APPENDIX 11

Geochemistry Assessment




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ON BEHALF OF MOUNT OWEN PTY LIMITED

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Geochemical Assessment of the Mount Owen Continued Operations Project Modification 2

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List of Abbreviations

Abbreviations Used in Geochemical Assessment

ARD	Acid Rock Drainage
AMD	Acid, Metalliferous and Saline Drainage
NMD	Neutral and Metalliferous Drainage
ABA	Acid Base Account
$pH_{1:2}$	pH of a sample slurry with a solid to water ratio of 1:2 (by weight)
$EC_{1:2}$	Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight)
ESP	Exchangeable Sodium Percentage
ECEC	Effective Cation Exchange Capacity
S	Sulphur
CRS	Chromium Reducible Sulphur
KCl	Potassium Chloride
H_2SO_4	Sulphuric Acid
SO_4	Sulphate
$CaCO_3$	Calcium Carbonate
ANC	Acid Neutralising Capacity in kg H_2SO_4/t
ANC_{ABCC}	Acid Neutralising Capacity in kg H2SO4/t estimated from ABCC testing
CNV	Carbonate Neutralising Value in kg H2SO4/t
MPA	Maximum Potential Acidity, calculated from total S in kg H_2SO_4/t
NAPP	Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg H_2SO_4/t.
NAG	Net Acid Generation (test)
NAGpH	pH of NAG solution before titration
$NAG_{(pH4.5)}$	NAG acidity titrated to pH 4.5 in kg H_2SO_4/t
$NAG_{(pH7.0)}$	NAG acidity titrated to pH 7.0 in kg H_2SO_4/t
ABCC	Acid Buffering Characteristic Curve
GAI	Geochemical Abundance Index based on multi-elements of solids
PAF	Potentially Acid Forming
PAF-LC	Potentially Acid Forming - Low Capacity
NAF	Non Acid Forming
UC	Uncertain
AC	Acid Consuming

Units of Measurement

%	Percentage
°C	Degrees Celsius
dS	Deci Siemen
μm	Micrometre
mm	Millimetre
m	Metre
mg	Milligram
g	Gram
mg	Milligram
kg	Kilogram
t	Tonne
L	Litre
ml	Millilitre

Other Abbreviations

ALS	Australian Laboratory Services
EGi	Environmental Geochemistry International Pty Ltd
ROM	Run-of-Mine

Executive Summary

Environmental Geochemistry International Pty Ltd (EGi) was commissioned by Umwelt (Australia) Pty Limited on behalf of Mt Owen Pty Limited (Mount Owen) to carry out a geochemical assessment of the Mount Owen Continued Operations Project Modification 2 (Proposed Modification). This assessment follows on from previous geochemical investigations associated with potential mining areas at the Mount Owen Complex carried out by EGi in 2013. This report will contribute to a Statement of Environmental Effects (SEE) for the Proposed Modification.

The objectives of the work were to assess the acid rock drainage (ARD), salinity, metal/metalloid leaching (including neutral mine drainage, NMD) of the proposed mine materials, identify any geochemical issues, and provide recommendations for materials management and any follow up test work required.

Since the Proposed Modification involves mining of a stratigraphic sequence already included in the 2013 EGi Study of the Mount Owen Complex, the 2013 and current study results and findings were used in conjunction to assess the geochemical implications for the Proposed Modification. A total of 147 overburden/interburden core samples were tested as part of the current study. The 2013 EGi Study included 265 overburden/interburden and coal samples, and 150 washery waste samples relevant to the Proposed Modification.

Results indicate that the vast bulk (over 95%) of overburden/interburden materials represented by the samples tested likely to be NAF, with a significant excess of acid neutralising capacity and low leachable salinity. Occasional thin (generally less than 0.3 m) zones of elevated sulphur were identified close to coal seams, but dilution and mixing during mining should be sufficient to mitigate any ARD generation.

Fresh overburden/interburden had a moderate median ANC of 20 kg H_2SO_4/t, providing a potential source of buffering to help mitigate any ARD from PAF materials. Fresh sandstone tended to have higher ANC than other lithologies, having a median of 25 kg H_2SO_4/t, and is also the most common lithology. Note that weathered overburden/interburden had a relatively low median ANC of 10 kg H_2SO_4/t and is unlikely to be a source of significant buffering.

The Proposed Modification will result in a stepped pit floor, comprising the floor of the Lemington DA Seam; floor of Liddell 6 Seam; and floor of the Lower Hebden Seam. Test results indicate the Lower Hebden Seam floor is likely to be NAF, with mixed NAF and PAF-LC materials indicated based on limited testing for the Liddell 6 Seam floor and Lemington DA Seam floor. The excess ANC in overlying backfilled overburden/interburden would be expected to account for any low capacity ARD generated from portions of these seam floors.

The coal materials represented by the samples tested appear to be mainly NAF, but may include potentially acid forming (PAF) and PAF-LC portions. Some occurrences of coal horizons generating ARD were observed in the current North Pit walls, but the vast majority of the pit walls showed no evidence of ARD, supporting the isolated nature of these pyritic horizons.

Results of coarse and fine rejects testing carried out as part of the 2013 EGi Study of the Mount Owen Complex are expected to be applicable to the Proposed Modification, which indicate these are likely to be mainly NAF. However, rejects from Pikes Gully, Liddell and Hebden Seam Groups may have a greater ARD hazard.

Kinetic NAG and leach column testing indicates that PAF materials are reactive and can rapidly generate ARD within weeks to a couple of months after exposure to atmospheric oxidation conditions. Constituents associated with ARD are likely to include Al, As, Co, Cu, Fe, Mn, Ni and Zn, and slightly elevated Cd and Cr. However, leach column results also show that thorough blending with NAF materials is likely to be an effective strategy in controlling ARD from PAF materials for at least 12 months.

Water extraction and leach column testing of NAF overburden/interburden and rejects indicated that neutral mine drainage was unlikely to contain significant metal/metalloid concentrations.

Water quality testing of the North Pit and West Pit areas for the Approved Operations shows that drainage into the existing pits and tailings storage have slightly alkaline pH, high alkalinity, and low metal/metalloid concentrations. Results confirm that the minor amounts of PAF materials expected in pit walls, overburden/interburden and washery wastes have not lowered the pH, with the excess alkalinity providing a high factor of safety for pH control and maintenance of low metal/metalloid concentrations. In addition, mine water dams are saline and dominated by Cl and SO_4 salts, and it is unlikely that there would be any significant salinity effects from ARD generated by PAF materials beyond what is already being managed on site.

Results have the following implications for mine materials management:

- The vast majority of overburden/interburden, coal and washery wastes for the Proposed Modification are expected to be NAF with excess ANC and are not expected to require special handling. Dilution and mixing during mining is expected to be sufficient to mitigate ARD from any occasional thin zones of pyrite that may be present in pit walls and pit backfill to prevent any significant impacts on downstream water quality.
- Although the PAF mine materials do not appear to represent a concern in terms of downstream water quality impacts, placement of PAF materials close to final surfaces could cause local effects on rehabilitation success through upward migration of acid and salinity into the growth horizon. The thorough intermingling of coarse rejects and overburden observed on site (Section 2), and the excess ANC in the overburden suggests, that these bulk fill zones are unlikely to result in any significant effects on rehabilitation. However, fine rejects (tailings) are not mixed with neutralising materials, and spigotting fine rejects can result in preferential deposition and concentration of pyritic materials, potentially resulting in PAF zones. These aspects need to be considered in the detailed final rehabilitation design of the tailings storage facilities (TSFs).
- Weathered Permian materials are likely to be NAF, but as per the 2013 EGi Study for the Mount Owen Complex appear to be sodic and dispersive, and may need to be treated with gypsum or lime if used as a plant growing horizon, exposed on dump surfaces or used in engineered structures. Finer grained fresh Permian materials may also be partly sodic and require treatment.
- The pit water quality in the North Pit developed as part of the Proposed Modification is expected to be similar to current pit water quality. More detailed assessment of existing surface and groundwater quality, together with geochemical modelling and water quality prediction would be required to confirm this.

It is recommended that additional investigations be carried out as follows:

- Carry out visual inspection of any further core drilling in the Proposed Modification mine area for evidence of pyrite occurrence to confirm the strong dominance of NAF overburden/interburden across the deposit.
- The potential impacts of fine rejects on final rehabilitation of the TSFs are uncertain, and it should be demonstrated that either the TSF will not contain zones of PAF materials close to surface, or that the final TSF capping design will be effective in controlling upward flux of any potential ARD products. This will need to be considered in the detailed final rehabilitation design of the TSFs.
- The Mount Owen Surface Water Management and Monitoring Plan (SWMMP) includes water quality monitoring provisions to monitor for ARD effects[1]. It is recommended that the following modifications should be carried out:
  - The monitoring points should be expanded to include the West Pit decant and North Pit dewatering prior to discharge to the ECD2 pond;
  - The parameters listed in the SWMMP should include the following relevant to ARD: pH, EC, SO_4, Ca, Mg, K, Na, Cl, Al, As, Co, Cu, Fe, Mn, Ni and Zn. Alkalinity should also be determined and carried out at the same frequency as pH and EC for all sites.
  - pH, EC, alkalinity SO_4, Ca, Mg, K, Na and Cl be determined monthly at water quality sites ECD2, West Pit decant and North Pit dewatering for 12 months and reviewed.

[1] *Surface Water Management and Monitoring Plan*, Mt Owen Open Cut, Glencore, Version 8. 17/10/17, Section 4.3.2.

1.0 Introduction

Environmental Geochemistry International Pty Ltd (EGi) was commissioned by Umwelt (Australia) Pty Limited on behalf of Mt Owen Pty Limited (Mount Owen) to carry out a geochemical assessment of the Mount Owen Continued Operations Project Modification 2 (Proposed Modification). This assessment follows on from previous geochemical investigations associated with potential mining areas at the Mount Owen Complex carried out by EGi in 2013[2] (2013 EGi Study). This report will contribute to a Statement of Environmental Effects (SEE) for the Proposed Modification.

The objectives of the work were to assess the acid rock drainage (ARD), salinity, metal/metalloid leaching (including neutral mine drainage, NMD) of the proposed mine materials, identify any geochemical issues, and provide recommendations for materials management and any follow up test work required.

The scope of work comprised the following:

- an initial scoping phase involving liaison with relevant project personnel, compilation of background project data, and a site visit in June 2017 to examine representative core through the proposed mine stratigraphic sequence and inspect pits and operations;
- preparation of an overburden and interburden sampling programme in conjunction with site geologists to represent the mine stratigraphy and expected geochemical variation of overburden, taking into account previous EGi assessment work;
- collection of samples by site personnel with advice from EGi;
- sample preparation and laboratory testing of samples; and
- assessment of results and reporting.

2.0 Background and Geology

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton, 24 km south-east of Muswellbrook and to the north of Camberwell. Mount Owen, a subsidiary of Glencore Coal Pty Limited (Glencore), currently owns three existing open cut operations in the Mount Owen Complex; Mount Owen (North Pit) and associated infrastructure, Ravensworth East (Bayswater North Pit) and Glendell (Barrett Pit).

Mount Owen received development consent (SSD-5850) from the NSW Planning Assessment Commission for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016. The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and Coal Handling and Preparation Plant

[2] *Geochemical Assessment of the Mount Owen Optimisation Project*, EGi Document No. 2352/1053, July 2013.

(CHPP) and Ravensworth East Mine and allows for continued and expanded mining until 2031, now referred to as the ‘Approved Operations’. Glendell Mine operates under a separate consent (DA 80/952) and does not form part of the Approved Operations.

In September 2017 Mount Owen modified SSD-5850 (Modification 1) to allow for the construction of a water pipeline from the Integra Underground Mine to the Mount Owen Complex and allow the integration of the Integra Underground Mine into the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Mount Owen now proposes to further modify development consent SSD-5850 to allow for the optimisation of the North Pit mine plan to access coal reserves from the mining tenements obtained by Glencore through its acquisition of the Integra Underground Mine (the Proposed Modification).

The Proposed Modification will involve further mining of the stratigraphic sequence currently being mined in the North Pit at Mount Owen. The coal deposit is a Permian aged multi-seamed resource hosted within the Wittingham Coal Measures, which is in turn part of the Singleton Super-Group. The Proposed Modification will enable access to approximately 35 million tonnes (Mt) of additional run-of-mine (ROM) coal from the North Pit. Recovery of the additional coal reserves will result in approximately 46 hectares (ha) of additional disturbance (Proposed Disturbance Area) (Figure 1), representing an increase of approximately 1.8 per cent to the total disturbance area currently approved, and require an increased depth in the North Pit to provide for mining down to the Hebden Seam. The change to the North Pit mine plan will require the extension of the mine life through to 2037 (an additional 6 years).

Figure 2 is a typical stratigraphic section for the Singleton Super-Group in the region. The stratigraphy targeted by the Approved Operations extend from the Ravensworth Seam to Lower Hebden groups, while target seams of the Proposed Modification comprise seam groups ranging from the base of the Lemington Seam to the floor of the Lower Hebden Seam groups (indicated by two horizontal red lines in Figure 2). Key non-coal sedimentary materials for the Proposed Modification are predominantly (in decreasing order of abundance) sandstones, siltstones, carbonaceous mudstone, mudstone and tuff.

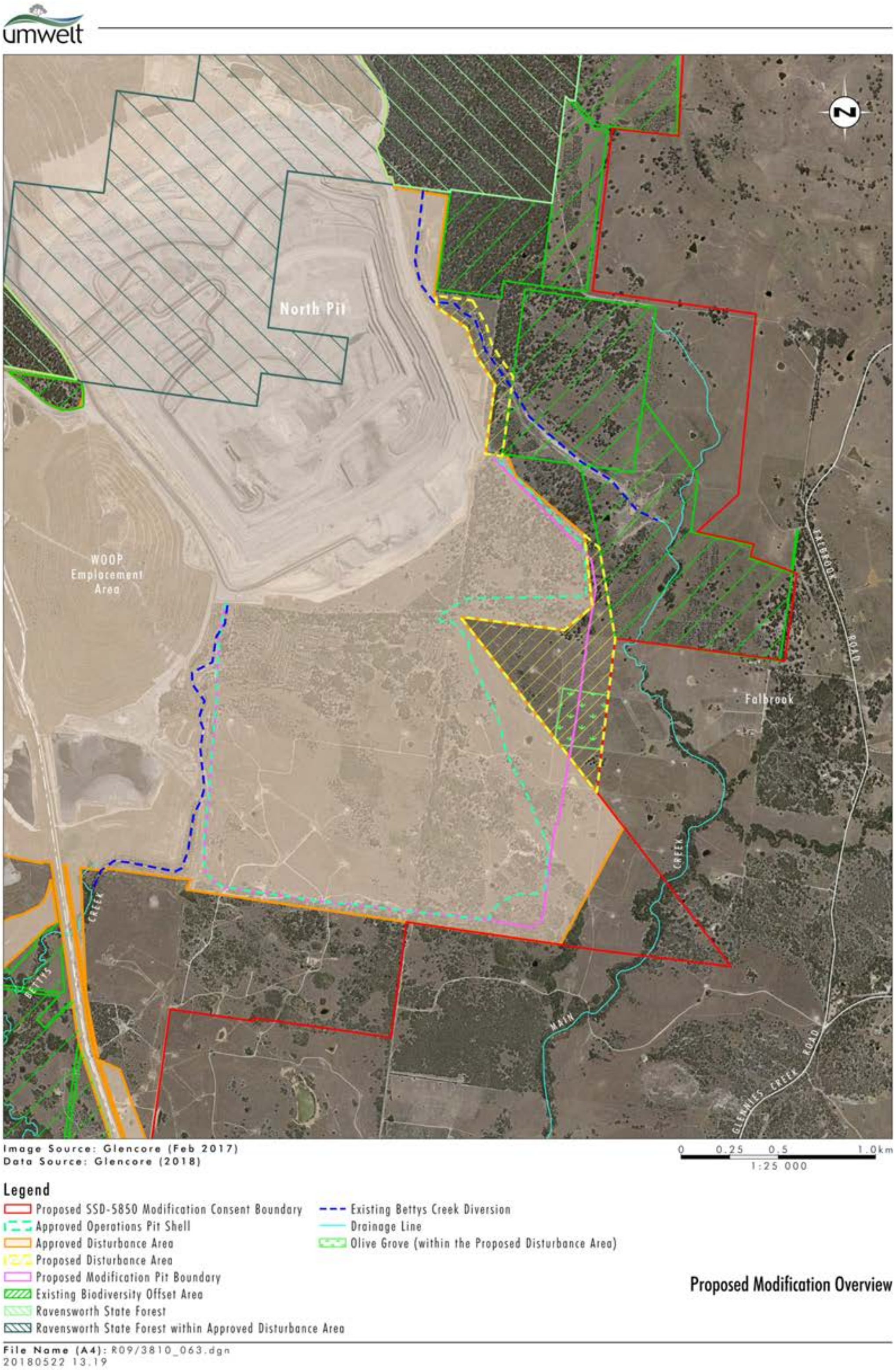

Figure 1 – Overview of the Proposed Modification showing the North Pit location and Proposed Disturbance Area.

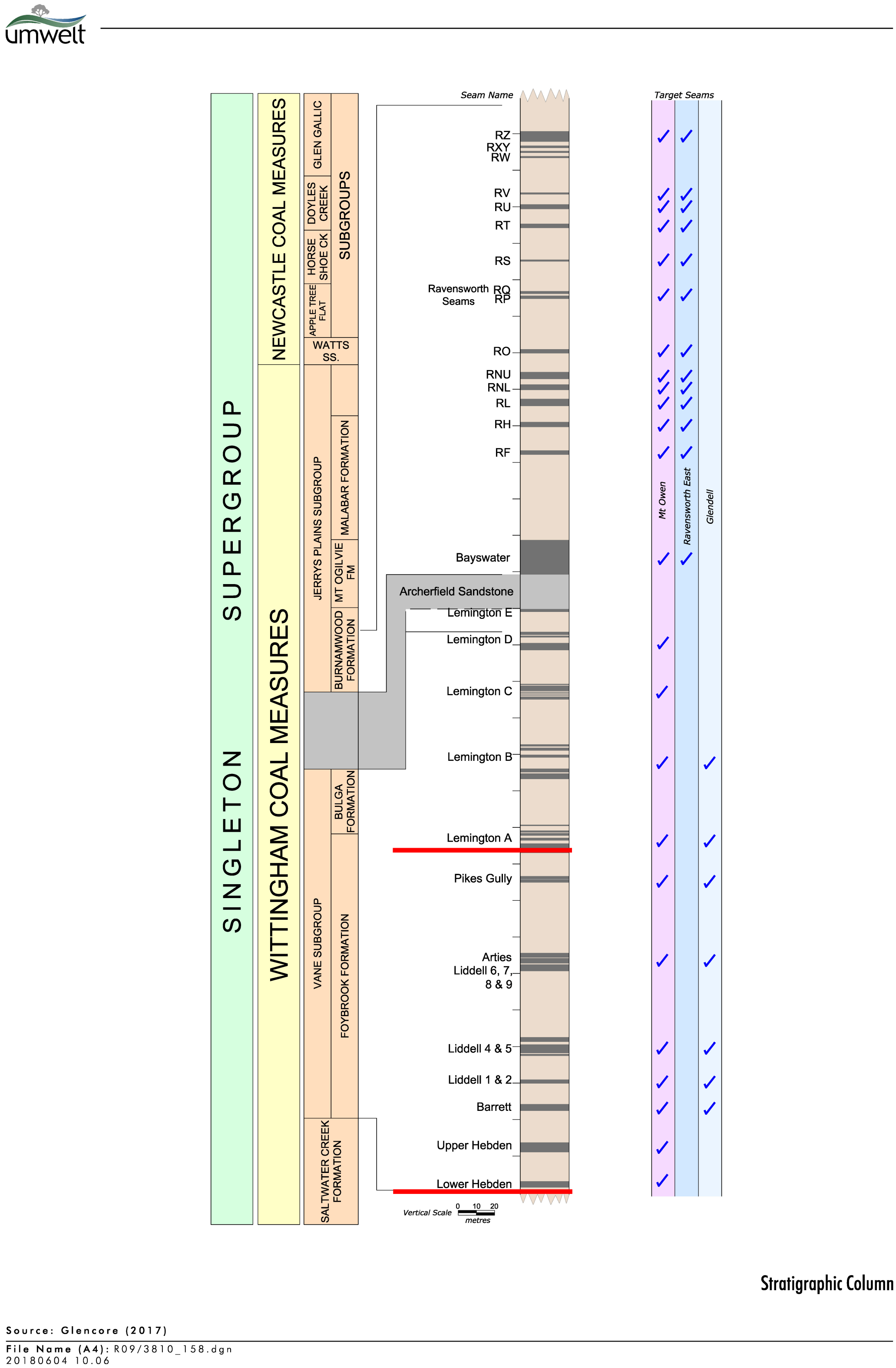

Figure 2 – Typical stratigraphic section of the Mount Owen Complex, showing the target seams for the Proposed Modification (marked by the two horizontal red lines).

Since the Proposed Modification involves mining of a stratigraphic sequence already included in the 2013 EGi Study of the Mount Owen Complex, the previous results can be used in conjunction with new results to assess the geochemical implications for the Proposed Modification.

Mining would involve continuation of current truck and excavator methods currently being used, and reach a final pit depth of approximately 380 m from surface. Overburden and interburden would be progressively backfilled into the existing pits, with some out of pit dumping as required, up to the approved heights.

All coal is washed at the existing Mount Owen Coal Handling and Preparation Plant (CHPP) to produce mainly thermal coal and around 20% soft coking coal, and coarse and fine rejects streams. Product coal is transported to the Port of Newcastle via the existing Mount Owen rail spur and the Main Northern Line. Coarse rejects are placed in pit with the overburden/interburden, and fine rejects thickened and deposited within the West Pit, in-pit tailings cells in North Pit/Bayswater North Pit, and/or transferred as part of the GRAWTS.

Cored holes SMC028 and SMC032 were examined during the June 2017 site visit as examples of interburden and overburden through the proposed mine stratigraphy. These holes were drilled in March to April 2016. The focus of the core inspection was to identify any pyrite and neutralising carbonate occurrence, and check for continuity with previous observations during assessment of the Approved Operations.

Previous inspection of core and geochemical test work conducted for the Mount Owen Complex[2] suggested that the pyrite was fast reacting and thus reaction products would be readily apparent through the presence of iron staining, and secondary salts associated with pyrite oxidation reactions, even in relatively fresh core. Exposure of the core from SMC028 and SMC032 for over a year before inspection was expected to be sufficient to allow partial oxidation of any pyrite and clearly highlight any pyritic zones. Note that coal seam intervals and immediate roof and floor materials had already been removed from the core examined, and no visual assessment could be made on pyrite occurrence in these materials.

As with previous observations for the Mount Owen Complex, the vast majority of the core showed no evidence of pyrite occurrence (Plate 1). Pyrite occurrence was generally very minor throughout the stratigraphy, occurring mainly as traces and as thin veneers on bedding surfaces associated with carbonaceous partings and plant fossils (Plate 2 and 3), pyrite containing lensoids and conglomerate clasts (Plate 4 and 5), carbonaceous wisps in sandstone (Plate 6), fractures (Plate 7), and more rarely as small (less than 150 mm) pyritic zones (Plate 8) and small lenses and bands (Plate 9). The more pyritic zones were generally within a meter of coal seams and associated carbonaceous horizons, supporting a selective sampling programme for the Proposed Modification that focusses on these horizons with a higher ARD hazard. Previous work and current observations show that those overburden/interburden zones with no visible evidence of pyrite can be assumed to be NAF.

Plate 1 – Typical benign sandstone and siltstone overburden/interburden. Hole SMC032, depth 175.10 to 183.79 m.

Plate 2 – Iron staining and sulphate salts due to partial oxidation of a pyrite coating parallel to bedding. Hole SMC032, depth 156.85 m.

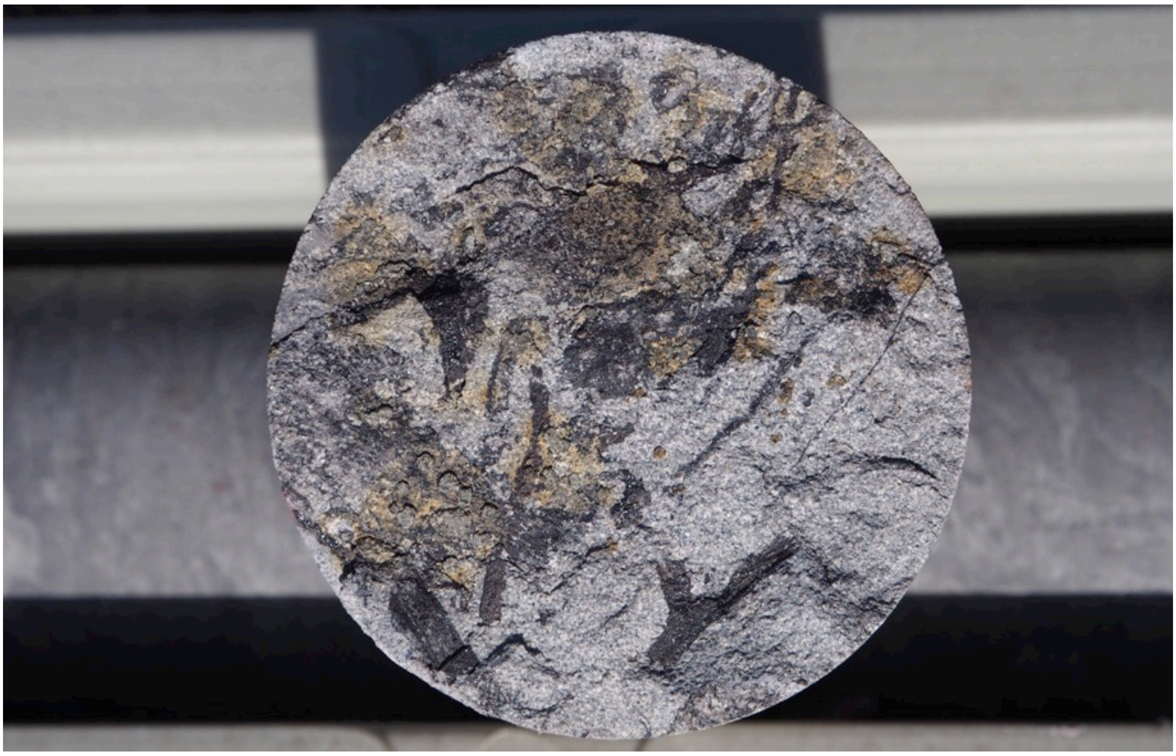

Plate 3 – Iron staining and sulphate salts due to partial oxidation of a pyrite coating parallel to bedding. Hole SMC028, depth 354.5 m.

Plate 4 – Iron staining and sulphate salts due to partial oxidation of a pyrite containing lensoid in sandstone. Hole SMC032, depth 250.4 m.

Plate 5 – Iron staining and sulphate salts due to partial oxidation of pyrite in a conglomerate clast. Hole SMC032, depth 192.1 m.

Plate 6 – Iron staining and sulphate salts due to partial oxidation of a pyrite associated with a carbonaceous wisp. Hole SMC028, depth 504.1 m.

Plate 7 – Iron staining and sulphate salts due to partial oxidation of pyrite in a fracture. Hole SMC032, depth 174.3 m.

Plate 8 – Iron staining and sulphate salts due to partial oxidation of a pyritic zone. Hole SMC032, depth 265.95 to 266.10 m.

Plate 9 – Pyrite band (partly oxidised) parallel to bedding. Hole SMC032, depth 153.5 m.

During inspection of core for the Mount Owen Complex, 15% HCl was applied to the core intermittently to provide an indication of the presence of reactive carbonate such as calcite and dolomite. Results showed common faint fizzing throughout the core, with occasional zones of strong fizzing indicting the presence of calcitic carbonate. The calcitic carbonate occurred in the matrix and as veins in sandstone horizons (Plate 10) and in some siltstone and conglomerate as veins in coal, as veinlets and in matrix associated with siderite lenses, and in a few instances as calcitic/sideritic layers with cone-in-cone textures (Plate 11). Cored holes SMC028 and SMC032 representing stratigraphy of the Proposed Modification showed similar veining and lithologies, and is expected to show similar properties in regard to reactive carbonate occurrence.

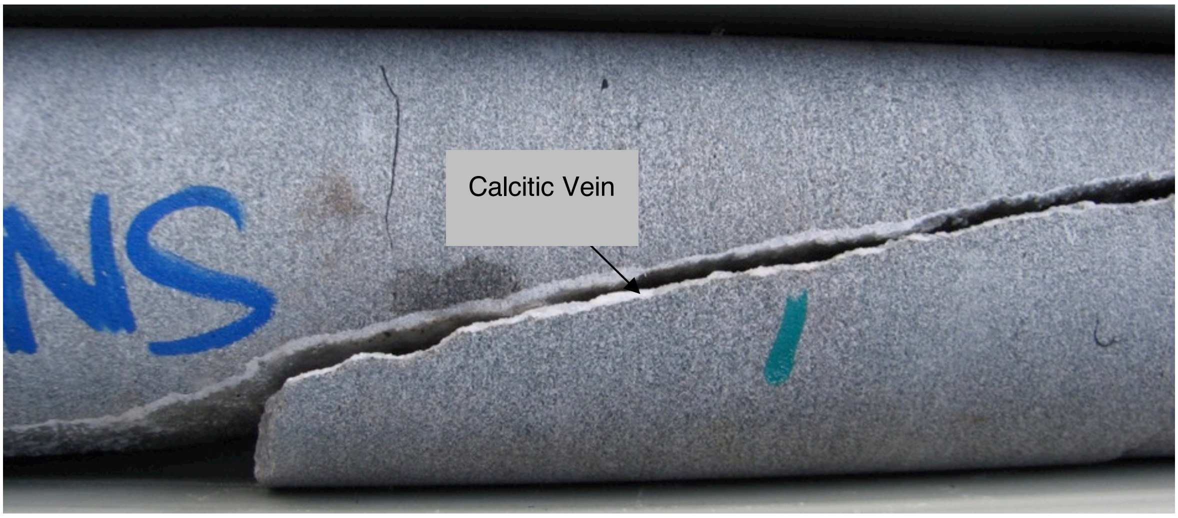

Plate 10 – Sandstone with calcitic carbonate in the matrix and veins. Hole SMC001, 51.5 m depth.

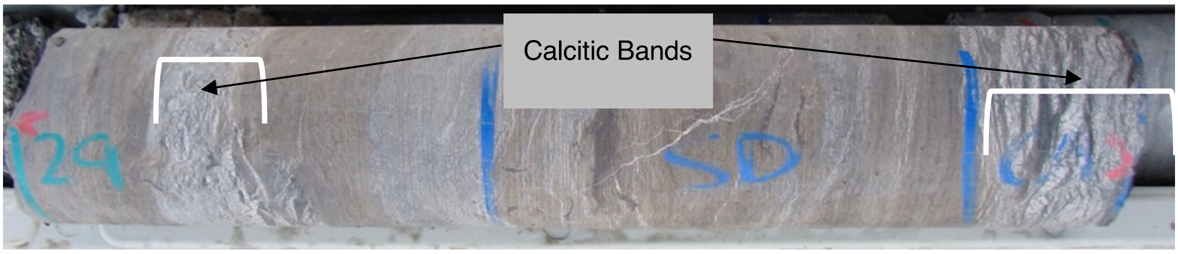

Plate 11 – Calcitic bands with cone-in-cone texture within a sideritic layer. Hole SMC001, 29.15 m depth.

The existing pit and overburden/interburden and coarse rejects materials and management were inspected during the EGi site visit.

Overburden/rejects are generally end tipped in 30 m lifts, with rejects dumped amongst the overburden/coarse rejects in intermingled end tips, and paddock dumps in blocks (Plates 12 and 13). Examination of dumped overburden/interburden and coarse rejects indicated a general lack of pyritic materials, apart from some isolated pyritic clasts in the coarse rejects (Plate 14).

Thin horizons of pyritic materials were observed in the pit walls in two locations associated with coal seams (Plates 15 to 17). These were readily apparent due to development of distinct yellow salts and iron staining after pyrite oxidation, and the lack of these products in the vast majority of the pit walls supports the isolated nature of these pyritic horizons.

Plate 12 – Backfill of the existing Mount Owen North Pit.

Plate 13 – End tipping of overburden/interburden and paddock dumping of rejects in the Mount Owen North Pit.

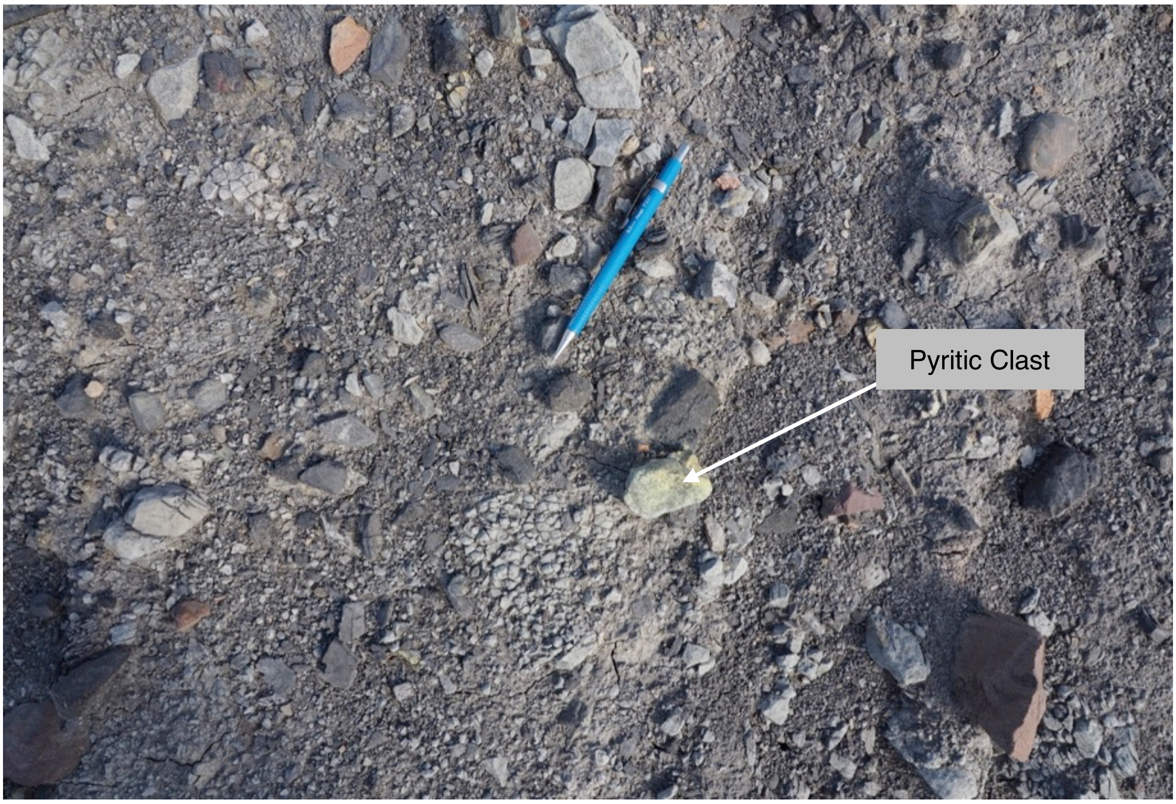

Plate 14 – Rejects placed in the Mount Owen North Pit showing isolated partly oxidised pyritic clast.

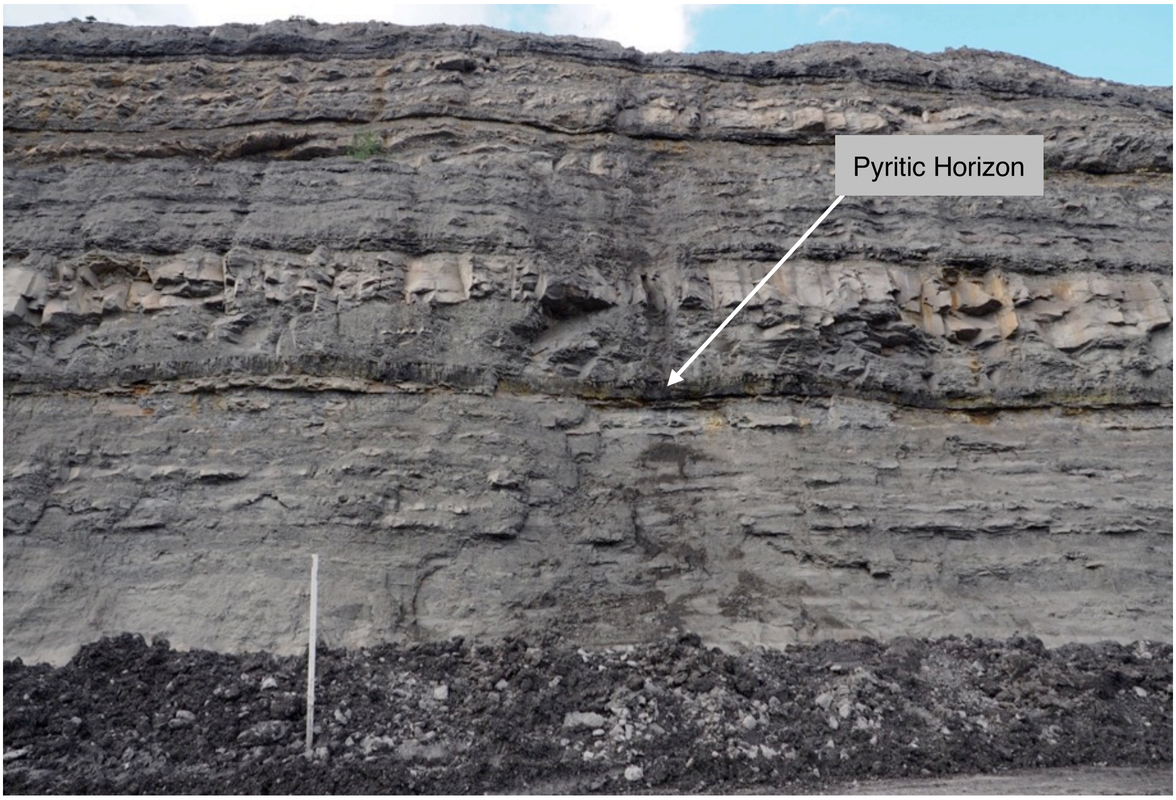

Plate 15 – Thin pyritic horizon associated with Pikes Gully Seam, showing distinct yellow salts and iron staining due to pyrite oxidation.

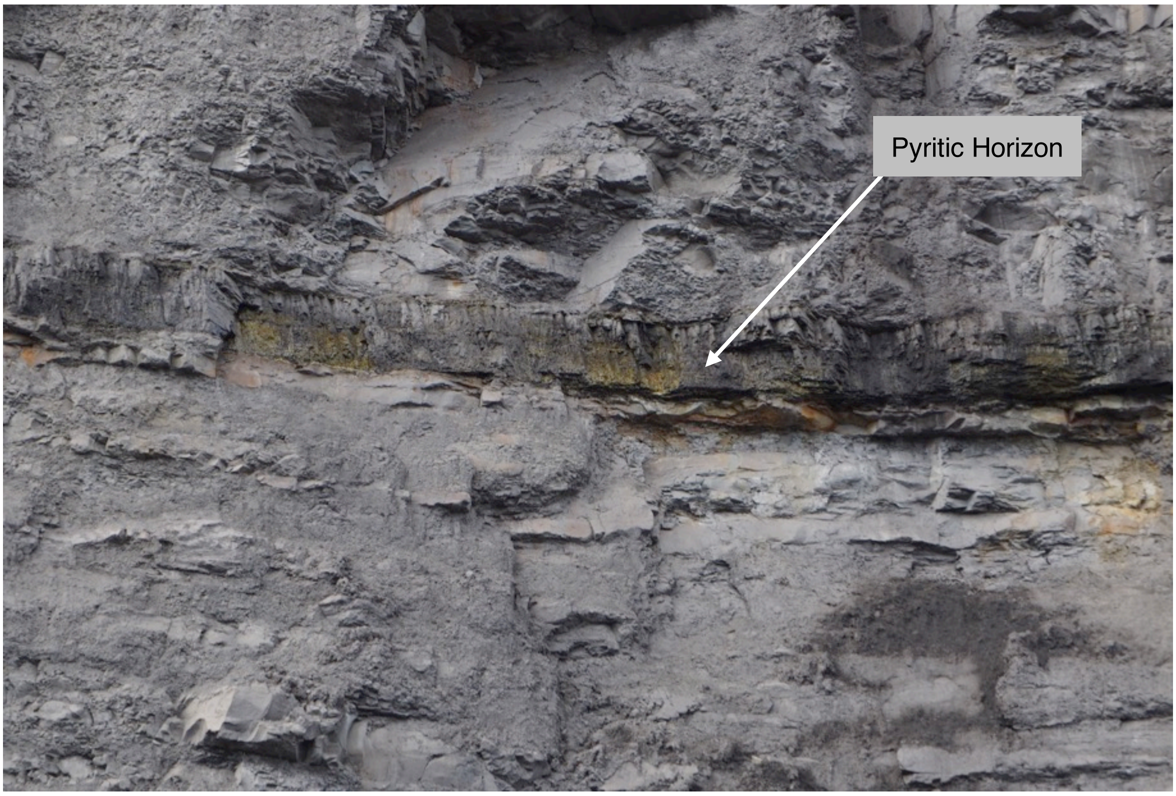

Plate 16 – Close up of Plate 15.

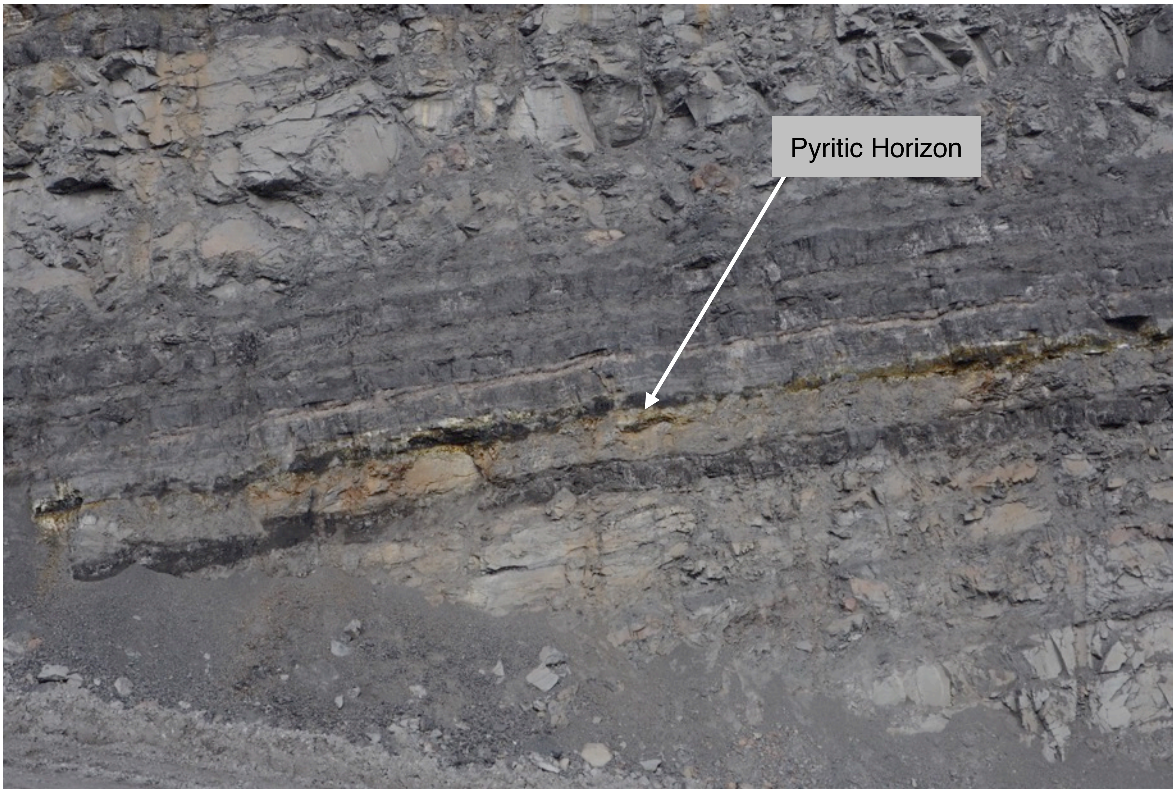

Plate 17 – Thin pyritic horizon associated with Lemington Seam, showing distinct yellow salts and iron staining due to pyrite oxidation.

Inspection of the core holes as part of the 2013 EGi Study and core holes SMC028 and SMC032 supports previous findings that the vast majority of overburden/interburden from the Mount Owen Complex is likely to be benign, with some higher ARD potential associated with carbonaceous materials and coal seams.

3.0 Sample Selection and Preparation

The original depositional environment largely controls the distribution and abundance of pyrite in coal bearing sedimentary sequences, with influences such as seawater incursions and presence of organic matter key to pyrite formation. As a result of these controls, pyrite is usually preferentially distributed in particular lithologies (such as carbonaceous mudstones) and stratigraphic horizons. Coal sequences usually have high lithological variation in the vertical sense, but tend to show lateral continuity, and hence sampling for ARD assessment needs to take this into account by obtaining detailed continuous samples in individual holes spaced at wide intervals. This was the approach taken for the Approved Operations, with the aim of screening the entire mine stratigraphy for acid potential and identify horizons of concern, and rely on geological controls to help predict the distribution of potentially acid forming (PAF) and non-acid forming (NAF) rock types. This approach results in better representation of mine materials in coal deposits than purely lithological based sampling.

The 2013 EGi Study for the Mount Owen Complex included two holes, SMC006 and GNC004, that intersected the same target stratigraphy to be assessed for the Proposed Modification. Results of that work showed that the PAF materials in the target stratigraphy were restricted to carbonaceous horizons, and particularly within and either side of coal seams. Observations described in Section 2 were consistent with the previous findings, and additional testing for the current study was focused on those horizons with a higher ARD hazard.

The same core holes SMC028 and SMC032 inspected during the site visit were selected for sampling, which covered the base of Lemington Seam to the base of the Lower Hebden Seam as follows:

SMC028 – Roof LAE Seam (296.74 m) to 2 m below the floor of H1/H2 Seam (499.32 m)

SMC032 – Roof LAD Seam (171.34 m) to 6 m below the floor of LHB Seam (372.44 m)

Hole locations are shown in Figure 3.

A total of 147 overburden/interburden core samples were selected for assessment from holes SMC028 and SMC032. Sampling was restricted to intervals where pyrite occurrence was observed, carbonaceous materials, and intervals either side of coal seams. The remaining overburden/interburden intervals could be reliably assumed to be NAF based on observation and previous results. Intervals were selected by site geologists in conjunction with EGi to match geological boundaries, with intervals ranging from less than 0.1 m to 4.7 m. Site personnel collected all samples. In addition, 68 selected coal quality samples were also provided by Mount Owen for geochemical testing to allow more complete representation of the coal, roof and floor materials.

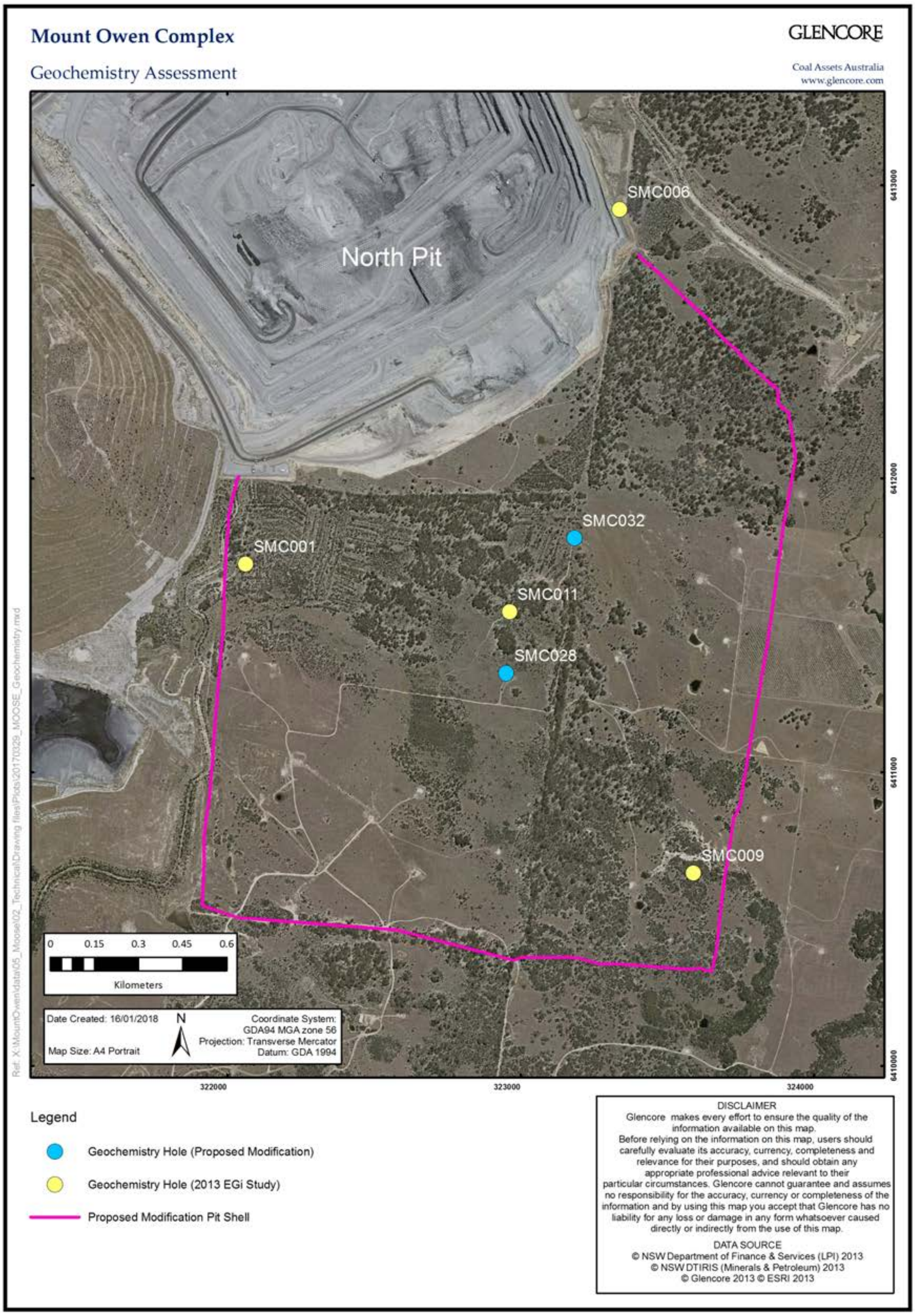

Figure 3 – Location of drillholes from the Proposed Modification sampled for geochemical testing.

Sample preparation of core was carried out by International Resource Laboratories (IRL) (Brisbane), which involved drying (as required), crushing to a nominal -4 mm, splitting, pulverising a 500 g split to -212 μm, and dispatch of 500 g of -212μm pulverised samples and 500 g of -4 mm crushed samples to EGi. The coal quality samples were supplied as pulverised samples.

4.0 Methodology

4.1 Proposed Modification

All 147 overburden/interburden samples from SMC028 and SMC032 were analysed for Leco total sulphur (S). Total S results for 101 coal quality samples were provided by Mount Owen.

The following was carried out on a subset of the overburden/interburden and coal quality samples:

- pH and electrical conductivity (EC) of deionised water extracts at a ratio of 1 part solid to 2 parts water ($pH_{1:2}$ and $EC_{1:2}$) (30 overburden/interburden and coal samples);
- acid neutralising capacity (ANC) (85 overburden/interburden and coal samples);
- net acid producing potential (NAPP) - calculated from total S and ANC (85 overburden/interburden and coal samples); and
- single addition net acid generation (NAG) test (85 overburden/interburden and coal samples).

