SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Appendix G-1
Geochemistry Technical Report

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Geochemical Assessment of Potential Coal Reject, Coal and Spoil Materials

SARAJI EAST COAL MINE PROJECT

Final: 26 April 2012

Prepared for: **BHP Billiton Mitsubishi Alliance and Sinclair Knight Merz**

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EXECUTIVE SUMMARY

RGS-Terrenus have been commissioned by Sinclair Knight Merz (SKM) on behalf of BHP Billiton Mitsubishi Alliance (BMA) to undertake a geochemical assessment of potential mining waste materials from the proposed Saraji East Coal Mining Project (the Project), Queensland. The assessment has been undertaken to assist BMA (the Proponent) with the management of coal and mineral waste materials that are likely to be generated by the Project and also as part of the environmental regulatory approvals process for the Project.

The Project is a proposed underground mine, extracting coal using longwall mining methods from the Harrow Creek Upper (H16) seam and the Dysart Lower (D14 and D24) seams and the access portals for the underground mine will commence from the highwall of the existing open pits at the neighbouring Saraji Mine (also owned by BMA). The nature of longwall underground mining, combined with the almost immediate access to coal from the Saraji Mine pit highwalls significantly limits the disturbance (extraction) of spoil material, therefore this geochemical assessment primarily addresses the geochemical characterisation and assessment of coal and potential coal reject materials, as the latter materials will form almost all of the likely mineral waste generated by the Project. An assessment of spoil (overburden) material was also undertaken, as some spoil will be disturbed during construction of the mine access portals from the existing Saraji Mine pit highwalls, although spoil is expected to comprise less than 1% of all mineral waste generated by the Project.

The coal and potential coal reject samples provided to RGS-Terrenus for assessment were obtained from exploration drill-core by BMA. The spoil samples provided to RGS-Terrenus for assessment were obtained from the existing Saraji Mine pit highwalls and from exploration drill-core by BMA. The assessment of all materials also utilised existing geochemical data from the project coal quality database and geochemical assessments undertaken in recent years at Saraji Mine on related spoil and reject materials.

The assessment has been based primarily on static geochemical test data, with results of kinetic leach column (KLC) tests being included for selected representative materials.

The environmental geochemical characteristics of the potential coal reject, coal and spoil materials can be summarised as follows:

Potential coal rejects

- Potential coal rejects are expected to generate pH-neutral to mildly alkaline, low-salinity runoff/seepage following surface exposure.
- The total sulfur concentration of all samples is low (75th percentile = 0.17%), however some samples have sufficient sulfide minerals (pyrite) to potentially generate acid.
- Some potential coal reject samples have been classified as potentially acid forming (PAF), however most samples, and therefore the bulk material, is expected to be non-acid forming (NAF). PAF rejects are expected to comprise less than 10% of all reject material.
- Total metal and metalloid concentrations in potential coal reject samples were low – below the applied health-based investigation levels for soils.

- The multi-element results indicate that a few potential coal reject materials may produce leachate containing elevated concentrations of some soluble elements (mainly arsenic, molybdenum and selenium).

Spoil

- Spoil is expected to generate alkaline, low-salinity runoff/seepage following surface exposure.
- The total sulfur and sulfide concentration of all spoil samples assessed is very low, and all samples assessed were classified as NAF.
- Total metal and metalloid concentrations in spoil samples were low – below the applied health-based investigation levels for soils.
- The multi-element results indicate that some spoil materials may produce leachate containing elevated concentrations of some soluble elements (mainly mercury, molybdenum and occasionally selenium).

Coal

- Coal mined from the Project (ROM coal) is expected to generate pH-neutral to mildly alkaline, low-salinity runoff/seepage following surface exposure.
- The total sulfur concentration of the samples tested was low to moderate (average 0.7%) and some samples contain low to moderate concentrations of sulfide.
- Some samples from H16 seam have been classified as PAF, however the D14 and D24 seam samples have been classified as NAF, therefore the bulk coal material is expected to be NAF. The extent of acidification for the H16 samples is unclear, but the samples are not expected to generate significant acidity due to the relatively low sulfide concentrations.
- Total metal and metalloid concentrations in coal samples were low – below the applied health-based investigation levels for soils.
- The multi-element results indicate that coal materials, overall, are not expected to produce leachate containing soluble elements in significant concentrations. The H16 coal sample, if it does become acid forming, could be expected to release soluble metals and metalloids, and is currently releasing elevated concentrations of soluble molybdenum.

Management and Mitigation Measures

Most coal seam roof and floor materials (potential coal reject materials) are unlikely to pose a significant risk of developing acid conditions. KLC test results suggest that any acidity and resulting acid generation will not be significant.

Some potential coal reject materials may have a low capacity to generate acid, however the management of these materials should not raise any significant environmental issues, especially if disposed into an in-pit rejects disposal area and covered with inert spoil, as is proposed, and as in line with currently approved practice at Saraji Mine.

There is some uncertainty regarding the acid generating nature of some coal materials (H16 seam), with the static testing indicating that coal from H16 may be PAF. However, as a bulk material, ROM coal is not expected to generate significant acidity as confirmed by the KLC test results for a composite coal material.

ROM and Product coal may be stored at the site for a relatively short period of time (weeks) compared to mining waste materials, which will be stored at the site in perpetuity. Management practices are therefore different for coal and will largely be based around managing seepage and run-off water quality from ROM pads and coal stockpiles – as is standard accepted practice at coal mines in Australia.

The very small quantity of spoil likely to be generated by the Project through the construction of the underground access portals is likely to have a high factor of safety and very low probability of acid generation, and is expected to have low salinity.

Geochemical Assessment of Potential Coal Reject, Coal and Spoil Materials

SARAJI EAST COAL MINE PROJECT

Final: 26 April 2012

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LIST of ABBREVIATIONS and DEFINITIONS

ABCC	Acid Buffering Characteristic Curve. A test to determine the proportion of acid neutralising capacity (ANC) of a sample that may be readily available for acid neutralisation. See also ANC.
Acid	A measure of hydrogen ion (H^+) concentration; generally expressed as pH.
Acid Base Account	Evaluation of the balance between acid generation and acid neutralisation processes. Generally determines the maximum potential acidity (MPA) and the inherent acid neutralising capacity (ANC), as defined below.
AMD	Acid and Metalliferous Drainage from mineral waste materials characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity. The term AMD is used more recently to replace the term ARD (see below) as metalliferous and saline drainage can occur under pH-neutral conditions.
ANC	Acid Neutralising Capacity, expressed as kg H_2SO_4 per tonne of sample. A measure of a sample's maximum potential ability to neutralise acid. See also ABCC.
ANC/MPA Ratio	Ratio of the acid neutralising capacity to the maximum potential acidity of a sample. Used to assess the risk of a sample generating acid conditions.
ARD	Acid Rock Drainage from mineral waste materials characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity.
CHPP	Coal Handling and Preparation Plant.
Coarse Rejects	Coarse mineral waste materials (usually in pieces greater than 2 cm) produced from the CHPP as part of the processing of coal. Coarse rejects usually comprise the carbonaceous mudstone, siltstone and fine-grained sandstone located immediately above and below the product coal, which is mined during coal extraction. See also "Tailings".
EC	Electrical Conductivity, expressed as µS/cm.
Interburden	Waste rock material between mined coal seams. See also "Parting" and "Spoil".
Kinetic test	Procedure used to measure the geochemical/weathering behaviour of a sample of mine material over time.
MPA	Maximum Potential Acidity. Calculated by multiplying the total sulfur or sulfide-sulfur (Scr) content of a sample by 30.6 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne.

NAF	Non Acid Forming. Geochemical classification criterion for a sample that will not generate acid conditions.
NAPP	Net Acid Producing Potential, expressed as kg H_2SO_4 per tonne. Calculated by subtracting the ANC from the MPA.
Overburden	Waste rock material overlying the uppermost mined coal seam. See also “Spoil”.
PAF	Potentially Acid Forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions.
Parting	Thin band (nominally less than 0.5m thick) of non-coal material (typically siltstone/claystone) between economic coal seams. The parting is mined as part of the coal seam and typically reports as coarse or fine rejects from the CHPP. Parting is interburden, but due to its low thickness it is not practical to selectively mine parting as “spoil”, therefore it is mined with coal. See also “Interburden”.
ROM	Run of Mine. Coal as it comes from the mine prior to screening or processing.
S	Total sulfur.
Scr	Chromium reducible sulfur. Analytical procedure to determine the sulfide-sulfur concentration in a sample.
SO_4	Sulfate.
Spoil	Waste rock material overlying and between coal seams. Spoil overlying a mined coal seam is called overburden. Spoil between mined coal seams is called interburden.
Static test	Procedure for characterising the geochemical nature of a sample at one point in time. Static tests may include measurements of mineral and chemical composition of a sample and the Acid Base Account.
Tailings	Very fine-grained mineral waste materials produced from the CHPP as part of the processing and washing of coal. Tailings, also called ‘fines’ or ‘fine rejects’ typically comprise very fine-grained mudstone, claystone and sand present in CHPP wastewater, which for the project is filtered to remove the water from the tailings, leaving behind ‘dewatered tailings’. See also “Coarse Rejects”.
Total Sulfur	Total sulfur content of a sample generally measured using a ‘LECO’ analyser expressed as % S.

1 Introduction, Background and Context

RGS-Terrenus[1] have been commissioned by Sinclair Knight Merz (SKM) on behalf of BHP Billiton Mitsubishi Alliance (BMA) to undertake a geochemical assessment of potential mining waste materials from the proposed Saraji East Coal Mining Project (the Project), Queensland (**Figure 1**).

BMA is currently developing the Project, which will comprise an underground coal mine to extract approximately 17 million tonnes per annum (Mt/a) of coal using longwall underground mining methods, augmented by a coal handling and preparation plant (CHPP) to process the coal.

To assess management and closure options for the Project, BMA (the Proponent) needs to understand the potential environmental risks associated with the mine and associated infrastructure. As part of this, RGS-Terrenus has been engaged by SKM[2] to assess the environmental geochemical characteristics of mineral wastes associated with the project. RGS-Terrenus' consulting services were required as an integral component of the environmental impact statement (EIS) documentation for the Project.

Using existing geochemical and geological data supplemented by new data, RGS-Terrenus has geochemically characterised coal, potential coal reject and spoil materials likely to be generated by the Project. The nature of underground longwall mining significantly limits the disturbance (extraction) of overburden and interburden (spoil) materials. As such, almost all mineral waste produced is expected to be coarse coal rejects and fine tailings. Coarse rejects and tailings are derived from the processing of coal, and primarily comprise immediate coal seam roof and coal seam floor (and some parting) material. Therefore, the focus of the geochemical assessment is the coal seam roof and floor materials. Product coal has also been included in the assessment as the environmental geochemical characteristics of coal need to be understood to manage this material during handling and storage on site prior to shipment. Spoil has also been included in the assessment as some spoil, although a minor quantity, will be mined and will report as waste.

The coal and potential coal reject (coal seam roof and floor) samples provided to RGS-Terrenus for assessment were obtained from exploration drill-core by the Proponent. The assessment of coal and potential coal reject materials also utilised existing geochemical data procured during coal quality assessments by the Proponent. The assessment of spoil was based on exploration drill-core samples and highwall grab samples obtained from the proposed location of the access portal entrances (and nearby) at the adjacent Saraji Mine, operated by BMA. The assessment of potential spoil materials also utilised existing geochemical data from Saraji Mine. In the context of this report the term 'spoil' refers to overburden and interburden material, unless otherwise stated.

1.1 Objective

The overall objective of this project was to:

Evaluate the geochemical nature of spoil, potential coal reject and coal materials likely to be produced from the Saraji East Coal Mining Project and identify potential environmental issues that may be associated with mining, handling and storing of these materials.

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[1] Collaboration between RGS Environmental Pty Ltd and Terrenus Earth Sciences.

[2] SKM are the lead consultants responsible for the management of the environmental approvals for the project.

BMA & SKM
SARAJI EAST COAL MINE PROJECT

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Regional Location Map

Drawn : carteform	Filename : TR002 EAST SARAJI F01 Project Location.dwg		Figure
Date : 20.07.2011	Checked :	Scale : Refer Scale Bar	Revision : A	1

1.2 Background to the Saraji East Coal Mining Project

With respect to mineral waste geochemistry, the key components of the Project are:

- An underground longwall coal mining operation mining two plys from the Dysart Lower seam (D14 and D24) and the Harrow Creek Upper (H16) seam.
- The mine will extract up to 17 Mt/a of run-of-mine (ROM) coal to produce approximately 14 Mt/a of metallurgical product coal over a 25 year mine life (350 Mt over 25 years). By difference, the Project will produce up to 3 Mt/a of rejects (75 Mt over 25 years); comprising coal rejects and dewatered tailings.
- The ROM pad and CHPP will be located within the existing Saraji Mine lease.
- Tailings will be dewatered and disposed in-pit at the Saraji Mine, along with coarse rejects.
- The underground mine will be accessed from the neighbouring Saraji Mine: via portals from the highwall of the Jacaranda Pit and the Bauhinia Pit.
- Mining will advance eastwards, down dip, from Saraji Mine.

1.3 Project geology

The Project is located within the Bowen Basin in south-east Queensland. The Bowen Basin is part of a connected group of Permian-Triassic basins in eastern Australia, that includes the Sydney and Gunnedah Basins. The Bowen Basin contains large reserves of Permian coals, which have been mined on a large scale by open-cut and underground methods since the 1970s.

The Saraji East deposit is situated on the north-western margin of the Bowen Basin, west of the Nebo synclinorium and on the southern side of the Collinsville Shelf. The Saraji East deposit dips eastwards at between 2 to 5 degrees, with local steepening to 9 degrees on the eastern margin of the Project area. In the Project area the Bowen Basin is characterised by typical basin-fill fluvial (and some marine) sediments, comprising mudstones, siltstones, sandstones and coal seams.

Both normal and thrust faults are present in the Project area with mapped trends describing two structural domains: one trending north-northwest and the other north-south.

Coal seams

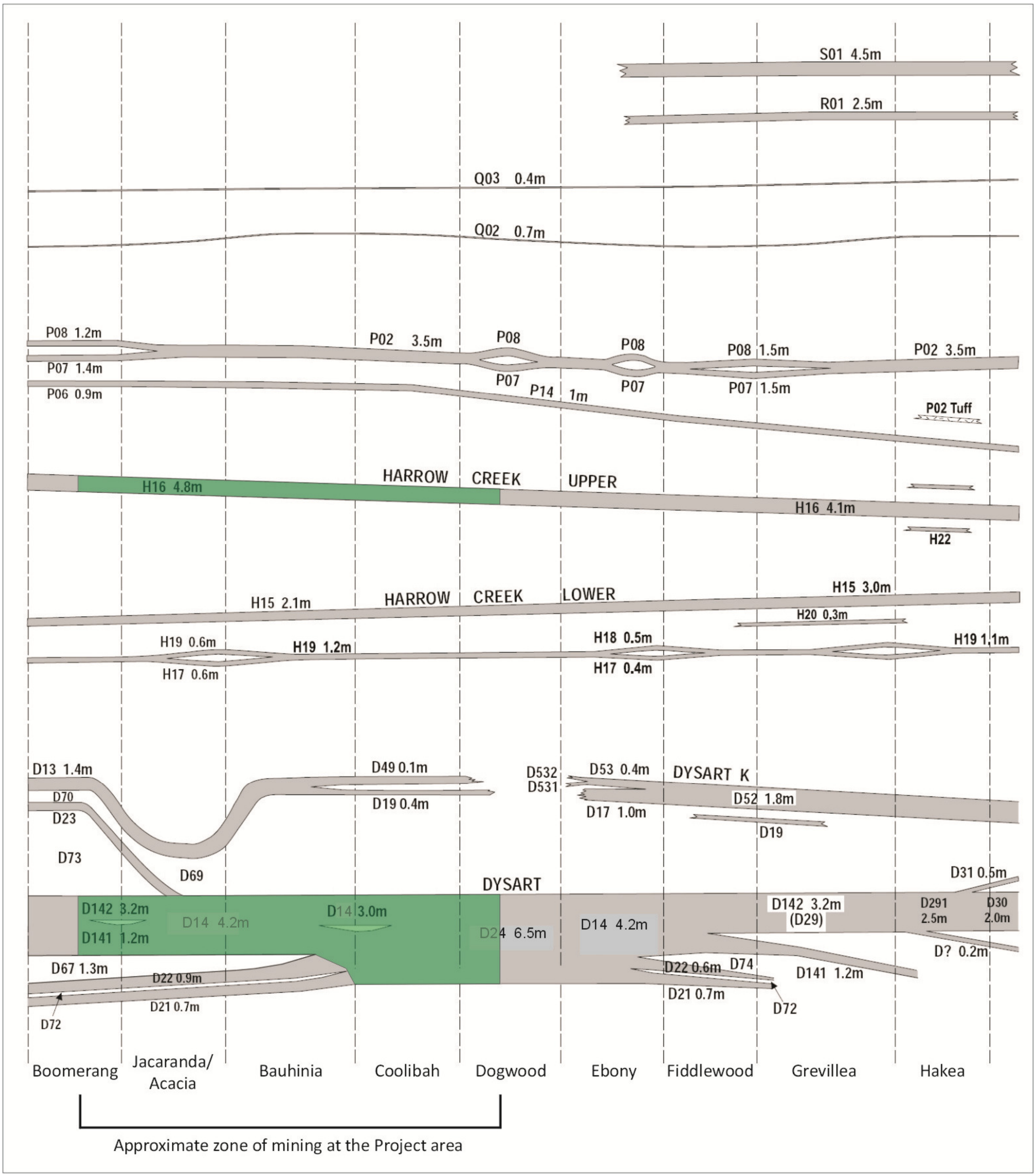
Two major coal bearing geological formations of Permian age occur in the Project area: the Fort Cooper Coal Measures and the Moranbah Coal Measures. Within these two major coal bearing formations lie six coal seam groups, listed in stratigraphic order from youngest to oldest:

• S seam	Lower-most seam of the Fort Cooper Coal Measures
• R seam	Upper-most seam of the Moranbah Coal Measures
• Q seam	Moranbah Coal Measures
• P seam	Moranbah Coal Measures
• Harrow Creek group	Moranbah Coal Measures. Equivalent to Goonyella Middle and Aquila/Tieri seams.
• Dysart group	Moranbah Coal Measures. Equivalent to Goonyella Lower and German Creek/Lilyvale seams.

The coal seams at the Project are named using the standard convention for the region, as used on the nearby Saraji, Peak Downs and Norwich Park Mines, which are all operated by BMA.

The Moranbah Coal Measures in the Project area are diagrammatically shown in **Figure 2**. The existing Saraji Mine pit names are shown at the bottom of **Figure 2**. The Project proposes to mine coal from the Harrow Creek Upper (H16) and Dysart Lower (D14 and D24) seams. The seams proposed to be mined are highlighted green in **Figure 2**.

Figure 2. Coal seam geology of the Project area
(Modified figure from EIS Project Description. Seams proposed to be mined are highlighted green)



Seam splitting is a common feature of the Saraji East deposit, as evident in **Figure 2**. In particular, the Dysart Lower (D24) seam forms a single working section from the area of the Bauhinia, Coolibah and Dogwood pits (Saraji Mine), but is split everywhere else to the north and south. The Dysart Lower (D24) seam is typically seven metres thick near the northern end of the deposit but thins to the north and splits to the south into the Dysart Lower (D14) seam, which ranges in thickness from approximately 4.5 to 5.8 metres. The Harrow Creek Upper (H16) seam is continuous throughout the Project area and relatively benign in terms of seam splitting, however in some areas the H16 is 'coked' due to the heating effects of igneous (basalt) intrusions. The Harrow Creek Upper (H16) seam is typically five metres thick throughout the Project area and is located approximately 60 to 80 metres above the Dysart Lower (D14 and D24) seams.

Coal seam roof and floor zones of the Moranbah Coal Measures are typically comprised of fine-grained sedimentary lithologies, such as mudstones, siltstones and very fine-grained sandstone, which is typical of the 'low energy' depositional environment of coal. These roof and floor zones are also commonly carbonaceous, containing wispy coal laminations. As mentioned above, basaltic intrusions are also present in some areas, particularly associated with the H16 seam.

1.4 Proposed coal mining

The Project's geological fault correlation has allowed the Saraji East deposit to be divided into two 'mines' based on northern and southern structural domains with contrasting normal and thrust fault orientations and distributions. The southern domain is referred to as 'Saraji East 1' and the northern domain is referred to as 'Saraji East 2'. The mining method and orientation of each domain has been designed to account for differences in fault structures and to maximise the extraction of the coal resource.

Saraji East 1 involves mining the Dysart Lower (D24) seam. Saraji East 2 is to be mined in a two seam operation of the Dysart Lower (D14) seam and Harrow Creek Upper (H16) seam.

Access to the underground workings will be via portals developed in the highwall of some of the Saraji Mine pits. Saraji East 1 will be via an access portal at the southern end of the Bauhinia Pit accessing the Dysart Lower (D24) seam. Saraji East 2 will have two access portals: one portal from the southern end of the Jacaranda Pit accessing the Harrow Creek Upper (H16) seam and the other portal from the northern end of the Bauhinia Pit accessing the Dysart Lower (D14) seam.

The exact elevation of the access portals where they will intersect the pit highwalls is still to be determined, therefore the exact lithological intersects at the highwalls are also unknown, but can be reasonably assumed to be closely associated with the minable coal seams; *ie*. within approximately 10 m above each of the coal seams to be mined, based on a 'typical' highwall portal entrance into an exposed seam[3]. Where geotechnical conditions allow, the access portals will commence directly into coal, therefore almost no spoil will be mined. If this is not possible the portals may be slightly above coal where roof strength is greater. In this case some spoil, comprising mudstone, siltstone and fine-grained sandstone, will be mined for a short distance (maximum 20m) until the coal seam is accessed for longwall mining. The exact dimensions of each access portal is still being refined (and is dependent on geotechnical conditions and final longwall layout), however the total volume of spoil expected to be mined during construction of the three access portals is very minor; less than 3000 m^3 (*ie*. less than 1000 m^3 for each portal).

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[3] This assumption is also supported by personal communications with Project engineers.

1.5 Proposed coal processing and mineral waste management

The Project will comprise a new ROM stockpile pad, new product coal stockpile pad and a new CHPP constructed within the existing Saraji Mine lease. The CHPP will process up to 17 Mtpa feed coal from the ROM, although not all of this ROM coal may be from the Project. The CHPP may be used to process open-cut coal from the Proponent's adjacent open-cut coal projects, in addition to coal produced by the Project.

The rejects from the CHPP will consist of:

- Dense medium coarse reject material;
- Reflux Classifier reject material; and
- Dewatered flotation tailings material.

Dewatering of CHPP tailings is achieved through the use of belt press filters. The combined dewatered tailings and coarse rejects will be conveyed from the CHPP to the rejects bin and then trucked to the existing Saraji Mine in-pit spoil dumps. The volume of coal rejects and dewatered tailings material (up to 3 Mt/a combined – 75Mt over the 25 year project life) will have a negligible impact on the size and management of the Saraji Mine in-pit spoil dumps.

All of the Saraji Mine in-pit spoil dumps will continue to be managed under the existing Saraji Mine plans and environmental authority.

Spoil (overburden and interburden) excavated and disturbed during construction of the access portals will be disposed at the Saraji Mine along with spoil from the existing Saraji Mine open-cut operation.

1.6 Summary of mineral wastes and mineral waste management

Over 99% of all mineral waste generated by the Project (75Mt) will be coarse reject and dewatered tailings, derived mainly from coal seam roof and floor (and some parting) materials. Spoil mined during construction of the underground access portals will comprise less than 3000 m^3 (~0.005 Mt[4]) of mineral waste.

Coarse reject and tailings (rejects) will be disposed, amongst spoil, into in-pit reject storage facilities at the existing Saraji Mine, well away from final landform surfaces, as per the current approved practice for rejects storage at Saraji Mine.

Over time, in-pit rejects will be covered by spoil, topsoil and rehabilitated.

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[4] Based on an assumed bulk density for siltstone of 1800 kg/m^3.

2 Geochemical Assessment Methodology

This section provides the methodology used for the geochemical characterisation and assessment of potential coal reject, coal and spoil materials likely to be produced by the Project.

2.1 Desktop review of existing information

A desktop review and understanding of available Project data and information was completed. The review included existing geochemical data, geological data, current and proposed coal exploration drilling programs, proposed mining methods and mine plan, proposed coal handling and processing methods, and proposed mineral waste disposal and management strategies. Discussions were held with Proponent personnel (predominantly geologists) to identify and discuss relevant technical information and also with SKM to understand the Project Description.

Geological information was obtained from the EIS Project Description, coupled with discussions with the Project geologists[5], and enhanced by data from exploration drill-hole logs from the Project. Based on this information, an understanding of the geological environment (lithology and structure) at the Project site was gained.

Some existing geochemical information on mine spoil, potential rejects (roof and floor) and actual coarse rejects was available from the neighbouring Saraji Mine (Emmerton, 2009; 2010). This information, where relevant, has also been utilised in the assessment.

2.2 Sampling strategy

RGS-Terrenus developed a geochemical sampling and testing program based on existing data that integrated with the exploration (resource definition) drilling and coal quality testing program. Existing spoil, potential reject and actual coarse reject geochemical data was available from the Project exploration drilling program and from the neighbouring Saraji Mine. This data was used to refine the current sampling program. This assessment is based on data from new samples collected for the Project (at the project area and at Saraji Mine) and supported, where relevant, by existing data from Saraji Mine collected by Emmerton (2009; 2010).

There are currently no specific regulatory requirements regarding the number of samples required to be obtained and tested for coal, spoil or potential reject materials at mines in Queensland. Whilst historical guidelines do exist in Queensland (DME, 1995), more recent Australian and international guidelines (DITR, 2007; INAP, 2009) advocate a risk-based approach to sampling, especially for proposed coal mines where the geology is well understood and existing information is available on similar coal and mineral waste materials.

The number of samples for the current assessment has been selected based on a number of factors including the geological variability and complexity in rock types; the size of the operation; the potential for significant environmental or health impacts; sample representation requirements; the volume of materials; the availability and representativeness of existing geochemical data; the level of confidence in predictive ability; and cost.

The potential coal reject, coal and spoil sampling strategy developed by RGS-Terrenus was based on the above requirements and also takes into account geological and exploration drilling

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[5] Personal communications with Alison Burke, Senior Project Geologist (BMA Geological Services) and Stavros Kalaitzidis, Geologist – Mine Operations (Saraji Mine).

information provided by the Proponent, as well as the proposed mine plan. A key requirement of the sampling strategy was to ensure that drill-core samples were selected to represent the various coal and mineral waste materials likely to be associated with the mine development.

As almost all mineral wastes will be coal rejects (coarse rejects and dewatered tailings), which will be derived from coal, coal seam roof, coal seam floor and coal seam parting materials, the sampling program focussed on acquiring representative samples of the potential coal reject material types.

Roof and floor samples collected (Exploration drill-core program)

Potential rejects, comprising coal seam roof, floor and parting materials, were collected from exploration drill-core as part of the BMA coal quality testing (resource definition) program (2010-2011). The geochemical data from this program included total sulfur data for roof, floor, parting and coal samples representing the Harrow Creek Upper (H16) seam and the Dysart Lower (D14 and D24) seams. RGS-Terrenus reviewed this data and selected sub-samples for detailed geochemical testing, based on total sulfur values. Only samples with total sulfur values above 0.2 weight % underwent detailed geochemical testing.

Spoil samples collected (Saraji Mine)

Spoil materials were represented by Saraji Mine drill-core and highwall grab samples collected by RGS-Terrenus and Saraji Mine geologists. The samples were from the highwall of Jacaranda, Acacia and Bauhinia pits, representing the geological units likely to be encountered during construction of the access portals. In most cases it was not possible to access the exact access portal highwall areas to collect samples (due to mine safety aspects). However, in all cases, the samples were collected from locations/zones along the highwall near the access portal areas, which are representative of the lithological zone expected to be mined during construction of the access portals. The target was the spoil material within about 10m above the Harrow Creek and Dysart coal seams, which primarily comprised siltstone materials, but also included some minor sandstone.

Coal samples collected (Exploration drill-core program)

Economic coal samples were included in the geochemical test program since some coal material may report directly as mined spoil (depending on the layout, function and accuracy of the longwall mining methods) or may report to waste as coal reject from the CHPP. Additionally, the environmental geochemical characteristics of coal need to be understood as part of the management of coal and surface water run-off from coal stockpiles.

Coarse reject samples collected (Saraji Mine)

To further enhance the program a small number of fresh coarse reject samples were collected by RGS-Terrenus from the Saraji Mine. The coarse reject samples were collected from the Ramp 4 coarse reject stockpile (in-pit pile), which contains rejects from a number of seams and pits at Saraji Mine. These samples are not discrete rejects from Harrow Creek and Dysart seams, but they do represent the same CHPP processing of the same types of roof and floor materials likely to be encountered at the Project, therefore are analogous of potential coarse rejects for the project.

Summary of samples collected

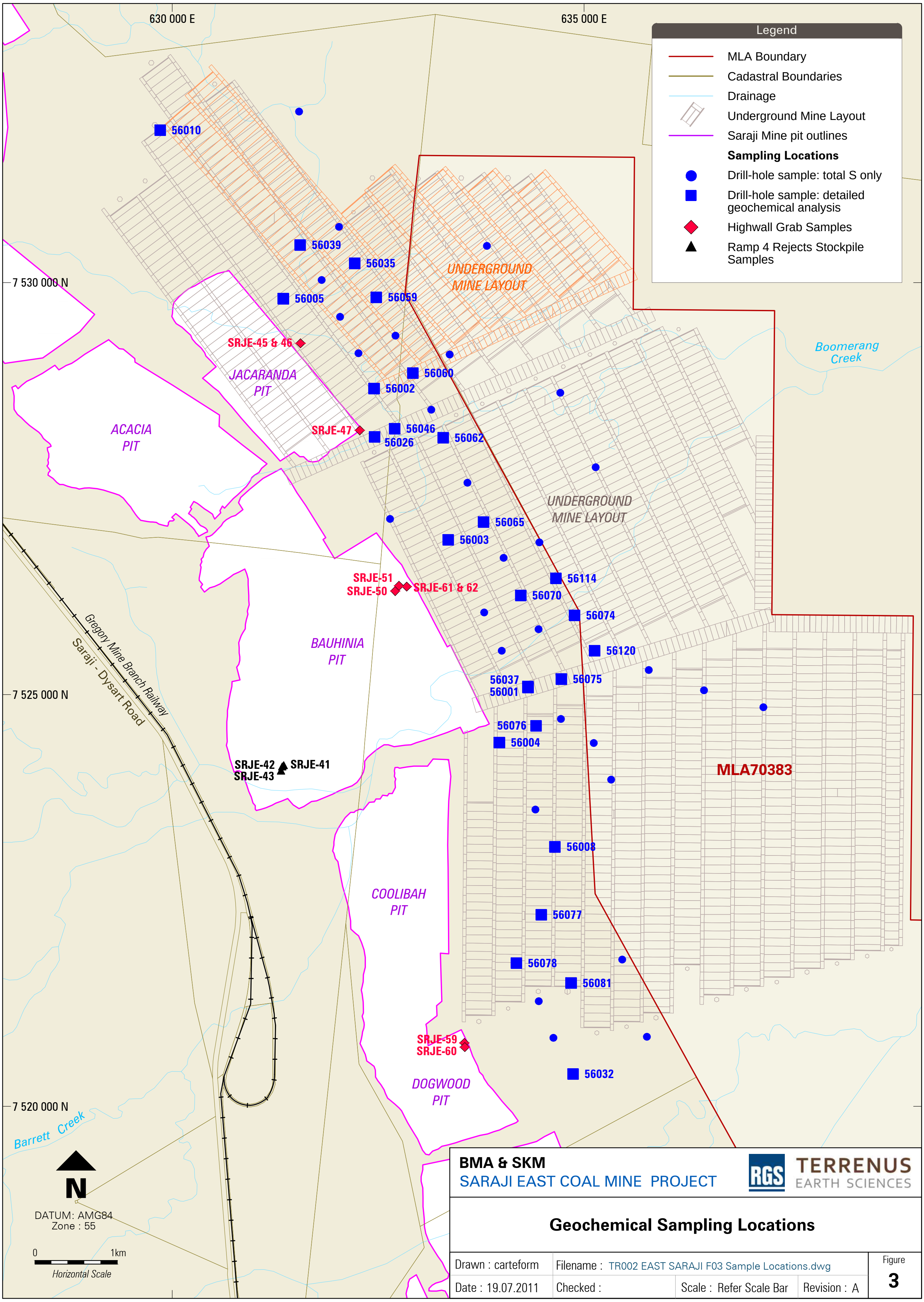
The samples used in the detailed geochemical assessment were derived from 26 drill-holes and 12 grab samples located throughout the Project area, including the eastern extent (highwalls) of the Saraji Mine. The sample locations are shown at **Figure 3**.

