

PROJECT NO.	DOCUMENT No	REV.	FIGURE
1546223	025	1	2G



PROJECT NO.	DOCUMENT No	REV.	FIGURE
1546223	025	1	2H



PROJECT NO. 1546223	DOCUMENT No	REV.	FIGURE
1540225	025	I	21



PROJECT NO.	DOCUMENT No	REV.	FIGURE
1546223	025	1	2J



+ BH Borehole Location with Identified PASS

HBH Borehole Location with Self-neutralising PASS

Interpreted Extent of PASS Area (without sufficent neutralising capacity)

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PROJECT NO.	document №	REV.	FIGUR
1546223	025	0	

TITLE EXTENTS OF POTENTIAL ACID SULFATE SOILS - SHEET 1



BH Borehole Location with Self-neutralising PASS

Interpreted Extent of PASS Area (without sufficent neutralising capacity)



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BARRON DE	LTA DMPA CON	ICEPT DESIGN		
CONSULTANT		YYYY-MM-DD	2017-10-25	
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		REVIEWED	PKS	
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PROJECT NO. 1546223	CONTROL 025	REV. 0		FIGURE

PROJECT CAIRNS SHIPPING DEVELOPMENT PROJECT

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11.October 2017

in air



APPENDIX A

Acid Sulfate Soil Management Procedures – Barron Delta DMPA

Procedure BD-A: Characterisation and Verification of SNP Dredged Materials

Procedure BD-B: Treatment and Verification of Dredged PASS



BD-A1. GENERAL

The procedure outlined below is provided to further characterise self-neutralizing PASS (SNP) placed in the Barron Delta DMPA to confirm the materials are self-neutralising.

BD-A2. OBJECTIVES

- 1) Appropriately characterise SNP materials placed above the permanent water table to confirm whether treatment is required or whether the material is self-neutralising.
- 2) Comply with conditions of licences, permits or other approvals issued for the project.

BD-A3. STATUTORY REQUIREMENTS AND GUIDELINES

- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines V4.0, 2014. Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M. Department of Science, Information Technology, Innovation and the Arts, Queensland Government;
- 2) Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland, 1998; Ahern, CR., Ahern, M.R. and Powell;
- 3) Environmental Protection Act 1994;
- 4) Environmental Protection Policy (Water) 2009

BD-A4. MANAGEMENT MEASURES

- During placement of SNP, a water cover of at least 1.5m shall be maintained to prevent draining/drying
 of these materials, prior to characterisation/verification.
- Samples of SNP materials deposited above 0.0m AHD will be progressively collected using a sampler from a punt/boat or other suitable method. These samples will be analysed for the Chromium Suite of tests to evaluate if these material will remain self-neutralising following deposition.
- An earthworks strategy shall be developed to spatially identify the locations of appropriately sized "lots" of placed SNP materials. Samples of the SNP material shall be collected on a 1 per lot basis. Characterisation/verification samples will be analysed using the Chromium Suite of tests, following removal of shells and shell fragments larger than 2mm.

BD-A5. PERFORMANCE CRITERIA

To be confirmed as SNP materials, laboratory testing must demonstrate one of the following:

- Sum of existing plus potential acidity (excluding neutralising capacity) of less than 18 mol H+/tonne (0.03% S); or
- A neutralising capacity of more than 3 times the sum of existing plus potential acidity, all measured in the same units (and using a minimum safety factor of 3).

Some individual samples may vary from these criteria, as outlined below:

- No single sample shall exceed a net acidity of 18 mol H+/tonne (0.03% S); and
- If any single sample has a net acidity between 0 and 18 mol H+/tonne (0.00 to 0.03% S), then the average of any four spatially adjacent samples (including the exceeding sample) shall have an average net acidity of zero or less.

BD-A6. CONTINGENGY MEASURES

Where the performance criterion is exceeded, the lot represented by the sample shall be lime treated as outlined in Procedure BD-B.