Further testing was carried out on selected samples to help resolve uncertainties in the above test results, as follows:

- extended boil and calculated NAG testing to account for high organic carbon contents (11 overburden/interburden and coal samples);
- sulphur speciation to obtain a guide to the proportion of pyritic S (11 overburden/interburden and coal samples); and
- acid buffering characteristic curve (ABCC) testing to define the relative availability of the ANC measured (9 overburden/interburden and coal samples).

A general description of ARD test methods and calculations used is provided in Appendix A.

In addition, selected samples were assayed for the following to identify any potential elemental concerns and to provide initial elemental solubility data:

- multi-element testing of solids (11 overburden/interburden samples); and
- multi-element testing of deionised water extracts at a ratio of 1 part solid to 2 parts water (11 overburden/interburden).

Water extractions for $pH_{1:2}$ and $EC_{1:2}$ and multi-element testing were carried out on -4 mm crushed samples. Pulverised samples were used for all other tests.

The sulphur speciation procedure involved Leco total S, chromium reducible sulphur (CRS) and KCl digestion to help differentiate pyritic S, acid forming sulphate, non-acid forming sulphate and other S forms (including organic S, jarosite S and elemental S).

Total sulphur assays and multi-element testing of solids were carried out by IRL (Brisbane) for the overburden/interburden samples. CRS analyses of sample solids were carried out by ALS Laboratory Group (Brisbane). Multi-element analyses of water extracts were carried out by ALS Laboratory Group (Sydney). Analyses of NAG solutions and S analysis of KCl digest solutions were carried out by Levay & Co. Environmental Services (Adelaide). All other analyses were carried out by EGi.

4.2 2013 EGi Study for the Mount Owen Complex

The 2013 EGi Study for the Mount Owen Complex included testing of overburden/interburden and coal samples from diamond drill holes, and washery rejects samples discharged from the existing coal handling and preparation plant (CHPP)[2]. The 2013 work included the following standard ARD testing of samples from within the same target stratigraphy as the additional mining area proposed as part of the Proposed Modification (including overburden/interburden and coal from holes SMC006 and GNC004):

- $pH_{1:2}$ and $EC_{1:2}$ (76 overburden/interburden and coal samples, and 25 washery waste samples);
- Total S (265 overburden/interburden and coal samples, and 150 washery waste samples);
- ANC (183 overburden/interburden and coal samples, and 36 washery waste samples);
- NAPP (calculated from total S and ANC) (183 overburden/interburden and coal samples, and 36 washery waste samples); and
- single addition NAG testing (84 overburden/interburden and coal samples, and 36 washery waste samples).

The following specialised testing was carried out on selected samples that were not necessarily from the exact target stratigraphy within the Proposed Modification mining area, but were representative of typical materials from the general stratigraphic sequence:

- extended boil and calculated NAG testing to account for high organic carbon contents (23 overburden/interburden and coal samples, and 4 washery waste samples);
- sulphur speciation to obtain a guide to the proportion of pyritic S (13 overburden/interburden and coal samples, and 11 washery waste samples);
- kinetic NAG testing of higher S samples to check pyrite reactivity and to indicate lag times (8 overburden/interburden and coal samples, and 4 washery waste samples);
- ABCC testing to define the relative availability of the ANC measured (28 overburden/interburden and coal samples, and 12 washery waste samples);
- multi-element testing of solids (25 overburden/interburden and coal samples and 12 washery waste samples); and
- multi-element testing of deionised water extracts at a ratio of 1 part solid to 2 parts water (25 overburden/interburden and coal samples and 12 washery waste samples).

Water extractions for $pH_{1:2}$ and $EC_{1:2}$ and multi-element testing were carried out on -4 mm crushed samples. Pulverised samples were used for all other tests.

5.0 Overburden, Interburden and Coal Results

Acid forming characteristics of the 248 overburden/interburden and coal samples specifically tested from holes SMC028 and SMC032 for the Proposed Modification are presented in Appendix B - Table B1, comprising results of standard geochemical tests pH and EC of water extracts, total S, maximum potential acidity (MPA), ANC, NAPP, ANC/MPA ratio and single addition NAG. Appendix B - Table B2 presents acid forming characteristics of the 265 samples from holes SMC006 and GNC004 tested as part of the 2013 EGi Study for the Mount Owen Complex and which represent the same target stratigraphy as the Proposed Modification mining area. Discussions and figures below incorporate both sets of results.

Specialised testing results (extended boil and calculated NAG, S speciation, kinetic NAG, ABCC, multi-element testing of solids, multi-element testing of water extracts, and leach columns) carried out as part of the 2013 EGi Study and the current investigations have been combined, and findings are discussed together in the relevant subsections. Specialised testing was used to help resolve uncertainties in standard geochemical testing, and better define total acid generating capacities, relative reactivities of sulphides and neutralising components, and multi-element compositions and mobility.

5.1 pH and EC

The $pH_{1:2}$ and $EC_{1:2}$ results were determined by equilibrating the sample in deionised water for approximately 16 hours at a solid to water ratio of 1:2 (w/w). This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area. A total of 106 samples (25 coal, 81 non-coal) were tested for $pH_{1:2}$ and $EC_{1:2}$.

The $pH_{1:2}$ values ranged from 4.2 to 9.6, with the vast majority (96%) of samples having a pH greater than 6 and showing no inherent acidity. Only four of the samples tested had a slightly acidic pH of less than 6.0. Three of these samples were non-coal lithologies (sample 12041, sample 12136 and sample 4080) and one was a coal sample (sample 3996).

$EC_{1:2}$ values ranged from 0.09 to 2.1 dS/m, with the vast majority (96%) falling within the non-saline to slightly range with an EC of 0.8 dS/m or less. Four of the five samples with an EC of greater than 0.8 dS/m, were moderately saline (0.8 to 1.6 dS/m – samples 12041, 12136, 4080, and 3996), and one was saline with an EC of 2.11 dS/cm (sample 4078-carbonaceous mudstone).

Figure 4 is a plot of $pH_{1:2}$ and $EC_{1:2}$ versus total S for all sample tested. The plot shows that acidic $pH_{1:2}$ values (< pH 6) and moderately saline $EC_{1:2}$ values (>0.8 dS/m) are associated with higher S (approximately >0.25 %S) samples. This indicates that lower $pH_{1:2}$ and higher $EC_{1:2}$ values are primarily the result of partial pyrite oxidation occurring between sample collection and sample testing.

Results suggest low leachable acidity and salinity in overburden/interburden materials represented by these samples except where pyrite is present and it has partially oxidised.

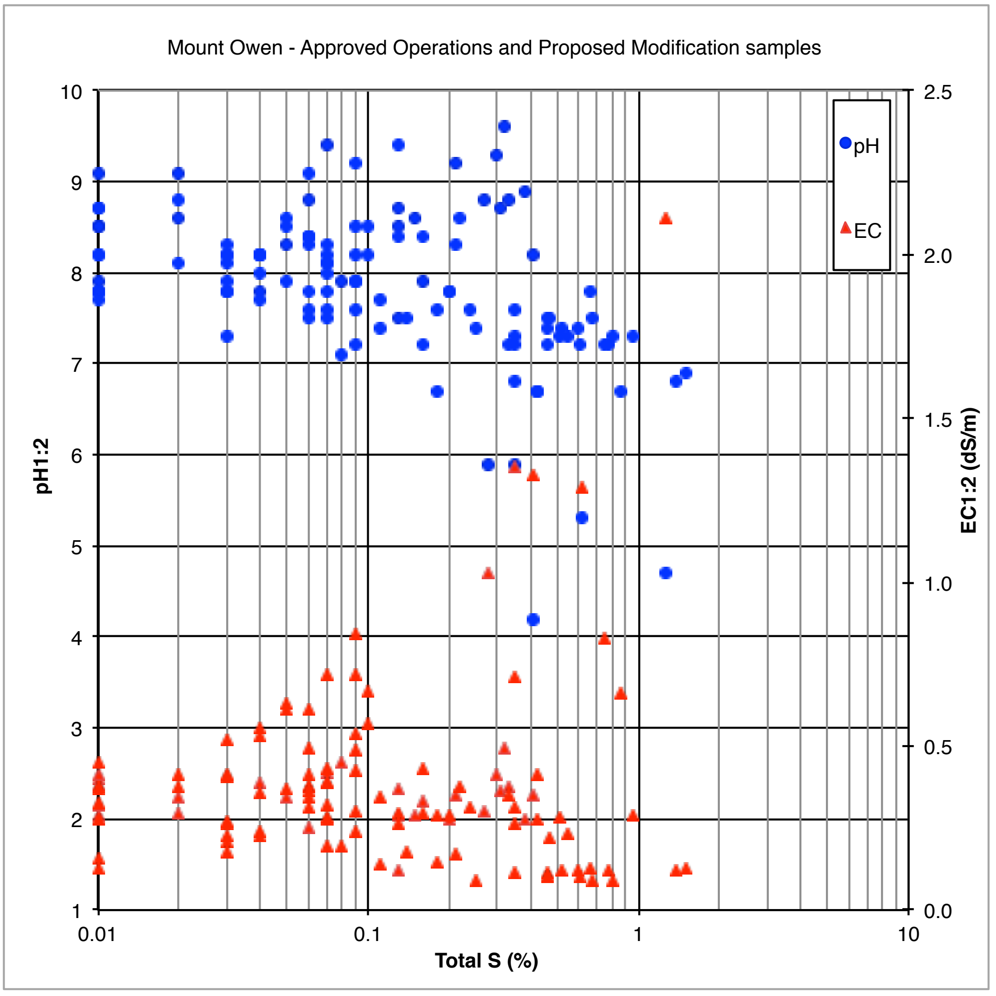

Figure 4 – Plot showing $pH_{1:2}$ and $EC_{1:2}$ versus total S for overburden/interburden and coal samples for samples sourced from Approved Operations and Proposed Modification

5.2 Acid Base (NAPP) Results

S data were available for 513 samples. S values ranged from below detection to 3.0%S, with the majority of samples (60%) having low S values of less than 0.1%S.

Figure 5 is a box plot of the distribution of S, split by lithology for the all samples tested. The plot highlights the lack of S in most lithologies, with the exception of coal (median S of 0.56%) and carbonaceous mudstone (median S of 0.16%). All other non-coal lithologies have low sulphur content with median S of less than 0.1%S.

Weathered zone, conglomerate, and sandstone have particularly low S values with 95% of the samples having S less than 0.1%S. The carbonaceous mudstone (75 sample tested) had a wide S concentration range from below detection limit to a maximum of approximately 2%. Coal materials

(222 samples tested) have a distinctively higher S distribution, with approximately 14% of the samples having S concentrations greater than 1%S.

ANC was tested on 268 coal and interburden/overburden samples sourced from lithologies occurring within the coal seams to be targeted by Proposed Modification. For this subset of samples ANC was low to moderate ranging up to 141 kg H_2SO_4/t, and with a median ANC of 22 kg H_2SO_4/t. Materials from the weathered zone show low ANC with a median of 10 kg H_2SO_4 /t.

Siltstone, mudstone, carbonaceous siltstone, carbonaceous mudstone and coal materials have a low median ANC of 10-20 kg H_2SO_4/t. The median ANC values conglomerate, sandstone, mudstone and tuff are slightly higher ranging from around 25 to 30 kg H_2SO_4/t.

The NAPP value is an acid-base account calculation using measured total S and ANC values. It represents the balance between the MPA and ANC. A negative NAPP value indicates that the sample may have sufficient ANC to prevent acid generation. Conversely, a positive NAPP value indicates that the material may be acid generating.

Figure 7 is an acid-base account plot of ANC versus total S as split by material type. The NAPP zero line is shown which defines the NAPP positive and NAPP negative domains, and the line representing an ANC/MPA value of 2 is also plotted. Note that the NAPP = 0 line is equivalent to an ANC/MPA of 1. The ANC/MPA value is used as an indication of the relative factor of safety within the NAPP negative domain. Usually a ratio of 2 or more signifies a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to ARD.

NAPP values were calculated for 268 samples. The results show that 80% or 215 of samples tested plot in the NAPP negative domain, and of these 190 (or 70%) had ANC/MPA ratios of 2 or more, indicating a high factor of safety. Fifty-three samples plot in the NAPP positive domain of which 33 samples (or 60%) are coal.

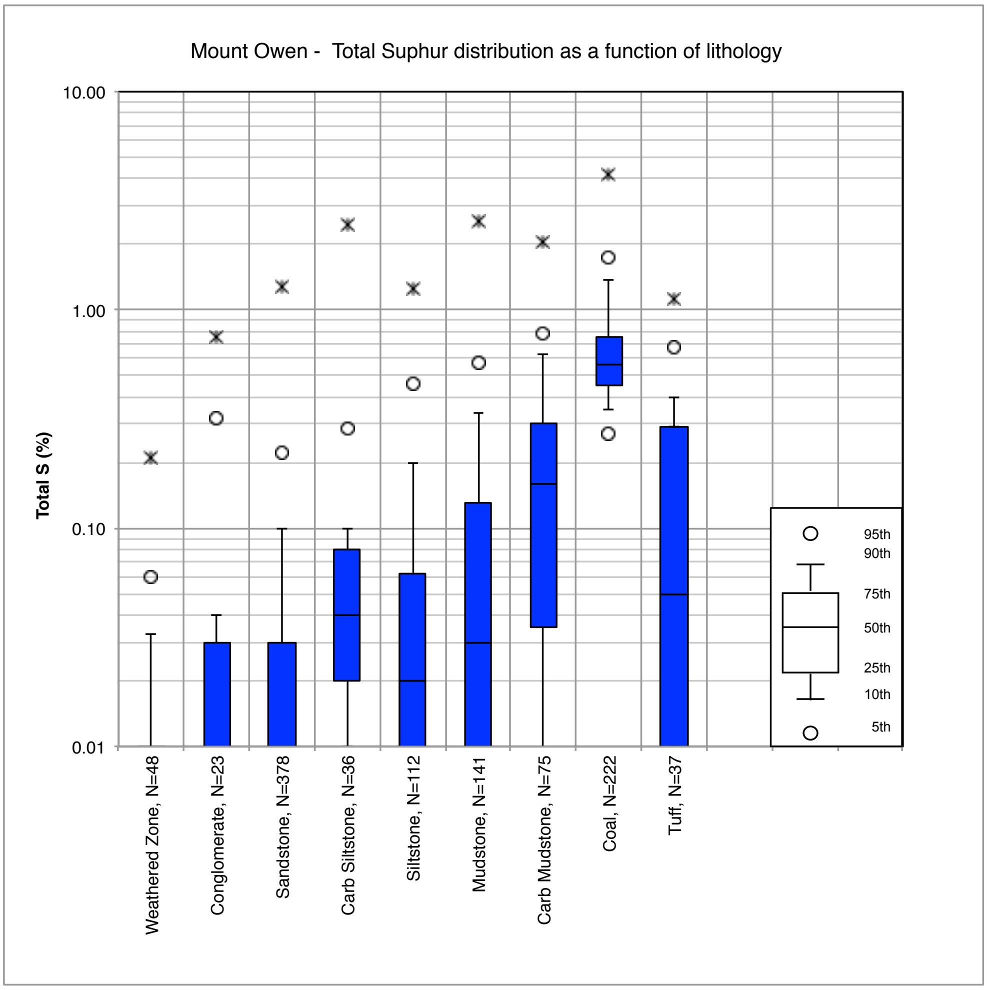

Figure 5 – Box plot showing the distribution of S split by lithology for overburden/interburden and coal samples. Box plots have 10th, 25th, 50th (median), 75th, 90th percentile. Star symbols = maximum values.

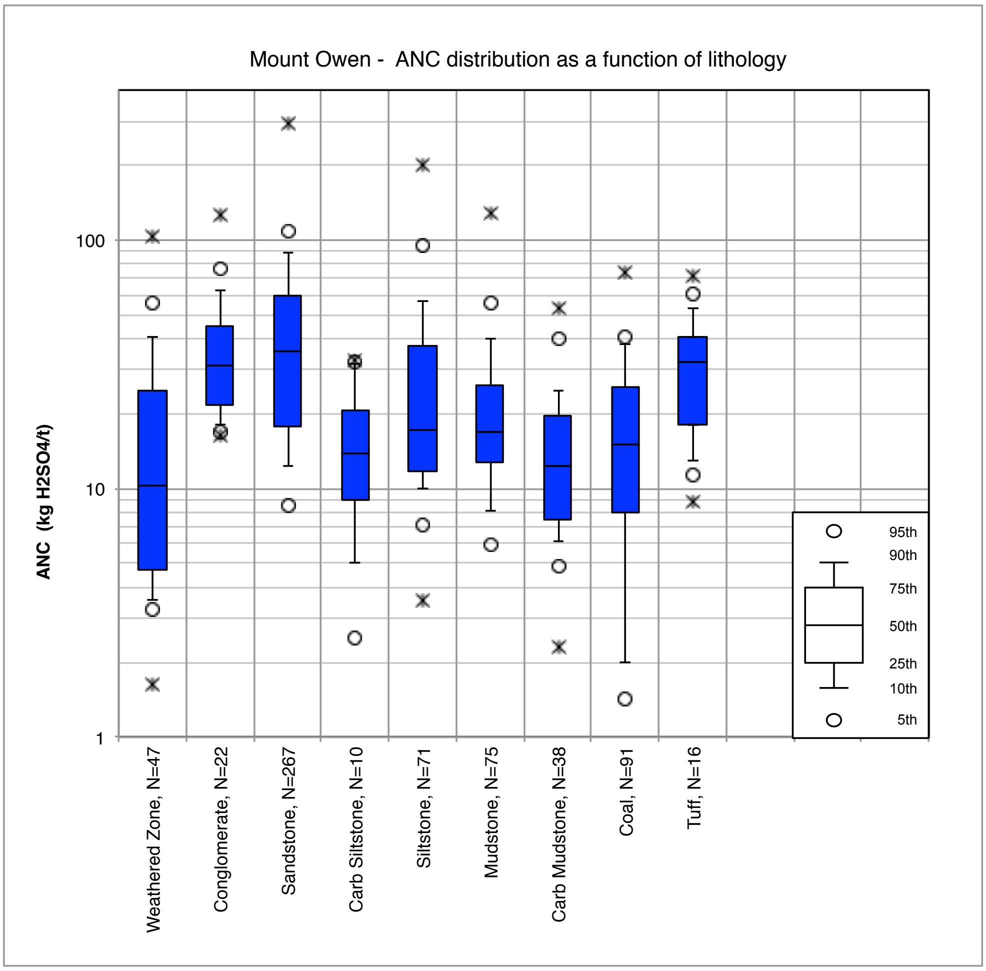

Figure 6 – Box plot showing the distribution of ANC split by lithology for overburden/interburden and coal samples. Box plots have 10th, 25th, 50th (median), 75th, 90th percentile. Star symbols = minimum and maximum values.

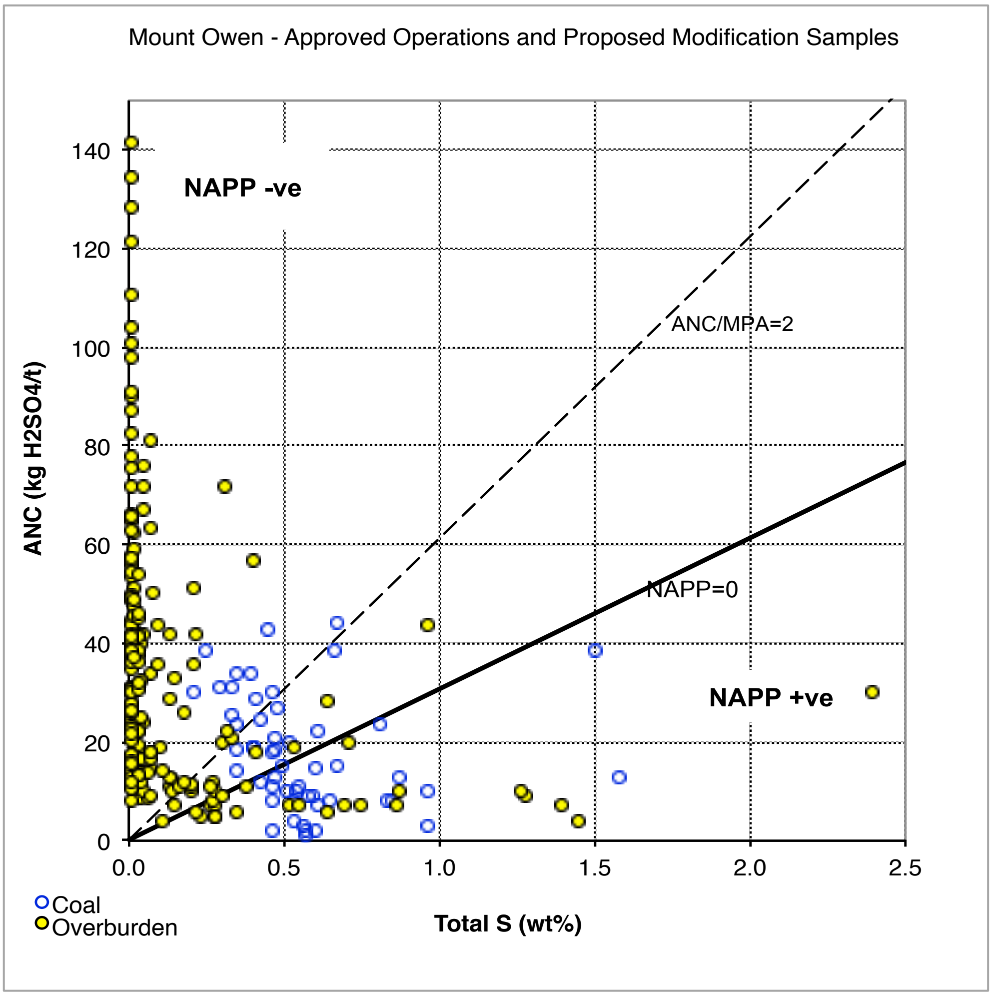

Figure 7 – Acid base account (ABA) plot showing ANC versus total S split by material type (i.e. overburden/interburden, coal) samples.

5.3 Single Addition NAG Results

Generally a NAGpH value less than 4.5 indicates a sample may be acid forming. However, samples with high organic carbon contents (such as coal and carbonaceous sedimentary materials) can cause interference with standard NAG tests due to partial oxidation of carbonaceous materials. This can lead to low NAGpH values and high acidities in standard single addition NAG tests unrelated to acid generation from sulphides.

NAG testwork was conducted on 169 samples. Of these 118 (or 70%) had NAGpH values of 4.5 and greater, indicating they are likely to be non-acid forming (NAF). A total of 51 samples (or 30%) had a NAGpH less than 4.5, but most of these (38 or 75% of the samples) were associated with carbonaceous horizons and coal seams, and results are inconclusive in isolation due to potential organic acid effects that may contribute acidity to the sample liquor in addition to that released from sulphide oxidation.

NAG test results are used in conjunction with NAPP values to classify samples according to acid forming potential. Figure 8 is an ARD classification plot showing NAGpH versus NAPP value.

Potentially acid forming (PAF), NAF and uncertain (UC) classification domains are indicated. A sample is classified PAF when it has a positive NAPP and NAGpH < 4.5, and NAF when it has a negative NAPP and NAGpH ≥ 4.5. Samples are classified uncertain 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.

The plot shows that most samples (65%) plot in the NAF domain, with 40 samples plotting in the PAF domain, 11 samples plotting in the lower left uncertain domain and 11 samples plotting in the upper right uncertain domain.

A total of 107 samples plot in the NAF domain, with 101 samples or 95% having a relatively low total S of 0.5%S or less. Samples 5300, 6824, 5303, 5304, 5305 and 4079 had higher total S values of 0.52%S to 0.96%S and moderate to high ANC values of 20 to 44 kg H_2SO_4/t, and further testing was carried out to confirm that buffering was sufficient to account for acid generated from these samples.

Of the 40 samples plotting in the PAF domain, 75% are coal or carbonaceous sediments. Of these, 17 samples are showing organic acid effects in the NAG test indicated by a large difference between the $NAG_{(pH4.5)}$ and $NAG_{(pH7.0)}$ values, and/or $NAG_{(pH4.5)}$ values very close to or exceeding that of MPA. In these samples the NAG results overestimate the acid potential. Samples showing organic acid effects are highlighted yellow in Table B1 and Table B2 (Appendix B). The remaining samples are expected to be PAF, with 11 samples likely to have a low acid generating capacity of less than 5 kg H_2SO_4/t. Specialised testing was carried out to help define the geochemical properties of the PAF samples and resolve uncertainties in the classification.

Six of the 11 samples plotting in the lower left uncertain domain showed organic acid effects in the NAG test, with one sample sourced from coal and five from carbonaceous sedimentary intervals. Follow up tests to check for organic acid effects and availability and nature of the acid neutralising capacity were carried out to resolve the classification of these samples.

The 11 samples plotting in the upper right uncertain domain have moderate total S of 0.4 to 1.5%S, low to moderate ANC values of 7 to 39 kg H_2SO_4/t, and NAGpH values greater than 4.5. The NAG test would normally account for most of the pyritic S in these samples and they are expected to be NAF. ABCC and S speciation testing was carried out to confirm a NAF classification.

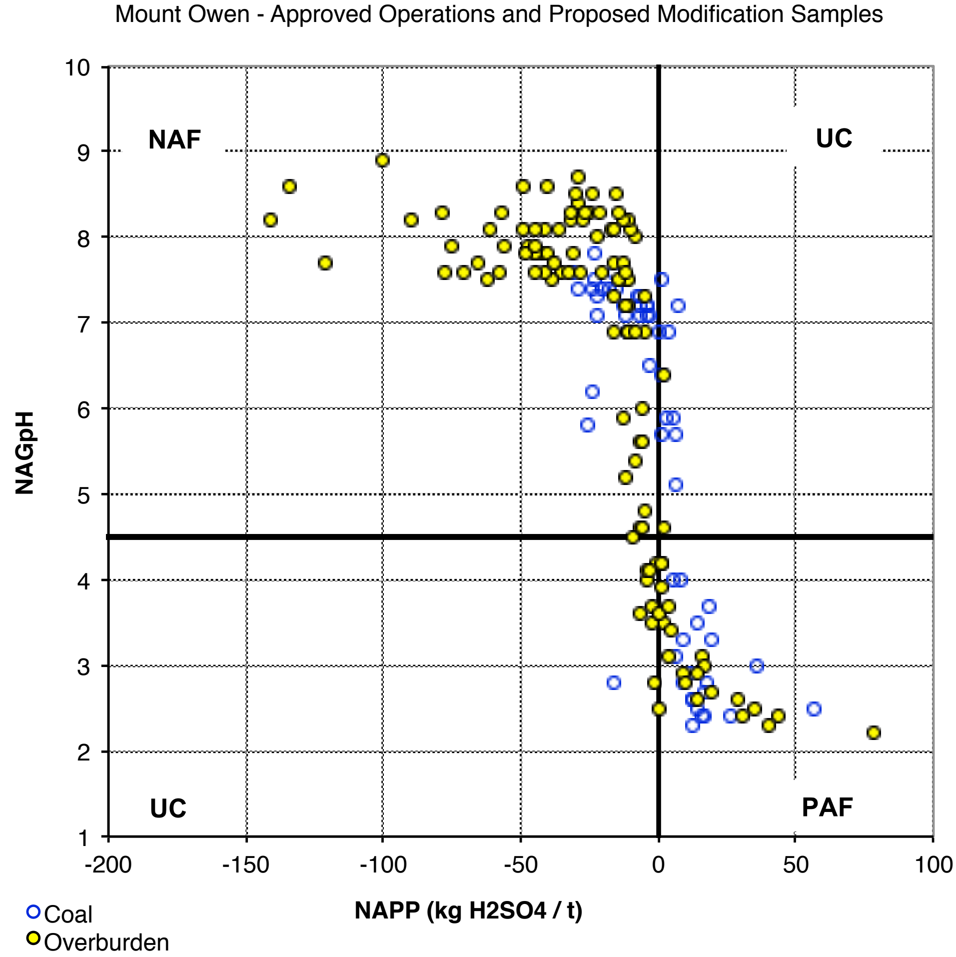

Figure 8 – ARD classification plot showing NAGpH versus NAPP split by material type (i.e. overburden/interburden, coal) samples, with ARD classification domains included for reference.

5.4 Extended Boil and Calculated NAG Results

Extended boil and calculated NAG testing was carried out on 34 selected samples to help resolve uncertainties in ARD classification based on standard NAG test results, as discussed in the previous section. Results are shown in Appendix B, Table B3.

Results show that the NAGpH value for most samples increases 2 to 4 pH units after the extended boiling step. The increase in NAGpH confirms the effects of organic acids. The extended boil NAGpH of samples, 3996 (coal), 5298 (coal), 5333 (coal), 11676 (coal), 11729 (coal), 4078 (carbonaceous mudstone), 11723 (carbonaceous mudstone), 3954 (sandstone), and 4080 (siltstone), remained less than 4.5, indicating these samples are likely to be acid producing.

Note that the extended boil NAGpH value can be used to confirm samples are PAF, but an extended boil NAGpH value greater than 4.5 does not necessarily mean that samples are NAF, due to some loss of free acid during the extended boiling procedure. To address this issue, a calculated NAG value is determined from assays of anions and cations released to the NAG solution. A calculated NAG value of less than or equal to 0 kg H_2SO_4/t indicates the sample is likely to be NAF, and a value of more than 0 kg H_2SO_4/t indicates the sample may be PAF.

The calculated NAG values for 10 of the samples (3813-coal, 5290-coal, 5324-coal 11716-coal, 12097-coal/carbonaceous mudstone, 11695-carbonaceous mudstone, 4056-carbonaceous siltstone, 12069 siltstone/carbonaceous mudstone, 12105-carbonaceous siltstone, and, 5338-sandstone) were negative or equal to zero, indicating that all acid generated in the standard NAG test for these samples is organic, and that materials represented by these samples are unlikely to be acid producing under field conditions.

The remaining 24 samples had positive calculated NAG values, indicating these samples are likely to be acid producing. Sample 3996 (coal), 5336 (coal), 5330 (coal), 5292 (coal), 5291 (coal), 3882 (carbonaceous mudstone), 3907 (mudstone), 11739 (coal), 11745 (coal), and 12136 (siltstone) had acid potential of less than 5 kg H_2SO_4/t, and is classified as potentially acid forming with a low capacity (PAF-LC).

Data suggest that in non-coal materials with S <0.3%S, organic acid effects dominate NAG testwork acidities, and that these materials are likely to be NAF. Most coal materials (80%, with S ranging from 0.41 to 1.6%S) were characterised as PAF by the calculated NAG test, suggesting that although organic acid effects are affecting NAG testwork results, a significant portion of the acidity is still associated with sulphide oxidation.

5.5 Acid Buffering Characteristic Curve (ABCC) Testing

Acid buffering characteristic curve (ABCC) testing was carried out on 37 selected overburden/interburden and coal samples to evaluate the availability of the ANC measured.

The ABCC test involves slow titration of a sample with acid while measuring the solution pH. The slow acid addition represents a milder treatment of a sample than that applied in the modified Sobek method (which involves reaction at around pH 1 to 2). The acid buffering of a sample to pH 4 can be used as an estimate of the proportion of readily available ANC.

Figure 9 illustrates the trends for the reference samples used for comparing the ANCs of the sample tested. Calcite and dolomite readily dissolve in acid and exhibit strongly buffered pH curves, rapidly dropping once the ANC is all exhausted. Calcite (i.e. limestone) displays a well defined, relatively flat pH plateau, while dolomite shows a slightly sloped curve. Ferroan dolomite shows a steeper curve compared to dolomite, which is associated with its lower reactivity and lower ANC. The siderite standard has a very steep pH curve, which reflects its very poor acid buffering capacity.

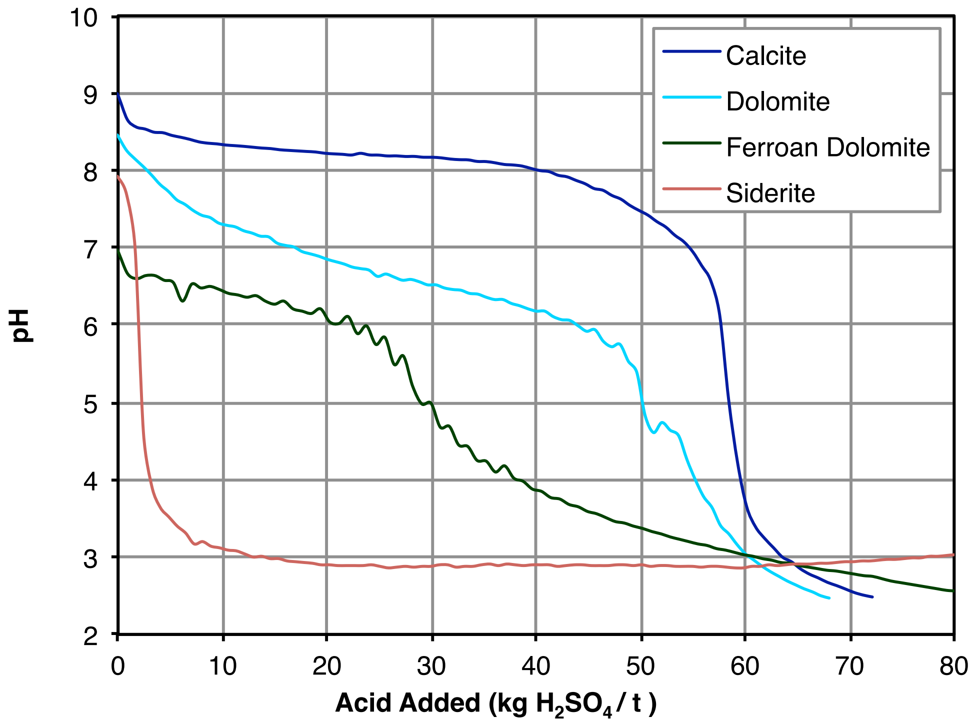

Figure 9 – Example of acid buffering characteristic curves for reference carbonates calcite, dolomite, ferroan dolomite and siderite (all reference samples had an ANC of approximately 50 kg H_2SO_4/t).

The ABCC curves for the 37 overburden/interburden and coal samples are presented in Appendix C (Figure C1 to C19) together with curves for reference samples representing calcite, dolomite, ferroan dolomite, and siderite, while ABCC results are summarised in Table B4 (Appendix B).

Key results are:

- Samples 11723 (carbonaceous mudstone - Figure C1) and 3804 (mudstone – Figure C8) have profiles that plot between the siderite and ferroan dolomite standard curves indicating slow reactivity and with only 30-50% of the total ANC likely to be effective. Sample 11723 has an acid buffering profile that plots close to that of ferroan dolomite up to pH 4.5, but then rapidly declines towards that of siderite, suggesting slightly more effective buffering capacity at higher pH ranges.
- Samples 11679 (coal/tuff – Figure C3), 12054 (siltstone – Figure C4), 5225 (mudstone - Figure C9), 5242 (weathered zone - Figure C7) have profiles that plot close to the ferroan dolomite standard curves. Results indicate slow reactivity with an effective ANC of around 50-75% of the total ANC. Samples 11679, 12054 and 5225 shows initial strong buffering, indicating a portion of the ANC is in calcitic/dolomitic form.
- Six samples, 12063 (sandstone – Figure C6), 12137 (Sandstone/Siltstone – Figure C1), 3850 (siltstone – Figure C18), 3880 (sandstone – Figure C8), 4057 (siltstone – Figure C10) and 4480 (sandstone – Figure C10) have profiles that plot between the dolomite and ferroan dolomite standard curves. The readily available ANC portion for these samples ranges from 45% to 95%

of the total ANC. Carbonate dissolution reaction rates in these samples are likely to be slower than for ANC dominated by dolomite.

- Sample 12055 (carbonaceous mudstone – Figure C2) has a profile that plots between the calcite and ferroan dolomite standard curves, with an initial strong buffering indicating that a portion of the ANC is associated with the dissolution of calcite. The readily available ANC portion is approximately 60% of the total ANC. The reaction rates are likely to be slower than dolomite.
- The ABCC profiles for the remaining 23 samples show strong buffering, with profiles plotting close to or between those of calcite and dolomite standard curves. For these samples the proportion of readily available ANC is elevated, ranging from 70% to 100% of the ANC.

Overall, ABCC results suggest that most of the ANC measured for Mount Owen Complex mine materials are likely to be fast reacting and effective. Some slower reacting materials were identified, which are likely to include a high proportion of iron carbonate and which will be partly ineffective.

5.6 Kinetic NAG Testing

Kinetic NAG tests provide an indication of the kinetics of sulphide oxidation and acid generation for a sample. Kinetic NAG testing was carried out on eight selected samples. Results are presented in Figures D1 to D8.

Typically, there will be a distinct temperature peak of 50°C or more in the kinetic NAG profile for samples with pyritic S greater than 0.7%S and low ANC. The kinetic NAG temperature profiles for samples 5290 (coal - Figure D1), 5330 (coal - Figure D2), 5298 (coal - Figure D5), and 4025 (sandstone - Figure D6) do not have distinct temperature peaks, and sample 5333 (coal - Figure D3) has a subdued temperature peak, indicating that these samples have pyritic S contents of less than 0.7%S and a significant proportion of non acid generating S forms.

Samples 5314 (coal - Figure D4) and 4080 (siltstone - Figure D8) showed distinct temperature peaks, typical of pyritic samples. Note that sample 4079 (sandstone - Figure D7) has a moderate and reactive ANC of 44 kg H_2SO_4/t, which results in reduced oxidation rates and only partial pyrite oxidation in the NAG test. Hence for this sample the temperature profile is not a valid indicator of pyritic S content.

The time to pH 4 in the kinetic NAG test can be used to estimate the lag time before acid conditions develop in a sample under atmospheric oxidation conditions.

Sample 4079 was expected to be NAF, and kinetic NAG testing was carried out to check if rates of acid buffering would match rates of acid generation in higher S samples. The pH profile (Figure D7) remained above 4.5 for the duration of the test, confirming matching rates of buffering and acid generation and the NAF classification.

Samples 5290 and 5330 did not produce acid in the time of the NAG test (Figures D1 and D2), indicating lag times of many years if they are acid forming. Calculated NAG testing (see Section 5.4) suggests sample 5290 is NAF and 5330 only marginally acid producing.

Sample 4025 shows a significant delay of 150 minutes before dropping below pH 4, indicating a lag time of 1 to 2 years before onset of acid conditions after exposure to atmospheric conditions.

The remaining four samples 5333, 5314, 5298 and 4080 show relatively fast reaction rates, dropping below pH 4 in 9 minutes or less, and indicating lag times of one month or less.

Overall, results indicate that PAF materials pyritic S of 0.7%S or greater are likely to have short lags of a month or less before onset of acid conditions after exposure to atmospheric conditions.

5.7 Sulphur Speciation

Sulphur speciation testing was carried out on 24 selected samples representative of overburden/interburden and coal materials. Results are shown in Table B5 (Appendix B) Note that the pyritic S value should only be treated as a guide to the pyrite content in the sample due to issues with repeatability in the chromium reducible sulphur (CRS) method[3].

Key observations are (Figure 10):

- Results are available for 11 coal samples. Data suggest that for all coal samples but two (5333 and 3883) pyritic S accounts for only 40% or less of the total S, indicating most of the S is in non-pyritic forms and most likely occurs as organic S. NAPP estimates based on total S may overestimate the acid forming potential of these samples. Two of the Lemington coal samples (3883 and 5333) have mainly pyritic S, accounting for 75% and 60% of the total S, respectively. For these samples, the occurrence of pyrite was noted in the geological database.
- ABCC testwork conducted on eight coal samples indicates in seven samples the ANC is associated with calcite/dolomite which is nearly 100% readily available. In sample 11716, ferroan dolomite was the main carbonate present with an availability of approximately 50%.
- Samples 11716, 5299, 5301 and 5307 had positive NAPP values but NAGpH values greater than 4.5. However, the NAPP values are negative when estimated based on pyritic S and effective ANC from ABCC testwork, which is consistent with the NAGpH results.
- For 10 out of 13 non-coal materials the proportion of pyritic sulphur tends to be greater than 50% ranging up to 77%. Exceptions are sample 12105 (carbonaceous siltstone – 6% pyritic S), 12136 (carbonaceous siltstone – 31% pyritic S), 12069 (Siltstone/carbonaceous mudstone – 40% pyritic S) and 3882 (carbonaceous mudstone – 41% pyritic S).
- The S speciation testing shows that the NAPP value based on total S will tend to overestimate the acid forming potential, particularly in coal samples.

Results suggest that the total S in non-coal samples is likely to be mainly pyritic, and that coal samples are likely to include a higher proportion of non pyritic S forms. Sulphur speciation results in conjunction ABCC testing show that coal samples plotting in the upper right hand uncertain domain are likely to be NAF.

[3] Environmental Geochemistry International, Levay and Co. and ACeSSS, 2008. *ACARP Project C15034: Development of ARD Assessment for Coal Process Wastes*, EGi Document No. 3207/817, July 2008. www.acarp.com.au.

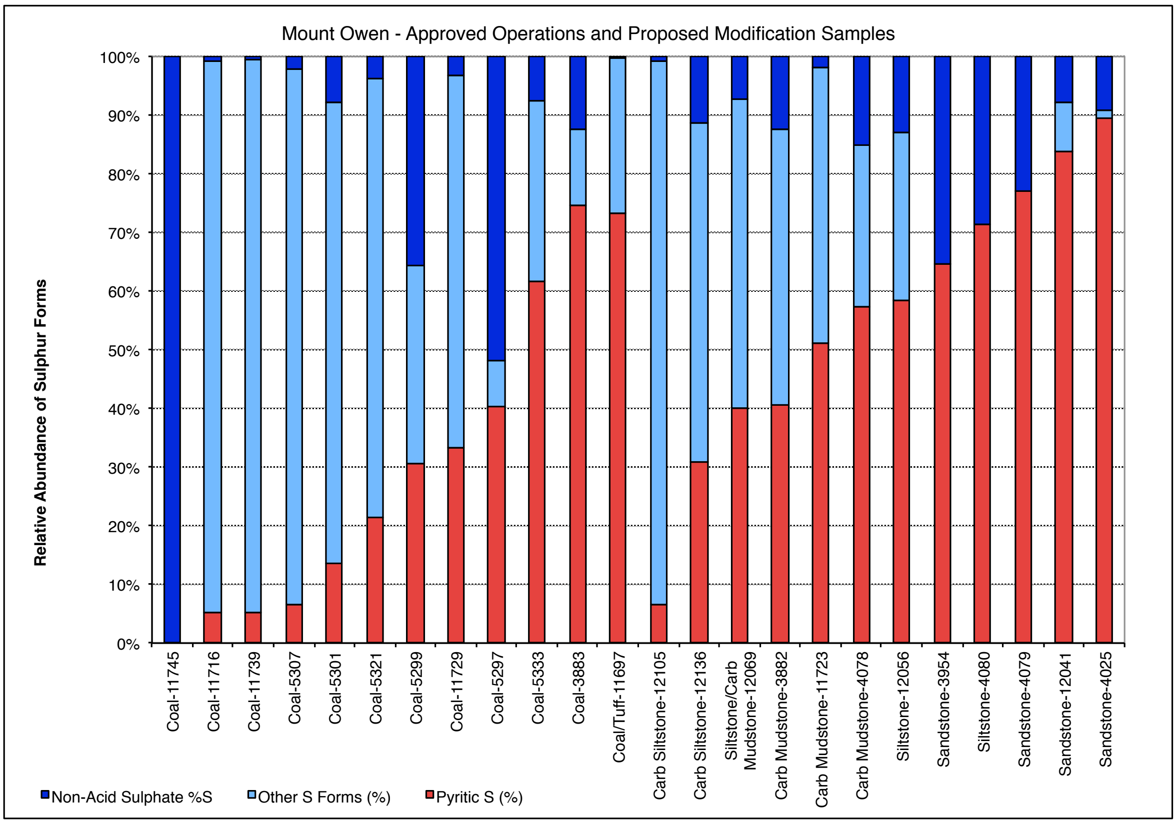

Figure 10 – Sulphur speciation for overburden/interburden and coal materials as a function of lithology and reactive S content.

5.8 Multi-Element Analysis of Solids and Water Extracts

Results of multi-element scans of solids from 36 selected samples were compared to the median soil abundance (from Bowen, 1979[4]) to highlight enriched elements. The extent of enrichment is reported as the Geochemical Abundance Index (GAI), which relates the actual concentration with an average or median abundance on a log 2 scale. The GAI is expressed in integer increments where a GAI of 0 indicates the element is present at a concentration similar to, or less than, median soil abundance; and a GAI of 6 indicates approximately a 100-fold enrichment above median soil abundance. As a general rule, a GAI of 3 or greater signifies enrichment that warrants further examination.

Results of multi-element analysis of solids are presented in E1 (Appendix E), and the corresponding GAI values are presented in Table E1 (Appendix E).

Many of the samples are slightly enriched in Be relative to median soils, but they are within normal ranges for sedimentary rock. Samples 4025 (sandstone) and 12041 (sandstone) showed enrichment in As, with sample 4025 also enriched in S. The As enrichment is likely to be due to small amounts arsenopyrite associated with pyrite or oxidation products containing arsenic. A

[4] Bowen, H.J.M. (1979) Environmental Chemistry of the Elements. Academic Press, New York, p 36-37.

number of samples also showed enrichment in S, which was already discussed in relation to acid forming potential. Other individual samples show enrichment of W and Tl.

The same sample solids were subjected to water extraction at a solids:liquor ratio of 1:2. Results are shown in Table E3 (Appendix E), and Illustrated in Figure 11.

Key results are as follows:

- The pH was slightly acidic to alkaline ranging from 4.9 to 9.8. ECs were variable, ranging from non-saline to saline (0.2 mS/cm to 2 mS/cm). In general, samples classified as PAF/PAF-LC have the highest salinities.
- There is a general positive correlation between sulphate concentration and sulphur content (R2 = 0.75), suggesting that the sulphate released in the leachate is mostly associated with oxidation/neutralisation reactions even in samples that have been classified as NAF.
- Five samples (12041-sandstone, 12136-carbonaceous siltstone, 3954-sandstone, 4025-sandstone, 4080-carbonaceous siltstone) are classified as PAF/PAF-LC. Sample 4080 had an acidic pH of 4.9, saline EC of approximately 2 mS/cm, and elevated S of 1.3%S. The acidic pH in sample 4080 is associated with elevated Fe, Mn and SO4, and slightly elevated Co, Ni and Zn. The other PAF samples (S ranging from 0.3%S to 0.86%S) had slightly acidic (pH 5.5) to alkaline (pH 7.2) pH extracts, and moderate concentrations in Co, Mn, Ni and Zn with concentrations generally increasing as a function of S.
- The remaining 31 samples were classified as NAF. These samples had circum-neutral to slightly alkaline pH extracts and they were generally characterised by lack of elevated metals/metalloids concentrations, with the exception of aluminium, which was elevated in some samples. Among the elements of environmental concern, aluminium, arsenic, manganese and molybdenum are detected in the majority of the samples, however median concentrations for these elements are generally low (for example median concentrations for manganese is 0.03 mg/L, and for arsenic and molybdenum is 0.02 mg/L).

Results indicate that significant metal/metalloid release from materials represented by the samples tested would only be associated with generation of ARD. The solubility of metals/metalloids will largely be determined by pH and therefore control of acid generation will effectively control metal leaching.

Water extracts from NAF materials indicated that metalliferous drainage is unlikely to contain significant metal/metalloid concentrations, but elevated SO_4 may occur where there is significant pyrite present.

Extracts show that initial metal/metalloid release associated with any ARD generated from pyritic materials would include Co, Fe, Mn, Ni, and Zn.

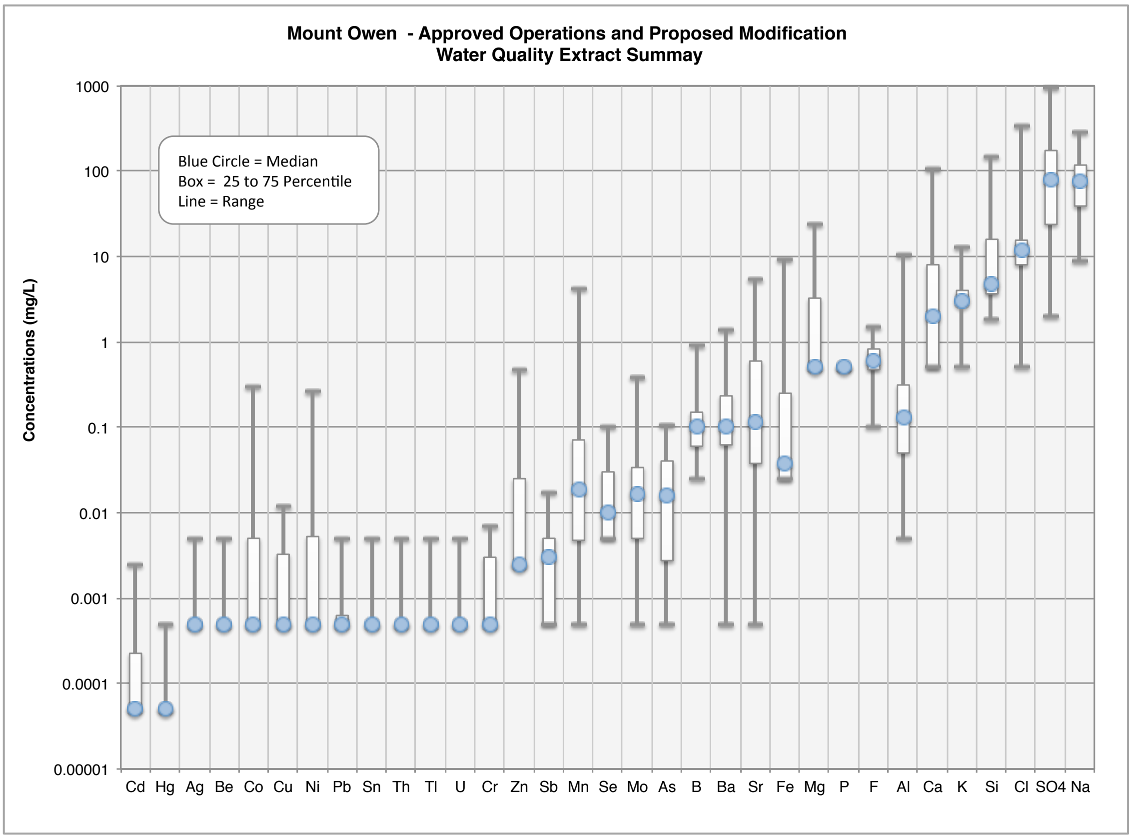

Figure 11 – Box plot of elemental concentrations in water extracts of overburden/interburden materials (all samples).

5.9 Kinetic Testwork Results

Eight samples representative of interburden/overburden materials underwent leach column testing by EGi for 52 weeks in 2013/2014[5]. The objective of the work was to provide information on leaching characteristics and lag times of key waste rock types for use in water quality predictions and to help refine materials management options.

The samples selected for testwork comprised five individual major overburden and interburden sedimentary units, plus two blended columns as follows:

- Weathered Zone (sample 6831)
- Non acid forming (NAF) Sandstone (sample 6832)
- NAF Claystone (sample 6833)
- NAF Siltstone (sample 6834)

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[5] *Leach Column Test Results for Overburden and Interburden from the Mount Owen Continued Operations Project*, EGi Document No. 2352/1126, October 2014.

- Potentially acid forming (PAF) Overburden/Interburden (sample 6835)
- PAF low capacity (PAF-LC) Overburden/Interburden (sample 6836)
- Blended PAF Overburden/Interburden /NAF Sandstone (sample 6837)
- Blended PAF-LC Overburden/Interburden /NAF Sandstone (sample 6838)

The weathered zone, NAF sandstone, NAF claystone and NAF siltstone columns were set up to evaluate neutral drainage chemistry. The PAF and PAF-LC overburden/interburden columns were set up to evaluate leaching characteristics of typical PAF and PAF-LC materials, including reaction rates and acid loadings, and metal/metalloid release. The blended columns were made up of PAF and PAF-LC overburden/interburden material mixed with NAF sandstone to help assess the effectiveness of operational blending for control of acid rock drainage (ARD).

