

Draft Huntly
Managed Fill Acid
Sulphate Soil
Management Plan

Prepared for:

Gleeson Managed Fill
Limited

Prepared by:

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Acronyms

ANC	Acid Neutralising Capacity
ASS	Acid Sulphate Soils
CRS	Chromium Reducible Sulphate
DAWR	Department of Agriculture and Water Resources
ENV	effective neutralisation value
FMP	Fill Management Plan
GMF	Gleeson Managed Fill Limited
MBO	monosulfide black ooze
NAPP	Net Acid Producing Potential
NV	neutralising value
pHox	pH oxidation
RIS	Reactive Iron Species
SCR	Chromium reducible Sulphur
TAA	Titrateable Actual Acidity
WAC	Waste Acceptance Criteria
WRC	Waikato Regional Council

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Units of Measure

Area	
ha	hectare
m ²	square metres
Density	
kg/m ³	kilograms per cubic metre
Electrical Conductance	
µS/cm	microsiemen per centimetre
dS/m	decisiemen per metre
mS/cm	millisiemen per centimetre
mV	millivolt
Length	
µm	micrometres
cm	centimetres
km	kilometres
m	metres
mm	millimetres
Mass	
µg	micrograms
g	grams
kg	kilograms
mg	milligrams
t	metric tonnes
Concentration by Mass	
µg/kg	microgram per kilogram
mg/kg	milligram per kilogram
Pressure	
kPa	kilopascals
Pa	Pascals
Temperature	
°C	degrees Celsius
°F	degrees Fahrenheit
K	kelvin
Velocity	
m/s	metres per second
Volume	
µL	microlitres
cL	centilitres

cm ³	cubic centimetre
GL	gigalitre
L	litres
m ³	cubic metre
mL	millilitres
ML	megalitre
Concentration by Volume	
µg/L	microgram per litre
mg/L	milligram per litre
ppmv	parts per million by volume
ppbv	parts per billion by volume



1 Introduction

EHS Support New Zealand Ltd (“EHS Support”) has been engaged by Paua Planning Limited (PP) on behalf of Gleeson Managed Fill Limited (GMF) to develop a management plan for managing receiving acid sulphate soils (ASS) submitted to the Huntly Managed Fill for disposal.

This ASS management plan is intended to supplement the Fill Management Plan (FMP).

1.1 Objectives

The objectives of the ASS management plan include:

1. Identification and classification of ASS that the Huntly Managed Fill may receive.
2. Outlining the process of neutralising ASS
3. Validation of neutralised soils before disposal.

1.2 What are Acid Sulphate Soils?

ASS is a term given to soils and sediments rich in naturally occurring iron sulphide minerals. Acid sulphate soils naturally occur in several locations within the Waikato, including the Coromandel region; primarily within geothermal areas, peat soils, some volcanic soils and certain areas in the North Waikato region. When these soils are disturbed and exposed to air, they may be oxidised. If there is an insufficient natural buffering capacity within the soils, they may generate acidic leachate water, mobilising inorganic elements.

In the Auckland and Northland area, many soils tested from the Putekoka formation and Holocene age alluvial soils have moderately to a highly acidic character.

1.3 Potentially Acid Sulphate Soils

For the purpose of this ASS management plan, the following soils/sediments are assumed to have acid-generating potential:

- All soils derived from dredging operations and flood mitigation works.
- Marine or estuarine sediments.
- All soils identified as being monosulfide black ooze (MBO).
- All peat soils.
- Soils identified as being acidic soils under the New Zealand Soil Classification Scheme, such as fluid Gley Raw Soils and Hydrothermal Raw Soils.
- Soils identified from geological maps as being areas identified in geological areas bearing sulphide minerals, or former marine shales/sediments.
- Soils identified in geological maps as being areas identified as being Pukekoka formation.
- Soils from geothermal features or have been altered by geothermal activity.
- Coastal and near-coastal soils (especially salt marshes, mangrove swamps, outer barrier tidal lakes and black swamps).
- All marine sediments.
- Soils identified as having a medium or high probability of ASS identified in **Figure 1-1**.
- Soils identified in any ASS hazard maps published by the Waikato Regional Council (WRC).

