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LandCorp

Report for Broome North Redevelopment

Acid Sulfate Soil Investigation

November 2009

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Executive Summary

LandCorp commissioned GHD Pty Ltd (GHD) to undertake an Acid Sulfate Soil (ASS) Investigation prior to the Redevelopment of Broome North, Broome. GHD completed the desktop ASS investigation prior to this study (GHD, 2009), which indicated a low ASS risk. An area of land however, exists approximately 1 km south of the Site, classed as a moderate to high risk of ASS occurring within 3 m of the natural soil surface, likely to be related to the influence of Roebuck Bay (which includes an area of mangroves). After discussion with LandCorp, GHD undertook a sampling program targeted in the areas most likely to contain ASS materials (if any). The purpose of this was to identify the prevalent risks associated with ASS in the locality.

This report presents the findings of the ASS Investigation and provides recommendations to be considered prior to the commencement of earthworks.

The scope of works completed by GHD is outlined below:

» A desktop study was undertaken prior to this investigation as a preliminary appraisal of ASS risk within the project area. This involved gathering information from ASS risk maps, generic soil maps, environmental geological maps and groundwater maps to make conclusions relating to ASS risk.

» Soil sampling was conducted at 20 locations (15 onsite and 5 in Roebuck Bay), undertaken to a depth of 1 m below ground level.

» Samples were collected at 0.25 m intervals, in accordance with Department of Environment and Conservation (DEC) guidelines (2009).

» Soil samples were analysed by ALS laboratory for pH field screening and the Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) suite.

» Laboratory results were assessed against DEC (2009) action criteria to determine the nature of existing acidity at the Site and to assess the requirement for further soil investigations.

The findings of this investigation are outlined below:

» ASS materials were not identified in the intrusive sampling locations (with the exception of one topsoil sample);

» Laboratory analysis of soil samples collected indicated that actual acidity (TAA), potential acidity (TPA), potential sulfidic acidity (S_{pos}) and net acidity values were all below the Laboratory Limit of Reporting (LOR) for the majority of samples;

» The sample from location BN15 at 0-0.25 m below ground level, exceeded the adopted net acidity criteria (18.7 mol H^+/tonne) however, contained 10,300 mol H^+/tonne ($CaCO_3$ equivalent) of ANC, pH_{KCl} of 9.5, pH_{ox} of 8.5 and an Scr value of <0.02%S; and

» Samples collected from the anticipated high risk area (Roebuck Bay) exhibited potential acidity however, also contained ANC values ranging from 852 to 125,000 mol H^+/tonne ($CaCO_3$ equivalent).

Based on these observations, it is considered that the risk of ASS occurrence at the Site is inherently low. Additionally, as limited sampling indicated the presence of ASS materials is negligible in the adjacent high risk area. Accordingly, it is considered that no further ASS investigations are required prior to earthworks being undertaken at the Site, on the assumption that the following are adhered to:

» Excavation works are limited to Pindan Soils; and

» Dewatering is not required.

If there is any deviation from the assumptions described above as part of the earthworks, it is recommended that LandCorp contact GHD for further ASS advice to ensure proposed earthworks are carried out in accordance with relevant DEC guidelines.

1. Introduction

LandCorp commissioned GHD to undertake an ASS Investigation prior to the proposed Broome North Redevelopment. GHD completed the desktop ASS investigation prior to this study which identified a low risk of ASS occurrence. At the request of LandCorp, field investigations were undertaken to confirm the prevalent low risk nature of ASS materials onsite (Figure 1).

This report presents the findings of the ASS investigation and the associated recommendations.

1.1 Objectives

The objectives of this ASS investigation were to:

» Evaluate the potential presence and risk of actual acid sulfate soils (AASS) or potential acid sulfate soils (PASS) along the proposed Site by undertaking a desktop study, soil sampling and laboratory analysis; and

» Make conclusions and recommendations that address the presence (if any) of ASS within the context of the proposed redevelopment works.

1.2 Scope of Works

The scope of this investigation is outlined below:

» 20 soil bores were hand augered (15 at the Site and 5 at Roebuck Bay) to a maximum depth of 1 m BGL.

» A total of 83 soil samples (including four duplicates) were collected at 0.25 m intervals from the soil bores.

» All soil samples were analysed by a NATA[1] accredited laboratory for pH field screening and SPOCAS analysis.

» Laboratory results were assessed against DEC (2009) action criteria to determine the likely nature of existing acidity at the Site and to assess the requirement for management.

» Recommendations were formed based upon the anticipated ASS risk and proposed earthworks.

The ASS investigation was undertaken in accordance with the document, *Identification and Management of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2009).

[1] National Association of Testing Authorities

2. Acid Sulfate Soils

2.1 Background on Acid Sulfate Soils

The classification of ASS includes both actual acid sulfate soils (AASS) and potential acid sulfate soils (PASS). AASS are soils that are generating acidity, whereas PASS are soils that have the potential to generate acidity.

ASS are soils containing naturally-occurring, fine-grained metal sulfides typically pyrite (FeS_2), formed under saturated, anoxic/reducing conditions. They generally occur in Quaternary (1.8 Ma – Present) marine or estuarine sediments, predominantly confined to coastal lowlands (elevations generally below 5 mAHD). Within these sediments, the majority of soils that present an environmental risk are generally confined to Holocene aged material (<10 000 years). Where these materials have oxidised, they commonly have a mottled appearance (orange and yellow discolouration) due to the presence of oxidised iron minerals.

Although soils described above represent typical conditions where ASS occurs, the presence of ASS materials is not limited to these soil types. In Western Australia, ASS materials have been identified in other soil types such as leached sands and silts. Accordingly, for areas where no data is available, the extent of ASS materials should be established through field investigations.

2.2 Potential Risks of AASS and PASS

When PASS are disturbed, either by excavation or lowering of the watertable below natural seasonal levels, sulfides present are exposed to air, allowing oxidisation and consequently, the formation of sulfuric acid (H_2SO_4). AASS are capable of generating acidity *in situ* in their natural state; disturbance is not required for acidic discharges to develop.

As a result of the presence of AASS, or the oxidation of PASS, surrounding land (soil) and nearby waterways may become acidic (pH<6.5). Under acidic conditions, metals such as aluminium (generally at pH<4.5) and iron, as well as trace heavy metals (including arsenic), become more mobile in the environment and can be taken up by infiltrating waters. As a result, surface and/or groundwater concentrations of these metals may reach concentrations which have the potential to cause acute or chronic toxicity to sensitive terrestrial and aquatic plants and animals.

Acidic conditions generated by ASS can also corrode concrete and steel (pipes, bridge abutments, underground services, and other infrastructure) and can result in the rapid deterioration of asphalt surfaces where they overlie AASS or PASS.

2.3 Management of ASS

Avoiding or minimising disturbance of ASS are the primary methods of management. Where avoiding disturbance is not possible, management techniques available for ASS can include:

- Chemical neutralisation (use of pure fine agricultural lime (AgLime) or a similar neutralising agent).
- Anoxic storage or placement of PASS below the water table and beneath clean non-ASS fill; and
- Hydraulic separation of pyrite from the soil (high maintenance process suitable for coarse grained sediment).

The addition of agricultural lime is the most common amelioration technique applied to acidic soils, where mechanical mixing is completed by plough or excavator to provide adequate homogeneity of the soil/sediment-lime mix.

2.4 Legislative Requirements in Western Australia

The following legislative requirements often apply to works involving ASS.

2.4.1 Western Australian Planning Commission Bulletin 64

The recently amended *Planning Bulletin 64/2009 (PB 64/09)* aims to provide advice and guidance on matters that should be taken into account in the rezoning, subdivision and development of land containing acid sulfate soils. PB 64/09 requires the identification, assessment and management of soils where:

- The surface elevation is ≤ 5m AHD, and it is proposed to excavate ≥ 100m^3 of soil;
- Where the surface elevation is ≥ 5m AHD, and it is proposed to excavate ≥ 100m^3, and the excavation depth is ≥ 2m; or
- Where any dewatering works are to be undertaken.

2.5 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act 1986) provides for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing.

To prevent environmental harm, the EP Act 1986 established under Section 50A, states that, *A person who –*

(a) *causes serious environmental harm; or*

(b) *allows serious environmental harm to be caused*.

(c) *commits an offence*.

Accordingly, all parties to a development must show that the environmental risk associated with the development has been assessed and minimised where possible.

3. Site Background

3.1 Site Description

The Site forms part of the Broome North Redevelopment. The Site comprises the south east corner of the proposed redevelopment area (Figure 2).

3.2 Environmental Site Setting

3.2.1 Topography

The 1:250 000 Environmental Geology Series Map (Gibson & Watson, 1982) indicates that the topography at the Site is approximately 50 m AHD, and is generally level with no significant topographical variation noted.

3.2.2 Geology

The Geological Survey of Western Australia Environmental Geology Series Maps (1982) indicates that the site is situated on a flat to gently undulating plain on the Dampier Peninsula, comprising predominantly of the Pindan soil type. These soils are generally described as, *red sands, fine to medium grained, minor silt content and of Aeolian in origin* (Kenneally *et al.,* 1996), developed during the quaternary period as regolith on desert sandstone.

3.2.3 Hydrogeology

The study area is located in the Cape Leveque Coast drainage basin (Department of the Environment, Water, Heritage and the Arts, 2008).

Information provided by the Department of Water (DoW) bore search indicates that the there are 6 groundwater wells in a 5 km radius of sites A and B. The depth to water ranged from 0.2 – 4.4 mAHD with an average of 2.2 mAHD.

Due to the reported nature of the geology, surface topography and the proximity of the nearest surface water bodies, it is considered that the sites are located in areas which do not indicate a significant potential to impact surrounding surface water resources.

3.2.4 Previous Investigations

GHD has undertaken Preliminary Environmental Impact Assessments (PEIA) and Biological Surveys in Areas A and B (GHD, 2009b). A summary of their findings in relation to ASS potential risks are as follows:

» No wetlands or watercourses are located within the study area. Roebuck Bay, an internationally significant wetland (RAMSAR listed site) is located within 10 km of the study area. It is unlikely that this RAMSAR listed site will be impacted by the proposed project;

» No Environmentally Sensitive Areas (ESA) are situated within the Areas A and B;

- Areas A and B are not located within a Public Drinking Water Source Area (PDWSA); and
- Alteration to surface drainage and stormwater runoff. As a result of vegetation clearing and the development of building and hard stands, there will be a reduction in infiltration of surface water to the ground and an increase in runoff from the site.

In summary, previous investigations do not indicate the presence of significant sensitive environmental receptors in the area.

3.3 Acid Sulfate Soil Mapping

A review of ASS risk mapping (WAPC, 2009) indicates that there is no data available for the proposed sites. It should however be noted that areas of land approximately 1 km south of the Site are classed as a moderate to high risk of ASS occurring within 3 m of the natural soil surface, likely to be related to the influence of Roebuck Bay.

4. ASS Field Investigation

The sampling locations were concentrated along the perimeter of the south east corner of the proposed development area (referred to here in as the Site), as this was identified as the most likely location to encounter ASS materials (if at all present). To complement this study, limited sampling was also undertaken within a mangrove swamp (Roebuck Bay). The purpose of this was to identify the extent and risk of ASS materials in an area of identified high risk (indicated through mapping) and compare them to the soil materials identified onsite.

Fieldwork was undertaken on the 6th and 7th of October 2009 by two GHD environmental scientists. The work was carried out in accordance with the DEC's guidance notes, *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (Dec, 2009).

The sampling locations are provided in Figure 2.

4.1 Soil Sampling

The ASS sampling program was undertaken utilising hand auger techniques. 20 soil bores were excavated to a depth of 1 m BGL.

The soil bores were logged in accordance with standard internal GHD logging procedures.

Soil samples were collected at 0.25 m intervals and were placed in zip lock bags with the air excluded. A total of 83 samples were collected (including 4 duplicates). The samples were stored on ice and delivered to ALS Laboratory in Malaga, Perth.

4.2 Quality Control and Quality Assurance

Quality control (QC) and Quality Assurance (QA) involved following the procedures outlined in the DEC's Acid Sulfate Soil and Contaminated Sites Guideline Series, Australian Standard 4482.1 and GHD's internal sampling procedures. QC and QA are discussed in detail in Section 7.

5. Laboratory Analysis – Technical Background

A glossary of technical terms and definitions used in this section is provided in Appendix A.

5.1 pH Field Screening

Field pH testing[2] provides a preliminary indication of existing sediment acidity and its potential to produce acid once oxidised. Table 1 summarises the soil pH trigger values set out in the *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2009) that are used as a preliminary screening tool to identify acidic soils, AASS and PASS.

Table 1 Field Testing pH Classifications

Soil pH	Indication
$4.0 < pH_f \leq 5.5$ (1)	Acidic Soil
$pH_f \leq 4.0$	AASS
$pH_{fox} < 3.0$ (2)	PASS likely
$\Delta pH > 2.0$ (3)	PASS likely

(1) pH_f is the in-situ pH of the soils

(2) pH_{fox} is the pH measured after the sample has been fully oxidised using H_2O_2.

(3) ΔpH is the difference in pH before and after oxidation.

5.2 Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) – Background Information

The *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2009) defines action criteria based on the net acidity of the soils. The net acidity is defined as:

Net acidity[3] = Potential Acidity + Existing Acidity – Acid Neutralising Capacity[4]

The trigger levels for net acidity based upon soil texture are presented in Table 2. The acidity trail comprises several components including TAA, TPA, TSA, S_{POS} and ANC. These are described in detail in the glossary in Appendix A.

[2] Although referred to as field testing, these tests are generally undertaken in a laboratory due to the health and safety issues related to the handling of peroxide.

[3] Equation has been extracted from the Department of Environment and Conservation's guidance document, *Identification and Investigation of Acid Sulfate and Acidic Landscapes (May, 2009)*

[4] Due to the particular characteristics of the soil and groundwater regime in Western Australia, DEC does not recognise the validity of ANC values without confirmatory kinetic testing or modified laboratory methods to provide a more accurate estimate of the actual amount of neutralising capacity that would be available under real field conditions. However, there may be instances where 10% of the ANC may be considered due to the laboratory preparation of the samples.

Table 2 Action Criteria Based on Net Acidity for Three Texture Categories

Soil Texture	Clay Content (%)	< 1,000 Tonnes Disturbed		> 1,000 Tonnes Disturbed	
		S (%)	H^+ (mol/tonne)	S (%)	H^+ (mol/tonne)
Coarse (sands – gravels)	< 5	0.03	18.7	0.03	18.7
Medium (sandy loam – light clay)	5 – 40	0.06	37.4	0.03	18.7
Fine (medium to heavy clays, silty clays)	> 40	0.10	64.8	0.03	18.7

Materials containing net acidity in excess of the values presented in Table 2 above are deemed to be soils that require treatment. Soils investigated in this study consisted of predominantly coarse grained materials, hence the action criteria of 0.03 %S (18.7 mol H^+/tonne) has been adopted.

SPOCAS analysis is an acid-base counting process which allows the determination of the net effect of acid generation and consideration of the acid neutralising components (base) within soil samples.

5.3 Chromium Reducible Sulfur

Chromium Reducible Sulfur (S_{cr}) is an estimation of the soils potential sulfidic acidity. This is achieved through measuring the reduced inorganic sulfur content within a soil sample. S_{cr} is not subject to interference from organic sulfur and therefore gives a reasonably accurate estimation of potential sulfidic acidity.

Given the leached, naturally acidic nature of soils in Western Australia, the DEC has stated that it prefers the SPOCAS method of analysis (DEC, 2009a).