In total, detailed geochemical data is available for 60 samples, which comprise:

- 14 spoil samples (representing spoil from the access portals) from exploration drill-core and Saraji Mine highwall grab samples;
- 37 potential coal reject samples from exploration drill-core:
    - 6 roof samples from immediately above the Harrow Creek Upper (H16) seam;
    - 3 parting samples from within the Harrow Creek Upper (H16) seam;
    - 9 floor samples from immediately below the Harrow Creek Upper (H16) seam;
    - 2 roof samples from immediately above the Dysart Lower (D14) seam;
    - 6 floor samples from immediately below the Dysart Lower (D14) seam;
    - 5 roof samples from immediately above the Dysart Lower (D24) seam; and
    - 6 floor samples from immediately below the Dysart Lower (D24) seam.
- 3 coarse coal reject samples from the Ramp 4 in-pit reject stockpile at Saraji Mine:
- 6 coal samples from exploration drill-core:
    - 2 coal samples from the Harrow Creek Upper (H16) seam;
    - 2 coal samples from the Dysart Lower (D14) seam; and
    - 2 coal samples from the Dysart Lower (D24) seam.

In addition to those samples above, total sulfur values are available from the recent BMA coal quality testing (resource definition) program (2010-2011) for 195 potential coal reject samples from 55 exploration drill-holes, as shown in **Figure 3**. Almost all of the 26 drill-holes utilised in the detailed geochemical assessment were also part of the coal quality testing program.

The drill-holes utilised in this assessment are summarised in **Appendix A**. Drill-logs for all sampled drill-holes can be provided upon request.



BMA & SKM
SARAJI EAST COAL MINE PROJECT

RGS TERRENUS EARTH SCIENCES

Geochemical Sampling Locations

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2.3 Geochemical tests

The environmental geochemical assessment of potential coal reject, coal and spoil materials comprised three broad work programs: the compilation and assessment of existing Saraji Mine geochemical data (provided to RGS-Terrenus by the Proponent) augmented by new static geochemical test work and kinetic geochemical test work initiated and completed by RGS-Terrenus as part of this assessment. The geochemical characterisation and assessment reported herein is based on static and kinetic geochemical test methods.

Static testing provides the fundamental geochemical characteristics of a sample. Static testing involved discrete analytical tests undertaken on samples, where the results represent the geochemical characteristics of the sample at a single time period and under simple experimental conditions as a ‘snapshot’ of the sample’s likely environmental geochemical characteristics.

In comparison, kinetic geochemical tests provide dynamic data on the likely geochemical characteristics of a sample material over time. One of the most common methods of completing kinetic geochemical tests is utilising kinetic leach column (KLC) tests. RGS-Terrenus have undertaken KLC tests on selected samples from Saraji East to confirm the static test results. The KLC results collected from seven fortnightly leaching ‘events’ are included in this report.

Existing test work data

The existing geochemical data from the Saraji Mine (Emmerton, 2009 and 2010) comprised static environmental geochemical testing of spoil, roof, floor and coal samples obtained from highwall drill-core and coarse rejects from the Saraji Mine Ramp 4 rejects stockpile. The data is not included in this assessment, but is referred to and discussed as supporting information, where relevant.

Static test methodology

The static test methods employed are summarised in **Table 2** and include:

- pH and electrical conductivity (EC) (1:5 w:v);
- Total sulfur [LECO method];
- Sulfide (chromium reducible sulfur – Scr) [AS 4969.7-2008 method]; and
- Acid neutralising capacity (ANC) [AMIRA, 2002].

From the Scr and ANC results, maximum potential acidity (MPA) and net acid producing potential (NAPP) was calculated. The MPA and NAPP of these samples was calculated using the Scr data instead of the total sulfur data, as using Scr data (for fresh samples) provides a more accurate representation of the MPA that could theoretically be generated, as acid generation primarily occurs from reactive sulfide, whereas total sulfur includes other sulfur forms such as sulfate and organic sulfur.

Based on the results of the initial screening tests selected individual samples with a range of ANC values underwent further analysis for:

- Acid-buffering characteristic curve (ABCC) tests [AMIRA, 2002].

The ABCC test results were used to evaluate the amount of neutralising capacity (ANC) likely to be readily available to buffer potential acidity.

Selected samples of the same lithological type, similar spatial (drill-hole) location and similar basic geochemical characteristics were grouped into composite samples. These composite samples were subjected to the following tests:

- pH and EC (1:5 w:v);
- Total metals and metalloids analyses by [HCl and HNO_3 acid digest followed by FIMS for Hg and ICP-AES for all other elements];
- Soluble metals and metalloids ICP-AES and FIMS (1:5 w:v water extracts); and
- Soluble cations and anions ICP-AES (1:5 w:v water extracts).

BMA coal quality drill-core samples (roof, floor and coal) were prepared at the BMA Barney Point (QLD) coal preparation laboratory and analysed for total sulfur by ALS at the ALS Ipswich coal laboratory (QLD). Selected BMA coal quality samples (selected by RGS-Terrenus on the basis of total sulfur values and sample distribution) underwent further geochemical characterisation at ALS Environmental (Brisbane, QLD).

Saraji Mine highwall drill-core and highwall grab samples, and Saraji Mine coarse reject grab samples were analysed for acid-base and multi-element parameters at ALS Environmental (Brisbane, QLD).

Kinetic test methodology

Six composite coal, potential coal rejects (coal seam roof and floor) and coarse rejects samples were subjected to free-draining KLC tests. The selected samples were identified from static test results as being PAF or having an ‘Uncertain’ acid generation classification.

The intent of the KLC test program was to characterise ongoing leachate from composite potential coal reject samples subjected to routine wetting and drying cycles, which simulated exposure to ‘atmospheric conditions’. The KLC program comprised seven fortnightly leach ‘events’. The results of the KLC program are included in this report.

The leachate collected from each KLC test is analysed to determine the pH, acidity, alkalinity and concentration of soluble metals/metalloids and salts. The KLC test method is based upon the AMIRA (2002) guideline method. Some modifications were made, and justified, to better suit the types of materials being assessed.

For each sample approximately two litres (1.2 to 1.6 kg[6]) of crushed coal or mineral waste was loosely packed into a polyethylene Buchner column, connected to a polyethylene Buchner funnel. The base of the column (above the funnel) was lined with a glass fibre filter membrane. The membrane acted to prevent fine sediment from flushing into the collection bottle. The entire unit was supported on a shelf within a custom-built cabinet to allow a collection bottle to sit under the funnel and a heat lamp was mounted approximately 25 cm above the column to maintain the sample surface temperature at approximately 35ºC

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[6] The sample weight added to each Buchner funnel was dependent upon the sample density.

The KLC test column was subjected to routine de-ionised water addition and subsequent heating/drying using the heat lamp to alternatively simulate the effects of rainfall and sunshine on the sample solids. During leaching events 1000 mL of water was applied (slowly added to the top of each sample) at fortnightly intervals and allowed to free-drain through the solids and the subsequent leachate was collected and analysed (refer to list of analytes below).

Leaching commenced in July 2011 and continued for approximately 12 weeks, with the final leach undertaken in mid-October 2011. Seven leaching events were undertaken during this period. Leachate for each sample underwent the following analyses:

- pH and EC;
- Alkalinity and acidity;
- Soluble metals and metalloids (25 elements) [ICP-AES];
- Soluble mercury [FIMS method];
- Soluble hexavalent chromium [discrete analyser];
- Soluble major cations [ICP-AES];
- Soluble sulfate [ICP-AES]; and
- Soluble chloride and fluoride [discrete analyser].

The KLC tests were completed at the RGS in-house leaching laboratory in Brisbane. All leachate from the KLC tests was analysed at ALS Environmental in Brisbane.

The geochemical test work program for static and kinetic testing is summarised in **Table 1**.

Table 1. Summary of the geochemical test program
(number of individual drill-core and grab samples, and composite samples, subjected to each test regime)

Analytical tests	Spoil	Coal seam immediate roof	Coal seam immediate floor	Coal	Saraji Mine Coarse rejects
Static testing					
Total sulfur only[1]	-	95 (drill-core)	100 (drill-core)	-	-
Static acid-base (pH, EC, total-sulfur, Scr, ANC)	5 (drill-core) 9 (grab)	16 (drill-core)[2]	21 (drill-core)	6 (drill-core)	3 (grab)
Total elements and sulfate in solids	2 (individual drill-core) 2 (individual grab)	4 (composite)[3]	4 (composite)	3 (composite)	1 (composite)
Soluble elements and major ions, pH and EC in 1:5 water extracts	2 (individual drill-core) 2 (individual grab)	4 (composite)[3]	4 (composite)	3 (composite)	1 (composite)
Kinetic leach column testing					
Soluble elements and major ions, pH and EC	-	1 (composite)	3 (composite)	1 (composite)	1 (composite)

All composite samples are composites of drill-core samples only or grab samples only (*ie*. no mixed drill-core/grab composites).

1: Samples analysed for total sulfur only by BMA as part of the coal-quality assessment program. All other analyses were initiated by RGS-Terrenus as part of this assessment.

2: Includes 3 parting samples (igneous intrusion within H16 coal).

3: Includes 1 composite parting sample (igneous intrusion within H16 coal).

Assessment of element enrichment and solubility

Multi-element scans are typically carried out to identify any elements (particularly metals and metalloids) present in a material at concentrations that may be of environmental concern with respect to revegetation and surface water quality. The assay result for each element is compared to potentially relevant guideline criteria to determine any concerns related to mine operation, environmental toxicity and final rehabilitation. Elements identified as enriched may not necessarily be a concern for revegetation, human/animal health or drainage water quality, but their significance should be evaluated. Similarly, because an element is not enriched does not mean it will never be a concern, because under some conditions (*eg*. low pH) the geochemical behaviour of common environmentally important elements such as Al, Cu, Cd and Zn increases significantly.

There are no guidelines and/or regulatory criteria specifically related to total metal concentrations in mine waste materials, such as overburden, coal and potential coal rejects. In the absence of these, and to provide relevant context for this assessment, the total concentration of each element reported in mineral waste samples (solids) has been compared to NEPC (1999a) health-based investigation levels (HIL) category 'E' for parks and recreation (open spaces). The applicability of the NEPC (1999a) guideline for 'open spaces' stems from the potential final land use of the mine following closure (*ie*. low-intensity livestock grazing).

The total metals concentration for individual elements in mineral waste materials can also be relevant for revegetation activities and/or where the potential exists for human contact (*eg*. if the material was to be used off-site).

Furthermore, coal and mineral waste materials can leach soluble metals at concentrations that may impact the environment or human health. Water extract tests are used to determine the immediate solubility and potential mobility of elements under existing pH and oxygen (redox) conditions. Soluble element concentrations can be compared with those recommended in relevant surface water and groundwater guideline criteria in order to provide some context.

Again, there are no guidelines and regulatory criteria specifically related to surface runoff and/or seepage from coal, spoil and potential coal reject materials since guidelines (and regulatory criteria) will depend upon the end-use and receiving environment of the seepage. Therefore, to provide relevant context, the soluble concentration of each element extracted from coal and mineral waste materials has been compared to livestock drinking water guidelines (NEPC, 1999b and ANZECC, 2000). These guidelines allow for higher concentrations of individual parameters (appropriate for an industrial facility in a rural area) and are less prescriptive and more appropriate (in the context of the project) than guidelines designed for water to be used for direct human consumption or being directly discharged into an aquatic environment (*eg*. stream, river, lake, etc.).

2.4 Sample classification criteria

Sample classification of coal and mineral waste materials from mining projects follows some general rules, however the classification has to take into account the site geology and other site-specific geochemical characteristics that may influence the classification criteria.

Samples for the Project were classified, with respect to acid generation, using total sulfur (or preferentially Scr, where available), NAPP and ANC/MPA ratio data into three broad categories: NAF; Uncertain; and PAF.

Within these three broad categories, the sample classification was refined as follows:

***NAF – Barren*:**

Total Sulfur ≤0.1 %

***NAF*:**

Sulfide-sulfur (S_{CR}) ≤0.1 % and ANC/MPA ratio >2 *or*

NAPP <-10 kg H_2SO_4/t and ANC/MPA ratio >3

Uncertain:

Sulfide-sulfur (S_{CR}) >0.1 % and NAPP <0 kg H_2SO_4/t and ANC/MPA ratio <2

***PAF – Low Capacity (PAF-LC)*:**

Sulfide-sulfur (S_{CR}) >0.1 % and NAPP between 0 and +10 kg H_2SO_4/t

***PAF*:**

NAPP >+10 kg H_2SO_4/t and ANC/MPA ratio <2

3 Static Geochemical Test Results

The data and interpretations in this report are reported in the context of mineral waste materials likely to report directly as access portal spoil or mineral waste designated as potential coal reject (*ie*. mineral waste material likely to be generated from the CHPP) [excluding coal product, which is not regarded as waste]. Coal samples have been assessed to understand their potential environmental risks when stockpiled, such as on a ROM pad. Existing coarse rejects samples from Saraji Mine have also been assessed, as these are analogous to the coarse rejects likely to be produced by the CHPP for the Project.

3.1 Total sulfur distribution

Total sulfur concentrations were available for 195 coal seam roof and floor samples (in total) from the H16, D14 and D24 seams, measured as part of the Project coal quality program (2010-2011). As shown in **Table 2** and **Figure 4**, total sulfur concentrations are all low, with the 75th percentile total sulfur value for the three seams being 0.18%, 0.18% and 0.15% for the H16, D14 and D24 seams, respectively.

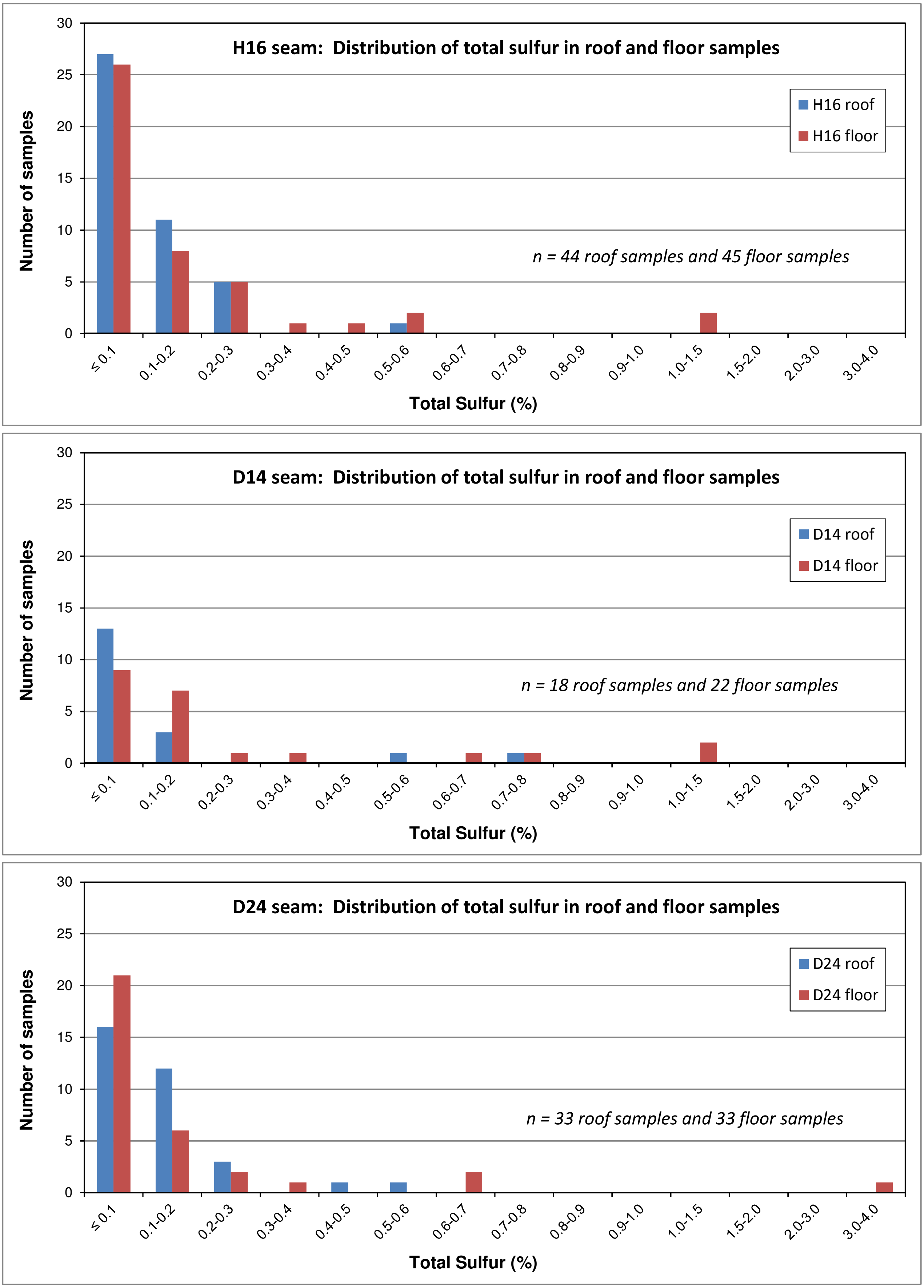
Table 2. Summary statistics for total sulfur concentration in coal seam roof and floor samples

Seam	Seam location	No. of Samples	Total Sulfur (%)					
			Minimum	25th percentile	50th Percentile (median)	75th percentile	90th percentile	Maximum
H16	roof	44	<0.01	0.04	0.09	0.17	0.21	0.58
	floor	45	0.01	0.03	0.08	0.20	0.38	1.41
	All H16	**89**	**<0.01**	**0.03**	**0.08**	**0.18**	**0.28**	**1.41**
D14	roof	18	0.02	0.03	0.06	0.11	0.26	0.73
	floor	22	0.02	0.07	0.16	0.22	0.73	1.34
	All D14	**40**	**0.02**	**0.05**	**0.09**	**0.18**	**0.69**	**1.34**
D24	roof	33	0.02	0.08	0.11	0.16	0.22	0.60
	floor	33	0.01	0.05	0.08	0.12	0.31	3.44
	All D24	**66**	**0.01**	**0.05**	**0.10**	**0.15**	**0.29**	**3.44**
All	**All**	**195**	**<0.01**	**0.04**	**0.09**	**0.17**	**0.31**	**3.44**

As evident in **Table 2** and **Figure 4**, the results are not significantly different between roof and floor samples from either of the three seams, although total sulfur values are marginally greater, overall, in the D14 floor samples compared to the D14 roof samples.

It is likely that roof and floor from two or more seams will be mined, stockpiled and processed at the same time, therefore the CHPP coal reject waste at any given time will more likely reflect a mixture of these potential rejects. Hence, the summary statistics for all three seams combined (bottom row of **Table 2**) would be representative of the overall potential reject total sulfur values. In this case, it is expected that potential coal rejects will have total sulfur concentrations generally less than 0.3% (90th percentile) and in most cases less than 0.2% (75th percentile value).

Figure 4. Distribution of total sulfur in coal seam roof and floor samples



3.2 Static geochemical results for potential coal reject samples

Acid-base accounting (ABA) is a theoretical balance between the potential for a sample to generate acid and neutralise acid, and in Australia is commonly expressed in units of kilograms of sulfuric acid per tonne of sample (kg H_2SO_4/t).

ABA results for the 37 potential coal reject samples that underwent detailed geochemical characterisation are presented in **Appendix B - Table B1** and summarised as follows, with reference to **Figures 5** to **9** (figures displayed at the end of this section). **Figures 5** to **9** also show the results of spoil, coal and existing coarse reject samples tested. The laboratory certificates for these samples, including the acid buffering characteristic curve (ABCC) data, are provided in **Appendix E**.

The 37 samples were selected from the full 195 sample set on the basis that these samples have total sulfur screening values of greater than 0.2%. Of the 195 samples in the full dataset, 42 samples (22%) have total sulfur values greater than or equal to 0.2%. Therefore, the 37 samples subjected to detailed static testing represent those 22% of all samples with the highest total sulfur values, and therefore with the greatest potential for acid generation.

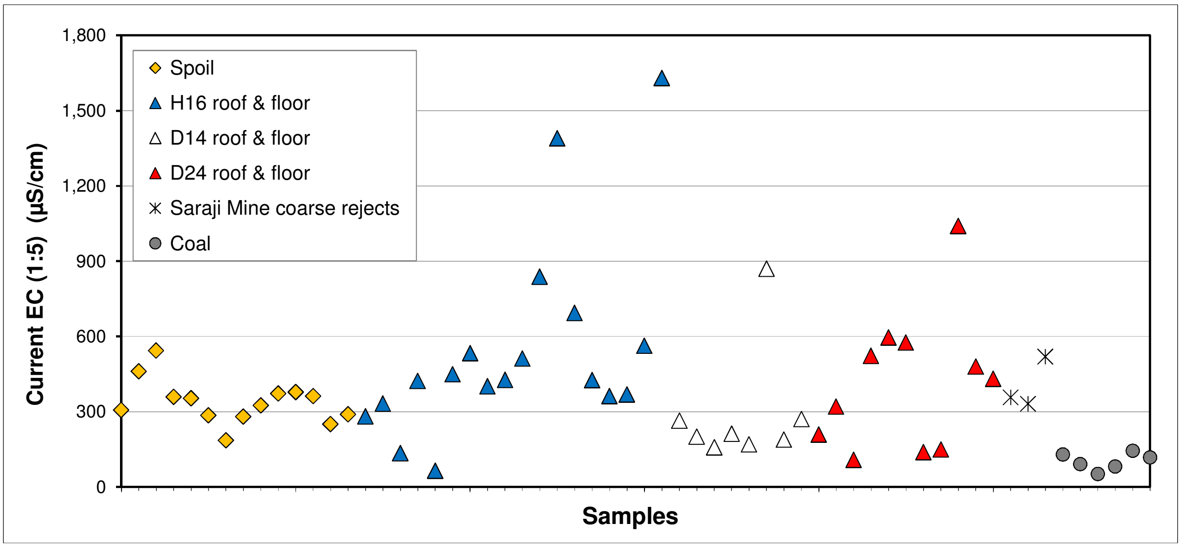
- The current $pH_{1:5}$ of potential coal reject samples is pH neutral to alkaline, ranging from pH 6.8 to pH 10.0 (median pH 9.4) (**Figure 5**). There is no significant difference between the pH of the roof or floor samples or between the three seams.
- The current $EC_{1:5}$ ranges from 64 to 1630 µS/cm, but the overall EC is low (median EC 401 µS/cm) (**Figure 5**), and the median EC value is regarded as representing ‘low’ salinity materials as defined in Queensland DME technical guideline (DME, 1995), reproduced in **Table 3**.

Table 3. Salinity criteria for potential coal reject mine waste assessment

	Very low	Low	Medium	High	Very high
$EC_{1:5}$ (sample:water) µS/cm	< 150	150 - 450	450 - 900	900 - 2000	> 2000

- The total sulfur concentration of these potential coal reject samples is low to moderate, with a median value of 0.41% and values ranging from 0.03% to 3.74% (**Figure 6**). Only 2 of the 37 potential coal reject samples had total sulfur values below 0.10% (thereby classifying these two samples as NAF-barren). The total median total sulfur values for the 37 samples (0.41%) was higher than the median value for all 195 coal quality roof and floor samples (0.09%), as expected, due to the 37 samples being selected for detailed testing on the basis of these samples having total sulfur ‘screening’ values of greater than 0.2%.

Figure 5. Current EC (µS/cm) and pH for all samples



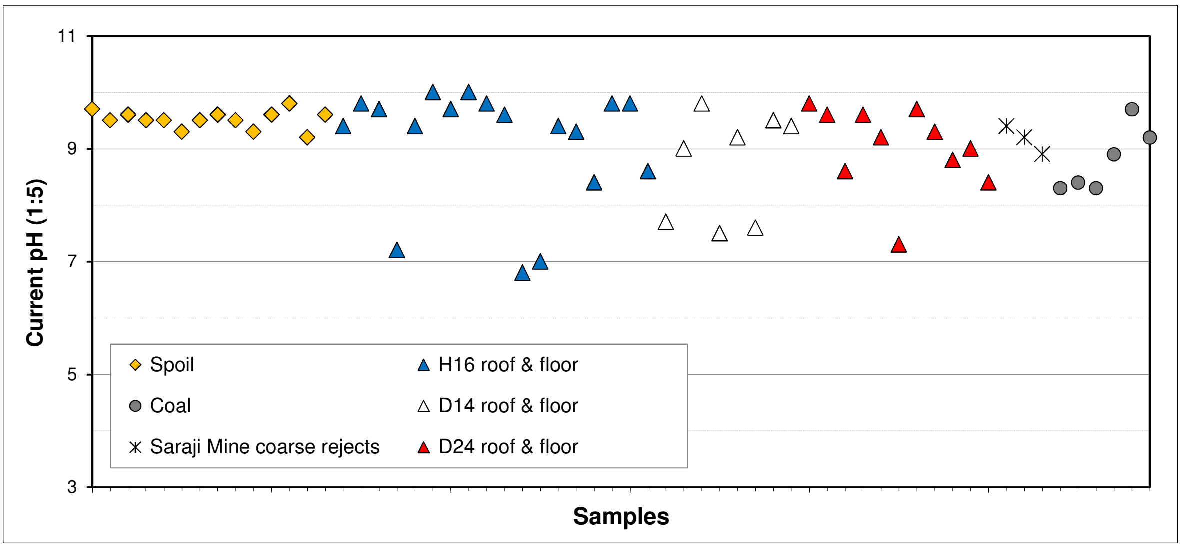
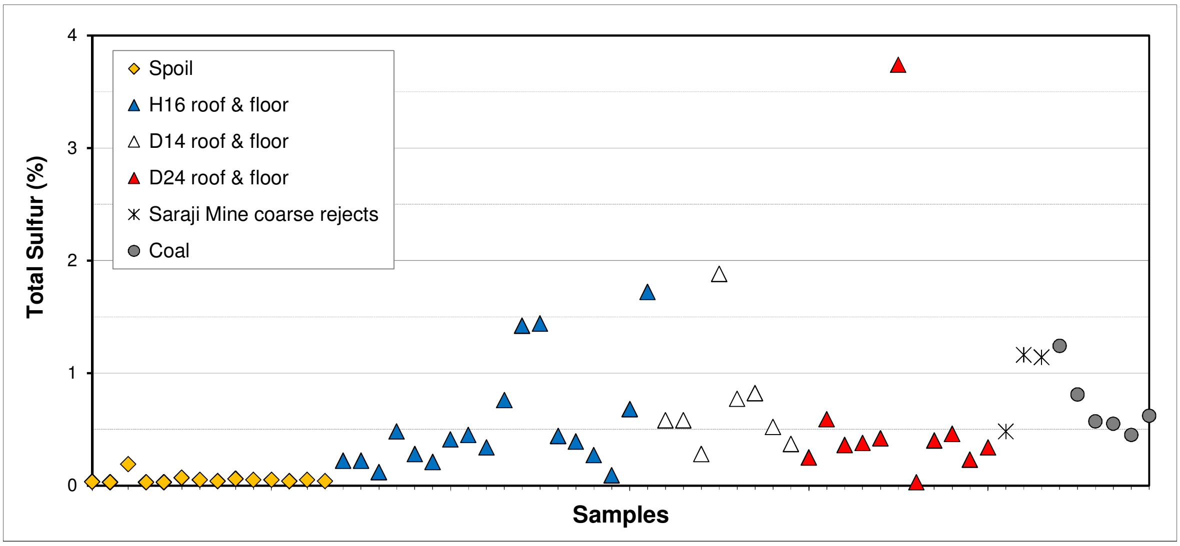


Figure 6. Total sulfur (%) for all samples



- The sulfide-sulfur (as Scr) concentrations for these samples ranged from 0.01% to 3.74%, with a median value of 0.17%. For about two-thirds of the potential reject samples, Scr represents about 50% or less of the total sulfur concentration (**Figure 7**), although for the remaining one-third of the samples more than 50% of the total sulfur is present as sulfide. Six samples had Scr values proportioning greater than 75% of the total sulfur concentration.

- The MPA that could be generated by the potential coal reject samples, calculated from Scr, was up to 114.5 kg H_2SO_4/t, however the median MPA value was very low (5.3 kg H_2SO_4/t). The median MPA value was 4.6, 12.5 and 3.7 kg H_2SO_4/t, for the H16, D14 and D24 seams, respectively. The lithological log for the D24 floor sample (SRJE-22) with the high MPA value of 114.5 kg H_2SO_4/t (**Figure 8**) and high Scr value (3.74%) shows it contains visible pyrite.

- The ANC values were also relatively low, with a low median ANC value of 8.9 kg H_2SO_4/t, but spanning a large range from 3.6 to 162 kg H_2SO_4/t (**Figure 8**). The five high ANC values from H16 seam (**Figure 8**) were from the three igneous parting samples and two igneous floor samples. These samples likely contain calcite.

- ABCC tests were undertaken on five potential coal reject samples. The results indicated that the readily available ANC for these five samples ranged from 14% to 46% (**Appendix B – Table B2**), with an average ABCC value of 29%, indicating that for these samples about one-third of the ANC is expected to be readily available to buffer acidity.

- Based on the large range of MPA and ANC values, the calculated NAPP values also spanned a large range, from -156 to +82.3 kg H_2SO_4/t, with a median NAPP value of -5.9 kg H_2SO_4/t. The median NAPP value was similar for each of the three seams, being -6.5, -0.6 and -5.9 kg H_2SO_4/t for the H16, D14 and D24 seams, respectively.

Generally those samples with an ANC/MPA mass ratio of greater than 2 are considered to have a negligible/low risk of acid generation and a high factor of safety in terms of potential for acid and metalliferous drainage (AMD) (DITR, 2007; INAP, 2009[7]). The results show that 22 (about 60%) of the 37 potential coal reject samples have an ANC/MPA ratio greater than 2 and are considered to have a negligible risk of acid generation and a high factor of safety (**Figure 9**). Of the remaining 15 samples, seven samples have ANC/MPA ratios of between 1 and 2, indicating that they have a 'theoretical' excess of neutralising capacity, however it cannot be assumed that all of this ANC will be available or in a suitable form to neutralise potential acidity, as has also been indicated from the ABCC tests. Eight samples have ANC/MPA ratios of less than 1, indicating that they have a theoretical excess of potential acidity relative to neutralising capacity.

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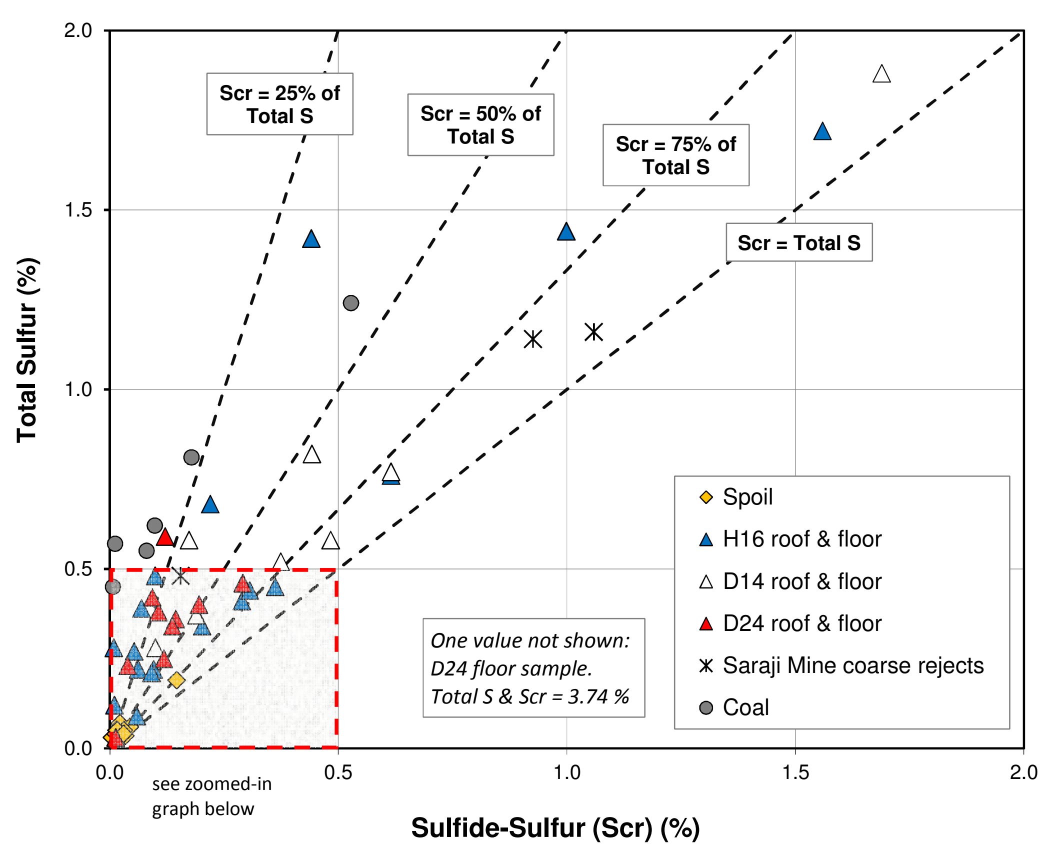
[7] INAP (2009) considers that mine materials with an ANC/MPA ratio greater than 2 are likely to be NAF unless significant preferential exposure of sulfides along fracture planes occurs in combination with insufficiently reactive ANC.

