Mt Arthur Coal

bhpbilliton

resourcing the future

Appendix I – Geochemistry Assessment of Overburden and Interburden

Mt Arthur Coal Open Cut Modification

Geochemistry Assessment of Overburden and Interburden

December 2012

Prepared For:

Hunter Valley Energy Coal Pty Ltd
Thomas Mitchell Drive, Muswellbrook, NSW 2333 Australia

Prepared By:

Geo-Environmental Management Pty Ltd
PO Box 6293 O'Connor ACT 2602 Australia
ABN 21 486 702 686

Table of Contents

Page

1.0 Introduction 1
- 1.1 Background...1
- 1.2 Study Objectives..3

2.0 Deposit Stratigraphy 5

3.0 Previous Geochemical Investigations 7

4.0 Geochemical Assessment Program..10
- 4.1 Testing Methodology and Program 10
- 4.2 Geochemical Classification 13
- 4.3 Sample Selection and Preparation 14

5.0 Overburden and Interburden Geochemistry..17
- 5.1 pH, Salinity and Sodicity..18
- 5.2 Acid Forming Characteristics..19
- 5.3 Metal Enrichment and Solubility...22

6.0 Confirmation Testing of Approved Open Cut Area 24

7.0 Conclusions and Recommendations 25
- 7.1 Overburden and Interburden...25
- 7.2 Coal Rejects...27

8.0 References 28

ATTACHMENT A: Drill-Hole Logs and Sample Interval Detail
ATTACHMENT B: Geochemical Test Results

Table of Contents (Continued)

Tables

Page

1: Sample types and quantities according to the predominant lithology for the Mt Arthur Coal Open Cut Modification drill-hole sampling program. 16

2: Summary of the pH, EC and acid-base characteristics of the different overburden and interburden material types from the Mt Arthur Coal Open Cut Modification 17

3: Stratigraphic distribution of the identified PAF and PAF/LC samples from the Mt Arthur Coal Open Cut Modification 22

4: Concentration ranges and average crustal abundances for enriched elements in selected overburden and interburden samples from the Mt Arthur Coal Open Cut Modification..........................22

5: Concentration ranges and the ANZECC (2000) Irrigation Water Quality Guideline values for readily soluble elements in the overburden and interburden samples from the Mt Arthur Coal Open Cut Modification..........................23

Figures

Page

1: Regional Location..........................2

2: Mt Arthur Coal Open Cut Modification 4

3: Stratigraphic Column for the Hunter Coalfield 6

4: Aerial Photograph of Mt Arthur Coal Mine Open Cut Modification and Drill Hole Locations. 15

5: Salinity and Sodicity Ranking for Selected Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification 18

6: Total Sulfur Content Plotted against the Sulfide Sulfur Content for Selected Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification 19

7: Acid-base Account Plot for the Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification 20

8: Geochemical Classification Plot for Selected Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification 21

1.0 Introduction

Geo-Environmental Management Pty Ltd (GEM) was commissioned by Hunter Valley Energy Coal (HVEC) to carry out an environmental geochemistry assessment for the Mt Arthur Coal Open Cut Modification (referred to herein as the Modification). The Mt Arthur Coal Mine is located in the Hunter Valley region of New South Wales and uses open cut mining methods to extract thermal coal for the domestic and export markets. HVEC is applying for a modification to its approval in order to facilitate an extension to the currently approved open cut mining operation. It is understood that HVEC is preparing an Environmental Assessment (EA) for the Modification, and that this environmental geochemistry assessment would be included as an appendix to the Main Report of the EA.

This report presents the results and findings of the geochemical assessment and the identified geochemical implications for the Modification, and provides recommendations for environmental management and any additional or future geochemical testing that may be required for the Modification.

1.1 Background

The Mt Arthur Coal Mine, as shown in Figure 1, is located approximately 5 kilometres south-west of the township of Muswellbrook in the Upper Hunter Valley of New South Wales. The open cut mining operations utilise conventional open pit mining methods involving drill and blast, truck and shovel extraction and on-site coal processing. The tailings are currently disposed within a dedicated facility within the Drayton sub-lease area, while coarse rejects are disposed within overburden emplacement areas. The overburden and interburden are disposed within surface (out-of-pit) overburden emplacements and mined-out sections of the open pit.

The Modification would include the following key components:

- a four year continuation of the open cut mine life from 2022 to 2026 at the currently approved rate of 32 million tonnes per annum;
- an increase in currently approved open cut disturbance areas;
- use of the conveyor corridor for overburden emplacement;
- duplication of the existing rail loop;
- an increase in the maximum number of train movements per day from 24 to 38;
- the relocation of the load point for the overland conveyor which delivers coal to Macquarie Generation's Bayswater Power Station;
- the relocation and upgrade of the explosives storage, magazine and associated facilities; and
- the construction of additional offices and a control room and a small extension to the run-of-mine coal stockpile footprint.

FIGURE 1
Regional Location

HVE-11-01 OCM EA_App Geochem_001B

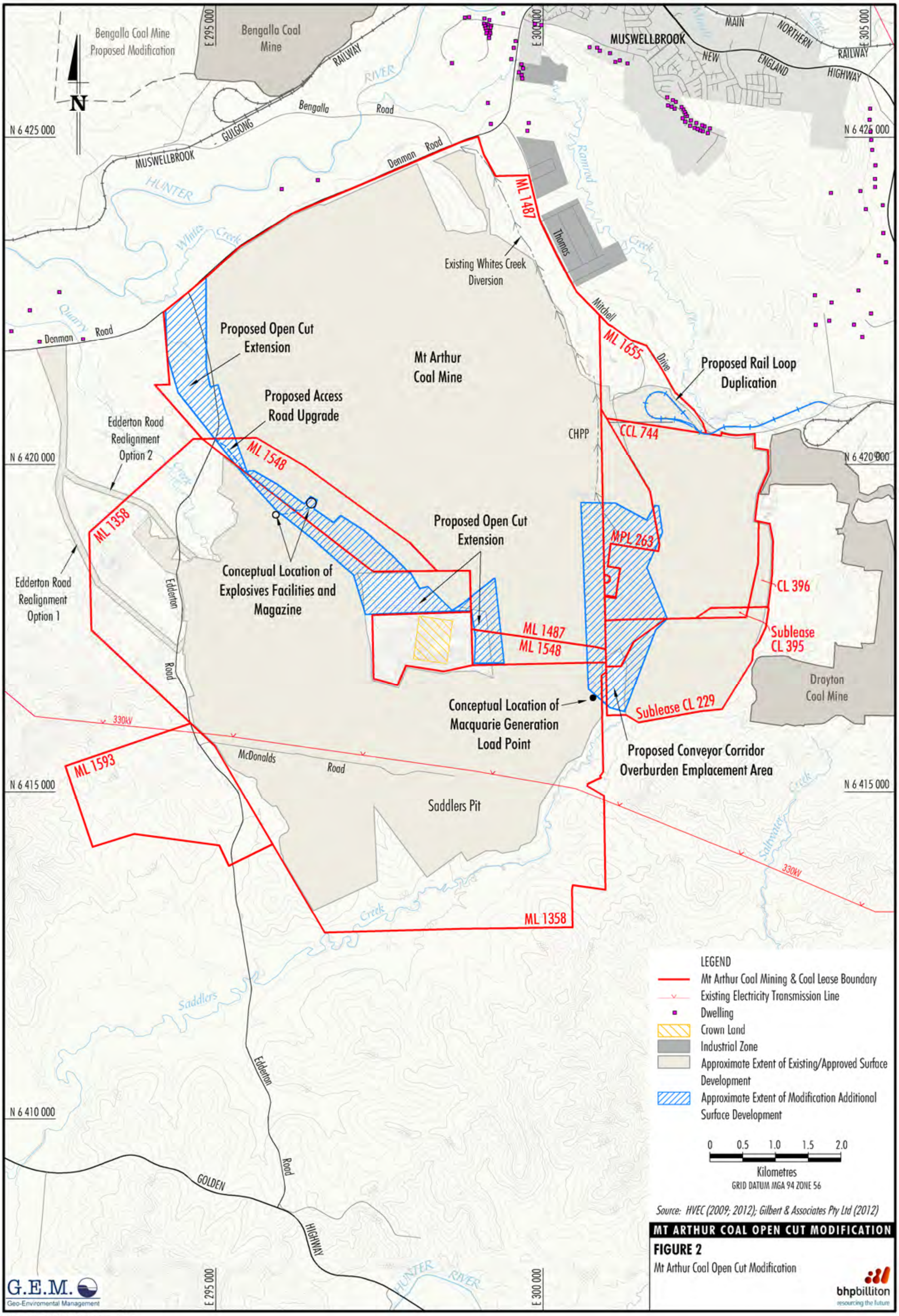
Figure 2 shows the general arrangement of the open cut mine and the changes that would be required for the proposed Modification.

Existing open cut mining areas are authorised by Project Approval 09_0062. This approval was supported by an EA *Mt Arthur Coal Consolidation Project* (HVEC, 2009). Previously, environmental geochemistry investigations were conducted as part of the *Mt Arthur North Environmental Impact Statement* (EIS) (Coal Operations Australia Limited, 2000).

1.2 Study Objectives

The objectives of this study include:

1. Review of the previous environmental geochemistry investigations presented in the Mt Arthur North EIS.
2. Review of the available geological mapping and drill-hole logs for the proposed pit extension areas.
3. Selection of samples to be taken from the available drill-core that are representative of the main rock units to be mined as overburden or interburden from the proposed additional pit area, and selection of samples of the coal rejects (coarse rejects and tailings) representative of the disposed reject materials.
4. Selection of test work parameters and suitable analytical laboratory to be used to assess the acid forming potential, salinity and sodicity, and metal enrichment and solubility of the samples selected in item 3 above.
5. Provision of instructions to HVEC to enable its on-site personnel to collect the required core samples, bag and dispatch them to the laboratory.
6. Management of the testing of the samples for the required parameters identified in item 4.
7. Receipt and interpretation of the results of the test work.
8. Preparation of a geochemistry assessment report which summarises the results of the previous test work (item 1), and describes in detail the current sampling and test work procedures (items 2 to 7). Using this information, the report is to evaluate and discuss the acid forming potential, salinity and sodicity, and metal enrichment and solubility of the overburden and interburden to be mined from the proposed additional pit area and the area immediately to the east of this area, and the coal rejects that would be produced.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 2

Mt Arthur Coal Open Cut Modification

HVE-11-01_OCM EA_App Geochem_1028

2.0 Deposit Stratigraphy

The Hunter Coalfield is situated in the northern portion of the Sydney Basin. This basin consists of coal bearing rocks of Permian age that were deposited during periods of marine transgression and regression. The depositional setting included periods of marine and terrestrial (alluvial and deltaic) sediment deposition. Coal formation occurred in back swamp areas of this environment. Major periods of coal formation in the Hunter Coalfield area are represented by the Greta Coal Measures, Wittingham Coal Measures and Wollombi Coal Measures (Beckett, 1988).

Multiple coal seams from the Wittingham Coal Measures are mined at the Mt Arthur Coal Mine. The Wittingham Coal Measures have a maximum thickness of approximately 600 metres (m) within the Modification area and contain in excess of 20 coal seams. A simplified stratigraphic column of the Wittingham Coal Measures is shown on Figure 3. The major coal bearing subgroups are the Vane Subgroup and the overlying Jerry's Plain Subgroup. The Vane Subgroup consists of the coal bearing Foybrook Formation, which contains up to six mineable coal seams, and the overlying Bulga Formation, which consists of laminated siltstone and fine-grained sandstone. The Bulga Formation is characterised by abundant animal burrows and pyrite grains and lenses consistent with shallow marine deposition (Beckett, 1988).

The Bulga Formation is overlain by the Archerfield Sandstone, which is used as the marker bed separating the Vane Subgroup from the Jerry's Plain Subgroup. The Archerfield Sandstone is a massive sandstone unit (15 to 20 m thick) that forms the floor of the Bayswater Seam. The Bayswater Seam forms the basal unit of the Jerry's Plain Subgroup and was formed in a back swamp environment (Beckett, 1988). The Jerry's Plain Subgroup consists of five coal bearing formations and three non-coal bearing claystone formations, and comprises 11 mineable coal seams within the Modification area.

The extension area is situated on the western limb of the north-northwest oriented Muswellbrook Anticline with the coal seams generally dipping to the west-southwest. Additionally, a series of large scale east-west striking normal faults causing displacements of up to 120 m occur within the Modification area. The Glen Munro and Woodlands Hill seams subcrop in the south with the Arrowfield and Bowfield seams form lower in the sequence subcropping in the north of the extension area.

There are a number of igneous intrusions in the form of dykes and sills within the area. These intrusions are thought to be mostly doleritic in composition and vary significantly in both character and degree of alteration.

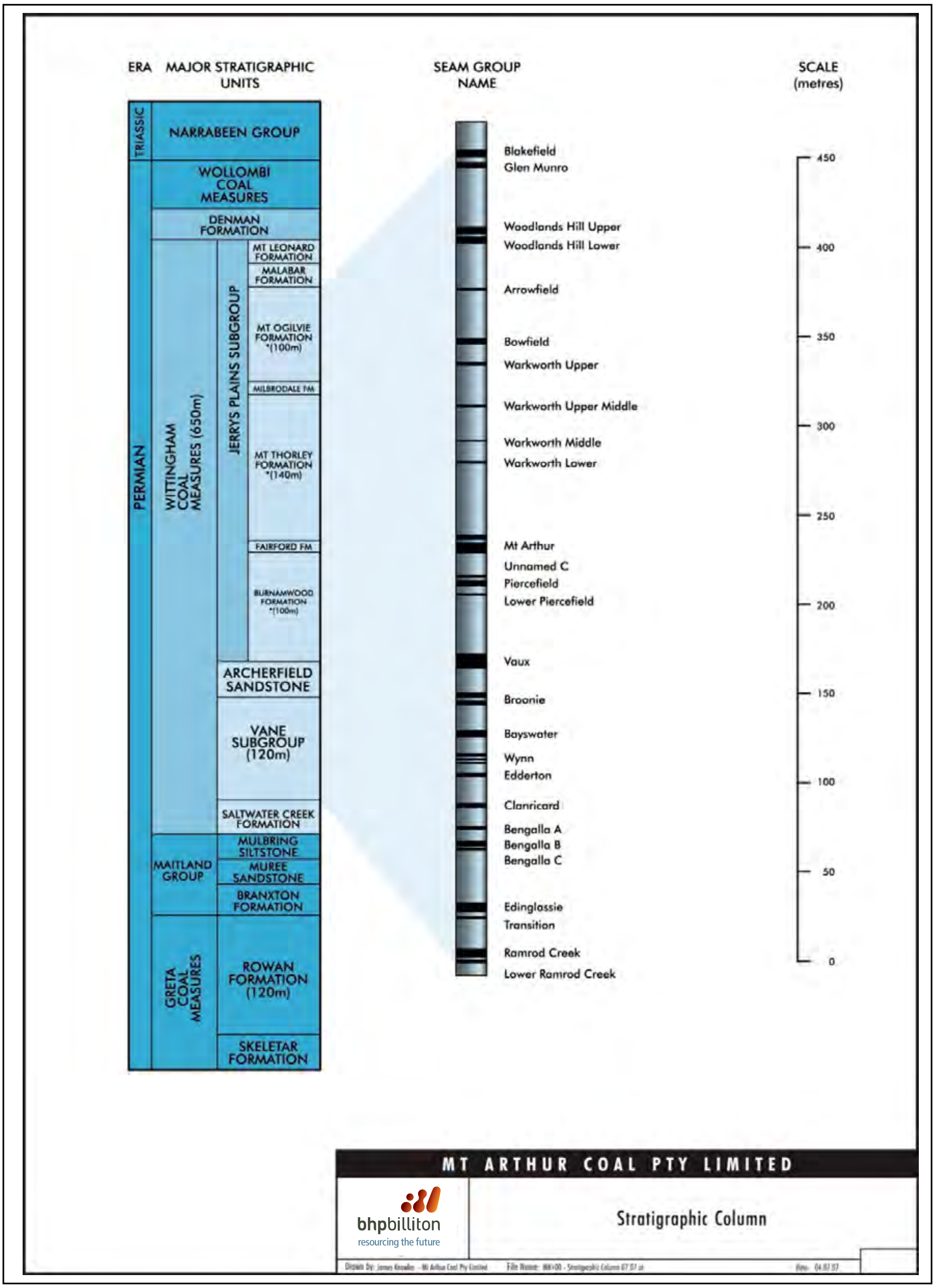


Figure 3: Stratigraphic Column for the Hunter Coalfield.

3.0 Previous Geochemical Investigations

A geochemical characterisation assessment of overburden and coal reject materials was conducted by Dames and Moore in April 2000 for the Mt Arthur North EIS. The presented results indicate that the overburden and interburden is generally expected to have a low sulfur content and to be non-acid forming (NAF). However, a relatively small proportion of the strata occurring immediately adjacent to the coal seams (roof and floor rock) has a risk of containing increased sulfur and this material has a risk of being potentially acid forming (PAF). Additionally, a number of bulk coal reject samples were characterised for this assessment (i.e. coarse reject and tailings samples were not available) and the results indicate that the rejects have a relatively high sulfur content and these materials are typically expected to be PAF with the rejects from some seams being highly reactive (i.e. expected short geochemical lag period) (Dames and Moore, 2000).

This assessment program included a total of 99 drill-hole samples representing the overburden and interburden from the proposed open cut pit area, and 10 bulk samples representing the coal rejects from individual coal seams. All of these samples were submitted for static acid-base accounting, and selected samples were submitted for salinity and sodicity assessment, net acid generation (NAG) testing and multi-element analysis of the solids and water extracts.

