These tables set out the operational controls required to achieve the objectives and targets set out in Environmental Program 04 Potential Acid Sulphate Soil Management.

BBA will, as a minimum, implement the control activities and performance measures set out below.

Table OCO 3.1 Contaminated Soils Management

Table OCO 4.1 Acid Sulphate Soils Management

Table OCO 4.1 Acid Sulphate Soils Management

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
INDUCTION AND TRAINING							
1.	Design Consultant briefing	CEMP 10	The Design Consultants will be briefed on the design aspects of this Control Document	Design Director	Prior to start of design.	Briefing record	
2.	Early works induction	CEMP 13	All employees, consultants and subcontractors involved in early works will be inducted into the environmental aspects and controls related to those works.	Start up Manager	Prior to personnel commencing work on site	Induction records	
3.	Staff Construction Environmental Management Plan induction	CEMP 13	All operations staff will be inducted into the requirements of the Construction Environmental Management Plan and all associated documents.	Construction Director	Prior to staff commencing work on site	Induction records	
4.	Initial site induction	CEMP 13	Conduct ASS/PASS awareness instruction of all BBA staff, contractors and field personnel as part of the General Site Induction. Objectives of ASS/PASS awareness training include: • Train managers and project staff to recognise signs of PASS and rock. • Procedures for managing ASS/PASS. • Legal and DTAE requirements.	Construction Director	Prior to personnel commencing work on site	Induction records	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
5.	Briefings	CEMP 13 CEMP14	Environmental briefings shall emphasize site-specific PASS control requirements.	General Superintendent	Prior to working in a specific area	Record of Briefing (eg SEP Briefing)	
DESIGN							
6.	Avoid ASS/PASS where possible.	Vic EPA Pub 655	Consider design alternatives to avoid disturbing potential or actual acid sulphate soils.	Design Director	During detailed design	ASS/PASS avoided	
7.	Test for pollutants.	Project Requirement	Test geotechnical samples taken from PASS areas to determine acid sulphate properties.	Design Director	Detailed design	Test taken	
PRE-CONSTRUCTION							
8.	Identify and investigate all reasonably foreseeable sources of PASS within the project alignment.	Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines Vic EPA Pub 655 Vic EPA Pub 680 LU1, Part 3, Sect 2, 2SL1.1, pg 65, (Seq pg 78) LU1, Part 3, Sect 2, 2SL2.1, pg 65, (Seq pg 78) LU3, Part 3, 2.4, pg 18, (Seq pg 257) LU3, Part 3, AS1.1, pg 24, (Seq pg 263) LU3, Part 3, AS1.2, pg 24, (Seq pg 263) LU4, Part 3, 2.4, pg 19, (Seq pg 308) LU4, Part 3, AS1.1, pg 25, (Seq pg 314) LU4, Part 3, AS1.2, pg 25 (Seq pg 314)	Review existing information on potential acid sulphate soils (PASS), particularly Attachment 1 to this OCO. PASS is most likely to be present in low lying deposits lower than 5 m AHD.	Environmental Manager	Project award	Review undertaken	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
9.	Prepare ASS Management Plans	As above	Where ASS or PASS is likely to occur, prepare ASS Management Plans to implement control measures described in Attachment 2 to this OCO.	Environmental Manager	During detailed design	Plans prepared	
10.	Look for field evidence	As above	Look for field evidence of ASS – rotten eggs odour, yellow caking of exposed clays, materials colour change from black to reddish oxides, extremely clear greenish water, reddish coagulation in water from iron hydroxides	Environmental Manager	During detailed design	Field inspections undertaken	
11.	Additional testing	As above	Carry out additional soil testing where required by the review.	Environmental Manager	During detailed design		
12.	Avoid ASS/PASS where possible.	Vic EPA Pub 655 plus as above	Consider construction alternatives to avoid disturbing potential or actual acid sulphate soils.	Project Manager	During construction	ASS/PASS avoided	
13.	Accurately identify the location of ASS.	Vic EPA Pub 655 Vic EPA Pub 680 plus as above	The presence of ASS/PASS in areas considered likely will be determined from a background review and field investigations. Minimum number of sample holes: up to 1 ha, 4 holes; 1-2 ha, 6 holes; 2-3 ha, 8 holes; 3-4 ha, 10 holes; >4 ha, 2 holes per ha. Samples from 0.5 m intervals in each bore will be analysed for suspension peroxide oxidation combined acidity and sulphur (SPOCAS) by a NATA laboratory that has passed the 2006 QLD government Proficiency Round. Field pH and peroxide pH measurements will be made at 0.25 m depth. A qualified soil scientist will interpret the results.	Environmental Manager	During detailed design	Investigations reported	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
14.	Minimise potential environmental effects of disturbing soils	Vic EPA Pub 655 plus as above	Minimise disturbance or drainage of ASS. This may include staging the works to minimise the time that ASS is exposed to oxygen. Generally soils replaced within two days do not require treatment. Cover with plastic sheet if possible or form an earthen bund to catch and treat runoff. Develop a ASS Management Plan for each site confirmed as ASS.	General Superintendent	Before start of construction	ASS Management Plans developed	
15.	Neutralise ASS to enable reuse within the project alignment or disposal offsite	NEPM Table 5-A Vic EPA Pub 655 Vic EPA Pub 680 plus as above	Where controls outlined above are not considered practical, develop methods to neutralise acid potential of soil with agricultural lime prior to reusing within project alignment or disposing offsite in accordance with guidelines	General Superintendent	Prior to construction	ASS Treatment Plans developed	