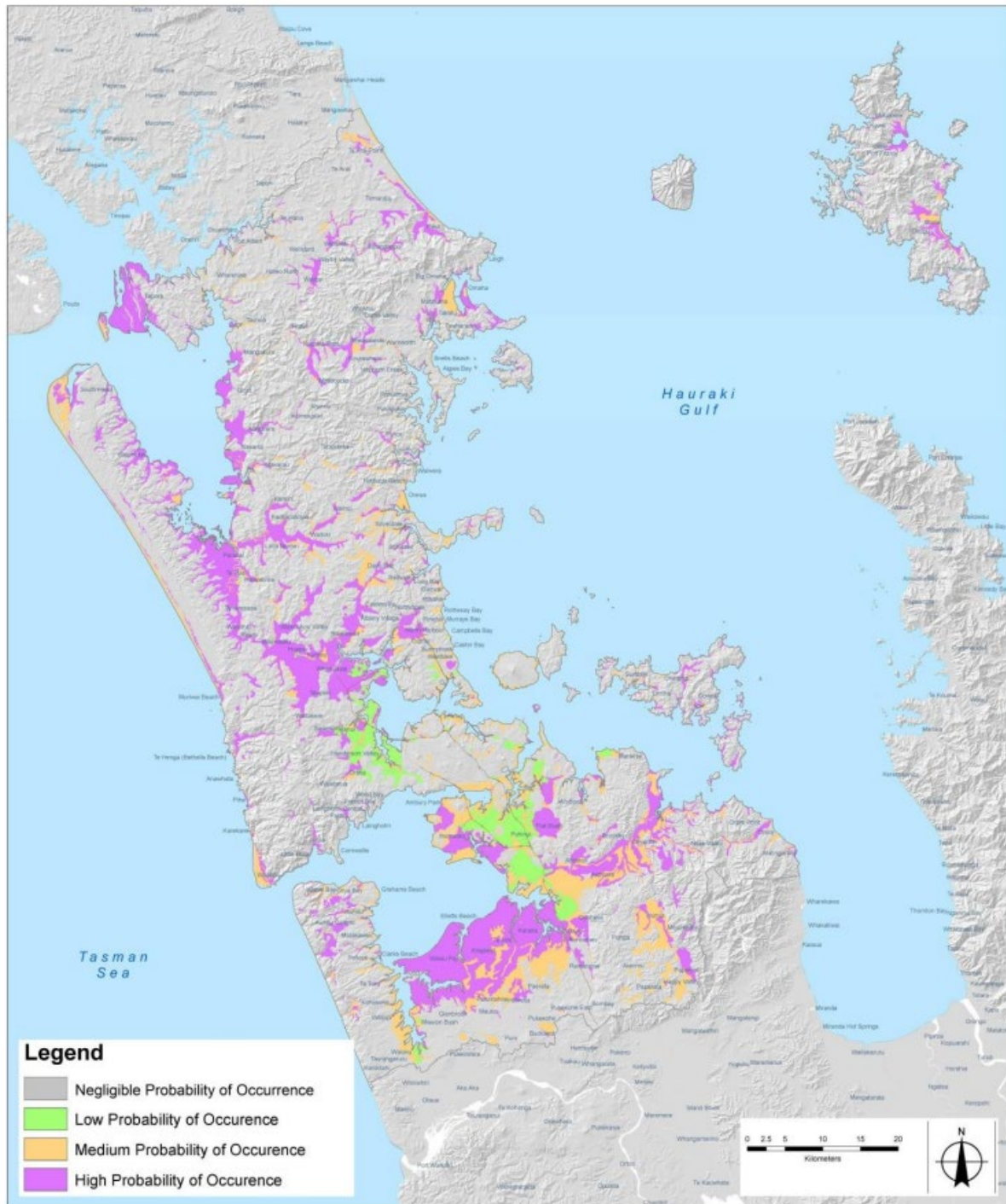


Figure 1-1 Preliminary Map of the Potential for Acid Sulphate Soils in the Auckland Region (Roberts, 2017)



1.4 Prohibited Acid Sulphate Soils

The soils or soil-like materials shall not be accepted from the following sources:

- Coal ash (including fly ash or bottom ash).
- Bulk Fertiliser.
- Acid-generating tailings from the processing of sulphide ore.
- Other sulphuric mine tailings materials.
- Waste from metalliferous minerals' physical and chemical processing (including mine mullock, iron slag and conveyor sludge).