Figure 7. Total sulfur (%) and Scr (%) for all samples



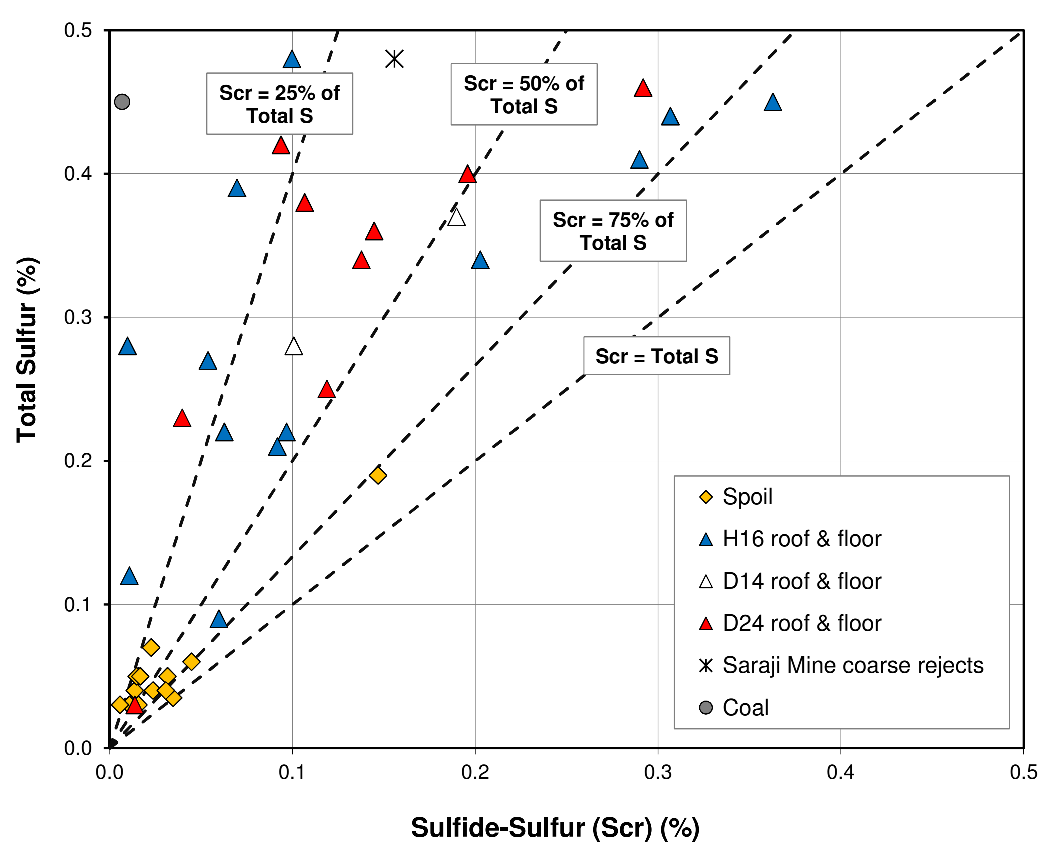
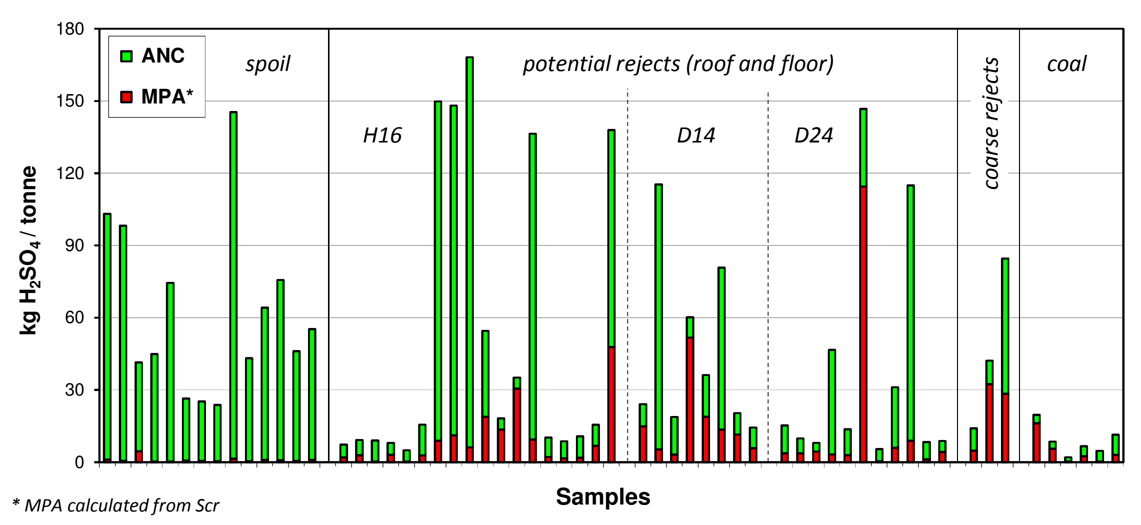


Figure 8. MPA and ANC (kg H_2SO_4/t) for all samples



* MPA calculated from Scr

Figure 9. ANC versus MPA (kg H_2SO_4/t) for all samples

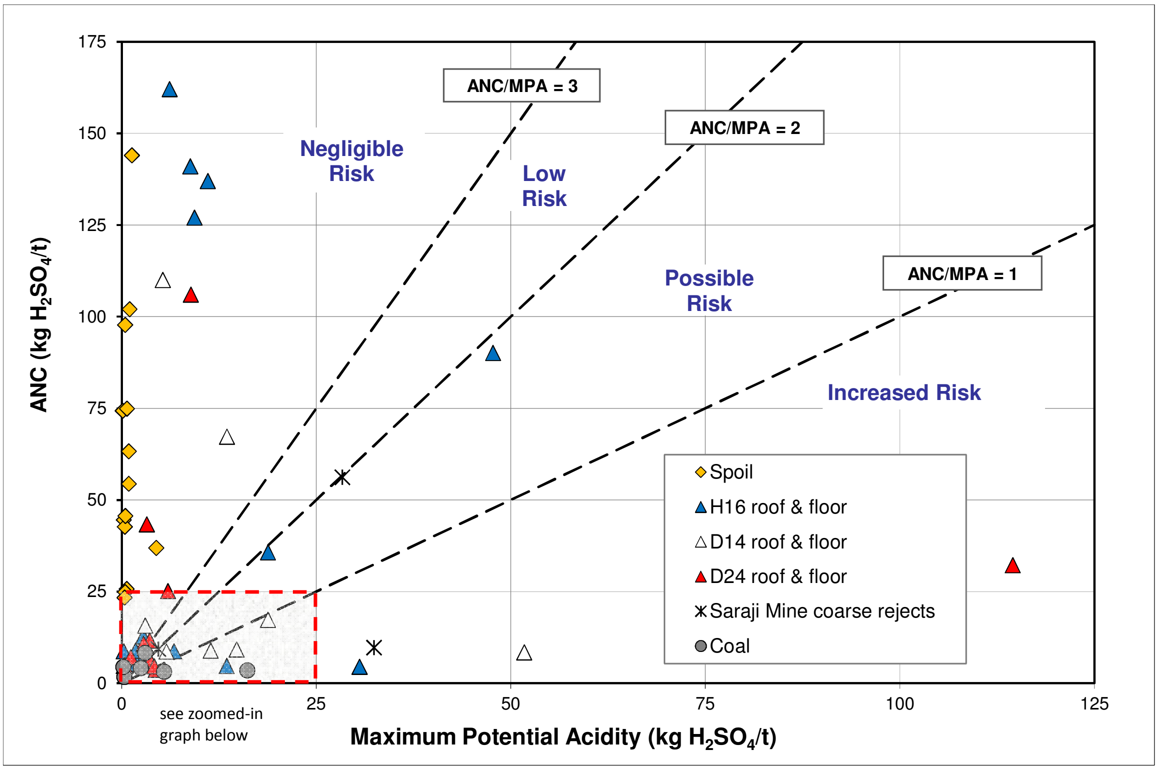
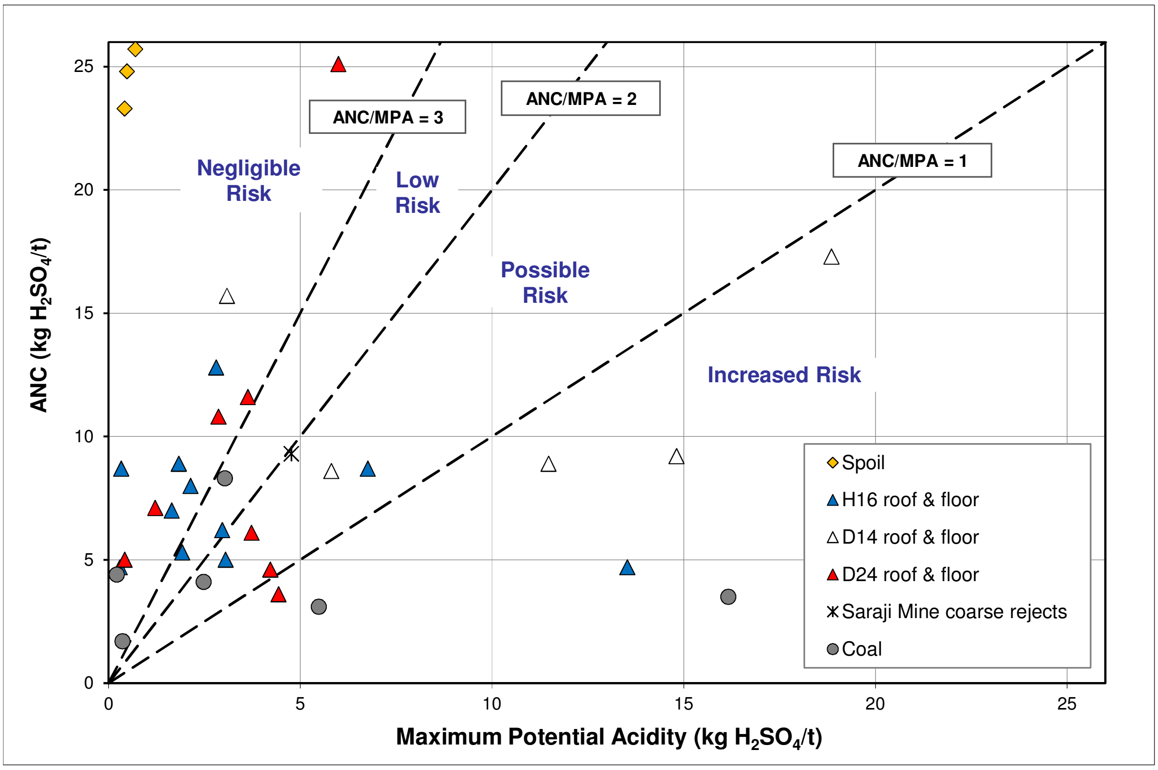


Figure 9 (cont). **ANC versus MPA (kg H_2SO_4/t) for all samples** [zoomed-in scale]



The ABA results presented in this section have been used to classify the acid forming nature of the 37 potential reject samples as shown in **Appendix B - Table B1**. The geochemical classification (acid forming nature) of the potential reject samples is summarised in **Table 4** below.

Table 4. **Geochemical classification of potential coal reject samples**

Geochemical Classification	Total Sulfur (%)	Scr (%)	NAPP (kg H_2SO_4/t)	ANC/MPA Ratio	No. of Potential Reject Samples
NAF - Barren	≤ 0.1				2
NAF		≤ 0.1		> 2	19
			≤ -10	> 3	
Uncertain		> 0.1	< 0	<2	8
PAF – Low Capacity		> 0.1	> 0 and < 10	<2	5
PAF		≥0.2	> 10	<2	3

The results in **Table 4** show that over half of the potential reject samples tested (21 of 37) fall in the NAF-Barren[8] or NAF categories. Five samples were classified as PAF-Low Capacity, three samples were classified as PAF and eight samples classified as 'Uncertain'. Of those samples classified as PAF-Low Capacity or PAF, all except one sample had total sulfur values above 0.5%.

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[8] Samples with a total sulfur content of ≤0.1 % are essentially barren of sulfur and have negligible capacity to generate acidity, even in the absence of significant ANC.

Bearing in mind that these 37 potential reject samples (from the larger set of 195 samples) were selected for more detailed geochemical testing on the basis of them having total sulfur values greater than 0.2% significantly skews the results towards the Uncertain and PAF classifications. This point is illustrated by the total sulfur values for the full dataset in **Section 3.1**, which shows that 112 of the 195 samples (57%) have total sulfur values of less than 0.1%, which classifies them as NAF-barren, and of the remaining 83 samples 47 (24%) have total sulfur values between 0.1 and 0.2% and 16 samples (8%) have total sulfur values between 0.2 and 0.3%.

The Scr data indicates that sulfide-sulfur accounts for, at most, 75% of the total sulfur concentration in the samples, which suggests that these samples have a very low potential to generate significant acidity. Therefore, from the total sulfur values alone, at least 80% of the 195 potential reject samples assessed are expected to have a negligible capacity to generate acidity – a finding that does not take into account any potential neutralising capacity that may be available. Only 20 of the 195 samples (10%) had total sulfur values above 0.3%.

As stated above, eight of the potential coal reject samples tested were classified as PAF-Low Capacity or PAF, and all except one of these samples had a total sulfur concentration of greater than 0.5%. Therefore, if the total sulfur values in the full dataset are calibrated, it suggests that roof and floor (potential coal reject) samples with a total sulfur content of greater than 0.5% are more likely to be PAF (of some capacity). Of the 195 samples, 15 samples (8%) have total sulfur values above 0.5%, and could indicatively be classified as PAF-Low Capacity or PAF.

Overall, from an acid generating perspective, the potential coal reject material (as a bulk material) is expected to be NAF, with less than 10% of rejects likely to be PAF. However, there are clearly some samples, and therefore potential coal reject materials, that contain sulfide minerals and have the capacity to generate acidity. Additionally, the limited availability of neutralising capacity for the roof and floor samples suggests that relatively low sulfide concentrations may still have some capacity to produce acidity.

The uncertain nature of several samples, combined with the PAF-LC and PAF classifications of some samples has led to the establishment of kinetic leaching columns to further assess any environmental risks that these materials may pose.

3.3 Static geochemical results for representative access portal spoil samples

ABA results for the 14 spoil samples representing material likely to be mined during construction of the access portals are presented in **Appendix B - Table B1** and summarised as follows, with reference to **Figures 5** to **9** presented in the previous section. The laboratory certificates for these representative access portal spoil samples are provided in **Appendix E**.

- The current $EC_{1:5}$ of spoil samples is relatively low, with EC values ranging from 186 to 544 µS/cm (median EC 339 µS/cm) (**Figure 5**). This median EC value of 339 µS/cm is regarded as representing 'low' salinity materials as defined in Queensland DME technical guideline (DME, 1995), reproduced in **Table 5**.

Table 5. Salinity criteria for spoil mine waste assessment

	Very low	Low	Medium	High	Very high
$EC_{1:5}$ (sample:water) µS/cm	< 150	150 - 450	450 - 900	900 - 2000	> 2000

- The current $pH_{1:5}$ is alkaline, ranging from pH 9.2 to pH 9.8 (median pH 9.5) (**Figure 5**).
- The total sulfur concentration of all 14 spoil samples is very low, with values ranging from 0.03% to 0.19% (median S% = 0.03%) (**Figure 6**). Only 1 of the 14 spoil samples had total sulfur values above 0.10% (thereby classifying 13 of the 14 spoil samples as NAF-barren).
- The sulfide-sulfur (as Scr) concentrations for spoil samples was very low, and ranged from less than 0.01% to 0.15%, with a median value of 0.02%. Scr represents about 45% (median value) of the total sulfur concentration, although some samples have Scr values approaching that of total sulfur, even though the concentrations are very low (**Figure 7**).
- The MPA that could be generated by these spoil samples, calculated from Scr, was low (4.5 kg H_2SO_4/t), with a negligible median MPA value of 0.6 kg H_2SO_4/t (**Figure 8**).
- The ANC values were moderate to high, with a median ANC value of 50 kg H_2SO_4/t, but spanning a large range from 23 to 144 kg H_2SO_4/t (**Figure 8**).

As evident in **Figure 8** and **Figure 9** the ANC significantly overwhelms the MPA for these spoil samples, and results in the ANC/MPA ratio for all spoil samples being significantly greater than 2 (ranging from 8 to 404 with a median ANC/MPA ratio of 90). This shows that these spoil samples are considered to have a negligible/low risk of acid generation and a high factor of safety in terms of potential for AMD (DITR, 2007; INAP, 2009[7]).

The ABA results presented in this section have been used to classify the acid forming nature of the 14 spoil samples as shown in **Appendix B - Table B1**. The geochemical classification (acid forming nature) of spoil samples is summarised in **Table 6** below.

Table 6. Geochemical classification of spoil samples

Geochemical Classification	Total Sulfur (%)	Scr (%)	NAPP (kg H_2SO_4/t)	ANC/MPA Ratio	No. of Spoil Samples
NAF - Barren	≤ 0.1				13
NAF		≤ 0.1		> 2	1
			≤ -10	> 3	
Uncertain		> 0.1	< 0	<2	none
PAF – Low Capacity		> 0.1	> 0 and < 10	<2	none
PAF		≥0.2	> 10	<2	none

The results in **Table 6** show that almost all spoil samples tested (13 out of 14 samples) fall in the NAF-Barren[8] category, with the remaining samples being classified as NAF. No samples were classified as PAF. Overall, from an acid generating perspective, the spoil material mined during construction of the access portals is likely to be a NAF material that contains significant excess ANC.

The results have also shown that, from an acid generating perspective, there is no difference or distinction between the various geological units and lithologies likely to be excavated during construction of each access portal.

These results support earlier work by Emmerton (2009) on highwall drill-core spoil samples from the Saraji Mine, which found that spoil samples close to the H16, D14 and D24 seams were all clearly NAF, with abundant ANC and low sulfur and sulfide concentrations. Emmerton's investigation identified some spoil and roof/floor samples as PAF (generally low capacity, similar to the current assessment), however these samples were associated with coal seams that will not be mined or disturbed as part of the Project.

3.4 Static geochemical results for coal samples

ABA results for the 6 coal samples are presented in **Appendix B - Table B1** and summarised as follows, with reference to **Figures 5** to **9** presented in the previous sections. The laboratory certificates for these coal samples are provided in **Appendix E**. Very little coal would be expected to report as waste, however the environmental geochemical characteristics of coal are important from an operational management perspective (*eg*. ROM pad, stockpile management).

- The current $EC_{1:5}$ of coal samples is very low, with EC values ranging from 52 to 144 µS/cm (median EC 104 µS/cm) (**Figure 5**). The current $pH_{1:5}$ is alkaline, ranging from pH 8.3 to pH 9.7 (median pH 8.7) (**Figure 5**).
- The total sulfur concentration of the coal samples ranges from 0.45% to 1.24% (median S% = 0.60%) (**Figure 6**). The sulfide-sulfur (as Scr) concentrations for these coal samples was low, and ranged from less than 0.01% to 0.53%, with a median value of 0.09%. Scr represents about 15% (median value) of the total sulfur concentration of coal (**Figure 7**). Most sulfur in these fresh samples was probably present as organic sulfur.
- The MPA that could be generated by these coal samples, calculated from Scr, was up to 16 kg H_2SO_4/t, with a low median MPA value of 2.8 kg H_2SO_4/t (**Figure 8**).
- The ANC values were very low, which is typical of Permian coals from the Bowen Basin, with a median ANC value of 3.8 kg H_2SO_4/t, and ranging from 1.7 to 8.3 kg H_2SO_4/t (**Figure 8**).

As evident in **Figure 8** and **Figure 9** the low MPA and low ANC results for these samples has produced a range of ANC/MPA ratios. Three of the six samples have an ANC/MPA ratio greater than 2, suggesting that these samples have a negligible/low risk of acid generation and a high factor of safety in terms of potential for ARD (DITR, 2007; INAP, 2009[7]).

The ABA results presented in this section have been used to classify the acid forming nature of the six coal samples as shown in **Appendix B - Table B1**. The geochemical classification (acid forming nature) of the coal samples is summarised in **Table 7** below.

Table 7. Geochemical classification of coal samples

Geochemical Classification	Total Sulfur (%)	Scr (%)	NAPP (kg H_2SO_4/t)	ANC/MPA Ratio	No. of Coal Samples
NAF - Barren	≤ 0.1				none
NAF		≤ 0.1		> 2	3
			≤ -10	> 3	
Uncertain		> 0.1	< 0	<2	1
PAF – Low Capacity		> 0.1	> 0 and < 10	<2	1
PAF		≥0.2	> 10	<2	1

The results in **Table 7** show that none of the coal samples tested fall in the NAF-Barren[8] category, three samples are classified as NAF, one sample as PAF-Low Capacity, one sample as PAF and one sample (D14 seam) as Uncertain. The PAF-LC and PAF samples are from H16 seam. Overall, from an acid generating perspective, the coal material from D14 and D24 is classified as NAF, but some coal from H16 may be PAF, although the extent of acid generation is unclear.

3.5 Static geochemical results for coarse reject samples from Saraji Mine

ABA results for the 3 coarse reject samples from Ramp 4 in-pit rejects stockpile at Saraji Mine are presented in **Appendix B - Table B1** and summarised as follows, with reference to **Figures 5** to **9** presented in the previous sections. The laboratory certificates for these coarse reject samples, including the ABCC data, are provided in **Appendix E**. These Saraji Mine coarse reject samples are included, as they are considered analogous to the coarse rejects likely to be produced by the CHPP for the Project.

- The current $EC_{1:5}$ of coarse reject samples is moderate, ranging from 331 to 519 µS/cm (average EC 402 µS/cm) (**Figure 5**). The current $pH_{1:5}$ is alkaline, ranging from pH 8.9 to pH 9.4 (average pH 9.2) (**Figure 5**).

- The total sulfur concentration of the coarse reject samples ranges from 0.48% to 1.16% (average S% = 0.93%) (**Figure 6**). The coarse reject samples had an average sulfide-sulfur (as Scr) concentration of 0.72% (**Figure 7**).

- The MPA that could be generated by these samples, calculated from Scr, was up to 33 kg H_2SO_4/t, with an average MPA value of 22 kg H_2SO_4/t (**Figure 8**).

- The ANC values were low (approximately 9 kg H_2SO_4/t) for two of the three samples but much higher (56 kg H_2SO_4/t) for the third sample, producing an average ANC value for all three samples of 25 kg H_2SO_4/t (**Figure 8**).

- An ABCC test was undertaken on one coarse reject sample, which indicated that 52% of the ANC was expected to be readily available to buffer acidity (**Appendix B – Table B2**).

As evident in **Figure 8** and **Figure 9** the similar MPA and ANC results for these samples has produced generally low ANC/MPA ratios – between 0.3 and 2, indicating that these samples may have some risk of acid generation and potential for ARD (DITR, 2007; INAP, 2009[7]).

The ABA results presented in this section have been used to classify the acid forming nature of the three coarse reject samples as shown in **Appendix B - Table B1**. The geochemical classification (acid forming nature) of the coarse reject samples is summarised in **Table 8** below.

Table 8. Geochemical classification of coarse reject samples from Saraji Mine

Geochemical Classification	Total Sulfur (%)	Scr (%)	NAPP (kg H_2SO_4/t)	ANC/MPA Ratio	No. of Coal Samples
NAF - Barren	≤ 0.1				none
NAF		≤ 0.1		> 2	none
			≤ -10	> 3	
Uncertain		> 0.1	< 0	<2	2
PAF – Low Capacity		> 0.1	> 0 and < 10	<2	none
PAF		≥0.2	> 10	<2	1

The results in **Table 8** show that none of the three coarse reject samples tested fall in the NAF-Barren[8] or NAF categories. One sample is classified as PAF and two samples are classified as Uncertain. Overall, from an acid generating perspective, these coarse reject samples can be regarded as having a potential acid generation risk, although the extent of this risk is unclear.

These results support earlier work by Emmerton (2010) on 12 existing coarse reject samples from the Ramp 4 in-pit reject stockpile at Saraji Mine. Emmerton reported that the acid generating characteristics of the Ramp 4 coarse reject samples was highly variable and that about one-third to one-half of the samples were classified as PAF and may potentially generate acidity if exposed to oxidising conditions. Some coarse reject samples had already reacted to some extent prior to testing, and were reporting initial pH values as low as pH 3.6 (one sample) and two samples reported initial pH values between pH 5 and 6.

It is important to recognise that the coarse rejects in the Saraji Mine Ramp 4 in-pit rejects stockpile represent coal rejects from many seams and pits at Saraji Mine. The characteristics of these samples are provided to show indicative and potentially comparable results, and must be viewed in this context.

3.6 Multi-elements in coal and mineral waste solids

The composition of each sample used for multi-element testing is provided in **Appendix B – Table B3**. The multi-element (solid) test results for the 5 individual and 11 composite samples are presented in **Appendix B – Table B4** and summarised below. The laboratory certificates for these composite samples subjected to multi-element analysis are provided in **Appendix E**.

Metals and metalloids

The multi-element (solid) results in **Appendix B – Table B4** show that total metal and metalloid concentrations in spoil, potential coal reject, coarse reject and coal samples tested are low. All samples reported total metals and metalloid concentrations below the applied NEPC (1999a) health-based investigation levels (HILs) (E) for soils.

The environmental significance of identified metal concentrations in overburden and potential reject materials and their water solubility in terms of risk is discussed in **Section 5**.

3.7 Initial solubility of coal and mineral wastes

To evaluate the initial solubility of multi-elements in solids, water extract (1:5 sample:water) tests were completed for selected individual and composite samples. The results from these tests are provided in **Appendix B – Table B5** and summarised below. The composition of each sample subjected to multi-element testing is provided in **Appendix B – Table B3**. The laboratory certificates for the samples subjected to soluble multi-element analysis are provided in **Appendix E**.

The soluble multi-element results in **Appendix B – Table B5** show that soluble metal and metalloid concentrations in water extracts from spoil, potential coal reject, coarse reject (from Saraji Mine) and coal samples tested are generally low, but soluble concentrations of mercury (Hg), molybdenum (Mo) and selenium (Se) are above the applied livestock drinking water quality guideline levels for some samples.

The samples are all pH-neutral to alkaline, with pH values ranging from 6.7 to 9.5. All except three samples have pH values above 8.5. The H16 coal seam composite sample (C14) has the lowest pH (pH 6.7), indicating that inherent sulfide in this sample may be oxidising, as predicted by the acid-base accounting assessment (Section 3.4). Similarly, potential coal reject samples C07 (H16 floor) and C10 (D14 floor) both reported neutral pH (about pH 7.5), which is lower than the average pH value for all other samples (>pH 9). Samples C07 and C10 are comprised of individual samples that were also classified as either PAF-Low Capacity or PAF.

All samples have relatively low to modest EC values, as expected by the initial ABA results. Sample C07 (H16 floor) has the greatest EC (1110 µS/cm) and a larger soluble sulfate concentration (408 mg/L) compared to all other samples (median SO_4 = 38 mg/L). This may indicate that sulfide oxidation (and formation of sulfate) is already occurring in this sample, but acid generation is being buffered by excess neutralising capacity, therefore the sample is not yet releasing acid.

Leachate from all four spoil samples and one potential coal reject sample (H16 parting) contain soluble Hg concentrations above the applied NEPC (1999b) and ANZECC (2000) livestock drinking water quality guidelines.

Leachate from most samples contained soluble Mo concentrations above the applied NEPC (1999b) groundwater investigation levels (livestock drinking water), but below the applied ANZECC (2000) livestock drinking water quality guidelines.

Leachate from one spoil sample (above the D24 seam) and six of the eight potential coal reject samples contained soluble Se concentrations typically marginally above the applied NEPC (1999b) and ANZECC (2000) livestock drinking water quality guidelines.

The remaining soluble elements and ions were at concentrations below the applied livestock drinking water quality guidelines, and in many cases, below the laboratory limit of reporting (LOR).

The environmental significance of identified metal concentrations in overburden and potential reject materials and their water solubility in terms of risk is discussed in **Section 5**.

4 Kinetic Geochemical Results

KLC tests were completed on six composite samples:

SRJE-C17	H16 roof	siltstone and carbonaceous siltstone
SRJE-C18	H16 floor	siltstone, with some very fine sandstone
SRJE-C19	D14 floor	carbonaceous mudstone and siltstone
SRJE-C20	D24 floor	siltstone, mudstone and claystone (some carbonaceous)
SRJE-C21	Coarse Reject	carbonaceous siltstone from Saraji Mine Ramp 4 rejects stockpile
SRJE-C22	Coal	composite sample from H16, D14 and D24 seams (contains minor (trace) claystone and mudstone).

Leaching commenced on 19 July 2011 and continued for approximately 12 weeks, with the final leach undertaken in October 2011. Seven leaching events were undertaken during this period and the results of all leaching events are presented herein.

The first leaching event (Leach 1, Week 0) is the 'first flush' event and commonly returns atypical results as fines are initially washed from the column. Leachate results from Leach 2 onwards are usually regarded as being more representative of actual leaching characteristics. This 'first flush' characteristic is evident in the KLC test results to date.

Leachate results for the six composite materials that underwent KLC tests are presented in **Appendix C - Tables C1 to C6** with trends plotted for pH, EC, sulfate release rate and net alkalinity in **Appendix C – Figures C1 to C6**.

4.1 KLC test results for potential coal reject samples

An estimate of the acid generation classification for each composite sample was undertaken, based on average ABA values for the individual samples that were used to prepare each composite. The H16 roof KLC sample was expected to be NAF, whereas the H16 floor, D14 floor and D24 floor samples were assigned 'Uncertain' classifications, as the individual samples used to prepare these composites have all three classifications (NAF, Uncertain and PAF).

After seven leaching events over 12 weeks, the following summary of leachate characteristics of potential coal reject samples can be made:

H16 roof sample

- Leachate has been pH-neutral to alkaline (pH 7.85 to 9.06) with a final pH of 8.73, very little measurable acidity (maximum 4 mg/L as $CaCO_3$) and a final net alkalinity of 34 mg/L (as $CaCO_3$).
- Leachate has relatively low salinity, commencing with an EC value of 534 µS/cm and finishing with a final EC value of 261 µS/cm (averaging 344 µS/cm throughout the leaching program).
- The sulfate release rate has been low, ranging from 57 mg/kg/flush at the start of leaching to a final value of 28 mg/kg/flush.

- Concentration of most metals in leachate has been low, generally at or close to the laboratory LOR, although concentrations of Mo and Se (up to 0.16 mg/L) and As (up to 0.037 mg/L) are sufficient to potentially trigger comparison against background concentrations.

  However, it must be recognised that it is impractical to directly compare leachate results from bench-scale columns to water quality guidelines, as leachate from a waste storage facility would be subject to greater dilution than the leachate generated from these columns. Furthermore, materials in a waste storage facility are subject to scale-up factors and a range of oxidising conditions. Essentially, the KLC tests provide an assumed 'worst case' scenario as free-draining and freely oxidising KLC tests were used in this assessment.

H16 floor sample

- Leachate has been mildly acidic (pH 5.6) to pH-neutral (pH 7.64), with a final pH of 7.01 and has contained weak acidity, which was generally between 2 and 5 mg/L (as $CaCO_3$) throughout the leaching program from Leach 2. Leachate has a final net alkalinity of 1 mg/L (as $CaCO_3$), which was low and stable throughout the leaching program after an initial net alkalinity of -12 mg/L (as $CaCO_3$).

- Leachate is moderately saline (slightly brackish), and has fluctuated from 805 µS/cm to 1184 µS/cm, with a final EC of 854 µS/cm.

- Similar to the EC, the sulfate release rate has fluctuated throughout the leaching program between 124 and 203 mg/kg/flush, with a final sulfate release rate of 176 mg/kg/flush.

- Concentration of metals in leachate has been low, generally at or close to the laboratory LOR.

D14 floor sample

- Leachate has been pH-neutral (7.20 to 7.73) with very low acidity at approximately the laboratory LOR (average acidity value of 2.4 mg/L (as $CaCO_3$)). The net alkalinity has been low, with an average value of 7 mg/L (as $CaCO_3$).

- Leachate has generally low salinity, with an initial EC of 302 µS/cm, which has increased to a maximum value of 490 µS/cm before decreasing to a final EC value of 310 µS/cm.

- The sulfate release rate has fluctuated between 50 and 100 mg/kg/flush throughout the leaching program (average 68 mg/kg/flush), achieving a final sulfate release rate of 61 mg/kg/flush.

- Concentration of metals in leachate has been low, generally at or close to the laboratory LOR.

D24 floor sample

- The pH of leachate has fluctuated close to pH 8 throughout the leaching program, with very low acidity at approximately the laboratory LOR (final acidity value of 2 mg/L (as $CaCO_3$)). The net alkalinity has averaged 16 mg/L (as $CaCO_3$), with a final net alkalinity value of 27 mg/L (as $CaCO_3$).

- The salinity of leachate has been moderate, with an average EC value of approximately 600 µS/cm throughout the leaching program.

- The sulfate release rate increased from an initial low of 45 mg/kg/flush to a maximum of 117 at Leach 3, before decreasing to a relatively stable release rate of approximately 95 mg/kg/flush.
- Concentration of metals in leachate has been low, generally at or close to the laboratory LOR.

The results confirm that these potential coal reject samples have low acidity concentrations, generally pH-neutral to slightly alkaline leachate, generally low to moderate salinity, low sulfate release rates and generally low concentrations of soluble metals. The H16 roof sample is generating leachate with soluble As, Mo and Se at concentrations that may require surface water and seepage control.

On this basis, the samples are all confirmed as NAF and the likelihood of acid generation from these samples is very low. The results suggest that even if one or more of these samples were to generate increased acidity, the acid concentrations in leachate would likely be very low and would not pose management problems.

