ENVIRONMENT & NATURAL RESOURCE SOLUTIONS
25 River Road SHOALHAVEN HEADS NSW 2535
TEL/FAX 9037 4708 Mobile: 0401 518 443
ABN 68 600 154 596
www.enrs.com.au

COMMON SEAL
ENRS PTY LTD
ABN: 68 600 154 596

Samantha Walsh
Shoalhaven City Council
Shoalhaven Heads, NSW 2535

18th July 2019
Project No: ENRS0627

M: 0447 963 211 E: samantha.walsh@shoalhaven.nsw.gov.au

SUBJECT: POTENTIAL ACID SULFATE SOIL ASSESSMENT (PASSA)
RIVER ROAD FORESHORE, SHOALHAVEN HEADS, NSW 2535

INTRODUCTION

Environment & Natural Resource Solutions (ENRS Pty Ltd) were commissioned as independent environmental consultants in June 2019 by the *Shoalhaven City Council* (the Client) to conduct site investigations and prepare a Potential Acid Sulfate Soil Assessment (PASSA) in anticipation of excavations for rehabilitation and construction works along the Shoalhaven River foreshore alongside River Road, Shoalhaven Heads 2535 (herein referred to as the site).

This letter report provides certification of soil conditions based on the results of test pit investigations and field observations. The investigation was conducted in general accordance with the NSW Acid Sulfate Soils Management Advisory Committee (ASSMAC;1998) guidelines, and with consideration of the NSW RTA (2005) Guidelines for the Management of Acid Sulfate Materials, and where appropriate the WA Department of Environment and Conservation (DEC;2013) guidelines for Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes.

SCOPE OF WORK

The scope of work for this PASSA included the review, assessment and reporting of site data under the following tasks:

- Soil test pit inspections and logging within footprint of proposed works area;
- Screening of soil for potential acid sulfate soil indicators using field indicators and preliminary laboratory analysis; and
- Make recommendations based on findings of field observations.

BACKGROUND - ACID SULFATE SOIL (ASS)

Acid Sulfate Soils (ASS) are the common name given to sediments and soils containing iron sulfides (usually pyrite), which when oxidised, release sulfuric acid which can have direct toxic effects and also indirect effects through increased metal availability (e.g. iron and aluminium precipitation) and reduced nutrient availability. ASS are typically located in low-lying coastal regions including mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

Table 1: ASS Definitions

Potential Acid Sulfate Soils (PASS)
Soils which contain iron sulfides or sulfidic material which have NOT been exposed to air and oxidised. The field pH of these soils in their undisturbed state is ***pH 4 or more*** and may be neutral or slightly alkaline. However, they pose a considerable environmental risk when disturbed, as they will become severely acid when exposed to air and oxidised.
Actual acid sulfate soils (AASS)
Soils containing highly acidic soil horizons or layers resulting from the aeration of soil materials that are rich in iron sulfides, primarily sulfide. This oxidation produces hydrogen ions in excess of the sediment's capacity to neutralise the acidity resulting in soils of ***pH of 4 or less*** when measured in dry season conditions. These soils can usually be identified by the presence of ***pale yellow*** mottles and coatings of jarosite.

