

Acidic Soils and Acid Sulfate Soils Management Plan

Former Oxley Secondary College

P425



Prepared for
Shadforth Civil

9 July 2020

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Document Information

Prepared for	Shadforth Civil
Project Name	Former Oxley Secondary College
File Reference	P425 Shadforth Civil Oxley Acid Sulfate Soils Management Plan 1.07.20.docx
Job Reference	P425
Date	9 July 2020
Version Number	2

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Effective Date 1/07/2020

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Date Approved 1/07/2020

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
1	1/07/20	Initial Issue	CH	DD
2	9/07/20	Factual report update (Appendix A)	CH	DD

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Executive Summary

This Acidic Soils and Acid Sulfate Soils Management Plan (ASSMP) is based on the information contained in the Acid Sulfate Soils (ASS) Factual Report conducted for the Former Oxley Secondary College redevelopment site (referred to as “the site”). The ASS Factual Report, dated 1 July 2020 should be read in conjunction with this report and is included in Appendix A.

Construction Sciences carried out an ASS investigation over a 1ha portion of the proposed development site on Tuesday the 23rd of July. Four (4) boreholes were advanced to 2m below ground level and eight (8) samples were submitted for SPOCAS analysis. The ASS investigation revealed that the site contained Acidic Soils and ASS consisting of Actual Acid Sulfate Soils (AASS). The highest recorded AASS levels were noted between 1 - 2m AHD.

The implementation of a site based ASSMP is recommended as the proposed works involve excavations in land identified as containing ASS. Management measures outlined in the following ASSMP references the recommendations outlined in the Queensland Acid Sulfate Soils Technical Manual – Soil Management Guidelines (version 4.0) June 2014 relating to the methodology recommended to manage ASS. For the acidic and AASS identified above 2.0m AHD, the estimated liming rate is 12kg/m³.

Due to the potential for ASS to leach acidity into the surrounding environment, this ASSMP for the site has been prepared. This plan details site management measures to be implemented during the construction phases of the project to address the acid leachate potential presented during the earthworks phase of the project. Management measures target the migration of acidity from oxidation of excavated ASS materials, via surface water transfer caused by rainfall and sheet flows intercepting stripped natural soils, stockpiled material or consolidation of underlying saturated soil strata. The measures to address the migration of acidity will require site preparation, periodic inspection of the measures implemented and ongoing water (ground and surface) quality monitoring to measure and record the quality of waters below and exiting the site.

The implementation of this ASSMP is essential to minimise the potential for adverse environmental impacts as a result of the proposed development.

Glossary

Acid Sulfate Soil (ASS)	Soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of iron sulfides (actual ASS) and/or sediment containing iron sulfides or other sulfidic material that has not been exposed to air and oxidised (potential ASS). The term Acid Sulfate Soils generally includes both actual and potential Acid Sulfate Soils.
Actual Acid Sulfate Soils (AASS)	Soils containing highly acidic soil horizons resulting from the aeration of soil materials that are rich in iron sulfides, primarily pyrite. This oxidation produces hydrogen ions in excess of the sediments capacity to neutralise the acidity, resulting in soils of pH 4 or less. These soils can usually be identified by the presence of jarosite.
Action Criteria	For ASS, the measured level of potential plus existing acidity beyond which management action is required is a soil or sediment is to be disturbed.
Agricultural Lime (Ag-lime)	A neutralising agent commonly used to treat acidic soils.
Australian Height Datum (AHD)	The datum used for the determination of elevations in Australia. The determination uses a national network of benchmarks and tide gauges, and sets mean sea level as zero elevation.
Borehole	The actual hole created when an auger or push-tube is inserted into the soil body.
Below Ground Level (BGL)	The depth as measure from the existing site surface level, generally recorded in metres.
Chromium Suite	In acid sulfate soils analysis, a suite of tests used to characterise the net acidity of a soil. The suite centres on the use of the chromium-reducible sulfur measure for potential acidity, along with a number of tests for other forms of acidity depending on the soil pH (TAA for actual acidity, S_{NAS} for retained acidity, and a choice of several ANC methods for acid neutralising capacity).
Cone of depression	In hydrology, the three-dimensional volume of soil or sediment dewatered around an extraction point. The slow movement of water through sediments means that dewatering an area also lowers the local watertable, with the effect attenuating with distance. Despite its name, the cone of depression is rarely a regular shape, since it is strongly influenced by the permeability and porosity of the sediments involved. These parameters are highly spatially variable.
Dewatering	The process of extracting water from a saturated soil or sediment.
Groundwater	Subsurface water in the zone of saturation, including water below the water table and water occupying cavities, pores and openings in underlying soil and rock.
Leachate	The soil constituent that is washed out from a mixture of soil solids.
Oxidised	Process of chemical change involving the addition of oxygen following exposure to air.
Potential Acid Sulfate Soils (PASS)	Soils containing un-oxidised sulphur related to Holocene marine sediments contained in an aerobic state. Disturbance through excavation or lowering of the local ground water horizon will generate substantial Acidity.
Piezometer	A pipe of small diameter installed in a borehole that is used to measure the height (elevation) of the water table.
Pyrite	Pale bronze or pale yellow, isometric mineral: FeS_2 ; the most widespread and abundant of the sulfide minerals.
pH_F	The pH of the soil in soil/distilled water paste.
pH_{FOX}	The pH of the soil after the addition of a small quantity of Hydrogen Peroxide.

%S	Percentage oxidisable sulfur.
Qld ASS Technical Manual	Planning and managing developments involving Acid Sulfate Soils.
Soil and Sediment	The natural accumulation of unconsolidated mineral particles (derived from weathered rocks) and organic matter that covers much of the earth's surface.
SPOCAS	The 'suspension peroxide oxidation combined acidity and sulfur' method, a peroxide-based method of measuring the acid-generating potential of an acid sulfate soil. The SPOCAS suite is a set of analytical results and derived calculations from the method that allow calculation of net acidity. An alternative to the chromium suite.
Sulfuric Acid	A compound with the formula H ₂ SO ₄ . A strong mineral acid that is highly soluble in water, it is a principal breakdown product of the oxidation of pyrite.
Titrateable Actual Acidity (TAA)	The acidity measured by titration to pH 6.5 with dilute sodium hydroxide (NaOH) following extraction from the soil with potassium chloride (KCl) solution. In an ASS context, this test is the operational definition of actual acidity.
Verification Testing	Laboratory testing to confirm that ASS have been properly treated by demonstrating compliance with the established performance criteria, namely that sufficient amounts of neutralising agent (e.g. aglime) have been thoroughly mixed with the soil.
Watertable	Portion of the ground saturated with water, often used specifically to refer to the upper limit of the saturated ground.

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1 Background and Site Description

1.1 Introduction

Acid Sulfate Soils (ASS) are common in low-lying coastal areas of Queensland, particularly in areas below 5m AHD. Regions adjacent to, and those incorporating estuaries, swamps, floodplains, salt marsh and mangroves have an increased likelihood of the presence of ASS. Potential Acid Sulfate Soils (PASS) are usually located below layers of alluvial soils in an anaerobic state below the water table. When disturbed and left untreated, the acidity present in these soils has the potential to damage the surrounding natural environment and built structures.

ASS are characterised by organically formed pyrite (FeS_2 – Iron Sulphide) which when exposed to air reacts to produce sulphuric acid and iron. Sulphuric acid can attack concrete, steel, aluminium and other construction materials and have significant adverse effects to the surrounding environment including degradation of waterway habitat and water quality with the potential to result in fish kills.

In response to the potential for such adverse environmental outcomes as a result of the disturbance of ASS, the Queensland Department of Environment and Science (DES) developed the Queensland Acid Sulfate Soils Technical Manual 2014 (Qld ASS Technical Manual) to provide direction for planning and managing developments involving ASS and its supporting guidelines. The Qld ASS Technical Manual provides examples and recommendations on best practice for developments involving ASS.

The Qld ASS Technical Manual applies to disturbances of soils, groundwater hydrology or surface drainage patterns at or below 5m AHD. This includes the soil or sediments below 5m AHD where the natural ground level is above 5 m AHD.

This Acid Sulfate Soils Management Plan (ASSMP) has been developed for Former Oxley Secondary College. It has been based on the results and conclusions of the ASS investigation documented by Construction Sciences at the site in relation to the construction works. A copy of the Former Oxley Secondary College ASS Factual Report is included in full in Appendix A. It is understood that the works involve excavation of contaminated soils (asbestos, aesthetically unsuitable fill material, metals and hydrocarbons) confirmed as also containing ASS.

The aim of this ASSMP is to develop mitigation strategies and management procedures to minimise the risk of adverse environmental outcomes occurring during the project.

1.2 Site Description

Shadforth Civil has been engaged by Economic Development Queensland (EDQ) to complete the civil works pertaining to the redevelopment of the former Oxley Secondary College site into a residential subdivision community. Civil works to be undertaken by Shadforth Civil include land clearing and bulk earthworks and surcharging.

The site is located in Oxley, in the Brisbane City Council jurisdiction. It is positioned within a Community Facilities (education) zone and Potential Acid Sulfate Soil zone (Brisbane City Council City Plan 2014). The site is composed of two allotments covering 19.9 ha. Elevations onsite range from 9m – 52m AHD, with approximately 11.46 ha positioned above 5m AHD and below 20m AHD. The site's property details are summarised in Table 1-1. The site location is shown in Figure 1-1.

