# CONSULTING EARTH SCIENTISTS

**ACID SULFATE SOILS MANAGEMENT PLAN**
**COOKS COVE DEVELOPMENT ZONE**
**ARNCLIFFE & BANKSIA, NSW**

CES DOCUMENT REFERENCE: CES130608-BP-AZ


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# 1 INTRODUCTION

## *1.1 PROJECT BACKGROUND*

This report has been prepared, on behalf of Cook Cove Inlet Pty Ltd, to support a Planning Proposal which seeks to amend the Bayside Local Environmental Plan 2021 (BLEP 2021) to rezone land known as Cook Cove. The rezoning process will insert planning controls for Cook Cove within BLEP 2011 and consequently remove the same area from State Environmental Planning Policy (Precincts- Eastern Harbour City) 2021 (formerly Sydney Regional Environmental Plan No. 33 – Cooks Cove (SREP 33)) which currently applies to the site.

CES understands that the Cooks Cove Master Plan will include a net development zone of approximately 15ha with up to 343,250m$^2$ Gross Floor Area (GFA) comprising:

- 290,000m$^2$ of multi-level logistics and warehousing;
- 20,000m$^2$ for hotel and visitor accommodation uses;
- 22,350m$^2$ for commercial office uses;
- 10,900m$^2$ of retail uses.

The proposal will limit gross floor area (GFA) to the south of Marsh Street to 340,000m$^2$, with a further 1.25:1 Floor Space Ratio (circa 3,250m$^2$ of GFA) to the north of Marsh Street, to achieve the overall intended logistics, commercial, retail and short-term accommodation land uses.

Cook Cove is located in the suburb of Arncliffe within the Bayside Council Local Government Area (LGA). The site is located to the west of the Cooks River, approximately 10 south of the Sydney Central Business District. The site enjoys adjacency to key trade related infrastructure being immediately west of Sydney Kingsford Smith International Airport and approximately 6 km west of Port Botany precinct.

The Cooks Cove Planning Proposal aims to facilitate the long planned transformation of 36 Ha of underutilised and strategically important land at Arncliffe, located to the north of the M5 motorway and adjacent the western foreshore of the Cooks River. The project seeks a renewed focus on delivering a contemporary logistics and warehousing precinct within a well connected location,

surrounded by enhanced open space provisions. The site forms part of the Bayside West 2036 Precinct and generally comprises the footprint of the current Kogarah Golf Club.

This report is an Acid Sulfate Soils Management Plan (ASSMP) prepared by Consulting Earth Scientists (CES) for the Cook Cove Development (CCD) site. The site location plan is presented in Figure 1.

This document supports the public exhibition and assessment of the Cook Cove Planning Proposal (PP-2022-1748) which was issued a Gateway Determination by the Department of Planning and Environment on 5 August 2022.

This ASSMP applies to the Cooks Cove Northern Precinct as presented in Figure 2. The Northern Precinct was previously described as Areas A and B of the CCD site in earlier studies.

This ASSMP presents how the proposed bulk earthworks will be managed to ensure the risks associated with ASS are minimised. This plan refers to all construction and open space works associated with the site as presented in Figure 2.

### *1.2 SITE BACKGROUND*

The site is located within the Bayside Local Government Area (formerly Rockdale City Council). The Cook Cove Northern Precinct site is currently zoned as a combination of Trade and Technology, Special Uses and Open Space under SREP 33. The Planning Proposal will seek new land use zones within the development zone, including a primary SP4 Enterprise zone across the majority of the Kogarah Golf Course freehold land, RE1 Public Recreation foreshore and passive open space zones and elements of SP2 Infrastructure. The Northern Precinct covers an approximate area of 36 ha.

As part of Stage 1 of the M6 motorway construction, WestConnex is currently temporarily occupying a portion of the Northern Precinct, which has been called the Arncliffe Motorway Complex (AMC) and the WestConnex Temporary Compound (WTC). These areas have not been assessed by CES as part of this project. The areas assessed by CES cover approximately 29.5 Ha.

### *1.3 BACKGROUND INFORMATION ON ACID SULFATE SOILS*

Acid Sulfate Soils are the common name given to naturally occurring sediments and soils containing iron sulfides (principally iron sulfide or iron disulfide or their precursors). The exposure

of the sulfide in these soils to oxygen by drainage or excavation may lead to the generation of sulfuric acid.

Acid Sulfate Soils (ASS) include Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS). AASS and PASS are often found in the same soil profile, with AASS generally overlying PASS horizons.

AASS are 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. These soils can usually be identified by the presence of pale yellow mottles and coatings of jarosite. PASS are soils which contain iron sulfides or sulfidic materials which have not been exposed to air and oxidised. The field pH of these soils in their undisturbed state is 4 or more and may be neutral or slightly alkaline. However they pose a considerable environmental risk when disturbed, as they can become strongly acidic following oxidation on exposure to the air.