BD-A7. MONITORING AND REPORTING

Records shall be kept by the Site Manager or their delegated representative to verify volumes of sampling. Specific records of volumes, origin, material type and placement, including photos, shall be maintained by the Site Manager or their delegated representative.

The Site Manager or their delegated representative shall develop the materials tracking register plan and maintain a register of test results.

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PROCEDURE BD-B Treatment and Verification of Dredged PASS

BD-B1. GENERAL

The procedures outlined below are provided as contingency measures for on-site treatment and verification of dredged materials placed above 0.0m AHD if confirmed to be not self-neutralising. This procedure should be reviewed and revised should other treatment options be considered.

BD-B2. OBJECTIVES

- Appropriately treat and manage PASS materials (detected in SNP) so as to minimise adverse effects on the natural and built environment (including infrastructure).
- Comply with conditions of licences, permits or other approvals issued for the project.

BD-B3. STATUTORY REQUIREMENTS AND GUIDELINES

- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines V4.0, 2014. Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M. Department of Science, Information Technology, Innovation and the Arts, Queensland Government;
- 2) Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland, 1998; Ahern, CR., Ahern, M.R. and Powell;
- 3) Environmental Protection Act 1994;
- 4) Environmental Protection Policy (Water) 2009

BD-B4. TREATMENT MEASURES

BD-B4 (a) In-line Dosing

Should initial testing of SNP (Procedure BD-A) consistently indicate PASS with insufficient self-neutralising capacity, in-line application of additional neutralising agents may be trialled to negate the need for other insitu treatments. A low soluble neutralising agent will need to be adopted.

BD-B4 (b) Earthworks Strategy

An earthworks strategy shall be developed to plan and track movement, treatment and verification of each appropriately sized "lot" of ASS material, where self-neutralisation performance criteria are not met.

BD-B4 (c) Insitu Treatment

Treatment of identified lots of PASS materials will occur within the DMPA as placement continues in other portions of the DMPA.

Identified PASS lots may be reworked using a small slurry pump to re-dredge the material and incorporate lime/neutralising agent into the material. Alternatively, neutralising agent injection and soil mixing may be undertaken with mechanical mixing methods (e.g. jet grouting and shallow soil mixing equipment, cutter soil mixer, etc).

BD-B4 (e) Neutralisation Rates

Neutralisation rates for each treatment lot shall be determined from the initial characterisation result.

The neutralising rate required to neutralise the Net Acidity (Existing Acidity + Potential Acidity) shall be calculated by:

- Multiplying Net Acidity by a safety factor of 3 to allow for mixing deficiencies and poor reactivity of the lime;
- Multiplying the above result by the bulk density of the soil to arrive at the liming rate (kg/m³).
- Multiplying the above result by the neutralising value of the neutralising agent.



PROCEDURE BD-B Treatment and Verification of Dredged PASS

BD-B4 (f) Verification Testing

Verification samples shall be collected for each treated lot. The samples shall be formed by compositing materials from three randomly selected locations across the lot. Samples shall be collected over the full thickness of the treated lot. The Chromium Suite shall be conducted on each sample to confirm net acidity by Acid Base Accounting.

BD-B5. PERFORMANCE CRITERIA

To confirm adequate treatment, laboratory testing must demonstrate the following:

 A neutralising capacity of more than 3 times the sum of existing plus potential acidity, all measured in the same units (and using a minimum safety factor of 3).

BD-B6. CONTINGENGY MEASURES

Additional treatment and further verification testing shall be conducted where adequate neutralisation is not initially indicated.

Performance Indicator Item An appropriate earthworks strategy has been prepared to track the treatment Earthworks strategy of PASS (appended to the ASSMP) PASS treatment Treatment procedures employed Neutralising rates Correct neutralising rates are applied for each treatment lot. Verification of treatment on each lot of treated material. Correct verification laboratory analysis used. Treatment verification If verification shows performance criteria in section BD-D5 are not met, additional treatment has been employed. Non conformance All non-conformances are reported and rectified.

BD-B7. PERFORMANCE INDICATORS

BD-B8. MONITORING AND REPORTING

Records shall be kept by the Site Foreman to verify volumes of soils treated.

