TERRA INSIGHT

Sealark Road, Callala Bay NSW Lot 5 DP 1225356

Report on Geotechnical Investigation

Prepared for:

PRM Architects & Town Planners

Our Ref: TERRA19258.Rep1.Rev1

Prepared for:
PRM Architects & Town Planners
Mr P Mahedy
Mail: P.O. Box 323,
Gerringong NSW 2534

21 August 2019

Attention: Mr P Mahedy

RE: Sealark Road, Callala Bay NSW Lot 5 DP 1225356
Report on Geotechnical Investigation

Dear Patrick,

Please find enclosed our geotechnical investigation report in relation to the acid sulphate soil assessment conducted for the above Site. This report should be read in conjunction with the attached document 'About Your Report' in Appendix A. The results of these assessments are documented herein and indicate that the Net Acidity (%S) on the site is in the range of 0.06%S or lower. This is below the NSW EPA trigger level of 0.1% for the clayey soils encountered on the site, above which a formal management plan would be required. A formal ASS management plan is therefore not deemed required for the site.

Based on the investigations and outcomes detailed herein, the area of land identified for residential re-zoning, as per PRM's drawing (ref Appendix B) it not impacted by ASS at a level above which it would be deemed not suitable for residential use. Should you have any questions please contact the undersigned.

For and on behalf of Terra Insight

Karen Gates
Principal Engineer/ Director
CPEng MIEaust BEng MEngSc(Geot) MEnvMgt MBA

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1 Introduction

At the request of PRM Architects & Town Planners (the client), Terra Insight Pty Ltd (Terra) has carried out an acid sulphate soil (ASS) assessment of Sealark Road, Callala Bay NSW Lot 5 DP 1225356, hereafter referred to as the Property.

The site is proposed to be subdivided into thirteen (13) individual lots as depicted on the drawings provided in Appendix B. The residential lots will be located on the south-western part of the site with access from Monarch Place and a new road to be located off Sealark Road. As part of the development, a storm water detention pond is proposed to be constructed on the southern-eastern- of the Property. The remainder of the property is to remain undeveloped for environment conservation and to provide a fire asset protection zone.

The objective of the geotechnical investigation was to determine whether acid sulphate soil is present on the site within the area of the proposed subdivision and if present, their net acidity, liming rate, and the requirement for an Acid Management Plan (if applicable).

2 Scope of work

The scope of work for this assessment included the following:

- A review of geological maps and aerial photography covering the site;
- A review of acid sulphate mapping covering the site;
- A visit to site to make observations of site surface conditions by a Geotechnical Engineer;
- A subsurface investigation comprising:
  - Four boreholes (named BH01 and BH04) to 1.5m depth.
  - Sampling of the subsurface soils at 0.5m intervals; and
  - Logging of the materials encountered by a geotechnical engineer;
- Laboratory testing including ASS field screen testing of all samples collected from the site and an ASS Chromium suite test on a representative sample of the ASS material encountered on the site; and
- Provision of report providing the findings of the assessment and recommendations in accordance with the objectives outlined above.

3 Investigation Findings

3.1 Site details

Sealark Road, Callala Bay NSW Lot 5 DP 1225356, is located approximately 0.6 km north east of Callala Bay town centre as shown on Figure 1. The area of the property is approximately 6.3ha. The area of the proposed sub division (the site) is approximately 1 ha in area and located within the south-western corner of the Property (in an area hereafter referred to as the Site).

The Site is bounded by Sealark Road on the western boundary, Monarch Place on the southern boundary, Wowly Gully on the eastern boundary, and underdeveloped land to the north. The site has an elevation of about RL 4 to 5 m AHD adjacent to Sealark Road, falling to RL 3m AHD on the site's eastern boundary.

3.2 Historical Aerial Imagery

Historical aerial photography of the site (refer Figure 2) indicates that the site has subject to little changed between 2008 and 2018, other than minor vegetation management.

3.3 Geology

The 1:250,000 geology sheet for Wollongong indicates the site is underlain by Wandrawandian Siltstone of the Shoalhaven Group, consisting of siltstone, silty sandstone and pebbly in parts.

3.4 ASS Maps

The acid sulphate soil risk map accessed online via eSPADE v2.0 indicates the site has no known occurrences of ASS however, is within proximity of areas of known acid sulphate soil occurrence. The closest being the Wowly Gully Estuary with a high probability of acid sulphate soil occurrences in bottom sediments and in areas to the east of the creek at elevations of 1-2m AHD (eg at depths greater than 3m below the current ground surface level).

Terra has undertaken several ASS investigations in the area and has identified that some of the rock formations within the Wandrwandian Siltstone are acidic rocks with a low potential to generate acid.

3.5 Site Observations

Observations of the site were made at the time of the site inspection. Photographs taken of the general site conditions are provided in Appendix C. These indicate:

- The property is vacant and gently slopes to the south east, towards two small creeks/drainage depressions that combine on the property.
- Trees and bushes surrounded the creek.
- Stormwater from residential streets and properties likely feed the creek, then drains into an estuary along the southern boundary of the property.
- The property is predominantly grassed on the northern side of the creek, part of this grassed area is sandy, appearing to have formed from slope wash. Old tree stumps are present throughout this area.
- To the south of the creek most of the remaining area of the property is dense bushland with partly cleared areas towards the south eastern comer of the property.