Characteristics of ASS typically include:

- Sediments of recent geological age (Holocene) up to 10,000 years old.
- Formation in soil horizons at an elevation of less than 5m AHD.
- Formation in marine or estuarine sediments and tidal lakes.
- Formation in coastal wetlands or back swamp areas; waterlogged or scalded areas interdune swales or coastal sand dunes.
- Formation where the dominant vegetation is mangroves, reeds, rushes and other swamp tolerant and marine vegetation.
- They may be present in areas identified in geological descriptions or in maps bearing sulfide minerals, coal deposits or former marine shales/sediments.
- They may be present in deeper older estuarine sediments greater than 10m below the ground surface of Holocene or Pleistocene age.
- They possess visual and olfactory indicators such as sulfidic odours, bright yellow, yellow or straw-coloured mottling and pore space and fissure infill and coatings that could indicate the presence of jarosite, goethite or other similar acid producing sulfate minerals.
- They may be indicated by the presence of shells, organic matter and dark reddish streaks that would indicate the presence of iron oxides.

- They may be indicated by the presence of dark grey or black monosulfidic sediments or material showing the characteristics of fluvial bottom sediments or sediments deposited in a lacustrine environment.

### *1.4 BAYSIDE LOCAL ENVIROMENTAL PLAN (2021)*

With reference to Clause 6.1 of Bayside LEP (2021) for Acid sulfate soils, which states:

1. The objective of this clause is to ensure that development does not disturb, expose or drain acid sulfate soils and cause environmental damage.

2. Development consent is required for the carrying out of works described in the Table to this subclause on land shown on the Acid Sulfate Soils Map as being of the class specified for those works.

## 2 OBJECTIVES AND SCOPE

The objectives of this report are to provide an ASSMP detailing the possible extent of ASS on the Site and providing the Client with suitable management strategies and concepts to minimise impact to the environment during the earthworks.

To achieve these objectives, the following scope of works was undertaken:

1. Desk study: a review of relevant information relating to ASS was undertaken, including previous ground investigation reports in the area, soil and geological maps, ASS planning maps, and the *Acid Sulfate Soil Manual,* NSW ASSMAC (1998);
2. Review of the proposed development works potentially affected by ASS; and
3. Preparation of this ASSMP.

# 3 SITE INFORMATION

## *3.1 SITE IDENTIFICATION*

The Cooks Cove Planning Proposal site consists of the following areas:

- Kogarah Golf Course (KGC);
- WestConnex Temporary Compound (WTC); and
- 19 Marsh Street, Arncliffe.

Information on each of the areas is provided in the Table 1.

**Table 1**: Site Identification

| Identification | Legal Description |
|---|---|
| Kogarah Golf Club (KGC) | Lot 100 DP 1231954 Part of Lot 1 DP108492 |
| WestConnex Temporary Compound (WTC) | Part of Lot 1 DP 108492<br>Part of Lot 14 DP 213314<br>Part of Lot 1 DP329283 |
| 19 Marsh Street | Part of Lot 31 DP 1231486 |

## *3.2 SITE DESCRIPTION*

### 3.2.1 Cook Cove

Cook Cove is located in the suburbs of Arncliffe and Banksia within the Bayside Council Local Government Area (LGA). The site is located to the west of the Cooks River and Sydney Kingsford Smith Airport, approximately 10km south of the Sydney Central Business District (CBD), 6km west of Port Botany and 1.5km north-east of the Rockdale local town centre.

Cook Cove is strategically located within close proximity to a number of railway stations including Rockdale, Banksia, Arncliffe, Wolli Creek and the International Airport Terminal, which vary in distance from the site between 500m and 1.5km. The M5 motorway, which provides regional connectivity to the Sydney Metropolitan area, dissects the site into two distinct precincts, the Northern Precinct and Southern Precinct.

### 3.2.2 Cook Cove Northern Precinct

The Cook Cove Northern Precinct is located to the north of the M5 Motorway and Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS), and is generally bound by the Cooks River to the east and Marsh Street to the north and west. The site is approximately 36ha and is owned and managed by a number of landowners, both public and private, including Kogarah Golf Club. Surrounding development includes a mix of low to medium density housing, recreation and open space and road and airport related infrastructure.

### 3.2.3 Kogarah Golf Club

Kogarah Golf Club was established in 1928, with the course occupying the land, now known as the Cook Cove Northern Precinct, since 1955. At this time, the Cooks River was reconfigured to its current alignment. The land presents a highly modified environment, with relatively flat topography, gently moulded fairways and greens, separated by strips of vegetation and man-made water bodies. The golf course clubhouse, car park and maintenance facilities are located in the northern corner of the site, adjacent the Cooks River. Access is provided via Levey Street.

### 3.2.4 Arncliffe Motorway Operation Complex

During 2016, the existing 18-hole championship golf course was progressively converted to a 15-hole operation due to the resumption of land for the widening of Marsh Street (March 2016) and the establishment of the temporary construction compound for the WestConnex New M5 tunnelling works (June 2016)(M8) and later Stage 1 of the M6 Motorway project . The temporary WestConnex facility occupies approximately 7.5ha and is expected to remain in its current arrangement until 2025. At this time the facility will reduce to approximately 1.5 ha to accommodate the permanent Arncliffe Motorway Operation Complex, located in the western corner of the site, adjacent Marsh Street. The complex will house plant and maintenance equipment for the sub-grade motorway.

### 3.2.5 RTA Frog Ponds

The Northern Precinct contains the existing RTA Frog Ponds, located in the south-west corner of the site, adjacent Marsh Street and SWSOOS. The two fenced areas contain ponds, constructed by the RTA as part of the M5 Motorway construction in 2002, as compensatory habitat for the Green and Golden Bell Frog.

