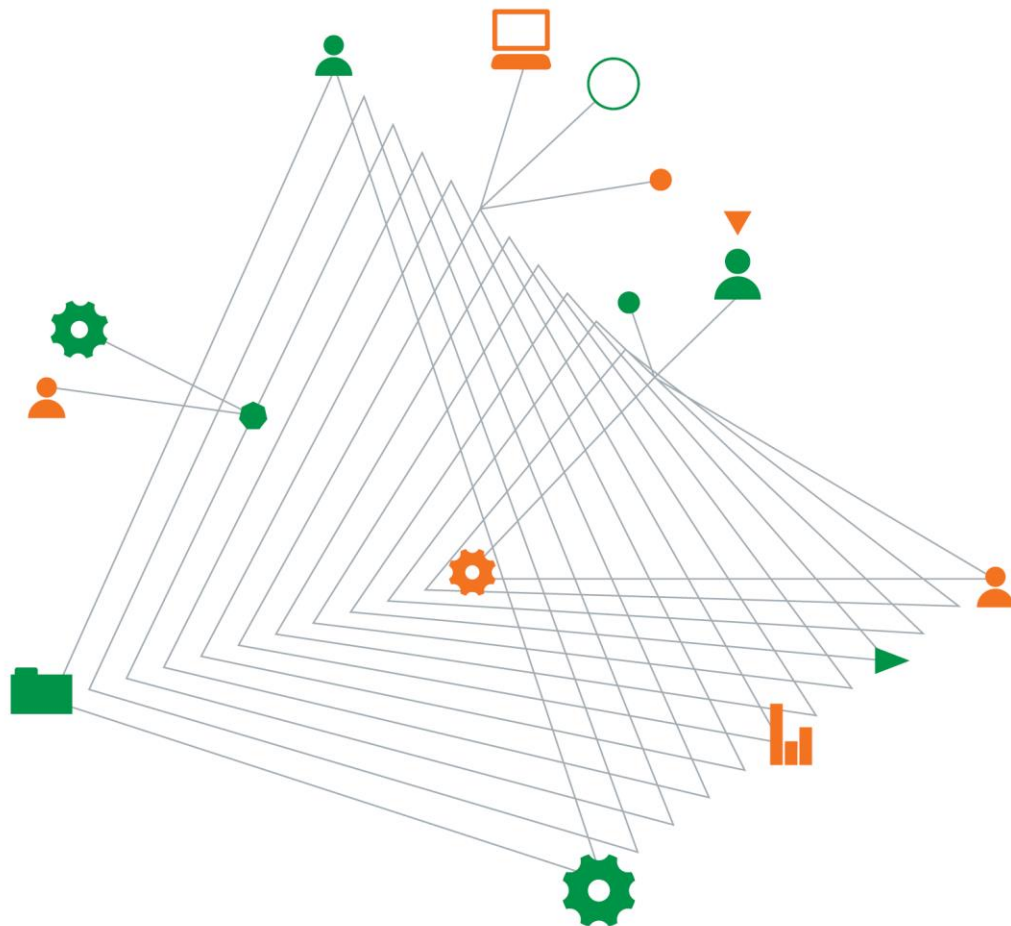


University of Newcastle

**Proposed Honeysuckle City Campus Site 1
Development**

Acid Sulfate Soil Management Plan

8 February 2019



Experience
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Acid Sulfate Soil Management Plan – Honeysuckle City Campus Development

Prepared for
University of Newcastle

Prepared by

Coffey Services Australia
19 Warabrook Boulevard
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754-NTLEN213472-R09

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1. Introduction

1.1. General

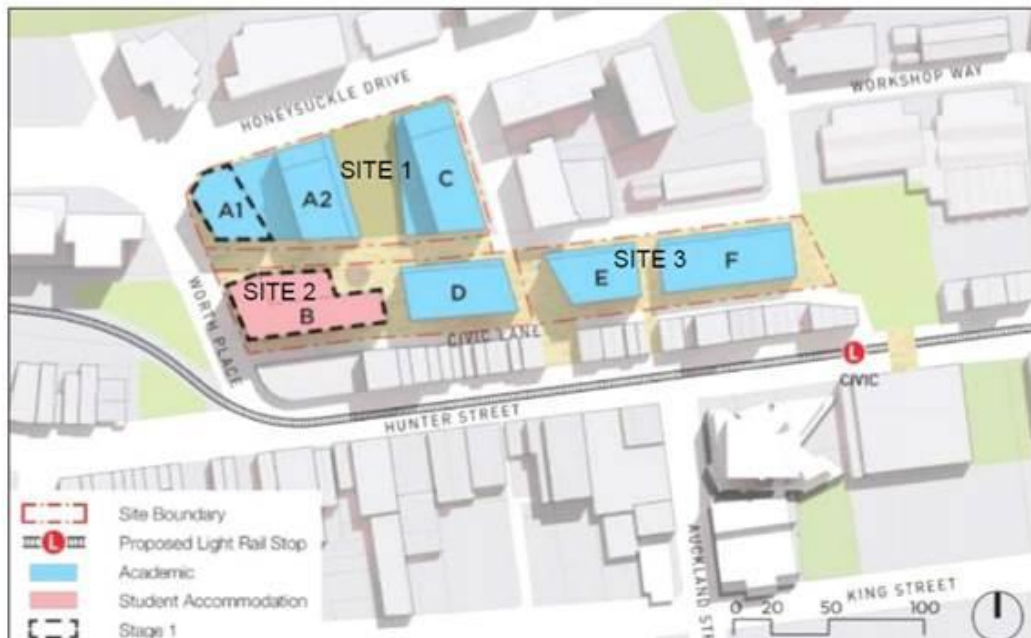
The following Acid Sulfate Soil Management Plan (ASSMP) has been prepared for the use by University of Newcastle (UON) during the proposed development works at Honeysuckle, Newcastle CBD, NSW. UON is proposing to develop the new city campus across three (3) sites which will be called the Honeysuckle City Campus Development (HCCD). The respective areas of the sites are as follows:

- Site 1 (8,546sqm;
- Site 2 (5,880sqm); and
- Site 3 (6,478sqm).