4.2 Preliminary KLC test results for the composite coarse reject sample

The ABA results for the composite coarse reject sample, based on average ABA values for the individual samples that were used to comprise the composite, show that the Saraji Mine coarse reject sample is expected to be PAF. After seven leaching events over approximately 12 weeks the following summary of leachate characteristics of the composite coarse reject sample can be made:

- Leachate has been pH-neutral (pH 7.53) to slightly alkaline (pH 8.47) with very low acidity at approximately the laboratory LOR (average acidity value of 2.2 mg/L (as $CaCO_3$)). The net alkalinity has been relatively low and stable, with an average value of 24 mg/L (as $CaCO_3$).
- Leachate has low to moderate salinity. The sample produced leachate with an initial EC of 1410 µS/cm, which decreased throughout the leaching program to a final value of 430 µS/cm.
- The sulfate release rate was initially elevated, starting from an initial value of 300 mg/kg/flush and decreasing throughout the leaching program to a final value of 109 mg/kg/flush.
- Concentration of metals in leachate has been low, generally at or close to the laboratory LOR.

The results suggest that sulfide oxidation may have commenced early, due to the elevated initial sulfate release rate, but the sample has buffered weak acidity generated and continued to maintain a pH-neutral to slightly alkaline pH. Additionally, the decreasing EC trend that mimics the decreasing sulfate release rate trend indicates that sulfide oxidation is probably now stabilised, if not decreasing.

On this basis the sample is currently NAF and the likelihood of acid generation from this sample is low. However it is possible that this sample may begin to generate weak acidity in the long-term, although the capacity for this sample to generate significantly acidic leachate is low.

4.3 Preliminary KLC test results for the composite coal sample

The ABA results for the composite coal sample, based on average ABA values for the individual samples that were used to comprise the composite, show that the coal sample has an ‘Uncertain’ classification. After seven leaching events over approximately 12 weeks the following summary of leachate characteristics of the composite coal sample can be made:

- Leachate is pH-neutral and has fluctuated between pH 6.75 and 7.39, with a final pH of 6.81. Leachate has contained very low acidity at approximately the laboratory LOR (average acidity value of 2 mg/L (as $CaCO_3$)). The net alkalinity of leachate has increased from an initial value of 1 mg/L (as $CaCO_3$) to final values of 14 and 12 mg/L (as $CaCO_3$) for the final two leaching events.
- Leachate has very low salinity, with an EC of less than 100 µS/cm.
- As expected by the low salinity, the sulfate release rate has been very low – less than 13 mg/kg/flush, with an average value of 4.4 mg/kg/flush.
- Concentration of metals in leachate has been very low, generally less than the laboratory LOR.

The results show that leachate is similar in composition to the de-ionised water used as the leaching fluid, with very low concentrations of major ions, salts and metals being released. This sample is unlikely to generate significant acidity and lead to acidic leachate.

5 Geochemical Characteristics of Coal and Mineral Wastes

The geochemical characteristics of spoil, potential coal reject, coal and existing coarse reject (from Saraji Mine) have been assessed, and kinetic leaching of selected samples has commenced.

The characterisation and assessment program has been undertaken to enable the proponent to understand the existing environmental geochemical characteristics of these materials, the potential operational impacts these materials may have on the Project and the potential environmental impacts these materials may have on the Project and neighbouring area.

The environmental geochemical characteristics of the materials is summarised below, with a focus on potential coal reject materials, as these materials will comprise almost all of the mineral waste for the project, with spoil materials comprising a negligible proportion. To place this into perspective, 75 Mt of rejects will be produced (over 25 years) and approximately 0.005 Mt of spoil[9] will be produced during construction of the underground access portals (Year 1). Therefore, rejects will comprise over 99% of the mineral waste generated by the Project.

The characteristics of potential coal rejects are also outlined as a bulk material and not separated by seam or by roof/floor. This is because the coal rejects are likely to be produced from the CHPP from several seams and seam locations at any given time. Additionally, whilst there are some geochemical distinctions between the three seams and between roof and floor materials, the differences are minor and insufficient to warrant selective mining or handling of any given seam or seam roof/floor.

Potential coal rejects

- Potential coal rejects are expected to generate pH-neutral to mildly alkaline, relatively low-salinity runoff/seepage following surface exposure. KLC test results align well with this expectation.
- The total sulfur concentration of all samples is low (75th percentile = 0.17%), however some samples contain sufficient sulfidic (pyritic) material to potentially generate acid. Sulfide-sulfur (Scr) comprises between 50 to 75% of the total sulfur concentration.
- Some samples have been classified as PAF (on the basis of static test results), however most samples, and therefore the bulk material, is expected to be NAF. PAF rejects are likely to have total sulfur concentrations above 0.5%, and are expected to comprise less than 10% of all reject material. The acid generating nature of these PAF and 'Uncertain' potential coal reject materials has been assessed through kinetic leaching experiments, and the results suggest that most materials will likely be NAF, and the magnitude of any acidity generated is expected to be very low.
- The potential for some coarse rejects to generate acid is supported by the results of a small number of actual coarse reject samples from Saraji Mine from this assessment and from a previous assessment (Emmerton, 2010). However, the coarse rejects (and surface water management of coarse rejects) at Saraji Mine are currently managed appropriately and do not pose a significant environmental risk.

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[9] Based on an assumed bulk density of siltstone of 1800 kg/m^3 and a maximum mined volume of 3000 m^3 for spoil.

- Total metal and metalloid concentrations in potential coal reject samples were low – below the applied health-based investigation levels for soils, however potential coal reject materials may produce leachate containing elevated soluble metal concentrations (mainly Mo and Se, but also potentially As from the H16 roof). Coal rejects from individual and discrete seams/zones will not be selectively handled and processed. All coal rejects will be 'mixed' and therefore potentially elevated concentrations of soluble metals from isolated coal reject sources will be diluted amongst the bulk reject material.

- The discussion of potential coal reject materials within this report must be read in context, since actual CHPP rejects (coarse rejects and dewatered tailings) from the operational CHPP may have different geochemical characteristics to these potential rejects obtained from drill-core roof and floor samples.

Spoil

- Spoil is expected to generate alkaline, low-salinity runoff/seepage following surface exposure.

- The total sulfur and sulfide concentration of all spoil samples assessed is very low, and all samples assessed were classified as NAF. This finding is supported by the results of highwall spoil samples from Saraji Mine from a previous assessment (Emmerton 2009).

- Total metal and metalloid concentrations in spoil samples were low – below the applied health-based investigation levels for soils, however the multi-element results indicate that spoil materials may produce leachate containing elevated soluble metal concentrations (mainly Hg and Mo).

Coal

- Coal mined from the Project (ROM coal) is expected to generate pH-neutral to mildly alkaline, low-salinity runoff/seepage following surface exposure. KLC test results align well with this expectation.

- The total sulfur concentration of the samples tested was low to moderate (average 0.7%) and some samples contain low to moderate concentrations of sulfide sulfur.

- Some coal samples from H16 seam have been classified as PAF, however the D14 and D24 seam samples have been classified as NAF, therefore the bulk coal material, is expected to be NAF. The acid forming nature of the H16 coal samples (specifically) is currently uncertain, but the samples are not expected to generate significant acidity due to relatively low sulfide concentration.

- Total metal and metalloid concentrations in coal samples were low – below the applied health-based investigation levels for soils and the multi-element results indicate that coal materials, overall, are not expected to produce leachate containing soluble elements in significant concentrations. The H16 coal sample, if it ever does become acid forming, may have the potential to release soluble metals and metalloids, and the static test results show that this material is currently releasing elevated soluble Mo concentrations. However, the KLC test results do not support this finding as leachate from the sample has remained pH-neutral throughout the test period.

6 Management and Mitigation Measures

Most coal seam roof and floor materials (potential coal reject materials) will not pose a significant risk of developing acid conditions, and the KLC test results suggest that the magnitude of any acid generation, if it occurs, is likely to be very small.

Some potential coal reject materials may have a small capacity to generate acid, however these materials can continue to be managed at the in-pit rejects disposal area and covered with inert spoil, as is current approved practice at Saraji Mine.

There is some uncertainty regarding the acid generating nature of some coal materials (H16 seam), with static test results indicating that coal from H16 may be PAF. However, as a bulk material, ROM coal is not expected to generate significant acidity and the KLC test results of a composite coal material aligns well with this prediction.

ROM and Product coal may be stored at the site for a relatively short period of time (weeks) compared to mining waste materials, which will be stored at the site in perpetuity. Management practices are therefore different for coal and will largely be based around managing seepage and run-off water quality from ROM pads and coal stockpiles – as is currently accepted practice at coal mines in Australia.

The very small quantity of spoil likely to be generated by the Project through the construction of the underground access portals is likely to have a high factor of safety and very low probability of acid generation, and is expected to generate low salinity surface runoff and seepage.

Runoff and seepage from ROM coal stockpiles, coarse reject and dewatered tailings storage areas should be monitored for water quality parameters including pH, EC and soluble metals.

7 References

ANZECC (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Livestock Drinking Water*. Australian and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). Canberra, ACT.

AS 4969.7-2008. *Analysis of acid sulfate soil – Dried samples – Methods of test. Method 7: Determination of chromium reducible sulfur (Scr)*. Standards Australia, June 2008.

DITR (2007) [Department of Industry, Tourism and Resources]. Leading Practice Sustainable Development Program for the Mining Industry. Managing Acid and Metalliferous Drainage. February 2007, Canberra ACT.

DME (1995). *Draft Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland, Technical Guideline – Assessment and Management of Acid Drainage*. Queensland Department of Minerals and Energy (DME).

Emmerton, B.A. (2009) Investigation of overburden, roof, interburden and floor material from future mining areas of Saraji Mine. Consultants report prepared by B.R. Emmerton Pty Ltd for BMA Saraji Mine, April 2009.

Emmerton, B.A. (2010) Investigation of acid-base characteristics of coal rejects material – Ramp 4 North, Saraji Mine. Consultants report prepared by B.R. Emmerton Pty Ltd for BMA Saraji Mine, June 2010.

INAP (2009). Global Acid Rock Drainage Guide (GARD Guide). Document prepared by Golder Associates on behalf of the International Network on Acid Prevention (INAP). June 2009 (http://www.inap.com.au/).

NEPC (1999a) [National Environment Protection Council]. *National Environmental Protection (Assessment of Site Contamination) Measure. Guideline on investigation levels for soil and groundwater*. HIL(E): parks, recreation open space and playing fields; HIL(F): commercial/industrial.

NEPC (1999b) [National Environment Protection Council]. *National Environmental Protection (Assessment of Site Contamination) Measure. Guideline on investigation levels for soil and groundwater*. Groundwater Investigations Levels.

Appendix A

Summary of Drill-holes utilised in the Geochemical Assessment

Drill-hole ID	Seams sampled (roof, floor and/or coal)			Geochemical data assessed	Easting	Northing
	H16	D14	D24			
56001	-	-	roof	Static geochemical testing	634319	7525083
56002	roof	-	-	Static geochemical testing	632450	7528713
56003	-	-	roof	Static geochemical testing	633350	7526876
56004	-	-	roof	Static geochemical testing	633971	7524417
	-	-	roof & floor	Total S only		
56005	-	roof	-	Static geochemical testing	631348	7529804
	roof & floor	roof & floor	-	Total S only		
56006	roof & floor	-	roof & floor	Total S only	634407	7523602
56007	roof & floor	-	roof & floor	Total S only	633582	7527568
56008	-	-	coal	Static geochemical testing	634646	7523150
	roof & floor	-	roof & floor	Total S only		
56009	roof & floor	roof & floor	-	Total S only	633143	7528455
56010	roof	floor	-	Static geochemical testing	629853	7531849
	roof & floor	roof & floor	-	Total S only		
56012	roof & floor	roof & floor	-	Total S only	631538	7532073
56015	roof & floor	S	roof & floor	Total S only	633819	7530444
56016	roof & floor	roof & floor	-	Total S only	633367	7529125
56019	roof & floor	roof & floor	-	Total S only	634709	7528662
56020	roof & floor	-	roof & floor	Total S only	635140	7527757
56021	roof & floor	roof & floor	-	Total S only	632708	7529354
56022	-	-	roof & floor	Total S only	634021	7526658
56023	-	-	roof & floor	Total S only	634445	7525790
56026	roof & floor	-	-	Static geochemical testing	632456	7528127
	roof & floor	roof & floor	-	Total S only		
56027	-	roof	-	Total S only	632642	7527130
56029	roof & floor	-	roof & floor	Total S only	634447	7521276
56030	roof & floor	-	roof & floor	Total S only	635462	7521782
56031	roof & floor	-	roof & floor	Total S only	634718	7524701
56032	-	-	roof	Static geochemical testing	634865	7520393
	-	-	roof & floor	Total S only		
56033	roof & floor	-	roof & floor	Total S only	635760	7520843
56035	roof	floor	-	Static geochemical testing	632215	7530233
	roof & floor	roof & floor	-	Total S only		
56036	-	-	roof & floor	Total S only	634319	7525090
56037	roof & floor	-	-	Static geochemical testing	634317	7525096
	roof & floor	-	-	Total S only		
56039	roof & coal	coal	-	Static geochemical testing	631553	7530455
	roof & floor	roof & floor	-	Total S only		
56040	-	-	roof & floor	Total S only	633356	7526882
56042	roof & floor	roof & floor	-	Total S only	632022	7530675
56043	roof & floor	roof & floor	-	Total S only	631812	7530031
56044	floor	roof & floor	-	Total S only	632036	7529583
56045	roof & floor	floor	-	Total S only	632259	7529142
56046	-	floor	-	Static geochemical testing	632700	7528226
	roof & floor	roof & floor	-	Total S only		
56054	roof & floor	-	roof & floor	Total S only	635783	7525295
56055	roof & floor	-	roof & floor	Total S only	635328	7523964
56059	-	floor	-	Static geochemical testing	632477	7529820
	roof & floor	roof & floor	-	Total S only		
56060	-	roof & floor	-	Static geochemical testing	632920	7528900
	roof & floor	roof & floor	-	Total S only		
56061	roof & floor	-	-	Total S only	634000	7525529

Drill-hole ID	Seams sampled (roof, floor and/or coal)			Geochemical data assessed	Easting	Northing
	H16	D14	D24			
56062	parting	-	-	Static geochemical testing	633289	7528116
	roof & floor	floor	-	Total S only		
56065	-	-	roof	Static geochemical testing	633780	7527093
	-	-	roof & floor	Total S only		
56068	floor	-	roof & floor	Total S only	634456	7526844
56069	-	-	floor	Total S only	633786	7525994
56070	floor	-	floor	Static geochemical testing	634231	7526202
	roof & floor	-	roof & floor	Total S only		
56074	floor	-	floor	Static geochemical testing	634883	7525960
	roof & floor	-	roof & floor	Total S only		
56075	-	-	floor	Static geochemical testing	634724	7525187
	roof & floor	-	roof & floor	Total S only		
56076	-	-	floor	Static geochemical testing	634416	7524620
	roof & floor	-	roof & floor	Total S only		
56077	floor	-	roof & floor	Static geochemical testing	634480	7522326
	floor	-	roof & floor	Total S only		
56078	-	-	roof & floor	Static geochemical testing	634177	7521739
	-	-	roof & floor	Total S only		
56081	roof & floor	-	floor	Static geochemical testing	634842	7521498
	roof & floor	-	roof & floor	Total S only		
56082	roof & floor	-	roof & floor	Total S only	634626	7520831
56110	roof & floor	-	roof & floor	Total S only	635115	7524409
56114	parting & floor	-	-	Static geochemical testing	634657	7526410
	roof & floor	-	-	Total S only		
56114AA	-	-	roof & floor	Total S only	634642	7526404
56120	floor	-	-	Static geochemical testing	635128	7525531
	roof & floor	-	roof & floor	Total S only		
56130	-	-	roof & floor	Total S only	636454	7525050
56131	roof & floor	-	roof & floor	Total S only	637175	7524844

Appendix B

Static Geochemical Results Tables
and
Sample Composition Table for Multi-Element Composite Samples

- Table B1 – ABA test results
- Table B2 – Acid buffering characteristic curve test results
- Table B3 – Composite sample details (sample composition)
- Table B4 – Total multi-element (solid) test results
- Table B5 – Soluble multi-element (1:5 water extract) test results

Table B1. Acid-base characteristics of coal and mineral waste samples

ALS Lab. Sample ID	Drill Hole ID or Sample Location	Sample ID	Sample Interval (m)		Lithology	Sample Type	pH[1]	EC[1]	Total Sulfur	Scr[2]	MPA[2,3]	ANC[2]	NAPP[2]	ANC/MPA ratio	Sample Classification[4]
			From	Depth				µS/cm	%		kg H_2SO_4/t				
Spoil															
EB1111719-041	Jacaranda highwall	SRJE-45	grab sample		Sandstone, fine-medium	spoil above HC	9.7	307	0.04	0.035	1.1	102	-100.9	95	Non-acid forming (barren)
EB1111719-042	Jacaranda highwall	SRJE-46	grab sample		Sandstone-carbonaceous	spoil above HC	9.5	461	0.03	0.016	0.5	97.7	-97.2	199	Non-acid forming (barren)
EB1111719-043	Jacaranda highwall	SRJE-47	grab sample		Siltstone-carbonaceous	spoil above HC	9.6	544	0.19	0.147	4.5	36.9	-32.4	8.2	Non-acid forming
EB1111719-048	56002	SRJE-56	100.4	0.10	Sandstone, fine-medium	spoil above H16	9.5	359	0.03	0.011	0.3	44.5	-44.2	132	Non-acid forming (barren)
EB1111719-049	56002	SRJE-57	99.4	0.98	Sandstone, medium	spoil above H16	9.5	353	0.03	0.006	0.2	74.3	-74.1	404	Non-acid forming (barren)
EB1111719-044	Bauhinia highwall	SRJE-50	grab sample		Siltstone; Siltstone-carbonaceous; Sandstone	spoil above DY	9.3	285	0.07	0.023	0.7	25.7	-25.0	36	Non-acid forming (barren)
EB1111719-045	Bauhinia highwall	SRJE-51	grab sample		Siltstone-carbonaceous	spoil above DY	9.5	186	0.05	0.016	0.5	24.8	-24.3	51	Non-acid forming (barren)
EB1111719-046	56001	SRJE-52	178.9	1.27	Siltstone-carbonaceous	spoil above D24	9.6	280	0.04	0.014	0.4	23.3	-22.9	54	Non-acid forming (barren)
EB1111719-047	56001	SRJE-53	175.4	1.92	Sandstone, fine-medium	spoil above D24	9.5	325	0.06	0.045	1.4	144	-142.6	104	Non-acid forming (barren)
EB1111719-050	56003	SRJE-58	154.7	1.78	Siltstone-carbonaceous	spoil above D24	9.3	373	0.05	0.015	0.5	42.7	-42.2	93	Non-acid forming (barren)
EB1111719-051	Dogwood cuttings	SRJE-59	grab sample		Sandstone; minor siltstone and coal fragments	spoil above D24	9.6	378	0.05	0.032	1.0	63.2	-62.2	64	Non-acid forming (barren)
EB1111719-052	Dogwood cuttings	SRJE-60	grab sample		Sandstone; minor siltstone and coal fragments	spoil above D24	9.8	362	0.04	0.024	0.7	74.9	-74.2	102	Non-acid forming (barren)
EB1111719-053	Bauhinia highwall	SRJE-61	grab sample		Siltstone; Siltstone-carbonaceous	spoil above D24	9.2	250	0.05	0.017	0.5	45.6	-45.1	88	Non-acid forming (barren)
EB1111719-054	Bauhinia highwall	SRJE-62	grab sample		Sandstone	spoil above D24	9.6	290	0.04	0.031	0.9	54.4	-53.5	57	Non-acid forming (barren)
Potential Coal Reject															
EB1111719-004	56010	SRJE-05	75.7	0.25	Siltstone-carbonaceous	H16 roof	9.4	281	0.22	0.063	1.9	5.3	-3.4	2.7	Non-acid forming
EB1111719-005	56026	SRJE-06	59.9	0.20	Siltstone-carbonaceous, some mudstone-carb.	H16 roof	9.8	332	0.22	0.097	3.0	6.2	-3.2	2.1	Non-acid forming
EB1111719-009	56035	SRJE-10	142.4	0.21	Siltstone	H16 roof	9.7	134	0.12	0.011	0.3	8.7	-8.4	26	Non-acid forming
EB1111719-011	56037	SRJE-12	70.3	0.24	Siltstone	H16 roof	7.2	423	0.48	0.100	3.1	5.0	-1.9	1.6	Uncertain
EB1111719-013	56039	SRJE-14	114.4	0.08	Siltstone-carbonaceous	H16 roof	9.4	64	0.28	0.010	0.3	4.7	-4.4	15	Non-acid forming
EB1111719-033	56081	SRJE-35	69.1	0.20	Siltstone, some Siltstone-carbonaceous	H16 roof	10.0	449	0.21	0.092	2.8	12.8	-10.0	4.5	Non-acid forming
EB1111719-018	56062	SRJE-19	108.2	0.16	Igneous	H16 parting	9.7	533	0.41	0.290	8.9	141	-132.1	16	Non-acid forming
EB1111719-019	56062	SRJE-20	107.6	0.20	Igneous	H16 parting	10.0	401	0.45	0.363	11.1	137	-125.9	12	Non-acid forming
EB1111719-036	56114	SRJE-39	120.0	0.40	Igneous	H16 parting	9.8	427	0.34	0.203	6.2	162	-155.8	26	Non-acid forming
EB1111719-006	56026	SRJE-07	65.7	0.26	Siltstone	H16 floor	9.6	512	0.76	0.616	18.9	35.7	-16.8	1.9	Uncertain
EB1111719-010	56037	SRJE-11	75.0	0.19	Siltstone	H16 floor	6.8	838	1.42	0.442	13.5	4.7	8.8	0.3	Potentially acid forming (low cap.)
EB1111719-022	56070	SRJE-23	81.9	0.20	Siltstone	H16 floor	7.0	1390	1.44	1.000	30.6	4.5	26.1	0.1	Potentially acid forming
EB1111719-024	56074	SRJE-26	139.5	0.55	Igneous	H16 floor	9.4	693	0.44	0.307	9.4	127	-117.6	14	Non-acid forming
EB1111719-026	56076	SRJE-28	72.7	0.20	Sandstone, very fine	H16 floor	9.3	426	0.39	0.070	2.1	8.0	-5.9	3.7	Non-acid forming
EB1111719-029	56077	SRJE-31	52.1	0.20	Siltstone	H16 floor	8.4	362	0.27	0.054	1.7	7.0	-5.3	4.2	Non-acid forming
EB1111719-034	56081	SRJE-36	74.1	0.20	Siltstone	H16 floor	9.8	368	0.09	0.060	1.8	8.9	-7.1	4.8	Non-acid forming (barren)
EB1111719-035	56114	SRJE-38	127.9	0.20	Siltstone	H16 floor	9.8	563	0.68	0.221	6.8	8.7	-1.9	1.3	Uncertain
EB1111719-037	56120	SRJE-40	157.9	0.40	Igneous	H16 floor	8.6	1630	1.72	1.560	47.8	90.1	-42.3	1.9	Uncertain

Table B1 (cont.). Acid-base characteristics of coal and mineral waste samples

ALS Lab. Sample ID	Drill Hole ID or Sample Location	Sample ID	Sample Interval (m)		Lithology	Sample Type	pH[1]	EC[1]	Total Sulfur	Scr[2]	MPA[2,3]	ANC[2]	NAPP[2]	ANC/MPA ratio	Sample Classification[4]
			From	Depth				µS/cm	%		kg H_2SO_4/t				
Potential Coal Reject (continued)															
EB1111719-002	56005	SRJE-02	189.4	0.07	Sandstone, fine	D14 roof	7.7	264	0.58	0.484	14.8	9.2	5.6	0.6	Potentially acid forming (low cap.)
EB1111719-017	56060	SRJE-18	229.0	0.20	Siltstone-carbonaceous	D14 roof	9.0	200	0.58	0.174	5.3	110	-104.7	21	Non-acid forming
EB1111719-003	56010	SRJE-04	180.3	0.32	Siltstone-carbonaceous	D14 floor	9.8	158	0.28	0.101	3.1	15.7	-12.6	5.1	Non-acid forming
EB1111719-008	56035	SRJE-09	253.4	0.46	Mudstone	D14 floor	7.5	212	1.88	1.690	51.8	8.4	43.4	0.2	Potentially acid forming
EB1111719-012	56039	SRJE-13	229.9	0.79	Mudstone	D14 floor	9.2	170	0.77	0.616	18.9	17.3	1.6	0.9	Potentially acid forming (low cap.)
EB1111719-014	56046	SRJE-15	190.1	0.49	Mudstone-carbonaceous	D14 floor	7.6	870	0.82	0.443	13.6	67.2	-53.6	5.0	Non-acid forming
EB1111719-015	56059	SRJE-16	250.4	0.48	Siltstone-carbonaceous	D14 floor	9.5	189	0.52	0.375	11.5	8.9	2.6	0.8	Potentially acid forming (low cap.)
EB1111719-016	56060	SRJE-17	229.4	0.24	Siltstone-carbonaceous, some sandstone v fine	D14 floor	9.4	270	0.37	0.190	5.8	8.6	-2.8	1.5	Uncertain
EB1111719-001	56004	SRJE-01	128.5	0.32	Mudstone-carbonaceous	D24 roof	9.8	209	0.25	0.119	3.6	11.6	-8.0	3.2	Uncertain
EB1111719-007	56032	SRJE-08	159.5	0.09	Siltstone-carbonaceous	D24 roof	9.6	320	0.59	0.122	3.7	6.1	-2.4	1.6	Uncertain
EB1111719-020	56065	SRJE-21	203.2	0.20	Siltstone	D24 roof	8.6	108	0.36	0.145	4.4	3.6	0.8	0.8	Potentially acid forming (low cap.)
EB1111719-027	56077	SRJE-29	152.2	0.20	Siltstone-carbonaceous, some tuff	D24 roof	9.6	522	0.38	0.107	3.3	43.3	-40.0	13	Non-acid forming
EB1111719-031	56078	SRJE-33	138.7	0.20	Siltstone-carbonaceous, some Claystone	D24 roof	9.2	596	0.42	0.094	2.9	10.8	-7.9	3.8	Non-acid forming
EB1111719-021	56070	SRJE-22	197.5	0.20	Mudstone-carbonaceous, some siltstone	D24 floor	7.3	575	3.74	3.740	114.5	32.2	82.3	0.3	Potentially acid forming
EB1111719-023	56074	SRJE-25	260.8	0.41	Siltstone	D24 floor	9.7	139	0.03	0.014	0.4	5.0	-4.6	12	Non-acid forming (barren)
EB1111719-025	56075	SRJE-27	224.4	0.20	Claystone; Sandstone; Coal; Siltstone	D24 floor	9.3	149	0.40	0.196	6.0	25.1	-19.1	4.2	Non-acid forming
EB1111719-028	56077	SRJE-30	159.2	0.28	Siltstone	D24 floor	8.8	1040	0.46	0.292	8.9	106	-97.1	12	Non-acid forming
EB1111719-030	56078	SRJE-32	146.0	0.20	Siltstone	D24 floor	9.0	480	0.23	0.040	1.2	7.1	-5.9	5.8	Non-acid forming
EB1111719-032	56081	SRJE-34	186.7	0.20	Siltstone-carbonaceous	D24 floor	8.4	431	0.34	0.138	4.2	4.6	-0.4	1.1	Uncertain
Coarse Reject (Saraji Mine)															
EB1111719-038	R4 in-pit stockpile	SRJE-41	grab sample		Coarse reject	Coarse reject	9.4	357	0.48	0.156	4.8	9.3	-4.5	1.9	Uncertain
EB1111719-039	R4 in-pit stockpile	SRJE-42	grab sample		Coarse reject	Coarse reject	9.2	331	1.16	1.060	32.5	9.7	22.8	0.3	Potentially acid forming
EB1111719-040	R4 in-pit stockpile	SRJE-43	grab sample		Coarse reject	Coarse reject	8.9	519	1.14	0.927	28.4	56.2	-27.8	2.0	Uncertain
Coal															
EB1111719-055	56039	SRJE-63	114.59	0.99	Coal, minor Claystone	H16 seam	8.3	129	1.24	0.528	16.2	3.5	12.7	0.2	Potentially acid forming
EB1111719-056	56039	SRJE-64	117.46	2.02	Coal, minor Claystone and Mudstone	H16 seam	8.4	91	0.81	0.179	5.5	3.1	2.4	0.6	Potentially acid forming (low cap.)
EB1111719-057	56039	SRJE-65	225.81	1.52	Coal	D14 seam	8.3	52	0.57	0.012	0.4	1.7	-1.3	4.6	Non-acid forming
EB1111719-058	56039	SRJE-66	227.33	2.53	Coal, minor Claystone and Mudstone	D14 seam	8.9	81	0.55	0.081	2.5	4.1	-1.6	1.7	Uncertain
EB1111719-059	56008	SRJE-67	178.22	1.33	Coal, minor Mudstone-carbonaceous	D24 seam	9.7	144	0.45	0.007	0.2	4.4	-4.2	21	Non-acid forming
EB1111719-060	56008	SRJE-68	179.93	2.97	Coal	D24 seam	9.2	117	0.62	0.099	3.0	8.3	-5.3	2.7	Non-acid forming

Notes

1. Current pH and EC provided for 1:5 sample:water extracts.
2. Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; and NAPP = Net acid producing potential.
3. MPA calculated from Scr.
4. Sample classification detail provided in report text.

Table B2. Acid buffering characteristic curve test results of selected potential coal reject and coarse reject samples

Drill Hole ID or Sample Location	Sample ID	Lithology	Sample Type	Static ANC[1]	Available ANC[2]	Proportion of static ANC likely to be available
				kg H_2SO_4/t		
56026	SRJE-07	Siltstone	H16 floor	36	11	31 %
56039	SRJE-13	Mudstone	D14 floor	17	2.5	14 %
56074	SRJE-26	Igneous	H16 floor	127	58	46 %
56077	SRJE-30	Siltstone	D24 floor	106	40	38 %
56114	SRJE-39	Igneous	H16 parting	162	27	17 %
R4 stockpile	SRJE-43	Coarse reject (siltstone)	Coarse reject	56	30	52 %

Notes

1. Static ANC = Acid neutralising capacity as determined by the standard static ANC test.
2. Available ANC = ANC at pH 4 as determined by the ABCC test.

ABCC graphs and raw titration data provided at Appendix E.