6. Results and Discussion

As outlined in Section 4.1, sampling was undertaken in two areas:

» 15 soil bores located along the south eastern perimeter of the Site; and

» 5 soil bores located within Roebuck Bay.

In total, 83 samples (inclusive of 4 quality control samples) were collected from the two areas; 59 from the Site and 24 from Roebuck Bay.

The soil bore logs are provided in Appendix B, the Laboratory Certificates are presented in Appendix C with a summary table provided in Appendix D.

6.1 Soil Lithology

Soils encountered at the site consisted of fine to medium grained red sands (consistent with Pindan Sands), confirming the anticipated lithology identified in desk study information.

6.2 pH Field Screening Results

6.2.1 Samples Collected from the Site

A total of 59 primary samples were submitted to ALS for pH_f and pH_{fox} rapid field screening.

Values for pH_f ranged from 6 to 8 with values for pH_{fox} ranging from 5.2 to 6.2. The ΔpH, (which is defined as pH_f minus pH_{fox}) ranged between 0.8 and 2.2.

The results suggest that the majority of the samples contain slightly acidic to alkaline soils. Analysis of the Δ pH does not indicate a large potential for the generation of acidity upon oxidation within the soils. If these soils were to oxidise, it is likely that a slightly acidic to neutral soil would result.

A summary of the exceedances of the pH screening results for the Site are presented in Table 3 below.

Table 3 pH Criteria Outliers - Site

Parameter and trigger level	Outliers (Location ID)	Indication
$4.0 < pH_f \leq 5.5$	Nil	Acidic Soil
$pH_f \leq 4.0$	Nil	AASS
$pH_{fox} < 3.0$	Nil	PASS likely
ΔpH > 2.0	BN1 – 0-0.25, 0.25-0.5 BN12 – 0-0.25, 0.25-0.5, 0.5-0.75	PASS likely

The field screening results are not strongly indicative of ASS materials being present at the locations sampled. Although the ΔpH screening criteria was exceeded in 2 locations, it is likely that the oxidation reactions observed are associated with the presence of organic matter and not inorganic sulfides.

6.2.2 Roebuck Bay

Although samples were collected from a mangrove swamp, it was observed that these soil materials contained significant amounts of calcareous materials on the surface. This was supported by pH_f values which ranged from 7.9 to 8.8. pH_{fox} values ranged from 6.2 to 6.4 with the ΔpH ranging between 1.6 and 2.5. A summary of exceedances are provided in Table 4 below.

Table 4 pH Criteria Outliers - Roebuck Bay

Parameter and trigger level	Outliers (Location ID)	Indication
$4.0 < pH_f \leq 5.5$	Nil	Acidic Soil
$pH_f \leq 4.0$	Nil	AASS
$pH_{fox} < 3.0$	Nil	PASS likely
ΔpH > 2.0	RB1 – 0-0.25, 0.25-0.5, 0.5-0.75, 0.75-1 RB2 – 0-0.25, 0.25-0.5 RB3 – 0.25-0.5, 0.5-0.75, 0.75-1.0 RB4– 0-0.25, 0.25-0.5, 0.5-0.75, 0.75-1 RB5 – 0-0.25, 0.25-0.5, 0.5-0.75, 0.75-1	PASS likely

The results indicate that materials contained in Roebuck Bay have the potential for oxidation reactions to occur however, given the calcareous content it is considered that a slightly acidic pH would be the 'worse case' result.

6.2.3 Summary

To confirm the low risk nature of acidity at the Site, and to determine the source of the oxidising materials in both of the areas, SPOCAS was conducted on 31 of the samples.

6.3 SPOCAS

6.3.1 Samples Collected from the Site

Based on the coarse texture category adopted, all of the samples (with the exception of one – BN15 0-0.25) analysed reported net acidity levels below the relevant action criteria (18.7 mol H+/tonne). Additionally, all samples (with the exception of aforementioned sample) reported below the laboratory limited of reporting (LOR).

The TAA results (measure of actual acidity) reported below the LOR for the majority of the samples. The highest TAA value was 4 mol H^+/tonne (BN 13 0.25-0.50). This indicates that actual acidity is not present in the samples collected.

TPA (measure of potential acidity) values were below the LOR for the majority of samples. The highest TPA reading was 11 mol H^+/tonne (BN 13 0.25-0.50). This indicates none-marginal amounts of potential acidity within the samples collected.

The S_{pos} (estimation of soil sulfide content) were all below the LOR with the exception of BN15 0-0.25. This sample exhibited 52 mol H^+/tonne, above the adopted criteria of 18.7 mol H^+/tonne. Generally, the results indicate that it is unlikely that sulfide bearing minerals are present within the soils sampled, however, potential sulfidic acidity may be present within the topsoil within the vicinity of BN15.

The presence of acid neutralising materials was highly variable with values ranging from below the LOR to 10 300 mol H^+/tonne. This indicates that in the event of acid generation, the soil materials present onsite have a variable capacity to neutralise the acidity. It should be noted that all samples that exhibited an ANC value below the LOR also exhibited, TAA, TPA, S_{pos} and net acidity values below the LOR.

6.3.2 Roebuck Bay

It was anticipated that given the environmental setting of Roebuck Bay, the likelihood of identifying ASS materials were greater in this area compared to the Site. As anticipated, four of the seven samples submitted for SPOCAS analysis reported net acidity values greater criteria. However, significant ANC values were present in all of the materials sampled. The results are summarised below.

- TAA values below the LOR in all samples;
- TPA values below the LOR in all samples;
- S_{pos} values ranged from below the LOR to 70 mol H^+/tonne; and
- ANC values ranged from 852 to 125,000 mol H^+/tonne.

6.4 Chromium Reducible Sulfur

S_{cr} analysis was completed on 10 samples to give an accurate indication of the potential sulfidic acidity. All of the samples analysed returned below the LOR, indicating that any potential acidity present in samples are not a result of oxidation of sulfide bearing minerals.

6.5 Summary

Based on the laboratory analyses and net acidity values, management measures pertaining to ASS are not required during construction works. This is further supported by sampling undertaken in an identified (WAPC, 2009) high risk ASS area (Roebuck Bay). Laboratory analysis indicated that although acidity was present (in the form of potential) in 4 of the 7 samples analysed for SPOCAS, ANC values were orders of magnitude greater, and would therefore offer a significant source of neutralising capacity that may buffer any acidity generated. As limited sampling indicated the presence of ASS materials is negligible in the adjacent high risk area, it is considered unlikely that ASS materials are present at the proposed Broome North Redevelopment area. A summary of the samples that exceeded criteria are presented in Table 5 below.

Table 5 Exceedances in Adopted Criteria

		TAA mol H^+/tonne	Spos mol H^+/tonne	TPA mol H^+/tonne	Chromium Reducible Sulfur %S	ANC mol H^+/tonne	Net Acidity mol H^+/tonne
RB3	**0.25-0.5**	<2	59	<2	<0.02	11,400	**59**
RB4	**0.75-1**	<2	52	<2	-	10,700	**52**
RB5	**0-0.25**	<2	63	<2	-	11,400	**63**
	0.75-1	<2	70	<2	-	125,000	**70**
BN15	**0-0.25**	<2	52	<2	<0.02	10,300	**52**

Based on laboratory results, it is considered that ASS materials have not been identified in locations subject to testing. The top soil at BN15 had an elevated net acidity value. However, based on the following information, it is considered that management is not required.

- Topsoils do not require treatment as per DEC guidelines, *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes* (DEC, 2009b)
- pH_{KCl} of 9.5
- pH_{ox} of 8.0
- ANC value of 10 300 H^+/tonne ($CaCO_3$ equivalent)
- Scr below the LOR (<0.02%S)

Accordingly, the inherent risk of ASS at the Site is considered to be low.

7. Quality Assurance/Quality Control

7.1 Introduction

GHD has reviewed the laboratory and quality assurance results in order to demonstrate that the analytical data in this report is of a suitable quality to draw reliable conclusions about the distribution of ASS materials on Site.

The minimum Field QA/QC requirements as listed in Section 8.2.1 of DEC (2009) are:

» Collection of field duplicates (1 in 20 samples) as quality control samples; and

» Use of standard field sampling forms (including Chain of Custody) and methods.

Laboratory QA/QC as discussed in Section 8.2.1 of DEC (2009) involves:

» NATA accreditation for the parameters and methodologies required;

» A statement on sample condition, date collected, date extracted, date analysed; holding times; and

» Reporting on internal laboratory quality control measures.

ALS Laboratory is accredited by the National Association of Testing Authorities (NATA) for the analyses performed. The internal laboratory Quality Assurance results are presented in Appendix E.

7.2 Field QA/QC

GHD recorded field observations on GHD standard soil logging sheets and all samples were sent to the laboratory with a Chain of Custody (COC) form. COCs are provided in Appendix E.

Samples were collected by hand with a designated pair of nitrile gloves for every sample to minimise the risk of cross contamination between samples.

7.2.1 Field Duplicates – Relative Percentage Differences

During the soil investigation, a total of 79 samples were collected with an additional 4 field duplicates.

A quantitative measure of the precision of the analytical results is made by calculating the Relative Percent Difference (RPD) between primary and duplicate results in accordance with the procedure described in AS 4482.1 *Guide to the sampling and investigation of potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (DEP, 2001). According to AS 4482.1 typical RPD's range between 30% and 50%, however AS 4482.1 recognises that this may be higher for low concentrations of analytes. RPD calculation results are provided in Appendix E

Where a result was reported below the laboratory detection limits for one of the duplicate pair samples, the sample was assigned a concentration equal to the detection limit for RPD calculation purposes.

A total of 20 RPDs were calculated with 4 of the calculations returning results above the adopted criteria. The exceedances were sourced from sample RB4 0.75-1.0. Given that the presence of buffering materials was evident in this sample, it is considered that the implication to S_{pos}, and net acidity (%S and mol H^+/tonne) are significant and have therefore interfered with the purposes of RPD calculations. For the other exceedance (TAA), given that the result was 2 and the LOR is also 2, using half of the reporting limit (acceptable practise) has resulted in an exceedance. As previously mentioned, AS 4482.1 recognises that RPD calculations may be higher for low concentrations of analytes.

7.3 Laboratory QA/QC

Internal laboratory QA/QC results are as follows:

- No holding time breaches were observed;
- No method blank outliers occurred;
- No duplicate outliers occurred; and
- No matrix spike outliers occurred.

7.4 Summary of QA/QC

The review of the laboratory and field quality assurance and quality control data indicates that the analytical data is considered to be of an adequate quality upon which to draw meaningful conclusions regarding the presence of ASS at the Site.

8. Conclusions and Recommendations of the Investigation

8.1 Conclusions

LandCorp commissioned GHD to undertake an Acid Sulfate Soil Investigation for the proposed Broome North Redevelopment, Broome.

Based upon the findings of this investigation, the following conclusions can been drawn:

- The Site is not within the boundary for ASS risk mapping (WAPC, 2009);
- The underlying geology on Site is consistent with a relatively low risk of ASS;
- The components of the acidity trail (TAA, TPA, S_{pos}) were below the laboratory limit of reporting for the majority of samples tested;
- One sample (BN15 - topsoil) exceeded the adopted criteria; and
- BN 15 contained 10 300 mol H^+/tonne ($CaCO_3$ equivalent) of ANC, pH_{KCl} of 9.5, pH_{ox} of 8.5 and a Scr value of <0.02%S.

Based on the above conclusions, a low risk of ASS materials is likely to be prevalent onsite. Additionally, as limited sampling indicated the presence of ASS materials is negligible in the adjacent high risk area, it is considered unlikely that ASS materials are present at the proposed Broome North Redevelopment area.

8.2 Recommendations

Given the findings of the investigation, it is considered that no further ASS investigations or management is likely to be required prior to earthworks being undertaken at the Broome North Redevelopment area, assuming the following:

- Materials excavated are limited to Pindan Soils; and
- Dewatering is not required.

If there is any deviation from the components described above as part of the earthworks, it is recommended that LandCorp contact GHD for further ASS advice to ensure proposed earthworks are carried out in accordance with relevant DEC guidelines.

9. References

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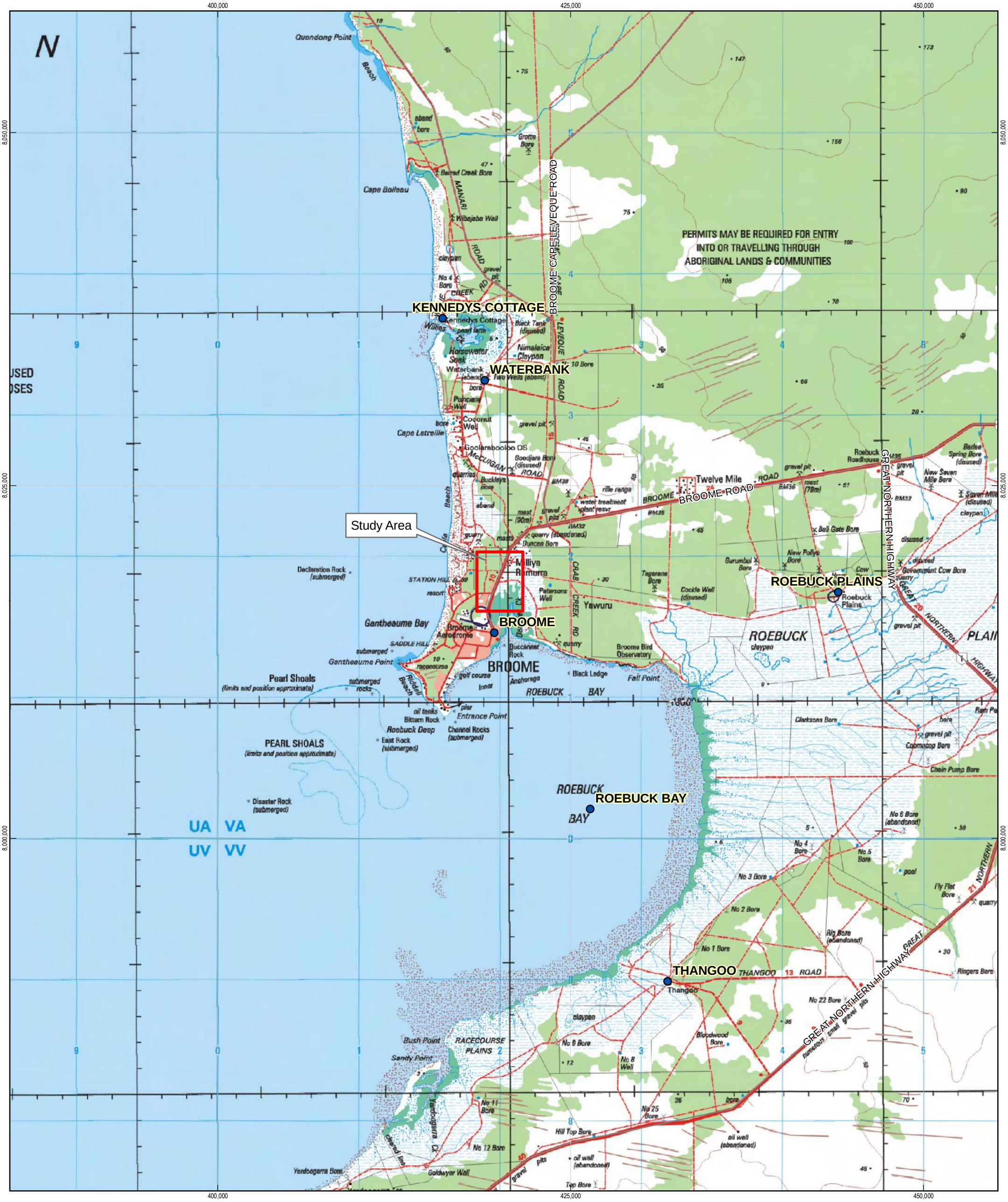

LEGEND

Roads

1:250,000(at A3)

0 2,500 5,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

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Landcorp
Broome North Redevelopment ASS Investigation

Job Number 61-24758
Revision 0
Date 10 NOV 2009

Site Location

Figure 1

G:\61\24758\MXDS\6124758_G001.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: GA: Roads - 20091112, Place Name - 20091112; Landgate: TOPO-250k - 2005. Created by: sidris

LEGEND

- Soil Sampling Location

1:10,000 (at A3)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

CLIENTS | PEOPLE | PERFORMANCE

Landcorp
Broome North Redevelopment ASS Investigation

Job Number	61-24758
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Soil Sampling Locations

Figure 2

G:\61\24758\mxds\6124758-G002.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: Landgate: Broome 3362 May 2007 Mosaic (extracted: SLIP 20091110); GHD: Soil Sampling Location - 20091109; GA: Road - 20091112 . Created by: sidris

Appendix A

Glossary

(Acid) Fizz test: The field test used for soils to test for the presence of carbonate minerals, whereby dilute hydrochloric acid is added to the soil. An effervescent fizzing reaction indicates the presence of carbonate minerals.