The University of Newcastle is currently preparing a development application to the Newcastle City Council (NCC) for a proposed building development located at Lot 1 DP 1163346. The building forms part of the larger plan to establish the University of Newcastle, Honeysuckle City Campus across Lots 1, 2 and 3 DP 1163346, with the proposed development area referred to as “Site 1” (the Site, in this report).

The Site will be developed over time to include three multi-storey campus buildings that comprise office and classroom spaces. No residential areas are proposed for the Site. The proposed development layout is shown in Figure 1-1.

Figure 1-1 - Proposed Honeysuckle City Campus Development Location



The HCCD development area is located in an area of high probability for the occurrence of acid sulfate soils between depths of 1 to 3 m below ground surface (bgs). An acid sulfate soil investigation

undertaken by Coffey and reported in a detailed site investigation report (754-NTLEN213472-R08), confirmed the presence of potential acid sulfate soils between about 2.5m and 4.0m bgs.

This ASSMP presents the approach and methodology for ASS management at the site to be followed by the contractor and its subcontractors. It provides a basis for specifications for ASS management. However, it is important to note that this document is not a specification.

The ASSMP was developed generally in accordance with the Acid Sulfate Soil Manual published by the Acid Sulfate Soils Management Advisory Committee (ASSMAC 1998), Queensland Acid Sulfate Soil Technical Manual 2014 – Soil Management Guidelines and the National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra, 2018 (National ASS Guidelines 2018).

1.2. Objectives

The objective of the ASSMP is to lower the potential environmental impacts associated with the disturbance of ASS during the proposed construction works.

1.3. Background Information

Coffey understands that the Newcastle City Council (NCC) has made a request for additional information in response to the submission of the Development Application (DA) for the HCCD Enabling Works Project. NCC has identified that given the high probability of Potential Acid Sulfate Soils (PASS) being present at depth, they have recommended that an Acid Sulfate Soil Management Plan (ASSMP) be prepared for the proposed works.

1.4. Coastal Acid Sulfate Soils

Coastal ASS are soils which contain significant concentrations of reduced inorganic sulphides (RIS), or pyrite which, when exposed to oxygen in the presence of sufficient moisture, oxidises, resulting in the generation of sulfuric acid. Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed, the oxidation of pyrite occurs, and sulfuric acids are generated, and the soils are said to be actual ASS.

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (i.e. 10,000 years ago to present day) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (i.e. >10,000 years ago) would already have oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen. There is still some potential for these older soils to contain stored acidity that could be released on exposure.

1.5. Significance of Coastal Acid Sulfate Soils

Disturbance or poorly managed development and use of coastal ASS can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off-site into aquatic ecosystems can have a detrimental effect on aquatic ecosystems.

2. Site Information

2.1. Site Location and Identification

General information relating to Site 1 is provided below in Table 2-1 - Summary of Site DetailsTable 2-1. The site location is shown in Figure 1 (Appendix A).

Table 2-1 - Summary of Site Details

Site Address	16, 16A and 16B Honeysuckle Drive, Newcastle NSW 2300
Approximate Site Area	Approximately 8,546m ²
Title Identification Details	Lot 1, 2 & 3 DP1163346
Current Land Zoning	B4 Mixed Zone Uses
Current Land use	The site comprises a vacant block with access via Wright Lane.
Proposed Land use	Commercial-Industrial (Offices and academic facilities)
Adjoining Site Uses	• North – Honeysuckle Drive, Lee Wharf Commercial Buildings; • South – Wright Lane, Wright Lane Car Park, Former Rail Corridor; • East – Settlement Way, Chifley Apartments, Commercial Offices; • West – Worth Place, Commercial Offices.
Site Coordinates	The centre of the site is located approximately at 32.926210646, 151.768890977

2.2. Site Topography and Drainage

Reference to the topographic map on NSW Land & Property Information Spatial Information exchange (SIX) website (<http://maps.six.nsw.gov.au/>) indicated that the site was situated on level ground. The topographic map indicates that the elevation of the site is about 3m AHD.

Where pavements exist, surface water would drain to the municipal stormwater system. In areas which are currently unpaved and vegetated, surface water would infiltrate into site soils and run-off would drain into the municipal stormwater system.

Surface water flow would generally be expected to follow the slope of the land from the centre of the site towards either the north west and/or south east. Surface water flow directions may vary in localised areas where the site surface has been levelled.

Stormwater from the site likely discharges into Newcastle Harbour, located approximately 130m to the north of the site.

2.3. Regional Geology

Reference to the 1:100,000 scale Newcastle Coalfields Regional Geology Map indicates that the site is underlain by fill, alluvial / estuarine soils that are in turn underlain by rock belonging to the Lambton Subgroup of the Newcastle Coal Measures. This subgroup comprises siltstone, sandstone and coal seams. The top of rock occurs at approximately -20m AHD and the anticipated presence of suitable founding conditions in the Unit 3 sand between approximately -5m and -10m AHD.