Table 1-1 Property Details

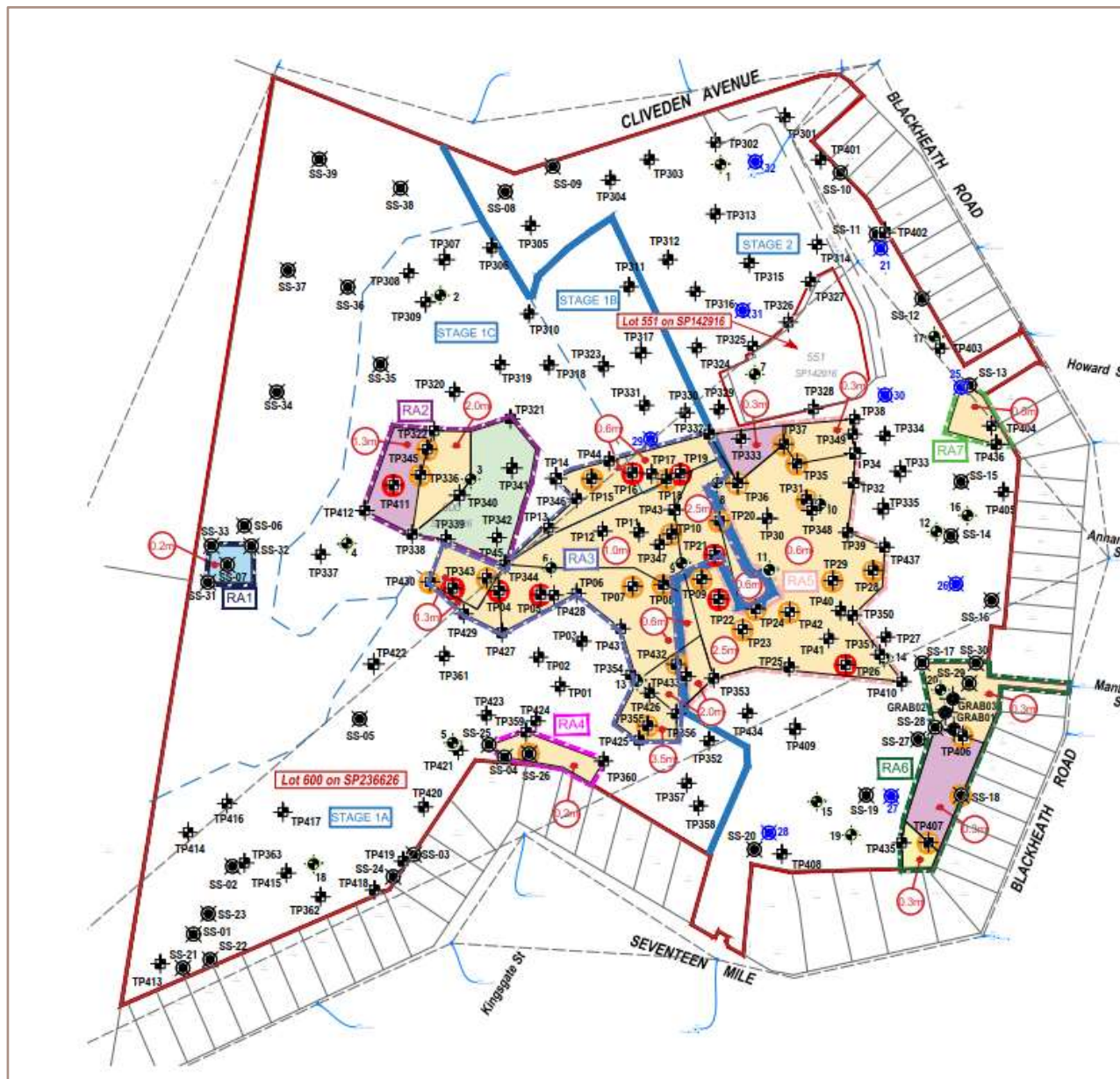
Lot No.	Plan No.	General Description Locality	Lot Size	Land Above 5m AHD and below 20m AHD
600	SP236626	53 Seventeen Mile Rocks Road, Oxley, Queensland	19.45 ha	11.01 ha
551	SP142916	113 Cliveden Avenue Oxley, Queensland	0.45 ha	0.45 ha

Figure 1-1 Site Location



Due to the current stage of works, this ASS investigation was limited to an approximate 1 hectare area within remediation area 3 (RA3) (refer Figure 1-2).

Figure 1-2 Remediation Zones (source: Provided)



1.3 Site Assessment Findings

The results of the ASS Investigation indicate that acidic soils and ASS, predominantly in the form of AASS is present on site. The sites ASS investigation was conducted to a maximum depth of 2m below ground level across four (4) boreholes. The highest recorded AASS levels were noted between 1 - 2m AHD. Boreholes were advanced from the existing surface level within the proposed excavation zone across the greater site area.

Indicative pH_F and pH_{Fox} analysis suggested soils can be classified as either Acidic Soils or Actual Acid Sulfate Soils (AASS). This is primarily due to pH_F being approximately of less than 5.5 and 4 respectively and the difference between pH_F & pH_{Fox} .

The results of the SPOCAS analysis suggest the site is predominantly underlain by both Acidic non-ASS and AASS. The AASS test method KCl Extractable Sulfur (S_{KCl}) (AS4969-23Ce) returned three (3) results above the limit of reporting ranging from 0.022%S – 0.114%S. Two (2) of the three (3) results were noted to exceed the nominated action criteria of 0.03%. This indicates a presence of actual acidity. The PASS test method Peroxide Oxidisable Sulfur (S_{Pos}) (AS4969-23E) returned only one (1) result above the limit of reporting at 0.021%S. This indicates that marginal levels of Potential Acidity remained unoxidised.

Results returned for SPOCAS testing reported low pH in all samples. Net acidity results in excess of the action criteria of 0.03%S were noted in all eight (8) samples selected for analysis. The low pH noted for samples not classified as AASS indicates the presence of Acidic Soils.

Liming Rates quoted assume that 1 mole of Ag Lime – Calcium Carbonate will neutralise 2 moles of H^+ . Liming rates are quoted in kilograms per m^3 . A dry soil density of $1.7t/m^3$ has been used in calculating liming rates. Recommended liming rates are derived from a mathematical equation and will need to be field validated.

In order to manage the ASS found on site it is proposed to treat all excavated spoil from the excavations at the lime dosage rates outlined in Table 1-2 below. These liming rates have been calculated to control the AASS identified in the surface soils.

Table 1-2 Table 1 - Summary of liming rates for excavated spoil

Works Area	Liming Rate
Surface soils to 2.0m AHD	12kg/ m^3

2 Site Based Acid Sulfate Soils Management Plan

This site based ASSMP is intended to be applied to the construction the nominated excavation zone. The intent of this management plan is to facilitate the proposed site works with due consideration of the potential environmental impacts and to give guidance with regard to appropriate management practices in order to minimise the potential for adverse environmental outcomes to occur as a result of the project.

2.1 Objectives

The objectives of the ASSMP are to:

1. Describe the methodology, treatment monitoring and reporting procedures to be employed at the site during the construction phases.
2. Provide effective management procedures to prevent environmental harm resulting from the potential leachate associated with acidic soils and AASS and surface water runoff from disturbed bare earth and stockpiled material.

2.2 General Environmental Duty

The Queensland *Environmental Protection Act 1994* (EP Act) describes that all persons have a “General Environmental Duty” and that “a person must not carry out an activity that causes, or is likely to cause environmental harm unless the person takes all reasonable and practical measures to prevent or minimise the harm” (s.319(1)).

The EP Act requires that appropriate action be taken to report that environmental harm is occurring or has the potential to occur, unless the harm is authorised under an environmental protection policy, an environmental management program, or an environmental protection order. This is known as the “Duty to Notify”. Failure to fulfil this duty is an offence and may result in prosecution (ss.320 – 320D).

2.3 Relevant Guidelines

The Following documents are relevant to the management of ASS and Acidic Soils in Queensland:

- > Queensland Acid Sulfate Soil technical Manual, Soil Management Guidelines Version 4.0 Dear et al (2014) Science Division – Department of Science, Information Technology, Innovation and the Arts
- > Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1, (2004) Ahern et al. Department of Natural Resources and Mines
- > Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland (1998) Ahern et al. (QASSIT) Department of Natural Resources and Mines.
- > Queensland Water Quality Guidelines (2009) Department of Environment and Science (DES).
- > Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZECC/ARMCANZ (2000).
- > National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) (1999); Schedule B(1) Guideline on the Investigation Levels for Soil and Groundwater.

3 Risk Assessment

3.1 Classification of Soils

The ASS Investigation conducted on the site was undertaken to assess the ASS status of the soils within the site. The investigations revealed that the greater site area moderate to high levels of Acidic Soils and AASS.

3.2 Disturbance of Acid Sulfate Soils

It is noted that disturbed ASS can result in the generation of substantial levels of acidity and can result in appreciable leaching of acidity and the associated transportation of metals from the soil. Thus it is necessary to implement management measures to monitor and control ASS such that environmental harm is mitigated.

Any subcontractors undertaking these works will need to be advised on the appropriate soil management requirements for excavation works.