### 3.2.6 Easements and Affectations

The Sydney Desalination Plant pipeline runs through the Northern Precinct, north-south adjacent the Cooks River from Kurnell, located to the south of Botany Bay. The pipe has a diameter of 1.8m and sits within an easement of approximately 6m in width. The Moomba Sydney Pipeline, containing ethane gas, runs along the eastern boundary of the Northern Precinct, adjacent the Cooks River. The pipeline easement is generally 5m wide with the pipe located at a depth of 1.2m-2.3m, with a diameter of 225mm nominal. .

## *3.3 SITE TOPOGRAPHY*

A review of the Botany Bay 1:25,000 Topographic Map (9130-3-S) indicates that the site elevation ranges from 0 to 6m above Australian Height Datum (AHD). The site topography has been significantly modified through the placement of fill material over the original swamp and delta. An undulating surface has been created to form the golf course including several small lakes.

The site generally drains in an easterly direction towards the Cooks River, although localised flow paths occur across the golf course, including an un-named intermittent stream draining the golf course shown on the 1:25,000 Topographic Map. In addition, the central portion of the golf course drains internally towards a series of lakes.

### *3.4 SITE GEOLOGY AND SOILS*

A review of the Sydney 1:100,000 Geological Series map indicated that the site is underlain by silty to peaty quartz sand, silt and clay. Ferruginous and humic cementation occurs in places with common shell layers also reported. This material is most likely of alluvial origin, deposited as sub-aerial and sub-aqueous components of the Cooks River delta. This deposit was reworked significantly last century as part of river diversion and training works. These works would have involved significant dredging operations.

An outcrop of Hawkesbury Sandstone is also shown in the location of the existing Kogarah Golf Club House. A review of the Sydney 1: 100,000 Soil Landscape Sheet 9130 indicated that the site is underlain by anthropogenic fill material. The southern portion of the site is underlain by sandy soils which are believed to have been dredged from the Cooks River and deposited on the site to from the KGC golf course.

A review of the Sydney 1:100,000 Soil Landscape Series Map (Sheet 9130: Soil Conservation Service of NSW, 1983) indicates that the site is underlain by a combination of Disturbed Terrain and Warriewood Soil Landscape Group. Disturbed Terrain is related to the former use of the site as a landfill. The Warriewood Soil Landscape Group is characterised by *"level to gently undulating swales, depressions and infilled lagoons. Soils generally consist of deep (< 150 cm) well sorted sandy Humus Podzols and dark, mottled Siliceous Sands, overlying buried Acid Peats in depressions or deep Podzols and pale Siliceous Sands on sandy rises"*.

### *3.5 ACID SULFATE SOILS MAPS*

The Botany Bay 1:25,000 Acid Sulfate Soils (ASS) Risk Map indicates the site is located within an Acid Sulfate Soil (ASS) zone. According to the ASS risk map, the majority of the site has been classified as Wa2, natural soils characterised as Aeolian (W) sandplain (a) found at between 2 and 4m AHD. The red shading (refer to Figure 3) indicates high probability of ASS occurrence. Wa2 soils are described as environmental risk if acid sulfate soil materials are disturbed by activities such as deep excavations for pipelines, dams and deep drains.

A small portion at the south-west corner of the site is classified as X4. These soils are characterised as Disturbed Terrain (X) found above an elevation of 4 mAHD. The grey shading (refer to Figure

3) indicates disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees.

### *3.6 HYDROGEOLOGY*

The groundwater at this site is expected to lie within a shallow unconfined aquifer, although localised layers of low permeability (eg. clay, peat and layers of localised iron-cemented sand) may act as local confining layers. Groundwater at the site is expected to flow in an easterly direction towards the Cooks River.

The Cooks River, Muddy Creek and the Spring Street Canal are tidal in the study area. It is expected that saline or brackish intrusion occurs around the periphery of the site. Diurnal fluctuations in groundwater levels in the peripheral areas are also expected to occur in response to tidal cycles.

## 4 SITE ASSESSMENT AND CHARACTERISATION

### *4.1 CES, SOIL SAMPLING AND ANALYSIS, 2001 AND 2008*

A limited sampling and analysis programme to assess the presence of ASS was undertaken by CES (CES, 2001). The seven out of ten samples collected in the 2001 investigation exceeded the assessment criterion, thus indicating that PASS were present on the majority of the site.

Eighteen samples collected from forty-six sampling locations during the 2008 investigations (CES, 2008a, 2008b, 2008c, 2008d, 2008e) were submitted for Peroxide Oxidation Combined Acidity and Sulfate (sPOCAS) laboratory analysis. The summarised results of laboratory analysis together with action criteria are provided in Table A1, Appendix A.

Results of the sPOCAS tests confirmed that all but two of the samples were classified as PASS. Both the Total Potential Acidity (TPA) and the Total Sulfidic Acidity (TSA) exceeded the Acid Sulfate Soil Management Advisory Committee (ASSMAC, 1998) criteria which are provided in Table 2. On the basis of this data the material is classified as PASS.

Based on the sPOCAS results, lime dosing rates of between 5.2 and 112 kg lime $T^{-1}$ were calculated for the soil samples. These results indicate the acid generating potential of the soils is vastly different between sampling points and that any PASS that requires neutralisation should be assessed to determine lime dosing rates.

From review of background information, analysis of soil samples collected from the site and in consideration of the location of the site, it is expected that most of the site is likely to be underlain by Acid Sulfate Soils (ASS) and/or Potential Acid Sulfate Soils (PASS). Therefore, it will be assumed that ASS and/or PASS are present beneath the site.