16.	Additional CRS testing	NEPM Table 5-A Vic EPA Pub 655 Vic EPA Pub 680 plus as above	Conduct additional Chromium Reducible Sulphur (CRS) testing (or equivalent) if required to determine the theoretical liming rate for soil to be disturbed. Exact liming rate to be determined based on quantity of soil to be disturbed and neutralising value of lime to be utilised.	Environmental Manager	Prior to construction	Liming rate determined (kg lime/ tonne soil)	
17.	Neutralise	As above	Develop methods to neutralise acidic water with a suitable agent such as hydrated lime.	Environmental Manager	Prior to construction	Water pH=6.4 – 7.7	
CONSTRUCTION							
18.	Implementation of ASS Management Plans to neutralise ASS to enable reuse within the project alignment or disposal offsite	NEPM Table 5-A Vic EPA Pub 655 Vic EPA Pub 680 plus as above	Neutralise acid potential of soil with agricultural lime in accordance with the ASS Management Plan for the area prior to reusing within project alignment or disposing offsite in accordance with EPA Bulletin 680 “Managing Waste Acid Sulfate Soils”.	General Superintendent	During work with ASS.	ASS Management Plans implemented	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
19.	Implementation of ASS Management Plans	Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines Permit 2SL1.1, p.78 2SL2.1, p.78 LU3, Part 3, 2.4, pg 18, (Seq pg 257) LU3, Part 3, AS1.1, pg 24, (Seq pg 263) LU3, Part 3, AS1.2, pg 24, (Seq pg 263) LU4, Part 3, 2.4, pg 19, (Seq pg 308) LU4, Part 3, AS1.1, pg 25, (Seq pg 314) LU4, Part 3, AS1.2, pg 25, (Seq pg 314)	Stage the works in accordance with the ASS Management Plan for the area to minimise the time that ASS is exposed to oxygen.	General Superintendent	During work with ASS.	ASS Management Plans implemented	
20.	Look for field evidence	As above	In PASS areas, further evaluation may need to be undertaken through sub-surface exploration to the depth of pipeline trenches to determine the presence of ASS and PASS materials	General Superintendent	During excavation	ASS and PASS identified where present	
21.	Prevent oxidation	As above	Prevent oxidation of excavated ASS by placing it in an anaerobic environment, usually beneath the water table. When temporarily stockpiled, wet and cover with a plastic sheet to prevent air contact. Do not place ASS or PASS over pipeline infrastructure, where acid attack on concrete could occur.	General Superintendent	Two days after excavation	Soil successfully buried or covered	
22.	Neutralise runoff	As above	Contain runoff in a ponded area and treat with lime sufficient to achieve pH 6.4-7.7 (quantity of lime required will depend on quantity of acid). Prior to discharge *BBA-FRM-1000-1400-0001 internal permit to discharge from pond* must be signed by the Site Environmental Officer and a copy given to pump operator.	General Superintendent	Two days after excavation	Water pH=6.4 – 7.7	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
23.	Monitor pH	As above	Monitor soil pH and any water runoff daily.	Site Environmental Officer	Daily	pH measured	
24.	Track ASS	As above	Track ASS from its origin to its final location.	General Superintendent	During work with ASS.	ASS tracked	
25.	Record final location	As above	Record final location using soil tracking system.	Site Environmental Officer	After ASS has been relocated	Record of final location	
26.	Mix with lime	As above	Mix ASS thoroughly with lime and spread additional lime around stockpile to neutralise any runoff.	General Superintendent	Before movement	Record of lime dose and mixing method	
27.	Track ASS	As above	Transport soil within the project or to a licensed waste receiver offsite, recording any movements using the soil tracking system.	General Superintendent	During transport	Soil tracking documentation	
28.	Cover loads	As above	Cover loads to limit fugitive emissions.	General Superintendent	During transport	No complaints on fugitive emissions	
29.	Monitor pH	As above	Monitor soil pH and any water runoff daily.	Site Environmental Officer	Daily	pH measured	
30.	Record final location	As above	Record final location on site plans if reused on site.	Site Environmental Officer	After ASS has been relocated	Record of final location	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
INCIDENTS							
31.	Potential environmental harm	CEMP incident response procedures	Class 1: *An actual adverse effect on the health or safety of human beings that is of a high impact or on a wide scale; an actual adverse effect on the environment that is of a high impact or on a wide scale; an actual loss or property damage of an amount, or amounts in aggregate, exceeding ten times the threshold amount ($5,000); an environmental nuisance of a high impact or on a wide scale; an actual adverse effect on the health or safety of human beings that is not negligible; an actual adverse effect on the environment that is not negligible* - cease relevant activities across all sites until the problem is fully understood and rectified; follow incident response procedures Class 2: *The emission of a pollutant that unreasonably interferes with, or is likely to unreasonably interfere with, a person's enjoyment of the environment; any emission specified in an environment protection policy to be an environmental nuisance; an actual loss or property damage of an amount, or amounts in aggregate, exceeding the threshold amount ($5,000)* - cease relevant activities at the site of occurrence until the problem is rectified; follow incident response procedures	Environmental Manager	Ongoing	Incident response records	