3.3 Management Strategies

To address the potential for acid leachate from the spoils scheduled for excavation, it is recommended that a neutralising agent (generally ag-lime) be applied to strip footing surfaces and any topsoil grubbed from the site prior to filling activities. Due to the presence of contaminated soils, it is understood that excavated ASS will be carted directly offsite to a licenced landfill.

Five (5) dominant neutralising controls are required onsite to ensure that the potential for acid leachate from ASS material is addressed to prevent adverse environmental outcomes from occurring.

1. The application of a neutralising agent below any fill or stockpile area is required to intercept acid migration through the soil profile to underlying ground water horizons.
2. Position lime enriched perimeters around any temporary stockpile areas.
3. Neutralisation of excavated material at 12kg/m³ for surface soils (noted as not required in this instance due to the material being disposed of to a licenced landfill directly offsite).
4. The implementation of surface water controls to ensure that water runoff from earthworks zones has pH correction prior to entering detention basins or adjacent watercourses.
5. Lime treatment of the upper fill layers of fill platforms and batters to mitigate against the potential for acid migration from fill embankments, as well as addressing the root zone of landscape areas which may be located over such areas.
6. Lime dusting the base of cut areas, with the area compacted following lime application to ensure that ag-lime is incorporated into the surface material.

3.4 Neutralising Agent and Treatment Rate

Neutralising agents are recommended to be slightly alkaline with a pH range of 7.0 – 9.0 and have low solubility. These characteristics minimise the potential for the neutralising agent to leach from the soil during rainfall events. The preferred neutralising agent is Agricultural Lime (CaCO₃). The particle size of the agricultural lime (ag-lime) is required to be matched to the nominated application. It is recommended to use fine grained ag-lime for applying to the stripped natural surface and coarse lime chip is recommended to be used in swale drains or surface water flow paths for longevity and controlled dosage.

Treatment rates for the ASS identified on the site is based on the highest net acidity result from the sites ASS Investigation. The calculated lime rates are calculated to incorporate a safety factor including the fineness factor, as recommended for ASS.

3.4.1 Storage of Neutralising Agents

Storage of neutralising Agent (Ag-lime) is to be controlled to ensure that the product is covered to prevent loss from surface water flows and wind. Position Ag-Lime stockpiles away from surface water flow channels and cover stockpiles when not in use with black plastic (builders film) to prevent excess migration from surface water and wind loss from stockpiled ag-lime. Position water diversion mounds upslope of the stockpiled ag-lime if rain is forecast or ag-lime stockpile is to remain unused for a period greater than 3 working days.

Table 3-1 Lime Treatment Rates

Earthworks Area Classification	Type of Neutralising Agent Recommended	Dosage Rate	Zone Neutralising Treatment Required
Base of stockpile or fill platform	Fine grained Ag-lime	2kg/m ² per vertical metre of fill	Under any fill platform greater than 0.5m or any stockpile greater than 50m ³
Stockpile or fill platform perimeter	Lime chip – nominal chip size 5mm to 10mm	2kg per linear metre	Position lime chip flow interception barrier on the upgrade side of silt fence (i.e. closest to disturbed acidic soil)
Surface water flow paths	Lime chip – nominal chip size 5mm to 10mm	Fill 100mm slotted ag-pipe with filter sock tied / secured at each end	Size and position at appropriate intervals along surface water flow paths 1 per 20m grades <5% 1 per 10m grades >5%
Groundwater flow paths	Lime chip – nominal chip size 5mm to 10mm	Cut-off trench comprising lime chips	Size and position lime cut-off trench in excavations at the boundary downstream of works Trench to be a minimum 100mm width x 1.5m depth, with lime positioned to 200mm of finished level
Base of excavations / cuts / trenches	Fine Grained Ag-lime	3kg/m ²	Spread lime over surface of cut area while material is moist and roll with sheep's foot roller to incorporate lime into exposed surface - horizontal surfaces only
Material scheduled for soil treatment generated from excavations – surface soils to 2.0m AHD	Fine grained Ag-lime	12kg/m ³ for all excavated natural material	Neutralising agent to be mixed into the soil to result in a homogenous lime soil matrix

4 Management of Acidic Soils

4.1 Responsibility

The bulk earthworks and civil works operations at the site shall be conducted in accordance with this site based ASSMP. The following communications, training and monitoring steps should be prepared and conducted to ensure successful implementation of this ASSMP:

- > Program for environmental training of relevant staff.
- > Names and responsibilities of specific staff members involved in the supervision of the implementation of this ASSMP.
- > Schedule of proactive site inspections to identify any environmental issues and plan necessary remedial actions, and to confirm the ongoing success of any maintenance mechanisms.
- > Whilst undertaking any civil works at the site, appropriately detailed records shall be maintained in the following areas:
 - Results of any ASS testing as required by this ASSMP, including verification testing.
 - Location of soil during the treatment process and rates / total quantities of ameliorant added to the soil requiring neutralisation.
 - Results of surface and ground water monitoring as required by this ASSMP.
 - Incidents, near incidents or complaints related to the performance of the works.

The contractor(s) should always seek a timely resolution with respect to any complaints received in relation to the environmental performance of the works at the site. The standard procedure for dealing with complaint resolution shall be included in the development and implementation of corrective actions to address any non-conformity with the requirements of this management plan. The objective of any complaint resolution process shall be to develop a response to minimise the potential for further complaints related to the same issue in the future.

4.2 Operational Policy

To prevent adverse impacts on the receiving waters (surface and groundwater) and built structures by effectively implementing the management measures required for filling over or disturbed of ASS and associated runoff during the proposed development. All staff responsible for site management are required to be aware of the requirements of the sites ASSMP. All staff under taking excavation and filling works are to be informed that the site has an ASSMP and controls are required to minimise the potential for adverse environmental outcomes.

4.3 Performance Criteria

Site Management criteria is outlined below to enable a measure of the implementation of the ASSMP.

4.3.1 Soil Criteria

1. The soil pH of the stripped exposed soil surfaces (including all areas prior to filling and area under structures and landscape areas) must be pH_{KCl} 6.5 or greater or Net Acidity less than 0.03%S (as measured by either SPOCAS or Chromium Suite – AS4969).
2. Material excavated from surface soils to 2.0m AHD are to be treated at a liming rated of 12kg/m³. Noted as not required in this instance due to the material being disposed of to a licenced landfill directly offsite.

4.3.2 Water Quality Criteria

1. pH of waters received in site water control basins is to be between pH 6.5 & 8.5 and turbidity of <10% NTU above baseline, Suspended Solids <50mg/L – water quality objectives required to be confirmed prior to release to stormwater or adjacent watercourse.
2. Re-use of retained waters onsite for dust suppression and fill conditioning can be undertaken if pH is between 6.5 and 8.5.

3. pH of downstream watercourse to be between pH 6.5 & 8.5 and turbidity within 10% of baseline – testing required following rainfall events greater than 20mm in 24 hours.
4. Establishment of baseline water quality downstream of site prior to projects earthworks is recommended, otherwise the water quality objectives noted in Table 4-1 – Statutory Water Quality Objectives will apply. If baseline downstream parameters are to be used, a minimum of 2 sampling events sampled >24 hours apart are to be undertaken and results need to vary by less than 10% to be deemed representative of receiving waters. Water Quality objectives are deemed acceptable if results are within 10% of baseline or less than those outlined in Table 4-1.
5. Ground Water Monitoring is to remain within 10% of baseline reference levels for the parameters Dissolved Iron, Dissolved Aluminium, Sulfate as SO₄, Chloride and the Chloride to Sulfate ratio. Establishment of baseline is to be undertaken on a minimum of 2 sampling events a minimum of 24 hours apart with results within 10% of each other (refer Table 4-2). Re-sampling and analysis until consecutive results comply with the 10% variation criteria for result to be used as baseline data.
6. If any surface films or rust coloured staining is noted on the surface of excavations or adjacent water courses, then photographs are to be taken and reported to the project superintendent and the project's environmental officer.

Table 4-1 Statutory Water Quality Objectives

Parameter	Criteria ¹	Unit
pH	6.5 – 8.5	pH
Conductivity	+/- 10% Baseline	µS
Turbidity	<10% ²	NTU
Suspended Solids	<50	mg/L

Notes:

¹ Water Quality Objectives based on Draft Urban Stormwater – Queensland Best Practice Environmental Management Guidelines, 2009.

² Released waters from the approved discharge point(s) to have turbidity (NTU) less than 10% above the receiving waters turbidity – measured immediately upstream of the site.

Table 4-2 ANZECC (2000) Water Quality Objectives and/or Base Parameters to be Established

Metals – dissolved (µg/L)	Criteria	Unit
Aluminum	55 and/or baseline +/- 10%	µg/L
Iron	300 and/or baseline +/- 10%	µg/L
Sulfate	Based on baseline	µg/L
Chloride	Based on baseline	µg/L
Chloride to Sulfate Ratio	Based on baseline (recommended 7:1)	Ratio
Standing Water Level	N/A	m BGL

Notes:

All parameters are to be established prior to site establishment works, consisting of a minimum of 2 sampling events, a minimum of 24 hours apart – sampled on an outgoing tide.

Baseline data required 2 consecutive sampling events to be within 10%.

