ACID SULFATE SOIL MANAGEMENT PLAN

University of Newcastle Gosford Campus, 305 Mann Street Gosford

20232408.004

22 May 2023

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University of Newcastle Gosford Campus, 305 Mann Street Gosford

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1 INTRODUCTION

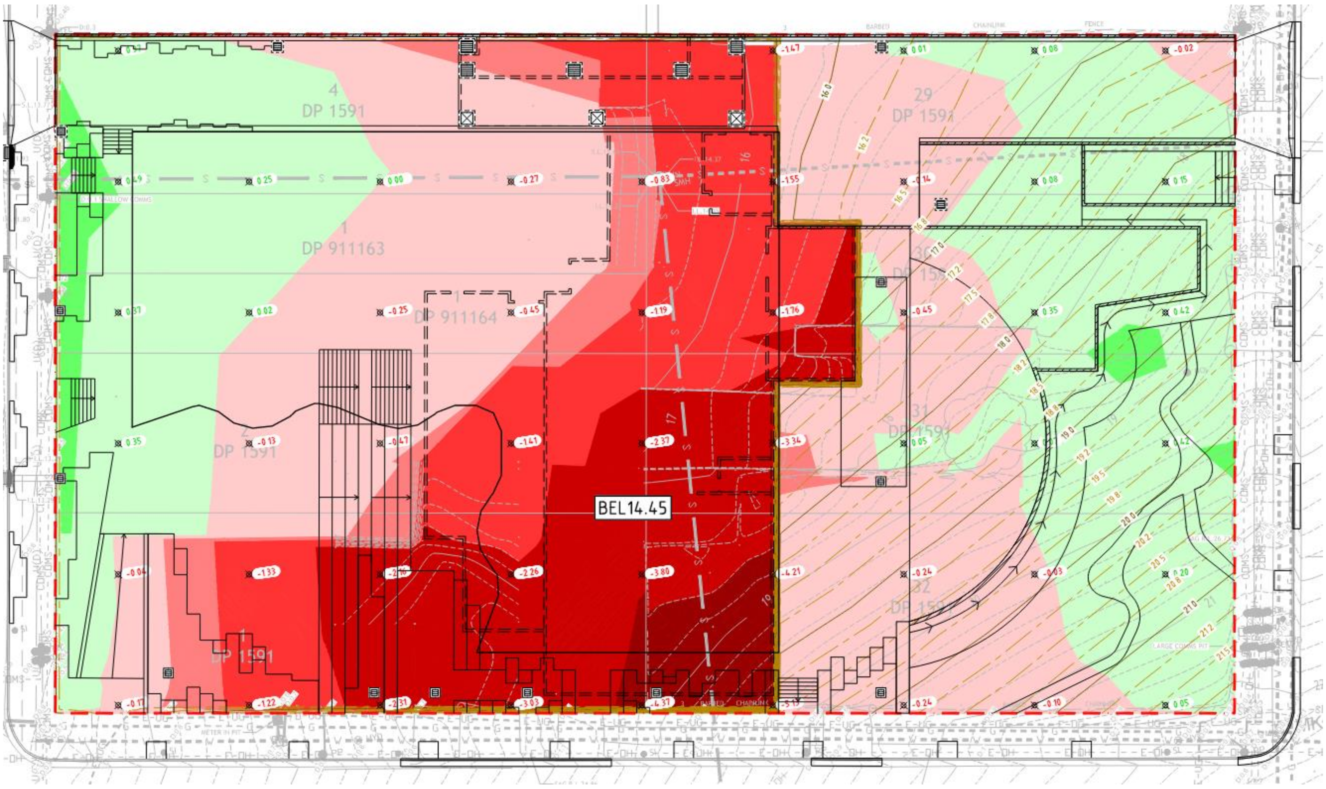
Kleinfelder Australia Pty Ltd (Kleinfelder) was commissioned by The University of Newcastle (UoN) to prepare an Acid Sulfate Soil Management Plan (ASSMP) at 305 Mann Street, Gosford (herein referred to as the 'Site'). The Site layout is presented in **Figure 1, Appendix A.**

It is understood that UoN is seeking to redevelop the Site into the Central Coast Campus of the University of Newcastle. Consent is sought for the proposal as a State Significant Development (SSD-47749715). This plan will guide the excavation and disposal of surplus soil at the site and help ensure it is undertaken in an environmentally responsible manner and follows all applicable guidance.

1.1 PROPOSED DEVELOPMENT

Kleinfelder understands that the proposed structure comprises a four-storey educational establishment building on the western portion of the site, retail, on-site parking, and publicly accessible open space along the western, southern, and eastern parts of the site. The building is to have an underground carpark level and therefore significant excavation of soils will be required, along with the construction of retaining walls. The proposed earthworks plan is shown in

Figure 1-1 below:



Surface Analysis: Elevation Ranges				
Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	Volume (m3)
1		-6.000	-4.000	38.8
2		-4.000	-2.000	691.8
3		-2.000	-1.000	925.9
4		-1.000	-0.500	678.4
5		-0.500	0.000	1084.8
6		0.000	0.500	349.4
7		0.500	1.000	3.2
8		1.000	1.500	0.0

Figure 1-1: Proposed Earthworks Plan

Anticipated earthworks volumes are cut 3,420m^3 and fill 353m^3, with a balance of 3067m^3. It is anticipated that this surplus material will have to be removed from site.

