APPENDIX B10

Construction Acid Sulfate Materials Management Plan

Windsor Bridge Replacement Project

Document control

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Plan approved by:

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1	Georgiou	0
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Contents

Tables

Appendices

Glossary / Abbreviations

Terms and definitions used within this document are provided below.

ASS	Acid Sulfate Soil
CEMP	Construction Environmental Management Plan
COA	Condition of Approval
CLM Act	NSW Contaminated Land Management Act 1997
CLMP	Contaminated Land Management Plan
Cwth	Commonwealth
DA	Development Application
DECCW	Now OEH
EIL	Ecological Investigation Level (NEPM)
EIS	Environmental Impact Statement
EMS	Environmental Management Systems
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Cwth)
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EWMS	Environmental Work Methods Statement
HIL	Health Investigation Levels (NEPM)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007 (NSW)
NEPM	National Environmental Protection (Assessment of Site Contamination) Measure 1999
NPW Act	National Parks And Wildlife Act 1974 (NSW)
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
PASS	Potential Acid Sulfate Soils
SEPP	State Environmental Planning Policy (NSW)
TfNSW	Transport for New South Wales

1. Introduction and purpose

1.1 Context

This Construction Acid Sulfate Materials Management Plan (CASMMP) forms part of the Construction Environmental Management Plan (CEMP) for the Windsor Bridge Replacement Project.

The Windsor Bridge Replacement project team, comprised of the Transport for New South Wales (TfNSW) and Georgiou Group (Georgiou) have partnered together to undertake construction activities for the new road bridge over the Hawkesbury River at Windsor (the Windsor Bridge Replacement Project), on behalf of the New South Wales (NSW) government.

This plan has been prepared to address the requirements of the Ministers Conditions of Approval (specifically CoA D5(d)(iv)), TfNSW's standard specification G1 and G36, the mitigation and management measures outlined in the Windsor Bridge Replacement EIS, the Modification Report (submitted to DPIE in September 2019and relevant statutory legislation.

1.2 Background

The Project has been assessed as State Significant Infrastructure under the former Part 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Windsor Bridge Replacement Project Environmental Impact Statement (EIS) was prepared by Sinclair Knight Merz in November 2012 for TfNSW. The EIS was on public exhibition until 17 December 2012. A Submissions Report (and preferred infrastructure report) was finalised in May 2013 which addressed stakeholder submissions received during the EIS exhibition period. Following this, in December 2013, the Project was approved by the Minister for Planning and Infrastructure.

As part of EIS development, sampling of river bed sediments indicated that there are potentially low strength acid sulfate soils present within sediments near the southern bank.

1.3 Environmental Management Systems Overview

The overall Environmental Management System for the Project is described in the Construction Environmental Management Plan (CEMP).

This plan forms part of Georgiou's environmental management framework for the Project, as described in Section 1.3 of the CEMP. Relevant management measures identified in this Plan will be incorporated into site or activity specific Environmental Work Method Statements (EWMS) where relevant.

Used together, the CEMP, strategies, procedures and relevant EWMS form management guides that clearly identify required environmental management actions for reference by Georgiou personnel and subcontractors. The review and document control processes for this Plan is detailed in Section 1.1 of the CEMP.

2. Purpose and Objectives

2.1 Purpose

The purpose of this Plan is to describe how interaction with ASS and PASS will be managed during the construction of the Project. Findings of the EIS and the Geotechnical Factual Report suggests that ASS is present in the alluvial sediment within the Hawkesbury River. There are a number of construction activities that require excavation into the alluvial sediment and will risk exposure of Acid sulfate or potential acid sulfate soils. These activities include piling and the toe excavation for scour protection.

2.2 Objectives

The key objective of the CASMMP is to ensure that the potential impacts from disturbance of acid sulfate soils are minimised. To achieve this objective, the following measures will be undertaken:

- Detail relevant procedures for managing ASS and PASS, which potentially could be encountered during the construction phase;
- Minimise the duration of exposure of disturbed ASS/PASS materials and excavations to minimise oxidation and resultant acid production.
- Ensure that soils identified as ASS or PASS are treated to ensure adequate neutralisation and prevent adverse environmental impacts.
- Provide effective mitigation measure to prevent adverse environmental impacts.
- Ensure appropriate measures are implemented to address CoA D5(d)(iv) and safeguards detailed in the EIS and TFNSW's QA Specification G36.

2.3 Targets

The following targets have been established for the management of contaminated soil impacts during the construction of the Project:

- Ensure compliance with the relevant legislative requirements and those contained in the EIS, CoA D5(d)(iv) and TFNSW QA Specification G36.
- No impacts from disturbing ASS and PASS.
- Ensure training is provided to all Project personnel on ASS management measures.

3. Environmental Requirements

3.1 Relevant Legislation and Guidelines

Legislation relevant to the management of Acid Sulfate Soils for the Project includes:

- Environmental Planning and Assessment Act 1979.
- Protection of the Environment Operations Act 1997.
- Protection of the Environment Operations (General) Regulation 2009.
- Protection of the Environment Operations (Waste) Regulation 2005.
- Contaminated Land Management Act 1997.
- Fisheries Management Act 1994.

The main guidelines, specifications and policy documents relevant to this Plan include:

- NSW Acid Sulfate Soils Manual (ASSMC, 1998) Acid Sulfate Soils Assessment Guideline, NSW Acid Sulfate Soil Management Advisory Committee, 1998.
- Guidelines for the Management of Acid Sulfate Material, Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze, RTA, 2005.
- Waste Classification Guidelines Part 1: Classifying waste, EPA, 2014
- EPA Waste classification guidelines Part 4: Acid sulfate soils, EPA, 2014
- NSW EPA publication "Assessing and Managing Acid Sulfate Soils"
- TFNSW Guidelines for the Management of Acid Sulfate Materials, April 2005

3.2 Conditions of Approval

The CoA relevant to this Plan are listed Table 3-1 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other Project management documents.