The sulfur content of the overburden and interburden samples was generally relatively low with a number of high sulfur samples. The total sulfur (total S) contents for these samples ranged from 0.02 to 5.42 percent sulfur (%S), with only six of the samples (6%) having a total S content > 1%S. Similarly, the acid neutralising capacity (ANC) of these samples was generally relatively low with a number of relatively high ANC samples. The ANC values of these samples ranged from zero to 240 kilograms (kg) of sulfuric acid per tonne of material (kg H_2SO_4/t) with only 32 of the samples (32%) having an ANC > 10 kg H_2SO_4/t and only two of the samples (2%) having an ANC > 100 kg H_2SO_4/t. The resulting net acid producing potential (NAPP) values for these samples range from minus 225 to 160 kg H_2SO_4/t with 35 of the samples (35%) being NAPP positive indicating an excess in acid generation over acid neutralising potential. The NAG test results indicated that the majority of the NAPP positive samples had NAGpH (pH of NAG liquor) values < 4.5 confirming that the materials represented by these samples are classified as PAF.

These results indicate that the majority of the overburden and interburden samples have relatively low sulfur and ANC and are relatively barren in terms of acid generation and neutralisation. However, some samples have relatively high sulfur contents with low ANC and are classified as PAF and some samples have relatively high ANC with low sulfur and are expected to be acid consuming. These results indicate that, due to the relatively low ANC of these materials, the overburden and interburden with a total S content as low as 0.1%S has a risk of being PAF.

The electrical conductivity (EC) was determined using 1:5 water extracts (i.e. one part sample to five parts deionised water) for 39 selected overburden and interburden samples. The $EC_{1:5}$ values ranged from 0.13 to 1.66 deciSiemens per metre (dS/m) with 17 samples (44%) classified as non-saline, seven samples (18%) classified as slightly saline, six samples (15%) classified as moderately saline and nine samples (23%) classified as highly saline, according to the salinity ranking provided below:

$EC_{1:5}$ (dS/m)	Salinity
< 0.2	Non-Saline
0.2 to 0.3	Slightly Saline
0.3 to 0.4	Moderately Saline
> 0.4	Highly Saline

The exchangeable sodium percent (ESP) was determined for eight of the overburden and interburden samples and the values ranged from 3 to 35%. One sample (12.5%) was classified as non-sodic, three samples (37.5%) were classified as slightly sodic, three samples (37.5%) were classified as moderately sodic and one sample (12.5%) was classified as highly sodic, according to the sodicity ranking provided below:

ESP	Sodicity	Dispersion
< 6	Non-Sodic	Not Dispersive
6 to 15	Slightly Sodic	Slightly Dispersive
15 to 30	Moderately Sodic	Moderately Dispersive
> 30	Highly Sodic	Highly Dispersive

Based on these test results it was concluded that some of the overburden and interburden materials may be saline and/or sodic and would need to be managed accordingly. Although it was found that the majority of the overburden and interburden was NAF, some of the materials associated with the coal seams (partings, and roof and floor rock) has a risk of being PAF, and it was recommended that all of these materials be selectively handled and buried with the overburden emplacement areas in order to reduce the risk of developing acid conditions.

The total S content of the coal reject samples was relatively high, ranging from 0.33 to 3.37%S and the ANC values relatively low ranging from 1 to 43 kg H_2SO_4/t. The resulting NAPP values range from minus 3 to 99 kg H_2SO_4/t with only two samples being NAPP negative, indicating an excess in acid buffering over acid potential, and the remaining eight samples being NAPP positive, indicating an excess in acid potential over acid buffering. These samples were not subjected to NAG testing in order to confirm the geochemical classification, however, due to the relatively high sulfur content and high NAPP values, it is expected that the majority of these samples are PAF.

The results presented for the multi-element scans indicate that the overburden and interburden materials are likely to be significantly enriched with arsenic (As), antimony (Sb), selenium (Se) and boron and the coal rejects are likely to be significantly enriched with As, Sb and Se. These results also indicate that some of the coal reject materials from the different coal seams may be significantly enriched with mercury (Hg).

4.0 Geochemical Assessment Program

4.1 Testing Methodology and Program

The laboratory program for this assessment included the following tests and procedures:

- pH and EC determination (all samples);
- acid-base analysis (total S, ANC, NAPP) (all samples);
- exchangeable cation analysis (selected samples);
- sulfide sulfur analysis (selected samples);
- single addition NAG testing (selected samples); and
- multi-element scans on solids and water extracts (selected samples).

The pH and EC determinations, and deionised water extracts for multi-element analyses were conducted in-house. The sample preparation, exchangeable cation analysis, acid-base analysis, and NAG testing were performed by Australian Laboratory Services Pty Ltd in Brisbane and the multi-element analyses on solids and water extracts were performed by Genalysis Laboratories in Perth.

An overview of the test procedures used for this program is presented below.

pH and EC Determination

The pH and EC of a sample is determined by equilibrating the sample in deionised water for a minimum of 2 hours at a solid to water ratio of 1:2 weight by weight. This gives an indication of the inherent acidity and salinity of the material when it is initially exposed. The general salinity ranking based on $EC_{1:2}$ is provided below:

$EC_{1:2}$ (dS/m)	Salinity
< 0.5	Non-Saline
0.5 to 1.5	Slightly Saline
1.5 to 2.5	Moderately Saline
> 2.5	Highly Saline

Exchangeable Cation Analysis

Exchangeable cation analyses are carried out to determine the sodicity of a sample. Sodicity occurs in materials that have high concentrations of exchangeable sodium relative to the other major cations (i.e. Calcium and Magnesium [Mg]), causing the material to be highly dispersive. The ESP is used to determine the sodicity of a sample by comparing the amount of exchangeable sodium to calcium and Mg concentrations. The ESP is used to rank materials according to sodicity and likely dispersion characteristics as shown below:

ESP	Sodicity	Dispersion
< 6	Non-Sodic	Not Dispersive
6 to 15	Slightly Sodic	Slightly Dispersive
15 to 30	Moderately Sodic	Moderately Dispersive
> 30	Highly Sodic	Highly Dispersive

Acid Forming Characteristic Evaluation

A number of test procedures are used to assess the acid forming characteristics of mine waste materials. The most widely used assessment methods are the acid-base account and the NAG test. These methods are referred to as static procedures because each involves a single measurement in time.

<u>Acid-Base Account</u>

The acid-base account involves laboratory procedures that evaluate the balance between acid generation processes (oxidation of sulfide minerals) and acid neutralising processes (dissolution of alkaline carbonates, displacement of exchangeable bases, and weathering of silicates). The values arising from the acid-base account are referred to as the maximum potential acidity (MPA) and the ANC, respectively. The difference between the MPA and ANC value is referred to as the NAPP.

The MPA is calculated using the total S content of the sample. This calculation assumes that all of the sulfur measured in the sample occurs as pyrite (FeS_2) and that the pyrite reacts under oxidising conditions to generate acid according to the following reaction:

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

According to this reaction, the MPA of a sample containing 1%S as pyrite would be 30.6 kg H_2SO_4/t. Hence the MPA of a sample is calculated from the total S content using the following formula:

$$MPA\ (kg\ H_2SO_4/t) = (Total\ \%S) \times 30.6$$

The use of the total S assay to estimate the MPA is a conservative approach because some sulfur may occur in forms other than pyrite. Sulfate-sulfur and native sulfur, for example, are non-acid generating sulfur forms. Also, some sulfur may occur as other metal sulfides (e.g. covellite, chalcocite, sphalerite, galena) that yield less acidity than pyrite when oxidised.

The acid formed from pyrite oxidation would, to some extent, react with acid neutralising minerals contained within the sample. This inherent acid neutralisation is quantified in terms of the ANC and is commonly determined using the Modified Sobek method. This method involves the addition of a known amount of standardised hydrochloric acid to an accurately weighed sample, allowing the sample time to react (with heating), then back titrating the mixture with standardised sodium hydroxide to determine the amount of unreacted hydrochloric acid. The amount of acid consumed by reaction with the sample is then calculated and expressed in the same units as the MPA (kg H_2SO_4/t).

The NAPP is a theoretical calculation commonly used to indicate if a material has the potential to produce acid. It represents the balance between the capacity of a sample to generate acid (MPA) and its capacity to neutralise acid (ANC). The NAPP is also expressed in units of kg H_2SO_4/t and is calculated as follows:

$$NAPP = MPA - ANC$$

If the MPA is less than the ANC then the NAPP is negative, which indicates that the sample may have sufficient ANC to prevent acid generation. Conversely, if the MPA exceeds the ANC then the NAPP is positive, which indicates that the material may be acid generating.

The ANC/MPA ratio is used as a means of assessing the risk of acid generation from mine waste materials. A positive NAPP is equivalent to an ANC/MPA ratio < 1, and a negative NAPP is equivalent to an ANC/MPA ratio > 1. Generally, an ANC/MPA ratio of 3 or more signifies that there is a high probability that the material is not acid generating.

<u>Net Acid Generation Test</u>

The NAG test is used in association with the NAPP to classify the acid generating potential of a sample. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulfide minerals contained within a sample. During the NAG test both acid generation and acid neutralisation reactions can occur simultaneously. Therefore, the end result represents a direct measurement of the net amount of acid generated by the sample. This value is commonly referred to as the NAG capacity and is expressed in the same units as NAPP, which is kg H_2SO_4/t.

The standard NAG test involves the addition of 250 millilitres of 15% hydrogen peroxide to 2.5 grams of sample. The peroxide is allowed to react with the sample overnight and the following day the sample is gently heated to accelerate the oxidation of any remaining sulfides, then vigorously boiled for several minutes to decompose residual peroxide. When cool, the pH and acidity of the NAG liquor are measured. The acidity of the liquor is then used to estimate the net amount of acidity produced per unit weight of sample.

Metal Enrichment and Solubility

Multi-element scans are carried out to identify any elements that are present in a material at concentrations that may be of environmental concern with respect to water quality and revegetation. The assay results from the solid samples are compared to the average crustal abundance for each element to provide a measure of the extent of element enrichment. The extent of enrichment is reported as the Geochemical Abundance Index (GAI). However, identified element enrichment does not necessarily mean that an element would be a concern for revegetation, water quality, or public health and this technique is used to identify any significant element enrichments that warrant further examination.

Multi-element scans are also performed on water extracts from the solid samples (1:2 sample/deionised water) to determine the immediate element solubilities under the existing sample pH conditions of the sample. However, common environmentally important elements that are not identified as significantly enriched or immediately soluble may still present an environmental risk under low pH conditions and where acid forming materials are identified, additional (kinetic) testing is required to develop an understanding of the geochemical behaviour of these materials.

4.2 Geochemical Classification

The acid forming potential of a sample is classified on the basis of the acid-base account and NAG test results into one of the following categories:

- barren;
- NAF;
- PAF;
- acid forming; and
- uncertain.

Barren
A sample classified as barren essentially has no acid generating capacity and no acid buffering capacity. This category is most likely to apply to highly weathered materials. In essence, it represents an 'inert' material with respect to acid generation. The criteria used to classify a sample as barren may vary between sites, but it generally applies to materials with a total S content ≤ 0.1%S and an ANC ≤ 5 kg H_2SO_4/t.

Non-Acid Forming
A sample classified as NAF may, or may not, have a significant sulfur content but the availability of ANC within the sample is more than adequate to neutralise all the acid that theoretically could be produced by any contained sulfide minerals. As such, material classified as NAF is considered unlikely to be a source of acidic drainage. A sample is usually defined as NAF when it has a negative NAPP and a final NAGpH ≥ 4.5.

Potentially Acid Forming
A sample classified as PAF always has a significant sulfur content, the acid generating potential of which exceeds the inherent ANC of the material. This means there is a high risk that such a material, even if pH circum-neutral when freshly mined or processed, could oxidise and generate acidic drainage if exposed to atmospheric conditions. A sample is usually defined as PAF when it has a positive NAPP and a final NAGpH < 4.5.

Acid Forming
A sample classified as acid forming has the same characteristics as the PAF samples, however, these samples also have an existing pH of < 4.5. This indicates that acid conditions have already been developed, confirming the acid forming nature of the sample.

Uncertain
An uncertain classification is used when there is an apparent conflict between the NAPP and NAG results (i.e. when the NAPP is positive and NAGpH > 4.5, or when the NAPP is negative and NAGpH ≤ 4.5).

4.3 Sample Selection and Preparation

A total of 137 drill-hole samples were collected from two drill-holes located within the proposed pit extension area by HVEC personnel for inclusion in the geochemical testing program. During this sampling program an additional 60 samples were collected from two drill-holes located within an area to the west of the current pit which was previously approved for mining (i.e. mining approved via the Mt Arthur Coal Consolidation Project EA Project Approval 09_0062). Figure 4 shows the location of the sampled drill-holes and the area limits for the currently approved pit and proposed Modification pit extension.

The intervals selected for sampling through each drill-hole were based on the lithology and proximity to the coal seams using the stratigraphic logs for the selected drill-holes. Strata that occur as finely interbedded materials of different lithology have been logged as discrete units of mixed lithology (e.g. carbonaceous mudstone and siltstone). The sample intervals selected comprise either discrete lithologies or discrete units of mixed lithology and the samples were collected continuously through each selected interval. The selected sample sets are therefore considered to be representative of the major overburden rock types within the proposed pit extension areas. The drill logs and sample details, including depth interval, lithology and degree of weathering, are provided in Attachment A (Tables A-1 to A-4).

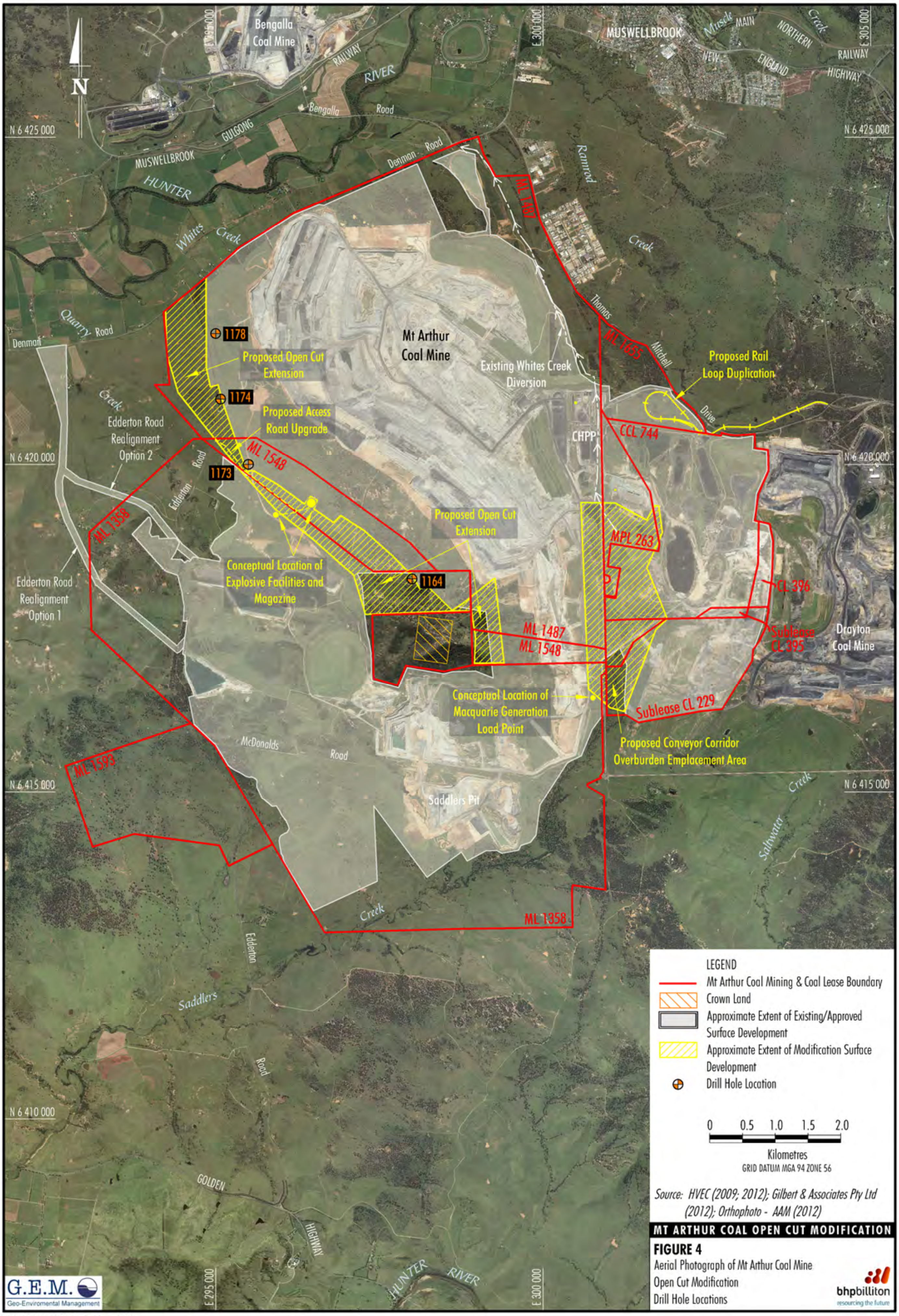


FIGURE 4
Aerial Photograph of Mt Arthur Coal Mine
Open Cut Modification
Drill Hole Locations

HVE-11-01_OCM EA_App Geochem_101D

Table 1 provides a summary of the sample quantities for this program. The mixed lithology samples are grouped according to the dominant lithology within the sample.

Table 1: Sample types and quantities according to the predominant lithology for the Mt Arthur Coal Open Cut Modification drill-hole sampling program.