Ref	Subject	Reference	Control Activity	Responsibility	Timing	Performance Measure	Audit Check
32.	Potential permit breach	CEMP incident response procedures	Class A: *A permit condition has been breached and either the environmental consequences are significant or the breach is due to a wilful or negligent failure to attempt to satisfy the condition* – cease relevant activities across all sites until the problem is fully understood and rectified; follow incident response procedures Class B: *A permit condition has been technically breached but the intent of the condition has been or will be achieved and environmental consequences of the breach are not significant* – cease relevant activities at the site of occurrence until the problem rectified; follow incident response procedures Class C: *Compliance with the permit has been raised as an issue but the intent and requirements established by the permit condition have been met* – examine the significance and potential for corrective action; follow incident response procedures	Environmental Manager	Ongoing	Incident response records	
EVALUATING PERFORMANCE							
33.	Inspections	CEMP 16	Inspect the condition of protection and control measures and arrange maintenance, as required.	Site Environmental Officer	Daily	Weekly Checklist	
34.	Reporting	CEMP 17	Report on the implementation of this EP in the environmental section of the monthly Project Report.	Environmental Manager	Ongoing	Monthly Report	
35.	Assess monitoring results	CEMP 19	Evaluate and assess monitoring results against specified targets	Environmental Manager	Ongoing	Reports	
36.	Corrective action	CEMP 19	Take corrective action, where required	Project Manager	As required	Action taken	

Definitions

Acid Sulphate Soils (ASS) – are any soil, sediment, unconsolidated geological material or disturbed rock mass containing metal sulphides which exceeds the criteria for acid sulphate soils specified in the Victorian EPA Information Bulletin 655 (Acid Sulphate Soil and Rock, 1999). ASS contain sulphide minerals, such as pyrite (iron sulphide), that can produce sulphuric acid and mobilise toxic heavy metals when exposed to oxidising conditions. This can potentially increase the acidity of adjacent soils and waterways and transport dissolved metals which are toxic to aquatic organisms.