### *4.2 EXCAVATIONS AND ACID SULFATE SOILS*

In consideration of the results documented in Section 4.1, any excavation into natural ground on the subject site has the potential to disturb PASS and expose it to the air so that it oxidises and becomes ASS. A Remediation Action Plan (RAP, CES 2016) for the various areas of the site will guide excavation and management of the contaminated fill, while management of PASS/ASS will be managed with reference to this plan.

Further review of the potential ASS risk for excavation areas that are covered in this ASSMP should be undertaken once the development drawings and proposed depth of excavations are available.

The ASS risk maps are included in Figure 3.

### *4.3 SAMPLING ADEQUACY*

As part of the CES sampling regime, a total of forty-six sampling locations with eighteen samples collected and tested for sPOCAS have been undertaken to date for ASS assessment at the site. Despite non-conformance to ASSMAC Guidelines (1998), CES considers the current sampling regime to be adequate in consideration of the expected disturbance area and current development plans of the site. Further sampling and testing works will be required if the disturbance area within the site is enlarged as a result of updated development plans. The further works are recommended to be undertaken in accordance with ASSMAC Guidelines (1998) and the planning controls within the Development Control Plan.

# 5 EXCAVATION OF ACID SULFATE SOILS

A summary of the methodology and process of excavating the ASS is provided below:

## *5.1 EXCAVATION METHODOLOGY*

The following recommendations are provided in relation to excavation of ASS at the site:

- Excavations should be carried out in a carefully managed and controlled sequence designed to reduce to a minimum, the amount of ASS (if encountered) disturbed and exposed at any one time. The excavation should also be carried out so that potentially acidic water within the excavation cannot migrate from the excavations.

  For the above reasons, consideration should be given to the use of bunding around the excavation area.

- Where necessary to excavate ASS, the excavated ASS should be placed either directly into trucks with sealed trays and/or placed directly into a designated Containment Area to prevent spillage, egress or leakage of water/leachate during handling and transportation.

  The designated Containment Area should consist of a bunded area of adequate size to contain the excavated ASS. The Containment Area shall have low permeability sides and base to contain any leachate produced. The size of the containment area will require to be a function of the anticipated excavation rate.

- Testing of groundwater within the excavations or testing of any leachate contained in the Containment Area should include pH (by simple field indicator tests). The pH should be between 6.5 and 8.5. If pH is not between 6.5 and 8.5, then treatment of the water by lime neutralisation will be required.

  Once the testing indicates the pH of the leachate/groundwater is between 6.5 and 8.5, the water can be considered neutralised and suitable for discharge (in accordance with relevant Authority requirements). Treated water that does not meet the criteria as listed above must be retreated and retested until it meets the test criteria.

Adequate water management will be required during the works to contain any potential acid leachate and to prevent clean storm/surface water from coming into contact with disturbed soil and/or leachate.

## *5.2 GROUNDWATER AND STORMWATER MANAGEMENT*

A Groundwater and Stormwater Management Strategy should be implemented for any excavations into natural ground and any groundwater remediation works, and include the following:

- Methods for dewatering the excavation if required;
- Methods for monitoring groundwater fluctuations in the natural superficial deposits in the event that a groundwater remediation system is implemented;
- Volumes of groundwater expected to be produced during dewatering and/or remediation;
- Storage and treatment methodology of any pumped groundwater and stormwater;
- Monitoring requirements for pumped groundwater and stormwater;
- Monitoring of sentinel (boundary) wells along the banks of Muddy Creek and Cooks River;
- Discharge methods of water; and
- Procedure of record keeping detailing monitoring results, discharge times and volumes.

The following should be included in the Groundwater and Stormwater Management Plan considering the ASS present onsite:

- The depth of dewatering (as a result of excavations or remediation) should be minimised to reduce the generation of ASS and or acidic conditions. The dewatering and excavation should be staged over short durations to reduce the time and volume of ASS exposed to oxidation in the excavation. This is an important consideration if disposal below the permanent groundwater table is to be used to manage the ASS.
- Approvals for the disposal of groundwater and stormwater may need to be obtained from Council, the NSW Office of Water, Sydney Water and any other relevant authority, considering that the Site contains ASS;
- Water from the excavation, remediation and potentially impacted stormwater should be collected in portable tanks or a suitably designed engineered pond where samples can be obtained for analysis;
- Prior to disposal, the pH of the water should be in the range of 6.5 to 8.5. If the pH is outside this range some treatment may be required prior to disposal;
- pH of groundwater should be monitored on a regular basis throughout the excavation, remediation and construction period, and treatment may be necessary to address a change in pH;
- The approvals for disposal from the relevant authorities may require further contaminants to be scheduled for analysis.

Stormwater should be diverted away from excavations and stockpiles by a series of bunds to be retained until excavations are backfilled or until permanent stormwater infrastructure is installed on the site. Management measures for the site should include:

- Stormwater diversion bunds around excavations and designated Containment Areas (as required);
- Minimising surface disturbance and maximising the retention of existing surface cover (pavements, vegetation) during the works;
- Construction of sediment controls downstream of any diversion bunds, hardstand and traffic areas to minimise the off-site migration of sediment; and
- Vehicular access is to be stabilised to prevent tracking of mud onto roads and footpaths. Soil, earth and mud shall be removed from the roadway by sweeping, shovelling or a means other than washing on a daily basis or as required.