Sample Type	Lithology	Number of Samples
Weathered Material *(5 Samples)*	Highly Weathered (mixed lithology)	2
	Moderately Weathered (mixed lithology)	1
	Slightly Weathered (mixed lithology)	2
Carbonaceous Claystone *(14 Samples)*	Carbonaceous Claystone	3
	Carbonaceous Claystone/Coal	1
	Carbonaceous Claystone/Claystone	9
	Carbonaceous Claystone/Siltstone	1
Claystone *(24 Samples)*	Claystone	22
	Claystone/Coal	2
Sandstone *(78 Samples)*	Sandstone	27
	Sandstone/Claystone	11
	Sandstone/Siltstone	31
	Sandstone/Siltstone/Claystone	8
	Sandstone/Siltstone/Carbonaceous Claystone	1
Siltstone *(11 Samples)*	Siltstone	8
	Siltstone/Claystone	2
	Siltstone/Carbonaceous Claystone	1
Minor Sample Types *(5 Samples)*	Tuff	2
	Gravelly Sand	1
	Conglomerate	1
	Dolerite	1

The samples were sent to Australian Laboratory Services Pty Ltd in Brisbane for preparation which involved crushing all of the sample to minus 4 millimetres and pulverising a 200 grams split to minus 75 micrometres prior to testing.

5.0 Overburden and Interburden Geochemistry

The geochemical test results for the 139 overburden and interburden samples, including the $pH_{(1:2)}$ and $EC_{(1:2)}$, acid forming characteristics, sodicity assessment and element enrichment and solubility, are provided in Attachment B and a summary of the $pH_{(1:2)}$ and $EC_{(1:2)}$, and acid-base characteristics of the different overburden and interburden material types is provided on Table 2.

Table 2: Summary of the pH, EC and acid-base characteristics of the different overburden and interburden material types from the Mt Arthur Coal Open Cut Modification.

Material Type		$pH_{1:2}$	$EC_{1:2}$ (dS/m)	Total S (%S)	MPA (kg H_2SO_4/t)	ANC (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)
All Samples	*min.*	5.0	0.111	<0.01	0	7	-175
	max.	9.9	2.440	1.16	35	176	25
(139 Samples)	*aver.*	8.9	0.353	0.08	2	44	-41
Weathered Material	*min.*	7.6	0.368	<0.01	0	8	-110
	max.	8.2	0.546	0.02	1	110	-8
(5 Samples)	*aver.*	8.0	0.440	0.01	0	53	-52
Carbonaceous Claystone	*min.*	5.0	0.187	0.02	1	9	-110
	max.	9.3	1.178	1.12	34	116	25
(14 Samples)	*aver.*	7.8	0.440	0.25	8	32	-25
Claystone	*min.*	5.3	0.111	<0.01	0	10	-175
	max.	9.6	1.265	0.20	6	176	-8
(24 Samples)	*aver.*	8.9	0.344	0.08	2	47	-44
Sandstone	*min.*	5.0	0.116	<0.01	0	7	-145
	max.	9.9	2.440	1.16	35	145	19
(78 Samples)	*aver.*	9.0	0.341	0.06	2	46	-44
Siltstone	*min.*	6.7	0.161	0.01	0	12	-75
	max.	9.6	0.675	0.22	7	75	-7
(11 Samples)	*aver.*	9.0	0.309	0.05	2	32	-30
Tuff	*min.*	8.5	0.146	<0.01	0	26	-58
	max.	9.2	0.569	<0.01	0	58	-25
(2 Samples)	*aver.*	8.9	0.358	<0.01	0	42	-41
Gravelly Sand *(1 Sample)*		8.2	0.311	0.06	2	73	-71
Conglomerate *(1 Sample)*		9.0	0.371	0.01	0	27	-26
Dolerite *(1 Sample)*		7.4	0.448	0.17	5	69	-64

Note: The median value is used for the average pH rather than the mean value due to the pH being a log-scale.

5.1 pH, Salinity and Sodicity

The pH of the overburden and interburden samples ranges from slightly acidic to alkaline with $pH_{1:2}$ values ranging from 5.0 to 9.9. This range in $pH_{1:2}$ values is typical for the different material types with median values ranging from 7.8 to 9.0. Relatively low pH samples (i.e. $pH_{1:2}$ < 6.0) occur within the carbonaceous claystone, claystone and sandstone materials.

The $EC_{1:2}$ values range from 0.111 to 2.440 dS/m indicating that these samples range from non-saline to moderately saline. However, the majority of the samples are non-saline or only have low salinity with 119 of the samples (87%) having an $EC_{1:2}$ < 0.5 dS/m and classified as non-saline, 16 of the samples (11.5%) having an $EC_{1:2}$ between 0.5 and 1.5 dS/m and classified as slightly saline, and only two of the samples (1.5%) having an $EC_{1:2}$ between 1.5 and 2.5 dS/m and classified as moderately saline. Table 2 shows that the range in $EC_{1:2}$ values is relatively consistent for the different material types with the average values all being < 0.5 dS/m.

Forty drill-hole samples representing the different overburden and interburden material types were selected for exchangeable cation analysis and determination of the ESP in order to assess the sodicity risk presented by these materials (Figure 5). The results from these analyses are provided in Attachment B (Table B-3). These results indicate a range of ESP values from 5.5 to 52.8 with nine of the samples (36%) having an ESP < 15% and classified as slightly sodic, 11 of the samples (44%) having an ESP of between 15 and 30%, and classified as moderately sodic, and five of the samples (20%) having an ESP > 30% and classified as highly sodic (Figure 5).

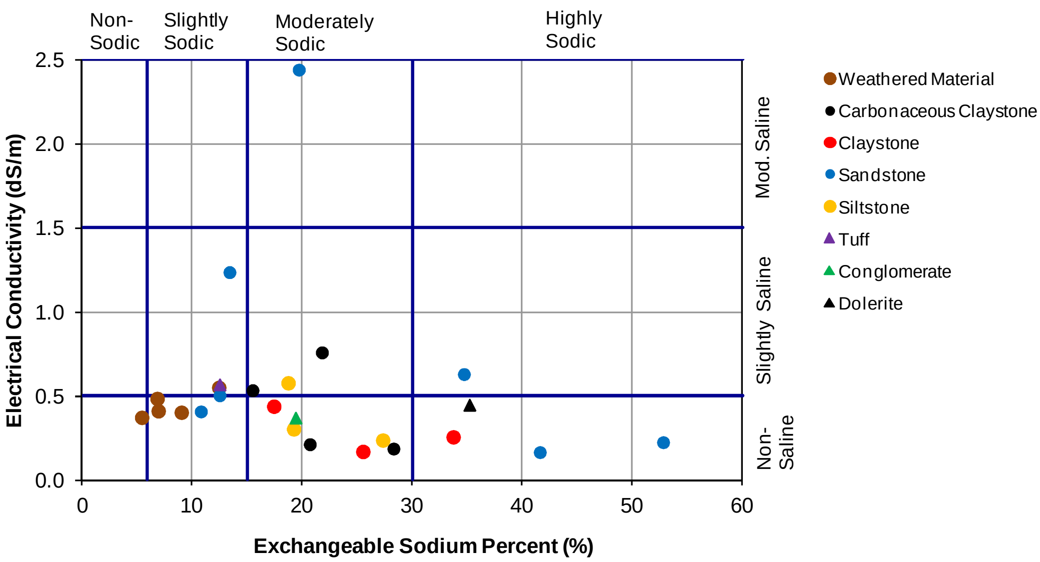


Figure 5: Salinity and Sodicity Ranking for Selected Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification.

5.2 Acid Forming Characteristics

The total S content of the overburden and interburden samples ranges from < 0.01 to 1.16%S with an average content of only 0.08%S. The majority of the samples have a relatively low sulfur content with 116 of the samples (85%) having a total S content ≤ 0.1%S and only four of the samples having a content > 0.5%S. The sulfur content of these four samples ranges from 1.03 to 1.16%S.

Fifty samples ranging in total S content from < 0.01 to 1.16%S were selected for sulfide sulfur analysis. The results from these analyses are provided in Attachment B and indicate a range of sulfide sulfur contents from < 0.005 to 1.010%S. Figure 6 is a plot of the total S content compared to the sulfide sulfur content for these samples. These results indicate that typically 40 to 90% of the contained sulfur in these materials occurs as reactive sulfur (sulfide), and the sulfide sulfur content of the higher sulfur samples (> 1.0%S) typically accounts for 80 to 90% of the contained sulfur.

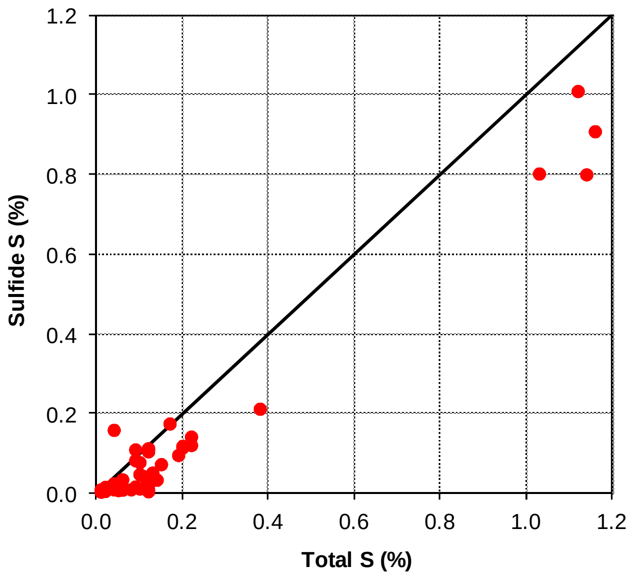


Figure 6: Total Sulfur Content Plotted against the Sulfide Sulfur Content for Selected Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification.

The ANC of the overburden and interburden samples ranges from 7 to 176 kg H_2SO_4/t with an average of 44 kg H_2SO_4/t. The majority of the samples have a moderate ANC with only four of the samples (3%) having an ANC < 10 kg H_2SO_4/t and only 14 of the samples (10%) having an ANC > 100 kg H_2SO_4/t, while 119 of the samples (87%) have an ANC between 10 and 100 kg H_2SO_4/t.

Figure 7 is a plot of the total S content compared to the ANC for the different material types. Samples that plot above the NAPP = 0 (ANC/MPA = 1) line are NAPP negative, indicating an excess in acid buffering capacity over potential acidity. Samples that plot above the ANC/MPA=2 line have at least a two-fold excess in acid buffering over acid potential and those that plot above the ANC/MPA=3 line have a three-fold excess. This plot shows that the majority of the samples are NAPP negative with ANC/MPA ratios > 3, indicating a significant excess in acid buffering over the acid potential, with only seven of the samples (5%) having an ANC/MPA ratio < 3. However, four of the samples (3%) are NAPP positive indicating an excess in potential acidity over acid buffering. The NAPP value for these samples ranges from 1 to 25 kg H_2SO_4/t.

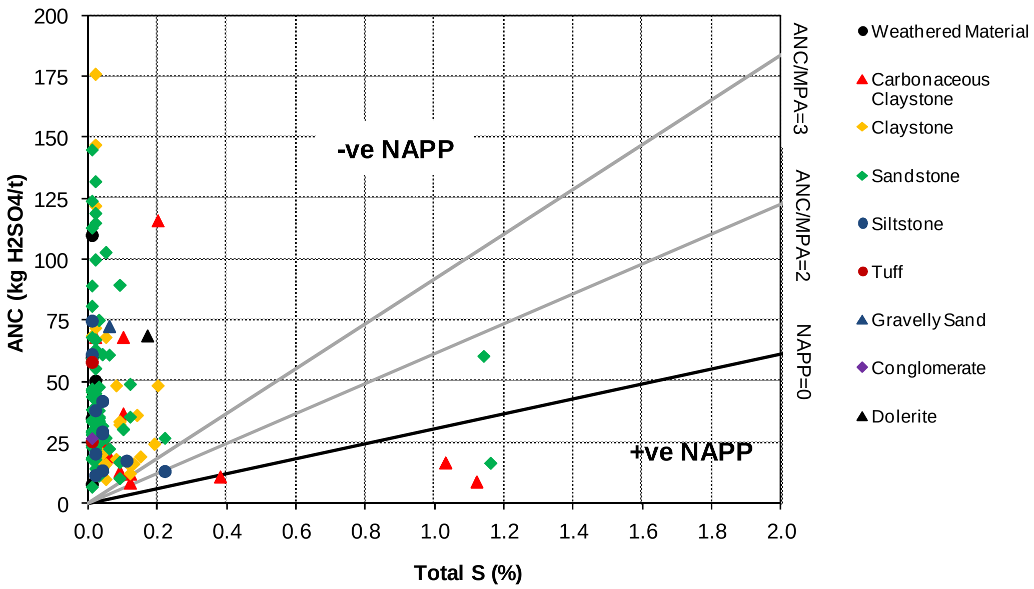


Figure 7: Acid-base Account Plot for the Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification.

Fifty-nine samples were selected for NAG testing to help determine the geochemical classification of these materials and the results from these tests are provided in Attachment B (Table B-1 and B-2). The NAGpH values range from 2.7 to 10.7 with six of the samples (10%) having a NAGpH < 4.5. Figure 8 is a geochemical classification plot for these samples, where the NAPP values are plotted against the NAGpH. Samples that plot in the upper left quadrate are NAPP negative with NAGpH values > 4.5, and these samples are confirmed as NAF. Samples that plot in the lower right quadrate are NAPP positive with NAGpH values < 4.5, and these samples are confirmed as PAF. However, samples that plot in the lower left or upper right quadrates have an uncertain geochemical classification due to conflicting NAPP and NAG test results.

This plot shows that the majority of the NAPP negative samples have a NAGpH > 4.5 and these samples are confirmed as NAF. This plot also shows that the four NAPP positive samples have NAGpH values < 4.5 and these samples are classified as PAF. However, two of the samples plot within the lower left quadrate, being NAPP negative with NAGpH's < 4.5, and the classification of these samples is uncertain (UC).

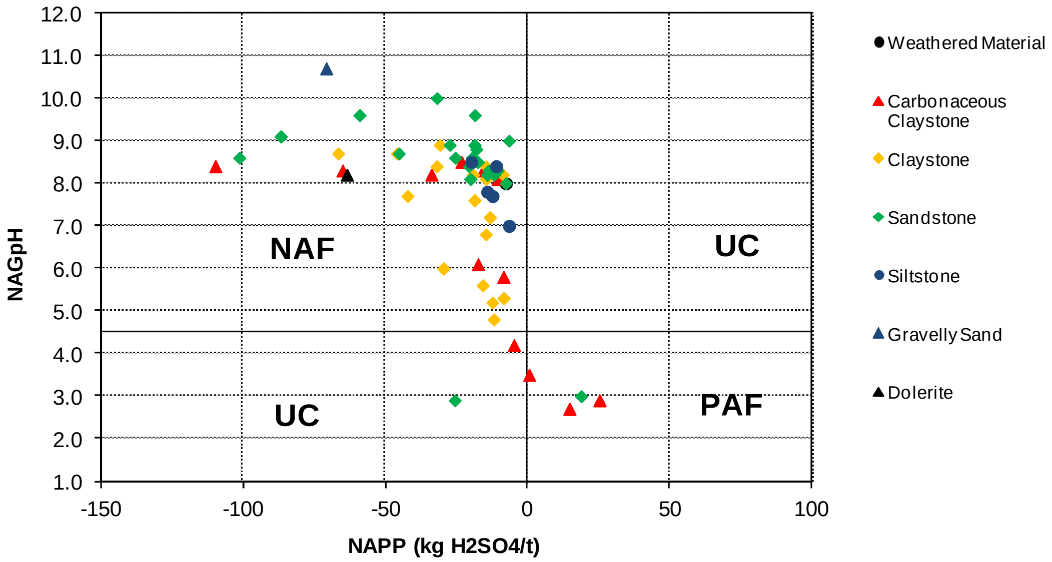


Figure 8: Geochemical Classification Plot for Selected Overburden and Interburden Samples from the Mt Arthur Coal Open Cut Modification.

Two of the PAF samples (ID64/38 and ID74/43) have NAG capacities of 4 and 6 kg H_2SO_4/t, respectively, when titrated to pH 4.5, and these samples are further classified as PAF/LC (i.e. PAF Low Capacity). The other two PAF samples (ID64/57 and ID74/44) have NAG capacities of 12 and 17 kg H_2SO_4/t, respectively.

The two samples with a UC geochemical classification include sample ID64/80 and sample ID74/11 with sulfide sulfur contents of 0.801 and 0.010%S, and ANC values of 61 and 9 kg H_2SO_4/t, respectively. Both of these samples have ANC/MPA ratios < 3, and based on these results it is expected that these samples are PAF. However, with NAG capacities, when titrated to pH 4.5, of 7 and 2 kg H_2SO_4/t, respectively, these samples are only expected to have a low capacity to generate acid and are classified as PAF/LC.

Based on these test results, six of the overburden and interburden samples (i.e. 4%) are expected to be PAF and of these, four samples are expected to be PAF/LC with only a low capacity to generate acid (i.e. < 10 kg H_2SO_4/t). All of the indentified PAF samples occur immediately above (roof) or below (floor) coal seams or as coal seam partings. The two PAF samples include the mixed lithologies of carbonaceous claystone/claystone and carbonaceous claystone/siltstone and the four PAF/LC samples include the carbonaceous claystone, sandstone and the mixed lithologies of carbonaceous claystone/claystone. Table 3 provides the stratigraphic distribution of the indentified PAF and PAF/LC samples.

Table 3: Stratigraphic distribution of the identified PAF and PAF/LC samples from the Mt Arthur Coal Open Cut Modification.