Table 3-1 Conditions of approval relating to acid sulfate soil management

CoA no.	Requirement	Reference
D5(d)(iv)	As part of the CEMP for the project, the Applicant shall prepare and implement the following sub plan(s): d) a Construction Soil and Water Quality Management Sub-plan to manage surface and groundwater impacts during construction of the project. The subplan shall be developed in consultation with the OEH, EPA, DPI (Fishing and Aquaculture) and NOW and include, but not necessarily be limited to: iv. a contingency plan, consistent with the Acid Sulfate Soils Manual, to deal with the unexpected discovery of actual or potential acid sulfate soils, including procedures for the investigation, handling, treatment and management of such soils and water seepage;	This Plan

4. Existing environment

4.1 Potential areas of acid sulfate soils

Acid Sulfate Soils (ASS) have formed naturally, commonly in estuarine areas along the east coast of Australia as well as other parts of the continent and throughout the world. If permanently deprived of oxygen, the sulphide minerals in ASS cause no environmental harm and the materials are referred to as Potential Acid Sulfate Soils (PASS). PASS occur predominantly in soils which sit below 5 metres Australian Height Datum (AHD). If exposed to oxygen, the sulphide minerals in the soil oxidise and can produce excess sulphuric acid. Such soils are referred to as actual acid sulfate soils.

The Windsor Bridge Replacement EIS sampling of river bed sediments indicated that there are potentially low strength acid sulfate soils present within sediments near the southern bank. However as noted in the Acid Sulfate Soils Assessment Guidelines (ASSMAC 1998),

estuarine sediments may give false positives to the presence of acid sulfate soil especially if there is a high proportion of organic matter in the sediments.

The Geotechnical Factual Report - Windsor Bridge Replacement Detailed Design (Jacobs 2017) showed 5 boreholes within the alluvial sediment that recorded the net acidity and the Chromium reducible sulphur levels greater than the action criteria (>0.03). See Appendix C for the results of the chromium suite analysis from alluvial sediment within the project area. The highest S% from all the test results is 0.1% which is a very low level acid sulfate soil and would require a liming rate of 5kg/T.

For the purposes of construction, Georgiou have assumed that the entirety of the alluvial sediment comprises either ASS or PASS soils and will undertake further testing of any excavated alluvial sediment to determine appropriate lime treatment rates. The method of this testing is detailed in Appendix A.

5. Environmental aspects and impacts

5.1 Construction Activities

Key aspects of the Project that could cause ASS related impacts include:

- Piling activities
- Surface and sub surface drainage
- Service relocation
- Construction basins (if needed)
- Dewatering activities
- Construction of scour protection on both banks of the Hawkesbury River

5.2 Potential impacts

Potential acid sulfate soils (PASS) are soils rich in iron sulfides (pyrite). If these soils are dried and the pyrite is brought into contact with oxygen, oxidisation occurs and they become acid sulfate soils (ASS). Soil acidification and dissolved acid runoff can adversely impact on the health of land and aquatic plants and animals. Potential ASS/PASS impacts from construction activities include:

- Uncontrolled surface runoff in areas of exposed ASS, causing the release of acid into the environment.
- Changes to surface run-off patterns promoting the release of acid into the environment;
- Leaching of acid into the environment at ASS treatment sites.
- Exposing ASS at/near new excavations, thus causing the release of acid into the environment in the short and long term.
- Exposure of PASS to the air thus causing oxidisation and conversion to ASS.

6. Environmental Management and Mitigation measures

A range of environmental requirements and control measures are identified in the various environmental documents, TfNSW specifications and Georgiou's Environmental Management Systems.

Specific measures and requirements to address contaminated sites are outlined in Table 6.1.

Table 6-1: Acid Sulfate Soil Management Measures.

ID	Mitigation Measure / Requirement	Resource Required	Implementation Stage	Responsibility	Reference
General					
ASS 1	All relevant site based construction personnel and contractors will be made aware of the location of the ASS treatment areas and their personal obligations to report excavated ASS or PASS material to their supervisor. Training will also involve understanding the requirements of the Acid Sulfate Materials Management Procedure (Appendix A).	Induction Toolbox Acid Sulfate Materials Management Procedure (Appendix A)	Pre-Construction	ESR, Construction Manager	G36 Good practice
ASS 2	The Unexpected Discovery of ASS/PASS Procedure (Appendix E) will be followed when ASS or PASS are unexpectedly encountered during excavation / construction activities	Unexpected Discovery of ASS/PASS Procedure (Appendix E)	Construction	ESR, Construction Manager, Superintendent	G38 Cl 2.1.2
ASS 3	Untreated acid sulfate material will be neutralised in a Treatment area which will be constructed in accordance with Section 6.1 of this CASMMP. Stockpiles of untreated ASS/PASS must remain in this treatment area until they area neutralised with lime and SPOCAS verification testing confirms effective neutralisation.	This plan	Construction	ESR, Engineer, Foreman	Good practice
ASS 4	Runoff from the stockpiles of untreated acid sulfate material will be diverted into a sump for monitoring and treatment for acid runoff, any pooled water will be monitored daily for acidity issues.	ASSMAC guidelines 1998	Construction	ESR, Engineer, Foreman	Good practice
ASS 5	Field pH monitoring will be conducted at least weekly and after each rain event causing run off where water has pooled within the treatment area, to determine water pH and appropriate treatment requirements to ensure that leachate is above a pH of 5.5 at all times to prevent toxic forms of aluminium and other heavy metals forming, as per the ASSMAC Guidelines.	ASSMAC guidelines 1998	Construction	ESR, Engineer, Foreman	Good practice
ASS 6	Water will be tested, treated and discharged in accordance with the Dewatering Permit – Appendix F	Dewatering Permit, Appendix F	Construction	ESR, Engineer, Foreman	Good practice

ID	Mitigation Measure / Requirement	Resource Required	Implementation Stage	Responsibility	Reference
ASS 7	Treatment of ASS material shall be done with Agricultural Lime (neutraliser) at a dosage rate determined from the SPOCAs results.	Acid Sulfate Materials Management Procedure (Appendix A)	Construction	ESR, Engineer, Foreman	Good practice
ASS8	The application of lime will be avoided in windy conditions (>15 knots) or where the lime dust is visibly leaving the work area should be avoided for safety and efficiency.	Acid Sulfate Materials Management Procedure (Appendix A)	Construction	ESR, Engineer, Foreman	Good practice
ASS 9	Agricultural Lime (neutraliser) will be stored in either of the following methods dependent on the amount required; ▪ In bulka bags on site in a bunded area ▪ Purchased in bulk and stockpiled with appropriate erosion and sediment controls (earthen bunds on the up slope to prevent erosion and covered in tarpaulin to prevent air quality impacts).		Construction	ESR, Engineer, Foreman	Good practice
ASS 10	Subject to approval from TfNSW, treated acid sulfate soil (neutralised) may be incorporated into general fill for the road. It is to be buried at least 0.4m from the finished surface level and not to be used in the upper zone of formation		Pre-Construction Construction	ESR, Engineer, Foreman	Good practice

6.1 Treatment of ASS

The treatment area is to be located at the main ancillary facility stockpile area and will be approximately 500m^2 in area and will be located 180m away from the river and at least 50m away from any stormwater infrastructure and on land with <2% grade. The actual location and layout is detailed in Figure 1 below. The area of 500m^2 has been calculated as a worst case scenario in the case that 100% of the toe excavation for the scour rock is PASS/ASS, the volume of excavation for this area is approximately 400m^3. Note that the toe of the scour rock will be excavated progressively in 25m lengths before installing scour rock, therefore treatment will likely occur in 100m^3 batch volumes at the treatment pad. Volumes of potential PASS/ASS from piling is less and will occur a number of months after the scour protection excavations.

