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Acid Sulfate Soil Investigation for Proposed Swimming Pool at 1/41 Belongil Crescent, Byron Bay.

ASCT Register: H23-3750

Prepared for Ben Goad

11-May-2023

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Table of Contents

1.0 Introduction & Understanding

As commissioned Australian Soil and Concrete Testing (ASCT) has undertaken the Acid Sulfate Soil (ASS) investigation, at the project site.

The work has been executed under the guidance provided within:

National Acid Sulfate Soils Sampling and Identification Methods Manual (NASS SIMM), and

National Acid Sulfate Soils Identification and Laboratory Methods Manual (NASS ILMM).

This report presents the results & findings of that ASS investigation.

2.0 Desktop Assessment

A desktop assessment was undertaken to determine the likelihood of ASS materials being present at the site. This assessment included a review of available ASS risk mapping, aerial photography, topographic mapping, geological mapping and ASCT experience.

A summary of the desktop assessment findings is provided in Table 1, below.

Table 1: Desktop Findings.

Element	Reference	Desktop Finding
ASS Risk Mapping	Byron Shire Council	Class 3
Photography	Google Earth	Old Dunes
Topography	Google Earth	<10m AHD
Geological	NSW – Tweed Heads 1:250k	Qx- Coastal and Estuarine Plain
ASCT Experience	H19-1251	ASS not likely

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3.0 Site Inspection

With knowledge of the desktop assessment findings, a site inspection was conducted. The site inspection provided further ASS/PASS indicators as listed in Table 2, below.

Table 2: Site Inspection Indicators.

Characteristic	Indicators (if any)	Inspection Result
Soil	Dark grey silty sands. Sulphurous smell.	Grey Sand Observed
Water	Iron staining of surface drainage.	Not Observed
Vegetation	Salt/acid tolerant vegetation (paperbarks).	Not Observed
Infrastructure	Corrosion of concrete pipe outlets.	Not Observed

4.0 Soil Sampling, Field Testing and Collection

4.1 Soil Sampling

One (1) borehole was drilled in the proposed swimming pool location at the site, on 27th April 2023.

A figure, showing the location of the boreholes, is included in Appendix A.

Starting from the existing ground surface, soil samples were representatively collected within vertical intervals not exceeding 0.25m. Where soil layers less than 0.25m in thickness were encountered, additional samples were collected to ensure that at least one sample represents each layer encountered.

All collected samples were handled, transported and stored to preserve their condition.

4.2 Field Testing

All field samples (above) were tested for *field pH* (pH_F) and *field pH peroxide* (pH_{FOX}) in accordance with the *National acid sulfate soils sampling and identification methods manual: Appendix A*.

The results of field testing are contained within the attached Borelogs/Lab Reports, provided in Appendix B.

4.3 Collection

The NASS SIM document, clause 6.7.4, defines the proposed site works as a 'Small-scale disturbance'.

As such, a limited number of samples were collected based on their likelihood to have the highest potential of an acidity hazard. These samples were collected from the 'pool' of field samples (obtained under section 4.1, above).

The resultant soil sample collection was detailed in a *Chain of Custody* (CoC) and forwarded to the laboratory for quantitative analysis.

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5.0 Laboratory Analysis

The collection of soil samples (detailed above) were submitted to the Environmental Analysis Laboratory (EAL, Lismore).

The sample collection was submitted with a request for analysis of:

- Moisture Content,
- Potential Sulfidic Acidity by chromium reducible sulfur (CRS),
- Actual Acidity by Titratable Actual Acidity (TAA),
- Net acidity, and
- Liming rate.

A summary of the Laboratory Results is provided in Table 3, below.

A complete copy of the laboratory report is included in Appendix C.

Table 3: Summary of Laboratory Results.

Field Sample Number	**1**
Sample Source (Borehole)	BH1
Depth (m)	1.0m
Material Description (Texture)	Coarse
Potential Sulfidic Acidity (mole H^+/tonne)	0
Actual Acidity (mole H^+/tonne)	0
Retained Acidity (mole H^+/tonne)	-
Net Acidity (mole H^+/tonne)	0
NASS ILMM Action Criteria[1] (mole H^+/tonne)	18
ASS Management Plan Triggered	No
Liming Rate (kg $CaCO_3$/tonne DW[2])	NA

[1] Action criteria taken from the *National Acid Sulfate Soils Identification and Laboratory Methods Manual* (NASS ILMM) Table 1.1, based on less than 1000 tonnes of soil to be disturbed and dependent on soil texture.

[2] DW denotes Dry Weight.

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6.0 Conclusion

The laboratory analysis indicates that none of the soil materials has triggered the NASS ILMM action criteria based on their Net Acidity. As such, these soil materials are:

- **Non ASS** (NASS: Non acid sulfate soils).

These soils materials do not pose an environmental hazard.