# 6 ACID SULFATE SOIL TREATMENT & DISPOSAL OPTIONS

The following ASS management options are provided in relation to the proposed natural soils excavation works. It should be noted that the most effective management strategy for dealing with ASS is to avoid disturbance of ASS. However, if disturbance of ASS cannot be avoided, the following management options/strategies are considered appropriate in order to minimise the impact of disturbance of ASS on the environment:

- Option 1 - Excavation and disposal of potential ASS beneath the water table at an approved landfill, prior to oxidisation;
- Option 2 - Excavation, neutralisation and disposal of ASS at a suitably licensed landfill facility; or
- Option 3 - Excavation, neutralisation and onsite re-use of PASS subject to compliance with EPA general and specific resource recovery exemptions.

Further consideration of these options are presented below:

## *6.1 OPTION 1 - EXCAVATION AND DISPOSAL OF PASS*

For the excavation and disposal of PASS below the water table at a suitably licensed landfill facility, the PASS should be excavated, transported and deposited below the water within a period of no greater than 24 hours. A number of conditions and controls must be satisfied for disposal beneath the water table to be a viable option for the disposal of PASS:

- There must be a suitably licenced landfill within a reasonable distance to the Site to ensure the excavation, transport and disposal can be carried out within 24 hours;
- The PASS should not have been impacted by contaminants; and
- The pH of soils on excavation and immediately prior to disposal has not experienced a significant change.

This management option is considered to be suitable for the proposed excavation works, where soils underlying the Site are considered to be PASS. Sequencing management and control of all excavation works will require careful consideration to prevent oxidization of PASS.

Landfill facilities in the Greater Sydney Area that are licenced to accept PASS as waste have specific agreements with the NSW EPA to accept PASS only if it meets the following criteria (as outlined in the *Waste Classification Guidelines Part 4: Acid Sulfate Soils,* NSW EPA 2014):

- PASS must be kept wet at all times during excavation and subsequent handling, transport and storage until they can be disposed of safely. They must be received at the proposed disposal point within 16 hours of being dug up.
- PASS can only be disposed of in water below the permanent water table before they have had a chance to oxidise, i.e. within 24 hours.
- PASS must be able to be classified as VENM in accordance with the NSW EPA (2014) Waste Classification Guidelines Part 4 Acid Sulfate Soils, even though they contain sulfidic ores or soils.
- The material should have a pH greater than 5.5, both immediately following excavation and immediately prior to disposal beneath the permanent water table; where soil pH is less than 5.5 it must be considered as Actual Acid Sulfate Soil and treated by neutralisation prior to disposal (in accordance with the ASSMAC Guidelines) and then chemically assessed as per the NSW EPA Waste Classification Guidelines, prior to disposal at an appropriate landfill.
- Documentation must be provided to the landfill operator for each truckload of PASS received, indicating that the soil's excavation, transport and handling have been in accordance with the ASSMAC and EPA Guidelines. Information to be included in documentation should include:
    - pH of each load of ASS recorded at the source site and at the disposal site;
    - details of the source site;
    - details of the transporter;
    - date and time of the extraction of the ASS;
    - pH of the ASS at time of extraction;
    - pH of ASS immediately prior to placement under the water in the landfill;
    - name and details of the person classifying the material as ASS;
    - satisfactory review and confirmation by a representative from the landfill of geotechnical and contamination reports pertaining to the source site;
    - an inspection of the source site by a representative of the landfill.

Soil pH levels should be screened during the ASS investigation to verify whether the soils are above pH 5.5. In the event that the soils are above pH of 5.5, this management option would be considered suitable for the Site, provided a suitably licenced landfill is available to accept the waste, and subject to the conditions outlined above and any further conditions imposed by the facility's licence.

### 6.1.1 Assessment Against Waste Classification Guidelines

In accordance with Waste Classification Guidelines Part 4: Acid Sulfate Soils (NSW EPA, 2014) PASS may be disposed of below the permanent water table provided:

- This occurs before they have had a chance to oxidise, i.e. within 24 hours of excavation; and
- They meet the definition of 'virgin excavated natural material' (VENM) under the Protection of the Environment Operations Act 1997, even though they contain sulfidic ores or soils.

In order to assess whether or not the PASS meets the definition of 'virgin excavated natural material', even though it may contain sulphidic ores or soils, a waste classification assessment would be required on the specific material encountered during the works and verification samples and confirmation laboratory analysis is recommended.

## *6.2 OPTION 2 - EXCAVATION, NEUTRALISATION AND OFF-SITE DISPOSAL*

Excavated soil identified as ASS could be treated by neutralisation with lime. The PASS should be spread out within the confines of the designated Containment Area in a maximum 0.3m deep layer, over a thin bed of lime, and allowed to dry. Once dried, a layer of lime should be placed over the excavated ASS and a rotary hoe (or similar) used to mix in the lime and aerate the soil (to allow oxidation).

On completion of lime neutralisation, SPOCAS tests shall be undertaken at a rate of two tests per 10 tonnes or part thereof (the rate is to be reassessed following the initial results). Once the pH is above 5.5 and the sulfur and acid trail are below the levels specified in Table 2, the soil can be considered neutralised.