Column testing showed that NAF overburden/interburden materials are likely to be a source of alkalinity in leachate and unlikely to release significant concentrations of metals/metalloids. The alkalinity is expected to report to infiltrating waters in overburden/ interburden dumps, providing an additional factor of safety in ARD management through interaction with PAF materials and any associated acid leachate. These materials may initially release some readily flushed salinity due to the presence of Na, Cl and SO_4 salts.

Results confirm that PAF materials are likely to generate significant ARD with short lag times. Acid release is likely to be associated with elevated Al, As, Co, Cu, Fe, Mn, Ni and Zn, and slightly elevated Cd and Cr. However, results also show that thorough blending with NAF materials is likely to be an effective strategy in controlling ARD from PAF materials for at least 12 months.

5.10 Sample Classification and Distribution of ARD Rock Types

The results and discussions presented above were used to classify samples as NAF, PAF, PAF low capacity (PAF-LC) or UC in Table B1 and B2 (Appendix B). PAF-LC samples are defined as having an acid capacity of 5 kg H_2SO_4/t or less.

Results from the combined 2013 EGi Study and Proposed Modification geochemical data set were used to determine whether total S alone could be used as an indicator of ARD potential. Data were restricted to those samples classified based on full geochemical testwork. Figure 12 is a box plot showing the S distribution for all samples classified either as PAF/PAF-LC or NAF, split by coal and overburden/interburden. The figure shows that for overburden/interburden materials, a total S cut-off of 0.1%S discriminates well between PAF samples from NAF samples. However, total S shows poor discrimination for coal materials due to the presence of organic S. Although a S cut-off of 0.4%S could be used for coal samples, it is overly conservative, with a large proportion NAF samples having S greater than 0.4%S.

Based on the S distribution, all overburden/interburden samples with S values of less than or equal to 0.1%S were classified NAF. Coal samples were only classified where full geochemical testing was available.

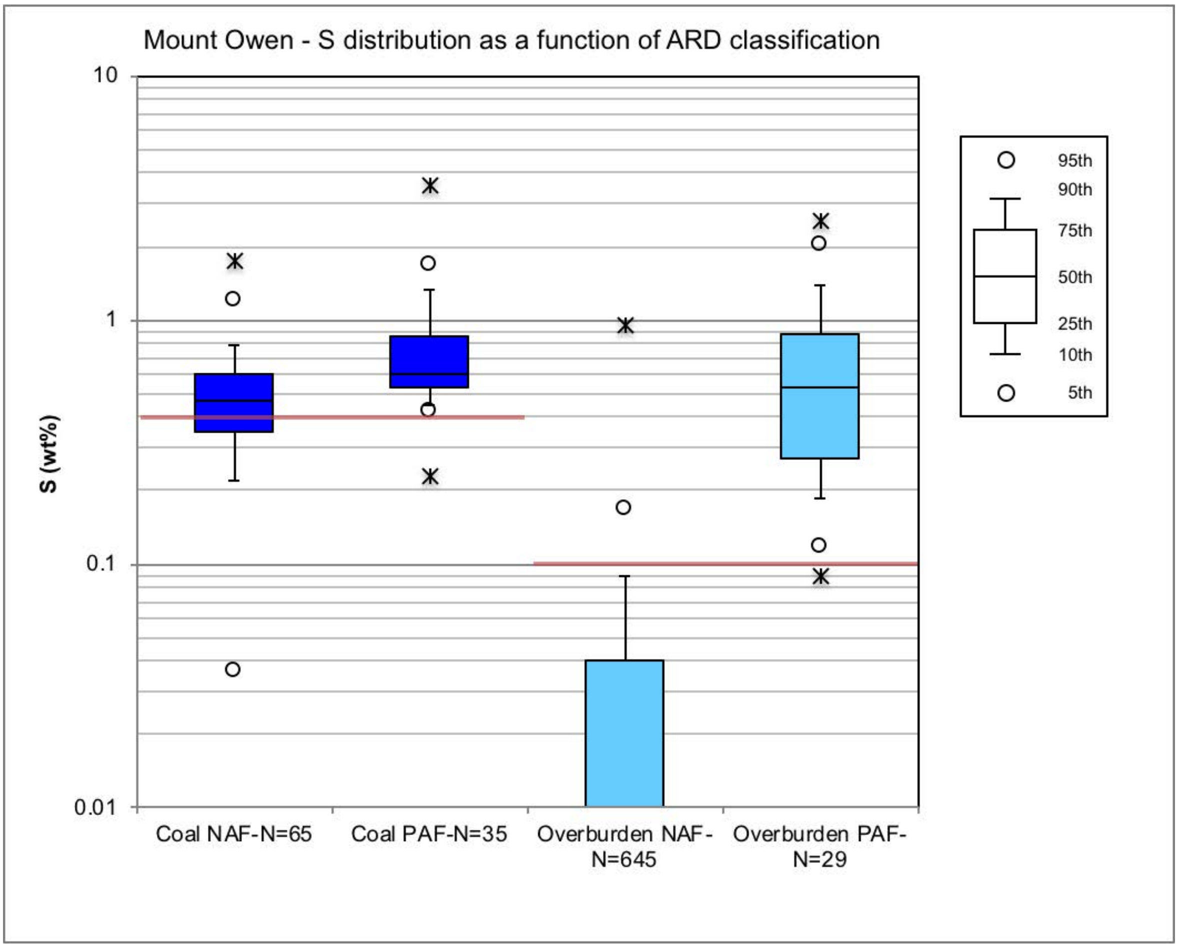

Figure 12 – Box plot showing the distribution of S for coal and overburden/interburden materials as a function of ARD classification. Box plots have 10th, 25th, 50th (median), 75th and 90th percentiles marked. Star symbols = minimum and maximum values.

Table 1 shows the approximate breakdown of geochemical rock types for the Proposed Modification mining area target stratigraphy based on the sample intervals tested to date (not taking spatial distribution or mining blocks into account) for overburden/interburden and coal.

Table 1 – Geochemical breakdown for coal and overburden/interburden materials for samples tested to date

Material Type	ARD Classification	
	NAF	PAF/PAF-LC
	Inc. UC(NAF)	Inc. UC(PAF)/UC(PAF-LC)
Coal	86%	14%
Overburden/Interburden	99%	1%

The estimated proportions of ARD classes indicate the vast majority of overburden/interburden is likely to be NAF, with PAF-LC/PAF materials estimated to be only 1%. Coal materials are likely to be mainly NAF, but coal tends to be more elevated in S than other lithologies (See Figure 5) and coal materials include a greater proportion of PAF.

Figures I1 to I4 (Appendix I) show down hole profiles of total S, ANC, NAPP and NAGpH values for each of the holes tested, with the stratigraphic position of coal seams plotted for reference. The plots also show sample ARD classifications for total S, ANC, NAPP and NAGpH profiles, with NAF (including UC(NAF)) samples represented as blue symbols, PAF-LC (including UC(PAF-LC)) samples as orange symbols, and PAF (including UC(PAF)) samples as red symbols. Note that many of the coal quality samples were not tested and classified by EGi, but total S results were available, providing a guide to the presence of pyritic horizons. These samples are shown as black symbols on the total S profiles.

The stratigraphic order from youngest to oldest for the holes tested starts from the base of the Lemington Seams to the base Lower Hebden Seam.

The profiles emphasise the preferential distribution of higher total S and PAF/PAF-LC samples in distinct zones associated with coal seams, coal seam partings, and immediate roof and floor. The vast majority of overburden/interburden is NAF with low S (most less than 0.2%S) and with median ANC of 25 kg H_2SO_4/t. The PAF/PAF-LC intercepts of seam roof, partings and floor are generally thin (less than 0.3 m), and dilution and mixing during mining should be sufficient to negate any serious ARD risk from these materials if they report to overburden.

Overall, results of the additional testing for the Proposed Modification confirm trends identified for the 2013 EGi Study of the Mount Owen Complex, and indicate overburden/interburden will be mainly NAF, with excess acid buffering.

The Proposed Modification will involve development to the base of the Lower Hebden Coal Seam, but with a stepped pit floor, so that the final pit floor will consist of three different seam floors: the floor of the Lemington DA Seam; floor of Liddell 6 Seam; and floor of the Lower Hebden Seam. All samples intercepting the base of the Lower Hebden Coal Seam were classified NAF, suggesting that any final pit floor below this seam is likely to be NAF. There is only limited information for the floor of Liddell 6 Seam, with results from SMC032 and GNC004 indicating a NAF Liddell 6 Seam floor, and holes SMC028 and SMC006 indicating a PAF-LC Liddell 6 Seam floor. The 2013 EGi Study included one intercept of the Lemington DA Seam floor in hole SMC009, with slightly elevated S, again indicating a PAF-LC Lemington DA Seam floor. The excess ANC in overlying backfilled overburden/interburden would be expected to account for any low capacity ARD generated from portions of these seam floors.

Given the expected high proportions of NAF relative to PAF (less than 1%), operational blending of NAF and PAF overburden/interburden together with the excess alkaline leachate from NAF materials is expected to be a robust approach to controlling ARD from PAF materials.

6.0 Washery Wastes Results

6.1 Preamble

Washery wastes were not geochemically assessed for this assessment, as it was assumed that the S distribution in the coal to be targeted by the Proposed Modification was comparable to that of the coal mined by the Approved Operations. Testing of coarse and fine (tailings) reject materials was carried out as part of the 2013 EGi Study of the Mount Owen Complex.

Figure 13 is a box plot showing total S distribution by coal seam, and comparing results for coal seams intersected by drilling for the Proposed Modification to S data from the raw coal sampler collected between 2009 and 2013. Data available for the Proposed Modification are limited to drillhole intercepts from 6 holes, but the plot suggests that median S concentrations for each coal seam group are comparable between the two data sets. In general, the span in S concentrations for coal sourced from the raw coal sampler is greater than that of material sourced from the Proposed Modification, with the exception of the Pikes Gully Coal Seam, which has a maximum S concentration greater than that measured for the raw coal sampler. The data available indicate that the previous work on rejects materials for the Mount Owen Complex will be a reasonable guide to what will be produced as part of the Proposed Modification. Periodic geochemical testing of rejects materials during development of the Proposed Modification would confirm this.

The section below summarises the geochemical properties of coal rejects assessed by EGi in 2013[2], but limited to coal seams targeted by the Proposed Modification.

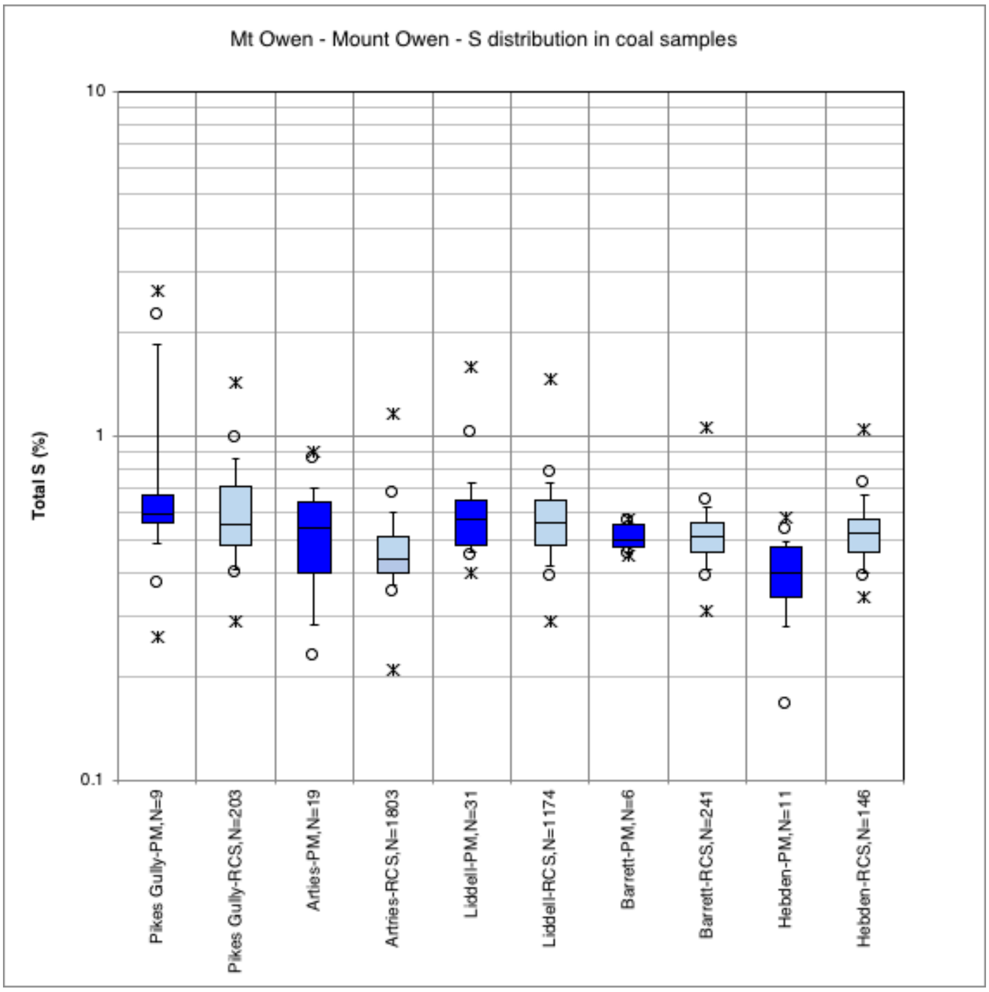

Figure 13 – Box plots showing the distribution of total S split by coal seam and project. Box plots have 10th, 25th, 50th (median), 75th, 90th percentile. Star symbols = minimum and maximum values; PM = Proposed Modification, RCS = Raw Coal Sampler Results 2009-2013.

6.2 Geochemical Characterisation Results

A total of 150 washery waste samples from the stratigraphic interval targeted by the Proposed Modification were geochemically tested in 2013 as part of the 2013 EGi Study of the Mount Owen Complex.

Total S was carried out on all 150 samples (Table F1, Appendix F), while a subset of 36 were subjected to standard ARD characterisation comprising pH/EC (11 samples excluded due to insufficient sample), ANC, ANC/MPA, NAPP, and single addition NAG with results shown in Table F2 (Appendix F).

The $pH_{1:2}$ values were circum-neutral to slightly alkaline, ranging from 7.8 to 9.4. $EC_{1:2}$ values were non saline (0.4 dS/m or less) to slightly saline (0.4 to 0.8 dS/m), and ranged from 0.21 to 0.48 dS/m. Results show a lack of immediately available acidity and salinity in these samples.

Total S values (Table G1) for the rejects vary from 0.03% to 4.57%S. Figure 14 is a plot showing the S distribution for the coarse and fine rejects. The S distribution in the fine rejects is distinctively higher than the coarse rejects, with a median of 0.8%S in the fine rejects compared to 0.2%S in the coarse. Results indicate that S minerals preferentially report to the fine rejects stream.

ANC values range from 13 to 140 kg H_2SO_4/t, but are generally moderate to high, with all but three samples having ANC values greater than 20 kg H_2SO_4/t. Figure 15 is a plot showing the ANC distribution for the coarse and fine rejects. Although Figure 14 indicated S preferentially reported to the fine rejects stream, Figure 15 shows that this is balanced by the tendency for ANC minerals to also report to the fine rejects.

Figure 16 is an acid-base account plot of ANC versus total S for the rejects samples. Results show that all but two samples are NAPP negative, and most samples (60%) have an ANC/MPA of 2 or more, indicating a high factor of safety. The plot highlights the higher S and ANC in the fine rejects relative to the coarse rejects, as described above.

Figure 17 is an ARD classification plot for the rejects samples. 32 samples plot in the NAF domain, but 13 of these have elevated S of over 0.5%S and pyrite oxidation may not have completed in single addition NAG testing of some of these samples. Sulphur speciation and ABCC testing was carried out to confirm the NAF classification for these samples. Two samples plot in the PAF domain and two samples plot in the lower left uncertain domain. Calculated NAG, sulphur speciation and ABCC testing was carried out to confirm the classification of these four samples.

Extended boil and calculated NAG testing results for the four samples plotting in the PAF and lower left uncertain domains are shown in Table F3 (Appendix F). The calculated NAG values were positive, indicating these samples are likely to be PAF.

ABCC testing was carried out on 12 selected samples and results are shown in Figures G1 to G7 (Appendix H), with results summarised in Table F4 (Appendix F). The ABCC profile for coarse rejects sample 6131 plots close to the ferroan dolomite standard curve (Figure G4), and indicates slow reactivity with an effective ANC of around 70% of the total ANC. Samples 6126, 6145 and 6158 have profiles that plot between the dolomite and ferroan dolomite standard curves (Figures G1, G3 and G5), indicating reaction rates slower than dolomite and a readily available ANC portion of 60% to 80% of the total ANC. The ABCC profiles for the remaining eight samples show strong buffering, with profiles plotting close to those of calcite and dolomite standard curves and indicating

60% to 100% of the ANC is readily available. ABCC results suggest that most of the ANC measured is likely to be fast reacting and effective.

Sulphur speciation test results for 11 selected rejects samples with elevated total S of 0.5%S or more are shown in Table F5 (Appendix F). Results indicate that the total S in the rejects will include a significant portion of pyritic S, with the acid generating S content estimated at over 50% for all samples. Table F5 includes a re-calculated NAPP value based on the proportion of acid generating S and readily available ANC estimated from ABCC testing. The recalculated NAPP values for samples 6126 (coarse reject), 6148 (fine reject) and 6158 (fine reject) are close to the calculated NAG value, and the samples are classified PAF and PAF-LC according to the later test result. The recalculated NAPP value for sample 6145 (coarse reject) is marginal at 0 kg H_2SO_4/t, but has a calculated NAG value of 2 kg H_2SO_4/t and is classified PAF-LC. The calculated NAPP value for sample 6164 (coarse reject) is 10 kg H_2SO_4/t, but the single addition NAGpH is 6. Sulphur speciation confirms most of the total S is pyritic, and the sample is assumed to be PAF consistent with calculated NAPP results. The remaining calculated NAPP results were negative, consistent with original NAPP and NAGpH values, and were classified NAF.

Kinetic NAG tests were carried out on four selected rejects samples with total S of 0.9% and above. Results are shown in Figures G8 to G11 (Appendix G). The pyritic nature of these samples was confirmed by sulphur speciation testing. The samples have varying ANC from 13 to 49 kg H_2SO_4/t, but all show a relatively rapid drop with time, reaching pH 4 in 15 minutes or less, and indicating lag times of 1 to 2 months before onset of acid conditions after exposure to atmospheric oxidation.

Most samples (90%) were classified NAF based on results discussed above. Although the fine rejects tended to have elevated S, this was offset by elevated and generally readily available ANC. Two samples were classified PAF and three samples PAF-LC. Four of the PAF/PAF-LC samples were from the Liddell Seam group and one from the Hebden Seam group. Note also that although the Pikes Gully Seam rejects samples were classified NAF, the Pikes Gully Seam showed high S relative to other seams (Figure 12), and a pyritic zone was observed in the pit wall (Plate 15 and 16). Overall, based on samples tested in 2013, results suggest that coarse and fine rejects produced as part of the Proposed Modification are likely to be predominantly NAF. However, additional operational monitoring would be required to confirm the ARD classification and variation of the Liddell, Hebden and Pike Gully Seam Group materials.

Multi-element scans were carried out on 12 selected rejects samples solids. Results of multi-element analysis of solids are presented in Table H1 (Appendix H) and the corresponding GAI values in Table H2 (Appendix H). A number of samples showed enrichment to slight enrichment in S (already discussed above in regard to acid forming potential) and slight enrichment in Be. Although slightly enriched relative to soils, Be contents are within the typical range for coal and carbonaceous materials. Liddell Seam group coarse rejects sample 6145 is elevated in S and also has elevated Tl and slightly elevated As. The elevated Tl and As are likely to be associated with pyrite in this sample. One sample is enriched in Ba, but this has low solubility in sulphate solutions and is not expected to be of environmental concern.

The same rejects samples were subjected to water extraction at a solids:liquor ratio of 1:2. Results are shown in Table I3. The extracts have slightly alkaline pH of 8.5 to 9.3, and apart from sample

6136, show low concentrations of major cations/anions and metals/metalloids. Coarse rejects sample 6136 has slightly elevated Al, As and Mo, but also has elevated Si of 27 mg/L, and the slightly elevated metals/metalloids in this sample are most likely due to the presence of fine particulates in the solution after filtering.

Results indicate that the coarse and fine rejects potentially representative of the Proposed Modification are likely to be NAF overall, and not significantly enriched in elements of environmental concern. Water extracts indicate metals and metalloids are unlikely to be mobilised to any significant extent from circum-neutral to slightly alkaline leachates. However, the presence of some higher S rejects are indicated (Pikes Gully, Liddell and Hebden Seam Groups), which could cause local impacts on rehabilitation due to upward migration of acid and salinity if placed close to final surfaces. The thorough intermingling of coarse rejects and overburden observed on site (Section 2), and the excess ANC in the overburden suggests, that these bulk fill zones are unlikely to result in any significant effects on rehabilitation. However, fine rejects (tailings) are not mixed with neutralising materials, and spigotting fine rejects can result in preferential deposition and concentration of pyritic materials.

There are two key uncertainties in assessing the potential impacts of these fine rejects on final TSF rehabilitation; the distribution, relative abundance and ARD potential of pyritic rejects; and the ability of the final TSF capping in controlling upward water flux.

Understanding the overall ARD hazard of fine reject materials would require more comprehensive testing as recommended in the 2013 EGi Study, with focus on fine reject materials from seams identified as having higher acid forming and salinity potential (such as Pikes Gully, Liddell and Hebden Seam Groups), and would need to include sampling of deposited materials to check for any segregation and concentration of pyritic materials.

However, if it can be demonstrated that the capping design will be effective in controlling upward flux of ARD products, the distribution of pyritic materials will be less important. It is understood that a nominal 3 m cap of overburden material is planned, which has been designed at other Glencore sites based on geotechnical considerations rather than hydrological and geochemical control. Demonstrating the long term success of this design would require hydrological/physical characterisation of fine rejects and cover materials, and cover system performance modelling of water flux through the profile under local climatic conditions. Depending on outcomes, modification of the design may need to be considered, including enhancing the capillary break, and increasing the cover thickness.

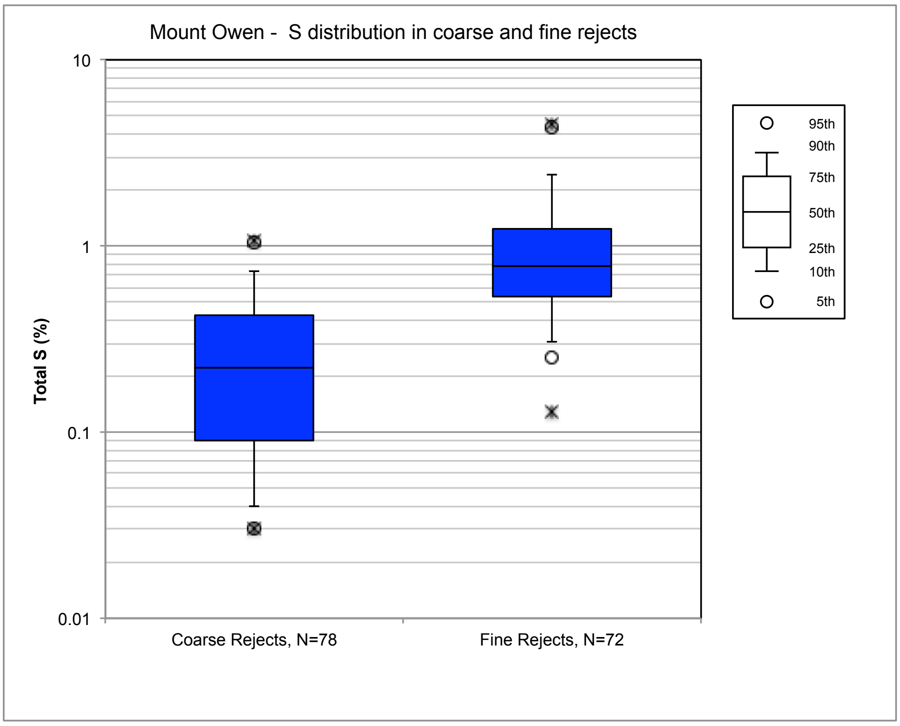

Figure 14 – Box plot showing the distribution of total S for coarse and fine rejects. Box plots have 10th, 25th, 50th (median), 75th and 90th percentiles marked. Star symbols = minimum and maximum values.

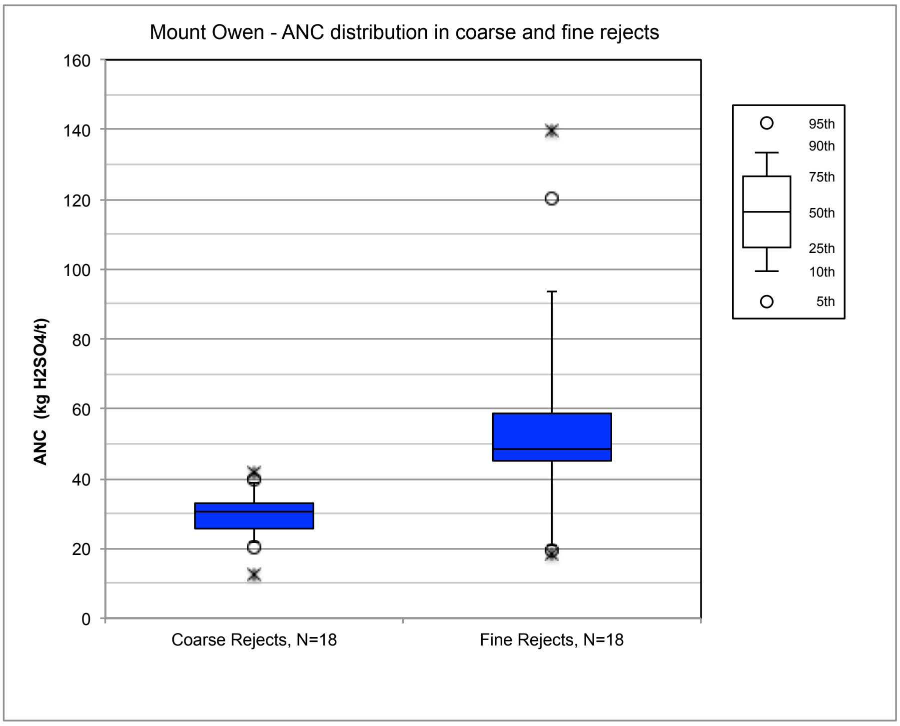

Figure 15 – Box plot showing the distribution of total S for coarse and fine rejects. Box plots have 10th, 25th, 50th (median), 75th and 90th percentiles marked. Star symbols = minimum and maximum values.

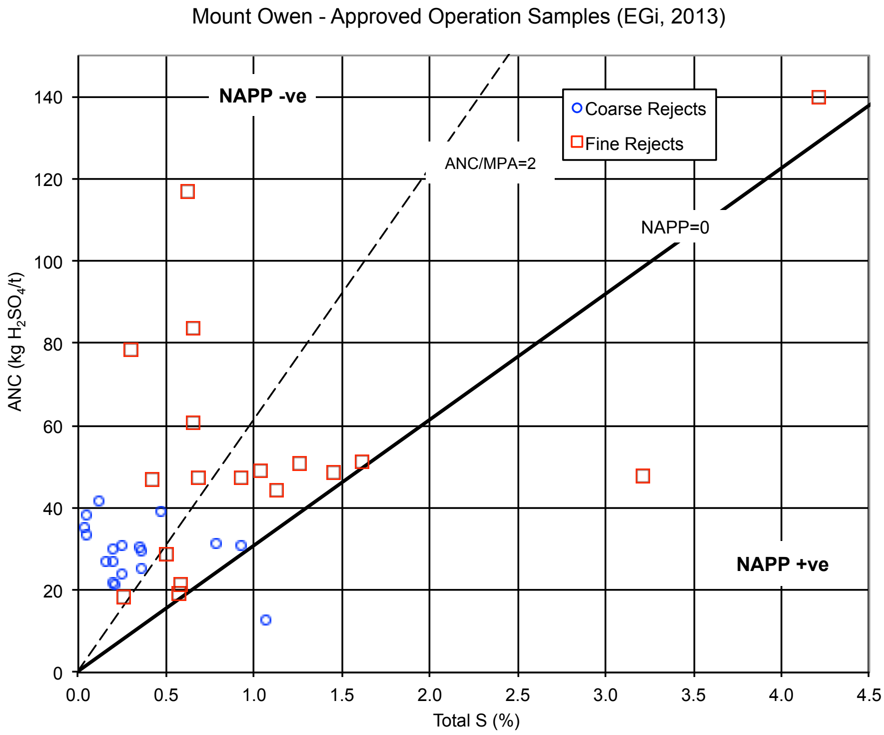

Figure 16 – Acid-base account (ABA) plot showing ANC versus total S coarse and fine rejects samples.

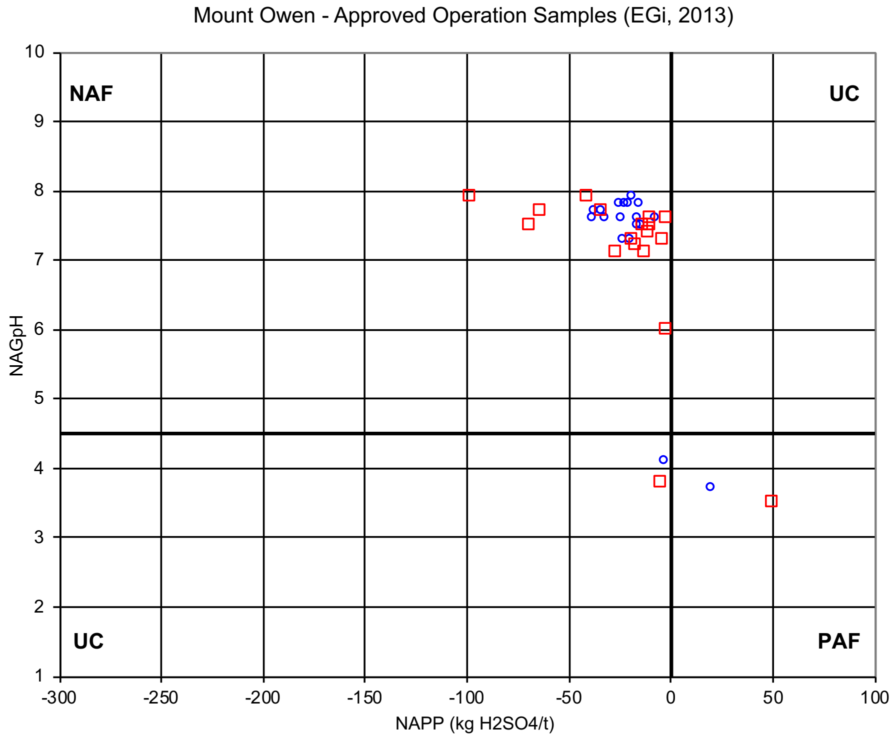

Figure 17 – ARD classification plot showing NAGpH versus NAPP for rejects samples, with ARD classification domains indicated.

7.0 Water Quality Sampling

Mount Owen arranged collection of water quality sample on 28 November 2017 from the following three sites to obtain more information on the quality of pit, overburden and fine rejects (tailings) drainage from the Approved Operations as a guide to expected water quality from the Proposed Modification:

- Dam SD5 – draining backfilled overburden and West Pit areas;
- West Pit – decant from pond in tailings backfill in West Pit; and
- North Pit to ECD2 – pit dewatering before discharge to ECD2 pond.

Results of pH, EC, alkalinity and dissolved metals/metalloids are shown in Table 2. Results show slightly alkaline pH of over 8.5, saline EC of 3 to 8 dS/m, high alkalinity, and low concentrations of dissolved metals/metalloids. The high alkalinity in these water samples suggests that any ARD generated by the small amounts of PAF materials in overburden/interburden, coarse rejects, and pit walls (mainly residual coal seams) would be insignificant relative to the background acid neutralisation, and unlikely to result in elevated metal/metalloid concentrations in the accumulated drainage.

Table 2 –Water quality for selected sites from the Approved Operations.

Parameter	Water Quality Site		
	SD5	West Pit	North Pit to ECD2
pH	8.9	8.8	8.6
EC (dS/m)	2.96	7.90	6.75
Total Alkalinity (mg $CaCO_3$/L)	442	747	891
Aluminium (mg/L)	<0.01	<0.01	0.01
Arsenic (mg/L)	0.002	0.017	0.009
Beryllium (mg/L)	<0.001	<0.001	<0.001
Barium (mg/L)	0.068	0.101	0.091
Cadmium (mg/L)	<0.0001	<0.0001	<0.0001
Cobalt (mg/L)	<0.001	0.002	0.004
Copper (mg/L)	0.001	<0.001	<0.001
Lead (mg/L)	<0.001	<0.001	<0.001
Manganese (mg/L)	<0.001	<0.001	0.031
Nickel (mg/L)	<0.001	0.012	0.008
Selenium (mg/L)	<0.01	0.02	<0.01
Zinc (mg/L)	<0.005	<0.005	0.010

Site ECD2 accepts water from a number of sites, and represents one of the key mine water management storages for the Approved Operations. Table 3 summarises the EC, Cl and SO_4 concentrations for ECD2, showing saline EC water quality similar to SD5, West and North Pit to ECD2 sites in Table 2, with salinity due to Cl and SO_4 salts. These data indicate that there would be no significant salinity effect from ARD generated by PAF materials beyond what is already being managed on site.

Table 3 – Summary of EC, Cl and SO_4 quality (2009 to 2017) for ECD2 pond from the Approved Operations.

	EC (dS/m)	Cl (mg/L)	SO_4 (mg/L)
Minimum	2.8	394	5
Maximum	7.4	1370	1450
Median	5.2	862	930

Overall, the expected relatively minor PAF overburden/interburden, washery waste and pit wall materials would be unlikely to have a significant impact on pit water quality, or require modification of the current saline water management. The pit water quality in the North Pit developed as part of the Proposed Modification is expected to be similar to current pit water quality. More detailed assessment of existing surface and groundwater quality, together with geochemical modelling and water quality prediction would be required to confirm this.

8.0 Conclusions and Recommendations

Results indicate that the vast bulk (over 95%) of overburden/interburden materials represented by the samples tested likely to be NAF, with a significant excess of acid neutralising capacity and low leachable salinity. Occasional thin (generally less than 0.3 m) zones of elevated S were identified close to coal seams, but dilution and mixing during mining should be sufficient to mitigate any ARD generation.

Fresh overburden/interburden had a moderate median ANC of 20 kg H_2SO_4/t, providing a potential source of buffering to help mitigate any ARD from PAF materials. Fresh sandstone tended to have higher ANC than other lithologies, having a median of 25 kg H_2SO_4/t, and is also the most common lithology. Note that weathered overburden/interburden had a relatively low median ANC of 10 kg H_2SO_4/t and is unlikely to be a source of significant buffering.

The Proposed Modification will result in a stepped pit floor, comprising the floor of the Lemington DA Seam; floor of Liddell 6 Seam; and floor of the Lower Hebden Seam. Test results indicate the Lower Hebden Coal Seam floor is likely to be NAF, with mixed NAF and PAF-LC materials indicated based on limited testing for the Liddell 6 Seam floor and Lemington DA Seam floor. The excess ANC in overlying backfilled overburden/interburden would be expected to account for any low capacity ARD generated from portions of these seam floors.

The coal materials represented by the samples tested appear to be mainly NAF, but may include potentially acid forming (PAF) and PAF-LC portions. Some occurrences of coal horizons generating ARD were observed in the current North Pit walls, but the vast majority of the pit walls showed no evidence of ARD, supporting the isolated nature of these pyritic horizons.

Results of coarse and fine rejects testing carried out as part of the 2013 EGi Study of the Mount Owen Complex are expected to be applicable to the Proposed Modification, which indicate these are likely to be mainly NAF. However, rejects from Pikes Gully, Liddell and Hebden Seam Groups may have a greater ARD hazard.

Kinetic NAG and leach column testing indicates that PAF materials are reactive and can rapidly generate ARD within weeks to a couple of months after exposure to atmospheric oxidation conditions. Constituents associated with ARD are likely to include Al, As, Co, Cu, Fe, Mn, Ni and Zn, and slightly elevated Cd and Cr. However, leach column results also show that thorough blending with NAF materials is likely to be an effective strategy in controlling ARD from PAF materials for at least 12 months.

Water extraction and leach column testing of NAF overburden/interburden and rejects indicated that neutral mine drainage was unlikely to contain significant metal/metalloid concentrations.

Water quality testing of the North Pit and West Pit areas for the Approved Operations shows that drainage into the existing pits and tailings storage have slightly alkaline pH, high alkalinity, and low metal/metalloid concentrations. Results confirm that the minor amounts of PAF materials expected in pit walls, overburden/interburden and washery wastes have not lowered the pH, with the excess alkalinity providing a high factor of safety for pH control and maintenance of low metal/metalloid concentrations. In addition, current salinity management ponds are saline and dominated by Cl and SO_4 salts, and it is unlikely that there would be any significant salinity effects from ARD generated by PAF materials beyond what is already being managed on site.

Results have the following implications for mine materials management:

- The vast majority of overburden/interburden, coal and washery wastes for the Proposed Modification are expected to be NAF with excess ANC and are not expected to require special handling. Dilution and mixing during mining is expected to be sufficient to mitigate ARD from any occasional thin zones of pyrite that may be present in pit walls and pit backfill to prevent any significant impacts on downstream water quality.
- Although the PAF mine materials do not appear to represent a concern in terms of downstream water quality impacts, placement of PAF materials close to final surfaces could cause local effects on rehabilitation success through upward migration of acid and salinity into the growth horizon. The thorough intermingling of coarse rejects and overburden observed on site (Section 2), and the excess ANC in the overburden suggests, that these bulk fill zones are unlikely to result in any significant effects on rehabilitation. However, fine rejects (tailings) are not mixed with neutralising materials, and spigotting fine rejects can result in preferential deposition and concentration of pyritic materials, potentially resulting in PAF zones. These aspects need to be considered in the detailed final rehabilitation design of the tailings storage facilities (TSFs).
- Weathered Permian materials are likely to be NAF, but as per the 2013 EGi Study for the Mount Owen Complex appear to be sodic and dispersive, and may need to be treated with gypsum or lime if used as a plant growing horizon, exposed on dump surfaces or used in engineered structures. Finer grained fresh Permian materials may also be partly sodic and require treatment.
- The pit water quality in the North Pit developed as part of the Proposed Modification is expected to be similar to current pit water quality. More detailed assessment of existing surface and groundwater quality, together with geochemical modelling and water quality prediction would be required to confirm this.

It is recommended that additional investigations be carried out as follows:

- Carry out visual inspection of any further core drilling in the Proposed Modification mine area for evidence of pyrite occurrence to confirm the strong dominance of NAF overburden/interburden across the deposit.
- The potential impacts of fine rejects on final rehabilitation of the TSFs are uncertain, and it should be demonstrated that either the TSF will not contain zones of PAF materials close to surface, or that the final TSF capping design will be effective in controlling upward flux of any potential ARD products. This will need to be considered in the detailed final rehabilitation design of the TSFs.
- The Mount Owen Surface Water Management and Monitoring Plan (SWMMP) includes water quality monitoring provisions to monitor for ARD effects[6]. It is recommended that the following modifications should be carried out:
  - The monitoring points should be expanded to include the West Pit decant and North Pit dewatering prior to discharge to the ECD2 pond;
  - The parameters listed in the SWMMP should include the following relevant to ARD: pH, EC, SO_4, Ca, Mg, K, Na, Cl, Al, As, Co, Cu, Fe, Mn, Ni and Zn. Alkalinity should also be determined and carried out at the same frequency as pH and EC for all sites.
  - pH, EC, alkalinity SO_4, Ca, Mg, K, Na and Cl be determined monthly at water quality sites ECD2, West Pit decant and North Pit dewatering for 12 months and reviewed.

[6] *Surface Water Management and Monitoring Plan*, Mt Owen Open Cut, Glencore, Version 8. 17/10/17, Section 4.3.2.

APPENDIX A

Assessment of Acid Forming Characteristics

Assessment of Acid Forming Characteristics

Introduction

Acid rock drainage (ARD) is produced by th. mospheric oxygen and water. The ability to identify in advance any mine materials that could potentially produce ARD is essential for timely implementation of mine waste management strategies.

A number of procedures have been developed to assess the acid forming characteristics of mine waste materials. The most widely used methods are the Acid-Base Account (ABA) and the Net Acid Generation (NAG) test. These methods are referred to as static procedures because each involves a single measurement in time.

Acid-Base Account

The acid-base account involves static laboratory procedures that evaluate the balance between acid generation processes (oxidation of sulphide 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 potential acidity and the acid neutralising capacity, respectively. The difference between the potential acidity and the acid neutralising capacity value is referred to as the net acid producing potential (NAPP).

The chemical and theoretical basis of the ABA are discussed below.

Potential Acidity

The potential acidity that can be generated by a sample is calculated from an estimate of the pyrite (FeS_2) content and assumes that the pyrite reacts under oxidising conditions to generate acid according to the following reaction:

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

Based on the above reaction, the potential acidity of a sample containing 1 %S as pyrite would be 30.6 kilograms of H_2SO_4 per tonne of material (i.e. kg H_2SO_4/t). The pyrite content estimate can be based on total S and the potential acidity determined from total S is referred to as the maximum potential acidity (MPA), and is calculated as follows:

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

The use of an MPA calculated from total sulphur is a conservative approach because some sulphur may occur in forms other than pyrite. Sulphate-sulphur, organic sulphur and native sulphur, for example, are non-acid generating sulphur forms. Also, some sulphur may occur as other metal sulphides (e.g. covellite, chalcocite, sphalerite, galena) which yield less acidity than pyrite when oxidised or, in some cases, may be non-acid generating.

The total sulphur content is commonly used to assess potential acidity because of the difficulty, costs and uncertainty involved in routinely determining the speciation of sulphur forms within samples, and determining reactive sulphide-sulphur contents. However, if the sulphide mineral forms are known then allowance can be made for non- and lesser acid generating forms to provide a better estimate of the potential acidity.

Acid Neutralising Capacity (ANC)

The acid formed from pyrite oxidation will to some extent react with acid neutralising minerals contained within the sample. This inherent acid buffer is quantified in terms of the ANC.

The ANC is commonly determined by the Modified Sobek method. This method involves the addition of a known amount of standardised hydrochloric acid (HCl) to an accurately weighed sample, allowing the sample time to react (with heating), then back-titrating the mixture with standardised sodium hydroxide (NaOH) to determine the amount of unreacted HCl. 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).

Net Acid Producing Potential (NAPP)

The NAPP is a theoretical calculation commonly used to indicate if a material has potential to produce acidic drainage. 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:

$$\text{NAPP} = \text{MPA} - \text{ANC}$$

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.

ANC/MPA Ratio

The ANC/MPA ratio is frequently used as a means of assessing the risk of acid generation from mine waste materials. The ANC/MPA ratio is another way of looking at the acid base account. A positive NAPP is equivalent to an ANC/MPA ratio less than 1, and a negative NAPP is equivalent to an ANC/MPA ratio greater than 1. A NAPP of zero is equivalent to an ANC/MPA ratio of 1.

The purpose of the ANC/MPA ratio is to provide an indication of the relative margin of safety (or lack thereof) within a material. Various ANC/MPA values are reported in the literature for indicating safe values for prevention of acid generation. These values typically range from 1 to 3. As a general rule, an ANC/MPA ratio of 2 or more signifies that there is a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to acid rock drainage.

Acid-Base Account Plot

Sulphur and ANC data are often presented graphically in a format similar to that shown in Figure 1. This figure includes a line indicating the division between NAPP positive samples from NAPP negative samples. Also shown are lines corresponding to ANC/MPA ratios of 2 and 3.

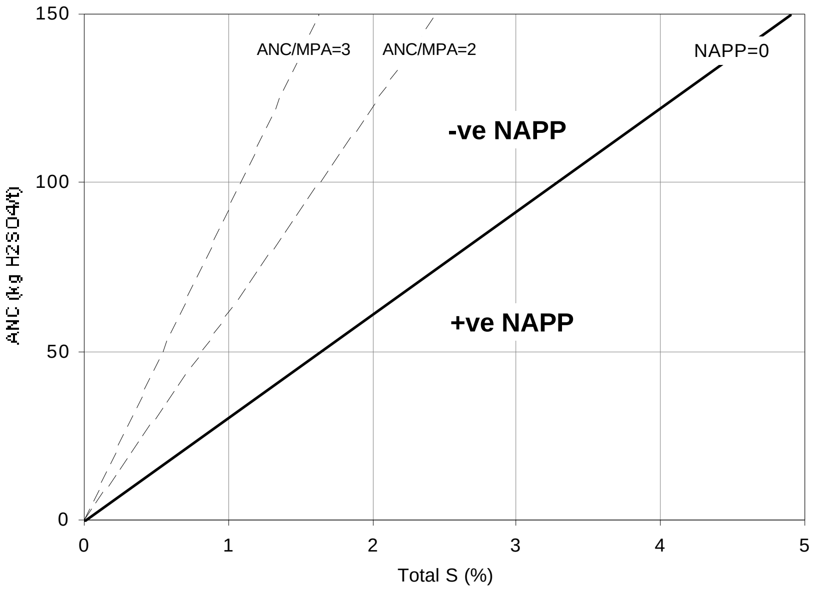

Figure 1: Acid-base account (ABA) plot

Net Acid Generation (NAG) Test

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 sulphide minerals contained within a sample. During the NAG test both acid generation and acid neutralisation reactions can occur simultaneously. The end result represents a direct measurement of the net amount of acid generated by the sample. The final pH is referred to as the NAGpH and the amount of acid produced is commonly referred to as the NAG capacity, and is expressed in the same units as the NAPP (kg H_2SO_4/t).

Several variations of the NAG test have been developed to accommodate the wide geochemical variability of mine waste materials. The four main NAG test procedures currently used by EGi are the single addition NAG test, the sequential NAG test, the kinetic NAG test, and the extended boil and calculated NAG test.

Single Addition NAG Test

The single addition NAG test involves the addition of 250 ml of 15% hydrogen peroxide to 2.5 g 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 sulphides, then vigorously boiled for several minutes to decompose residual peroxide. When cool, the NAGpH and NAG capacity are measured.

An indication of the form of the acidity is provided by initially titrating the NAG liquor to pH 4.5, then continuing the titration up to pH 7. The titration value at pH 4.5 includes acidity due to free acid (i.e. H_2SO_4) as well as soluble iron and aluminium. The titration value at pH 7 also includes metallic ions that precipitate as hydroxides at between pH 4.5 and 7.

Sequential NAG Test

When testing samples with high sulphide contents it is not uncommon for oxidation to be incomplete in the single addition NAG test. This can sometimes occur when there is catalytic breakdown of the hydrogen peroxide before it has had a chance to oxidise all of the sulphides in a sample. To overcome this limitation, a sequential NAG test is often carried out. This test may also be used to assess the relative geochemical lag of PAF samples with high ANC.

The sequential NAG test is a multi-stage procedure involving a series of single addition NAG tests on the one sample (i.e. 2.5 g of sample is reacted two or more times with
250 ml aliquots of 15% hydrogen peroxide). At the end of each stage, the sample is filtered and the solution is used for measurement of NAGpH and NAG capacity. The NAG test is then repeated on the solid residue. The cycle is repeated until such time that there is no further catalytic decomposition of the peroxide, or when the NAGpH is greater than pH 4.5. The overall NAG capacity of the sample is then determined by summing the individual acid capacities from each stage.

Kinetic NAG Test

The kinetic NAG test is the same as the single addition NAG test except that the temperature and pH of the liquor are recorded. Variations in these parameters during the test provide an indication of the kinetics of sulphide oxidation and acid generation. This, in turn, can provide an insight into the behaviour of the material under field conditions. For example, the pH trend gives an estimate of relative reactivity and may be related to prediction of lag times and oxidation rates similar to those measured in leach columns. Also, sulphidic samples commonly produce a temperature excursion during the NAG test due to the decomposition of the peroxide solution, catalysed by sulphide surfaces and/or oxidation products.

Extended Boil and Calculated NAG Test

Organic acids may be generated in NAG tests due to partial oxidation of carbonaceous materials[1] such as coal washery wastes. This can lead to low NAGpH values and high acidities in standard single addition NAG tests unrelated to acid generation from sulphides. Organic acid effects can therefore result in misleading NAG values and misclassification of the acid forming potential of a sample.

The extended boil and calculated NAG tests can be used to account for the relative proportions of pyrite derived acidity and organic acidity in a given NAG solution, thus providing a more reliable measure of the acid forming potential of a sample. The procedure involves two steps to differentiating pyritic acid from organic derived acid:

Extended Boil NAG	decompose the organic acids and hence remove the influence of non-pyritic acidity on the NAG solution.
Calculated NAG	calculate the net acid potential based on the balance of cations and anions in the NAG solution, which will not be affected by organic acid.

The extended boiling test is carried out on the filtered liquor of a standard NAG test, and involves vigorous boiling of the solution on a hot plate for 3-4 hours. After the boiling step the solution is cooled and the pH measured. An extended boil NAGpH less than 4.5 confirms the sample is potentially acid forming (PAF), but a pH value greater than 4.5 does not necessarily mean that the sample is non acid forming (NAF), due to some loss of free acid during the extended boiling procedure. To address this issue, a split of the same filtered NAG solution is assayed for concentrations of S, Ca, Mg, Na, K and Cl, from which a calculated NAG value is determined[2].

The concentration of dissolved S is used to calculate the amount of acid (as H_2SO_4) generated by the sample and the concentrations of Ca, Mg, Na and K are used to estimate the amount of acid neutralised (as H_2SO_4). The concentration of Cl is used to correct for soluble cations associated with Cl salts, which may be present in the sample and unrelated to acid generating and acid neutralising reactions.

[1] Stewart, W., Miller, S., Thomas, J.E., and Smart R. (2003), 'Evaluation of the Effects of Organic Matter on the Net Acid Generation (NAG) Test', in *Proceedings of the Sixth International Conference on Acid Rock drainage (ICARD), Cairns, 12-18th July 2003*, 211-222.

[2] Environmental Geochemistry International, Levay and Co. and ACeSSS, 2008. *ACARP Project C15034: Development of ARD Assessment for Coal Process Wastes*, EGi Document No. 3207/817, July 2008.

The calculated NAG value is the amount of acid neutralised subtracted from the amount of acid generated. A positive value indicates that the sample has excess acid generation and is likely to be PAF, and a zero or negative value indicates that the sample has excess neutralising capacity and is likely to be NAF.

Sample Classification

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

- Barren;
- Non-acid forming (NAF);
- Potentially acid forming (PAF); and
- Uncertain (UC).

Barren

A sample classified as barren essentially has no acid generating capacity and no acid buffer 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 for hard rock mines it generally applies to materials with a total sulphur content ≤ 0.1 %S and an ANC ≤ 5 kg H_2SO_4/t.

Non-acid forming (NAF)

A sample classified as NAF may, or may not, have a significant sulphur 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 sulphide 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 the final NAG pH ≥ 4.5.

Potentially acid forming (PAF)

A sample classified as PAF always has a significant sulphur content, the acid generating potential of which exceeds the inherent acid neutralising capacity 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.

Uncertain (UC)

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). Uncertain samples are generally given a tentative classification that is shown in brackets e.g. UC(NAF).

Figure 2 shows the format of the classification plot that is typically used for presentation of NAPP and NAG data. Marked on this plot are the quadrats representing the NAF, PAF and UC classifications.