4.4 Implementation Strategy

The Site Management Strategies outlined in section 3.3 are required to be implemented to ensure that management measures are in place to address the potential environmental harm posed by ASS. ASS management measures should be logged and reported monthly noting;

- > Surface water flow paths which have management measures installed;
- > Groundwater flow paths which have management measures installed;
- > Weekly site inspection check sheets;

- > Rainfall register;
- > Post rainfall water quality results for both waters retained onsite and downstream catchments;
- > Fill Areas - basal liming register – to be signed off prior to fill / material being received;
- > Fill Pad and Stockpile Area register noting perimeter lime interception locations – checked weekly;
- > Fill Pad Levels Noted Weekly – Specific attention to any indicators of overburden pressure soil displacement;
- > Material export register noting validation test reports confirming that material is free of acid soil concerns; and
- > Lime Register noting Lime received onsite, area stored and where used.

4.5 Earthworks Strategy

Quality Assurance register to note the required Acidic Soil management requirements (basal liming), perimeter runoff intercept measure and check tests (pH tests on upper 0.5m fill layers) required.

4.5.1 Fill Platforms

Quality Assurance register to note the neutralising treatment works outlined in the ASSMP including basal liming under fill areas and validation tests confirming the treatment of any natural soils required at a frequency of 1 / 1000m³ (Chromium Suite tests – AS4969).

4.5.2 Cut Areas

Quality Assurance register to note the required Acidic Soil management requirements (lime application to finished surface) and check tests (pH tests on exposed layer) required.

4.5.3 Stockpiled Material

The Quality Assurance Register is to note the required ASS management requirements (basal liming) and perimeter runoff intercept measures implemented.

4.6 Monitoring

Regular monitoring will be required throughout the earthworks construction phase of the development as outlined in the following sections.

4.6.1 Water Quality Monitoring

Water Quality Monitoring is to be conducted on surface and groundwater monitoring locations weekly. The water quality sampling is to be undertaken on any retained waters prior to discharge from site. In addition to the weekly monitoring, sampling of the Surface Water monitoring points is required to be undertaken within 24 hours following rainfall events greater than 20mm in 24 hours.

4.6.1.1 Surface Water Monitoring

Surface Water monitoring of areas of concern is required, including:

1. Any retained waters held within the site works areas including sediment and erosion control basins; and
2. Receiving waters downstream of the site boundary (establish a monitoring location downstream of site works).

Conduct weekly inspections of Erosion and Sediment Controls and Lime runoff protection measures post rainfall (>20mm in 24 hours) of environmental protection measures installed including:

- > Perimeter protection of fill areas and stockpiles;
- > Surface water flow controls; and
- > Lime intercept filters points.

4.6.1.2 *Ground Water Monitoring*

Monitoring of the ground water is required to record any fluctuations in the regional ground water quality associated with excavations below the ground water table. It is recommended that groundwater monitoring wells be installed to enable monitoring of the groundwater parameters and any fluctuations in the groundwater table underlying the site throughout the construction phase of works.

It is recommended that ground water quality is confirmed to enable a baseline dataset to be established. Groundwater monitoring should be conducted weekly during the earthworks phase of the project and then monthly for a 3 month period following completion of earthworks. Groundwater monitoring is to record the Standing Water Level, time of sampling, tide state and proximity to most recent high tide. Ground water monitoring is to consist of all parameters except turbidity and Suspended solids - noted in Tables 4-1 and 4-2 in section 4.3.

4.6.2 **Excavated Material**

Separate the material excavated to and dispose of directly offsite to a licenced landfill.

If treatment of impacted material is conducted on site (i.e. confirmed as an option by the Contaminated Land Remediation consultants), validation testing of soil will be required to confirm the successful treatment of ASS by conducting Chromium Suite testing at a rate of 1 per 1000m³ prior to re-burial of material. If natural spoil is mixed fill material, all spoil will require ASS treatment. A material register should be prepared to ensure that volumes of ASS treated on site is documented.

Storage of excavated spoil in stockpile should not to exceed 72 hours prior to treatment. If stockpiles remain untreated onsite due to weather conditions or public holidays then stockpiles are to be covered with black plastic to minimise soil moisture loss.

4.7 **Reporting**

All ASS registers and reports are to be held onsite and be available for auditing by third parties if requested.

4.8 **Contingency**

Ensure that a supply of an appropriate quantity of ag-lime product is held on site to enable repairs to surface water flow controls and neutralisation of upper fill layers or exposed cut faces as dictated by the construction program.

A minimum of 100kg of lime chip and 0.5 tonne of fine grained ag-lime is recommended as the minimum neutralising agent required to be held onsite during the construction phase. The neutralising agent is to be stored as per the recommendations outlined in section 3.4 of this document.

5 Conclusion

The Former Oxley Secondary College site has been identified to contain ASS. ASS present a risk of generating acidic leachate, capable of adversely affecting the surrounding environment if disturbed and left untreated.

The implementation of construction management measures outlined in this site specific ASSMP are required to address the potential for environmental degradation which can result from the disturbance of ASS. Site controls outlined are documented to provide a strategy to control and measure the impacts of the proposed development.

APPENDIX

A

ASS FACTUAL REPORT

Acid Sulfate Soils Factual Report

Former Oxley Secondary College

P425



Prepared for
Shadforth Civil

9 July 2020

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Document Information

Prepared for	Shadforth Civil
Project Name	Former Oxley Secondary College
File Reference	P425 Shadforth Civil Oxley ASS Factual Report 1.07.20.docx
Job Reference	P425
Date	9 July 2020
Version Number	2

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Effective Date 1/07/2020

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Date Approved 1/07/2020

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
1	1/07/2020	Initial Issue	CH	DD
2	9/07/2020	Update borehole logs	CH	DD

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Executive Summary

Shadforth Civil has engaged Construction Sciences to conduct an Acid Sulfate Soils (ASS) investigation at the Former Oxley Secondary College redevelopment site to assess for the presence of ASS. ASS field investigation works were completed on site, advancing four (4) boreholes to a maximum depth of 2m below ground level (BGL). Samples were recovered from these boreholes for the completion of qualitative pH_{Field} and pH_{Fox} and quantitative Suspended Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) ASS analysis.

The results of the qualitative and quantitative analysis suggest the site is predominantly underlain by both Acidic non-ASS and Actual ASS.

The Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines v4.0 recommends that developments involving Acid Sulfate Soils are required to implement site management measures to mitigate the potential for environmental degradation. Management of the proposed earthworks at the site requires the implementation of a site based Acidic Soils and Acid Sulfate Soil Management Plan (ASSMP) to avoid adverse environmental consequences.

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Glossary

Acid Sulfate Soil (ASS):	Soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of iron sulfides (actual ASS) and/or sediment containing iron sulfides or other sulfidic material that has not been exposed to air and oxidised (potential ASS). The term Acid Sulfate Soils generally includes both actual and potential Acid Sulfate Soils.
Actual Acid Sulfate Soils (AASS):	Acidity the result of lowering of the local ground water table or prior oxidisation of PASS.
Agricultural Lime:	A neutralising agent commonly used to treat acidic soils.
AHD (Australian Height Datum):	The datum used for the determination of elevations in Australia.
Borehole:	The actual hole created when an auger or push-tube is inserted into the soil body.
BGL (Below Ground Level):	The depth as measure from the existing site surface level, generally recorded in metres.
Groundwater:	Subsurface water in the zone of saturation, including water below the water table and water occupying cavities, pores and openings in underlying soil and rock.
Leachate:	The soil constituent that is washed out from a mixture of soil solids.
Oxidised:	Process of chemical change involving the addition of oxygen following exposure to air.
Potential Acid Sulfate Soils (PASS):	Soils containing un-oxidised sulphur related to Holocene marine sediments contained in an aerobic state. Disturbance through excavation or lowering of the local ground water horizon will generate substantial Acidity
Piezometer:	A pipe of small diameter installed in a borehole that is used to measure the height (elevation) of the water table.
Pyrite:	Pale bronze or pale yellow, isometric mineral: FeS_2 ; the most widespread and abundant of the sulfide minerals.
pH_F :	The pH of the soil in soil/distilled water paste.
pH_{FOX} :	The pH of the soil after the addition of a small quantity of Hydrogen Peroxide.
Qld ASS Technical Manual:	Planning and managing developments involving Acid Sulfate Soils.
%S:	Percentage oxidisable sulfur.
Soil and Sediment:	The natural accumulation of unconsolidated mineral particles (derived from weathered rocks) and organic matter that covers much of the earth's surface.
SPOCAS	Suspended Peroxide Oxidation Combined Acidity and Sulfur
Water table:	Portion of the ground saturated with water, often used specifically to refer to the upper limit of the saturated ground.

1 Introduction

Acid Sulfate Soils (ASS) are common in low-lying coastal areas of Queensland, particularly in areas below 5m AHD. Regions adjacent to, and those incorporating estuaries, swamps, floodplains, salt marsh and mangroves have an increased likelihood of the presence of ASS. Potential Acid Sulfate Soils (PASS) are usually located below layers of alluvial soils in an anaerobic state below the water table. When disturbed and left untreated, the acidity present in these soils has the potential to damage the surrounding natural environment and built structures.

ASS are characterised by organically formed pyrite (FeS_2 – Iron Sulphide). When exposed to air, the iron sulphide reacts to produce sulphuric acid and iron. Sulphuric acid can attack concrete, steel, aluminium and other construction materials and have significant adverse effects to the surrounding environment including degradation of waterway habitat, water quality and may result in fish kills.