2 Background Information

GMF operates a managed fill operation at 310 Riverview Road, Huntly. The intention of the managed fill is to accept cleanfill and soils containing elevated concentrations of contaminants (as defined in the FMP Waste Acceptance Criteria). Some soils (or sediments) may contain sulphide minerals, which, when disturbed by the excavation process, may form ASS. This document describes the process for identifying potential ASS and how they will be managed on-site to neutralise the acid-generating capabilities of the soils.

2.1 Treatment of Acid Sulphate Soils

Potential ASS/ASS will be identified by the client and tested for Chromium-reducible sulphate to allow GMF to identify the amount of AgLime required to neutralise the soils. Once GMF has assessed AgLime required and verified that there is a sufficient amount of AgLime and space available on the treatment pads available, then the fill material will be accepted on-site (in writing?).

The Gleeson Cox facility is designed to treat up to 1,000 m³ per day, on a continuous basis to ensure that material is not stockpiled within the process pad when the site is not attended or, to the extent practicable, during rainfall.. The general design and layout of the ASS treatment system is presented in **Appendix A**.

Once the material is accepted on-site, it will be placed onto the treatment pad which provides space for two active processing piles (see **Section 2.2** for details of the treatment pad design). Aglime will be mixed into the soil using a rotary cultivator or similar. Once the Aglime has been added, then pHox testing will be undertaken (see **Section 4.3** and **Appendix B**) to confirm that sufficient AgLime has been added to the soil. When pHox is at the required level, the material will be loaded on site trucks and carried to the active managed fill site. This process will operate continuously, such that the site is cleared at the end of each working day. To ensure that this can be achieved, loads will not be accepted after 3:30p.m. on any working day and, to the extent practicable, will not be received if rain is forecast.

If the pHox test is inclusive or indicates insufficient AgLime has been added, soil samples will be collected and sent to a certified laboratory for chromium-reducible sulphide testing¹. The material will be covered in one stockpile for quarantine until cleared for export to the managed fill..

2.2 Treatment Pad

A treatment pad should be prepared according to **Figure 2-1**, as per the Queensland Acid Sulfate Soil Technical Manual (Dear et al. 2002). An impermeable layer and leachate collection system are required. The treatment pad will be located at least 40 m from any waterway and placed in a topographically high area to avoid inundation following heavy rain (see **Appendix A** for the location of treatment pads). To achieve this, the pad is to be located within the vicinity of the completed overburden disposal site to the south-west of the quarry pit.

¹ It should be noted that CRS testing must be undertaken in Australia as there are no commercial laboratories offering this service. Analysis could take up to 2-3 weeks before results are obtained.

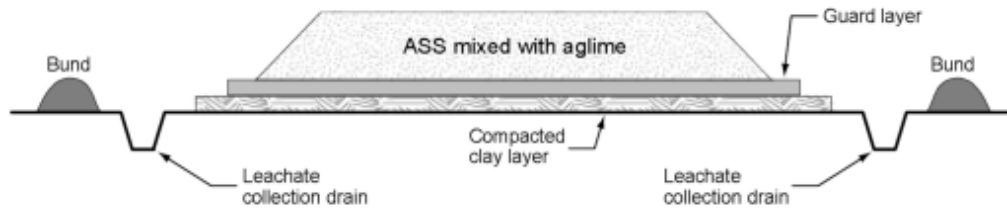


Figure 2-1 Cross-Section of a Typical Treatment Pad

Figure 2-1 shows a cross-section of typical treatment pad. Soils for treatment should be spread in thin (<200 mm) layers on the impervious pad, the required lime spread and then incorporated by rotary hoe/road stabiliser/discing machine or similar.

The treatment pad will be bunded with a minimum 1 m high perimeter bund of compacted clay capped with compacted crushed limestone to contain potential leachate runoff within the treatment pad area and prevent surface water runoff from entering the treatment pad area.

The treatment area will be covered with heavy-duty plastic when it is being used to treat or quarantine soil to prevent runoff, particularly when inclement weather is forecast.

Design information for the treatment pad is attached in **Appendix B**. The treatment pad allows up to 1,000 m³ of ASS to be treated.

