limit:-	55 %	87 %
Linear Shrinkage:-	15.0 %	19.0 %
Iss:-	2.7 %	4.1 %

Calculated Y's Value -	64 mm	*Y's - characteristic surface movement determined on soil properties only, does NOT include the effects of trees (refer Design Y's Range)*
Calculated Y't Value -	0 mm	*Y't - the calculated potential surface movement due to the tree induced suction change in addition to the normal design suction change.*
Est. Differential Settlement - of Level 1 Controlled Fill	4 mm	*The estimated differential settlement is the value by which Level 1 controlled fill may further displace and is generally proportionate to the variation in fill heights. Note: The estimated differential settlement values may be re-assessed if predicted settlement figures are provided to STA Consulting Engineers from the company that undertook the fill certification.*
Age of Level 1 - Controlled Fill	1 Year	

Design Y's Range

Y's + Yt :-	65 to 75 mm	*Note :*

Classification by characteristic surface movement as per AS2780-2011

SITE CLASSIFICATION SYMBOLS	DESIGN Y'S RANGE	GENERALISED DESCRIPTION (Guide Only)
'A'	0 < Ys	Most sand and rock sites with little or no ground movement from moisture changes.
'S'	0 < Ys ≤ 20	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
'M'	20 < Ys ≤ 40	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
'H1'	40 < Ys ≤ 60	Highly reactive clay sites, which may experience high ground movement from moisture changes
'H2'	60 < Ys ≤ 75	Highly reactive clay sites, which may experience very high ground movement from moisture changes
'E'	Ys > 75	Extremely reactive clay sites, which may experience extreme ground movement from 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..
'- D'	N/A	For classes M, H1, H2 and E this further classification may be required, based on the depth of expected moisture change. Applied to sites with deep-seated moisture changes characteristic of dry climates and corresponding to a design depth of suction change (Hs), equal to or greater than 3 metres.

Test Methods: AS1289 3.1.2 (liquid limit), 3.4.1(linear shrinkage), 7.1.1(shrink-swell)

Supplied Fill Certificate

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Project Number: PTP/03821
Letter Number: PTP/03821 – 0008
Project Name: Rosewood Green Estate Stage 1B

Attention: Campbell Thompson
Email: Campbell.Thompson@shadcivil.com

Report on Level 1 Earthworks
207 Rosewood Thagoona Road,
Rosewood, QLD, 4340

1. Introduction

This report summarises the results of inspection and testing provided by Protest Engineering (Protest) for the bulk earthworks as part of the Rosewood Green Estate Stage 1B project located at 207 Rosewood Thagoona Road undertaken between 8 October 2019 to 20 October 2019. The works were undertaken at the request of Shadforth.

The scope of inspection and testing undertaken was in general accordance with AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*. As part of the inspection and testing undertaken, Protest provided Level 1 supervision in accordance with Section 8.2 of AS3798-2007.

Approximately 8,600m^3 of fill was placed at the site with a maximum depth of approximately 1.0m. *Drawing C3D, Revision 1 – Cut and Fill Plan* attached is the bulk earthworks cut to fill plan. The frequency of field density testing adopted for this project was based on AS3798-2007, Table 8.1 with a minimum of one test per 500m^3 placed for a *Type 1 – Large Scale Operation*.

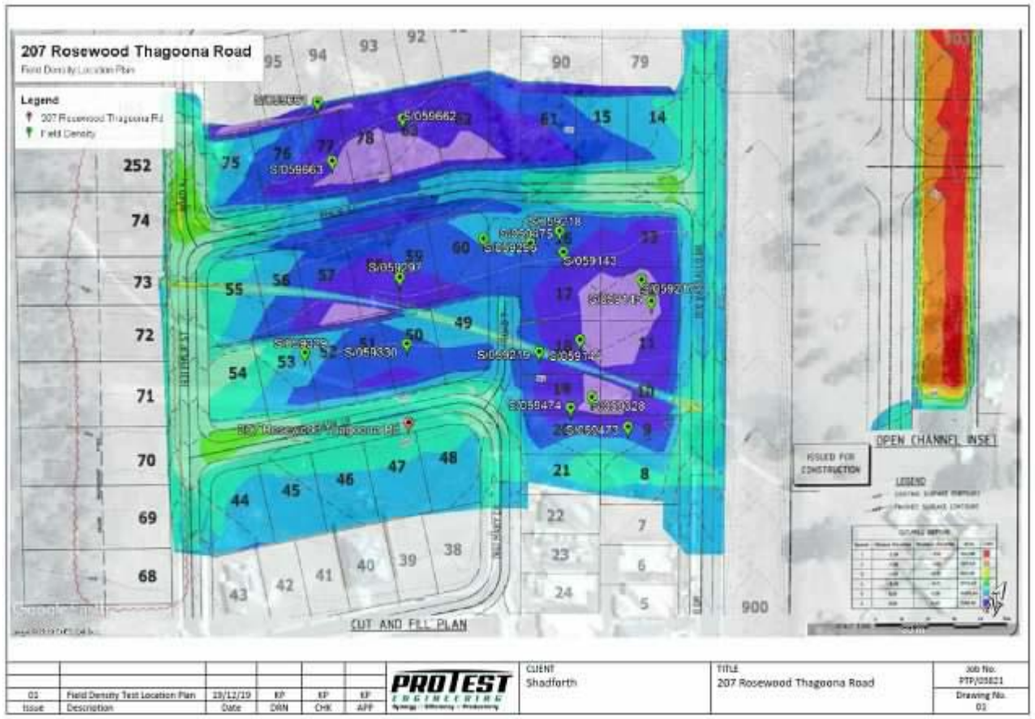
The minimum relative compaction requirements are specified in Drawing C2D, Revision 1 – Bulk Earthworks Plan and is attached. A summary of the criteria is summarized in Table 1.