Table B3. Composite sample details

ALS Laboratory Sample ID	Drill Hole ID or Sample Location	Sample ID	Lithology	Sample Type	Composite Sample Number
Spoil					
EB1111719-041	Jacaranda highwall	SRJE-45	Sandstone, fine-medium	spoil above HC	
EB1111719-042	Jacaranda highwall	SRJE-46	Sandstone-carbonaceous	spoil above HC	
EB1111719-043	Jacaranda highwall	SRJE-47	Siltstone-carbonaceous	spoil above HC	SRJE-C01
EB1111719-044	Bauhinia fresh spoil	SRJE-50	Siltstone; Siltstone-carbonaceous; Sandstone	spoil above DY	
EB1111719-045	Bauhinia highwall	SRJE-51	Siltstone-carbonaceous	spoil above DY	
EB1111719-046	56001	SRJE-52	Siltstone-carbonaceous	spoil above D24	SRJE-C02
EB1111719-047	56001	SRJE-53	Sandstone, fine-medium	spoil above D24	
EB1111719-048	56002	SRJE-56	Sandstone, fine-medium	spoil above H16	SRJE-C03
EB1111719-049	56002	SRJE-57	Sandstone, medium	spoil above H16	
EB1111719-050	56003	SRJE-58	Siltstone-carbonaceous	spoil above D24	
EB1111719-051	Dogwood cuttings	SRJE-59	Sandstone; minor siltstone and coal fragments	spoil above D24	
EB1111719-052	Dogwood cuttings	SRJE-60	Sandstone; minor siltstone and coal fragments	spoil above D24	
EB1111719-053	Bauhinia highwall	SRJE-61	Siltstone; Siltstone-carbonaceous	spoil above D24	SRJE-C04
EB1111719-054	Bauhinia highwall	SRJE-62	Sandstone	spoil above D24	
Potential Coal Rejects					
EB1111719-004	56010	SRJE-05	Siltstone-carbonaceous	H16 roof	
EB1111719-013	56039	SRJE-14	Siltstone-carbonaceous	H16 roof	SRJE-C05
EB1111719-009	56035	SRJE-10	Siltstone	H16 roof	
EB1111719-005	56026	SRJE-06	Siltstone-carbonaceous, some mudstone-carb.	H16 roof	
EB1111719-011	56037	SRJE-12	Siltstone	H16 roof	
EB1111719-033	56081	SRJE-35	Siltstone, some Siltstone-carbonaceous	H16 roof	
EB1111719-018	56062	SRJE-19	Igneous	H16 parting	SRJE-C06
EB1111719-019	56062	SRJE-20	Igneous	H16 parting	
EB1111719-036	56114	SRJE-39	Igneous	H16 parting	
EB1111719-006	56026	SRJE-07	Siltstone	H16 floor	
EB1111719-022	56070	SRJE-23	Siltstone	H16 floor	SRJE-C07
EB1111719-035	56114	SRJE-38	Siltstone	H16 floor	
EB1111719-010	56037	SRJE-11	Siltstone	H16 floor	
EB1111719-024	56074	SRJE-26	Igneous	H16 floor	
EB1111719-037	56120	SRJE-40	Igneous	H16 floor	
EB1111719-026	56076	SRJE-28	Sandstone, very fine	H16 floor	SRJE-C08
EB1111719-029	56077	SRJE-31	Siltstone	H16 floor	
EB1111719-034	56081	SRJE-36	Siltstone	H16 floor	
EB1111719-002	56005	SRJE-02	Sandstone, fine	D14 roof	
EB1111719-017	56060	SRJE-18	Siltstone-carbonaceous	D14 roof	SRJE-C09
EB1111719-008	56035	SRJE-09	Mudstone	D14 floor	SRJE-C10
EB1111719-012	56039	SRJE-13	Mudstone	D14 floor	
EB1111719-003	56010	SRJE-04	Siltstone-carbonaceous	D14 floor	
EB1111719-014	56046	SRJE-15	Mudstone-carbonaceous	D14 floor	
EB1111719-015	56059	SRJE-16	Siltstone-carbonaceous	D14 floor	
EB1111719-016	56060	SRJE-17	Siltstone-carbonaceous, some sandstone v fine	D14 floor	
EB1111719-007	56032	SRJE-08	Siltstone-carbonaceous	D24 roof	
EB1111719-020	56065	SRJE-21	Siltstone	D24 roof	
EB1111719-001	56004	SRJE-01	Mudstone-carbonaceous	D24 roof	SRJE-C11
EB1111719-027	56077	SRJE-29	Siltstone-carbonaceous, some tuff	D24 roof	
EB1111719-031	56078	SRJE-33	Siltstone-carbonaceous, some Claystone	D24 roof	
EB1111719-023	56074	SRJE-25	Siltstone	D24 floor	
EB1111719-025	56075	SRJE-27	Claystone; Sandstone; Coal; Siltstone	D24 floor	
EB1111719-028	56077	SRJE-30	Siltstone	D24 floor	SRJE-C12
EB1111719-030	56078	SRJE-32	Siltstone	D24 floor	
EB1111719-021	56070	SRJE-22	Mudstone-carbonaceous, some siltstone	D24 floor	
EB1111719-032	56081	SRJE-34	Siltstone-carbonaceous	D24 floor	

Table B3 (cont.). Composite sample details

ALS Laboratory Sample ID	Drill Hole ID or Sample Location	Sample ID	Lithology	Sample Type	Composite Sample Number
Coarse Rejects (Saraji Mine)					
EB1111719-038	R4 stockpile	SRJE-41	Coarse reject	Coarse reject	SRJE-C13
EB1111719-039	R4 stockpile	SRJE-42	Coarse reject	Coarse reject	
EB1111719-040	R4 stockpile	SRJE-43	Coarse reject	Coarse reject	
Coal					
EB1111719-055	56039	SRJE-63	Coal, minor Claystone	H16 seam	SRJE-C14
EB1111719-056	56039	SRJE-64	Coal, minor Claystone and Mudstone	H16 seam	
EB1111719-057	56039	SRJE-65	Coal	D14 seam	SRJE-C15
EB1111719-058	56039	SRJE-66	Coal, minor Claystone and Mudstone	D14 seam	
EB1111719-059	56008	SRJE-67	Coal, minor Mudstone-carbonaceous	D24 seam	SRJE-C16
EB1111719-060	56008	SRJE-68	Coal	D24 seam	

Table B4. Multi-element concentrations in coal and mineral waste samples

			Spoil				Potential rejects (roof & floor)								Coarse reject	Coal		
	Composite ID (SRJE-) -->		C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15	C16
	Seam -->		above HC	above D24	above H16	above D24	H16 roof	H16 parting	H16 floor	H16 floor	D14 roof	D14 floor	D24 roof	D24 floor	Ramp 4	H16	D14	D24
	Material description -->		Siltstone - carbonaceous	Siltstone - carbonaceous	Sandstone (fine-medium)	Siltstone and Carbonaceous Siltstone	Siltstone and Carbonaceous Siltstone	Igneous	Siltstone	Siltstone and Sandstone (v. fine)	Siltstone - carbonaceous	Mudstone	Siltstone and Mudstone - carbonaceous	Siltstone	Existing Coarse Reject from Ramp 4 rejects stockpile	Coal, with minor Claystone & Mudstone	Coal, with minor Claystone & Mudstone	Coal, with minor Carbonaceous Mudstone
Parameters	Detection Limit	NEPC[1] Health-Based Investigation Level																
Elements	All units mg/kg																	
Aluminium (Al)	50	-	6,090	2,580	4,170	2,550	5,120	13,900	2,420	6,860	1,680	4,290	4,590	3,550	3,560	2,000	1,140	2,240
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic (As)	5	200	10	<5	21	<5	<5	<5	<5	<5	<5	12	12	<5	17	11	<5	<5
Boron (B)	50	6,000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (Cd)	1	40	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcium (Ca)	10	-	5,470	3,970	9,220	4,130	1,580	47,900	6,620	1,080	39,300	2,280	6,990	18,900	5,280	1,630	4,180	5,780
Chromium (Cr) total	2	-*	13	5	18	6	4	14	5	10	<2	4	<2	4	7	<2	<2	<2
Cobalt (Co)	2	200	18	19	23	13	7	29	5	3	<2	13	13	4	4	<2	<2	<2
Copper (Cu)	5	2,000	30	41	20	40	48	74	26	29	26	25	24	24	36	16	20	12
Iron (Fe)	50	-	37,500	48,800	14,100	59,300	3,520	54,400	8,450	9,330	21,300	30,000	23,300	14,300	20,000	7,120	3,580	3,640
Lead (Pb)	5	600	14	23	14	25	25	<5	13	14	<5	28	26	14	26	7	5	5
Magnesium (Mg)	10	-	4,730	2,820	3,590	4,500	1,720	20,700	1,380	3,350	10,300	1,720	2,900	6,360	3,070	650	460	750
Manganese (Mn)	5	3,000	591	1,050	304	992	32	974	76	65	1,170	390	512	498	348	156	56	58
Mercury (Hg)	0.1	30	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	4	<2	<2	<2	<2	<2	<2	4	2	<2	<2
Nickel (Ni)	2	600	29	29	35	22	14	43	18	14	<2	22	14	9	9	3	<2	<2
Potassium (K)	10	-	1,120	1,050	710	900	990	2,140	890	1,170	340	970	1,410	1,630	1,100	260	140	250
Selenium (Se)	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Sodium (Na)	10	-	1,160	1,360	730	770	860	5,970	850	1,060	440	670	1,370	1,160	1,080	320	140	390
Vanadium (V)	5	-	22	18	17	25	8	81	8	12	8	8	9	<5	8	<5	<5	<5
Zinc (Zn)	5	14,000	56	92	89	85	60	102	53	45	50	98	118	24	44	16	16	24

Notes: '<' indicates less than the analytical detection limit. '-' indicates no result (no analysis) for the given element.

1. NEPC (1999)a. Guideline on investigation levels for soil. HIL(E); parks, recreation open space and playing fields.

* Guideline level for Cr(VI) = 200 mg/kg. Guideline level for Cr(III) = 24% of total Cr.

Table B5. Soluble multi-element concentrations in 1:5 water extracts from coal and mineral waste samples

			Spoil				Potential rejects (roof & floor)								Coarse reject	Coal		
	Composite ID (SRJE-) -->		C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15	C16
	Seam -->		above HC	above D24	above H16	above D24	H16 roof	H16 parting	H16 floor	H16 floor	D14 roof	D14 floor	D24 roof	D24 floor	Ramp 4	H16	D14	D24
	Material description -->																	
Parameters	Detection Limit	Guideline Levels[1]	Siltstone - carbonaceous	Siltstone - carbonaceous	Sandstone (fine-medium)	Siltstone and Carbonaceous Siltstone	Siltstone and Carbonaceous Siltstone	Igneous	Siltstone	Siltstone and Sandstone (v. fine)	Siltstone - carbonaceous	Mudstone	Siltstone and Mudstone - carbonaceous	Siltstone	Existing Coarse Reject from Ramp 4 rejects stockpile	Coal, with minor Claystone & Mudstone	Coal, with minor Claystone & Mudstone	Coal, with minor Carbonaceous Mudstone
pH	0.1 pH unit	-	9.0	9.4	9.2	9.0	9.2	9.5	7.9	9.0	9.0	7.4	9.3	9.1	9.1	6.7	8.5	9.3
Electrical Conductivity	1 µS/cm	-	446	221	335	201	161	495	1,110	406	188	293	531	635	451	88	77	48
Total Alkalinity (mgCaCO$_3$/L)	1 mg/L	-	103	136	105	112	96	206	119	75	82	56	145	127	124	42	56	103
Bicarbonate Alkalinity (mgCaCO$_3$/L)	1 mg/L	-	84	98	77	98	77	141	119	66	73	56	117	113	105	42	52	80
Carbonate Alkalinity (mgCaCO$_3$/L)	1 mg/L	-	19	37	28	14	19	66	<1	9	9	<1	28	14	19	<1	5	23
Major Ions	All element concentrations in mg/L																	
Calcium (Ca)	2	1,000	<2	<2	<2	<2	<2	<2	38	<2	2	<2	<2	<2	<2	<2	4	<2
Magnesium (Mg)	2	-	<2	<2	<2	<2	<2	<2	26	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium (Na)	2	-	82	42	64	36	32	98	166	76	34	54	108	128	94	24	14	36
Potassium (K)	2	-	2	<2	4	<2	<2	<2	18	2	<2	<2	<2	4	4	<2	<2	<2
Chloride (Cl)	2	-	44	4	32	2	4	12	48	48	<2	<2	8	50	24	8	2	6
Sulphate (SO_4)	2	1,000	66	14	38	20	12	62	408	68	32	92	132	138	102	28	6	8
Metals	All element concentrations in mg/L																	
Aluminium (Al)	0.2	5	0.2	1.0	0.4	0.4	0.6	<0.2	<0.2	0.4	<0.2	<0.2	0.2	<0.2	0.2	<0.2	<0.2	<0.2
Antimony (Sb)	0.02	-	<0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.02	<0.02	<0.02	0.04	0.02	<0.02	<0.02	<0.02	<0.02
Arsenic (As)	0.02	0.5	<0.02	<0.02	0.20	<0.02	0.02	<0.02	<0.02	0.08	<0.02	<0.02	<0.02	<0.02	0.02	0.02	<0.02	<0.02
Boron (B)	0.2	5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium (Cd)	0.02	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium (Cr)	0.02	1 / -	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cobalt (Co)	0.02	1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper (Cu)	0.02	1 / 0.5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron (Fe)	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Lead (Pb)	0.02	0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (Mn)	0.02	-	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	0.18	<0.02	<0.02	<0.02	<0.02	<0.02	0.020	<0.02	<0.02	<0.02
Mercury (Hg)	0.0001	0.002	0.0380	0.0206	0.0080	0.0022	0.0019	0.0033	0.0004	0.0003	0.0003	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum (Mo)	0.02	0.15 / 0.01	<0.02	0.06	0.04	0.04	0.06	0.08	<0.02	0.02	0.02	0.06	0.10	0.04	0.02	0.06	<0.02	0.02
Nickel (Ni)	0.02	1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium (Se)	0.02	0.02	0.02	0.04	0.02	<0.02	0.06	<0.02	0.06	0.04	0.04	0.04	0.10	0.02	<0.02	0.02	<0.02	<0.02
Vanadium (V)	0.02	- / 0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc (Zn)	0.02	20	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Notes: < Indicates concentration less than the detection limit. Shaded cells indicate values that exceed one or more of the applied ANZECC/NEPC guideline values.

1. The first guideline level shown refers to ANZECC (2000) and the second to NEPC (1999b) e.g. 0.15 / 0.01. Where the two guidelines limits for a given element are in agreement, only one value is shown. A 'dash' represents no trigger value provided for this element.

Appendix C

Kinetic Leach Column Test Result Tables

- Table C1 – H16 Roof – SRJE-C17
- Table C2 – H16 Floor – SRJE-C18
- Table C3 – D14 Floor – SRJE-C19
- Table C4 – D24 Floor – SRJE-C20
- Table C5 – Saraji Mine Coarse Reject – SRJE-C21
- Table C6 – Coal (H16/D14/D24) – SRJE-C22

Table C1. KLC test results - H16 roof [SRJE-C17]

Sample set-up mass and average ABA values from individual solid samples. Composite of 6 samples.					
Sample Weight (kg)	1.543	Total S (%)	0.26	ANC (kg H_2SO_4/t)	7.1
pH(1:5)	9.3	S_{CR} (%)	0.06	NAPP (kg H_2SO_4/t)	-5.3
EC(1:5) (µS/cm)	281	MPA (kg H_2SO_4/t)	1.8	ANC:MPA ratio	3.9

Date	**19-Jul-11**	**3-Aug-11**	**18-Aug-11**	**31-Aug-11**	**14-Sep-11**	**27-Sep-11**	**11-Oct-11**
Week	**0**	**2**	**4**	**6**	**8**	**10**	**12**
Leach Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume Collected (L)	0.650	0.713	0.685	0.691	0.710	0.630	0.790
Cum. Volume (L)	0.65	1.36	2.05	2.74	3.45	4.08	4.87
Pore Volumes	0.5	1.0	1.5	2.0	2.6	3.0	3.6
pH	7.85	8.90	8.92	9.06	8.85	8.10	8.73
EC (µS/cm)	534	410	398	280	284	242	261
Acidity (mg/L)[1]	<1	<1	<1	2	4	2	<1
Alkalinity (mg/L)[1]	32	25	24	20	20	16	34
Net Alkalinity (mg/L)[1]	32	25	24	18	16	14	34
Dissolved elements (mg/L)							
Al	0.05	0.08	0.10	0.12	0.63	0.42	0.42
As	0.028	0.032	0.033	0.028	0.029	0.018	0.037
B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ca	4	1	2	<1	<1	<1	<1
Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	46	53	39	29	31	26	25
Co	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.002	<0.001	0.001	0.002	0.003	0.004	0.002
Fe	<0.05	<0.05	<0.05	0.08	0.07	0.10	<0.05
K	2	1	<1	<1	<1	<1	<1
Mg	1	<1	<1	<1	<1	<1	<1
Mn	0.002	<0.001	<0.001	<0.001	<0.001	0.004	<0.001
Mo	0.062	0.150	0.135	0.117	0.158	0.110	0.121
Na	104	85	76	57	58	52	56
Ni	<0.001	<0.001	<0.001	0.001	0.002	0.003	0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	136	90	102	64	66	51	54
Sb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	0.10	0.15	0.15	0.10	0.09	0.07	0.08
Zn	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005
RESULTS[2]							
SO_4 Release Rate	57	42	45	29	30	21	28
Cumulative SO_4 Release	57	99	144	173	203	224	252
Ca Release Rate	1.7	0.5	0.9	0.2	0.2	0.2	0.3
Cumulative Ca Release	1.7	2.1	3.0	3.3	3.5	3.7	3.9
Mg Release Rate	0.4	0.2	0.2	0.2	0.2	0.2	0.3
Cumulative Mg Release	0.4	0.7	0.9	1.1	1.3	1.5	2
Residual ANC (%)	100	100	100	100	100	100	100
Residual Sulfur (%)	99	99	98	98	97	97	97
SO_4/(Ca+Mg) molar ratio	10	21	15	20	21	16	17

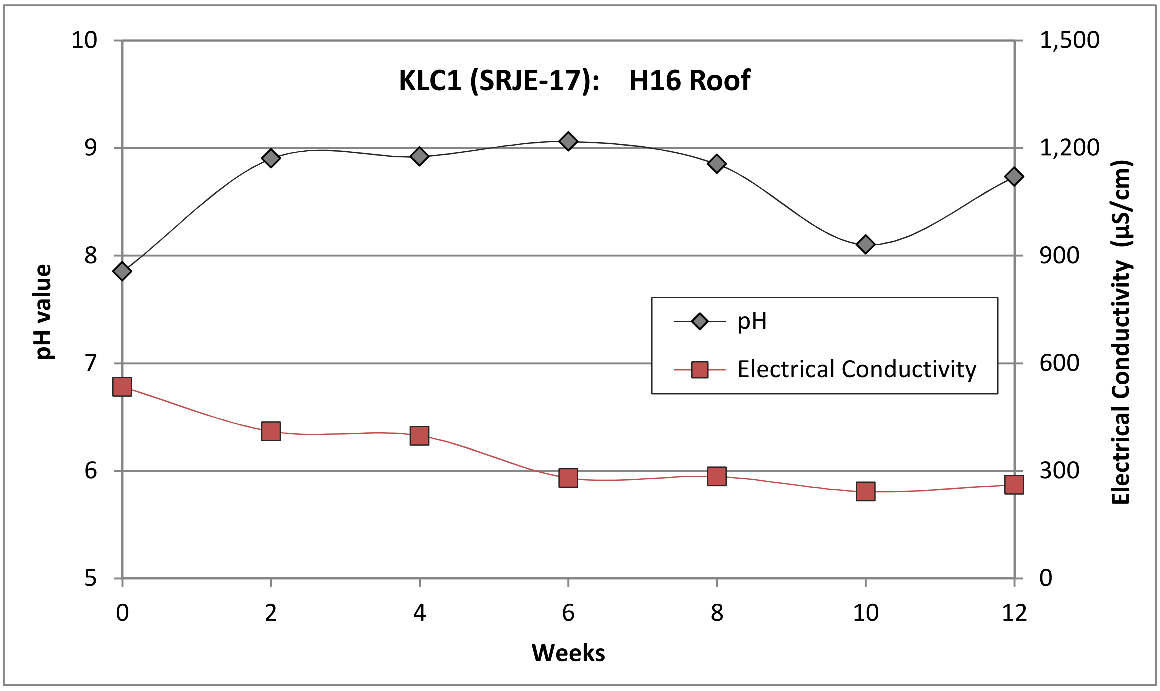
< indicates less than the analytical detection limit.

1. Acidity and Alkalinity data calculated in mg $CaCO_3$/L

2. SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur, Scr = Chromium Reducible Sulfur, MPA = Maximum Potential Acidity, ANC = Acid Neutralising Capacity, and NAPP = Net Acid Producing Potential

Figure C1. KLC test result trends for H16 roof [SRJE-C17]: pH, EC (µS/cm), sulfate release rate (mg/kg/flush) and net alkalinity (mg/L as $CaCO_3$)



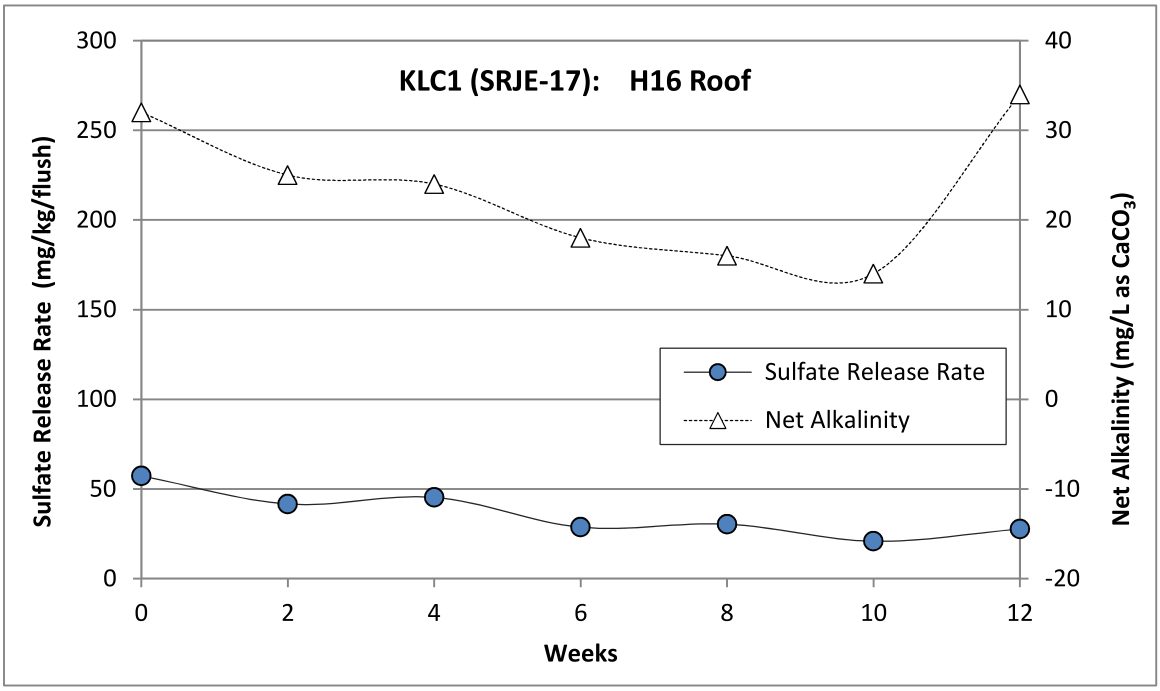


Table C2. KLC test results - H16 floor [SRJE-C18]

Sample set-up mass and average ABA values from individual solid samples. Composite of 7 samples.							
Sample Weight (kg)	1.571	**Total S (%)**		0.72	**ANC (kg H_2SO_4/t)**		11
pH(1:5)	8.7	**S_{CR} (%)**		0.35	**NAPP (kg H_2SO_4/t)**		-0.4
EC(1:5) (µS/cm)	637	**MPA (kg H_2SO_4/t)**		11	**ANC:MPA ratio**		1.0
Date	**19-Jul-11**	**3-Aug-11**	**18-Aug-11**	**31-Aug-11**	**14-Sep-11**	**27-Sep-11**	**11-Oct-11**
Week	**0**	**2**	**4**	**6**	**8**	**10**	**12**
Leach Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume Collected (L)	0.658	0.715	0.710	0.706	0.720	0.620	0.768
Cum. Volume (L)	0.66	1.37	2.08	2.79	3.51	4.13	4.90
Pore Volumes	0.5	1.0	1.5	2.1	2.6	3.1	3.6
pH	5.60	6.56	7.43	7.64	6.99	6.85	7.01
EC (µS/cm)	830	1,184	1,038	805	1,096	808	854
Acidity (mg/L)^1	12	3	4	2	5	3	5
Alkalinity (mg/L)^1	<1	4	7	7	6	7	6
Net Alkalinity (mg/L)^1	-12	1	3	5	1	4	1
Dissolved elements (mg/L)							
Al	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.002
B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ca	32	15	17	14	25	16	21
Cd	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	49	127	63	57	60	36	29
Co	0.035	0.006	0.003	0.002	0.003	0.004	0.002
Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	1.95	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
K	4	4	3	3	4	3	4
Mg	10	19	14	10	18	10	12
Mn	0.182	0.046	0.034	0.026	0.039	0.040	0.029
Mo	<0.001	0.002	0.003	0.003	0.003	0.002	0.003
Na	124	214	183	156	187	144	147
Ni	0.076	0.014	0.007	0.004	0.006	0.008	0.006
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	327	409	407	291	444	314	360
Sb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	0.02	0.07	0.05	0.04	0.04	0.03	0.02
Zn	0.062	0.033	0.008	0.007	0.010	0.014	0.012
RESULTS^2							
SO_4 Release Rate	137	186	184	131	203	124	176
Cumulative SO_4 Release	137	323	507	638	841	965	1141
Ca Release Rate	13	6.8	7.7	6.3	11.5	6.3	10.3
Cumulative Ca Release	13	20	28	34	46	52	62
Mg Release Rate	4.2	8.6	6.3	4.5	8.2	3.9	5.9
Cumulative Mg Release	4.2	13	19	24	32	36	42
Residual ANC (%)	100	99	99	98	98	98	97
Residual Sulfur (%)	99	99	98	97	96	96	95
SO_4/(Ca+Mg) molar ratio	2.8	3.7	4.2	4.0	3.4	4.0	3.7

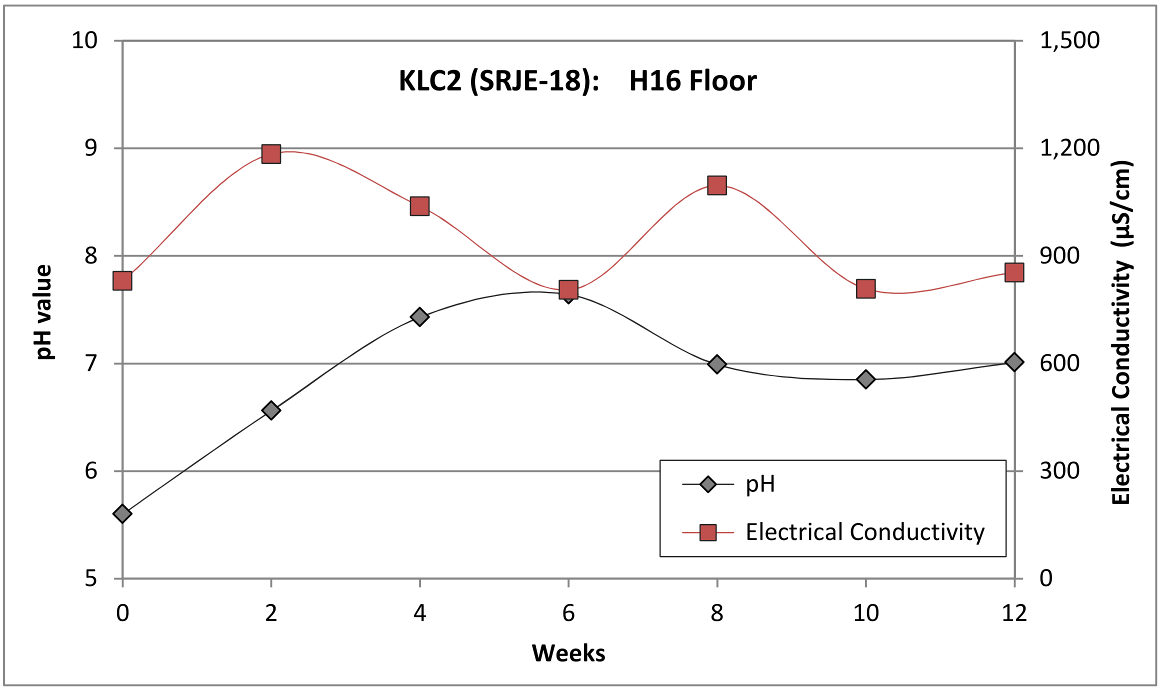
< indicates less than the analytical detection limit.

1. Acidity and Alkalinity data calculated in mg $CaCO_3$ /L

2. SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur, Scr = Chromium Reducible Sulfur, MPA = Maximum Potential Acidity, ANC = Acid Neutralising Capacity, and NAPP = Net Acid Producing Potential

Figure C2. KLC test result trends for H16 floor [SRJE-C18]: pH, EC (µS/cm), sulfate release rate (mg/kg/flush) and net alkalinity (mg/L as $CaCO_3$)



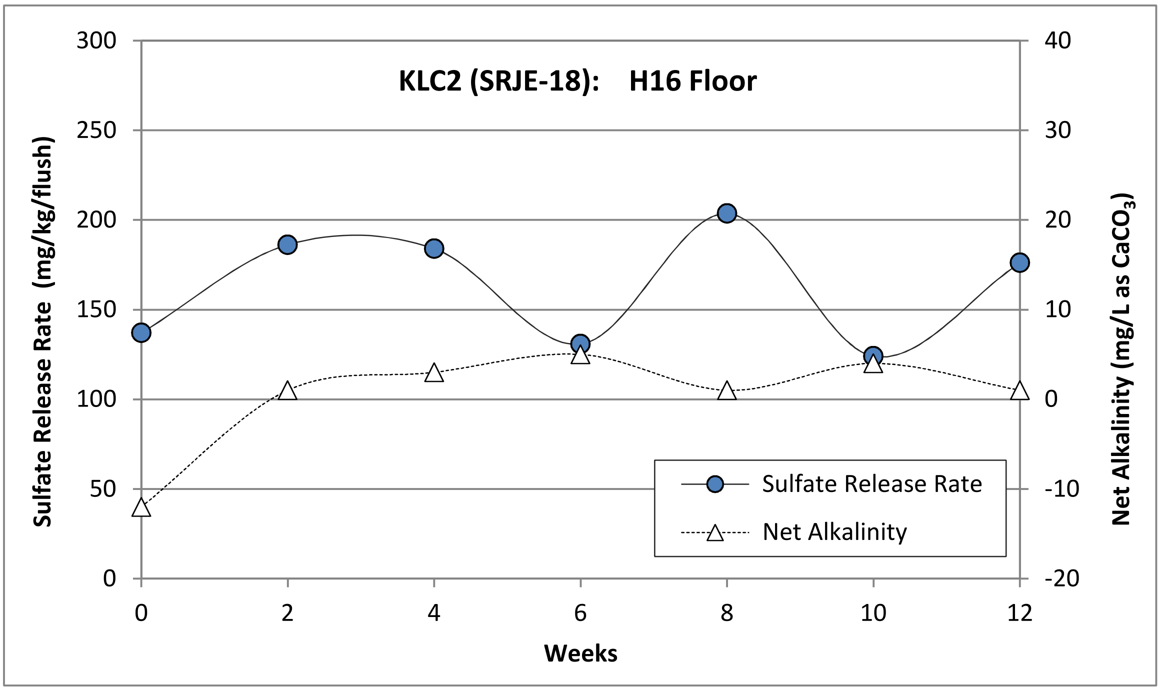


Table C3. KLC test results – D14 floor [SRJE-C19]

Sample set-up mass and average ABA values from individual solid samples. Composite of 6 samples.					
Sample Weight (kg)	1.649	Total S (%)	0.77	ANC (kg H_2SO_4/t)	21
pH(1:5)	8.8	S_{CR} (%)	0.57	NAPP (kg H_2SO_4/t)	-3.5
EC(1:5) (µS/cm)	312	MPA (kg H_2SO_4/t)	17	ANC:MPA ratio	1.2

Date	19-Jul-11	3-Aug-11	18-Aug-11	31-Aug-11	14-Sep-11	27-Sep-11	11-Oct-11
Week	0	2	4	6	8	10	12
Leach Number	1	2	3	4	5	6	7
Volume Collected (L)	0.634	0.690	0.684	0.715	0.720	0.657	0.757
Cum. Volume (L)	0.63	1.32	2.01	2.72	3.44	4.10	4.86
Pore Volumes	0.5	1.0	1.5	2.0	2.6	3.0	3.6
pH	7.39	7.69	7.72	7.73	7.50	7.20	7.35
EC (µS/cm)	302	490	457	299	486	334	310
Acidity (mg/L)[1]	1	<1	2	2	4	2	2
Alkalinity (mg/L)[1]	11	7	9	8	10	10	9
Net Alkalinity (mg/L)[1]	10	7	7	6	6	8	7
Dissolved elements (mg/L)							
Al	<0.01	0.02	0.02	0.03	0.03	<0.01	0.02
As	<0.001	<0.001	<0.001	0.001	0.002	<0.001	0.003
B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ca	19	8	6	5	8	6	6
Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	3	3	17	3	3	2	3
Co	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
K	1	<1	<1	<1	<1	<1	<1
Mg	3	3	2	1	2	2	2
Mn	0.036	0.004	0.008	0.006	0.011	0.018	0.003
Mo	0.001	0.009	0.006	0.004	0.007	0.003	0.004
Na	37	90	87	51	90	62	58
Ni	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	121	199	208	117	211	141	133
Sb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	0.02	0.12	0.08	0.05	0.06	0.04	0.04
Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
RESULTS[2]							
SO_4 Release Rate	47	83	86	51	92	56	61
Cumulative SO_4 Release	47	130	216	267	359	415	476
Ca Release Rate	7.3	3.3	2.5	2.2	3.5	2.4	2.8
Cumulative Ca Release	7.3	11	13	15	19	21	24
Mg Release Rate	1.2	1.3	0.8	0.4	0.9	0.8	0.9
Cumulative Mg Release	1.2	2.4	3.2	3.7	4.5	5.3	6.3
Residual ANC (%)	100	100	100	100	100	100	100
Residual Sulfur (%)	100	99	99	99	98	98	98
SO_4/(Ca+Mg) molar ratio	2.1	6.4	9.3	7.3	7.8	6.3	6.0

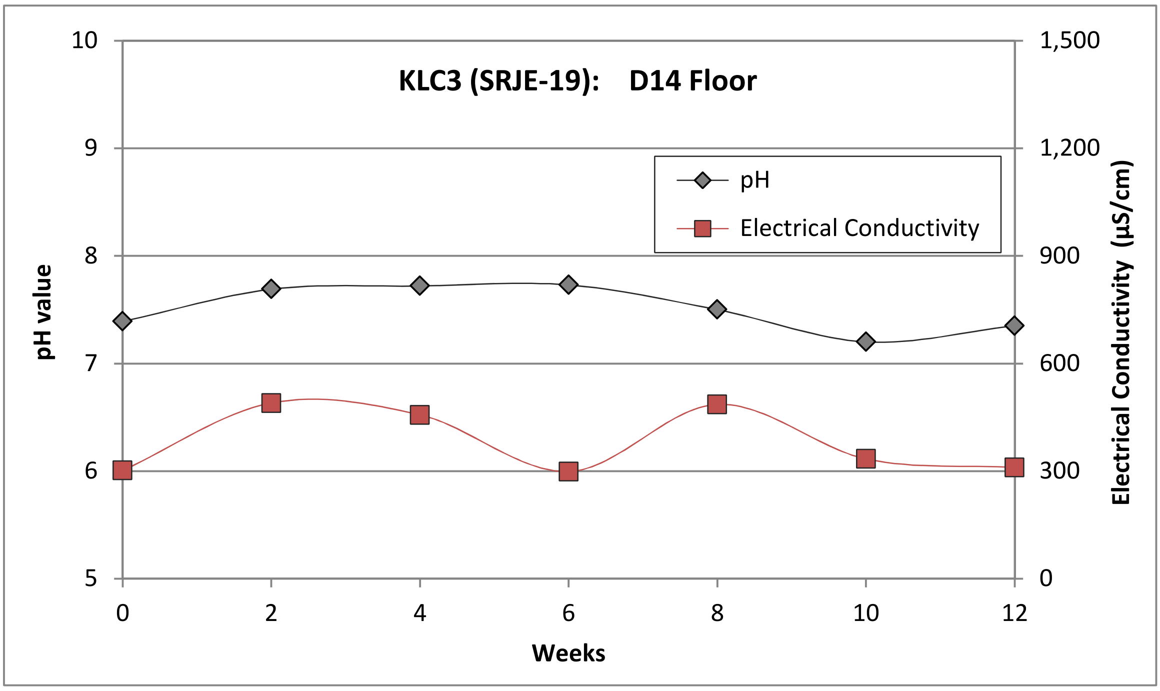
< indicates less than the analytical detection limit.