In response to the potential for such adverse environmental outcomes as a result of the disturbance of ASS and Acid Soils, the Department of Environment and Science (formerly the Department of Environment and Heritage Protection) developed the Queensland Acid Sulfate Soil Technical Manual 2014. This document provides examples and recommendations on best practice for developments involving ASS.

The Queensland Acid Sulfate Soil Technical Manual 2014 provides detailed soil management guidelines to implement appropriate planning measures to developments involving land, soil or sediment at or below 5m AHD where the natural surface level is below 20mAHD and applies to development that would result in:

- > the excavation of, or otherwise removing 100m³ or more of soil or sediment; or
- > filling of land involving 1000t (500m³) or more of filling with an average depth of 0.5m or greater over land less than 5m AHD.

The following report details the results and conclusions of the ASS investigation conducted by Construction Sciences for Shadforth Civil at the Former Oxley Secondary College redevelopment site.

The aim of this ASS Investigation is to assess the presence or otherwise and distribution/severity of ASS at the site. This information can then be used to develop management procedures (where required) to minimise the risk of adverse environmental outcomes occurring during the project.

This ASS Factual Report is supplementary to previous ASS documentation including:

- > Report – Preliminary Geotechnical Investigation, Former Oxley Secondary College, Blackheath Road, Oxley, Project No. 018-118A, Butler Partners 16 May 2018; and
- > Gap Analysis – Former Oxley Secondary College Acid Sulfate Soils Gap Analysis, Construction Sciences 17 June 2018.

2 Site Description

Shadforth Civil has been engaged by Economic Development Queensland (EDQ) to complete the civil works pertaining to the redevelopment of the former Oxley Secondary College site into a residential subdivision community. Civil works to be undertaken by Shadforth Civil include land clearing, bulk earthworks and surcharging.

The site is located in Oxley, in the Brisbane City Council jurisdiction. It is positioned within a Community Facilities (education) zone and Potential Acid Sulfate Soil zone (Brisbane City Council City Plan 2014). The site is composed of two allotments encompassing 19.9 ha. Elevations onsite range from 9m – 52m AHD, with approximately 11.46 ha positioned above 5m AHD and below 20m AHD. The site's property details are summarised in Table 2-1.

Table 2-1 Property Details

Lot No.	Plan No.	General Description Locality	Lot Size	Land Above 5m AHD and below 20m AHD
600	SP236626	53 Seventeen Mile Rocks Road, Oxley, Queensland	19.45 ha	11.01 ha
551	SP142916	113 Cliveden Avenue Oxley, Queensland	0.45 ha	0.45 ha

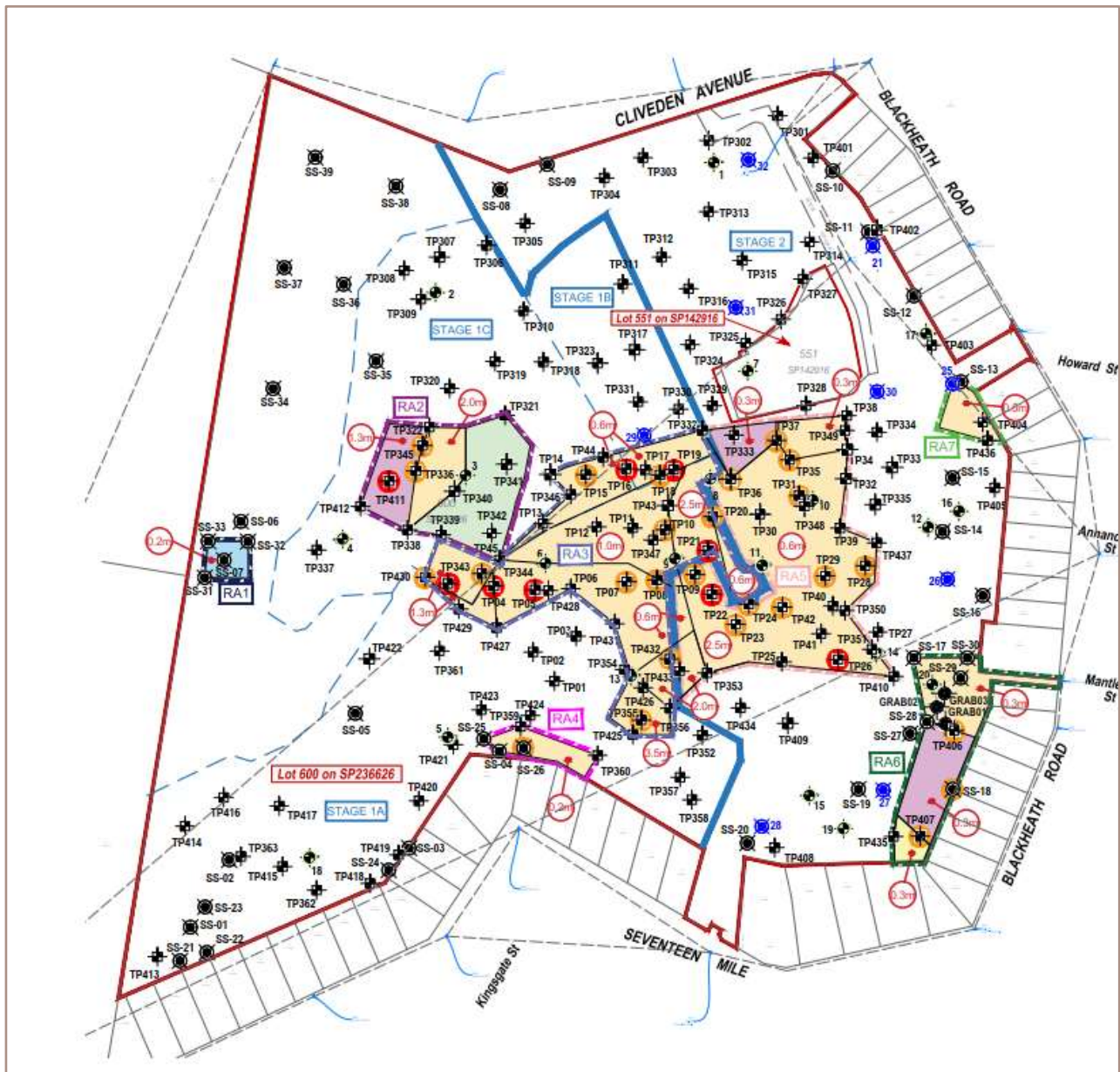
Remediation works are currently being undertaken at the site by Butler Partners due to a presence of contaminants of concern including asbestos, aesthetically unsuitable fill material, metals and hydrocarbons. An aerial photograph highlighting the overall site is included in Figure 2-2 below.

Figure 2-2 Locality Plan (source: Nearmap)



Due to the current stage of works, this ASS investigation was limited to an approximate 1 hectare area within remediation area 3 (RA3) (refer Figure 2-3).

Figure 2-3 Remediation Zones (source: Provided)



3 Methodology

3.1 Background

Limited ASS investigations have been historically conducted onsite, chiefly accompanying a Geotechnical Investigation conducted by Butler Partners in May 2018. The investigation consisted of a single sample, a summary of the analysis conducted is noted in Table 3-1.

Table 3-1 ASS Results Summary

Bore	Depth (m)	Sample Description	pH _{KCL}	Oxidised ASS based Acidity (S _{KCL})%S	Titrateable Actual Acidity %S	Chromium Reducible Sulfur (S _{CR}) %S	Net Acidity %S	Liming Rate kg CaCO ₃ /tonne
7	3.0-3.45	Silty Clay	4.1	0.03	0.13	<0.005	0.13	6

The brief investigation revealed the presence of sulphur based acidity (S_{KCL}) which is attributable to oxidised ASS. The Net acidity result of 0.13%S exceed QLD Acid Sulfate Soils Technical Manual action criteria of 0.03%S, indicating the presence of Actual Acid Sulfate Soils (AASS) in the sample analysed. However due to the limited sample size, further investigation is required to ascertain the depth and distribution of acidic soils/ASS across the greater site area.

3.2 Field Investigation

Construction Sciences were engaged by Shadforth Civil to complete an ASS Investigation on portions of the works area at the Former Oxley Secondary College. A total of four (4) boreholes to a depth of 2m were advanced during the ASS investigation works. The location of the boreholes was determined to provide an indication of the ASS status of the material that will be disturbed during redevelopment works (refer Figure 3-1 - Borehole Location Plan).

A photographic log of field works and associated borehole logs are included in Appendix A. A summary of the location of these boreholes is included in Table 3-2.

Table 3-2 Borehole Summary

Borehole Number	Investigation Area	Latitude	Longitude	Ground Water (BGL)
TP1	RA3	-27.5510	152.9689	N/A
TP2	RA3	-27.5510	152.9696	N/A
TP2	RA3	-27.5514	152.9700	N/A
TP4	RA3	-27.5518	152.9694	N/A

Figure 3-1 Borehole Location Plan



Samples were recovered at 0.5m intervals from the four (4) boreholes advanced and qualitatively analysed for $pH_{FIELD(F)}$ and pH_{FOX} . The results of the qualitative investigation was indicative of acidic soil and the results provided the basis for further quantitative laboratory analysis. Samples were recovered from the four (4) boreholes at 1m intervals and quantitatively analysed for the Suspended Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) suite.