AgLime will be stored in a silo located adjacent to the treatment pad. The silo will ensure that the AgLime is not wetted prior to use. The silo will be re-filled on an as-required basis. It will sit within a bund. Re-filling will be direct from trucks to minimise spillage. The bunding will ensure that any unintended spillage is contained and can be removed before any discharge occurs. Such material will be used in the treatment pad operation.

2.3 Treatment of stormwater

All stormwater from the treatment pad will be collected via the perimeter drains and directed into a stormwater holding pond sized to accommodate runoff from the 50 year ARI rainfall event. Acidity and pH of the water will be tested, and if the pH of the stormwater is between 6 to 9, then the water will be pumped to the quarry pit or taken by tanker for use in dust suppression. Otherwise, the pH of the stormwater will be adjusted using caustic soda (NaOH) and re-tested to ensure that the pH is within an acceptable range for disposal.



3 Assessment Criteria

The client shall sample all potential ASS using either chromium reducible sulphur (SCR)² suite of analysis or Net Acid Producing Potential (NAPP) tests and present the results to Gleeson Managed Fill Limited before any soils can be accepted into the managed fill.

Table 3-1 details the texture-based action criteria for the management of ASS disturbance, as sourced from the National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual (NASSG), Department of Agriculture and Water Resources (DAWR), Canberra, 2018 (Water Quality Australia, 2018). The suspension peroxide oxidation combined acidity and sulphur (chromium reducible sulphur (SCR)¹ suite of analysis or Net Acid Producing Potential (NAPP) is used to assess soil for the presence of ASS.

The net acidity result for each sample is compared against the criteria within **Table 3-1**. The components that make up the net acidity using acid-base accounting techniques (i.e. actual, potential or residual acidity) are also assessed against the criteria. Where soils containing concentrations at or above the action criteria are disturbed, an ASS management plan is needed. There is a potential for the soil to generate acid, and specific management may be required.

Table 3-1 Acid Sulphate Soils Classification Criteria

Type of Material	The volume of soil from a site < 1,000 tonnes		The volume of soil from a site > 1,000 tonnes	
	% S-equiv	Mol. H ⁺ /tonne	% S-equiv	Mol. H ⁺ /tonne
Coarse texture Sand to loamy sands	0.03	18	0.03	18
Medium Texture Clayey sand to light clays	0.06	36	0.03	18
Fine Texture Medium to heavy Clays	0.1	62	0.03	18

² Note historically SPOCAS assessment criteria has been used for assessing the amount of neutralisation required,. However, this test is now considered unreliable and only Chromium Reducible Sulphate test or Net Acid Producing Potential (NAPP) tests should be used for assessing neutralisation requirements.



4 Soil Neutralisation

Neutralisation of ASS will be accomplished by adding a sufficient amount of AgLime to buffer the acid-generating capacity of the soils.

4.1 Selection of Neutralisation materials

Neutralising agents such as fine AgLime (calcium carbonate), which passes a 2 mm sieve, will be used. Before using the AgLime, the particle size distribution of the lime will be determined to determine the effectiveness of the lime for neutralising soil acidity. The particle size proportion will be determined for the following size fractions:

- - 2.00 mm
- 0.85 – 1.00 mm
- 0.3-0.850 mm
- <0.3 mm.

4.2 Calculating the quantity of AgLime for the treatment of ASS

It is important to provide adequate neutralising material to reduce the potential for environmental harm or damage. Sufficient neutralising material should be applied to soil, in accordance with the Treatment and management of soil and water in ASS landscapes guidelines (Department of Water and Environmental Regulation, 2015) to counteract the theoretical acid production potential of the soil. The theoretical acid production potential of the soil is determined based on the existing plus the potential acidity of the soil, multiplied by a 'safety factor' of 1.5.