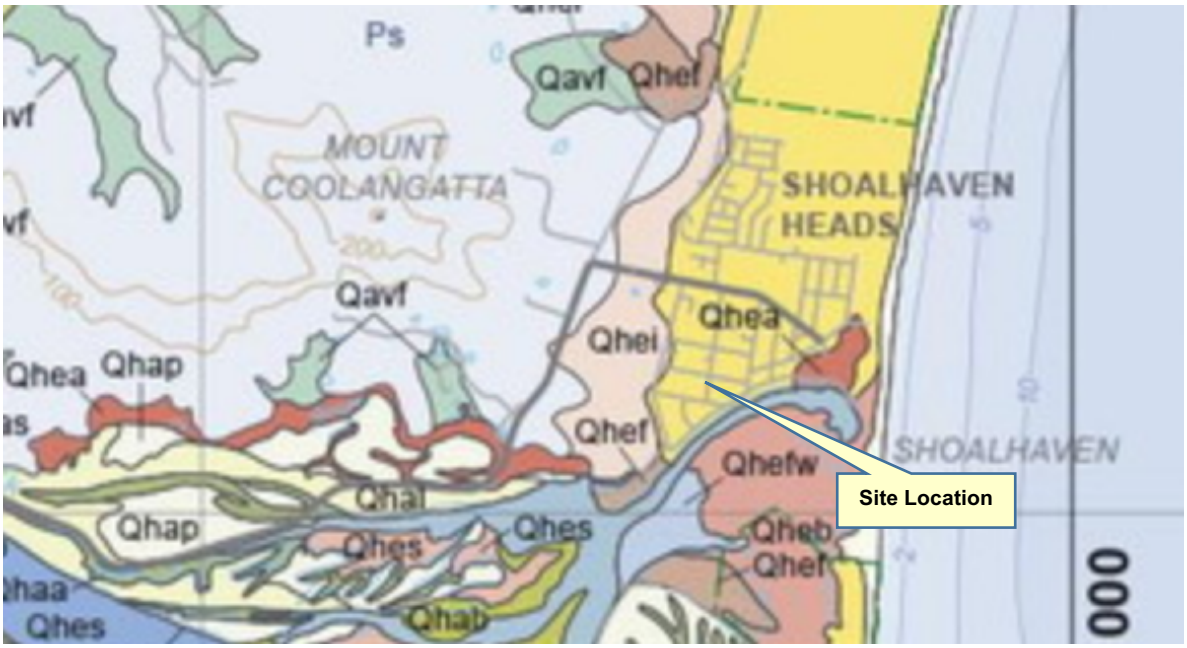
ASS is commonly managed during excavation works by ***neutralisation*** where alkaline materials (Lime) are physically incorporated into the soil. Sufficient neutralising agent(s) needs to be used to ensure that there is the capacity to neutralise all existing acidity that may be present and all potential acidity that could be generated from complete oxidation of the sulfides over time.

The preferred agent for treating ASS is Agricultural Lime (Aglime) as $CaCO_3$. However, there can be difficulties in effectively mixing fine Aglime with wet, lumpy, clayey or cohesive sediments. Alternatively liquid lime may be applied or similar alkaline material.

GEOLOGY

A review of the geological setting was conducted with reference to the Nowra 1:25,000 Coastal Quaternary Geology Sheet as shown in **Figure 1**. The Site area is situated in an area mapped as Holocene beach ridge and associated strandplain (Qhbr - yellow) described as marine sand, shell and gravel.