Acid Base Accounting (ABA): The process by which the various acid-producing components of the soil are compared with the acid neutralising components so that the soil's net acidity can be calculated.

Action criteria: The critical net acidity values (expressed in units of equivalent % pyrite sulfur, or equivalent mol H^+/t) for different soil texture groups and sizes of soil disturbance that trigger the need for ASS management.

Actual Acidity: A component of existing acidity. The soluble and exchangeable acidity already present in the soil, often as a consequence of previous oxidation of sulfides. It is this acidity that will be mobilised and discharged following a rainfall event. It is measured in the laboratory using the TAA method. It does not include the less soluble acidity (i.e. retained acidity) held in hydroxy-sulfate minerals such as jarosite.

ANC: Acid neutralising capacity. A measure of a soil's inherent ability to buffer acidity and resist the lowering of the soil pH.

ANC_{BT}: Acid neutralising capacity by back titration. Acid neutralising capacity measured by acid digest followed by back titration of the acid that has not been consumed.

ANC_E: Excess acid neutralising capacity. Found in soils with acid neutralising capacity in excess of that needed to neutralise the acidity generated by oxidation of sulfides. The soil is oxidised with peroxide, then a titration is performed with dilute hydrochloric acid to a pH of 4, followed by a second peroxide digestion. If a soil has a positive ANC_E result then the TPA result is zero and vice versa.

Ca_{HCl}: Calcium soluble in 4 M HCl, which includes soluble and exchangeable calcium as well as calcium found in certain carbonate minerals (e.g. dolomite, calcite, aragonite).

Ca_{KCl}: Potassium chloride extractable calcium measured following the TAA analysis, which includes soluble and exchangeable calcium as well as calcium from gypsum.

Ca_{NAS}: Net acid soluble calcium. The calcium soluble in 4 M HCl that is not soluble in 1 M KCl. (Ca_{HCl} – Ca_{KCl}). It can be used (in combination with Mg_{NAS}) to provide an estimate of the soil carbonate content, but may be an overestimate if calcium is dissolved from non-carbonate or non-acid-neutralising minerals.

Ca_P: Peroxide calcium. Calcium measured following the TPA analysis, which includes soluble and exchangeable calcium, calcium from gypsum, as well as calcium (e.g. from carbonates) dissolved as a result of acid produced due to oxidation of sulfides by peroxide.

Chromium Suite: The acid base accounting approach used to calculate net acidity which uses the chromium reducible sulfur method to determine potential sulfidic acidity. A decision tree approach based on the pH_{KCl} result is then used to determine the other components of the acid base account. C_{IN}: Inorganic carbon. (C_T – C_{TO}). It is used to estimate the carbonate content of the soil.

CRS: The acronym often given to the Chromium Reducible Sulfur method.

C_T: Total carbon. A measure of the total carbon content of the soil, encompassing both organic and inorganic forms.

C_{TO}: Total organic carbon. The carbon in sample measured following a sulfurous acid digestion procedure used to remove carbonate carbon.

Existing Acidity: The acidity already present in acid sulfate soils, usually as a result of oxidation of sulfides, but which can also be from organic material or acidic cations. It can be further sub-divided into actual and retained acidity, i.e. Existing Acidity = Actual Acidity + Retained Acidity.

Fineness factor: A factor applied to the acid neutralising capacity result in the acid base account to allow for the poor reactivity of coarser carbonate or other acid neutralising material. The minimum factor is 1.5 for finely divided pure agricultural lime, but may be as high as 3.0 for coarser shell material.

Jarosite: Jarosite is a characteristic pale yellow mineral deposit that can precipitate as pore fillings and coatings on fissures. Where there is a fluctuating watertable, jarosite may be found along cracks and root channels in the soil. However, jarosite is not always found in AASS.

Mg_A: Reacted magnesium. The magnesium soluble after the peroxide digest and TPA titration that was not soluble following KCl-extraction and TAA titration. (Mg_P – Mg_{KCl}). It can be used (in combination with Ca_A) to provide an estimate of the soil carbonate content, but may be an underestimate if the HCl-titration to pH 4 has not been performed as part of the TPA/ANC_E procedure.

Mg_{HCl}: Magnesium soluble in 4 M HCl, which includes soluble and exchangeable magnesium as well as magnesium found in certain carbonate minerals (e.g. dolomite, magnesite).

Mg_{KCl}: Potassium chloride extractable magnesium measured following the TAA analysis, which includes soluble and exchangeable magnesium.

Mg_{NAS}: Net acid soluble magnesium. The calcium soluble in 4 M HCl that is not soluble in 1 M KCl. (Mg_{HCl} – Mg_{KCl}). It can be used (in combination with Ca_{NAS}) to provide an estimate of the soil carbonate content, but may be an overestimate if magnesium is dissolved from noncarbonated or non-acid-neutralising minerals.

Mg_P: Peroxide magnesium. Magnesium measured following the TPA analysis, which includes soluble and exchangeable magnesium, as well as magnesium (e.g. from carbonates) dissolved as a result of acid produced due to oxidation of sulfides by peroxide.

Monosulfides: The term given to the highly reactive iron sulfide minerals found in ASS that have the approximate formula 'FeS' and which are soluble in hydrochloric acid (as opposed to iron disulfides such as pyrite that are not appreciably soluble in hydrochloric acid).

Monosulfidic Black Ooze (MBO): The term used to describe black, oily in appearance, gel-like substances (moisture content >70%), greatly enriched in monosulfides (up to 27%), high in organic matter (usually 10% organic carbon) and can form thick (>1.0m) accumulations in waterways, including drains, in acid sulfate soil landscapes.

Net Acidity: The result obtained when the values for various components of soil acidity and acid neutralising capacity are substituted into the Acid Base Accounting equation. Calculated as:

Net Acidity = Potential Sulfidic Acidity + Existing Acidity – (Acid Neutralising Capacity/Fineness Factor)

pH_F: Field pH. Field determination of pH in a soil: water paste.

pH_{FOX}: Field peroxide pH. Field determination of pH in a soil:water mixture following reaction with hydrogen peroxide.

pH_{KCl}: Potassium chloride pH. pH in a 1:40 (W/V) suspension of soil in a solution of 1 M potassium chloride measured prior to TAA titration.

pH_{ox}: Peroxide oxidised pH. pH in a suspension of soil in a solution after hydrogen peroxide digestion in the SPOCAS method.

POCAS: An acronym standing for Peroxide Oxidation Combined Acidity and Sulfate method (Method Code 21). This method has been superseded by the SPOCAS method.

POCASm: An acronym standing for the modified Peroxide Oxidation Combined Acidity and Sulfate method. This method has been superseded by the SPOCAS method.

Potential (sulfidic) acidity: The latent acidity in ASS that will be released if the sulfide minerals they contain (e.g. pyrite) are fully oxidised. It can be estimated by titration (i.e. TSA) if no acid neutralising material is present, or calculated from S_{POS} or S_{CR} results.

Retained Acidity: The 'less available' fraction of the existing acidity (not measured by the TAA) that may be released slowly into the environment by hydrolysis of relatively insoluble sulfate salts (such as jarosite, natrojarosite, and other iron and aluminium hydroxy-sulfate minerals).

S_{CR}: The symbol given to the result from the Chromium Reducible Sulfur method (Method 22B). The S_{CR} method provides a measure of reduced inorganic sulfide content using iodometric titration after an acidic chromous chloride reduction. This method is not subject to interferences from organic sulfur.

S_{HCl}: Sulfur soluble in 4 M HCl which includes soluble and adsorbed sulfate, sulfate from gypsum, as well as sulfate from hydroxy-sulfate minerals such as jarosite and natrojarosite.

S_{KCl}: Potassium chloride extractable sulfur measured following the TAA analysis, which includes soluble and adsorbed sulfate as well as sulfate from gypsum.

S_{NAS}: Net acid soluble sulfur ($S_{HCl} – S_{KCl}$). The sulfur soluble in 4 M HCl that is not soluble in 1 M KCl. It provides an estimate of the sulfate contained in jarosite and similar low solubility hydroxy-sulfate minerals (and can be used to estimate retained acidity).

S_P: Peroxide sulfur. Sulfur measured following the TPA analysis, which includes soluble and exchangeable sulfate, sulfate from gypsum, as well as sulfide converted to sulfate and that released from organic matter as a result of peroxide oxidation.

S_{POS}: Peroxide oxidisable sulfur from the SPOCAS method. The sulfur soluble after the peroxide digest and TPA titration that was not soluble following KCl-extraction and TAA titration. ($S_P – S_{KCl}$). It provides an estimate of the soil sulfide content, but is affected by the presence of organic sulfur.

S_{RAS}: Residual acid soluble sulfur. The sulfur measured by 4 M HCl extraction on the soil residue remaining after peroxide digestion and TPA titration of the SPOCAS method. It provides an estimate of the sulfate contained in jarosite and similar low solubility hydroxy-sulfate minerals (and can be used to estimate retained acidity).

S_T: Total sulfur. A measure of the total sulfur content of the soil, encompassing both organic and inorganic forms.

S_{TOS}: Total oxidisable sulfur. An estimate of soil oxidisable sulfur made from determining the sulfur not soluble in 4 M HCl. ($S_T – S_{HCl}$). It tends to provide an overestimate of soil sulfide content.

Self-neutralising soils: This term is given to ASS where there is sufficient acid neutralising capacity (with the relevant safety factor applied) to neutralise the potential sulfidic acidity held in the soil (i.e. the net acidity from the Acid Base Account is zero or negative). Soils may be 'self-neutralising' due to an abundance of naturally occurring calcium or magnesium carbonates (e.g. crushed shells, marine animal exoskeletons, coral) or other acid-neutralising material.

SPOCAS: An acronym standing for Suspension Peroxide Oxidation Combined Acidity and Sulfur method (Method Code 23), the peroxide-based method that supersedes the previous POCAS and POCASm methods.

SPOCAS Suite: The acid base accounting approached used to calculate net acidity based on the Suspension Peroxide Oxidation Combined Acidity and Sulfur method. A decision tree approach based on the values of pH_{KCl} and pH_{OX} is used to decide what analytical path is followed in order to allow calculation of net acidity.

TAA: Titratable actual acidity. The acidity measured by titration with dilute NaOH following extraction with KCl-solution in the SPOCAS method. Previously referred to as Total Actual Acidity in the POCAS and POCASm methods.

TPA: Titratable peroxide acidity. The acidity measured by titration with dilute NaOH following peroxide digestion in the SPOCAS method. Previously referred to as Total Potential Acidity in the POCAS and POCASm methods.

TSA: Titratable sulfidic acidity. The difference in acidity measured by titration with dilute NaOH following extraction with KCl-solution and the acidity titrated following peroxide digestion in the SPOCAS method. (TPA – TAA). Previously referred to as Total Sulfidic Acidity in the POCAS and POCASm methods.

Appendix B

Soil Bore Logs

Location	Sample ID		Geology	Date
	From (m)	To (m)		
RB1	0	0.5	Buff to pale yellow sandy clay, very fine, medium plasticity, moderately graded, 2% iron staining	6-7 Nov 09
	0.5	1	Buff to pale yellow sandy clay, very fine, medium plasticity, moderately graded, 10% iron staining	
RB2	0	0.75	Buff to pale yellow sandy clay, very fine, medium plasticity, moderately sorted, 2% iron staining	6-7 Nov 09
	0.75	1	Buff to pale yellow sandy clay, very fine, high plasticity, moderately graded, 15% iron staining	
RB3	0	0.25	Brown sandy clay, very fine, medium plasticity, red mottling, moderately graded	6-7 Nov 09
	0.25	1	Grey sandy clay, very fine, high plasticity	
RB4	0	0.25	Buff to pale yellow sandy clay, very fine, medium plasticity, moderately graded	6-7 Nov 09
	0.5	0.75	As above, jarosite present	
	0.75	1	Buff to pale yellow sandy clay, very fine, high plasticity, well graded, signficant calcareous fragments	
RB5	0	1	Buff to pale yellow sandy clay, very fine, high plasticity, well graded, jarosite present	6-7 Nov 09

Location	Sample ID		Geology	Date
	From (m)	To (m)		
BN1	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN2	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN3	0	1	Red fine to medium grained sand, uniformly graded 10% organic matter	6-7 Nov 09
BN4	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN5	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN6	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN7	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN8	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN9	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN10	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN11	0	1	Red fine to medium grained sand, uniformly graded	6-7 Nov 09
BN12	0	0.3	Red clayey sand, low plasticity, moderately graded	6-7 Nov 09
	0.3	1	Red fine to medium grained sand, uniformly graded	
BN13	0	0.25	Red clayey sand, low plasticity, moderately graded	6-7 Nov 09
	0.25	1	Red fine to medium grained sand, slightly cemented, uniformly graded	
BN14	0	1	Red fine to medium grained sand, uniformly graded, 10% organic matter	6-7 Nov 09
BN15	0	1	Red fine to medium grained sand, uniformly graded, 15% organic matter	6-7 Nov 09

Appendix C

Laboratory Certificates

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0906175**	Page	: 1 of 19
Client	: **LANDCORP**	Laboratory	: Environmental Division Perth
Contact	: SHAUN WONG	Contact	: Michael Sharp
Address	: Level 3, 40 The Esplanade PERTH WA, Australia 6832	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: shaun.wong@ghd.com	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: 7453-7459	Date Samples Received	: 28-OCT-2009
Sampler	: SHAUN WONG	Issue Date	: 29-OCT-2009
Site	: LandCorp Broome North		
		No. of samples received	: 83
Quote number	: ----	No. of samples analysed	: 83

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Tenae Madden	Acid Sulphate Soils - Production Coordinator	Perth ASS