Once the net acidity has been determined, the amount of lime needed for soil treatment can be calculated using the following equation:

$$\text{Lime needed (kg CaCO}_3\text{/m}^3\text{ soil)} = \text{bulk density soil (tonne/m}^3\text{)} \times \text{net acidity (S\%} \times 30.59) \times 1.028 \times 1.5 \text{ (safety factor)} \times 100/\text{ENV}$$

The effective neutralisation value (ENV) is a factor that takes into account:

- Neutralising value (NV)—i.e. the amount of calcium carbonate (fine Aglime), expressed as a percentage. For Aglime, the neutralising value is assumed to be 0.85 (see (Department of Water and Environmental Regulation, 2015)
- Particle size distribution (percentage by weight)—i.e. the fineness of the neutralising material. The finer the product, the greater the surface area for the neutralising chemical reactions to occur; and
- Solubility of the neutralising material.

The ENV is calculated as shown in **Table 4-1**.

Table 4-1 ENV Calculations

Neurtailisation Value (Ag Lime)	Particle Size	Proportion	Utilisation Factor	ENV
0.85	1.00-2.00	TBD	0.01	
0.85	0.85-1.00	TBD	0.10	
0.85	0.3	TBD	0.60	



Neurtailisation Value (Ag Lime)	Particle Size	Proportion	Utilisation Factor	ENV
0.85	<0.3	TBD	1.0	
Total ENV				TBD

Table Notes:

Total ENV = NV x UF x %proportion/100

TBD = to be determined by testing the particle size distribution of Aglime

4.3 Validation of Soil Treatment

GMF will maintain a stockpile register that allows for tracking of material from the source, through the treatment process, to the disposal location. To facilitate the tracking process and ensure risks of potential ASS oxidisation are managed, the following protocol will be implemented:

1. Four field samples will be collected from each quarter of the stockpile. Each sample should be a composite of five grab samples from the quarter of the stockpile being assessed.
2. The samples will be screened using the field peroxide method (**Appendix B**).
3. Field screening results will be assessed and actioned as follows: — If all results show field pH peroxide (pHFOX) >6, then the soil is considered very low risk of being ASS and therefore suitable for on-site disposal.
4. If one or more results show pHFOX <6, submit a composite of the four samples for testing at the lab by the CRS method³.
5. If lab results confirm that no further lime is required, the material will be considered appropriately treated and suitable for disposal.
6. Note that the protocol for assessing whether sufficient lime has been applied, in accordance with NASSG (Water Quality Australia, 2018) is to determine the added Acid Neutralising Capacity (ANC) by subtracting the untreated soil ANC from the treated soil ANC and using this figure for the purpose of acid-base accounting.

$$\text{Net acidity} = \text{TAA} + \text{SCr} + \text{NAS} - (\text{ANC after treatment} - \text{ANC before treatment})$$

(Successful treatment requires the Net Acidity to be ≤ 0)

TAA = Total Actual Acidity

7. If further liming is required, this will be applied, mixed and the verification testing repeated; and
8. Records of the testing and verification works will be maintained throughout the works.

Where test results show treatment is necessary, the recommended liming rate will be applied, and the lime will be mixed thoroughly before verification testing occurs.

³ Chromium Reducible Sulphate



5 Limitations

Within the limitations of the above agreed scope of work, this Acid Sulphate Soil Management Plan has been undertaken and performed in a professional manner, in accordance with generally accepted practices, using a degree of skill and care ordinarily exercised by members of its profession and consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report.

This report is intended for the sole use of Gleeson Managed Fill (GMF). The scope of services performed in the preparation of this document may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or of the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

Background information, design bases, and other data have been furnished to EHS Support New Zealand Ltd (EHS Support) by GMF and/or third parties, which EHS Support has used in preparing this report. EHS Support has relied on this information as furnished and is neither responsible for nor has confirmed the accuracy of this information.

Opinions presented herein apply to the existing and reasonably foreseeable site conditions at the time of our assessment/review. They cannot apply to site changes of which EHS Support is unaware and has not had the opportunity to review. Changes in the condition of this property may occur with time due to natural processes or works of man at the site or on adjacent properties. Changes in applicable standards may also occur as a result of legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes beyond our control.



6 References

- Dear et al. (2002). Queensland Acid Sulfate Soil Technical Manual
- Department of Water and Environmental Regulation. (2015). *Treatment and Management of soil and water in acid sulfate soil landscapes*. Perth: Government of Western Australia.
- Roberts, R. M. (2017). Preliminary Assessment of the Acid Sulphate Soil Hazard in the Auckland Region. In G. C. Alexander, *Proceeding 20th New Zealand Geotechnical Society Geotechnical Symposium*. Napier: NZGS.
- Water Quality Australia. (2018). *National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual*. Canberra: Australian Government Department of Agriculture and Water Resources.