1.2 BACKGROUND

Previous investigations undertaken have identified indicators of acidic soils within the proposed civil excavation footprint within the Development Area exceeding NSW Acid Sulfate Soil Assessment Guidelines 1998 ('ASSMAC') minimum 'action criteria' threshold. Earthworks in areas where exceedances of ASSMAC action criteria are verified require the preparation of an Acid Sulfate Soil Management Plan ('ASSMP').

The University of Newcastle has submitted a State Significant Development (SSD-47749715) application for the expansion of its' Gosford campus situated at 305 Mann Street, Gosford. The following responses have been received in relation to ASS.

- DPE Water has requested that the proponent prepare an Acid Sulfate Soil Management Plan in accordance with the NSW Acid Sulfate Soil Manual, by including an acid sulphate soil and salinity monitoring plan.
- The EPA recommends the Department of Planning and Environment requests an update of the EIS to include a management plan for potential onsite acid sulfate soils.

This plan has been prepared in response to the above.

2 OBJECTIVES

The objective of this ASSMP is to consider both the existing and potential future environmental impacts relating to Acid Sulfate Soil (ASS) or Acidic Soil material in and around the Site, in the context of the proposed building construction, and to detail mitigation measures to minimise the potential impacts on the environment.

This ASSMP has been prepared for the proposed excavation at the Site, including the installation of the GPT and associated services.

The control measures outlined in this ASSMP are designed to mitigate the environmental impacts of the proposed excavations to anticipated levels and have been developed to be in general accordance with the ASSMAC Management guidelines (1998) and current best practice and achieve the following objectives:

- Control and, where possible, minimisation of disturbance of acidic and acid sulfate soils (if present).
- Confirmation of the success of control measures by the means of validation monitoring.
- Compliance with statutory requirements; and
- Preservation of water quality on an ongoing basis.

Each environmental protection measure is based upon methodologies from established industry practice.

2.1 Description of Acid Sulfate Soils

Acid Sulphate Soils (ASS) is the common name given to naturally occurring sediments and soils containing iron sulfides, the most common being pyrite. The exposure of sulfide in these soils to oxygen, by drainage or excavation, leads to the generation of sulfuric acid. The release of sulfuric acid from ASS often mobilises metals such as aluminium, iron, and magnesium and arsenic and phosphate, from otherwise stable soil matrices. Elevated concentrations of such elements in site runoff may result in changes which are potentially detrimental to receiving water bodies and associated aquatic organisms.

Most acid sulfate sediments were formed by natural processes during the Holocene geological period (the last 10,000 years), when formation conditions were optimum. Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of buffering reaction substances such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas and at the bottom of coastal rivers and lakes.

ASS which formed on coastal lowlands are generally found less than 2.5 to 3 m Above Sea Level (ASL), corresponding with the highest point of sea level rise following ice shelf melting during the mid-Holocene. The sea level has been dropping ever since due to isostatic adjustment of the lithosphere.

In an undisturbed and waterlogged state these soils are harmless, but when disturbed and/or exposed to oxygen through drainage, excavation or climate change, a process of oxidation can produce sulfuric acid in large quantities. In an undisturbed, unreacted state these soils are called Potential Acid Sulfate Soils (PASS). Once they are disturbed and start oxidising, they are called Actual Acid Sulfate Soils (AASS). Collectively, they are referred to as Acid Sulfate Soils (ASS).

Within some ASS terrains, it is not always easy to accurately predict or formally prove whether some soils with high titratable actual acidity (TAA) values were formed by the oxidation of sulfides. This may be attributed to a variety of reasons including age, landscape position, geochemical interactions or other soil-forming processes. These soils can include highly organic peats, heavily leached iron and aluminium rich tropical soils, and coffee rock horizons in coastal Podosols which may overlie or are adjacent to ASS. Some soils with sufficient organic content may become saturated and reducing during protracted wet periods, during which ferrous compounds may form, including iron-monosulfides if there is available sulfate for reduction. These compounds are metastable and react rapidly when the soil begins to dry out, and the subsequent oxidation can generate significant soil acidity.

It is a NSW regulatory requirement that all coastal soils less than 5m AHD, that are likely to be disturbed by excavation or water table draw-down, are assessed for their ASS properties. Where their presence is identified and disturbance intended, a management plan for minimising impacts should be developed, if ASS properties exceed trigger criteria.

2.1.1 Potential Impacts

Oxidation of PASS material can result in generation of Actual ASS. The generation of AASS can result in the release of sulfuric acid and iron into the soil and groundwater. Similarly, acidic soils or acid forming soils which have the potential to acidify further with oxidation, could result in a similar release though not conforming with typical ASS/PASS characteristics. This acidification, in turn, can release aluminium, nutrients, heavy metals and metalloids such as arsenic, stored within the soil matrix. Once mobilised in this way, the acid, metals and nutrients can seep into waterways, impact soil and groundwater quality and can affect flora and fauna and degrade concrete, steel pipes and structures to the point of failure.