Figure 1 Site Geology and Soil Landscape

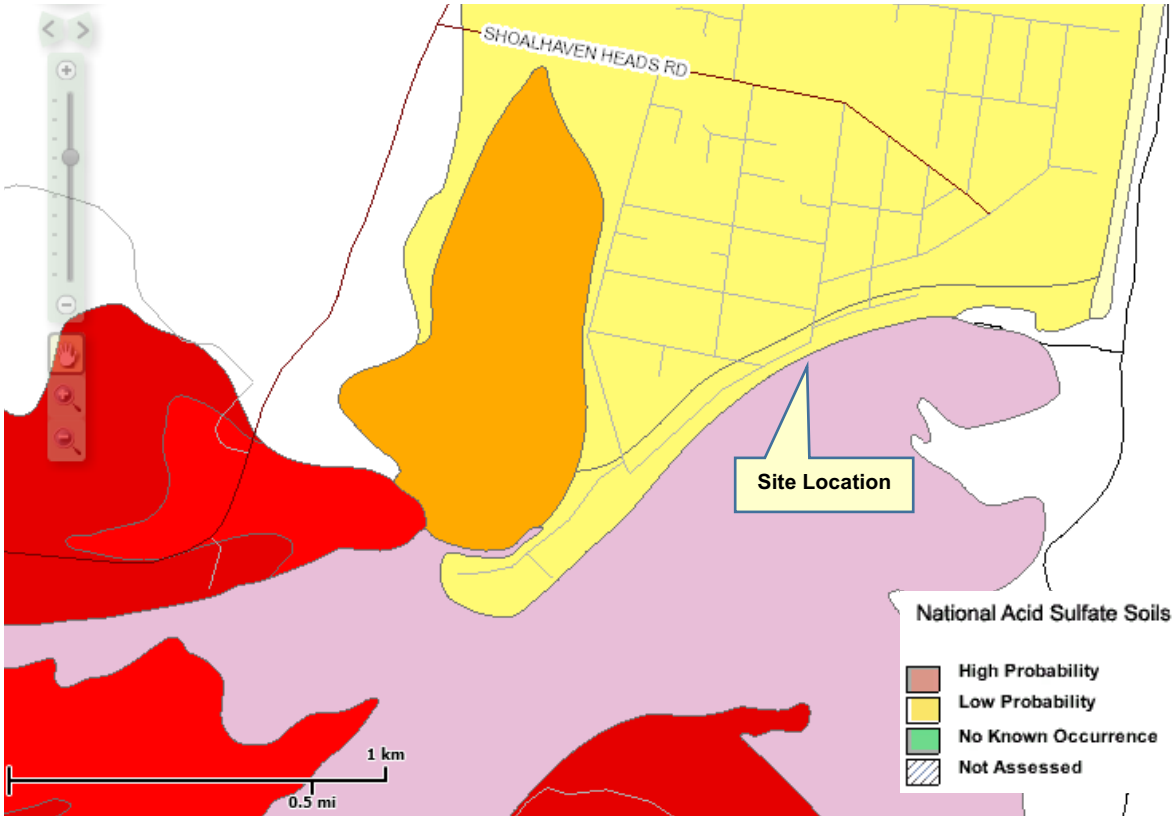


https://search.geoscience.nsw.gov.au/product/1786. Sited 18/07/2019

RISK MAPS

A pre-commencement assessment was conducted for Potential Acid Sulfate Soil (PASS) with reference to the online Acid Sulfate Soil Risk maps. The site is noted to be in the 'yellow' area mapped as '***Low probability of occurrence between 2 and 4 metres below ground*** surface', refer to **Figure 2**.

Figure 2 ASS Risk Map



https://data.nsw.gov.au/data/dataset/acid-sulfate-soils-risk0196c. Sited 18/07/2019

FIELD INDICATORS

Field indicators of potential (PASS) and actual (AASS) ASS should be applied by the Site Environment Officer and project personnel to identify ASS conditions. A summary of field indicators is outlined in **Table 2**.

Table 2: ASS Field Indicators

TYPE	FIELD INDICATORS
Acid Sulfate Soils (ASS)	dominance of mangroves, reeds, rushes and other marine/estuarine or swamp-tolerant vegetation.
	low lying areas, back swamps or scalded/bare areas in coastal estuaries and floodplains.
	sulfurous smell after rain following a dry spell or when the soils are disturbed.
Actual Acid Sulfate Soil (AASS)	**Soil characteristics**
	field **pH ≤ 4** in soils.
	presence of **shell.**
	any jarositic horizons or substantial **iron oxide mottling** in auger holes, in surface encrustations or in any material dredged or excavated and left exposed. Jarosite is a characteristic **pale yellow** mineral deposits which can be precipitate as pore fillings and coatings on fissures. In the situation of a fluctuating watertable, jarosite may be found along cracks and root channels in the soil. However, jarosite is not always found in actual acid sulfate soils.
	Water characteristics
	water of pH < 5.5 in adjacent streams, drains, groundwater or ponding on the surface.
	unusually clear or milky blue-green drain water flowing from or within the area (aluminium released by the acid sulfate soils acts as a flocculating agent.).
	extensive iron stains on any drain or pond surfaces, or iron-stained water and ochre deposits.
Potential Acid Sulfate Soils (PASS)	**Soil characteristics**
	waterlogged soils - unripe muds (soft, buttery, blue grey or dark greenish grey) or **estuarine** silty sands or sands (mid to dark grey) or bottom sediments of estuaries or tidal lakes (dark grey to black).
	presence of **shell**.
	soil pH usually neutral but may be acid - positive Peroxide Test.
	Water Characteristics
	water pH usually neutral (6-8) but may be acid.