The laboratory results indicate mild actual acidity. This acidity may be the result of previously oxidised ASS soil or soluble aluminium and iron from other acid forming coastal processes. Soils with actual acidity are common in coastal areas of eastern Australia and based on the data available the soils investigated would be classed as "acidic" rather than "acid sulfate". Liming of naturally acidic ecosystems, leading to un-naturally alkaline environments, can result in ecological damage to the acidophilic organisms that relied on the acidic nature of those ecosystems.

We have taken every care to be to accurate, complete & objective in the execution of your commission. Should you have any queries, or require further assistance, please do not hesitate to contact our office. This report is your intellectual property, and we will not provide it to any 3rd party without your permission. May we also respectfully request that if you provide this report to others (e.g.: Designer): you provide it in its' entirety, to avoid any miscommunication.

Yours faithfully,
Australian Soil & Concrete Testing Pty Ltd

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Limitations

This report relies on information supplied by the client and the results of investigations conducted in accordance with accepted practices and standards. The report is intended to represent a reasonable interpretation of the appropriate legislation and the condition of the site at the time of the investigation. However, due to these elements being subject to change over time the report under no circumstances can be considered to represent the definitive state of the site at all times.

This site investigation report ("The Report") has been prepared in accordance with the commission set out in the contract or quote, or as otherwise agreed between the Customer and Australian Soil & Concrete Testing (ASCT). The commission may be limited by a range of factors such as time, cost, accessibility or site constraints and conditions.
In preparing the report, ASCT has relied upon information provided, surveys, analyses, designs, plans and other documentation provided by the customer or other individuals and organisations, most of which are referred to in preparing the report. Except as otherwise stated in the report, ASCT has not verified the accuracy or completeness of the information provided to the extent that the statements, opinions, facts, information, conclusions and recommendations in the report are based in whole or in part on the information provided. The recommendations and conclusions are contingent upon the accuracy and completeness of the information provided. ASCT will not be liable in relation to incorrect conclusions should any provided information or site condition be incorrect or have been concealed, withheld, mis-represented or otherwise not fully disclosed to ASCT.

Geotechnical site classification is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. This report was prepared expressly for the Customer and expressly for the purposes indicated. Use by any other persons for any purpose or by the customer for a different purpose, may result in problems which ASCT cannot be responsible for. The Customer should not use this report for other than its intended purpose without seeking additional geotechnical advice.

This geotechnical report is based on a subsurface investigation which only identifies the conditions at the locations and time when the investigation was undertaken.

The *Limitations of Geotechnical Site Investigation* in making an assessment of a site from a limited number of boreholes or test pits is the possibility that actual conditions may vary from those identified at the investigation locations. The Site investigation identifies specific subsurface conditions only at those points from which samples have been taken. The investigation programme undertaken is used to provide a general profile of the subsurface condition. The information obtained from the site investigation and subsequent laboratory testing is used to form a presumed opinion regarding the overall subsurface conditions and their likely behaviour. The borehole logs are the subjective interpretation of the limited site investigation and cannot always be definitive.

A geotechnical report is based on conditions which existed at the time of site investigation. The subsurface conditions may change due to natural forces or man-made influences. Civil works at or adjacent to the site and natural events such as floods or groundwater fluctuations may also affect subsurface conditions and the relevance of the geotechnical report.

The geotechnical report may be misinterpreted by other design professionals. ASCT should be retained to explain relevant geotechnical findings and to review the adequacy of plans and specifications and the implications to the report. The geotechnical report should be maintained as a whole and should not be copied, divided or altered.

It is recommended that ASCT should be retained through the construction stage to confirm the actual subsurface conditions are consistent with the geotechnical report. If variations are encountered additional tests may be required to confirm conditions comply with the design specifications and advise on changes to the construction if required.

The geotechnical report has been prepared for the benefit of the customer and no other party. ASCT assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusion expressed in the report. ASCT will not be responsible for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusion expressed in the report (including, without limitation, matters arising from any negligent act or omission of ASCT or any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy and completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

ASCT will not be liable to update or revise the report to take into account any events of emergent circumstances or facts occurring or becoming apparent after the date of the report.