This ASSMP has been developed to manage ASS/PASS/acidic soils/reactive acid producing soils at the Site and mitigate potential impacts resulting from the exposure of such soils during excavation for the building.

2.2 Guidelines

This ASSMP has been prepared in general accordance with the NSW ASSMAC Acid Sulfate Soils Management Guidelines (Ahern et al., 1998), and The National Acid Sulphate Soils Guidance, 'Guidance for the dewatering of acid sulphate spoils in shallow groundwater environments, June 2018, the National Strategy for the Management of Coastal ASS (2000) and Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines v4.0. The latter guidance was included due to its inclusion of non-ASS acidic soils.

2.3 Construction Site Management

This plan is a live document and is based upon the advised construction methodology, this plan shall be updated and maintained in line with any changes to the methodology assumed herein.

3 SITE CHARCTERISATION

3.1 Site Location

The Site is located at 305 Mann Street, Gosford 2308, approximately 90 km southwest of Newcastle. A summary of the Site details is outlined in **Table 3-1**.

Table 3-1: Site Details

Site Name	Former Mitre 10 Warehouse
Site Address	305 Mann Street, Gosford, NSW 2308
Current Title Identification	• Lots 1, 2, 4, 29, 30, 31 & 32. • Section 1 – DP 1591 • Lot 1 – DP 911163, DP 911164
Local Council	Central Coast Council
Site Zoning	B4 – Mixed Use
Site Owner	University of Newcastle
Current Site Use	Vacant commercial premises (most recent past operation as a Mitre 10 hardware store).
Proposed Site Use	UoN campus, consistent with current zoning (B4 Mixed Use).

3.2 Site Features

The Site covers an area of approximately 4675 m^2. Structures and features at the Site include a large warehouse (which housed the former Mitre 10 store) occupying the western portion, a central vegetated garden area and a concreted open car park that occupies the remainder of the Site.

The concreted open car park and central garden area slope toward the north-west and are in poor condition with several cracks and vegetation growing throughout.

3.3 Surrounding Land Use

Adjacent, surrounding land use comprises:

- **North** – Numerous commercial businesses are located northwards along Mann Street, zoned as Mixed Use (B4). Approximately 150 m north-east and 180 m north-west are residential properties, zoned as General Residential (R1). The Gosford Golf Club is located approximately 400 m north-west, within a Public Recreation (RE1) planning zone.
- **East** – Variable zoning including Mixed Use (B4), General Residential (R1) and Public Recreation (RE1) are present directly east. Further east is the Rumbalara Reserve located approximately 170 m from Site.
- **South** – Mixed Use (B4) zoning continues south of the Site for approximately 250 m, with Commercial Core (B3) zoning beyond. Hotel Gosford, Woolworths and Chemist Warehouse are all located along Mann Street within 500 m of the Site.
- **West** – A rail infrastructure facility, within an Infrastructure (SP2) planning zone, runs north-south approximately 50m west of the Site, adjacent to Showground Road. Central Coast Local Health District and Gosford Hospital are located 100m west of the Site, zoned as Infrastructure (SP2). South of the hospital is residential housing, zoned as General Residential (R1), with Gosford High Waterview Park located approximately 500 m south-west under Public Recreation (RE1) zoning.

3.4 CLIMATE, HYDROLOGY AND DRAINAGE

Typical landforms within the regional landscape are made up of undulating to rolling rises and low hills, with local relief of <60 m and slope gradients below 25%. The surface elevation on-site ranges from 15 m to 22 m Australian Height Datum (AHD).

It is considered that surface water from the Site during periods of rainfall would run off the concrete surfaces (including roof drainage) and enter stormwater drains adjacent to Mann St. Where concrete is not present i.e., in the central vegetated garden, rainfall would infiltrate the soil profile.

The nearest surface water bodies to the Site include:

- Brisbane Water – estuary system located approximately 1.1 km to the southwest.
- Narara Creek - located approximately 1 km northwest of the Site, flows in a south-westerly direction into Brisbane Water.

Monthly climate statistics from the Gosford (Narara Research Station) automatic weather station (AWS 061087) located approximately 5 km northwest of the Site, indicate the Site experiences warm summers to cold winters with an average maximum temperature of 23.0°C and an average minimum temperature of 11.1°C. The average annual rainfall is approximately 1,330 mm with the highest rainfall period between January and March and the lowest rainfall period from July to October.

3.5 GEOLOGY

The Soil Landscape Map of Gosford – Lake Macquarie (Soil Landscape Series Sheet 9131-9231, Scale 1:100,000, 1993), indicates that the Site is located within the Erina Landscape, which comprises undulating to rolling rises and low hills on the Terrigal Formation. Soils within this landscape are generally moderately deep to deep, commonly prone to waterlogging, mass movement and high erosion. These soils are also commonly highly acidic.

Geological mapping from https://minview.geoscience.nsw.gov.au (Se**e**

Figure 3-1 below) indicates that the Site soils comprise the Burralow Formation of the Gosford Sub-group which form part of the Narrabeen Group of Triassic age.