**Table 2: Action Criteria for ASS**

| Type of Material | | Action Criteria | | | |
|---|---|---|---|---|---|
| | | 1-1000 tonnes disturbed | | > 1000 tonnes disturbed | |
| **Texture** | **Approx Clay Content** *(%<0.002 mm)* | **Sulfur Trail** % S oxidisable (*oven-dry basis*) e.g.: STOS or SPOS | **Acid Trail** mol H+ / tonne (*oven-dry basis*) e.g.: TPA or TSA | **Sulfur Trail** % S oxidisable (*oven-dry basis*) e.g.: STOS or SPOS | **Acid Trail** mol H+ / tonne (*oven-dry basis*) e.g.: TPA or TSA |
| **Coarse** *Sands to loamy sands* | 5 | 0.03 | 18 | 0.03 | 18 |
| **Medium** *Sandy loams to light clays* | 5 – 40 | 0.06 | 36 | 0.03 | 18 |
| **Fine** *Medium to heavy clays and silty clays* | 40 | 0.1 | 62 | 0.03 | 18 |

Source: Table 4.4 – ASSMAC – 1998

Treated soils that do not meet the pH, sulfur trail and acid trail criteria stated in Table 2 must be re-treated with the required extra lime dosage and re-tested until they meet the above criteria.

Based upon existing sPOCAS test results, the required liming rates range between nil and 113kg $CaCO_3$/tonne. It is expected that the majority of natural materials excavated within the ASS zones will require liming at a rate in the vicinity of 11 and 113kg $CaCO_3$/tonne.

Following adequate neutralisation of the ASS, Waste Classification of the soils should be undertaken in accordance with the NSW EPA Waste Classification Guidelines. The material should then be removed from site and disposed of at a suitably licensed landfill facility.

### *6.3 OPTION 3 - EXCAVATION, NEUTRALISATION AND ON-SITE RE-USE*

For the excavation, neutralisation and onsite re-use of treated ASS, the ASS is excavated and neutralised with lime as described above. The treated ASS could be re-used onsite, provided that it is geotechnically and environmentally suitable for purpose. The re-use of treated ASS on site would require the following to be confirmed prior to re-use:

- The ASS has not been impacted by contaminants;
- The acid producing potential of the ASS has been sufficiently neutralised;

- The treated material complies with a General or Specific Resource Recovery Exemption as authorised by the NSW EPA.
- Written approval has been obtained from the NSW EPA and Council; and
- The soil material is geotechnically suitable for use.

# 7 WORK HEALTH AND SAFETY CONSIDERATIONS

A Work Health and Safety (WHS) plan should be prepared to ensure that the works are conducted in a controlled and safe manner with due regard for potential hazards and safe work practices. The WHS plan should be implemented and enforced by the appointed site supervisor. The following considerations should be included, relating to the presence and treatment of ASS at the site.

## *7.1 PERSONNEL AND RESPONSIBILITY*

All personnel should be made aware of the person responsible for implementing health and safety procedures. All personnel should read and understand the WHS plan prior to commencing work and have signed a statement to verify this understanding. Contractors shall be responsible for ensuring that their employees are aware of and comply with the WHS plan.

## *7.2 IDENTIFICATION OF POTENTIAL HAZARDS*

### 7.2.1 Chemical Hazards

Chemicals or compounds that may be present at the site include, but are not limited to:

- Acidic soils
- Heavy metals;
- Total Petroleum Hydrocarbons (TPH);
- Polycyclic Aromatic Hydrocarbons (PAHs); and
- Monocyclic Aromatic Hydrocarbons (benzene, toluene, ethylbenzene, xylenes, BTEX);
- Strongly alkaline materials (Lime).

Potential risks to personnel associated with these compounds, if present at the site, include:

1. Ingestion of soil or liquids;
2. Dermal (skin) contact with contaminated soil or liquids including acidic soils and lime; and
3. Inhalation of dust or aerosols containing contaminants.

### 7.2.2 Physical Hazards

The following physical hazards may exist at the site:

- Heavy equipment;
- Excavations;

- Heat exposure;
- Traffic and vehicle hazards;
- Buried Services;
- Noise;
- Dust;
- Electrical equipment; and
- Any lime or other neutralising agents used in the management of ASS.

## *7.3 MEDICAL SURVEILLANCE*

It is expected that all personnel on the site have undergone specific training for working on contaminated excavation sites and to be participants in a recognised medical surveillance scheme.

## *7.4 SITE WORK PRACTICES*

### 7.4.1 Personal Hygiene

A designated clean location should be allocated for smoking and the consumption of food or drink. These areas should be equipped with hand washing facilities which must be used prior to engaging in these activities. Personnel should be made aware of the location of these facilities.

### 7.4.2 Personal Protection

Personnel should take measures to avoid coming into direct contact with ASS material. Workers are to ensure that soil, surface water or groundwater are not ingested or swallowed and that direct contact with skin is avoided. It is recommended that personnel should wear the following Personal Protective Equipment (PPE):

1. Steel-capped boots;
2. Safety vest;
3. Hard hat meeting AS1801-1981 requirements when working within the site;
4. Hearing protection meeting AS1270-1988 requirements when working around machinery or plant and equipment if noise levels exceed exposure standards;
5. Dust masks meeting appropriate Australian Standards when handling and administering neutralising agents for ASS;
6. Safety glasses or goggles with side shields meeting AS1337-1992 requirements as necessary (particularly during demolition and when neutralising ASS); and

7. Disposable latex gloves for personnel involved in soil or water sampling and the handling of neutralising agents.

## *7.5 EMERGENCY RESPONSE PLAN*

An emergency response plan should be developed for the site.