3.6 Subsurface conditions

The subsurface investigation was undertaken on the 22nd of July and comprised the auguring of four test sites to a depth of 1.5m (BH01 to BH04) below the existing ground surface level within the western part of the site which is proposed for subdivision. A fifth surface sample was taken towards the centre north of the site (BH05). The test sites were named borehole BH01 to BH05. The location of each test site is shown on Figure 4. The subsurface conditions encountered in the boreholes are summarised on Table 3.1. Engineering logs are provided in Appendix D. The subsurface conditions encountered within the boreholes were generally consistent, comprised of a surficial layer of topsoil, under by around 0.5 to 0.7m of alluvial soil and then residual soil which graded into weathered rock at depths of around 1.5m

Table 3.1: Summary of subsurface investigation

Subsurface conditions *(Soil name, plasticity or particle characteristics, colour, secondary components and minor components)*	Structure and other comments	Depth encountered in test site/exposure (m)				
		BH01	BH02	BH03	BH04	BH05
Sandy SILT/Silty SAND: Low plasticity, pale brown, fine sand, trace of angular and sub rounded gravel, clayey in parts.	Topsoil	0.0-0.3	0.0-0.2	0.0-0.2	0.0-0.3	0.0-0.3
Silty CLAY: medium to high plasticity, orange brown with red mottling, trace of rootlets.	Alluvial	0.3-0.6	0.2-0.5	0.2-0.6	0.3-0.7	
Silty CLAY: medium to high plasticity, grey and red, with fine sand and trace of fine sub rounded gravel.	Residual	0.6-1.3	0.5-1.5*	0.6-1.3	0.7-1.2	
Sandy CLAY/Silty CLAY: medium to high plasticity, fine to medium sand, grey with red mottling, greyer with depth trace of fine to medium sub angular gravel. BH04 – Greyish white, with orange mottling.	Extremely weathered	1.3-1.5*		1.3-1.5*	1.2-1.5*	

*Notes * - End of hole at target depth; ᶠ - Early refusal, NE – not encountered*

A groundwater table was not encountered during the investigation. However, the soils were observed to be in moist and moist to wet condition in parts.

3.7 Laboratory Analysis

Acid sulfate soils (ASS) are grouped into two types, viz:

- **Actual (Active) Acid Sulfate Soils (AASS)** where the soils are oxidising, and acid is already being produced. These soils are typically identified because the pH of the soil when mixed with water is low (e.g. pHf < 4);
- **Potential (Passive) Acid Sulfate Soils (PASS)** where there is the potential for acid to be generated but the soil is not yet exposed to oxidizing conditions. In this case, a low pH is produced when the soil is mixed with an oxidizing solution resulting in a low pH (e.g. pH_{fox} < 3). Other indicators of PASS soils are a notable reaction when the oxidizing solution is applied and a pH_{fox} at least one unit lower than pH_f.

A summary of the results of acid sulfate soil field screening tests undertaken on samples of soil retrieved from each of the test sites as summarised in **Table 3-2** on the following page and provided in Appendix E.

The ASS field screening shows the natural pH of the soils is typically lower than 5 but above 4, indicating the soils are slightly acidic but not indicative that AASS are present in the near surface soils in the proposed location of the subdivision.

Several samples showed a drop in pH greater than 1 during the testing with two samples (BH05 S1 at 0.5m depth and BH03 at 0.5m depth) also showing a strong reaction during the field testing. The pHfox results are all above 3 but below 4. This result is inclusive for the presence of PASS. However, given the elevation of the site, the shallow depth to weathered rock which may potentially be slightly acidic and nearby ASS mapping, these results are indicative of the following:

- The near surface soils are comprised of some humic (organic) material which results in a slight drop in the pH.
- Closer to the creek, the alluvial soils also show a higher drop in the pH, most likely associated with increased humic material and potentially sporadic and weak PASS deposited during historical flood events.
- acidity associated with underlying acid rock of the Wandrawandian Siltstone Formation.

Terra Insight has undertaken several investigation which including sampling and testing for acid sulfate soils in the Callala Bay area. Results of a Chromium Suite test undertaken on alluvial soils from Emmett Street with similar field screen test results are provided in Table 3.3. This result shows a net acid generating capacity of 0.06% for clayey soils on Emmett Street of 0.06%.

Table 3-2: Summary of ASS field screening laboratory results

Test Hole Number	Sample Depth (m)	$pH_{(f)}$	$pH_{(fox)}$	Reaction (X slight, XX Moderate, XXX strong, to XXXX extreme)	ΔpH $pH_{(f)}$ - $pH_{(Fox)}$	AASS indicator ($pH_f < 4$)[A]	PASS indicators			Potential for ASS[D]
							pHfox[C]<3	ΔpH[B] (>1)	Strong or very strong reaction	
BH01	S1 0.5	4.7	3.6	XX	1.1	✗	✗	✓	✗	LOW - Humic
	S2 1.0	4.9	3.8	XX	1.1	✗	✗	✓	✗	LOW - Humic
	S3 1.5	4.9	4.0	XX	0.9	✗	✗	✗	✗	LOW
BH02	S1 0.5	4.5	3.6	XX	0.9	✗	✗	✗	✗	LOW
	S2 1.0	4.3	3.7	XX	0.6	✗	✗	✗	✗	LOW
	S3 1.5	4.3	3.6	XX	0.7	✗	✗	✗	✗	LOW
BH03	S1 0.5	4.6	3.5	XXX	1.1	✗	✗	✓	✓	MODERATE
	S2 1.0	4.7	3.8	XX	0.9	✗	✗	✗	✗	LOW
	S3 1.5	4.8	3.9	XX	0.9	✗	✗	✗	✗	LOW
BH04	S1 0.5	4.7	3.5	XX	1.2	✗	✗	✓	✗	LOW-- Humic
	S2 1.0	4.5	3.4	XX	1.1	✗	✗	✓	✗	LOW-- Humic
	S3 1.5	4.7	3.5	XX	1.2	✗	✗	✓	✗	LOW-
BH05	S1 0.5	4.2	3.0	XXX	1.2	✗	✗	✓	✓	MODERATE

Notes to table: *A) This indicator is not used on its own as soils with high organic content can contain humic acid or manganese oxides which also produce a reaction;*

B) As the ΔpH increases, there is an increased probability that PASS is present.

C) The lower the pHfox the greater the potential for PASS to be present. Where pHfox < 3 and there is a strong reaction and high ΔpH, there is a high probability that PASS is present. Where the pHfox < 4 the result is less positive and further laboratory testing is required to determine the source of acid generation. Where pHfox < 5 the test is inconclusive, sulfides may be present either in small quantities or may be poorly reactive under quick field test conditions or the sample may contain carbonate which neutralises some or all acid production by oxidation. Equally the low value may be due to weak organic acids and there may be no sulfides present. Further testing to identify the cause of acid generation is recommended.