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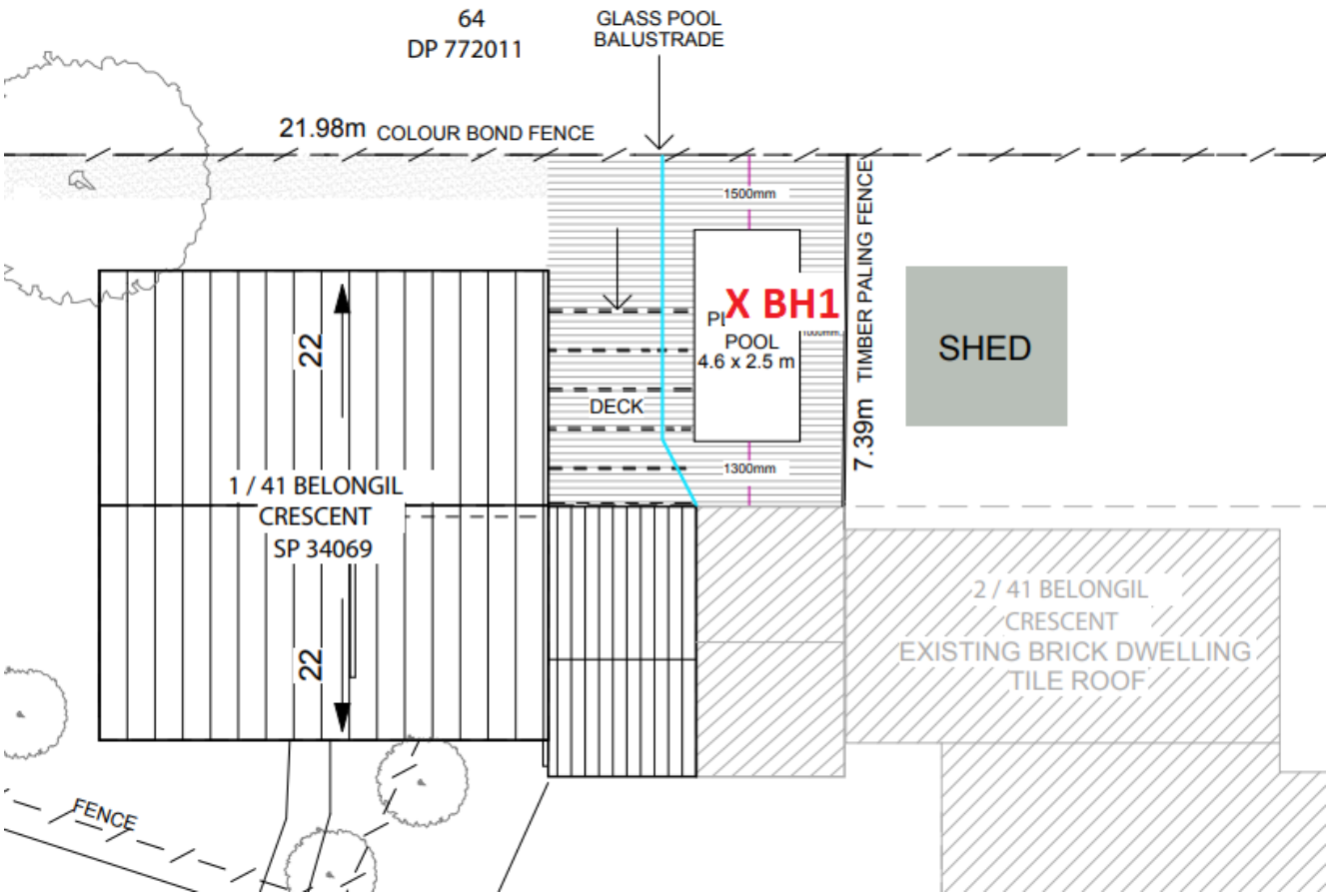
APPENDIX A – Borehole Locations



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APPENDIX B – Borehole Logs / Field Reports

ASS TEST HOLE LOG - BH 1

Client:	Ben Goad	**ASCT Ref No:**	H23-3750
Project:	Street# 1/41 , Belongil Crescent, Byron Bay	**Sample Date:**	27/05/2023
Latitude/Longitude:	Name	**Sample Team:**	Jake Vincent
Surface Elevation:	Exisiting Surface, Australian Height Datum (AHD) =	**Sample Equipment:**	Spiral auger
Watertable Depth:	NA	**Sample Method:**	Push tube
Lab Testing:	Denotes samples submitted to Lab for quantitative testing.		

Depth	Symbol	Texture	Soil Description	pH	pH	pH	Reaction
m		NSM-3.1	Australian Soil and Land Survey Field Handbook	F	FOX	Δ	
0.00-0.25	**S**	**Coarse**	Silty Sand	6.9	5.4	1.5	Medium
0.25-0.50	**S**	**Coarse**	Sand	6.9	5.4	1.5	Medium
0.50-0.75	**S**	**Coarse**	Sand	6.9	4.3	2.6	Medium
0.75-1.00	**S**	**Coarse**	Sand	6.9	4.3	2.6	Medium
1.00-1.25	**S**	**Coarse**	Sand	6.3	5.2	1.1	Medium
1.25-1.50	**S**	**Coarse**	Sand	6.3	5.2	1.1	Medium
1.50-1.75	**S**	**Coarse**	Sand				
1.75-2.00							
2.00-2.25							
2.25-2.50							
2.50-2.75							
2.75-3.00							

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APPENDIX C – Laboratory Reports

RESULTS OF ACID SULFATE SOIL ANALYSIS

1 sample supplied by Australian Soil & Concrete Testing on 1/05/2023. Lab Job No. P0182.
Analysis requested by Zar Harper. Your Job: H23-3750.