Figure 3-1: Geological Map

The Burralow Formation comprises fine-grained, micaceous, quartz to quartz-lithic sandstone; interbedded with siltstone, grey shale and red-brown claystone. The upper layers of the Burralow Formayion are likely to have weathered to a sandy Clay/clayey Sand.

Given that the Site has been previously developed it was considered likely that there would be some fill present.

3.6 Previous Investigations

Driller's logs from previous environmental investigations undertaken by Geotechnique during a Stage 2 Contamination Assessment in 2004, identified subsurface conditions at the Site to primarily consist of four lithological units:

- Surface Cover – concrete (underlain by gravel), pavers or imported gravel, ranging in thickness from near surface to approx. 0.35m below ground level (bgl).
- Fill – generally reworked silty clayey Sand, fine to medium grained with some gravels, ranging in depth from approx. 0.3m to 1.25m bgl.
- Topsoil (where fill is absent) –silty clayey Sand, fine to medium grained, dark brown, typically 0.2m to 0.4m thick below ground surface.
- Natural Soil – generally firm to stiff and stiff silty Clay, medium to high plasticity with occasional; layers of Medium dense clayey Sand, fine to medium grained, or encountered beneath the fill and/or topsoil layers at depths ranging from approx. 0.4m and 1.25m bgl and extending to the maximum depth of investigation of 3.0m m bgl.

Bedrock was not encountered.

Groundwater was not encountered in these previous investigations.

Kleinfelder undertook Contaminated Land and Geotechnical Investigations in October and November 2022. The subsurface profile encountered was generally consistent across the investigation locations.

- Surface cover comprised a shallow layer of concrete/asphalt where present, underlain by sandy clay / gravelly sand Fill material
- Very soft to soft and firm Silty / sandy Clay and bands of loose clayey Sand
- Stiff and very stiff silty Clay / Clay with trace sand medium to high plasticity
- Completely weathered clayey Sandstone / Siltstone (white to red, firm to stiff) with occasional small bands of ironstone bedrock
- Weathered very low or low strength Siltstone and Claystone with some bands of high strength Sandstone.
- Medium to high strength Sandstone, reddish brown with grey and yellow mottling, with occasional thin (0.1-0.5m) bands of low medium and high strength Siltstone and Claystone.

Groundwater was recorded at between 2.2 and 4.4 m bgl in boreholes and monitoring wells during the investigation period.

3.7 Acid Sulphate Soils

A review of the Acid Sulfate Soils (ASS) Map performed as part of the Enviro Screen report (LIR, 2022) obtained by Kleinfelder, identified the Site and land within its 500m buffer to be Class 5, meaning that "development consent is required for the carrying out of works within 500m of adjacent Class 1, 2, 3 or 4 land that is below 5m AHD and by which the water table is likely to be lowered below 1m AHD on adjacent Class 1, 2, 3 or 4 land".

Class 4 land is present within 500m of the site to the south-east; however, this land is at an elevation of above 16m AHD.

3.8 Hydrogeology

Groundwater water was encountered in all boreholes during drilling at the depths indicated in **Table 3-2** below.

Table 3-2: Groundwater Strikes During Drilling

Borehole	Depth Encountered (m bgl)	Standing Level after 5mins	Stratum of Groundwater Strike
BH1	4.0	No Rise	Silty Clay

Borehole	Depth Encountered (m bgl)	Standing Level after 5mins	Stratum of Groundwater Strike
BH2	3.9	2.9	Clay
BH3	2.3	No Rise	Clay
BH4	3.5	No Rise	Clay
BH5	3.5	No Rise	Clay
BH6	Not Encountered	-	-
BH7	5.9	No Rise	Weathered Siltstone
BH8	3.2	No Rise	Clay

A total of three groundwater monitoring wells were installed in BH1, BH7 and BH8 within the soft to firm and stiff to very stiff clay layers. At-rest groundwater levels were monitored on 23 November 2022 and are shown in Table 3-3 below:

Table 3-3: Groundwater Level Monitoring

Borehole	Depth of Well (m bgl)	Depth to Water (m bgl)
BH1	6.55	4.44
BH7	6.81	3.23
BH8	6.98	2.24

Groundwater is known to fluctuate due to local and regional factors including, but not limited to, irrigation, precipitation events, site topography, seasonal changes, well pumping, and periods of wet or dry weather. Therefore, subsurface water conditions at other times may be different from those described in this report.

4 PREVIOUS INVESTIGATIONS FOR ASS

An ASS investigation, comprising eight boreholes, was undertaken on the Site by Kleinfelder in October and November 2022 and identified the presence of acidic soils. A summary of the SPOCAS test results is shown in **Table 4-2** on the subsequent page. Soils were also tested for Sulphate, Electrical Conductivity, Chloride and pH, results are shown in **Table 4-1** below.