D) Samples which meet all the QASSIT indicators for PASS are assigned a high potential. Samples which meet some of the indicators for PASS are assigned a moderate potential. Samples which show an inconclusive result are assigned a low potential. It is noted that it is possible for some 'non-ASS soils' to generate acid and have all or some of the indicators of ASS. Further testing is required to assess the nature of acid generation.

Table 3-3: Summary of Chromium Suite laboratory test results

Test Location	Soil Type	Depth (m)	pH KCL	Actual Acidity [A] % S-TAA	Potential Acidity (% Sr)	Retained Acidity [C] (% S-S_{nas})	- Acid Neutralising Capacity ANCB (% S)[B]	Net Acidity (%S)	Fineness Factor	Liming Rate excluding ANC (kg/t)
LOR			*0.1*	*0.02*	*0.005*	*0.02*	*0.02*	*0.02*	*0.5*	*1*
Emmett Street1	Sandy Clay	0.5	4.9	0.04	0.026	NA	NA	0.06	1.5	3

Notes to table: LOR – level of reporting. NA – not applicable. A) only required where pH_{kci} is < 5.5, B) only required where pH_{kci} is >6.5 C) only required where pH_{kcl}<4

4 Engineering Assessment

4.1 Acid Sulfate Soils

The treatment of ASS is typically required where the level of Net Acidity (% S) is greater than the following:

- Sands and loamy (clayey) sands: 0.03%.
- Sandy Loams (Sandy Clays) and light clays 0.06%
- Medium to heavy Clays 0.1%

The Chromium Suite ASS testing indicates Net Acidity (%S) on the site is in the range of 0.06%S. This is below the NSW EPA trigger level of 0.1% for the clayey soils encountered on the site, above which a formal management plan would be required. A formal ASS management plan is therefore not deemed required for the site.

However, the site is in an area with a low and sporadic potential for ASS to be present in the near surface alluvial surface soils and is potentially underlain by residual and alluvial soils derived from underlying acidic rock associated with the Wandrawandian Siltstone. If the site is underlain by acidic rock, it is likely that the environment has become accustomed to a slightly reduced pH. Any in situ treatment of soils on the site will need to be targeted to ensure that only the potential for excess acidity is managed and that any treatment implemented on the site does not result in an alkaline environment. In situ passive treatment would be best suited to the site. Consequently, the following should be implemented on the site:

- To facilitate off-site disposal, all material for offsite disposal should be treated at a rate of 3kg/tonne, with the lime mixed well into the spoil. For small volumes of spoil and for ease of treatment and disposal, spoil can be contained and treated within skip bins. Verification testing should be undertaken to confirm the acid generating capacity of the spoil has been adequately neutralised prior to off-site disposal.
- If the soils are to be stockpiled on site for a period exceeding 2 weeks, further advice shall be sort from a competent ASS professional. Stockpiles shall be observed for obvious signs of oxidation, such as jarosite staining (an example is shown in image 1). Advice should be sort from an environmental professional if such staining or signs of oxidation are observed;

