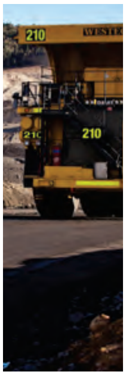

Moolarben Coal Complex
Open Cut Optimisation Modification

Environmental Assessment

APPENDIX H

Geochemistry Review

LEADERS IN MINING GEOCHEMISTRY

Geochemistry Review to Support an Application to Modify the Project Approvals for Stages 1 and 2 of Moolarben Coal Complex

Report Prepared for:

MOOLARBEN COAL OPERATIONS PTY LTD

Geochemistry Review to Support an Application to Modify the Project Approvals for Stages 1 and 2 of Moolarben Coal Complex

Prepared for: Moolarben Coal Operations Pty Ltd

DOCUMENT CONTROL

Report Title	Geochemistry Review to Support an Application to Modify the Project Approvals for Stages 1 and 2 of Moolarben Coal Complex		
Project Name	Moolarben Stage 1 and 2 Project Approvals Modification Application: Geochemistry Review		
RGS Job Number	2017032	**Client**	Moolarben Coal Operations Pty Ltd
Date	October 2017	**Status**	Final Report

123 Wynne St, Sunnybank Hills, QLD 4109
Webpage: www.rgsenv.com; Tel: +61 7 3344 1222

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GLOSSARY OF TERMS AND ACRONYMS

Acidity	A measure of hydrogen ion (H^+) concentration; generally expressed as pH.
Alkalinity	A measure of the capacity of alkaline water to buffer/neutralise acidity.
ABA	Acid Base Account, an evaluation of the balance between acid generation and acid neutralisation processes. Generally determines the MPA and the inherent ANC, as defined below, and is commonly used in assessing the potential for AMD associated with mining.
AMD	Acid and metalliferous drainage caused by exposure of sulfide minerals in mine waste materials to oxygen and water. Typically characterised by low pH and elevated concentrations of salts, sulfate and metals.
ANC	Acid neutralising capacity of a sample as kg H_2SO_4 per tonne of sample. Commonly referred to as the buffering capacity.
ANC:MPA Ratio	Ratio of the acid neutralising capacity and maximum potential acidity of a sample. Used to assess the risk of a sample generating acid conditions.
Coal	Material that has been mined with sufficient economic value to warrant processing/sale.
CRS	Chromium reducible sulfur test measures the sulfide sulfur content of a sample material.
Dispersive	Dispersive soil and rock materials are structurally unstable and disperse into basic particles such as sand, silt and clay in water. When a dispersive soil is wet, the basic structure has a tendency to collapse, whereas when it is dry it is prone to surface sealing and crusting.
EC	Electrical Conductivity, expressed as µS/cm, is a measure of electrical conductance.
eCEC	Effective cation exchange capacity provides a measure of the amount of exchangeable cations (Ca, Mg, Na and K) in a sample.
ESP	Exchangeable sodium percentage provides a measure of the sodicity of a material and propensity to erode.
KLC test	Kinetic leach column tests are procedures used to measure the geochemical/ weathering behaviour of a sample of mine material over time, and are a recognised laboratory method of replicating natural processes affecting in-situ mine material.
LoR	Limit of Reporting. Laboratory detection limit for the reporting of results for a particular geochemical test.
MPA	Maximum Potential Acidity calculated by multiplying the total sulfur content of a sample by 30.625 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne.
NAF	Non-acid forming. Geochemical classification criterion for a sample that does not have the potential to generate acid conditions.

NAF-Barren	Non-acid forming and barren of sulfur (i.e. less than or equal to 0.1% sulfur). Geochemical classification criterion for a sample that will not generate acid conditions.
NAG test	Net acid generation test. Hydrogen peroxide solution is used to oxidise sulfides in a sample, then any acid generated through oxidation may be consumed by neutralising components in the sample. Any remaining acidity is expressed as kg H_2SO_4 per tonne.
NAPP	Net acid producing potential expressed as kg H_2SO_4 per tonne. NAPP is the balance between the capacity of a sample to generate acidity (MPA) minus its capacity to neutralise acidity (ANC).
NMD	Neutral mine drainage typically caused by exposure of sulfide minerals in mine waste materials to oxygen and water and then neutralisation by gangue minerals. Typically characterised by neutral pH and elevated concentrations of salts, sulfate and metals.
PAF	Potentially acid forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions.
PAF-LC	Potentially acid forming – low capacity. Geochemical classification criterion for a sample that has the potential, but low capacity, to generate acid conditions.
Coal Reject	Material that has been mined with insufficient economic value to warrant processing/sale or is produced as a by-product of coal processing.
%S	Percent sulfur. A measurement unit for the sulfur content of a sample material.
Sodic	Sodic soil and rock materials are characterised by a disproportionately high concentration of sodium (Na) in their cation exchange complex and are innately unstable, exhibiting poor physical and chemical properties, which impede water infiltration, water availability, and ultimately plant growth.
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.
Total Sulfur	Total sulfur content of a sample generally measured using a 'Leco' analyser expressed as %S.
Sulfide Sulfur	Sulfide sulfur content of a sample generally measured using the Chromium Reducible Sulfur method.
TSS	Total suspended solids is a measurement of the suspended solids concentration in a water sample.
Overburden	Material that overlies economic coal seam(s) and must be removed to mine the seam(s).
Interburden	Material that lies between economic coal seams and must be removed to mine the seams. In this report, any interburden has been included with overburden.

1.0 INTRODUCTION

RGS Environmental Pty Ltd. (RGS) was commissioned by Moolarben Coal Operations Pty Ltd. (MCO) to complete a Geochemistry Review to Support an Application to Modify the Project Approvals for Stages 1 and 2 of Moolarben Coal Complex.

1.1 Background

Moolarben Coal Complex is an approved open cut and underground coal mine, approximately 3 kilometres (km) east of the village of Ulan and 40 km north of Mudgee, New South Wales (NSW). MCO is the operator of the Moolarben Coal Complex on behalf of the Moolarben Joint Venture; Moolarben Coal Mines Pty Ltd, Sojitz Moolarben Resources Pty Ltd and a consortium of Korean power companies. MCO and Moolarben Coal Mines Pty Ltd are wholly owned subsidiaries of Yancoal Australia Limited.

Moolarben Coal Complex comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (a coal handling and preparation plant [CHPP], raw and product coal stockpiles, a rail loop and rail loader, and office and workshop support facilities) as shown in **Figure 1** (**Attachment A**). Open cut mining utilises conventional truck, shovel and dozer methods, while underground mining will utilise longwall mining methods. MCO is currently operating OC1, OC2 and OC4, and first workings in UG1 have commenced. Coal mining in OC1 commenced in May 2010. MCO is seeking to modify Project Approvals for Stages 1 and 2 of Moolarben Coal Complex (referred to as the Open Cut Optimisation Modification [the Modification]) to allow for changes to the currently approved open cut mining operations, including:

- Increased run-of-mine (ROM) coal production from the Stage 1 (OC2/OC3) and Stage 2 (OC4) open cuts, and associated increase in product coal. (A schematic is provided at **Figure 2**, **Attachment A**).
- Associated increase in annual production rate of coal reject material.

The Modification does not involve mining in new areas (only minor extensions).

In addition, MCO is seeking approval as part of the Modification for increased controlled water releases from the site, and associated water treatment facility on-site.

1.2 Purpose

RGS has completed a review of the geochemical nature of mine materials as part of the Modification Application.

The purpose of this report is to:

- Inform treatment requirements for controlled water releases and make recommendations for ongoing water quality monitoring.
- Assess the potential impact of the proposed increase in annual production rate of coal reject material.
- Make recommendations for ongoing water quality monitoring.

2.0 METHODOLOGY

RGS personnel worked closely with MCO geological and environmental personnel to gather and collate previous and existing geochemical information on mining by-products including overburden, interburden and coal reject materials from Moolarben Coal Complex.

In addition, RGS received water quality monitoring information from the MCO water quality database related to existing water storages and groundwater monitoring bores.

A list of the relevant information supplied to RGS and included in the review program is provided below:

- Moolarben Coal Project, Appendix 10, Geochemical Assessment of the Moolarben Coal Project (EGi, 2006);
- Moolarben Coal Project Stage 2, Appendix 17, Geochemical Assessment (EGi, 2008);
- Mining by-products geochemical test work results from November 2015 to March 2017 (MCO, 2017a);
- MCO water quality monitoring database (2012 to 2017) (MCO, 2017b).

Supplementary documents were also provided to RGS and components of these were included, where applicable, in the review process and comprised:

- Moolarben Coal Operations EPL 12932 (26 May, 2016) (NSW EPA, 2016);
- Moolarben Coal Stage 1– Consolidated Approval (December, 2016) (NSW, DPE, 2016a) as modified;
- Moolarben Coal Stage 2– Consolidated Approval (February, 2016) (NSW, DPE, 2016b) as modified; and
- Moolarben Coal Complex Surface Water Management Plan (28 January, 2016) (MCO, 2016b).

The findings of the geochemistry review process are provided in **Section 3.0.**

Following completion of the geochemistry review process for the information listed above, RGS has prepared and presented a summary of the results of the review, which includes:

- Previous mining by-product management findings.
- The potential for specific enriched/soluble metals and salinity.

RGS has also provided a comparison of water quality data in existing on-site water storages / groundwater monitoring bores[1] against expected outcomes of previous geochemistry assessments with specific focus on acidity, salinity, major ions and enriched/soluble metals/metalloids.

[1] A figure showing the location of the groundwater monitoring bores at the Moolarben Coal Complex is provided in **Figure 3** (**Attachment A**).

3.0 GEOCHEMISTRY REVIEW

An explanation of the methodology used and data reviewed in this section is provided in **Section 2.0** and **Attachment B**; and a glossary of geochemical terms and acronyms used is listed on **Pages V** and **VI**.

3.1 2006 EGi Geochemical Assessment

In 2006, a geochemical assessment of the Moolarben Coal Complex was completed as part of the Stage 1 Project approvals application process (EGi, 2006). The assessment focussed on investigating any potential Acid Rock Drainage (now known as Acid and Metalliferous Drainage (AMD)), salinity and sodicity issues associated with development of the coal resource.

The EGi report described the stratigraphy at Moolarben as comprising a sequence of Permian sandstone, siltstone, mudstone, tuff and coal, of which the Ulan Seam was the only seam of economic significance. Sub-economic seams intersected in the mine stratigraphy include Moolarben and Bungaba seams[2]. The authors suggested that the Permian sediments appeared to have been deposited in a mainly fluvial dominated environment, although occasional marine influence was indicated in the sandstone horizons. Pyrite (the source of any potential AMD) was not visually observed in the drill core. Quaternary/Tertiary alluvial erosion channels cut through portions of the Permian sequence, and were estimated to make up about 10% of the total overburden. Siderite was the main carbonate observed, and field testing indicated a lack of acid neutralising minerals.

A total of six drill holes were utilised by EGi to collect representative drill core and drill chip samples from the three proposed open pits (OC1, OC2 and OC3) and underground development (UG4). The samples were selected to best represent the full mine stratigraphic section, including weathered Permian and Quaternary/Alluvial materials.

Geochemical testing was completed on 72 representative samples of overburden from the proposed open cut development and 48 representative samples from the proposed underground development, including overburden materials from the proposed vent shaft and underground access. The samples were mainly comprised of overburden materials, although some Ulan coal seam (6 samples) and floor (6 samples) materials were included. In addition a further two composite washability trial samples were included in the assessment to represent coal reject from washing high ash thermal product coal (Ulan seams A to C) and low ash thermal product (Ulan seams D to E), respectively.

The EGi report found that over 90% of the proposed open cut and underground samples were non-acid forming (NAF) and the remaining 10% were potentially acid forming – low capacity (PAF-LC). All of the open cut floor samples were found to be NAF and it was therefore suggested that the final pit floor would be NAF and therefore not a source of AMD.

Most of the coal seam samples were classified as PAF-LC and it was suggested that some minor acidity could potentially be released from coal stockpiles and underground workings. The two coal reject samples were found to be acid forming with low ash coal reject sample showing the highest AMD potential. The authors indicated that management of these materials could be required to limit the potential for AMD.

While the sulfur content of the overburden was relatively low, the sulfur concentration was generally elevated in the coal and coal reject materials, and sulfur ranges in coal were consistent with Moolarben total sulfur results for washed coal samples from the open cut and underground deposits.

[2] A schematic of the typical stratigraphic column at the Moolarben Coal Complex is provided in **Figure 4** (**Attachment A**).

The inherent acid neutralising capacity (ANC) values in overburden, coal and coal reject were generally found to be moderate, low and negligible, respectively.

The authors cautioned against over reliance on acid buffering from overburden (for management of PAF reject materials, for example), because a proportion of the measured ANC was indicated as not being fully effective with overburden potentially requiring a long residence time and low flushing rates to provide effective acid buffering.

Overburden, coal seam floor and coal reject samples were found to be non-saline and coal samples were moderately saline to saline.

Overburden materials (including samples representing topsoil, Quaternary/Tertiary alluvials and weathered Permian materials) showed some potential for sodic/dispersive behaviour, and the authors indicated such materials could require amendment with gypsum or lime, if exposed on dump surfaces or used in engineered structures.

No significant enrichment of metals/metalloids was indicated from testing overburden, coal or reject solids when compared to average concentrations in soils[3]. Water extract testing indicated that most metals/metalloids were sparingly soluble in initial contact water from these materials. The main exception was elevated soluble Al concentrations in some samples. However, Al has low solubility at neutral pH, and the authors attributed the elevated Al to the presence of small amounts of fine particulates (colloids) in the leachate solutions tested.

While minor mobilisation of Co, Cu and Zn was indicated in kinetic leach column tests for the high ash coal reject sample and Al, Ni and Zn for the low ash coal reject sample, mobilisation of these elements and other metals/metalloids was expected by the authors to be largely controlled by pH, so that management of AMD would effectively control potential metal/metalloid release.

On the basis of the results of the 2006 report, EGi indicated that for materials management:

- Normal ROM operational blending of overburden should be sufficient to control AMD, pending confirmation with leach column testing.
- Containment of run off and leachate from coal stockpiles and underground operations may be required to monitor water quality and determine whether treatment is required.
- The sensitivity of groundwater and surface water to saline and acidic water should be investigated to determine the degree of management required. Provision for acid treatment may be needed, which could include use of a mobile lime dosing plant to treat acid waters and broadcast application of agricultural lime.
- Rejects appear to have a higher AMD risk than other mine materials, and are likely to require specific management to control AMD. Possible approaches include underwater disposal, lime treatment, isolation from infiltration, or a combination of these.
- Materials with sodic/dispersion potential may require treatment (with gypsum or lime) if exposed on dump surfaces or used in engineered structures.
- A routine system of AMD testing should be established during operations to check the AMD potential of mine materials and allow for modification of materials management strategies, if required.

[3] It is noted that the reference provided in the 2006 EGi report (Bowen, 1979) is correct, however the page numbers referenced (p36-37) refer to the elemental composition of some igneous rocks rather than the median elemental composition of soils, which is located on pages 60 to 61.

3.2 2008 EGi Geochemical Assessment

In 2008, a geochemical assessment of the Moolarben Coal Complex was completed as part of the Moolarben Coal Project Stage 2 approvals application process (EGi, 2008). The assessment included 107 chip samples from three drill holes drilled to the base of the Ulan seam, selected to best represent the full mine stratigraphic sequence.

The findings were comparable with the previous 2006 assessment in that the majority of the overburden and floor samples (95%) from the Stage 2 operations were classified as NAF. PAF overburden material was mainly associated with the Moolarben seam, and roof and floor of the Ulan seam. The Ulan coal seam samples had a greater proportion of PAF materials than overburden or floor samples, indicating possible AMD issues associated with coarse rejects, fine rejects and coal stockpiles.

In terms of material management, the 2008 EGi report indicated that:

- The coarse and fine reject streams could be partly PAF and should be managed as PAF material.
- PAF overburden represents a small proportion of bulk overburden materials and operational mixing may be sufficient to control AMD from these materials, depending on the overall distribution of the PAF materials and the acid potential. PAF overburden materials could also be selectively handled with the rejects, as an alternative management strategy.
- Closure strategies for PAF waste materials could involve in-pit placement below the water table and/or construction of a cover system to isolate PAF materials from infiltrating water, both with potential limestone amendment.
- Operational monitoring of the quality of runoff and seepage from pits and overburden dumps to determine whether AMD controls are required prior to implementation of closure strategies.
- Containment of runoff and leachate from coal stockpiles and underground operations to allow water quality monitoring and treatment, if required (eg. crushed limestone addition).
- Ongoing routine AMD testing of mine materials and review of management strategies.
- Routine site water quality monitoring programs including pH, Electrical Conductivity (EC), acidity/alkalinity, sulfate and dissolved Al, As, Co, Cu, Fe, Mn, Ni and Zn.

3.3 Mine Procedures and Approval Conditions

Ongoing geochemical characterisation of MCO coal, overburden and reject materials is generally carried out in line with EGi recommendations. The current management procedures were reviewed by RGS.

The Moolarben Coal Project Stage 1 and Stage 2 have two separate Project Approval Documents (NSW DPE, 2016a and 2016b), which contain specific conditions related to 'in pit emplacement, encapsulation or capping of fine rejects, acid forming and PAF materials to prevent the migration of pollutants beyond the pit shell'. The site operates in accordance with an approved Surface Water Management Plan (MCO, 2016b) and also Environmental Protection Licence Number 12932 (NSW EPA, 2016). The licence contains 'concentration' limits for pH, EC, Oil and Grease, Total Suspended Solids (TSS) and Turbidity for identified monitoring discharge points.

The geochemical characterisation results for coal, overburden and coal reject materials obtained in recent years by MCO (November 2015 to March 2017) are presented and discussed in **Section 3.4**.

3.4 Current Geochemical Data Set (November 2015 to March 2017)

From November 2015 to April 2016 MCO completed geochemical characterisation tests on 28 samples of mine materials (coal, floor, overburden and roof samples). In December 2016, MCO commenced an intensive monthly sampling and geochemical testing program for coal, overburden and coal reject materials, which is scheduled to continue for 12 months until December 2017. In the period December 2016 to March 2017, a total of 94 samples were collected and sent to ALS Brisbane for geochemical characterisation. The currently available static test results from the combined total of 122 samples included in the MCO sampling and geochemical test program from November 2015 to March 2017 are presented in **Section 3.4.1**.

Static geochemical tests provide a 'snapshot' of the geochemical characteristics of a sample material at a single point in time. These tests allow screening of a large number of samples before selecting either individual and/or composite samples of interest for more detailed static (and potentially kinetic) geochemical test work.

The 122 MCO samples represent 36 coal samples, 12 floor samples, 37 overburden samples, 3 parting samples, 18 reject samples (including coarse reject, fine and ultrafine reject), and 16 roof samples. The samples were sourced directly from areas in the open cut pits (26 samples), exploration holes at the open pit (58 samples), ROM pad (20 samples) and CHPP (18 samples)[4].

3.4.1 Acid Base Account Results

The Acid Base Account (ABA) was used as a screening procedure whereby the acid-neutralising and acid-generating characteristics of a material were assessed. All 122 samples were screened using ABA. The ABA screening included static geochemical testing for the following parameters on most samples:

- pH (1:5 w:v, sample:deionised water);
- EC (1:5 w:v, sample:deionised water);
- Total sulfur [Leco method]; and
- ANC [AMIRA, 2002 method].

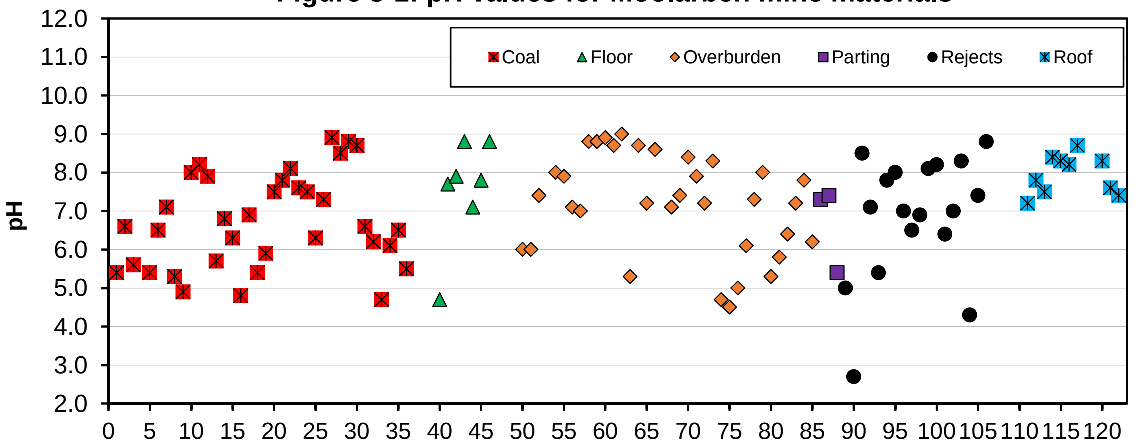
[4] The CHPP and ROM samples included 4 samples of coal and coarse, fine and ultrafine rejects derived from strata associated with the planned underground mine.

Forty-five (45) of the 122 samples were also tested for sulfide sulfur using the Chromium Reducible Sulfur (CRS) method [AS 4969.7-2008 method] and 29 of the 122 samples were subjected to the Net Acid Generation (NAG) test [AMIRA, 2002]. The ABA and NAG test results for the 122 samples of the various mine materials are provided in **Table C1 (Attachment C).** The data trends discussed in this section are presented in **Figures 3-1** to **3-6**.

- **pH:** The pH values for (1:5 solid:water) extracts from the 122 samples of MCO mine materials are shown in **Figure 3-1** (not all samples have a recorded pH value). It should be noted that the deionised water used by ALS in the water extract procedure generally has a pH in the range 5.0 to 6.5.