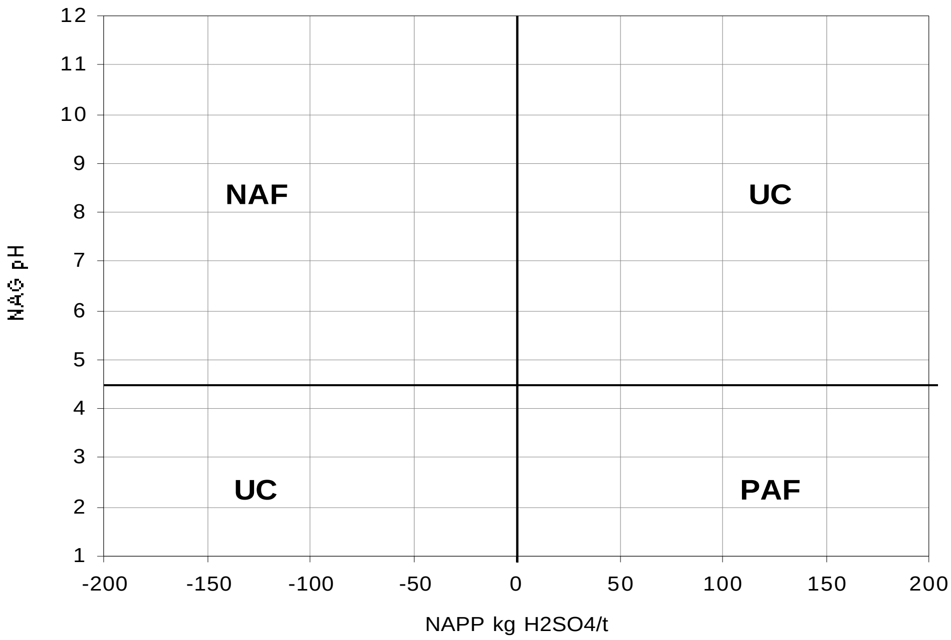

Figure 2 ARD classification plot

Other Methods

Other test procedures may be used to define the acid forming characteristics of a sample.

pH and Electrical Conductivity

The pH and electrical conductivity (EC) of a sample is determined by equilibrating the sample in deionised water for a minimum of 12 hours (or overnight), typically at a solid to water ratio of 1:2 (w/w). This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

Acid Buffering Characteristic Curve (ABCC) Test

The ABCC test involves slow titration of a sample with acid while continuously monitoring pH. These data provides an indication of the portion of ANC within a sample that is readily available for acid neutralisation.

APPENDIX B

Acid Forming Characteristics

Overburden, Interburden and Coal Materials

Geochemical Testwork Results

Table B1: Mount Owen Proposed Modification Project – Acid Forming Characteristics of overburden/interburden and coal samples (this project)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION ANG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/ MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC028	296.74	297.06	0.32	Coal	LAE	LAE	Coal	FR		QSMC028-78		11658			0.52	16							
SMC028	297.06	298.26	1.20	Sandstone/Mudstone			Overburden	FR			31876	12025			0.01	0							NAF
SMC028	298.26	298.54	0.28	Mudstone			Overburden	FR	Carboceous		31877	12026			0.05	2							NAF
SMC028	298.54	298.59	0.05	Coal	LAD	LAD	Coal	FR		QSMC028-79		11659			0.77	24							
SMC028	298.59	299.79	1.20	Mudstone			Overburden	FR	Carboceous		31878	12027			0.03	1							NAF
SMC028	299.79	300.03	0.24	Coal	LAC	LAC	Coal	FR	M Carbote	QSMC028-80		11660			0.56	17							
SMC028	300.03	300.24	0.21	Tuff/Siltstone			Overburden	FR	Minor Coal, Carboceous	QSMC028-81		11661			0.07	2	18	-16	8.40	7.3	0	0	NAF
SMC028	300.24	300.43	0.19	Coal	LAB	LAB	Coal	FR		QSMC028-82		11662			0.52	16							
SMC028	300.43	300.76	0.33	Coal	LAA	LAA	Coal	FR		QSMC028-83		11663			0.65	20							
SMC028	300.76	301.68	0.92	Siltstone/Sandstone			Overburden	FR			31879	12028			0.02	1							NAF
SMC028	301.68	301.93	0.25	Mudstone/Coal			Overburden	FR	Carboceous		31880	12029			0.07	2							NAF
SMC028	301.93	302.18	0.25	Coal	PG3	PG3	Coal	FR	Carbote	QSMC028-84		11664			0.61	19							
SMC028	302.18	302.19	0.01	Mudstone			Overburden	FR			NS												
SMC028	302.19	303.96	1.77	Sandstone/Siltstone			Overburden	FR	Geotech = 0.22m		31882	12030			0.02	1							NAF
SMC028	303.96	306.06	2.10	Sandstone			Overburden	FR			31883	12031			0.01	0							NAF
SMC028	323.57	324.74	1.17	Sandstone			Overburden	FR			31884	12032			0.01	0							NAF
SMC028	324.74	326.27	1.53	Sandstone			Overburden	FR	Siderite		31885	12033			0.02	1							NAF
SMC028	326.27	326.62	0.35	Siltstone			Overburden	FR	Carbote		31886	12034			0.03	1							NAF
SMC028	326.62	327.05	0.43	Coal/Siltstone	PG2	PG2	Overburden	FR		QSMC028-85		11665			0.26	8	7	1	0.88	4.2	1	7	UC(PAF-LC)
SMC028	327.05	328.53	1.48	Sandstone/Siltstone			Overburden	FR			31887	12035			0.02	1							NAF
SMC028	328.53	328.87	0.34	Siltstone			Overburden	FR	Pyrite		31888	12036			0.06	2							NAF
SMC028	328.87	329.12	0.25	Coal	PG1	PG1	Coal	FR		QSMC028-86		11666			0.59	18							
SMC028	329.12	329.57	0.45	Siltstone			Overburden	FR		QSMC028-87		11667			0.05	2	10	-8	6.54	5.4	0	2	NAF
SMC028	329.57	330.29	0.72	Coal	ART3C	ART3C	Coal	FR		QSMC028-88		11668			0.57	17							
SMC028	330.29	331.15	0.86	Carb Mudstone/Siltstone			Overburden	FR			31889	12037			0.06	2							NAF
SMC028	331.15	333.42	2.27	Sandstone			Overburden	FR			31890	12038			0.01	0							NAF
SMC028	333.42	335.19	1.77	Siltstone			Overburden	FR			31891	12039			0.02	1							NAF
SMC028	335.19	336.32	1.13	Sandstone/Siltstone			Overburden	FR	Carboceous		31892	12040			0.08	2							NAF
SMC028	336.32	336.67	0.35	Coal	ART3A	ART3A	Coal	FR		QSMC028-89		11669			0.53	16							
SMC028	336.67	336.83	0.16	Carb Mudstone			Overburden	FR		QSMC028-90		11670			0.20	6	10	-4	1.63	4.1	2	13	UC(PAF-LC)
SMC028	336.83	337.56	0.73	Coal	ART3	ART3	Coal	FR		QSMC028-91		11671			0.60	18							
SMC028	337.56	338.60	1.04	Sandstone			Overburden	FR	Geotech = 0.2m, Carboceous		31893	12041	5.9	1.35	0.35	11	6	5	0.56	3.4	3	10	PAF-LC
SMC028	338.60	340.47	1.87	Sandstone			Overburden	FR			31894	12042			0.02	1							NAF
SMC028	340.47	341.63	1.16	Siltstone			Overburden	FR	Geotech = 0.24m		31895	12043			0.05	2							NAF
SMC028	341.63	341.75	0.12	Coal	ART2H	ART2H	Coal	FR		QSMC028-92		11672			0.54	17							
SMC028	341.75	342.15	0.40	Siltstone			Overburden	FR			31896	12044			0.01	0							NAF
SMC028	342.15	343.12	0.97	Siltstone/Sandstone			Overburden	FR	Carboceous		31897	12045			0.01	0							NAF
SMC028	343.12	343.99	0.87	Mudstone/Sandstone			Overburden	FR	Carboceous		31898	12046			0.05	2							NAF
SMC028	351.11	354.03	2.92	Sandstone/Siltstone			Overburden	FR	Geotech = 0.22m		31899	12047			0.01	0							NAF
SMC028	354.03	354.77	0.74	Sandstone/Siltstone			Overburden	FR	Geotech = 0.17m		31900	12048			0.04	1							NAF
SMC028	354.77	355.72	0.95	Coal	ART2	ART2	Coal	FR		QSMC028-93		11673			0.65	20							
SMC028	355.72	356.30	0.58	Carb Mudstone/Sandstone			Overburden	FR		QSMC028-94		11674			0.22	7	42	-35	6.24	7.6	0	0	NAF
SMC028	356.30	357.20	0.90	Coal	ART1	ART1	Coal	FR		QSMC028-95		11675			0.39	12							NAF
SMC028	357.20	358.21	1.01	Siltstone/Sandstone			Overburden	FR	Carboceous		31901	12049			0.04	1							NAF
SMC028	358.21	359.64	1.43	Siltstone			Overburden	FR			31902	12050			0.02	1							NAF
SMC028	359.64	360.63	0.99	Sandstone			Overburden	FR	Coal at base		31903	12051			0.06	2							NAF
SMC028	364.01	365.46	1.45	Sandstone			Overburden	FR			31904	12052			0.01	0							NAF
SMC028	365.46	367.36	1.90	Sandstone			Overburden	FR			31905	12053			0.02	1							NAF
SMC028	367.36	368.10	0.74	Siltstone			Overburden	FR	Pyrite, Carbote, Geotech = 0.16m		31906	12054	7.5	0.12	0.13	4	42	-38	10.56	7.7	0	0	NAF
SMC028	368.10	368.31	0.21	Carb Mudstone			Overburden	FR			31907	12055	8.2	0.35	0.41	13	18	-5	1.43	6.9	0	0	NAF
SMC028	368.31	368.48	0.17	Coal			Coal	FR		QSMC028-96		11676			0.96	29	10	19	0.34	3.3	4	12	PAF-LC
SMC028	368.48	368.76	0.28	Coal	LID9	LID9	Coal	FR		QSMC028-97		11677			0.72	22							
SMC028	368.76	369.19	0.43	Coal	LID8	LID8	Coal	FR		QSMC028-98		11678			0.55	17							
SMC028	369.19	369.28	0.09	Mudstone			Overburden	FR	Carbote	QSMC028-99		11679			0.53	16	19	-3	1.17	3.5	2	8	UC(PAF-LC)
SMC028	369.28	370.03	0.75	Coal	LID7	LID7	Coal	FR	Carbote	QSMC028-100		11680			0.48	15							

Table B1: Mount Owen Proposed Modification Project – Acid Forming Characteristics of overburden/interburden and coal samples (this project)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION ANG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/ MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC028	370.03	370.41	0.38	Mudstone			Overburden	FR		QSMC028-101		11681			0.04	1	40	-39	32.68	7.5	0	0	NAF
SMC028	370.41	371.45	1.04	Coal	LID6	LID6	Coal	FR		QSMC028-102		11682			0.46	14							
SMC028	371.45	371.71	0.26	Siltstone			Overburden	FR	Pyrite		31908	12056			0.11	3	4	-1	1.19	4.2	1	7	UC(PAF-LC)
SMC028	371.71	372.59	0.88	Sandstone			Overburden	FR	Geotech = 0.24m		31909	12057			0.03	1							NAF
SMC028	372.59	374.46	1.87	Sandstone			Overburden	FR			31910	12058			0.01	0							NAF
SMC028	389.90	391.49	1.59	Siltstone/Sandstone			Overburden	FR			31911	12059			0.04	1							NAF
SMC028	391.49	392.71	1.22	Siltstone/Sandstone			Overburden	FR			31912	12060			0.02	1							NAF
SMC028	392.71	393.01	0.30	Siltstone			Overburden	FR	Geotech = 0.15m, Carboceous		31913	12061			0.02	1							NAF
SMC028	393.01	393.16	0.15	Coal	LID5E	LID5E	Coal	FR		QSMC028-103		11683			0.53	16							
SMC028	393.16	393.47	0.31	Siltstone			Overburden	FR		QSMC028-104		11684			0.07	2	9	-7	4.20	5.6	0	1	NAF
SMC028	393.47	394.02	0.55	Coal	LID5D	LID5D	Coal	FR		QSMC028-105		11685			0.71	22							
SMC028	394.02	394.69	0.67	Coal	LID5C	LID5C	Coal	FR		QSMC028-106		11686			1.16	35							
SMC028	394.69	395.00	0.31	Mudstone/Coal			Overburden	FR	Carbote	QSMC028-107		11687			0.18	6	26	-20	4.72	7.6	0	0	NAF
SMC028	395.00	395.41	0.41	Siltstone			Overburden	FR			31914	12062			0.04	1							NAF
SMC028	395.41	396.55	1.14	Sandstone			Overburden	FR			31915	12063	8.7	0.37	0.31	9	72	-63	7.59	7.5	0	0	NAF
SMC028	396.55	398.50	1.95	Sandstone/Siltstone			Overburden	FR			31916	12064			0.01	0							NAF
SMC028	401.53	404.52	2.99	Sandstone			Overburden	FR			31917	12065			0.01	0							NAF
SMC028	404.52	406.75	2.23	Sandstone			Overburden	FR	Carboceous		31918	12066			0.03	1							NAF
SMC028	406.75	407.28	0.53	Siltstone			Overburden	FR	Pyrite, Geotech = 0.17m		31919	12067	8.9	0.28	0.38	12	11	1	0.95	4.2	0.4	6	PAF-LC
SMC028	407.28	408.01	0.73	Coal	LID5B	LID5B	Coal	FR		QSMC028-108		11688			0.62	19							
SMC028	408.01	408.08	0.07	Mudstone/Coal			Overburden	FR		QSMC028-109		11689			0.13	4							
SMC028	408.08	409.26	1.18	Coal	LID5A	LID5A	Coal	FR	Carbote	QSMC028-110		11690			0.44	13							
SMC028	409.26	409.33	0.07	Mudstone			Overburden	FR		QSMC028-111		11691			0.02	1	43	-42	70.26	7.8	0	0	NAF
SMC028	409.33	409.84	0.51	Coal	LID4	LID4	Coal	FR		QSMC028-112		11692			0.46	14							
SMC028	409.84	410.23	0.39	Sandstone			Overburden	FR	Geotech = 0.25m		31920	12068			0.01	0							NAF
SMC028	410.23	410.76	0.53	Siltstone/Carb Mudstone			Overburden	FR			31921	12069	8.6	0.29	0.15	5	7	-2	1.53	3.7	3	15	NAF
SMC028	410.76	411.11	0.35	Coal	LID4L	LID4L	Coal	FR		QSMC028-113		11693			0.64	20							
SMC028	411.11	411.20	0.09	Siltstone			Overburden	FR			31922	12070			0.02	1							NAF
SMC028	411.20	412.95	1.75	Sandstone			Overburden	FR			31923	12071			0.03	1							NAF
SMC028	412.95	414.35	1.40	Sandstone			Overburden	FR	M pyrite		31924	12072			0.01	0							NAF
SMC028	432.91	435.05	2.14	Sandstone			Overburden	FR			31925	12073			0.01	0							NAF
SMC028	435.05	436.59	1.54	Sandstone			Overburden	FR			31926	12074			0.01	0							NAF
SMC028	436.59	437.96	1.37	Coal	LID1	LID1	Coal	FR		QSMC028-114		11694			0.48	15							
SMC028	437.96	438.29	0.33	Carb Mudstone			Overburden	FR		QSMC028-115		11695			0.28	9	5	4	0.58	3.1	11	26	NAF
SMC028	438.29	438.85	0.56	Siltstone			Overburden	FR	Geotech = 0.19m/Carboceous		31927	12075			0.04	1							NAF
SMC028	438.85	439.27	0.42	Sandstone			Overburden	FR			31928	12076			0.01	0							NAF
SMC028	439.27	441.31	2.04	Siltstone			Overburden	FR			31929	12077			0.01	0							NAF
SMC028	444.09	445.87	1.78	Sandstone			Overburden	FR			31930	12078			0.01	0							NAF
SMC028	445.87	446.84	0.97	Sandstone			Overburden	FR	Geotech = 0.18m, Carboceous		31931	12079			0.09	3							NAF
SMC028	446.84	447.03	0.19	Siltstone/Siderite			Overburden	FR	Carboceous		31932	12080			0.08	2							NAF
SMC028	447.03	447.50	0.47	Coal	BAR3	BAR3	Coal	FR		QSMC028-116		11696			0.52	16							
SMC028	447.50	447.75	0.25	Coal/Tuff			Overburden	FR		QSMC028-117		11697			2.39	73	30	43	0.41	2.4	26	32	PAF
SMC028	447.75	449.51	1.76	Coal	BAR2	BAR2	Coal	FR	Carbote	QSMC028-118		11698			0.48	15							
SMC028	449.51	449.64	0.13	Carb Mudstone/Siltstone			Overburden	FR	Carboceous	QSMC028-119		11699			0.28	9	7	2	0.82	6.4	0	1	UC(NAF)
SMC028	449.64	449.88	0.24	Coal	BAR1	BAR1	Coal	FR		QSMC028-120		11700			0.45	14							
SMC028	449.88	450.73	0.85	Carb Mudstone			Overburden	FR			31933	12081			0.07	2							NAF
SMC028	450.73	453.41	2.68	Sandstone			Overburden	FR			31934	12082			0.01	0							NAF
SMC028	453.41	454.73	1.32	Siltstone			Overburden	FR	Carboceous		31935	12083			0.04	1							NAF
SMC028	471.10	472.08	0.98	Siltstone			Overburden	FR			31936	12084			0.01	0							NAF
SMC028	472.08	473.12	1.04	Sandstone			Overburden	FR			31937	12085			0.01	0							NAF
SMC028	473.12	474.34	1.22	Siltstone			Overburden	FR	Geotech = 0.25m/Carboceous		31938	12086			0.02	1							NAF
SMC028	474.34	474.68	0.34	Siltstone			Overburden	FR	Carboceous		31939	12087			0.04	1							NAF
SMC028	474.68	475.12	0.44	Coal			Coal	FR	Carbote	QSMC028-121		11701			0.35	11	34	-23	3.17	7.5	0	0	NAF
SMC028	475.12	475.24	0.12	Tuff/Carb Mudstone			Overburden	FR	Carbote	QSMC028-122		11702			0.05	2	72	-70	47.06	7.6	0	0	NAF
SMC028	475.24	475.97	0.73	Coal	UH2	UH2	Coal	FR	Carbote	QSMC028-123		11703			0.49	15							

Table B1: Mount Owen Proposed Modification Project – Acid Forming Characteristics of overburden/interburden and coal samples (this project)

Hole ID	Depth (m) From	Depth (m) To	Depth (m) Interval	Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS Total %S	MPA	ANC	NAPP	ANC/ MPA	SINGLE ADDITION ANG NAGpH	NAG(pH4.5)	NAG(pH7.0)	ARD Classification
SMC028	475.97	476.19	0.22	Tuff			Overburden	FR	Carbote	QSMC028-124		11704			0.03	1	46	-45	50.11	8.1	0	0	NAF
SMC028	476.19	477.90	1.71	Coal	UH1	UH1	Coal	FR		QSMC028-125		11705			0.40	12							
SMC028	477.90	478.19	0.29	Carb Mudstone			Overburden	FR	Carboceous	QSMC028-126		11706			0.30	9	20	-11	2.18	7.2	0	0	NAF
SMC028	478.19	478.44	0.25	Siltstone			Overburden	FR	Geotech = 0.13m		31940	12088			0.08	2							NAF
SMC028	478.44	480.17	1.73	Siltstone/Sandstone			Overburden	FR	Carboceous		31941	12089			0.01	0							NAF
SMC028	480.17	481.62	1.45	Sandstone			Overburden	FR	Carboceous		31942	12090			0.02	1							NAF
SMC028	488.00	490.38	2.38	Sandstone			Overburden	FR			31943	12091			0.02	1							NAF
SMC028	490.38	491.84	1.46	Sandstone/Siltstone			Overburden	FR	Carboceous		31944	12092			0.02	1							NAF
SMC028	491.84	492.59	0.75	Siltstone			Overburden	FR	Carboceous, Siderite		31945	12093			0.07	2							NAF
SMC028	492.59	492.70	0.11	Coal/Tuff			Overburden	FR	Carbote	QSMC028-127		11707			0.71	22	20	2	0.92	4.6	0	6	UC(NAF)
SMC028	492.70	494.11	1.41	Coal	LHB	LHB	Coal	FR		QSMC028-128		11708			0.58	18							
SMC028	494.11	495.51	1.40	Sandstone			Overburden	FR	Geotech = 0.23m		31946	12094			0.01	0							NAF
SMC028	495.51	495.99	0.48	Siltstone			Overburden	FR	Carbote, Carboceous		31947	12095			0.08	2							NAF
SMC028	495.99	496.95	0.96	Coal	H1/H2	H1/H2	Coal	FR	Siltstone at base	QSMC028-129		11709			0.28	9							NAF
SMC028	496.95	497.75	0.80	Sandstone/Siltstone			Overburden	FR	Carboceous		31948	12096			0.06	2							NAF
SMC028	497.75	497.98	0.23	Coal/Carb Mudstone			Overburden	FR			31949	12097	8.8	0.30	0.27	8	12	-4	1.45	4.0	2	13	NAF
SMC028	497.98	499.32	1.34	Sandstone			Overburden	FR			31950	12098			0.01	0							NAF
SMC032	171.34	171.55	0.21	Coal	LAD	LAD	Coal	FR		QSMC032-52		11710			0.53	16	8	8	0.49	4.0	2	11	UC(PAF-LC)
SMC032	171.55	171.75	0.20	Tuff/Coal			Overburden	FR		QSMC032-53		11711			0.07	2	18	-16	8.40	6.9	0	0	NAF
SMC032	171.75	171.98	0.23	Coal	LAC	LAC	Coal	FR		QSMC032-54		11712			0.83	25	8	17	0.31	2.8	18	33	UC(PAF)
SMC032	171.98	172.21	0.23	Coal	LAB	LAB	Coal	FR		QSMC032-55		11713			1.85	57	0	57	0.00	2.5	17	20	PAF
SMC032	172.21	172.36	0.15	Siltstone/Carb Mudstone			Overburden	FR			31801	12099			0.06	2							NAF
SMC032	172.36	173.80	1.44	Sandstone			Overburden	FR	Carboceous, Geotech = 0.19m		31802	12100			0.05	2							NAF
SMC032	173.80	173.91	0.11	Carb Mudstone			Overburden	FR		QSMC032-56		11714			0.52	16	7	9	0.44	2.9	13	32	PAF
SMC032	173.91	174.25	0.34	Coal	LAA	LAA	Coal	FR		QSMC032-57		11715			0.96	29	3	26	0.10	2.4	29	46	PAF
SMC032	174.25	175.25	1.00	Sandstone			Overburden	FR			31803	12101			0.04	1							NAF
SMC032	175.25	178.57	3.32	Sandstone			Overburden	FR			31804	12102			0.01	0							NAF
SMC032	180.29	180.42	0.13	Core Loss			Overburden	FR			NS												
SMC032	180.42	181.19	0.77	Sandstone/Siltstone			Overburden	FR			31805	12103			0.01	0							NAF
SMC032	181.19	182.42	1.23	Sandstone			Overburden	FR	Carboceous		31806	12104	9.1	0.39	0.01	0							NAF
SMC032	182.42	182.57	0.15	Siltstone/Coal			Overburden	FR	Carboceous		31807	12105	9.3	0.41	0.30	9	9	0	0.98	3.6	5	16	NAF
SMC032	182.57	183.36	0.79	Sandstone/Siltstone			Overburden	FR			31808	12106			0.01	0							NAF
SMC032	183.36	185.57	2.21	Sandstone			Overburden	FR			31809	12107	8.4	0.37	0.01	0							NAF
SMC032	193.61	197.00	3.39	Sandstone			Overburden	FR			31810	12108			0.01	0							NAF
SMC032	197.00	198.02	1.02	Sandstone/Siltstone			Overburden	FR			31811	12109	7.9	0.40	0.01	0							NAF
SMC032	198.02	198.51	0.49	Coal	PG3	PG3	Coal	FR		QSMC032-58		11716			0.54	17	10	7	0.61	3.1	9	20	NAF
SMC032	198.51	199.50	0.99	Sandstone			Overburden	FR	Carboceous		31812	12110			0.05	2							NAF
SMC032	199.50	202.00	2.50	Sandstone			Overburden	FR	Carboceous		31813	12111			0.01	0							NAF
SMC032	202.00	202.74	0.74	Siltstone			Overburden	FR	Carboceous		31814	12112	7.8	0.39	0.04	1							NAF
SMC032	202.74	203.00	0.26	Coal	PG2	PG2	Coal	FR		QSMC032-59		11717			0.67	21	15	6	0.73	4.0	3	11	UC(PAF-LC)
SMC032	203.00	203.28	0.28	Siltstone/Carb Mudstone			Overburden	FR		QSMC032-60		11718			0.14	4	10	-6	2.33	4.6	0	5	NAF
SMC032	203.28	204.04	0.76	Coal	PG1	PG1	Coal	FR		QSMC032-61		11719			0.56	17	3	14	0.18	2.5	29	48	UC(PAF)
SMC032	204.04	204.34	0.30	Siltstone			Overburden	FR			NS												
SMC032	204.34	207.00	2.66	Sandstone/Siltstone			Overburden	FR	Carboceous, Geotech = 0.31m		31816	12113	8.7	0.28	0.01	0							NAF
SMC032	207.00	210.34	3.34	Sandstone/Siltstone			Overburden	FR			31817	12114			0.01	0							NAF
SMC032	210.34	211.34	1.00	Sandstone/Siltstone			Overburden	FR	Carboceous		31818	12115			0.02	1							NAF
SMC032	211.34	211.67	0.33	Siltstone/Tuff			Overburden	FR	Carboceous		31819	12116			0.09	3							NAF
SMC032	211.67	211.79	0.12	Coal	ART3C	ART3C	Coal	FR		QSMC032-62		11720			0.65	20	8	12	0.40	2.3	46	70	UC(PAF)
SMC032	211.79	212.13	0.34	Siltstone			Overburden	FR		QSMC032-63		11721			0.26	8	11	-3	1.38	4.1	1	5	UC(PAF-LC)
SMC032	212.13	212.54	0.41	Coal	ART3A	ART3A	Coal	FR		QSMC032-64		11722			0.58	18	9	9	0.51	2.8	18	35	UC(PAF)
SMC032	212.54	212.77	0.23	Carb Mudstone			Overburden	FR	Pyrite	QSMC032-65		11723			0.87	27	10	17	0.38	3.0	7	15	PAF
SMC032	212.77	213.54	0.77	Coal	ART3	ART3	Coal	FR		QSMC032-66		11724			0.85	26	8	18	0.31	3.7	4	11	UC(PAF-LC)
SMC032	213.54	214.97	1.43	Sandstone			Overburden	FR	Pyrite		31820	12117	8.8	0.25	0.06	2							NAF
SMC032	214.97	217.42	2.45	Sandstone			Overburden	FR			31821	12118			0.02	1							NAF
SMC032	217.42	217.97	0.55	Siltstone			Overburden	FR	Pyrite		31822	12119	7.8	0.28	0.20	6	11	-5	1.80	4.8	0	3	NAF

Table B1: Mount Owen Proposed Modification Project – Acid Forming Characteristics of overburden/interburden and coal samples (this project)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION ANG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/ MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC032	217.97	218.23	0.26	Coal	ART2H	ART2H	Coal	FR	Carbote	QSMC032-67		11725			0.45	14	43	-29	3.12	7.4	0	0	NAF
SMC032	218.23	219.25	1.02	Sandstone/Carb Mudstone			Overburden	FR	Carboceous, Geotech = 0.19m		31823	12120			0.04	1							NAF
SMC032	219.25	219.52	0.27	Carb Mudstone/Coal			Overburden	FR	Carbote		31824	12121	8.5	0.29	0.13	4	11	-7	2.77	4.6	0	7	NAF
SMC032	219.52	220.86	1.34	Sandstone			Overburden	FR	Minor Carb Mudstone		31825	12122			0.03	1							NAF
SMC032	220.86	223.41	2.55	Sandstone			Overburden	FR			31826	12123			0.01	0							NAF
SMC032	223.41	224.41	1.00	Sandstone/Coal			Overburden	FR			31827	12124			0.10	3							NAF
SMC032	224.41	224.73	0.32	Tuff			Overburden	FR	Carbote		31828	12125			0.01	0							NAF
SMC032	224.73	226.02	1.29	Coal	ART2	ART2	Coal	FR	Core Loss at base (0.23m)	QSMC032-68		11726			0.39	12	34	-22	2.85	7.1	0	0	NAF
SMC032	226.02	226.50	0.48	No Record			Overburden	FR		QSMC032-69		11727			0.05	2	42	-40	27.45	7.8	0	0	NAF
SMC032	226.50	227.57	1.07	Coal	ART1	ART1	Coal	FR		QSMC032-70		11728			0.29	9	31	-22	3.49	7.3	0	0	NAF
SMC032	227.57	228.60	1.03	Sandstone			Overburden	FR	Geotech = 0.17m		31829	12126	8.3	0.34	0.05	2							NAF
SMC032	228.60	232.77	4.17	Sandstone			Overburden	FR			31830	12127			0.02	1							NAF
SMC032	239.90	241.84	1.94	Sandstone			Overburden	FR	Geotech = 0.27m		31831	12128			0.02	1							NAF
SMC032	241.84	242.66	0.82	Siltstone			Overburden	FR	Minor Coal		31832	12129			0.09	3							NAF
SMC032	242.66	242.80	0.14	Coal	LID9	LID9	Coal	FR		QSMC032-71		11729			1.58	48	13	35	0.27	3.0	7	14	PAF
SMC032	242.80	242.85	0.05	Mudstone			Overburden	FR	Carboceous	QSMC032-72		11730			0.28	9	10	-1	1.17	2.8	20	39	UC(PAF)
SMC032	242.85	243.35	0.50	Coal	LID8	LID8	Coal	FR		QSMC032-73		11731			0.59	18	9	9	0.50	3.3	8	19	UC(PAF)
SMC032	243.35	243.53	0.18	Siltstone			Overburden	FR	Carboceous	QSMC032-74		11732			0.04	1	12	-11	9.80	6.9	0	0	NAF
SMC032	243.53	244.90	1.37	Coal	LID7	LID7	Coal	FR		QSMC032-75		11733			0.48	15	27	-12	1.84	7.1	0	0	NAF
SMC032	244.90	245.52	0.62	Sandstone/Core Loss			Overburden	FR		QSMC032-76		11734			0.04	1	14	-13	11.44	5.9	0	1	NAF
SMC032	245.52	246.35	0.83	Coal	LID6	LID6	Coal	FR		QSMC032-77		11735			0.40	12	19	-7	1.55	7.2	0	0	NAF
SMC032	246.35	247.42	1.07	Sandstone/Siltstone			Overburden	FR	Carboceous		31833	12130			0.02	1							NAF
SMC032	247.42	249.45	2.03	Sandstone			Overburden	FR			31834	12131			0.01	0							NAF
SMC032	259.79	261.26	1.47	Sandstone			Overburden	FR	Carboceous		31835	12132			0.01	0							NAF
SMC032	261.26	261.76	0.50	Siltstone/Coal			Overburden	FR	Carboceous		31836	12133			0.10	3							NAF
SMC032	261.76	264.26	2.50	Sandstone/Siltstone			Overburden	FR			31837	12134	7.8	0.42	0.01	0							NAF
SMC032	264.26	264.90	0.64	Siltstone			Overburden	FR	Carboceous, Geotech = 0.2m		31838	12135			0.08	2							NAF
SMC032	264.90	265.09	0.19	Coal	LID5D	LID5D	Coal	FR		QSMC032-78		11736			0.57	17	2	15	0.11	2.4	28	47	PAF
SMC032	265.09	265.12	0.03	Carb Mudstone			Overburden	FR		QSMC032-79		11737			0.27	8	8	0	0.97	2.5	34	61	UC(PAF)
SMC032	265.12	265.76	0.64	Coal	LID5C	LID5C	Coal	FR		QSMC032-80		11738			0.53	16	4	12	0.25	2.6	18	33	UC(PAF)
SMC032	265.90	266.11	0.21	Siltstone			Overburden	FR	Carboceous		31839	12136	5.9	1.03	0.28	9	5	4	0.58	3.7	2	12	UC(PAF-LC)
SMC032	266.61	266.90	0.29	Sandstone/Siltstone			Overburden	FR	Carboceous, Geotech = 0.23m, Pyrite		31840	12137	8.7	0.37	0.13	4	13	-9	3.27	4.5	0	5	NAF
SMC032	266.90	268.84	1.94	Sandstone			Overburden	FR			31841	12138			0.02	1							NAF
SMC032	268.84	269.30	0.46	Siltstone/Coal/Siderite			Overburden	FR	Pyrite		31842	12139	9.2	0.35	0.21	6	51	-45	7.94	7.8	0	0	NAF
SMC032	269.30	270.29	0.99	Sandstone			Overburden	FR			31843	12140			0.01	0							NAF
SMC032	276.15	279.63	3.48	Sandstone/Siltstone			Overburden	FR	Carboceous		31844	12141	8.6	0.30	0.02	1							NAF
SMC032	279.63	280.57	0.94	Siltstone/Sandstone			Overburden	FR	Carboceous		31845	12142			0.02	1							NAF
SMC032	280.57	281.19	0.62	Coal	LID5B	LID5B	Coal	FR	Geotech = 0.19m	QSMC032-81		11739			0.60	18	2	16	0.11	2.7	17	33	UC(PAF-LC)
SMC032	281.19	281.25	0.06	Tuff			Overburden	FR	Carboceous	QSMC032-82		11740			0.02	1	49	-48	80.07	7.8	0	0	NAF
SMC032	281.25	282.44	1.19	Coal	LID5A	LID5A	Coal	FR		QSMC032-83		11741			0.47	14	21	-7	1.46	7.1	0	0	NAF
SMC032	282.44	282.52	0.08	Coal/Mudstone			Overburden	FR			NS												
SMC032	282.52	282.58	0.06	Tuff			Overburden	FR	Carboceous	QSMC032-84		11742			0.15	5	33	-28	7.19	7.6	0	0	NAF
SMC032	282.58	282.95	0.37	Coal	LID4	LID4	Coal	FR		QSMC032-85		11743			0.61	19	7	12	0.38	2.9	14	27	UC(PAF)
SMC032	282.95	283.10	0.15	Siltstone			Overburden	FR	Pyrite		31847	12143			0.01	0							NAF
SMC032	283.10	284.61	1.51	Sandstone			Overburden	FR	Carboceous, Geotech = 0.25m		31848	12144			0.02	1							NAF
SMC032	284.61	285.06	0.45	Siltstone/Mudstone			Overburden	FR	Carboceous		31849	12145			0.08	2							NAF
SMC032	285.06	285.54	0.48	Coal	LID4L	LID4L	Coal	FR		QSMC032-86		11744			0.87	27	13	14	0.49	3.5	3	11	PAF-LC
SMC032	285.54	286.05	0.51	Siltstone			Overburden	FR			31850	12146	8.5	0.29	0.01	0							NAF
SMC032	286.05	288.14	2.09	Sandstone/Siltstone			Overburden	FR	Carboceous		31851	12147			0.01	0							NAF
SMC032	300.89	304.11	3.22	Sandstone			Overburden	FR			31852	12148			0.01	0							NAF
SMC032	304.11	304.75	0.64	Siltstone/Sandstone			Overburden	FR	Carboceous, Siderite		31853	12149			0.02	1							NAF
SMC032	304.75	305.38	0.63	Siltstone/Carb Mudstone			Overburden	FR	Pyrite		31854	12150	7.9	0.33	0.16	5	11	-6	2.25	6.0	0	1	NAF
SMC032	305.98	306.13	0.15	Tuff/Carb Mudstone			Overburden	FR	Geotech = 0m		NS												
SMC032	306.13	307.46	1.33	Coal	LID1	LID1	Coal	FR		QSMC032-87		11745			0.46	14	2	12	0.14	2.6	17	34	UC(PAF-LC)
SMC032	307.46	307.74	0.28	Carb Mudstone			Overburden	FR		QSMC032-88		11746			0.22	7	6	1	0.89	3.9	2	14	PAF-LC

Table B1: Mount Owen Proposed Modification Project – Acid Forming Characteristics of overburden/interburden and coal samples (this project)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION ANG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/ MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC032	307.74	307.99	0.25	Mudstone			Overburden	FR	Carboceous		31855	12151			0.03	1							NAF
SMC032	307.99	309.00	1.01	Sandstone			Overburden	FR			31856	12152			0.01	0							NAF
SMC032	320.36	320.80	0.44	Siltstone			Overburden	FR			31857	12153			0.02	1							NAF
SMC032	320.80	320.99	0.19	Mudstone			Overburden	FR	Carboceous		31858	12154			0.02	1							NAF
SMC032	320.99	321.88	0.89	Siltstone			Overburden	FR	Carboceous, Geotech = 0.2m		31859	12155			0.03	1							NAF
SMC032	321.88	322.10	0.22	Coal	BAR3	BAR3	Coal	FR		QSMC032-89		11747			0.57	17	1	16	0.06	2.4	27	46	UC(PAF)
SMC032	322.10	322.40	0.30	Tuff/Carb Mudstone			Overburden	FR	Carbote, Carboceous	QSMC032-90		11748			0.40	12	57	-45	4.66	7.9	0	0	NAF
SMC032	322.40	324.63	2.23	Coal	BAR2	BAR2	Coal	FR		QSMC032-91		11749			0.47	14	13	1	0.90	6.4	0	2	NAF
SMC032	324.63	324.99	0.36	Coal/Siltstone	BAR1	BAR1	Coal	FR		QSMC032-92		11750			0.23	7	5	2	0.71	3.5	4	17	UC(PAF-LC)
SMC032	324.99	325.72	0.73	Siltstone/Carb Mudstone			Overburden	FR			31860	12156	9.4	0.42	0.07	2							NAF
SMC032	325.72	327.19	1.47	Siltstone/Sandstone			Overburden	FR	Carboceous		31861	12157			0.02	1							NAF
SMC032	327.19	328.63	1.44	Sandstone			Overburden	FR			31862	12158			0.01	0							NAF
SMC032	348.29	351.66	3.37	Sandstone			Overburden	FR	Siderite		31863	12159	8.5	0.32	0.01	0							NAF
SMC032	351.66	352.67	1.01	Siltstone			Overburden	FR	Carboceous		31864	12160			0.03	1							NAF
SMC032	352.67	352.84	0.17	Siltstone			Overburden	FR	Carboceous, Geotech = 0.21m		NS												
SMC032	352.84	353.20	0.36	Coal			Coal	FR	Carbote	QSMC032-93		11751			0.21	6	30	-24	4.67	7.8	0	0	NAF
SMC032	353.20	353.76	0.56	Coal	UH2	UH2	Coal	FR		QSMC032-94		11752			0.33	10	31	-21	3.07	7.4	0	0	NAF
SMC032	353.76	353.84	0.08	Tuff	UH2	UH2	Overburden	FR	Carboceous	QSMC032-95		11753			0.02	1	37	-36	60.46	8.1	0	0	NAF
SMC032	353.84	354.55	0.71	Coal	UH2	UH2	Coal	FR		QSMC032-96		11754			0.46	14	18	-4	1.28	7.2	0	0	NAF
SMC032	354.55	354.78	0.23	Tuff			Overburden	FR	Carboceous	QSMC032-97		11755			0.03	1	32	-31	34.86	7.8	0	0	NAF
SMC032	354.78	356.48	1.70	Coal	UH1	UH1	Coal	FR	Carbote	QSMC032-98		11756			0.40	12	19	-7	1.55	7.3	0	0	NAF
SMC032	356.48	356.88	0.40	Carb Mudstone/Siltstone			Overburden	FR	Carboceous	QSMC032-99		11757			0.10	3	19	-16	6.21	7.7	0	0	NAF
SMC032	356.88	358.25	1.37	Siltstone			Overburden	FR	Carboceous, Geotech = 0.21m		31865	12161			0.04	1							NAF
SMC032	358.25	358.66	0.41	Carb Mudstone/Siltstone			Overburden	FR	Carboceous		31866	12162	8.8	0.38	0.33	10	21	-11	2.08	6.9	0	0	NAF
SMC032	358.66	360.63	1.97	Sandstone/Siltstone			Overburden	FR	Carboceous		31867	12163	7.9	0.45	0.08	2							NAF
SMC032	360.63	361.70	1.07	Siltstone			Overburden	FR			31868	12164			0.01	0							NAF
SMC032	361.70	362.53	0.83	Sandstone			Overburden	FR	Carboceous/Pyrite		31869	12165			0.01	0							NAF
SMC032	362.53	364.51	1.98	Siltstone			Overburden	FR	Siderite		31870	12166			0.06	2							NAF
SMC032	364.51	364.85	0.34	Siltstone			Overburden	FR	Carboceous		31871	12167			0.06	2							NAF
SMC032	364.85	366.31	1.46	Coal	LHB	LHB	Coal	FR	Carbote	QSMC032-100		11758			0.49	15	15	0	1.00	6.9	0	0	NAF
SMC032	366.31	367.11	0.80	Sandstone/Siltstone			Overburden	FR			31872	12168	9.1	0.35	0.02	1							NAF
SMC032	367.11	370.35	3.24	Sandstone			Overburden	FR			31873	12169			0.01	0							NAF
SMC032	370.35	371.10	0.75	Sandstone/Siltstone			Overburden	FR	Carboceous, Siderite		31874	12170			0.01	0							NAF
SMC032	371.10	372.44	1.34	Siltstone/Coal			Overburden	FR	Carbote		31875	12171	9.6	0.50	0.32	10	22	-12	2.25	7.6	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 (kgH_2SO_4/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)

NAF = Non-Acid Forming

PAF = Potentially Acid Forming

PAF-LC = PAF Low Capacity

UC = Uncertain Classification (expected classification in brackets)

Coal seam interval

Missing interval or sample not available

Table B2: Mount Owen Approved Operations – Acid Forming Characteristics of overburden/interburden and coal samples (EGi, 2013)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION NAG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC006	159.32	159.81	0.49	Coal	LAE	Lemington	Coal	FR		184624					0.99	30							
SMC006	159.81	160.34	0.53	Mudstone/Coal			Overburden	FR		184625					0.18	6							
SMC006	160.34	160.61	0.27	Coal	LAD	Lemington	Coal	FR		184626					0.62	19							
SMC006	160.61	160.82	0.21	Tuff			Overburden	FR		184627					0.01	0							NAF
SMC006	160.82	161.16	0.34	Coal	LAC	Lemington	Coal	FR		184628					1.83	56							
SMC006	161.16	161.34	0.18	Mudstone			Overburden	FR		184629		6820			2.56	78	0	78	0.00	2.2	32	41	PAF
SMC006	161.34	161.63	0.29	Coal	LAB	Lemington	Coal	FR		184630					3.02	92							
SMC006	161.63	162.12	0.49	Siltstone/Mudstone			Overburden	FR		184631					0.11	3							
SMC006	162.12	162.46	0.34	Coal	LAA	Lemington	Coal	FR		184632					0.96	29							
SMC006	162.46	162.57	0.11	Siltstone/Carb Siltstone			Overburden	FR		184633					0.02	1							NAF
SMC006	162.57	162.99	0.42	Siltstone/Mudstone			Overburden	FR	Minor Coal		186533	3990	7.5	0.35	0.06	2	14	-12	7.43	5.2	0	3	NAF
SMC006	162.99	165.05	2.06	Sandstone/Siltstone/Mudstone			Overburden	FR			186534	3991	7.6	0.72	0.07	2	64	-61	29.68	8.1	0	0	NAF
SMC006	165.05	166.54	1.49	Sandstone/Siltstone			Overburden	FR	Siderite Band		186535	3992			0.01	0	40	-40	130.51				NAF
SMC006	166.54	167.60	1.06	Mudstone			Overburden	FR			186536	3993			0.01	0	11	-11	37.57				NAF
SMC006	167.60	169.13	1.53	Sandstone			Overburden	FR			186537	3994			0.01	0	41	-41	269.08				NAF
SMC006	169.13	169.99	0.86	Mudstone/Sandstone/Siltstone			Overburden	FR			186538	3995			0.01	0	12	-12	81.30				NAF
SMC006	169.99	170.16	0.17	Coal	PG3	Pikes Gully	Coal	FR			186539	3996	4.2	1.33	0.41	13	29	-16	2.27	2.8	14	37	PAF-LC
SMC006	170.16	171.03	0.87	Sandstone			Overburden	FR			186540	3997	7.3	0.21	0.03	1	42	-41	45.73	7.6	0	0	NAF
SMC006	171.03	171.89	0.86	Sandstone			Overburden	FR			186541	3998	7.4	0.25	0.01	0	45	-45	292.47	7.8	0	0	NAF
SMC006	171.89	173.02	1.13	Sandstone/Mudstone			Overburden	FR			186542	3999	7.6	0.24	0.01	0	56	-56	365.71	7.9	0	0	NAF
SMC006	173.02	175.37	2.35	Sandstone/Siltstone/Mudstone			Overburden	FR	Coally		186543	4000	7.8	0.28	0.07	2	34	-32	15.91	8.2	0	0	NAF
SMC006	175.37	177.68	2.31	Sandstone			Overburden	FR			186544	4001			0.01	0	72	-72	468.72				NAF
SMC006	177.68	177.80	0.12	Sandstone			Overburden	FR		184622					0.09	3							NAF
SMC006	177.80	177.99	0.19	Coal	PG2U	Pikes Gully	Coal	FR		184634		5299	6.9	0.13	1.50	46	39	7	0.84	7.2	0	0	UC(NAF)
SMC006	177.99	178.27	0.28	Mudstone/Carb Mudstone			Overburden	FR		184635		6821			1.45	44	4	40	0.09	2.3	21	35	PAF
SMC006	178.27	178.42	0.15	Coal	PG2L	Pikes Gully	Coal	FR		184636					2.63	80							
SMC006	178.42	178.64	0.22	Mudstone			Overburden	FR		184637		6822			1.28	39	9	30	0.23	2.4	15	25	PAF
SMC006	178.64	180.04	1.40	Coal	PG1	Pikes Gully	Coal	FR		184638		5300	7.2	0.10	0.61	19	22	-4	1.19	6.5	0	1	NAF
SMC006	180.04	180.16	0.12	Sandstone			Overburden	FR		184639					0.12	4							
SMC006	180.16	181.29	1.13	Siltstone/Sandstone/Mudstone			Overburden	FR			186545	4002			0.01	0	10	-10	68.22				NAF
SMC006	181.29	183.84	2.55	Sandstone			Overburden	FR			186546	4003			0.01	0	38	-37	245.20				NAF
SMC006	183.84	186.88	3.04	Sandstone			Overburden	FR			186547	4004			0.01	0	27	-27	175.11				NAF
SMC006	186.88	189.73	2.85	Sandstone/Siltstone			Overburden	FR			186548	4005			0.01	0	13	-13	84.25				NAF
SMC006	189.73	191.92	2.19	Sandstone/Siltstone			Overburden	FR	Siderite Band		186549	4006			0.01	0	40	-39	258.70				NAF
SMC006	191.92	193.23	1.31	Sandstone			Overburden	FR			186550	4007			0.01	0	12	-12	38.80				NAF
SMC006	193.23	197.23	4.00	Conglomerate			Overburden	FR	Two Bags		186551	4008			0.01	0	28	-27	90.84				NAF
SMC006	197.23	198.71	1.48	Sandstone			Overburden	FR			186552	4009			0.01	0	31	-31	203.86				NAF
SMC006	198.71	202.11	3.40	Conglomerate			Overburden	FR			186553	4010			0.03	1	24	-23	26.14				NAF
SMC006	202.11	203.46	1.35	Sandstone/Conglomerate			Overburden	FR			186554	4011	8.1	0.20	0.07	2	81	-79	37.80	8.3	0	0	NAF
SMC006	203.46	204.40	0.94	Mudstone/Siderite			Overburden	FR	Siderite Band		186555	4012	7.5	0.18	0.14	4	12	-8	2.91	8.0	0	0	NAF
SMC006	204.40	204.56	0.16	Mudstone			Overburden	FR		184640					0.11	3							
SMC006	204.56	204.71	0.15	Coal	ARU3	Arties	Coal	FR		184641					0.61	19							
SMC006	204.71	205.01	0.30	Mudstone			Overburden	FR		184642		6823			0.69	21	7	14	0.34	2.9	4	15	PAF-LC
SMC006	205.01	205.44	0.43	Coal	ARU2/A	Arties	Coal	FR	Incudes 11cm (	184643_45					0.64	20							
SMC006	205.44	205.56	0.12	Siltstone			Overburden	FR		184646					0.10	3							
SMC006	205.56	206.37	0.81	Coal	ART4	Arties	Coal	FR		184647		5301	7.3	0.09	0.81	25	23	1	0.94	7.5	0	0	UC(NAF)
SMC006	206.37	206.71	0.34	Mudstone			Overburden	FR		184648					0.02	1							NAF
SMC006	206.71	207.53	0.82	Coal	ART4L1	Arties	Coal	FR	Incudes ST par	184649_53		5302	7.4	0.09	0.25	8	39	-31	5.06	7.6	0	0	NAF
SMC006	207.53	207.77	0.24	Tuff			Overburden	FR		184654		6824			0.64	20	28	-9	1.44	6.9	0	0	NAF
SMC006	207.77	209.12	1.35	Coal	ART3	Arties	Coal	FR		184655		5303	7.5	0.09	0.67	21	44	-24	2.15	7.4	0	0	NAF
SMC006	209.12	209.26	0.14	Tuff			Overburden	FR		184656					0.01	0							NAF
SMC006	209.26	209.65	0.39	Coal	ART2	Arties	Coal	FR		184657					0.41	13							
SMC006	209.65	209.72	0.07	Tuff/Carb Mudstone			Overburden	FR		184658					0.04	1							NAF
SMC006	209.72	210.27	0.55	Coal	ART1	Arties	Coal	FR		184659					0.41	13							
SMC006	210.27	210.39	0.12	Sandstone			Overburden	FR		184660					0.10	3							
SMC006	210.39	211.79	1.40	Sandstone/Siltstone			Overburden	FR			186556	4013	7.3	0.21	0.01	0	75	-75	492.73	7.9	0	0	NAF
SMC006	211.79	212.48	0.69	Mudstone			Overburden	FR			186557	4014			0.01	0	13	-13	42.77				NAF
SMC006	212.48	215.24	2.76	Sandstone/Siltstone			Overburden	FR			186558	4015			0.01	0	31	-31	203.18				NAF