Potential Acid Sulphate Soils (PASS) – are soils with the potential to develop acidic conditions if exposed to air (oxidising) but which are stable in their oxygen poor (reducing) environment. They are deposited as sediment in water saturated soil profiles with reducing environments and have the potential to become ASS if exposed to oxidising conditions.

Attachment 1 – Review of Potential for Acid Sulphate Soils in the Tamar Valley

Introduction

The existence of acid sulphate soils in Tasmania was assessed in a 2000/01 survey under Natural Heritage Trust funding by the Mineral Resources Tasmania (Gurung, 2001). Available information on anecdotal evidence and likely geological formations was collated and follow-up field investigations were carried out. The latter included both site testing and laboratory analysis in accordance with Queensland guidelines. Most of the test sites in the Tamar region indicated low potential for acid sulphate soils, although there were some indications of the presence of sulphidic sub-soils.

Investigations of potential for these soils was limited within the Tamar to the northern parts around Georgetown, Beaconsfield and Beauty Point, and in the coastal zone east of Georgetown. The proposed pipelines for water supply and for effluent delivery to the ocean outfall passes through and along the eastern side of the Tamar Valley, an area not specifically included in the 200/2001 reconnaissance survey.

A preliminary review of potential for acid sulphate soils and an approach to field identification, laboratory analysis and site management techniques is outlined in this report.

Distribution of Acid Sulphate Soils in Tasmania

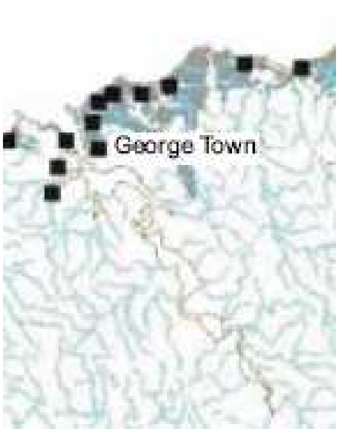
The main conclusions following the 2000/2001 reconnaissance survey on distribution of potential acid sulphate soils were:

- Main area of known occurrence is in the north west, where extensive agricultural drainage works has possibly exposed ASS and caused acid runoff. Indicators of potential areas of ASS were Holocene sediments, typically backswamps;
- King Island, areas of iron-rich sediments in underlying coastal marine deposits;
- North East Tasmania, extensive coastal sand dunes, barrier dunes and saltwater lagoons;
- Flinders Island, presence indicated in groundwater by oxidation of iron-rich sediment, also iron and sulphate-rich groundwater with arsenic and aluminium;
- In south east Tasmania, few isolated patches of Holocene sediments
- In south west Tasmania, Holocene limited to Henty Dunes system.

Locations of potential for ASS in the Tamar and north east were indicated by pH change after oxidation and elevated Total Oxidisable Sulphur at:

- Beaconsfield in Quaternary sand with mottles at 0.5 m depth (pH to 3.5)
- Bluff Point in pyritic siltstone/sandstone at 0.5 m depth (pH to 3.8)
- Georgetown at 1.5 m depth (pH to 4.0, TOS 1.55 %).

Of particular note is that no assessment was carried out higher up in the Tamar River Valley (refer figure below).



Extract from Tasmanian Geological Survey Record 2001/06: Tasmanian Acid Drainage Reconnaissance 2. Distribution of Acid Sulphate Soils in Tasmania (Dr Shivaraj Gurung, 2001): Grey areas represent distribution of Holocene; Black squares represent field test locations.

Holocene Geology in the Tamar River Valley

Acid sulphate soils have formed around the coastline of Australia, following relatively rapid rise in sea levels to about 6500 years ago, following which the sea level has remained at a relatively constant level. Coastal sediments deposited below present day high tide level have remained buried, and in the presence of organic matter, iron from sediments, sulphates from seawater, warm temperatures the formation of iron pyrite has resulted in sulphidic sub-soils in certain areas.