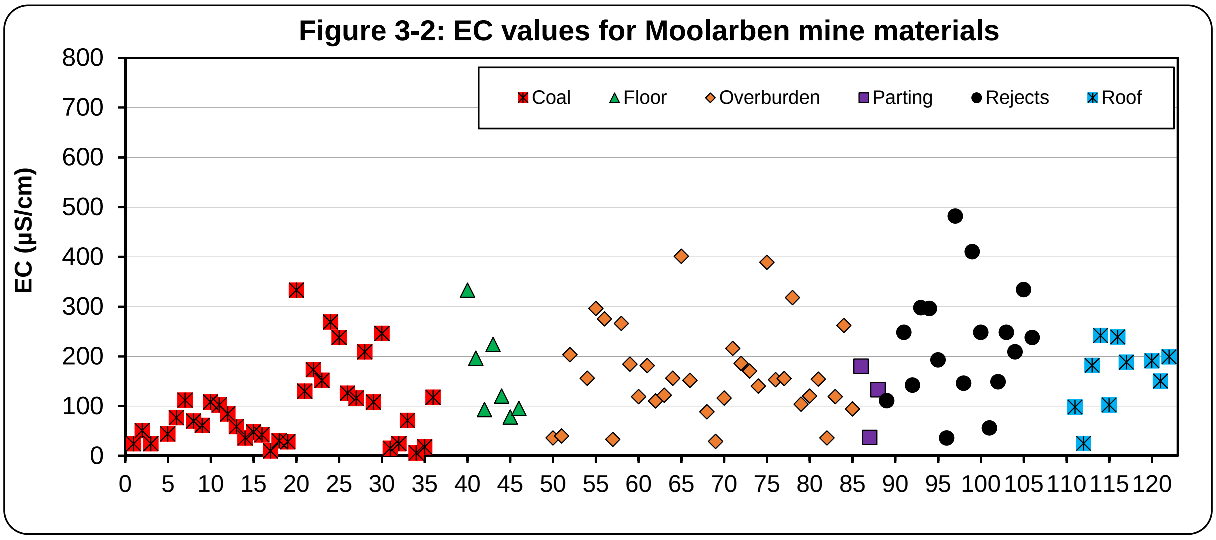
  The results show that most samples have a pH value either within or above the pH value of the deionised water used in the test. Only eight of the samples (3 coal, 1 floor, 2 overburden and 2 reject samples) have a pH value less than pH 5.0. The data suggest that most mine materials are likely to (at least initially) generate circum-neutral to slightly alkaline pH values in the range 6 to 9 in contact water. However, some of the coal and reject materials may generate a reduced acidic pH value in contact water after a limited period of exposure to oxidising conditions.

Figure 3-1: pH values for Moolarben mine materials



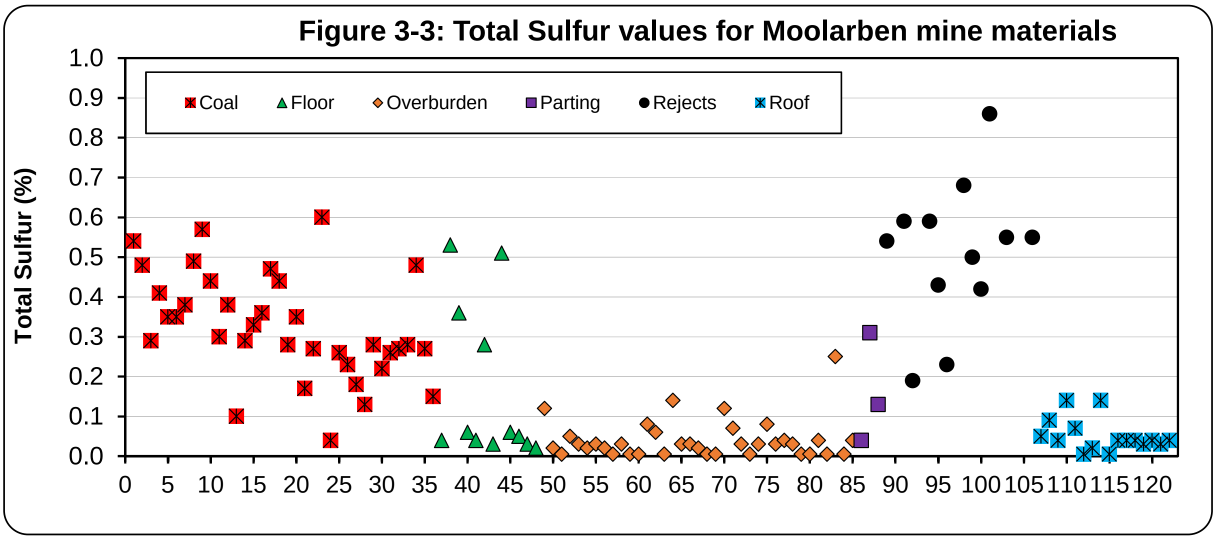
- **EC: Figure 3-2** shows the EC value for (1:5 solid:water) extracts from the 122 samples of mine materials. Again not all samples have an EC value recorded.

  The results show that most samples have a relatively low initial EC value for contact water (typically less than 300 µS/cm). Eight samples (1 coal, 1 floor, 3 overburden and 3 reject) have an EC value between 300 and 500 micro Siemens per centimetre (µS/cm). The data suggest that most mine materials are likely to (at least initially) generate relatively low salinity values in contact water.



- Total Sulfur: The total sulfur content of the 122 samples of mine materials is illustrated in **Figure 3-3**. In this case all 122 samples have total sulfur values recorded.

  The results show that the total sulfur content of all of the coal, roof, floor and overburden samples is less than 0.7 %, but that some (7) of the 18 reject samples have higher sulfur content. Some of the coal, reject and floor samples have elevated sulfur content. However, the overburden and roof samples (and some of the floor samples) have low sulfur content, which is mostly less than 0.1 % (ie. the average crustal abundance of sulfur[5]). Materials with a total sulfur content less than or equal to 0.1 %S are essentially barren of sulfur, generally represent background concentrations, and have negligible capacity to generate any additional acidity. Hence, most overburden and roof (and some floor) samples have negligible capacity to generate any significant acidity through sulfide oxidation, whilst most coal, reject and some floor and parting samples may have some capacity to generate acidity.

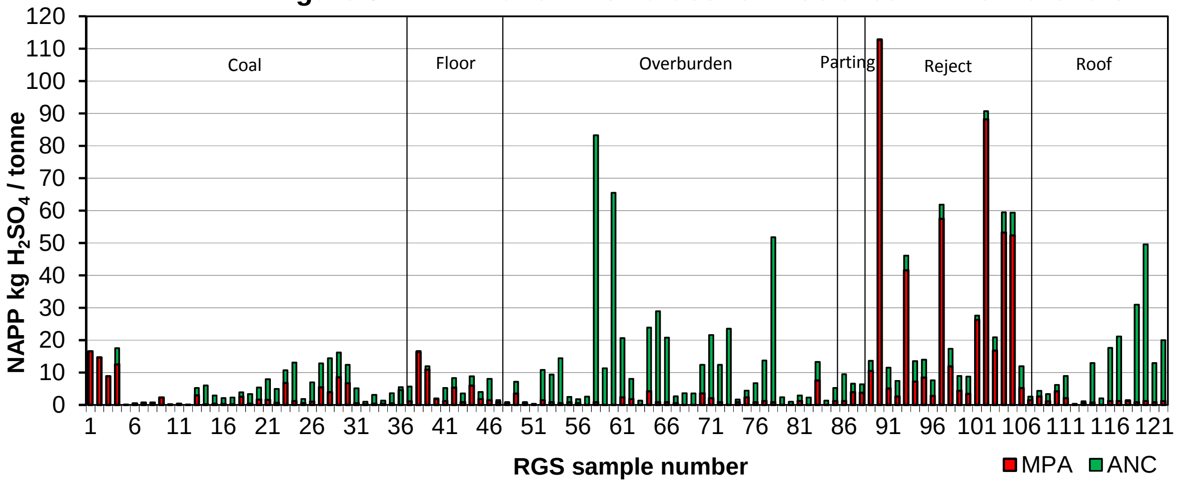


Note: Six reject samples have total sulfur content greater than 1%S and are not shown in this figure.

[5] The average crustal abundance of sulfur is approximately 0.1 % (INAP, 2009).

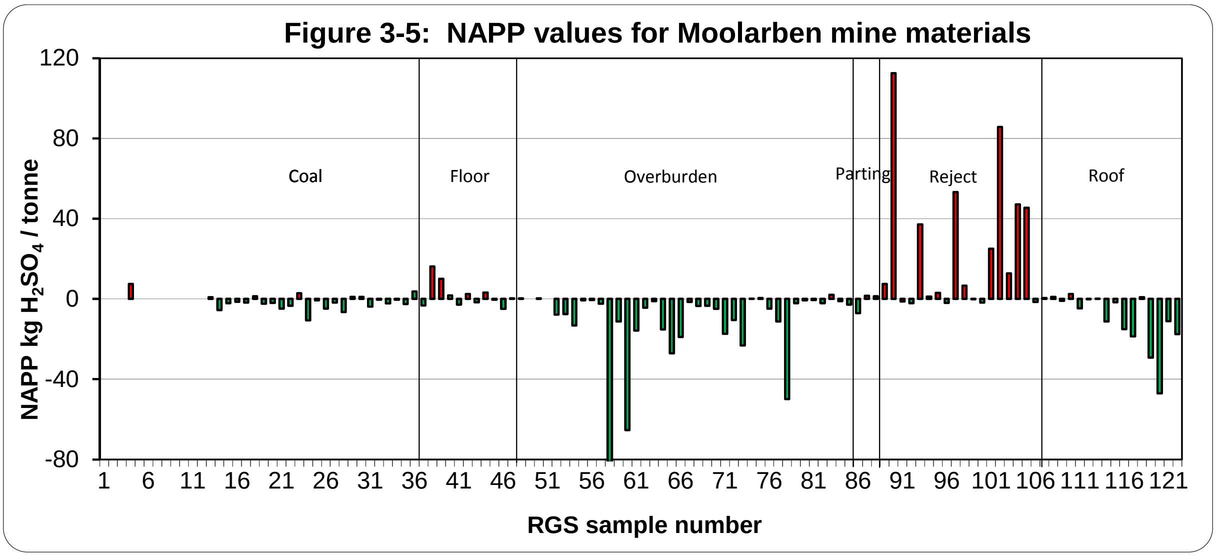
- **Sulfide Sulfur:** Forty-five (45) of the 122 samples have had Chromium Reducible Sulfur (CRS) tests completed to determine the sulfide sulfur content. Most samples have sulfide sulfur content significantly less than the total sulfur value, indicating that a proportion of the sulfur is likely to be present as other forms of sulfur such as organic sulfur which, in comparison to a reactive sulfur form such as pyrite, has negligible capacity to generate any additional acidity if exposed to oxidising conditions. In particular, most of the total sulfur present in coal samples appears to be present as organic sulfur with very little present as sulfide sulfur.
- **Maximum Potential Acidity (MPA)**: The MPA for the 122 samples is calculated from the total sulfur value (or CRS value, where available). CRS data (for fresh samples) generally provides a more accurate representation of the MPA that could theoretically be generated, as acid generation primarily occurs from oxidation of reactive sulfides (eg. pyrite), whereas total sulfur includes other forms of sulfur such as organic sulfur, which produces negligible acidity. The MPA is highest in the reject samples; is only slightly elevated in the coal samples where sulfide sulfur data is not available; is slightly elevated in the floor and parting samples, and generally very low in the overburden and roof samples (**Figure 3-4**).
- **Acid Neutralising Capacity (ANC)**: The ANC value for 111 of the 122 samples where this data is available is low in the coal, reject and floor samples and elevated in some of the overburden and roof samples (**Figure 3-4**).

Figure 3-4: MPA and ANC values for Moolarben mine materials

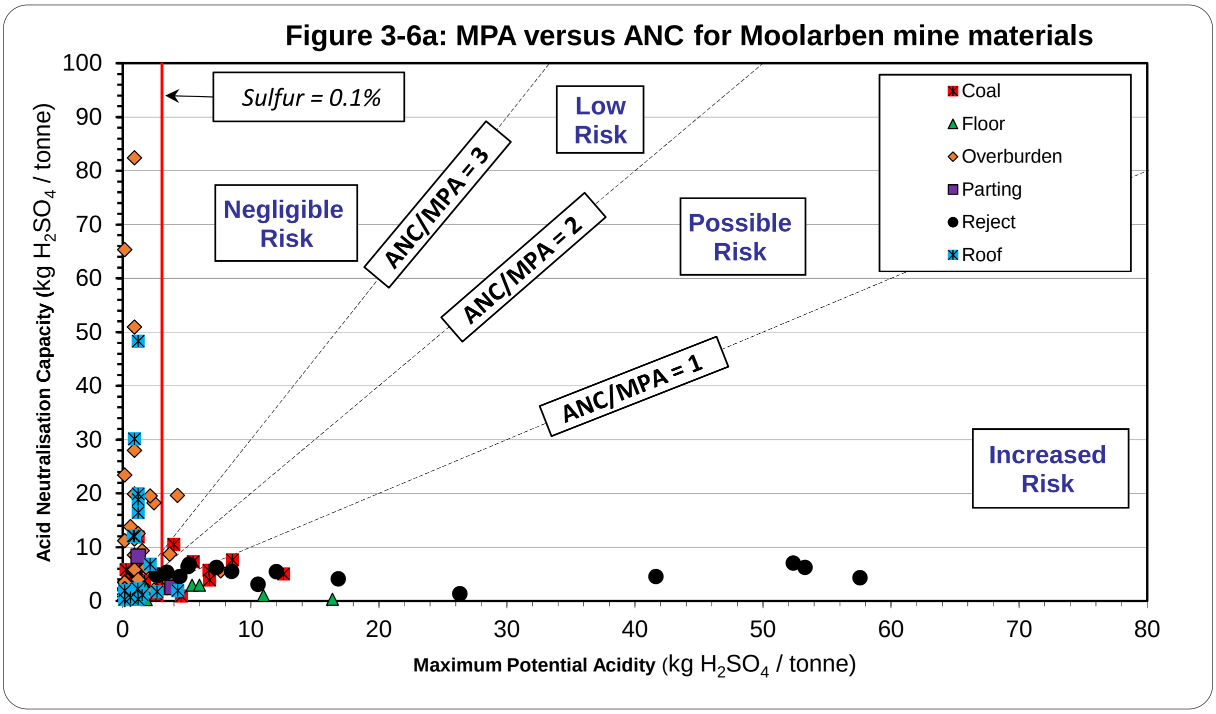


- **Net Acid Producing Potential (NAPP)**: The NAPP is the balance between the capacity of a sample to generate acidity (MPA) minus its capacity to neutralise acidity (ANC). The calculated NAPP values (for 111 of the 122 samples where this value is available) are presented in **Figure 3-5**. The NAPP value is highest in the reject samples and slightly elevated in some of the floor samples. The NAPP value is typically negative or close to zero in the coal, overburden, parting and roof samples.

  Overall, the NAPP results indicate that most overburden and roof, parting (and some floor) samples are likely to be NAF, whilst most reject and some floor samples may be PAF.



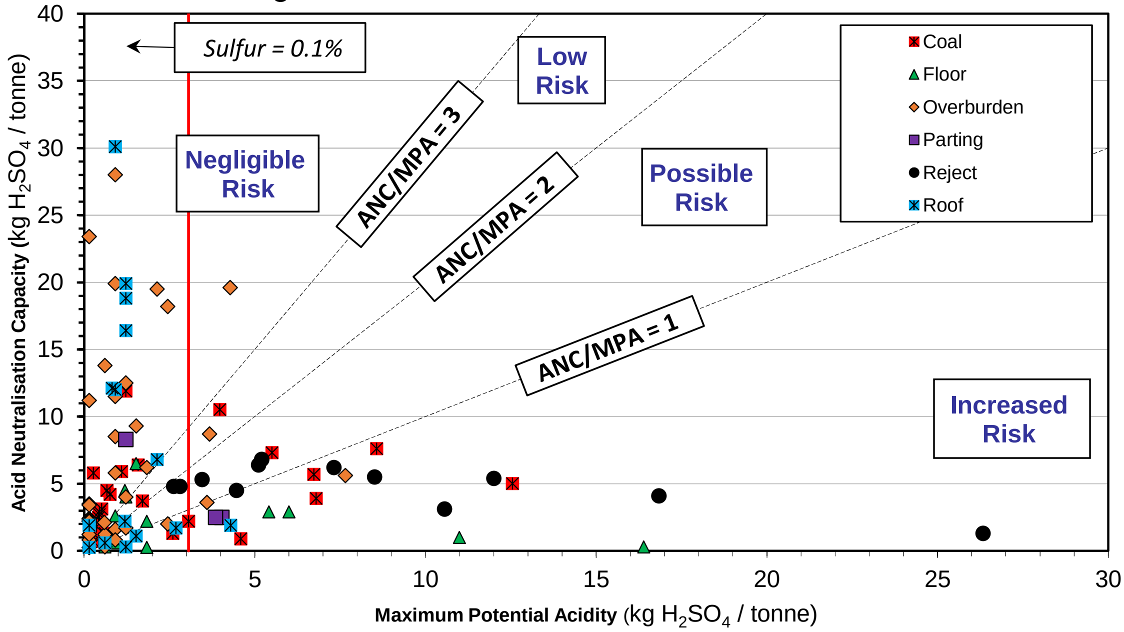
- **ANC:MPA Ratio: Figure 3-6a** shows a plot of ANC versus MPA for 122 samples of the various mine materials. ANC:MPA ratio lines have been plotted on the graph to illustrate the factor of safety associated with the samples, in terms of potential for generation of AMD. Generally those samples with an ANC:MPA ratio of greater than 2 and sulfur content <0.1% are considered to represent material with a low to negligible risk of acid generation and a high factor of safety in terms of potential for AMD (COA, 2016; INAP, 2009).



The majority of the coal, overburden, parting and roof samples fall within the negligible and low risk domains in the graph and therefore have a high factor of safety and very low risk of generating AMD and neutral mine drainage (NMD). In contrast, the majority of coal reject and some of the floor samples fall in the increased risk domain and therefore have a reduced factor of safety with respect to potential for generating AMD and NMD. It should be noted that the risk of AMD from a few coal samples is eliminated when additional CRS results are available, as most sulfur in these samples appears to be present as organic sulfur (rather than pyrite) and is therefore likely to generate negligible additional acidity.

Figure 3-6b shows the majority of the same ANC and MPA results shown in **Figure 3-6a**, using a magnified scale on the X and Y-axes, so that it is easier to differentiate between the characteristics of the various mine material types. Again this illustrates that any significant AMD and NMD risk is restricted to coal reject and some floor samples.

Figure 3-6b: MPA versus ANC for Moolarben mine materials



The ABA test data presented in **Table C1 (Attachment C)** and discussed in this section have been used to classify the acid forming nature of the mine materials. These classification criteria generally reflect Australian (COA, 2017) and international (INAP, 2009) guideline criteria for classification of mine materials. **Table 3-1** provides a summary of the criteria used by RGS to classify the acid forming nature of the samples and a breakdown of the number of samples in each classification category by material type.

Note that whilst NAG test data was available for 29 of the 122 samples of mine materials, the standard NAG test is known to be unreliable in coal mining operations due to the presence and partial oxidation of organic matter (EGi, 2008 and ACARP, 2008). RGS has therefore based the geochemical classification of the various Moolarben mine materials on more reliable ABA (including CRS) data.

The data presented in **Table 3-1** illustrate that the geochemical nature of the mine materials can be correlated with material type. The coal samples (where CRS data is available) generally represent

NAF material; the overburden, parting and roof samples are mostly classified as NAF and the coal reject samples are mostly classified as PAF. The floor samples represent a mix of NAF and PAF materials.

As a result of these findings, it is recommended that in future, most samples with elevated sulfur content (ie. >0.1 %) be subjected to the CRS test to determine if the sulfur is present in a reactive (pyritic) form or in an unreactive organic form, in terms of potential to generate AMD and/or NMD. Representative individual and/or composite samples of coal, overburden, coal reject and floor materials should also be subjected to Kinetic Leach Column (KLC) tests to verify the predicted NAF or PAF characteristics of these materials over time and determine the likely quality of contact water over time.

Table 3-1: Geochemical classification criteria for mine materials

Geochemical Classification	Sulfur[1] (%)	NAPP (kg H_2SO_4/t)	ANC: MPA Ratio	Coal (n = 36)	Overburden (n = 37)	Roof (n = 16)	Floor (n = 12)	Reject (n = 18)	Parting (n = 3)
Non-Acid Forming (Barren)[2]	0.1	-	-	25	31	15	7	2	0
Non-Acid Forming	> 0.1	-5	> 2	1	3	0	0	0	1
Uncertain[3]	> 0.1	5 & > -5	< 2	8	1	1	2	6	2
Potentially Acid Forming (Low Capacity)	> 0.1	> 5 & 10	< 2	1	2	0	1	2	0
Potentially Acid Forming	> 0.1	> 10	< 2	1	0	0	2	8	0

Notes:
1. If total sulfur or sulfide sulfur is less than or equal to 0.1 %, the NAPP and ANC:MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur. If the sample pH is < 5.0, the sample is classified as Acid Forming.
2. A sample classified as NAF can be further described as 'barren' (NAF-Barren) if the total sulfur or sulfide sulfur content is less than or equal to 0.1 per cent, as the sample essentially has negligible acid generating capacity.
3. Samples that fall outside the stated NAF-Barren/PAF classification categories based on the criteria provided are classified as Uncertain.