Table 4-1: Aggressivity Test Results

Analyte			Inorganics			
			Sulphate	Chloride	Electrical Conductivity @ 25°C	pH
LOR			10	10	1.0	0.1
Units			mg/kg	mg/kg	µS/cm	pH units
Sample Name	Sample Date	Start Depth (m)				
BH1_1.0	19-Oct-22	1.0	**40**	< 10	**30**	**5.3**
BH1_3.0	19-Oct-22	3.0	**10**	< 10	**17**	**5.4**
BH2_1.0	18-Oct-22	1.0	< 10	< 10	**19**	**7.6**
BH2_3.0	18-Oct-22	3.0	**40**	< 10	**32**	**5.1**
BH3_1.0	19-Oct-22	1.0	**90**	< 10	**58**	**4.8**
BH3_2.5	19-Oct-22	2.5	**30**	< 10	**30**	**5.0**
BH4_1.0	17-Oct-22	1.0	< 10	< 10	**93**	**8.3**
BH4_3.0	17-Oct-22	3.0	**20**	< 10	**21**	**5.7**
BH5_1.0	17-Oct-22	1.0	-	-	**67**	**6.9**
BH5_1.9	17-Oct-22	1.9	**40**	< 10	**35**	**4.9**
BH5_2.0	17-Oct-22	2.0	**20**	< 10	**23**	**5.4**
BH6_1.0	21-Oct-22	1.0	**50**	< 10	**42**	**4.9**
BH6_4.0	21-Oct-22	4.0	**20**	< 10	**41**	**4.9**
BH7_1.0	21-Oct-22	1.0	**50**	**10**	**45**	**5.6**
BH7_3.0	21-Oct-22	3.0	**30**	< 10	**28**	**4.9**
BH7_4.0	21-Oct-22	4.0	**40**	< 10	**39**	**5.1**
BH7_6.0	21-Oct-22	6.0	**40**	**50**	**62**	**5.2**
BH8_1.0	10-Nov-22	1.0	**90**	**20**	**105**	**7.9**
BH8_5.0	10-Nov-22	5.0	**30**	< 10	**22**	**5.2**

Explanatory Notes to Table 4-1:

The following Key is used to interpretate the results.

1=Slight	Effervescence Reaction Rate
2= Moderate	
3= Strong	
4= Extreme	

Bold indicates a detection above the laboratory limit of reporting
Highlighting indicates an exceedance of the corresponding criteria (highlighting corresponds to the guideline with the highest criteria value where analytical result exceeds more than one guideline)

Criteria:
ASSMAC (1998) Indicators of Actual or Potential Acid Sulphate Soils (Section 4.3 - Tables 4.4 & 4.6) greater than 1000 tonnes disturbed MEDIUM textured soils.