3.2.2 Groundwater

Groundwater was not encountered during the field works and has not been included within the scope of this investigation. It is understood that comprehensive groundwater investigations and monitoring are being conducted as a component of the greater site remediation works. This investigation can be extended to accommodate an assessment of potential ASS impact on groundwater where required.

4 Acid Sulfate Soil Assessment

The following information was used to assess the presence of ASS at the site:

- > Desktop study;
- > Onsite indicators;
- > Chemical tests including:
 - pH_F and pH_{FOX} ; and
 - SPOCAS analysis.

4.1 Site Geology

The Ipswich Surface Geology 1:100,000, Queensland Government, Natural Resources and Mines (sheet 9442) indicates the site is underlain by the Darra Formation sedimentary rock, consisting of *Lacustrine and fluvialite lithic labile sandstone, mudstone, siltstone, shale, minor conglomerate; lateritised* from the Tertiary era.

4.2 pH_F and pH_{FOX}

Initial soil screening was conducted as pH Field (pH_F) and Field Oxidised (pH_{FOX}) tests, conducted on 0.5m soil profile intervals prior to samples being selected for full SPOCAS Analysis. The results of this analysis are included in Appendix B. Qualitative pH_F and pH_{FOX} test results were reviewed and results flagged a requirement for additional quantitative SPOCAS testing.

Indicative pH_F and pH_{FOX} analysis suggest soils can be classified as either Acidic Soils or Actual Acid Sulfate Soils (AASS). This is primarily due to pH_F being of less than 5.5 and the difference between pH_F & pH_{FOX} being greater than 1 pH unit.

Samples were then sent for SPOCAS analysis based on these results and to allow for adequate spatial and vertical distribution. The analysis of samples recovered was conducted via quantitative laboratory testing utilising the chromium suite in accordance with AS4969.

4.3 Analytical Laboratory Analysis

ASS are characterised by the presence of iron sulphides which are reported in the SPOCAS method when presented as Actual Acid Sulfate Soils (AASS) (S_{KCl}) and Potential Acid Sulfate Soils (PASS) as S_{POS} .

The AASS test method KCl Extractable Sulfur (SKCl) (AS4969-23Ce) returned three (3) results above the limit of reporting ranging from 0.022%S – 0.114%S. Two (2) of the three (3) results were noted to exceed the nominated action criteria of 0.03%. This indicates a presence of actual acidity. The PASS test method Peroxide Oxidisable Sulfur (S_{POS}) (AS4969-23E) returned only one (1) result above the limit of reporting at 0.021%S. This indicates that marginal levels of Potential Acidity remained unoxidised.

Results returned for SPOCAS testing reported low pH in all samples. Net acidity results in excess of the action criteria of 0.03%S were noted in all eight (8) samples selected for analysis. The low pH noted for samples not classified as AASS indicates the presence of Acidic Soils.

The results of the SPOCAS analysis suggest the site is predominantly underlain by both Acidic non-ASS and AASS. Laboratory reports are included within Appendix C.

Management of the proposed earthworks at the site requires the implementation of a site based Acidic Soils and Acid Sulfate Soil Management Plan (ASSMP) to avoid adverse environmental consequences.

4.3.1 Liming Rates

Liming Rates quoted assume that 1 mole of Ag Lime – Calcium Carbonate will neutralise 2 moles of H^+ . Liming rates are quoted in kilograms per m^3 . A dry soil density of $1.7\text{t}/\text{m}^3$ has been used in calculating liming rates. Recommended liming rates are derived from a mathematical equation and will need to be field validated.

In order to manage the ASS found on site it is proposed to treat all excavated spoil from the excavations at the lime dosage rates outlined in Table 4-1 below. These liming rates have been calculated to control the AASS

identified in the surface soils. An ASSMP will be documented and outline site management procedures in detail.

Table 4-1 Summary of liming rates for excavated spoil

Works Area	Liming Rate
Surface soils to 2.0m AHD	12kg/m ³

5 Limitations

This report has been prepared for the use of Shadforth Civil for civil works planning purposes in accordance with accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties as it may not contain sufficient information for the purposes of other parties or for other uses.

6 References

- > Brisbane City Council City Plan 2014
- > Gap Analysis – Former Oxley Secondary College Acid Sulfate Soils Gap Analysis, Construction Sciences 17 June 2018.
- > Ipswich Surface Geology 1:100,000, Queensland Government, Natural Resources and Mines (sheet 9442).
- > Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines, Version 4.0 (June 2014).
- > Report – Preliminary Geotechnical Investigation, Former Oxley Secondary College, Blackheath Road, Oxley, Project No. 018-118A, Butler Partners 16 May 2018.

APPENDIX

A

FIELD DOCUMENTATION



**Construction
Sciences**

Photographic Log



Figure A1 Field works in progress



Figure A2 TP4 Locations



Figure A3 Material present on site



Figure A4 Material present on site



Geebung QLD 4034

Fax:

07 3865 5295

BOREHOLE LOG SHEET

Page 1 of 1

Location:

Lab Ref: 2624EV/S/3488

[illegible]



Client:	Shadforth's Civil Pty Ltd	Drilling Commenced:	23/06/2020	Relative Level:	-	Borehole Number:	TP2
Project:	Former Oxley Secondary College	Drilling Completed:	23/06/2020	Groundwater:	-	Location:	
Project No:	2624EV/P/425	Rig Type:	Geoprobe	Casing Diameter:	-		
Lab Ref:	2624EV/S/3489	Driller:	BC	Angle From Horiz:	90.0°		
		Logged By:	David Dethlefs	Date Logged:	26/06/2020		

Depth (m)	RL	DCP	V Bit "TC" Bit Washbore Casing	Ground -water	Sample or Field Test	Graphic Log	USCS Symbol	DESCRIPTION (SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							CH	Clay, dark brown with light orange, high pasticity, hard, moist, fill.
0.5							CH	Clay, dark brown, high pasticity, very hard, dry, fill.
1.0							CH	Clay, dark brown with light orange, high pasticity, very hard, dry, fill.
1.5							CH	Clay, dark brown with red and orange, high pasticity, very hard, dry, fill.
2.0							CH	Clay, dark brown, high pasticity, very hard, dry, fill.
2.5								Terminated
3.0								

APPENDIX

B

PH FIELD AND PH FOX RESULTS



Construction Sciences

Construction Sciences Pty Ltd
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Brendale QLD 4500

Phone: 07 3865 3212

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Report on ASS Field Indicator Test - pHF and pHFox			
Client:	Shadforth	Report No:	2624EV20200626.1
Client Address:	99 McRoyle Street, Wacol QLD 4076	Report Date:	26/06/2020
Project:	Former Oxley Secondary College Redevelopment	Report Page:	1
Works Component:	Acid Sulfate Soils Analysis	Project No:	2624EV/P425
Materials Used:	Distilled Water, Hydrogen Peroxide, Sodium Hydroxide	Test Request/Order:	N/A

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP1	23/06/2020	Surface		TP1	23/06/2020	0.5m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	5.9		pHF	pH	5.6
pHFox	pH	4.78		pHFox	pH	4.81
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP1	23/06/2020	1.0m		TP1	23/06/2020	1.5m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	5.73		pHF	pH	6.12
pHFox	pH	4.92		pHFox	pH	5.81
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP1	23/06/2020	2.0m		TP2	23/06/2020	Surface
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	6.08		pHF	pH	5.61
pHFox	pH	5.48		pHFox	pH	5.34
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP2	23/06/2020	0.5m		TP2	23/06/2020	1.0m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	6.18		pHF	pH	5.74
pHFox	pH	5.88		pHFox	pH	5.41
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP2	23/06/2020	1.5m		TP2	23/06/2020	2.0m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	5.62		pHF	pH	5.71
pHFox	pH	5.5		pHFox	pH	5.61
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Abbreviations	Report Remarks and Endorsement
AASS	Actual Acid Sulphate Soils
PASS	Potential Acid Sulphate Soils
pHFox	pH field oxidised with peroxide - stabilised to 5.5 pH
Sampling and Test Methods AS 1289.E2.1 Acid Sulphate Soils Laboratory Methods Guidelines Section H - Field Tests (Version 2.1 June 2004)  Issued By: Danielle Townsend	

* The rate of the reaction generally indicates the level of sulfides present, but depends also on texture and other soil constituents. A soil containing very little sulfides may only rate an 'X' however a soil containing high levels of sulfides (remember the exact level of sulfides cannot be determined using the pHFOX test) is more likely to rate a 'XXXX' although there are exceptions. This rating scale alone should not be used to identify ASS. It is not a very reliable feature in isolation as there are other factors including manganese and organic acids which may trigger reactions. Reactions with organic matter tend to be more 'frothing' and don't tend to generate as much heat as sulfidic reactions. Manganese reactions will be quite extreme, but don't tend to lower the pHFOX.