3.4.2 Multi-Element Concentration in Solids

Multi-element scans were completed on nine selected samples of mine materials to identify the presence of any elements (metals/metalloids) at concentrations that may be important with respect to materials handling, storage, final rehabilitation and water quality. RGS has compared the total metal/metalloid concentration of the selected fine reject samples with the average crustal abundance for unmineralised soils (Bowen, 1979; and INAP, 2009). The extent of any enrichment is reported as the Geochemical Abundance Index (GAI), which relates the actual concentration with an average abundance on a $\log_{10}$ scale.

The GAI is expressed in integer increments from 0 to 6, where a GAI value of 0 indicates that the element is present at a concentration less than, or similar to, the median crustal abundance; and a GAI value of 6 indicates an approximate 100-fold enrichment above median crustal abundance as illustrated in **Table 3-2**.

Table 3-2: Geochemical Abundance Index (GAI) values and Enrichment Factor

GAI	Enrichment factor	GAI	Enrichment factor
-	Less than 3-fold enrichment	4	24 – 48 fold enrichment
1	3 – 6 fold enrichment	5	48 – 96 fold enrichment
2	6 – 12 fold enrichment	6	Greater than 96 fold enrichment
3	12 – 24 fold enrichment		

As a general rule, a GAI value of 3 or greater signifies enrichment that may warrant further examination. This is particularly the case with some environmentally important ‘trace’ elements, such as As, Cr, Cd, Cu, Pb, Se and Zn, more so than with major rock-forming elements, such as Al, Ca, Fe, Mg and Na.

Elements identified as enriched may not necessarily be a concern for revegetation, water quality or public health, but their significance should still 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 solubility of common environmentally important elements such as Al, Cu, Cd, Fe and Zn increases significantly.

The results from multi-element testing (total metals/metalloids) of the nine samples of mine materials from Moolarben mine are presented in **Table C2 (Attachment C)**. The relative enrichment of metals/ metalloids in the samples compared to average crustal abundance is presented in **Table C3 (Attachment C)**. The results indicate that the metals/metalloids tested in the nine samples are typically not significantly enriched compared to average crustal abundance. The only exception is Beryllium (Be) in four of the nine samples tested.

The potential solubility of metals/metalloids in the sample materials is investigated further using water extract tests in **Section 3.4.3**.

3.4.3 Water Quality Static Leach Tests

RGS has compared the multi-element results in water extracts from 12 samples of mine materials completed by MCO in December 2016 as well as the nine samples of mine materials described in **Sections 3.4.2** with ANZECC & ARMCANZ (2000) guideline values. These guidelines are provided for context only and are not intended to be interpreted as “maximum permissible levels” for site water storage or discharge.

It should also be recognised that direct comparison of geochemical data with guideline values can be misleading. For the purpose of this study, guideline values are only provided for broad context and should not be interpreted as arbitrary ‘maximum’ values or ‘trigger’ values. Using sample pulps (ground to passing 75 µm) provides a very high surface area to solution ratio, which encourages mineral reaction and dissolution of the solid phase. As such, the results of screening tests on water extract solutions are assumed to represent an assumed ‘worst case’ scenario for initial surface runoff and seepage from mine materials.

The results from multi-element testing of water extracts (1:5 solid:water) from the 12 samples of mine materials (including coal, roof, floor, parting and overburden materials) completed by MCO in December 2016 are presented in **Table C4 (Attachment C)**. The samples were tested for pH, EC, major ions (Ca, Mg, Na and SO_4) and a limited suite of metals/metalloids (Al, Fe and Mn).

The water extract results show that most samples will initially generate neutral pH leachate. Whilst three samples generate a pH value lower than the pH range of 6 to 9 described in water quality guidelines for 95 % protection of moderately disturbed freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000), only one sample (a carbonaceous mudstone floor sample from OC2) has a pH value (pH 4.7) lower than the typical pH range of the deionised water used in the water extract tests (ie. pH 5 to 6.5).

The EC values are relatively low in the water extracts indicating that the materials represented by these samples will generate low salinity values upon initial contact with water, less than the value (1,000 µS/cm) described in water quality guidelines for 95 % protection of moderately disturbed freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000). The concentration of major ions in the water extracts is also low, reflecting the low salinity values, and well within the applied water quality guideline limits (1,000 milligrams per litre [mg/L]) for calcium and sulfate in livestock drinking water (ANZECC and ARMCANZ, 2000).

Of the three metals/metalloids tested, only aluminium has a dissolved concentration that exceeds the applied water quality guideline values for 95 % protection of moderately disturbed freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000) in some samples. Given the neutral pH of these water extracts, the elevated Al concentration is most likely due to the presence of fine colloidal material passing through the sample filtration stage. Notwithstanding, the dissolved aluminium concentration is less than the applied water quality guideline limit for livestock drinking water (ANZECC & ARMCANZ, 2000) in all water extract samples.

The results from multi-element testing of water extracts (1:5 solid:water) from the nine samples of mine materials (including coal, roof, floor, parting and overburden materials) tested by MCO in March 2017 are presented in **Table C5 (Attachment C)**. The samples were tested for pH, EC, major ions (Ca, k, Mg, Na and SO_4) and a suite of trace metals/metalloids and trace metals (Al, As, B, Ba, Be, Cd, Co, Cu, Cr, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, V and Zn).

The pH of the water extracts ranges from slightly acidic (pH 5.4) to slightly alkaline (pH 8.0). Only one of the nine samples (a coal reject sample from OC1) has a pH value lower than the pH range of 6 to 9 described in guidelines for freshwater aquatic ecosystems (ANZECC and ARMCANZ, 2000). None of the samples have a pH value below the pH range of deionised water typically used in water extract tests (ie. pH 5.0 to 6.5).

The EC in the water extracts ranges from 33 to 700 µS/cm for the selected samples of mine materials. This confirms that these materials have low salinity values and contain relatively low concentrations of dissolved solids upon initial contact with water. The concentration of the major ions in the water extracts is generally dominated by sulfate, although calcium and some of the other ions tested are slightly elevated in some of the water extracts from the coal reject samples. The concentration of calcium and sulfate in the water extracts from one of the fine reject samples is elevated compared to the applied livestock drinking water guideline value (1,000 mg/L).

The concentration of most of the trace metals/metalloids tested in the water extracts is below the laboratory limit of reporting (LoR) in most samples and within applied livestock drinking water guidelines values. Comparison against trigger values for freshwater aquatic ecosystems (95% species protection level) indicates some water extracts contain metals/metalloids at elevated concentrations including nickel (two coal reject samples), selenium (one reject sample) and zinc (two coal reject samples and one coal sample).

The results indicate that most dissolved metal/metalloids are likely to be sparingly soluble in surface runoff and seepage from pH neutral mine materials at relevant storage facilities. However under acidic conditions, the solubility and potential mobility of some metals/metalloids has the potential to increase.

It should be noted that during sample collection and laboratory preparation, the physical agitation and mixing of the samples can grossly affect the physical stability of minerals and increase their solubility in "first flush" leaching events such as static water extract tests. However, the concentration of soluble parameters in subsequent leaching events from solid samples is expected to be significantly less. For example, in KLC tests as the sample materials return to, and reach, equilibrium after several leach events, the leachate chemistry is likely to be more indicative of oxidised sample pore water chemistry under field conditions.

3.4.4 On-Site Surface and Underground Storage Water Quality Data

The MCO water quality database contains information on the water quality at on-site storages (including underground) from 2012 to 2017. A summary of this information is provided in **Table C6** (**Attachment C**). The data set provided to RGS was separated into three groups (ie. mine water dams, open cuts and underground). The information in the database indicates that the concentration of dissolved metals/metalloids is relatively low compared to Livestock Drinking Water Guidelines (ANZECC & ARMCANZ, 2000).

When compared to the applied water quality guidelines for 95 % protection of moderately disturbed freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000), pH values in on site water storages are occasionally above and below the recommended pH range of 6 to 9. Notwithstanding, most pH values recorded are within the recommended pH range. EC values are also elevated compared to the applied guideline value (> 1,000 µS cm) in on-site water storages. The concentrations of major ions measured in on-site water storages (ie. Ca, Mg and SO_4) is relatively low and within applied guideline values, where these exist, but is dominated by SO_4). It is noted that the concentration of sodium is not currently monitored in on-site water storages.

In addition, the concentrations of some dissolved metal/metalloids can be slightly elevated in some on-site water storages (eg. Al, Cd, Cu, Mn, Ni and Zn) compared to the applied freshwater aquatic ecosystem guideline values. However, the concentrations of all metals/metalloids tested are less than the applied guideline values for livestock drinking water.

It is noted that concentration of Fe is also elevated compared to the irrigation water guideline concentration (1 mg/L) (ANZECC & ARMCANZ, 2000) for this metal in some of the on-site water storages particularly for some water quality monitoring samples from the open cut water storage area.

3.4.5 Groundwater Monitoring Bore Water Quality Data

The salinity of Permian groundwater at the Moolarben Coal Complex is highly variable. Notwithstanding, HydroSimulations (2017) notes measured EC is generally lower over the northern area of Moolarben Coal Complex at UG1 and UG4.
Therefore, the salinity of water generated from the underground mining areas is anticipated to be consistent with the existing observed mine water quality.

3.5 Increased Reject Production

The Modification would involve an increase in annual production rate of coal reject material. The coal reject material that would be produce would be consistent with the coal rejects produced by the existing/approved Moolarben Coal Complex.

Therefore, subject to implementation of the existing procedures outlined in **Section 3.3**, the increase in the rate of coal reject material production would have a negligible impact on downstream water quality.

3.6 Comparison of On-Site Water Quality Data with Previous Water Quality Predictions

The findings of the previous (EGi, 2006 and 2008) geochemical assessment reports with respect to the geochemical characteristics of overburden and coal reject materials and potential impacts on water quality are detailed in **Sections 3.1** and **3.2**, respectively.

In 2006, the authors predicted that bulk overburden materials and the final pit floor would be NAF and would not be a source of AMD (or salinity). It was suggested that some minor acidity and salinity could potentially be released from coal stockpiles and underground workings. Rejects had a higher AMD risk than other mine materials, and were likely to require specific management to control AMD.

Most major ions and metals/metalloids were sparingly soluble in initial contact water from these materials and elevated Al concentrations were attributed to the presence of small amounts of fine particulates (colloids) in the leachate solutions tested. Minor mobilisation of Al, Co, Cu, Ni and Zn was indicated in kinetic leach column tests for coal reject materials although mobilisation of these elements and other metals/metalloids was expected to be largely controlled by pH, so that management of AMD would effectively control potential metal/metalloid release.

In 2008, EGi confirmed that the majority of the overburden and floor samples from the Stage 2 operations were classified as NAF and results indicated that bulk overburden and pit floor materials were unlikely to be a source of AMD or salinity. PAF overburden material was mainly associated with the uneconomic Moolarben seam, and roof and floor of the Ulan seam. The Ulan coal seam sample results indicated possible AMD issues associated with coarse rejects, fine rejects and coal stockpiles. The report recommended that coarse and fine reject streams be managed as PAF material and that runoff and leachate from coal stockpiles and underground operations be contained to allow water quality monitoring and treatment, if required (eg. crushed limestone addition). Routine site water quality monitoring of pH, EC, acidity/alkalinity, sulfate and dissolved Al, As, Co, Cu, Fe, Mn, Ni and Zn was recommended.

The on-site water quality monitoring results for surface and underground water storages at the Moolarben Coal Complex are described in **Section 3.4.4** and for groundwater monitoring bores are described in **Section 3.4.5**. The on-site water quality monitoring results compare well with previous predictions regarding likely water quality at the Moolarben Coal Complex (EGi, 2006 and 2008).

In particular, pH values in mine water storages are mostly in the neutral pH range with only a few samples recording acidic (<pH 5) or alkaline (>pH 9) pH values. Salinity values (ie. EC values) are generally elevated (> 1,000 µS/cm) in mine water storages, although this parameter is likely to be influenced by evapo-concentration of salts and/or contact with coal and reject materials.

The concentrations of major ions measured in on-site water storages (ie Ca, Mg and SO_4) are relatively low and within applied guideline values, where these exist, and are dominated by SO_4 as would be expected given previous predictions regarding coal and coal reject materials.

The concentrations of some dissolved metal/metalloids can be slightly elevated in some on-site water storages (eg. Al, Cd, Cu, Mn, Ni and Zn) compared to the applied freshwater aquatic ecosystem guideline values. However, the concentrations of all metals/metalloids tested are less than the applied guideline values for livestock drinking water. The potential for slightly elevated concentrations of some metals/metalloids Al, Co, Cu, Ni and Zn in contact water with coal reject materials was predicted by EGi in 2006.

The Fe concentration is also elevated compared to the applied irrigation water guideline concentration (1 mg/L) (ANZECC & ARMCANZ, 2000) for this metal in some of the on-site water storages particularly for some water quality monitoring samples from the open cut water storage area.

3.7 Implications for On-Site Water Treatment

It is understood that MCO is currently investigating potential water treatment options at the Moolarben Coal Complex. The water quality monitoring results described above indicate that the quality of water in on-site water storages is generally pH neutral, slightly saline and may contain slightly elevated concentrations of some metals/metalloids. If a water treatment option such as reverse osmosis (RO) were selected, the concentration of Fe in the water storages may be important as iron precipitates have the potential to foul the RO membrane. If that is the case, then a pre-treatment process may be required to remove Fe from solution prior to final removal of metals/metalloids using RO.

If a pre-treatment process for Fe removal was required, this would generate a sludge by-product most likely containing an amorphous Fe precipitate, sulfate salts and potentially other metals/metalloids precipitated from solution. The by-product would require appropriate disposal.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

RGS has completed a review of the geochemical nature of mine materials as part of the Modification Application. As a result of this review, RGS concludes that:

- Previous geochemical studies were completed in line with relevant technical guidelines and other related information regarding the geochemical assessment of mine materials in Australia (AMIRA, 2002; ACARP, 2008; and COA, 2016) and worldwide (INAP, 2009). The sampling programs appear to have been designed to ensure that the sampling processes were appropriate, risk based and focused on obtaining representative samples of mine waste materials.
- Previous geochemical studies provide a reasonably accurate prediction that bulk overburden materials and the final pit floor at the Moolarben Coal Complex will be NAF and will not be a significant source of AMD (or salinity). Some minor acidity and salinity could potentially be released from coal stockpiles and underground workings. Rejects have a higher AMD risk than other mine materials, and are likely to require specific management to control AMD (e.g. in-pit emplacement, encapsulation or capping in final rehabilitated landforms).
- A review of the on-site water quality monitoring results for water storages (including underground) at the Moolarben Coal Complex collected over the past five years indicates that results contained in the water quality monitoring database compare well with previous predictions made regarding site water quality.
- Mine water storages generally contain water in the pH neutral range with only a few samples recording acidic (<pH 5) or alkaline (>pH 9) pH values. Salinity values (ie. EC values) are generally elevated (> 1,000 µS/cm) in mine water storages, although this parameter is most likely influenced by evapo-concentration of salts and/or contact with mine materials.
- The concentrations of major ions measured in on-site water storages (ie Ca, Mg and SO_4) are relatively low and within applied guideline values, where these exist, and are typically dominated by SO_4 as would be expected given previous predictions regarding coal and coal reject materials.
- The concentrations of some dissolved metal/metalloids can be slightly elevated in some on-site water storages (eg. Al, Cd, Cu, Mn, Ni and Zn) compared to applied freshwater aquatic ecosystem guideline values. However, the concentrations of all metals/metalloids tested are less than the applied guideline values for livestock drinking water. The potential for slightly elevated concentrations of some metals/metalloids (Al, Co, Cu, Ni and Zn) in contact water with coal reject materials was predicted in 2006.
- Elevated iron and sulfate salt concentrations in some of the on-site water storages may require water treatment prior to release.

4.2 Recommendations

As a result of the geochemistry review work described in this report on the Moolarben Coal Complex mine materials, it is recommended that MCO considers:

- Continuing the sampling and geochemical testing campaign for mine materials.
- Continuing in-pit emplacement, encapsulation or capping of rejects in final landforms.

- Surface water and site water storages should be monitored. It is therefore recommended that MCO continues to monitor pH, EC and TSS on a quarterly basis and the following suite of major ions (Ca, K, Mg, Na and SO_4) and trace metals (Al, As, B, Ba, Be Cd, Co, Cu, Cr, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, V and Zn) opportunistically and at least on an annual basis.

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6.0 LIMITATIONS

This report has been prepared by RGS for the use of MCO. It is based on accepted consulting practices and standards and no other warranty is made as to the review information or professional advice included in this report.

This report was prepared from March to October 2017 and is based on the information provided by MCO at the time of preparation. RGS disclaims responsibility for any changes that may have occurred after this time.

The sources of information and methodology used by RGS are outlined in this report and no independent verification of this information has been made. RGS assumes no responsibility for any inaccuracies or omissions, although no indication was found that any information contained in this report as provided to RGS was incorrect.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not provide legal advice, which can only be given by qualified legal practitioners.

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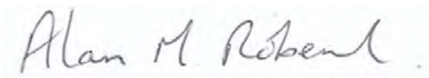
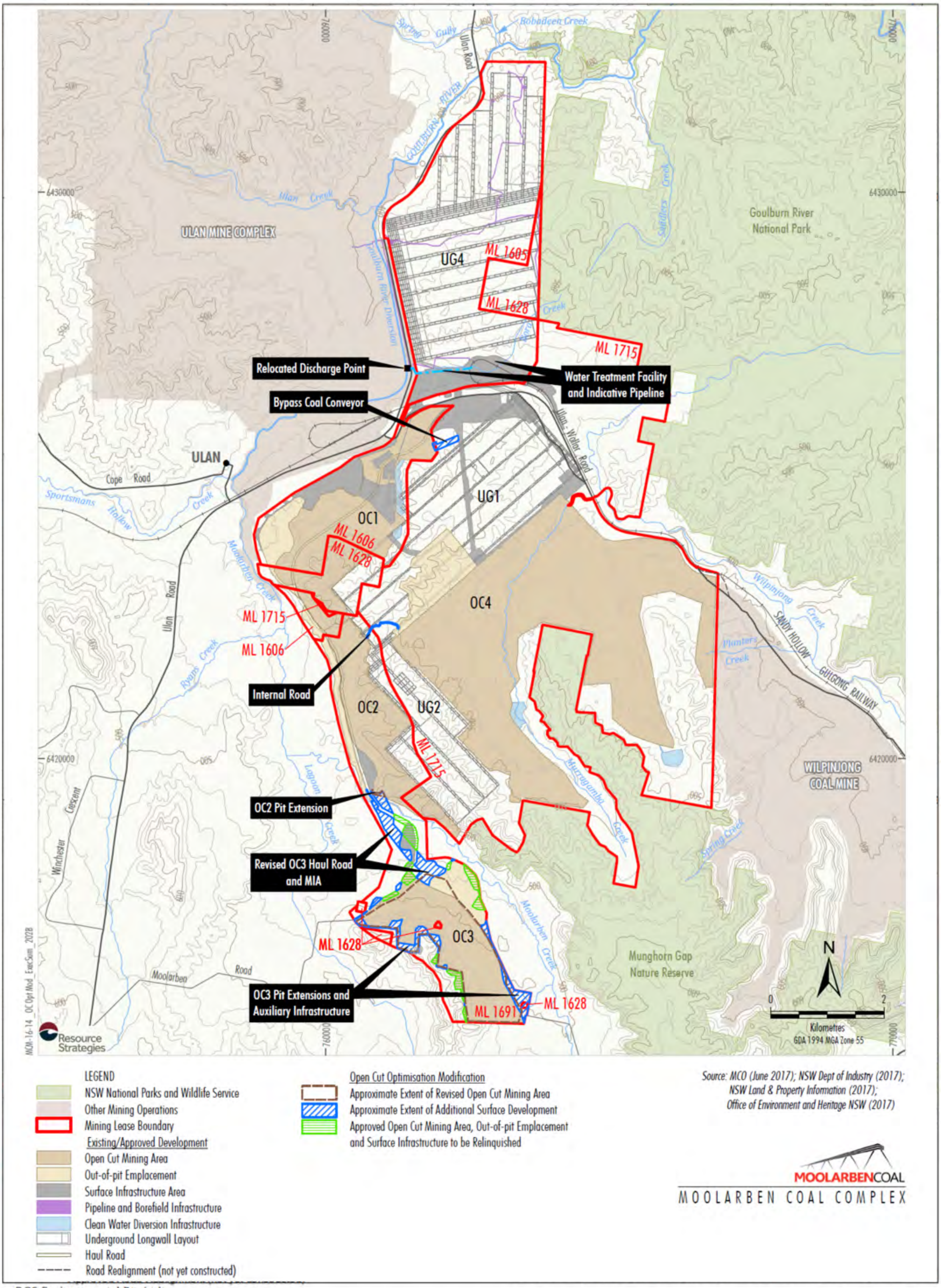


Dr. Alan M. Robertson
Principal Geochemist/Director

ATTACHMENT A

Figures



RGS Environmental Pty Ltd
123 Wynne Street, Sunnybank Hills
QLD 4109 Australia
Tel +61 7 3344 1222
Mobile 0431 620 623
Email alan@rgsenv.com
File: 2017032-008 A4
Date: 18/10/2017

MOOLARBEN COAL OPERATIONS PTY LTD

MOOLARBEN STAGES 1 AND 2 PROJECT APPROVALS
MODIFICATION APPLICATION - GEOCHEMISTRY

Figure: 1

INDICATIVE STUDY AREA

RGS Environmental Pty Ltd
123 Wynne Street, Sunnybank Hills
QLD 4109 Australia
Tel +61 7 3344 1222
Mobile 0431 620 623
Email alan@rgsenv.com
File: 2017032-002 A4
Date: 18/10/2017