### 7.5.1 Responsibilities

The site supervisor will be responsible for ensuring that site personnel are aware of emergency services available. A site safety officer should be available during works.

# 8 ENVIRONMENTAL MANAGEMENT CONSIDERATIONS

Excavation works shall be conducted in a manner to minimise environmental impacts and to meet statutory requirements. Site works should comply with the relevant legislation and consent(s).

The contractor should endeavour to:

- Minimise fugitive dust emissions;
- Minimise the volume of water containing suspended sediment leaving the site;
- Ensure that all water discharged from the site conforms to water quality criteria contained in the Council consent conditions, and ASSMAC (1998) guidelines;
- Prevent vehicles from tracking mud on local roads; and
- Ensure that noise and vibration levels conform to legislative requirements.

## *8.1 SITE SECURITY, RESTRICTED ACCESS AND SIGNAGE*

Access to the site should be restricted and gates locked outside operating hours.

Vehicular access to the site shall be through controlled entry and exit points. All loads shall be covered with a tarpaulin prior to leaving the site.

During works, the site will be designated as a construction area. Consequently, access will be restricted to authorised staff and contractors equipped with appropriate Personal Protective Equipment (PPE). Site access will be controlled by the site supervisor. All visitors will report to the site supervisor prior to entering the site.

## *8.2 CONTROL OF DUST AND ODOUR*

It is not expected that dust will be produced by the excavation works as all soil materials are expected to be wet. However, works should be undertaken in a manner that minimises fugitive dust and odour emissions. The following measures can be taken to control dust and odour:

- Careful handling of material in a manner that minimises dust emissions;
- Placement of screening material (e.g., hessian) on perimeter fences adjacent to excavations;
- Spraying dusty parts of the site with water;
- Keeping excavations moist (where practical);
- Use of tarpaulins to cover loads (incoming and outgoing).

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# Figures


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Title

**Figure 1. Site Location Plan**

| CES Project ID: | Date: |
|---|---|
| CES130608-BP | 17/02/2023 |
| Prepared By: T.Goodbody | Checked By: D. Lowe |


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**Figure 2. Site Layout Plan**

| CES Project ID: | Date: |
|---|---|
| CES130608-BP | 17/02/2023 |
| Prepared By: T.Goodbody | Checked By: D. Lowe |