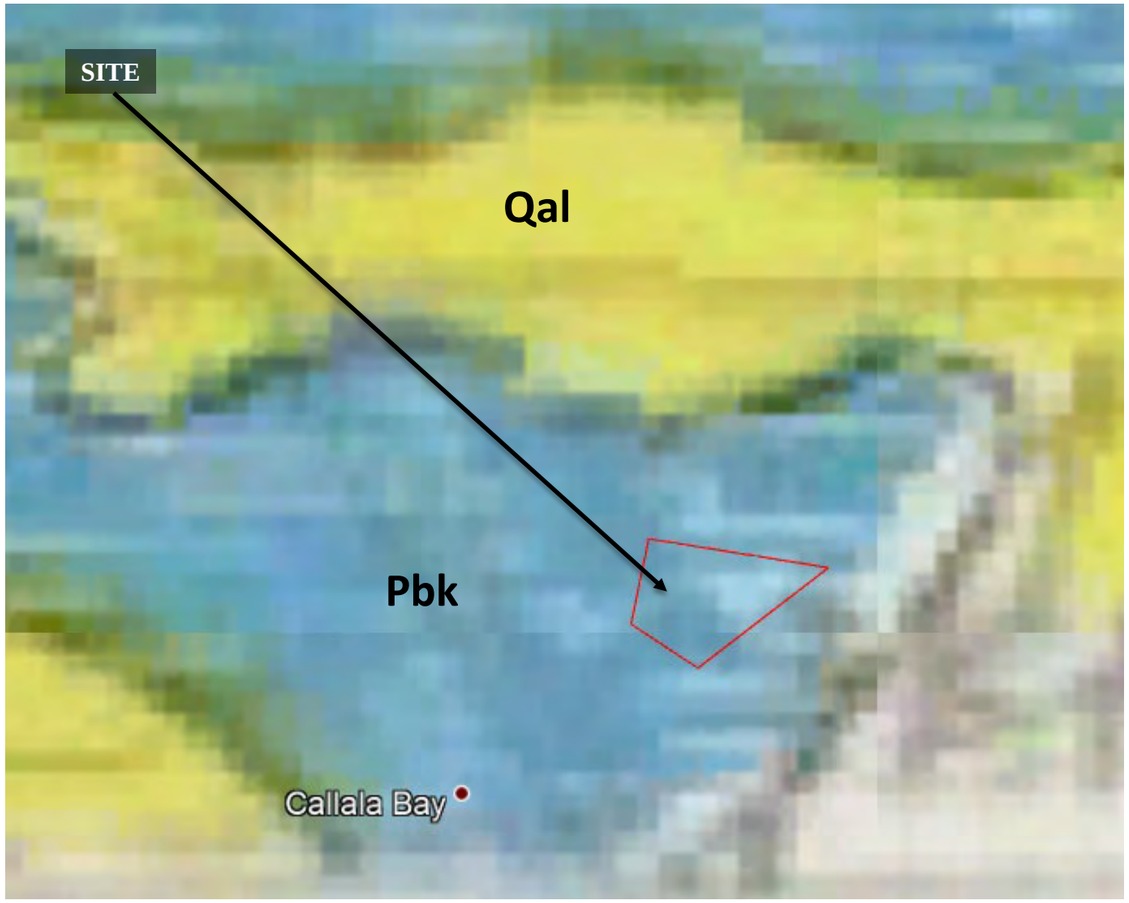
Image 1: Example of Jarosite staining

- Excavated soil that is to remain on the site shall be treated at a rate of 2kg/tonne.
- Materials excavated for service trenches etc, should be replaced within 48 hours.
- The sides and bases of excavations should be treated with lime (sprinkled across the exposed faces). In the case of the sedimentation basin, the sides should be lined with clay soils with a neutral pH or alternatively, they could be lined with a layer of crushed concrete.

4.2 Waste minimisation

Waste materials will be generated because of site earthworks. To minimise the costs associated with construction (including off-site disposal of excavated materials), it is preferable to minimise the disturbance of the in-situ soils and/or re-use these materials where possible. Footings which minimise the need for deep excavations, such as screw piers, are best suited to the site.

Figures



Wollongong 1:250,000 geological map

Site Geology

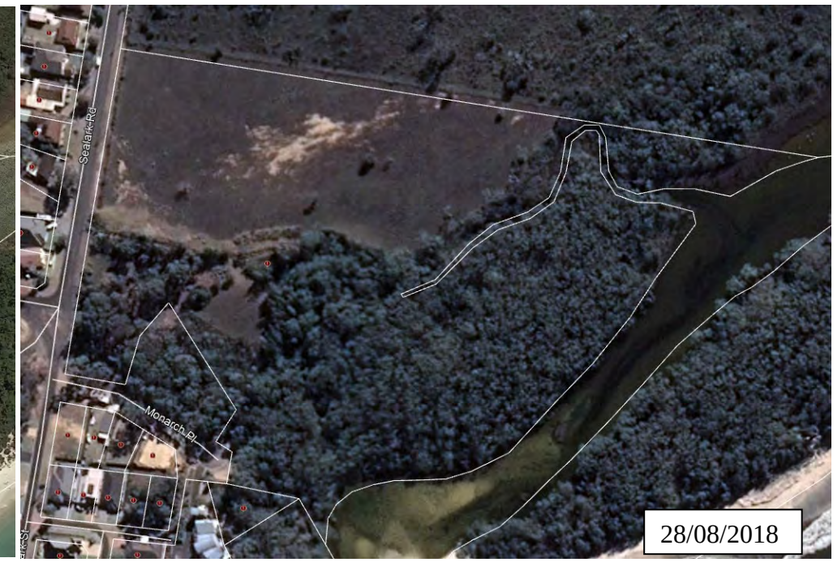
Symbol	Group	Sub-group	Unit	Lithology
Qal	-	-	-	Alluvium, gravel, sand, silt and clay
Psw	Shoalhaven Group	Undifferented	Wandrawandian Siltstone	Siltstone, silty sandstone, pebbly in parts

Site Location

revision	description	drawn	approved	date
	Site location	HJP	KEG	17/08/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
title:	**Site Location**
scale	NTS
original size	**A3**
project no:	**TERRA19258**
figure no:	**FIGURE 1**