It will be designed to ensure that it acid leachate is collected in an impervious leachate / runoff collection system capable of containing all leachate runoff. The treatment area should be graded such that surface water can be collected at a low point and treated as required. Specific details including the location of controls, storage of lime and neutralised Acid sulfate soils will be included in the EWMS for acid sulfate management and in the relevant PESCPs for the stockpile and ancillary areas.

The treatment pad will be constructed in accordance with the following;

- A layer of compacted non-ASS clayey material (0.1 – 0.3 metres thick) placed on the surface of the treatment pad can reduce the infiltration of leachate to the soil and groundwater.
- In accordance with the ASSMAC guidelines 1998, if an impervious pad has not been established then as a precautionary measure a guard layer of lime should be applied. This 'guard layer' will be an application of lime at 5 kilograms aglime per m2 per vertical metre of fill.
- The base layer should be slightly domed or sloped to prevent leachate from pooling in the treatment pad area
- The area will be contained by an earthen bund to direct stormwater runoff and leachates to an impervious collection sump, the containment capacity for the bund / sump is to be at least 10m^3. This capacity is based on the 85th %ile 5 day rainfall event for the treatment catchment area of 500m^2. The actual containment volume of the treatment area will be around 150m^3 when considering it will have a 300mm high perimeter containment bund.
- The containment bund and containment sump wall will be a minimum height of 300mm and will be constructed from imported clay and will not be constructed from ASS or PASS it will be constructed to withstand a 1:5 ARI storm event.

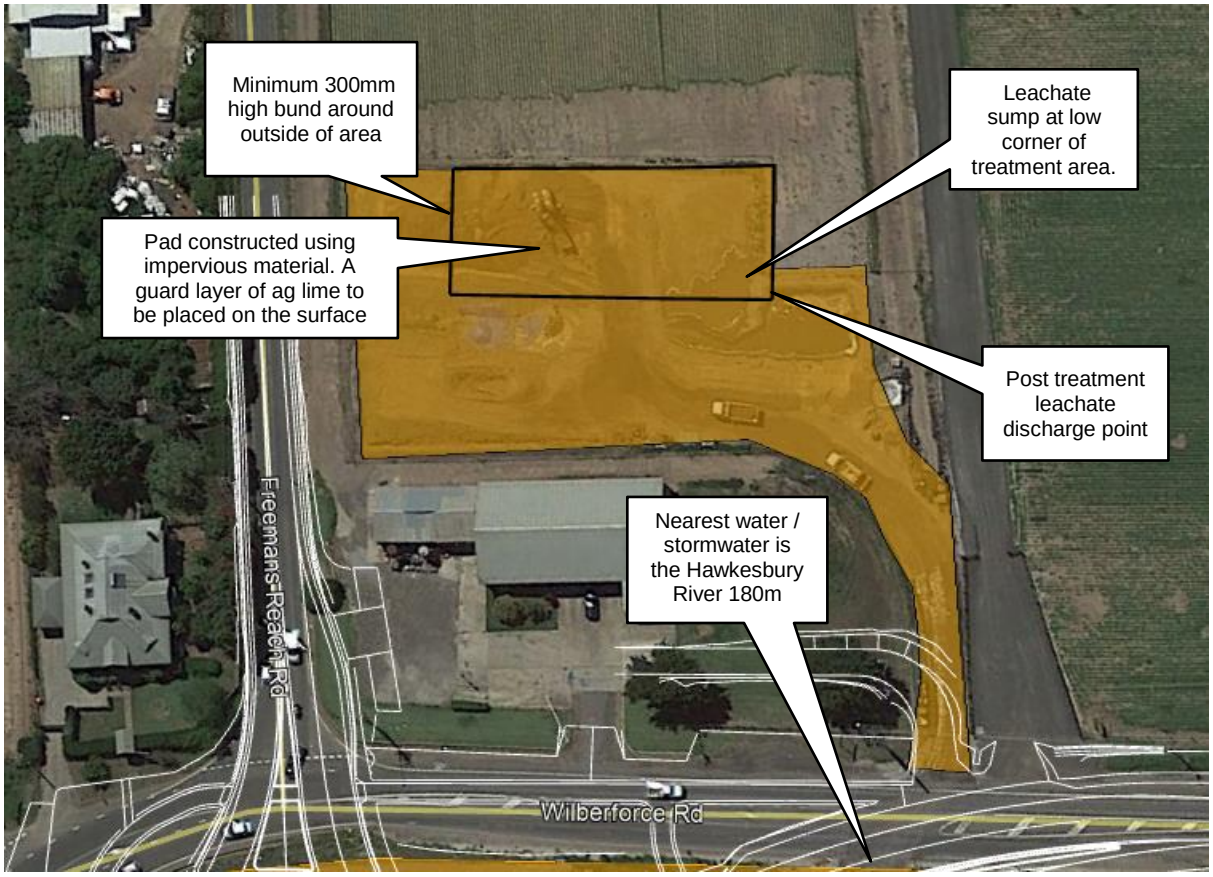

Figure 1 - Proposed Location of Acid Sulfate Soil Treatment Area

6.2 Stockpiling of ASS or PASS

All excavated ASS or PASS will be stockpiled in the treatment area in figure 1 until it has been neutralised with lime and SPOCAS verification testing confirms effective neutralisation.
Post treatment and once verified as neutralised PASS/ASS stockpiles will be moved from the bunded treatment area and into the adjacent stockpile area.