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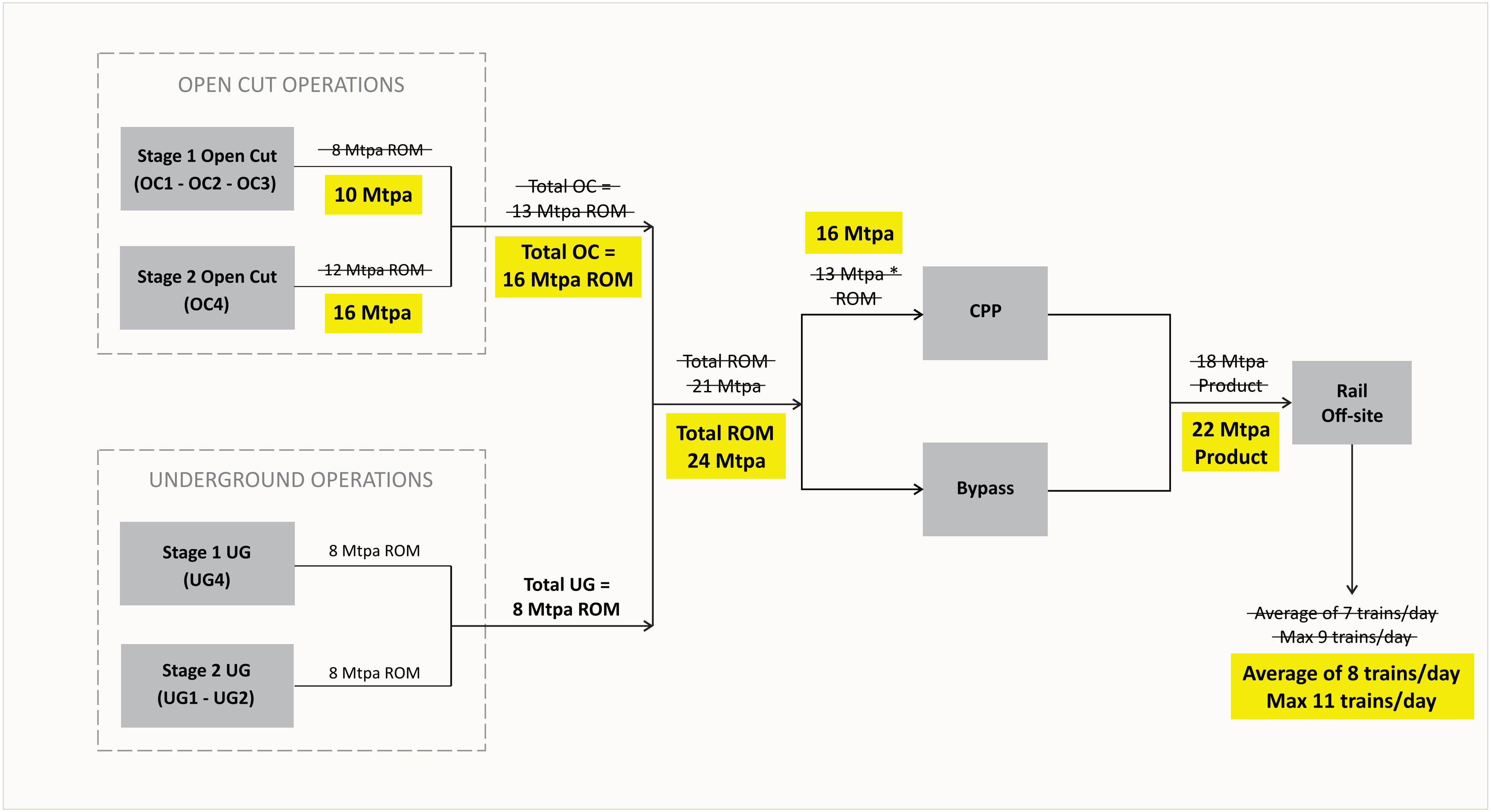
Figure: **2**

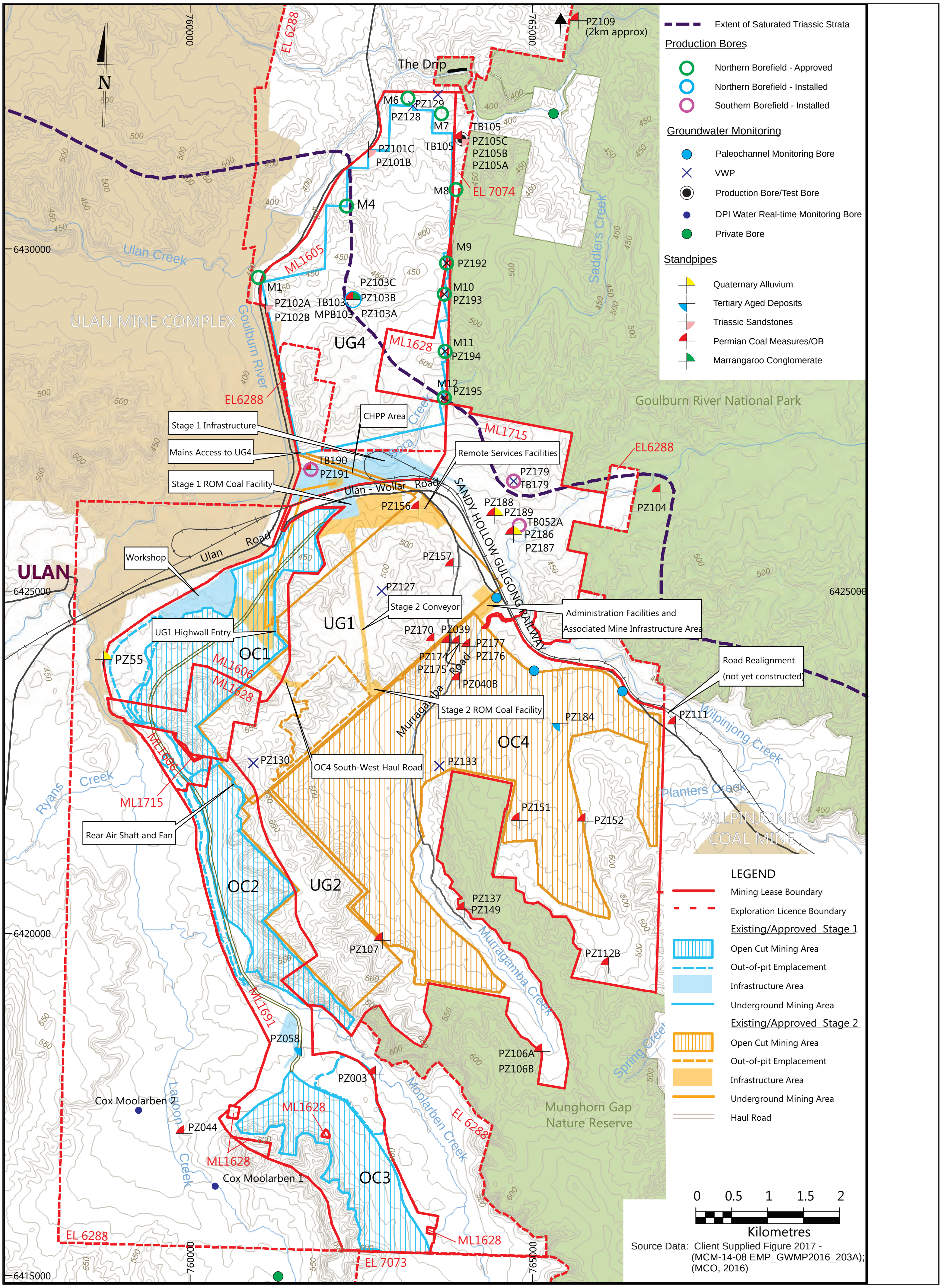
COAL HANDLING AND PROCESSING SCHEMATIC



LEGEND
Modified Component

* Note: 13.5 Mtpa ROM in 2017

Source Data: Client Supplied Figure 2017 (MCM-16-14_OC Opt Mod_001C)



RGS Environmental Pty Ltd
123 Wynne Street, Sunnybank Hills
QLD 4109 Australia
Tel +61 7 3344 1222
Mobile 0431 620 623
Email alan@rgsenv.com

File: 2017032-003 A4
Date: 18/10/2017

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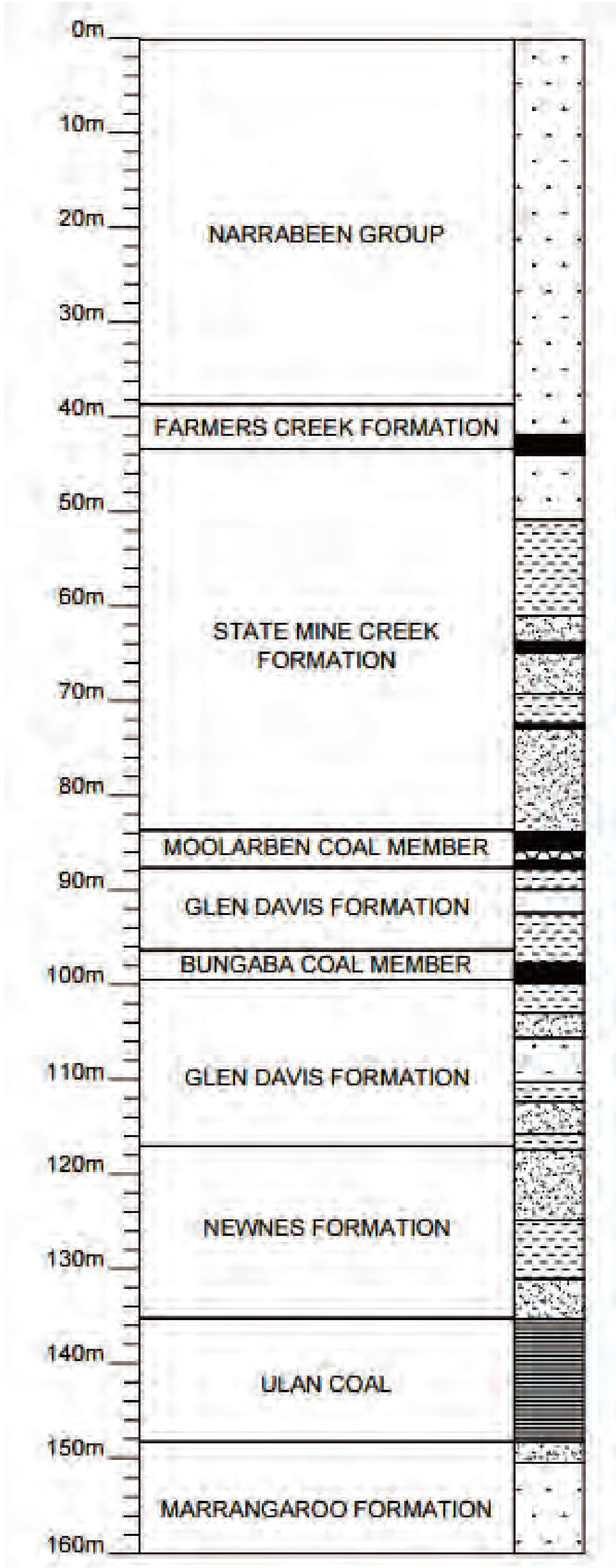
MODIFICATION APPLICATION - GEOCHEMISTRY

Figure: **3**

GROUNDWATER MONITORING PROGRAMME



Source Data: Client Supplied Figure 2017

RGS Environmental Pty Ltd
123 Wynne Street, Sunnybank Hills
QLD 4109 Australia
Tel +61 7 3344 1222
Mobile 0431 620 623
Email alan@rgsenv.com
File: 2017032-004 A4
Date: 18/10/2017

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Figure: **4**

TYPICAL STRATIGRAPHIC COLUMN

ATTACHMENT B

Geochemical Assessment of Mine Materials

ATTACHMENT B

GEOCHEMICAL ASSESSMENT OF MINE MATERIALS

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 S 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:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \dashrightarrow Fe(OH)_3 + 2\ H_2SO_4$$

According to this reaction, the maximum potential acidity (MPA) of a sample containing 1 %S as pyrite would be 30.6 kg H_2SO_4/t. 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) measured on 1:5 w/w water extract. This gives an indication of the inherent acidity and salinity of the mine material when initially exposed in an emplacement area.

Total Sulfur Content and Maximum Potential Acidity (MPA)

Total sulfur content is determined by the Leco high temperature combustion method. The total sulfur content is then used to calculate the MPA, which is based on the assumption that the entire sulfur content is present as reactive pyrite. Direct determination of the pyritic sulfur content can provide a more accurate estimate of the MPA.

Acid Neutralising Capacity (ANC)

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

Net Acid Producing Potential (NAPP)

The net acid producing potential (NAPP) is used as an indicator of materials that may be of concern with respect to acid generation. The NAPP calculation represents the balance between the maximum potential acidity (MPA) of a sample, which is derived from the total or sulfide sulfur content, and the acid neutralising capacity (ANC) of the material, which is determined experimentally. By convention, the NAPP result is expressed in units of kg H_2SO_4/t sample. If the capacity of the solids to neutralise acid (ANC) exceeds their capacity to generate acid (MPA), then the NAPP of the material is negative. Conversely, if the MPA exceeds the ANC, the NAPP of the material is positive.

Net Acid Generation (NAG)

The net acid generation (NAG) test involves the addition of hydrogen peroxide to a sample of mine rock or process residue to oxidise reactive sulfide, then measurement of pH and titration of any net acidity produced by the acid generation and neutralisation reactions occurring in the sample. A significant NAG result (*i.e.* final NAG_{pH} < 4.5) indicates that the sample is potentially acid forming (PAF) and the test provides a direct measure of the net amount of acid remaining in the sample after all acid generating and acid neutralising reactions have taken place. A NAG_{pH} > 4.5 indicates that the sample is non-acid forming (NAF). The NAG test provides a direct assessment of the potential for a material to produce acid after a period of exposure and weathering and can be used to refine the results of the theoretical NAPP predictions, if required. The NAG test can sometimes be used as a stand-alone test at some hard rock mines, but is recommended that this only be considered after site specific calibration work is carried out. The standard NAG test is generally unsuitable for some coal mine waste samples and can produce a false positive result.

ASSESSMENT OF ELEMENT ENRICHMENT AND SOLUBILITY

In mineralised areas 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 (or readily leachable from a material) at concentrations that may be of environmental concern with respect to surface water quality, revegetation and public health. The samples are generally analysed for the following elements:

Major elements Al, Ca, Fe, K, Mg, Na and S.

Minor elements As, B, Cd, Co, Cr, Cu, F, Hg, Mn, Mo, Ni, Pb, Sb, Se and Zn.

The concentration of these elements in samples can be directly compared with relevant state or national environmental and health based concentration guideline criteria to provide context and assess the level of significance. Water extracts are used to determine the immediate element solubilities under the existing sample pH conditions of the sample and again provide some context, but cannot be directly compared against water quality guideline concentrations. The following tests are normally carried out:

Multi-Element Composition of Solids

Multi-element composition of solid samples determined using a combination of ICP-mass spectroscopy (ICP-MS), ICP-optical emission spectroscopy (OES), and atomic absorption spectrometry (AAS).

Multi-Element Composition of Water Extracts (1:5 w/v)

Multi-element composition of water extracts from solid samples determined using a combination of ICP-mass spectroscopy (ICP-MS), ICP-optical emission spectroscopy (OES), and atomic absorption spectrometry (AAS).

Under some conditions (*eg*. low pH) the solubility and mobility of common environmentally important elements can increase significantly. If element mobility under initial pH conditions is deemed likely and/or subsequent low pH conditions may occur, kinetic leach column test work may be completed on representative samples.

KINETIC LEACH COLUMN TESTS

Kinetic leach column (KLC) tests can be used to provide information on the reaction kinetics of mine waste materials. The major objectives of kinetics tests are to:

- Provide time-dependent data on the kinetics and rate of acid generation and acid neutralising reactions under laboratory controlled (or onsite conditions);
- Investigate metal release and drainage/seepage quality; and
- Assess treatment options such as addition of alkaline materials.

The KLC tests simulate the weathering process that leads to acid and base generation and reaction under laboratory controlled or site conditions. The kinetic tests allow an assessment of the acid forming characteristics and indicate the rate of acid generation, over what period it will occur, and what management controls may be required.

In KLC tests, water is added to a sample and the mixture allowed to leach products and by-products of acid producing and consuming reactions. Samples of leachate are then collected and analysed. Intermittent water application is applied to simulate rainfall and heat lamps are used to simulate sunshine. These tests provide real-time information and may have to continue for months or years. Monitoring includes trends in pH, sulfate, acidity or alkalinity, and metals, for example. The pH of the collected leachate simulates the acid drainage process, acidity or alkalinity levels indicate the rate of acid production and acid neutralisation, and sulfate production can be related to the rate of sulfide oxidation. Metal concentration data provides an assessment of metal solubility and leaching behaviour.

Figure B1 shows the kinetic leach column set up typically used by RGS adapted from *AMIRA, 2002*. The columns are placed under heat lamps to allow the sample to dry between water additions to ensure adequate oxygen ingress into the sample material.

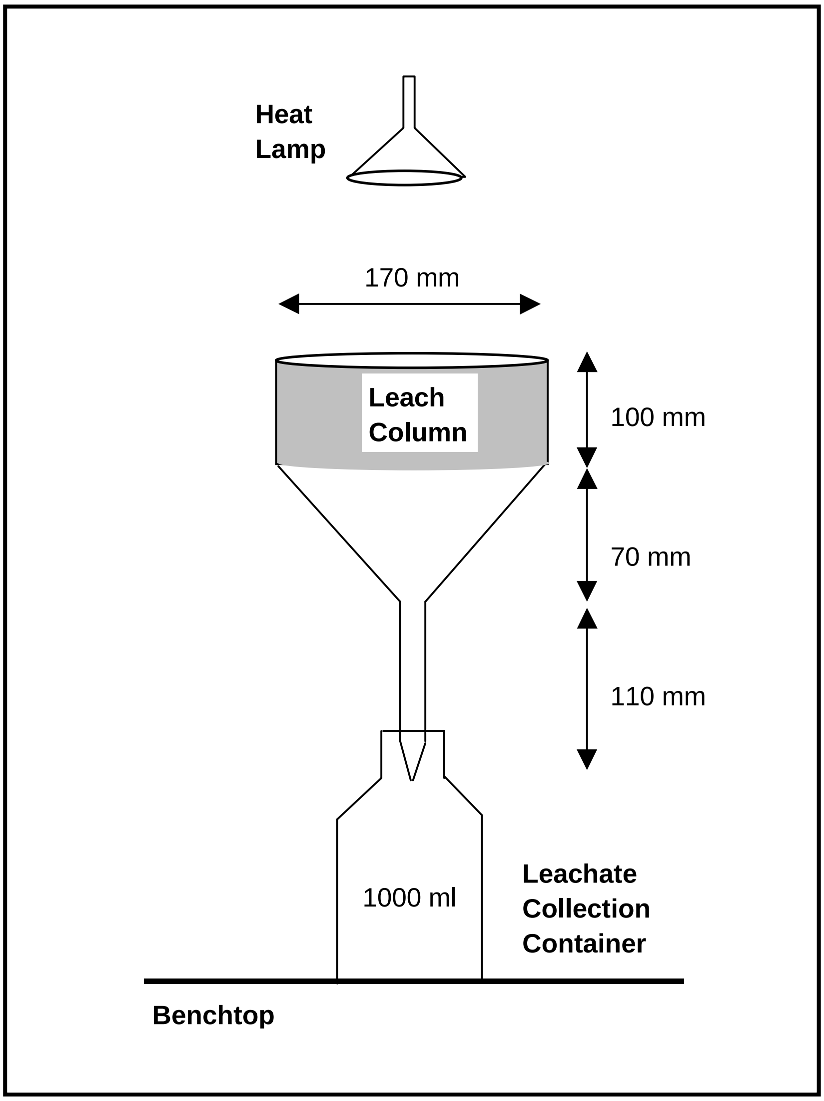
Approximately 2 kg of sample is accurately weighed and used in the leach columns depending on the physical nature of the material and particle size. Some materials can be used on an as-received basis (*i.e.* no crushing as with process residues and fine reject materials), whereas others are crushed to nominal 5-10 mm particle size (as with overburden).

The sample in the column is initially leached with deionised water at a rate of about 400 ml/kg of sample and the initial leachate from the columns collected and analysed. Subsequent column leaching is carried out at a rate of about 400 ml/kg per month or quarterly, and again collected and analysed. The leaching rate can be varied to better simulate expected site conditions or satisfy test program data requirements.

The column must be exposed to drying conditions in between watering events. The residual water content and air void content in the column can be determined by comparing the wet and dry column weights. A heat lamp is generally used above the sample during daylight hours to maintain the leach column surface temperature at about 30^{o}C.

Figure B1

Kinetic Leach Column Setup



AMIRA (2002). *ARD Test Handbook: Project 387A Prediction and Kinetic Control of Acid Mine Drainage*. Australian Minerals Industry Research Association, Ian Wark Research Institute and Environmental Geochemistry International Pty Ltd, May 2002.