FIELD INVESTIGATION

ENRS conducted soil investigations in test pits on the 28th of June and 1st of July 2019 within the proposed excavation footprint (**Figure 3**) in accordance with industry standards. Soil logging identified coarse marine sands to the maximum investigation depth of 1.5 metres below ground level (mbgl). No silty jarosite or oxide staining was observed in the loose sediments. No visual or olfactory evidence of ASS conditions was noted. Field screening of excavated material was conducted with three (3) samples from each borehole tested at depths of 0.5m, 1.0m and 1.5m below ground level. All samples reported oxidised pH values greater than pH4. Borehole logs identifying soil conditions and field screening results are presented in **Attachment 2**. Samples were not submitted for further laboratory testing as the Site was deemed to present a very low to negligible risk for potential acid sulfate soil.

RECCOMENDATIONS

Based on the findings of field observations compared against field indicators and mapped PASS/ASS soils it was determined that the soil to be excavated as part of the proposed works is likely to present a very low to negligible risk for potential acid sulfate soil.

ENRS note that although *Shoalhaven City Council* identified a maximum excavation depth of 2.5m below ground level, boreholes were terminated at 1.5m due to the homogenous ground conditions observed which corresponded with the Site geology identified in **Figure 1**. ENRS recommend that the findings of this PASSA be considered representative of ground conditions likely to be encountered during the proposed works within the Site.

If during excavation works different subsurface conditions are encountered to those documented in this report the soil should be re-assessed against the criteria detailed in **Table 2** by a person suitably qualified to do so.

Should the reader have any queries regarding this letter report, please do not hesitate to contact ENRS on 0401 518 443 for further information or assistance.

Yours sincerely,

Rohan Last (BSc, MSc)
Hydrogeologist & Environmental Scientist
SafeWork NSW Asbestos Assessor (LA000166)
e rohan@enrs.com.au **t** 02 9037 4708 **m** 0401 518 443

Christopher Allen
Environmental Scientist & Consultant
Asbestos Competent Person (CPCCBC5014A)
e chris@enrs.com.au **t** 02 9037 4708 **m** 0478 725 692

Figure 3 - Site Plan

ENRS
Environment & Natural Resource Solutions
108 Jerry Bailey Road, Shoalhaven Heads, NSW, 2535
Tel: 02 4448 5490 Fax: 02 90374708 projects@enrs.com.au
www.enrs.com.au

Client:	**Shoalhaven City Council**	Drawn:	**CA**	Figure:	**3**
Project:	**ENRS0627**	Source:	**SixMaps**	Date:	**19/07/2019**
Location:	**Shoalhaven River Foreshore, Shoalhaven Heads**	Scale:	**Scale Bar**	Title:	**Site Plan**
		Status:	**Rev 1**		

Attachment 1:

Photograhic Record of Subsurface Conditions

Photograph 1: Borehole #1 Soil profile

Photograph 2: Borehole #2 Soil profile

Photograph 3: Borehole #3 Soil profile

Attachment 2:

Borehole Logs

ENVIRONMENT & NATURAL RESOURCE SOLUTIONS
www.enrs.com.au ABN 58 015 337 499
25 RIVER ROAD
SHOALHAVEN HEADS NSW 2535
t/f: 02 9037 4708 m: 0401 518 443

ENVIRONMENTAL TESTPIT INVESTIGATION LOG

Borehole Number: 1

PROJECT No:	ENRS0627	**DATE:**	28/01/2019
LOCATION:	Shoalhaven Heads (River) Foreshore	**LOGGED BY:**	CA
CLIENT:	Shoalhaven City Council	**EXCAVATED BY:**	ENRS
SURFACE RL:	-	**METHOD:**	Hand Auger
EASTING:	293328	**WIDTH:**	0.05m
NORTHING:	6140634	**DEPTH:**	1.5m