Table 4-2: SPOCAS Testing Results

Analyte			Field pH				SPOCAS Analysis				Acidity												
			pH (F)	pH (Fox)	Reaction Rate	pH (F) - pH (Fox)	pH (KCl)	Net Acidity (Sulfur units)	Net Acidity (acidity units)	Liming Rate	Titratable Actual Acidity (23F)	Sulfidic - Titratable Actual Acidity (s-23F)	Net Acid Soluble Sulfur (20Je)	Acidity - Net Acid Soluble Sulfur (a-20J)	KCl Extractable Sulfur (23Ce)	Chromium Reducible Sulfur (22B)	HCl Extractable Sulfur (20Be)	acidity - Chromium Reducible Sulfur (a-22B)	Sulfidic - Net Acid Soluble Sulfur (s-20J)	ANC Fineness Factor	Net Acidity excluding ANC (Sulfur units)	Net Acidity excluding ANC (acidity units)	Liming Rate excluding ANC
LOR			0.1	0.1	1.0	0.1	0.1	0.02	10	1.0	2.0	0.02	0.02	10	0.02	0.005	0.02	10	0.02	0.5	0.02	10	1.0
Units			pH units	pH units	Reaction units	pH units	pH units	% S	mole H+/t	kg CaCO3/t	mole H+/t	% pyrite S	% S	mole H+/t	% S	% S	% S	mole H+/t	% pyrite S	-	% S	mole H+/t	kg CaCO3/t
ASSMAC (1998) Indicators of Actual or Potential Acid Sulphate Soils			--	--	Effervescence Reaction Rate	Drop in pH of >1 unit	--	0.06	36	>LOR	--	--	--	--	--	--	--	--	--	--	--	--	--
Sample Name	Sample Date	Start Depth (m)																					
BH1_1.0	19-Oct-22	1.0	**5.3**	**4.0**	**2**	**1.3**	**4.2**	**0.23**	**146**	**11**	**134**	**0.22**	< 0.02	< 10	< 0.02	**0.018**	< 0.02	**11**	< 0.02	**1.5**	**0.23**	**146**	**11**
BH1_2.0	19-Oct-22	2.0	**4.7**	**3.5**	**2**	**1.2**	**4.3**	**0.15**	**95**	**7.0**	**83**	**0.13**	< 0.02	< 10	< 0.02	**0.019**	< 0.02	**12**	< 0.02	**1.5**	**0.15**	**95**	**7.0**
BH2_0.5	18-Oct-22	0.5	-	-	-	-	**8.2**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.014**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
BH2_1.0	18-Oct-22	1.0	**6.5**	**4.9**	**2**	**1.6**	**6.8**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.013**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
BH2_3.0	18-Oct-22	3.0	**4.9**	**3.8**	**2**	**1.1**	**4.8**	**0.08**	**50**	**4.0**	**45**	**0.07**	-	-	-	**0.009**	-	< 10	-	**1.5**	**0.08**	**50**	**4.0**
BH3_0.5	19-Oct-22	0.5	-	-	-	-	**7.6**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.015**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
BH3_1.0	19-Oct-22	1.0	**4.4**	**3.2**	**2**	**1.2**	**4.0**	**0.31**	**195**	**15**	**178**	**0.28**	< 0.02	< 10	**0.05**	**0.015**	**0.05**	< 10	< 0.02	**1.5**	**0.31**	**195**	**15**
BH3_2.5	19-Oct-22	2.5	**4.8**	**3.4**	**2**	**1.4**	**4.3**	**0.18**	**112**	**8.0**	**72**	**0.11**	**0.06**	**30**	< 0.02	**0.018**	**0.03**	**11**	**0.05**	**1.5**	**0.18**	**112**	**8.0**
BH4_1.0	17-Oct-22	1.0	**7.5**	**4.6**	**3**	**2.9**	**7.4**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.014**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
BH4_2.0	17-Oct-22	2.0	**6.8**	**5.0**	**2**	**1.8**	**5.5**	**0.04**	**23**	**2.0**	**13**	**0.02**	-	-	-	**0.016**	-	< 10	-	**1.5**	**0.04**	**23**	**2.0**
BH5_0.5	17-Oct-22	0.5	-	-	-	-	**7.2**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.012**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
BH5_1.0	17-Oct-22	1.0	**7.0**	**4.4**	**2**	**2.6**	**6.9**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.016**	-	**10**	-	**1.5**	< 0.02	**10**	< 1.0
BH5_1.9	17-Oct-22	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH6_1.0	21-Oct-22	1.0	**7.2**	**4.6**	**2**	**2.6**	**5.3**	**0.03**	**18**	**1.0**	**12**	< 0.02	-	-	-	**0.01**	-	< 10	-	**1.5**	**0.03**	**18**	**1.0**
BH6_4.0	21-Oct-22	4.0	**4.4**	**2.9**	**2**	**1.5**	**4.4**	**0.19**	**116**	**9.0**	**80**	**0.13**	**0.06**	**27**	< 0.02	**0.014**	**0.03**	< 10	**0.04**	**1.5**	**0.19**	**116**	**9.0**
BH7_1.0	21-Oct-22	1.0	**5.7**	**3.3**	**2**	**2.4**	**5.3**	**0.03**	**17**	**1.0**	**13**	**0.02**	-	-	-	**0.007**	-	< 10	-	**1.5**	**0.03**	**17**	**1.0**
BH7_4.0	21-Oct-22	4.0	-	-	-	-	**4.2**	**0.28**	**174**	**13**	**145**	**0.23**	**0.05**	**24**	< 0.02	**0.009**	**0.02**	< 10	**0.04**	**1.5**	**0.28**	**174**	**13**
BH7_6.0	21-Oct-22	6.0	-	-	-	-	**4.8**	**0.07**	**46**	**3.0**	**41**	**0.06**	-	-	-	**0.009**	-	< 10	-	**1.5**	**0.07**	**46**	**3.0**
HA01_1.4	18-Oct-22	1.4	-	-	-	-	**7.0**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.012**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
HA01_2.0	18-Oct-22	2.0	-	-	-	-	**6.0**	< 0.02	< 10	< 1.0	**3.0**	< 0.02	-	-	-	**0.01**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0
HA03_0.3	18-Oct-22	0.3	-	-	-	-	**5.9**	< 0.02	**11**	< 1.0	**5.0**	< 0.02	-	-	-	**0.01**	-	< 10	-	**1.5**	< 0.02	**11**	< 1.0
HA04_0.8	18-Oct-22	0.8	-	-	-	-	**6.2**	< 0.02	< 10	< 1.0	< 2.0	< 0.02	-	-	-	**0.01**	-	< 10	-	**1.5**	< 0.02	< 10	< 1.0

4.1 INTERPRETATION OF LABORATORY TEST RESULTS

The test results indicated that samples of the natural soils in BH1, BH2, BH3, BH4, BH5, BH6 and BH7 at depths of between 1m and 6m m bgl exceeded the >1000 tonne soil threshold for provision of an ASS and groundwater management plan; however, the site is at an elevation of around 18m AHD and is not mapped a being an Acid Sulphate Soil site. The results in **Table 4-2** show low chloride content and low conductivity which are atypical for the more saline conditions usually associated with PASS/ASS formation. Additionally, low soluble Sulfur (S_{KCl} <0.03%) and low Chromium Reducible Sulfur related acidity are also atypical of ASS/PASS. However, pH_{KCL} below 5.5 in some soils, the elevated Titratable Actual Acidity and the pH reduction in soils following oxidation would suggest acid conditions and acid producing behaviour. It is anticipated that such acidity is likely the result of the oxidation of Sulfur minerals in the soil, potentially derived from the underlying bedrock. It should be noted that the Soil landscape mapping in **Section 3.5** identifies the Terrigal Formation to be commonly highly acidic.