ATTACHMENT C

Summary Tables of Geochemical Results

Table C1: Acid Base Account (ABA) and NAG Test Results for Moolarben Mine Materials

RGS Sample No. for Figures	ALS Sample ID	Sample Date	Pit/Underground	Sample Description	Sampling Location	Lithology	From	To	Depth	pH[1]	EC[1]	Total S	CRS	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	NAG pH	Sample Classification[3]
								(m)			(µS/cm)	(%)	(%)		kg H_2SO_4/t				
1	EB1611124007	12/04/2016	Open Cut 1	Coal	Pit	Coal				5.4	24	0.54		16.5					Uncertain
2	EB1611124008	12/04/2016	Open Cut 1 (Mod 9)	Coal	Pit	Coal/Tuff				6.6	51	0.48		14.7					Uncertain
3	EB1611124010	12/04/2016	Open Cut 1 (Mod 9)	Coal	Pit	Coal				5.6	24	0.29		8.9					Uncertain
4	EB1538857007	10/11/2015	Open Cut 2	Coal	Pit	Coal						0.41		12.6	5.0	7.5	0.4	3.0	Potentially Acid Forming
5	EB1538857001	10/11/2015	Open Cut 2	Coal	ROM	Coal				5.4	44	0.35	0.003	0.1					Non-Acid Forming (Barren)
6	EB1538857002	10/11/2015	Open Cut 2	Coal	ROM	Coal				6.5	77	0.35	0.015	0.5					Non-Acid Forming (Barren)
7	EB1538857003	10/11/2015	Open Cut 2	Coal	ROM	Coal				7.1	112	0.38	0.023	0.7					Non-Acid Forming (Barren)
8	EB1538857004	10/11/2015	Open Cut 2	Coal	ROM	Coal				5.3	70	0.49	0.023	0.7					Non-Acid Forming (Barren)
9	EB1538857006	10/11/2015	Open Cut 2	Coal	ROM	Coal				4.9	61	0.57	0.075	2.3					AF-Low Capacity
10	EB1600951001	05/01/2016	Open Cut 2	Coal	ROM	Coal				8.0	108	0.44	0.006	0.2					Non-Acid Forming (Barren)
11	EB1600951002	05/01/2016	Open Cut 2	Coal	ROM	Coal				8.2	102	0.30	0.013	0.4					Non-Acid Forming (Barren)
12	EB1600951003	05/01/2016	Open Cut 2	Coal	ROM	Coal				7.9	84	0.38	0.005	0.2					Non-Acid Forming (Barren)
13	EB1630337008	20/12/2016	Open Cut 2	Coal	Pit	Tuff				5.7	59	0.10		3.1	2.2	0.9	0.7	6.7	Non-Acid Forming (Barren)
14	EB1630337010	20/12/2016	Open Cut 2	Coal	Pit	Coal/Stoney				6.8	36	0.29	0.009	0.3	5.8	-5.5	21.0	6.9	Non-Acid Forming (Barren)
15	EB1630337002	16/12/2016	Open Cut 2	Coal	ROM	Coal				6.3	48	0.33	0.014	0.4	2.5	-2.1	5.8		Non-Acid Forming (Barren)
16	EB1630337003	16/12/2016	Open Cut 2	Coal	ROM	Coal				4.8	42	0.36	0.012	0.4	1.8	-1.4	4.9		Non-Acid Forming (Barren)
17	EB1630337004	16/12/2016	Open Cut 2	Coal	ROM	Coal				6.9	10	0.47	0.008	0.2	2.1	-1.9	8.6		Non-Acid Forming (Barren)
18	EB1703734010	17/02/2017	Open Cut 2	Coal	ROM	Coal				5.4	30	0.44	0.085	2.6	1.3	1.3	0.5		Non-Acid Forming (Barren)
19	EB1703734011	17/02/2017	Open Cut 2	Coal	ROM	Coal				5.9	28	0.28	0.015	0.5	2.9	-2.4	6.3		Non-Acid Forming (Barren)
20	EB1701807007	6/01/2017	Open Cut 3	Coal	Exploration	Coal	16	21	5	7.5	333	0.35	0.056	1.7	3.7	-2.0	2.2		Non-Acid Forming (Barren)
21	EB1701807017	10/01/2017	Open Cut 3	Coal	Exploration	W. Coal and Parting	13	15	2	7.8	130	0.17	0.052	1.6	6.4	-4.8	4.0		Non-Acid Forming (Barren)
22	EB1701807018	10/01/2017	Open Cut 3	Coal	Exploration	Coal and Parting	17	21	4	8.1	173	0.27	0.025	0.8	4.2	-3.4	5.5		Non-Acid Forming (Barren)
23	EB1701807019	10/01/2017	Open Cut 3	Coal	Exploration	Coal	21	25	4	7.6	152	0.60	0.222	6.8	3.9	2.9	0.6		Uncertain
24	EB1701807023	12/01/2017	Open Cut 3	Coal	Exploration	Coal	4	6	2	7.5	269	0.04		1.2	11.9	-10.7	9.7		Non-Acid Forming (Barren)
25	EB1701807024	12/01/2017	Open Cut 3	Coal	Exploration	Coal	6	12	6	6.3	238	0.26	0.020	0.6	1.3	-0.7	2.1		Non-Acid Forming (Barren)
26	EB1701807011	14/01/2017	Open Cut 3	Coal	Exploration	Coal and Parting	6	14	8	7.3	126	0.23	0.036	1.1	5.9	-4.8	5.4		Non-Acid Forming (Barren)
27	EB1704873014	4/02/2017	Open Cut 3	Coal	Exploration	Coal	36	40	4	8.9	116	0.18		5.5	7.3	-1.8	1.3		Uncertain
28	EB1704873018	4/02/2017	Open Cut 3	Coal	Exploration	Coal/Carb Claystone	23	25	2	8.5	209	0.13		4.0	10.5	-6.5	2.6		Non Acid Forming
29	EB1704873020	4/02/2017	Open Cut 3	Coal	Exploration	Coal	43	48	5	8.8	108	0.28		8.6	7.6	1.0	0.9		Uncertain
30	EB1704873024	4/02/2017	Open Cut 3	Coal	Exploration	Coal	17	23	6	8.7	246	0.22		6.7	5.7	1.0	0.8		Uncertain
31	EB1630337014	20/12/2016	Open Cut 4	Coal	ROM	Coal				6.6	15	0.26	0.022	0.7	4.5	-3.8	6.7	7.0	Non-Acid Forming (Barren)
32	EB1630337016	20/12/2016	Open Cut 4	Coal	ROM	Coal				6.2	24	0.27	0.009	0.3	0.7	-0.4	2.5	6.6	Non-Acid Forming (Barren)
33	EB1703734012	17/02/2017	Open Cut 4	Coal	ROM	Coal				4.7	71	0.28	0.015	0.5	2.7	-2.2	5.9		Non-Acid Forming (Barren)
34	EB1703734013	17/02/2017	Open Cut 4	Coal	ROM	Coal				6.1	6	0.48	0.014	0.4	0.9	-0.5	2.1		Non-Acid Forming (Barren)
35	EB1630337005	16/12/2016	Underground	Coal	ROM	Coal				6.5	18	0.27	0.017	0.5	3.1	-2.6	6.0		Non-Acid Forming (Barren)
36	EB1704873028	4/02/2017	Open Cut 4	Coal	Exploration	Coal	17	20	3	5.5	118	0.15		4.6	0.9	3.7	0.2		Uncertain
37	EB1611124011	12/04/2016	Open Cut 1 (Mod 9)	Floor	Pit	Tuff						0.04		1.2	4.5	-3.3	3.8	7.4	Non-Acid Forming (Barren)
38	EB1611124002	12/04/2016	Open Cut 2	Floor	Pit	Carbonaceous Siltstone						0.53		16.4	0.3	16.2	0.02	3.8	Potentially Acid Forming
39	EB1611124003	12/04/2016	Open Cut 2	Floor	Pit	Carbonaceous Siltstone						0.36		11.0	1.0	10.0	0.1	4.4	Potentially Acid Forming
40	EB1630337007	20/12/2016	Open Cut 2	Floor	Pit	Carbonaceous Mudstone				4.7	333	0.06		1.8	0.3	1.8	0.1	6.4	AF-Low Capacity
41	EB1701807008	6/01/2017	Open Cut 3	Floor	Exploration	Siltstone	21	22	1	7.7	196	0.04		1.2	4.0	-2.8	3.3		Non-Acid Forming (Barren)
42	EB1701807020	10/01/2017	Open Cut 3	Floor	Exploration	Sandstone	25	26	1	7.9	93	0.28	0.177	5.4	2.9	2.5	0.5		Uncertain
43	EB1701807025	12/01/2017	Open Cut 3	Floor	Exploration	Sandstone	12	14	2	8.8	224	0.03		0.9	2.6	-1.7	2.8		Non-Acid Forming (Barren)
44	EB1701807012	14/01/2017	Open Cut 3	Floor	Exploration	Coal	14	19	5	7.1	120	0.51	0.196	6.0	2.9	3.1	0.5		Uncertain
45	EB1701807013	14/01/2017	Open Cut 3	Floor	Exploration	Claystone / Siltstone	19	20	1	7.8	78	0.06		1.8	2.2	-0.4	1.2		Non-Acid Forming (Barren)
46	EB1704873016	4/02/2017	Open Cut 3	Floor	Exploration	Siltstone	48	49	1	8.8	95	0.05		1.5	6.5	-5.0	4.2		Non-Acid Forming (Barren)
47	EB1538857009	1/12/2015	Open Cut 4	Floor	Exploration	Sandstone						0.03		0.9	0.6	0.3	0.7	4.6	Non-Acid Forming (Barren)
48	EB1538857011	1/12/2015	Open Cut 4	Floor	Exploration	Sandstone						0.02		0.6	0.3	0.3	0.5	5.2	Non-Acid Forming (Barren)
49	EB1611124009	12/04/2016	Open Cut 1 (Mod 9)	Overburden	Pit	Tuff						0.12		3.6	3.6	0.0	1.0	5.5	Uncertain
50	EB1601349001	29/12/2015	Open Cut 1 (Mod 9)	Overburden	Pit	Sandstone				6.0	36	0.02		0.6	0.3	0.3		6.8	Non-Acid Forming (Barren)
51	EB1630337013	20/12/2016	Open Cut 1 (Mod 9)	Overburden	Pit	Siltstone				6.0	40	0.01		0.2	0.3	0.0	1.6		Non-Acid Forming (Barren)
52	EB1601349002	29/12/2015	Open Cut 2	Overburden	Pit	Sandstone/Siltstone				7.4	203	0.05		1.5	9.3	-7.8	6.1	7.8	Non-Acid Forming (Barren)
53	EB1610089001	8/04/2016	Open Cut 2	Overburden	Pit	Sandstone/Siltstone						0.03		0.9	8.5	-7.6	9.3	8.1	Non-Acid Forming (Barren)
54	EB1630337012	20/12/2016	Open Cut 2	Overburden	Pit	Sandstone				8.0	156	0.02		0.6	13.8	-13.2	22.5	8.2	Non-Acid Forming (Barren)
55	EB1701807004	6/01/2017	Open Cut 3	Overburden	Exploration	Claystone	1	4	3	7.9	296	0.03		0.9	1.6	-0.7	1.7		Non-Acid Forming (Barren)
56	EB1701807005	6/01/2017	Open Cut 3	Overburden	Exploration	Sandstone	4	8	4	7.1	275	0.02		0.6	1.2	-0.6	2.0		Non-Acid Forming (Barren)

Table C1: Acid Base Account (ABA) and NAG Test Results for Moolarben Mine Materials

RGS Sample No. for Figures	ALS Sample ID	Sample Date	Pit/Underground	Sample Description	Sampling Location	Lithology	From	To	Depth	pH[1]	EC[1]	Total S	CRS	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	NAG pH	Sample Classification[3]
							(m)				(µS/cm)	(%)	(%)	kg H_2SO_4/t					
57	EB1701807014	10/01/2017	Open Cut 3	Overburden	Exploration	Alluvium	0	3	3	7.0	33	0.01		0.2	2.4	-2.4	15.7		Non-Acid Forming (Barren)
58	EB1701807015	10/01/2017	Open Cut 3	Overburden	Exploration	Siltstone	3	7	4	8.8	266	0.03		0.9	82.4	-81.5	89.7		Non-Acid Forming (Barren)
59	EB1701807021	12/01/2017	Open Cut 3	Overburden	Exploration	Clay	0	3	3	8.8	184	0.01		0.2	11.2	-11.2	73.1		Non-Acid Forming (Barren)
60	EB1701807009	14/01/2017	Open Cut 3	Overburden	Exploration	Claystone/Siltstone	1	5	4	8.9	119	0.01		0.2	65.3	-65.3	426.4		Non-Acid Forming (Barren)
61	EB1704873013	4/02/2017	Open Cut 3	Overburden	Exploration	Siltstone	26	36	10	8.7	181	0.08		2.5	18.2	-15.8	7.4		Non-Acid Forming (Barren)
62	EB1704873015	4/02/2017	Open Cut 3	Overburden	Exploration	Conglomerate	40	43	3	9.0	110	0.06		1.8	6.2	-4.4	3.4		Non-Acid Forming (Barren)
63	EB1704873017	4/02/2017	Open Cut 3 (OB1)	Overburden	Exploration	Sandstone	0	3	3	5.3	122	0.01		0.2	1.2	-1.0	7.8		Non-Acid Forming (Barren)
64	EB1704873021	4/02/2017	Open Cut 3	Overburden	Exploration	Conglomerate	25	26	1	8.7	156	0.14		4.3	19.6	-15.3	4.6		Non Acid Forming
65	EB1704873022	4/02/2017	Open Cut 3	Overburden	Exploration	Claystone/Coal	3	10	7	7.2	401	0.03		0.9	28.0	-27.1	30.5		Non-Acid Forming (Barren)
66	EB1704873023	4/02/2017	Open Cut 3	Overburden	Exploration	Sandstone	10	14	4	8.6	152	0.03		0.9	19.9	-19.0	21.7		Non-Acid Forming (Barren)
67	EB1611124006	12/04/2016	Open Cut 4	Overburden	Pit	Sandstone/Siltstone						0.02		0.6	2.1	-1.5	3.5	5.9	Non-Acid Forming (Barren)
68	EB1630337018	20/12/2016	Open Cut 4	Overburden	Pit	Sandstone				7.1	88	0.01		0.2	3.5	-3.5	22.9	8.8	Non-Acid Forming (Barren)
69	EB1630337017	20/12/2016	Open Cut 4	Overburden	Pit	Palaeo Sand				7.4	29	0.01		0.2	3.4	-3.4	22.2	8.4	Non-Acid Forming (Barren)
70	EB1704873001	4/02/2017	Open Cut 4 (OB4)	Overburden	Exploration	Sandstone/Siltstone	20	28	8	8.4	116	0.12		3.7	8.7	-5.0	2.4		Non Acid Forming
71	EB1704873002	4/02/2017	Open Cut 4 (OB5)	Overburden	Exploration	Siltstone	30	46	16	7.9	216	0.07		2.1	19.5	-17.4	9.1		Non-Acid Forming (Barren)
72	EB1704873004	4/02/2017	Open Cut 4 (OB5)	Overburden	Exploration	Siltstone	28	35	7	7.2	186	0.03		0.9	11.5	-10.6	12.5		Non-Acid Forming (Barren)
73	EB1704873005	4/02/2017	Open Cut 4 (OB6)	Overburden	Exploration	Sandstone	35	43	8	8.3	170	0.01		0.2	23.4	-23.2	152.8		Non-Acid Forming (Barren)
74	EB1704873007	4/02/2017	Open Cut 4 (OB1)	Overburden	Exploration	Claystone/Coal	1	8	7	4.7	140	0.03		0.9	0.8	0.1	0.9		AF-Low Capacity
75	EB1704873008	4/02/2017	Open Cut 4 (OB2)	Overburden	Exploration	Siltstone/Coal	8	17	9	4.5	389	0.08		2.5	2.0	0.5	0.8		AF-Low Capacity
76	EB1704873009	4/02/2017	Open Cut 4 (OB3)	Overburden	Exploration	Sandstone/Siltstone	17	28	11	5.0	153	0.03		0.9	5.8	-4.9	6.3		Non-Acid Forming (Barren)
77	EB1704873010	4/02/2017	Open Cut 4 (OB4)	Overburden	Exploration	Sandstone/Siltstone	28	37	9	6.1	155	0.04		1.2	12.5	-11.3	10.2		Non-Acid Forming (Barren)
78	EB1704873011	4/02/2017	Open Cut 4 (OB5)	Overburden	Exploration	Sandstone	37	42	5	7.3	318	0.03		0.9	50.9	-50.0	55.4		Non-Acid Forming (Barren)
79	EB1704873025	4/02/2017	Open Cut 4 (OB1)	Overburden	Exploration	Gravel	0	7	7	8.0	104	0.01		0.2	2.3	-2.1	15.0		Non-Acid Forming (Barren)
80	EB1704873026	4/02/2017	Open Cut 4 (OB2)	Overburden	Exploration	Siltstone/Sandstone	7	12	5	5.3	120	0.01		0.2	0.8	-0.6	5.2		Non-Acid Forming (Barren)
81	EB1704873027	4/02/2017	Open Cut 4 (OB3)	Overburden	Exploration	Siltstone	12	17	5	5.8	154	0.04		1.2	1.7	-0.5	1.4		Non-Acid Forming (Barren)
82	EB1704873029	4/02/2017	Open Cut 4 (OB4)	Overburden	Exploration	Sandstone	23	28	5	6.4	36	0.01		0.2	2.2	-2.0	14.4		Non-Acid Forming (Barren)
83	EB1704873030	4/02/2017	Open Cut 4 (OB2)	Overburden	Exploration	Coal/Claystone	14	16	2	7.2	119	0.25		7.7	5.6	2.1	0.7		Non Acid Forming
84	EB1704873031	4/02/2017	Open Cut 4 (OB1)	Overburden	Exploration	Sandstone	0	13	13	7.8	262	0.01		0.2	1.2	-1.0	7.8		Non-Acid Forming (Barren)
85	EB1704873032	4/02/2017	Open Cut 4 (OB3)	Overburden	Exploration	Siltstone	16	23	7	6.2	94	0.04		1.2	4.0	-2.8	3.3		Non-Acid Forming (Barren)
86	EB1630337011	20/12/2016	Open Cut 2	Parting	Pit	Tuff				7.3	180	0.04		1.2	8.3	-7.1	6.8	5.3	Non-Acid Forming (Barren)
87	EB1630337001	16/12/2016	Open Cut 2	Parting	ROM	Coal/ Tuff				7.4	37	0.31	0.132	4.0	2.5	1.5	0.6		Uncertain
88	EB1630337015	20/12/2016	Open Cut 4	Parting	ROM	Tuff				5.4	133	0.13	0.126	3.9	2.5	1.4	0.6	6.3	Uncertain
89	EB1701807001	18/01/2017	Open Cut 1 (Mod 9)	Reject	CHPP	Coal (Coarse)				5.0	111	0.54	0.345	10.6	3.1	7.5	0.3		PAF-Low Capacity
90	EB1701807002	18/01/2017	Open Cut 1 (Mod 9)	Reject	CHPP	Coal (Fine)				2.7	1740	4.24	3.680	112.7	0.3	112.5	0.002		Potentially Acid Forming
91	EB1701807003	18/01/2017	Open Cut 1 (Mod 9)	Reject	CHPP	Coal (Ultrafine)				8.5	248	0.59	0.167	5.1	6.4	-1.3	1.3		Uncertain
92	EB1703734001	20/02/2017	Open Cut 2	Reject	CHPP	Coal (Coarse)				7.1	142	0.19	0.086	2.6	4.8	-2.2	1.8		Non-Acid Forming (Barren)
93	EB1703734002	20/02/2017	Open Cut 2	Reject	CHPP	Coal (Fine)				5.4	298	1.61	1.360	41.7	4.5	37.2	0.1		Potentially Acid Forming
94	EB1703734003	20/02/2017	Open Cut 2	Reject	CHPP	Coal (Ultrafine)				7.8	296	0.59	0.239	7.3	6.2	1.1	0.8		Uncertain
95	EB1630337019	14/12/2016	Open Cut 4	Reject	CHPP	Coal (Coarse)				8.0	193	0.43	0.278	8.5	5.5	3.0	0.6		Uncertain
96	EB1703734007	20/02/2017	Open Cut 4	Reject	CHPP	Coal (Coarse)				7.0	36	0.23	0.092	2.8	4.8	-2.0	1.7		Non-Acid Forming (Barren)
97	EB1630337020	14/12/2016	Open Cut 4	Reject	CHPP	Coal (Fine)				6.5	482	2.31	1.880	57.6	4.3	53.3	0.1		Potentially Acid Forming
98	EB1703734008	20/02/2017	Open Cut 4	Reject	CHPP	Coal (Fine)				6.9	146	0.68	0.392	12.0	5.4	6.6	0.4		PAF-Low Capacity
99	EB1630337021	14/12/2016	Open Cut 4	Reject	CHPP	Coal (Ultrafine)				8.1	410	0.50	0.146	4.5	4.5	0.0	1.0		Uncertain
100	EB1703734009	20/02/2017	Open Cut 4	Reject	CHPP	Coal (Ultrafine)				8.2	248	0.42	0.113	3.5	5.3	-1.8	1.5		Uncertain
101	EB1705503001	15/03/2017	Open Cut 4	Reject	CHPP	Coal (Coarse)				6.4	56	0.86		26.3	1.3	25.0	0.05		Potentially Acid Forming
102	EB1705503002	15/03/2017	Open Cut 4	Reject	CHPP	Coal (Fine)				7.0	149	2.88		88.2	2.5	85.7	0.03		Potentially Acid Forming
103	EB1705503003	15/03/2017	Open Cut 4	Reject	CHPP	Coal (Ultrafine)				8.3	248	0.55		16.8	4.1	12.7	0.2		Potentially Acid Forming
104	EB1703734004	20/02/2017	Underground	Reject	CHPP	Coal (Coarse)				4.3	209	2.24	1.740	53.3	6.2	47.1	0.1		Potentially Acid Forming
105	EB1703734005	20/02/2017	Underground	Reject	CHPP	Coal (Fine)				7.4	334	2.29	1.710	52.4	7.0	45.4	0.1		Potentially Acid Forming
106	EB1703734006	20/02/2017	Underground	Reject	CHPP	Coal (Ultrafine)				8.8	238	0.55	0.170	5.2	6.8	-1.6	1.3		Uncertain

Table C1: Acid Base Account (ABA) and NAG Test Results for Moolarben Mine Materials