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ASS Field Screening: NATA accreditation does not cover performance of this service.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	RB1 0-0.25	RB1 0.25-0.5	RB1 0.5-0.75	RB1 0.75-1.0	RB2 0-0.25
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-001	EP0906175-002	EP0906175-003	EP0906175-004	EP0906175-005
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**8.5**	**8.2**	**8.4**	**8.4**	**8.8**
pH (Fox)	----	0.1	pH Unit		**6.3**	**6.2**	**6.2**	**6.3**	**6.3**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	RB2 0.25-0.5	RB2 0.5-0.75	RB2 0.75-1.0	RB3 0-0.25	RB3 0.25-0.5
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-006	EP0906175-007	EP0906175-008	EP0906175-009	EP0906175-010
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**8.4**	**7.9**	**8.3**	**8.3**	**8.4**
pH (Fox)	----	0.1	pH Unit		**6.3**	**6.3**	**6.4**	**6.4**	**6.3**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	RB3 0.5-0.75	RB3 0.75-1.0	RB4 0-0.25	RB4 0.25-0.5	RB4 0.5-0.75
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-011	EP0906175-012	EP0906175-013	EP0906175-014	EP0906175-015
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**8.4**	**8.6**	**8.6**	**8.7**	**8.6**
pH (Fox)	----	0.1	pH Unit		**6.4**	**6.4**	**6.3**	**6.4**	**6.3**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	RB4 0.75-1.0	RB5 0-0.25	RB5 0.25-0.5	RB5 0.5-0.75	RB5 0.75-1.0
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-016	EP0906175-017	EP0906175-018	EP0906175-019	EP0906175-020
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**8.5**	**8.4**	**8.4**	**8.3**	**8.4**
pH (Fox)	----	0.1	pH Unit		**6.3**	**6.2**	**6.3**	**6.3**	**6.4**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN1 0-0.25	BN1 0.25-0.5	BN1 0.5-0.75	BN1 0.75-1.0	BN2 0-0.25
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-021	EP0906175-022	EP0906175-023	EP0906175-024	EP0906175-025
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.9**	**7.8**	**7.6**	**7.3**	**7.6**
pH (Fox)	----	0.1	pH Unit		**5.7**	**5.6**	**6.2**	**5.6**	**5.7**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN2 0.25-0.5	BN2 0.5-0.75	BN2 0.75-1.0	BN3 0-0.25	BN3 0.25-0.5
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-026	EP0906175-027	EP0906175-028	EP0906175-029	EP0906175-030
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.5**	**7.5**	**7.4**	**7.2**	**7.0**
pH (Fox)	----	0.1	pH Unit		**5.6**	**5.6**	**5.6**	**5.4**	**5.5**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Moderate**	**Moderate**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN3 0.5-0.75	BN3 0.75-1.0	BN4 0-0.25	BN4 0.25-0.5	BN4 0.5-0.75
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-031	EP0906175-032	EP0906175-033	EP0906175-034	EP0906175-035
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.0**	**7.4**	**6.9**	**6.9**	**7.2**
pH (Fox)	----	0.1	pH Unit		**5.4**	**5.5**	**5.4**	**5.6**	**5.6**
Reaction Rate	----	1	-		**Moderate**	**Moderate**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN4 0.75-1.0	BN5 0-0.25	BN5 0.25-0.5	BN5 0.5-0.75	BN5 0.75-1.0
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-036	EP0906175-037	EP0906175-038	EP0906175-039	EP0906175-040
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.3**	**7.2**	**6.8**	**6.7**	**7.4**
pH (Fox)	----	0.1	pH Unit		**5.6**	**5.5**	**5.5**	**5.4**	**5.7**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN6 0-0.25	BN6 0.25-0.5	BN6 0.5-0.75	BN6 0.75-1.0	BN7 0-0.25
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-041	EP0906175-042	EP0906175-043	EP0906175-044	EP0906175-045
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.3**	**6.7**	**7.0**	**7.5**	**6.8**
pH (Fox)	----	0.1	pH Unit		**5.4**	**5.5**	**5.5**	**5.5**	**5.4**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: SOIL	Client sample ID	BN7 0.25-0.5	BN7 0.5-0.75	BN7 0.75-1.0	BN8 0-0.25	BN8 0.25-0.5
	Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
Compound / CAS Number / LOR / Unit		EP0906175-046	EP0906175-047	EP0906175-048	EP0906175-049	EP0906175-050
EA037: Ass Field Screening Analysis						
pH (F) ---- 0.1 pH Unit		**7.0**	**7.0**	**7.3**	**7.0**	**6.5**
pH (Fox) ---- 0.1 pH Unit		**5.4**	**5.3**	**5.4**	**5.4**	**5.3**
Reaction Rate ---- 1 -		**Slight**	**Slight**	**Slight**	**Slight**	**Moderate**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN8 0.5-0.75	BN8 0.75-1.0	BN9 0-0.25	BN9 0.25-0.5	BN9 0.5-0.75
				Client sampling date / time: 26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906175-051	EP0906175-052	EP0906175-053	EP0906175-054	EP0906175-055
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.0**	**7.0**	**7.0**	**6.8**	**6.6**
pH (Fox)	----	0.1	pH Unit	**5.4**	**5.3**	**5.6**	**5.2**	**5.3**
Reaction Rate	----	1	-	**Moderate**	**Slight**	**Moderate**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN9 0.75-1.0	BN10 0-0.25	BN10 0.25-0.5	BN10 0.5-0.75	BN10 0.75-1.0
				Client sampling date / time: 26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906175-056	EP0906175-057	EP0906175-058	EP0906175-059	EP0906175-060
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.9**	**6.8**	**6.7**	**6.9**	**7.1**
pH (Fox)	----	0.1	pH Unit	**5.3**	**5.4**	**5.3**	**5.4**	**5.4**
Reaction Rate	----	1	-	**Slight**	**Moderate**	**Moderate**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN11 0-0.25	BN11 0.25-0.5	BN11 0.5-0.75	BN11 0.75-1.0	BN12 0-0.25
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-061	EP0906175-062	EP0906175-063	EP0906175-064	EP0906175-065
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.0**	**6.8**	**7.0**	**7.0**	**7.4**
pH (Fox)	----	0.1	pH Unit		**5.2**	**5.3**	**5.4**	**5.3**	**5.4**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN12 0.25-0.5	BN12 0.5-0.75	BN12 0.75-1.0	BN13 0-0.25	BN13 0.25-0.5
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-066	EP0906175-067	EP0906175-068	EP0906175-069	EP0906175-070
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.5**	**7.4**	**7.5**	**7.2**	**7.3**
pH (Fox)	----	0.1	pH Unit		**5.3**	**5.3**	**5.6**	**5.4**	**5.4**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN13 0.5-0.75	BN13 0.75-1.0	BN14 0-0.25	BN14 0.25-0.5	BN14 0.5-0.75
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906175-071	EP0906175-072	EP0906175-073	EP0906175-074	EP0906175-075
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.3**	**7.3**	**7.1**	**7.3**	**7.0**
pH (Fox)	----	0.1	pH Unit		**5.3**	**5.3**	**5.4**	**5.4**	**5.4**
Reaction Rate	----	1	-		**Slight**	**Slight**	**Slight**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN14 0.75-1.0	BN15 0-0.25	BN15 0.25-0.5	BN15 0.75-1.0	QC1
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906175-076	EP0906175-077	EP0906175-078	EP0906175-079	EP0906175-080
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.2**	**6.6**	**6.0**	**6.3**	**8.0**
pH (Fox)	----	0.1	pH Unit	**5.4**	**5.3**	**5.2**	**5.2**	**6.1**
Reaction Rate	----	1	-	**Slight**	**Moderate**	**Moderate**	**Slight**	**Slight**

Analytical Results

Sub-Matrix: SOIL	Client sample ID	QC2	QC3	QC4	----	----
	Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	----	----
Compound	CAS Number / LOR / Unit	EP0906175-081	EP0906175-082	EP0906175-083	----	----
EA037: Ass Field Screening Analysis						
pH (F)	---- / 0.1 / pH Unit	**6.9**	**7.3**	**6.8**	----	----
pH (Fox)	---- / 0.1 / pH Unit	**5.4**	**5.4**	**5.3**	----	----
Reaction Rate	---- / 1 / -	**Moderate**	**Slight**	**Moderate**	----	----

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0906266**	Page	: 1 of 17
Amendment	: **1**		
Client	: **LANDCORP**	Laboratory	: Environmental Division Perth
Contact	: SHAUN WONG	Contact	: Michael Sharp
Address	: Level 3, 40 The Esplanade PERTH WA, Australia 6832	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: shaun.wong@ghd.com	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Ex EP0906175 6124758	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 30-OCT-2009
Sampler	: ----	Issue Date	: 09-NOV-2009
Site	: ----		
		No. of samples received	: 33
Quote number	: ----	No. of samples analysed	: 33

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Stacey Hawkins	Senior Chemist - Acid Sulphate Soils	Perth ASS

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.**
- **Retained Acidity not required because pH KCl greater than or equal to 4.5**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: RB1 0.5-0.75	RB2 0-0.25	RB2 0.75-1.0	RB3 0.25-0.5	RB4 0.75-1.0
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-001	EP0906266-002	EP0906266-003	EP0906266-004	EP0906266-005
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	----	<0.02	----	<0.02	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**9.3**	**9.5**	**9.2**	**9.5**	**9.4**
pH OX (23B)	----	0.1	pH Unit	**7.9**	**8.1**	**8.3**	**8.3**	**8.5**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	**0.02**	**0.02**	**0.03**	**0.06**	**0.06**
Peroxide Sulfur (23De)	----	0.02	% S	**0.02**	**0.04**	**0.04**	**0.16**	**0.14**
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	<0.02	**0.10**	**0.08**
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	**59**	**52**
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	**0.20**	**0.19**	**0.24**	**0.24**	**0.26**
Peroxide Calcium (23Wh)	----	0.02	% Ca	**1.75**	**5.53**	**5.25**	**22.3**	**21.1**
Acid Reacted Calcium (23X)	----	0.02	% Ca	**1.55**	**5.34**	**5.01**	**22.0**	**20.8**
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**773**	**2660**	**2500**	**11000**	**10400**
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	**1.24**	**4.27**	**4.01**	**17.6**	**16.7**
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	**0.03**	**0.03**	**0.04**	**0.08**	**0.07**
Peroxide Magnesium (23Tm)	----	0.02	% Mg	**0.07**	**0.14**	**0.12**	**0.74**	**0.82**
Acid Reacted Magnesium (23U)	----	0.02	% Mg	**0.04**	**0.11**	**0.07**	**0.66**	**0.74**
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	**30**	**92**	**60**	**543**	**613**
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	**0.05**	**0.15**	**0.10**	**0.87**	**0.98**
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	**4.26**	**13.0**	**12.5**	**57.0**	**53.7**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	**852**	**2590**	**2500**	**11400**	**10700**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: RB1 0.5-0.75	RB2 0-0.25	RB2 0.75-1.0	RB3 0.25-0.5	RB4 0.75-1.0
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-001	EP0906266-002	EP0906266-003	EP0906266-004	EP0906266-005
EA029-F: Excess Acid Neutralising Capacity - Continued								
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	**1.36**	**4.15**	**4.00**	**18.2**	**17.2**
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**0.10**	**0.08**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	**59**	**52**
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	**4**	**4**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: RB5 0-0.25	RB5 0.75-1.0	BN1 0.25-0.5	BN1 0.75-1.0	BN2 0-0.25
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-006	EP0906266-007	EP0906266-008	EP0906266-009	EP0906266-010
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	----	----	----	----	<0.02
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**9.4**	**9.5**	**9.2**	**9.1**	**9.3**
pH OX (23B)	----	0.1	pH Unit	**8.0**	**8.4**	**8.2**	**8.1**	**8.2**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	**0.07**	**0.08**	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S	**0.17**	**0.19**	<0.02	<0.02	<0.02
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	**0.10**	**0.11**	<0.02	<0.02	<0.02
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	**63**	**70**	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	**0.27**	**0.28**	**0.17**	**0.19**	**0.17**
Peroxide Calcium (23Wh)	----	0.02	% Ca	**23.6**	**26.5**	**1.08**	**0.99**	**1.06**
Acid Reacted Calcium (23X)	----	0.02	% Ca	**23.3**	**26.2**	**0.91**	**0.80**	**0.89**
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**11600**	**13100**	**455**	**400**	**444**
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	**18.6**	**21.0**	**0.73**	**0.64**	**0.71**
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	**0.09**	**0.09**	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg	**0.91**	**0.90**	**0.04**	**0.04**	**0.04**
Acid Reacted Magnesium (23U)	----	0.02	% Mg	**0.82**	**0.82**	**0.03**	**0.03**	**0.03**
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	**676**	**672**	**23**	**24**	**23**
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	**1.08**	**1.08**	**0.04**	**0.04**	**0.04**
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	**57.4**	**624**	**1.65**	**2.31**	**2.50**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	**11400**	**125000**	**330**	**461**	**499**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: RB5 0-0.25	RB5 0.75-1.0	BN1 0.25-0.5	BN1 0.75-1.0	BN2 0-0.25
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-006	EP0906266-007	EP0906266-008	EP0906266-009	EP0906266-010
EA029-F: Excess Acid Neutralising Capacity - Continued								
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	**18.4**	**200**	**0.53**	**0.74**	**0.80**
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.10**	**0.11**	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**63**	**70**	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	**5**	**5**	<1	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN3 0.5-0.75	BN3 0.75-1.0	BN4 0.5-0.75	BN5 0.75-1.0	BN6 0.25-0.5
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-011	EP0906266-012	EP0906266-013	EP0906266-014	EP0906266-015
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	----	<0.02	----	<0.02	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**8.3**	**8.8**	**8.8**	**6.6**	**8.8**
pH OX (23B)	----	0.1	pH Unit	**6.7**	**7.2**	**7.6**	**6.1**	**7.6**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	**0.14**	**0.12**	**0.20**	**0.05**	**0.16**
Peroxide Calcium (23Wh)	----	0.02	% Ca	**0.16**	**0.13**	**0.35**	**0.05**	**0.23**
Acid Reacted Calcium (23X)	----	0.02	% Ca	**0.03**	<0.02	**0.15**	<0.02	**0.07**
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**13**	<10	**73**	<10	**36**
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	**0.02**	<0.02	**0.12**	<0.02	**0.06**
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	**0.24**	**0.20**	**0.78**	----	**0.54**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	**49**	**40**	**155**	----	**107**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN3 0.5-0.75	BN3 0.75-1.0	BN4 0.5-0.75	BN5 0.75-1.0	BN6 0.25-0.5
			Client sampling date / time:	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-011	EP0906266-012	EP0906266-013	EP0906266-014	EP0906266-015
EA029-F: Excess Acid Neutralising Capacity - Continued								
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	**0.08**	**0.06**	**0.25**	----	**0.17**
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN6 0.75-1.0	BN7 0.75-1.0	BN8 0.25-0.5	BN8 0.75-1.0	BN9 0.75-1.0
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906266-016	EP0906266-017	EP0906266-018	EP0906266-019	EP0906266-020
EA026 : Chromium Reducible Sulphur									
Chromium Reducible Sulphur	----	0.02	%		----	----	<0.02	----	----
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit		**7.0**	**8.5**	**6.7**	**6.6**	**6.6**
pH OX (23B)	----	0.1	pH Unit		**6.0**	**7.2**	**5.8**	**5.8**	**5.8**
EA029-B: Acidity Trail									
Titratable Actual Acidity (23F)	----	2	mole H+ / t		<2	<2	<2	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t		<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t		<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t		<10	<10	<10	<10	<10
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.02	% Ca		**0.06**	**0.14**	**0.03**	**0.03**	**0.03**
Peroxide Calcium (23Wh)	----	0.02	% Ca		**0.07**	**0.14**	**0.03**	**0.03**	**0.04**
Acid Reacted Calcium (23X)	----	0.02	% Ca		<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t		<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg		<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg		<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Magnesium (23U)	----	0.02	% Mg		<0.02	<0.02	<0.02	<0.02	<0.02
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t		<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
EA029-F: Excess Acid Neutralising Capacity									
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3		----	**0.34**	----	----	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t		----	**67**	----	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN6 0.75-1.0	BN7 0.75-1.0	BN8 0.25-0.5	BN8 0.75-1.0	BN9 0.75-1.0
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-016	EP0906266-017	EP0906266-018	EP0906266-019	EP0906266-020
EA029-F: Excess Acid Neutralising Capacity - Continued								
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	----	**0.11**	----	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN10 0.25-0.5	BN10 0.75-1.0	BN11 0.5-0.75	BN12 0.25-0.5	BN12 0.75-1.0
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-021	EP0906266-022	EP0906266-023	EP0906266-024	EP0906266-025
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	<0.02	----	----	----	<0.02
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**5.8**	**6.1**	**5.8**	**5.6**	**5.7**
pH OX (23B)	----	0.1	pH Unit	**5.2**	**5.7**	**5.4**	**5.5**	**5.7**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**2**	<2	**2**	**3**	**2**
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**2**	<2	**2**	**5**	**6**
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	**3**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.02	**0.03**	**0.02**	**0.02**	**0.03**
Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.02	**0.03**	**0.02**	**0.02**	**0.03**
Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BN10 0.25-0.5	BN10 0.75-1.0	BN11 0.5-0.75	BN12 0.25-0.5	BN12 0.75-1.0
				Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
					EP0906266-021	EP0906266-022	EP0906266-023	EP0906266-024	EP0906266-025
EA029-H: Acid Base Accounting - Continued									
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN13 0.25-0.5	BN13 0.75-1.0	BN14 0.25-0.5	BN14 0.75-1.0	BN15 0-0.25
				Client sampling date / time: 26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-026	EP0906266-027	EP0906266-028	EP0906266-029	EP0906266-030
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	<0.02	----	----	----	<0.02
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**5.6**	**5.5**	**6.1**	**5.7**	**9.5**
pH OX (23B)	----	0.1	pH Unit	**5.6**	**5.7**	**5.4**	**5.4**	**8.0**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**4**	**3**	<2	**2**	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**6**	**11**	<2	**4**	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	**2**	**7**	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**0.06**
Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**0.14**
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**0.08**
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	**52**
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	**0.02**	**0.03**	**0.03**	<0.02	**0.24**
Peroxide Calcium (23Wh)	----	0.02	% Ca	**0.02**	**0.02**	**0.02**	<0.02	**20.9**
Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.02	<0.02	<0.02	<0.02	**20.7**
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	<10	<10	**10300**
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**16.6**
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	**0.06**
Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	**0.76**
Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	**0.70**
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	**580**
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**0.93**
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	----	----	----	----	**51.7**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	----	----	----	**10300**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN13 0.25-0.5	BN13 0.75-1.0	BN14 0.25-0.5	BN14 0.75-1.0	BN15 0-0.25
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00
				EP0906266-026	EP0906266-027	EP0906266-028	EP0906266-029	EP0906266-030
EA029-F: Excess Acid Neutralising Capacity - Continued								
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	----	----	----	----	**16.6**
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**0.08**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	**52**
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	**4**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN15 0.75-1.0	QC1	QC2	----	----
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	----	----
				EP0906266-031	EP0906266-032	EP0906266-033	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**6.4**	**5.6**	**9.1**	----	----
pH OX (23B)	----	0.1	pH Unit	**5.2**	**5.6**	**8.4**	----	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	**2**	<2	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	**7**	<2	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	**5**	<2	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	----	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	----	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	**0.06**	<0.02	**0.18**	----	----
Peroxide Calcium (23Wh)	----	0.02	% Ca	**0.09**	<0.02	**0.68**	----	----
Acid Reacted Calcium (23X)	----	0.02	% Ca	**0.03**	<0.02	**0.51**	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**16**	<10	**253**	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	**0.03**	<0.02	**0.40**	----	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	<0.02	----	----
Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	**0.03**	----	----
Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	<0.02	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	**12**	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	**0.02**	----	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	----	----	**1.56**	----	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	----	**311**	----	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	----	----	**0.50**	----	----
EA029-H: Acid Base Accounting								