Depth Metres	Description	Sample ID (ASS)	Sample ID (Chem)	PID Reading (ppm)	pH (field)	pH (FOX)
0.00						
0.10						
0.20						
0.30						
0.40						
0.50	0 - 1.5m: Coarse marine sand. No visual or olfactory evidence of ASS conditions were noted.	BH01/1.0	N/A	N/A	7.84	6.34
0.60						
0.70						
0.80						
0.90						
1.00		BH01/0.5	N/A	N/A	8.41	6.71
1.10						
1.20						
1.30						
1.40						
1.50	BH terminated after required depth reached.	BH01/1.5	N/A	N/A	8.08	6.74
1.60						
1.70						
1.80						
1.90						
2.00						
2.10						
2.20						
2.30						
2.40						
2.50						
2.60						
2.70						
2.80						
2.90						
3.00						

Notes:
Descriptions are based on observations and hand testing of grab samples.
Mechanical Tests were not performed unless otherwise stated

ENVIRONMENT & NATURAL RESOURCE SOLUTIONS
www.enrs.com.au ABN 58 015 337 499
25 RIVER ROAD
SHOALHAVEN HEADS NSW 2535
t/f: 02 9037 4708 m: 0401 518 443

ENVIRONMENTAL TESTPIT INVESTIGATION LOG

Borehole Number: 2

PROJECT No:	ENRS0627	**DATE:**	28/01/2019
LOCATION:	Shoalhaven Heads (River) Foreshore	**LOGGED BY:**	CA
CLIENT:	Shoalhaven City Council	**EXCAVATED BY:**	ENRS
SURFACE RL:	-	**METHOD:**	Hand Auger
EASTING:	293405	**WIDTH:**	0.1m
NORTHING:	6140686	**DEPTH:**	1.5m

Depth Metres	Description	Sample ID (ASS)	Sample ID (Chem)	PID Reading (ppm)	pH (field)	pH (FOX)
0.00						
0.10						
0.20						
0.30						
0.40						
0.50		BH01/1.0	N/A	N/A	8.58	6.42
0.60						
0.70	0 - 1.5m: Coarse marine sand. No visual or olfactory evidence of ASS conditions were noted.					
0.80						
0.90						
1.00		BH01/0.5	N/A	N/A	7.69	6.42
1.10						
1.20						
1.30						
1.40						
1.50		BH01/1.5	N/A	N/A	7.92	6.49
1.60	BH terminated as required depth reached					
1.70						
1.80						
1.90						
2.00						
2.10						
2.20						
2.30						
2.40						
2.50						
2.60						
2.70						
2.80						
2.90						
3.00						

Notes:
Descriptions are based on observations and hand testing of grab samples.
Mechanical Tests were not performed unless otherwise stated

ENVIRONMENT & NATURAL RESOURCE SOLUTIONS
www.enrs.com.au ABN 58 015 337 499
25 RIVER ROAD
SHOALHAVEN HEADS NSW 2535
t/f: 02 9037 4708 m: 0401 518 443

ENVIRONMENTAL TESTPIT INVESTIGATION LOG

Borehole Number: 3

PROJECT No:	ENRS0627	**DATE:**	28/01/2019
LOCATION:	Shoalhaven Heads (River) Foreshore	**LOGGED BY:**	CA
CLIENT:	Shoalhaven City Council	**EXCAVATED BY:**	ENRS
SURFACE RL:	-	**METHOD:**	Hand Auger
EASTING:	293476	**WIDTH:**	0.1m
NORTHING:	6140722	**DEPTH:**	1.5m

Depth Metres	Description	Sample ID (ASS)	Sample ID (Chem)	PID Reading (ppm)	pH (field)	pH (FOX)
0.00						
0.10						
0.20						
0.30						
0.40						
0.50	0 - 1.5m: Coarse marine sand. No visual or olfactory evidence of ASS conditions were noted.	BH01/1.0	N/A	N/A	8.07	6.77
0.60						
0.70						
0.80						
0.90						
1.00		BH01/0.5	N/A	N/A	8.52	6.85
1.10						
1.20						
1.30						
1.40						
1.50	BH terminated as required depth reached.	BH01/1.5	N/A	N/A	8.39	6.82
1.60						
1.70						
1.80						
1.90						
2.00						
2.10						
2.20						
2.30						
2.40						
2.50						
2.60						
2.70						
2.80						
2.90						
3.00						

Notes:
Descriptions are based on observations and hand testing of grab samples.
Mechanical Tests were not performed unless otherwise stated