Table 1: Test Request Compaction and Moisture Content Specification

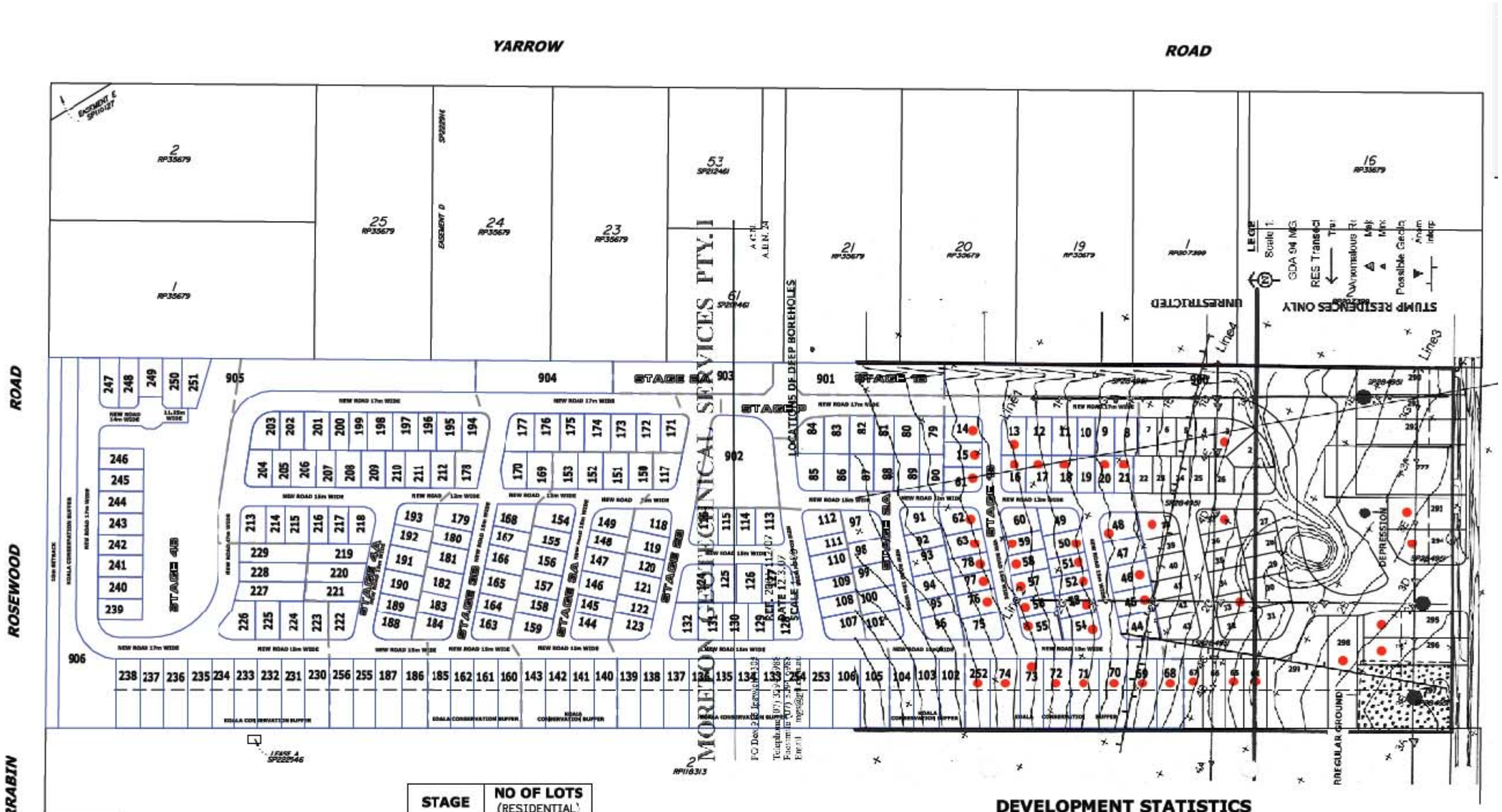
Fill Types	Maximum Dry Density Ratio (%)	Optimum Moisture Content Variation (%)
Filling to Building Platforms	>98%	±2% (Dry of Wet of OMC [1])
Subgrade	>100%	±2% (Dry of Wet of OMC [1])
General Filling	>95%	±2% (Dry of Wet of OMC [1])