2.4. Acid Sulfate Soils

Reference to the Lower Hunter River Catchment (2008) Acid Sulfate Soil Risk Map indicates that the site is in an area of disturbed terrain. The DLWC 1997 ASS risk map indicates the site is in an area of “High Probability” of Acid Sulfate Soils (ASS) between 1 and 3 metres below the ground surface. The Site was also classified as Class 3¹ in the Newcastle City Council, Local Environment Plan, Map 4, 2012.

2.5. Hydrogeology

Groundwater was observed during site investigations at depths between 2.0m and 3.8m below ground surface (mbgs).

A search of the NSW Office of Water for registered groundwater bores located within a 500m radius of the site was undertaken. The search revealed that there are three groundwater bores registered within this radius. A summary of the groundwater search is included in Table 2-2.

Table 2-2 - Groundwater Bore Search Results Summary

Monitoring Well ID	Purpose of bore	Distance and direction from site	Water Bearing Zones
GW201489	Monitoring Bore	421m South East	2.00 – 5.00m bgs
GW201490	Monitoring Bore	479m South East	2.00 – 4.50m bgs
GW201491	Monitoring Bore	434m South East	2.00 – 4.50m bgs

¹ Works more than 1 metre below the natural ground surface and works by which the water table is likely to be lowered more than 1 metre below natural ground surface may require a Management Plan or Preliminary Assessment prior to development consent being issued

3. Field and Laboratory Program

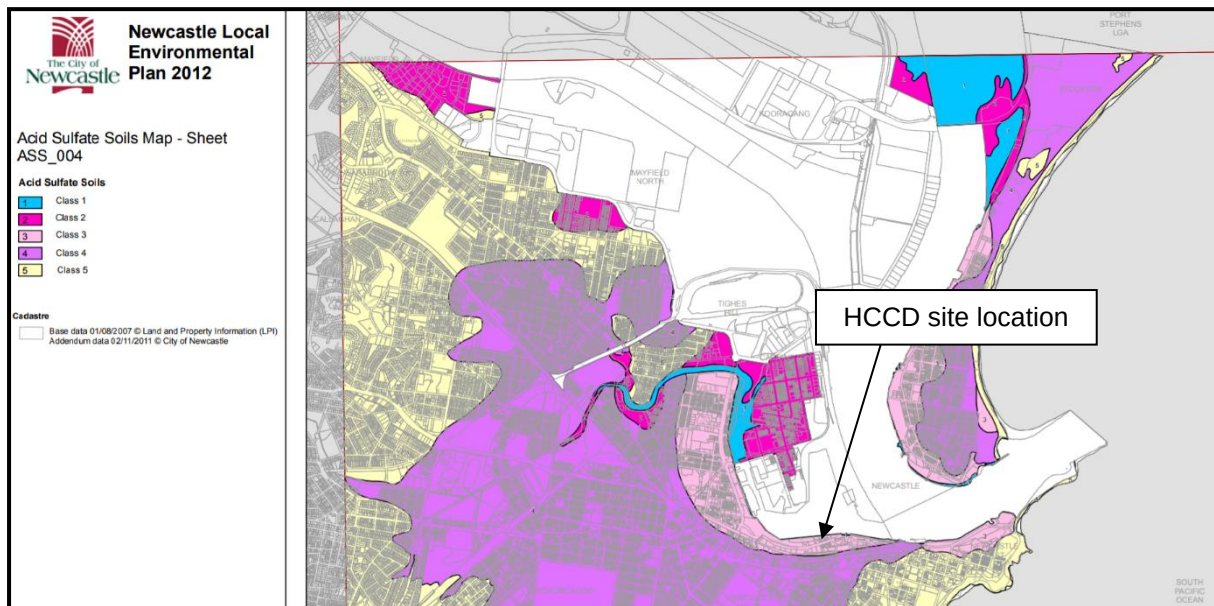
3.1. Field Works

Soil sampling was undertaken from 18 and 19 December 2018 and 9 January 2019 by a Coffey Environmental Scientist. Sampling locations are shown in Figure 2 (Appendix A).

Environmental samples were collected by Coffey from boreholes advanced as part of the detailed site investigation and also during installation of monitoring well bores at the site. Samples were collected at regular 0.5 metre depth intervals.

For the purpose of assessing the acid sulfate soil potential at the site, 25 samples were collected by Coffey and screened for the presence of acid sulfate soils. The proposed arrangement of the buildings to be constructed on the Site are shown in Figure 1-1 and the relevant section of the Newcastle 1:40,000 Acid Sulfate Soils Map, Newcastle Local Environmental Plan 2012 is shown on Figure 3-1. The Acid Sulfate Soil Map indicates that the site is in an area classified as “Class 3”, which identifies that a Management Plan or Preliminary Assessment may be required prior to development and specifically for “*Works more than 1 metre below the natural ground surface*” and “*Works by which the water table is likely to be lowered more than 1 metre below natural ground surface.*”

Figure 3-1 - ASS Risk Map and Site Location



4. Assessment Criteria

4.1. Acid Sulfate Soils

Depending on the amount of soils disturbed during the project, future results will need to be compared to the appropriate criteria listed below. If there is doubt about the amount of soil to be disturbed, the more conservative criteria should be adopted. The action criteria provided in the ASSMAC 1998 Acid Soil Manual are summarised in Table 4-1 below.