Table B2: Mount Owen Approved Operations – Acid Forming Characteristics of overburden/interburden and coal samples (EGi, 2013)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION NAG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC006	215.24	219.97	4.73	Sandstone			Overburden	FR	Two Bags		186559	4016			0.01	0	50	-50	326.18				NAF
SMC006	219.97	222.22	2.25	Sandstone/Siderite/Mudstone			Overburden	FR	Siderite Band		186560	4017			0.01	0	49	-49	159.68				NAF
SMC006	222.22	224.32	2.10	Sandstone			Overburden	FR			186561	4018			0.01	0	44	-44	286.45				NAF
SMC006	224.32	225.00	0.68	Mudstone			Overburden	FR			186562	4019			0.03	1	13	-12	14.48				NAF
SMC006	225.00	225.07	0.07	Mudstone			Overburden	FR		184661					0.18	6							
SMC006	225.07	226.21	1.14	Coal	LID8	Liddell	Coal	FR		184662		5304	7.4	0.12	0.52	16	20	-4	1.24	7.1	0	0	NAF
SMC006	226.21	226.29	0.08	Tuff			Overburden	FR		184663					0.32	10							
SMC006	226.29	227.47	1.18	Coal	LID7	Liddell	Coal	FR		184664		5305	7.8	0.13	0.66	20	39	-18	1.91	7.4	0	0	NAF
SMC006	227.47	228.34	0.87	Coal	LID6	Liddell	Coal	FR		184665					0.53	16							
SMC006	228.34	228.46	0.12	Sandstone			Overburden	FR		184666					0.37	11							
SMC006	228.46	228.94	0.48	Sandstone			Overburden	FR			186563	4020			0.01	0	8	-8	51.94				NAF
SMC006	228.94	230.30	1.36	Sandstone/Siltstone			Overburden	FR			186564	4021			0.03	1	41	-40	45.08				NAF
SMC006	230.30	234.93	4.63	Sandstone			Overburden	FR	Lesser ST, Two Bags		186565	4022			0.03	1	19	-19	21.23				NAF
SMC006	234.93	236.10	1.17	Conglomerate/Sandstone			Overburden	FR			186566	4023			0.02	1	63	-62	102.20				NAF
SMC006	236.10	239.15	3.05	Sandstone			Overburden	FR			186567	4024			0.01	0	104	-104	679.34				NAF
SMC006	239.15	239.52	0.37	Sandstone			Overburden	FR			186568	4025	6.7	0.67	0.86	26	7	19	0.27	2.7	14	19	PAF
SMC006	239.52	239.68	0.16	Coal	LID5B E	Liddell	Coal	FR			186569	4026	8.3	0.16	0.01	0	25	-24	160.97	6.2	0	2	NAF
SMC006	239.68	240.54	0.86	Mudstone			Overburden	FR			186570	4027	8.1	0.14	0.01	0	12	-12	81.02	7.5	0	0	NAF
SMC006	240.54	240.73	0.19	Coal	LID5B E	Liddell	Coal	FR			186571	4028	8.2	0.12	0.01	0	26	-26	170.36	5.8	0	3	NAF
SMC006	240.73	241.83	1.10	Sandstone/Siltstone			Overburden	FR			186572	4029	8.1	0.23	0.01	0	58	-58	378.30	7.6	0	0	NAF
SMC006	241.83	242.31	0.48	Mudstone			Overburden	FR			186573	4030			0.01	0	13	-13	84.35				NAF
SMC006	242.31	242.44	0.13	Mudstone			Overburden	FR		184667					0.08	2							NAF
SMC006	242.44	242.87	0.43	Coal	LID5B	Liddell	Coal	FR		184668					0.67	21							
SMC006	242.87	243.03	0.16	Sandstone			Overburden	FR		184669					0.01	0							NAF
SMC006	243.03	243.35	0.32	Sandstone			Overburden	FR			186574	4031			0.01	0	12	-12	77.67				NAF
SMC006	243.35	244.14	0.79	Mudstone/Coal			Overburden	FR			186575	4032			0.01	0	54	-53	349.84				NAF
SMC006	244.14	244.25	0.11	Mudstone			Overburden	FR		184670					0.01	0							NAF
SMC006	244.25	245.09	0.84	Coal	LID5	Liddell	Coal	FR		184671					0.59	18							
SMC006	245.09	245.21	0.12	Mudstone			Overburden	FR		184672					0.34	10							
SMC006	245.21	246.58	1.37	Sandstone			Overburden	FR	Coally		186576	4033			0.01	0	11	-11	35.39				NAF
SMC006	246.58	247.26	0.68	Mudstone/Siltstone			Overburden	FR			186577	4034			0.03	1	14	-13	15.50				NAF
SMC006	247.26	252.22	4.96	Sandstone			Overburden	FR	Two Bags		186578	4035			0.01	0	41	-41	269.13				NAF
SMC006	252.22	257.39	5.17	Sandstone			Overburden	FR	Two Bags		186579	4036			0.01	0	65	-65	422.88				NAF
SMC006	257.39	259.18	1.79	Sandstone			Overburden	FR			186580	4037	7.7	0.28	0.01	0	121	-121	395.92	7.7	0	0	NAF
SMC006	259.18	259.82	0.64	Siltstone/Calcite/Siderite			Overburden	FR	Calcite&Siderite, Band Not A		186581												
SMC006	259.82	261.42	1.60	Siltstone			Overburden	FR			186582	4039	7.8	0.29	0.20	6	11	-5	1.86	7.3	0	0	NAF
SMC006	261.42	261.54	0.12	Carb Mudstone/Mudstone			Overburden	FR		184673		6825			1.39	43	7	35	0.17	2.5	26	32	PAF
SMC006	261.54	264.29	2.75	Coal	LID4	Liddell	Coal	FR		184674		5306	7.4	0.12	0.60	18	15	3	0.81	6.9	0	0	UC(NAF)
SMC006	264.29	264.41	0.12	Siltstone			Overburden	FR		184675					0.03	1							NAF
SMC006	264.41	266.25	1.84	Sandstone			Overburden	FR			186583	4040	7.5	0.28	0.01	0	66	-65	428.92	7.7	0	0	NAF
SMC006	266.25	267.34	1.09	Siltstone/Siderite			Overburden	FR	Siderite Band		186584	4041			0.03	1	36	-35	39.33				NAF
SMC006	267.34	267.44	0.10	Carb Mudstone			Overburden	FR		184676					0.28	9							
SMC006	267.44	267.85	0.41	Coal	LID3	Liddell	Coal	FR		184677					0.71	22							
SMC006	267.85	267.96	0.11	Sandstone/Mudstone			Overburden	FR		184678					0.02	1							NAF
SMC006	267.96	269.59	1.63	Sandstone			Overburden	FR	Siderite		186585	4042			0.03	1	31	-30	33.62				NAF
SMC006	269.59	270.99	1.40	Mudstone/Sandstone			Overburden	FR			186586	4043			0.01	0	36	-36	236.04				NAF
SMC006	270.99	271.39	0.40	Mudstone/Siderite			Overburden	FR	Sideirte bands, coally		186587	4044			0.01	0	128	-128	838.32				NAF
SMC006	271.39	274.43	3.04	Sandstone			Overburden	FR	Lesser ST		186588	4045			0.01	0	57	-57	372.09				NAF
SMC006	274.43	275.04	0.61	Mudstone/Siderite/Siltstone			Overburden	FR	Sideirte bands, coally		186589	4046			0.05	2	67	-65	43.80				NAF
SMC006	275.04	277.02	1.98	Sandstone			Overburden	FR			186590	4047			0.01	0	38	-38	125.13				NAF
SMC006	277.02	277.64	0.62	Sandstone/Mudstone			Overburden	FR	Sideirte bands		186591	4048			0.01	0	40	-40	131.78				NAF
SMC006	277.64	280.23	2.59	Sandstone			Overburden	FR			186592	4049			0.01	0	66	-66	431.38				NAF
SMC006	280.23	281.42	1.19	Sandstone/Siltstone/Mudstone			Overburden	FR			186593	4050			0.03	1	11	-10	12.04				NAF
SMC006	281.42	283.01	1.59	Sandstone/Siltstone			Overburden	FR			186594	4051			0.01	0	31	-31	200.98				NAF
SMC006	283.01	284.35	1.34	Sandstone/Mudstone			Overburden	FR			186595	4052			0.01	0	15	-15	49.54				NAF
SMC006	284.35	288.33	3.98	Sandstone			Overburden	FR	Two Bags		186596	4053			0.01	0	42	-42	137.13				NAF
SMC006	288.33	289.31	0.98	Siltstone			Overburden	FR			186597	4054			0.01	0	20	-20	66.60				NAF
SMC006	289.31	290.34	1.03	Sandstone/Siltstone			Overburden	FR			186598	4055	7.9	0.27	0.03	1	12	-11	13.50	7.5	0	0	NAF

Table B2: Mount Owen Approved Operations – Acid Forming Characteristics of overburden/interburden and coal samples (EGi, 2013)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION NAG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
SMC006	290.34	290.45	0.11	Sandstone/Carb Siltstone			Overburden	FR		184679		6826			0.64	20	6	14	0.30	2.6	11	16	PAF
SMC006	290.45	291.73	1.28	Coal	LID12	Liddell	Coal	FR		184680					0.47	14							
SMC006	291.73	292.02	0.29	Carb Mudstone/Siltstone			Overburden	FR		184681					0.16	5							
SMC006	292.02	292.25	0.23	Siltstone/Coal			Overburden	FR	Core Loss?		186599	4056	9.1	0.37	0.06	2	9	-7	4.82	3.6	5	17	NAF
SMC006	292.25	294.50	2.25	Siltstone			Overburden	FR			186600	4057	8.7	0.33	0.01	0	23	-22	74.42	8.0	0	0	NAF
SMC006	294.50	295.56	1.06	Siltstone/Mudstone			Overburden	FR			186601	4058	8.8	0.41	0.02	1	46	-45	74.63	7.6	0	0	NAF
SMC006	295.56	295.68	0.12	Mudstone/Carb Mudstone			Overburden	FR		184682					0.05	2							NAF
SMC006	295.68	298.38	2.70	Coal	BAR13/	Barrett	Coal	FR		184687		5307	7.5	0.12	0.46	14	11	3	0.79	5.9	0	2	UC(NAF)
SMC006	298.38	298.50	0.12	Sandstone			Overburden	FR		184686					0.01	0							NAF
SMC006	298.50	299.60	1.10	Sandstone			Overburden	FR			186602	4059			0.04	1	11	-9	8.66				NAF
SMC006	299.60	303.48	3.88	Sandstone			Overburden	FR	Lesser ST, Two Bags		186603	4060			0.02	1	23	-23	37.98				NAF
SMC006	303.48	308.48	5.00	Sandstone			Overburden	FR	Two Bags		186604	4061			0.02	1	37	-36	60.60				NAF
SMC006	308.48	313.65	5.17	Sandstone			Overburden	FR	Two Bags		186605	4062			0.01	0	37	-37	120.82				NAF
SMC006	313.65	319.05	5.40	Sandstone			Overburden	FR	Two Bags		186606	4063			0.01	0	26	-26	172.65				NAF
SMC006	319.05	320.82	1.77	Sandstone			Overburden	FR			186607	4064			0.01	0	55	-54	356.93				NAF
SMC006	320.82	322.31	1.49	Siltstone			Overburden	FR			186608	4065			0.01	0	22	-22	71.27				NAF
SMC006	322.31	322.53	0.22	Mudstone/Coal			Overburden	FR			186609	4066			0.04	1	9	-7	7.12				NAF
SMC006	322.53	322.63	0.10	Mudstone			Overburden	FR		184688					0.01	0							NAF
SMC006	322.63	324.21	1.58	Coal	UH2	Hebden	Coal	FR		184689		5308	7.3	0.11	0.35	11	23	-13	2.18	7.2	0	0	NAF
SMC006	324.21	324.41	0.20	Tuff			Overburden	FR		184690					0.01	0							NAF
SMC006	324.41	326.15	1.74	Coal	UH1	Hebden	Coal	FR		184691		5309	7.4	0.10	0.46	14	8	6	0.57	5.1	0	6	UC(NAF)
SMC006	326.15	326.24	0.09	Siltstone			Overburden	FR		184692					0.01	0							NAF
SMC006	326.24	327.57	1.33	Siltstone			Overburden	FR			186610	4067			0.04	1	17	-15	13.49				NAF
SMC006	327.57	331.03	3.46	Sandstone			Overburden	FR	Two Bags		186611	4068			0.03	1	37	-37	40.81				NAF
SMC006	331.03	334.87	3.84	Sandstone			Overburden	FR	Two Bags		186612	4069			0.01	0	25	-25	165.09				NAF
SMC006	334.87	340.30	5.43	Sandstone			Overburden	FR	Two Bags		186613	4070			0.01	0	35	-35	227.59				NAF
SMC006	340.30	340.99	0.69	Siltstone/Mudstone			Overburden	FR			186614	4071	7.8	0.27	0.03	1	13	-12	14.26	7.2	0	0	NAF
SMC006	340.99	341.09	0.10	Mudstone/Carb Mudstone			Overburden	FR	Calcite	184693					0.01	0							NAF
SMC006	341.09	342.81	1.72	Coal	HEB	Hebden	Coal	FR		184694		5310	7.2	0.10	0.46	14	30	-16	2.16	7.6	0	0	NAF
SMC006	342.81	342.92	0.11	Sandstone			Overburden	FR		184695					0.01	0							NAF
SMC006	342.92	343.75	0.83	Sandstone			Overburden	FR			186615	4072	7.9	0.24	0.09	3	36	-33	13.05	7.6	0	0	NAF
SMC006	343.75	346.36	2.61	Sandstone/Siltstone			Overburden	FR			186616	4073	7.6	0.23	0.01	0	28	-28	180.98	8.2	0	0	NAF
SMC006	346.36	346.56	0.20	Coal/Mudstone/Sandstone			Overburden	FR			186617	4074	9.4	0.26	0.13	4	29	-25	7.28	8.3	0	0	NAF
SMC006	346.56	349.04	2.48	Sandstone/Siltstone			Overburden	FR			186618	4075	8.3	0.26	0.01	0	49	-49	320.02	8.1	0	0	NAF
SMC006	349.04	350.19	1.15	Sandstone			Overburden	FR			186619	4076	8.2	0.27	0.01	0	90	-90	588.42	8.2	0	0	NAF
SMC006	350.19	350.37	0.18	Mudstone			Overburden	FR			186620	4077	8.0	0.43	0.07	2	15	-13	6.97	7.7	0	0	NAF
SMC006	350.37	350.51	0.14	Mudstone			Overburden	FR		184696					0.01	0							NAF
SMC006	350.51	350.94	0.43	Coal	UNK		Coal	FR	Calcite	184697					0.50	15							
SMC006	350.94	351.06	0.12	Mudstone			Overburden	FR	Calcite	184698					0.01	0							NAF
SMC006	351.06	351.24	0.18	Carb Mudstone			Overburden	FR			186621	4078	7.2	0.83	0.75	23	7	16	0.32	3.1	6	21	PAF
SMC006	351.24	352.98	1.74	Sandstone			Overburden	FR			186622	4079	7.3	0.29	0.96	29	44	-14	1.49	7.5	0	0	NAF
SMC006	352.98	354.25	1.27	Siltstone			Overburden	FR			186623	4080	4.7	2.11	1.26	39	10	28	0.26	2.6	16	27	PAF
SMC006	354.25	358.04	3.79	Sandstone			Overburden	FR	Two Bags		186625	4081	7.2	0.30	0.09	3	44	-41	15.93	8.1	0	0	NAF
SMC006	358.04	364.09	6.05	Sandstone			Overburden	FR	Two Bags		186624	4082	7.1	0.20	0.08	2	50	-48	20.49	7.9	0	0	NAF
GNC004	135.09	139.14	4.05	Coal/Mudstone	LAHM/H	Lemington	Coal	FR	Calcite	184269_84		5315	6.7	0.28	0.42	13	24	-11	1.88	6.9	0	0	NAF
GNC004	139.14	139.24	0.10	Siltstone			Overburden	FR		184285					0.01	0							NAF
GNC004	139.24	139.37	0.13	Siltstone/Carb Mudstone			Overburden	FR			31148	4517	6.7	0.15	0.18	6	12	-6	2.12	5.6	0	1	NAF
GNC004	139.37	141.68	2.31	Sandstone			Overburden	FR			31149	4518	8.2	0.15	0.01	0	41	-40	265.60	8.6	0	0	NAF
GNC004	141.68	142.55	0.87	Siltstone	BAND2		Overburden	FR	Siderite, incl BAND2 10cm		31150	4519	7.5	0.22	0.01	0	27	-26	173.45	8.3	0	0	NAF
GNC004	142.55	144.67	2.12	Sandstone			Overburden	FR			31151	4520	8.1	0.22	0.01	0	17	-17	110.30	8.1	0	0	NAF
GNC004	144.67	146.61	1.94	Siltstone/Mudstone			Overburden	FR			31152	4521			0.01	0	16	-16	52.04				NAF
GNC004	146.61	151.54	4.93	Sandstone/Siltstone			Overburden	FR	Siderite, Calcite		31153	4522			0.02	1	47	-47	77.38				NAF
GNC004	151.54	153.66	2.12	Siltstone/Sandstone			Overburden	FR	Siderite, Calcite		31154	4523			0.01	0	39	-39	252.70				NAF
GNC004	153.66	156.64	2.98	Sandstone/Siltstone			Overburden	FR			31155	4524			0.01	0	16	-16	102.85				NAF
GNC004	156.64	159.67	3.03	Sandstone			Overburden	FR			31156	4525			0.01	0	87	-87	570.65				NAF
GNC004	159.67	162.66	2.99	Sandstone			Overburden	FR	Siderite		31157	4526			0.01	0	13	-13	86.17				NAF
GNC004	162.66	164.94	2.28	Sandstone/Siltstone			Overburden	FR			31158	4527			0.01	0	24	-23	154.32				NAF
GNC004	164.94	169.20	4.26	Sandstone			Overburden	FR			31159	4528			0.01	0	41	-41	270.75				NAF

Table B2: Mount Owen Approved Operations – Acid Forming Characteristics of overburden/interburden and coal samples (EGi, 2013)

Hole ID	Depth (m)			Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS					SINGLE ADDITION NAG			ARD Classification
	From	To	Interval												Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	NAG(pH4.5)	NAG(pH7.0)	
GNC004	169.20	171.67	2.47	Conglomerate			Overburden	FR			31160	4529	8.3	0.18	0.01	0	78	-78	507.63	7.6	0	0	NAF
GNC004	171.67	173.56	1.89	Conglomerate/Sandstone			Overburden	FR			31161	4530	7.6	0.19	0.01	0	31	-31	200.54	8.5	0	0	NAF
GNC004	173.56	174.62	1.06	Sandstone			Overburden	FR			31162	4531	7.7	0.20	0.01	0	24	-24	159.90	8.5	0	0	NAF
GNC004	174.62	174.73	0.11	Sandstone			Overburden	FR		184286					0.03	1							NAF
GNC004	174.73	176.14	1.41	Coal	PG3/2	Pikes Gully	Coal	FR	Calcite	184287_89		5316	7.3	0.28	0.51	16	10	6	0.64	5.9	0	1	UC(NAF)
GNC004	176.14	176.68	0.54	Mudstone/Siltstone			Overburden	FR		184290					0.01	0							NAF
GNC004	176.68	177.96	1.28	Coal	PG1	Pikes Gully	Coal	FR	Calcite	184291		5317	7.2	0.35	0.33	10	25	-15	2.52	7.4	0	0	NAF
GNC004	177.96	178.11	0.15	Mudstone/Coal			Overburden	FR		184292					0.21	6							
GNC004	178.11	178.92	0.81	Mudstone/Carb Mudstone			Overburden	FR			31163	4532			0.03	1	22	-21	24.20				NAF
GNC004	178.92	182.49	3.57	Siltstone/Sandstone			Overburden	FR	(2 bags for G samples)		31164	4533			0.03	1	45	-44	49.18				NAF
GNC004	182.49	183.11	0.62	Sandstone			Overburden	FR	Minor Coal		31165	4534			0.03	1	39	-38	42.17				NAF
GNC004	183.11	183.23	0.12	Sandstone/Mudstone			Overburden	FR		184293					0.01	0							NAF
GNC004	183.23	185.17	1.94	Coal/Tuff	ART3U/	Arties	Coal	FR		184294_300		5318	6.8	0.31	0.35	11	18	-8	1.73	7.3	0	0	NAF
GNC004	185.17	185.32	0.15	Mudstone			Overburden	FR		186001					0.17	5							
GNC004	185.32	186.24	0.92	Mudstone/Sandstone			Overburden	FR			31166	4535			0.03	1	18	-18	20.09				NAF
GNC004	186.24	188.10	1.86	Sandstone/Siltstone			Overburden	FR	Siderite, Calcite		31167	4536			0.01	0	23	-23	74.97				NAF
GNC004	188.10	192.69	4.59	Sandstone			Overburden	FR	(2 bags for G samples)		31168	4537			0.01	0	66	-65	428.81				NAF
GNC004	192.69	196.09	3.40	Sandstone/Siltstone			Overburden	FR	Siderite (2 bags for G sampl		31169	4538			0.01	0	36	-36	118.59				NAF
GNC004	196.09	198.74	2.65	Sandstone/Siltstone			Overburden	FR	Siderite		31170	4539			0.01	0	30	-30	99.34				NAF
GNC004	198.74	203.33	4.59	Sandstone/Siltstone			Overburden	FR	(2 bags for G samples)		31171	4540			0.01	0	38	-38	123.85				NAF
GNC004	203.33	206.01	2.68	Sandstone/Siltstone			Overburden	FR	Siderite		31172	4541			0.02	1	59	-58	96.58				NAF
GNC004	206.01	206.71	0.70	Mudstone/Siltstone			Overburden	FR	Siderite		31173	4542			0.02	1	15	-15	24.75				NAF
GNC004	206.71	206.79	0.08	Mudstone			Overburden	FR		186002					0.02	1							NAF
GNC004	206.79	209.97	3.18	Coal/Tuff	LID8/7/(	Liddell	Coal	FR		186003_8		5319	7.2	0.26	0.35	11	14	-4	1.35	7.1	0	0	NAF
GNC004	209.97	210.09	0.12	Siderite/Carb Mudstone			Overburden	FR	Siderite	186009					0.02	1							NAF
GNC004	210.09	211.12	1.03	Siltstone/Mudstone			Overburden	FR	Siderite		31174	4543			0.01	0	98	-98	320.45				NAF
GNC004	211.12	214.79	3.67	Sandstone/Mudstone			Overburden	FR			31175	4544			0.01	0	30	-30	98.39				NAF
GNC004	214.79	217.66	2.87	Sandstone/Mudstone			Overburden	FR	Siderite, Calcite		31176	4545	7.5	0.17	0.01	0	101	-101	658.44	8.9	0	0	NAF
GNC004	217.66	219.44	1.78	Sandstone			Overburden	FR			31177	4546	7.4	0.15	0.01	0	135	-134	879.22	8.6	0	0	NAF
GNC004	219.44	221.01	1.57	Siltstone/Mudstone			Overburden	FR	Siderite		31178	4547	8.0	0.15	0.01	0	57	-57	373.40	8.3	0	0	NAF
GNC004	221.01	222.33	1.32	Sandstone/Carb Mudstone			Overburden	FR			31179	4548			0.04	1	25	-24	20.44				NAF
GNC004	222.33	222.46	0.13	Mudstone			Overburden	FR		186010					0.19	6							
GNC004	222.46	223.53	1.07	Coal/Mudstone	LID5C	Liddell	Coal	FR		186011					0.62	19							
GNC004	223.53	223.64	0.11	Mudstone			Overburden	FR		186012					0.40	12							
GNC004	223.64	224.72	1.08	Sandstone/Mudstone			Overburden	FR			31180	4549	7.7	0.14	0.11	3	14	-11	4.21	8.2	0	0	NAF
GNC004	224.72	225.69	0.97	Mudstone			Overburden	FR			31181	4550	8.2	0.18	0.03	1	11	-10	12.12	8.1	0	0	NAF
GNC004	225.69	225.77	0.08	Core Loss			Overburden	FR															
GNC004	225.77	230.92	5.15	Sandstone			Overburden	FR	Siderite		31182	4551	7.8	0.23	0.03	1	22	-21	24.14	8.3	0	0	NAF
GNC004	230.92	232.77	1.85	Sandstone			Overburden	FR			31183	4552	7.9	0.19	0.01	0	141	-141	923.74	8.2	0	0	NAF
GNC004	232.77	234.26	1.49	Mudstone/Sandstone			Overburden	FR			31184	4553	7.7	0.18	0.01	0	30	-30	194.09	8.4	0	0	NAF
GNC004	234.26	239.48	5.22	Siderite/Sandstone/Siltstone			Overburden	FR	Siderite		31185	4554	8.2	0.24	0.04	1	33	-31	26.70	8.3	0	0	NAF
GNC004	239.48	240.78	1.30	Siltstone/Carb Mudstone			Overburden	FR			31186	4555	8.3	0.17	0.21	6	36	-29	5.54	8.7	0	0	NAF
GNC004	240.78	242.89	2.11	Mudstone			Overburden	FR			31187	4556			0.02	1	51	-51	83.72				NAF
GNC004	242.89	243.74	0.85	Mudstone			Overburden	FR	Siderite		31188	4557			0.05	2	76	-74	49.53				NAF
GNC004	243.74	243.86	0.12	Mudstone			Overburden	FR		186013					0.35	11							
GNC004	243.86	244.64	0.78	Coal	LID5B	Liddell	Coal	FR		186014					0.47	14							
GNC004	244.64	244.71	0.07	Tuff			Overburden	FR		186015					0.01	0							NAF
GNC004	244.71	245.80	1.09	Coal	LID5A	Liddell	Coal	FR		186016					0.40	12							
GNC004	245.80	245.85	0.05	Tuff			Overburden	FR		186017					0.05	2							NAF
GNC004	245.85	246.34	0.49	Coal	LID4B	Liddell	Coal	FR	Calcite	186018					0.40	12							
GNC004	246.34	246.46	0.12	Carb Mudstone			Overburden	FR		186019					0.15	5							
GNC004	246.46	246.85	0.39	Coal	LID4A	Liddell	Coal	FR		186020					0.84	26							
GNC004	246.85	247.00	0.15	Mudstone/Carb Mudstone			Overburden	FR		186021					0.01	0							NAF
GNC004	247.00	248.56	1.56	Mudstone/Carb Mudstone			Overburden	FR			31189	4558			0.05	2	24	-22	15.70				NAF
GNC004	248.56	248.67	0.11	Carb Mudstone			Overburden	FR		186022					0.14	4							
GNC004	248.67	250.94	2.27	Coal/Tuff	LID3B/3	Liddell	Coal	FR		186023_27		5320	6.7	0.42	0.43	13	12	1	0.92	5.7	0	1	UC(NAF)
GNC004	250.94	251.42	0.48	Carb Mudstone			Overburden	FR		186028					0.12	4							
GNC004	251.42	251.68	0.26	Coal	LID1L	Liddell	Coal	FR		186029					0.37	11							NAF

Table B2: Mount Owen Approved Operations – Acid Forming Characteristics of overburden/interburden and coal samples (EGi, 2013)

Hole ID	Depth (m) From	To	Interval	Lithology	Seam Name	Seam Group	Lithology Group	Weathering	Comments	Coal Quality Sample No	Overburden/ Interburden Sample No	EGi Sample Number	pH1:2	EC1:2	ACID-BASE ALYSIS Total %S	MPA	ANC	NAPP	ANC/MPA	SINGLE ADDITION NAG NAGpH	NAG(pH4.5)	NAG(pH7.0)	ARD Classification
GNC004	251.68	251.78	0.10	Mudstone			Overburden	FR		186030					0.10	3							
GNC004	251.78	252.75	0.97	Mudstone/Siltstone			Overburden	FR			31190	4559			0.01	0	14	-13	44.70				NAF
GNC004	252.75	255.80	3.05	Sandstone			Overburden	FR			31191	4560			0.03	1	54	-53	58.61				NAF
GNC004	255.80	260.36	4.56	Sandstone			Overburden	FR			31192	4561			0.01	0	91	-91	593.06				NAF
GNC004	260.36	263.75	3.39	Siltstone/Sandstone			Overburden	FR	Siderite		31193	4562			0.03	1	30	-30	33.19				NAF
GNC004	263.75	264.91	1.16	Mudstone			Overburden	FR			31194	4563			0.01	0	13	-13	83.92				NAF
GNC004	264.91	265.06	0.15	Sandstone/Mudstone			Overburden	FR		186031					0.24	7							
GNC004	265.06	268.35	3.29	Coal	BAR3U/	Barrett	Coal	FR		186032_38		5321	7.5	0.22	0.47	14	19	-4	1.29	7.2	0	0	NAF
GNC004	268.35	268.46	0.11	Mudstone			Overburden	FR		186039					0.07	2							NAF
GNC004	268.46	268.93	0.47	Siltstone/Carb Mudstone			Overburden	FR			31195	4564			0.03	1	13	-12	14.57				NAF
GNC004	268.93	270.68	1.75	Sandstone/Siltstone			Overburden	FR			31196	4565			0.01	0	14	-14	46.74				NAF
GNC004	270.68	273.72	3.04	Sandstone			Overburden	FR			31197	4566			0.01	0	26	-26	169.07				NAF
GNC004	273.72	276.75	3.03	Sandstone			Overburden	FR			31198	4567			0.01	0	111	-111	724.24				NAF
GNC004	276.75	279.71	2.96	Sandstone/Siltstone			Overburden	FR			31199	4568			0.01	0	13	-13	83.13				NAF
GNC004	279.71	282.75	3.04	Sandstone			Overburden	FR	Siderite, Calcite		31200	4569			0.01	0	83	-82	539.22				NAF
GNC004	282.75	284.57	1.82	Sandstone			Overburden	FR			31201	4570			0.01	0	63	-63	410.73				NAF
GNC004	284.57	284.94	0.37	Siltstone			Overburden	FR			31202	4571			0.01	0	12	-12	38.76				NAF
GNC004	284.94	285.04	0.10	Siltstone			Overburden	FR		186040					0.04	1							NAF
GNC004	285.04	287.31	2.27	Coal	UH3/2/1	Hebden	Coal	FR	Calcite	186041_45		5322	7.3	0.23	0.55	17	11	6	0.64	5.7	0	1	UC(NAF)
GNC004	287.31	287.48	0.17	Carb Mudstone			Overburden	FR		186046					0.43	13							
GNC004	287.48	287.75	0.27	Coal	H1	Hebden	Coal	FR		186047					0.56	17							
GNC004	287.75	287.79	0.04	Mudstone			Overburden	FR		186048					0.16	5							
GNC004	287.79	288.01	0.22	Coal	H2	Hebden	Coal	FR		186049					0.36	11							NAF
GNC004	288.01	288.17	0.16	Sandstone/Mudstone			Overburden	FR		186050					0.01	0							NAF
GNC004	288.17	289.66	1.49	Siltstone/Mudstone/Sandstone			Overburden	FR			31203	4572			0.01	0	18	-17	57.34				NAF
GNC004	289.66	290.38	0.72	Sandstone/Coal	H3/H4	Hebden	Coal	FR	Incl H3(3cm)&H4(4cm) with S		31204	4573			0.01	0	14	-14	93.79				NAF
GNC004	290.38	291.83	1.45	Sandstone/Siltstone			Overburden	FR			31205	4574			0.01	0	14	-14	92.97				NAF
GNC004	291.83	294.81	2.98	Siltstone/Sandstone			Overburden	FR			31206	4575	8.2	0.16	0.01	0	16	-16	52.99	8.1	0	0	NAF
GNC004	294.81	297.85	3.04	Sandstone			Overburden	FR			31207	4576	8.1	0.22	0.01	0	49	-49	321.60	8.6	0	0	NAF
GNC004	297.85	298.56	0.71	Siltstone			Overburden	FR			31208	4577	7.8	0.17	0.01	0	16	-15	101.35	8.5	0	0	NAF
GNC004	298.56	298.67	0.11	Mudstone			Overburden	FR		186051					0.02	1							NAF
GNC004	298.67	298.92	0.25	Coal	LHB	Hebden	Coal	FR		186052					0.69	21							
GNC004	298.92	299.06	0.14	Siltstone			Overburden	FR		186053		6830			0.55	17	7	9	0.44	2.8	7	12	PAF
GNC004	299.06	299.57	0.51	Siltstone			Overburden	FR	Siderite		31209	4578	8.2	0.28	0.07	2	17	-15	7.83	8.3	0	0	NAF
GNC004	299.57	300.84	1.27	Sandstone			Overburden	FR			31210	4579	7.8	0.13	0.01	0	13	-13	42.23	8.2	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 (kgH_2SO_4/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)

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

Coal seam interval

Missing interval or sample not available

Table B3: Mount Owen – Extended boil and calculated NAG test results for selected overburden/interburden and coal samples.

EGi Code	Project	Litholgoy	Seam ID	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG
				Total	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$		
				%S	kg H_2SO_4/t					kg H_2SO_4/t			kg H_2SO_4/t
11676	Proposed Modification	Coal		0.96	29	10	19	0.34	3.3	4	12	4.2	7
11695	Proposed Modification	Carb Mudstone		0.28	9	5	4	0.58	3.1	11	26	7.1	-2
11716	Proposed Modification	Coal	PG3	0.54	17	10	7	0.61	3.1	9	20	7.3	-5
11723	Proposed Modification	Carb Mudstone		0.87	27	10	17	0.38	3.0	7	15	3.7	12
11729	Proposed Modification	Coal	LID9	1.58	48	13	35	0.27	3.0	7	14	3.8	12
11739	Proposed Modification	Coal	LID5B	0.60	18	2	16	0.11	2.7	17	33	6.9	1.2
11745	Proposed Modification	Coal	LID1	0.46	14	2	12	0.14	2.6	17	34	6.2	1.4
12069	Proposed Modification	Siltstone/Carb Mudstone		0.15	5	7	-2	1.53	3.7	3	15	7.2	-0.4
12097	Proposed Modification	Coal/Carb Mudstone		0.27	8	12	-4	1.45	4.0	2	13	7.4	-6
12105	Proposed Modification	Carb Siltstone		0.30	9	9	0	0.98	3.6	5	16	7.4	-4
12136	Proposed Modification	Carb Siltstone		0.28	9	5	4	0.58	3.7	2	12	6.0	2
3813	Approved Operations	Coal	BAND	0.23	7	38	-31	5.43	4.4	3	19	7.6	-19
3882	Approved Operations	Carb Mudstone		0.32	10	9	1	0.89	3.1	20	44	7.1	0.9
3907	Approved Operations	Mudstone		0.09	3	11	-9	4.16	4.2	1	9	6.9	1.1
3954	Approved Operations	Sandstone		0.62	19	7	12	0.38	3.5	4	12	4.2	6
3996	Approved Operations	Coal	PG3	0.41	13	29	-16	2.27	2.8	14	37	4.1	2
4056	Approved Operations	Carb Siltstone		0.06	2	9	-7	4.82	3.6	5	17	7.1	-5
4078	Approved Operations	Carb Mudstone		0.75	23	7	16	0.32	3.1	6	21	3.6	9
4080	Approved Operations	Siltstone		1.26	39	10	28	0.26	2.6	16	27	3.0	18
5286	Approved Operations	Coal	RVU	0.42	13	2	11	0.13	2.2	73	106	5.7	6
5287	Approved Operations	Coal	RVL	0.45	14	2	12	0.11	2.2	88	124	5.6	6
5289	Approved Operations	Coal	RS	0.57	17	1	16	0.07	2.3	133	184	5.7	10
5290	Approved Operations	Coal	RNU	0.71	22	20	1	0.94	2.9	25	43	7.4	-10
5291	Approved Operations	Coal	RLU/RLL	0.48	15	7	8	0.48	2.5	30	46	7.1	1.0
5292	Approved Operations	Coal	BAY1	0.44	13	2	12	0.14	2.3	39	60	6.9	5
5296	Approved Operations	Coal	BAY5U/BAY5	0.75	23	1	22	0.06	2.5	70	102	4.9	10
5298	Approved Operations	Coal	LBG	1.39	43	9	34	0.21	3.0	10	23	3.5	11
5311	Approved Operations	Coal	LDJ	0.58	18	2	16	0.11	2.3	66	94	5.4	7
5312	Approved Operations	Coal	LDB	0.47	14	3	11	0.24	2.2	69	103	5.9	6
5324	Approved Operations	Coal	BY3/BY4U2/BY4U	0.48	15	10	5	0.66	3.3	9	28	5.6	-3
5330	Approved Operations	Coal	BY5U1/BY5	0.69	21	9	12	0.44	2.8	25	56	5.8	3
5333	Approved Operations	Coal	LEE	1.25	38	13	25	0.33	3.5	5	16	3.9	15
5336	Approved Operations	Coal	LED/C/B/A/AL	0.70	22	8	14	0.35	3.1	7	21	6.3	3
5338	Approved Operations	Sandstone		0.16	5	9	-4	1.84	3.7	2	8	7.1	-2

KEY

MPA = Maximum Potential Acidity (kgH_2SO_4/t)
ANC = Acid Neutralising Capacity (kgH_2SO_4/t)
NAPP = Net Acid Producing Potential (kgH_2SO_4/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)
Extended Boil NAGpH = pH of NAG liquor after extended heating
Calculated NAG = The net acid potential based on assay of anions and cations released to the NAG solution (kgH_2SO_4/t)

Table B4: Mount Owen – Acid buffering characteristics testwork results for selected overburden/interburden/coal samples.

EGi Sample Number	Project	Lithology	TS wt%	ANC (Sobeck)	Effective ANC (to pH4)	ANC(Sobeck)	Likely buffering carbonate
				kg H_2SO_4/ t		available %	
12055	Proposed Modification	Carb Mudstone	0.41	18	11	60	Ferroan Dolomite/Calcite
11723	Proposed Modification	Carb Mudstone	0.87	10	4	39	Ferroan Dolomite/Siderite
12162	Proposed Modification	Carb Mudstone/Siltstone	0.33	21	18	86	Calcite/Dolomite
11716	Proposed Modification	Coal	0.54	10	5	51	Ferroan Dolomite
11697	Proposed Modification	Coal/Tuff	2.39	30	15	49	Ferroan Dolomite/Siderite
12063	Proposed Modification	Sandstone	0.31	72	43	60	Dolomite/Ferroan Dolomite
12137	Proposed Modification	Sandstone/Siltstone	0.13	13	6	45	Dolomite/Ferroan Dolomite
12054	Proposed Modification	Siltstone	0.13	42	32	75	Ferroan Dolomite
12139	Proposed Modification	Siltstone/Coal/Siderite	0.21	157	153	97	Calcite/Dolomte
5224	Approved Operations	Claystone	0.03	36	28	78	Calcite/Dolomite
3831	Approved Operations	Claystone	0.005	19	14	72	Ferroan Dolomite
3804	Approved Operations	Claystone	0.02	16	5	34	Ferroan Dolomite/Siderite
3883	Approved Operations	Coal	0.55	24	23	96	Calcite
5297	Approved Operations	Coal	0.77	45	45	100	Calcite
5333	Approved Operations	Coal	1.25	13	12	96	Calcite/Dolomite
5301	Approved Operations	Coal	0.81	23	25	109	Calcite/Dolomite
5299	Approved Operations	Coal	1.5	39	39	100	Calcite/Dolomite
5307	Approved Operations	Coal	0.46	11	11	98	Dolomite
5321	Approved Operations	Coal	0.47	19	17	90	Dolomite
3903	Approved Operations	Conglomerate	<0.01	32	28	89	Calcite/Dolomite
4023	Approved Operations	Conglomerate	0.02	63	65	103	Calcite/Dolomite
4079	Approved Operations	Sandstone	0.96	44	48	109	Calcite
3831	Approved Operations	Sandstone	<0.01	32	23	72	Calcite/Dolomite
3833	Approved Operations	Sandstone	<0.01	63	61	97	Calcite/Dolomite
4483	Approved Operations	Sandstone	<0.01	72	72	100	Calcite/Dolomite
3852	Approved Operations	Sandstone	<0.01	128	128	100	Calcite/Dolomite
3886	Approved Operations	Sandstone	0.005	95	95	100	Dolomite
3880	Approved Operations	Sandstone	0.22	13	8	62	Dolomite/Ferroan Dolomite
4480	Approved Operations	Sandstone	0.11	23	17	72	Dolomite/Ferroan Dolomite
3916	Approved Operations	Siltstone	0.06	50	46	91	Calcite
4080	Approved Operations	Siltstone	1.26	10	10	100	Calcite/Dolomite
3850	Approved Operations	Siltstone	<0.01	109	51	47	Dolomite/Ferroan Dolomite
4057	Approved Operations	Siltstone	0.01	23	22	94	Dolomite/Ferroan Dolomite
5247	Approved Operations	Weathered Zone	<0.01	16	16	100	Calcite
5240	Approved Operations	Weathered Zone	0.03	102	102	100	Calcite
5246	Approved Operations	Weathered Zone	<0.01	39	39	100	Calcite/Dolomite
5242	Approved Operations	Weathered Zone	<0.01	10	6	64	Ferroan Dolomite

Table B5: Mount Owen – Sulphur speciation testwork results for selected overburden/interburden/coal samples.

EGi Sample Number	Project	Rock type	Seam Name	Total %S	Pyritic S (%)	Acid Sulphate %S	Total Acid Generating S (%)	Non-Acid Sulphate %S	Other S Forms (%)	Proportion Total Acid Generating to Total S
12136	Proposed Modification	Carb Siltstone		0.26	0.08	0.00	0.08	0.03	0.15	31%
12105	Proposed Modification	Carb Siltstone		0.31	0.02	0.00	0.02	0.00	0.29	6%
12069	Approved Operations	Siltstone/Carb Mudstone		0.15	0.06	0.00	0.06	0.01	0.08	40%
12056	Proposed Modification	Siltstone		0.12	0.07	0.00	0.07	0.02	0.03	58%
12041	Proposed Modification	Sandstone		0.31	0.26	0.00	0.26	0.02	0.03	84%
11745	Proposed Modification	Coal	LID1	0.42	0.00	0.00	-	0.01	-	0%
11739	Proposed Modification	Coal	LID5B	0.58	0.03	0.00	0.03	0.00	0.55	5%
11729	Proposed Modification	Coal	LID9	1.56	0.52	0.00	0.52	0.05	0.99	33%
11723	Proposed Modification	Carb Mudstone		0.94	0.48	0.00	0.48	0.02	0.44	51%
11716	Proposed Modification	Coal	PG3	0.59	0.03	0.00	0.03	0.01	0.55	5%
11697	Proposed Modification	Coal/Tuff		2.70	1.98	0.00	1.98	0.00	0.72	73%
5333	Approved Operations	Coal	LEE	1.25	0.77	0.00	0.77	0.09	0.39	62%
5321	Approved Operations	Coal	BAR3U/3/2/1/1L	0.47	0.10	0.00	0.10	0.02	0.35	21%
5307	Approved Operations	Coal	BAR13/12	0.46	0.03	0.00	0.03	0.01	0.42	7%
5301	Approved Operations	Coal	ART4	0.81	0.11	0.00	0.11	0.06	0.64	14%
5299	Approved Operations	Coal	PG2U	1.50	0.46	0.00	0.46	0.53	0.51	31%
5297	Approved Operations	Coal	LCA	0.77	0.31	0.00	0.31	0.40	0.06	40%
4080	Approved Operations	Siltstone		1.26	0.90	0.00	0.90	0.36	0.00	71%
4079	Approved Operations	Sandstone		0.96	0.74	0.00	0.74	0.22	0.00	77%
4078	Approved Operations	Carb Mudstone		0.75	0.43	0.00	0.43	0.11	0.21	57%
4025	Approved Operations	Sandstone		0.86	0.77	0.00	0.77	0.08	0.01	90%

Table B5: Mount Owen – Sulphur speciation testwork results for selected overburden/interburden/coal samples.

EGi Sample Number	Project	Rock type	Seam Name	Total %S	Pyritic S (%)	Acid Sulphate %S	Total Acid Generating S (%)	Non-Acid Sulphate %S	Other S Forms (%)	Proportion Total Acid Generating to Total S
3954	Approved Operations	Sandstone		0.62	0.40	0.00	0.40	0.22	0.00	65%
3883	Approved Operations	Coal	LEF	0.55	0.41	0.00	0.41	0.07	0.07	75%
3882	Approved Operations	Carb Mudstone		0.32	0.13	0.00	0.13	0.04	0.15	41%

Pyritic S (%) = CRS (%)

Acid Sulphate S = KCl Acid Sulphate S

Total Acid Generating S = Pyritic S + Acid Sulphate S

Non-Acid Sulphate S = KCl S – KCl Acid Sulphate S

Other S Forms = Total S - (CRS + KCl S)

APPENDIX C

ABCC Plots

Overburden/Interburden and Coal Materials

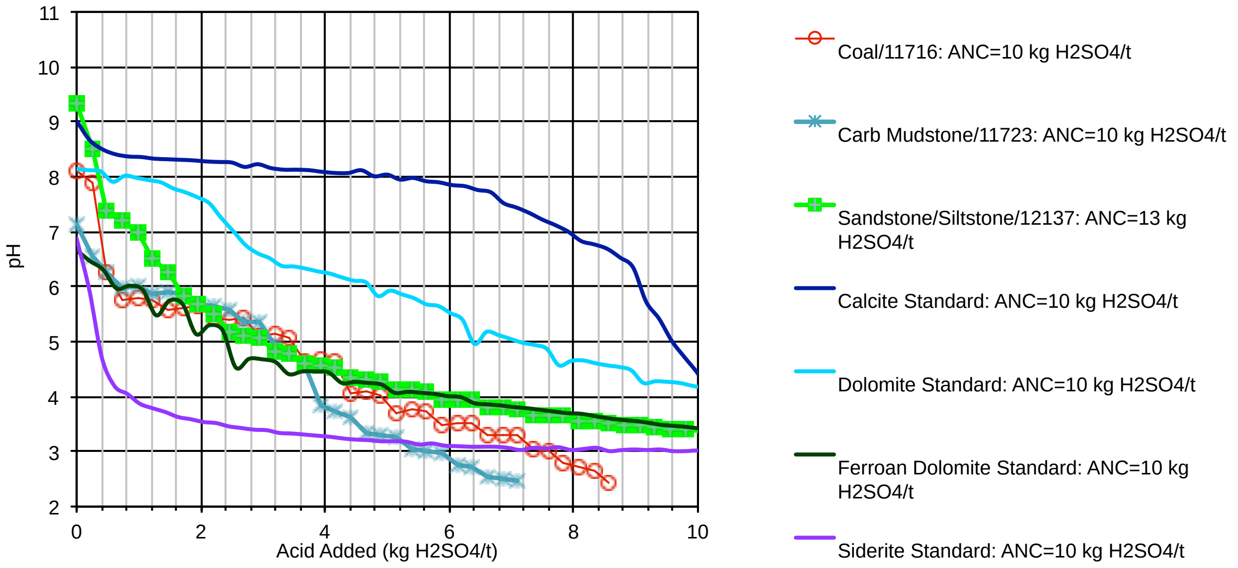

Figure C1: ABCC profile samples with an ANC value close to 10 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Proposed Modification Project

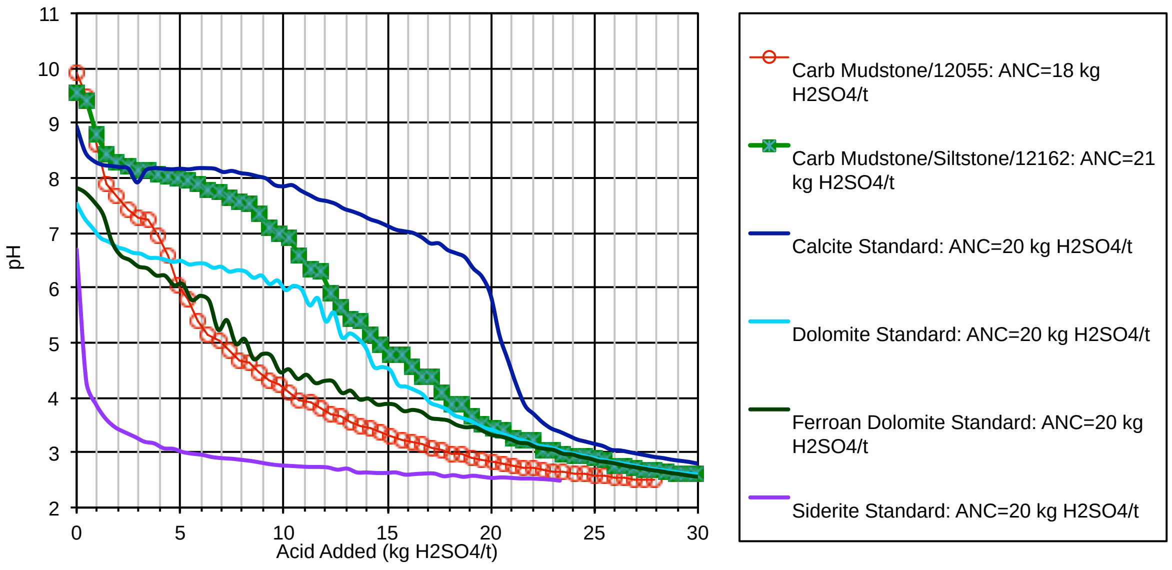

Figure C2: ABCC profile for samples with an ANC value close to 20 kg H_2SO_4 /t. Carbonate standard curves are included for reference - Proposed Modification Project

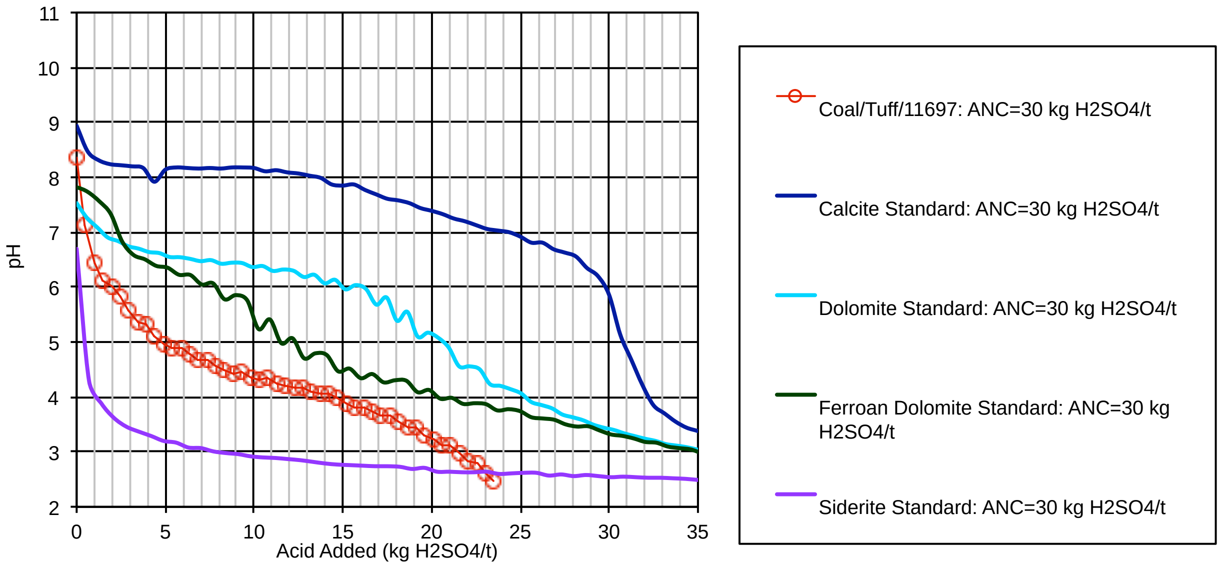

Figure C3: ABCC profile for sample 11697 with an ANC value close to 30 kg H_2SO_4 /t. Carbonate standard curves are included for reference - Proposed Modification Project