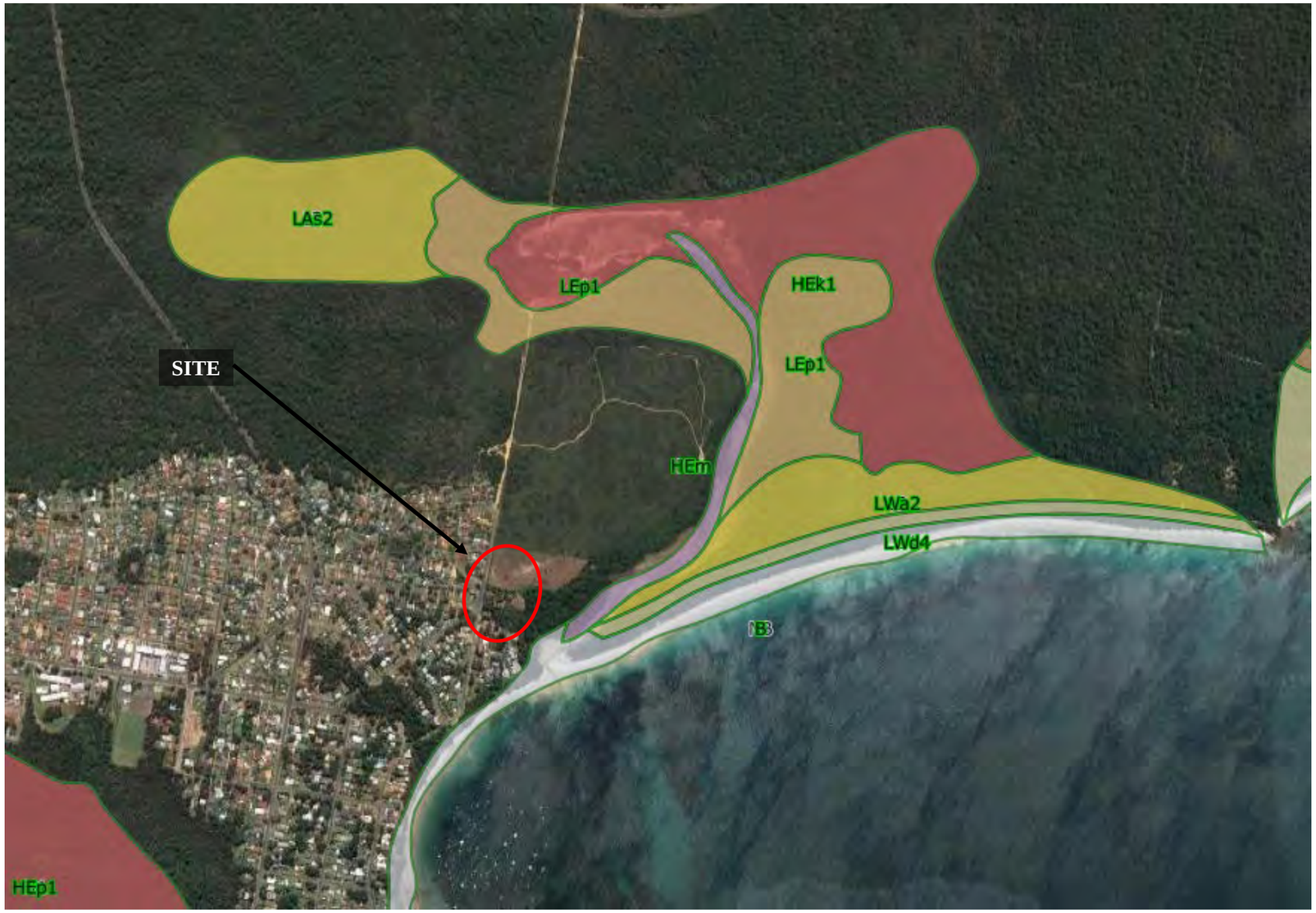


Historical Imagery

description	drawn	approved	date
Aerial images	HJP	KEG	25/07/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
scale	NTS
title:	**Historical Imagery**
original size	**A3**
project no: **TERRA19258**	figure no: **FIGURE 2**



Legend

- Hm: High probability, bottom sediments
- H0: High probability at/near ground surface
- H1: High probability <1 m below ground surface
- H2: High probability 1 - 3 m below ground surface
- H4: High probability >3 m below ground surface
- Lm: Low probability, bottom sediments
- L0: Low probability, at/near ground surface
- L1: Low probability, <1 m below ground surface
- L2: Low probability, 1 - 3 m below ground surface
- L4: Low probability, >3 m below ground surface
- N: No known occurrence
- NB: No known occurrence, beach
- X2: Disturbed terrain
- X4: Disturbed terrain

Landform Process Class		Landform Element				Elevation*	
W	Aeolian	b	Backplain	t	Levee toe	0	0-1 m
A	Alluvium	k	Backswamp	o	Ox-bow	1	1-2 m
B	Beach	m	Bottom sediments	p	Plain	2	2-4 m
E	Estuarine	n	Channel	a	Sandplain	4	>4 m
L	Lacustrine	d	Dune	s	Swamp	Additional Descriptive Codes	
S	Swamp	r	Interbarrier swamp	y	Splay	(p)	Pleistocene
		i	Intertidal flat	u	Supratidal flat	(s)	Acidic scald
		g	Lagoon	w	Swale		
X	Disturbed Terrain*	l	Levee	c	Tidal creek		

*Elevation levels given on the map refer to the elevation of the ground surface at the time of mapping. Depending on the nature of the disturbance, these elevation levels may or may not represent the original ground surface elevation.

*Approximate AHD

ASS Mapping (eSPADE v2.0)

revision	description	drawn	approved	date
	Aerial images	HJP	KEG	25/07/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
scale	NTS
title:	**ASS Mapping Excerpt**
original size	**A3**
project no:	**TERRA19258**
figure no:	**FIGURE 4**

N

Legend

Test site

Test Site Locations

revision	description	drawn	approved	date
	Aerial images	HJP	KEG	25/07/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**		
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**		
scale	NTS	title:	**Test Site Locations**
original size	**A3**	project no: **TERRA19258**	figure no: **FIGURE 4**

Appendix A: Your Report

TERRA INSIGHT

Your Report

These notes have been prepared to help you understand the advice provided in Your Report and its limitations.

Your Report is based on what you tell us

Your Report has been developed based on the information you have provided such as the scope and size of your project. It applies only to the site investigated. If there are changes to the proposed works, then the advice provided within Your Report may need to be reviewed

Your Report is written with your needs in mind

The advice provided within Your Report is also not relevant to another purpose other than that originally specified at the time the report was issued. Please seek advice from Terra Insight before you share Your Report with another third party – except for the purpose for which the report was written.

Terra Insight assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in Your Report.

Your Report is based on what we observed

The advice provided within Your Report assumes that the site conditions, revealed through selective point sampling (undertaken in accordance with normal practices and standards) at a particular point in time, are indicative of the actual conditions on your site. However, the nature of the materials underlying your site is affected by natural processes and the activity of man. Under no circumstances can it be considered that these findings represent the actual state at all points. The subsurface conditions may vary significantly on the other parts of the site, particularly where no nearby sampling and testing work has been carried out.

As a result conditions on your site can change with time; they can also vary spatially. As a result, the actual conditions encountered may differ from those detailed within Your Report. Although nothing can be done to change the actual site conditions which exist, steps can be taken to gain a better understanding of the subsurface conditions underlying your site and reduce the potential for unexpected conditions to be encountered

The advice within Your Report also relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it. Only Terra Insight is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If the details of your project have changed, the site conditions have changed or a significant amount of time as elapsed since our report was written, the advice provided within Your Report may need to be reviewed.

Your Report has been written by a Professional

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

Your Report is better when it is kept together

Your Report presents all the findings of the site assessment and should not be copied in part or altered in any way. Keeping Your Report intact reduces the potential for yourself or other design professionals to misinterpret the report.