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BN15 0.75-1.0	QC1	QC2	----	----
			Client sampling date / time	26-OCT-2009 15:00	26-OCT-2009 15:00	26-OCT-2009 15:00	----	----
				EP0906266-031	EP0906266-032	EP0906266-033	----	----
EA029-H: Acid Base Accounting - Continued								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	----	----

Appendix D

Acid Sulfate Soil Summary Table

61/24758 Broome North Redevelopment Acid Sulfate Soil Investigation

Acid Sulfate Soil Summary Table

Sample Description				Field Test Results				Lab pH		Acidity									Calculations	
		Lithology																		
Location	Sample Depth	Soil Colour	Field Texture	pH_F	pH_{FOX}	Reaction	ΔpH	pH_{KCl}	pH_{OX}	TAA	POS	TSA	s-TAA	s-TPA	s-TSA	S_{POS}	Scr	ANC	Net Acidity	Net Acidity
				pH Unit			-	pH Unit		mole H+ / t			% pyrite S					mol H+/t	% S	mol H+/t
				0.01	0.01	-	0.01	0.1	0.1	2	10	10	0.02	0.02	0.02	0.02	0.02	10	0.02	NA
				<4	<4	-	>2	<4	<4	>18.7	>18.7	>18.7	>0.03	>0.03	>0.03	>0.03	>0.03	NA	>0.03	>18.7
RB1	0.25	Buff to Pale Yellow	Sandy Clay	8.5	6.3	Slight	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
RB1	0.5			8.2	6.2	Slight	2	-	-	-	-	-	-	-	-	-	-	-	-	-
RB1	0.75			8.4	6.2	Slight	2.2	9.3	7.9	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	852	<0.02	<10
RB1	1			8.4	6.3	Slight	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
RB2	0.25	Buff to Pale Yellow	Sandy Clay	8.8	6.3	Slight	2.5	9.5	8.1	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	2590	<0.02	<10
RB2	0.5			8.4	6.3	Slight	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
RB2	0.75			7.9	6.3	Slight	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
RB2	1			8.3	6.4	Slight	1.9	9.2	8.3	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	2500	<0.02	<10
RB3	0.25	Brown	Sandy Clay	8.3	6.4	Slight	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
RB3	0.5			8.4	6.3	Slight	2.1	8.3	8.3	<2	59	<2	<0.02	<0.02	<0.02	0.1	<0.02	11400	0.1	59
RB3	0.75			8.4	6.4	Slight	2	-	-	-	-	-	-	-	-	-	-	-	-	-
RB3	1	Grey		8.6	6.4	Slight	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
RB4	0.25	Buff to Pale Yellow	Sandy Clay	8.6	6.3	Slight	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-
RB4	0.5			8.7	6.4	Slight	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-
RB4	0.75			8.6	6.3	Slight	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-
RB4	1			8.5	6.3	Slight	2.2	9.4	8.5	<2	52	<2	<0.02	<0.02	<0.02	0.08	-	10700	0.08	52
RB5	0.25	Buff to Pale Yellow	Sandy Clay	8.4	6.2	Slight	2.2	9.4	8	<2	63	<2	<0.02	<0.02	<0.02	0.1	-	11400	0.1	63
RB5	0.5			8.4	6.3	Slight	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
RB5	0.75			8.3	6.3	Slight	2	-	-	-	-	-	-	-	-	-	-	-	-	-
RB5	1			8.4	6.4	Slight	2	9.5	8.4	<2	70	<2	<0.02	<0.02	<0.02	0.11	-	125000	0.1	70
BN1	0.25	Red	Sand	7.9	5.7	Slight	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
BN1	0.5			7.8	5.6	Slight	2.2	9.2	8.2	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	330	<0.02	<10
BN1	0.75			7.6	6.2	Slight	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-
BN1	1			7.3	5.6	Slight	1.7	9.1	8.1	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	461	<0.02	<10
BN2	0.25	Red	Sand	7.6	5.7	Slight	1.9	9.3	8.2	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	499	<0.02	<10
BN2	0.5			7.5	5.6	Slight	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
BN2	0.75			7.5	5.6	Slight	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
BN2	1			7.4	5.6	Slight	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BN3	0.25	Red	Sand	7.2	5.4	Moderate	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BN3	0.5			7	5.5	Moderate	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
BN3	0.75			7	5.4	Moderate	1.6	8.3	6.7	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	49	<0.02	<10
BN3	1			7.4	5.5	Moderate	1.9	8.8	7.2	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	40	<0.02	<10
BN4	0.25	Red	Sand	6.9	5.4	Slight	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
BN4	0.5			6.9	5.6	Slight	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BN4	0.75			7.2	5.6	Slight	1.6	8.8	7.6	<2	<10	<2	<0.02	<0.02	<0.02	<0.02		155	<0.02	<10
BN4	1			7.3	5.6	Slight	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BN5	0.25	Red	Sand	7.2	5.5	Slight	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BN5	0.5			6.8	5.5	Slight	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BN5	0.75			6.7	5.4	Slight	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BN5	1			7.4	5.7	Slight	1.7	6.6	6.1	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<10

Sample Description				Field Test Results				Lab pH		Acidity									Calculations	
		Lithology																		
Location	Sample Depth	Soil Colour	Field Texture	pH_F	pH_{FOX}	Reaction	ΔpH	pH_{KCl}	pH_{OX}	TAA	POS	TSA	s-TAA	s-TPA	s-TSA	S_{POS}	Scr	ANC	Net Acidity	Net Acidity
				pH Unit			-	*pH Unit*		*mole H+ / t*			*% pyrite S*					*mol H+/t*	*% S*	*mol H+/t*
				0.01	0.01	-	0.01	0.1	0.1	2	10	10	0.02	0.02	0.02	0.02	0.02	10	0.02	NA
				<4	**<4**	**-**	**>2**	**<4**	**<4**	**>18.7**	**>18.7**	**>18.7**	**>0.03**	**>0.03**	**>0.03**	**>0.03**	**>0.03**	**NA**	**>0.03**	**>18.7**
BN6	0.25	Red	Sand	7.3	5.4	Slight	1.9	8.8	7.6	<2	<10	<2	<0.02	<0.02	<0.02	<0.02		107	<0.02	<10
BN6	0.5			6.7	5.5	Slight	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-
BN6	0.75			7	5.5	Slight	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
BN6	1			7.5	5.5	Slight	2.0	7	6	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN7	0.25	Red	Sand	6.8	5.4	Slight	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-
BN7	0.5			7	5.4	Slight	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
BN7	0.75			7	5.3	Slight	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BN7	1			7.3	5.4	Slight	1.9	8.5	7.2	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	67	<0.02	<10
BN8	0.25	Red	Sand	7	5.4	Slight	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
BN8	0.5			6.5	5.3	Moderate	1.2	6.7	5.8	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<10
BN8	0.75			7	5.4	Moderate	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
BN8	1			7	5.3	Slight	1.7	6.6	5.8	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN9	0.25	Red	Sand	7	5.6	Moderate	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-
BN9	0.5			6.8	5.2	Slight	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
BN9	0.75			6.6	5.3	Slight	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BN9	1			6.9	5.3	Slight	1.6	6.6	5.8	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN10	0.25	Red	Sand	6.8	5.4	Slight	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-
BN10	0.5			6.7	5.3	Moderate	1.4	5.8	5.2	2	<10	2	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<10
BN10	0.75			6.9	5.4	Moderate	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
BN10	1			7.1	5.4	Slight	1.7	6.1	5.7	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN11	0.25	Red	Sand	7	5.2	Slight	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BN11	0.5			6.8	5.3	Slight	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
BN11	0.75			7	5.4	Slight	1.6	5.8	5.4	2	<10	2	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN11	1			7	5.3	Slight	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BN12	0.25	Red	Clayey Sand	7.4	5.4	Slight	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-
BN12	0.5	Red	Sand	7.5	5.3	Slight	2.2	5.6	5.5	3	<10	5	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN12	0.75			7.4	5.3	Slight	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
BN12	1			7.5	5.6	Slight	1.9	5.7	5.7	3	<10	6	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<10
BN13	0.25	Red	Clayey Sand	7.2	5.4	Slight	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BN13	0.5	Red	Sand	7.3	5.4	Slight	1.9	5.6	5.6	4	<10	6	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<10
BN13	0.75			7.3	5.3	Slight	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-
BN13	1			7.3	5.3	Slight	2.0	5.5	5.7	3	<10	11	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN14	0.25	Red	Sand	7.1	5.4	Slight	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BN14	0.5			7.3	5.4	Slight	1.9	6.1	5.4	<2	<10	<2	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN14	0.75			7	5.4	Slight	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
BN14	1			7.2	5.4	Slight	1.8	5.7	5.4	2	<10	4	<0.02	<0.02	<0.02	<0.02	-	-	<0.02	<10
BN15	0.25	Red	Sand	6.6	5.3	Moderate	1.3	9.5	8	<2	52	<2	<0.02	<0.02	<0.02	0.08	<0.02	10300	0.08	52
BN15	0.5			6	5.2	Moderate	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BN15	0.75			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BN15	1			6.3	5.2	Slight	1.1	6.4	5.2	<2	<10	<2	<0.02	<0.02	<0.02	<0.03	-	-	<0.02	<10

Sample Description				Field Test Results				Lab pH		Acidity									Calculations	
		Lithology																		
Location	Sample Depth	Soil Colour	Field Texture	pH_F	pH_{FOX}	Reaction	ΔpH	pH_{KCl}	pH_{OX}	TAA	POS	TSA	s-TAA	s-TPA	s-TSA	S_{POS}	Scr	ANC	Net Acidity	Net Acidity
				pH Unit			-	*pH Unit*		*mole H+ / t*			*% pyrite S*					*mol H+/t*	*% S*	*mol H+/t*
				0.01	0.01	-	0.01	0.1	0.1	2	10	10	0.02	0.02	0.02	0.02	0.02	10	0.02	NA
				<4	**<4**	**-**	**>2**	**<4**	**<4**	**>18.7**	**>18.7**	**>18.7**	**>0.03**	**>0.03**	**>0.03**	**>0.03**	**>0.03**	**NA**	**>0.03**	**>18.7**
QC1	RB4 0.75-1	[redacted]		8	6.1	Slight	1.9	5.6	5.6	2	<10	5	<0.02	<0.02	<0.02	<0.03	-	-	<0.02	<10
QC2	BN3 0.5-0.75			6.9	5.4	Moderate	1.5	9.1	8.4	<2	<10	<2	<0.02	<0.02	<0.02	<0.03	-	311	<0.02	<10
QC3	BN14 0.5-0.75			7.3	5.4	Slight	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
QC4	BH15 0-0.25			6.8	5.3	Moderate	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix E

Quality Assurance and Quality Control Documentation

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS|PEOPLE|PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

7453

Project: Broome North	
Client: LandCorp	Job No.: 61/24758
Laboratory Quote No.:	Turnaround Time:
Job Manager (Invoice): Shaun Wong	Email Address (Results): shaun.wong@ghd.com

Laboratory: ALS Enviro

Address: Hodd Way, Malaga

Laboratory Contact:

Please Note:
Please sign white copy on receipt and release of samples. Samples are delivered to Laboratory Address. On receipt of samples laboratory contact should sign white copy and fax to GHD contact at above address. On completion of analyses please return white copy with results. Yellow copy is retained by laboratory. Pink copy is retained by sampler.