The Site Foreman shall be responsible for ensuring neutralisation and verification tests are completed for each lot of PASS.

The Site Foreman shall maintain a register of testing results and a record of inspections.

A summary report of all test results and inspections shall be complied by the Site Foreman each week and submitted to the Environmental Manager.

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APPENDIX B

Acid Sulfate Soil Management Procedures – Tingira Street DMPA

Procedure TS-A: Identification and Characterisation or Possible ASS Procedure TS-B: Treatment and Verification of Identified ASS



PROCEDURE TS-A Identification and Characterisation of Possible ASS

TS-A1. GENERAL

The procedure outlined below is provided for the visual inspection and characterisation of possible ASS materials within stiff clay materials arriving at the Tingira Street DMPA.

TS-A2. OBJECTIVES

- Visual inspection for the presence of ASS materials.
- Comply with conditions of licences, permits or other approvals issued for the project.

TS-A3. STATUTORY REQUIREMENTS AND GUIDELINES

- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines V4.0, 2014. Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M. Department of Science, Information Technology, Innovation and the Arts, Queensland Government;
- 2) Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland, 1998; Ahern, CR., Ahern, M.R. and Powell;
- 3) Environmental Protection Act 1994;
- 4) Environmental Protection Policy (Water) 2009

TS-A4. INSPECTION FOR ASS

Each load of stiff clay arriving at the Tingira Street DMPA will be inspected for the presence of soft, dark coloured (particularly grey hued soils) clays mixed or comingled with the stiff, yellow/orange hued clays. Visual examples of each of these materials are presented in Plates 1 and 2.







Plate 1 – Soft Clays - Possible Acid Sulfate Soils



Plate 2 - Stiff Clays - non Acid Sulfate Soil





PROCEDURE TS-A Identification and Characterisation of Possible ASS

TS-A5. MANAGEMENT MEASURES

Training – Equipment operators and supervisors at the Tingira Street DMPA shall be trained in the basic recognition of ASS as part of a site induction presentation. An experienced ASS practitioner shall be appointed to conduct site inspections and assist in the identification of ASS on an 'as required' basis.

Soil Handling – Material arriving at the Tingira Street DMPA shall be placed in bunded areas where drying and then placement and compaction will occur. Where possible ASS is observed during the inspection, this material should be segregated from non-ASS materials where this is feasible/practical. Segregated materials should be directly be removed for disposal at a licenced PASS disposal site or characterised and treated at the DMPA as per Procedure TS-B.

Where, it is not practical to segregate the non-ASS from possible ASS materials. A sample of the possible material shall be collected for characterisation and that load of comingled material shall be treated at the liming rate indicated by the characterisation test.

Characterisation – Where suspected ASS is observed a samples shall be collected for analysis by the Chromium Suite of tests. Materials returning net acidity less than 0.03%S shall be reused at the DMPA without further acid sulfate management. Where net acidity greater than 0.03%S is found, the materials shall be transported directly to a treatment area and measures described in Procedure TS-B shall be followed.

TS-A6. MONITORING AND REPORTING

The Site Foreman or their delegated representative shall keep a record of all equipment operators and supervisors who are trained in the basic recognition of ASS as part of induction training.

The Site Foreman shall maintain a register of inspections of each load received at the DMPA and records of any test results on samples of suspected ASS.

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PROCEDURE TS-B Treatment and Verification of Identified ASS

TS-B1. GENERAL

The procedures outlined below are provided as a **contingency measure** for the on-site treatment and verification of ASS materials, if identified commingled with stiff clays at the Tingira Street DMPA.

TS-B2. OBJECTIVES

- Appropriately treat and manage confirmed ASS materials so as to minimise adverse effects on the natural and built environment (including infrastructure).
- Comply with conditions of licences, permits or other approvals issued for the project.