Appendix A Field PHox Method?



A1 Soil field test equipment

It is important that prior to conducting the field tests, the appropriate testing equipment is obtained. For a basic set up the following items are required:

- 1) pH meter and electrode (charged and calibrated),
- 2) at least 2 buffer solutions (for example pH 4.0 and pH 7.0),
- 3) centrifuge tubes or beakers – wide, unbreakable, heat resistant and clear (for example Falcon 50 mL polypropylene),
- 4) centrifuge tube or jar rack marked with soil sample depths – use a separate rack for pH_F tests and pH_{FOX} tests in case they bubble over,
- 5) stirrers for centrifuge tubes,
- 6) 30% hydrogen peroxide (H₂O₂) pH adjusted to 4.5–5.5,
- 7) storage bottle for H₂O₂,
- 8) sodium hydroxide (NaOH) to raise pH of peroxide to 4.5–5.5 (pH 5.5 ideal),
- 9) deionised (DI) water,
- 10) squirt bottle for DI water,
- 11) tissues,
- 12) gloves and safety glasses,
- 13) protective clothing,
- 14) bucket to collect used soil and hydrogen peroxide,
- 15) bucket and brush to clean tubes for next sample,
- 16) recording sheets,
- 17) excess water for rinsing,
- 18) first aid kit – especially eye wash solutions, and
- 19) 1 M hydrochloric (HCl) acid to test for shell presence.

A1.4.2 Field pH test (pH_F) – NSM-1.1

The procedure for the pH_F is outlined below:

- 1) Calibrate battery powered field pH meter according to manufacturer's instructions.

Prepare the centrifuge tubes in a tube rack. Mark the rack with the depths to identify the top and bottom of the profile. Use separate racks for the pH_F and pH_{FOX} tests to prevent cross-contamination from violent pH_{FOX} reactions.

For each layer place approximately half a teaspoon of soil into each of the pH_F and pH_{FOX} tubes. It is important the two sub-samples come from the same depth and are similar in characteristics.

Place enough deionised (DI) water in the pH_F test tube to make a paste similar to 'grout mix' or 'white sauce'; stir the soil:water paste to ensure all soil 'lumps' are removed (demineralised)



water can be substituted; never use tap water). Water must be added to the soil samples within 10 min of sampling to reduce the risk of RIS oxidation; monosulfidic material may start to oxidise in less than 5 min, substantially affecting pH_F results.

Immediately place the pH spear point electrode into the soil:water paste, ensuring the spear point is completely submerged. Never stir the paste with the electrode as this may damage the semi-permeable glass membrane.

Measure the pH_F with the calibrated pH meter.

Wait for the reading to stabilise and record the pH measurement.

All measurements should be recorded on a data sheet.

(a) *Rating soil reactions of the pH_{FOX} test*

Table A1 indicates the reaction scale for pH_{FOX} tests. The rate of the reaction generally indicates the level of RIS present, but depends also on texture and other soil constituents. A soil containing very little RIS may only have a slight reaction (L), however a soil containing high levels of RIS (remember the exact level of RIS cannot be determined using the pH_{FOX} test) is more likely to have an extreme/volcanic reaction (X–V), 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 do not tend to generate as much heat as sulfidic reactions. Manganese reactions can be quite extreme, but do not tend to lower the pH_{FOX} .

Table A1 Soil reaction rating scale for the pH_{FOX} test.

Reaction scale	Rate of reaction
L	Low reaction
M	Medium reaction
H	High reaction
X	Extreme reaction
V	Volcanic reaction

Source: DER (2015a).

A1.4.4 Interpretation of field pH tests

The pH_F test can help identify Actual ASS. While a pH_F of less than or equal to 4 is indicative of the presence of Actual ASS, it is not conclusive of the presence of ASS on its own, as naturally occurring, non ASS soils such as many organic soils (for example peats) and heavily leached soils may also have pH_F less than or equal to 4.

To identify as an Actual ASS, other evidence must be presented that indicates that the low pH_F has been mainly caused by the oxidation of reactive iron species (RIS). Such information includes the presence of jarosite in the soil layer/horizon, or the location of other Actual ASS or PASS materials within or in the nearby vicinity to the sampling location.