GHD Sample ID	Laboratory Sample ID	Date	Time	Container: Sample Matrix (S-Soil/SL-Sludge/W-Water/A-Air)	Container: Type (B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic)	Container: Preservative (Unpreserved/HCl/H_2SO_4/HNO_3/Other)	Container: No	Container: Total Volume (mL)	Analyses: PHc	Analyses: PHfox	Remarks
RB1 0-0.25	1	26-10-09		S	Bag	U	1		X	X	
RB1 0.25-0.5	2								X	X	
RB1 0.5-0.75	3								X	X	
RB1 0.75-1.0	4								X	X	
RB2 0-0.25	5								X	X	
RB2 0.25-0.5	6								X	X	
RB2 0.5-0.75	7								X	X	
RB2 0.75-1.0	8								X	X	
RB3 0-0.25	9								X	X	
RB3 0.25-0.5	10								X	X	
RB3 0.5-0.75	11								X	X	
RB3 0.75-1.0	12								X	X	
RB4 0-0.25	13								X	X	

Environmental Division
Perth
Work Order
EP0906175

Telephone : +61-8-9209 7655

Sampled by: S. Wong	Date/Time 26-10-09	Relinquished by: S. Wong	Date/Time 27-10-09
Received by: Kristine	Date/Time 28/10/09	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS|PEOPLE|PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

Project	
Client	Job No.
Laboratory Quote No.	Turnaround Time
Job Manager (Invoice)	Email Address (Results)

Laboratory:

Address:

Laboratory Contact:

Please Note:
Please sign white copy on receipt and release of samples. Samples are delivered to Laboratory Address. On receipt of samples laboratory contact should sign white copy and fax to GHD contact at above address. On completion of analyses please return white copy with results. Yellow copy is retained by laboratory. Pink copy is retained by sampler.

GHD Sample ID	Laboratory Sample ID	Date	Time	Container: Sample Matrix (S-Soil/SL-Sludge/W-Water/A-Air)	Container: Type (B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic)	Container: Preservative (Unpreserved/HCl/H_2SO_4/HNO_3/Other)	Container: No	Container: Total Volume (mL)	Analyses: pHf	Analyses: pHfox	Remarks
RB4 0.25-0.5	14	26.10.09		S	Bag	U	1		X	X	
RB4 0.5-0.75	15								X	X	
RB4 0.75-1.0	16								X	X	
RB5 0-0.25	17								X	X	
RB5 0.25-0.5	18								X	X	
RB5 0.5-0.75	19								X	X	
RB5 0.75-1.0	20								X	X	
BN1 0-0.25	21								X	X	
BN1 0.25-0.5	22								X	X	
BN1 0.5-0.75	23								X	X	
BN1 0.75-1.0	24								X	X	
BN2 0-0.25	25								X	X	
BN2 0.25-0.5	26								X	X	

Sampled by: S. Wong	Date/Time 26.10.09	Relinquished by: S. Wong	Date/Time 27.10.09
Received by: Kristina	Date/Time 28/10/09 0909	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS|PEOPLE|PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

7455

Project		Laboratory:
Client	Job No.	Address:
Laboratory Quote No.	Turnaround Time	Laboratory Contact:
Job Manager (Invoice)	Email Address (Results)	

Please Note:
Please sign white copy on receipt and release of samples. Samples are delivered to Laboratory Address. On receipt of samples laboratory contact should sign white copy and fax to GHD contact at above address. On completion of analyses please return white copy with results. Yellow copy is retained by laboratory. Pink copy is retained by sampler.

GHD Sample ID	Laboratory Sample ID	Date	Time	Container: Sample Matrix (S-Soil/SL-Sludge/W-Water/A-Air)	Container: Type (B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic)	Container: Preservative (Unpreserved/HCl/H_2SO_4/ HNO_3/Other)	Container: No	Container: Total Volume (mL)	Analyses: PHC	Analyses: PHC fox	Remarks
BN2 0.5-0.75	27	26.10.09		S	Bag	U	1		x	x	
BN2 0.75-1.0	28								x	x	
BN3 0-0.25	29								x	x	
BN3 0.25-0.5	30								x	x	
BN3 0.5-0.75	31								x	x	
BN3 0.75-1.0	32								x	x	
BN4 0-0.25	33								x	x	
BN4 0.25-0.5	34								x	x	
BN4 0.5-0.75	35								x	x	
BN4 0.75-1.0	36								x	x	
BN5 0-0.25	37								x	x	
BN5 0.25-0.5	38								x	x	
BN5 0.5-0.75	39								x	x	

Sampled by: S. Wong	Date/Time 26.10.09	Relinquished by: S. Wong	Date/Time 27.10.09
Received by: K Kristina	Date/Time 26/10/09 0904	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS|PEOPLE|PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

7456

Project		Laboratory:
Client	Job No.	Address:
Laboratory Quote No.	Turnaround Time	Laboratory Contact:
Job Manager (Invoice)	Email Address (Results)	

Please Note:
Please sign white copy on receipt and release of samples. Samples are delivered to Laboratory Address. On receipt of samples laboratory contact should sign white copy and fax to GHD contact at above address. On completion of analyses please return white copy with results. Yellow copy is retained by laboratory. Pink copy is retained by sampler.

GHD Sample ID	Laboratory Sample ID	Date	Time	Container: Sample Matrix (S-Soil/SL-Sludge/W-Water/A-Air)	Container: Type (B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic)	Container: Preservative (Unpreserved/HCl/H_2SO_4/HNO_3/Other)	Container: No	Container: Total Volume (mL)	Analyses: pHf	Analyses: pHfox	Remarks
BN5 0.75-1.0	40	26.10.09		S	Bag	U	1		x	x	
BN6 0-0.25	41								x	x	
BN6 0.25-0.5	42								x	x	
BN6 0.5-0.75	43								x	x	
BN6 0.75-1.0	44								x	x	
BN7 0-0.25	45								x	x	
BN7 0.25-0.5	46								x	x	
BN7 0.5-0.75	47								x	x	
BN7 0.75-1.0	48								x	x	
BN8 0-0.25	49								x	x	
BN8 0.25-0.5	50								x	x	
BN8 0.5-0.75	51								x	x	
BN8 0.75-1.0	52								x	x	

Sampled by: S. Wong	Date/Time 26.10.09	Relinquished by: S. Wong	Date/Time 27.10.09
Received by: Kristina	Date/Time 28/10/09 0904	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS|PEOPLE|PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

Project		Laboratory:
Client	Job No.	Address:
Laboratory Quote No.	Turnaround Time	Laboratory Contact:
Job Manager (Invoice)	Email Address (Results)	

Please Note:
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GHD Sample ID	Laboratory Sample ID	Date	Time	Container: Sample Matrix (S-Soil/SL-Sludge/W-Water/A-Air)	Container: Type (B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic)	Container: Preservative (Unpreserved/HCl/H_2SO_4/HNO_3/Other)	Container: No	Container: Total Volume (mL)	Analyses: pHc	Analyses: pHox	Remarks
BN9 0-0.25	53	26.10.09		S	Bag	U	1		X	X	
BN9 0.25-0.5	54								X	X	
BN9 0.5-0.75	55								X	X	
BN9 0.75-1.0	56								X	X	
BN10 0-0.25	57								X	X	
BN10 0.25-0.5	58								X	X	
BN10 0.5-0.75	59								X	X	
BN10 0.75-1.0	60								X	X	
BN11 0-0.25	61								X	X	
BN11 0.25-0.5	62								X	X	
BN11 0.5-0.75	63								X	X	
BN11 0.75-1.0	64								X	X	
BN12 0-0.25	65								X	X	

Sampled by: S. Wong	Date/Time 26.10.09	Relinquished by: S. Wong	Date/Time 27.10.09
Received by: Kristina	Date/Time 28/10/09 0904	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

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GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

7458

Project		Laboratory:
Client	Job No.	Address:
Laboratory Quote No.	Turnaround Time	Laboratory Contact:
Job Manager (Invoice)	Email Address (Results)	

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GHD Sample ID	Laboratory Sample ID	Date	Time	Container: Sample Matrix (S-Soil/SL-Sludge/W-Water/A-Air)	Container: Type (B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic)	Container: Preservative (Unpreserved/HCl/H_2SO_4/HNO_3/Other)	Container: No	Container: Total Volume (mL)	Analyses: pH4	Analyses: pHFox	Remarks
BN12 [redacted]	0.25-0.5 66	26.10.09		S	Bag	U	1		X	X	
BN12 0.5-0.75	67								X	X	
BN12 0.75-1.0	68								X	X	
BN13 0-0.25	69								X	X	
BN13 0.25-0.5	70								X	X	
BN13 0.5-0.75	71								X	X	
BN13 0.75-1.0	72								X	X	
BN14 0-0.25	73								X	X	
BN14 0.25-0.5	74								X	X	
BN14 0.5-0.75	75								X	X	
BN14 0.75-1.0	76								X	X	
BN15 0-0.25	77								X	X	
BN15 0.25-0.5	78	↓		↓	↓	↓	↓		X	X	

Sampled by: S. Wong	Date/Time 26.10.09	Relinquished by: S. Wong	Date/Time 27.10.09
Received by: Kristina	Date/Time 28/10/09 0904	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

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Perth WA 6004

PO Box Y3106
Perth WA 6832

Telephone 08 6222 8222
Facsimile 08 6222 8555

7459

Project	
Client	Job No.
Laboratory Quote No.	Turnaround Time
Job Manager (Invoice)	Email Address (Results)

Laboratory:

Address:

Laboratory Contact:

Please Note:
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GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil/SI-Sludge/W-Water/A-Air	Container Type B-Bottle/J-Jar/V-Vial/Bag G-Glass/P-Plastic	Container Preservative Unpreserved/HCl/H_2SO_4/HNO_3/Other	Container No	Container Total Volume (mL)	Analyses pHf	Analyses pHfox	Remarks
BN15 0.75-1.0	79	26.10.09		S	Bag	U	1		X	X	
QC1	80	↓		↓	↓	↓	↓		X	X	
QC2	81								X	X	
QC3	82								X	X	
QC4	83								X	X	

Sampled by: S. Wong	Date/Time 26.10.09	Relinquished by: S. Wong	Date/Time 27.10.09
Received by: Kristina	Date/Time 26/10/09 0404	Relinquished by:	Date/Time
Received by Lab:	Date/Time	Courier/Transport Company:	
Sample Conditions:	Remarks:		

an Wolterman

From: Stacey Hawkins
Sent: Friday, 30 October 2009 12:23 PM
To: Samples Perth
Subject: FW: rebatch request
Attachments: rebatch request.pdf

Stacey Hawkins
Senior Chemist - Acid Sulfate Soils
ALS Laboratory Group
Environmental Division
Perth, Western Australia
Phone: +61 8 92097655
Fax: +61 8 92097600
www.alsglobal.com

From: Shaun.Wong@ghd.com [mailto:Shaun.Wong@ghd.com]
Sent: Friday, 30 October 2009 11:58 AM
To: Stacey Hawkins
Cc: Michael Sharp
Subject: rebatch request

Hi Stacey,

Could I please get the following samples indicated on the attached file analysed for SPOCAS and Chromium Reducible Sulfur (not the suite).

Cheers

Regards,

Shaun Wong
Environmental Scientist

GHD | CLIENTS | PEOPLE | PERFORMANCE
T 61 8 6222 8932 | M 0401 884 410 | F 61 8 6222 8555 | shaun.wong@ghd.com.au
GHD House 239 Adelaide Terrace Perth WA 6004 | www.ghd.com.au

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Matrix:	Workgroup:	ıame/number:			EA037: A pH (F)	pH (Fox)	Reaction Rate	
SOIL	EP0906175	61 24758						
					pH Unit	pH Unit	-	
					0.1	0.1	1	SPOCAS CRS
ıle Type:	ALS Sample number:	Sample date:	ID (1st):	ID (2nd):				
REG	EP0906175001	26/10/2009	RB1	0-0.25	8.5	6.3	Slight	
REG	EP0906175002	26/10/2009	RB1	0.25-0.5	8.2	6.2	Slight	
REG	EP0906175003	26/10/2009	RB1	0.5-0.75	8.4	6.2	Slight	
REG	EP0906175004	26/10/2009	RB1	0.75-1.0	8.4	6.3	Slight	
REG	EP0906175005	26/10/2009	RB2	0-0.25	8.8	6.3	Slight	✔
REG	EP0906175006	26/10/2009	RB2	0.25-0.5	8.4	6.3	Slight	
REG	EP0906175007	26/10/2009	RB2	0.5-0.75	7.9	6.3	Slight	
REG	EP0906175008	26/10/2009	RB2	0.75-1.0	8.3	6.4	Slight	
REG	EP0906175009	26/10/2009	RB3	0-0.25	8.3	6.4	Slight	
REG	EP0906175010	26/10/2009	RB3	0.25-0.5	8.4	6.3	Slight	✔
REG	EP0906175011	26/10/2009	RB3	0.5-0.75	8.4	6.4	Slight	
REG	EP0906175012	26/10/2009	RB3	0.75-1.0	8.6	6.4	Slight	
REG	EP0906175013	26/10/2009	RB4	0-0.25	8.6	6.3	Slight	
REG	EP0906175014	26/10/2009	RB4	0.25-0.5	8.7	6.4	Slight	
REG	EP0906175015	26/10/2009	RB4	0.5-0.75	8.6	6.3	Slight	
REG	EP0906175016	26/10/2009	RB4	0.75-1.0	8.5	6.3	Slight	
REG	EP0906175017	26/10/2009	RB5	0-0.25	8.4	6.2	Slight	✔
REG	EP0906175018	26/10/2009	RB5	0.25-0.5	8.4	6.3	Slight	
REG	EP0906175019	26/10/2009	RB5	0.5-0.75	8.3	6.3	Slight	
REG	EP0906175020	26/10/2009	RB5	0.75-1.0	8.4	6.4	Slight	
REG	EP0906175021	26/10/2009	BN1	0-0.25	7.9	5.7	Slight	
REG	EP0906175022	26/10/2009	BN1	0.25-0.5	7.8	5.6	Slight	
REG	EP0906175023	26/10/2009	BN1	0.5-0.75	7.6	6.2	Slight	
REG	EP0906175024	26/10/2009	BN1	0.75-1.0	7.3	5.6	Slight	
REG	EP0906175025	26/10/2009	BN2	0-0.25	7.6	5.7	Slight	✔
REG	EP0906175026	26/10/2009	BN2	0.25-0.5	7.5	5.6	Slight	
REG	EP0906175027	26/10/2009	BN2	0.5-0.75	7.5	5.6	Slight	
REG	EP0906175028	26/10/2009	BN2	0.75-1.0	7.4	5.6	Slight	