Table 4-1 - ASSMAC (1998) Acid Sulfate Soil Action Criteria

Soil Texture Category	Approximate Clay Content (%)	Action Criteria (<1000 tonnes) ¹		Action Criteria (>1000 tonnes) ²	
		Sulfur Trail	Acid Trail	Sulfur Trail	Acid Trail
		Net Acidity	Net Acidity	Net Acidity	Net Acidity
		(S _{POS} or S _{CR})	TAA, TPA or TSA	(S _{POS} or S _{CR})	TAA, TPA or TSA
		(%)	(mol H ⁺ /tonne)	(%)	(mol H ⁺ /tonne)
Coarse	<5%	0.03	18	0.03	18
Medium	5% to 40%	0.06	36	0.03	18
Fine	>40%	0.1	62	0.03	18

Notes:

1 - Action criteria where less than 1000 tonnes of ASS is to be disturbed

2 - Action criteria where greater than 1000 tonnes of ASS is to be disturbed

Net Acidity calculated using acid base accounting

S_{POS} Peroxide oxidisable sulphur

S_{CR} Chromium reducible sulphur

TAA Total Actual Acidity

TPA Total Potential Acidity

TSA Total Sulfidic Acidity

To assess the potential for acid sulfate soils at the site, field pH screening was completed in accordance with Appendix 1 of the NSW ASSMAC (1998) *Acid Sulfate Soil Manual* (ASSMAC). Results of the pH screening were compared against Section 2.2 of the ASSMAC (1998). The ASSMAC (1998) assessment guidelines in Appendix 1 state the following:

- A pH less than or equal to 4 is likely to indicate the presence of Actual Acid Sulfate Soils (AASS) when soil is added to a mixture with a ratio of 1:5 with distilled water; and
- A final pH of less than 3, strong sulphuric odour and colour change can be indicative of Potential Acid Sulfate Soils (PASS) when soil is added to a mixture with a ratio of 1:5 with hydrogen peroxide.

A final pH of 3.5 will be adopted for this assessment as experience has shown that RIS can be present at this higher pH and indicate the presence of ASS.

5. Acid Sulfate Soils Investigation Results

5.1. Acid Sulfate Soil Assessment

A summary of the analytical results is presented in Table LR1 in Appendix B. Laboratory reports are provided in Appendix I.

The results of the laboratory analysis of the Acid Sulfate Soil samples (Table LR1 – Appendix B) collected during the most recent site investigation indicate the following;

- Field screening of 25 primary soil samples collected in the natural material observed on site was undertaken by NATA accredited laboratory Eurofins Mgt;
- Samples in a 1:5 mixture with distilled water were recorded at a pH between 8.6 to 9.6 (pH units). A pH less than or equal to 4 is likely to indicate the presence of Actual Acid Sulfate Soils;
- pH_{FOX} ranging from 2.8 to 7.8 (pH units), with reactions recorded between no reaction/ slight reaction to extreme reactions with constant froth, after oxidation in hydrogen peroxide, were observed for the samples. pH_{FOX} of less than 3.5 can be indicative of Potential Acid Sulfate Soils (PASS);
- The total pH drop was in the range of 0.6 to 6.2 pH units. A drop of more than 1 unit, plus increase in temperature, effervescence, colour and odour factors can be indicative of PASS;
- Chromium suite analysis was undertaken on 14 selected samples which were visually and olfactory assessed to contain Potential ASS characteristics. The samples included: (BHP9 3.4-3.5, BHP9 3.8-3.9, BHP11 3.3-3.5, BHP13 2.5-2.6, BHP14 3.3-3.5, BHP18 3.5-3.8, BHP19 3.1-3.3, BHP20 2.9-3.0, MW01 3.8-4.0, MW02 3.8-4.0, MW02 4.8-5.0 and MW03 3.8-4.0). The results indicated:
 - 12 of the 14 samples tested (excluding BHP15 2.5-2.8 and BHP16 2.8-3.0) exceeded the adopted SAC for the site of 0.03 % S. Results ranged between 0.032 and 0.44.
 - Coffey calculated a liming rate for the samples that exceeded the above criteria. A liming rate of between 1.5 and 20.59 kg/tonne was calculated for the above stated samples.

The results showed that potential acid sulfate soils (PASS) was identified in soils between 2.5m – 4.0m bgs at sites BHP9, BHP11, BHP13, BHP14, BHP15, BHP16, BHP18, BHP19, BHP20, MW01, MW02 and MW03 with further confirmation below 4.0m at MW02. A preliminary liming rate was established based on the highest concentration of %S obtained at BHP18 3.5-3.8 (0.44%S) of 21 kg CaCO₃ per tonne with an included safety factor of 1.5.

6. ASS Management Plan

The risk of encountering acid sulfate soils during earthworks and construction is low unless works are planned in low lying areas of the site (e.g. excavations that extend to or beyond 2.0m bgs). The following management principles and procedures should be implemented in the event that suspected acid sulfate soils are encountered during construction.

6.1. General Principles

The following is an outline of the general principles for mitigating impacts associated with identified ASS as per ASSMAC (1998):

- i. Avoid land where ASS occur;
- ii. Avoid disturbing ASS soils if present on the property and avoid lowering the water table;
- iii. Prevent the oxidation of sulfides;
- iv. Neutralising acid as it is produced;
- v. Separate out and treat the sulfidic component (i.e. pyrite) by sluicing if this material is very sandy; and
- vi. Immediate burial of excavated ASS below the permanent water table.

Once the actual construction scenario is defined and it is assessed that the proposed work could intersect and disturb ASS, a site specific ASSMP should be prepared using the framework provided by this general ASSMP. The site specific ASSM should either be prepared by the earth works contractor, or by the Principal's representative in consultation with the Contractor.