RGS Sample No. for Figures	ALS Sample ID	Sample Date	Pit/Underground	Sample Description	Sampling Location	Lithology	From	To	Depth	pH[1]	EC[1]	Total S	CRS	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	NAG pH	Sample Classification[3]
							(m)				(µS/cm)	(%)	(%)	kg H_2SO_4/t					
107	EB1610089002	08/04/2016	Open Cut 1 (Mod 9)	Roof	Pit	Siltstone						0.05		1.5	1.1	0.4	0.7	7.4	Non-Acid Forming (Barren)
108	EB1611124004	12/04/2016	Open Cut 1 (Mod 9)	Roof	Pit	Siltstone						0.09		2.7	1.7	1.0	0.6	7.5	Non-Acid Forming (Barren)
109	EB1611124005	12/04/2016	Open Cut 1 (Mod 9)	Roof	Pit	Sandstone						0.04		1.2	2.2	-1.0	1.8	5.1	Non-Acid Forming (Barren)
110	EB1611124001	12/04/2016	Open Cut 2	Roof	Pit	Siltstone						0.14		4.3	1.9	2.4	0.4	3.8	Uncertain
111	EB1630337009	20/12/2016	Open Cut 2	Roof	Pit	Siltstone				7.2	98	0.07		2.1	6.8	-4.7	3.2	9.0	Non-Acid Forming (Barren)
112	EB1630337006	20/12/2016	Open Cut 2	Roof	Pit	Conglomerate				7.8	25	0.01		0.2	0.3	-0.1	1.6	8.9	Non-Acid Forming (Barren)
113	EB1701807006	6/01/2017	Open Cut 3	Roof	Exploration	Sandstone Weathered	12	14	2	7.5	182	0.02		0.6	0.6	0.0	1.0		Non-Acid Forming (Barren)
114	EB1701807016	10/01/2017	Open Cut 3	Roof	Exploration	Siltstone Weathered	10	12	2	8.4	242	0.14	0.027	0.8	12.1	-11.3	14.6		Non-Acid Forming (Barren)
115	EB1701807022	12/01/2017	Open Cut 3	Roof	Exploration	Claystone	3	4	1	8.3	102	0.01		0.2	1.9	-1.7	12.4		Non-Acid Forming (Barren)
116	EB1701807010	14/01/2017	Open Cut 3	Roof	Exploration	Siltstone Weathered	5	6	1	8.2	239	0.04		1.2	16.4	-15.2	13.4		Non-Acid Forming (Barren)
117	EB1704873019	4/02/2017	Open Cut 3	Roof	Exploration	Siltstone	14	23	9	8.7	188	0.04		1.2	19.9	-18.7	16.2		Non-Acid Forming (Barren)
118	EB1538857008	01/12/2015	Open Cut 4	Roof	Exploration	Sandstone						0.04		1.2	0.3	0.9	0.2	3.4	Non-Acid Forming (Barren)
119	EB1538857010	01/12/2015	Open Cut 4	Roof	Exploration	Sandstone						0.03		0.9	30.1	-29.2	32.8	8.3	Non-Acid Forming (Barren)
120	EB1704873003	4/02/2017	Open Cut 4	Roof	Exploration	Sandstone/Siltstone	46	49	3	8.3	191	0.04		1.2	48.3	-47.1	39.4		Non-Acid Forming (Barren)
121	EB1704873006	4/02/2017	Open Cut 4	Roof	Exploration	Siltstone	43	50	7	7.6	150	0.03		0.9	12.0	-11.1	13.1		Non-Acid Forming (Barren)
122	EB1704873012	4/02/2017	Open Cut 4	Roof	Exploration	Siltstone/Coal	42	49	7	7.4	199	0.04		1.2	18.8	-17.6	15.3		Non-Acid Forming (Barren)

1. Current pH, EC provided for 1:5 sample:water extracts.
2. CRS = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification criteria detail provided in report text.

* Where total sulfur or ANC results are less than the laboratory LoR, a value of half of the LoR is used in the Table .

Table C2: Multi-Element Test Results for Selected Samples of Moolarben Mine Materials

Parameters	Material Type →	Floor	Coal	Overburden	Reject	Reject	Overburden	Coal / Parting	Reject	Reject
	RGS Sample Number →	44	15 to 17	68 and 69	95, 97 and 99	89 to 91	55 and 56	21 and 22	92 to 94	104 to 106
	ALS Laboratory ID →	EB1701807012	EB1630337002 to EB1630337004	EB1630337017 to EB1630337018	EB1630337019 to EB1630337021	EB1701807001 to EB1701807003	EB1701807004 to EB1701807005	EB1701807017 to EB1701807018	EB1703734001 to EB1703734003	EB1703734004 to EB1703734006
	Pit/Underground →	Open Cut 3	Open Cut 2	Open Cut 4	Open Cut 4	Open Cut 1	Open Cut 3	Open Cut 3	Open Cut 2	Underground
	Sample Source →	Exploration	ROM	Pit	CHPP	CHPP	Exploration	Exploration	CHPP	CHPP
	Rock Type →	Coal	Coal	Sandstone / Paleo Sand	Coal	Coal	Claystone / Sandstone	Coal / Parting	Reject	Coal
	Material Description →	OC3 CL-ELW WS2	Composite 1 (Composite of 2 - 5)	Composite 2 (Composite of 10 & 11)	Composite 3 (Composite of 12 - 14)	Composite 4 (Composite of 15 - 17)	Composite 5 (Composite of 18 & 19)	Composite 6 (Composite of 24 & 25)	Composite 7 (Composite of 29 - 31)	Composite 8 (Composite of 35 - 37)
	Limit of Reporting									
Major Elements	All units mg/kg									
Aluminium (Al)	50	1,680	810	2,630	2,200	3080	4420	2100	3770	2600
Iron (Fe)	50	5,710	370	23,700	10,600	14500	12400	11500	8060	20600
Minor Elements	All units mg/kg									
Antimony (Sb)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic (As)	5	5	<5	13	<5	16	<5	<5	14	6
Barium (Ba)	10	30	<10	10	130	<10	40	20	30	130
Beryllium (Be)	1	4	3	<1	1	3	<1	2	3	1
Boron (B)	50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (Cd)	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium (Cr)	2	4	6	63	8	7	59	7	6	8
Cobalt (Co)	2	2	<2	4	<2	5	4	<2	40	4
Copper (Cu)	5	12	11	10	14	22	11	14	17	9
Fluoride (F)	40	100	50	120	90	170	500	130	130	140
Lead (Pb)	5	21	8	6	36	34	25	25	39	23
Mercury (Hg)	0.1	<0.1	<0.1	<0.1	0.2	0.1	<0.1	<0.1	0.2	0.1
Manganese (Mn)	5	94	<5	83	7	18	49	178	64	364
Molybdenum (Mo)	2	<2	<2	<2	<2	7	<2	<2	5	<2
Nickel (Ni)	2	6	2	9	6	14	12	5	135	19
Selenium (Se)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Vanadium (V)	5	7	7	12	7	7	6	8	12	8
Zinc (Zn)	5	34	15	24	66	78	17	50	254	56

Notes: < indicates less than the laboratory limit of reporting.

Table C3: Geochemical Abundance Index (GAI) Results for Selected Samples of Moolarben Mine Materials

Parameters	Material Type →	Floor	Coal	Overburden	Reject	Reject	Overburden	Coal / Parting	Reject	Reject
	RGS Sample Number →	44	15 to 17	68 and 69	95, 97 and 99	89 to 91	55 and 56	21 and 22	92 to 94	104 to 106
	ALS Laboratory ID →	EB1701807012	EB1630337002 to EB1630337004	EB1630337017 to EB1630337018	EB1630337019 to EB1630337021	EB1701807001 to EB1701807003	EB1701807004 to EB1701807005	EB1701807017 to EB1701807018	EB1703734001 to EB1703734003	EB1703734004 to EB1703734006
	Pit/Underground →	Open Cut 3	Open Cut 2	Open Cut 4	Open Cut 4	Open Cut 1	Open Cut 3	Open Cut 3	Open Cut 2	Underground
	Sample Source →	Exploration	ROM	Pit	CHPP	CHPP	Exploration	Exploration	CHPP	CHPP
	Rock Type →	Coal	Coal	Sandstone / Paleo Sand	Coal	Coal	Claystone / Sandstone	Coal / Parting	Reject	Coal
	Material Description → Average Crustal Abundance[1]	OC3 CL-ELW WS2	Composite 1 (Composite of 2 - 5)	Composite 2 (Composite of 10 & 11)	Composite 3 (Composite of 12 - 14)	Composite 4 (Composite of 15 - 17)	Composite 5 (Composite of 18 & 19)	Composite 6 (Composite of 24 & 25)	Composite 7 (Composite of 29 - 31)	Composite 8 (Composite of 35 - 37)
Major Elements	mg/kg	Geochemical Abundance Index								
Aluminium (Al)	71,000	0	0	0	0	0	0	0	0	0
Iron (Fe)	40,000	0	0	0	0	0	0	0	0	0
Minor Elements	mg/kg	Geochemical Abundance Index								
Antimony (Sb)	1	0	0	0	0	0	0	0	0	0
Arsenic (As)	6	0	0	1	0	1	0	0	1	0
Barium (Ba)	500	0	0	0	0	0	0	0	0	0
Beryllium (Be)	0.3	3	3	0	1	3	0	2	3	1
Boron (B)	20	0	0	0	0	0	0	0	0	0
Cadmium (Cd)	0.35	0	0	0	0	0	0	0	0	0
Chromium (Cr)	70	0	0	0	0	0	0	0	0	0
Cobalt (Co)	8	0	0	0	0	0	0	0	2	0
Copper (Cu)	30	0	0	0	0	0	0	0	0	0
Fluoride (F)	200	0	0	0	0	0	1	0	0	0
Lead (Pb)	35	0	0	0	0	0	0	0	0	0
Mercury (Hg)	0.06	0	0	0	1	0	0	0	1	0
Manganese (Mn)	1000	0	0	0	0	0	0	0	0	0
Molybdenum (Mo)	1.2	0	0	0	0	2	0	0	1	0
Nickel (Ni)	50	0	0	0	0	0	0	0	1	0
Selenium (Se)	0.4	0	0	0	0	0	0	0	0	0
Vanadium (V)	90	0	0	0	0	0	0	0	0	0
Zinc (Zn)	90	0	0	0	0	0	0	0	1	0

Notes:

GAI's greater than or equal to 3 are highlighted.

1. Average crustal abundance (ie. median elemental composition of soils) taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, Academic Press, New York, p60-61.

Table C4: Multi-Element Test Results for Water Extracts from Selected Samples of Moolarben Mine Materials (December 2016)

			Rock Type →	Conglomerate	Carbonaceous Mudstone	Tuff	Siltstone	Coal/ Stoney	Tuff	Sandstone	Coal	Tuff	Coal	Palaeo Sand	Sandstone
			RGS Sample Number →	9	10	11	12	13	14	15	16	17	18	19	20
			ALS Laboratory ID →	EB1630337006	EB1630337007	EB1630337008	EB1630337009	EB1630337010	EB1630337011	EB1630337012	EB1630337014	EB1630337015	EB1630337016	EB1630337017	EB1630337018
			Pit/Underground →	Open Cut 2	Open Cut 2	Open Cut 2	Open Cut 2	Open Cut 2	Open Cut 2	Open Cut 2	Open Cut 4	Open Cut 4	Open Cut 4	Open Cut 4	Open Cut 4
			Sample Source →	Pit	Pit	Pit	Pit	Pit	Pit	Pit	ROM	ROM	ROM	Pit	Pit
			Material Type →	Roof	Floor	Coal	Roof	Coal	Parting	Overburden	Coal	Parting	Coal	Overburden	Overburden
			Material Description →												
Parameters	Limit of Reporting	Aquatic Ecosystems (freshwater)[1]	Livestock Drinking Water[2]	OC2 S15 B6 A1 ROOF	OC2 S15 B6 WS2 FLOOR	OC2 S15 B6 CMK	OC2 S15 B3 IRO ROOF	OC2 S15 B3 IRO1	OC2 S15 B3 IRO PARTING	OC2 OVERBURDEN	OC4 WS2 S1 B16 ROM	OC4 WS2 PARTING CMK ROM	OC4 WS1L S1 B16 ROM	OC4 S2 B5 PALAEO SAND	OC4 S2 B12 OVERBURDEN
pH	0.1 pH unit	6 to 9	-	7.80	4.70	5.70	7.20	6.80	7.30	8.00	6.60	5.40	6.20	7.40	7.10
Electrical Conductivity	1 µS/cm	<1,000[#]	3,580[^]	25	333	59	98	36	180	156	15	133	24	29	88
Major Ions	All units mg/L			All units mg/L											
Sulfate (SO_4)	1	-	1,000	3	<1	6	7	1	5	8	1	19	1	<1	7
Calcium (Ca)	1	-	1,000	<1	<1	<1	<1	<1	3	2	<1	3	<1	<1	1
Magnesium (Mg)	1	-	-	<1	1	1	<1	<1	1	3	<1	2	<1	<1	<1
Sodium (Na)	1	-	-	4	13	1	5	1	45	10	<1	1	<1	11	4
Trace Metals/Metalloids	All units mg/L			All units mg/L											
Aluminium (Al)	0.01	0.055	5	0.89	1.73	0.04	1.5	0.07	0.47	0.89	<0.01	0.02	0.02	2.02	0.42
Iron (Fe)	0.05	-	-	0.1	0.3	0.06	0.41	<0.05	<0.05	0.13	<0.05	0.05	<0.05	1.48	<0.05
Manganese (Mn)	0.001	1.90	-	0.001	0.001	0.001	0.01	0.01	0.012	0.004	0.001	0.004	0.001	0.006	0.006

Concentrations less than the laboratory Limit of Reporting (LoR) have been halfed.

for still water bodies only, moving rivers at low flow rates should not exceed 2,200µS/cm

^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400mg/L for livestock drinking water.

Table C5: Multi-Element Test Results for Water Extracts from Selected Samples of Moolarben Mine Materials (2017)

		Material Type →		Floor	Coal	Overburden	Reject	Reject	Overburden	Coal / Parting	Reject	Reject
		RGS Sample Number →		44	15 to 17	68 and 69	95, 97 and 99	89 to 91	55 and 56	21 and 22	92 to 94	104 to 106
		ALS Laboratory ID →		EB1701807012	EB1630337002 to EB1630337004	EB1630337017 to EB1630337018	EB1630337019 to EB1630337021	EB1701807001 to EB1701807003	EB1701807004 to EB1701807005	EB1701807017 to EB1701807018	EB1703734001 to EB1703734003	EB1703734004 to EB1703734006
		Pit/Underground →		Open Cut 3	Open Cut 2	Open Cut 4	Open Cut 4	Open Cut 1	Open Cut 3	Open Cut 3	Open Cut 2	Underground
		Sample Source →		Exploration	ROM	Pit	CHPP	CHPP	Exploration	Exploration	CHPP	CHPP
		Rock Type →		Coal	Coal	Sandstone / Paleo Sand	Coal	Coal	Claystone / Sandstone	Coal / Parting	Reject	Coal
		Material Description →										
Parameters	Limit of Reporting	Aquatic Ecosystems (freshwater)[1]	Livestock Drinking Water[2]	OC3 CL-ELW WS2	Composite 1 (Composite of 2 - 5)	Composite 2 (Composite of 10 & 11)	Composite 3 (Composite of 12 - 14)	Composite 4 (Composite of 15 - 17)	Composite 5 (Composite of 18 & 19)	Composite 6 (Composite of 24 & 25)	Composite 7 (Composite of 29 - 31)	Composite 8 (Composite of 35 - 37)
pH	0.1 pH unit	6 to 9	-	7.10	6.00	7.15	7.53	5.40	7.50	8.00	6.77	6.83
Electrical Conductivity	1 µS/cm	<1,000#	3,580^	120	33	59	362	700	286	157	245	260
Major Ions	All units mg/L			All units mg/L								
Calcium (Ca)	2	-	1,000	8	<	<	70	114	<	4	42	14
Magnesium (Mg)	2	-	-	8	<	<	16	20	<	4	18	6
Sodium (Na)	2	-	-	10	5	6	10	50	54	12	28	8
Potassium (K)	2	-	-	8	5	5	5	8	6	10	10	6
Chloride (Cl)	2	-	-	8	4	4	8	8	50	10	22	4
Sulfate (SO_4)	2	-	1,000	58	12	14	190	348	40	16	196	52
Trace Metals/Metalloids	All units mg/L			All units mg/L								
Aluminium (Al)	0.2	0.055	5	<	<	<	<	<	<	<	<	<
Antimony (Sb)	0.02	-	-	<	<	<	<	<	0.02	0.02	<	0.02
Arsenic (As)	0.02	0.024	0.5	<	<	<	<	<	<	<	<	<
Barium (Ba)	0.2	-	-	<	<	<	<	<	<	<	<	<
Beryllium (Be)	0.02	-	-	<	<	<	<	<	<	<	<	<
Boron (B)	0.2	0.37	5	<	<	<	<	<	<	<	<	<
Cadmium (Cd)	0.02	0.0002	0.01	<	<	<	<	<	<	<	<	<
Chromium (Cr) (Hex)	0.02	0.001	1 (total)	<	<	<	<	<	<	<	<	<
Cobalt (Co)	0.02	-	1	<	<	<	<	0.08	<	<	0.10	<
Copper (Cu)	0.02	0.0014	1	<	<	<	<	<	<	<	<	<
Fluoride (F)	0.2	-	2	0.4	<	0.4	0.8	0.6	1.0	1.0	0.4	0.6
Iron (Fe)	0.2	-	-	<	<	<	<	<	<	<	<	<
Lead (Pb)	0.02	0.034	0.1	<	<	<	<	<	<	<	<	<
Manganese (Mn)	0.02	1.90	-	0.2	<	<	0.02	0.62	<	<	0.38	<
Mercury (Hg)	0.0001	0.0006	0.002	<	<	<	<	<	<	<	<	<
Molybdenum (Mo)	0.02	-	0.15	<	<	<	0.04	0.04	<	0.04	0.06	<
Nickel (Ni)	0.02	0.011	1	<	<	<	<	0.18	<	<	0.18	<
Selenium (Se)	0.02	0.011	0.02	<	<	<	<	0.02	<	<	<	<
Vanadium (V)	0.02	-	-	<	<	<	<	<	<	<	<	<
Zinc (Zn)	0.02	0.008	20	<	0.04	<	<	0.12	<	<	0.04	<

< = concentration less than the laboratory Limit of Reporting (LoR)

for still water bodies only, moving rivers at low flow rates should not exceed 2,200µS/cm

^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400mg/L for livestock drinking water.

Table C6: Mine Water Quality Data Summary for Surface and Underground Water Storages at Moolarben Coal Complex