1. Acidity and Alkalinity data calculated in mg $CaCO_3$ /L

2. SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur, Scr = Chromium Reducible Sulfur, MPA = Maximum Potential Acidity, ANC = Acid Neutralising Capacity, and NAPP = Net Acid Producing Potential

Figure C3. KLC test result trends for D14 floor [SRJE-C19]: pH, EC (µS/cm), sulfate release rate (mg/kg/flush) and net alkalinity (mg/L as $CaCO_3$)



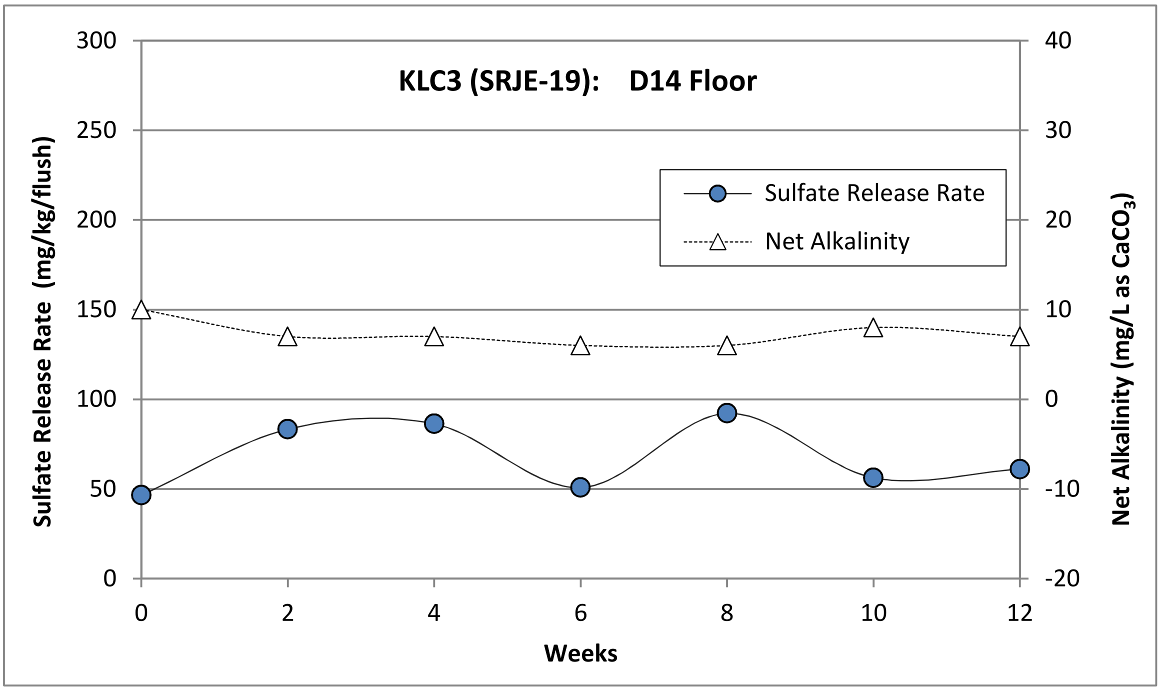


Table C4. KLC test results – D24 floor [SRJE-C20]

Sample set-up mass and average ABA values from individual solid samples. Composite of 6 samples.					
Sample Weight (kg)	1.475	**Total S (%)**	0.87	**ANC (kg H_2SO_4/t)**	30
pH(1:5)	8.8	**S_{CR} (%)**	0.74	**NAPP (kg H_2SO_4/t)**	-7.3
EC(1:5) (µS/cm)	469	**MPA (kg H_2SO_4/t)**	23	**ANC:MPA ratio**	1.3

Date	**19-Jul-11**	**3-Aug-11**	**18-Aug-11**	**31-Aug-11**	**14-Sep-11**	**27-Sep-11**	**11-Oct-11**
Week	**0**	**2**	**4**	**6**	**8**	**10**	**12**
Leach Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume Collected (L)	0.639	0.684	0.697	0.672	0.704	0.618	0.732
Cum. Volume (L)	0.64	1.32	2.02	2.69	3.40	4.01	4.75
Pore Volumes	0.5	1.0	1.5	2.0	2.5	3.0	3.5
pH	7.73	8.22	7.98	7.68	7.94	7.65	8.55
EC (µS/cm)	342	594	654	669	586	735	580
Acidity (mg/L)[1]	1	<1	3	2	3	2	2
Alkalinity (mg/L)[1]	21	11	12	10	15	24	29
Net Alkalinity (mg/L)[1]	20	11	9	8	12	22	27
Dissolved elements (mg/L)							
Al	0.02	0.02	0.02	0.01	0.03	0.01	0.03
As	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ca	11	8	9	9	8	10	6
Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	23	38	30	36	38	38	28
Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
K	1	1	1	1	<1	1	1
Mg	2	3	3	3	4	4	3
Mn	0.083	0.012	0.026	0.030	0.028	0.025	0.001
Mo	0.002	0.002	0.001	0.002	0.002	0.002	0.002
Na	53	115	122	135	109	148	114
Ni	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	103	200	248	216	186	233	189
Sb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	<0.01	0.02	0.02	0.01	0.01	0.02	0.01
Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
RESULTS[2]							
SO_4 Release Rate	45	93	117	98	89	98	94
Cumulative SO_4 Release	45	137	255	353	442	539	633
Ca Release Rate	4.8	3.7	4.3	4.1	3.8	4.2	3.0
Cumulative Ca Release	4.8	8.5	13	17	21	25	28
Mg Release Rate	0.9	1.4	1.4	1.4	1.9	1.7	1.5
Cumulative Mg Release	0.9	2.3	3.7	5.0	7.0	8.6	10.1
Residual ANC (%)	100	100	100	100	100	100	100
Residual Sulfur (%)	100	99	99	99	98	98	98
SO_4/(Ca+Mg) molar ratio	3.0	6.4	7.4	6.5	5.3	5.9	7.2

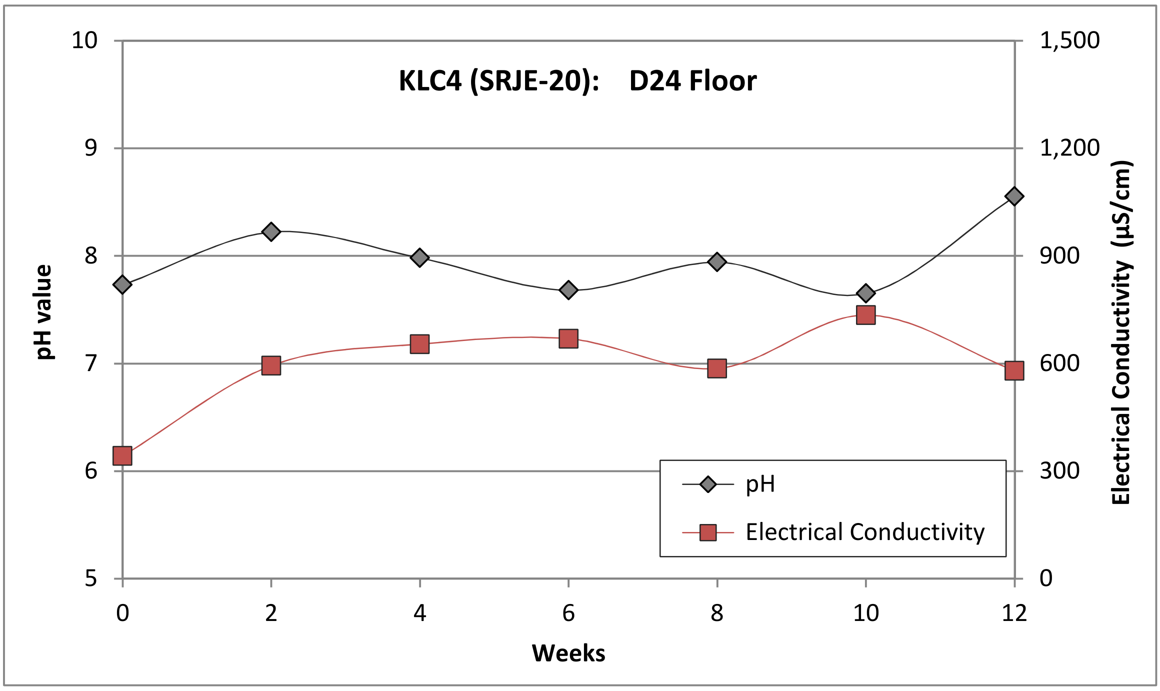
< indicates less than the analytical detection limit.

1. Acidity and Alkalinity data calculated in mg $CaCO_3$/L

2. SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur, Scr = Chromium Reducible Sulfur, MPA = Maximum Potential Acidity, ANC = Acid Neutralising Capacity, and NAPP = Net Acid Producing Potential

Figure C4. KLC test result trends for D24 floor [SRJE-C20]: pH, EC (µS/cm), sulfate release rate (mg/kg/flush) and net alkalinity (mg/L as $CaCO_3$)



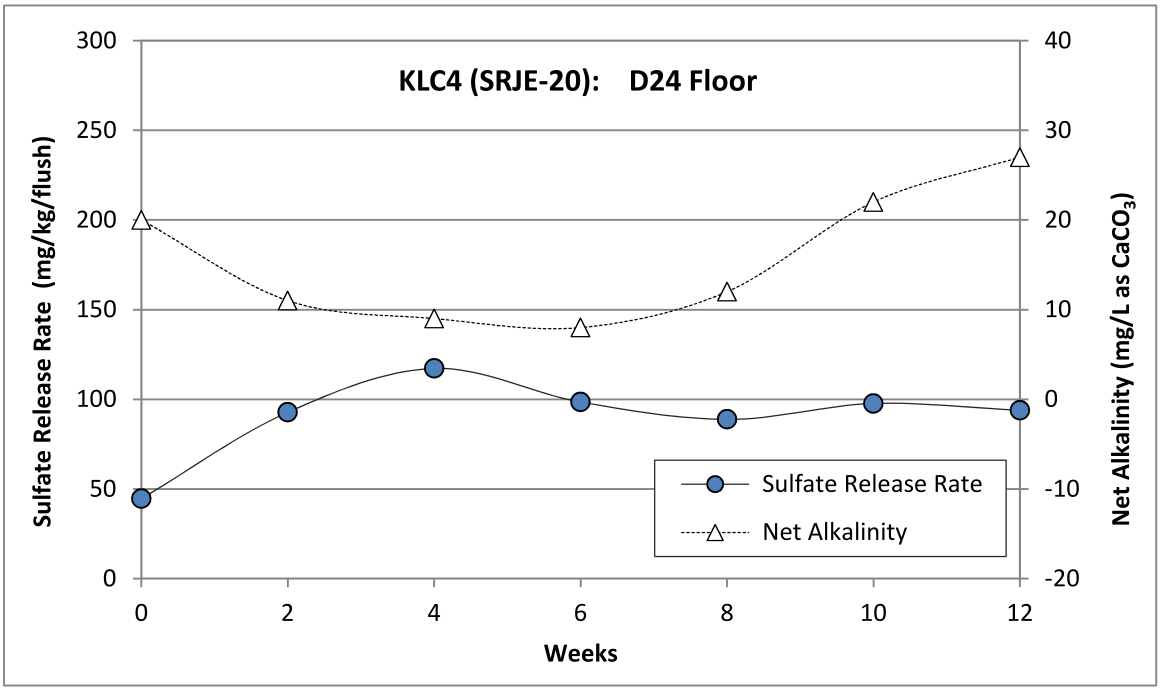


Table C5. KLC test results – Saraji Mine coarse reject [SRJE-C21]

Sample set-up mass and average ABA values from individual solid samples. Composite of 3 samples.					
Sample Weight (kg)	1.181	Total S (%)	0.93	ANC (kg H_2SO_4/t)	25
pH(1:5)	9.2	S_{CR} (%)	0.71	NAPP (kg H_2SO_4/t)	-3.4
EC(1:5) (µS/cm)	402	MPA (kg H_2SO_4/t)	22	ANC:MPA ratio	1.2

Date	19-Jul-11	3-Aug-11	18-Aug-11	31-Aug-11	14-Sep-11	27-Sep-11	11-Oct-11
Week	0	2	4	6	8	10	12
Leach Number	1	2	3	4	5	6	7
Volume Collected (L)	0.780	0.716	0.718	0.649	0.702	0.707	0.778
Cum. Volume (L)	0.78	1.50	2.21	2.86	3.57	4.27	5.05
Pore Volumes	0.6	1.1	1.6	2.1	2.6	3.2	3.7
pH	7.65	8.47	8.33	8.10	8.00	7.53	7.96
EC (µS/cm)	1,410	865	610	627	420	462	430
Acidity (mg/L)[1]	1	2	2	2	3	2	2
Alkalinity (mg/L)[1]	23	27	26	28	25	22	29
Net Alkalinity (mg/L)[1]	22	25	24	26	22	20	27
Dissolved elements (mg/L)							
Al	<0.01	<0.01	0.01	<0.01	0.08	<0.01	0.02
As	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ca	16	4	2	4	2	3	3
Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	145	52	28	20	10	8	6
Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Fe	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
K	5	3	2	2	2	2	2
Mg	16	4	2	3	2	3	3
Mn	0.006	0.001	0.009	0.008	0.008	0.010	0.003
Mo	0.009	0.008	0.007	0.007	0.007	0.006	0.005
Na	266	175	118	132	84	90	84
Ni	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	454	289	226	228	158	181	165
Sb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
RESULTS[2]							
SO_4 Release Rate	300	175	137	125	94	108	109
Cumulative SO_4 Release	300	475	612	738	832	940	1049
Ca Release Rate	11	2.4	1.2	2.2	1.2	1.8	2.0
Cumulative Ca Release	11	13	14	16	18	19	21
Mg Release Rate	11	2.4	1.2	1.6	1.2	1.8	2.0
Cumulative Mg Release	11	13	14	16	17	19	21
Residual ANC (%)	100	100	100	100	100	100	99
Residual Sulfur (%)	99	98	98	97	97	97	96
SO_4/(Ca+Mg) molar ratio	4.5	11	18	11	12	10	9

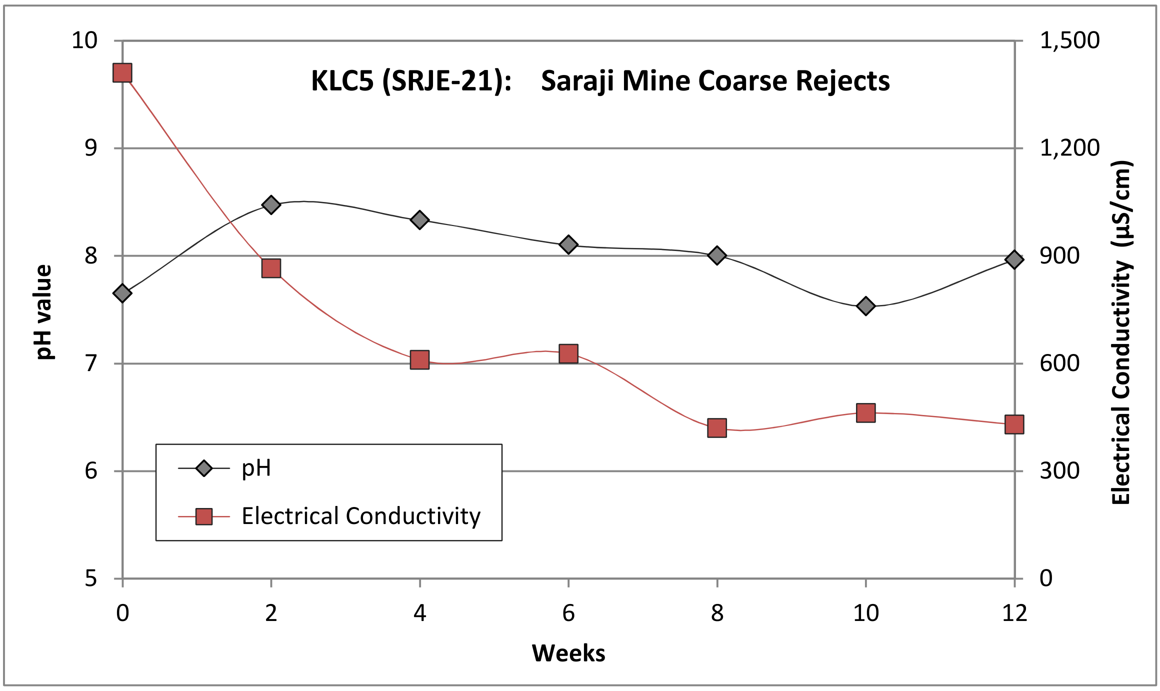
< indicates less than the analytical detection limit.

1. Acidity and Alkalinity data calculated in mg $CaCO_3$/L

2. SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur, Scr = Chromium Reducible Sulfur, MPA = Maximum Potential Acidity, ANC = Acid Neutralising Capacity, and NAPP = Net Acid Producing Potential

Figure C5. KLC test result trends for Saraji Mine coarse reject [SRJE-C21]: pH, EC (µS/cm), sulfate release rate (mg/kg/flush) and net alkalinity (mg/L as $CaCO_3$)



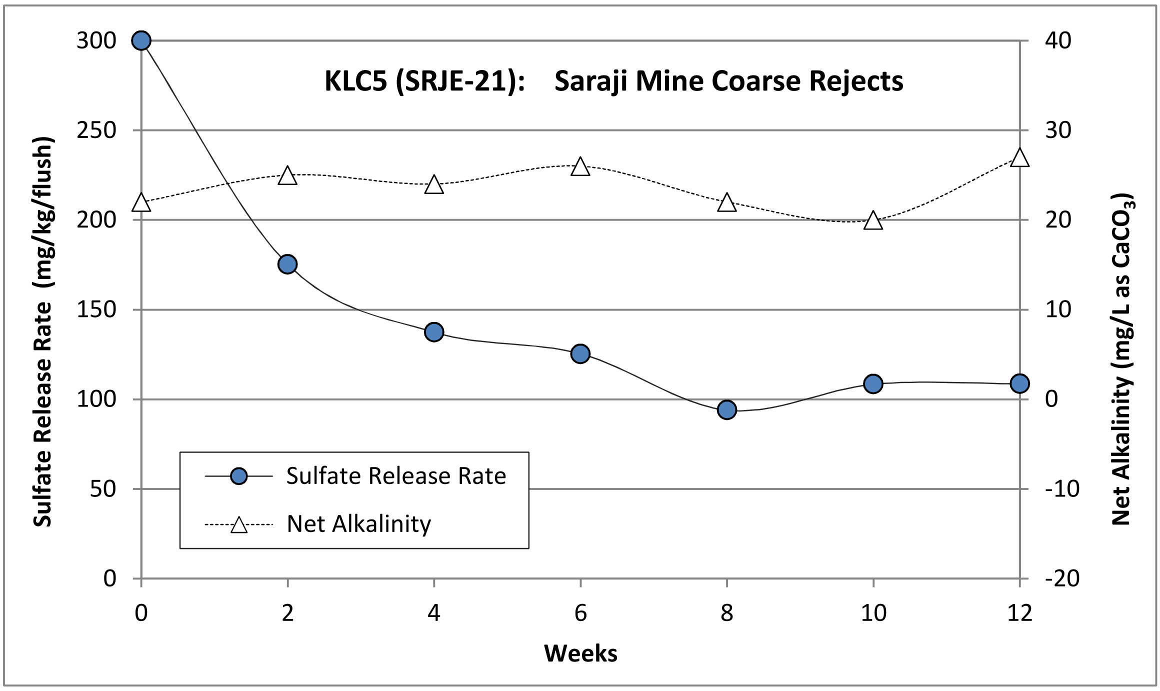


Table C6. KLC test results – Coal (H16/D14/D24) [SRJE-C22]

Sample set-up mass and average ABA values from individual solid samples. Composite of 6 samples.					
Sample Weight (kg)	1.529	**Total S (%)**	0.71	**ANC (kg H_2SO_4/t)**	4.2
pH(1:5)	8.8	**S_{CR} (%)**	0.15	**NAPP (kg H_2SO_4/t)**	0.4
EC(1:5) (µS/cm)	102	**MPA (kg H_2SO_4/t)**	4.6	**ANC:MPA ratio**	0.9

Date	**19-Jul-11**	**3-Aug-11**	**18-Aug-11**	**31-Aug-11**	**14-Sep-11**	**27-Sep-11**	**11-Oct-11**
Week	**0**	**2**	**4**	**6**	**8**	**10**	**12**
Leach Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Volume Collected (L)	0.972	0.976	0.950	0.968	0.925	0.798	0.982
Cum. Volume (L)	0.97	1.95	2.90	3.87	4.79	5.59	6.57
Pore Volumes	0.7	1.4	2.1	2.9	3.5	4.1	4.9
pH	6.85	7.39	6.75	7.34	7.15	7.25	6.81
EC (µS/cm)	20	16	21	25	92	81	63
Acidity (mg/L)[1]	2	2	2	1	3	2	2
Alkalinity (mg/L)[1]	3	3	5	5	8	16	14
Net Alkalinity (mg/L)[1]	1	1	3	4	5	14	12
Dissolved elements (mg/L)							
Al	0.02	<0.01	0.02	0.02	0.02	0.03	0.04
As	<0.001	<0.001	0.003	0.001	0.003	0.010	0.008
B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ca	<1	<1	<1	<1	2	<1	<1
Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	3	<1	2	1	7	5	3
Co	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
K	<1	<1	<1	<1	<1	<1	<1
Mg	<1	<1	<1	<1	<1	<1	<1
Mn	<0.001	<0.001	0.002	0.002	0.027	0.015	0.004
Mo	0.002	0.002	0.005	0.004	0.035	0.046	0.028
Na	2	2	3	2	17	16	11
Ni	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	2	1	2	1	21	17	9
Sb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01
Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
RESULTS[2]							
SO_4 Release Rate	1.3	0.6	1.2	0.6	12.7	8.9	5.8
Cumulative SO_4 Release	1.3	1.9	3.2	3.8	16.5	25.4	31.1
Ca Release Rate	0.3	0.3	0.3	0.3	1.2	0.3	0.3
Cumulative Ca Release	0.3	0.6	0.9	1.3	2.5	2.7	3.1
Mg Release Rate	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Cumulative Mg Release	0.3	0.6	0.9	1.3	1.6	1.8	2.1
Residual ANC (%)	100	100	100	100	100	100	100
Residual Sulfur (%)	100	100	100	100	100	100	100
SO_4/(Ca+Mg) molar ratio	0.6	0.3	0.6	0.3	3.1	5.4	2.8

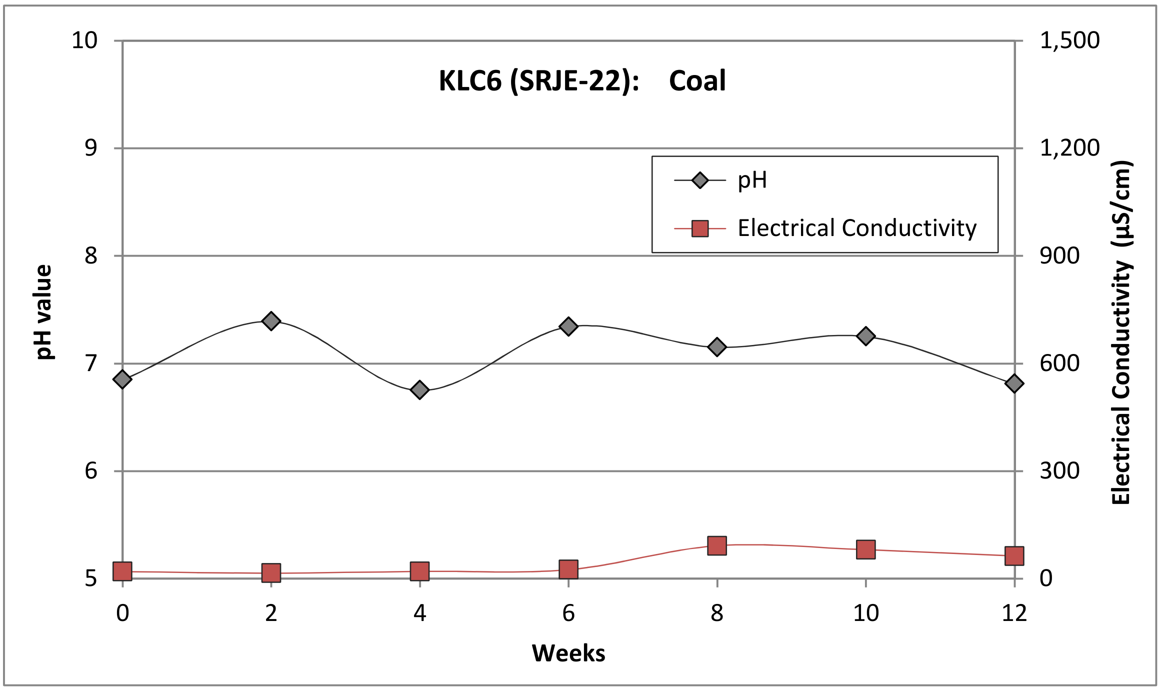
< indicates less than the analytical detection limit.

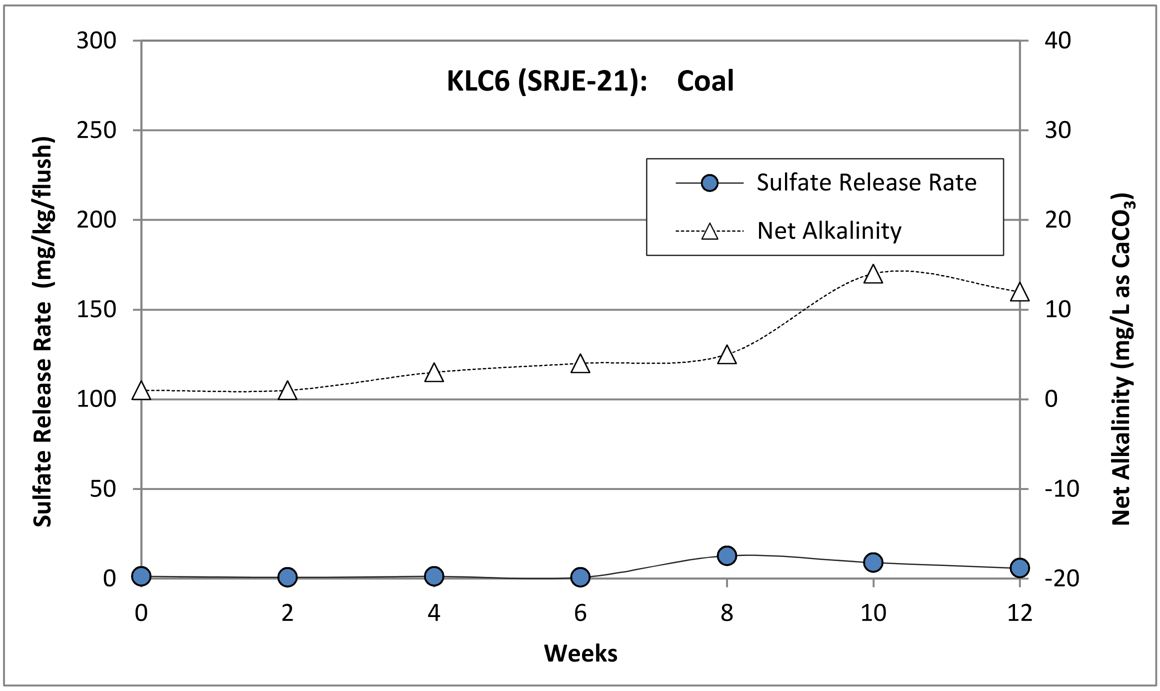
1. Acidity and Alkalinity data calculated in mg $CaCO_3$ /L

2. SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur, Scr = Chromium Reducible Sulfur, MPA = Maximum Potential Acidity, ANC = Acid Neutralising Capacity, and NAPP = Net Acid Producing Potential

Figure C6. KLC test result trends for Coal (H16/D14/D24) [SRJE-C22]: pH, EC (µS/cm), sulfate release rate (mg/kg/flush) and net alkalinity (mg/L as $CaCO_3$)





Appendix D

Evaluation and Interpretation of Geochemical Test Data

D1. Acid Generation and Prediction

Acid generation is caused by the exposure of sulfide minerals, most commonly pyrite (FeS_2), to atmospheric oxygen and water. Sulfur assay results are used to calculate the maximum acid that could be generated by the sample by either directly determining the pyritic sulfur content or assuming that all sulfur not present as sulfate occurs as pyrite. Pyrite reacts under oxidising conditions to generate acid according to the following overall reaction:

$$\mathbf{FeS_2 + \tfrac{15}{4} O_2 + \tfrac{7}{2} H_2O \text{ ---> } Fe(OH)_3 + 2\, H_2SO_4}$$

According to this reaction, the maximum potential acidity (MPA) of a sample containing one per cent sulfur as pyrite would be 30.6 kg H_2SO_4/t; *ie*. 30.6 kg of acid generated per tonne of rock.

The chemical components of the acid generation process consist of the above sulfide oxidation reaction and acid neutralisation, which is mainly provided by inherent carbonates and to a lesser extent silicate materials. The amount and rate of acid generation is determined by the interaction and overall balance of the acid generation and neutralisation components.

Determination of pH and Electrical Conductivity

pH and electrical conductivity (EC) are measured (and reported) on 1:5 weight/weight water extract. This gives an indication of the inherent acidity and salinity of the mineral waste material when initially exposed in an emplacement area.

Total sulfur (S), chromium-reducible sulfur (S_{CR}) and Maximum Potential Acidity (MPA)

Total sulfur concentration is determined by the LECO high temperature combustion method.

The total sulfur is typically used to calculate the Maximum Potential Acidity (MPA), which is based on the assumption that all sulfur is present as reactive pyrite.

If a more accurate estimate of the MPA is required, this can be achieved by determining pyritic sulfur and other sulfide forms directly, such as by determining S_{CR}. S_{CR} is determined by the reduction of inorganic sulfur in a hot acidic chromous chloride solution, where evolved H_2S is carried in nitrogen gas and trapped in a zinc acetate trapping solution as zinc sulfide. This solution is then titrated with iodine. For the Project, S_{CR} was used instead of total sulfur to determine MPA where S_{CR} data was available.

Acid neutralising capacity (ANC)

The ANC measures the capacity of a sample to react with and neutralise acid by addition of acid to a known weight of sample, then titration with NaOH to determine the amount of residual acid. The ANC can be further evaluated by slow acid titration to a set end-point and then calculation of the amount of acid consumed and evaluation of the resultant titration curve, called an Acid Buffering Characteristic Curve (ABCC).

Net acid producing potential (NAPP)

Calculated from the MPA and ANC results. The NAPP represents the balance between a samples inherent capacity to generate acid (MPA) and neutralise acid (ANC). If the MPA is greater than the ANC (*ie*. a net excess of acidity) then the NAPP is positive. If the MPA is less than the ANC (*ie*. a net excess of alkalinity) then the NAPP is negative. A strongly positive NAPP result generally indicates that a sample is PAF, whereas a strongly negative NAPP generally indicates that a sample is NAF. By Australian convention, the NAPP result is expressed in units of kg H_2SO_4/t sample.

D2. Assessment of Element Enrichment and Solubility

In mineralised areas, including coal deposits, it is common to find a suite of enriched elements that have resulted from natural geological processes. Multi-element scans are carried out to identify any elements that are present in a material at concentrations that may be of environmental concern with respect to surface water quality and revegetation. The samples are typically analysed for the following elements, although the actual suite of elements tested is project specific:

Major elements	Al, Ca, Fe, K, Mg, Na, Si, and S
Minor elements	As, B, Cd, Co, Cr, Cu, F, Hg, Mn, Mo, Ni, P, Pb, Sb, Se, Zn

The assay result for each element is compared to either average background concentrations to evaluate any potential concerns related to rock emplacement or process residue facility operation and final rehabilitation, or compared to soil quality guidelines where applicable.

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality, or public health but their significance should be evaluated. Similarly, because an element is not enriched does not mean it will never be a concern, because under some conditions (*eg.* low pH) the geochemical behaviour of common environmentally important elements such as Al, Cu, Cd, Fe and Zn increases significantly.

Water extracts or leaching tests can be used to determine the element solubilities under the existing pH conditions of the sample (*eg*. bottle leaching tests) or under changing conditions (*eg*. kinetic leach column tests). Where applicable, element concentrations in water extracts or leachates have been compared with applied water quality guidelines to determine their potential environmental significance.