7. Compliance management

7.1 Roles and Responsibility

The Project Team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 5 of this Plan.

7.2 Training

All employees, contractors and sub-contractors working on site will undergo site induction training relating to potential land contamination management issues. Additionally, targeted Toolbox training and EWMS regarding identification, treatment and training on ASS or PASS will be regularly provided to maintain awareness of the onsite environmental issues.

The induction training will address elements related to ASS management including:

- Existence and requirements of this CASMMP
- Relevant legislation.
- Procedure to be implemented for the management and treatment of ASS and PASS.
- Acid sulfate material stockpile locations and control methods.
- Identification of acid sulfate material

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

7.3 Monitoring, inspection and testing

Regular monitoring and inspections will be undertaken in the lead up to, during and following construction activities that have the potential to interact with acid sulfate soils. Monitoring will include but not be limited to;

- Inspection of the construction of the treatment pad
- Inspection of the construction of the bunding for the stockpile area
- Inspections during piling activities for the identification of materials
- Inspections during the excavation for the scour protection
- Monitoring of the movements of neutralised soils in accordance with Section 7.3.1 below
- Monitoring of water in the leachate sump at the treatment area to determine pH and the appropriate treatment requirements to prevent the toxic forms of aluminium and other heavy metals

7.4 Incident Response

An Incident Reporting Procedure (CEMP Appendix A6) covers incidents involving pollution events deriving from acid sulfate soils. A Pollution Incident Response Management Plan (CEMP - Appendix B12) has been developed to minimise the impact of spills including details on the requirements for managing, cleaning up and reporting.

7.5 Auditing

Both internal and external audits will be undertaken throughout the construction period to assess the effectiveness of environmental controls, compliance with this plan, CoA and other relevant approval, licenses and guidelines.

Auditing requirements and responsibilities are documented in Section 8.5 of the CEMP.

7.6 Reporting

The final destination of the neutral soil will be tracked and recorded using a treated ASS Tracking Register. The register will provide details of excavation location, date and volume (m3) as well as liming rate (kg/m3), treatment location, date, SPOCAS verification results post treatment and reinstatement location.

8. Review and improvement

8.1 Continuous Improvement

Continuous improvement of this plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets

8.2 Plan Update and Amendment

The processes described in Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Any revisions to the CASMMP will be in accordance with the process outlined in Section 9 and 10 of the CEMP, including consultation with TFNSW and relevant stakeholders.

Specific details including the location of controls, storage of lime and neutralised Acid sulfate soils will be included in the EWMS for acid sulfate management and in the relevant PESCPs for the stockpile and ancillary areas. These will be progressively revised throughout construction.

Acid Sulfate Materials Management Plan

Appendix A

Acid Sulfate Materials Management Procedure

Revision history

Revision	Date	Description	Approval
0			
B	25/06/18	RMS review	
A	28/05/18	For review	

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1	RMS	A
2	RMS	B
3		
4		
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Appendix A
Acid Sulfate Materials Management Procedure

Purpose
The purpose of this management procedure is to effectively manage actual and potential acid sulfate soils on the Windsor Bridge replacement Project

Scope
This procedure is applicable to all activities conducted by Georgiou personnel that have the potential to come into contact with acid sulfate materials.

Induction/Training
All Georgiou personnel are to be inducted on the identification of potential acid sulfate soils occurring on site and the relevant actions for them with regards to this procedure during the project site induction and regular toolbox talks.

Procedure
All proposed excavations into the Hawkesbury River alluvial sediments will be assumed as either ASS or PASS and will be transported to the Acid sulfate soil treatment pad for further confirmatory testing and possible neutralization. The activities that involve excavation of the alluvial sediment include;

- Piling for the new bridge
- Excavation at the toe of the scour protection along the bank of the river.

ASS and PASS identification testing

Field screening will be undertaken to further delineate ASS and PASS material prior to treatment. Sampling and testing for acid sulfate material shall be in accordance with ASSMAC Guidelines. Acid sulfate material screen testing to identify acid sulfate soils shall be by pHFOX (oxidised using 30 per cent H^2 O^2 solution) testing as materials are excavated. No further testing will be carried out on samples assessed not to be acid sulfate based on ASSMAC Guidelines. That is if pHf>4 and pHfox >3 and change in pH is less than 1pH unit.
For field samples that do meet the criteria of ASS or PASS based on the ASSMAC guidelines then the highest lime dosing rate identified during the pre-construction geotechnical investigations will be applied. This liming rate is 5kg/T for the sample with the 0.1%S.

Action Criteria

Action criteria from the ASSMAC guidelines (1998) are based on texture and clay content of the soil being analysed and the total volume of soil to be disturbed. For the purpose of this plan the adopted action criteria is applied for coarse texture soils due to the sandy alluvial sediments. As the potential amount of ASS requiring excavation, if any, is unknown both the criteria for 1 to 1,000 T disturbed and for >1,000 T disturbed have been considered.
The Table below outlines the assessment criteria

Action criteria from the ASSMAC guidelines (1998)

Course Texture (Sands to loamy sands) >5% clay content		Action criteria 1- 1000T disturbed	Action Criteria >1000T disturbed
SPOS	%	0.03	0.03
Equivalent Acid TPA	mol H+/tonne	18	18

S_{POS} – Peroxide oxidisable sulfur
TPA – Titratable peroxide acidity
TSA – Titratable sulfidic acidity
ASSMAC (1998) guidelines present action criteria as either the concentration of TPA or TSA

Treatment at the Acid Sulfate Treatment pad

The pad is to be designed to ensure that it is impervious to acid leachate with a leachate / runoff collection system capable of containing all leachate runoff. The treatment area should be graded such that surface water can be collected at a low point and treated as required. The treatment area will approximately 500m2 in area and will be located at least 50m away from any stormwater pits or surface stormwater drains and on land with <2% grade. Specific details including the location of controls, storage of lime and neutralised Acid sulfate soils will be included in the EWMS for acid sulfate management and in the relevant PESCPs for the stockpile and ancillary areas.

A layer of compacted non-ASS clayey material (0.1 – 0.3 metres thick) placed on the surface of the treatment will reduce the infiltration of leachate to the soil and groundwater. In accordance with the ASSMAC guidelines 1998, if an impervious pad has not been established then as a precautionary measure a guard layer of lime should be applied. This 'guard layer' will be an application of lime at 5 kilograms aglime per m2 per vertical metre of fill. Where the highest detected sum of existing and potential acidity is more than 1.0% S-equivalent (not at Windsor Bridge Project), the rate will be at minimum 10 kilograms fine aglime per m2 per vertical metre of fill. The base layer should be slightly domed or sloped to prevent leachate from pooling in the treatment pad area.