Current guidance for the treatment of ASS/PASS is available in recognised NSW and national documentation (see **References**). Additionally, dealing with acidic soils that may not be ASS/PASS is included in the Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines. Section 8.6.1 (Qld Guide). This indicates that management of acidic and acid producing soils, where the source of acidity is unclear, should still be undertaken, because the origins of acidity within an ASS terrain are unimportant if downstream environmental impacts are likely. While it may be unnecessary to regulate these acidic soils as ASS, it is prudent to treat the acidity (in line with Section 8.6.1 of the QLD Guide) if the soils are being disturbed. Therefore, the following sections will provide an Acid Soil Management Plan in accordance with current practice.

5 MANAGEMENT OF ACID SOILS

5.1 ROLES AND RESPONSIBILITIES

The key stakeholders responsible for the implementation of the control measures outlined in the ASSMP are presented in **Table 5-1**Error! Reference source not found..

Table 5-1: Stakeholders

Role	Responsibilities
Regulator Department of Planning, Industry and Environment (DPIE)	Review and approve formal requests for permission to carry out a 'development'.
University of Newcastle (Principal)	• To Engage the consultants and contractors. • Undertake Stakeholder management. • Provide advice and leadership on environmental management.
Principal's Representative (APP and Kleinfelder)	Manage and assist the contractors to meet their environmental responsibilities and minimise the potential for environmental incidents. Review the CEMP and sub-plans for adequacy. Review the Construction Contractor's environmental monitoring reports and compliance documentation to confirm that the CEMP and sub-plans are being implemented and remain adequate. Issue a stop work direction immediately where an unacceptable environmental impact may occur. Liaise with the DPIE and other relevant regulators as required.
Community Engagement Consultant (CEC)	Manage the relevant enquiries and complaints. Working with contractors in the organisation and delivery of community notifications and/or information dissemination. Reviewing contractor community relations materials, including notifications, letters, advertising, signs and factsheets. Monitoring, responding to and triaging Project calls and emails from community stakeholders. Working with Contractor's Environmental Manager and Community Liaison Manager on environmental complaints received from the public
Contractor's Project Manager (Contractor's PM)	Oversee the implementation and maintenance of the CEMP. Report to senior management and the Principal's Representative on the performance of the system and environmental breaches. Take action to resolve environmental non-conformances, non-compliances and incidents. Demonstrate that suppliers and sub-contractors are implementing Project environmental requirements. Report environmental incidents to the Principal's Representative Authorise expenditure to implement environmental management requirements within limits of authority as defined in the Principal's Representatives Project requirements. Coordinate Incident Cause Analysis Method (ICAM) investigations. Review audit corrective actions and take action as necessary to ensure timely close out of issues. Direct works to be performed in a more environmentally responsible manner that reduces impacts or stop works if there is a risk of environmental harm.

Role	Responsibilities
Contractor's Construction Manager (Contractor's CM)	Communicating with all personnel and sub-contractors regarding conformance with the CEMP and site-specific environmental issues Identifying resources and competencies required for implementation of the CEMP. Co-ordinating the implementation and maintenance of site environmental controls and provide support for the Contractor's EM. Report all environmental incidents in accordance with incident reporting protocol. Participate in ICAM investigations. Take action to resolve non-conformances, non-compliances and incidents. Manage and direct works in an environmentally responsible manner that reduces environmental impacts or stop works if there is a risk of environmental harm.
Contractor's Environmental Manager (Contractor's EM)	Assist and guide the respective workers to meet their environmental responsibilities and minimise the potential for environmental incidents. Undertake regular environmental inspections including against implementation of management measures and environmental controls. Report to the Contractor's CM on environmental issues Implement appropriate action to address any environmental incidents. Investigate and report on identified non-conformances and non-compliances. Ongoing identification and mitigation of environmental risks and notify the Principals Representative of any required change. Develop environmental components of site induction and ensure a register of attendance is maintained. Present and participate in toolbox meetings. Manage environmental document control, reporting, inductions and training. Oversee site monitoring, inspections and internal audits. Monitor and report on the environmental capability and performance of subcontractors. Participate in ICAM investigations. Report environmental non-conformances, incidents and potential incidents to the Contractor's PM Cooperate and participate in audits and action results of any audit findings.
Environmental Suitability Qualified Person (ESQP) (in accordance with NEPM Schedule B9[9] 2013)	Assessing Materials and determining treatment requirements – soils and waters. Validate all stockpiles and remediated soils. Prepare validation Report.

5.2 Anticipated Construction Methodology

It is anticipated that the following construction methodology will be adopted:

- Demolition of the existing structure and removal of all hardstand and footings etc.
- Installation of bored pile wall to form the retaining element of the structure.
- Cut to Fill exercise, anticipated earthworks volumes are cut 3,420m^3, fill 353m^3 with a balance of 3067m^3 cut. It is anticipated that this material will have to be removed from site.
- Service installation.
- Construction of the building.

Any soil excavated during these activities, whether it is to be removed from site or not, will be treated as Acid Soil and managed as below.