Sample ID	Interval (m)	Lithology	Geochemical Classification	Coal Seam	Stratigraphic Association
ID74/11	0.83	Carb. Claystone/Claystone	PAF/LC	Bowfield	Parting
ID64/38	0.36	Carb. Claystone	PAF/LC	Warkworth	Roof
ID74/43	5.25	Sandstone	PAF/LC	Bayswater (Lower)	Floor
ID74/44	1.52	Carb. Claystone/Siltstone	PAF	Wyn (Upper)	Roof
ID64/57	0.62	Carb. Claystone/Claystone	PAF	Wyn (Lower)	Floor
ID64/80	2.10	Sandstone	PAF/LC	Ramrod Creek	Floor

5.3 Metal Enrichment and Solubility

Twenty-five of the overburden and interburden samples were selected for multi-element analysis based on their stratigraphic location, lithology and geochemical characteristics. The results from these analyses and the GAI for the selected samples are provided in Attachment B (Tables B-4 and B-5).

These results indicate that As, Sb and Se are slightly enriched compared to the average crustal abundance in the majority of the samples with GAI of 1 and 2, and that As and Se are significantly enriched in some of the samples with GAI values 3. The enrichment of As, Sb and Se is a relatively common characteristic of coal deposits of this region. Additionally, Hg was found to be slightly enriched in three of the samples with GAI values of 1 and 2. The concentration ranges and average crustal abundance of these elements are summarised in Table 4.

Table 4: Concentration ranges and average crustal abundances for enriched elements in selected overburden and interburden samples from the Mt Arthur Coal Open Cut Modification.

Element	*Average Crustal Abundance (mg/kg)	Concentration Range (mg/kg)
As	1.5	0.6 to 39.2
Hg	0.05	<0.001 to 0.286
Sb	0.2	0.27 to 1.46
Se	0.05	0.02 to 0.97

*Bowen H.J.M. (1979) Environmental Chemistry of the Elements.

Multi-element scans were also performed on the water extracts (1 part sample/2 parts deionised water) from the selected overburden and interburden samples in order to provide an indication of relative element solubility in these materials. The results from these scans are presented in Attachment B (Table B-6) and indicate that As, Molybdenum (Mo) and Se are likely to be relatively soluble in the overburden and interburden materials. However, these elements are typically less soluble in the weathered material samples and this is most likely due to leaching of the readily soluble constituents in these materials over time. Although slightly enriched in some of the overburden samples, Hg and Sb were not found to be readily soluble in the samples tested. The concentration ranges of As, Mo and Se are compared to Australian and New Zealand Environment Conservation Council (ANZECC) irrigation water quality guidelines (ANZECC, 2000) in Table 5 in order to provide an indication of the relative solubility of these elements.

Table 5: Concentration ranges and the ANZECC (2000) Irrigation Water Quality Guideline values for readily soluble elements in the overburden and interburden samples from the Mt Arthur Coal Open Cut Modification.

Element	Concentration Range (µg/L)	Irrigation Water Quality Guideline (ANZECC, 2000)	
		Short-Term Exposure (µg/L)	Long-Term Exposure (µg/L)
As	0.7 - 343.9	2000	100
Mo	0.32 - 163.48	50	10
Se	2.5 - 122.0	50	10

µg/L = micrograms per litre

The pH of the water extracts ranged from 5.0 to 9.5. Relatively high concentrations of dissolved metals including Mg, cadmium, cobalt, iron, manganese, nickel and zinc were found in the samples with a water extract pH < 6 indicating the increased solubility of these metals in response to decreasing pH. This finding highlights the need to ensure that low pH conditions are not allowed to develop within the overburden emplacement areas.

6.0 Confirmation Testing of Approved Open Cut Area

Geochemical characterisation testing of overburden and interburden materials from an area to the west of the current operations within the approved open cut mine area, shown on Figure 4, was conducted by GEM in order to confirm that the geochemical characteristics of these materials are consistent with those from the previous assessment conducted for the Mt Arthur North EIS (Dames and Moore, 2000) and the current assessment. The findings from this testing program were reported by GEM in August, 2012 (Mt Arthur Coal Open Cut Mine - Geochemical Characterisation of Overburden and Interburden from Drill-Holes ID1173 and ID1178). For this testing program 60 samples of the overburden and interburden from this area were submitted for the following analyses:

- pH and EC determination;
- acid-base analysis (total S, ANC, NAPP);
- sulfide sulfur analysis;
- single addition NAG testing; and
- multi-element scans on solids and water extracts.

The results from this program are consistent with the results from the previous and current assessment programs. The bulk of the overburden and interburden is expected to be NAF. However, some of the materials in close stratigraphic proximity to the coal seams (i.e. roof, floor or parting) have a risk of being PAF or PAF/LC. The identified PAF and PAF/LC strata include PAF/LC carbonaceous claystone/coal forming the roof of the Warkworth Seam and PAF sandstone forming the floor of the Ramrod Creek Seam.

The bulk of the overburden and interburden from this area is also expected to be enriched with As, Sb and Se, and some of these materials may also be slightly enriched with Hg compared to the average crustal abundance. Similar to the overburden and interburden from the proposed Modification area, As, Mo and Se are likely to be relatively soluble in the overburden and interburden materials from this area.

7.0 Conclusions and Recommendations

7.1 Overburden and Interburden

Previous geochemical investigations conducted by Dames and Moore (April, 2000) and concurrent confirmatory geochemical testing conducted by GEM (August, 2012) for the approved open cut mining operations at Mt Arthur Coal Mine indicated that the bulk of the overburden and interburden was likely to be NAF and non-saline. Due to the relatively inert nature of the overburden, it was recommended that no specific constraints relating to the handling and storage of the general overburden and interburden would be required for geochemically secure disposal of this material. However, due to the sporadic occurrence of PAF materials associated with some of the coal seams it was recommended that the uneconomic coal seams, partings, and roof and floor strata, estimated to comprise approximately 5% of the overburden and interburden, be selectively mined and buried at a depth of > 5m within the overburden emplacements in order to reduce the risk of developing acid condition and acid rock drainage. This strategy was considered feasible by Dames and Moore (2000), given that the total volume of coal-associated overburden was approximately 5% of the total annual overburden produced, and that coal-associated overburden is readily identifiable in the field.

Additionally, due to the occurrence of moderately sodic materials within the overburden and interburden it was recommended that any sodic materials exposed within the final surfaces of the emplacements be treated with the direct application of gypsum or lime prior to topdressing.

The results of the current geochemical investigations indicate that the overburden and interburden from the proposed Modification area of the open cut mining operations, as shown on Figure 2, is generally expected to be NAF with a low salinity risk. However, consistent with the previous and concurrent investigations, a relatively small quantity of the overburden and interburden occurring in close proximity to the coal seams (i.e. partings, and roof and floor rock) has a risk of being PAF or PAF/LC. The occurrence of this material is sporadic through the strata and based on the samples tested it is expected that the only a minor proportion of the materials associated with the coal seams would be PAF and PAF/LC. However, it is expected that these materials would be relatively reactive and likely develop acid conditions within a relatively short period, if left exposed to oxidation.

These investigations have also confirmed that a significant quantity of the overburden and interburden from the Modification area is likely to be moderately or highly sodic. If these sodic materials are left exposed on the final emplacement surfaces they may become highly dispersive causing problems with emplacement stability, increased erosion potential and impacting water quality due to increased suspended solids.

Consistent with the previous and concurrent geochemical investigations and typical of the coal deposits in this region, the overburden and interburden materials from the Modification area are likely to contain significantly enriched concentrations of As, Sb and Se and some of these materials may also contain slightly enriched concentrations of Hg compared to the average crustal abundance. Although these findings indicate that Hg and Sb are not expected to be readily soluble, As, Mo and Se are expected to be relatively readily soluble under the prevailing near-neutral pH conditions of these materials.

Based on these findings the following recommendations are made:

1. Because of the identified risk of a small quantity of the overburden and interburden associated with the coal seams (uneconomic coal seams, partings, and roof and floor rock) being PAF or PAF/LC, it is recommended that the same management strategy be adopted for this material as developed for the currently approved operations. This strategy involves the selective mining and burial of this material within the overburden emplacements such that the outer 5 m of the final surfaces comprises only NAF material (Dames and Moore, 2000).

2. In order to manage long-term stability and erosion control of the emplacements, and to help with maintaining the quality of the site water (suspended solids), consistent with Dames and Moore (2000), the final emplacement surfaces (top and batter slopes) would need to be treated with gypsum and/or constructed of material that is known to be non-sodic or to only have low sodicity.

3. It is recommended that the water quality monitoring program for the potentially impacted areas (e.g. dams containing runoff from overburden areas) include the following parameters:

   - pH, EC, TSS, total alkalinity/acidity, sulfate, As, Hg, Sb, Se, and Mo.

   It is assumed that the water samples for this program would be collected every month to two months. The data generated should be periodically reviewed and it is recommended that this be carried out annually. The reviews should be able to identify if exposure of sodic or PAF materials within the emplacements or pit walls is impacting water quality and would also indicate if the release of any of the enriched or soluble elements is adversely impacting the quality of water in the receiving environment. The parameter list should also be evaluated and modified as required during the reviews.

4. It is recommended that additional geochemical investigations be conducted on overburden and interburden in the future if the mining operations expand or move into new areas not covered by the previous or current investigations.

7.2 Coal Rejects

Suitable samples of the coal rejects (tailings and coarse rejects) were not available for this assessment. However, based on the geochemical characteristics of the bulk coal rejects from the previous geochemical investigations (Dames and Moore, 2000) and the geochemical characteristics of the strata associated with the coal seams from the current investigations, it is expected that the coal rejects would be PAF. Based on this the management strategy developed for the coal rejects from the approved mining operations should also be adopted for those from the Modification. This strategy involves compaction and burial of the co-disposed tailings and coarse rejects within the overburden emplacements with a minimum cover thickness of 5 m of NAF material.

It is recommended that a detailed geochemical testing program be conducted on representative samples of the tailing and coarse rejects as part of future engineering investigations into coal rejects disposal in order to confirm the geochemical characteristics of these materials.

8.0 References

Australian and New Zealand Environment Conservation Council (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra, October.

Beckett J. (1988). The Hunter Coalfield – Notes to Accompany the 1:100,000 Geological Map. Geological Survey Report No. GS 1988/051. Department of Minerals and Energy.

Bowen H.J.M. (1979). Environmental Chemistry of the Elements. Academic Press, London.

Coal Operations Australia Limited (2000). Mt Arthur North Environmental Impact Statement.

Dames & Moore (2000). Mount Arthur North Coal Project Geochemical Characterisation of Overburden and Reject Coal. April, 2000.

Geo-Environmental Management Pty Ltd (2012). Mt Arthur Coal Open Cut Mine - Geochemical Characterisation of Overburden and Interburden from Drill-Holes ID1173 and ID1178. August, 2012.

Hunter Valley Energy Coal (2009). Mt Arthur Coal Consolidation Project.

Attachment A

Drill-Hole Logs and Sample Interval Detail

Table A-1: Drill-hole ID1164 log and sample interval detail.

Table A-2: Drill-hole ID1174 log and sample interval detail.

Table A-3: Drill-hole ID1173 log and sample interval detail.

Table A-4: Drill-hole ID1178 log and sample interval detail.

Table A-1: Drill-hole ID1164 log and sample interval detail.

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID64/1	15.57	16.01	0.44	Highly weathered	
ID64/2	16.01	16.97	0.96	Moderately weathered	
ID64/3	16.97	19.44	2.47	Slightly weathered	
ID64/4	19.44	21.54	2.10	Claystone	
-	21.54	21.64	0.10	-	
	21.64	23.19	1.55	Coal Seam	BK
ID64/5	23.19	24.09	0.90	Tuff	
-	24.09	24.45	0.36	-	
	24.45	24.60	0.15	Coal Seam	BK
ID64/6	24.60	25.27	0.67	Sandstone/Siltstone	
-	25.27	25.41	0.14	-	
ID64/7	25.41	31.08	5.67	Sandstone/Siltstone	
-	31.08	36.60	5.52	-	
ID64/8	36.60	42.78	6.18	Sandstone/Siltstone	
-	42.78	42.93	0.15	-	
ID64/9	42.93	50.65	7.72	Siltstone	
-	50.65	50.69	0.04	-	
	50.69	55.61	4.92	Coal Seam	GM
ID64/10	55.61	56.03	0.42	Claystone	
-	56.03	56.05	0.02	-	
ID64/11	56.05	57.82	1.77	Siltstone	
ID64/12	57.82	66.65	8.83	Sandstone/Siltstone	
ID64/13	66.65	73.78	7.13	Sandstone	
-	73.78	73.90	0.12	-	
ID64/14	73.90	80.37	6.47	Sandstone/Siltstone	
ID64/15	80.37	81.43	1.06	Siltstone	
-	81.43	81.47	0.04	-	
	81.47	85.53	4.06	Coal Seam	WH
ID64/16	85.53	86.95	1.42	Sandstone/Siltstone	
	86.95	91.07	4.12	Coal Seam	WH
ID64/17	91.07	91.34	0.27	Siltstone	
-	91.34	91.35	0.01	-	
ID64/18	91.35	97.61	6.26	Sandstone/Siltstone	
ID64/19	97.61	98.54	0.93	Claystone	
ID64/20	98.54	106.36	7.82	Sandstone	
-	106.36	107.28	0.92	-	
ID64/21	107.28	111.75	4.47	Sandstone/Siltstone	
-	111.75	115.75	4.00	-	
ID64/22	115.75	116.52	0.77	Sandstone	
	116.52	116.75	0.23	Coal Seam	UNB
ID64/23	116.75	117.77	1.02	Sandstone	
-	117.77	117.82	0.05	-	
ID64/24	117.82	118.63	0.81	Claystone	
ID64/25	118.63	130.19	11.56	Sandstone/Siltstone/Claystone	
ID64/26	130.19	130.62	0.43	Carb. claystone/Claystone	
	130.62	130.87	0.25	Coal Seam	UNBL
ID64/27	130.87	132.87	2.00	Sandstone/Claystone	
	132.87	135.90	3.03	Coal Seam	AF
ID64/28	135.90	136.68	0.78	Claystone	
-	136.68	142.89	6.21	-	
ID64/29	142.89	144.20	1.31	Claystone	
-	144.20	144.21	0.01	-	
	144.21	149.13	4.92	Coal Seam	BF
ID64/30	149.13	154.89	5.76	Sandstone/Claystone	
-	154.89	160.21	5.32	-	
ID64/31	160.21	163.51	3.30	Carb. claystone/Claystone	
	163.51	163.84	0.33	Coal Seam	WW
ID64/32	163.84	164.46	0.62	Claystone	
-	164.46	164.97	0.51	-	
ID64/33	164.97	167.70	2.73	Sandstone	
	167.70	167.84	0.14	Coal Seam	WW
ID64/34	167.84	170.72	2.88	Siltstone/Carb. claystone	
-	170.72	180.58	9.86	-	
ID64/35	180.58	183.06	2.48	Sandstone	
	183.06	183.36	0.30	Coal Seam	WW
ID64/36	183.36	186.65	3.29	Sandstone/Siltstone/Carb. claystone	
ID64/37	186.65	188.54	1.89	Sandstone	
ID64/38	188.54	188.90	0.36	Carb. claystone	
	188.90	190.18	1.28	Coal Seam	WW

Table A-1: Drill-hole ID1164 log and sample interval detail. CONTINUED

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID64/39	190.18	192.91	2.73	Claystone/Coal	
-	192.91	200.45	7.54	-	
ID64/40	200.45	204.46	4.01	Sandstone/Siltstone	
	204.46	204.73	0.27	Coal Seam	BAND
ID64/41	204.73	207.61	2.88	Sandstone	
ID64/42	207.61	208.20	0.59	Gravelly sand	
ID64/43	208.20	208.96	0.76	Sandstone/Claystone	
	208.96	209.82	0.86	Coal Seam	M
ID64/44	209.82	211.57	1.75	Tuff	
	211.57	217.52	5.95	Coal Seam	M
ID64/45	217.52	218.06	0.54	Sandstone/Claystone	
	218.06	218.29	0.23	Coal Seam	M
ID64/46	218.29	218.85	0.56	Sandstone	
ID64/47	219.17	222.15	2.98	Sandstone/Siltstone	
ID64/48	222.15	222.63	0.48	Claystone	
	222.63	225.79	3.16	Coal Seam	PU
ID64/49	225.79	226.64	0.85	Claystone	
-	226.64	231.00	4.36	-	
ID64/50	231.00	232.97	1.97	Claystone	
	232.97	233.51	0.54	Coal Seam	PL
ID64/51	233.51	234.37	0.86	Claystone	
-	234.37	238.69	4.32	-	
ID64/52	238.69	241.27	2.58	Siltstone	
-	241.27	241.30	0.03	-	
	241.30	241.57	0.27	Coal Seam	UNI
ID64/53	241.57	243.85	2.28	Sandstone	
ID64/54	243.85	244.64	0.79	Carb. claystone/Claystone	
	244.64	246.10	1.46	Coal Seam	VU
ID64/55	246.10	247.18	1.08	Sandstone/Claystone	
ID64/56	247.18	251.40	4.22	Sandstone/Siltstone	
-	251.40	251.47	0.07	-	
	251.47	251.78	0.31	Coal Seam	WL
ID64/57	251.78	252.40	0.62	Carb. claystone/Claystone	
-	252.40	252.43	0.03	-	
	252.43	252.78	0.35	Coal Seam	EDU
-	252.78	252.79	0.01	-	
ID64/58	252.79	253.83	1.04	Claystone	
	253.83	255.75	1.92	Coal Seam	ED
-	255.75	255.82	0.07	-	
ID64/59	255.82	257.90	2.08	Sandstone/Siltstone	
ID64/60	257.90	258.94	1.04	Claystone	
-	258.94	260.99	2.05	-	
ID64/61	260.99	263.10	2.11	Claystone/Coal	
-	263.10	264.04	0.94	-	
ID64/62	264.04	268.23	4.19	Sandstone	
ID64/63	268.23	269.01	0.78	Claystone	
-	269.01	269.03	0.02	-	
	269.03	270.97	1.94	Coal Seam	CN
ID64/64	270.97	273.73	2.76	Sandstone/Claystone	
-	273.73	276.53	2.80	-	
ID64/65	276.53	279.11	2.58	Sandstone/Claystone	
	279.11	281.73	2.62	Coal Seam	BA
ID64/66	281.73	284.92	3.19	Sandstone/Siltstone	
-	284.92	285.48	0.56	-	
ID64/67	285.48	292.07	6.59	Sandstone	
	292.07	292.92	0.85	Coal Seam	BB
ID64/68	292.92	294.51	1.59	Sandstone/Claystone	
	294.51	295.47	0.96	Coal Seam	BB
ID64/69	295.47	300.14	4.67	Sandstone/Claystone	
	300.14	301.04	0.90	Coal Seam	BC
ID64/70	301.04	301.72	0.68	Sandstone	
ID64/71	301.72	311.46	9.74	Sandstone/Siltstone/Claystone	
ID64/72	311.46	313.05	1.59	Claystone	
	313.05	313.43	0.38	Coal Seam	UNE
ID64/73	313.43	315.38	1.95	Sandstone/Siltstone	
-	315.38	318.20	2.82	-	
ID64/74	318.20	319.23	1.03	Sandstone	
	319.23	323.70	4.47	Coal Seam	EG
ID64/75	323.70	324.85	1.15	Siltstone/Claystone	

Table A-1: Drill-hole ID1164 log and sample interval detail. CONTINUED

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
-	324.85	337.35	12.50	-	
ID64/76	337.35	339.01	1.66	Claystone	
-	339.01	340.41	1.40	-	
ID64/77	340.41	342.18	1.77	Siltstone/Claystone	
	342.18	343.31	1.13	Coal Seam	TR
	343.31	347.69	4.38	Coal Seam	RK
ID64/78	347.69	354.54	6.85	Sandstone	
-	354.54	356.10	1.56	-	
ID64/79	356.10	356.87	0.77	Claystone	
	356.87	358.91	2.04	Coal Seam	RK
ID64/80	358.91	361.01	2.10	Sandstone	
-	361.01	369.80	8.79	-	

Table A-2: Drill-hole ID1174 log and sample interval detail.