Stormwater runoff and leachates will be contained within the treatment pad by a perimeter bund; this bund will direct runoff to a collection sump. Both the bund and the sump should be constructed to withstand a 1:5 ARI storm event. The diversion bund and containment sump wall will be a minimum height of 300mm and will be constructed from imported clay and will not be constructed from ASS or PASS. The internal walls of the bunds and the sump (including base) will be maintained with a surface cover of lime to assist with neutralisation of any acidic stormwater. The sump will be constructed in the lowest corner of the treatment pad and will consist of a shallow excavation (<1m), the excavation will be lined with builders plastic or backfilled and compacted with a layer (0.1 – 0.3m) of imported clay.

Liming Procedure

1. Excavate ASS from site and immediately load and haul to the ASS treatment pad
2. Lime the base of the treatment pad with lime at a rate of 1 kg / m2 agricultural lime;
3. spread excavated ASS onto the pad in layers 300 mm thick;
4. The ASS must be sufficiently dry before neutralising is commenced so that the lime can be mixed through the soil. Where moisture levels in soil are high, the soil must be dried by spreading and leaving open to the atmosphere.
5. Apply lime at the liming rate indicated in the SPOCAS results for the excavation. Windy conditions (>15 knots) or where the lime dust is visibly leaving the work area should be avoided for safety and efficiency;

6. The neutralising agent and ASS should be thoroughly mixed and aerated using, for example, an agricultural lime spreader and excavator. The soil should be treated in layers up to 300 mm thick to encourage aeration
7. Once the batch has been thoroughly mixed with the excavator it is to be tested by laboratory analysis to validate neutralisation as detailed below

Lime handling and storage

Ensure an adequate supply of agricultural grade lime is available at short notice for use on site as needed for treatment of ASS. All lime stored on site is to be stored and handled in accordance with the material data sheet (MDS). A copy of the MDS is to be maintained on site at all times. Aglime will be covered with tarpaulin and stored in 'dry areas' to prevent runoff leaching into the surrounding area and to minimise dust. The procured lime is to have a neutralising Value (NV) of >95% with a particle size <800 microns, this will be confirmed with the supplier before sourcing the lime.

Lime, is an alkaline material that is reactive in the presence of moisture. Workers handling lime must be trained and wear proper protective equipment including;

- Eye protection (chemical goggles, safety glasses and/or face shield).
- Protective gloves and clothing that fully covers arms and legs are recommended.
- Nuisance dusts masks to provide adequate respiration protection.

Post lime soil treatment testing

All excavated ASS or PASS will be stockpiled in the treatment area in figure 1 until it has been neutralised with lime and SPOCAS verification testing confirms effective neutralisation.

SPOCAS tests will be carried out by a NATA accredited laboratory to assess the adequacy of treatment. The neutralising capacity available in the treated soil should be sufficient to neutralise any existing and potential acidity. The acid concentrations must be below the action criteria from the ASSMAC guidelines (table above) Should the neutralising capacity to be insufficient, recalculation of liming rates should be undertaken and treatment reapplied. Validation sampling will occur at the following rates and these are dependent on the test results of the initial potential acidity;

- <0.5% S-equivalent (<312 mol H+/tonne) – 1 per 1000 m3
- 0.5−2% S-equivalent (312−1247 mol H+/tonne) – 1 per 500 m3
- >2% S-equivalent (>1247 mol H+/tonne) – 1 per 250 m3.

Final use of treated ASS / PASS

Upon verification of treatment, the neutralised ASS could be re-used on-site for construction (subject to Geotechnical and environmental suitability) or disposed off-site to a suitably licensed waste management facility (additional waste classification analysis / testing may be required). As a precautionary measure when incorporated into general fill for the road it should be buried at least 0.4m from the finished surface level and not to be used in the upper zone of formation

Treated ASS Tracking Register

The final destination of the neutral soil will be tracked and recorded using a treated ASS Tracking Register. The register will provide details of excavation location, date and volume

(m3) as well as liming rate (kg/m3), treatment location, date, SPOCAS verification results post treatment and reinstatement location.

Decommissioning of Acid Sulfate Treatment pad and sump

As part of the rehabilitation of the Acid Sulfate Treatment area the pad and sump will be tested to the depth of the capping layer prior to topsoiling and revegetation. No further testing will be carried out on samples assessed not to be acid sulfate based on ASSMAC Guidelines. That is if pHf>4 and pHfox >3 and change in pH is less than 1pH unit. If it does not meet the of ASS or PASS based on the ASSMAC guidelines then the sulphur % and lime dosing rate will be determine by undertaking SPOCAS Plus analysis testing using a NATA accredited laboratory. Given the amount of lime used at the treatment area it is unlikey that the soil in the sump or treatment pad will be acid generating.

Treatment of leachate

Acid Sulfate soil leachate captured at the Acid Sulfate Soil treatment area will need to be assessed for water quality treated prior to surface discharge.
When the pH of the leachate pond falls below 6.5 the water must be treated prior to discharge using hydrated lime in the ratio detailed in the Table below. Discharge from leachate capture ponds shall be in accordance with Dewatering Permit - Appendix F.

Leachate Liming Rates

Current water pH	H+ (mol/L)	Hydrated Lime to neutralise 1ML (kg pure Ca(OH)2
1	0.1	3705
1.5	0.032	1185
2	0.01	370
2.5	0.0032	118
3	0.001	37
3.5	0.00032	12
4	0.0001	4
4.5	0.000032	1.18
5	0.00001	0.37
5.5	0.0000032	0.12
6	0.000001	0.037
6.5	0.00000032	0.12

Acid Sulfate Materials Management Plan

Appendix B

Field pH screening Test (Assmac Guidelines)

Revision history

Revision	Date	Description	Approval
0			
B	25/06/18	RMS review	
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Field pH screening Test (Assmac Guidelines)

Sample Method

Use field pH meter with a robust, spear point. The probe can be inserted directly into soft wet soils or soil mixed up into a paste with deionised water. An approximate 1:5 ratio of soil: deionised water suspension can be made up in small tubes, hand shaken and pH of the solution measured. Care must be exercised not to scratch the electrode on sandy or gravely soils. The probe should be standardised prior to use and regularly during use against standard solutions according to the manufacturer's instructions.