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Report on ASS Field Indicator Test - pHF and pHFox			
Client:	Shadforth	Report No:	2624EV20200626.1
Client Address:	99 McRoyle Street, Wacol QLD 4076	Report Date:	26/06/2020
Project:	Former Oxley Secondary College Redevelopment	Report Page:	2
Works Component:	Acid Sulfate Soils Analysis	Project No:	2624EV/P425
Materials Used:	Distilled Water, Hydrogen Peroxide, Sodium Hydroxide	Test Request/Order:	N/A

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP3	23/06/2020	Surface		TP3	23/06/2020	0.5m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	5.73		pHF	pH	5.82
pHFox	pH	4.91		pHFox	pH	5.06
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP3	23/06/2020	1.0m		TP3	23/06/2020	1.5m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	6.08		pHF	pH	5.66
pHFox	pH	5.54		pHFox	pH	5.31
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	Acidic Soil

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP3	23/06/2020	2.0m		TP4	23/06/2020	Surface
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	5.58		pHF	pH	4.61
pHFox	pH	5.49		pHFox	pH	4.38
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	Acidic Soil		Classification	-	ASS

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP4	23/06/2020	0.5m		TP4	23/06/2020	1.0m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	4.43		pHF	pH	4.08
pHFox	pH	4.28		pHFox	pH	3.75
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	ASS		Classification	-	ASS

Sample Number	Sample Date	Test Depth		Sample Number	Sample Date	Test Depth
TP4	23/06/2020	1.5m		TP4	23/06/2020	2.0m
Parameters	Units	Test Results		Parameters	Units	Test Results
Date Tested	-	23/06/2020		Date Tested	-	23/06/2020
pHF	pH	4.13		pHF	pH	4.4
pHFox	pH	4.06		pHFox	pH	4.21
Reaction Intensity	-	XX		Reaction Intensity	-	XX
Frothing or Effervescing (F/E)	-	F		Frothing or Effervescing (F/E)	-	F
Classification	-	ASS		Classification	-	ASS

Abbreviations		Report Remarks and Endorsement
AASS	Actual Acid Sulphate Soils	
PASS	Potential Acid Sulphate Soils	
pHFox	pH field oxidised with peroxide - stabilised to 5.5 pH	
Sampling and Test Methods		
AS 1289.E2.1		Issued By:
Acid Sulphate Soils Laboratory Methods Guidelines		Danielle Townsend
Section H - Field Tests (Version 2.1 June 2004)		

* The rate of the reaction generally indicates the level of sulfides present, but depends also on texture and other soil constituents. A soil containing very little sulfides may only rate an 'X' however a soil containing high levels of sulfides (remember the exact level of sulfides cannot be determined using the pHFOX test) is more likely to rate a 'XXXX' although there are exceptions. This rating scale alone should not be used to identify ASS. It is not a very reliable feature in isolation as there are other factors including manganese and organic acids which may trigger reactions. Reactions with organic matter tend to be more 'frothing' and don't tend to generate as much heat as sulfidic reactions. Manganese reactions will be quite extreme, but don't tend to lower the pHFOX.

APPENDIX

C

LABORATORY RESULTS



**Construction
Sciences**

CERTIFICATE OF ANALYSIS

Work Order : **EB2016889**
Client : **CONSTRUCTION SCIENCES PTY LTD**
Contact : CHRISTINE HOWLAND
Address :
Telephone : ----
Project : Shadforth Oxley
Order number : ----
C-O-C number : ----
Sampler : DANIELLE TOWNSEND
Site : ----
Quote number : EN/024/18
No. of samples received : 8
No. of samples analysed : 8

Page : 1 of 6
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61 7 3552 8616
Date Samples Received : 25-Jun-2020 16:30
Date Analysis Commenced : 29-Jun-2020
Issue Date : 29-Jun-2020 16:18



Accreditation No. 825
 Accredited for compliance with
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- ASS: EA029 (SPOCAS): Excess ANC not required because pH OX less than 6.5.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m³ in-situ soil, multiply reported results x wet bulk density of soil in t/m³.



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	TP1 1 - 2m	TP1 0 - 1m	TP3 0 - 1m	TP4 1 - 2m	TP3 1 - 2m
Client sampling date / time					23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016889-001	EB2016889-002	EB2016889-003	EB2016889-004	EB2016889-005
					Result	Result	Result	Result	Result
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit		4.6	4.4	4.8	4.6	4.2
pH OX (23B)	----	0.1	pH Unit		5.1	4.8	4.8	4.1	3.8
EA029-B: Acidity Trail									
Titratable Actual Acidity (23F)	----	2	mole H+ / t		28	45	17	33	74
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t		37	71	23	102	129
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t		9	26	6	69	55
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S		0.045	0.072	0.027	0.053	0.119
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S		0.060	0.114	0.037	0.164	0.206
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S		<0.020	0.042	<0.020	0.111	0.088
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.020	% S		<0.020	<0.020	<0.020	0.114	0.022
Peroxide Sulfur (23De)	----	0.020	% S		<0.020	<0.020	0.021	0.128	0.033
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S		<0.020	<0.020	0.021	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t		<10	<10	13	<10	<10
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.020	% Ca		<0.020	<0.020	0.097	0.025	0.034
Peroxide Calcium (23Wh)	----	0.020	% Ca		<0.020	<0.020	0.098	0.027	0.036
Acid Reacted Calcium (23X)	----	0.020	% Ca		<0.020	<0.020	<0.020	<0.020	<0.020
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t		<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S		<0.020	<0.020	<0.020	<0.020	<0.020
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg		0.126	0.138	0.124	0.196	0.112
Peroxide Magnesium (23Tm)	----	0.020	% Mg		0.132	0.138	0.124	0.212	0.120
Acid Reacted Magnesium (23U)	----	0.020	% Mg		<0.020	<0.020	<0.020	<0.020	<0.020
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t		<10	<10	<10	13	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S		<0.020	<0.020	<0.020	0.021	<0.020
EA029-G: Retained Acidity									
HCl Extractable Sulfur (20Be)	----	0.020	% S		----	0.054	----	----	0.027
Net Acid Soluble Sulfur (20Je)	----	0.020	% S		----	0.054	----	----	<0.020
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t		----	25	----	----	<10
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.020	% pyrite S		----	0.040	----	----	<0.020



Analytical Results

Sub-Matrix: **SOIL**
 (Matrix: **SOIL**)

Client sample ID

				TP1 1 - 2m	TP1 0 - 1m	TP3 0 - 1m	TP4 1 - 2m	TP3 1 - 2m
Client sampling date / time				23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EB2016889-001	EB2016889-002	EB2016889-003	EB2016889-004	EB2016889-005
				Result	Result	Result	Result	Result
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.04	0.11	0.05	0.07	0.13
Net Acidity (acidity units)	----	10	mole H+ / t	28	70	30	42	83
Liming Rate	----	1	kg CaCO3/t	2	5	2	3	6
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	0.11	0.05	0.07	0.13
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	28	70	30	42	83
Liming Rate excluding ANC	----	1	kg CaCO3/t	2	5	2	3	6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID		TP2 0 -1m	TP2 1 - 2m	TP4 0 - 1m	----	----	
Client sampling date / time				23-Jun-2020 00:00		23-Jun-2020 00:00		23-Jun-2020 00:00		----	----
Compound	CAS Number	LOR	Unit	EB2016889-006		EB2016889-007		EB2016889-008		-----	-----
				Result		Result		Result		----	----
EA029-A: pH Measurements											
pH KCl (23A)	----	0.1	pH Unit	4.1		4.5		4.3		----	----
pH OX (23B)	----	0.1	pH Unit	4.4		4.8		4.0		----	----
EA029-B: Acidity Trail											
Titratable Actual Acidity (23F)	----	2	mole H+ / t	94		38		48		----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	128		60		93		----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	34		22		45		----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	0.151		0.061		0.077		----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	0.205		0.097		0.149		----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	0.054		0.035		0.072		----	----
EA029-C: Sulfur Trail											
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020		<0.020		0.106		----	----
Peroxide Sulfur (23De)	----	0.020	% S	<0.020		<0.020		0.108		----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020		<0.020		<0.020		----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10		<10		<10		----	----
EA029-D: Calcium Values											
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	<0.020		<0.020		<0.020		----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	<0.020		<0.020		<0.020		----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020		<0.020		<0.020		----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10		<10		<10		----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020		<0.020		<0.020		----	----
EA029-E: Magnesium Values											
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	0.063		0.112		0.202		----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	0.067		0.112		0.202		----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020		<0.020		<0.020		----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10		<10		<10		----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020		<0.020		<0.020		----	----
EA029-G: Retained Acidity											
HCl Extractable Sulfur (20Be)	----	0.020	% S	<0.020		----		0.108		----	----
Net Acid Soluble Sulfur (20Je)	----	0.020	% S	<0.020		----		<0.020		----	----
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t	<10		----		<10		----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.020	% pyrite S	<0.020		----		<0.020		----	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	TP2 0 -1m	TP2 1 - 2m	TP4 0 - 1m	----	----
Client sampling date / time					23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2016889-006	EB2016889-007	EB2016889-008	-----	-----
					Result	Result	Result	----	----
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		1.5	1.5	1.5	----	----
Net Acidity (sulfur units)	----	0.02	% S		0.15	0.06	0.08	----	----
Net Acidity (acidity units)	----	10	mole H+ / t		94	38	50	----	----
Liming Rate	----	1	kg CaCO3/t		7	3	4	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		0.15	0.06	0.08	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		94	38	50	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t		7	3	4	----	----