TS-B3. STATUTORY REQUIREMENTS AND GUIDELINES

- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines V4.0, 2014. Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M. Department of Science, Information Technology, Innovation and the Arts, Queensland Government;
- 2) Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland, 1998; Ahern, CR., Ahern, M.R. and Powell;
- 3) Environmental Protection Act 1994;
- 4) Environmental Protection Policy (Water) 2009

TS-B4. TREATMENT MEASURES

TS-B4 (a) Stockpiling of Identified ASS

Stockpiling and treatment of identified ASS materials shall only be conducted within a bunded area on the DMPA.

TS-B4 (b) Treatment Facility

A treatment facility shall be constructed within the DMPA area in general accordance with the requirement detailed in *Soil Management Guidelines, 2014* (refer Figure TS-B1) and the following additional requirement:

A guard layer of fine ground agricultural lime shall be applied to the treatment areas prior to placement
of soils at a rate 5 kg/m² for each 1m height of soil to be treated.

The treatment facility shall be inspected on a daily basis and maintained to prevent escape of soils or water from the facility.

Figure TS-B1: Schematic cross-section of a treatment pad, including a compacted clay layer, guard layer, leachate collection system and containment with bund



Identified ASS materials shall be placed into appropriately identified treatment lots at the treatment facility where the material shall be spread in layers and allowed to dry (if required).





The overall layer thickness shall not exceed 250 mm thickness unless effective treatment over a greater thickness can be demonstrated. Where required, drying shall be enhanced by mechanical methods (rotary hoe, disc plough, etc) to create a relatively homogenous, friable material prior to addition of lime for neutralisation.

Fine ground agricultural lime (or other approved neutralising agent) shall be applied to the ASS surface in each treatment lot using a spreader truck or other approved method. Following lime application, the lime shall be mixed into the ASS layer using mechanical methods (disc plough, rotary hoe, etc).

TS-B4 (c) Liming Rates

The liming rates shall be determined from Chromium Suite testing. The highest indicated rate shall apply to a treatment lot.

TS-B4 (d) Verification Testing

Verification samples shall be collected for each treated lot (1 per lot). The samples shall be formed by compositing materials from three randomly selected locations across the allotment. Samples shall be collected over the full thickness of the treated lot. Chromium Suite testing shall be conducted on each sample to confirm net acidity by Acid Base Accounting.

TS-B5. PERFORMANCE CRITERIA

To confirm adequate lime treatment, laboratory testing must demonstrate the following:

 A neutralising capacity of more than 1.5 times the sum of existing plus potential acidity, all measured in the same units (and using a minimum safety factor of 1.5).

Some individual samples may vary from these criteria, as outlined below:

- No single sample shall exceed a net acidity of 18 mol H+/tonne (0.03% S); and
- If any single sample has a net acidity between 0 and 18 mol H+/tonne (0.00 to 0.03% S), then the average of any four spatially adjacent samples (including the exceeding sample) shall have an average net acidity of zero or less.

TS-B6. CONTINGENGY MEASURES

Additional lime treatment and further verification testing shall be conducted where adequate neutralisation is not initially indicated.

TS-B7. PERFORMANCE INDICATORS

ltem	Performance Indicator
Earthworks strategy	 An appropriate earthworks strategy has been prepared to track the treatment of ASS (appended to the ASSMP)
Liming rates	 Correct liming rates are applied for each treatment lot.
Treatment verification	 Verification of treatment on each of treated material.
	 Correct verification laboratory analysis used.
	 If verification shows performance criteria in section TS-B5 are not met, additional treatment has been employed.
Non conformance	 All non-conformances are reported and rectified.



PROCEDURE TS-B Treatment and Verification of Identified ASS

TS-B8. MONITORING AND REPORTING

Records shall be kept to track identified ASS materials, volumes transported to the treatment facility, treatment rates applied. The Site Foreman shall conduct an inspection of the treatment areas including bunds and sumps on a weekly basis.

The Site Foreman shall be responsible for ensuring lime neutralisation and verification tests are completed for each lot of excavated ASS.

The Site Foreman shall maintain a register of testing results and a record of inspections.

A summary report of all test results and inspections shall be complied by the Site Foreman each week and submitted to the Environmental Manager.

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