6.2. Training, roles and responsibilities

The earthworks contractor should appoint an appropriately trained person who is responsible for managing the ASS issues during the earthwork activities.

This person should be familiar with:

- Council and other relevant statutory requirements;
- Recognition of ASS materials;
- Acid sulfate soil testing and treatment procedures;
- Onsite management of ASS materials, including implementing management procedures.

The classification of ASS materials during construction should be carried out by personnel trained in the identification of ASS and be based on visual classification and the field screening test. If required, a suitably qualified Environmental Consultant could be engaged to assist or train the Contractor in the identification of ASS.

6.3. Visual Classification

The preliminary visual checking of the soils will be based on material type, colour, odour and consistency. ASS material is generally characterised by grey, dark grey, and black clayey sands and

sandy clays which can be accompanied by a sulfuric odour. Marine sediments when encountered will often contain seashells. It is important that when these characteristics are encountered that the procedures documented in the ASSMP are implemented. Where doubt exists an experienced ASS consultant should be contacted so the material can be assessed, separated and managed correctly to allow the works to progress.

6.4. Management of Excavated Acid Sulfate Soils

Excavated soils should be either placed in temporary stockpiles or transported directly to a specially prepared treatment area for liming.

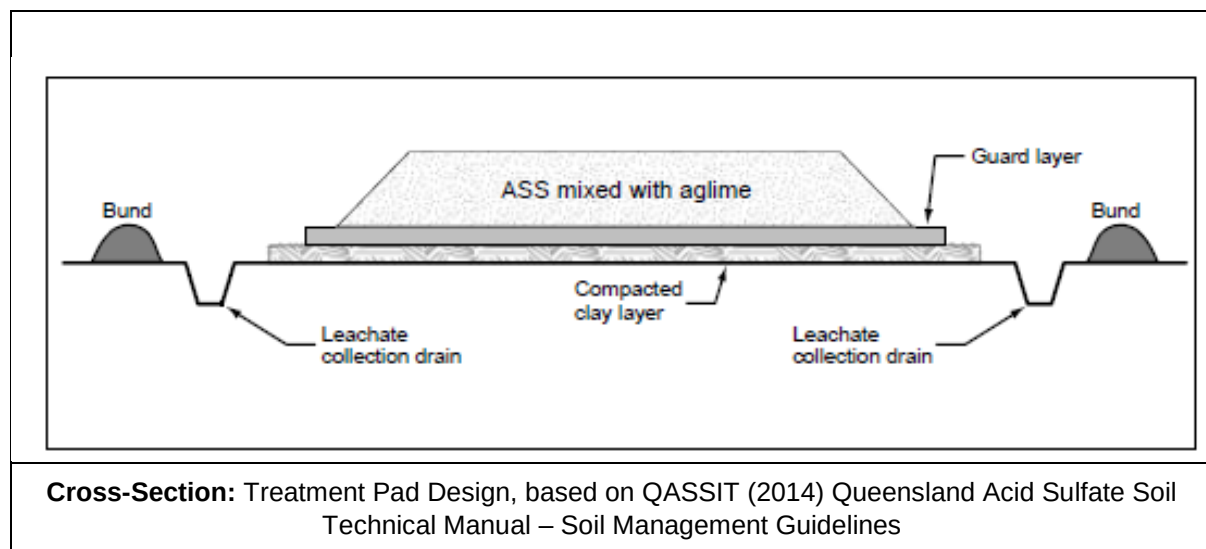
6.5. Establishment of Treatment Pads

Bunded, impervious treatment areas should be constructed for the purpose of treatment/neutralisation of ASS, or to store ASS material that would remain onsite for longer than 2 days (for sands) or 5 days (for more clayey materials) before treatment. Treatment areas should be constructed using impervious clay or plastic sheeting as a base. The treatment area should be suitably bunded to prevent stormwater from entering or leaving the area.

The treatment area should include installation of a leachate collection pond to collect runoff. The treatment area should be graded towards the leachate pond for efficient drainage. The settlement leachate pond should be designed to capture and store runoff from a 1 in 10-year storm duration event. Leachate runoff collected in the settlement pond should be assessed prior to disposal of the settlement pond. Sediment removed from the leachate pond should also be assessed for the presence of ASS.

The treatment pad should be constructed as per the cross-section in Figure 6-1.

Figure 6-1 - PASS Treatment Pad Construction



6.6. Temporary Stockpiling

Where temporary stockpiling exceeds a few days, the excavated soils should be bunded and covered with plastic to help slow the oxidation process. Where extended periods of stockpiling occur (i.e. greater than one week) the soils should be removed to a treatment area and lime applied. Appropriate stormwater and sediment controls should be in place. Extended periods of stockpiling

may require leachate collection and monitoring. Where monitoring of the leachate indicates low pH, the addition of a neutralising agent (e.g. lime) will be required prior to discharge to stormwater.

Where temporary stockpiles are created, stockpiles should be placed on relatively level ground, and away (e.g. at least 40m) from nearby waterways. Stockpile heights should be kept to a maximum of 2m, and stockpile areas should be bunded with appropriate sediment controls such as silt fences or hay bales.

6.7. Liming Methodology

A suitable supply of lime should be available on site during the construction works when ASS is identified in order to enable efficient neutralisation of ASS. A lime register should be maintained by the contractor to record the amount of lime delivered and used on site.

The type and amount of lime to be applied will be such that a neutralising value (NV) of 95 can be achieved. NV relates to the purity of the lime and an NV of 100 is required to ensure that the lime is effective in neutralising the potential acid. Fine powdered agricultural lime (CaCO_3) generally has an NV of 90% to 100% whilst other manufactured forms of lime can have an NV as low as 80%. Where NV is below 100, the factor of safety, hence the amount of lime, will have to be adjusted accordingly.