In Tasmania, there has been limited recognition of such acid sulphate soil materials, and indications from the 200/2001 survey are that the key risk area is in the North West. However, a precautionary approach is warranted to assess the potential for acid sulphate soils in certain parts of the pipeline route through the Tamar Valley and northern coastal areas.

Remnants of Holocene sediments occur at:

- Mainly the western flats at the proposed pipeline crossing location, near Trevallyn
- Tamar Island to Barnards Creek area
- Symons Creek / Dilston Wetland
- Georgetown
- Coastal zone, back-dune areas of Five Mile Bluff.

Attachment 2 – Management of Acid Sulphate Soils

Potential Issues

Of particular relevance to the proposed pipeline (and other risk areas) is:

- the potential for exposure of buried sulphidic materials and consequent acid generation, metal dissolution and runoff to adjacent waterways;
- activation of buried sulphidic materials, acid generation and corrosion attack on buried infrastructure (concrete corrosion).

Assessment for pyritic Sub-soils

An assessment of potential for ASS should be carried out during the detailed design of the pipeline route and materials. This would entail:

- Literature review of previous detailed geological and soil surveys;
- Follow-up detailed mapping of sediments and soils to identify late Quaternary sediments;
- Sampling soils at 50 metre intervals through late Quaternary sediments and at change boundaries;
- Samples collected at each identifiable soil horizon and at 250 mm thickness intervals in massive sediment layers to the buried depth of the pipeline.
- Site analysis of actual acidity by direct pH measurement;
- Site analysis of potential acidity by peroxide reaction and pH measurement of oxidised material;
- Where indicative of sulphidic content, collection of samples and laboratory analysis of Total Oxidisable Sulphur.

In areas of identified acid sulphate soils from the above, follow-up testing is to be carried out to quantify actual acidity and potential acidity and potential implications for environmental damage from excavated materials, and design considerations for pipeline materials. The latter detailed investigation is required to measure the potential for free acids following any inherent buffering within the soils from shell fragments, clays, and organic content.

In situations where the ASS investigation has identified high levels of sulfides in the soil, investigate the use of alternative alignments. If groundwater levels are not affected by earthworks, undisturbed *in situ* PASS can be covered with clean fill. Filling activities may disturb in situ ASS by:

- bringing AASS into contact with the groundwater (and thus potentially mobilising and transporting existing acidity out of the AASS into the groundwater);

- displacing or extruding previously saturated PASS above the groundwater table and aerating these soils or sediments11; and/or
- raising acidic groundwater tables with the short-term release of acid into waterways.

Site Management

Acid sulphate soils can be managed on site, with the main approach being:

- Minimising the exposure of excavated materials to water and air (reducing the time of exposure by return to waterlogged sub-surface conditions, following pipeline construction)
- Application of lime, although limited by poor mixing with plastic clay materials, but more effective with sandy pyritic materials
- Containment of any runoff locally and dosing with lime to neutralise acidity;
- Disposal of excess materials to water impoundments, artificial wetlands, burial beneath water table.

The potential for acid attack on the pipeline itself requires specific attention, and will be dependent on quantifying actual and potential acidity in the trench walls and excavated materials replaced into the trench. After disturbance of any sulphidic sub-soils, the presence of open air and water passages through replacement trench materials has potential to allow acids to reach the pipeline materials and cause corrosion.

Management of trench materials where potential acidity of trench wall materials is high, will include:

- Avoiding replacement of high pyritic material into the trench as backfill
- Backfilling around the pipeline with well-mixed sandy/shell grit material
- Backfilling remainder of trench with lime-mixed clayey loam
- Placing a plastic barrier around the pipeline trench to exclude air and water from the trench walls
- Immediate burial of any excess excavated materials, together with neutralising lime, and clay capping.

Revision Status

Revision	Date	Revision Description	Prepared	Reviewed	Approved
A0	27 April 2007	Draft for BBA review	IW		
A1	9 May 2007	Draft for DTAE review	IW		
B0	22 October 2007	Revised for submission to DTAE following auditor's comments	IW	JD	JC
B3	30 January 2008	Revised following DTAE comments	JRD	JD	CF