QUALITY CONTROL REPORT

Work Order	: EB2016889	Page	: 1 of 5
Client	: CONSTRUCTION SCIENCES PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: CHRISTINE HOWLAND	Contact	: Carsten Emrich
Address	:	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8616
Project	: Shadforth Oxley	Date Samples Received	: 25-Jun-2020
Order number	: ----	Date Analysis Commenced	: 29-Jun-2020
C-O-C number	: ----	Issue Date	: 29-Jun-2020
Sampler	: DANIELLE TOWNSEND		
Site	: ----		
Quote number	: EN/024/18		
No. of samples received	: 8		
No. of samples analysed	: 8		



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA029-A: pH Measurements (QC Lot: 3104199)									
EB2016889-001	TP1 1 - 2m	EA029: pH KCl (23A)	----	0.1	pH Unit	4.6	4.6	0.00	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	5.1	5.2	1.94	0% - 20%
EA029-B: Acidity Trail (QC Lot: 3104199)									
EB2016889-001	TP1 1 - 2m	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.045	0.043	4.04	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	0.060	0.059	2.03	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	28	27	4.04	0% - 50%
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	37	37	0.00	0% - 50%
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	9	10	0.00	No Limit
EA029-C: Sulfur Trail (QC Lot: 3104199)									
EB2016889-001	TP1 1 - 2m	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-D: Calcium Values (QC Lot: 3104199)									
EB2016889-001	TP1 1 - 2m	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-E: Magnesium Values (QC Lot: 3104199)									

Page : 3 of 5
 Work Order : EB2016889
 Client : CONSTRUCTION SCIENCES PTY LTD
 Project : Shadforth Oxley



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA029-E: Magnesium Values (QC Lot: 3104199) - continued									
EB2016889-001	TP1 1 - 2m	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.126	0.124	1.51	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.132	0.130	1.34	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-H: Acid Base Accounting (QC Lot: 3104199)									
EB2016889-001	TP1 1 - 2m	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.00	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	0.04	0.04	0.00	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	0.04	0.00	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	2	2	0.00	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	2	2	0.00	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	28	27	4.04	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	28	27	4.04	No Limit



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EA029-A: pH Measurements (QCLot: 3104199)								
EA029: pH KCl (23A)	----	0.1	pH Unit	<0.1	4.4 pH Unit	97.7	70.0	130
EA029: pH OX (23B)	----	0.1	pH Unit	<0.1	4.2 pH Unit	102	70.0	130
EA029-B: Acidity Trail (QCLot: 3104199)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	15 mole H+ / t	106	70.0	130
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	27.5 mole H+ / t	117	70.0	130
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 3104199)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	0.072 % S	124	70.0	130
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	0.204 % S	107	70.0	130
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-D: Calcium Values (QCLot: 3104199)								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	0.102 % Ca	117	70.0	130
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	0.2 % Ca	106	70.0	130
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	----	----	----	----
EA029-E: Magnesium Values (QCLot: 3104199)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	0.255 % Mg	85.0	70.0	130
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.020	0.228 % Mg	109	70.0	130
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	----	----	----	----
EA029-G: Retained Acidity (QCLot: 3104199)								
EA029: Net Acid Soluble Sulfur (20Je)	----	0.02	% S	<0.020	----	----	----	----
EA029: acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: HCl Extractable Sulfur (20Be)	----	0.02	% S	<0.020	0.279 % S	105	70.0	130
EA029-H: Acid Base Accounting (QCLot: 3104199)								
EA029: ANC Fineness Factor	----	0.5	-	<0.5	----	----	----	----



Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result			LCS	Low
EA029-H: Acid Base Accounting (QCLOT: 3104199) - continued								
EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB2016889	Page	: 1 of 6
Client	: CONSTRUCTION SCIENCES PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: CHRISTINE HOWLAND	Telephone	: +61 7 3552 8616
Project	: Shadforth Oxley	Date Samples Received	: 25-Jun-2020
Site	: ----	Issue Date	: 29-Jun-2020
Sampler	: DANIELLE TOWNSEND	No. of samples received	: 8
Order number	: ----	No. of samples analysed	: 8

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- **NO** Matrix Spike outliers occur.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.

Matrix: SOIL

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA029-A: pH Measurements							
Snap Lock Bag TP1 1 - 2m, TP1 0 - 1m, TP3 0 - 1m, TP4 1 - 2m, TP3 1 - 2m, TP2 0 - 1m, TP2 1 - 2m, TP4 0 - 1m		29-Jun-2020	24-Jun-2020	5	----	----	----
EA029-B: Acidity Trail							
Snap Lock Bag TP1 1 - 2m, TP1 0 - 1m, TP3 0 - 1m, TP4 1 - 2m, TP3 1 - 2m, TP2 0 - 1m, TP2 1 - 2m, TP4 0 - 1m		29-Jun-2020	24-Jun-2020	5	----	----	----
EA029-C: Sulfur Trail							
Snap Lock Bag TP1 1 - 2m, TP1 0 - 1m, TP3 0 - 1m, TP4 1 - 2m, TP3 1 - 2m, TP2 0 - 1m, TP2 1 - 2m, TP4 0 - 1m		29-Jun-2020	24-Jun-2020	5	----	----	----
EA029-D: Calcium Values							
Snap Lock Bag TP1 1 - 2m, TP1 0 - 1m, TP3 0 - 1m, TP4 1 - 2m, TP3 1 - 2m, TP2 0 - 1m, TP2 1 - 2m, TP4 0 - 1m		29-Jun-2020	24-Jun-2020	5	----	----	----
EA029-E: Magnesium Values							
Snap Lock Bag TP1 1 - 2m, TP1 0 - 1m, TP3 0 - 1m, TP4 1 - 2m, TP3 1 - 2m, TP2 0 - 1m, TP2 1 - 2m, TP4 0 - 1m		29-Jun-2020	24-Jun-2020	5	----	----	----
EA029-F: Excess Acid Neutralising Capacity							
Snap Lock Bag TP1 1 - 2m, TP1 0 - 1m, TP3 0 - 1m, TP4 1 - 2m, TP3 1 - 2m, TP2 0 - 1m, TP2 1 - 2m, TP4 0 - 1m		29-Jun-2020	24-Jun-2020	5	----	----	----
EA029-G: Retained Acidity							



Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA029-G: Retained Acidity - Analysis Holding Time Compliance							
Snap Lock Bag		29-Jun-2020	24-Jun-2020	5	----	----	----
TP1 1 - 2m,	TP1 0 - 1m,						
TP3 0 - 1m,	TP4 1 - 2m,						
TP3 1 - 2m,	TP2 0 -1m,						
TP2 1 - 2m,	TP4 0 - 1m						
EA029-H: Acid Base Accounting							
Snap Lock Bag		29-Jun-2020	24-Jun-2020	5	----	----	----
TP1 1 - 2m,	TP1 0 - 1m,						
TP3 0 - 1m,	TP4 1 - 2m,						
TP3 1 - 2m,	TP2 0 -1m,						
TP2 1 - 2m,	TP4 0 - 1m						

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-A: pH Measurements								
Snap Lock Bag (EA029)		23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
TP1 1 - 2m,	TP1 0 - 1m,							
TP3 0 - 1m,	TP4 1 - 2m,							
TP3 1 - 2m,	TP2 0 -1m,							
TP2 1 - 2m,	TP4 0 - 1m							
EA029-B: Acidity Trail								
Snap Lock Bag (EA029)		23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
TP1 1 - 2m,	TP1 0 - 1m,							
TP3 0 - 1m,	TP4 1 - 2m,							
TP3 1 - 2m,	TP2 0 -1m,							
TP2 1 - 2m,	TP4 0 - 1m							



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-C: Sulfur Trail							
Snap Lock Bag (EA029) TP1 1 - 2m, TP3 0 - 1m, TP3 1 - 2m, TP2 1 - 2m, TP1 0 - 1m, TP4 1 - 2m, TP2 0 -1m, TP4 0 - 1m	23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
EA029-D: Calcium Values							
Snap Lock Bag (EA029) TP1 1 - 2m, TP3 0 - 1m, TP3 1 - 2m, TP2 1 - 2m, TP1 0 - 1m, TP4 1 - 2m, TP2 0 -1m, TP4 0 - 1m	23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
EA029-E: Magnesium Values							
Snap Lock Bag (EA029) TP1 1 - 2m, TP3 0 - 1m, TP3 1 - 2m, TP2 1 - 2m, TP1 0 - 1m, TP4 1 - 2m, TP2 0 -1m, TP4 0 - 1m	23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
EA029-F: Excess Acid Neutralising Capacity							
Snap Lock Bag (EA029) TP1 1 - 2m, TP3 0 - 1m, TP3 1 - 2m, TP2 1 - 2m, TP1 0 - 1m, TP4 1 - 2m, TP2 0 -1m, TP4 0 - 1m	23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
EA029-G: Retained Acidity							
Snap Lock Bag (EA029) TP1 1 - 2m, TP3 0 - 1m, TP3 1 - 2m, TP2 1 - 2m, TP1 0 - 1m, TP4 1 - 2m, TP2 0 -1m, TP4 0 - 1m	23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔
EA029-H: Acid Base Accounting							
Snap Lock Bag (EA029) TP1 1 - 2m, TP3 0 - 1m, TP3 1 - 2m, TP2 1 - 2m, TP1 0 - 1m, TP4 1 - 2m, TP2 0 -1m, TP4 0 - 1m	23-Jun-2020	29-Jun-2020	24-Jun-2020	✖	29-Jun-2020	27-Sep-2020	✔



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	8	12.50	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house