Appendix E

Laboratory Certificates of Analysis

- Static acid-base test results – ALS Batch EB1111719
- Multi-element and ABCC test results – ALS Batch EB1112586
- Kinetic leach column test results:
    i. Leach 1 - ALS Batch EB1114253
    ii. Leach 2 - ALS Batch EB1115393
    iii. Leach 3 - ALS Batch EB1116605
    iv. Leach 4 - ALS Batch EB1117692
    v. Leach 5 - ALS Batch EB1118817
    vi. Leach 6 - ALS Batch EB1120550
    vii. Leach 7 - ALS Batch EB1121080

Static Geochemical Results

Acid-Base Accounting

- ALS Environmental Batch EB1111719

CERTIFICATE OF ANALYSIS

Work Order	: **EB1111719**	Page	: 1 of 14
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
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Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 16-JUN-2011
Sampler	: BMA	Issue Date	: 27-JUN-2011
Site	: ----		
		No. of samples received	: 60
Quote number	: BN/057/11 V2	No. of samples analysed	: 60

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*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

- **ANC Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong.**

Analytical Results

Sub-Matrix: **SOLID**			*Client sample ID*	**SRJE-01**	**SRJE-02**	**SRJE-04**	**SRJE-05**	**SRJE-06**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-001**	**EB1111719-002**	**EB1111719-003**	**EB1111719-004**	**EB1111719-005**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.8**	**7.7**	**9.8**	**9.4**	**9.8**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**209**	**264**	**158**	**281**	**332**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**11.6**	**9.2**	**15.7**	**5.3**	**6.2**
^ ANC as CaCO3	----	0.1	% CaCO3	**1.2**	**0.9**	**1.6**	**0.5**	**0.6**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**1**	**0**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.119**	**0.484**	**0.101**	**0.063**	**0.097**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.25**	**0.58**	**0.28**	**0.22**	**0.22**

Analytical Results

Sub-Matrix: **SOLID**			*Client sample ID*	**SRJE-07**	**SRJE-08**	**SRJE-09**	**SRJE-10**	**SRJE-11**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-006**	**EB1111719-007**	**EB1111719-008**	**EB1111719-009**	**EB1111719-010**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.6**	**9.6**	**7.5**	**9.7**	**6.8**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**512**	**320**	**212**	**134**	**838**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**35.7**	**6.1**	**8.4**	**8.7**	**4.7**
^ ANC as CaCO3	----	0.1	% CaCO3	**3.6**	**0.6**	**0.9**	**0.9**	**0.5**
Fizz Rating	----	0	Fizz Unit	**2**	**0**	**0**	**0**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.616**	**0.122**	**1.69**	**0.011**	**0.442**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.76**	**0.59**	**1.88**	**0.12**	**1.42**

Analytical Results

Sub-Matrix: **SOLID**

			Client sample ID	SRJE-12	SRJE-13	SRJE-14	SRJE-15	SRJE-16
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-011**	**EB1111719-012**	**EB1111719-013**	**EB1111719-014**	**EB1111719-015**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.2**	**9.2**	**9.4**	**7.6**	**9.5**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**423**	**170**	**64**	**870**	**189**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**5.0**	**17.3**	**4.7**	**67.2**	**8.9**
^ ANC as CaCO3	----	0.1	% CaCO3	**0.5**	**1.8**	**0.5**	**6.8**	**0.9**
Fizz Rating	----	0	Fizz Unit	**0**	**1**	**0**	**2**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.100**	**0.616**	**0.010**	**0.443**	**0.375**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.48**	**0.77**	**0.28**	**0.82**	**0.52**

Analytical Results

Sub-Matrix: **SOLID**			*Client sample ID*	**SRJE-17**	**SRJE-18**	**SRJE-19**	**SRJE-20**	**SRJE-21**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-016**	**EB1111719-017**	**EB1111719-018**	**EB1111719-019**	**EB1111719-020**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.4**	**9.0**	**9.7**	**10.0**	**8.6**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**270**	**200**	**533**	**401**	**108**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**8.6**	**110**	**141**	**137**	**3.6**
^ ANC as CaCO3	----	0.1	% CaCO3	**0.9**	**11.2**	**14.4**	**13.9**	**0.4**
Fizz Rating	----	0	Fizz Unit	**0**	**2**	**3**	**3**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.190**	**0.174**	**0.290**	**0.363**	**0.145**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.37**	**0.58**	**0.41**	**0.45**	**0.36**

Analytical Results

Sub-Matrix: **SOLID**			Client sample ID	**SRJE-22**	**SRJE-23**	**SRJE-25**	**SRJE-26**	**SRJE-27**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-021**	**EB1111719-022**	**EB1111719-023**	**EB1111719-024**	**EB1111719-025**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.3**	**7.0**	**9.7**	**9.4**	**9.3**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**575**	**1390**	**139**	**693**	**149**
EA013: Acid Neutralising Capacity								
ANC as H_2SO_4	----	0.5	kg H_2SO_4 equiv./t	**32.2**	**4.5**	**5.0**	**127**	**25.1**
^ ANC as $CaCO_3$	----	0.1	% $CaCO_3$	**3.3**	**0.4**	**0.5**	**12.9**	**2.6**
Fizz Rating	----	0	Fizz Unit	**2**	**0**	**0**	**3**	**1**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**3.74**	**1.00**	**0.014**	**0.307**	**0.196**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**3.18**	**1.44**	**0.03**	**0.44**	**0.40**

Analytical Results

Sub-Matrix: **SOLID**			*Client sample ID*	**SRJE-28**	**SRJE-29**	**SRJE-30**	**SRJE-31**	**SRJE-32**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-026**	**EB1111719-027**	**EB1111719-028**	**EB1111719-029**	**EB1111719-030**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.3**	**9.6**	**8.8**	**8.4**	**9.0**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**426**	**522**	**1040**	**362**	**480**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**8.0**	**43.3**	**106**	**7.0**	**7.1**
^ ANC as CaCO3	----	0.1	% CaCO3	**0.8**	**4.4**	**10.8**	**0.7**	**0.7**
Fizz Rating	----	0	Fizz Unit	**0**	**2**	**2**	**0**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.070**	**0.107**	**0.292**	**0.054**	**0.040**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.39**	**0.38**	**0.46**	**0.27**	**0.23**

Analytical Results

Sub-Matrix: **SOLID**			Client sample ID	SRJE-33	SRJE-34	SRJE-35	SRJE-36	SRJE-38
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	CAS Number	LOR	Unit	EB1111719-031	EB1111719-032	EB1111719-033	EB1111719-034	EB1111719-035
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.2**	**8.4**	**10.0**	**9.8**	**9.8**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**596**	**431**	**449**	**368**	**563**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**10.8**	**4.6**	**12.8**	**8.9**	**8.7**
^ ANC as CaCO3	----	0.1	% CaCO3	**1.1**	**0.5**	**1.3**	**0.9**	**0.9**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.094**	**0.138**	**0.092**	**0.060**	**0.221**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.42**	**0.34**	**0.21**	**0.09**	**0.68**

Analytical Results

Sub-Matrix: **SOLID**			Client sample ID	SRJE-39	SRJE-40	SRJE-41	SRJE-42	SRJE-43
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	CAS Number	LOR	Unit	EB1111719-036	EB1111719-037	EB1111719-038	EB1111719-039	EB1111719-040
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.8	8.6	9.4	9.2	8.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	427	1630	357	331	519
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	162	90.1	9.3	9.7	56.2
^ ANC as CaCO3	----	0.1	% CaCO3	16.5	9.2	1.0	1.0	5.7
Fizz Rating	----	0	Fizz Unit	3	2	0	0	2
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.203	1.56	0.156	1.06	0.927
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.34	1.72	0.48	1.16	1.14

Analytical Results

Sub-Matrix: **SOLID**			*Client sample ID*	**SRJE-45**	**SRJE-46**	**SRJE-47**	**SRJE-50**	**SRJE-51**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-041**	**EB1111719-042**	**EB1111719-043**	**EB1111719-044**	**EB1111719-045**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.7**	**9.5**	**9.6**	**9.3**	**9.5**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**307**	**461**	**544**	**285**	**186**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**102**	**97.7**	**36.9**	**25.7**	**24.8**
^ ANC as CaCO3	----	0.1	% CaCO3	**10.4**	**10.0**	**3.8**	**2.6**	**2.5**
Fizz Rating	----	0	Fizz Unit	**2**	**2**	**2**	**1**	**1**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.035**	**0.016**	**0.147**	**0.023**	**0.016**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.03**	**0.03**	**0.19**	**0.07**	**0.05**

Analytical Results

Sub-Matrix: **SOLID**

			Client sample ID	**SRJE-52**	**SRJE-53**	**SRJE-56**	**SRJE-57**	**SRJE-58**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-046**	**EB1111719-047**	**EB1111719-048**	**EB1111719-049**	**EB1111719-050**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.6**	**9.5**	**9.5**	**9.5**	**9.3**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**280**	**325**	**359**	**353**	**373**
EA013: Acid Neutralising Capacity								
ANC as H_2SO_4	----	0.5	kg H_2SO_4 equiv./t	**23.3**	**144**	**44.5**	**74.3**	**42.7**
^ ANC as $CaCO_3$	----	0.1	% $CaCO_3$	**2.4**	**14.7**	**4.5**	**7.6**	**4.4**
Fizz Rating	----	0	Fizz Unit	**1**	**3**	**2**	**2**	**2**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.014**	**0.045**	**0.011**	**0.006**	**0.015**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.04**	**0.06**	**0.03**	**0.03**	**0.05**

Analytical Results

Sub-Matrix: **SOLID**			Client sample ID	**SRJE-59**	**SRJE-60**	**SRJE-61**	**SRJE-62**	**SRJE-63**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-051**	**EB1111719-052**	**EB1111719-053**	**EB1111719-054**	**EB1111719-055**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.6**	**9.8**	**9.2**	**9.6**	**8.3**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**378**	**362**	**250**	**290**	**129**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**63.2**	**74.9**	**45.6**	**54.4**	**3.5**
^ ANC as CaCO3	----	0.1	% CaCO3	**6.4**	**7.6**	**4.6**	**5.6**	**0.4**
Fizz Rating	----	0	Fizz Unit	**2**	**2**	**2**	**2**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.032**	**0.024**	**0.017**	**0.031**	**0.528**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.05**	**0.04**	**0.05**	**0.04**	**1.24**

Analytical Results

Sub-Matrix: **SOLID**			Client sample ID	**SRJE-64**	**SRJE-65**	**SRJE-66**	**SRJE-67**	**SRJE-68**
			Client sampling date / time	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]	[16-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1111719-056**	**EB1111719-057**	**EB1111719-058**	**EB1111719-059**	**EB1111719-060**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**8.4**	**8.3**	**8.9**	**9.7**	**9.2**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**91**	**52**	**81**	**144**	**117**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**3.1**	**1.7**	**4.1**	**4.4**	**8.3**
^ ANC as CaCO3	----	0.1	% CaCO3	**0.3**	**0.2**	**0.4**	**0.4**	**0.8**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.179**	**0.012**	**0.081**	**0.007**	**0.099**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.81**	**0.57**	**0.55**	**0.45**	**0.62**

Static Geochemical Results

Multi-Elements and ABCC

- ALS Environmental Batch EB1112586

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1112586**	Page	: 1 of 10
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR IAN SWANE (Terrenus)	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: iswane@terrenus.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: ----	Telephone	: +61 7 3243 7222
Facsimile	: ----	Facsimile	: +61 7 3243 7218
Project	: Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 29-JUN-2011
Sampler	: Ian Swane	Issue Date	: 29-JUL-2011
Site	: ----		
		No. of samples received	: 56
Quote number	: BN/057/11 V2	No. of samples analysed	: 16

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.

WORLD RECOGNISED
ACCREDITATION

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*
Andrew Epps	Metals Production Chemist	Brisbane Inorganics
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

- **$$: NATA accreditation does not cover performance of this service.**
- **EG035S (Soluble Mercury), Sample EB1112586-46 (SRJE-C06) shows poor matrix spike recovery due to matrix interference. Confirmed by re-extraction and re-analysis.**

Analytical Results

Sub-Matrix: **PULP**			Client sample ID	**SRJE-C01**	**SRJE-C02**	**SRJE-C03**	**SRJE-C04**	**SRJE-C05**
			Client sampling date / time	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-041**	**EB1112586-042**	**EB1112586-043**	**EB1112586-044**	**EB1112586-045**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.0**	**9.4**	**9.2**	**9.0**	**9.2**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**446**	**221**	**335**	**201**	**161**
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	**515**	**679**	**527**	**562**	**480**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	**421**	**492**	**387**	**492**	**386**
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	**94**	**187**	**140**	**70**	**94**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**330**	**70**	**190**	**100**	**60**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	**220**	**20**	**160**	**10**	**20**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	**410**	**210**	**320**	**180**	**160**
Potassium	7440-09-7	10	mg/kg	**10**	<10	**20**	<10	<10
ED093T: Total Major Cations								
Sodium	7440-23-5	10	mg/kg	**1160**	**1360**	**730**	**770**	**860**
Potassium	7440-09-7	10	mg/kg	**1120**	**1050**	**710**	**900**	**990**
Calcium	7440-70-2	10	mg/kg	**5470**	**3970**	**9220**	**4130**	**1580**
Magnesium	7439-95-4	10	mg/kg	**4730**	**2820**	**3590**	**4500**	**1720**
EG005S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	**1**	**5**	**2**	**2**	**3**
Antimony	7440-36-0	0.1	mg/kg	<0.1	**0.1**	**0.1**	**0.1**	**0.1**
Arsenic	7440-38-2	0.1	mg/kg	<0.1	<0.1	**1.0**	<0.1	**0.1**
Boron	7440-42-8	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	1	mg/kg	<1	<1	<1	<1	<1
Lead	7439-92-1	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/kg	<0.1	<0.1	**0.2**	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	<0.1	**0.3**	**0.2**	**0.2**	**0.3**
Nickel	7440-02-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.1	mg/kg	**0.1**	**0.2**	**0.1**	<0.1	**0.3**
Vanadium	7440-62-2	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **PULP**			*Client sample ID*	**SRJE-C01**	**SRJE-C02**	**SRJE-C03**	**SRJE-C04**	**SRJE-C05**
			Client sampling date / time	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-041**	**EB1112586-042**	**EB1112586-043**	**EB1112586-044**	**EB1112586-045**
EG005S : Soluble Metals by ICPAES - Continued								
Zinc	7440-66-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**6090**	**2580**	**4170**	**2550**	**5120**
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	**10**	<5	**21**	<5	<5
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**13**	**5**	**18**	**6**	**4**
Cobalt	7440-48-4	2	mg/kg	**18**	**19**	**23**	**13**	**7**
Copper	7440-50-8	5	mg/kg	**30**	**41**	**20**	**40**	**48**
Iron	7439-89-6	50	mg/kg	**37500**	**48800**	**14100**	**59300**	**3520**
Lead	7439-92-1	5	mg/kg	**14**	**23**	**14**	**25**	**25**
Manganese	7439-96-5	5	mg/kg	**591**	**1050**	**304**	**992**	**32**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	**29**	**29**	**35**	**22**	**14**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**22**	**18**	**17**	**25**	**8**
Zinc	7440-66-6	5	mg/kg	**56**	**92**	**89**	**85**	**60**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	**0.190**	**0.103**	**0.0400**	**0.0111**	**0.0096**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **PULP**			*Client sample ID*	**SRJE-C06**	**SRJE-C07**	**SRJE-C08**	**SRJE-C09**	**SRJE-C10**
			Client sampling date / time	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-046**	**EB1112586-047**	**EB1112586-048**	**EB1112586-049**	**EB1112586-050**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.5**	**7.9**	**9.0**	**9.0**	**7.4**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**495**	**1110**	**406**	**188**	**293**
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	**1030**	**597**	**375**	**410**	**281**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	**703**	**597**	**328**	**363**	**281**
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	**328**	<1	**47**	**47**	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**310**	**2040**	**340**	**160**	**460**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	**60**	**240**	**240**	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	**190**	<10	**10**	<10
Magnesium	7439-95-4	10	mg/kg	<10	**130**	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	**490**	**830**	**380**	**170**	**270**
Potassium	7440-09-7	10	mg/kg	<10	**90**	**10**	<10	<10
ED093T: Total Major Cations								
Sodium	7440-23-5	10	mg/kg	**5970**	**850**	**1060**	**440**	**670**
Potassium	7440-09-7	10	mg/kg	**2140**	**890**	**1170**	**340**	**970**
Calcium	7440-70-2	10	mg/kg	**47900**	**6620**	**1080**	**39300**	**2280**
Magnesium	7439-95-4	10	mg/kg	**20700**	**1380**	**3350**	**10300**	**1720**
EG005S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	<1	<1	**2**	<1	<1
Antimony	7440-36-0	0.1	mg/kg	**0.2**	**0.2**	**0.1**	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/kg	<0.1	<0.1	**0.4**	<0.1	<0.1
Boron	7440-42-8	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	1	mg/kg	<1	<1	<1	<1	<1
Lead	7439-92-1	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/kg	<0.1	**0.9**	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	**0.4**	<0.1	**0.1**	**0.1**	**0.3**
Nickel	7440-02-0	0.1	mg/kg	<0.1	**0.1**	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.1	mg/kg	<0.1	**0.3**	**0.2**	**0.2**	**0.2**
Vanadium	7440-62-2	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **PULP**			*Client sample ID*	**SRJE-C06**	**SRJE-C07**	**SRJE-C08**	**SRJE-C09**	**SRJE-C10**
			Client sampling date / time	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-046**	**EB1112586-047**	**EB1112586-048**	**EB1112586-049**	**EB1112586-050**
EG005S : Soluble Metals by ICPAES - Continued								
Zinc	7440-66-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**13900**	**2420**	**6860**	**1680**	**4290**
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	**12**
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**14**	**5**	**10**	<2	**4**
Cobalt	7440-48-4	2	mg/kg	**29**	**5**	**3**	<2	**13**
Copper	7440-50-8	5	mg/kg	**74**	**26**	**29**	**26**	**25**
Iron	7439-89-6	50	mg/kg	**54400**	**8450**	**9330**	**21300**	**30000**
Lead	7439-92-1	5	mg/kg	<5	**13**	**14**	<5	**28**
Manganese	7439-96-5	5	mg/kg	**974**	**76**	**65**	**1170**	**390**
Molybdenum	7439-98-7	2	mg/kg	**4**	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	**43**	**18**	**14**	<2	**22**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**81**	**8**	**12**	**8**	**8**
Zinc	7440-66-6	5	mg/kg	**102**	**53**	**45**	**50**	**98**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	**0.0165**	**0.0022**	**0.0016**	**0.0013**	**0.0008**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.1**	<0.1	<0.1	<0.1	**0.1**

Analytical Results

Sub-Matrix: **PULP**			*Client sample ID*	**SRJE-C11**	**SRJE-C12**	**SRJE-C13**	**SRJE-C14**	**SRJE-C15**
			Client sampling date / time	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-051**	**EB1112586-052**	**EB1112586-053**	**EB1112586-054**	**EB1112586-055**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.3**	**9.1**	**9.1**	**6.7**	**8.5**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**531**	**635**	**451**	**88**	**77**
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	**726**	**633**	**621**	**211**	**281**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	**586**	**563**	**527**	**211**	**258**
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	**140**	**70**	**94**	<1	**23**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**660**	**690**	**510**	**140**	**30**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	**40**	**250**	**120**	**40**	**10**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	**20**
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	**540**	**640**	**470**	**120**	**70**
Potassium	7440-09-7	10	mg/kg	<10	**20**	**20**	<10	<10
ED093T: Total Major Cations								
Sodium	7440-23-5	10	mg/kg	**1370**	**1160**	**1080**	**320**	**140**
Potassium	7440-09-7	10	mg/kg	**1410**	**1630**	**1100**	**260**	**140**
Calcium	7440-70-2	10	mg/kg	**6990**	**18900**	**5280**	**1630**	**4180**
Magnesium	7439-95-4	10	mg/kg	**2900**	**6360**	**3070**	**650**	**460**
EG005S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	**1**	<1	**1**	<1	<1
Antimony	7440-36-0	0.1	mg/kg	**0.2**	**0.1**	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/kg	<0.1	<0.1	**0.1**	**0.1**	<0.1
Boron	7440-42-8	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	1	mg/kg	<1	<1	<1	<1	<1
Lead	7439-92-1	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/kg	<0.1	<0.1	**0.1**	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	**0.5**	**0.2**	**0.1**	**0.3**	<0.1
Nickel	7440-02-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.1	mg/kg	**0.5**	**0.1**	<0.1	**0.1**	<0.1
Vanadium	7440-62-2	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **PULP**			*Client sample ID*	**SRJE-C11**	**SRJE-C12**	**SRJE-C13**	**SRJE-C14**	**SRJE-C15**
			Client sampling date / time	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00	16-JUN-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-051**	**EB1112586-052**	**EB1112586-053**	**EB1112586-054**	**EB1112586-055**
EG005S : Soluble Metals by ICPAES - Continued								
Zinc	7440-66-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**4590**	**3550**	**3560**	**2000**	**1140**
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	**12**	<5	**17**	**11**	<5
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	<2	**4**	**7**	<2	<2
Cobalt	7440-48-4	2	mg/kg	**13**	**4**	**4**	<2	<2
Copper	7440-50-8	5	mg/kg	**24**	**24**	**36**	**16**	**20**
Iron	7439-89-6	50	mg/kg	**23300**	**14300**	**20000**	**7120**	**3580**
Lead	7439-92-1	5	mg/kg	**26**	**14**	**26**	**7**	**5**
Manganese	7439-96-5	5	mg/kg	**512**	**498**	**348**	**156**	**56**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	**4**	**2**	<2
Nickel	7440-02-0	2	mg/kg	**14**	**9**	**9**	**3**	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**9**	<5	**8**	<5	<5
Zinc	7440-66-6	5	mg/kg	**118**	**24**	**44**	**16**	**16**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	**0.1**	<0.1	<0.1

Analytical Results

Sub-Matrix: **PULP**

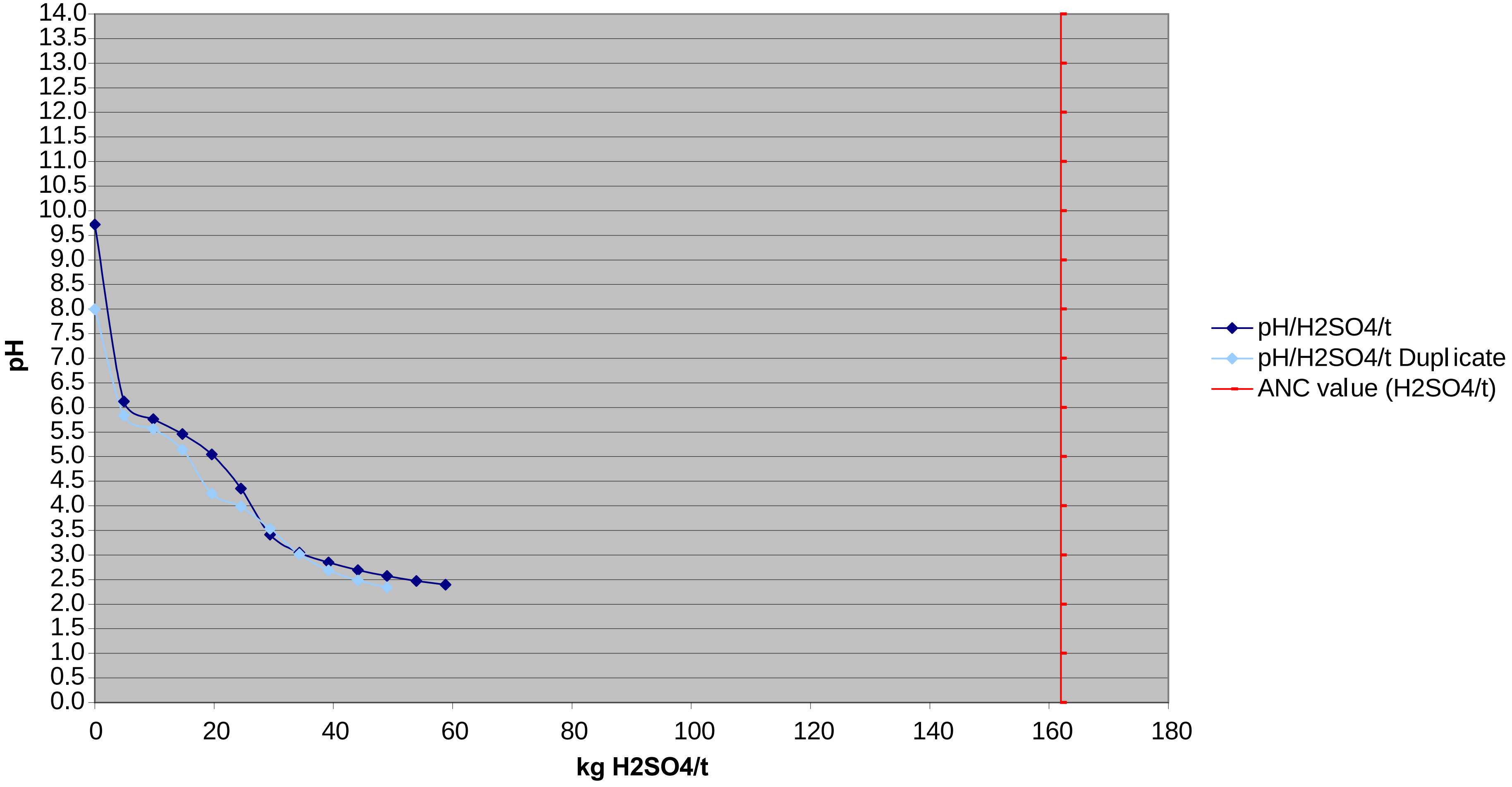
			Client sample ID	**SRJE-C16**	----	----	----	----
			Client sampling date / time	16-JUN-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112586-056**	**----**	**----**	**----**	**----**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.3**	----	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**48**	----	----	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	**515**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	**398**	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	**117**	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**40**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	**30**	----	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----
Sodium	7440-23-5	10	mg/kg	**180**	----	----	----	----
Potassium	7440-09-7	10	mg/kg	<10	----	----	----	----
ED093T: Total Major Cations								
Sodium	7440-23-5	10	mg/kg	**390**	----	----	----	----
Potassium	7440-09-7	10	mg/kg	**250**	----	----	----	----
Calcium	7440-70-2	10	mg/kg	**5780**	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	**750**	----	----	----	----
EG005S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	<1	----	----	----	----
Antimony	7440-36-0	0.1	mg/kg	<0.1	----	----	----	----
Arsenic	7440-38-2	0.1	mg/kg	<0.1	----	----	----	----
Boron	7440-42-8	1	mg/kg	<1	----	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----
Chromium	7440-47-3	0.1	mg/kg	<0.1	----	----	----	----
Cobalt	7440-48-4	0.1	mg/kg	<0.1	----	----	----	----
Copper	7440-50-8	0.1	mg/kg	<0.1	----	----	----	----
Iron	7439-89-6	1	mg/kg	<1	----	----	----	----
Lead	7439-92-1	0.1	mg/kg	<0.1	----	----	----	----
Manganese	7439-96-5	0.1	mg/kg	<0.1	----	----	----	----
Molybdenum	7439-98-7	0.1	mg/kg	**0.1**	----	----	----	----
Nickel	7440-02-0	0.1	mg/kg	<0.1	----	----	----	----
Selenium	7782-49-2	0.1	mg/kg	<0.1	----	----	----	----
Vanadium	7440-62-2	0.1	mg/kg	<0.1	----	----	----	----

Analytical Results

Sub-Matrix: **PULP**			Client sample ID	**SRJE-C16**	----	----	----	----
			Client sampling date / time	16-JUN-2011 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit	**EB1112586-056**	**----**	**----**	**----**	**----**
EG005S : Soluble Metals by ICPAES - Continued								
Zinc	7440-66-6	0.1	mg/kg	<0.1	----	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**2240**	----	----	----	----
Antimony	7440-36-0	5	mg/kg	<5	----	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg	<2	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	<2	----	----	----	----
Copper	7440-50-8	5	mg/kg	**12**	----	----	----	----
Iron	7439-89-6	50	mg/kg	**3640**	----	----	----	----
Lead	7439-92-1	5	mg/kg	**5**	----	----	----	----
Manganese	7439-96-5	5	mg/kg	**58**	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Vanadium	7440-62-2	5	mg/kg	<5	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**24**	----	----	----	----
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	----	----	----

EB1112586-035(SRJE-39)
Acid Buffering Characteristic Curve

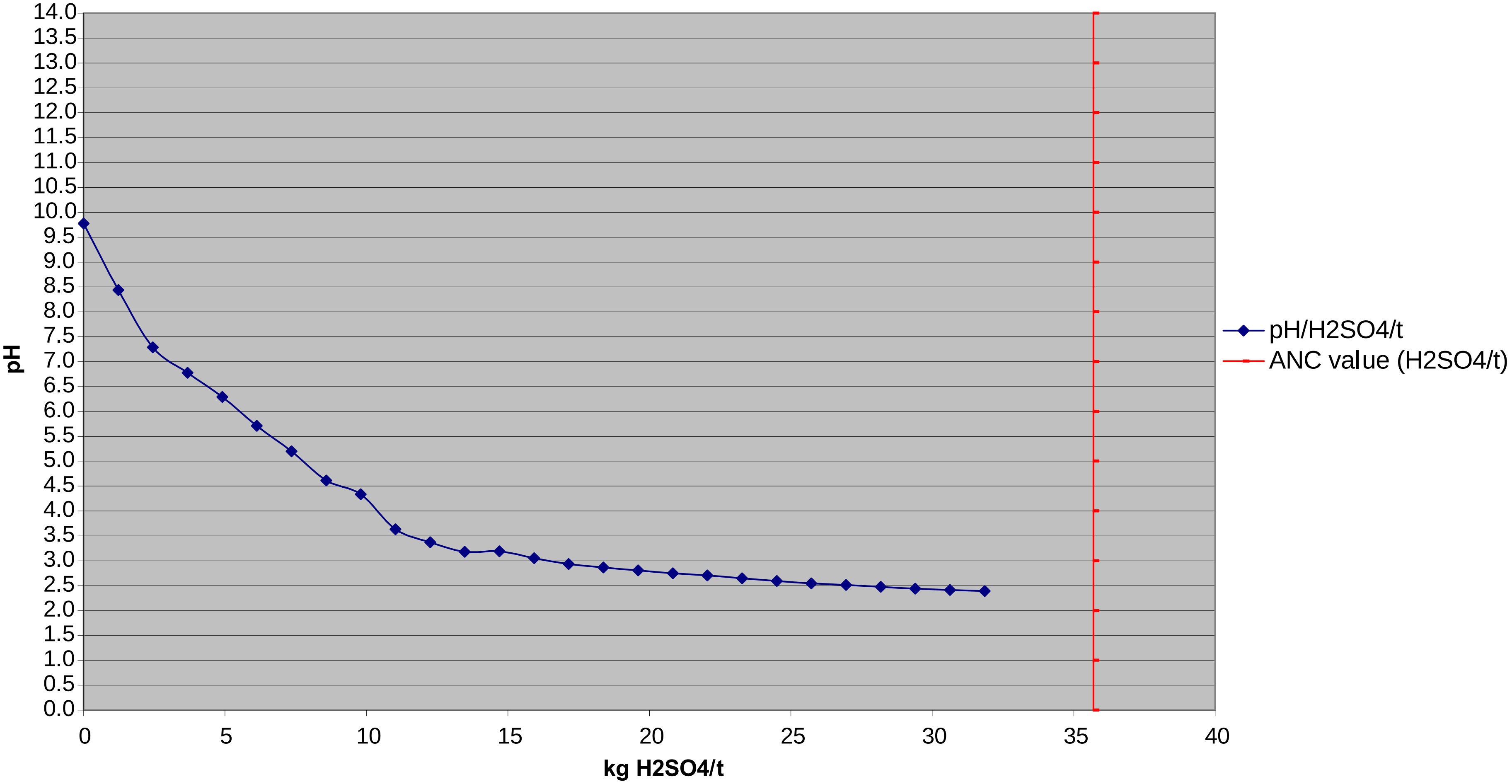
Titrating with 0.5M HCl, in increments of 0.4 mLs every 1000 seconds



EB1112586-036 (SRJE-)