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID74/1	12.17	13.30	1.13	Highly weathered	
ID74/2	13.30	13.88	0.58	Slightly weathered	
ID74/3	13.88	16.15	2.27	Sandstone/Siltstone/Claystone	
	16.15	16.36	0.21	Coal Seam	UNB
ID74/4	16.36	18.99	2.63	Sandstone/Siltstone	
-	18.99	20.51	1.52	-	
ID74/5	20.51	20.91	0.40	Claystone	
-	20.91	25.45	4.54	-	
ID74/6	25.45	33.10	7.65	Sandstone	
-	33.10	33.15	0.05	-	
ID74/7	33.15	38.30	5.15	Sandstone/Siltstone	
	38.30	39.98	1.68	Coal Seam	AF
-	39.98	40.08	0.10	-	
ID74/8	40.08	43.14	3.06	Sandstone/Siltstone	
ID74/9	43.14	51.45	8.31	Sandstone	
-	51.45	53.57	2.12	-	
ID74/10	53.57	54.27	0.70	Carb. claystone/Claystone	
	54.27	55.56	1.29	Coal Seam	BF
ID74/11	55.56	56.39	0.83	Carb. claystone/Claystone	
	56.39	56.66	0.27	Coal Seam	BF
ID74/12	56.66	57.95	1.29	Carb. claystone/Claystone	
	57.95	58.40	0.45	Coal Seam	BF
ID74/13	58.40	60.46	2.06	Sandstone/Siltstone/Claystone	
ID74/14	60.46	65.81	5.35	Sandstone/Siltstone	
	65.81	67.58	1.77	Coal Seam	WW
ID74/15	67.58	73.13	5.55	Sandstone/Siltstone	
	73.13	73.34	0.21	Coal Seam	WW
ID74/16	73.34	76.08	2.74	Sandstone/Siltstone/Claystone	
ID74/17	76.08	76.73	0.65	Dolerite	
-	76.73	80.86	4.13	-	
ID74/18	80.86	82.05	1.19	Claystone	
-	82.05	82.70	0.65	-	
ID74/19	82.70	83.17	0.47	Carb. claystone	
ID74/20	83.17	83.90	0.73	Sandstone/Siltstone/Claystone	
	83.90	84.39	0.49	Coal Seam	WW
ID74/21	84.39	91.95	7.56	Sandstone/Siltstone/Claystone	
	91.95	92.29	0.34	Coal Seam	WW
ID74/22	92.29	96.34	4.05	Sandstone/Siltstone	
-	96.34	96.39	0.05	-	
ID74/23	96.39	108.73	12.34	Sandstone/Siltstone	
	108.73	116.32	7.59	Coal Seam	M
ID74/24	116.32	118.25	1.93	Sandstone/Siltstone	
	118.25	118.63	0.38	Coal Seam	M
ID74/25	118.63	123.00	4.37	Sandstone/Siltstone	
ID74/26	123.00	123.75	0.75	Carb. claystone/Claystone	
	123.75	124.59	0.84	Coal Seam	UNC
ID74/27	124.59	125.44	0.85	Claystone	
-	125.44	126.43	0.99	-	
ID74/28	126.43	133.74	7.31	Siltstone	
-	133.74	136.99	3.25	-	
ID74/29	136.99	142.16	5.17	Sandstone	
-	142.16	143.05	0.89	-	
	143.05	145.80	2.75	Coal Seam	PU
	145.83	146.39	0.56	Coal Seam	PL
-	146.39	146.43	0.04	-	
ID74/30	146.43	147.76	1.33	Sandstone	
-	147.76	152.84	5.08	-	
ID74/31	152.84	153.67	0.83	Carb. claystone	
	153.67	154.39	0.72	Coal Seam	UNH
ID74/32	154.39	156.05	1.66	Siltstone/Claystone	
-	156.05	161.12	5.07	-	
ID74/33	161.12	164.45	3.33	Siltstone	
-	164.45	167.44	2.99	-	
ID74/34	167.44	174.13	6.69	Sandstone	
ID74/35	174.13	181.80	7.67	Sandstone/Siltstone	
	181.80	184.16	2.36	Coal Seam	VU
-	184.16	184.30	0.14	-	
	184.30	185.87	1.57	Coal Seam	VM
ID74/36	185.87	186.91	1.04	Sandstone	

Table A-2: Drill-hole ID1174 log and sample interval detail. CONTINUED

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID74/37	186.91	187.83	0.92	Carb. claystone/Claystone	
-	187.83	191.35	3.52	-	
	191.35	193.12	1.77	Coal Seam	VL
ID74/38	193.12	200.17	7.05	Sandstone/Siltstone	
-	200.17	205.47	5.30	-	
ID74/39	205.47	206.18	0.71	Claystone	
ID74/40	206.18	206.87	0.69	Carb. claystone,Coal	
-	206.87	209.16	2.29	-	
	209.16	210.45	1.29	Coal Seam	BR
	210.35	211.92	1.57	Coal Seam	BU
-	211.92	211.95	0.03	-	
ID74/41	211.95	215.74	3.79	Sandstone	
-	215.74	218.21	2.47	-	
ID74/42	218.21	218.45	0.24	Conglomerate	
-	218.45	219.45	1.00	-	
	219.45	224.19	4.74	Coal Seam	BL
-	224.19	224.21	0.02	-	
ID74/43	224.21	229.46	5.25	Sandstone	
ID74/44	229.46	230.98	1.52	Carb. claystone/Siltstone	
	230.98	232.76	1.78	Coal Seam	WU
ID74/45	232.76	239.31	6.55	Sandstone/Claystone	
	239.31	239.46	0.15	Coal Seam	WM
ID74/46	239.46	240.06	0.60	Siltstone	
	240.06	240.87	0.81	Coal Seam	WL
-	240.87	241.03	0.16	-	
	241.03	241.45	0.42	Coal Seam	ED
-	241.45	241.79	0.34	-	
	241.79	243.87	2.08	Coal Seam	ED
ID74/47	243.87	245.28	1.41	Sandstone	
ID74/48	245.28	252.11	6.83	Sandstone/Siltstone/Claystone	
	252.11	252.23	0.12	Coal Seam	CN
-	252.23	252.28	0.05	-	
ID74/49	252.28	254.95	2.67	Sandstone/Siltstone	
-	254.95	255.06	0.11	-	
	255.06	257.42	2.36	Coal Seam	CN
ID74/50	257.42	265.98	8.56	Sandstone/Siltstone	
-	265.98	266.17	0.19	-	
	266.17	268.16	1.99	Coal Seam	BA
ID74/51	268.16	272.20	4.04	Sandstone/Siltstone	
-	272.20	272.22	0.02	-	
	272.22	273.44	1.22	Coal Seam	BB
ID74/52	273.44	277.91	4.47	Sandstone	
-	277.91	278.06	0.15	-	
	278.06	278.65	0.59	Coal Seam	BC
ID74/53	278.65	292.79	14.14	Sandstone/Siltstone	
-	292.79	292.85	0.06	-	
ID74/54	292.85	293.62	0.77	Claystone	
ID74/55	293.62	304.78	11.16	Sandstone/Siltstone	
-	304.78	305.12	0.34	-	
	305.12	309.86	4.74	Coal Seam	EG
ID74/56	309.86	314.51	4.65	Sandstone/Siltstone	
-	314.51	314.71	0.20	-	
	314.71	315.15	0.44	Coal Seam	TR
ID74/57	315.15	318.25	3.10	Sandstone/Claystone	
	318.25	318.65	0.40	Coal Seam	TR
ID74/58	318.65	327.19	8.54	Sandstone/Siltstone	
-	327.19	327.38	0.19	-	
	327.38	331.39	4.01	Coal Seam	RK
-	331.39	331.85	0.46	-	
ID74/59	331.85	342.25	10.40	Sandstone	
	342.25	343.68	1.43	Coal Seam	RK
ID74/60	343.68	346.63	2.95	Sandstone	
-	346.63	354.67	8.04	-	

Table A-3: Drill-hole ID1173 log and sample interval detail.

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
-	9.99	10.42	0.43	-	
ID73/1	10.42	13.67	3.25	Sandstone (Highly Weathered)	
ID73/2	13.67	15.51	1.84	Sandstone (Moderately Weathered)	
ID73/3	15.51	18.48	2.97	Sandstone (Slightly Weathered)	
ID73/4	18.48	20.57	2.09	Claystone (Slightly Weathered)	
-	20.57	20.90	0.33	-	
	20.90	24.88	3.98	Coal Seam	WH
ID73/5	24.88	25.45	0.57	Carb. claystone/Claystone	
-	25.45	55.02	29.57	-	
ID73/6	55.02	65.81	10.79	Sandstone	
-	65.81	71.01	5.20	-	
ID73/7	71.01	73.94	2.93	Sandstone	
-	73.94	74.25	0.31	-	
	74.25	77.74	3.49	Coal Seam	AF
ID73/8	77.74	80.80	3.06	Sandstone/Claystone	
-	80.80	87.91	7.11	-	
ID73/9	87.91	88.75	0.84	Carb. claystone/Claystone	
	88.75	92.82	4.07	Coal Seam	BF1
-	92.82	103.66	10.84	-	
ID73/10	103.66	104.08	0.42	Carb. claystone/Coal	
	104.08	104.70	0.62	Coal Seam	WW
ID73/11	104.70	105.26	0.56	Carb. claystone/Coal	
-	105.26	121.09	15.83	-	
ID73/12	121.09	121.97	0.88	Carb. claystone	
	121.97	122.55	0.58	Coal Seam	WW
-	122.55	130.46	7.91	-	
ID73/13	130.46	131.08	0.62	Carb. claystone	
	131.08	131.56	0.48	Coal Seam	WW
-	131.56	142.04	10.48	-	
ID73/14	142.04	157.13	15.09	Sandstone	
-	157.13	175.32	18.19	-	
ID73/15	175.32	175.65	0.33	Claystone	
	175.65	184.12	8.47	Coal Seam	MU
-	184.12	189.22	5.10	-	
ID73/16	189.22	189.86	0.64	Carb. claystone	
	189.86	190.78	0.92	Coal Seam	UNC
ID73/17	190.78	191.78	1.00	Claystone	
-	191.78	214.76	22.98	-	
	214.76	219.45	4.69	Coal Seam	PU
ID73/18	219.45	222.08	2.63	Sandstone/Siltstone	
-	222.08	243.54	21.46	-	
	243.54	245.31	1.77	Coal Seam	UNH
-	245.31	245.45	0.14	-	
	245.45	245.94	0.49	Coal Seam	UNI
-	245.94	246.01	0.07	Carb. claystone/Claystone	
ID73/19	246.01	251.35	5.34	Sandstone	
-	251.35	253.00	1.65	-	
	253.00	257.70	4.70	Coal Seam	V
ID73/20	257.70	260.26	2.56	Sandstone/Siltstone	
-	260.26	260.46	0.20	-	
	260.46	262.34	1.88	Coal Seam	VL
ID73/21	262.34	269.54	7.20	Sandstone/Siltstone	
-	269.54	270.35	0.81	-	
	270.35	274.86	4.51	Coal Seam	BR
ID73/22	274.86	276.14	1.28	Sandstone	
-	276.14	281.00	4.86	-	
	281.00	286.22	5.22	Coal Seam	BL
-	286.22	286.79	0.57	-	
ID73/23	286.79	289.00	2.21	Conglomerate	
-	289.00	294.18	5.18	-	
	294.18	296.00	1.82	Coal Seam	WU
ID73/24	296.00	298.85	2.85	Siltstone	
-	298.85	300.63	1.78	-	
ID73/25	300.63	301.76	1.13	Siltstone	
	301.76	302.82	1.06	Coal Seam	WL
	302.71	303.28	0.57	Coal Seam	EDU
-	303.28	303.80	0.52	-	
	303.80	305.97	2.17	Coal Seam	ED
-	305.97	308.45	2.48	-	

Table A-3: Drill-hole ID1173 log and sample interval detail. CONTINUED

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID73/26	308.45	315.86	7.41	Sandstone/Siltstone	
-	315.86	316.25	0.39	-	
	316.25	316.80	0.55	Coal Seam	CN1
ID73/27	316.80	318.08	1.28	Sandstone	
-	318.08	318.42	0.34	-	
	318.42	322.60	4.18	Coal Seam	CN2
-	322.60	329.50	6.90	-	
ID73/28	329.50	329.94	0.44	Claystone	
	329.94	331.72	1.78	Coal Seam	BA
-	331.72	334.41	2.69	-	
ID73/29	334.41	337.40	2.99	Sandstone	
	337.40	338.98	1.58	Coal Seam	BB
-	338.98	344.81	5.83	-	
	344.81	345.23	0.42	Coal Seam	BC
ID73/30	345.23	347.02	1.79	Sandstone	
-	347.02	370.73	23.71	-	
	370.73	375.25	4.52	Coal Seam	EG
ID73/31	375.25	375.78	0.53	Claystone	
-	375.78	379.84	4.06	-	
	379.84	380.45	0.61	Coal Seam	TR
ID73/32	380.45	381.18	0.73	Siltstone	
	381.18	381.33	0.15	Coal Seam	TR3
-	381.33	385.80	4.47	-	
ID73/33	385.80	392.74	6.94	Sandstone	
-	392.74	392.91	0.17	-	
	392.91	397.14	4.23	Coal Seam	RK
-	397.14	406.25	9.11	-	
ID73/34	406.25	406.76	0.51	Claystone	
-	406.76	406.81	0.05	-	
	406.81	408.21	1.40	Coal Seam	RK4
ID73/35	408.21	412.82	4.61	Sandstone	
-	412.82	418.81	5.99	-	

Table A-4: Drill-hole ID1178 log and sample interval detail.