	REG	EP0906175029	26/10/2009	BN3	0-0.25	7.2	5.4	Moderate
	REG	EP0906175030	26/10/2009	BN3	0.25-0.5	7.0	5.5	Moderate
11	REG	EP0906175031	26/10/2009	BN3	0.5-0.75	7.0	5.4	Moderate
12	REG	EP0906175032	26/10/2009	BN3	0.75-1.0	7.4	5.5	
	REG	EP0906175033	26/10/2009	BN4	0-0.25	6.9	5.4	Slight
	REG	EP0906175034	26/10/2009	BN4	0.25-0.5	6.9	5.6	Slight
13	REG	EP0906175035	26/10/2009	BN4	0.5-0.75	7.2	5.6	Slight
	REG	EP0906175036	26/10/2009	BN4	0.75-1.0	7.3	5.6	Slight
	REG	EP0906175037	26/10/2009	BN5	0-0.25	7.2	5.5	Slight
	REG	EP0906175038	26/10/2009	BN5	0.25-0.5	6.8	5.5	Slight
	REG	EP0906175039	26/10/2009	BN5	0.5-0.75	6.7	5.4	Slight
14	REG	EP0906175040	26/10/2009	BN5	0.75-1.0	7.4	5.7	Slight
	REG	EP0906175041	26/10/2009	BN6	0-0.25	7.3	5.4	Slight
15	REG	EP0906175042	26/10/2009	BN6	0.25-0.5	6.7	5.5	Slight
	REG	EP0906175043	26/10/2009	BN6	0.5-0.75	7.0	5.5	Slight
16	REG	EP0906175044	26/10/2009	BN6	0.75-1.0	7.5	5.5	Slight
	REG	EP0906175045	26/10/2009	BN7	0-0.25	6.8	5.4	Slight
	REG	EP0906175046	26/10/2009	BN7	0.25-0.5	7.0	5.4	Slight
	REG	EP0906175047	26/10/2009	BN7	0.5-0.75	7.0	5.3	Slight
17	REG	EP0906175048	26/10/2009	BN7	0.75-1.0	7.3	5.4	Slight
	REG	EP0906175049	26/10/2009	BN8	0-0.25	7.0	5.4	Slight
18	REG	EP0906175050	26/10/2009	BN8	0.25-0.5	6.5	5.3	Moderate
	REG	EP0906175051	26/10/2009	BN8	0.5-0.75	7.0	5.4	Moderate
19	REG	EP0906175052	26/10/2009	BN8	0.75-1.0	7.0	5.3	Slight
	REG	EP0906175053	26/10/2009	BN9	0-0.25	7.0	5.6	Moderate
	REG	EP0906175054	26/10/2009	BN9	0.25-0.5	6.8	5.2	Slight
	REG	EP0906175055	26/10/2009	BN9	0.5-0.75	6.6	5.3	Slight
20	REG	EP0906175056	26/10/2009	BN9	0.75-1.0	6.9	5.3	Slight
	REG	EP0906175057	26/10/2009	BN10	0-0.25	6.8	5.4	Moderate
21	REG	EP0906175058	26/10/2009	BN10	0.25-0.5	6.7	5.3	Moderate
	REG	EP0906175059	26/10/2009	BN10	0.5-0.75	6.9	5.4	Slight
22	REG	EP0906175060	26/10/2009	BN10	0.75-1.0	7.1	5.4	Slight

REG	EP0906175061	26/10/2009	BN11	0-0.25	7.0	5.2	Slight
REG	EP0906175062	26/10/2009	BN11	0.25-0.5	6.8	5.3	Slight
REG	EP0906175063	26/10/2009	BN11	0.5-0.75	7.0	5.4	Slight
REG	EP0906175064	26/10/2009	BN11	0.75-1.0	7.0	5.3	Slight
REG	EP0906175065	26/10/2009	BN12	0-0.25	7.4	5.4	Slight
REG	EP0906175066	26/10/2009	BN12	0.25-0.5	7.5	5.3	Slight
REG	EP0906175067	26/10/2009	BN12	0.5-0.75	7.4	5.3	Slight
REG	EP0906175068	26/10/2009	BN12	0.75-1.0	7.5	5.6	Slight
REG	EP0906175069	26/10/2009	BN13	0-0.25	7.2	5.4	Slight
REG	EP0906175070	26/10/2009	BN13	0.25-0.5	7.3	5.4	Slight
REG	EP0906175071	26/10/2009	BN13	0.5-0.75	7.3	5.3	Slight
REG	EP0906175072	26/10/2009	BN13	0.75-1.0	7.3	5.3	Slight
REG	EP0906175073	26/10/2009	BN14	0-0.25	7.1	5.4	Slight
REG	EP0906175074	26/10/2009	BN14	0.25-0.5	7.3	5.4	Slight
REG	EP0906175075	26/10/2009	BN14	0.5-0.75	7.0	5.4	Slight
REG	EP0906175076	26/10/2009	BN14	0.75-1.0	7.2	5.4	Slight
REG	EP0906175077	26/10/2009	BN15	0-0.25	6.6	5.3	Moderate
REG	EP0906175078	26/10/2009	BN15	0.25-0.5	6.0	5.2	Moderate
REG	EP0906175079	26/10/2009	BN15	0.75-1.0	6.3	5.2	Slight
REG	EP0906175080	26/10/2009	QC1		8.0	6.1	Slight
REG	EP0906175081	26/10/2009	QC2		6.9	5.4	Moderate
REG	EP0906175082	26/10/2009	QC3		7.3	5.4	Slight
REG	EP0906175083	26/10/2009	QC4		6.8	5.3	Moderate

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **EP0906266**	Page	: 1 of 9
Amendment	: **1**		
Client	: LANDCORP	Laboratory	: Environmental Division Perth
Contact	: SHAUN WONG	Contact	: Michael Sharp
Address	: Level 3, 40 The Esplanade PERTH WA, Australia 6832	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: shaun.wong@ghd.com	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Ex EP0906175 6124758	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 30-OCT-2009
Sampler	: ----	Issue Date	: 09-NOV-2009
Order number	: ----		
		No. of samples received	: 33
Quote number	: ----	No. of samples analysed	: 33

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non -volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA026 : Chromium Reducible Sulphur								
80* dried soil								
RB2 - 0-0.25,	RB3 - 0.25-0.5,	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	31-JAN-2010	✓
BN2 - 0-0.25,	BN3 - 0.75-1.0,							
BN5 - 0.75-1.0,	BN8 - 0.25-0.5,							
BN10 - 0.25-0.5,	BN12 - 0.75-1.0,							
BN13 - 0.25-0.5,	BN15 - 0-0.25							
EA029-A: pH Measurements								
80* dried soil								
RB1 - 0.5-0.75,	RB2 - 0-0.25,	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓
RB2 - 0.75-1.0,	RB3 - 0.25-0.5,							
RB4 - 0.75-1.0,	RB5 - 0-0.25,							
RB5 - 0.75-1.0,	BN1 - 0.25-0.5,							
BN1 - 0.75-1.0,	BN2 - 0-0.25,							
BN3 - 0.5-0.75,	BN3 - 0.75-1.0,							
BN4 - 0.5-0.75,	BN5 - 0.75-1.0,							
BN6 - 0.25-0.5,	BN6 - 0.75-1.0,							
BN7 - 0.75-1.0,	BN8 - 0.25-0.5,							
BN8 - 0.75-1.0,	BN9 - 0.75-1.0,							
BN10 - 0.25-0.5,	BN10 - 0.75-1.0,							
BN11 - 0.5-0.75,	BN12 - 0.25-0.5,							
BN12 - 0.75-1.0,	BN13 - 0.25-0.5,							
BN13 - 0.75-1.0,	BN14 - 0.25-0.5,							
BN14 - 0.75-1.0,	BN15 - 0-0.25,							
BN15 - 0.75-1.0,	QC1,							
QC2								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-B: Acidity Trail							
80* dried soil							
RB1 - 0.5-0.75, RB2 - 0-0.25, RB2 - 0.75-1.0, RB3 - 0.25-0.5, RB4 - 0.75-1.0, RB5 - 0-0.25, RB5 - 0.75-1.0, BN1 - 0.25-0.5, BN1 - 0.75-1.0, BN2 - 0-0.25, BN3 - 0.5-0.75, BN3 - 0.75-1.0, BN4 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0.25-0.5, BN6 - 0.75-1.0, BN7 - 0.75-1.0, BN8 - 0.25-0.5, BN8 - 0.75-1.0, BN9 - 0.75-1.0, BN10 - 0.25-0.5, BN10 - 0.75-1.0, BN11 - 0.5-0.75, BN12 - 0.25-0.5, BN12 - 0.75-1.0, BN13 - 0.25-0.5, BN13 - 0.75-1.0, BN14 - 0.25-0.5, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.75-1.0, QC1, QC2	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓
EA029-C: Sulfur Trail							
80* dried soil							
RB1 - 0.5-0.75, RB2 - 0-0.25, RB2 - 0.75-1.0, RB3 - 0.25-0.5, RB4 - 0.75-1.0, RB5 - 0-0.25, RB5 - 0.75-1.0, BN1 - 0.25-0.5, BN1 - 0.75-1.0, BN2 - 0-0.25, BN3 - 0.5-0.75, BN3 - 0.75-1.0, BN4 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0.25-0.5, BN6 - 0.75-1.0, BN7 - 0.75-1.0, BN8 - 0.25-0.5, BN8 - 0.75-1.0, BN9 - 0.75-1.0, BN10 - 0.25-0.5, BN10 - 0.75-1.0, BN11 - 0.5-0.75, BN12 - 0.25-0.5, BN12 - 0.75-1.0, BN13 - 0.25-0.5, BN13 - 0.75-1.0, BN14 - 0.25-0.5, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.75-1.0, QC1, QC2	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-D: Calcium Values							
80* dried soil							
RB1 - 0.5-0.75, RB2 - 0-0.25, RB2 - 0.75-1.0, RB3 - 0.25-0.5, RB4 - 0.75-1.0, RB5 - 0-0.25, RB5 - 0.75-1.0, BN1 - 0.25-0.5, BN1 - 0.75-1.0, BN2 - 0-0.25, BN3 - 0.5-0.75, BN3 - 0.75-1.0, BN4 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0.25-0.5, BN6 - 0.75-1.0, BN7 - 0.75-1.0, BN8 - 0.25-0.5, BN8 - 0.75-1.0, BN9 - 0.75-1.0, BN10 - 0.25-0.5, BN10 - 0.75-1.0, BN11 - 0.5-0.75, BN12 - 0.25-0.5, BN12 - 0.75-1.0, BN13 - 0.25-0.5, BN13 - 0.75-1.0, BN14 - 0.25-0.5, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.75-1.0, QC1, QC2	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓
EA029-E: Magnesium Values							
80* dried soil							
RB1 - 0.5-0.75, RB2 - 0-0.25, RB2 - 0.75-1.0, RB3 - 0.25-0.5, RB4 - 0.75-1.0, RB5 - 0-0.25, RB5 - 0.75-1.0, BN1 - 0.25-0.5, BN1 - 0.75-1.0, BN2 - 0-0.25, BN3 - 0.5-0.75, BN3 - 0.75-1.0, BN4 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0.25-0.5, BN6 - 0.75-1.0, BN7 - 0.75-1.0, BN8 - 0.25-0.5, BN8 - 0.75-1.0, BN9 - 0.75-1.0, BN10 - 0.25-0.5, BN10 - 0.75-1.0, BN11 - 0.5-0.75, BN12 - 0.25-0.5, BN12 - 0.75-1.0, BN13 - 0.25-0.5, BN13 - 0.75-1.0, BN14 - 0.25-0.5, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.75-1.0, QC1, QC2	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-F: Excess Acid Neutralising Capacity							
80* dried soil							
RB1 - 0.5-0.75, RB2 - 0-0.25, RB2 - 0.75-1.0, RB3 - 0.25-0.5, RB4 - 0.75-1.0, RB5 - 0-0.25, RB5 - 0.75-1.0, BN1 - 0.25-0.5, BN1 - 0.75-1.0, BN2 - 0-0.25, BN3 - 0.5-0.75, BN3 - 0.75-1.0, BN4 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0.25-0.5, BN6 - 0.75-1.0, BN7 - 0.75-1.0, BN8 - 0.25-0.5, BN8 - 0.75-1.0, BN9 - 0.75-1.0, BN10 - 0.25-0.5, BN10 - 0.75-1.0, BN11 - 0.5-0.75, BN12 - 0.25-0.5, BN12 - 0.75-1.0, BN13 - 0.25-0.5, BN13 - 0.75-1.0, BN14 - 0.25-0.5, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.75-1.0, QC1, QC2	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓
EA029-G: Retained Acidity							
80* dried soil							
RB1 - 0.5-0.75, RB2 - 0-0.25, RB2 - 0.75-1.0, RB3 - 0.25-0.5, RB4 - 0.75-1.0, RB5 - 0-0.25, RB5 - 0.75-1.0, BN1 - 0.25-0.5, BN1 - 0.75-1.0, BN2 - 0-0.25, BN3 - 0.5-0.75, BN3 - 0.75-1.0, BN4 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0.25-0.5, BN6 - 0.75-1.0, BN7 - 0.75-1.0, BN8 - 0.25-0.5, BN8 - 0.75-1.0, BN9 - 0.75-1.0, BN10 - 0.25-0.5, BN10 - 0.75-1.0, BN11 - 0.5-0.75, BN12 - 0.25-0.5, BN12 - 0.75-1.0, BN13 - 0.25-0.5, BN13 - 0.75-1.0, BN14 - 0.25-0.5, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.75-1.0, QC1, QC2	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-H: Acid Base Accounting								
80* dried soil								
RB1 - 0.5-0.75,	RB2 - 0-0.25,	**26-OCT-2009**	**30-OCT-2009**	26-OCT-2010	✓	**03-NOV-2009**	28-JAN-2010	✓
RB2 - 0.75-1.0,	RB3 - 0.25-0.5,							
RB4 - 0.75-1.0,	RB5 - 0-0.25,							
RB5 - 0.75-1.0,	BN1 - 0.25-0.5,							
BN1 - 0.75-1.0,	BN2 - 0-0.25,							
BN3 - 0.5-0.75,	BN3 - 0.75-1.0,							
BN4 - 0.5-0.75,	BN5 - 0.75-1.0,							
BN6 - 0.25-0.5,	BN6 - 0.75-1.0,							
BN7 - 0.75-1.0,	BN8 - 0.25-0.5,							
BN8 - 0.75-1.0,	BN9 - 0.75-1.0,							
BN10 - 0.25-0.5,	BN10 - 0.75-1.0,							
BN11 - 0.5-0.75,	BN12 - 0.25-0.5,							
BN12 - 0.75-1.0,	BN13 - 0.25-0.5,							
BN13 - 0.75-1.0,	BN14 - 0.25-0.5,							
BN14 - 0.75-1.0,	BN15 - 0-0.25,							
BN15 - 0.75-1.0,	QC1,							
QC2								

Quality Control Parameter Frequency Compliance

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

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chromium Reducible Sulphur	EA026	1	10	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	4	33	**12.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Chromium Reducible Sulphur	EA026	1	10	**10.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Chromium Reducible Sulphur	EA026	1	10	**10.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Reducible Sulphur	EA026	SOIL	Sullivan et al (1998) The CRS method converts reduced inorganic sulfur to H2S by CrCl2 solution ; the evolved H2S is trapped in a zinc acetate solution as ZnS which is quantified by iodometric titration.
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

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

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **EP0906266**	Page	: 1 of 10
Amendment	: **1**		
Client	: **LANDCORP**	Laboratory	: Environmental Division Perth
Contact	: SHAUN WONG	Contact	: Michael Sharp
Address	: Level 3, 40 The Esplanade PERTH WA, Australia 6832	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: shaun.wong@ghd.com	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Ex EP0906175 6124758	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 30-OCT-2009
Sampler	: ----	Issue Date	: 09-NOV-2009
Order number	: ----		
		No. of samples received	: 33
Quote number	: ----	No. of samples analysed	: 33

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

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

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Stacey Hawkins	Senior Chemist - Acid Sulphate Soils	Perth ASS