(Notes: [1] Optimum Moisture Content)

It is understood that the Level 1 inspection was conducted according to the referenced standards and a Protest representative was on-site full time during the placement and compaction of the fill materials.



Supplied Plan



STAGE	NO OF LOTS (RESIDENTIAL)
1A	43
1B	46
2A	26
2B	37
3A	20

DEVELOPMENT STATISTICS

LOT AREA (m^2)	NO OF LOTS (RESIDENTIAL)	RATIO OF RES LOTS REMAINING
Stage 1A	43	Registered
450–599	49	22%
600–620	105	47%

Section 4 - Glossary of Terms

The following are definitions of words used in this report and attached documents.

Allowable Bearing Capacity - Maximum bearing pressure that can be sustained by the foundation from the proposed footing system under service loads which should avoid failure or excessive settlement.

Silt - Fine grained soil that is non-cohesive and non-plastic when wet, can include some sand and clay.

Sand - Granular soil that may contain a small proportion of fines including silt or clay. The amount of fines may be assessed as small by visual inspection or if the amount passing a 425 um sieve is 15% or less. Material with a higher proportion of fines shall be treated as silt or clay.

Clay - Fine grained soil with plastic properties when wet. Includes sandy or silty clays.

Rock - Strong material including shaley material and strongly cemented sand or gravel that does not soften in water. Material that cannot readily be excavated by a back hoe may be taken to be rock.

Foundation - Ground which supports the building.

Footing System - General term used to refer to slabs, footings, piers and pile systems used to transfer load from the structure to the foundations.

Liquid Limit [wl] - Moisture content at which the soil passes from plastic to the liquid state as determined by the liquid limit test.

Linear Shrinkage [LS] - Decrease in length expressed as a percentage of the original length when a sample of soil is oven dried from a moisture content of about the liquid limit as determined by the linear shrinkage test.

Plastic Limit [wp] - Moisture content at which the soil becomes too dry to be in a plastic condition as determined by the plastic limit test.

Plasticity Index [Ip] - Numerical difference between the liquid limit and the plastic limit of a soil.

Services - Means all under ground services to the site including but not limited to power, telephone, sewerage, water & storm water.

Site - Block upon which the testing was carried out.

Surface Movement (Ys) - Design movement at the surface of a reactive site caused by moisture changes.

Surface Movement Trees (Yt) - Potential surface movement due to the tree-induced suction change in addition to the normal design suction change.

Standard Residential Allotment - Means that if the lot/allotment is larger than 650 metres square then the client needs to identify where the proposed dwelling structure is to be erected.

Pocket Penetrometer (P.P) - Instrument used to evaluate consistency and approximate unconfined compressive strength of saturated cohesive soils.

Dynamic Cone Penetrometer (D.C.P) - Field equipment used to determine underlying soil strength by measuring the penetration of the device into the soil after each hammer blow.

Section 5 - Appendix

5.01 Soil test / Report Parameters

It is the clients responsibility to ensure that accurate details have been conveyed to STA Consulting Engineers prior to production of this report. STA Consulting Engineers is also not responsible for bracing and/or tie down requirements.