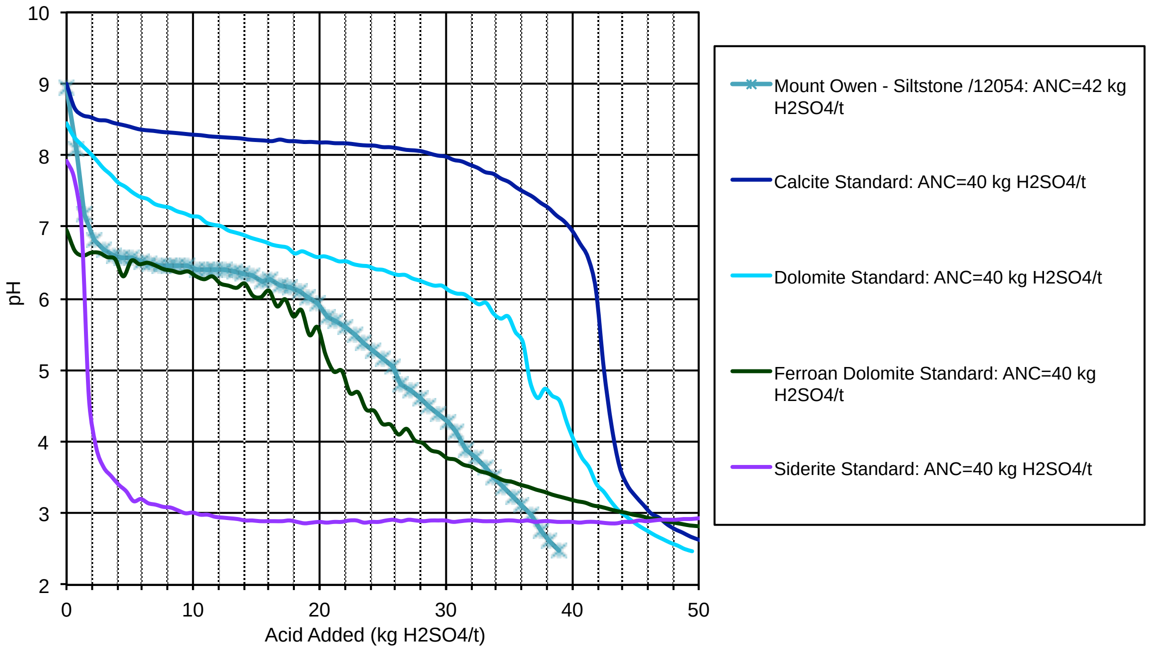

Figure C4: ABCC profile for sample 12054 with an ANC value close to 40 kg H_2SO_4 /t. Carbonate standard curves are included for reference - Proposed Modification Project

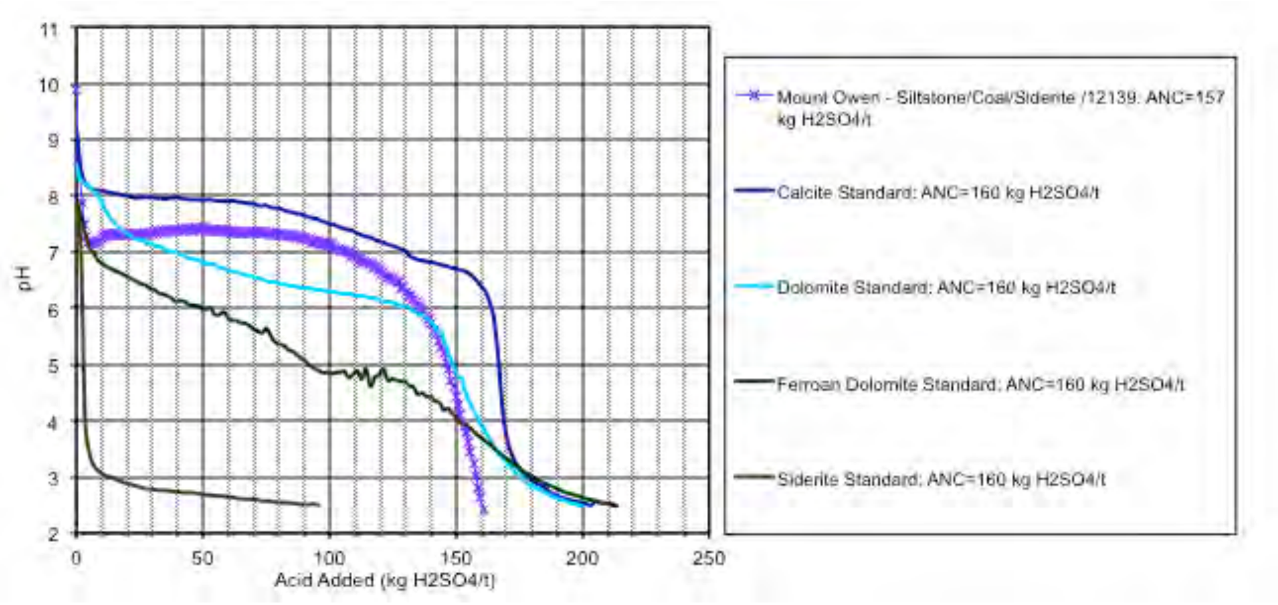

Figure C5: ABCC profile for sample 12139 with an ANC value close to 160 kg H_2SO_4 /t. Carbonate standard curves are included for reference - Proposed Modification Project

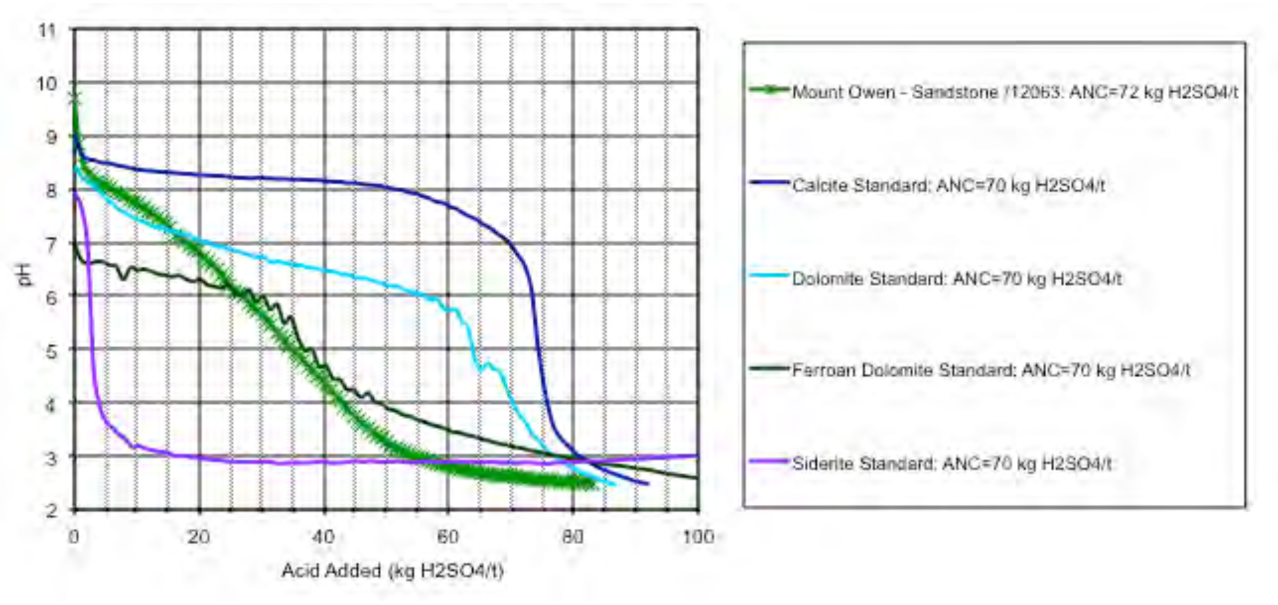

Figure C6: ABCC profile for sample 12063 with an ANC value close to 70 kg H_2SO_4 /t. Carbonate standard curves are included for reference - Proposed Modification Project

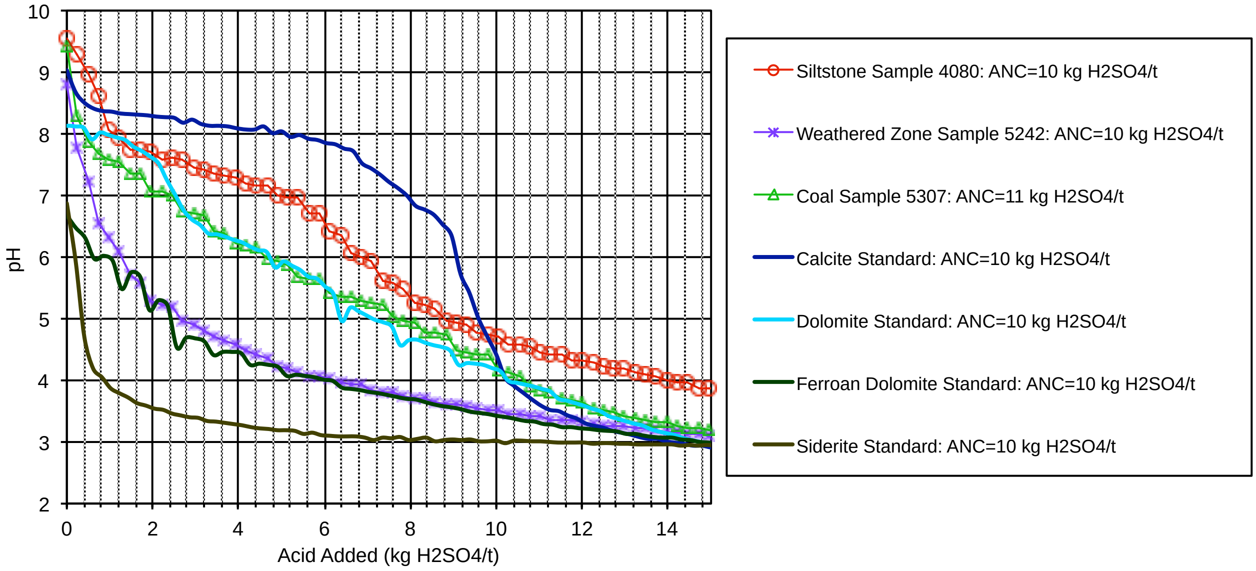

Figure C7: ABCC profile for samples with an ANC value close to 10 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

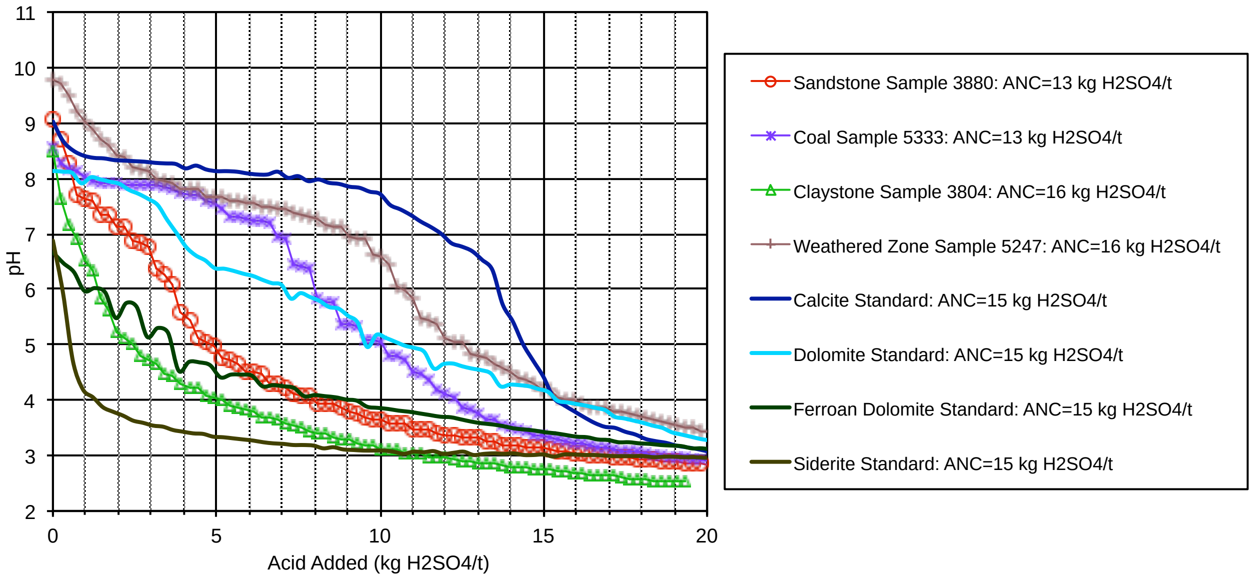

Figure C8: ABCC profile for samples with an ANC value of 15 kg H_2SO_4 /t. Carbonate standard curves are included for reference reference – Approved Operations.

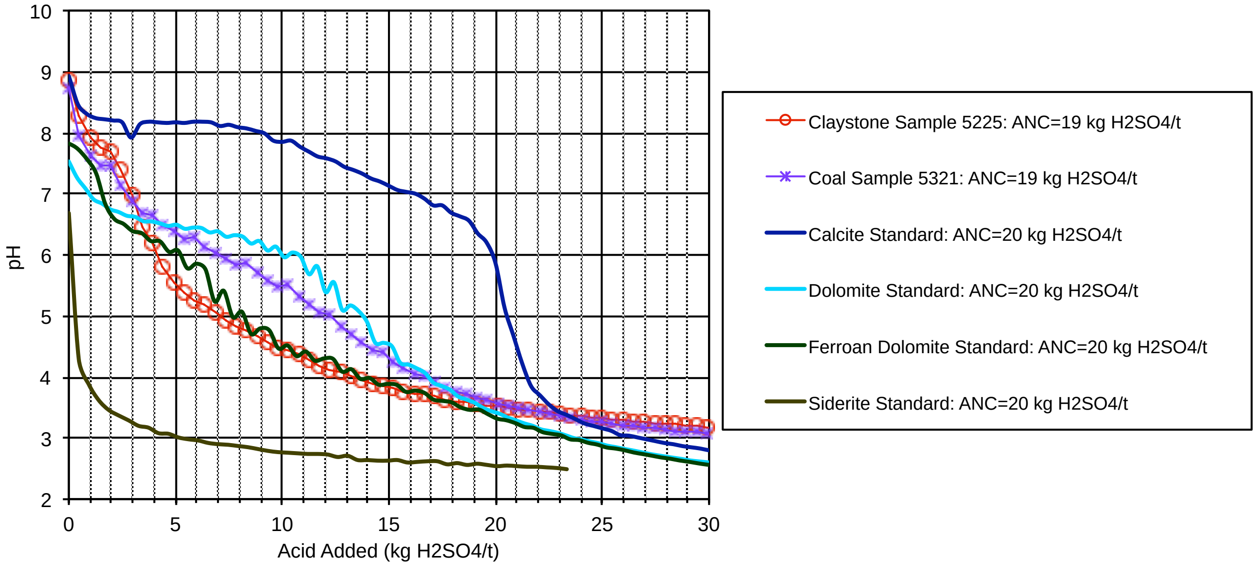

Figure C9: ABCC profile for samples with an ANC value close to 20 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

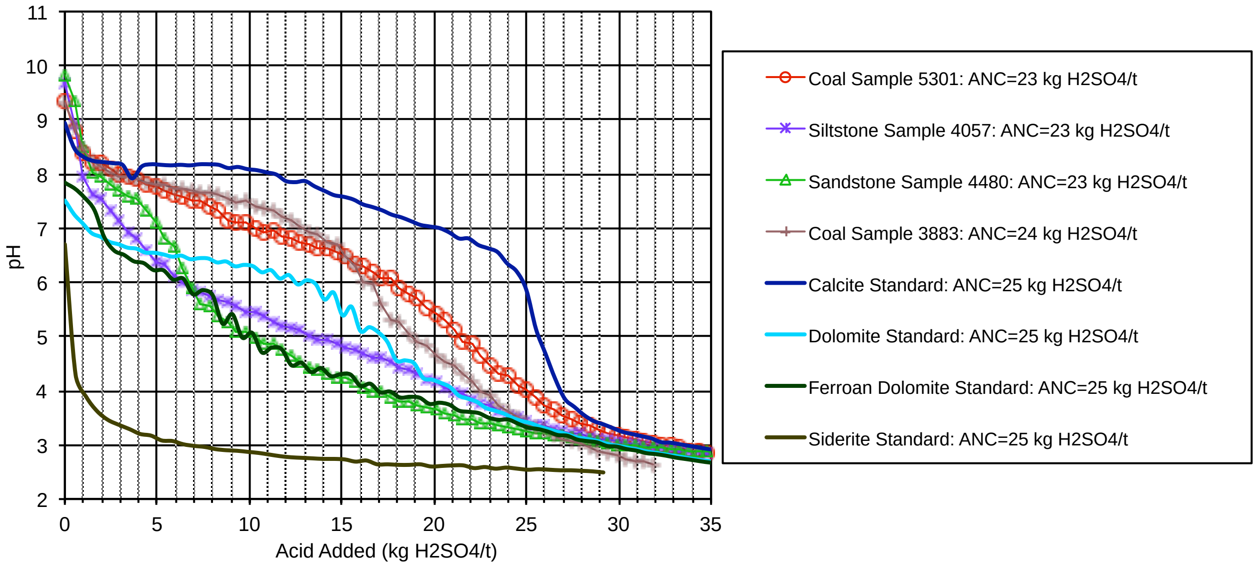

Figure C10: ABCC profile for samples with an ANC value close to 25 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

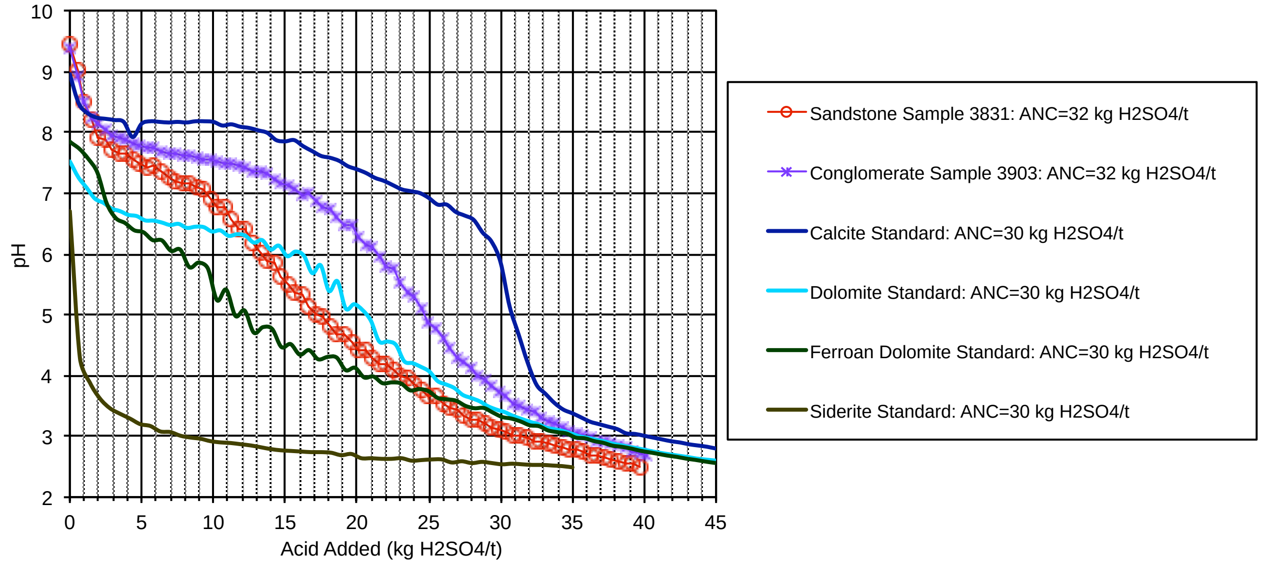

Figure C11: ABCC profile for samples with an ANC value close to 30 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

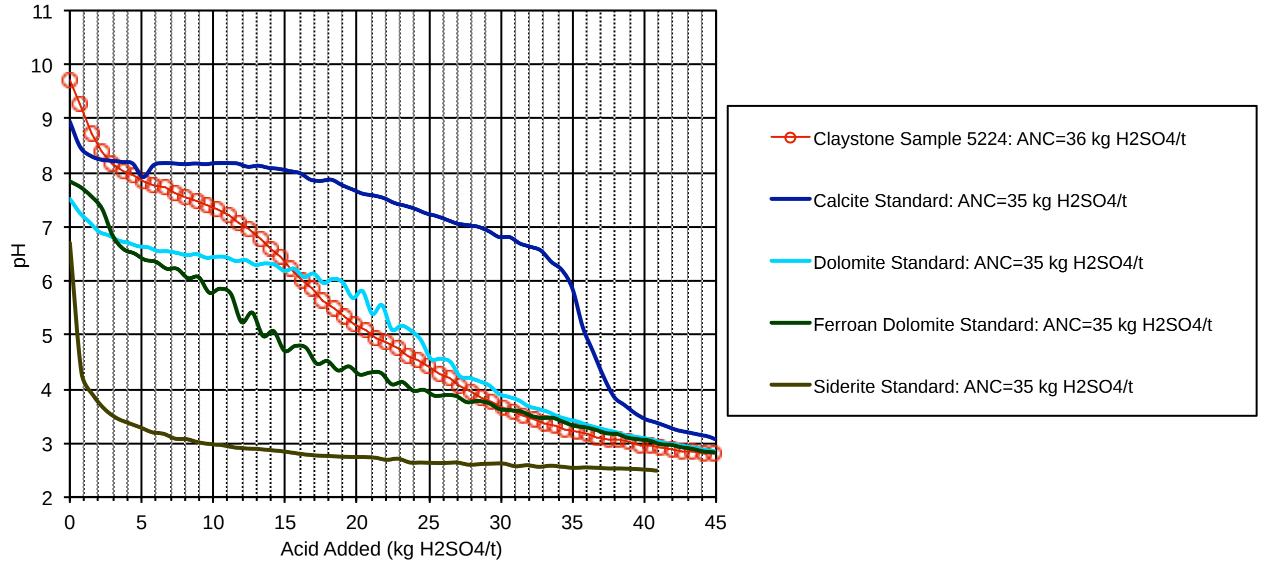

Figure C12: ABCC profile for sample 5224 with an ANC value close to 35 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

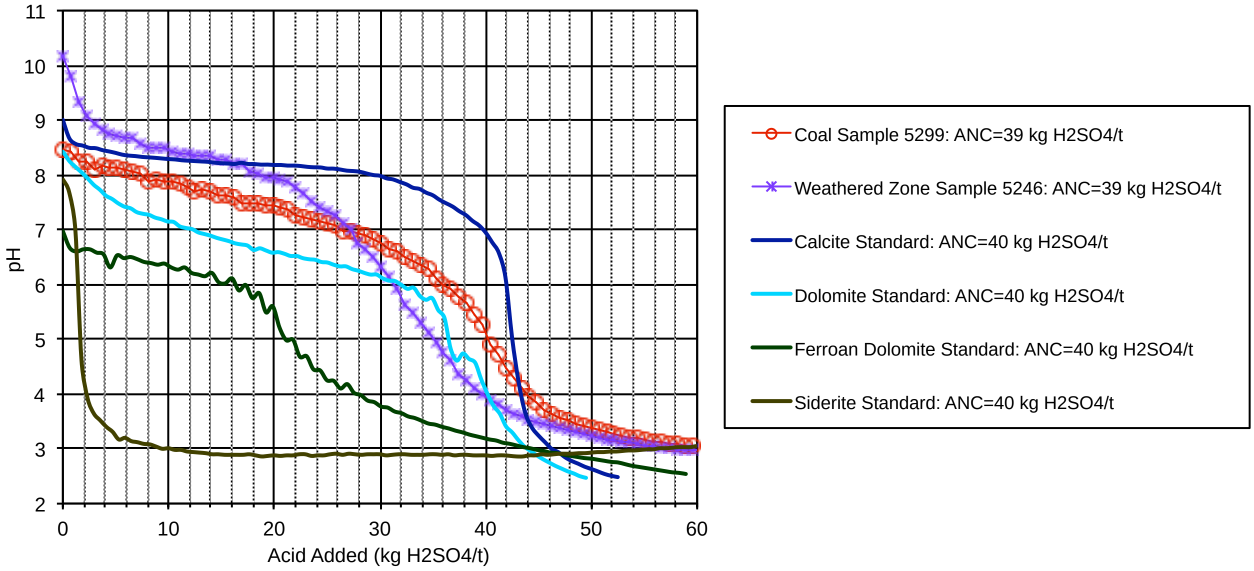

Figure C13: ABCC profile for samples with an ANC value close to 40 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

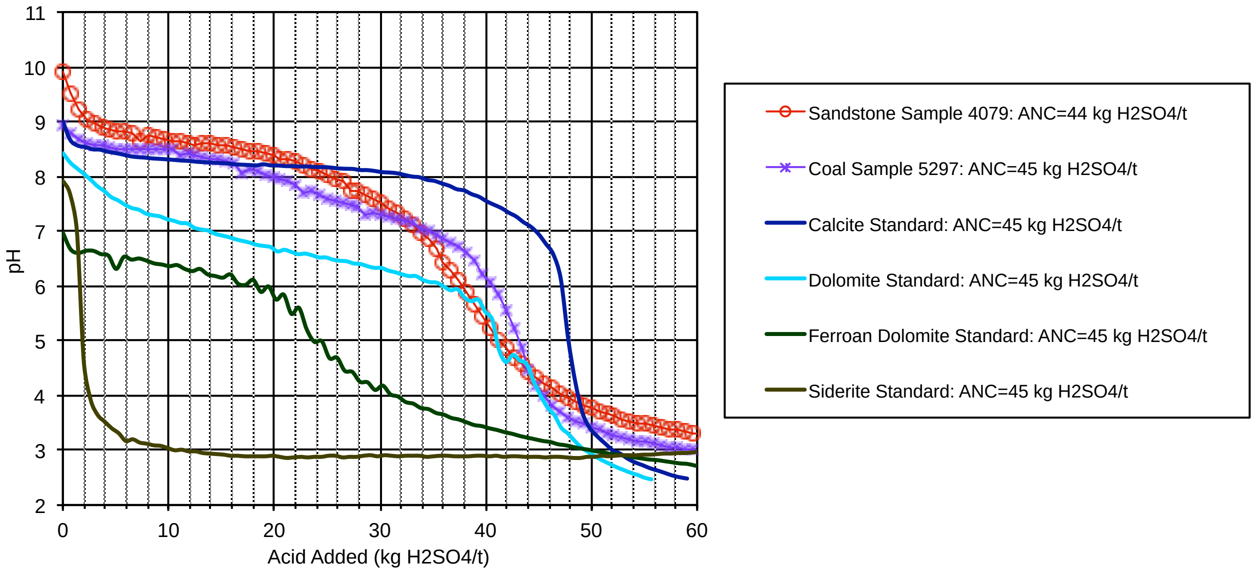

Figure C14: ABCC profile for samples with an ANC value close to 45 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

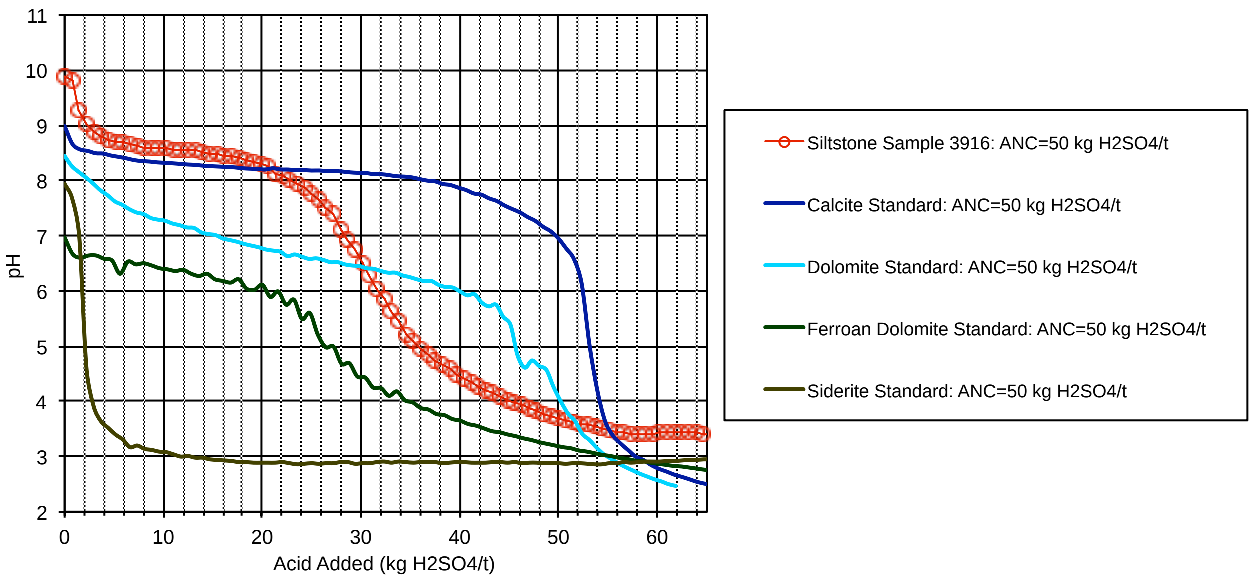

Figure C15: ABCC profile for sample 3916 with an ANC value close to 50 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

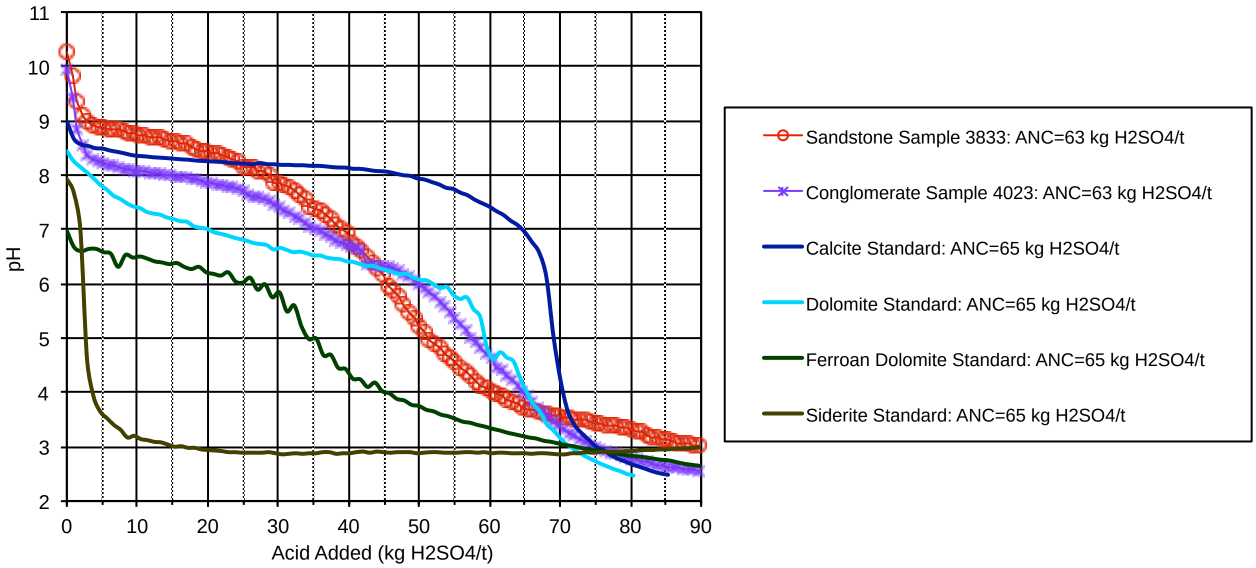

Figure C16: ABCC profile for samples with an ANC value close to 65 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

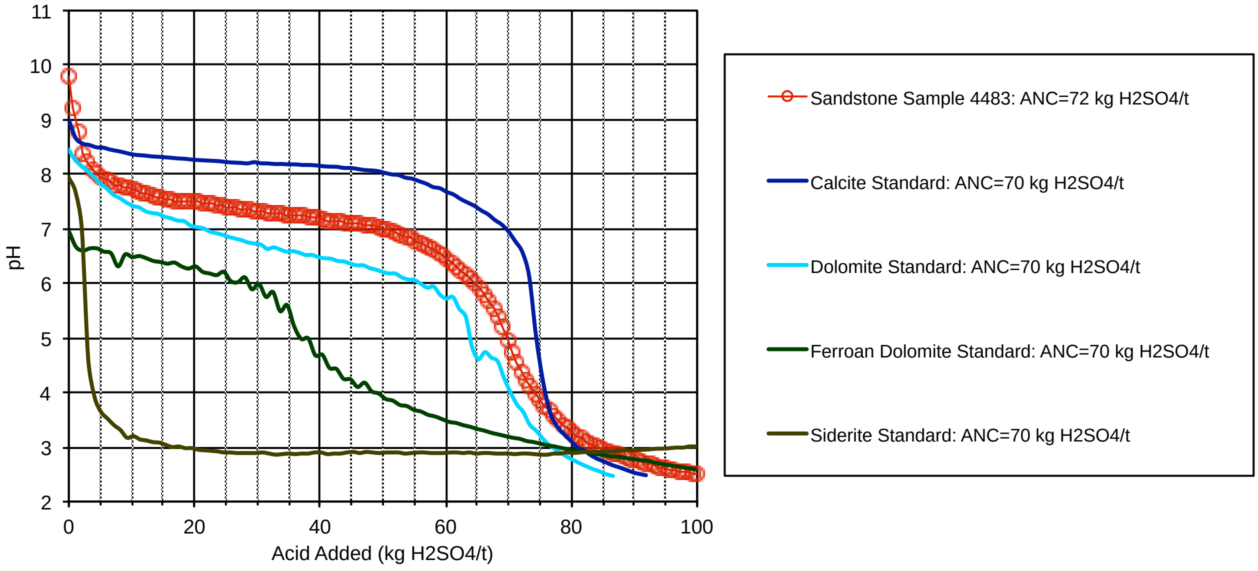

Figure C17: ABCC profile for sample 4483 with an ANC value close to 70 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

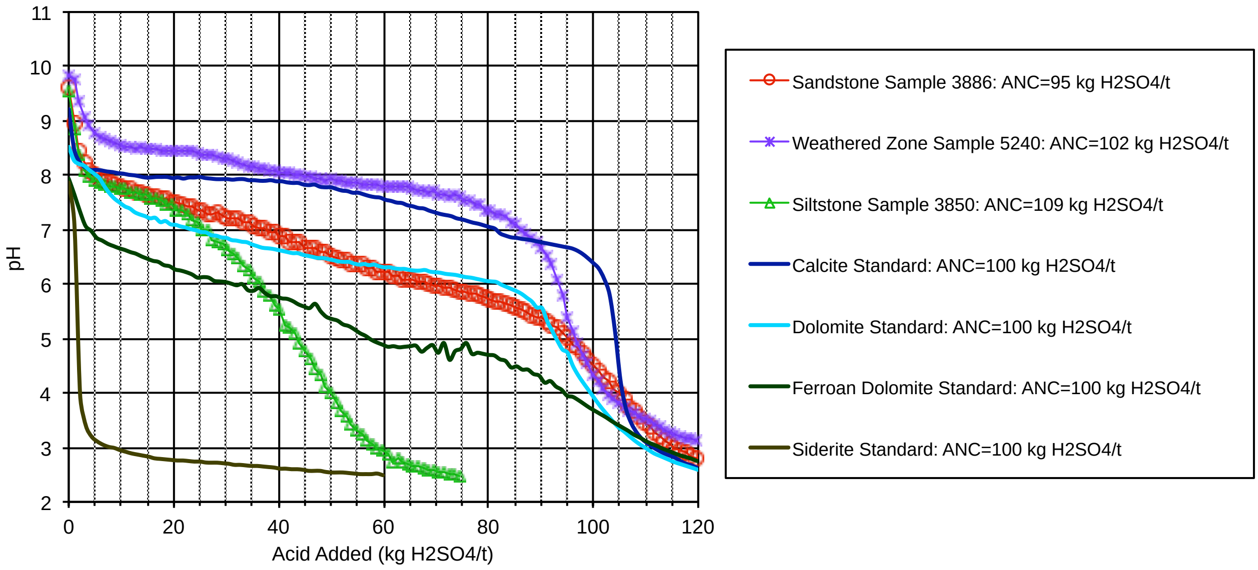

Figure C18: ABCC profile for samples with an ANC value close to 100 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

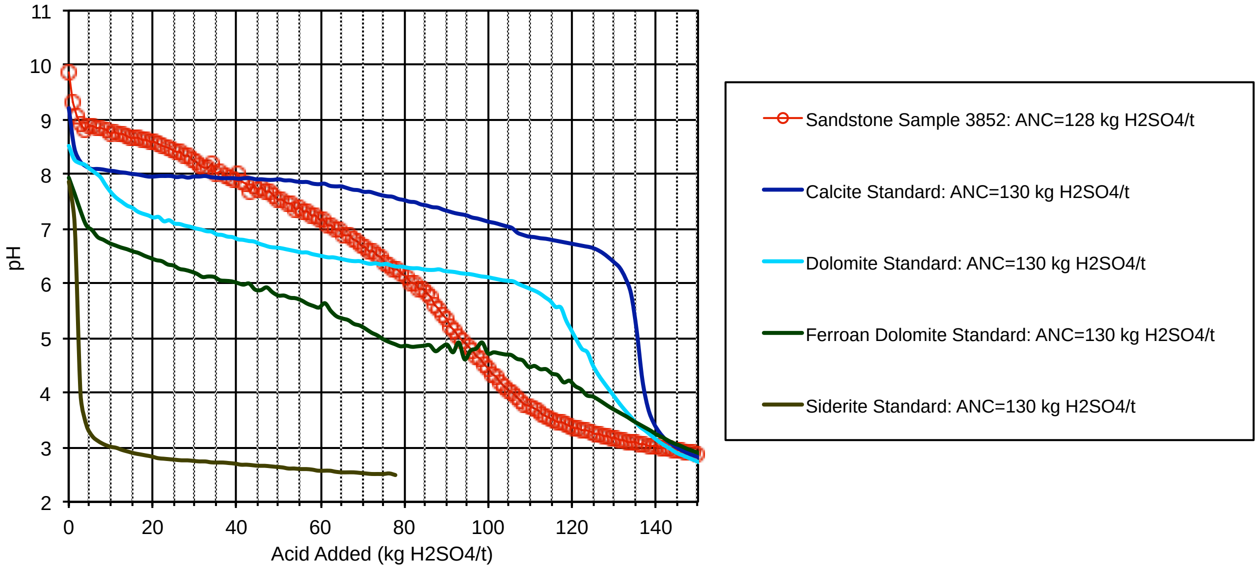

Figure C19: ABCC profile for sample 3852 with an ANC value close to 130 kg H_2SO_4 /t. Carbonate standard curves are included for reference – Approved Operations.

APPENDIX D

Kinetic NAG Plots

Overburden, Interburden and Coal Materials

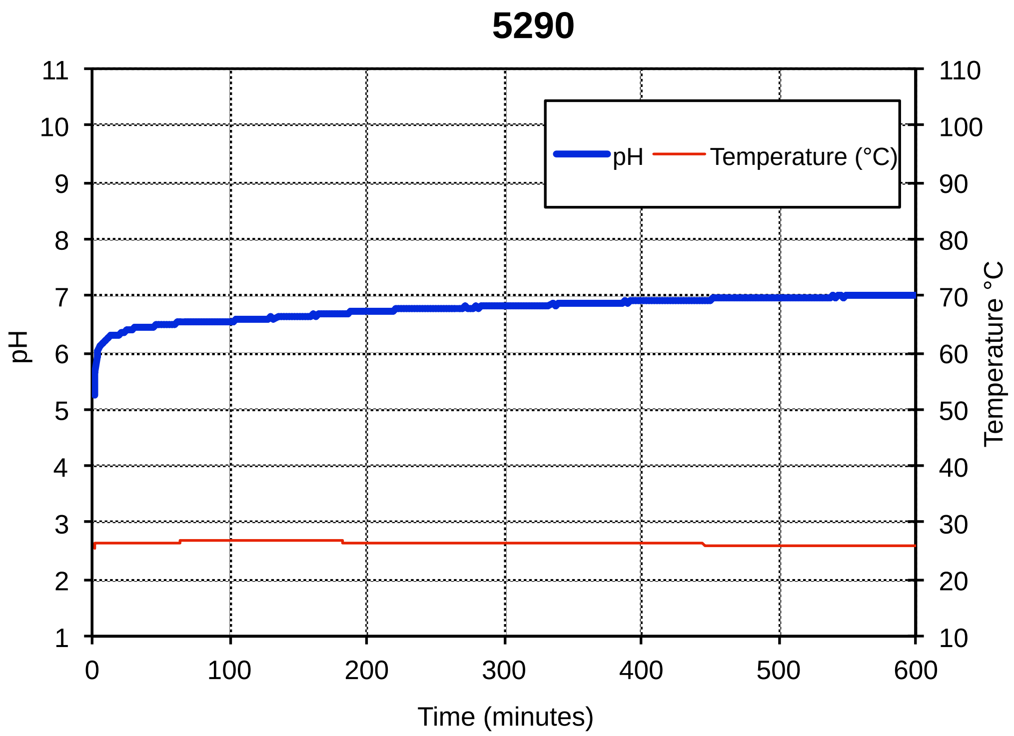

Figure D1: Kinetic NAG graph for coal sample 5290.

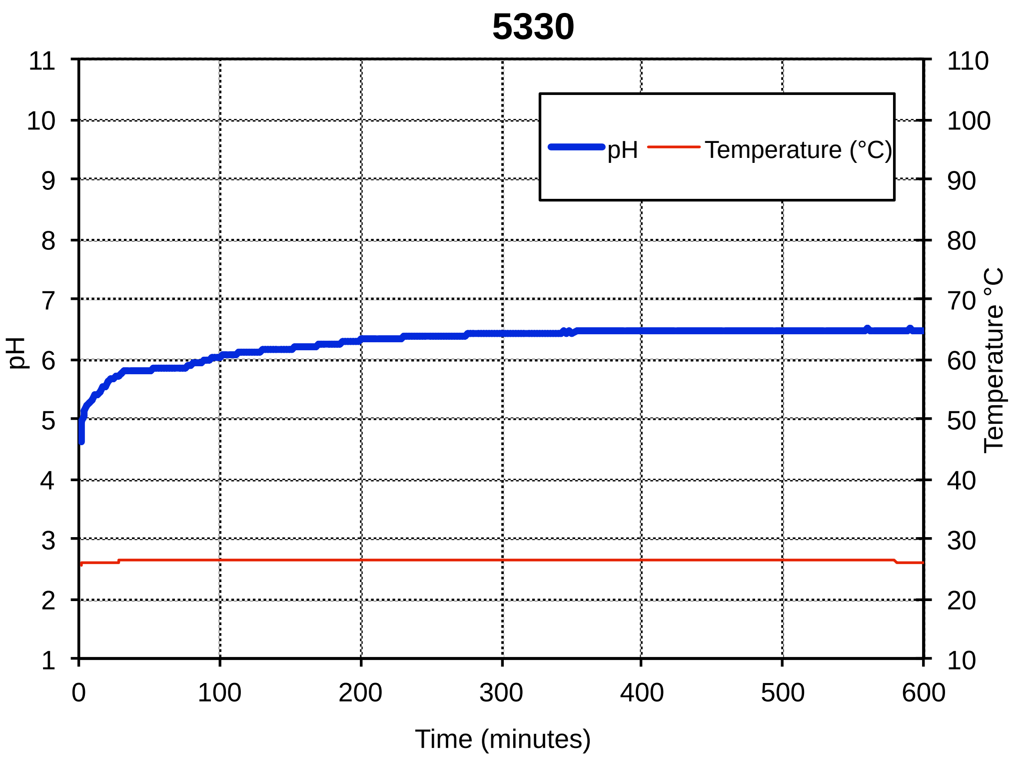

Figure D2: Kinetic NAG graph for coal sample 5330.

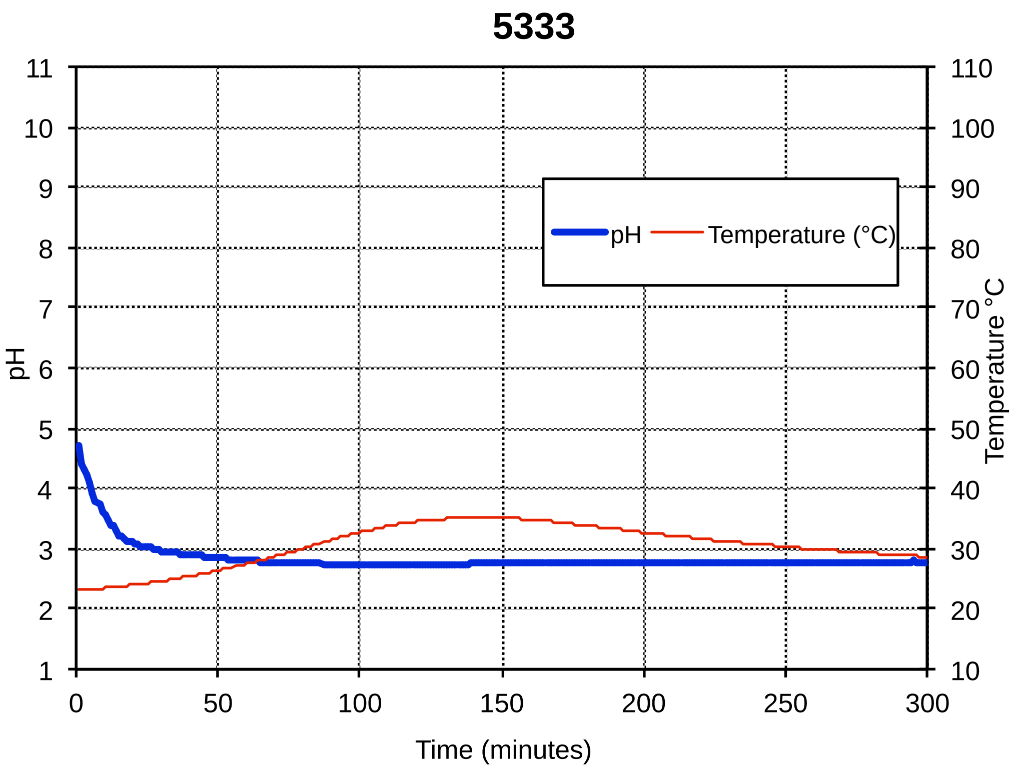

Figure D3: Kinetic NAG graph for coal sample 5333.

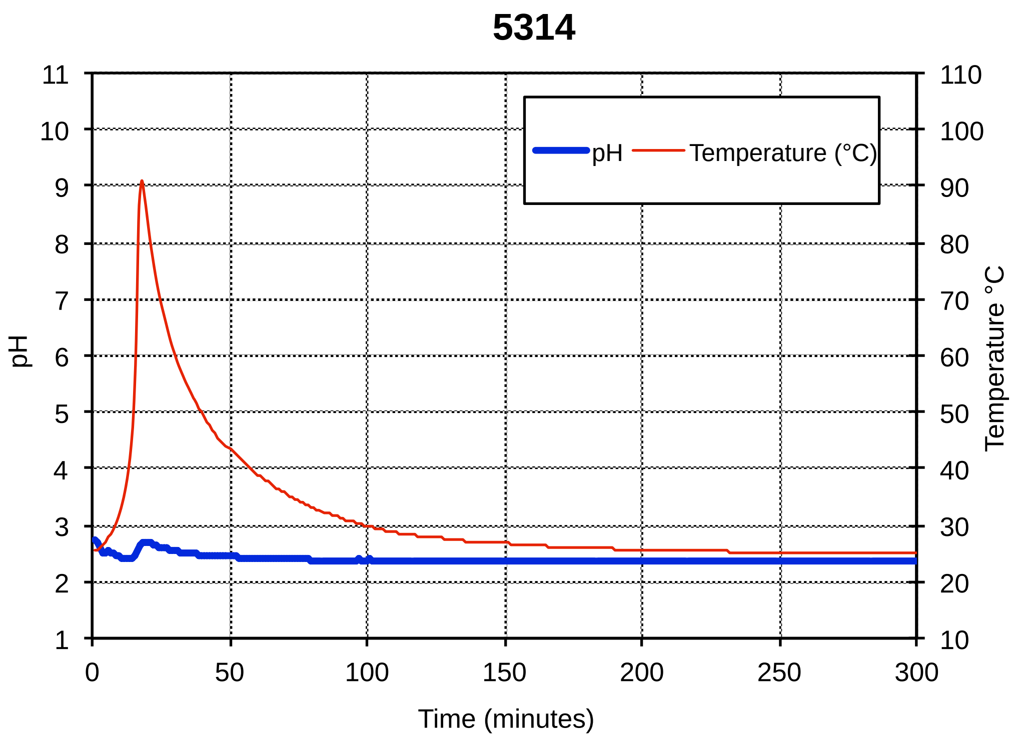

Figure D4: Kinetic NAG graph for coal sample 5314.

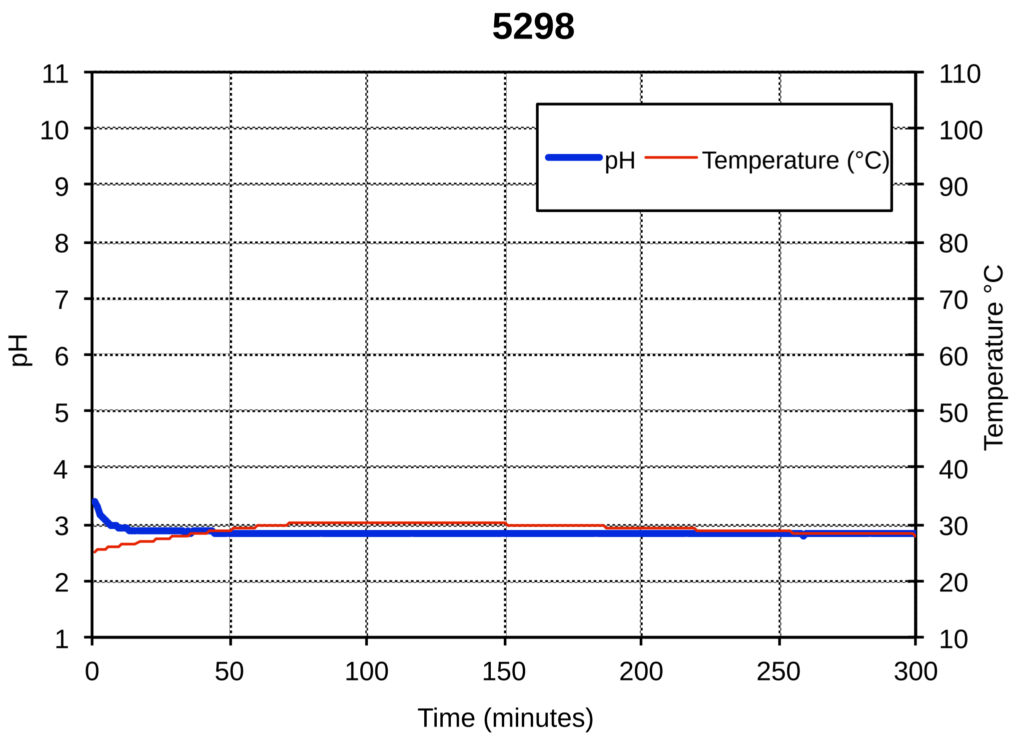

Figure D5: Kinetic NAG graph for coal sample 5298.

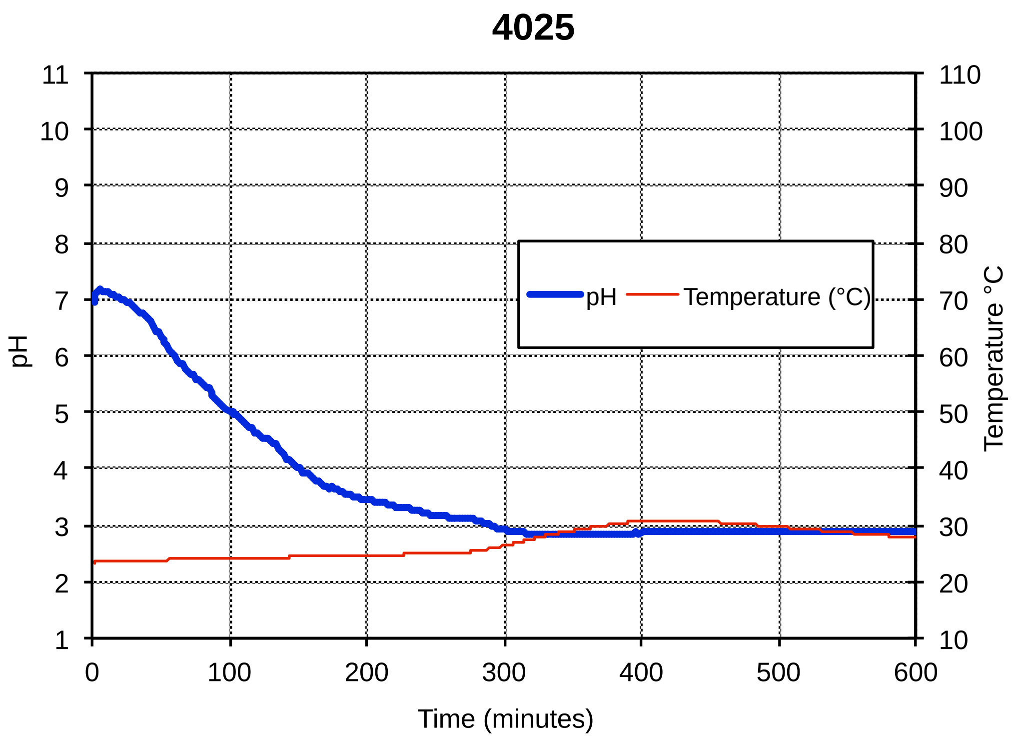

Figure D6: Kinetic NAG graph for sandstone sample 4025.