	Various Chemical and Physical Sample Characteristics															Major Ions			Trace Metals														
Parameter	**Field pH**	**EC (µs/cm)**	**Temperature °C**	**Total Dissolved Solids**	**TSS**	**Turbidity NTU**	**Acidity**	**Bicarbonate Alkalinity as $CaCO_3$**	**Carbonate Alkalinity as $CaCO_3$**	**Hydroxide Alkalinity as $CaCO_3$**	**Total Alkalinity as $CaCO_3$**	**Total Hardness as CaCO3**	**Oil & Grease mg/L**	**Total Nitrogen as N**	**Total Phosphorus as P**	**Calcium**	**Magnesium**	**Sulfate**	**Aluminium**	**Arsenic**	**Barium**	**Cadmium**	**Chromium**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Lithium**	**Manganese**	**Nickel**	**Selenium**	**Strontium**	**Zinc**
Mine Water Dams																																	
Aquatic Ecosystems (Freshwater)[1]	6-9	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.024	-	0.0002	0.001	-	0.0014	-	0.0034	-	1.9	0.01	0.011	-	0.01
Livestock Drinking Water[2]	-	3,580	-	-	-	-	-	-	-	-	-	-	-	-	-	1,000	-	1,000	5	0.5	-	0.01	1	1	1	-	0.1	-	-	1	0.02	-	20
No. of Samples	103	103	104	91	98	72	11	11	11	11	11	9	96	6	6	9	9	11	12	22	13	13	10	12	22	93	13	13	22	22	7	13	94
Minimum	4.90	818	7.3	504	4	0.8	1.0	16	<1	<1	16	301	5	1.2	0.020	42	41	135	0.020	0.001	0.05	0.00020	<0.001	0.002	<0.001	0.05	<0.001	0.05	0.003	0.007	<0.01	0.183	0.005
10%	6.90	992	12.0	596	5	3.5	1.6	76	<1	<1	76	302	6	1.4	0.031	44	43	176	0.020	0.001	0.05	0.00029	<0.001	0.002	<0.001	0.06	<0.001	0.07	0.026	0.010	<0.01	0.186	0.007
50%	8.17	1,256	20.2	748	12	11.4	2.0	93	<1	<1	94	307	8	2.0	0.075	51	49	226	0.085	0.002	0.06	0.00065	<0.001	0.008	<0.001	0.14	<0.001	0.25	0.225	0.074	<0.01	0.214	0.020
80%	8.54	1,547	26.6	865	24	29.4	2.8	111	<1	<1	111	320	16	2.3	0.108	52	49	260	0.264	0.002	0.08	0.00092	<0.001	0.020	<0.001	0.28	<0.001	0.27	0.724	0.139	<0.01	0.273	0.494
90%	8.68	1,650	28.3	1005	39	39.6	3.4	132	<1	<1	132	325	17	2.4	0.119	53	49	305	0.379	0.002	0.1	0.00101	<0.001	0.038	<0.001	0.48	<0.001	0.32	1.588	0.190	<0.01	0.273	0.632
Maximum	9.97	2,380	31.1	1600	181	72.4	4.0	168	9	<1	168	329	18	2.5	0.130	53	49	387	0.450	0.002	0.14	0.00110	<0.001	0.064	0.001	1.24	0.001	0.34	3.200	0.73	<0.01	0.276	0.860
Open Cuts																																	
Aquatic Ecosystems (Freshwater)[1]	6-9	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.024	-	0.0002	0.001	-	0.0014	-	0.0034	-	1.9	0.01	0.011	-	0.01
Livestock Drinking Water[2]	-	3,580	-	-	-	-	-	-	-	-	-	-	-	-	-	1,000	-	1,000	5	0.5	-	0.01	1	1	1	-	0.1	-	-	1	0.02	-	20
No. of Samples	16	17	17	14	15	12	4	4	4	4	4	2	14	2	2	2	2	4	4	6	4	4	2	4	6	12	4	4	6	6	2	4	12
Minimum	5.83	655	15.6	424	8	3.7	3.0	71	<1	<1	71	259	<5	0.5	<0.01	36	41	142	0.020	0.002	0.043	0.00010	<0.001	0.007	0.001	0.08	<0.001	0.02	0.017	0.006	<0.01	0.096	0.017
10%	6.07	944	18.6	525	8	9.6	3.0	88	<1	<1	88	272	<5	2.3	<0.01	38	43	171	0.056	0.002	0.044	0.00012	<0.001	0.012	0.001	0.17	<0.001	0.03	0.124	0.020	<0.01	0.120	0.031
50%	7.10	1,224	25.6	718	30	23.9	3.5	131	<1	<1	131	322	<5	9.7	<0.01	48	49	295	0.200	0.004	0.058	0.00020	<0.001	0.034	0.001	1.50	<0.001	0.17	1.042	0.044	<0.01	0.245	0.052
80%	8.13	1,514	28.2	905	42	50.3	9.2	148	<1	<1	148	359	<5	15.2	<0.01	55	54	354	0.362	0.005	0.136	0.00026	<0.001	0.049	0.002	3.59	0.001	0.36	1.740	0.266	<0.01	0.317	0.125
90%	8.23	1,664	31.6	1024	73	52.1	13.1	158	<1	<1	158	372	<5	17.1	<0.01	58	55	354	0.416	0.006	0.186	0.00028	<0.001	0.054	0.003	6.92	0.001	0.42	1.795	0.496	<0.01	0.320	0.212
Maximum	8.42	1,867	35.5	1060	73	64.4	17.0	167	<1	<1	167	384	<5	18.9	<0.01	60	57	355	0.470	0.006	0.236	0.00030	<0.001	0.059	0.003	44.30	0.001	0.49	1.850	0.726	<0.01	0.323	0.237
Underground 1																																	
Aquatic Ecosystems (Freshwater)[1]	6-9	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.024	-	0.0002	0.001	-	0.0014	-	0.0034	-	1.900	0.01	0.011	-	0.01
Livestock Drinking Water[2]	-	3,580	-	-	-	-	-	-	-	-	-	-	-	-	-	1,000	-	1,000	5	0.5	-	0.01	1	1	1	-	0.1	-	-	1	0.02	-	20
No. of Samples	5	5	5	3	4	4	3	3	3	3	3	1	3	1	1	1	1	3	3	3	1	3	0	3	3	3	1	1	3	3	0	1	3
Minimum	3.38	1,260	18.5	676	12	20.1	1.0	169	<1	<1	169	334	<5	0.2	<0.01	68	40	170	0.040	<0.001	0.096	<0.0001	-	0.003	<0.001	0.110	<0.001	0.09	0.447	0.017	-	0.37	0.021
10%	5.16	1,264	20.1	688	14	22.2	4.8	171	<1	<1	171	334	<5	0.2	<0.01	68	40	184	0.088	<0.001	0.096	<0.0001	-	0.005	<0.001	0.210	<0.001	0.09	0.490	0.024	-	0.37	0.022
50%	7.95	1,296	23.9	738	24	37.5	20.0	179	<1	<1	179	334	<5	0.2	<0.01	68	40	238	0.280	<0.001	0.096	<0.0001	-	0.014	<0.001	0.610	<0.001	0.09	0.663	0.052	-	0.37	0.025
80%	8.19	1,460	25.9	745	53	65.6	31.4	184	<1	<1	184	334	<5	0.2	<0.01	68	40	608	1.576	<0.001	0.096	<0.0001	-	0.232	0.052	1.300	<0.001	0.09	3.793	0.576	-	0.37	0.874
90%	8.30	1,693	27.6	748	62	78.8	35.2	186	<1	<1	186	334	<5	0.2	<0.01	68	40	731	2.008	<0.001	0.096	<0.0001	-	0.305	0.052	1.530	<0.001	0.09	4.873	0.750	-	0.37	1.157
Maximum	8.41	1,927	29.4	750	72	92.1	39.0	188	<1	<1	188	334	<5	0.2	<0.01	68	40	854	2.440	<0.001	0.096	<0.0001	-	0.378	0.052	1.760	<0.001	0.09	5.880	0.925	-	0.37	1.440

Notes: All units mg/L except pH, EC, temperature and turbidity

1. ANZECC & ARMCANZ (2000). Trigger values for moderately disturbed freshwater aquatic ecosystems (95% species protection level). 2. ANZECC & ARMCANZ (2000). Recommended guideline limits for Livestock Drinking Water.

1 + 2 taken from the "Australian and New Zealand Guidelines for Fresh and Marine Water Quality", National Water Quality Management Strategy, ANZECC and ARMCANZ (2000).

ATTACHMENT D

ALS Laboratory Characterisation Results

CERTIFICATE OF ANALYSIS

Work Order	: **EB1630337**	Page	: 1 of 10
Client	: **MOOLARBEN COAL OPERATIONS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Michelle Cavanagh	Contact	: Customer Services EB
Address	: Locked Bag 2003 MUDGEE NSW 2850	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: NAF/PAF Sampling Regime	Date Samples Received	: 28-Dec-2016 14:00
Order number	: 4800043358	Date Analysis Commenced	: 03-Jan-2017
C-O-C number	: ----	Issue Date	: 13-Jan-2017 17:10
Sampler	: BEAU FERNANCE, M.Hicks		
Site	: ----		
Quote number	: BN/456/16		
No. of samples received	: 21		
No. of samples analysed	: 21		

Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Greg Vogel	Laboratory Manager	Brisbane Acid Sulphate Soils, Stafford, QLD
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD

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 insufficient 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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	OC2 S15 B6 A1 Roof	OC2 S15 B6 WS2 Floor	OC2 S15 B6 CMK	OC2 S15 B3 IRO Roof	OC2 S15 B3 IRO1
			Client sampling date / time	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00
Compound	CAS Number	LOR	Unit	EB1630337-006	EB1630337-007	EB1630337-008	EB1630337-009	EB1630337-010
				Result	Result	Result	Result	Result
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	3	<1	6	7	1
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	<1	<1	<1	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	1	1	<1	<1
Sodium	7440-23-5	1	mg/L	4	13	1	5	1
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.89	1.73	0.04	1.50	0.07
Manganese	7439-96-5	0.001	mg/L	0.001	0.001	0.001	0.010	0.010
Iron	7439-89-6	0.05	mg/L	0.10	0.30	0.06	0.41	<0.05

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	OC2 S15 B3 IRO Parting	OC2 Overburden	OC4 WS2 S1 B16 ROM	OC4 WS2 Parting CMK ROM	OC4 WS1L S1B16 ROM
			Client sampling date / time	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00
Compound	CAS Number	LOR	Unit	EB1630337-011	EB1630337-012	EB1630337-014	EB1630337-015	EB1630337-016
				Result	Result	Result	Result	Result
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**5**	**8**	**1**	**19**	**1**
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	**2**	<1	**3**	<1
Magnesium	7439-95-4	1	mg/L	**1**	**3**	<1	**2**	<1
Sodium	7440-23-5	1	mg/L	**45**	**10**	<1	**1**	<1
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.47**	**0.89**	<0.01	**0.02**	**0.02**
Manganese	7439-96-5	0.001	mg/L	**0.012**	**0.004**	**0.001**	**0.004**	**0.001**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.13**	<0.05	**0.05**	<0.05

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	OC4 S2 B5 Palaeo Sand	OC4 S2 B12 Overburden	----	----	----
			Client sampling date / time	20-Dec-2016 00:00	20-Dec-2016 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1630337-017	EB1630337-018	--------	--------	--------
				Result	Result	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	**7**	----	----	----
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**1**	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	----	----	----
Sodium	7440-23-5	1	mg/L	**11**	**4**	----	----	----
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**2.02**	**0.42**	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.006**	**0.006**	----	----	----
Iron	7439-89-6	0.05	mg/L	**1.48**	<0.05	----	----	----

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Client sample ID	OC2 A2 Parting S14 B5 Coal & Tuff from ROM	OC2 WS1L S14 B5 Coal from ROM	OC2 WS2 S14 B6 Coal from ROM	OC2 A1 S14 B5 Coal from ROM	UG1 DEVELOPMENT DWS LW01 Coal from ROM
			Client sampling date / time	16-Dec-2016 00:00	16-Dec-2016 00:00	16-Dec-2016 00:00	16-Dec-2016 00:00	16-Dec-2016 00:00
Compound	CAS Number	LOR	Unit	EB1630337-001	EB1630337-002	EB1630337-003	EB1630337-004	EB1630337-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.4	6.3	4.8	6.9	6.5
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	7.0	7.6	9.2	12.3	5.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	37	48	42	10	18
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.5	2.5	1.8	2.1	3.1
ANC as CaCO3	----	0.1	% CaCO3	0.2	0.2	0.2	0.2	0.3
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.31	0.33	0.36	0.47	0.27
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	----	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	OC2 S15 B6 A1 Roof	OC2 S15 B6 WS2 Floor	OC2 S15 B6 CMK	OC2 S15 B3 IRO Roof	OC2 S15 B3 IRO1
			Client sampling date / time	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1630337-006**	**EB1630337-007**	**EB1630337-008**	**EB1630337-009**	**EB1630337-010**
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.8**	**4.7**	**5.7**	**7.2**	**6.8**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	**1.8**	**0.9**	**-4.6**	**3.1**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**25**	**333**	**59**	**98**	**36**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	**2.2**	**6.8**	**5.8**
ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	**0.2**	**0.7**	**0.6**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	**0.06**	**0.10**	**0.07**	**0.29**
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	**8.9**	**6.4**	**6.7**	**9.0**	**6.9**

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	OC2 S15 B3 IRO Parting	OC2 Overburden	MOD9 S5 B6 Overburden	OC4 WS2 S1 B16 ROM	OC4 WS2 Parting CMK ROM
Client sampling date / time				20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00
				EB1630337-011	EB1630337-012	EB1630337-013	EB1630337-014	EB1630337-015
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.3	8.0	6.0	6.6	5.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-7.1	-13.2	<0.5	3.4	1.5
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	180	156	40	15	133
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	8.3	13.8	<0.5	4.5	2.5
ANC as CaCO3	----	0.1	% CaCO3	0.8	1.4	<0.1	0.4	0.2
Fizz Rating	----	0	Fizz Unit	0	1	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.02	<0.01	0.26	0.13
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	5.3	8.2	----	7.0	6.3

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Client sample ID	OC4 WS1L S1B16 ROM	OC4 S2 B5 Palaeo Sand	OC4 S2 B12 Overburden	Coarse coal reject sample WS2	Fine coal reject sample WS2
			Client sampling date / time	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	[14-Dec-2016]	[15-Dec-2016]
Compound	CAS Number	LOR	Unit	EB1630337-016	EB1630337-017	EB1630337-018	EB1630337-019	EB1630337-020
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.2	7.4	7.1	8.0	6.5
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	7.6	-3.4	-3.5	7.6	66.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	24	29	88	193	482
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	0.7	3.4	3.5	5.5	4.3
ANC as CaCO3	----	0.1	% CaCO3	<0.1	0.3	0.4	0.6	0.4
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.27	<0.01	<0.01	0.43	2.31
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	6.6	8.4	8.8	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Ultra fine coal reject sample OC4 WS2	----	----	----	----
			Client sampling date / time	[16-Dec-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1630337-021	--------	--------	--------	--------
				Result	----	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**8.1**	----	----	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**10.8**	----	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**410**	----	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**4.5**	----	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	**0.5**	----	----	----	----
Fizz Rating	----	0	Fizz Unit	**0**	----	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.50**	----	----	----	----
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	----	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1701807**	Page	: 1 of 7
Amendment	: **1**		
Client	: **MOOLARBEN COAL OPERATIONS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Michelle Cavanagh	Contact	: Customer Services EB
Address	: Locked Bag 2003 MUDGEE NSW 2850	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: NAF/PAF Sampling Regime	Date Samples Received	: 30-Jan-2017 10:35
Order number	: 4800044227	Date Analysis Commenced	: 07-Feb-2017
C-O-C number	: ----	Issue Date	: 21-Feb-2017 15:13
Sampler	: B. Crowe and L. Zaarour, M. Hicks		
Site	: ----		
Quote number	: BN/456/16		
No. of samples received	: 25		
No. of samples analysed	: 25		

ilac-MRA NATA

Accreditation No. 825
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This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is 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, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

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

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Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Coarse Coal Reject, WS2, MOD 9	Fine Coal Reject, WS2, MOD9	Ultra Fine Reject, WS2, MOD9	OC3 MCX457 OB1	OC3 MCX457 OB2
			Client sampling date / time	[18-Jan-2017]	[18-Jan-2017]	[18-Jan-2017]	[06-Jan-2017]	[06-Jan-2017]
Compound	*CAS Number*	*LOR*	*Unit*	EB1701807-001	EB1701807-002	EB1701807-003	EB1701807-004	EB1701807-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**5.0**	**2.7**	**8.5**	**7.9**	**7.1**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**13.4**	**130**	**11.6**	**-0.7**	**-0.6**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**111**	**1740**	**248**	**296**	**275**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**3.1**	<0.5	**6.4**	**1.6**	**1.2**
ANC as CaCO3	----	0.1	% CaCO3	**0.3**	<0.1	**0.6**	**0.2**	**0.1**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.54**	**4.24**	**0.59**	**0.03**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OC3 MCX457 C2 ROOF	OC3 MCX457 CL-ELW WS2	OC3 MCX457 ELW FLOOR	OC3 MCX473 OB	OC3 MCX473 A1 ROOF
			Client sampling date / time	[06-Jan-2017]	[06-Jan-2017]	[06-Jan-2017]	[14-Jan-2017]	[14-Jan-2017]
Compound	CAS Number	LOR	Unit	EB1701807-006	EB1701807-007	EB1701807-008	EB1701807-009	EB1701807-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.5	7.5	7.7	8.9	8.2
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	7.0	-2.8	-65.3	-15.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	182	333	196	119	239
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	0.6	3.7	4.0	65.3	16.4
ANC as CaCO3	----	0.1	% CaCO3	<0.1	0.4	0.4	6.6	1.7
Fizz Rating	----	0	Fizz Unit	0	0	0	2	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.35	0.04	<0.01	0.04

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OC3 MCX473 A1-C2 WS1 + CMK	OC3 MCX473 CL-ELW FLOOR	OC3 MCX473 ELW FLOOR	OC3 MCR463 OB1	OC3 MCR463 OB2
			Client sampling date / time	[14-Jan-2017]	[14-Jan-2017]	[14-Jan-2017]	[10-Jan-2017]	[10-Jan-2017]
Compound	CAS Number	LOR	Unit	EB1701807-011	EB1701807-012	EB1701807-013	EB1701807-014	EB1701807-015
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.3	7.1	7.8	7.0	8.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	1.1	12.7	0.00	-2.4	-81.5
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	126	120	78	33	266
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	5.9	2.9	2.2	2.4	82.4
ANC as CaCO3	----	0.1	% CaCO3	0.6	0.3	0.2	0.2	8.4
Fizz Rating	----	0	Fizz Unit	1	0	0	0	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.23	0.51	0.06	<0.01	0.03

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OC3 MCR463 A1 ROOF	OC3 MCR463 A2	OC3 MCR463 B1-C2 WS1+CMK	OC3 MCR463 CL-ELW WS2	OC3 MCR463 ELW FLOOR
			Client sampling date / time	[10-Jan-2017]	[10-Jan-2017]	[10-Jan-2017]	[10-Jan-2017]	[10-Jan-2017]
Compound	CAS Number	LOR	Unit	EB1701807-016	EB1701807-017	EB1701807-018	EB1701807-019	EB1701807-020
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.4	7.8	8.1	7.6	7.9
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-7.8	-1.2	4.1	14.5	7.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	242	130	173	152	93
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	12.1	6.4	4.2	3.9	0.7
ANC as CaCO3	----	0.1	% CaCO3	1.2	0.6	0.4	0.4	<0.1
Fizz Rating	----	0	Fizz Unit	1	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.14	0.17	0.27	0.60	0.28

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OC3 MCX469 OB	OC3 MCX469 B1-C2 ROOF	OC3 MCX469 B1-C2 WS1	OC3 MCX469 CL-ELW WS2+CMK	OC3 MCX469 ELW FLOOR
			Client sampling date / time	[12-Jan-2017]	[12-Jan-2017]	[12-Jan-2017]	[12-Jan-2017]	[12-Jan-2017]
Compound	CAS Number	LOR	Unit	EB1701807-021	EB1701807-022	EB1701807-023	EB1701807-024	EB1701807-025
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**8.8**	**8.3**	**7.5**	**6.3**	**8.8**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-11.2**	**-1.9**	**-10.7**	**6.6**	**-1.7**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**184**	**102**	**269**	**238**	**224**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**11.2**	**1.9**	**11.9**	**1.3**	**2.6**
ANC as CaCO3	----	0.1	% CaCO3	**1.1**	**0.2**	**1.2**	**0.1**	**0.3**
Fizz Rating	----	0	Fizz Unit	**1**	**0**	**1**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	**0.04**	**0.26**	**0.03**

CERTIFICATE OF ANALYSIS

Work Order	: **EB1704873**	Page	: 1 of 9
Client	: **MOOLARBEN COAL OPERATIONS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Michelle Cavanagh	Contact	: Customer Services EB
Address	: Locked Bag 2003 MUDGEE NSW 2850	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: NAF/PAF Sampling Regime - Exploration	Date Samples Received	: 08-Mar-2017 14:00
Order number	: 4800044227	Date Analysis Commenced	: 21-Mar-2017
C-O-C number	: ----	Issue Date	: 24-Mar-2017 18:11
Sampler	: B. CROWE		
Site	: ----		
Quote number	: BN/456/16 V2		
No. of samples received	: 32		
No. of samples analysed	: 32		

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Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD

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^ = This result is computed from individual analyte detections at or above the level of reporting
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Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Client sample ID	OB4 20-28m	OB5 30-46m	ROOF 46-49m	OB5 28-35m	OB6 35-43m
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1704873-001	EB1704873-002	EB1704873-003	EB1704873-004	EB1704873-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.4	7.9	8.3	7.2	8.3
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.0	-17.4	-47.1	-10.6	-23.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	116	216	191	186	170
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	8.7	19.5	48.3	11.5	23.4
ANC as CaCO3	----	0.1	% CaCO3	0.9	2.0	4.9	1.2	2.4
Fizz Rating	----	0	Fizz Unit	0	1	2	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.12	0.07	0.04	0.03	<0.01

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	ROOF 43-50m	OB1 1-8m	OB2 8-17m	OB3 17-28m	OB4 28-37m
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1704873-006	EB1704873-007	EB1704873-008	EB1704873-009	EB1704873-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.6	4.7	4.5	5.0	6.1
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-11.1	<0.5	<0.5	-4.9	-11.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	150	140	389	153	155
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	12.0	0.8	2.0	5.8	12.5
ANC as CaCO3	----	0.1	% CaCO3	1.2	<0.1	0.2	0.6	1.3
Fizz Rating	----	0	Fizz Unit	1	0	0	0	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.03	0.08	0.03	0.04

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OB5 37-42m	ROOF 42-49m	SILTSTONE INTERBURDEN 26-36m	C1-C2 WS1 36-40m	CONGLOMERATE INTERBURDEN (2) 40-43m
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1704873-011	EB1704873-012	EB1704873-013	EB1704873-014	EB1704873-015
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.3	7.4	8.7	8.9	9.0
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-50.0	-17.6	-15.8	-1.8	-4.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	318	199	181	116	110
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	50.9	18.8	18.2	7.3	6.2
ANC as CaCO3	----	0.1	% CaCO3	5.2	1.9	1.8	0.7	0.6
Fizz Rating	----	0	Fizz Unit	2	1	1	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.04	0.08	0.18	0.06

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Client sample ID	FLOOR 48-49m	OB1 0-3m	B1-B2 WS1 23-25m	ROOF 14-23m	DWS-ELW WS2 43-48m
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1704873-016	EB1704873-017	EB1704873-018	EB1704873-019	EB1704873-020
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.8	5.3	8.5	8.7	8.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.0	-1.2	-6.5	-18.7	1.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	95	122	209	188	108
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.5	1.2	10.5	19.9	7.6
ANC as CaCO3	----	0.1	% CaCO3	0.7	0.1	1.1	2.0	0.8
Fizz Rating	----	0	Fizz Unit	0	0	1	1	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	<0.01	0.13	0.04	0.28

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Client sample ID	CONGLOMERATE INTERBURDEN (1) 25-26m	OB2 3-10m	OB3 10-14m	CL-ELW WS2 17-23m	OB1 0-7m
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1704873-021	EB1704873-022	EB1704873-023	EB1704873-024	EB1704873-025
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.7	7.2	8.6	8.7	8.0
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-15.3	-27.1	-19.0	1.0	-2.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	156	401	152	246	104
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	19.6	28.0	19.9	5.7	2.3
ANC as CaCO3	----	0.1	% CaCO3	2.0	2.9	2.0	0.6	0.2
Fizz Rating	----	0	Fizz Unit	1	1	1	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.14	0.03	0.03	0.22	<0.01