Acid Buffering Characteristic Curve

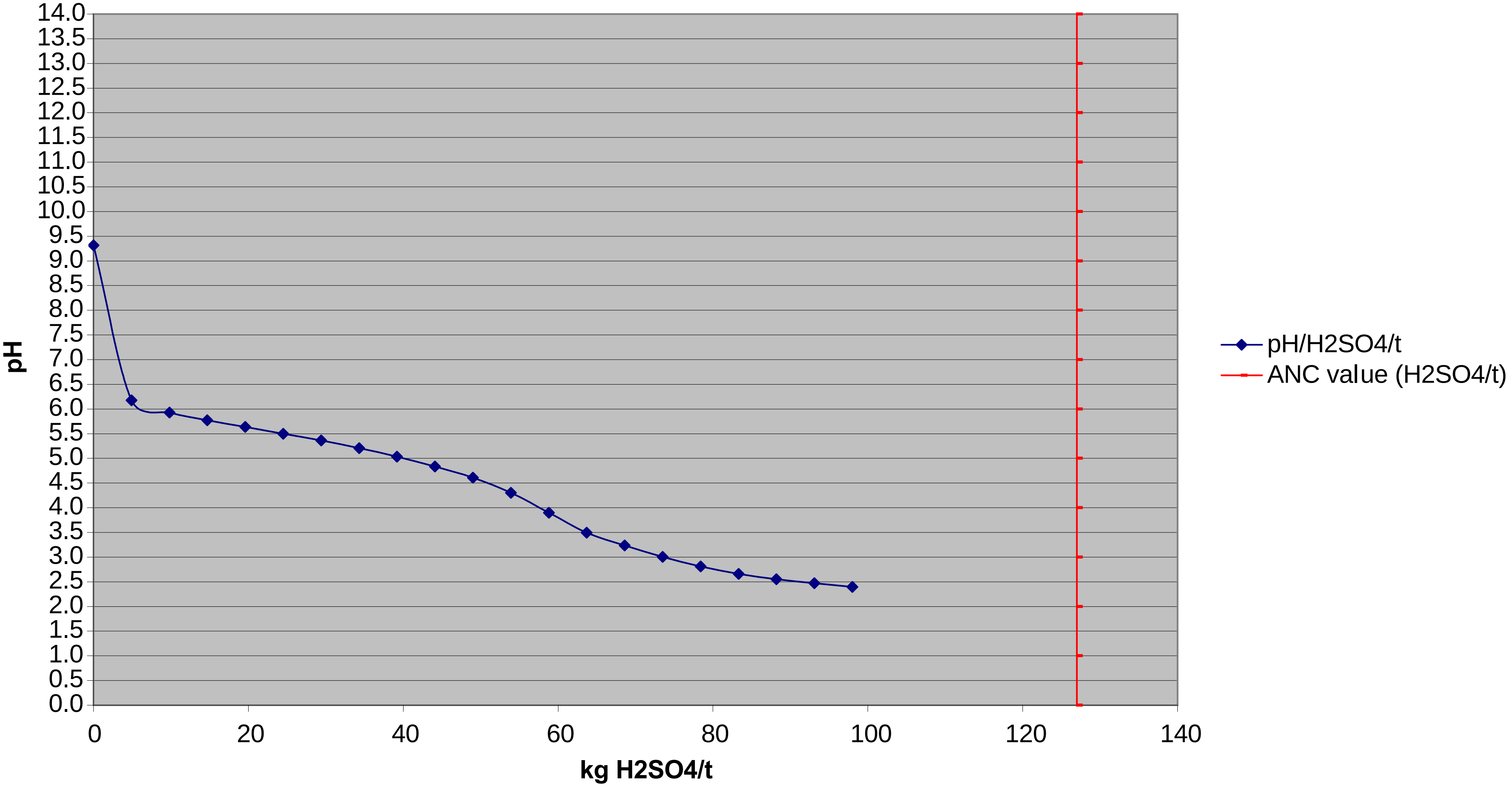
Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds



EB1112586-6 03 (SRJE-26)

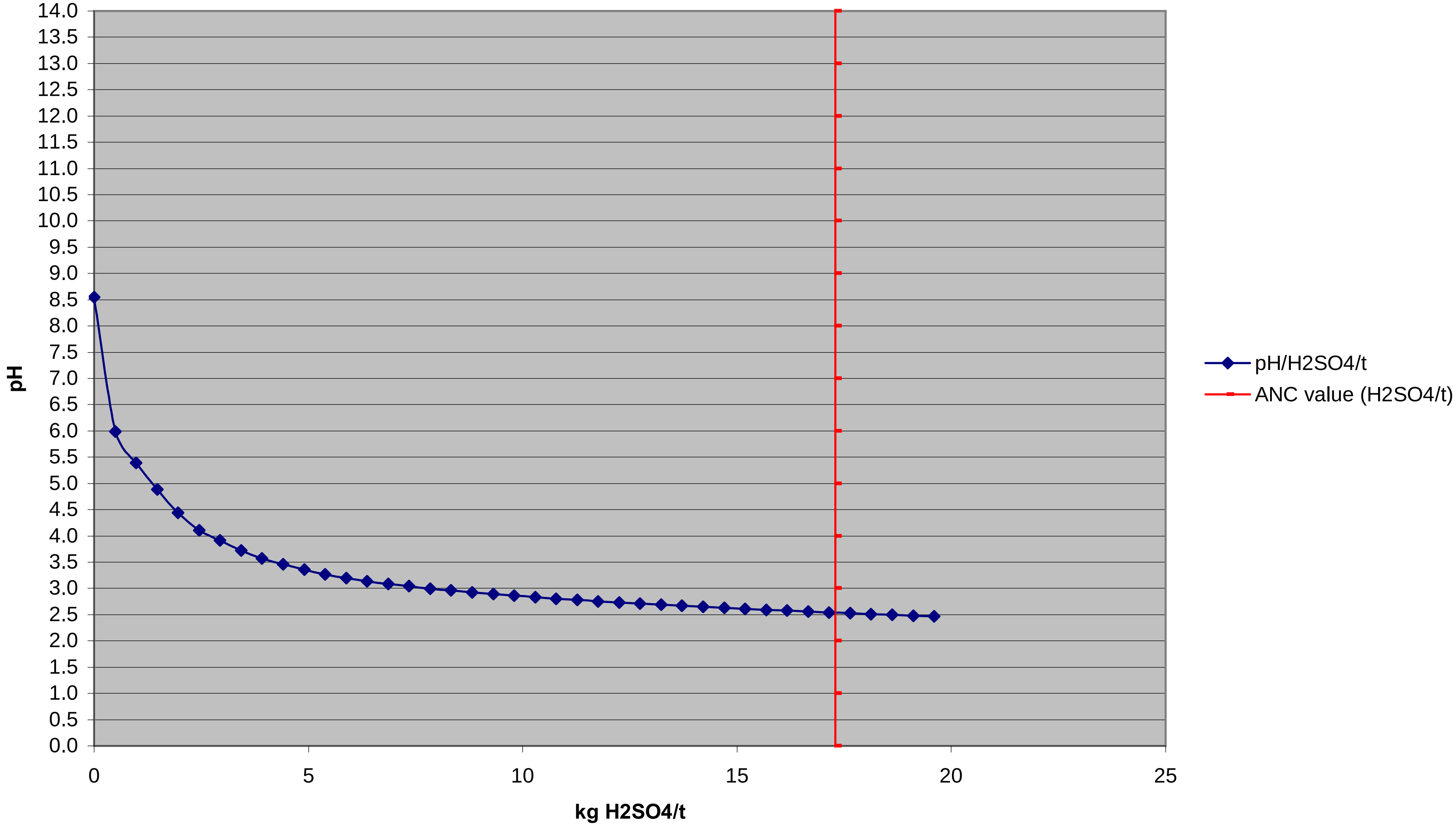
Acid Buffering Characteristic Curve

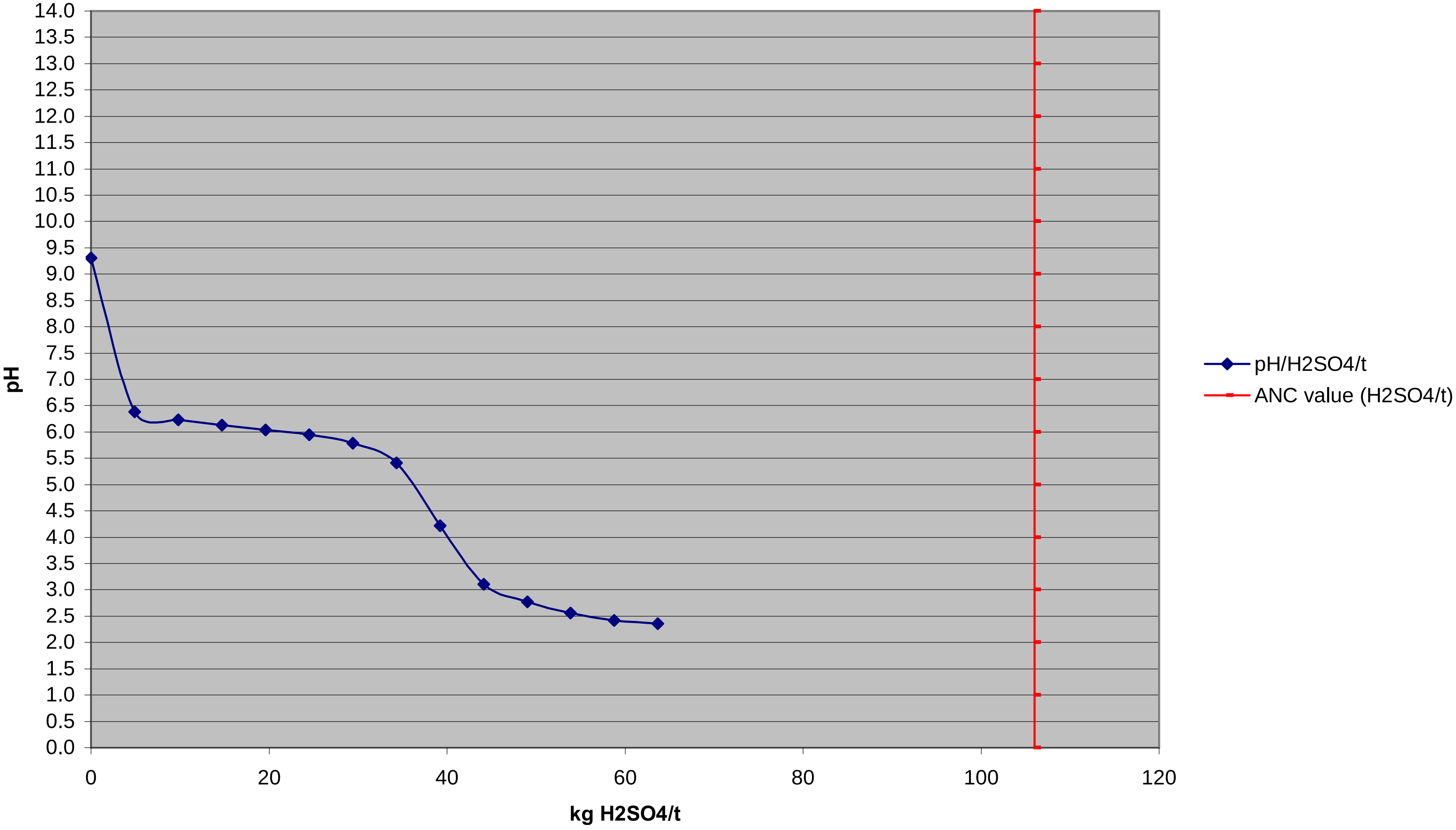
Titrating with 0.5M HCl, in increments of 0.4 mLs every 1000 seconds



EB1112586 – 038 (SRJE-13)
Acid Buffering Characteristic Curve

Titrating with 0.1M HCl, in increments of 0.2 mLs every 1000 seconds

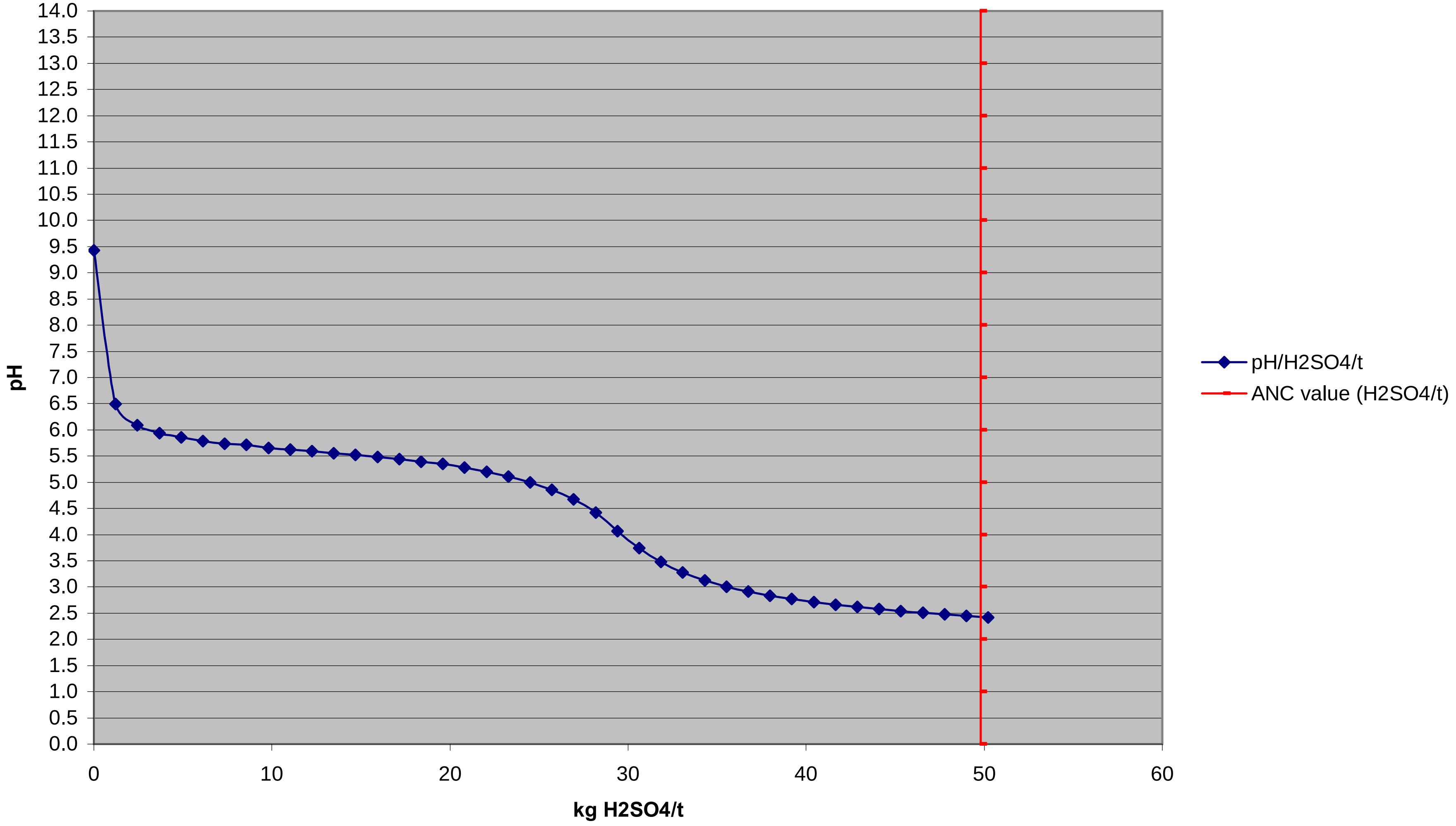




EB1112586 – 039 (SRJE-30)
Acid Buffering Characteristic Curve
Titrating with 0.5M HCl, in increments of 0.4 mLs every 1000 seconds

EB1112586 – 040 (SRJE-43)
Acid Buffering Characteristic Curve

Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds



Kinetic Column Leaching Results

Leach event 1 (week 0)

- ALS Environmental Batch EB1114253

CERTIFICATE OF ANALYSIS

Work Order	: **EB1114253**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RACHEL	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: rachel@rgsenv.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: 101119 Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 21-JUL-2011
Sampler	: A Robertson	Issue Date	: 01-AUG-2011
Site	: ----		
		No. of samples received	: 6
Quote number	: BN/567/10	No. of samples analysed	: 6

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
WORLD RECOGNISED ACCREDITATION

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*
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

Analytical Results

Sub-Matrix: **WATER**			*Client sample ID*	**SRJE-C17 H16 roof**	**SRJE-C18 H16 floor**	**SRJE-C19 D14 floor**	**SRJE-C20 D24 floor**	**SRJE-C21 Saraji Mine Coarse reject**
			Client sampling date / time	19-JUL-2011 15:00	19-JUL-2011 15:00	19-JUL-2011 15:00	19-JUL-2011 15:00	19-JUL-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1114253-001**	**EB1114253-002**	**EB1114253-003**	**EB1114253-004**	**EB1114253-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.85**	**5.60**	**7.39**	**7.73**	**7.65**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**534**	**830**	**302**	**342**	**1410**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**32**	<1	**11**	**21**	**23**
Total Alkalinity as CaCO3	----	1	mg/L	**32**	<1	**11**	**21**	**23**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	**12**	**1**	**1**	**1**
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**136**	**327**	**121**	**103**	**454**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**46**	**49**	**3**	**23**	**145**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**4**	**32**	**19**	**11**	**16**
Magnesium	7439-95-4	1	mg/L	**1**	**10**	**3**	**2**	**16**
Sodium	7440-23-5	1	mg/L	**104**	**124**	**37**	**53**	**266**
Potassium	7440-09-7	1	mg/L	**2**	**4**	**1**	**1**	**5**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.05**	<0.01	<0.01	**0.02**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.028**	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	**0.001**
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.035**	**0.002**	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.076**	**0.002**	**0.001**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.062**	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.182**	**0.036**	**0.083**	**0.006**
Molybdenum	7439-98-7	0.001	mg/L	**0.062**	<0.001	**0.001**	**0.002**	**0.009**
Selenium	7782-49-2	0.01	mg/L	**0.10**	**0.02**	**0.02**	<0.01	**0.02**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	<0.05	**1.95**	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **WATER**

			Client sample ID	**SRJE-C22 Coal**	----	----	----	----
			Client sampling date / time	19-JUL-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1114253-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.85**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**20**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**3**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**3**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**2**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**3**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**2**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

Kinetic Column Leaching Results

Leach event 2 (week 2)

- ALS Environmental Batch EB1115393

CERTIFICATE OF ANALYSIS

Work Order	: **EB1115393**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RACHEL	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: rachel@rgsenv.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: 101119 Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 03-AUG-2011
Sampler	: A Robertson/R Rait	Issue Date	: 15-AUG-2011
Site	: ----		
		No. of samples received	: 6
Quote number	: BN/567/10	No. of samples analysed	: 6

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

WORLD RECOGNISED ACCREDITATION

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*
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

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.

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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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

Analytical Results

Sub-Matrix: **LEACHATE**			*Client sample ID*	**SRJE-C17 H16 roof**	**SRJE-C18 H16 floor**	**SRJE-C19 D14 floor**	**SRJE-C20 D24 floor**	**SRJE-C21 Saraji Mine Coarse reject**
			Client sampling date / time	03-AUG-2011 15:00	03-AUG-2011 15:00	03-AUG-2011 15:00	03-AUG-2011 15:00	03-AUG-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1115393-001**	**EB1115393-002**	**EB1115393-003**	**EB1115393-004**	**EB1115393-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.90**	**6.64**	**7.81**	**8.25**	**8.22**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**433**	**1210**	**508**	**617**	**879**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**4**	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**20**	**4**	**7**	**11**	**27**
Total Alkalinity as CaCO3	----	1	mg/L	**25**	**4**	**7**	**11**	**27**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	**3**	<1	<1	**2**
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**90**	**409**	**199**	**200**	**289**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**53**	**127**	**3**	**38**	**52**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1**	**15**	**8**	**8**	**4**
Magnesium	7439-95-4	1	mg/L	<1	**19**	**3**	**3**	**4**
Sodium	7440-23-5	1	mg/L	**85**	**214**	**90**	**115**	**175**
Potassium	7440-09-7	1	mg/L	**1**	**4**	<1	**1**	**3**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.08**	<0.01	**0.02**	**0.02**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.032**	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.006**	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.014**	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.033**	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.046**	**0.004**	**0.012**	**0.001**
Molybdenum	7439-98-7	0.001	mg/L	**0.150**	**0.002**	**0.009**	**0.002**	**0.008**
Selenium	7782-49-2	0.01	mg/L	**0.15**	**0.07**	**0.12**	**0.02**	**0.02**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **LEACHATE**			*Client sample ID*	**SRJE-C22 Coal**	----	----	----	----
			Client sampling date / time	03-AUG-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1115393-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.82**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**14**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**3**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**3**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**1**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	<1	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**2**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

Kinetic Column Leaching Results

Leach event 3 (week 4)

- ALS Environmental Batch EB1116605

CERTIFICATE OF ANALYSIS

Work Order	: **EB1116605**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: 101119 Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 18-AUG-2011
Sampler	: A ROBERTSON	Issue Date	: 29-AUG-2011
Site	: ----		
		No. of samples received	: 6
Quote number	: BN/567/10	No. of samples analysed	: 6

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*
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

Analytical Results

Sub-Matrix: LEACHATE			Client sample ID	SRJE-C17 H16 roof	SRJE-C18 H16 floor	SRJE-C19 D14 floor	SRJE-C20 D24 floor	SRJE-C21 Saraji Mine Coarse reject
			Client sampling date / time	18-AUG-2011 11:00	18-AUG-2011 11:00	18-AUG-2011 11:00	18-AUG-2011 11:00	18-AUG-2011 11:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1116605-001**	**EB1116605-002**	**EB1116605-003**	**EB1116605-004**	**EB1116605-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.62**	**6.76**	**7.44**	**7.61**	**7.70**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**403**	**1020**	**465**	**664**	**607**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**5**	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**19**	**7**	**9**	**12**	**26**
Total Alkalinity as CaCO3	----	1	mg/L	**24**	**7**	**9**	**12**	**26**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	**4**	**2**	**3**	**2**
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**102**	**407**	**208**	**248**	**226**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**39**	**63**	**17**	**30**	**28**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**17**	**6**	**9**	**2**
Magnesium	7439-95-4	1	mg/L	<1	**14**	**2**	**3**	**2**
Sodium	7440-23-5	1	mg/L	**76**	**183**	**87**	**122**	**118**
Potassium	7440-09-7	1	mg/L	<1	**3**	<1	**1**	**2**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.10**	<0.01	**0.02**	**0.02**	**0.01**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.033**	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.003**	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.007**	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.008**	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.034**	**0.008**	**0.026**	**0.009**
Molybdenum	7439-98-7	0.001	mg/L	**0.135**	**0.003**	**0.006**	**0.001**	**0.007**
Selenium	7782-49-2	0.01	mg/L	**0.15**	**0.05**	**0.08**	**0.02**	**0.02**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **LEACHATE**			Client sample ID	**SRJE-C22 Coal**	----	----	----	----
			Client sampling date / time	18-AUG-2011 11:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1116605-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.73**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**23**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**5**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**5**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**2**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**2**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**3**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.003**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.002**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.005**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

Kinetic Column Leaching Results

Leach event 4 (week 6)

- ALS Environmental Batch EB1117692

CERTIFICATE OF ANALYSIS

Work Order	: **EB1117692**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: 101119 Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 31-AUG-2011
Sampler	: A Robertson	Issue Date	: 12-SEP-2011
Site	: Saraji East		
		No. of samples received	: 6
Quote number	: BN/567/10	No. of samples analysed	: 6

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.

WORLD RECOGNISED ACCREDITATION

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*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

- **EG020A-F: (Dissolved Metals): Sample EB1117692-001 (SRJE-C17 H16 roof) shows poor duplicate results due to matrix interference. Confirmed by re-extraction and re-analysis.**

Analytical Results

Sub-Matrix: **WATER**			*Client sample ID*	**SRJE-C17 H16 roof**	**SRJE-C18 H16 floor**	**SRJE-C19 D14 floor**	**SRJE-C20 D24 floor**	**SRJE-C21Saraji Mine Coarse reject**
			Client sampling date / time	31-AUG-2011 15:00	31-AUG-2011 15:00	31-AUG-2011 15:00	31-AUG-2011 15:00	31-AUG-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1117692-001**	**EB1117692-002**	**EB1117692-003**	**EB1117692-004**	**EB1117692-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.16**	**6.94**	**7.33**	**7.60**	**7.69**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**294**	**840**	**299**	**676**	**630**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**20**	**7**	**8**	**10**	**28**
Total Alkalinity as CaCO3	----	1	mg/L	**20**	**7**	**8**	**10**	**28**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	**2**	**2**	**2**	**2**
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**64**	**291**	**117**	**216**	**228**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**29**	**57**	**3**	**36**	**20**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**14**	**5**	**9**	**4**
Magnesium	7439-95-4	1	mg/L	<1	**10**	**1**	**3**	**3**
Sodium	7440-23-5	1	mg/L	**57**	**156**	**51**	**135**	**132**
Potassium	7440-09-7	1	mg/L	<1	**3**	<1	**1**	**2**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.12**	<0.01	**0.03**	**0.01**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.028**	<0.001	**0.001**	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.001**	**0.004**	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.007**	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.026**	**0.006**	**0.030**	**0.008**
Molybdenum	7439-98-7	0.001	mg/L	**0.117**	**0.003**	**0.004**	**0.002**	**0.007**
Selenium	7782-49-2	0.01	mg/L	**0.10**	**0.04**	**0.05**	**0.01**	**0.02**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	**0.08**	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **WATER**			*Client sample ID*	**SRJE-C22 Coal**	----	----	----	----
			Client sampling date / time	31-AUG-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1117692-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.67**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**11**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**5**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**5**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**1**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**1**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**1**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**2**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.002**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.004**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

Kinetic Column Leaching Results

Leach event 5 (week 8)

- ALS Environmental Batch EB1118817

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1118817**	Page	: 1 of 4
Amendment	: **1**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: 101119 Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 14-SEP-2011
Sampler	: A.Robertson	Issue Date	: 12-OCT-2011
Site	: ----		
		No. of samples received	: 6
Quote number	: BN/567/10	No. of samples analysed	: 6

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

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ACCREDITATION

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*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Stephen Hislop	Senior Inorganic Chemist	Brisbane Inorganics

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

- **This report has been amended following changes to the analytical data reported. The quality system is being utilised to resolve this issue. The specific data affected includes samples SRJE-C21 and SRJE-C22 Coal pH, EC and Alkalinity results.**

Analytical Results

Sub-Matrix: **WATER**			*Client sample ID*	**SRJE-C17 H16 roof**	**SRJE-C18 H16 floor**	**SRJE-C19 D14 floor**	**SRJE-C20 D24 floor**	**SRJE-C21 Saraji Mine Coarse reject**
			Client sampling date / time	14-SEP-2011 15:00	14-SEP-2011 15:00	14-SEP-2011 15:00	14-SEP-2011 15:00	14-SEP-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1118817-001**	**EB1118817-002**	**EB1118817-003**	**EB1118817-004**	**EB1118817-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.84**	**6.81**	**7.24**	**7.48**	**7.76**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**299**	**1120**	**506**	**606**	**450**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**20**	**6**	**10**	**15**	**25**
Total Alkalinity as CaCO3	----	1	mg/L	**20**	**6**	**10**	**15**	**25**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**4**	**5**	**4**	**3**	**3**
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**66**	**444**	**211**	**186**	**158**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**31**	**60**	**3**	**38**	**10**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**25**	**8**	**8**	**2**
Magnesium	7439-95-4	1	mg/L	<1	**18**	**2**	**4**	**2**
Sodium	7440-23-5	1	mg/L	**58**	**187**	**90**	**109**	**84**
Potassium	7440-09-7	1	mg/L	<1	**4**	<1	<1	**2**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.63**	<0.01	**0.03**	**0.03**	**0.08**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.029**	**0.001**	**0.002**	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.003**	<0.001	<0.001	<0.001	**0.001**
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.003**	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.006**	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.010**	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.039**	**0.011**	**0.028**	**0.008**
Molybdenum	7439-98-7	0.001	mg/L	**0.158**	**0.003**	**0.007**	**0.002**	**0.007**
Selenium	7782-49-2	0.01	mg/L	**0.09**	**0.04**	**0.06**	**0.01**	**0.02**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	**0.07**	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **WATER**			*Client sample ID*	**SRJE-C22 Coal**	----	----	----	----
			Client sampling date / time	14-SEP-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1118817-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.26**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**99**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**8**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**8**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**3**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**21**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**7**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**17**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.003**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.002**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.027**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.035**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.02**	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

Kinetic Column Leaching Results

Leach event 6 (week 10)

- ALS Environmental Batch EB1120550

CERTIFICATE OF ANALYSIS

Work Order : **EB1120550**
Client : **RGS ENVIRONMENTAL PTY LTD**
Contact : MR ALAN ROBERTSON
Address : 18 INGLIS STREET
GRANGE QLD, AUSTRALIA 4051
E-mail : alan@rgsenv.com
Telephone : +61 07 3856 5591
Facsimile : +61 07 3856 5591
Project : 101119
Order number : ----
C-O-C number : ----
Sampler : A.ROBERTSON
Site : ----

Quote number : BN/567/10

Page : 1 of 4
Laboratory : Environmental Division Brisbane
Contact : Customer Services
Address : 32 Shand Street Stafford QLD Australia 4053
E-mail : Brisbane.Enviro.Services@alsglobal.com
Telephone : +61 7 3243 7222
Facsimile : +61 7 3243 7218
QC Level : NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Date Samples Received : 04-OCT-2011
Issue Date : 13-OCT-2011

No. of samples received : 6
No. of samples analysed : 6

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*
Stephen Hislop	Senior Inorganic Chemist	Brisbane Inorganics

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

Analytical Results

Sub-Matrix: **LEACHATE**			*Client sample ID*	**SARAJI 17**	**SARAJI 18**	**SARAJI 19**	**SARAJI 20**	**SARAJI 21**
			Client sampling date / time	28-SEP-2011 15:00	28-SEP-2011 15:00	28-SEP-2011 15:00	28-SEP-2011 15:00	28-SEP-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1120550-001**	**EB1120550-002**	**EB1120550-003**	**EB1120550-004**	**EB1120550-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.00**	**6.78**	**7.10**	**7.53**	**7.47**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**274**	**875**	**366**	**796**	**504**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**16**	**7**	**10**	**24**	**22**
Total Alkalinity as CaCO3	----	1	mg/L	**16**	**7**	**10**	**24**	**22**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	**3**	**2**	**2**	**2**
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**51**	**314**	**141**	**233**	**181**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**26**	**36**	**2**	**38**	**8**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**16**	**6**	**10**	**3**
Magnesium	7439-95-4	1	mg/L	<1	**10**	**2**	**4**	**3**
Sodium	7440-23-5	1	mg/L	**52**	**144**	**62**	**148**	**90**
Potassium	7440-09-7	1	mg/L	<1	**3**	<1	**1**	**2**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.42**	<0.01	<0.01	**0.01**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.018**	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.004**	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.002**	**0.004**	**0.002**	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.003**	**0.008**	**0.002**	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.007**	**0.014**	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	**0.004**	**0.040**	**0.018**	**0.025**	**0.010**
Molybdenum	7439-98-7	0.001	mg/L	**0.110**	**0.002**	**0.003**	**0.002**	**0.006**
Selenium	7782-49-2	0.01	mg/L	**0.07**	**0.03**	**0.04**	**0.02**	**0.02**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	**0.10**	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **LEACHATE**			*Client sample ID*	**SARAJI 22**	----	----	----	----
			Client sampling date / time	28-SEP-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1120550-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.99**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**94**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**16**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**16**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**17**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**5**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**16**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.010**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.015**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.046**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.02**	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

Kinetic Column Leaching Results

Leach event 7 (week 12)

- ALS Environmental Batch EB1121080

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1121080**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RACHEL	Contact	: Customer Services
Address	: 18 INGLIS STREET GRANGE QLD, AUSTRALIA 4051	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: rachel@rgsenv.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 07 3856 5591	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3856 5591	Facsimile	: +61 7 3243 7218
Project	: 101119 Saraji East	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 11-OCT-2011
Sampler	: A Robertson	Issue Date	: 19-OCT-2011
Site	: ----		
		No. of samples received	: 6
Quote number	: BN/567/10	No. of samples analysed	: 6

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.

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- General Comments
- Analytical Results

NATA
WORLD RECOGNISED
ACCREDITATION

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*
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Stephen Hislop	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

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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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

Analytical Results

Sub-Matrix: **LEACHATE**			*Client sample ID*	**SARAJI 17**	**SARAJI 18**	**SARAJI 19**	**SARAJI 20**	**SARAJI 21**
			Client sampling date / time	11-OCT-2011 15:00	11-OCT-2011 15:00	11-OCT-2011 15:00	11-OCT-2011 15:00	11-OCT-2011 15:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1121080-001**	**EB1121080-002**	**EB1121080-003**	**EB1121080-004**	**EB1121080-005**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.63	7.05	7.54	8.14	7.77
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	290	925	346	626	468
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	3	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	31	6	9	29	29
Total Alkalinity as CaCO3	----	1	mg/L	34	6	9	29	29
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	5	2	2	2
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	54	360	133	189	165
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	25	29	3	28	6
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	21	6	6	3
Magnesium	7439-95-4	1	mg/L	<1	12	2	3	3
Sodium	7440-23-5	1	mg/L	56	147	58	114	84
Potassium	7440-09-7	1	mg/L	<1	4	<1	1	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.42	<0.01	0.02	0.03	0.02
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.037	0.002	0.003	0.001	0.002
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.002	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.001	0.006	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	0.012	<0.005	<0.005	<0.005
Manganese	7439-96-5	0.001	mg/L	<0.001	0.029	0.003	0.001	0.003
Molybdenum	7439-98-7	0.001	mg/L	0.121	0.003	0.004	0.002	0.005
Selenium	7782-49-2	0.01	mg/L	0.08	0.02	0.04	0.01	0.02
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **LEACHATE**			*Client sample ID*	**SARAJI 22**	----	----	----	----
			Client sampling date / time	11-OCT-2011 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1121080-006**	**----**	**----**	**----**	**----**
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.45**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**59**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**14**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**14**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**9**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**3**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**11**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.04**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.008**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.004**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.028**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

RGS

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