Liming should be undertaken inside a treatment pad constructed as outlined above. The following liming procedures (or other equivalent) should be undertaken:

- If practical, spreading of the soil in thin (<200mm) layers within the boundary of the site works; and
- Addition of lime followed by mixing, using excavated bucket or equivalent. The equipment used should be based on the ease of mixing. Should silty clays be encountered then more robust liming machinery may be required (eg pug mill).

6.8. Liming Rate

In the event that potential acid sulphate soils are encountered the assessed liming rate of 21kg agricultural lime (CaCO_3) per tonne of soils should be utilised to treat the PASS material.

6.9. Offsite Disposal Acid Sulfate Soils

6.9.1. Offsite Disposal

Once treated with lime the soils may be disposed of to an appropriately licensed landfill following a waste classification. The waste classification and disposal should be undertaken in accordance with relevant standards and requirements, including the NSW DECCW (2014) *Waste Classification Guidelines – Part 4*.

7. Dewatering

7.1. Management of dewatering activities

Groundwater is located about 2.0m below ground surface and may be encountered. Some dewatering may also be required from the excavations and sumps (if installed). Groundwater parameters should be monitored and analysed prior to dewatering. This should include pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), chloride, sulfate and heavy metal concentrations,

If there is a potential for the groundwater table to be lowered for a considerable period of time (several weeks or months) the Contractor should install and/or employ an appropriate groundwater control system to minimise the ingress of groundwater into the excavation such that the surrounding groundwater table will be maintained. The surrounding groundwater level should be monitored for pH regularly by the Contractor, and this should involve monitoring from nearby existing wells or installation of new monitoring wells. The Contractor should also endeavour to minimise the length of dewatering where possible.

Options for disposal of groundwater include:

- Land irrigation;
- Disposal to the Hunter River or local stormwater or sewer systems; and
- Offsite disposal to a wastewater disposal facility.

The most effective option would be land irrigation, or re-injection via existing wells or upgradient trenches as this will assist in maintaining groundwater levels. Confirmation of requirement of specific permission from regulatory authorities should be sought from the NSW Department of Industry, Water prior to undertaking this activity. Based on the groundwater assessment undertaken as part of a Detailed Site Investigation undertaken at the Site and reported in 754-NTLEN213472-RO8, the water should be suitable for disposal to stormwater and specific discussions with Council should be undertaken to confirm this as a disposal option.

Should groundwater require pH adjustment prior to disposal offsite or to stormwater, the following general procedures should be followed:

- Water should be placed in an acid-resistant holding tank or pond, and samples collected to assess the pH, electrical conductivity, chloride, sulfate ions, and heavy metals;
- Should pH adjustment be required, a neutralising agent should be added to the water at a rate assessed from the results of the testing and Table 7.1 of Management Guidelines in the ASSMAC (1998) *Acid Sulfate Soils Manual* (a copy is attached);
- Following treatment, the water should be re-sampled and tested again for pH, electrical conductivity and metals to assess the disposal options; and

Depending on the laboratory results, the treated water could either be applied to land, discharged to stormwater or be removed and disposed by a licensed liquid waste contractor. Permission from the relevant regulatory authority (i.e. NSW Office of Water and/or Newcastle City Council) must be obtained before disposal to stormwater networks.

8. Performance criteria and verification testing

In order to demonstrate that appropriate quantities of lime have been used, a lime register shall be maintained by the Contractor. The register shall list the amount of lime delivered to the site, verified by delivery dockets, and where/when the lime has been used. The lime usage shall quantify areas limed and soil volumes treated, liming rates and quantities of lime used. The amount of lime to be kept on-site for emergencies will be assessed by the Contractor.

A validation plan shall be prepared in consultation with an experienced ASS consultant which will be based on Section 8.2 of Dear et al (2014) and will depend on the quantities and production rates of ASS treatment. The principals should be as follows:

- Minimum 3 test samples or 1 sample per 250m³;
- Each test sample to be made from a composite of six individual samples;
- Samples to be tested using the S_{CR} suite with full acid base accounting including retained acidity.

Assuming the soil type is medium- and fine-textured material (sandy clay), the performance criteria will be:

- No single sample shall exceed a net acidity of 62 moles H⁺/tonne (0.10% S) where disturbance is less than 1,000 tonnes. A net acidity of 18 moles H⁺/tonne (0.03%S) will be used where disturbance is greater than 1,000 tonnes
- If any single sample is between 0 and 62 moles H⁺/tonne (or 0 and 18 moles H⁺/tonne if greater than 1000 tonnes), then the average of any four spatially adjacent samples (including the exceeding sample) shall have an average net acidity of zero or less.

9. Monitoring and Reporting

Complete records of all testing, treatment and monitoring should be kept by the contractor including:

- Results of additional ASS testing and or field screening;
- Groundwater monitoring results and details of the dewatering methodology;
- Records of off-site disposal and monitoring results;
- The lime register;
- Results of verification testing;
- Results of Waste Classification if disposed off site and
- Validation Reports (if material is re-used on site)

This report must be read in conjunction with the attached sheet entitled “*Important Information about your Coffey Environmental Report*”, which can be found at the end of this report.