The difference between the pH_F and the pH_{FOX} is helpful in the preliminary identification of PASS. When combined, the pH_F and pH_{FOX} results can be a useful aid with soil sample selection for laboratory analysis during Stage 2 of the field site investigations.

The pH_{FOX} result when compared to the pH_F result can give an indication of the presence of RIS in the sample. To ensure accurate results both of these tests must be conducted in the field as soon as possible after the sample is collected as the pH of the soil sample can change relatively quickly with time (hours to days) even when recommended sample preservation techniques are employed. For



example, it is not unusual for soil pH test carried out at a laboratory to differ considerably (that is greater than a pH unit) from soil pH test measured in the field after even one day of storage, and as such, a laboratory determination of pH_F at a later date cannot be relied upon to represent field conditions at the time of sampling.

Soil field pH_F and pH_{FOX} tests whilst useful exploratory tools, however, are not determinative and cannot be substituted for laboratory analysis for either the identification of ASS materials and quantification of the acidity hazards these materials pose. A recent review of the utility of these field tests in Western Australia indicated that these tests only accurately identified ASS materials in 60 to 80 per cent of cases (DER 2015a).

A comparison of pH_F and pH_{FOX} test results can often give a strong indication of the presence of ASS. The greater the drop in pH from pH_F following the addition of peroxide, the greater the likelihood of PASS, although there are exceptions. A combination of a large difference between the two pH tests, a strong reaction with peroxide and a low pH after peroxide oxidation (that is pH_{FOX} less than 3) strongly indicates the presence of PASS.

However, it is important to note that the definitive confirmation of either the presence or absence of PASS materials in the field can only be accomplished by appropriate laboratory testing. Tables A2 and A3 provide some guidance on the interpretation of pH_F and pH_{FOX} test results, respectively.

Table A2 Interpretation of some pH_F test ranges.

pH value	Result	Comments
$pH_F \leq 4$, jarosite not observed in the soil layer/horizon	May indicate an AASS indicating previous oxidation of RIS or may indicate naturally occurring, non ASS soils	Generally not conclusive as naturally occurring, non ASS soils, such as many organic soils (for example peats) and heavily leached soils, often also return $pH_F \leq 4$
$pH_F \leq 4$, jarosite observed in the soil layer/horizon	The soil material is an AASS	Jarosite and other iron precipitate minerals in ASS such as schwertmannite require a $pH < 4$ to form and indicate prior oxidation of RIS
$pH_F > 7$	Expected in waterlogged, unoxidised, or poorly drained soils	Marine muds commonly have a $pH > 7$ which reflects a seawater ($pH 8.2$) influence. Oxidation of samples with H_2O_2 can help indicate if the soil materials contain RIS

Table A3 Interpretation of some pH_{OX} test ranges

pH value and reaction	Result	Comments
Strong reaction of soil with H_2O_2 (that is X or V)	Useful indicator of the presence of RIS but cannot be used alone	Organic rich substrates such as peat and coffee rock, and soil constituents like manganese oxides, can also cause a reaction. Care must be exercised in interpreting these results. Laboratory analyses are required to confirm if appreciable RIS is present
pH_{FOX} value at least one unit below field pH_F and strong reaction with H_2O_2 (that is X or V)	May indicate PASS	The difference between pH_F and pH_{FOX} is termed the ΔpH . Generally the larger the ΔpH the more indicative of PASS. The lower the final pH_{FOX} the better the likelihood of an appreciable RIS content. For example, a change from pH_F of 8 to pH_{FOX} of 7 (that is a ΔpH of 1) would not indicate PASS, however, a unit change from pH_F of 3.5 to pH_{FOX} of 2.5 would be indicative of PASS. Laboratory analyses are required to confirm if appreciable RIS is present