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID78/1	30.05	30.61	0.56	Carb. claystone/Sandstone	
	30.61	31.29	0.68	Coal Seam	WW
-	31.29	31.55	0.26	-	
ID78/2	31.55	35.34	3.79	Sandstone/Siltstone	
-	35.34	38.27	2.93	-	
ID78/3	38.27	39.78	1.51	Carb. claystone	
-	39.78	39.81	0.03	-	
	39.81	40.44	0.63	Coal Seam	WW3
-	40.44	40.89	0.45	-	
ID78/4	40.89	43.14	2.25	Claystone	
-	43.14	70.70	27.56	-	
	70.70	72.41	1.71	Coal Seam	MU
-	72.38	72.41	0.03	-	
ID78/5	72.41	73.68	1.27	Tuff	
	73.68	75.84	2.16	Coal Seam	MM1
ID78/6	75.84	77.13	1.29	Carb. claystone/Sandstone	
	77.13	78.81	1.68	Coal Seam	ML
-	78.81	85.29	6.48	-	
ID78/7	85.29	86.37	1.08	Carb. claystone/Claystone	
	86.37	87.14	0.77	Coal Seam	UNC
-	87.14	100.97	13.83	-	
ID78/8	100.97	115.92	14.95	Sandstone	
-	115.92	119.28	3.36	-	
ID78/9	119.28	119.79	0.51	Claystone	
	119.79	123.11	3.32	Coal Seam	PU
-	123.11	123.17	0.06	-	
	123.17	123.44	0.27	Coal Seam	PL1
-	123.44	123.64	0.20	-	
	123.64	124.18	0.54	Coal Seam	PL
-	124.18	139.73	15.55	-	
ID78/10	139.73	141.23	1.50	Claystone	
-	141.23	141.56	0.33	-	
	141.56	142.02	0.46	Coal Seam	UNI
-	142.02	143.50	1.48	-	
	143.50	147.93	4.43	Coal Seam	VU
ID78/11	147.93	150.26	2.33	Sandstone/Siltstone	
-	150.26	156.99	6.73	-	
	156.99	158.45	1.46	Coal Seam	VL
-	158.45	164.47	6.02	-	
ID78/12	164.47	165.46	0.99	Carb. claystone/Claystone	
	165.46	171.61	6.15	Coal Seam	BR
-	171.61	176.55	4.94	-	
ID78/13	176.55	179.59	3.04	Sandstone	
	179.59	183.68	4.09	Coal Seam	BL
-	183.68	188.67	4.99	Carb. claystone/Claystone	
	188.67	189.69	1.02	Coal Seam	WU1
ID78/14	189.69	192.30	2.61	Carb. claystone	
-	192.30	192.32	0.02	-	
	192.32	192.90	0.58	Coal Seam	WU2
ID78/15	192.90	198.26	5.36	Sandstone/Siltstone	
-	198.26	198.79	0.53	-	
	198.79	199.70	0.91	Coal Seam	WM
	199.67	199.91	0.24	Coal Seam	EDU
-	199.91	204.13	4.22	-	
ID78/16	204.13	205.86	1.73	Conglomerate	
-	205.86	207.01	1.15	-	
	207.01	209.12	2.11	Coal Seam	ED
-	209.12	209.87	0.75	-	
ID78/17	209.87	210.57	0.70	Claystone/Coal	
-	210.57	216.97	6.40	-	
	216.97	217.38	0.41	Coal Seam	CN1
ID78/18	217.38	223.09	5.71	Sandstone	
	223.09	224.36	1.27	Coal Seam	CN2
-	224.36	233.86	9.50	-	
	233.86	235.58	1.72	Coal Seam	BA
ID78/19	235.58	238.69	3.11	Sandstone/Siltstone	
-	238.69	238.75	0.06	-	
	238.75	239.83	1.08	Coal Seam	BB
	239.75	241.14	1.39	Coal Seam	BC

Table A-4: Drill-hole ID1178 log and sample interval detail. CONTINUED

Sample ID	Depth (m)			Material Type	Seam
	from	to	Interval		
ID78/20	241.14	244.71	3.57	Sandstone/Siltstone	
-	244.71	257.88	13.17	-	
ID78/21	257.88	262.12	4.24	Sandstone	
-	262.12	267.52	5.40	-	
	267.52	271.95	4.43	Coal Seam	EG
-	271.95	271.97	0.02	-	
ID78/22	271.97	272.41	0.44	Carb. claystone/Claystone	
	272.41	272.65	0.24	Coal Seam	TR1
-	272.65	275.78	3.13	-	
	275.78	276.29	0.51	Coal Seam	TR2
ID78/23	276.29	277.36	1.07	Sandstone	
-	277.36	280.41	3.05	-	
	280.41	280.50	0.09	Coal Seam	TR3
ID78/24	280.50	282.84	2.34	Sandstone/Siltstone	
-	282.84	290.62	7.78	-	
	290.62	294.59	3.97	Coal Seam	RK
-	294.59	303.97	9.38	-	
	303.97	305.61	1.64	Coal Seam	RK4
ID78/25	305.61	311.60	5.99	Sandstone	
-	311.60	315.98	4.38	-	

Attachment B

Geochemical Test Results

Table B-1: Acid forming characteristics of drill-hole ID1164 samples, Mt Arthur Coal Open Cut Modification.

Table B-2: Acid forming characteristics of drill-hole ID1174 samples, Mt Arthur Coal Open Cut Modification.

Table B-3: pH and EC, exchangeable cations and exchangeable sodium percent for selected drill-hole samples from the Mt Arthur Coal Open Cut Modification.

Table B-4: Multi-element composition of selected drill-hole samples, Mt Arthur Coal Open Cut Modification.

Table B-5: Geochemical abundance indices of selected drill-hole samples, Mt Arthur Coal Open Cut Modification.

Table B-6: Chemical composition of water extracts from selected drill-hole samples, Mt Arthur Coal Open Cut Modification.

Table B-1: Acid forming characteristics of drill-hole ID1164 samples, Mt Arthur Coal Open Cut Modification.

Sample Code	Depth (m)			Sample Description	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS						NAG TEST			ARD Classification
	from	to	inter.				Total %S	Sulfide %S	MPA	ANC	NAPP	ANC/ MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	
ID64/1	15.57	16.01	0.44	Highly weathered	8.0	0.480	0.02		1	50	-50	82.2				NAF
ID64/2	16.01	16.97	0.96	Moderately weathered	7.6	0.407	<0.01		0	35	-35	114.4				NAF
ID64/3	16.97	19.44	2.47	Slightly weathered	8.1	0.368	<0.01		0	60	-60	195.8				NAF
ID64/4	19.44	21.54	2.10	Claystone	7.7	0.338	<0.01		0	69	-68	224.8				NAF
ID64/5	23.19	24.09	0.90	Tuff	8.5	0.569	<0.01		0	26	-25	83.3				NAF
ID64/6	24.60	25.27	0.67	Sandstone/Siltstone	7.9	0.301	0.02		1	31	-31	51.0				NAF
ID64/7	25.41	31.08	5.67	Sandstone/Siltstone	8.4	0.292	0.01		0	68	-68	222.9				NAF
ID64/8	36.60	42.78	6.18	Sandstone/Siltstone	8.3	0.523	0.03		1	41	-40	44.3				NAF
ID64/9	42.93	50.65	7.72	Siltstone	8.3	0.573	0.04		1	42	-41	34.3				NAF
ID64/10	55.61	56.03	0.42	Claystone	7.1	0.434	0.13	0.053	4	16	-12	4.1	5.2	0	4	NAF
ID64/11	56.05	57.82	1.77	Siltstone	7.8	0.319	0.04	0.026	1	14	-12	11.1	7.7	0	0	NAF
ID64/12	57.82	66.65	8.83	Sandstone/Siltstone	8.6	0.317	0.02	0.007	1	14	-14	23.5	8.3	0	0	NAF
ID64/13	66.65	73.78	7.13	Sandstone	9.2	0.270	<0.01		0	89	-89	291.8				NAF
ID64/14	73.90	80.37	6.47	Sandstone/Siltstone	8.6	0.230	0.01		0	24	-24	78.4				NAF
ID64/15	80.37	81.43	1.06	Siltstone	7.8	0.299	0.04		1	29	-28	23.5				NAF
ID64/16	85.53	86.95	1.42	Sandstone/Siltstone	7.1	0.341	0.05		2	103	-101	67.3	8.6	0	0	NAF
ID64/17	91.07	91.34	0.27	Siltstone	6.7	0.675	0.11	0.044	3	18	-14	5.2	7.8	0	0	NAF
ID64/18	91.35	97.61	6.26	Sandstone/Siltstone	8.8	0.218	0.01		0	29	-29	95.4				NAF
ID64/19	97.61	98.54	0.93	Claystone	8.1	0.324	0.04	0.022	1	15	-13	11.8	7.2	0	0	NAF
ID64/20	98.54	106.36	7.82	Sandstone	9.0	0.308	0.01		0	46	-45	149.7				NAF
ID64/21	107.28	111.75	4.47	Sandstone/Siltstone	7.5	0.365	0.03		1	29	-28	31.8				NAF
ID64/22	115.75	116.52	0.77	Sandstone	8.4	0.345	0.02		1	63	-63	103.3				NAF
ID64/23	116.75	117.77	1.02	Sandstone	8.9	0.257	0.01		0	60	-59	194.4				NAF
ID64/24	117.82	118.63	0.81	Claystone	8.8	0.319	0.09		3	32	-30	11.8	6.0	0	2	NAF
ID64/25	118.63	130.19	11.56	Sandstone/Siltstone/Claystone	9.4	0.309	0.02		1	31	-30	49.8				NAF
ID64/26	130.19	130.62	0.43	Carbonaceous claystone/Claystone	8.3	0.190	0.06	0.010	2	19	-17	10.5	6.1	0	1	NAF
ID64/27	130.87	132.87	2.00	Sandstone/Claystone	6.3	1.236	0.22	0.143	7	27	-20	4.0	8.1	0	0	NAF
ID64/28	135.90	136.68	0.78	Claystone	6.8	0.768	0.20	0.116	6	48	-42	7.9	7.7	0	0	NAF
ID64/29	142.89	144.20	1.31	Claystone	5.3	1.265	0.04	0.160	1	21	-19	16.7	8.2	0	0	NAF
ID64/30	149.13	154.89	5.76	Sandstone/Claystone	9.2	0.360	0.04		1	61	-60	50.0				NAF
ID64/31	160.21	163.51	3.30	Carbonaceous claystone/Claystone	8.8	0.280	0.05	0.014	2	25	-23	16.2	8.5	0	0	NAF
ID64/32	163.84	164.46	0.62	Claystone	8.3	0.139	0.12	0.006	4	16	-12	4.2	4.8	0	7	NAF
ID64/33	164.97	167.70	2.73	Sandstone	8.9	0.296	0.02		1	29	-29	47.7				NAF
ID64/34	167.84	170.72	2.88	Siltstone/Carbonaceous claystone	9.0	0.235	0.04		1	30	-28	24.1				NAF
ID64/35	180.58	183.06	2.48	Sandstone	8.8	0.479	0.02		1	43	-42	69.6				NAF

KEY

$pH_{1:2}$ = pH of 1:2 extract

$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)

MPA = Maximum Potential Acidity (kgH_2SO_4/t)

ANC = Acid Neutralising Capacity (kgH_2SO_4/t)

NAPP = Net Acid Producing Potential (kgH2SO4/t)

NAGpH = pH of NAG liquor

$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)

$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

ARD Classification Key

NAF = Non-Acid Forming

PAF = Potentially Acid Forming

PAF/LC = PAF Low Capacity

UC = Uncertain (expected classification)

Table B-1: Acid forming characteristics of drill-hole ID1164 samples, Mt Arthur Coal Open Cut Modification. CONTINUED

Sample Code	Depth (m) from	to	inter.	Sample Description	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	Sulfide %S	MPA	ANC	NAPP	ANC/MPA	NAG TEST NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
ID64/36	183.36	186.65	3.29	Sandstone/Siltstone/Carb. claystone	8.7	0.227	0.03		1	36	-35	38.8				NAF
ID64/37	186.65	188.54	1.89	Sandstone	8.6	0.262	0.03		1	35	-34	38.2				NAF
ID64/38	188.54	188.90	0.36	Carbonaceous claystone	5.4	0.759	0.38	0.213	12	11	1	1.0	3.5	4	18	PAF/LC
ID64/39	190.18	192.91	2.73	Claystone/Coal	6.4	0.458	0.15	0.074	5	19	-15	4.2	6.8	0	0	NAF
ID64/40	200.45	204.46	4.01	Sandstone/Siltstone	8.9	0.162	0.01	0.011	0	7	-7	22.5	9.0	0	0	NAF
ID64/41	204.73	207.61	2.88	Sandstone	9.3	0.179	0.03		1	25	-24	27.1				NAF
ID64/42	207.61	208.20	0.59	Gravelly sand	8.2	0.311	0.06		2	73	-71	39.6	10.7	0	0	NAF
ID64/43	208.20	208.96	0.76	Sandstone/Claystone	8.8	0.179	0.03		1	27	-26	28.9				NAF
ID64/44	209.82	211.57	1.75	Tuff	9.2	0.146	<0.01		0	58	-58	189.5				NAF
ID64/45	217.52	218.06	0.54	Sandstone/Claystone	9.2	0.163	0.03		1	48	-47	52.1				NAF
ID64/46	218.29	218.85	0.56	Sandstone	8.4	0.116	0.02	0.010	1	19	-19	31.5	8.9	0	0	NAF
ID64/47	219.17	222.15	2.98	Sandstone/Siltstone	9.2	0.220	0.02		1	55	-55	90.5				NAF
ID64/48	222.15	222.63	0.48	Claystone	8.2	0.263	0.04	0.025	1	16	-15	13.0	8.4	0	0	NAF
ID64/49	225.79	226.64	0.85	Claystone	8.2	0.125	0.08	0.011	2	18	-16	7.5	5.6	0	2	NAF
ID64/50	231.00	232.97	1.97	Claystone	9.0	0.230	0.03		1	43	-42	46.4				NAF
ID64/51	233.51	234.37	0.86	Claystone	9.0	0.165	0.05	0.018	2	10	-8	6.5	5.3	0	2	NAF
ID64/52	238.69	241.27	2.58	Siltstone	9.1	0.240	0.01		0	61	-61	200.0				NAF
ID64/53	241.57	243.85	2.28	Sandstone	9.6	0.217	<0.01		0	113	-113	369.3				NAF
ID64/54	243.85	244.64	0.79	Carbonaceous claystone/Claystone	9.3	0.391	0.03		1	29	-28	31.2				NAF
ID64/55	246.10	247.18	1.08	Sandstone/Claystone	9.0	0.155	0.04	0.022	1	13	-12	10.7	8.2	0	0	NAF
ID64/56	247.18	251.40	4.22	Sandstone/Siltstone	9.0	0.370	0.12	0.114	4	36	-32	9.7	10.0	0	0	NAF
ID64/57	251.78	252.40	0.62	Carbonaceous claystone/Claystone	5.0	1.178	1.03	0.803	32	17	15	0.5	2.7	12	26	PAF
ID64/58	252.79	253.83	1.04	Claystone	9.2	0.111	0.02		1	147	-146	240.2				NAF
ID64/59	255.82	257.90	2.08	Sandstone/Siltstone	8.5	0.240	0.09	0.084	3	10	-8	3.8	8.0	0	0	NAF
ID64/60	257.90	258.94	1.04	Claystone	7.6	0.327	0.14	0.035	4	36	-32	8.5	8.4	0	0	NAF
ID64/61	260.99	263.10	2.11	Claystone/Coal	9.2	0.252	0.12	0.112	4	12	-9	3.4	8.2	0	0	NAF
ID64/62	264.04	268.23	4.19	Sandstone	9.4	0.223	0.02		1	34	-33	55.1				NAF
ID64/63	268.23	269.01	0.78	Claystone	9.4	0.153	0.08		2	48	-46	19.8	8.7	0	0	NAF
ID64/64	270.97	273.73	2.76	Sandstone/Claystone	8.9	0.166	0.03	0.014	1	12	-11	12.5	8.3	0	0	NAF
ID64/65	276.53	279.11	2.58	Sandstone/Claystone	9.3	0.152	0.02	0.014	1	20	-19	32.8	8.6	0	0	NAF
ID64/66	281.73	284.92	3.19	Sandstone/Siltstone	9.7	0.180	<0.01		0	29	-29	96.1				NAF
ID64/67	285.48	292.07	6.59	Sandstone	9.9	0.220	<0.01		0	124	-124	405.2				NAF
ID64/68	292.92	294.51	1.59	Sandstone/Claystone	9.5	0.170	0.02		1	32	-32	52.9				NAF
ID64/69	295.47	300.14	4.67	Sandstone/Claystone	9.3	0.165	<0.01	0.009	0	19	-19	61.8	9.6	0	0	NAF
ID64/70	301.04	301.72	0.68	Sandstone	9.1	0.343	0.04		1	32	-31	26.1				NAF

KEY

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity (kgH_2SO_4/t)
ANC = Acid Neutralising Capacity (kgH_2SO_4/t)

NAPP = Net Acid Producing Potential (kgH2SO4/t)
NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

ARD Classification Key

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF/LC = PAF Low Capacity
UC = Uncertain (expected classification)

Table B-1: Acid forming characteristics of drill-hole ID1164 samples, Mt Arthur Coal Open Cut Modification. CONTINUED

Sample Code	Depth (m) from	Depth (m) to	Depth (m) inter.	Sample Description	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	Sulfide %S	MPA	ANC	NAPP	ANC/ MPA	NAG TEST NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
ID64/71	301.72	311.46	9.74	Sandstone/Siltstone/Claystone	9.5	0.182	0.02		1	67	-67	109.8				NAF
ID64/72	311.46	313.05	1.59	Claystone	9.5	0.214	0.02		1	122	-121	199.3				NAF
ID64/73	313.43	315.38	1.95	Sandstone/Siltstone	9.5	0.120	0.02		1	38	-38	62.4				NAF
ID64/74	318.20	319.23	1.03	Sandstone	-	-	-	-	-	-	-	-	-	-	-	- -
ID64/75	323.70	324.85	1.15	Siltstone/Claystone	-	-	-	-	-	-	-	-	-	-	-	- -
ID64/76	337.35	339.01	1.66	Claystone	9.4	0.162	0.02		1	40	-39	64.5				NAF
ID64/77	340.41	342.18	1.77	Siltstone/Claystone	9.4	0.161	0.02	0.010	1	12	-11	19.1	8.4	0	0	NAF
ID64/78	347.69	354.54	6.85	Sandstone	9.1	0.208	<0.01		0	28	-28	92.5				NAF
ID64/79	356.10	356.87	0.77	Claystone	9.4	0.143	0.02		1	72	-71	117.6				NAF
ID64/80	358.91	361.01	2.10	Sandstone	5.0	1.570	1.14	0.801	35	61	-26	1.7	2.9	7	12	UC(PAF/LC)

KEY

$pH_{1:2}$ = pH of 1:2 extract

$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)

MPA = Maximum Potential Acidity (kgH_2SO_4/t)

ANC = Acid Neutralising Capacity (kgH_2SO_4/t)

NAPP = Net Acid Producing Potential (kgH2SO4/t)

NAGpH = pH of NAG liquor

$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)

$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

ARD Classification Key

NAF = Non-Acid Forming

PAF = Potentially Acid Forming

PAF/LC = PAF Low Capacity

UC = Uncertain (expected classification)

Table B-2: Acid forming characteristics of drill-hole ID1174 samples, Mt Arthur Coal Open Cut Modification.