5.02 Site Class and Potential Surface Movement

Methods adopted are in accordance with guidelines specified in AS 2870 ,
appendix D. Potential surface movement and the resultant site classification are therefore in consideration of the local depth of the zone of consideration of significant soil moisture variations and the entire ground profile. This includes the influence of reactive clay based soils and/or the presence of fill, as well as the effect of stable materials such as dense sands or shallow rock. Site classification is divided into various classes, dependent on the Design Yst (potential movement). Class are;

Site Classification Symbols	Description
.....*A.....	Most shallow rock sites and some sand sites with little potential for movement through moisture change.
.....*S.....	Slightly reactive sites, have only slight potential for ground movement through moisture change.
.....M.....	Moderately reactive sites, can under go moderate ground movement through moisture change, May be considered as your average site.
.....H1.....	Highly reactive sites, can experience a high level of ground movement. Additional costs are generally incurred in building on such sites.
.....H2.....	Highly reactive sites, can experience a very high level of ground movement. Additional costs are generally incurred in building on such sites.
.....E.....	Extremely reactive sites can experience extremely high amounts of ground movement. Special considerations should be taken into account when building on these sites
.....P.....	Problem sites which generally have soils associated with uncontrolled fill, abnormal moisture conditions, mine subsidence, landslip and/or soft, collapsing or disturbed soils.
.....D.....	For classes M, H1, H2 & E this further classification may be required, based on the depth of expected moisture change. Applied to sites with deep-seated moisture changes characteristic of dry climates and corresponding to a design depth of suction change (Hs), equal or greater than 3 metres.

**** Additional costs can be incurred on sites due to possible difficulties in excavations/earthworks.***

5.03 Field and Laboratory Procedures

Site testing is conducted in strict accordance with AS 1726, Geotechnical site investigations. Insitu scala-cone penetrometer, pocket penetrometer and shear vane testing are converted to allowable bearing pressures. Refer respectively to Determination of Allowable Bearing Pressures Under Small Structures (1977) by MJ Stockwell and Skemptonsv Theorem (1954). Clay based soils are sampled and tested for their plasticity parameters, in accordance with AS 1289 3.1.2,3.4.1 and 6.3.2. STA Consulting Engineers is also NATA (National Association Testing Authorities) accredited for appropriate test procedures.

5.04 Site Maintenance

The performance of the footings and/or slab is largely dependent upon a responsible approach by the builder and the owner/occupant towards vegetation and site drainage. STA Consulting Engineers has classified the site allowing for the trees and vegetation present at the time of testing, however if any additional trees or vegetation are to be planted it recommended that the following guidelines are adhered to.

It is not recommended to have trees within a distance from the structure equivalent to;

- 75 % of the mature tree height, for Class M
- 100 % of the mature tree height, for Class H1
- 125 % of the mature tree height, for Class H2
- 150 % of the mature tree height, for Class E

* Note: Where offsets cannot be obtained as indicated above, root/moisture barriers must be adopted. Alternatively the designing engineer must be notified of such a scenario prior to the completion of the foundation recommendations.

Additional Critical Issues are;
• Water must not be permitted to pond in or around footings. • Garden Beds adjacent to the structure should be avoided. • The development of gardens should not interfere with effective site drainage. • Moderated watering of the garden is preferred to indiscriminate neglect and/or irregular saturation. • Plumbing leaks and in particular damaged storm water pipes should be repaired promptly. • Grated drain inlets are to be positioned under exterior taps which are located adjacent to the structure.

5.05 Sub Surface Mining / Slope Stability

This report does not cover slope stability. If this is required an independent assessment and investigation should be carried out by a qualified Geotechnical Engineer specialising in this area.

Unless STA Consulting Engineers has been instructed to the contrary, findings and recommendations contained in this report are not relevant should existing or proposed mining projects and/or slope instability adversely influence the ground conditions.

5.06 Site Drainage

Site preparation must include provision for a ground fall of no less than 1 in 20 away from the structure for a distance of at least 1 meter and where possible, a spoon drain at the base of cut banks directing surface drainage around and away from the footings.

5.07 Fill Material and Compaction

For totally filling the pad to level, CBR 15 or decomposed rock is recommended. Fill placed behind a brick cavity is to be of a granular base consisting of either sand, CBR 15, decomposed rock or crusher-dust. Highly reactive clay-based soil is not recommended for use as fill. Fill is to be placed in 150 mm deep layers, moistened and compacted to achieve the equivalent of 95% standard compaction. Compaction testing is to be in accordance with AS 1289, section 5.2.1. A vibrating sheeps-foot roller is recommended for compaction of the totally-filled pad. A vibrating-plate or wacker-packer is recommended for compaction of fill restrained by a brick-cavity. ***Note; Fill is not to be compacted within 500 mm of the brick cavity base (retaining wall)***

5.08 Existing / Proposed Services

Existing or proposed services may have an impact on the design recommendations supplied by the designing engineer. Therefore it is strongly recommended that you contact the local authority and confirm the positioning of any underground services that may be on site prior to any proposed excavations.