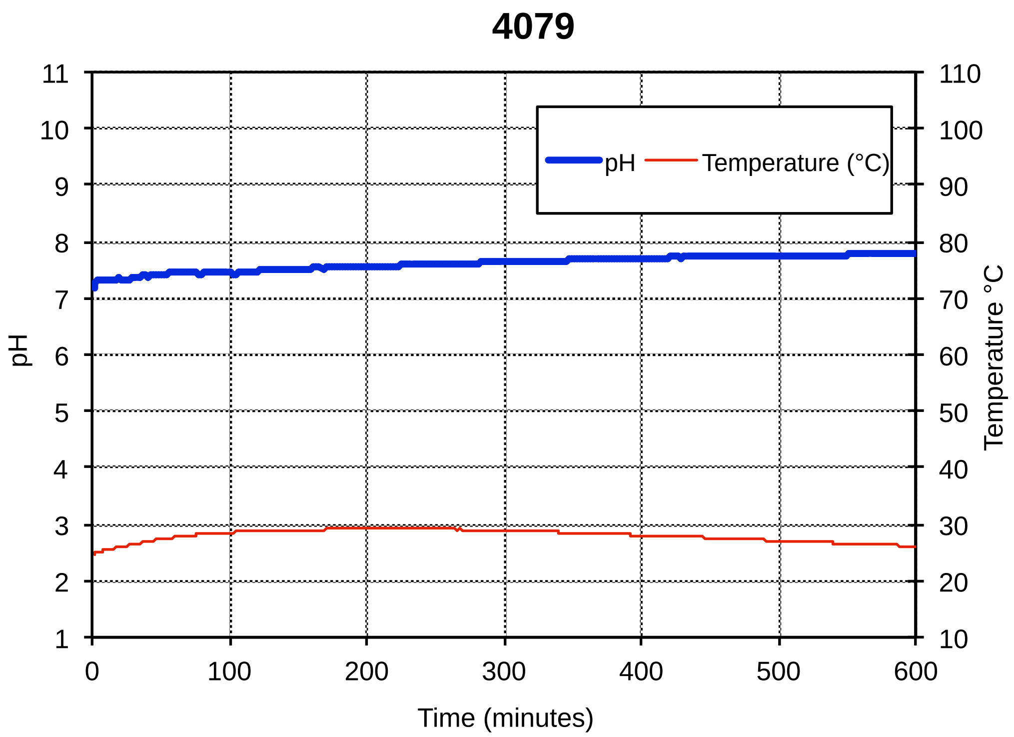

Figure D7: Kinetic NAG graph for sandstone sample 4079.

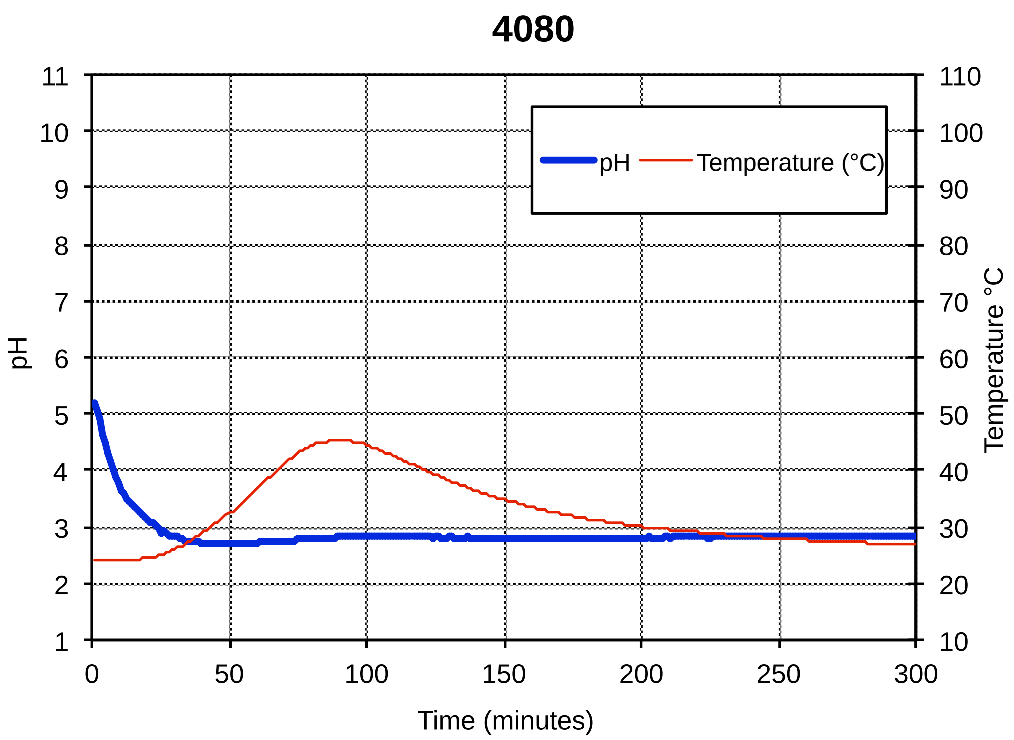

Figure D8: Kinetic NAG graph for siltstone sample 4080.

APPENDIX E

Multi-element Composition, GAI Values, and Extract Water Quality

Overburden, Interburden and Coal Materials

Table E1 Mount Owen – Multi-element composition for selected overburden/interburden/coal samples. Solids mg/kg exept where specified, Part I (this project)

Element	Detection Limit	Sample Number																					
		12041	12108	12112	12114	12118	12134	12136	12150	12159	12163	12166	12427	12428	12429	12430	12431	12432	12433	12434	12435	12438	12440
Ag	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Al	0.01%	7.4%	8.05%	0.0834	7.86%	7.13%	8.36%	7.83%	7.15%	7.83%	6.94%	6.62%	7.68%	8.39%	5.36%	6.75%	6.31%	5.95%	6.72%	6.72%	7.98%	8.48%	10.28%
As	0.2	154	7	6	8	7	10	22	48	9	12	11	25	25	27	10	28	37	32	27	21	14	23
B	10	-	-	-	-	-	-	-	-	-	-	-	18	12	14	-	22	<17	18	18	15	-	-
Ba	10	413	333	297	325	472	465	366	384	400	369	318	296	>5000	2617	649	236	929	507	507	174	255	229
Be	0.05	1.4	1.8	2.1	1.6	1.2	1.6	2	2.7	1.7	1.5	1.8	1.4	1.2	1.6	2.4	1.6	1.1	1.3	1.2	1.3	1.8	1.2
Bi	0.01	0.2	0.29	0.45	0.28	0.15	0.25	0.51	0.36	0.25	0.19	0.27	0.62	1.07	0.7	0.43	0.7	1.2	0.78	0.79	0.72	0.68	0.62
Ca	0.01%	0.28%	1.45%	0.23%	1.63%	1.22%	0.55%	0.17%	0.41%	1.37%	2.10%	2.30%	0.64%	1.09%	0.48%	0.06%	0.32%	0.25%	2.34%	2.32%	0.59%	0.42%	0.81%
Cd	0.02	0.1	0.12	0.18	0.11	0.08	0.13	0.2	0.17	0.13	0.09	0.13	0.13	0.13	0.14	-	0.54	0.17	0.14	0.13	0.13	0.2	0.25
Ce	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co	0.1	17.8	9.4	11	15.2	8.6	9.1	17.7	10.9	11.2	10.6	10.5	8.7	4.2	13.7	4.3	5.3	3.9	2.4	2.1	4.3	3.6	5
Cr	1	61	35	33	34	38	33	34	26	30	32	23	13	14	44	24	22	24	9	9	13	10	13
Cs	0.05	4.70	6.90	10.20	6.40	3.30	6.10	10.80	8.20	6.40	4.50	6.20	11.70	5.20	2.40	10.60	3.20	4.00	8.50	7.40	9.50	9.60	4.70
Cu	0.2	13	20	28	18	9	18	31	20	22	14	22	20	10	15	18	12	12	11	11	13	13	15
F	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Ga	0.05	16.5	17.8	20.3	17.5	15.2	18.9	19.9	17.9	18.0	15.7	15.5	17.4	16.7	12.3	18.5	14.2	13.1	13.9	13.4	18.1	16.7	21.4
Ge	0.05	1.1	1.1	1.2	1.1	1.2	1.1	1.7	2.1	1.3	0.9	0.5	1.6	0.6	3.6	1.4	0.5	0.9	0.4	0.2	0.9	0.3	0.6
Hf	0.01	2.8	3.1	3.3	3	2.5	3.1	3.4	4.5	3.2	2.8	2.7	5.1	4.6	3.3	4.1	3.8	3.4	4.2	4.3	5.5	5.5	4.9
Hg	0.005	0.07	0	0.07	0	0	0	0.06	<0.070	0	0	0	0.12	0.15	0.11	0	0.17	0.25	0.12	0.14	0.16	0.08	0.17
In	0.005	0	0	0.05	0	0	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	0.01%	2.04%	1.94%	2.26%	1.76%	1.97%	2.01%	1.83%	1.96%	1.92%	1.53%	1.52%	1.07%	0.52%	0.48%	1.85%	0.44%	0.46%	0.90%	0.76%	0.70%	1.82%	0.88%
La	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Li	0.2	24.1	27.5	30.3	27.1	20.7	27.7	32.4	20.6	23.4	22.7	21.7	26	25.4	17.8	15.9	21.9	17.2	20.8	19.6	29.7	37.8	28.9
Mg	0.01%	0.56%	0.76%	0.87%	0.80%	0.53%	0.72%	0.81%	0.69%	0.75%	0.62%	0.77%	0.45%	0.73%	0.74%	0.27%	0.44%	0.35%	0.86%	1.08%	0.59%	0.29%	0.21%
Mn	5	124	625	531	659	223	278	154	180	622	1085	1965	173	1308	868	164	3349	1198	1018	897	128	458	623
Mo	0.05	2	0.6	0.5	0.9	0.8	0.8	1.8	2.3	0.7	0.6	0.6	1.4	2.6	3.6	0.9	3.7	7.5	3.4	4	2.1	1.2	1.9

Element	Detection Limit	Sample Number																					
		12041	12108	12112	12114	12118	12134	12136	12150	12159	12163	12166	12427	12428	12429	12430	12431	12432	12433	12434	12435	12438	12440
Na	0.01%	1.49%	1.42%	0.87%	1.35%	1.58%	1.65%	0.68%	1.03%	1.50%	1.38%	1.11%	0.22%	0.38%	0.67%	0.20%	0.40%	0.90%	0.25%	0.36%	0.59%	0.13%	0.14%
Nb	0.1	5.7	6	6.6	5.6	4.8	5.9	6.2	9	5.6	5.7	4.9	6.4	8.7	12.2	9.2	8.5	8.5	6.1	5.9	7.7	7	9.4
Ni	0.2	19	11	16	14	10	9	21	12	11	9	7	13	5	37	5	13	7	4	3	9	4	8
P	10	349	453	430	431	308	400	285	582	497	349	1269	95	138	299	78	149	138	165	185	117	127	136
Pb	0.5	14	12	18	12	10	14	22	17	13	10	12	25	41	21	17	24	28	30	32	30	27	20
Rb	0.1	90	96.5	124.8	88.8	80.8	96	111.4	103.5	97	72	80.3	80.1	33.8	24.4	78	24.9	27.4	56.5	47.5	50.7	99.3	53.1
Re	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S	0.01%	0.32%	0.02%	0.04%	0.02%	0.04%	0.03%	0.25%	<0.00	0.03%	0.09%	0.10%	0.34%	1.17%	1.49%	0.41%	1.62%	4.84%	0.75%	0.77%	0.33%	0.14%	0.12%
Sb	0.05	1.9	0.7	0.8	0.9	0.7	0.7	1.4	1.5	0.8	0.8	0.7	0.7	0.7	1	0.8	0.6	1.3	0.6	0.5	0.6	0.4	0.5
Sc	0.1	11	14	17	13	9	13	18	12	14	11	13	10	8	8	10	10	7	7	8	8	7	8
Se	1	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-
Sn	0.2	1.7	2.1	2.7	2	1.5	2.1	2.6	2.3	1.9	1.8	1.8	4.2	5.7	3	3.2	3.5	4.7	4.2	4.1	5.4	4.3	4.6
Sr	0.2	184.2	274.5	257.5	298.8	217.9	319.7	298.8	308.2	325.8	247.8	257.9	103	124.3	107.1	50.5	77.6	98.1	239.6	218.5	122.7	84.3	75.8
Ta	0.05	0.46	0.48	0.55	0.45	0.39	0.46	0.53	0.57	0.44	0.43	0.39	0.75	1.09	1.05	0.6	0.81	0.83	0.79	0.77	0.9	1.02	1.06
Te	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	-	-	-	-	-
Th	0.2	8.35	9.02	11.19	8.81	7.61	9.23	11.72	10.99	8.29	7.68	7.68	18.83	31.09	13.58	12.19	21.86	17.36	21.42	21.69	23.5	19.39	17.91
Ti	0.005%	0.38%	0.38%	0.39%	0.34%	0.28%	0.38%	0.35%	0.33%	0.38%	0.41%	0.31%	0.24%	0.20%	0.27%	0.27%	0.18%	0.17%	0.18%	0.18%	0.22%	0.22%	0.34%
Tl	0.02	1.46	0.47	0.64	0.46	0.47	0.49	0.71	0.9	0.49	0.47	0.48	1.11	2.77	2.2	1.03	2.67	7.71	1.81	1.94	0.71	0.58	0.57
U	0.1	2.27	2.48	3.08	2.43	1.93	2.6	3.76	3.05	2.36	2.11	2.26	4.76	7.81	7.21	3.54	5.87	4.81	5.39	5.4	6.5	4.43	5.52
V	1	117	100	123	94	77	94	132	79	100	92	91	43	23	41	83	20	22	23	19	32	31	27
W	0.1	1.1	1.3	1.6	1.2	0.9	1.2	1.5	1.8	1.2	1	1.1	1.6	2.4	1.9	5.6	2.1	2.2	1.8	1.6	1.6	1.1	2.7
Y	0.1	16.5	20	22.4	19.8	14.3	20.2	25.8	29.2	22.4	17.4	24.3	21.9	28.3	16.6	26.5	27.4	16.6	22.7	21.2	24.5	28.5	22.6
Zn	2	79	89	100	86	59	87	108	105	88	77	76	41	61	67	38	105	64	33	38	38	54	71
Zr	0.5	95	100	104	95	86	103	105	175	105	94	87	139	118	98	127	109	94	109	110	147	158	124

Table E1 Mount Owen – Multi-element composition for selected overburden/interburden/coal samples. Solids mg/kg exept where specified, Part II (EGi, 2013)

Element	Detection Limit	Lithology/Sample Number																								
		3778	3831	3833	3850	3852	3859	5216	5221	3880	3886	5232	3900	3911	3954	3962	3978	4025	4057	4079	4080	4479	4480	4483	4547	5240
Ag	0.01	0.10	0.06	0.05	0.12	0.06	0.09	0.04	0.08	0.04	0.04	0.09	0.04	0.08	0.10	0.07	0.04	0.04	0.08	0.06	0.09	0.08	0.08	0.03	0.11	0.10
Al	0.01%	9.28%	8.45%	7.82%	8.50%	7.51%	9.77%	8.42%	6.33%	7.20%	7.11%	6.50%	6.41%	8.81%	9.98%	8.51%	6.21%	6.87%	8.74%	8.03%	9.38%	8.97%	8.20%	6.86%	7.79%	6.65%
As	0.2	3.3	7.6	5.6	4.9	9.8	8.2	8.6	5.8	19.2	3.8	9.2	13.3	15	36.6	3.8	20.5	301	11.4	31.9	22.8	18.2	9.8	4.8	15	5.4
B	10	20	10	10	10	10	20	40	30	10	10	30	10	20	10	10	10	<10	10	20	30	30	30	20	40	20
Ba	10	100	430	370	280	420	330	1090	500	500	350	690	520	300	420	350	580	620	290	310	330	330	380	510	390	490
Be	0.05	2	1.68	1.48	2.36	1.49	1.86	2.01	1.15	1.78	1.17	1.32	1.42	1.95	2.18	1.7	1.3	1.15	1.74	1.76	2	1.88	1.6	0.98	1.96	1.05
Bi	0.01	0.69	0.25	0.22	0.4	0.2	0.49	0.38	0.14	0.2	0.19	0.15	0.15	0.26	0.39	0.46	0.17	0.14	0.43	0.2	0.34	0.42	0.35	0.14	0.39	0.15
Ca	0.01%	0.66%	1.03%	2.20%	2.34%	3.57%	0.47%	0.29%	2.04%	0.35%	3.60%	0.19%	0.96%	0.44%	0.35%	0.68%	0.59%	0.38%	0.71%	1.96%	0.47%	0.32%	0.51%	2.87%	0.73%	4.06%
Cd	0.02	0.13	0.11	0.09	0.13	0.09	0.18	0.16	0.09	0.1	0.08	0.04	0.06	0.1	0.16	0.14	0.05	0.06	0.18	0.13	0.21	0.18	0.14	0.05	0.15	0.08
Ce	0.01	60	56.6	53.8	61.8	51.6	72.1	51.9	46.5	61.2	44.3	55.7	53.8	63.4	91.4	61.2	56.7	57.1	65.9	45.2	62.9	61.3	55.7	45.8	61.8	38.7
Co	0.1	2.4	10.8	10.4	13.7	11	11	15.2	8.3	10.1	9.3	5.9	7	19.4	28.2	16.2	6.8	15.4	10.1	13.4	14.1	15.1	13	6.5	16.9	5.5
Cr	1	6	58	59	39	57	45	41	65	114	51	82	88	82	99	36	90	94	34	35	43	34	45	78	34	65
Cs	0.05	9.04	6.31	5.60	9.21	4.70	12.20	10.00	3.15	5.54	4.16	2.73	3.03	6.16	9.49	11.80	2.63	2.67	10.60	5.43	7.34	11.00	9.06	2.71	9.23	2.82
Cu	0.2	6.4	19.8	17.9	31.7	15.7	39.8	31.3	9.7	14.2	12.5	9.5	8.6	36.5	46.9	36.4	8.8	6.5	34.9	15.9	29	62.2	26.8	8.8	29.9	9.4
F	20	720	330	330	390	270	350	760	410	270	270	440	260	330	680	870	400	360	700	570	700	860	800	360	700	480
Fe	0.01%	1.63%	3.47%	3.31%	8.14%	3.41%	2.26%	3.13%	2.14%	1.94%	2.32%	1.57%	1.58%	3.81%	2.83%	3.17%	2.06%	1.68%	3.24%	3.79%	4.05%	3.05%	4.56%	1.73%	8.62%	1.69%
Ga	0.05	26.7	20.0	19.7	22.2	17.4	26.1	22.7	14.9	17.5	15.9	16.0	16.1	23.9	26.0	23.8	15.6	15.8	23.4	19.3	23.3	24.9	20.9	15.6	21.0	15.7
Ge	0.05	0.31	0.21	0.19	0.16	0.15	0.2	0.22	0.19	0.21	0.2	0.19	0.21	0.28	0.28	0.25	0.24	0.18	0.25	0.21	0.22	0.22	0.25	0.22	0.27	0.26
Hf	0.01	5.8	3.4	3.4	3.7	3	4.2	4	3.2	3.4	2.9	3.6	3.7	4.9	5	4	3.2	3.2	3.8	3.4	4.7	4.1	3.3	2.6	3.2	2.6
Hg	0.005	0.019	0.019	0.011	0.033	0.022	0.018	0.047	<0.005	0.069	0.006	0.01	0.012	0.037	0.114	0.027	0.021	0.067	0.028	0.118	0.092	0.034	0.024	0.006	0.023	<0.005
In	0.005	0.065	0.065	0.058	0.069	0.053	0.09	0.076	0.048	0.061	0.048	0.046	0.05	0.089	0.083	0.085	0.048	0.043	0.081	0.057	0.078	0.088	0.074	0.039	0.071	0.04
K	0.01%	2.03%	1.89%	1.70%	1.66%	1.63%	1.97%	2.03%	1.83%	2.18%	1.34%	2.15%	2.00%	1.39%	1.74%	2.22%	1.63%	2.02%	1.71%	1.47%	1.77%	1.98%	1.88%	1.71%	1.81%	1.91%
La	0.5	25.1	28.1	26.7	29.8	24.6	33.9	22.8	22.7	30.3	20.5	28.4	26.5	29.9	42.4	28.9	28.9	28.5	31.4	20.7	31.9	28.4	26.9	22.6	29.4	18.4
Li	0.2	11	32.1	29.8	38.2	26.1	36.4	36.4	18.4	18.1	21.2	15.3	17.5	35.6	40.2	30	21.1	17.9	32.6	28	31.4	39.4	31.7	17.4	28.2	16.7
Mg	0.01%	1.17%	0.73%	0.69%	0.93%	0.81%	0.70%	0.77%	0.45%	0.38%	0.78%	0.26%	0.38%	0.76%	0.67%	0.94%	0.44%	0.27%	0.85%	0.47%	0.61%	0.92%	0.90%	0.44%	0.61%	0.42%
Mn	5	45	618	560	1730	587	184	211	365	177	421	440	287	749	79	357	411	107	515	756	359	209	863	503	1700	541
Mo	0.05	2.78	0.81	0.76	1.04	0.79	0.89	0.89	0.92	1.11	1.17	1.64	1.2	0.85	1.82	0.93	1.62	1.46	0.67	0.81	1.49	0.93	0.94	1.21	0.79	0.88

Element	Detection Limit	Lithology/Sample Number																								
		3778	3831	3833	3850	3852	3859	5216	5221	3880	3886	5232	3900	3911	3954	3962	3978	4025	4057	4079	4080	4479	4480	4483	4547	5240
Na	0.01%	0.26%	1.46%	1.50%	0.77%	1.30%	0.30%	1.02%	1.51%	0.80%	1.63%	1.61%	1.99%	0.69%	0.77%	0.81%	1.44%	1.50%	0.89%	1.40%	1.38%	0.89%	1.16%	1.93%	1.11%	1.71%
Nb	0.1	8.8	6.5	6.6	7.1	5.7	8.1	7.7	6.2	7.5	5.3	6.9	6.4	8.3	10.5	7.8	6.6	5.5	7.5	6	7.5	7.2	6.5	5.1	6.8	5.1
Ni	0.2	4	14.9	13	19.5	13.3	20.8	20.6	10.6	14.3	10.3	11.3	9.1	47.8	73	24	10.8	15	17.2	13.7	18.3	19.3	16.9	7.2	18.3	6.6
P	10	120	410	450	800	460	310	260	310	250	360	270	410	520	540	480	380	310	450	370	470	470	430	340	570	340
Pb	0.5	36.1	14.1	13.2	17.8	12.5	21.8	17.2	11.3	14	12.5	11.4	11.4	16.6	20.5	17.4	10.7	18.6	17.7	12.5	18.6	18.2	16.2	11	16.8	11.4
Rb	0.1	80	96.2	81.4	97.3	80.5	120.5	117	75.4	107.5	60.6	87.7	86.1	76.8	112	135	70.9	81.4	107	73.7	99.4	113.5	102.5	73.1	101.5	75.4
Re	0.002	<0.002	0.002	0.002	0.004	0.002	0.003	0.004	0.003	0.003	0.002	0.002	0.004	0.003	0.005	<0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.002	0.002	0.002	0.002
S	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.02%	0.04%	<0.01%	0.22%	<0.01%	<0.01%	<0.01%	0.03%	0.62%	0.03%	0.35%	0.86%	0.01%	0.96%	1.26%	0.17%	0.11%	<0.01%	<0.01%	<0.00
Sb	0.05	0.73	0.83	0.75	1.12	0.68	1.27	1.35	0.75	1	0.58	0.87	0.69	0.5	0.8	0.87	0.88	1.55	0.89	0.65	1.25	1.17	0.97	0.59	1.02	0.54
Sc	0.1	4.8	15.8	14.7	18.6	13	22.1	18	10.4	13	12	9.5	10.2	23.3	23.1	20.2	9.8	7	20.7	14.1	18.3	19	17.3	9.6	17.3	8.7
Se	1	2	2	2	3	2	2	2	2	2	1	2	2	3	3	3	2	2	2	2	2	2	2	1	3	1
Sn	0.2	5.6	2.1	2.1	2.5	1.8	3	2.6	1.8	2	1.6	2.2	1.9	2.5	3.3	2.8	1.9	1.7	2.8	2	2.5	2.7	2.3	1.6	2.4	1.5
Sr	0.2	234	292	307	232	321	123	167	177	138	538	103.5	204	229	404	178	142.5	201	410	238	243	214	206	258	246	179.5
Ta	0.05	1.01	0.54	0.56	0.59	0.47	0.72	0.64	0.52	0.55	0.48	0.58	0.54	0.62	0.83	0.7	0.55	0.5	0.63	0.49	0.63	0.62	0.56	0.42	0.56	0.41
Te	0.05	<0.05	0.05	<0.05	0.1	0.05	0.1	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.11	<0.05	<0.05	0.07	<0.05	0.08	0.1	<0.05	<0.05	0.07	0.05
Th	0.2	18.2	9.4	9	11.5	8	12.5	9.6	7.4	9.3	7.1	9.5	9.1	8.6	13.4	11.7	9.3	8.8	11.5	7.6	11.3	10.6	10.4	7	10.8	6.5
Ti	0.005%	0.07%	0.42%	0.45%	0.41%	0.35%	0.47%	0.44%	0.38%	0.36%	0.33%	0.30%	0.27%	0.58%	0.57%	0.43%	0.26%	0.24%	0.44%	0.38%	0.47%	0.47%	0.40%	0.30%	0.38%	0.30%
Tl	0.02	0.58	0.49	0.42	0.53	0.4	0.59	0.71	0.42	0.68	0.3	0.46	0.49	0.39	0.93	0.55	0.63	1.23	0.56	1.26	1.75	0.62	0.51	0.33	0.56	0.38
U	0.1	5	2.4	2.3	3.1	2	3.5	3.1	1.8	2.1	1.9	2	2.1	2.3	2.8	3.2	2.1	2	3.1	2	3.1	3.1	2.9	1.7	3	1.7
V	1	13	98	101	118	81	141	118	72	132	70	54	50	143	172	125	50	54	120	82	113	130	109	67	109	69
W	0.1	0.6	1.3	1.3	1.6	1.7	1.8	1.8	2.3	1.3	1.2	14	1.2	1.2	1.8	1.9	1.3	1.1	1.7	1.2	1.5	1.7	1.5	1	1.5	1.9
Y	0.1	29.6	22.9	21.5	30.9	21.6	29.1	25.3	19.2	20.4	17.4	22.1	22.5	29.3	27.7	26.3	21.5	18.7	25.5	21.7	26.1	26	25.3	18.2	27.2	17.2
Zn	2	72	79	74	98	65	98	94	52	69	65	46	50	91	121	100	44	50	105	73	90	110	93	49	92	50
Zr	0.5	137	107	109	120	98	132	128	105	111	88	112	113	185	177	121	100	100	119	112	149	120	108	87	106	88

Table E2 Mount Owen – Geochemical abundance indices (GAI) of selected overburden/interburden/coal samples. Values 3 and over are highlighted in yellow, Part I (this project)

Element	Median Soil Abundance*	Lithology/Sample Number																					
		12041	12108	12112	12114	12118	12134	12136	12150	12159	12163	12166	12427	12428	12429	12430	12431	12432	12433	12434	12435	12438	12440
Ag	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Al	7.1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As	6	4	-	-	-	-	-	1	2	-	-	-	1	1	2	-	2	2	2	2	1	1	1
B	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba	500	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Be	0.3	2	2	2	2	1	2	2	3	2	2	2	2	1	2	2	2	1	2	1	2	2	1
Bi	0.2	-	-	1	-	-	-	1	-	-	-	-	1	2	1	1	1	2	1	1	1	1	1
Ca	1.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cd	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ce	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co	8	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cr	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cs	4	-	-	1	-	-	-	1	-	-	-	-	1	-	-	1	-	-	1	-	1	1	-
Cu	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe	4.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ga	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ge	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Hf	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hg	0.06	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	1	1	-	1
In	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	1.4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
La	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Li	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mg	0.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Mn	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Mo	1.2	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	2	1	1	-	-	-
Na	0.5%	1	1	-	1	1	1	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Nb	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ni	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rb	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Re	0																						

Element	Median Soil Abundance*	Lithology/Sample Number																					
		12041	12108	12112	12114	12118	12134	12136	12150	12159	12163	12166	12427	12428	12429	12430	12431	12432	12433	12434	12435	12438	12440
S	0.07%	-	-	-	-	-	-	1	-	-	-	-	-	3	4	2	4	6	3	3	2	-	-
Sb	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sc	7	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Se	0.4	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
Sn	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sr	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ta	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Te	0																						
Th	9	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	1	1	1	-
Ti	0.50%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tl	0.2	2	1	1	1	1	1	1	2	1	1	1	2	3	3	2	3	5	3	3	1	1	1
U	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	1	1	1	1	1	1	1
V	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Y	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zr	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table E2 Mount Owen – Geochemical abundance indices (GAI) of selected overburden/interburden/coal samples. Values 3 and over are highlighted in yellow, Part II (EGi, 2013)

Element	Median Soil Abundance*	Lithology/Sample Number																								
		3778	3831	3833	3850	3852	3859	5216	5221	3880	3886	5232	3900	3911	3954	3962	3978	4025	4057	4079	4080	4479	4480	4483	4547	5240
Ag	0.05	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Al	7.1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As	6	-	-	-	-	-	-	-	-	1	-	-	1	1	2	-	1	5	-	2	1	1	-	-	1	-
B	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba	500	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Be	0.3	2	2	2	2	2	2	2	1	2	1	2	2	2	2	2	2	1	2	2	2	2	2	1	2	1
Bi	0.2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-
Ca	1.5%	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cd	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ce	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co	8	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Cr	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cs	4	1	-	-	1	-	1	1	-	-	-	-	-	-	1	1	-	-	1	-	-	1	1	-	1	-

Cu	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	200	1	-	-	-	-	-	1	-	-	-	1	-	-	1	2	-	-	1	1	1	2	1	-	1	1
Fe	4.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Ga	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ge	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hf	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hg	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
In	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	1.4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
La	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Li	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mg	0.5%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mn	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mo	1.2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Na	0.5%	-	1	1	-	1	-	-	1	-	1	1	1	-	-	-	1	1	-	1	1	-	1	1	1	1
Nb	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ni	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rb	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Re	0																									
S	0.07%	-	-	-	-	-	-	-	-	1	-	-	-	-	3	-	2	3	-	3	4	1	-	-	-	-
Sb	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sc	7	-	1	-	1	-	1	1	-	-	-	-	-	1	1	1	-	-	1	-	1	1	1	-	1	-
Se	0.4	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1
Sn	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sr	250	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ta	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Te	0																									
Th	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ti	0.50%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tl	0.2	1	1	-	1	-	1	1	-	1	-	1	1	-	2	1	1	2	1	2	3	1	1	-	1	-
U	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W	1.5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Y	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zr	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table E3 Mount Owen – Single batch extracts water quality for selected overburden/interburden/coal samples, Part I.

Parameter		Limit of reporting	12136	12041	3954	4025	4080	3831	3833	3852	3886	4483	12108	12114	12118	12134	12159	12163	4480
			Carb Silststone	Sandstone	Sandstone	Sandstone	Siltstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone
			0.28 S%	0.35 S%	0.62 S%	0.86 S%	1.26 S%	0.005 S%	0.005 S%	0.005 S%	0.005 S%	0.005 S%	0.01 S%	0.01 S%	0.02 S%	0.01 S%	0.01 S%	0.08 S%	0.11 S%
			UC(PAF-LC)	PAF-LC	PAF-LC	PAF	PAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF
pH		0.1	6.9	6.0	5.5	7.2	4.9	8.5	8.6	8.5	8.2	8.5	9.8	9.8	9.7	8.8	8.9	9.1	8.2
EC	dS/m	0.001	0.846	1.276	0.99	0.69	1.96	0.24	0.29	0.41	0.33	0.28	0.581	0.544	0.436	0.329	0.496	0.529	0.25
Ag	mg/l	0.001	<0.001	<0.01*	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010
Al	mg/l	0.01	0.08	<0.10*	<0.01	<0.10	0.35	0.28	0.14	0.12	0.06	0.15	0.27	3.86	1.70	10.5	1.5	4.24	0.26
As	mg/l	0.001	<0.001	0.01*	<0.001	0.046	0.002	0.066	0.030	0.044	0.007	0.017	0.040	0.073	0.041	0.031	0.072	0.071	0.015
B	mg/l	0.05	0.07	<0.1*	0.11	<0.50	0.12	0.12	0.1	0.07	0.06	0.07	0.15	0.12	0.07	0.13	0.15	0.22	<0.50
Ba	mg/l	0.001	0.068	0.1*	0.08	1.4	0.103	0.05	0.066	0.104	0.105	0.233	0.341	0.157	0.236	0.233	1.06	0.192	<0.010
Be	mg/l	0.001	<0.001	<0.01*	<0.001	<0.010	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010
Ca	mg/l	1	23	24*	8	18	68	<1	1	2	2	2	5	<1	<1	<1	6	1	<1
Cd	mg/l	0.0001	0.0003	<0.005*	0.0002	<0.0010	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0010
Cl	mg/l	1	6	18	5	41	4	8	10	9	7	13	18	15	24	15	335	14	17
Co	mg/l	0.001	0.057	0.06*	0.069	0.127	0.293	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.007	<0.001	<0.010
Cr	mg/l	0.001	<0.001	<0.01*	<0.001	<0.010	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.002	0.007	<0.001	0.003	<0.010
Cu	mg/l	0.001	0.003	<0.01*	<0.001	<0.010	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.012	<0.001	<0.010
F	mg/l	0.1	0.1	0.1	0.1	0.3	0.3	0.9	0.7	0.8	0.6	0.6	1.0	0.7	0.5	0.6	0.9	1.5	0.6
Fe	mg/l	0.05	<0.05	9.3*	0.08	<0.50	5.85	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.58	0.20	1.44	3.28	0.56	<0.50
Hg	mg/l	0.0001	<0.0001	IS	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0010
K	mg/l	1	4	9*	6	4	3	2	3	3	3	4	3	4	3	4	4	3	3
Mg	mg/l	1	4	6*	9	9	24	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1
Mn	mg/l	0.001	0.07	0.82*	0.033	0.731	4.15	0.035	0.036	0.037	0.017	0.012	0.002	0.003	<0.001	0.005	0.139	0.009	<0.010
Mo	mg/l	0.001	<0.001	<0.01*	0.001	0.075	<0.001	0.033	0.032	0.029	0.046	0.008	0.023	0.033	0.037	0.026	0.012	0.041	0.016
Na	mg/l	1	145	173*	126	68	278	53	50	32	28	50	109	103	81	54	87	119	91
Ni	mg/l	0.001	0.06	0.03*	0.122	0.086	0.258	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	<0.001	<0.010
P	mg/l	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.001	<0.01*	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	<0.001	<0.010
Sb	mg/l	0.001	<0.001	0.01*	<0.001	0.017	<0.001	0.006	0.004	0.004	0.004	0.003	0.003	0.003	0.001	<0.001	0.002	0.006	<0.010
Se	mg/l	0.01	0.03	0.03*	0.04	<0.10	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.10
Si	mg/l	0.1	2.9	4.0	4	2	5	4	4	4	4	3	4.8	8.4	4.7	37.2	6.0	21.3	42
Sn	mg/l	0.001	<0.001	<0.01*	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010
SO4	mg/l	1	357	422	363	177	952	17	14	21	23	32	111	54	33	24	19	37	156
Sr	mg/l	0.001	2.39	2.5*	1.79	1.97	5.28	0.034	0.068	0.098	0.2	0.104	0.348	0.137	0.081	0.08	0.463	0.068	0.023
Th	mg/l	0.001	<0.001	IS	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010
Tl	mg/l	0.001	<0.001	<0.01*									<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
U	mg/l	0.001	<0.001	IS	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010
Zn	mg/l	0.005	0.082	0.16*	0.163	0.102	0.467	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	0.046	<0.005	<0.050

IS = Insufficient sample

< element at or below analytical detection limit.

- ICP-AES results used as insufficient sample for ICP-MS analysis

Table E3 Mount Owen – Single batch extracts water quality for selected overburden/interburden/coal samples, Part II.

Parameter		Limit of reporting	3880	4079	3850	4547	4057	12166	12150	3859	12112	4479	3978	3900
			Sandstone	Sandstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Carb Siltstone	Carb Siltstone	Carb Mudstone	Conglomerate	Conglomerate
			0.22 S%	0.96 S%	0.005 S%	0.005 S%	0.01 S%	0.06 S%	0.16 S%	0.02 S%	0.04 S%	0.17 S%	0.35 S%	0.005 S%
			NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF
pH		0.1	**8.0**	**7.8**	**8.7**	**8.4**	**8.9**	**9.7**	**8.2**	**8.6**	**8.5**	**8.4**	**7.8**	**8.1**
EC	dS/m	0.001	**0.45**	**0.33**	**0.48**	**0.17**	**0.42**	**0.677**	**0.539**	**0.65**	**0.416**	**0.34**	**0.68**	**0.43**
Ag	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.010	<0.010	<0.001	<0.001
Al	mg/l	0.01	<0.01	<0.01	**0.3**	**0.73**	**0.04**	**2.52**	**0.29**	**0.05**	**0.23**	**0.11**	**0.02**	**0.03**
As	mg/l	0.001	**0.004**	**0.002**	**0.020**	**0.106**	**0.021**	**0.034**	**0.023**	**0.017**	**0.007**	**0.010**	<0.001	**0.003**
B	mg/l	0.05	**0.06**	**0.1**	**0.08**	<0.50	<0.05	**0.17**	**0.12**	**0.06**	**0.12**	<0.50	<0.05	**0.06**
Ba	mg/l	0.001	**0.426**	**0.078**	**0.064**	<0.010	**0.001**	**0.105**	**0.06**	**0.25**	**0.043**	<0.010	**0.28**	**0.288**
Be	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001
Ca	mg/l	1	**24**	**107**	<1	<1	**1**	**1**	**8**	**4**	**2**	<1	**14**	**17**
Cd	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0010	<0.0001	<0.0001
Cl	mg/l	1	**10**	**7**	**6**	<10	**11**	**13**	**15**	**11**	**14**	**11**	**7**	**8**
Co	mg/l	0.001	<0.001	**0.005**	<0.001	<0.010	<0.001	<0.001	**0.006**	<0.001	<0.001	<0.010	**0.003**	<0.001
Cr	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	**0.002**	<0.001	<0.001	**0.001**	<0.010	<0.001	<0.001
Cu	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	**0.001**	<0.010	<0.001	<0.001
F	mg/l	0.1	**0.5**	**0.6**	**0.7**	**0.6**	**0.3**	**1.3**	**0.5**	**1**	**0.4**	**0.8**	**0.4**	**0.4**
Fe	mg/l	0.05	<0.05	<0.05	**0.05**	<0.50	<0.05	**0.37**	<0.05	<0.05	<0.05	<0.50	<0.05	<0.05
Hg	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0010	<0.0010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0010	<0.0001	<0.0001
K	mg/l	1	**11**	**13**	**3**	**2**	**4**	**3**	**4**	**4**	**5**	**3**	**4**	**7**
Mg	mg/l	1	**14**	**9**	<1	<1	<1	<1	**1**	**2**	<1	<1	**8**	**8**
Mn	mg/l	0.001	**0.367**	**0.468**	**0.03**	<0.010	<0.001	**0.006**	**0.02**	**0.093**	**0.009**	<0.010	**0.074**	**0.054**
Mo	mg/l	0.001	**0.009**	**0.005**	**0.046**	**0.026**	**0.005**	**0.036**	**0.044**	**0.031**	**0.017**	**0.013**	**0.006**	**0.004**
Na	mg/l	1	**39**	**289**	**39**	**113**	**82**	**117**	**139**	**30**	**126**	**72**	**16**	**30**
Ni	mg/l	0.001	<0.001	**0.006**	<0.001	<0.010	<0.001	<0.001	**0.008**	<0.001	<0.001	<0.010	**0.006**	<0.001
P	mg/l	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001
Sb	mg/l	0.001	<0.001	<0.001	**0.005**	**0.012**	<0.001	**0.003**	**0.002**	**0.001**	**0.003**	<0.010	<0.001	<0.001
Se	mg/l	0.01	<0.01	<0.01	**0.03**	**0.1**	<0.01	**0.01**	**0.02**	**0.02**	**0.03**	<0.10	<0.01	<0.01
Si	mg/l	0.1	**3**	**3**	**4**	**125**	**49**	**14.1**	**7.6**	**3**	**10.8**	**45**	**2**	**2**
Sn	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001
SO4	mg/l	1	**217**	**906**	**19**	**117**	**117**	**62**	**251**	**59**	**173**	**163**	**87**	**134**
Sr	mg/l	0.001	**1.49**	**4.19**	**0.053**	**0.027**	**0.018**	**0.074**	**0.734**	**0.172**	**0.359**	**0.022**	**0.55**	**1.42**
Th	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.010	<0.010	<0.001	<0.001
Tl	mg/l	0.001						<0.001	<0.001		<0.001			
U	mg/l	0.001	<0.001	<0.001	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001	<0.010	<0.010	<0.001	<0.001
Zn	mg/l	0.005	<0.005	**0.017**	<0.005	<0.050	<0.005	<0.005	**0.01**	<0.005	<0.005	<0.050	**0.011**	<0.005

< element at or below analytical detection limit.

Table E3 Mount Owen – Single batch extracts water quality for selected overburden/interburden/coal samples, Part III.

Parameter		Limit of reporting	3911	3962	3778	5221	5232	5240	5216
			Mudstone	Mudstone	Tuff	Weathered Zone	Weathered Zone	Weathered Zone	Weathered Zone
			0.03 S%	0.03 S%	0.005 S%	0.005 S%	0.005 S%	0.03 S%	0.04 S%
			NAF	NAF	NAF	NAF	NAF	NAF	NAF
pH		0.1	**8.7**	**8.2**	**7.9**	**8.5**	**8.3**	**8.7**	**7.2**
EC	dS/m	0.00	**0.50**	**0.45**	**0.35**	**0.23**	**0.25**	**0.32**	**0.28**
Ag	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
Al	mg/l	0.01	<0.10	**0.62**	<0.10	**0.06**	**0.29**	**0.08**	**0.02**
As	mg/l	0.001	<0.010	**0.006**	**0.084**	**0.002**	**0.002**	**0.002**	<0.001
B	mg/l	0.05	<0.50	**0.1**	**0.91**	**0.06**	**0.1**	**0.06**	<0.05
Ba	mg/l	0.001	**0.063**	**0.065**	**0.012**	**0.212**	**0.096**	**0.169**	<0.001
Be	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
Ca	mg/l	1	**3**	<1	**1**	**2**	<1	**1**	<1
Cd	mg/l	0.0001	<0.0010	<0.0001	<0.0010	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/l	1	**15**	**8**	**47**	**11**	**40**	**14**	**72**
Co	mg/l	0.001	<0.010	**0.001**	<0.010	<0.001	<0.001	<0.001	<0.001
Cr	mg/l	0.001	<0.010	**0.001**	<0.010	<0.001	**0.001**	<0.001	<0.001
Cu	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
F	mg/l	0.1	**0.7**	**0.8**	**1**	**0.5**	**1**	**1**	**0.8**
Fe	mg/l	0.05	<0.50	**0.09**	<0.50	<0.05	**0.09**	<0.05	<0.05
Hg	mg/l	0.0001	<0.0010	<0.0001	<0.0010	<0.0001	<0.0001	<0.0001	<0.0001
K	mg/l	1	**4**	**3**	**3**	<1	<1	<1	<1
Mg	mg/l	1	**3**	<1	**1**	<1	<1	<1	<1
Mn	mg/l	0.001	**0.024**	<0.001	**0.4**	<0.001	**0.004**	<0.001	<0.001
Mo	mg/l	0.001	**0.016**	**0.049**	**0.385**	**0.002**	**0.006**	**0.002**	<0.001
Na	mg/l	1	**97**	**43**	**119**	**34**	**38**	**42**	**9**
Ni	mg/l	0.001	<0.010	**0.002**	<0.010	<0.001	<0.001	<0.001	<0.001
P	mg/l	1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
Sb	mg/l	0.001	<0.010	**0.005**	**0.01**	<0.001	<0.001	<0.001	<0.001
Se	mg/l	0.01	<0.10	**0.03**	<0.10	<0.01	<0.01	<0.01	<0.01
Si	mg/l	0	**49**	**6**	**76**	**5**	**6**	**4**	**148**
Sn	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
SO4	mg/l	1	**140**	**43**	**69**	**4**	**9**	**2**	**181**
Sr	mg/l	0.001	**0.237**	**0.039**	**0.129**	**0.03**	**0.004**	**0.011**	<0.001
Th	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
Tl	mg/l	0.001							
U	mg/l	0.001	<0.010	<0.001	<0.010	<0.001	<0.001	<0.001	<0.001
Zn	mg/l	0.005	<0.050	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005

< element at or below analytical detection limit.