Your Geo-Environmental Report

If Your Report is for geotechnical purposes only, it will not relate any findings, conclusions, or recommendations about the potential for hazardous materials to exist at the site unless you have specifically asked us to do so. If your report is written for Geo-Environmental purposes the following should be noted in addition to the above:

- Advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in Your Report should be verified if you propose to use this report more than 6 months after its date of issue;
- Your Report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. The assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, which includes budget and timing;
- The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice. Any interpretation in Your Report is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment.
- We may have relied on data and other information provided by you and other qualified individuals in preparing Your Report. We have not verified the accuracy or completeness of such data or information except as otherwise stated in Your Report. For these reasons Your Report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.
- For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination posed in the context of the agreed purpose. If the proposed use of the site changes, the assessment may no longer be valid and will need to be reviewed.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Appendix B: Proposed site development

Surveyed bangalee sand forest Zone

Ref: Dimitir Young Report 10 March 2006

NSW National Park Boundary

15M APZ-BAL-FLAME ZONE

20 M build

20M BUFFER ZONE

25m APZ - BAL: FLAME ZONE

7m APZ-BAL-40

BAL 29 setback 10 Metres

895 m² Lot 8

550 m² Lot 7

561 m² Lot 9

532 m² Lot 10

502 m² Lot 11

610 m² Lot 12

611 m² Lot 6

605 m² Lot 5

605 m² Lot 4

620 m² Lot 3

536 m² Lot 2

632 m² Lot 1

15M APZ

7M

20 M Road Reserve 6 M laneway

Land allocated to Re-direct Flooding to Detention Pond

Stormwater Detention Pond

SCC Road Reserve

1,800m² Lot 13 Medium Density

Public Path

12 Metres

245 m²

SCC Public Reserve

Lot 1 528 m²

PT 15-B 505m² DP 1002772

Lot 5 500m²

Lot 4 530 m²

Monarch Place

SUPERB CR

DP

GH

Sealark Road

Lot 18 Subdivision + natural features, Bush fire + EEC setbacks
Concept Layout PLAN-Option A Scale:1:750

Dwg Issue:	Revision Notes:	Date Issued:

General Notes:
1. COPYRIGHT: The drawings & design remain the property & copyright of the architect. Reproduction of any drawing,the design and/or any design element may only occur with the architect's written permission
2. DIMENSIONS: Written dimensions take precedence, do not scale drawings. Double check all dimensions on site and prior to construction. Verify any discrepancies with the project architect prior to proceeding with any work.

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PO Box 323 Gerringong 2534 Fax: 423 40 341
Email: patrick@prmarchitects.com.au
www.PRMArchitects.com.au

Client	Hare Bay Development Group
Project	Proposed Lot 18 Sealark Rd. Callala Bay
Drawing:	Subdivison Concept PLAN A
Sheet	1/1
Issue:	SD01 A
Drawn: PRM	Check:
Issue Date:	25 Feb 2016
Scale	1:750
Job No	

Appendix C: Site Images

Photograph 1: View of northern portion of the site looking south-west towards Sealark Road from proposed lot 9

Photograph 2: View of northern portion of site looking east from around lot 9. Creek is located along and east of tree line.

Photograph 3: View of northern portion of site, looking west towards Sealark Road from around Lot 9.

Photograph 4: View of northern portion of site, looking north-west towards Sealark Road from round lot 9.

revision	description	drawn	approved	date
	Plate1	HJP	KEG	16/08/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
scale	NTS
Title	**Images of the site**
original size	**A3**
project no:	**TERRA19258**
Plate no:	**1**

Photograph 5: View of northern portion of site, looking north from around lot 9

Photograph 6: View of south-western portion of the site, looking north towards the creek from lot 13

Photograph 7: View of south-western part of the site, looking north west from lot 13. A creek is visible amongst the bushes towards the centre of the image.

Photograph 8: View of south-western portion of site looking north towards the creek

revision	description	drawn	approved	date
	Plate2	XJ	KEG	16/08/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
scale	NTS
Title	**Images of the site**
original size	**A3**
project no:	**TERRA19258**
Plate no:	**2**

Photograph 9: South-western portion of the site, looking north east.

Photograph 10: South-western portion of the Site looking south east towards the detention basin.

Photograph 11: South-western portion of the site south from lot 13 towards Monarch Place.

Photograph 12: South-western portion of the site, looking south-west towards Monarch Place.

revision	description	drawn	approved	date
	Plate3	XJ	KEG	16/08/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
scale	NTS
Title	**Images of the site**
original size	**A3**
project no:	**TERRA19258**
Plate no:	**3**

Photograph 12: Slight clearing to the north east of creek.

Photograph 13: Minor rubbish found on the surface, within the south-western corner of the site (plastic, glass bottles, tin cans).

Photograph 14: View of site south-western part of the site looking west along Monarch Place.

Photograph 15: View of south-western corner of the looking east along Monarch Place.

revision	description	drawn	approved	date
	Plate4	XJ	KEG	16/08/2019

TERRA INSIGHT

client:	**PRM Architects & Town Planners**
project:	**Geotechnical Investigation No. 5 Sealark Road Callala Bay NSW**
scale	NTS
Title	**Images of the site**
original size	**A3**
project no:	**TERRA19258**
Plate no:	**4**

Photograph 16: Residual to extremely weathered material encountered at 1.5m depth typically found in test locations across the site.

Photograph 17: Residual to extremely weathered material encountered at 1.5m depth typically found in test locations across the site.

revision	description	drawn	approved	date
	Plate5	XJ	KEG	16/08/2019

TERRA INSIGHT

scale	NTS	Title	**Images of the site**
original size	**A3**	project no: **TERRA19258**	Plate no:**5**

client: **PRM Architects & Town Planners**

project: **Geotechnical Investigation**
No. 5 Sealark Road
Callala Bay NSW

Appendix D: Engineering logs

TERRA INSIGHT

How to interpret the engineering logs in Your Report

FIELD DECRIPTIONS OF SOILS

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)				USC	PRIMARY NAME
COARSE GRAINED SOILS More than 65% of materials less than 63 mm is larger than 0.075 mm	GRAVELS More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	GRAVEL
			Predominantly one size or a range of sizes with more intermediate sizes missing.	GP	GRAVEL
		GRAVELS WITH FINES Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	GM	SILTY GRAVEL
			Plastic fines (for identification procedures see CL below)	GC	CLAYEY GRAVEL
	SANDS More than half of coarse fraction is smaller than 2.36 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes	SW	SAND
			Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	SAND
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	SM	SILTY SAND
			Plastic fines (for identification procedures see CL below).	SC	CLAYEY SAND