17 DeHavilland Crescent BALLINA NSW 2478

											Non-treated soil		Non-treated soil	
Sample Identification	**EAL Lab Code**	**Texture**	**Moisture Content**		**Potential Sulfidic Acidity** (Chromium Reducible Sulfur - CRS)			**Actual Acidity** (Titratable Actual Acidity - TAA)	**Retained Acidity**		**Acid Neutralising Capacity** (ANC_{BT})		**Net Acidity**	**Lime Calculation**
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	(% S_{Cr})	(mol H^+/t)	pH_{KCl}	(mol H^+/t)	(%S_{RAS})	(mol H^+/t)	(% $CaCO_3$)	(mol H^+/t)	(mol H^+/t)	(kg $CaCO_3$/t DW)
Method Info.		**	**		*(in-house method S20)*			*(in-house method 16b)*	**		*(in-house method S14)*		**	**
H23-3750 1m	*P0182/1*	Coarse	6.4	0.07	<0.005	0	6.76	0	..	..	0.08	16	0	0

NOTES:

1. All analysis is reported on a dry weight (DW) basis, unless wet weight (WW) is specified.
2. Samples are dried and ground immediately upon arrival (unless supplied dried and ground).
3. Analytical procedures are sourced from Sullivan L, Ward N, Toppler N and Lancaster G. 2018. National acid sulfate soils guidance: national acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0.
4. The Acid Base Accounting Equation, where Acid Neutralising Capacity has not been corroborated by other data, is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity (Eq. 3.2; Sullivan et al. 2018 - full reference above).
5. The Acid Base Accounting Equation for post-limed soil materials is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity - (post treatment Acid Neutralising Capacity - initial Acid Neutralising Capacity) (Eq. 3.3; Sullivan et al. 2018 - full reference above).
   While the Acid Neutralising Capacity of a soil material may not be included in the Net Acidity calculation (Note 4), it must be measured to give an Initial Acid Neutralising Capacity if verification testing is planned post-liming.
   The Inital Acid Neutralising Capacity must be provided by the client to enable EAL to produce Verification Net Acidity and Liming calculations for post-limed soil materials.
6. The Acid Base Accounting Equation, where Acid Neutralising Capacity has been corroborated by other data, is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity - Acid Neutralising Capacity (Eq. 3.1; Sullivan et al. 2018 - full reference above).
7. The lime calculation includes a Safety Factor of 1.5 as a safety margin for acid neutralisation (Sullivan et al. 2018). This is only applied to positive values. An increased Safety Factor may be required in some cases.
8. Retained Acidity is required when the pHKCl < 4.5 or where jarosite has been visually observed.
9. A negative Net Acidity result indicates an excess acid neutralising capacity.
10. If insufficient mixing occurs during intial sampling, or during post-liming, or both: the Potential Sulfidic Acidity may be greater in the post-limed sample than in the intial sample; the post-liming Acid Neutralising Capacity may be lower in the post-limed sample than in the intial sample.
11. **An acid sulfate soil management plan is triggered by Net Acidity results greater than the texture dependent criterion: coarse texture ≥ 0.03% S or 18 mol H+/t; medium texture ≥ 0.06% S or 36 mol H+/t; fine texture ≥ 0.1% S or 62 mol H+/t) (Table 1.1; Sullivan et al. 2018 - full reference above)**
12. For projects that disturb > 1000 t of soil material, the coarse trigger of ≥ 0.03% S or ≥ 18 mol H+/t must be applied in accordance with Sullivan et al. (2018) (full reference above).
13. Acid sulfate soil texture triggers can be related to NCST (2009) textures: coarse and peats = sands to loamy sands; medium = clayey sand to light clays; fine = light medium to heavy clays (Sullivan et al. 2018 - full reference above).
14. Bulk density is required to convert liming rates to soil volume based results. Field bulk density rings can be submitted to EAL for bulk density determination.
15. A negative Net Acidity result indicates an excess acid neutralising capacity.
16. '..' is reported where a test is either not requested or not required. Where pHKCl is < 4.5 or > 6.5, zero is reported for SNAS and ANC in Net Acidity calculations, respectively.
17. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.
18. ** NATA accreditation does not cover the performance of this service.
19. Analysis conducted between sample arrival date and reporting date.
20. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal/t&cs or on request).
21. Results relate to the samples tested.
22. This report was issued on 4/05/2023.

NATA
Accredited for compliance with ISO/IEC 17025 - Testing

checked: .....
Graham Lancaster
Laboratory Manager

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