Field pH test measurements

The field pH (pHF) of actual ASS tends to be ≤ 4 while the field pH of PASS tends to be neutral. Field pH provides a useful quick indication of the likely presence and severity of "actual" acid sulfate soils. The field pH is a qualitative method only that cannot be used as a substitute for laboratory analysis in the identification of acid sulfate soils for assessment purposes. Field pH readings should be taken at regular intervals down the soil profile. It is recommended this test be done every 0.25m down the profile but at least every 0.5m interval or horizon whichever is the lesser.
pH Indications:

- pH readings of pH ≤4, indicates that actual acid sulfate soil are present with the sulphides having been oxidised in the past, resulting in acid soil (and soil pore water) conditions.
- pH values >4 and <5.5 are acid and may be the result of some previous or limited oxidation of sulphides, but is not a definite confirmation of actual ASS. Substantial exchangeable / soluble aluminium and hydrogen ions usually exist at these pH values. Other factors such as excessive fertiliser use, organic acids or strong leaching can cause pH >4 - <5.5. Field pH alone cannot indicate potential ASS as they may be neutral to slightly alkaline when unoxidised.

In order to test for potential acid sulfate soils that contain unoxidised sulphides, peroxide is used to rapidly oxidise the iron sulphides (usually pyrite), resulting in the production of acid with a corresponding drop in pH.

Field Peroxide pH test measurements

To test for the presence of unoxidised sulphides and therefore PASS, the oxidation of the soil with 30% (100 volume) hydrogen peroxide can be performed in the field. The most common method is:
A small sample of soil (approx. 5 g) is placed in a small glass container (e.g. short clear centrifuge tubes, clear tissue culture clusters or sample jar) and a small volume of peroxide is dropped onto the soil (20 mL).
Note: Allow the digested solution to cool after the reaction.
A pH probe will only measure to 60°C.
The reaction should be observed and rated. In some cases, the reaction may be instantaneous; in others, it may take 10 minutes or more. Heating over hot water or in the sun may be necessary to start the reaction on cool days, particularly if the peroxide is cold.
Potentially positive reactions for PASS include one or more of the following:

- change in colour of the soil from grey tones to brown tones
- effervescence

- the release of sulphurous odours
- final pH of < 3
- lowering of soil pH by at least one pH unit

The strength of the reaction is a useful indicator. The peroxide test is most useful and reliable with clays and loams containing low levels of organic matter. It is least useful on coffee rock, sands or gravels, particularly dredged sands with low levels of sulphuric material (e.g. <0.05 % S). With soils containing high organic matter (such as surface soils, peats, mangrove / estuarine muds, and marine clays), care must be exercised when interpreting the reaction as high levels of organic matter and other soil constituents particularly manganese oxides can also cause a reaction.

pH After Oxidation

The measurement of the change in the pH FOX following oxidation can give a useful indication of the presence of sulphuric material and can give an early indication of the distribution of sulphide down a core/ profile or across the site. The pH after oxidation test is not a substitute for analytical test results.
If the pH FOX value is at least one unit below field pH F, it may indicate potential acid sulfate soils. The greater the difference between the two measurements, the more indicative the value is of a potential acid sulfate soils. The lower the final pH FOX value is, the better the indication of a positive result.

- If the pH FOX < 3 and there was a strong reaction to the peroxide, there is a high level of certainty of a potential acid sulfate soils. The more the pH FOX drops below 3, the more positive the presence of sulphides.
- A pH FOX 3-4 is less positive and laboratory analyses are needed to confirm if sulphides are present. Sands particularly may give confusing field test results and must be confirmed by laboratory analysis.
- For pH FOX 4-5 the test is neither positive nor negative. Sulphides may be present either in small quantities and be poorly reactive under quick test field conditions. In some cases, the sample may contain shell / carbonate that neutralises some or all acid produced by oxidation. In other cases, the pH FOX value may be due to the production of organic acids and there may be no sulphides present. In these cases, analysis for sulphur using the POCAS method would be the best to check for the presence of oxidisable sulphides.
- For pH >5 and little or no drop in pH from the field value, little net acid generating ability is indicated. Again, the sulphur trail of the SPOCAS method should be used to check some samples to confirm the absence of oxidisable sulphides.

Care is needed with interpretation of the result on highly reactive soils. Some soil minerals other than pyrite react vigorously with peroxide, particularly manganese but may only show small pH changes.

Note: When selecting soil for testing it is advisable to avoid material high in organic matter as the oxidation of organic matter can lead to the generation of acid. However pH of soils containing organic matter and no pyrite do not generally stay below 4 on extended oxidation. In general positive tests on ‘apparently well drained’ surface soils should always be treated with caution and followed up with laboratory confirmation

Use of Peroxide

30 % hydrogen peroxide is a strong oxidising agent and should be handled carefully with appropriate eye and skin protection. This test should be only undertaken by trained personnel.

The pH of analytical grade peroxide may be as low as 3 as manufacturers stabilise technical grade peroxide with acid, the peroxide pH should be checked on every new container and regularly before taking to the field and adjusted to 4.5 - 5.5 with a few drops of 0.1M NaOH if necessary. False field pH FOX readings could result if this step is not undertaken.

Acid Sulfate Materials Management Plan

Appendix C

Geotechnical Factual report ASS/PASS test results

Revision history

Revision	Date	Description	Approval
0			
B	25/06/18	RMS review	
A	28/05/18	For review	

Distribution of controlled copies

Copy no.	Issued to	Version
1	RMS	A
2	RMS	B
3		
4		
5		

Geotechnical Factual report ASS/PASS test results

These samples were selected for confirmation of ASS potential using Chromium Suite analysis. The Chromium Suite test is an acid base accounting approach widely used for predicting net acidity from the oxidation of sulphides present in ASS, and has the advantage of not being subjected to significant interferences from the sulphur in either organic matter or sulfate minerals present in the soil. The test determines net acidity by calculating the summation of Potential Sulfidic Acidity (SCR), Existing Acidity (Actual Acidity [STAA] + Retained Acidity [SNAS]) and Acid Neutralising Capacity (SANC).

The results were compared against the action criteria (ASSAG, 1998), which indicate that there is the potential for PASS soils at the site, where some samples recorded the net acidity and the Chromium reducible sulphur levels greater than the action criteria (>0.03). The highest S% is 0.1% which requires a liming rate of 5kg/T.