FINE GRAINED SOILS More than 35% of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm (Note a 75Um particle is about the smallest particle that is visible to the naked eye.)				
		DRY STRENGTH	DILATANCY	TOUGHNESS	USC	PRIMARY NAME
	SILTS & CLAYS Liquid limit less than 50	None to Low	Quick to slow	None	ML	SILT
		Medium to High	None	Medium	CL	CLAY
		Low to medium	Slow to very slow	Low	CL	ORGANIC SILT
	SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium	MH	SILT
		High	None	High	CH	CLAY
		Medium to High	None	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC	Readily identified by colour, odour, spongy feel and frequently by fibrous texture by fibrous texture.				PT	PEAT

● Low plasticity – Liquid Limit w_L less than 35%. ● Medium plasticity – w_L between 35% and 50%. ● High plasticity – w_L greater than 50%.

Particle size descriptive terms

NAME	SUBDIVISION	SIZE
Boulders Cobbles		>200 mm 63 mm to 200 mm
Gravel	coarse medium fine	20 mm to 63 mm 6 mm to 20 mm 2.36 mm to 6 mm
Sand	coarse medium fine	600 µm to 2.36 mm 200 µm to 600 µm 75 µm to 200 µm

Minor components

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

TERRA INSIGHT

How to interpret the engineering logs in Your Report

Moisture condition

TERM	DEFINITION
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

Soil structure

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

Consistency of cohesive soils

TERM	UNDRAINED STRENGTH s_u (kPa)	VISUAL OBSERVATION IN FIELD
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 – 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 – 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 – 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 – 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

Density of granular soils

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 – 35
Medium Dense	35 – 65
Dense	65 – 85
Very Dense	Greater than 85

Geological origin

TRANSPORTED SOILS

Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TERRA INSIGHT

How to interpret the engineering logs in Your Report

FIELD DESCRIPTIONS OF ROCK

The descriptive terms used by Terra Insight are given below. They are broadly consistent with Australian Standard AS1726-1993.

Rock Substance — **In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.**

Defect — **Discontinuity or break in the continuity of a substance or substances.**

Mass — **Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.**

Classification of weathering products

Term	Abbreviation	Definition
Residual Soil	RS	Soil derived from the weatherinç rock; the mass structure and substance fabric are no longer evident; there is a large change volume but the soil has not beer significantly transported.
Extremely Weathered Material	XW	Material is weathered to such ar extent that it has soil properties, it either disintegrates or can be remoulded in water. Original roc fabric still visible.
Highly Weathered Rock	HW	Rock strength is changed by weathering. The whole of the rc substance is discoloured, usuall iron staining or bleaching to the extent that the colour of the orig rock is not recognisable. Some minerals are decomposed to cla minerals. Porosity may be increa by leaching or may be decrease due to the deposition of mineral pores.
Moderately Weathered Rock	MW	The whole of the rock substance discoloured, usually by iron stair or bleaching , to the extent that colour of the fresh rock is no lon recognisable.
Slightly Weathered Rock	SW	Rock substance affected by weathering to the extent that pa staining or partial discolouration the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rc is recognisable; strength proper are essentially those of the fresh rock substance.
Fresh Rock	FR	Rock substance unaffected by weathering.

Notes on Weathering:

AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.

Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

Rock substance strength terms

Term	Abbreviation	UCS (MPa)	Point Load Index, $I_{s(50)}$ (MPa)	Field Guide
Very Low	**VL**	<2	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	6 to 20	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	20 to 60	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	60 to 200	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	>200	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index Is(50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

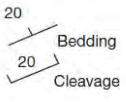
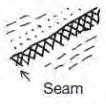
SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

TERRA INSIGHT

How to interpret the engineering logs in Your Report

Common defects observed in rock

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.

Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Veneer	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

TERRA INSIGHT

Borehole No.
BH01
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA19258

Client:	PRM Architectects and Town Planners	Commenced:	22/07/2019
Project Name:	Geotechinal Investigation	Completed:	22/07/2019
Hole Location:	No. 5 Sealark Rd Callala Bay	Logged By:	XJ
Hole Position:	292540.0 m E 6125380.8 m N MGA94 Zone 56	Checked By:	KG
Drill Model and Mounting:	1.8t excavator	Inclination: -90°	RL Surface: 4.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator: GF

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
						3.8	0.2		ML	Sandy SILT: Low plasticity, pale brown, fine sand, trace of angular and sub rounded gravel	D	L to MD		TOPSOIL
						3.6	0.4		CI-CH	Silty CLAY: medium to high plasticity, orange brown with red mottling, trace of rootlets	D to M	F		ALLUVIAL SOIL
				S1 0.50 m		3.4	0.6		CI-CH	Silty CLAY: medium to high plasticity, grey and red, with fine sand and trace of fine sub rounded gravel	D to M	F to St		RESIDUAL SOIL
				S2 1.00 m		3.0	1.0							
						2.8	1.2							
						2.6	1.4		CI	Sandy CLAY: medium plasticity, fine to medium sand, grey with red mottling	D to M	St		RESIDUAL SOIL to EXTREMELY WEATHERED MATERIAL
				S3 1.50 m		2.4	1.6			Hole Terminated at 1.50 m Target				
						2.2	1.8							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Borehole No.
BH02
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA19258

Client:	PRM Architectects and Town Planners	Commenced:	22/07/2019
Project Name:	Geotechinal Investigation	Completed:	22/07/2019
Hole Location:	No. 5 Sealark Rd Callala Bay	Logged By:	XJ
Hole Position:	292573.0 m E 6125415.0 m N MGA94 Zone 56	Checked By:	KG
Drill Model and Mounting:	1.8t excavator	Inclination: -90°	RL Surface: 4.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator: GF