10. References

- Ahearn CR, McElnea AE, Sullivan LA (2004) *Acid Sulfate Soil Laboratory Methods Guidelines in Queensland Acid Sulfate Soils Manual*. Department of Natural Resources Mines and Energy Indooroopilly, Queensland, Australia;
- 1:250,000 scale Newcastle series sheet;
- Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M., (2014). *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines*. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government.
- Department of Water and Conservation 1:25,000 Acid Sulfate Soil Risk Map;
- Newcastle City Council, Newcastle Local Environmental Plan 2012, Acid Sulfate Soils Map, SheetASS_004;
- NSW Acid Sulfate Soil Management Advisory Committee (1998) *Acid Sulfate Soil Manual*;
- NSW Office of Environment and Heritage (2011) *Contaminated Sites: Guidance for Consultants Reporting on Contaminated Sites*;
- NSW Environmental Protection Authority (2014) *Waste Classification Guidelines – Part 1: Classifying Waste*; and
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G, 2018, National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra ACT. CC BY 4.0.

Important information about your **Coffey** Environmental Report

Introduction

This report has been prepared by Coffey for you, as Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

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.

The 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. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice,

This interpretation 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. Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

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 pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Coffey should be kept apprised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statutes and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but

steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Coffey 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 the report.

To avoid misuse of the information presented in your report, we recommend that Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Coffey prepared the report and has familiarity with the site, Coffey is well placed to provide such

assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

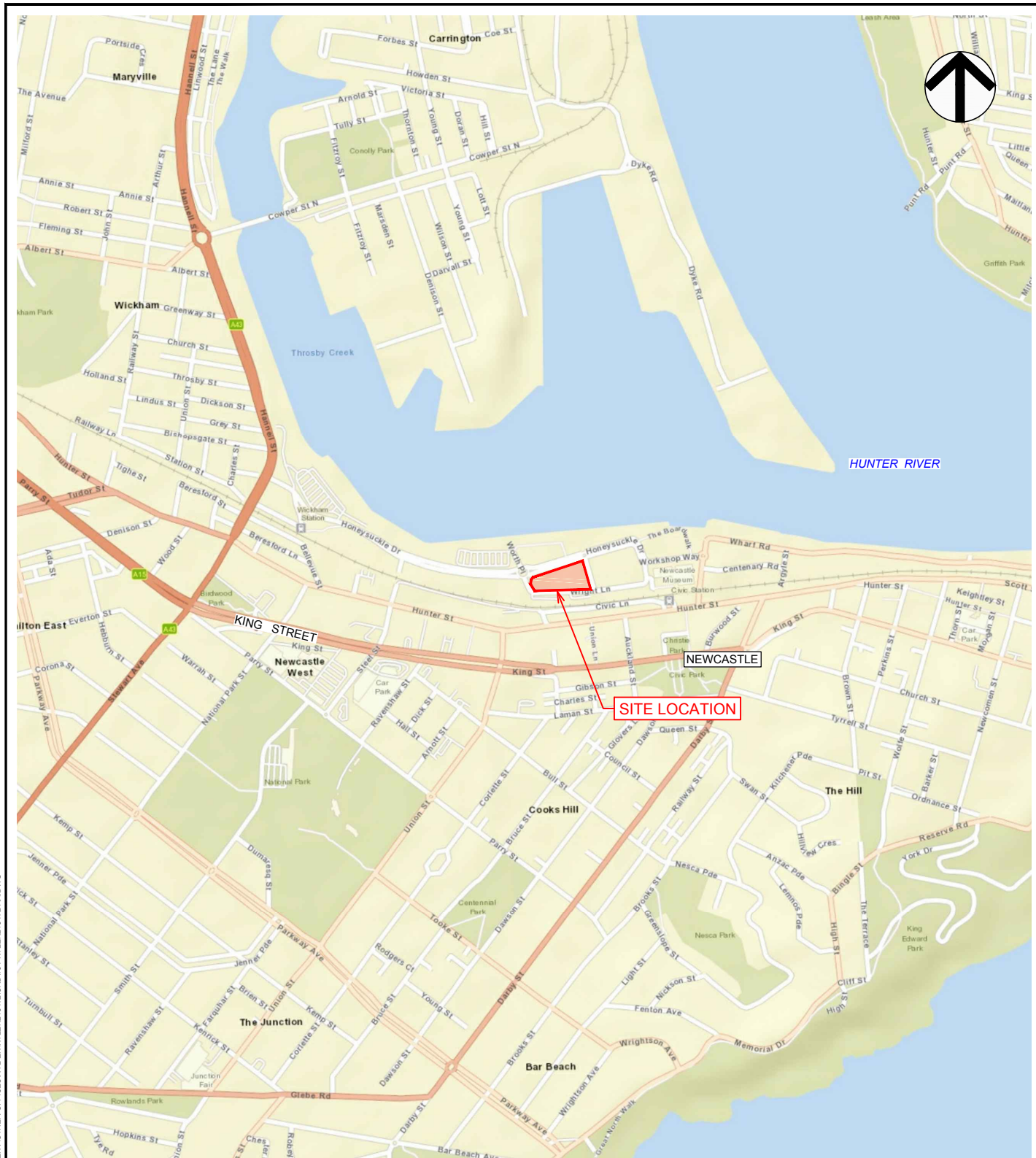
The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Appendix A – Figures



Scale (metres) 1:15000

IMAGERY SOURCE: WORLD STREET MAP
 SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN,
 METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, ©
 OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

drawn	SR / AW
approved	-
date	22 / 01 / 19
scale	AS SHOWN
original size	A4



client:	UNIVERSITY OF NEWCASTLE		
project:	HONEYSUCKLE CITY CAMPUS DEVELOPMENT 16 HONEYSUCKLE DRIVE, NEWCASTLE, NSW		
title:	SITE LOCATION PLAN		
project no:	754-NTLEN213472-R09	figure no:	FIGURE 1
		rev:	A