pH value and reaction	Result	Comments
pH _{FOX} < 3, large ΔpH and a strong reaction with H ₂ O ₂ (that is X or V)	Strongly indicates PASS	The lower the pH _{FOX} below 3, the greater the likelihood that appreciable RIS is present. A combination of all three parameters – pH _{FOX} , ΔpH and reaction strength – gives the best indication of PASS. Laboratory analyses are required to confirm that appreciable RIS is present
A pH _{FOX} 3–4 and Low, Medium or Strong reaction with H ₂ O ₂	Inconclusive	RIS may be present; however, organic matter may also be responsible for the decrease in pH. Laboratory analyses are required to confirm the presence of RIS
pH _{FOX} 4–5	Inconclusive	RIS may be present in small quantities, or poorly reactive under rapid oxidation, or the sample may contain shell/ carbonate which neutralises some or all acid produced on oxidation. Equally, the pH _{FOX} value may be due to the production of organic acids with no RIS present. Laboratory analyses are required to confirm if appreciable RIS is present
pH _{FOX} > 5, small or no ΔpH, but Low, Medium or Strong reaction with H ₂ O ₂	Inconclusive	For neutral to alkaline pHF with shell or white concretions, the fizz test with 1 M HCl can be used to identify the presence of carbonates. Laboratory analyses are required to confirm if appreciable RIS is present and further testing is required to confirm that effective self-neutralising materials are present

Source: Adapted from DER (2015a).



Appendix B ASS Treatment System Design and Layout



REV	DATE	REVISION DETAILS	APPROVED
A	01.06.22	Draft for review.	



Project	Huntly Quarry
Title	Acid Sulphate Soil Management - Site Plan
Drawn	Checked
MP	
Drawing No.	Sheet No.
ESCP-001-01	1 of 2

Acid Sulphate Soil Management Notes

The management of acid sulphate soils must be in accordance with the Huntly Managed Fill Acid Sulphate Management Plan (ASMP), May 2022 or most recent update.

The site must be managed to ensure, to the greatest extent practicable, that no acid sulphate spoil is stored within the processing area overnight or during rainfall.

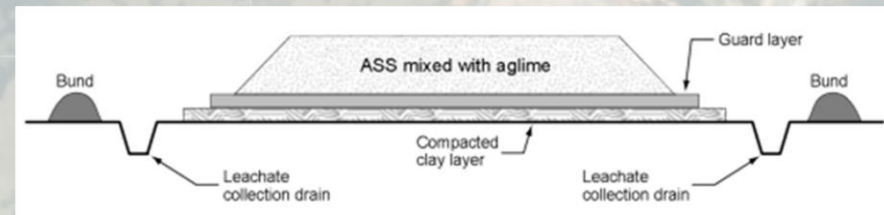
Fill will be placed within the management area and processed on arrival. Testing will be undertaken as soon as lime is applied and mixed. As soon as the test report is acceptable under the criteria of the ASMP, the material will be transferred to the current active managed fill site.

No material will be received on site after 3:30pm on any working day, to provide sufficient time for processing and disposal to the fill site by the end of the day.

To the extent practicable, soil will not be received when rain is forecast.

Runoff will be piped to a holding pond, sized for up to the 50 year storm event (based on HIRDS data). The pond will be dewatered by pumping to the quarry pit when its pH is between 6 and 9.

Treatment pad typical detail (Figure 2-1 of ASMP)



Runoff Collection Pond Details

The water collection tank must be sized to contain runoff from the 2500m² catchment for a 24hr 50 ARI event, based on HIRDS data. The pond will be dewatered to the quarry pit between rainfall events, once pH with the range of 6 and 9. The pH of the pond water will be monitored and buffered with caustic soda, if required, to ensure the pH range is achieved.

Pond Volume Calculation

- 2 ARI event: 68.9mm = 172.5m³
- 10 ARI event: 105mm = 262.5m³
- 20 ARI event: 122mm = 305m³
- 50 ARI event: 145mm = 362.5m³**

Lime hopper. A sealed silo to prevent wetting of lime before application. To be re-filled on an as-required basis. Area to be banded to ensure any spillage is contained and removed immediately after refilling completed.

Stabilised truck entry over the bund to allow fill to be transported to and from the stockpiles for

60m

1789123.86 5836995.97 Meters | Scale 1:2257



REV	DATE	REVISION DETAILS	APPROVED
A	01.06.22	Draft for review.	



Project	Huntly Quarry
Title	Acid Sulphate Soil Management Site Plan
Drawn	Checked
MP	
Drawing No.	ESCP-001-02
Sheet No.	2 of 2