5.09 Batter Angles for Embankments

Recommendations for unsupported cut/ fill batters are presented in the following table:

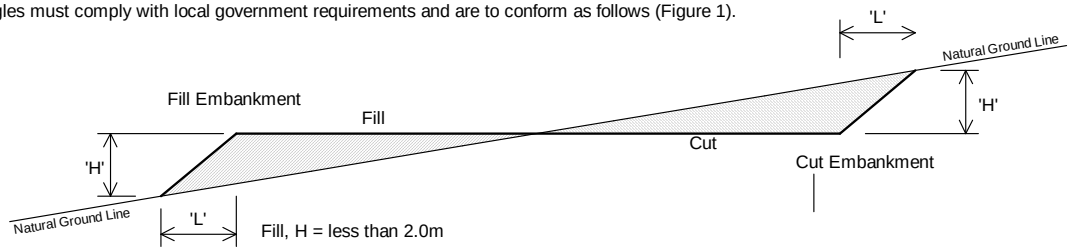
Earth Works Specifications

Batter Angles for Embankments:-

It is the builders responsibility to ensure that the site works do not undermine or place additional surcharge on any existing s tructures. If this can not be achieved STA Consulting Engineers must be contacted prior to any site works being undertaken.

Batter angles must comply with local government requirements and are to conform as follows (Figure 1).

Figure 1.



	Material Type (Refer Bore Logs)	Stable Rock	Sand	Silt	Clay		Soft Soils
					Firm Clay	Soft Clay	
Embankment Slopes (Height Length)	Compacted Fill	2 : 3	1 : 2	1 : 4	1 : 2	Not Suitable	Not Suitable
	Cutting	8 : 1	2 : 3	1 : 4	1 : 1	2 : 3	Not Suitable

Note: Retaining walls or other forms of soil retaining methods must be adopted where the slope ratio is greater than that indicated in the table above

TABLE 3: CUT/FILL BATTER RECOMMENDATIONS

Recommendations in table 3 assume that:

- Excavations in soil are above the groundwater table;
- The ground surface at the crest of the excavation is horizontal;
- There is no surcharge at the crest of the excavation for a distance equal to the depth of the excavation;
- All cuts are protected from erosion.

Batters should be reassessed if any of the above criteria are not met.

Section 6 - Disclaimer

Where any footing excavations may indicate significant variations to the ground conditions specified in this report then STA Consulting Engineers must be informed immediately before further work proceeds on site.

The site classification is based upon the condition of the site at the time of the investigation and does not take into account any proposed earthworks or proposed site preparation details unless indicated. If any extensive cutting, cut/filling or total filling is proposed, a re assessment of the site classification will be required.

The Yt range is based on the mature height of the trees and vegetation present at the time of testing. If any additional trees are vegetation are to be placed STA Consulting Engineers should be contacted to re-evaluate the site classification and design recommendations *(if applicable).*

Where this report is used by a designing engineer then an original of the complete report must be provided to that engineer.

The information contained within this report is only applicable to the site address supplied by our client. Also, if the site is not a standard residential allotment, information contained in this report is only relevant to those areas investigated.

The bore hole locations, slope directions and offsets are estimations only and should not be taken as being accurate or relied on for set out.

It is the clients sole responsibility to determine:

- the set out of any proposed structure on the site;
- the location of any services.

This report does not cover termite prevention, investigation or treatment. Any queries concerning these matters should be referred to appropriately qualified person.

It is the clients obligation to advise STA Consulting Engineers in writing of any known or suspected peculiarities or irregularities concerning the site.

Where STA Consulting Engineers relies upon information and documentation provided by the client the responsibility for the accuracy of any such information or documentation so provided is the clients sole responsibility.

Where the site is situated in a new development, it is the responsibility of the client to provide certifications of fill compaction to STA Consulting Engineers at the time of our engagement to prepare this report. Where the relevant certifications of fill compaction are not provided by the client to STA Consulting Engineers then the classification of this site may change which may increase the over all costs of construction of the proposed structure on the site. Where the certifications of fill compaction are provided after the completion of this report, then the client will be liable for an additional fee for the work necessary to revise the report in view of that additional documentation.

In the instances where by significant levels of filling are observed, there will always remain the possibility of tilt within a rafted foundation as a result of differential settlement in the fill. Australian Standard (AS2870-2011) does not cater for tilting of the slab as a result of differential settlement within certified filling nor does the Australian Standard address the possible occurance when shallow foundations are adopted.

This report should only be relied upon by the client where the report is provided in an original format and not as a copy.

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