The results of the testing are summarised below (extract from Geotechnical Factual report(Jacobs 2017).

Location ID	Sample Depth (m)	pH_{KCL}	S_{CR}/S_{POS} (%S)	S_{TAA} (%S)	S_{NAS} (%S)	S_{ANC} (%S)	Net Acidity (%s)	Action Criteria
NA-BH01	7.00	4.8	<0.005	0.02	<0.005	<0.05	0.02	-
NA-BH01	9.50	5.2	<0.005	<0.01	-	<0.01	<0.01	-
NA-BH01	15.00	5.2	0.01	<0.01	<0.005	<0.05	0.02	-
NA-BH02	6.80	6.5	<0.005	0.02	-	<0.01	0.03	-
OW-BH01	0.60	8.1	0.05	<0.01	-	1.2	<0.01	> 0.03 (exceeds action criteria)
OW-BH02	1.20	6.6	<0.005	<0.01	-	0.12	<0.01	-
OW-BH03	7.00	5.9	<0.005	<0.01	-	<0.05	<0.01	-
OW-BH04	3.00	5.5	0.01	0.02	-	<0.05	0.01	-
SS01	0.40							
SS02	0.20	4.9	0.02	0.01	-	<0.05	0.03	-
SS03	0.20	5.7	<0.005	<0.01	-	<0.05	<0.01	-
SS04	1.80	5.7	<0.005	<0.01	-	<0.05	<0.01	-
SS05	0.60	5.2	<0.005	<0.01	-	<0.05	<0.01	-
SS08	1.00	5.6	0.1	0.01	-	<0.05	0.11	> 0.03 (exceeds action criteria)
SS09	0.80	5.3	0.08	<0.01	-	<0.05	0.09	> 0.03 (exceeds action criteria)
SS10	1.50	4.8	0.05	0.02	-	<0.05	0.07	> 0.03 (exceeds action criteria)
SS11	0.30	4.8	0.02	0.01	-	<0.05	0.03	-
SS12	1.70 – 1.80	4.6	0.04	<0.01	-	<0.05	0.05	> 0.03 (exceeds action criteria)

Acid Sulfate Materials Management Plan

Appendix D

ASS/PASS test locations

Revision history

Revision	Date	Description	Approval
0			
B	25/06/18	RMS review	
A	28/05/18	For review	

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1	RMS	A
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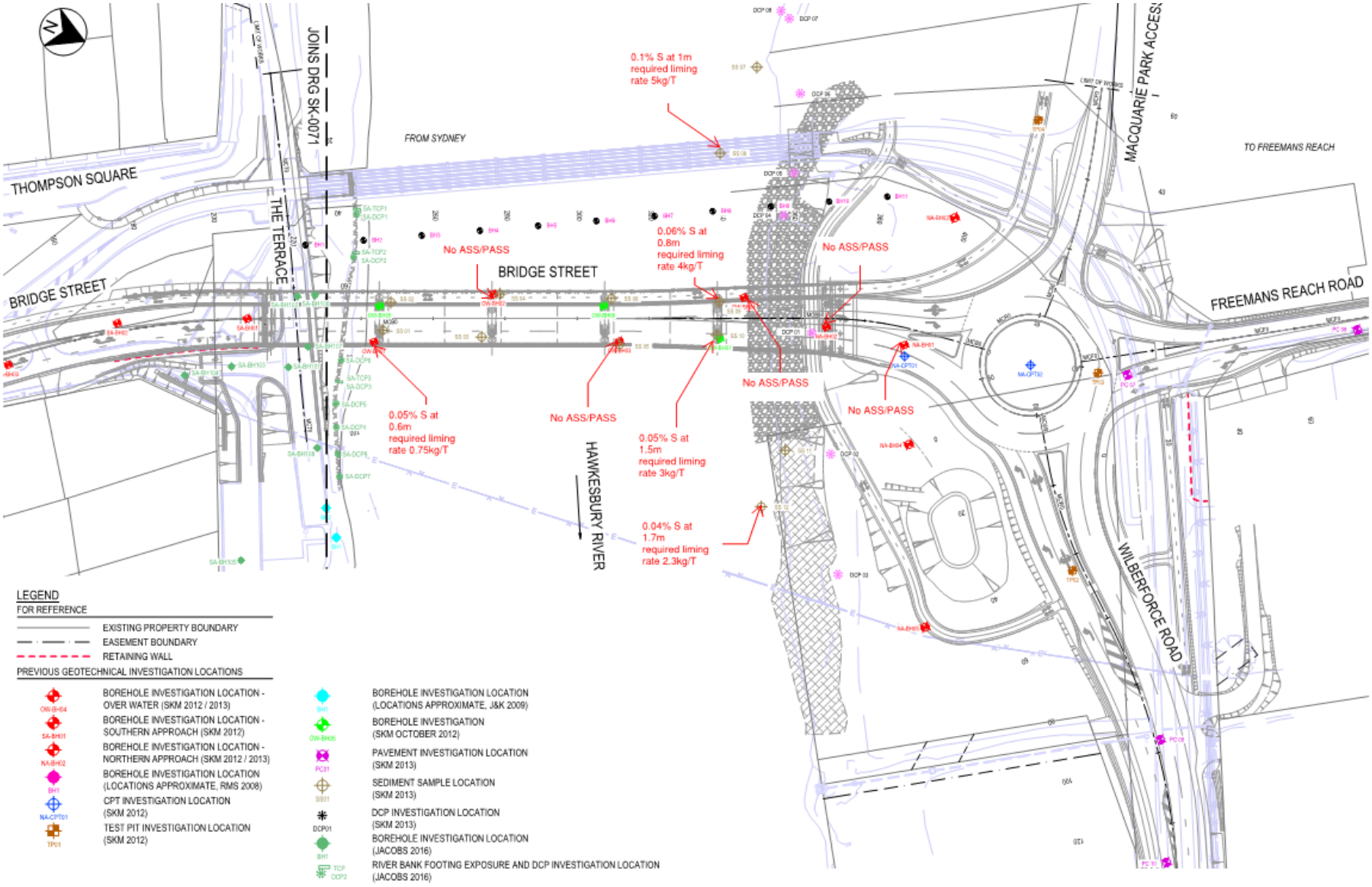
JOINS DRG SK-0071
FROM SYDNEY
TO FREEMANS REACH
THOMPSON SQUARE
THE TERRACE
BRIDGE STREET
BRIDGE STREET
MACQUARIE PARK ACCESS
FREEMANS REACH ROAD
WILBERFORCE ROAD
HAWKESBURY RIVER
0.1% S at 1m required liming rate 5kg/T
0.06% S at 0.8m required liming rate 4kg/T
0.05% S at 0.6m required liming rate 0.75kg/T
0.05% S at 1.5m required liming rate 3kg/T
0.04% S at 1.7m required liming rate 2.3kg/T
No ASS/PASS
No ASS/PASS
No ASS/PASS
No ASS/PASS
No ASS/PASS
LEGEND
FOR REFERENCE
EXISTING PROPERTY BOUNDARY
EASEMENT BOUNDARY
RETAINING WALL
PREVIOUS GEOTECHNICAL INVESTIGATION LOCATIONS
BOREHOLE INVESTIGATION LOCATION - OVER WATER (SKM 2012 / 2013)
BOREHOLE INVESTIGATION LOCATION - SOUTHERN APPROACH (SKM 2012)
BOREHOLE INVESTIGATION LOCATION - NORTHERN APPROACH (SKM 2012 / 2013)
BOREHOLE INVESTIGATION LOCATION (LOCATIONS APPROXIMATE, RMS 2008)
CPT INVESTIGATION LOCATION (SKM 2012)
TEST PIT INVESTIGATION LOCATION (SKM 2012)
BOREHOLE INVESTIGATION LOCATION (LOCATIONS APPROXIMATE, J&K 2009)
BOREHOLE INVESTIGATION (SKM OCTOBER 2012)
PAVEMENT INVESTIGATION LOCATION (SKM 2013)
SEDIMENT SAMPLE LOCATION (SKM 2013)
DCP INVESTIGATION LOCATION (SKM 2013)
BOREHOLE INVESTIGATION LOCATION (JACOBS 2016)
RIVER BANK FOOTING EXPOSURE AND DCP INVESTIGATION LOCATION (JACOBS 2016)