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA026 : Chromium Reducible Sulphur (QC Lot: 1150118)									
EP0906266-002	RB2 0-0.25	EA026: Chromium Reducible Sulphur	----	0.02	%	<0.02	<0.02	0.0	No Limit
EA029-A: pH Measurements (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: pH KCl (23A)	----	0.1	pH Unit	9.3	9.3	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	7.9	7.9	0.0	0% - 20%
EP0906266-011	BN3 0.5-0.75	EA029: pH KCl (23A)	----	0.1	pH Unit	8.3	8.2	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	6.7	6.6	1.7	0% - 20%
EA029-A: pH Measurements (QC Lot: 1150119)									
EP0906266-021	BN10 0.25-0.5	EA029: pH KCl (23A)	----	0.1	pH Unit	5.8	5.8	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	5.2	5.3	0.0	0% - 20%
EP0906266-031	BN15 0.75-1.0	EA029: pH KCl (23A)	----	0.1	pH Unit	6.4	6.4	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	5.2	4.9	6.3	0% - 20%
EA029-B: Acidity Trail (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
EP0906266-011	BN3 0.5-0.75	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
EA029-B: Acidity Trail (QC Lot: 1150119)									
EP0906266-021	BN10 0.25-0.5	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	2	2	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA029-B: Acidity Trail (QC Lot: 1150119) - continued									
EP0906266-021	BN10 0.25-0.5	EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	2	2	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
EP0906266-031	BN15 0.75-1.0	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
EA029-C: Sulfur Trail (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	0.02	0.02	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	0.02	<0.02	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EP0906266-011	BN3 0.5-0.75	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-C: Sulfur Trail (QC Lot: 1150119)									
EP0906266-021	BN10 0.25-0.5	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EP0906266-031	BN15 0.75-1.0	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-D: Calcium Values (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.20	0.22	8.6	0% - 50%
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	1.75	1.67	4.5	0% - 20%
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	1.55	1.45	6.3	0% - 20%
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	1.24	1.16	6.3	0% - 20%
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	773	726	6.3	0% - 20%
EP0906266-011	BN3 0.5-0.75	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.14	0.14	0.0	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.16	0.15	9.3	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA029-D: Calcium Values (QC Lot: 1150117) - continued									
EP0906266-011	BN3 0.5-0.75	EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	0.03	<0.02	0.0	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	0.02	<0.02	0.0	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	13	<10	26.3	No Limit
EA029-D: Calcium Values (QC Lot: 1150119)									
EP0906266-021	BN10 0.25-0.5	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.02	<0.02	0.0	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EP0906266-031	BN15 0.75-1.0	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.06	0.05	0.0	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.09	0.08	0.0	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	0.03	0.03	0.0	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	0.03	0.02	0.0	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	16	13	22.4	No Limit
EA029-E: Magnesium Values (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.03	0.03	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.07	0.06	0.0	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	0.04	0.03	0.0	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	0.05	0.04	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	30	26	15.1	No Limit
EP0906266-011	BN3 0.5-0.75	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-E: Magnesium Values (QC Lot: 1150119)									
EP0906266-021	BN10 0.25-0.5	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EP0906266-031	BN15 0.75-1.0	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA029-E: Magnesium Values (QC Lot: 1150119) - continued									
EP0906266-031	BN15 0.75-1.0	EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-F: Excess Acid Neutralising Capacity (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	4.26	4.25	0.3	0% - 20%
		EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	1.36	1.36	0.0	0% - 20%
		EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	852	850	0.3	0% - 20%
EP0906266-011	BN3 0.5-0.75	EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	0.24	0.25	0.0	0% - 50%
		EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	0.08	0.08	0.0	No Limit
		EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	49	49	0.0	No Limit
EA029-H: Acid Base Accounting (QC Lot: 1150117)									
EP0906266-001	RB1 0.5-0.75	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EP0906266-011	BN3 0.5-0.75	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-H: Acid Base Accounting (QC Lot: 1150119)									
EP0906266-021	BN10 0.25-0.5	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EP0906266-031	BN15 0.75-1.0	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA029-H: Acid Base Accounting (QC Lot: 1150119) - continued									
EP0906266-031	BN15 0.75-1.0	EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit

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

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

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA026 : Chromium Reducible Sulphur (QCLot: 1150118)								
EA026: Chromium Reducible Sulphur	----	0.02	%	<0.02	0.199 %	102	83.1	121
EA029-B: Acidity Trail (QCLot: 1150117)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA029-B: Acidity Trail (QCLot: 1150119)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 1150117)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	----	----	----	----
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.02	----	----	----	----
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 1150119)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	----	----	----	----
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.02	----	----	----	----
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.02	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-D: Calcium Values (QCLot: 1150117)								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.02	----	----	----	----
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.02	----	----	----	----
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.02	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.02	----	----	----	----
EA029-D: Calcium Values (QCLot: 1150119)								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.02	----	----	----	----
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.02	----	----	----	----
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.02	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EA029-D: Calcium Values (QCLot: 1150119) - continued								
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.02	----	----	----	----
EA029-E: Magnesium Values (QCLot: 1150117)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	----	----	----	----
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	----	----	----	----
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	----	----	----	----
EA029-E: Magnesium Values (QCLot: 1150119)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	----	----	----	----
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	----	----	----	----
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	----	----	----	----

Matrix Spike (MS) Report

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

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

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **EP0906175**	Page	: 1 of 11
Client	: LANDCORP	Laboratory	: Environmental Division Perth
Contact	: SHAUN WONG	Contact	: Michael Sharp
Address	: Level 3, 40 The Esplanade PERTH WA, Australia 6832	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: shaun.wong@ghd.com	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: LandCorp Broome North		
C-O-C number	: 7453-7459	Date Samples Received	: 28-OCT-2009
Sampler	: SHAUN WONG	Issue Date	: 29-OCT-2009
Order number	: ----		
		No. of samples received	: 83
Quote number	: ----	No. of samples analysed	: 83

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis - Continued							
Snap Lock Bag							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis - Continued							
RB1 - 0-0.25, RB1 - 0.25-0.5, RB1 - 0.5-0.75, RB1 - 0.75-1.0, RB2 - 0-0.25, RB2 - 0.25-0.5, RB2 - 0.5-0.75, RB2 - 0.75-1.0, RB3 - 0-0.25, RB3 - 0.25-0.5, RB3 - 0.5-0.75, RB3 - 0.75-1.0, RB4 - 0-0.25, RB4 - 0.25-0.5, RB4 - 0.5-0.75, RB4 - 0.75-1.0, QC1, RB5 - 0-0.25, RB5 - 0.25-0.5, RB5 - 0.5-0.75, RB5 - 0.75-1.0, BN1 - 0-0.25, BN1 - 0.25-0.5, BN1 - 0.5-0.75, BN1 - 0.75-1.0, BN2 - 0-0.25, BN2 - 0.25-0.5, BN2 - 0.5-0.75, BN2 - 0.75-1.0, BN3 - 0-0.25, BN3 - 0.25-0.5, BN3 - 0.5-0.75, BN3 - 0.75-1.0, QC2, BN4 - 0-0.25, BN4 - 0.25-0.5, BN4 - 0.5-0.75, BN4 - 0.75-1.0, BN5 - 0-0.25, BN5 - 0.25-0.5, BN5 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0-0.25, BN6 - 0.25-0.5, BN6 - 0.5-0.75, BN6 - 0.75-1.0, BN7 - 0-0.25, BN7 - 0.25-0.5, BN7 - 0.5-0.75, BN7 - 0.75-1.0, QC3, BN8 - 0-0.25, BN8 - 0.25-0.5, BN8 - 0.5-0.75, BN8 - 0.75-1.0, BN9 - 0-0.25, BN9 - 0.25-0.5, BN9 - 0.5-0.75, BN9 - 0.75-1.0, BN10 - 0-0.25, BN10 - 0.25-0.5, BN10 - 0.5-0.75, BN10 - 0.75-1.0, BN11 - 0-0.25, BN11 - 0.25-0.5, BN11 - 0.5-0.75, QC4, BN11 - 0.75-1.0, BN12 - 0-0.25, BN12 - 0.25-0.5, BN12 - 0.5-0.75, BN12 - 0.75-1.0, BN13 - 0-0.25, BN13 - 0.25-0.5, BN13 - 0.5-0.75, BN13 - 0.75-1.0, BN14 - 0-0.25, BN14 - 0.25-0.5, BN14 - 0.5-0.75, BN14 - 0.75-1.0, BN15 - 0-0.25, BN15 - 0.25-0.5,	**26-OCT-2009**	**28-OCT-2009**	27-OCT-2009	✘	**28-OCT-2009**	27-OCT-2009	✘

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis - Continued							
BN15 - 0.75-1.0							

Quality Control Parameter Frequency Compliance

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

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
ASS Field Screening Analysis	EA037	9	83	**10.8**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
ASS Field Screening Analysis	EA037	SOIL	Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA037: Ass Field Screening Analysis						

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA037: Ass Field Screening Analysis - Analysis Holding Time Compliance						
Snap Lock Bag						

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA037: Ass Field Screening Analysis - Analysis Holding Time Compliance						
RB1 - 0-0.25, RB1 - 0.25-0.5, RB1 - 0.5-0.75, RB1 - 0.75-1.0, RB2 - 0-0.25, RB2 - 0.25-0.5, RB2 - 0.5-0.75, RB2 - 0.75-1.0, RB3 - 0-0.25, RB3 - 0.25-0.5, RB3 - 0.5-0.75, RB3 - 0.75-1.0, RB4 - 0-0.25, RB4 - 0.25-0.5, RB4 - 0.5-0.75, RB4 - 0.75-1.0, QC1, RB5 - 0-0.25, RB5 - 0.25-0.5, RB5 - 0.5-0.75, RB5 - 0.75-1.0, BN1 - 0-0.25, BN1 - 0.25-0.5, BN1 - 0.5-0.75, BN1 - 0.75-1.0, BN2 - 0-0.25, BN2 - 0.25-0.5, BN2 - 0.5-0.75, BN2 - 0.75-1.0, BN3 - 0-0.25, BN3 - 0.25-0.5, BN3 - 0.5-0.75, BN3 - 0.75-1.0, QC2, BN4 - 0-0.25, BN4 - 0.25-0.5, BN4 - 0.5-0.75, BN4 - 0.75-1.0, BN5 - 0-0.25, BN5 - 0.25-0.5, BN5 - 0.5-0.75, BN5 - 0.75-1.0, BN6 - 0-0.25, BN6 - 0.25-0.5, BN6 - 0.5-0.75, BN6 - 0.75-1.0, BN7 - 0-0.25, BN7 - 0.25-0.5, BN7 - 0.5-0.75, BN7 - 0.75-1.0, QC3, BN8 - 0-0.25, BN8 - 0.25-0.5, BN8 - 0.5-0.75, BN8 - 0.75-1.0, BN9 - 0-0.25, BN9 - 0.25-0.5, BN9 - 0.5-0.75, BN9 - 0.75-1.0, BN10 - 0-0.25, BN10 - 0.25-0.5, BN10 - 0.5-0.75, BN10 - 0.75-1.0, BN11 - 0-0.25, BN11 - 0.25-0.5, BN11 - 0.5-0.75, QC4, BN11 - 0.75-1.0, BN12 - 0-0.25, BN12 - 0.25-0.5, BN12 - 0.5-0.75, BN12 - 0.75-1.0, BN13 - 0-0.25, BN13 - 0.25-0.5, BN13 - 0.5-0.75, BN13 - 0.75-1.0, BN14 - 0-0.25, BN14 - 0.25-0.5, BN14 - 0.5-0.75, BN14 - 0.75-1.0,	28-OCT-2009	27-OCT-2009	**1**	28-OCT-2009	27-OCT-2009	**1**

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA037: Ass Field Screening Analysis - Analysis Holding Time Compliance						
BN15 - 0-0.25, BN15 - 0.25-0.5, BN15 - 0.75-1.0						

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

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

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **EP0906175**	Page	: 1 of 5
Client	: **LANDCORP**	Laboratory	: Environmental Division Perth
Contact	: SHAUN WONG	Contact	: Michael Sharp
Address	: Level 3, 40 The Esplanade PERTH WA, Australia 6832	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: shaun.wong@ghd.com	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: LandCorp Broome North		
C-O-C number	: 7453-7459	Date Samples Received	: 28-OCT-2009
Sampler	: SHAUN WONG	Issue Date	: 29-OCT-2009
Order number	: ----		
		No. of samples received	: 83
Quote number	: ----	No. of samples analysed	: 83

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

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

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Tenae Madden	Acid Sulphate Soils - Production Coordinator	Perth ASS

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA037: Ass Field Screening Analysis (QC Lot: 1146160)									
EP0906175-001	RB1 0-0.25	EA037: pH (F)	----	0.1	pH Unit	8.5	8.5	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.3	6.4	0.0	0% - 20%
EP0906175-010	RB3 0.25-0.5	EA037: pH (F)	----	0.1	pH Unit	8.4	8.4	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.3	6.3	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 1146161)									
EP0906175-021	BN1 0-0.25	EA037: pH (F)	----	0.1	pH Unit	7.9	8.0	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.7	5.6	2.1	0% - 20%
EP0906175-030	BN3 0.25-0.5	EA037: pH (F)	----	0.1	pH Unit	7.0	7.0	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.5	5.4	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 1146162)									
EP0906175-041	BN6 0-0.25	EA037: pH (F)	----	0.1	pH Unit	7.3	7.2	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.4	5.4	0.0	0% - 20%
EP0906175-050	BN8 0.25-0.5	EA037: pH (F)	----	0.1	pH Unit	6.5	6.5	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.3	5.3	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 1146163)									
EP0906175-061	BN11 0-0.25	EA037: pH (F)	----	0.1	pH Unit	7.0	7.1	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.2	5.2	0.0	0% - 20%
EP0906175-070	BN13 0.25-0.5	EA037: pH (F)	----	0.1	pH Unit	7.3	7.2	1.7	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.4	5.3	0.0	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 1146164)									
EP0906175-081	QC2	EA037: pH (F)	----	0.1	pH Unit	6.9	6.8	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.4	5.4	0.0	0% - 20%

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

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

- **No Method Blank (MB) or Laboratory Control Spike (SCS) Results are required to be reported.**

Matrix Spike (MS) Report

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

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

61/24758 Broome North Redevelopment

RPD Summary Table

		Field Results		Laboratory Results					
Sample Type	Sample ID	pHf	pHfox	pH KCL	pH OX	TAA	Spos	Net Acidity (Sulfur units)	Net Acidity (Acidity units)
		pH Unit				*mole H+ / t*	*% pyrite S*	*% pyrite S*	*mole H+ / t*
Primary	RB4 0.75-1.0	8.5	6.3	8.5	8.4	<2	0.08	0.08	52
Duplicate	QC1	8	6.1	5.6	5.6	2	<0.02	<0.02	<10
RPD Value		-6.06%	-3.23%	-41.13%	-40.00%	66.67%	155.56%	-120.00%	-164.91%
Primary	BN3 0.5-0.75	7	5.4	8.3	6.7	<2	<10	<0.02	<10
Duplicate	QC2	6.9	5.4	9.1	8.4	<2	<10	<0.02	<10
RPD Value		-1.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Primary	BN14 0.5-0.75	7.3	5.4	-	-	-	-	-	-
Duplicate	QC3	7.3	5.4	-	-	-	-	-	-
RPD Value		0.00%	0.00%	-	-	-	-	-	-
Primary	BN15 0-0.25	6.6	5.3	-	-	-	-	-	-
Duplicate	QC4	6.8	5.3	-	-	-	-	-	-
RPD Value		2.99%	0.00%	-	-	-	-	-	-

96.1%	RPDs above 50% criteria
<0.5	Where one sample is below detectable levels, evaluated as equivalent to half detection limit

GHD

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Document Status

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