5.3 Recommended Additional On-site Acidic Soil Management Procedures

The above construction methodology, which will involve the timely removal of excavated soils, effectively minimises the risk of acid generation from Acid Soil disturbance on site; however, it is appropriate that some additional measures are put in place to manage acidity risks from exported soils and to assess the effectiveness of the measures and ensure site groundwater and any discharges are within acceptable limits.

- Pre-start groundwater monitoring event at all monitoring wells (BH1, BH7, BH8, BH9 BH10 and BH11) to be undertaken to establish baseline readings for pH, sulfate, chloride, aluminium, iron, magnesium and arsenic.
- Weekly groundwater monitoring events during construction at all monitoring wells for pH, sulfate, chloride, aluminium, iron, magnesium and arsenic. Any significant lowering of pH levels or increase in metals concentrations should be reported to the site supervisor as soon as possible and management measures reviewed.
- Daily monitoring of dewatered groundwater for pH. A drop in pH of 1 or more should be reported as soon as possible to the site supervisor and management measures reviewed.
- Unusual odours (particularly sulfidic in nature) or water discolouration, during groundwater monitoring or excavation and dewatering, should be reported to the site supervisor as soon as possible and management measures reviewed.
- Post works groundwater monitoring events at all surviving wells during the works for pH, sulfate, chloride, aluminium, iron, magnesium and arsenic. Monitoring should continue until groundwater conditions are noted to be stabilized as per pre-start conditions.
- To minimise environmental risks from exported acidity, the soils to be used for fill or exported are to be limed prior to scraping, transport and subsequent placement (see below for liming rates) or disposal as required. Thorough mixing and a fully contained treatment pad are not considered necessary. Instead, neutralising agent may be:
    - Spread in key areas as part of the cut and filling operations to intercept any acidic leachate flow.
    - Added to truckloads of disturbed material while being moved, thus achieving a degree of mixing during transport and placement.
    - Spread as a guard layer under any temporary or permanent stockpiles or treatment areas.
    - Incorporated as lime-enriched perimeters around temporary or permanent stockpiles or treatment areas.
    - Positioned in drains and areas most likely to experience flow.
- Backfill material to be non-calcareous to avoid any reaction with any acidic soils or acidic groundwater.

5.4 Calculation of Application Rate for Neutralisation Materials

Test results from the Kleinfelder investigation calculated a general liming rate of up to 15kg Aglime per tonne of site soils requiring treatment. Liming rate is typically calculated using the following formula:

$$\text{Lime required (kg } CaCO_3\text{/t)} = \text{kg } H_2SO_4\text{/t of material x Safety Factor} = \text{(Oxidisable S\% x 30.59) x SF}$$

The laboratory calculated liming rate incorporates a Safety Factor of 1.5. A reduced safety factor of 1.2 could potentially be adopted, in accordance with Section 8.6.1 of the QLD ASS Guide, assuming the soils to potentially not be ASS. However, given that the acid forming nature of the soils has not been further investigated and categorised, a liming rate of 15kg Aglime per tonne of site soil is recommended.

5.5 Soil Sampling Protocol for Suspected PASS/AASS

In the event that suspected PASS or AASS or other acidic soils are identified, the soils acid generating potential will need to be determined. The following sampling regime will be followed:

- Collection of soil samples 1 per 25m^3 for laboratory analysis.
- Testing of each sample for chromium reducible Sulfur or SPOCAS suite, including retained acidity, by a NATA accredited laboratory.

The adopted sampling approach will be consistent with National Acid Sulfate Soils Guidance, NEPM (2013) and AS4482.1 (2005) where appropriate. Soil sampling must be undertaken by the ESQP.

6 REFERENCES

- Kleinfelder, Central Coast Campus Geotechnical Investigation Report, 305 Mann Street Gosford, NCA22R147463, December 2022.
- Kleinfelder, Central Coast Campus - Detailed Site Investigation, 305 Mann Street, Gosford NSW, NCA22R14011, December 2022.
- Australian Standard – AS 1726-2017 Geotechnical Site Investigation.
- NSW Acid Sulfate Soils Manual (Stone et al., 1998).
- National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification manual and National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, 2018.
- The National Acid Sulphate Soils Guidance, 'Guidance for the dewatering of acid sulphate spoils in shallow groundwater environments, June 2018, Department of Agriculture and Water Resources.
- National Strategy for the Management of Coastal ASS, 2000, Department of Agriculture and Water Resources.
- Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines v4.0, Landscape Sciences, Science Division, Department of Science, Information Technology, Innovation and the Arts, The Stare of Queensland, 2014.

APPENDIX A – FIGURES

Legend

- Site Boundary
- Primary Road
- Local Road

Sample Locations

- Borehole to rock
- Core Borehole 12m Medium Strength Sandstone

Metres
0 2.5 5 10 15 20

N

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PROJECT REFERENCE: 20232408
DATE DRAWN: 9/12/2022 12:31 Version 1
DRAWN BY: CMiskell
DATA SOURCE:
LPI - 2009
Nearmap - 2022

Site Figure & Sampling Locations

University of Newcastle
Geotechnical Investigation
UoN Gosford campus
305 Mann Street, Gosford, 2308

FIGURE:
1

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