Sample Code	Depth (m) from	Depth (m) to	Depth (m) inter.	Sample Description	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	Sulfide %S	MPA	ANC	NAPP	ANC/MPA	NAG TEST NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
ID74/1	12.17	13.30	1.13	Highly weathered	8.2	0.398	<0.01		0	110	-110	359.5				NAF
ID74/2	13.30	13.88	0.58	Slightly weathered	7.8	0.546	<0.01	<0.005	0	8	-8	26.1	8.0	0	0	NAF
ID74/3	13.88	16.15	2.27	Sandstone/Siltstone/Claystone	7.8	0.412	0.02		1	22	-21	35.1				NAF
ID74/4	16.36	18.99	2.63	Sandstone/Siltstone	7.8	0.504	0.06	0.036	2	23	-21	12.3	8.4	0	0	NAF
ID74/5	20.51	20.91	0.40	Claystone	8.9	0.436	0.02		1	176	-175	287.6				NAF
ID74/6	25.45	33.10	7.65	Sandstone	9.5	0.408	0.01		0	81	-81	264.7				NAF
ID74/7	33.15	38.30	5.15	Sandstone/Siltstone	9.1	0.342	<0.01		0	26	-26	84.6				NAF
ID74/8	40.08	43.14	3.06	Sandstone/Siltstone	8.9	0.310	<0.01		0	30	-30	97.7				NAF
ID74/9	43.14	51.45	8.31	Sandstone	9.5	0.443	<0.01		0	145	-145	473.9				NAF
ID74/10	53.57	54.27	0.70	Carbonaceous claystone/Claystone	7.3	0.244	0.02		1	68	-68	111.4				NAF
ID74/11	55.56	56.39	0.83	Carbonaceous claystone/Claystone	9.2	0.187	0.12	0.010	4	9	-5	2.3	4.2	2	18	UC(PAF/LC)
ID74/12	56.66	57.95	1.29	Carbonaceous claystone/Claystone	8.0	0.200	0.20	0.120	6	116	-110	19.0	8.4	0	0	NAF
ID74/13	58.40	60.46	2.06	Sandstone/Siltstone/Claystone	9.2	0.355	0.02		1	100	-99	163.4				NAF
ID74/15	67.58	73.13	5.55	Sandstone/Siltstone	9.4	0.383	0.02		1	132	-131	215.7				NAF
ID74/16	73.34	76.08	2.74	Sandstone/Siltstone/Claystone	7.9	0.630	0.09	0.111	3	17	-14	6.2	8.2	0	0	NAF
ID74/17	76.08	76.73	0.65	Dolerite	7.4	0.448	0.17	0.176	5	69	-64	13.2	8.2	0	0	NAF
ID74/18	80.86	82.05	1.19	Claystone	8.9	0.412	0.05		2	68	-67	44.6	8.7	0	0	NAF
ID74/19	82.70	83.17	0.47	Carbonaceous claystone	7.4	0.445	0.10	0.049	3	68	-65	22.3	8.3	0	0	NAF
ID74/20	83.17	83.90	0.73	Sandstone/Siltstone/Claystone	8.9	0.346	0.12	0.106	4	49	-45	13.3	8.7	0	0	NAF
ID74/21	84.39	91.95	7.56	Sandstone/Siltstone/Claystone	8.9	0.308	0.03		1	75	-74	81.9				NAF
ID74/22	92.29	96.34	4.05	Sandstone/Siltstone	8.8	0.299	0.02		1	23	-22	36.8				NAF
ID74/23	96.39	108.73	12.34	Sandstone/Siltstone	9.2	0.217	0.01		0	25	-24	81.0				NAF
ID74/24	116.32	118.25	1.93	Sandstone/Siltstone	8.7	0.258	0.03		1	31	-30	34.0				NAF
ID74/25	118.63	123.00	4.37	Sandstone/Siltstone	8.1	0.257	0.02	0.015	1	18	-18	29.7	8.5	0	0	NAF
ID74/26	123.00	123.75	0.75	Carbonaceous claystone/Claystone	8.2	0.334	0.04	0.011	1	17	-16	13.9	8.3	0	0	NAF
ID74/27	124.59	125.44	0.85	Claystone	6.9	0.666	0.19	0.097	6	25	-19	4.2	7.6	0	0	NAF
ID74/28	126.43	133.74	7.31	Siltstone	9.1	0.260	0.02		1	38	-38	62.4				NAF
ID74/29	136.99	142.16	5.17	Sandstone	8.9	0.158	0.01		0	47	-47	153.9				NAF
ID74/30	146.43	147.76	1.33	Sandstone	9.0	0.161	0.02		1	115	-114	187.9				NAF
ID74/31	152.84	153.67	0.83	Carbonaceous claystone	9.1	0.213	0.09	0.018	3	13	-11	4.8	8.1	0	0	NAF
ID74/32	154.39	156.05	1.66	Siltstone/Claystone	8.2	0.233	0.22	0.122	7	13	-7	2.0	7.0	0	0	NAF
ID74/33	161.12	164.45	3.33	Siltstone	9.6	0.238	0.01		0	75	-75	244.8				NAF
ID74/34	167.44	174.13	6.69	Sandstone	9.2	0.275	0.01		0	113	-113	369.3				NAF
ID74/35	174.13	181.80	7.67	Sandstone/Siltstone	9.3	0.310	0.09		3	90	-87	32.5	9.1	0	0	NAF

KEY

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity (kgH_2SO_4/t)
ANC = Acid Neutralising Capacity (kgH_2SO_4/t)

NAPP = Net Acid Producing Potential (kgH2SO4/t)
NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

ARD Classification Key

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF/LC = PAF Low Capacity
UC = Uncertain (expected classification)

Table B-2: Acid forming characteristics of drill-hole ID1174 samples, Mt Arthur Coal Open Cut Modification. CONTINUED

Sample Code	Depth (m) from	to	inter.	Sample Description	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	Sulfide %S	MPA	ANC	NAPP	ANC/ MPA	NAG TEST NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
ID74/36	185.87	186.91	1.04	Sandstone	8.7	0.363	0.06		2	61	-59	33.2	9.6	0	0	NAF
ID74/37	186.91	187.83	0.92	Carbonaceous claystone/Claystone	6.7	0.534	0.10	0.079	3	37	-34	12.1	8.2	0	0	NAF
ID74/38	193.12	200.17	7.05	Sandstone/Siltstone	9.3	0.280	0.02		1	45	-45	73.9				NAF
ID74/39	205.47	206.18	0.71	Claystone	8.9	0.152	0.05	0.009	2	16	-15	10.6	8.1	0	0	NAF
ID74/40	206.18	206.87	0.69	Carbonaceous claystone	7.5	0.374	0.12	0.024	4	12	-9	3.3	5.8	0	3	NAF
ID74/41	211.95	215.74	3.79	Sandstone	7.5	0.214	<0.01		0	18	-18	59.5				NAF
ID74/42	218.21	218.45	0.24	Conglomerate	9.0	0.371	0.01		0	27	-26	87.6				NAF
ID74/43	224.21	229.46	5.25	Sandstone	5.1	2.440	1.16	0.909	35	17	19	0.5	3.0	6	10	PAF/LC
ID74/44	229.46	230.98	1.52	Carbonaceous claystone/Siltstone	6.4	0.833	1.12	1.010	34	9	25	0.3	2.9	17	28	PAF
ID74/45	232.76	239.31	6.55	Sandstone/Claystone	9.4	0.389	0.03		1	34	-33	36.9				NAF
ID74/46	239.46	240.06	0.60	Siltstone	9.4	0.167	0.02	0.017	1	21	-20	33.5	8.5	0	0	NAF
ID74/47	243.87	245.28	1.41	Sandstone	9.1	0.214	0.01		0	23	-23	75.8				NAF
ID74/48	245.28	252.11	6.83	Sandstone/Siltstone/Claystone	8.7	0.212	0.01	0.009	0	18	-18	60.1	8.8	0	0	NAF
ID74/49	252.28	254.95	2.67	Sandstone/Siltstone	9.2	0.326	0.02		1	37	-36	60.3				NAF
ID74/50	257.42	265.98	8.56	Sandstone/Siltstone	9.0	0.274	0.01		0	26	-25	83.7				NAF
ID74/51	268.16	272.20	4.04	Sandstone/Siltstone	9.5	0.281	0.01		0	39	-38	126.1				NAF
ID74/52	273.44	277.91	4.47	Sandstone	9.3	0.268	<0.01		0	34	-33	110.1				NAF
ID74/53	278.65	292.79	14.14	Sandstone/Siltstone	9.4	0.414	0.01		0	47	-46	152.0				NAF
ID74/54	292.85	293.62	0.77	Claystone	9.6	0.404	0.09		3	34	-31	12.2	8.9	0	0	NAF
ID74/55	293.62	304.78	11.16	Sandstone/Siltstone	9.3	0.323	0.01		0	44	-44	143.5				NAF
ID74/56	309.86	314.51	4.65	Sandstone/Siltstone	9.4	0.225	0.05		2	27	-25	17.6	8.6	0	0	NAF
ID74/57	315.15	318.25	3.10	Sandstone/Claystone	9.3	0.194	0.10	0.013	3	31	-27	10.0	8.9	0	0	NAF
ID74/58	318.65	327.19	8.54	Sandstone/Siltstone	9.6	0.384	0.02		1	119	-118	194.4				NAF
ID74/59	331.85	342.25	10.40	Sandstone	9.2	0.220	<0.01		0	34	-34	112.4				NAF
ID74/60	343.68	346.63	2.95	Sandstone	9.4	0.530	0.03		1	38	-37	41.6				NAF

KEY

$pH_{1:2}$ = pH of 1:2 extract

$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)

MPA = Maximum Potential Acidity (kgH_2SO_4/t)

ANC = Acid Neutralising Capacity (kgH_2SO_4/t)

NAPP = Net Acid Producing Potential (kgH2SO4/t)

NAGpH = pH of NAG liquor

$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)

$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

ARD Classification Key

NAF = Non-Acid Forming

PAF = Potentially Acid Forming

PAF/LC = PAF Low Capacity

UC = Uncertain (expected classification)

Table B-3: pH and EC, exchangeable cations and exchangeable sodium percent for selected drill-hole samples from the Mt Arthur Coal Open Cut Modification.

Sample Code	Sample Description	$pH_{1:2}$	$EC_{1:2}$	Exch. Cations (meq/100g)				ESP
				Ca	Mg	K	Na	
ID64/1	Highly Weathered	8.0	0.480	7.1	27.6	1.5	2.7	6.9
ID64/2	Moderately Weathered	7.6	0.407	5.4	23.0	1.5	2.2	7.0
ID64/3	Slightly Weathered	8.1	0.368	8.1	16.8	1.2	1.5	5.5
ID64/5	Tuff	8.5	0.569	8.7	53.7	3.3	9.3	12.5
ID64/9	Siltstone	8.3	0.573	4.7	11.7	2.0	4.3	18.8
ID64/10	Claystone	7.1	0.434	2.0	7.1	1.4	2.2	17.5
ID64/15	Siltstone	7.8	0.299	2.3	7.5	1.9	2.8	19.3
ID64/27	Sandstone/Claystone	6.3	1.236	3.9	8.9	1.4	2.2	13.4
ID64/38	Carbonaceous Claystone	5.4	0.759	2.5	8.2	1.3	3.3	21.8
ID64/51	Claystone	9.0	0.165	3.3	5.8	2.1	3.8	25.6
ID64/61	Claystone/Coal	9.2	0.252	3.4	3.7	2.4	4.8	33.8
ID64/64	Sandstone/Claystone	8.9	0.166	3.3	2.5	1.6	5.2	41.6
ID74/1	Highly Weathered	8.2	0.398	7.2	10.2	0.9	1.8	9.1
ID74/2	Slightly Weathered	7.8	0.546	3.9	11.6	1.4	2.4	12.5
ID74/4	Sandstone/Siltstone	7.8	0.504	4.3	12.0	1.5	2.5	12.5
ID74/6	Sandstone	9.5	0.408	19.3	9.3	1.3	3.6	10.8
ID74/11	Carbonaceous Claystone/Claystone	9.2	0.187	1.8	5.2	1.2	3.2	28.3
ID74/16	Sandstone/Siltstone/Claystone	7.9	0.630	2.9	5.7	1.5	5.4	34.7
ID74/17	Dolerite	7.4	0.448	2.8	7.1	1.9	6.4	35.2
ID74/31	Carbonaceous claystone	9.1	0.213	6.1	8.2	2.4	4.3	20.7
ID74/32	Siltstone/Claystone	8.2	0.233	2.5	6.2	1.7	3.9	27.4
ID74/37	Carbonaceous Claystone/Claystone	6.7	0.534	3.7	6.4	1.6	2.1	15.5
ID74/42	Conglomerate	9.0	0.371	8.2	6.4	1.3	3.8	19.4
ID74/43	Sandstone	5.1	2.440	11.5	8.7	1.2	5.2	19.7
ID74/56	Sandstone/Siltstone	9.4	0.225	3.4	2.0	1.4	7.6	52.8

KEY

$pH_{1:2}$ = pH of 1:2 extract

$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)

ESP = Exchangeable Sodium Percent (%)

Table B-4: Multi-element composition of selected drill-hole samples, Mt Arthur Coal Open Cut Modification.

Element	**Unit**	**Detection Limit**	**Sample Description/Code**													
			Weathered Material			Carb. claystone					Claystone			Siltstone		
			ID64/1	ID64/2	ID74/2	ID64/38	ID64/57	ID74/31	ID74/37	ID74/44	ID64/10	ID64/51	ID64/61	ID64/9	ID64/15	ID74/32
Ag	mg/kg	0.05	<	<	<	<	0.07	<	<	<	0.06	<	<	0.05	<	<
Al	%	0.005%	8.370%	8.385%	9.231%	8.398%	7.783%	9.072%	8.220%	8.941%	7.649%	8.746%	9.245%	8.243%	8.629%	8.505%
As	mg/kg	0.5	13.4	7.8	7.6	5.6	35.0	3.2	5.5	27.0	4.9	2.2	37.6	8.6	6.7	39.2
B	mg/kg	50	<	68	62	<	57	60	<	<	60	59	65	<	<	<
Ba	mg/kg	0.1	463.8	358.0	368.2	438.6	259.5	206.9	201.3	191.8	318.1	392.3	526.8	452.1	316.0	199.8
Be	mg/kg	0.05	2.10	2.12	2.21	2.63	2.13	1.80	1.98	2.57	1.75	1.76	2.33	2.30	1.76	1.92
Ca	%	0.005%	1.042%	0.557%	0.165%	0.123%	0.145%	0.241%	0.368%	0.164%	0.141%	0.109%	0.170%	0.535%	0.191%	0.199%
Cd	mg/kg	0.02	0.06	0.08	0.09	0.16	0.22	0.20	0.10	0.22	0.10	0.19	0.15	0.12	0.11	0.19
Co	mg/kg	0.1	15.9	17.1	46.0	12.9	18.0	9.4	15.8	15.2	8.3	10.4	16.3	25.6	7.3	23.8
Cr	mg/kg	5	91	122	136	35	16	27	32	79	31	30	26	165	36	31
Cu	mg/kg	1	17	26	40	33	27	33	35	28	30	38	42	30	27	31
Fe	%	0.01%	4.70%	2.88%	3.32%	2.99%	2.19%	2.81%	7.51%	2.07%	1.94%	1.22%	2.55%	5.21%	1.90%	3.13%
Hg	mg/kg	0.001	0.030	0.031	0.080	0.098	0.202	0.040	0.010	0.286	0.044	0.020	0.010	0.059	0.030	0.062
K	%	0.002%	2.014%	1.896%	2.419%	1.634%	1.632%	2.753%	1.632%	2.047%	2.173%	2.657%	2.790%	1.838%	2.332%	1.619%
Mg	%	0.002%	1.188%	0.990%	0.528%	0.390%	0.458%	0.650%	0.603%	0.320%	0.628%	0.485%	0.639%	1.077%	0.582%	0.582%
Mn	mg/kg	1	625	424	666	383	172	520	750	71	138	76	310	1253	196	451
Mo	mg/kg	0.1	0.7	1.0	1.8	0.5	2.8	0.7	0.5	1.9	0.4	0.6	1.0	1.0	0.5	1.7
Na	%	0.002%	1.037%	0.847%	0.245%	0.276%	0.557%	0.323%	0.364%	0.253%	0.260%	0.477%	0.932%	0.655%	0.986%	0.399%
Ni	mg/kg	1	78	71	145	27	35	16	25	28	13	16	22	185	20	31
P	mg/kg	50	670	503	366	417	128	374	485	169	324	309	353	620	418	312
Pb	mg/kg	0.5	19.1	17.7	17.7	25.7	36.5	16.4	14.7	23.9	18.5	19.8	18.3	18.5	18.0	16.2
Sb	mg/kg	0.05	0.64	0.63	0.73	0.58	1.19	1.32	0.69	0.58	1.04	1.17	1.46	0.68	0.90	1.03
Se	mg/kg	0.01	0.15	0.15	0.15	0.42	0.97	0.22	0.14	0.31	0.16	0.16	0.26	0.19	0.15	0.52
Si	%	0.1%	28.1%	28.8%	31.2%	20.8%	20.2%	25.4%	24.6%	26.2%	25.6%	26.9%	29.5%	26.7%	30.1%	23.1%
Sn	mg/kg	0.1	3.1	3.6	3.0	3.1	2.7	3.1	2.3	2.9	2.7	3.6	3.5	3.4	2.9	2.6
Th	mg/kg	0.01	8.24	10.51	10.35	11.33	10.79	11.48	9.41	10.67	10.92	12.52	12.85	10.87	10.87	9.11
U	mg/kg	0.01	2.90	2.56	2.35	2.48	2.99	2.63	1.99	2.55	2.76	3.15	3.02	2.53	2.64	2.35
V	mg/kg	1	98	111	135	111	116	155	134	170	138	139	149	118	123	111
Zn	mg/kg	1	74	76	116	100	130	108	58	97	90	84	118	102	101	94

< element at or below analytical detection limit.