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
						3.8	0.2		SP	Clayey Silty SAND: fine to medium sand, brown with rootlets.	D to M	L to MD		TOPSOIL
						3.6	0.4		ML-MH	Clayey SILT: low to medium plasticity, orange brown with fine sand	M to W	F		ALLUVIAL SOIL
				S1 0.50 m		3.4	0.6		CI-CH	Silty CLAY: medium to high plasticity, grey and red, trace of fine to medium sub rounded gravel	D to M	St		RESIDUAL SOIL
				S2 1.00 m		3.2	0.8							
						3.0	1.0							
						2.8	1.2							
						2.6	1.4							
				S3 1.50 m		2.4	1.6			Hole Terminated at 1.50 m Target				
						2.2	1.8							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Borehole No.
BH03
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA19258

Client:	PRM Architectects and Town Planners	Commenced:	22/07/2019
Project Name:	Geotechinal Investigation	Completed:	22/07/2019
Hole Location:	No. 5 Sealark Rd Callala Bay	Logged By:	XJ
Hole Position:	292619.0 m E 6125446.0 m N MGA94 Zone 56	Checked By:	KG
Drill Model and Mounting:	1.8t excavator	Inclination: -90°	RL Surface: 5.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator: GF

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description: Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
						4.8	0.2		ML	Sandy SILT: Low plasticity, pale brown, fine sand, trace of angular and sub rounded gravel	D to M	L to MD		TOPSOIL
									ML-MH	Clayey SILT: low to medium plasticity, orange brown with fine to medium sand	M	F		ALLUVIAL SOIL
				S1 0.50 m		4.6	0.4							
						4.4	0.6		CI-CH	Silty CLAY: medium to high plasticity, grey and red, with fine sand and trace of fine sub rounded gravel	D to M	F to St		RESIDUAL SOIL
						4.2	0.8							
				S2 1.00 m		4.0	1.0							
						3.8	1.2							
									CI-CH	Sandy CLAY: medium plasticity, fine to medium sand, grey with red mottling	D to M	St		RESIDUAL SOIL to EXTREMELY WEATHERED MATERIAL
				S3 1.50 m		3.6	1.4							
						3.4	1.6			Hole Terminated at 1.50 m Target				
						3.2	1.8							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Borehole No.
BH04
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA19258

Client:	PRM Architectects and Town Planners	Commenced:	22/07/2019
Project Name:	Geotechinal Investigation	Completed:	22/07/2019
Hole Location:	No. 5 Sealark Rd Callala Bay	Logged By:	XJ
Hole Position:	292545.0 m E 6125317.0 m N MGA94 Zone 56	Checked By:	KG
Drill Model and Mounting:	1.8t excavator	Inclination: -90°	RL Surface: 5.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator: GF

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
						4.8	0.2		SP	Silty SAND: fine to medium sand, pale brown	D	L to MD		TOPSOIL
						4.6	0.4		ML-MH	Clayey SILT: low to medium plasticity, yellow brown, with roots and fine to medium sand	M	F		ALLUVIAL SOIL
				S1 0.50 m		4.4	0.6							
						4.2	0.8		CI-CH	Silty CLAY: medium to high plasticity, grey and red, greyer with depth, with fine sand	D to M	F to St		RESIDUAL SOIL
				S2 1.00 m		4.0	1.0							
						3.8	1.2		CI-CH	Silty CLAY: medium to high plasticity, greyish white with orange mottling	D to M	St		RESIDUAL SOIL to EXTREMELY WEATHERED MATERIAL
				S3 1.50 m		3.6	1.4							
						3.4	1.6			Hole Terminated at 1.50 m Target				
						3.2	1.8							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

Appendix E: ASS Laboratory Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EW1903111**	Page	: 1 of 5
Client	: **TERRA INSIGHT**	Laboratory	: Environmental Division NSW South Coast
Contact	: MS KAREN GATES	Contact	: Aneta Prosaroski
Address	: PO BOX 414 UNANDERRA NSW 2526	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ----	Telephone	: +61 2 4225 3125
Project	: 5 Sealark Rd Callala Bay - TERRA19258	Date Samples Received	: 22-Jul-2019 14:03
Order number	:	Date Analysis Commenced	: 26-Jul-2019
C-O-C number	: ----	Issue Date	: 26-Jul-2019 17:14
Sampler	: KAREN GATES		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 13		
No. of samples analysed	: 13		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
~ = Indicates an estimated value.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH01 0.5	BH01 1.0	BH01 1.5	BH02 0.5	BH02 1.0
			Client sampling date / time	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00
Compound	CAS Number	LOR	Unit	EW1903111-001	EW1903111-002	EW1903111-003	EW1903111-004	EW1903111-005
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**4.7**	**4.9**	**4.9**	**4.5**	**4.3**
pH (Fox)	----	0.1	pH Unit	**3.6**	**3.8**	**4.0**	**3.6**	**3.7**
Reaction Rate	----	1	-	**2**	**2**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH02 1.5	BH03 0.5	BH03 1.0	BH03 1.5	BH04 0.5
			Client sampling date / time	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00
Compound	CAS Number	LOR	Unit	EW1903111-006	EW1903111-007	EW1903111-008	EW1903111-009	EW1903111-010
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**4.3**	**4.6**	**4.7**	**4.8**	**4.7**
pH (Fox)	----	0.1	pH Unit	**3.6**	**3.5**	**3.8**	**3.9**	**3.5**
Reaction Rate	----	1	-	**2**	**3**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH04 1.0	BH04 1.5	BH05 0-0.3	----	----
			Client sampling date / time	22-Jul-2019 00:00	22-Jul-2019 00:00	22-Jul-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	EW1903111-011	EW1903111-012	EW1903111-013	--------	--------
				Result	Result	Result	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**4.5**	**4.7**	**4.2**	**----**	**----**
pH (Fox)	----	0.1	pH Unit	**3.4**	**3.5**	**3.0**	**----**	**----**
Reaction Rate	----	1	-	**2**	**2**	**3**	**----**	**----**