LEGEND

FORMER BOREHOLE LOCATION

BOREHOLE LOCATION

MONITORING WELL LOCATION

SURFACE SOIL SAMPLE LOCATION

revision	no.	description				drawn	approved	date
	A	ORIGINAL ISSUE						

10

0

10

30

50

Scale (metres) 1:1000

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drawn	SR / AW
approved	-
date	23 / 01 / 19
scale	AS SHOWN
original size	A3

coffey

A TETRA TECH COMPANY

client: UNIVERSITY OF NEWCASTLE	
project: HONEYSUCKLE CITY CAMPUS DEVELOPMENT 16 HONEYSUCKLE DRIVE, NEWCASTLE, NSW	
title: BOREHOLE LOCATION PLAN	
project no: 754-NTLEN213472-R09	figure no: FIGURE 2
rev: A	

Appendix B – ASS Assessment Results



Table LR1
Acid Sulfate Soil Results Table
HCCD - Site 1
754-NTLEN213472

				Field ID	BHP9 3.4-3.5	BHP9 3.8-3.9	BHP11 2.8-2.9	BHP11 3.3-3.5	BHP13 2.5-2.6	BHP14 2.5-2.8	BHP14 3.3-3.5	BHP15 2.5-2.8	BHP16 2.8-3.0	BHP18 2.7-3.0	BHP18 3.5-3.8	BHP19 3.1-3.3	BHP20 2.9-3.0
				Sampled Date	18-Dec-18	18-Dec-18	19-Dec-18	19-Dec-18	18-Dec-18	19-Dec-18	19-Dec-18	19-Dec-18	19-Dec-18	19-Dec-18	19-Dec-18	19-Dec-18	18-Dec-18
	Units	EQL	Action Criteria if More than 1,000 tonnes disturbed - Sulfur Trail %S (Coarse Texture)	Action Criteria if More than 1,000 tonnes disturbed - Acid Trail mol H+ (Coarse Texture)													
pH-F (Field pH test)	pH Units	0.1			8.9	9.1	8.9	9	9.2	9.2	8.9	9.3	9.1	8.8	9.3	8.6	8.7
pH-FOX (Field pH Peroxide test)	pH Units	0.1			7.1	7.2	7.4	3.6	3	7.7	2.8	7.5	7.6	7.4	3.9	7.8	7.4
Reaction Ratings*	Comment				2	2	4	2	4	2	4	2	4	2	4	4	2
pH KCl (23A)	pH Unit	0.1			9.2	9.3	-	9.1	8.9	-	8.7	9.5	9.6	-	8.8	9.4	9.3
Titratable Actual Acidity	mole H+ / t	2	18		< 2	< 2	-	< 2	< 2	-	< 2	< 2	< 2	-	< 2	< 2	< 2
sulfidic - Titratable Actual Acidity	% pyrite S	0.02			< 0.02	< 0.02	-	< 0.02	< 0.02	-	< 0.02	< 0.02	< 0.02	-	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur	% S	0.005	0.03		0.035	0.032	-	0.087	0.24	-	0.19	0.015	0.023	-	0.44	0.18	0.052
Calculated Liming Rate (Coffey)	kg CaCO3/t				1.64	1.5	-	4.07	11.24	-	8.9	0.7	1.08	-	20.59	8.42	2.43
acidity - Chromium Reducible Sulfur	mole H+ / t	3			22	20	-	54	150	-	120	< 3	14	-	270	110	33
Acid Neutralising Capacity	% CaCO3	0.01			1.9	1.9	-	2	2	-	0.9	6.2	6.5	-	3.4	18	9.5
acidity - Acid Neutralising Capacity	mole H+ / t	10			380	380	-	410	390	-	180	1200	1300	-	690	3500	1900
sulfidic - Acid Neutralising Capacity	% pyrite S	0.01			0.61	0.61	-	0.65	0.63	-	0.29	2	2.1	-	1.1	5.7	3.1
ANC Fineness Factor		0.5			1.5	1.5	-	1.5	1.5	-	1.5	1.5	1.5	-	1.5	1.5	1.5
Net Acidity (sulfur units)	% S	0.02			n/a	n/a	-	n/a	n/a	-	n/a	n/a	n/a	-	n/a	n/a	n/a
Net Acidity (acidity units)	mole H+ / t	10			n/a	n/a	-	n/a	n/a	-	n/a	n/a	n/a	-	n/a	n/a	n/a
Liming Rate	kg CaCO3/t	1			< 1	< 1	-	< 1	< 1	-	< 1	< 1	< 1	-	< 1	< 1	< 1
Net Acidity excluding ANC (sulfur units)	% S	0.02			n/a	n/a	-	n/a	n/a	-	n/a	n/a	n/a	-	n/a	n/a	n/a
Net Acidity excluding ANC (acidity units)	mole H+ / t	10			<10	<10	-	<10	<10	-	<10	<10	<10	-	<10	<10	<10
Liming Rate excluding ANC	kg CaCO3/t	1			n/a	n/a	-	n/a	n/a	-	n/a	n/a	n/a	-	n/a	n/a	n/a
Acid Volatile Sulfur	%	0.001			n/a	n/a	-	n/a	n/a	-	n/a	n/a	n/a	-	n/a	n/a	n/a
Exceeds Action Criteria																	

N/R - ANC not required as pH KCl less than 6.5
* Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth; 4.0; Extreme reaction.

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