Acid Sulfate Materials Management Plan

Appendix E

Unexpected Discovery of ASS/PASS Procedure

Revision history

Revision	Date	Description	Approval
0			
B	25/06/18	RMS review	
A	28/05/18	For review	

Distribution of controlled copies

Copy no.	Issued to	Version
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4		
5		

Unexpected Discovery of ASS/PASS Procedure

Purpose
The purpose of this management procedure is to effectively manage actual and potential acid sulfate soils on the Windsor Bridge replacement Project

Scope
This procedure is applicable to all activities conducted by Georgiou personnel that have the potential to come into contact with acid sulfate materials.

Induction and training
All Georgiou personnel are to be inducted on the identification and characteristics of potential acid sulfate soils occurring on site and the relevant actions for them with regards to this procedure during the project site induction and regular toolbox talks.

Unexpected discovery
If ASS are unexpectedly disturbed / encountered during excavation/construction activities:

- STOP ALL WORK in the immediate/affected area
- Isolate the area with NO GO Fencing/Signage as appropriate
- Immediately notify the Environment Site Representative
- Recommence works in an alternate area where practicable

ASS Characteristics
Any of the following characteristics may indicate the presence of ASS

- A sulphurous smell following soil disturbance;
- Pale yellow surface encrustations;
- Excessive iron staining on drain surfaces or stream banks, or iron stained drain water and orange red ochre deposits around water bodies;
- Excessive corrosion of concrete and / or steel structures exposed to ground or drainage waters, or rapid corrosion of fresh steel in the soil; and
- Blue-grey, blue-green or grey waterlogged soils which smell of rotten egg gas.

High risk indicators for ASS could include:

- Low position in the landscape;
- Soil from beneath the water table;
- Heavy textures;
- Dark colours; and
- Sulphur odour (rotten egg odour)

Positive or Inconclusive Test for ASS
The ESR will undertake the field pH screening Test of ASS/PASS in accordance with Appendix B. If field tests are positive or inconclusive, laboratory analysis (SPOCAS) will be required to determine if the material is in fact ASS and/or the required treatment rates based on the net acidity. In this event all disturbed undetermined material must be temporarily stockpiled and bunded in accordance with this Procedure awaiting confirmation of laboratory analysis. If the net acidity results confirm the presence of ASS, the material will be treated in accordance with the Acid Sulfate Materials Management Procedure (Appendix A).

Acid Sulfate Materials Management Plan

Appendix F

Dewatering Permit

Revision history

Revision	Date	Description	Approval
1			
0	19/06/18	RMS review	
A	28/05/18	For review	

Distribution of controlled copies

Copy no.	Issued to	Version
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2	RMS	B
3		
4		
5		

Dewatering Permit

A. General Information		Checklist Number:	
SEDIMENT BASIN NUMBER:		DATE:	
OTHER DISCHARGE POINT: (Mulch retention basin, trench / excavation, concrete washout)		Hours since last rain event:	
Name of Operator:		The rainfall recorded of last rainfall event (mm):	
B. Dewatering Requirements	**Y/N**	**Comments & any action required**	
Can the water be reused on site for dust suppression or fill conditioning?		***If yes, test for 1 and 3 below***	
Does the water require direct discharge to ground as a concentrated flow or to a water course?		***If yes, answer all 4 questions below***	
C. Testing Requirements (PER to carry out)	**Y/N**	**Result / Comment**	
1. Is the pH reading of the basin between 6.5-8.5pH?			
2. Is the TSS reading of the basin less than 50mg/L?			
3. No signs of Oil/hydrocarbon sheen?			
4. If dewatering via a pump, has the inlet been floated to draw upon the clean surface waters?			

- ***If answered YES to all the relevant testing requirements go to Section E for sign off***
- ***If answered NO to the relevant testing requirements complete Section D***

D. TREATMENT ***If answered NO to the relevant testing requirements*** follow with treatment and record the following details below	
Treatment Details	**Volumes used (L)**
What chemicals were used for treatment?	Gypsum or other RMS approved Floc _____ L hydrochloric acid _____L Ag Lime _____ L Spill absorbent material _____Kg
POST TREATMENT **After treatment has occurred and the basin been left to compensate for 24 -48hrs** **Return to Section C and retest. If the test results pass complete section E for SIGN OFF.**	
ESR Name: ..... Signature:..... Date: ..... Date & Time of field test and sample: ……..	