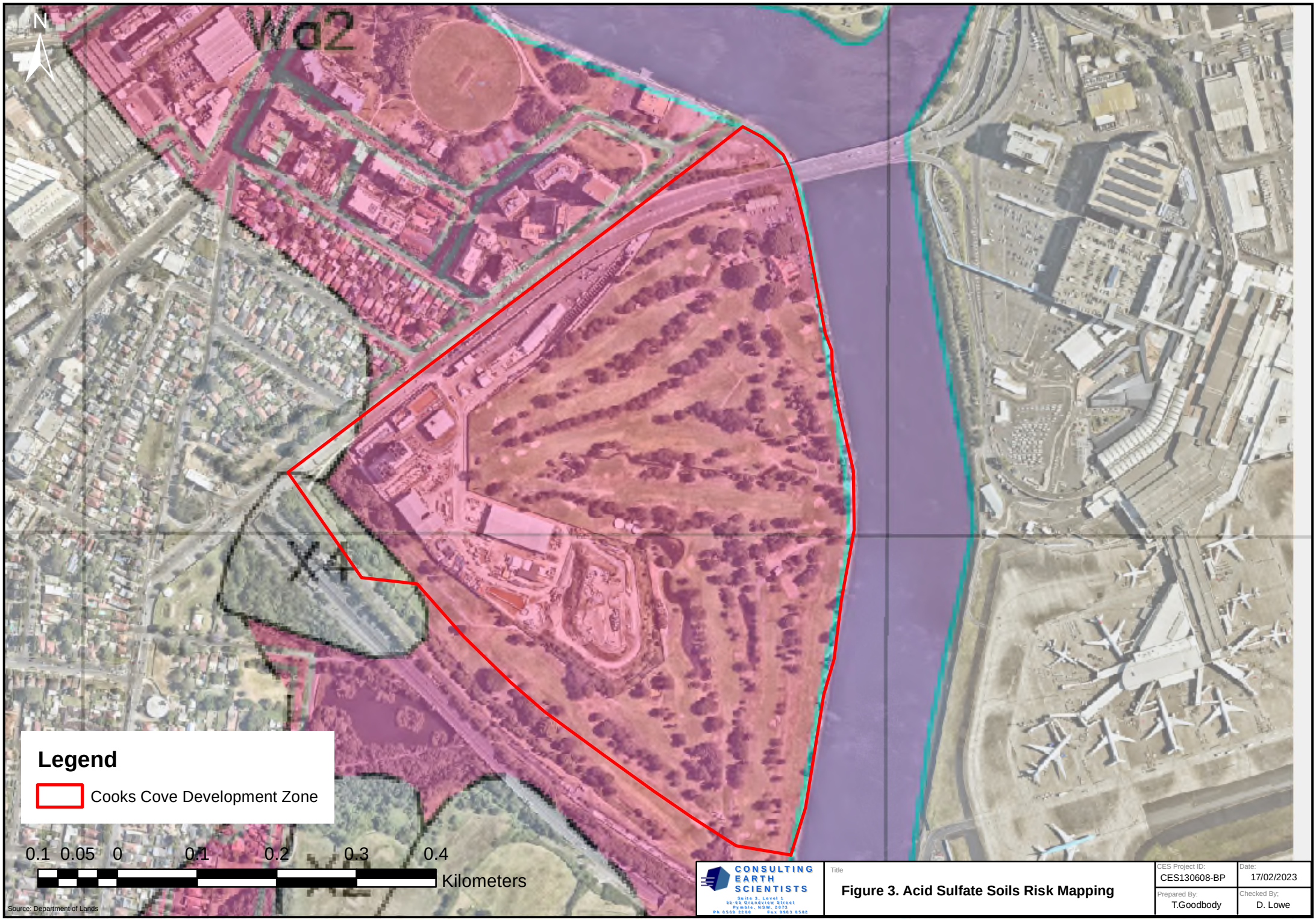


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**Figure 3. Acid Sulfate Soils Risk Mapping**

| CES Project ID: | Date: |
|---|---|
| CES130608-BP | 17/02/2023 |
| Prepared By: T.Goodbody | Checked By: D. Lowe |

# Appendix A
# Laboratory Results

| Table A1: Soil analytical results - sPOCAS - Cooks Cove | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Parameters | | | | TAA (mol H+/tonne) | TPA (mol H+/tonne) | S-KCl (%) | S-P (%) | S-POS (%) | TSA (mol H+/tonne) | Liming Rate |
| Sample | Date | Borehole | Material | | | | | | | kg $CaCO_3$/tonne |
| **Area A** | | | | | | | | | | |
| - | 7-May-08 | ABH203(1.9-2.0) | Sand | 12 | **130** | 0.02 | 0.33 | **0.31** | 118 | 15 |
| - | 6-May-08 | ABH210(2.6-2.8) | Sand | <5 | 5 | 0.008 | 0.053 | **0.045** | <5.0 | 2.3 |
| - | 6-May-08 | ABH228(1.9-2.2) | Silty sand | 12 | **165** | 0.039 | 0.48 | **0.44** | 153 | 22 |
| - | 8-May-08 | ABH255(2.4-2.6) | Sand | 5 | **213** | 0.072 | 0.58 | **0.51** | 213 | 19 |
| - | 13-May-08 | ABH273(2.4-2.6) | Silty clay | <5 | **505** | 0.034 | 1.1 | **1** | 505 | 41 |
| - | 13-May-08 | ABH274(2.5-2.7) | Silty clay | <5 | **338** | 0.031 | 0.81 | **0.78** | 338 | 29 |
| - | 13-May-08 | ABH276(2.6-2.8) | Silty sand | <5 | **418** | 0.058 | 1.2 | **1.1** | 418 | 52 |
| - | 13-May-08 | ABH278(2.6-2.8) | Silty sand | <5 | **240** | 0.038 | 0.68 | **0.65** | 240 | 30 |
| - | 15-May-08 | ABH286(2.0-2.2) | Silty sand | <5 | **463** | 0.036 | 0.72 | **0.69** | 463 | 35 |
| **Area B** | | | | | | | | | | |
| - | 28-Apr-08 | BBH403(2.0-2.2) | Silty sand | <5 | **333** | 0.047 | 0.76 | **0.71** | 333 | 28 |
| - | 29-Apr-08 | BBH406(1.8-1.9) | Sand | 7.5 | **108** | 0.016 | 0.22 | **0.21** | 100 | 10 |
| - | 29-Apr-08 | BBH411(2.2-2.3) | Sand | 5 | <5 | 0.009 | 0.12 | **0.11** | <5 | 5.5 |
| - | 28-Apr-08 | BBH412(2.2-2.4) | Sand | <5 | **338** | 0.039 | 0.78 | **0.74** | 335 | 35 |
| - | 29-Apr-08 | BBH427(2.6-2.8) | Clayey silt | <5 | **1010** | 0.13 | 3.9 | **3.7** | 1010 | 109 |
| - | 29-Apr-08 | BBH437(3.3-3.4) | Silty sand | <5 | **52** | 0.011 | 0.17 | **0.17** | 52 | 5.2 |
| - | 1-May-08 | BBH440(2.3-2.4) | Silty clay | <5 | **253** | 0.024 | 0.52 | **0.49** | 253 | 20 |
| - | 30-Apr-08 | BBH453(2.5-2.6) | Silt | <5 | **195** | 0.043 | 0.56 | **0.52** | 198 | 24 |
| - | 1-May-08 | BBH458(3.8-4.0) | Silty sand | <5 | **1185** | 0.13 | 2.5 | **2.4** | 1188 | 112 |
| **Action Criteria (1 - 1000 tonnes)** | | Sands to loamy sands | | - | **18** | - | - | **0.03** | - | - |
| | | Sandy loams to light clays | | - | **36** | - | - | **0.06** | - | - |
| | | Medium to heavy clays | | - | **62** | - | - | **0.1** | - | - |
| **Action Criteria (>1000 tonnes)** | | Sands to loamy sands | | - | **18** | - | - | **0.03** | - | - |
| | | Sandy loams to light clays | | - | **18** | - | - | **0.03** | - | - |
| | | Medium to heavy clays | | - | **18** | - | - | **0.03** | - | - |

Note: Concentrations over action criteria are highlighted and shown in bold text.

# Net acidity could not be determined due to the high acid neutralizing capacity of the soil