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OB2 7-12m	OB3 12-17m	IRONDALE 17-20m	OB4 23-28m	OB2 14-16m
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]	[04-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1704873-026	EB1704873-027	EB1704873-028	EB1704873-029	EB1704873-030
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**5.3**	**5.8**	**5.5**	**6.4**	**7.2**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-0.8**	**0.00**	**3.7**	**-2.2**	**2.0**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**120**	**154**	**118**	**36**	**119**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**0.8**	**1.7**	**0.9**	**2.2**	**5.6**
ANC as CaCO3	----	0.1	% CaCO3	<0.1	**0.2**	<0.1	**0.2**	**0.6**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	**0.04**	**0.15**	<0.01	**0.25**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OB1 0-13m	OB3 16-23m	----	----	----
			Client sampling date / time	[04-Feb-2017]	[04-Feb-2017]	----	----	----
Compound	CAS Number	LOR	Unit	EB1704873-031	EB1704873-032	--------	--------	--------
				Result	Result	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.8**	**6.2**	----	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-1.2**	**-2.8**	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**262**	**94**	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**1.2**	**4.0**	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	**0.1**	**0.4**	----	----	----
Fizz Rating	----	0	Fizz Unit	**0**	**0**	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	**0.04**	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1703734**	Page	: 1 of 5
Client	: **MOOLARBEN COAL OPERATIONS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Michelle Cavanagh	Contact	: Customer Services EB
Address	: Locked Bag 2003 MUDGEE NSW 2850	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: NAF/PAF Sampling Regime Round 3	Date Samples Received	: 27-Feb-2017 11:20
Order number	: 4800044227	Date Analysis Commenced	: 28-Feb-2017
C-O-C number	: ----	Issue Date	: 07-Mar-2017 12:57
Sampler	: BEAU FERNANCE, M. HICKS		
Site	: ----		
Quote number	: BN/456/16 V2		
No. of samples received	: 13		
No. of samples analysed	: 13		

NATA
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Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD

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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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	WS2 OC2 Strip 10 CHPP Coarse Coal Rejects	WS2 OC2 Strip 10 CHPP Fine Coal Rejects	WS2 OC2 Strip 10 CHPP Ultra Fine Coal Rejects	Underground Coal CHPP Coarse Coal	Underground Coal CHPP Fine Coal
			Client sampling date / time	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00
Compound	CAS Number	LOR	Unit	EB1703734-001	EB1703734-002	EB1703734-003	EB1703734-004	EB1703734-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.1**	**5.4**	**7.8**	**4.3**	**7.4**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**1.0**	**44.5**	**13.6**	**62.3**	**63.1**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**142**	**298**	**296**	**209**	**334**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**4.8**	**4.8**	**4.5**	**6.2**	**7.0**
ANC as CaCO3	----	0.1	% CaCO3	**0.5**	**0.5**	**0.4**	**0.6**	**0.7**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.19**	**1.61**	**0.59**	**2.24**	**2.29**

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Client sample ID	Underground Coal CHPP Ultra Fine Coal	OC4 WS1 Lower Strip 2 CHPP Coarse Coal Rejects	OC4 WS1 Lower Strip 2 CHPP Fine Coal Rejects	OC4 WS1 Lower Strip 2 CHPP Ultra Fine Coal Rejects	OC2 S9 B3 WS2 ROM Coal
			Client sampling date / time	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	17-Feb-2017 00:00
Compound	CAS Number	LOR	Unit	EB1703734-006	EB1703734-007	EB1703734-008	EB1703734-009	EB1703734-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.8	7.0	6.9	8.2	5.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	10.0	2.2	15.4	7.6	12.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	238	36	146	248	30
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.8	4.8	5.4	5.3	1.3
ANC as CaCO3	----	0.1	% CaCO3	0.7	0.5	0.6	0.5	0.1
Fizz Rating	----	0	Fizz Unit	0	0	1	1	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.55	0.23	0.68	0.42	0.44

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OC2 S15 B4 WS1L ROM Coal	OC4 S2 B1 WS1L ROM Coal	OC4 S2 B1 A1 ROM Coal	----	----
			Client sampling date / time	17-Feb-2017 00:00	17-Feb-2017 00:00	17-Feb-2017 00:00	----	----
Compound	CAS Number	LOR	Unit	EB1703734-011	EB1703734-012	EB1703734-013	--------	--------
				Result	Result	Result	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.9	4.7	6.1	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	5.7	5.9	13.8	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	28	71	6	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.9	2.7	0.9	----	----
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.3	<0.1	----	----
Fizz Rating	----	0	Fizz Unit	0	0	0	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.28	0.28	0.48	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1705503**	Page	: 1 of 2
Client	: **MOOLARBEN COAL OPERATIONS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Michelle Cavanagh	Contact	: Customer Services EB
Address	: Locked Bag 2003 MUDGEE NSW 2850	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: NAF/PAF Sampling Regime Round 4	Date Samples Received	: 21-Mar-2017 10:40
Order number	: 4800047761	Date Analysis Commenced	: 22-Mar-2017
C-O-C number	: ----	Issue Date	: 28-Mar-2017 13:58
Sampler	: M. Hicks		
Site	: ----		
Quote number	: BN/456/16 V2		
No. of samples received	: 3		
No. of samples analysed	: 3		

NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Greg Vogel	Laboratory Manager	Brisbane Acid Sulphate Soils, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD

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 insufficient 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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	OC4 WS2 S2 B7 Coarse Coal Rejects	OC4 WS2 S2 B7 Fine Coal Rejects	OC4 WS2 S2 B7 Ultra Fine Coal Rejects	----	----
			Client sampling date / time	[15-Mar-2017]	[15-Mar-2017]	[15-Mar-2017]	----	----
Compound	CAS Number	LOR	Unit	EB1705503-001	EB1705503-002	EB1705503-003	--------	--------
				Result	Result	Result	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**6.4**	**7.0**	**8.3**	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**25.0**	**85.6**	**12.7**	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**56**	**149**	**248**	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**1.3**	**2.5**	**4.1**	----	----
ANC as CaCO3	----	0.1	% CaCO3	**0.1**	**0.2**	**0.4**	----	----
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.86**	**2.88**	**0.55**	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1708062**	Page	: 1 of 14
Amendment	: **1**		
Client	: **MOOLARBEN COAL OPERATIONS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Michelle Cavanagh	Contact	: Customer Services EB
Address	: Locked Bag 2003 MUDGEE NSW 2850	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Further NAF-PAF analysis for Rounds 1-3	Date Samples Received	: 20-Apr-2017 16:02
Order number	: 4800044227	Date Analysis Commenced	: 27-Apr-2017
C-O-C number	: ----	Issue Date	: 05-May-2017 15:06
Sampler	: ----		
Site	: ----		
Quote number	: BN/456/16 V2		
No. of samples received	: 49		
No. of samples analysed	: 45		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

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- Analytical Results

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Signatories

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

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD
Chris Lemaitre	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD

General Comments

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
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Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	OC2 A2 Parting S14 B5 Coal & Tuff from ROM EB1633037001	OC2 WS1L S14 B5 Coal from ROM EB1630337002	OC2 WS2 S14 B6 Coal from ROM EB1630337003	OC2 A1 S14 B5Coal from ROM EB1630337004	UG1 DEVELOPMENT DWS LW0 Coal from ROM1 EB1630337005
			Client sampling date / time	16-Dec-2016 00:00	16-Dec-2016 00:00	16-Dec-2016 00:00	16-Dec-2016 00:00	16-Dec-2016 00:00
Compound	CAS Number	LOR	Unit	EB1708062-001	EB1708062-002	EB1708062-003	EB1708062-004	EB1708062-005
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.132**	**0.014**	**0.012**	**0.008**	**0.017**

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	OC2 S15 B3 IRO1 EB1630337010	OC4 WS2 S1 B16 ROM EB1630337014	OC4 WS2 Parting CMK ROM EB1630337015	OC4 WS1L S1B16 ROM EB1630337016	Coarse coal reject sample WS2 EB1630337019
			Client sampling date / time	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	20-Dec-2016 00:00	14-Dec-2016 00:00
Compound	CAS Number	LOR	Unit	EB1708062-006	EB1708062-007	EB1708062-008	EB1708062-009	EB1708062-012
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.009**	**0.022**	**0.126**	**0.009**	**0.278**

Analytical Results

Sub-Matrix: **PULP**
(Matrix: SOIL)

			Client sample ID	Fine coal reject sample WS2 EB1630337020	Ultra fine coal reject sample OC4 WS2 EB1630337021	"Coarse Coal Reject WS2	"Fine Coal Reject WS2	"Ultra Fine Reject WS2
			Client sampling date / time	15-Dec-2016 00:00	16-Dec-2016 00:00	18-Jan-2017 00:00	18-Jan-2017 00:00	18-Jan-2017 00:00
Compound	CAS Number	LOR	Unit	EB1708062-013	EB1708062-014	EB1708062-015	EB1708062-016	EB1708062-017
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**1.88**	**0.146**	**0.345**	**3.68**	**0.167**

Analytical Results

Sub-Matrix: **PULP**
(Matrix: **SOIL**)

			Client sample ID	OC3 MCX457 CL-ELW WS2 EB1701807007	OC3 MCX473 A1-C2 WS1 + CMK EB1701807011	OC3 MCX473 CL-ELW FLOOR EB1701807012	OC3 MCR463 A1 ROOF EB1701807016	OC3 MCR463 A2 EB1701807017
			Client sampling date / time	06-Jan-2017 00:00	14-Jan-2017 00:00	14-Jan-2017 00:00	10-Jan-2017 00:00	10-Jan-2017 00:00
Compound	CAS Number	LOR	Unit	EB1708062-020	EB1708062-021	EB1708062-022	EB1708062-023	EB1708062-024
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.056**	**0.036**	**0.196**	**0.027**	**0.052**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	**290**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	**40**	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	----	**40**	----	----
Magnesium	7439-95-4	10	mg/kg	----	----	**40**	----	----
Sodium	7440-23-5	10	mg/kg	----	----	**50**	----	----
Potassium	7440-09-7	10	mg/kg	----	----	**40**	----	----
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	----	----
Barium	7440-39-3	1	mg/kg	----	----	<1	----	----
Beryllium	7440-41-7	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	----	----	**1.0**	----	----
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	----	----
Zinc	7440-66-6	0.1	mg/kg	----	----	<0.1	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	**1680**	----	----
Antimony	7440-36-0	5	mg/kg	----	----	<5	----	----
Arsenic	7440-38-2	5	mg/kg	----	----	**5**	----	----

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	OC3 MCX457 CL-ELW WS2 EB1701807007	OC3 MCX473 A1-C2 WS1 + CMK EB1701807011	OC3 MCX473 CL-ELW FLOOR EB1701807012	OC3 MCR463 A1 ROOF EB1701807016	OC3 MCR463 A2 EB1701807017
			Client sampling date / time	06-Jan-2017 00:00	14-Jan-2017 00:00	14-Jan-2017 00:00	10-Jan-2017 00:00	10-Jan-2017 00:00
Compound	CAS Number	LOR	Unit	EB1708062-020	EB1708062-021	EB1708062-022	EB1708062-023	EB1708062-024
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Barium	7440-39-3	10	mg/kg	----	----	**30**	----	----
Beryllium	7440-41-7	1	mg/kg	----	----	**4**	----	----
Boron	7440-42-8	50	mg/kg	----	----	<50	----	----
Cadmium	7440-43-9	1	mg/kg	----	----	<1	----	----
Chromium	7440-47-3	2	mg/kg	----	----	**4**	----	----
Cobalt	7440-48-4	2	mg/kg	----	----	**2**	----	----
Copper	7440-50-8	5	mg/kg	----	----	**12**	----	----
Iron	7439-89-6	50	mg/kg	----	----	**5710**	----	----
Lead	7439-92-1	5	mg/kg	----	----	**21**	----	----
Manganese	7439-96-5	5	mg/kg	----	----	**94**	----	----
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	----	----
Nickel	7440-02-0	2	mg/kg	----	----	**6**	----	----
Selenium	7782-49-2	5	mg/kg	----	----	<5	----	----
Vanadium	7440-62-2	5	mg/kg	----	----	**7**	----	----
Zinc	7440-66-6	5	mg/kg	----	----	**34**	----	----
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	----	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	----	----	**2**	----	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	----	----	**100**	----	----

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	OC3 MCR463 B1-C2 WS1+CMK EB1701807018	OC3 MCR463 CL-ELW WS2 EB1701807019	OC3 MCR463 ELW FLOOR EB1701807020	OC3 MCX469 CL-ELW WS2+CMK EB1701807024	WS2 OC2 Strip 10 CHPP Coarse Coal Rejects EB1703734001
			Client sampling date / time	10-Jan-2017 00:00	10-Jan-2017 00:00	10-Jan-2017 00:00	12-Jan-2017 00:00	20-Feb-2017 00:00
Compound	CAS Number	LOR	Unit	EB1708062-025	EB1708062-026	EB1708062-027	EB1708062-028	EB1708062-029
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.025**	**0.222**	**0.177**	**0.020**	**0.086**

Analytical Results

Sub-Matrix: **PULP**
(Matrix: **SOIL)**

			Client sample ID	WS2 OC2 Strip 10 CHPP Fine Coal Rejects EB1703734002	WS2 OC2 Strip 10 CHPP Ultra Fine Coal Rejects EB1703734003	Underground Coal CHPP Coarse Coal EB1703734004	Underground Coal CHPP Fine Coal EB1703734005	Underground Coal CHPP Ultra Fine Coal EB1703734006
			Client sampling date / time	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00
Compound	CAS Number	LOR	Unit	EB1708062-030	EB1708062-031	EB1708062-032	EB1708062-033	EB1708062-034
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**1.36**	**0.239**	**1.74**	**1.71**	**0.170**

Analytical Results

Sub-Matrix: **PULP** (Matrix: **SOIL**)			Client sample ID	**OC4 WS1 Lower Strip 2 CHPP Coarse Coal Rejects EB1703734007**	**OC4 WS1 Lower Strip 2 CHPP Fine Coal Rejects EB1703734008**	**OC4 WS1 Lower Strip 2 CHPP Ultra Fine Coal Rejects EB1703734009**	**OC2 S9 B3 WS2 ROM Coal EB1703734010**	**OC2 S15 B4 WS1L ROM Coal EB1703734011**
			Client sampling date / time	20-Feb-2017 00:00	20-Feb-2017 00:00	20-Feb-2017 00:00	17-Feb-2017 00:00	17-Feb-2017 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**EB1708062-035**	**EB1708062-036**	**EB1708062-037**	**EB1708062-038**	**EB1708062-039**
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.092**	**0.392**	**0.113**	**0.085**	**0.015**

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	OC4 S2 B1 WS1L ROM Coal EB1703734012	OC4 S2 B1 A1 ROM Coal EB1703734013	Composite 1 Composite of 2-5	Composite 2 Composite of 10 & 11	Composite 3 Composite of 12-14
			Client sampling date / time	17-Feb-2017 00:00	17-Feb-2017 00:00	[16-Dec-2016]	[20-Dec-2016]	[16-Dec-2016]
Compound	CAS Number	LOR	Unit	EB1708062-040	EB1708062-041	EB1708062-042	EB1708062-043	EB1708062-044
				Result	Result	Result	Result	Result
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.015**	**0.014**	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	**60**	**70**	**950**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	**20**	**20**	**40**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	----	<10	<10	**350**
Magnesium	7439-95-4	10	mg/kg	----	----	<10	<10	**80**
Sodium	7440-23-5	10	mg/kg	----	----	**20**	**30**	**60**
Potassium	7440-09-7	10	mg/kg	----	----	**20**	**20**	**20**
EG005S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	----	----	<1	<1	<1
Antimony	7440-36-0	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Barium	7440-39-3	1	mg/kg	----	----	<1	<1	<1
Beryllium	7440-41-7	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Boron	7440-42-8	1	mg/kg	----	----	<1	<1	<1
Cadmium	7440-43-9	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Chromium	7440-47-3	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Iron	7439-89-6	1	mg/kg	----	----	<1	<1	<1
Lead	7439-92-1	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/kg	----	----	<0.1	<0.1	**0.1**
Molybdenum	7439-98-7	0.1	mg/kg	----	----	<0.1	<0.1	**0.2**
Nickel	7440-02-0	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Vanadium	7440-62-2	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/kg	----	----	**0.2**	<0.1	<0.1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	**810**	**2630**	**2200**
Antimony	7440-36-0	5	mg/kg	----	----	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	----	----	<5	**13**	<5

Analytical Results

Sub-Matrix: **PULP**
(Matrix: **SOIL**)

Client sample ID				OC4 S2 B1 WS1L ROM Coal EB1703734012	OC4 S2 B1 A1 ROM Coal EB1703734013	Composite 1 Composite of 2-5	Composite 2 Composite of 10 & 11	Composite 3 Composite of 12-14
Client sampling date / time				17-Feb-2017 00:00	17-Feb-2017 00:00	[16-Dec-2016]	[20-Dec-2016]	[16-Dec-2016]
Compound	CAS Number	LOR	Unit	EB1708062-040	EB1708062-041	EB1708062-042	EB1708062-043	EB1708062-044
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Barium	7440-39-3	10	mg/kg	----	----	<10	**10**	**130**
Beryllium	7440-41-7	1	mg/kg	----	----	**3**	<1	**1**
Boron	7440-42-8	50	mg/kg	----	----	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	----	----	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	----	----	**6**	**63**	**8**
Cobalt	7440-48-4	2	mg/kg	----	----	<2	**4**	<2
Copper	7440-50-8	5	mg/kg	----	----	**11**	**10**	**14**
Iron	7439-89-6	50	mg/kg	----	----	**370**	**23700**	**10600**
Lead	7439-92-1	5	mg/kg	----	----	**8**	**6**	**36**
Manganese	7439-96-5	5	mg/kg	----	----	<5	**83**	**7**
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	----	----	**2**	**9**	**6**
Selenium	7782-49-2	5	mg/kg	----	----	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	----	----	**7**	**12**	**7**
Zinc	7440-66-6	5	mg/kg	----	----	**15**	**24**	**66**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	----	----	<0.0005	<0.0005	<0.0005
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	----	<0.1	<0.1	**0.2**
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	----	----	<1	**2**	**4**
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	----	----	**50**	**120**	**90**

Analytical Results

Sub-Matrix: **PULP** (Matrix: **SOIL**)			Client sample ID	Composite 4 Composite of 15-17	Composite 5 Composite of 18 & 19	Composite 6 Composite of 24 & 25	Composite 7 Composite of 29-31	Composite 8 Composite of 35-37
			Client sampling date / time	18-Jan-2017 00:00	06-Jan-2017 00:00	10-Jan-2017 00:00	[20-Feb-2017]	[20-Feb-2017]
Compound	CAS Number	LOR	Unit	EB1708062-045	EB1708062-046	EB1708062-047	EB1708062-048	EB1708062-049
				Result	Result	Result	Result	Result
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**1740**	**200**	**80**	**980**	**260**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**40**	**250**	**50**	**110**	**20**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	**570**	<10	**20**	**210**	**70**
Magnesium	7439-95-4	10	mg/kg	**100**	<10	**20**	**90**	**30**
Sodium	7440-23-5	10	mg/kg	**50**	**270**	**60**	**140**	**40**
Potassium	7440-09-7	10	mg/kg	**40**	**30**	**50**	**50**	**30**
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	<0.1	**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
Barium	7440-39-3	1	mg/kg	<1	<1	<1	<1	<1
Beryllium	7440-41-7	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	**0.4**	<0.1	<0.1	**0.5**	<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	**3.1**	<0.1	<0.1	**1.9**	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	**0.2**	<0.1	**0.2**	**0.3**	<0.1
Nickel	7440-02-0	0.1	mg/kg	**0.9**	<0.1	<0.1	**0.9**	<0.1
Selenium	7782-49-2	0.1	mg/kg	**0.1**	<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
Zinc	7440-66-6	0.1	mg/kg	**0.6**	<0.1	<0.1	**0.2**	<0.1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**3080**	**4420**	**2100**	**3770**	**2600**
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	**16**	<5	<5	**14**	**6**
Barium	7440-39-3	10	mg/kg	<10	**40**	**20**	**30**	**130**
Beryllium	7440-41-7	1	mg/kg	**3**	<1	**2**	**3**	**1**
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50

Analytical Results

Sub-Matrix: **PULP** (Matrix: **SOIL**)			Client sample ID	**Composite 4 Composite of 15-17**	**Composite 5 Composite of 18 & 19**	**Composite 6 Composite of 24 & 25**	**Composite 7 Composite of 29-31**	**Composite 8 Composite of 35-37**
			Client sampling date / time	18-Jan-2017 00:00	06-Jan-2017 00:00	10-Jan-2017 00:00	[20-Feb-2017]	[20-Feb-2017]
Compound	CAS Number	LOR	Unit	**EB1708062-045**	**EB1708062-046**	**EB1708062-047**	**EB1708062-048**	**EB1708062-049**
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**7**	**59**	**7**	**6**	**8**
Cobalt	7440-48-4	2	mg/kg	**5**	**4**	<2	**40**	**4**
Copper	7440-50-8	5	mg/kg	**22**	**11**	**14**	**17**	**9**
Iron	7439-89-6	50	mg/kg	**14500**	**12400**	**11500**	**8060**	**20600**
Lead	7439-92-1	5	mg/kg	**34**	**25**	**25**	**39**	**23**
Manganese	7439-96-5	5	mg/kg	**18**	**49**	**178**	**64**	**364**
Molybdenum	7439-98-7	2	mg/kg	**7**	<2	<2	**5**	<2
Nickel	7440-02-0	2	mg/kg	**14**	**12**	**5**	**135**	**19**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**7**	**6**	**8**	**12**	**8**
Zinc	7440-66-6	5	mg/kg	**78**	**17**	**50**	**254**	**56**
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	**0.2**	**0.1**
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**3**	**5**	**5**	**2**	**3**
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**170**	**500**	**130**	**130**	**140**

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