Table B-4: Multi-element composition of selected drill-hole samples, Mt Arthur Coal Open Cut Modification. CONTINUED

Element	**Unit**	**Detection Limit**	**Sample Description/Code**										
			Sandstone								Tuff	Dolerite	Conglom.
			ID64/27	ID64/46	ID64/64	ID74/4	ID74/6	ID74/16	ID74/43	ID74/56	ID64/5	ID74/17	ID74/42
Ag	mg/kg	0.05	<	<	<	<	<	<	<	0.15	<	0.06	<
Al	%	0.005%	8.171%	8.772%	8.913%	8.836%	8.170%	8.875%	6.988%	7.970%	10.134%	7.064%	6.531%
As	mg/kg	0.5	4.8	18.4	3.0	5.4	4.1	5.5	30.1	7.2	1.3	0.6	6.2
B	mg/kg	50	<	<	62	<	<	<	<	61	<	<	<
Ba	mg/kg	0.1	701.8	467.2	511.0	312.5	422.3	372.1	228.4	357.8	115.2	123.9	414.0
Be	mg/kg	0.05	1.79	0.96	1.79	1.76	2.09	2.72	1.47	1.77	1.41	2.30	0.99
Ca	%	0.005%	0.475%	0.383%	0.217%	0.479%	2.109%	0.212%	0.590%	0.307%	0.306%	0.149%	0.609%
Cd	mg/kg	0.02	0.11	0.12	0.12	0.09	0.08	0.14	0.07	0.16	0.13	0.13	0.03
Co	mg/kg	0.1	14.9	10.9	17.6	14.8	7.2	4.7	10.9	15.4	1.2	3.5	14.9
Cr	mg/kg	5	31	27	24	30	22	32	48	23	<	<	6
Cu	mg/kg	1	30	18	24	26	18	21	7	27	4	4	5
Fe	%	0.01%	5.57%	1.29%	1.58%	2.58%	2.76%	1.87%	2.40%	6.17%	2.11%	2.91%	1.63%
Hg	mg/kg	0.001	0.030	0.010	<	0.031	0.009	0.031	0.150	0.020	0.040	0.021	0.011
K	%	0.002%	1.921%	2.145%	2.287%	2.384%	2.169%	2.026%	2.008%	2.019%	0.848%	1.809%	1.783%
Mg	%	0.002%	0.827%	0.405%	0.492%	0.719%	0.889%	0.548%	0.396%	0.616%	2.251%	0.752%	0.468%
Mn	mg/kg	1	1021	234	121	327	456	245	146	757	54	316	228
Mo	mg/kg	0.1	1.4	0.9	1.2	1.0	0.4	1.8	2.8	1.0	0.4	0.7	0.9
Na	%	0.002%	0.673%	1.296%	1.653%	0.820%	1.175%	0.418%	0.355%	1.182%	0.417%	0.233%	0.156%
Ni	mg/kg	1	22	18	21	21	10	19	11	12	5	6	15
P	mg/kg	50	1146	453	432	440	408	399	196	337	174	160	327
Pb	mg/kg	0.5	17.8	14.5	18.9	18.4	16.1	28.7	14.0	17.5	52.2	34.5	12.7
Sb	mg/kg	0.05	0.86	0.53	0.76	0.97	0.70	0.80	0.57	1.05	0.27	0.41	0.74
Se	mg/kg	0.01	0.23	0.13	0.17	0.02	0.03	0.13	0.41	0.10	0.05	0.03	0.05
Si	%	0.1%	25.1%	31.0%	31.5%	28.6%	28.5%	30.8%	32.8%	26.1%	25.6%	32.6%	34.8%
Sn	mg/kg	0.1	2.6	2.3	2.7	2.7	2.5	5.1	2.0	2.6	8.8	6.7	1.9
Th	mg/kg	0.01	10.18	8.83	11.29	10.62	9.66	18.25	8.79	10.30	30.97	21.75	8.64
U	mg/kg	0.01	2.61	2.33	2.63	2.67	2.27	4.43	1.92	2.62	6.75	4.46	1.91
V	mg/kg	1	124	95	126	112	102	76	133	125	1	9	62
Zn	mg/kg	1	98	99	95	69	67	93	67	130	108	71	41

< element at or below analytical detection limit.

Table B-5: Geochemical abundance indices of selected drill-hole samples, Mt Arthur Coal Open Cut Modification.

Element	*Mean Crustal Abundance	Sample Description/Code													
		Weathered Material			Carb. claystone					Claystone			Siltstone		
		ID64/1	ID64/2	ID74/2	ID64/38	ID64/57	ID74/31	ID74/37	ID74/44	ID64/10	ID64/51	ID64/61	ID64/9	ID74/32	ID64/15
Ag	0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Al	8.2%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As	1.5	**3**	2	2	1	**4**	1	1	**4**	1	-	**4**	2	**4**	2
B	10	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Ba	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Be	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ca	4.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cd	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co	20	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Cr	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cu	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe	4.1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hg	0.05	-	-	-	-	1	-	-	2	-	-	-	-	-	-
K	2.1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mg	2.3%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mn	950	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mo	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Na	2.3%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ni	80	-	-	-	-	-	-	-	-	-	-	-	1	-	-
P	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	14	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Sb	0.2	1	1	1	1	2	2	1	1	2	2	2	1	2	2
Se	0.05	1	1	1	2	**4**	2	1	2	1	1	2	1	**3**	1
Si	27.7%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sn	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Th	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
U	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

Table B-5: Geochemical abundance indices of selected drill-hole samples, Mt Arthur Coal Open Cut Modification. CONTINUED

Element	***Mean Crustal Abundance**	**Sample Description/Code**										
		Sandstone								Tuff	Dolerite	Conglom.
		ID64/27	ID64/46	ID64/64	ID74/4	ID74/6	ID74/16	ID74/43	ID74/56	ID64/5	ID74/17	ID74/42
Ag	0.07	-	-	-	-	-	-	-	1	-	-	-
Al	8.2%	-	-	-	-	-	-	-	-	-	-	-
As	1.5	1	**3**	-	1	1	1	**4**	2	-	-	1
B	10	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Ba	500	-	-	-	-	-	-	-	-	-	-	-
Be	2.6	-	-	-	-	-	-	-	-	-	-	-
Ca	4.0%	-	-	-	-	-	-	-	-	-	-	-
Cd	0.11	-	-	-	-	-	-	-	-	-	-	-
Co	20	-	-	-	-	-	-	-	-	-	-	-
Cr	100	-	-	-	-	-	-	-	-	-	-	-
Cu	50	-	-	-	-	-	-	-	-	-	-	-
Fe	4.1%	-	-	-	-	-	-	-	-	-	-	-
Hg	0.05	-	-	-	-	-	-	1	-	-	-	-
K	2.1%	-	-	-	-	-	-	-	-	-	-	-
Mg	2.3%	-	-	-	-	-	-	-	-	-	-	-
Mn	950	-	-	-	-	-	-	-	-	-	-	-
Mo	1.5	-	-	-	-	-	-	-	-	-	-	-
Na	2.3%	-	-	-	-	-	-	-	-	-	-	-
Ni	80	-	-	-	-	-	-	-	-	-	-	-
P	1000	-	-	-	-	-	-	-	-	-	-	-
Pb	14	-	-	-	-	-	-	-	-	1	1	-
Sb	0.2	2	1	1	2	1	1	1	2	-	-	1
Se	0.05	2	1	1	-	-	1	2	-	-	-	-
Si	27.7%	-	-	-	-	-	-	-	-	-	-	-
Sn	2.2	-	-	-	-	-	1	-	-	1	1	-
Th	12	-	-	-	-	-	-	-	-	1	-	-
U	2.4	-	-	-	-	-	-	-	-	1	-	-
V	160	-	-	-	-	-	-	-	-	-	-	-
Zn	75	-	-	-	-	-	-	-	-	-	-	-

*Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

Table B-6: Chemical composition of water extracts from selected drill-hole samples, Mt Arthur Coal Open Cut Modification.

Parameter		**Detection Limit**	**Chemical Composition**													
			Weathered Material			Carb. claystone					Claystone			Siltstone		
			ID64/1	ID64/2	ID74/2	ID64/38	ID64/57	ID74/31	ID74/37	ID74/44	ID64/10	ID64/51	ID64/61	ID64/9	ID64/15	ID74/32
pH		0.1	8.0	7.6	7.8	5.4	5.0	9.1	6.7	6.4	7.1	9.0	9.2	8.3	7.8	8.2
EC	dS/m	0.001	0.480	0.407	0.546	0.759	1.178	0.213	0.534	0.833	0.434	0.165	0.252	0.573	0.299	0.233
SO4	mg/l	0.3	56.6	42.8	32.0	713.2	815.4	47.1	281.2	488.9	193.1	62.9	121.2	288.7	127.4	95.3
Cl	mg/l	5	180	157	156	7	<	12	14	<	48	8	7	17	14	14
Al	mg/l	0.01	0.07	0.02	0.41	0.09	0.07	1.31	0.19	0.02	0.09	0.59	2.02	0.30	0.41	1.21
B	mg/l	0.01	0.03	0.02	0.01	0.06	0.04	0.02	0.02	0.02	0.19	0.02	0.02	0.04	0.04	0.03
Ca	mg/l	0.01	3.91	3.15	2.07	20.06	23.39	0.54	6.30	3.87	3.60	0.20	0.90	2.05	0.42	0.38
Cr	mg/l	0.01	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Cu	mg/l	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	<	0.02	0.01	0.03	<	0.01	0.01
Fe	mg/l	0.01	<	<	0.05	0.99	13.51	0.16	<	0.57	0.01	0.14	0.60	0.08	0.09	0.20
K	mg/l	0.1	7.2	6.4	2.8	4.5	4.9	2.6	5.7	3.0	6.7	1.2	2.0	6.3	2.7	2.4
Mg	mg/l	0.01	26.75	22.71	7.98	40.69	24.22	1.45	9.58	2.28	10.65	0.50	1.00	5.37	1.55	1.01
Mn	mg/l	0.01	0.02	0.02	0.03	0.69	0.16	0.01	0.03	0.05	0.04	0.01	0.02	0.02	0.01	0.01
Na	mg/l	0.1	129.6	110.9	130.0	250.2	319.2	83.5	141.0	249.0	129.0	72.3	102.6	183.8	93.0	88.6
Ni	mg/l	0.01	0.01	<	<	0.06	0.41	0.01	0.02	0.02	0.03	0.01	0.02	0.02	0.01	0.02
P	mg/l	0.1	0.1	0.1	<	<	0.1	0.1	<	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Si	mg/l	0.05	1.87	2.31	1.87	4.95	3.83	3.12	1.79	2.07	2.72	2.43	4.52	2.00	2.53	2.73
V	mg/l	0.01	<	<	<	<	<	<	<	<	<	0.01	<	<	<	<
Zn	mg/l	0.01	0.03	0.02	0.02	0.2	0.4	0.04	0.02	0.03	0.26	0.02	0.11	<	0.02	0.04
Ag	ug/l	0.01	0.02	<	0.04	<	0.06	0.01	<	<	0.12	<	0.04	<	0.02	0.01
As	ug/l	0.1	1.6	1.9	1.0	3.4	5.7	19.0	4.7	3.1	20.1	16.3	21.6	12.6	27.7	103.3
Ba	ug/l	0.05	5.62	3.29	13.30	19.04	24.80	9.20	11.79	6.55	7.21	5.30	125.53	4.30	1.51	7.09
Be	ug/l	0.1	<	<	<	0.5	0.6	0.3	<	<	<	0.1	0.8	<	<	0.3
Cd	ug/l	0.02	0.65	0.26	0.11	1.80	1.46	0.16	0.15	0.14	0.14	0.12	0.34	0.13	0.10	0.17
Co	ug/l	0.1	0.4	0.2	1.4	27.1	299.5	3.5	1.8	6.5	3.6	7.7	18.4	0.6	0.6	13.0
Hg	ug/l	0.1	<	<	<	<	<	<	<	<	<	<	<	<	<	<
Mo	ug/l	0.05	2.65	2.98	7.46	0.32	1.68	74.02	6.40	15.75	20.67	132.80	137.37	163.48	51.30	126.51
Pb	ug/l	0.5	4.1	2.6	0.6	6.5	3.5	2.4	1.2	<	4.1	1.6	3.5	2.8	1.3	2.2
Sb	ug/l	0.01	0.10	0.11	0.15	0.04	0.16	3.15	0.24	0.25	0.80	6.14	5.71	4.06	1.46	2.76
Se	ug/l	0.5	4.9	5.3	2.5	45.4	57.1	56.6	41.0	45.0	58.9	62.6	43.4	122.0	53.6	56.7
Sn	ug/l	0.1	<	<	<	<	<	<	<	<	0.2	<	<	<	<	<
Th	ug/l	0.005	0.020	0.032	0.040	0.007	0.030	0.017	<	0.016	0.089	<	0.039	0.038	0.145	0.054
U	ug/l	0.005	0.678	0.374	0.090	0.075	0.157	1.796	0.119	0.037	0.181	1.194	0.806	0.851	0.121	0.655

< element at or below analytical detection limit.

Table B-6: Chemical composition of water extracts from selected drill-hole samples, Mt Arthur Coal Open Cut Modification. CONTINUED

Parameter		Detection Limit	Chemical Composition										
			Sandstone								Tuff	Dolerite	Conglom.
			ID64/27	ID64/46	ID64/64	ID74/4	ID74/6	ID74/16	ID74/43	ID74/56	ID64/5	ID74/17	ID74/42
pH		0.1	6.3	8.4	8.9	7.8	9.5	7.9	5.1	9.4	8.5	7.4	9.0
EC	dS/m	0.001	1.236	0.116	0.166	0.504	0.408	0.630	2.440	0.225	0.569	0.448	0.371
SO4	mg/l	0.3	950.7	59.1	64.1	154.6	73.8	327.0	2423.3	52.9	82.0	249.7	176.2
Cl	mg/l	5	19	8	9	68	47	25	8	<	66	18	6
Al	mg/l	0.01	0.05	0.35	2.85	0.08	0.41	0.19	0.04	0.96	0.29	0.16	1.13
B	mg/l	0.01	0.04	0.02	0.02	0.02	0.03	0.02	<	0.03	0.07	0.02	0.01
Ca	mg/l	0.01	57.79	0.47	1.68	3.08	0.85	0.88	242.98	0.46	0.68	0.13	1.23
Cr	mg/l	0.01	<	<	<	<	<	<	<	<	<	<	<
Cu	mg/l	0.01	<	<	0.03	<	<	0.01	<	0.02	0.02	<	0.01
Fe	mg/l	0.01	<	0.04	0.80	<	0.03	<	82.67	0.26	0.02	<	0.05
K	mg/l	0.1	10.3	1.0	2.6	3.7	2.4	3.0	16.6	1.0	4.3	1.7	2.4
Mg	mg/l	0.01	122.26	1.14	1.38	9.80	2.41	1.56	143.75	0.34	3.05	0.49	1.03
Mn	mg/l	0.01	0.97	0.02	0.02	0.02	0.01	0.02	5.82	0.02	0.01	0.01	0.01
Na	mg/l	0.1	210.8	61.6	74.3	139.1	127.8	208.1	591.5	93.4	112.0	150.0	128.8
Ni	mg/l	0.01	0.21	0.01	0.05	0.01	<	0.01	0.50	0.01	0.01	<	0.01
P	mg/l	0.1	<	0.1	0.1	0.1	0.1	0.1	0.2	<	0.1	0.1	0.1
Si	mg/l	0.05	2.09	1.91	6.33	1.42	1.17	1.60	3.17	2.31	2.19	1.79	2.00
V	mg/l	0.01	<	0.01	0.02	<	<	<	<	0.01	<	<	<
Zn	mg/l	0.01	0.25	0.01	0.16	0.01	0.02	0.01	1.14	0.03	0.02	0.01	<
Ag	ug/l	0.01	<	<	<	0.01	0.02	0.05	<	<	<	0.02	0.02
As	ug/l	0.1	4.8	343.9	19.9	7.8	14.0	8.8	2.2	55.7	5.4	0.7	15.4
Ba	ug/l	0.05	31.30	1.95	244.41	1.86	1.21	3.07	17.14	12.72	1.35	1.17	5.60
Be	ug/l	0.1	<	<	1.4	<	<	<	0.5	0.2	<	<	<
Cd	ug/l	0.02	0.84	0.14	0.62	0.23	0.27	0.26	3.16	0.15	0.45	0.12	0.17
Co	ug/l	0.1	190.9	1.5	46.9	2.8	0.6	0.5	354.9	11.5	0.2	0.4	1.8
Hg	ug/l	0.1	<	<	<	<	<	<	<	<	<	<	<
Mo	ug/l	0.05	9.67	85.28	106.21	115.34	43.23	53.00	0.78	76.65	77.48	16.71	64.75
Pb	ug/l	0.5	4.2	1.8	11.4	0.9	0.5	2.6	<	2.4	4.7	<	2.9
Sb	ug/l	0.01	0.32	3.58	1.15	0.96	1.97	1.40	0.06	2.82	3.49	0.43	1.60
Se	ug/l	0.5	75.0	34.3	32.4	32.2	23.8	34.9	30.6	46.8	9.3	4.4	11.0
Sn	ug/l	0.1	<	<	<	<	<	<	<	<	<	<	<
Th	ug/l	0.005	<	<	0.013	<	<	0.006	0.271	0.008	0.080	<	<
U	ug/l	0.005	0.465	0.258	0.786	0.341	0.209	0.629	0.294	0.891	2.149	0.042	0.274

< element at or below analytical detection limit.