APPENDIX F

Geochemical Testwork Results for Washery Waste Samples

Table F1: Mount Owen – Total S results for CHPP discharged rejects for coal seams targeted by the Proposed Modification Project (EGi, 2013)

Date	Time	Seam	Seam Group	Raw Coal Total S (%)	Coarse Rejects Total S (%)	Fine Rejects Total S (%)
5/10/12	7:00am	Upper Hebden	Hebden	0.47	0.09	4.45
7/10/12	7:00am	Upper Liddell/Upper Hebden	Liddell/Hebden	0.58	1.04	3.13
8/10/12	7:00am	AUL/RAV F	Arties/Ravensworth	0.47	0.03	0.54
9/10/12	7:00am	AUL	Arties	0.58	0.04	
10/10/12	7:00am	AUL/RAV F	Arties/Ravensworth			2.45
11/10/12	7:00am	Upper Hebden	Hebden	0.46	0.23	4.57
23/10/12	7:00am	LLD/Rav H	Liddell/Ravensworth	0.37	0.04	1.39
27/10/12	7:00am	LLD/Rav F	Liddell/Ravensworth	0.59	0.25	1.77
28/10/12	7:00am	LLD	Liddell	0.60	1.04	0.93
29/10/12	7:00am	ULD	Liddell	0.74	1.06	0.95
30/10/12	7:00am	LLD/Rav F	Liddell/Ravensworth	0.43	0.03	1.13
11/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	0.47	0.05	0.65
12/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	0.42	0.04	3.27
13/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	0.46		2.27
14/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	0.73	0.23	1.49
19/11/12	7:00am	ULD	Liddell	0.70		1.35
20/11/12	7:00am	Barrett/Rav F	Barrett/Ravensworth	0.52	0.06	1.58
21/11/12	7:00am	ULD/Upper Hebden	Liddell/Hebden	0.70	0.24	4.26
22/11/12	7:00am	Lem A	Lemington	0.51	0.23	0.23
23/11/12	0.50	Lem A, Arties	Lemington	0.46	0.05	0.41
24/11/12	7:00am	Lem A	Lemington	0.53	0.31	1.04
25/11/12	7:00am	Lem A	Lemington	0.38	0.84	1.20
26/11/12	7:00am	LLD	Liddell	0.49	0.05	1.11
30/11/12	7:00am	Lower Hebden	Hebden	0.48	0.24	
1/12/12	7:00am	Lower Hebden	Hebden		0.39	
3/12/12	0.58	AUL	Arties		0.66	0.87
4/12/12	7:00am	Lem A	Lemington	0.58	0.64	4.57
6/12/12	7:00am	Lower Hebden	Hebden	0.75	0.07	
7/12/12	7:00am	MLD-B	Liddell	0.56	0.16	
8/12/12	7:00am	AUL	Arties	0.37	0.21	
9/12/12	7:00am	MLD-B	Liddell	0.51	0.23	
10/12/12	7:00am	MLA	Liddell	0.54	0.17	
12/12/12	7:00am	Lem A	Lemington	0.69	0.47	1.13
14/12/12	7:00am	MLA/Upper Hebden	Liddell/Hebden	0.65	0.21	1.57
17/12/12	7:00am	AUL/Barrett	Arties/Barrett	0.63	0.21	0.62
18/12/12	7:00am	ULD	Liddell	0.66	0.52	0.87
19/12/12	7:00am	ULD	Liddell	0.66	0.62	0.84
20/12/12	7:00am	LLD	Liddell	0.44	0.06	0.55
21/12/12	7:00am	LLD	Liddell	0.56	0.20	0.55
23/12/12	7:00am	Barrett/LLD	Barrett/Liddell	0.33	0.23	0.73
28/12/12	7:00am	AUL	Arties	0.39	0.21	0.84
29/12/12	7:00am	AUL	Arties	0.49	0.12	0.62
30/12/12	7:00am	Pikes Gully	Pikes Gully	0.74	0.20	0.65
4/1/13	7:00am	AUL	Arties	0.38	0.08	0.52
5/1/13	7:00am	Upper Hebden	Hebden	0.58	0.35	1.04
6/1/13	7:00am	Upper Hebden	Hebden	0.53	0.45	1.89
7/1/13	12:30pm	ULA	Liddell	0.72	0.78	0.68

Date	Time	Seam	Seam Group	Raw Coal Total S (%)	Coarse Rejects Total S (%)	Fine Rejects Total S (%)
9/1/12	7:00am	AUL	Arties	0.46	0.52	
14/1/13	7:00am	Barrett	Barrett	0.53	0.42	0.52
17/1/13	7:00am	Barrett	Barrett	0.41	0.34	0.63
18/1/13	7:00am	Barrett	Barrett	0.53	0.36	0.66
19/1/13	7:00am	Upper Hebden	Hebden	0.57	0.68	0.80
20/1/13	12:30pm	MLA	Liddell	0.55	0.55	0.89
21/1/13	7:00am	MLA	Liddell	0.57	0.39	0.26
22/1/13	12:00md	Pikes Gully	Pikes Gully	0.52	0.16	0.26
23/1/13	7:00am	Barrett	Barrett	0.49	0.29	0.84
25/1/13	7:00am	Lower Hebden	Hebden	0.52	0.20	0.42
27/1/13	7:00am	Barrett	Barrett	0.64	0.23	0.42
1/2/13	12:00pm	Arties 3	Arties	0.42	0.04	0.13
2/2/13	7:00am	Arties 3	Arties	0.38	0.03	0.23
6/2/13	7:00am	MLA/MLB	Liddell	0.65	0.25	1.49
11/2/13	7:00am	Barrett	Barrett	0.62	0.36	0.68
12/2/13	7:00am	MLT	Liddell	0.63	0.15	0.34
19/2/12	7:00am	AUL	Arties		0.13	1.27
25/2/13	7:00am	AUL/Arties 3	Arties	0.80	0.57	1.26
26/2/13	7:00am	Arties 3	Arties	0.35	0.21	1.15
27/2/13	7:00am	MLA	Liddell	0.54	0.88	0.69
28/2/13	7:00am	ULD	Liddell	0.71	0.72	0.72
1/3/13	7:00am	AUL/Arties 3	Arties	0.56	0.03	0.78
4/3/13	7:00am	MLA	Liddell	0.63	1.07	0.58
5/3/13	7:00am	MLA/UHB	Liddell/Hebden	0.52	0.32	0.93
6/3/13	7:00am	MLT	Liddell	0.60	0.06	0.65
10/3/13	7:00am	AUL	Arties	0.39	0.05	0.30
11/3/13	7:00am	UHB/MLA	Hebden/Liddell	0.48	0.59	0.79
13/3/13	7:00am	AUL	Arties	0.45	0.14	0.54
14/3/13	7:00am	AUL	Arties	0.43	0.18	0.55
15/3/13	7:00am	LLD/AUL	Liddell/Arties	0.46	0.04	0.39
16/3/13	7:00am	LLD/AUL	Liddell/Arties	0.43	0.11	0.38
18/3/13	7:00am	PKG/BAYS	Pikes Gully/Bayswater		0.18	0.32
19/3/13	7:00am	ULD/MLB	Liddell	0.48	0.09	0.36
20/3/13	7:00am	MLB	Liddell	0.38	0.10	0.27

Table F2: Mount Owen – Acid Forming Characteristics for selected CCHP discharge rejects samples (EGi, 2013)

Date	Time	Seam	Seam Group	Material Type	Raw Coal Total S (%)	EGi Sample No	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG	ARD Classification
			Seam Name	Ply Code					Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$			
27/10/12	7:00am	LLD/Rav F	Liddell/Ravensworth	Coarse Rejects	0.59	6125			0.25	8	24	-16	3.13	7.6	0	0			NAF
28/10/12	7:00am	LLD	Liddell	Coarse Rejects	0.60	6126			1.07	33	13	20	0.39	3.7	1	14	4.2	10	PAF
11/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	Coarse Rejects	0.47	6129			0.05	2	33	-32	21.78	7.6	0	0			NAF
12/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	Coarse Rejects	0.42	6130			0.04	1	35	-34	28.65	7.7	0	0			NAF
12/12/12	7:00am	Lem A	Lemington	Coarse Rejects	0.69	6131	9.1	0.33	0.47	14	39	-25	2.72	7.8	0	0			NAF
21/12/12	7:00am	LLD	Liddell	Coarse Rejects	0.56	6132	8.4	0.35	0.20	6	22	-16	3.58	7.5	0	0			NAF
29/12/12	7:00am	AUL	Arties	Coarse Rejects	0.49	6133			0.12	4	42	-38	11.38	7.6	0	0			NAF
30/12/12	7:00am	Pikes Gully	Pikes Gully	Coarse Rejects	0.74	6134	8.6	0.28	0.20	6	27	-21	4.43	7.8	0	0			NAF
5/1/13	7:00am	Upper Hebden	Hebden	Coarse Rejects	0.58	6135	8.5	0.28	0.35	11	31	-20	2.86	7.3	0	0			NAF
18/1/13	7:00am	Barrett	Barrett	Coarse Rejects	0.53	6137	8.9	0.29	0.36	11	30	-19	2.70	7.9	0	0			NAF
22/1/13	12:00md	Pikes Gully	Pikes Gully	Coarse Rejects	0.52	6138	8.8	0.35	0.16	5	27	-22	5.53	7.8	0	0			NAF
25/1/13	7:00am	Lower Hebden	Hebden	Coarse Rejects	0.52	6139	8.7	0.30	0.20	6	30	-24	4.93	7.6	0	0			NAF
6/2/13	7:00am	MLA/MLB	Liddell	Coarse Rejects	0.65	6141	7.8	0.37	0.25	8	31	-23	4.01	7.3	0	0			NAF
11/2/13	7:00am	Barrett	Barrett	Coarse Rejects	0.62	6142	8.2	0.29	0.36	11	25	-14	2.29	7.5	0	0			NAF
25/2/13	7:00am	AUL/Arties 3	Arties	Coarse Rejects	0.80	6143	8.4	0.38	0.78	24	32	-8	1.32	7.6	0	0			NAF
26/2/13	7:00am	Arties 3	Arties	Coarse Rejects	0.35	6144	8.7	0.40	0.21	6	22	-15	3.35	7.8	0	0			NAF
4/3/13	7:00am	MLA	Liddell	Coarse Rejects	0.63	6145	9.0	0.45	0.93	28	31	-3	1.09	4.1	0.1	4	5.2	2	PAF-LC
10/3/13	7:00am	AUL	Arties	Coarse Rejects	0.39	6147	8.8	0.41	0.05	2	38	-37	25.13	7.7	0	0			NAF
27/10/12	7:00am	LLD/Rav F	Liddell/Ravensworth	Fine Rejects	0.59	6148			3.21	98	48	50	0.49	3.5	2	9	4.0	5	PAF-LC
28/10/12	7:00am	LLD	Liddell	Fine Rejects	0.60	6149			0.93	28	48	-19	1.67	7.3	0	0			NAF
11/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	Fine Rejects	0.47	6152			0.65	20	84	-64	4.21	7.7	0	0			NAF
12/11/12	7:00am	AUL/RAV F	Arties/Ravensworth	Fine Rejects	0.42	6153			4.21	129	140	-11	1.09	7.4	0	0			NAF
12/12/12	7:00am	Lem A	Lemington	Fine Rejects	0.69	6154			1.13	35	44	-10	1.28	7.6	0	0			NAF
21/12/12	7:00am	LLD	Liddell	Fine Rejects	0.56	6155			0.50	15	29	-13	1.88	7.5	0	0			NAF
29/12/12	7:00am	AUL	Arties	Fine Rejects	0.49	6156	8.2	0.35	0.62	19	117	-98	6.17	7.9	0	0			NAF
30/12/12	7:00am	Pikes Gully	Pikes Gully	Fine Rejects	0.74	6157	7.8	0.32	0.65	20	61	-41	3.06	7.9	0	0			NAF
5/1/13	7:00am	Upper Hebden	Hebden	Fine Rejects	0.58	6158	8.8	0.32	1.45	44	49	-4	1.10	3.8	1	8	4.1	2	PAF-LC
18/1/13	7:00am	Barrett	Barrett	Fine Rejects	0.53	6160	7.8	0.30	0.57	17	19	-2	1.11	7.6	0	0			NAF
22/1/13	12:00md	Pikes Gully	Pikes Gully	Fine Rejects	0.52	6161	7.9	0.29	0.26	8	18	-10	2.29	7.5	0	0			NAF
25/1/13	7:00am	Lower Hebden	Hebden	Fine Rejects	0.52	6162	8.4	0.41	0.42	13	47	-34	3.63	7.7	0	0			NAF
6/2/13	7:00am	MLA/MLB	Liddell	Fine Rejects	0.65	6164	8.5	0.43	1.61	49	51	-2	1.04	6.0	0	1			PAF
11/2/13	7:00am	Barrett	Barrett	Fine Rejects	0.62	6165	8.6	0.35	0.68	21	47	-26	2.27	7.1	0	0			NAF
25/2/13	7:00am	AUL/Arties 3	Arties	Fine Rejects	0.80	6166	8.7	0.48	1.26	39	51	-12	1.32	7.1	0	0			NAF
26/2/13	7:00am	Arties 3	Arties	Fine Rejects	0.35	6568	8.9	0.23	1.04	32	49	-17	1.54	7.2	0	0			NAF

Date	Time	Seam	Seam Group	Material Type	Raw Coal Total S (%)	EGi Sample No	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG	ARD Classification
			Seam Name	Ply Code					Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$			
4/3/13	7:00am	MLA	Liddell	Fine Rejects	0.63	6569	9.0	0.32	0.58	18	22	-4	1.22	7.3	0	0			NAF
10/3/13	7:00am	AUL	Arties	Fine Rejects	0.39	6571	9.4	0.21	0.30	9	78	-69	8.55	7.5	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 (kgH_2SO_4/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)

Extended Boil NAGpH = pH of NAG liquor after extended heating

Calculated NAG = The net acid potential based on assay of anions and cations released to the NAG solution (kgH_2SO_4/t)

NAF = Non-Acid Forming

PAF = Potentially Acid Forming

PAF-LC = PAF Low Capacity

UC = Uncertain Classification

(expected classification in brackets)

Standard NAG results overestimate acid potential due to organic acid effects

Table F3: Mount Owen – Organic carbon NAG (NAGorg) test results for selected rejects samples (EGi, 2013)

EGi Code	Sample No	Sample Description	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG
			Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$		
6126	6126	Coarse Rejects	1.07	33	13	20	0.39	3.7	1	14	4.2	10
6145	6145	Coarse Rejects	0.93	28	31	-3	1.09	4.1	0	4	5.2	2
6148	6148	Fine Rejects	3.21	98	48	50	0.49	3.5	2	9	4.0	5
6158	6158	Fine Rejects	1.45	44	49	-4	1.10	3.8	0.7	8	4.1	2

Table F4: Mount Owen – Acid buffering characteristics testwork results for selected rejects samples (EGi, 2013)

EGi Sample Number	Project	Material type	TS wt%	ANC (Sobeck)	Effective ANC (to pH4)	ANC(Sobeck)	Likely buffering carbonate
				kg H_2SO_4/ t		Available %	
6126	Approved Operations	Coarse Rejects	1.07	13	10	75	Dolmite/Ferroan Dolomite
6160	Approved Operations	Fine Rejects	0.57	19	23	119	Calcite/Dolomite
6155	Approved Operations	Fine Rejects	0.5	29	29	100	Dolomite
6145	Approved Operations	Coarse Rejects	0.93	31	20	65	Dolmite/Ferroan Dolomite
6143	Approved Operations	Coarse Rejects	0.78	32	29	92	Dolomite
6568	Approved Operations	Fine Rejects	1.04	49	52	106	Calcite/Dolomite
6131	Approved Operations	Coarse Rejects	0.47	39	26	66	Ferroan Dolomite
6148	Approved Operations	Fine Rejects	3.21	48	49	101	Calcite
6158	Approved Operations	Fine Rejects	1.45	49	30	62	Dolmite/Ferroan Dolomite
6164	Approved Operations	Fine Rejects	1.61	51	31	61	Dolomite
6150	Approved Operations	Fine Rejects	n/a	88	93	106	Calcite
6153	Approved Operations	Fine Rejects	4.21	140	99	71	Calcite/Dolomite

Table F5: Mount Owen – Sulphur speciation testwork results for selected rejects samples (EGi, 2013)

EGi Sample Number	Material Type	Seam Group	Total %S	Pyritic S (%)	Acid Sulphate %S	Total Acid Generating S (%)	Non-Acid Sulphate %S	Other S Forms (%)	Proportion Total Acid Generating to Total S
6126	Coarse Rejects	Liddell	1.07	0.70	0.00	0.70	0.06	0.31	65%
6143	Coarse Rejects	Arties	0.78	0.60	0.00	0.60	0.05	0.13	77%
6145	Coarse Rejects	Liddell	0.93	0.66	0.00	0.66	0.03	0.24	71%
6148	Fine Rejects	Liddell/Ravensworth	3.21	1.77	0.00	1.77	0.42	1.02	55%
6150	Fine Rejects	Lemington	2.72	2.03	0.00	2.03	0.12	0.57	75%
6153	Fine Rejects	Arties/Ravensworth	4.21	2.82	0.00	2.82	0.23	1.16	67%
6155	Fine Rejects	Liddell	0.50	0.27	0.00	0.27	0.04	0.19	54%
6158	Fine Rejects	Hebden	1.45	1.03	0.00	1.03	0.04	0.38	71%
6160	Fine Rejects	Barrett	0.57	0.41	0.00	0.41	0.04	0.12	72%
6164	Fine Rejects	Liddell	1.61	1.34	0.00	1.34	0.08	0.19	83%
6568	Fine Rejects	Arties	1.04	0.85	0.00	0.85	0.04	0.15	82%

APPENDIX G

ABCC and Kinetic NAG Plots

Rejects Materials

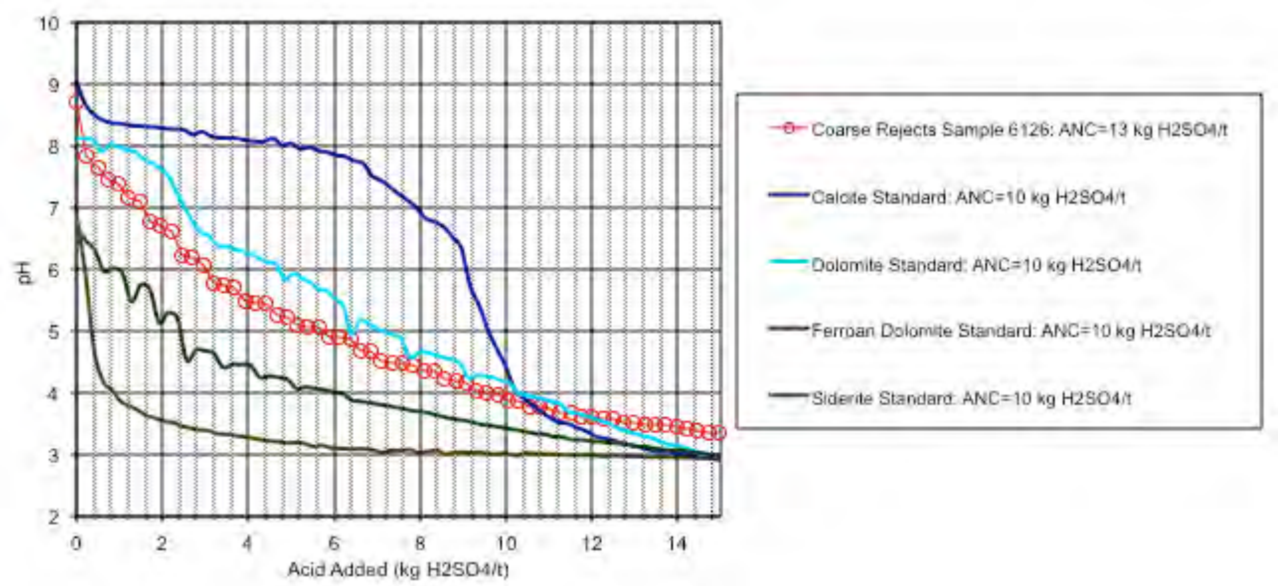

Figure G1: ABCC profile for rejects sample 6126 with an ANC value close to 10 kg H_2SO_4 /t. Carbonate standard curves are included for reference– Approved Operations

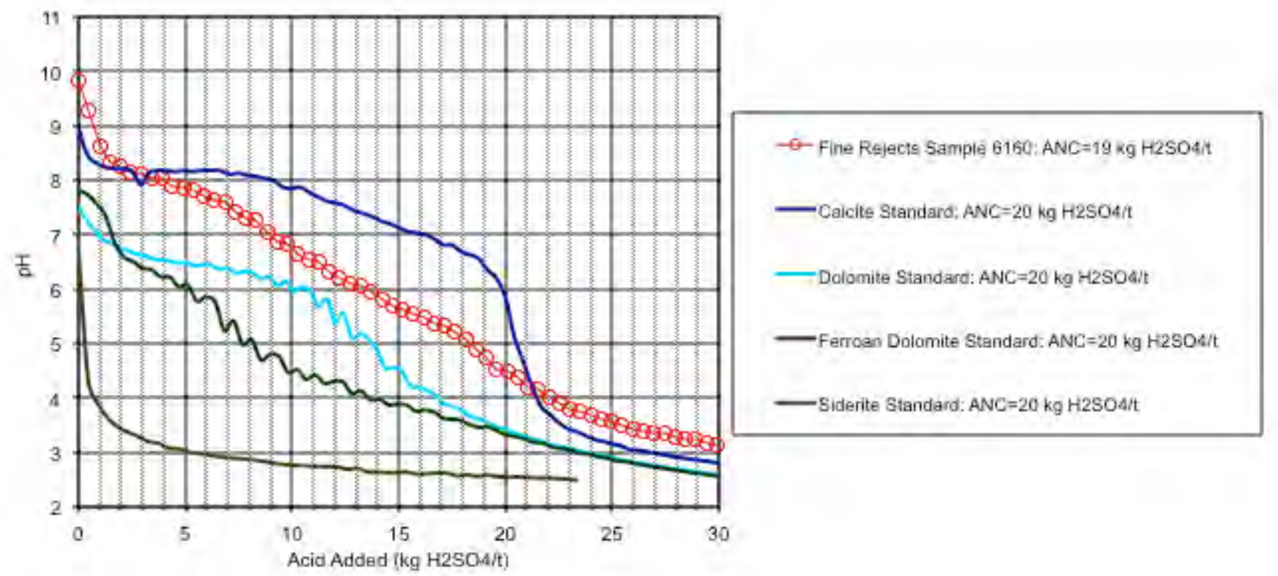

Figure G2: ABCC profile for rejects sample 6160 with an ANC value close to 20 kg H_2SO_4 /t. Carbonate standard curves are included for reference.

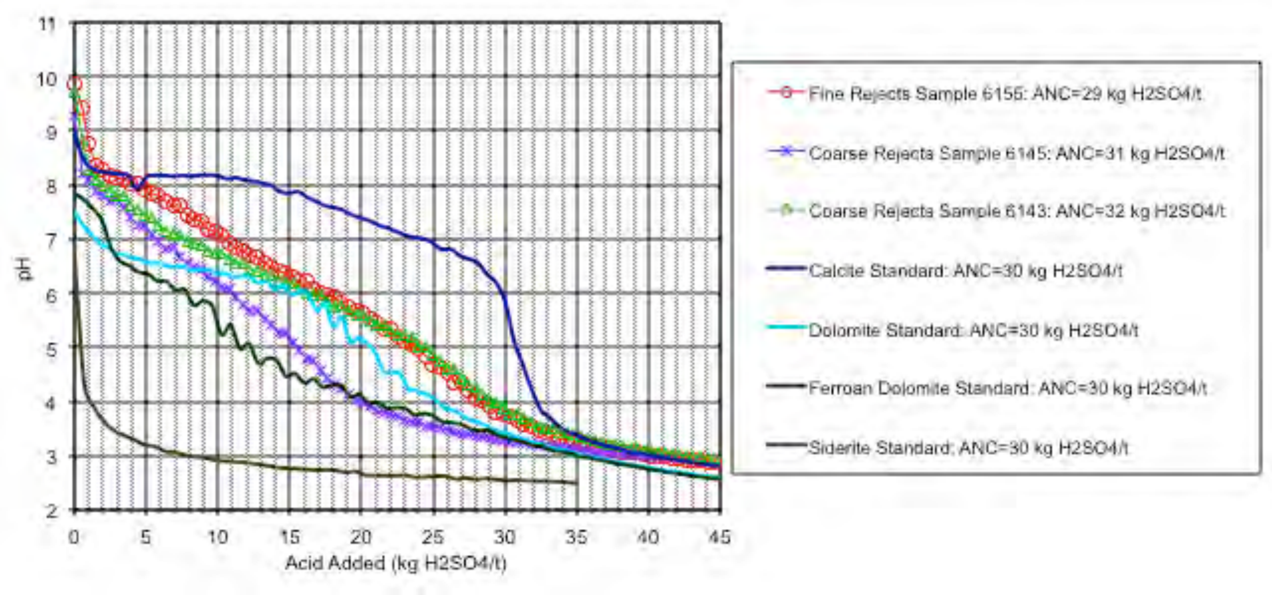

Figure G3: ABCC profile for rejects samples with an ANC value close to 30 kg H2SO4/t. Carbonate standard curves are included for reference.

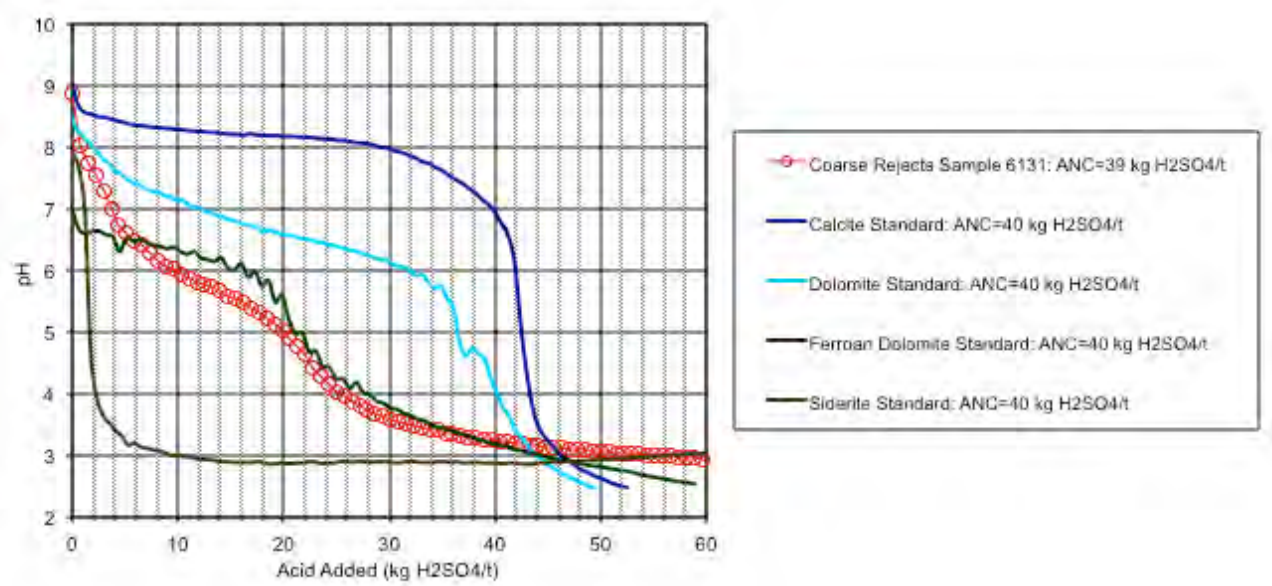

Figure G4: ABCC profile for rejects sample 6131 with an ANC value close to 40 kg H_2SO_4 /t. Carbonate standard curves are included for reference.

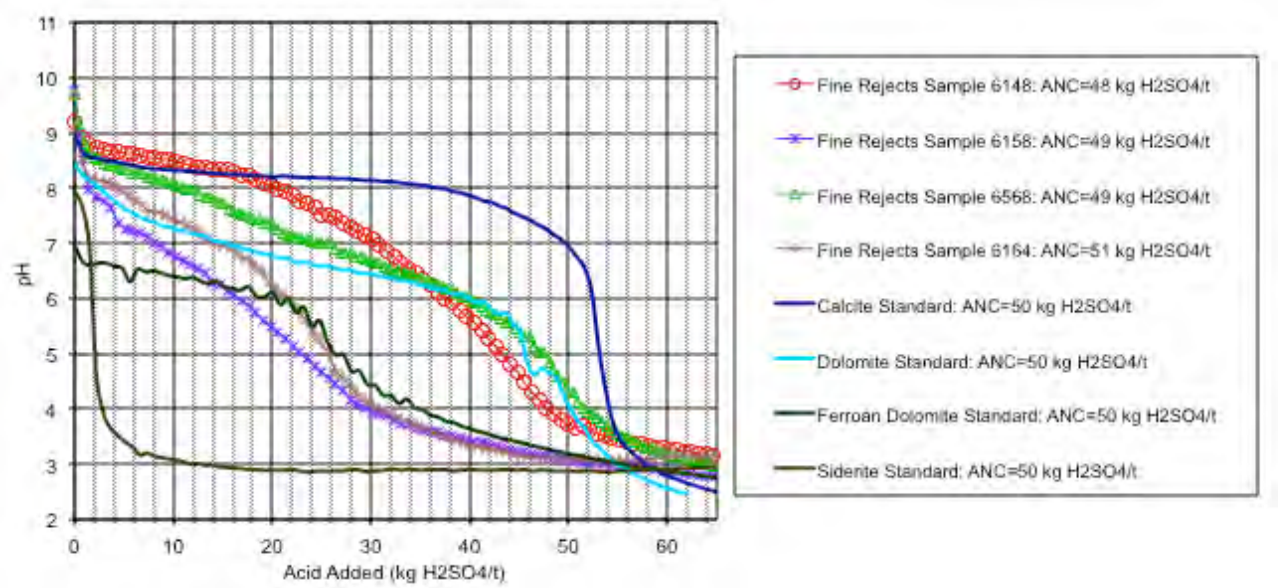

Figure G5: ABCC profile for rejects samples with an ANC value close to 50 kg H_2SO_4 /t. Carbonate standard curves are included for reference.

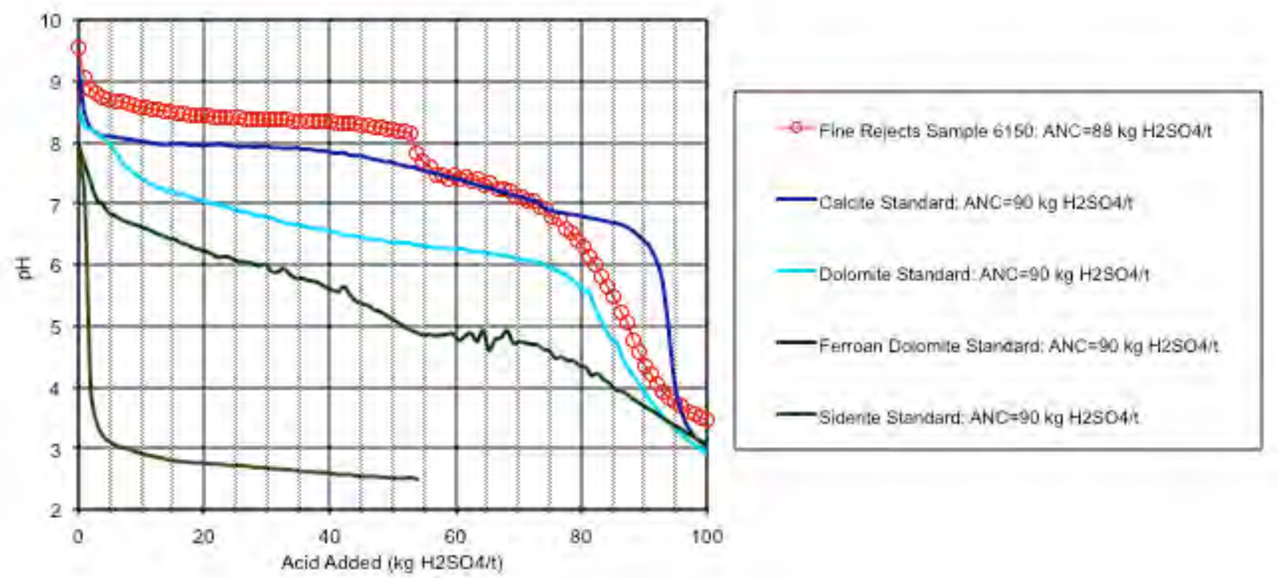

Figure G6: ABCC profile for rejects sample 6150 with an ANC value close to 90 kg H2SO4/t. Carbonate standard curves are included for reference.

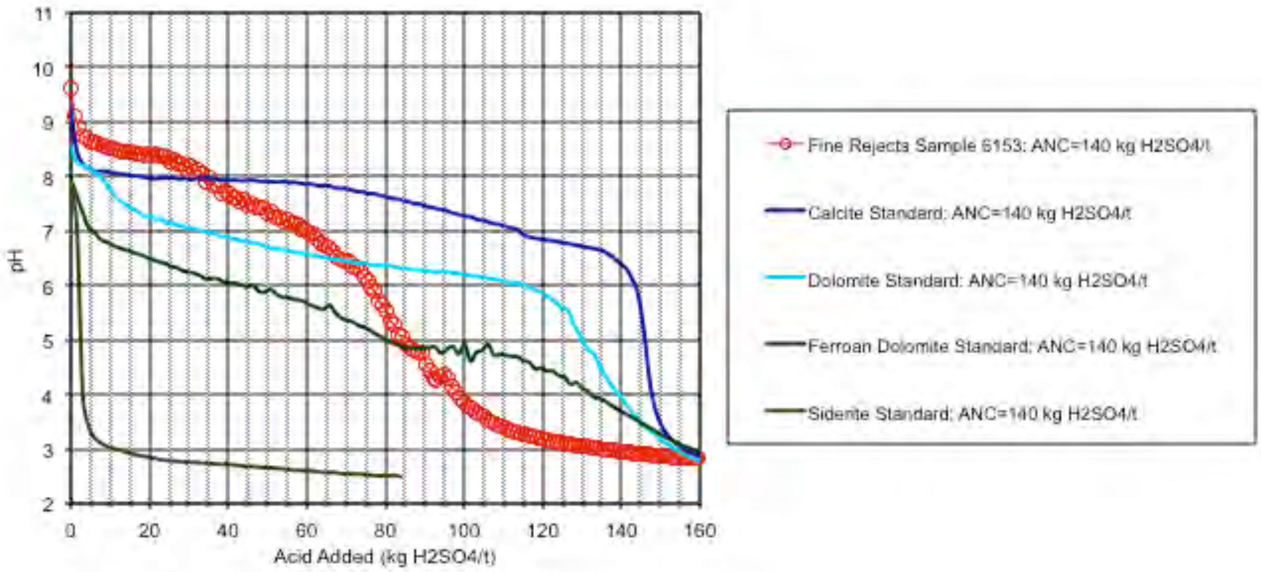

Figure G7: ABCC profile for rejects sample 6153 with an ANC value close to 140 kg H2SO4/t. Carbonate standard curves are included for reference.

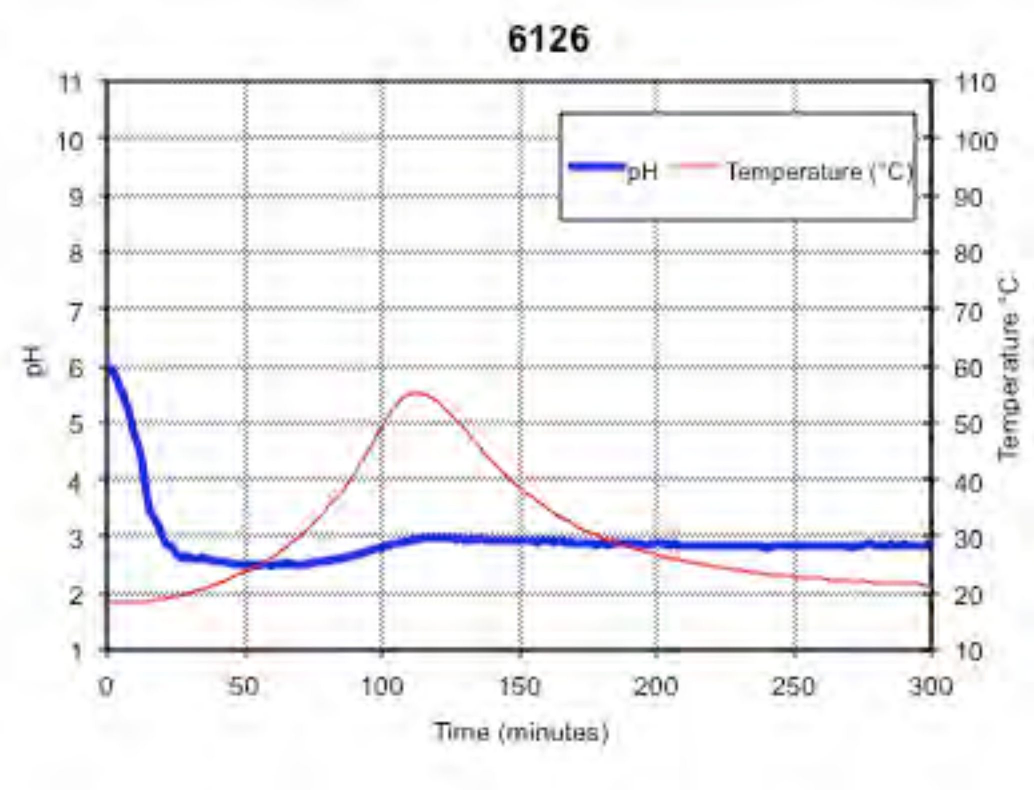

Figure G8: Kinetic NAG graph for coarse rejects sample 6126.

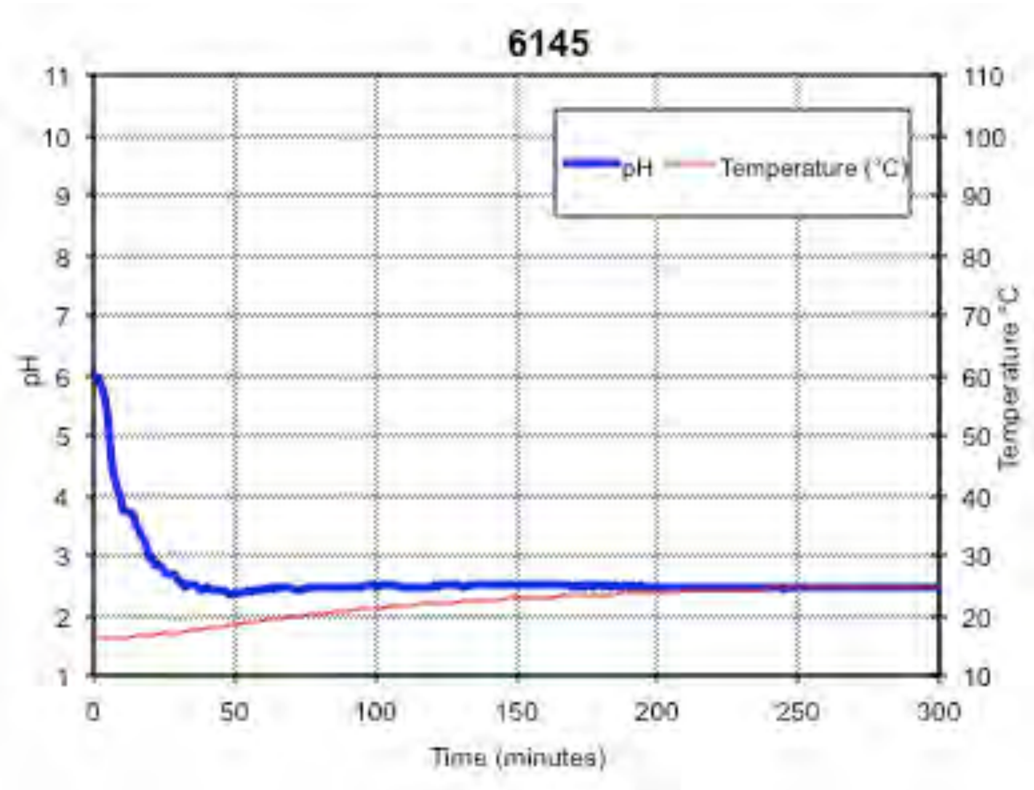

Figure G9: Kinetic NAG graph for coarse rejects sample 6145.

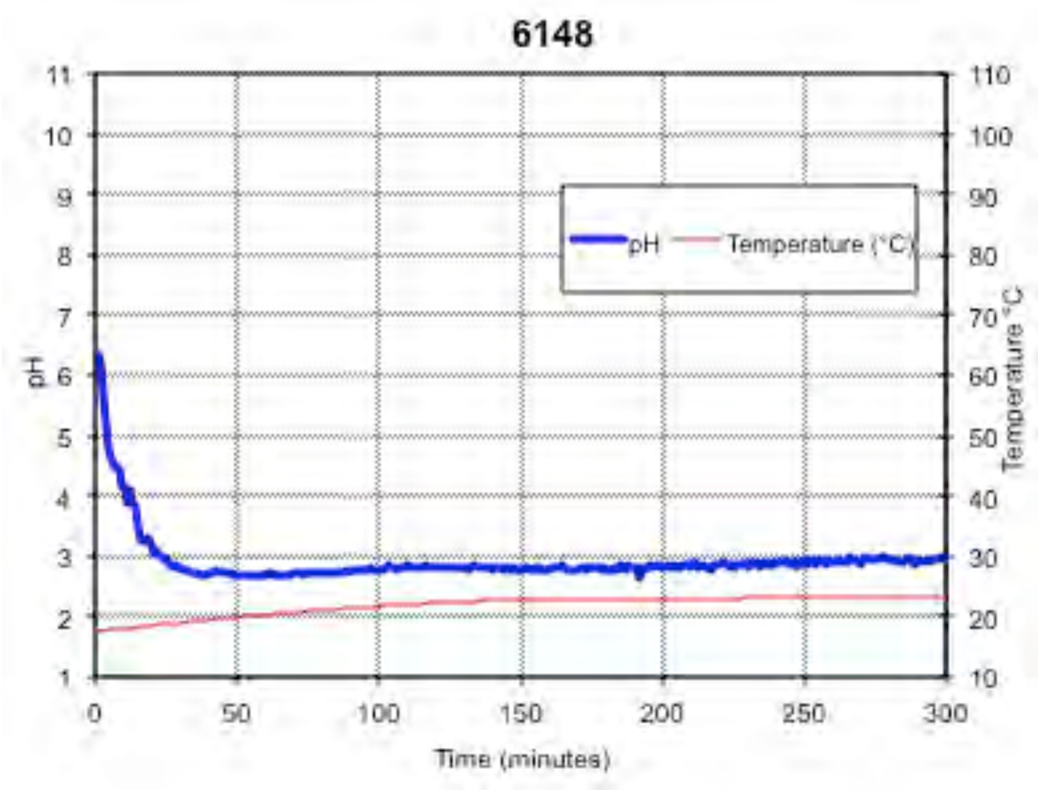

Figure G10: Kinetic NAG graph for fine rejects sample 6148.

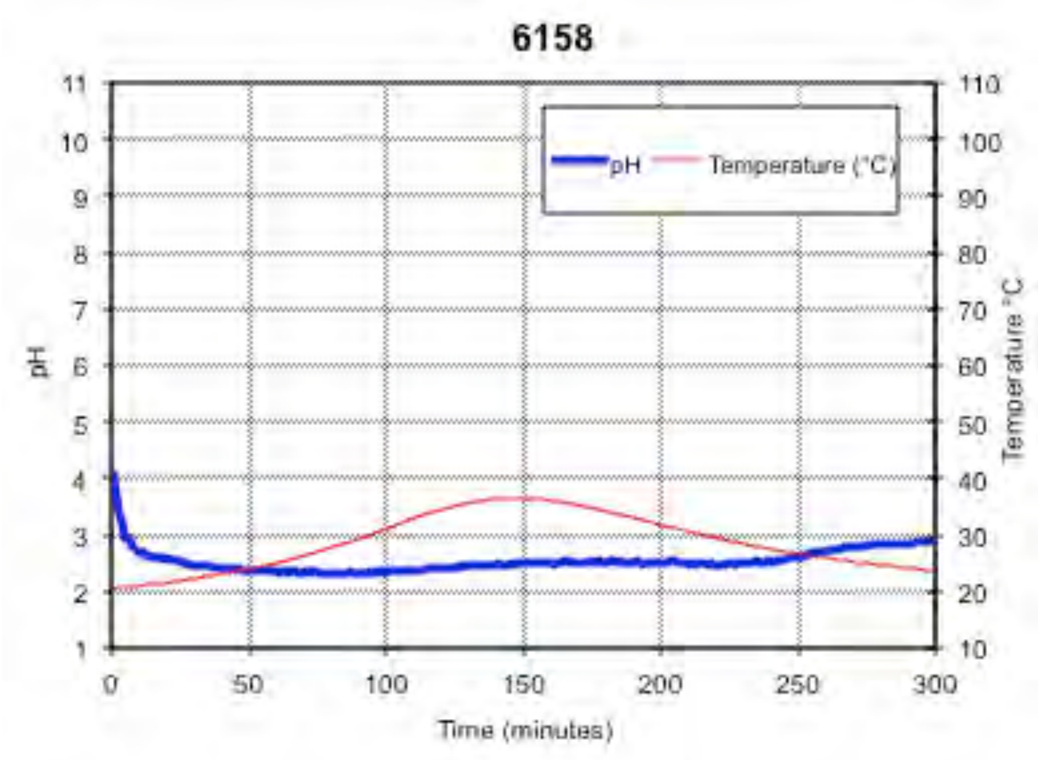

Figure G11: Kinetic NAG graph for fine rejects sample 6158.

APPENDIX H

Multi-element Composition, GAI Values, and Extracts Water Quality for Rejects Materials

Table H1: Mount Owen – Multi-element composition for selected rejects samples (EGi, 2013)

Element	Detection Limit	Rejects Type/Seam Group/Sample Number											
		Coarse Rejects						Fine Rejects					
		Hebden	Lemington	Bayswater	Liddell	Arties	Liddell	Hebden	Lemington	Bayswater	Liddell	Arties	Liddell
		6135	6136	6140	6141	6144	6145	6158	6159	6163	6164	6568	6569
Ag	0.01	0.10	0.10	0.11	0.11	0.11	0.11	0.05	0.06	0.08	0.06	0.09	0.08
Al	0.01%	6.54%	5.14%	6.55%	6.98%	7.15%	5.71%	4.82%	3.72%	4.40%	4.49%	5.03%	4.95%
As	0.2	13.13	16.49	6.81	15.52	7.77	40.70	9.52	9.91	4.86	15.94	9.10	11.38
B	10	20	31	22	22	18	21	16	31	20	10	16	21
Ba	10	7526	241	265	461	257	251	296	430	357	542	311	572
Be	0.05	1.34	1.26	1.93	1.37	1.34	1.34	1.11	1.22	1.43	0.99	1.11	1.36
Bi	0.01	0.40	0.37	0.48	0.44	0.43	0.44	0.29	0.29	0.40	0.29	0.35	0.41
Ca	0.01%	0.64%	0.64%	0.86%	0.62%	0.54%	0.37%	1.64%	1.81%	1.89%	1.15%	1.55%	0.77%
Cd	0.02	0.19	0.17	0.20	0.20	0.12	0.21	0.12	0.10	0.15	0.12	0.10	0.11
Ce	0.01	23.2	27.1	50.4	36.2	52.4	24.5	22.8	19.7	26.9	22.7	28.7	33.7
Co	0.1	8.4	10.9	5.5	10.3	6.6	10.2	6.6	10.2	5.3	8.3	7.7	7.7
Cr	1	32	33	27	36	39	27	28	19	29	29	33	40
Cs	0.05	6.91	4.17	5.96	7.26	7.85	6.47	4.10	2.83	2.61	4.07	5.87	7.57
Cu	0.2	41.2	52.5	58.7	61.4	47.0	65.1	29.2	31.1	27.3	24.4	34.5	36.0
F	20	430	470	440	525	435	460	315	280	470	300	260	225
Fe	0.01%	2.25%	1.50%	1.88%	2.58%	1.88%	2.99%	2.81%	1.58%	1.69%	4.99%	2.15%	1.63%
Ga	0.05	21.2	21.5	23.6	23.4	21.0	20.7	14.7	13.3	18.7	12.6	15.1	16.1
Ge	0.05	0.08	0.20	0.14	0.14	0.10	0.19	0.08	0.22	0.27	0.08	0.14	0.18
Hf	0.01	3.4	4.3	6.1	3.6	4.2	3.2	2.5	2.9	5.1	2.3	2.4	2.7
Hg	0.005	0.07	0.08	0.06	0.10	0.05	0.35	0.06	0.04	0.08	0.16	0.06	0.05
In	0.005	0.08	0.08	0.10	0.08	0.08	0.08	0.05	0.05	0.07	0.05	0.06	0.06
K	0.01%	1.60%	1.13%	1.31%	1.53%	1.36%	1.37%	0.98%	0.66%	0.79%	0.83%	0.97%	1.23%
La	0.5	9.3	11.0	21.9	14.6	23.4	9.3	9.5	8.0	10.6	9.4	12.3	14.6
Li	0.2	28.6	40.5	32.2	38.4	33.5	36.5	23.4	23.4	23.5	19.6	21.7	25.9
Mg	0.01%	0.50%	0.40%	0.45%	0.53%	0.50%	0.40%	0.42%	0.30%	0.39%	0.45%	0.41%	0.46%
Mn	5	253	129	268	416	192	408	261	135	219	684	198	153
Mo	0.05	2.33	2.45	1.91	2.75	2.67	3.35	2.05	2.38	2.08	2.87	2.79	2.61
Na	0.01%	0.60%	0.63%	0.61%	0.43%	0.38%	0.40%	0.33%	0.29%	0.38%	0.22%	0.17%	0.35%
Nb	0.1	7.0	8.2	11.9	6.9	6.8	6.0	4.5	4.8	7.8	3.8	4.8	5.0
Ni	0.2	16.6	25.8	12.9	20.6	20.6	17.5	14.8	15.2	14.9	38.1	19.3	24.0
P	10	460	434	341	841	560	574	343	205	305	431	380	450
Pb	0.5	18.9	20.3	21.0	21.9	18.3	23.3	13.4	12.9	15.8	12.4	11.2	13.7

Element	Detection Limit	Rejects Type/Seam Group/Sample Number											
		Coarse Rejects						Fine Rejects					
		Hebden	Lemington	Bayswater	Liddell	Arties	Liddell	Hebden	Lemington	Bayswater	Liddell	Arties	Liddell
		6135	6136	6140	6141	6144	6145	6158	6159	6163	6164	6568	6569
Rb	0.1	46.4	36.8	61.2	65.3	73.3	53.6	27.6	13.3	14.3	27.1	35.3	61.4
Re	0.002	0.007	0.004	0.004	0.006	0.004	0.005	0.002	0.004	0.005	0.003	0.004	0.005
S	0.01%	0.35%	0.21%	0.07%	0.25%	0.21%	0.93%	1.45%	0.40%	0.10%	1.61%	1.04%	0.58%
Sb	0.05	0.97	0.72	0.81	1.00	0.58	1.20	1.18	0.92	0.76	0.96	0.83	1.03
Sc	0.1	11.5	8.1	12.1	11.9	12.4	8.8	8.7	7.1	7.5	8.2	10.7	10.5
Se	1	1.7	1.6	1.5	1.6	1.6	1.6	1.2	1.0	1.3	1.1	1.2	1.2
Sn	0.2	2.6	3.3	4.6	3.3	3.5	2.9	1.7	1.9	3.6	1.5	2.1	2.3
Sr	0.2	840	231	247	293	169	215	271	290	529	260	242	232
Ta	0.05	0.56	0.72	1.00	0.60	0.72	0.60	0.38	0.38	0.77	0.33	0.40	0.46
Te	0.05	0.10	0.08	0.11	0.11	0.12	0.17	0.08	0.09	0.06	0.07	0.07	0.09
Th	0.2	4.9	5.2	9.5	7.4	10.0	5.3	4.4	3.4	5.0	4.4	5.5	6.4
Ti	0.005%	0.47%	0.51%	0.39%	0.51%	0.40%	0.40%	0.31%	0.26%	0.27%	0.25%	0.27%	0.27%
Tl	0.02	0.77	0.64	0.48	0.99	0.57	2.19	0.89	0.45	0.40	0.99	0.64	0.74
U	0.1	2.8	2.9	3.3	3.4	3.2	3.0	1.8	1.2	1.6	1.6	1.6	2.2
V	1	98	88	76	91	75	80	69	68	62	60	77	77
W	0.1	1.4	3.4	4.9	2.4	2.7	2.6	1.0	2.2	3.0	0.9	3.4	5.4
Y	0.1	11.9	10.2	21.8	14.7	19.4	9.2	10.9	11.0	14.3	11.6	13.6	13.4
Zn	2	100	72	84	103	80	96	59	53	56	52	56	60
Zr	0.5	104.9	125.5	207.4	104.3	126.3	88.4	76.3	90.1	155.0	68.1	77.1	84.2

< element at or below analytical detection limit.

Table H2: Mount Owen – Geochemical abundance indices (GAI) of selected rejects sample solids. Values 3 and over are highlighted in yellow, (EGi, 2013)

Element	Median Soil Abundance*	Rejects Type/Seam Group/Sample Number											
		Coarse Rejects						Fine Rejects					
		Hebden	Lemington	Bayswater	Liddell	Arties	Liddell	Hebden	Lemington	Bayswater	Liddell	Arties	Liddell
		6135	6136	6140	6141	6144	6145	6158	6159	6163	6164	6568	6569
Ag	0.05	-	-	1	-	1	1	-	-	-	-	-	-
Al	7.1%	-	-	-	-	-	-	-	-	-	-	-	-
As	6	1	1	-	1	-	2	-	-	-	1	-	-
B	20	-	-	-	-	-	-	-	-	-	-	-	-
Ba	500	3	-	-	-	-	-	-	-	-	-	-	-
Be	0.3	2	1	2	2	2	2	1	1	2	1	1	2
Bi	0.2	-	-	1	1	1	1	-	-	-	-	-	-
Ca	1.5%	-	-	-	-	-	-	-	-	-	-	-	-
Cd	0.35	-	-	-	-	-	-	-	-	-	-	-	-
Ce	50	-	-	-	-	-	-	-	-	-	-	-	-
Co	8	-	-	-	-	-	-	-	-	-	-	-	-
Cr	70	-	-	-	-	-	-	-	-	-	-	-	-
Cs	4	-	-	-	-	-	-	-	-	-	-	-	-
Cu	30	-	-	-	-	-	1	-	-	-	-	-	-
F	200	1	1	1	1	1	1	-	-	1	-	-	-
Fe	4.0%	-	-	-	-	-	-	-	-	-	-	-	-
Ga	20	-	-	-	-	-	-	-	-	-	-	-	-
Ge	1	-	-	-	-	-	-	-	-	-	-	-	-
Hf	6	-	-	-	-	-	-	-	-	-	-	-	-
Hg	0.06	-	-	-	-	-	2	-	-	-	1	-	-
In	1	-	-	-	-	-	-	-	-	-	-	-	-
K	1.4%	-	-	-	-	-	-	-	-	-	-	-	-
La	40	-	-	-	-	-	-	-	-	-	-	-	-
Li	25	-	-	-	-	-	-	-	-	-	-	-	-
Mg	0.5%	-	-	-	-	-	-	-	-	-	-	-	-
Mn	1000	-	-	-	-	-	-	-	-	-	-	-	-
Mo	1.2	-	-	-	1	1	1	-	-	-	1	1	1
Na	0.5%	-	-	-	-	-	-	-	-	-	-	-	-
Nb	10	-	-	-	-	-	-	-	-	-	-	-	-
Ni	50	-	-	-	-	-	-	-	-	-	-	-	-
P	800	-	-	-	-	-	-	-	-	-	-	-	-
Pb	35	-	-	-	-	-	-	-	-	-	-	-	-
Rb	150	-	-	-	-	-	-	-	-	-	-	-	-
Re													

Element	Median Soil Abundance*	Rejects Type/Seam Group/Sample Number											
		Coarse Rejects						Fine Rejects					
		Hebden	Lemington	Bayswater	Liddell	Arties	Liddell	Hebden	Lemington	Bayswater	Liddell	Arties	Liddell
		6135	6136	6140	6141	6144	6145	6158	6159	6163	6164	6568	6569
S	0.07%	2	1	-	1	1	3	4	2	-	4	3	2
Sb	1	-	-	-	-	-	-	-	-	-	-	-	-
Sc	7	-	-	-	-	-	-	-	-	-	-	-	-
Se	0.4	1	1	1	1	1	1	1	1	1	1	1	1
Sn	4	-	-	-	-	-	-	-	-	-	-	-	-
Sr	250	1	-	-	-	-	-	-	-	-	-	-	-
Ta	2	-	-	-	-	-	-	-	-	-	-	-	-
Te													
Th	9	-	-	-	-	-	-	-	-	-	-	-	-
Ti	0.50%	-	-	-	-	-	-	-	-	-	-	-	-
Tl	0.2	1	1	1	2	1	3	2	1	-	2	1	1
U	2	-	-	-	-	-	-	-	-	-	-	-	-
V	90	-	-	-	-	-	-	-	-	-	-	-	-
W	1.5	-	1	1	-	-	-	-	-	-	-	1	1
Y	40	-	-	-	-	-	-	-	-	-	-	-	-
Zn	90	-	-	-	-	-	-	-	-	-	-	-	-
Zr	400	-	-	-	-	-	-	-	-	-	-	-	-

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

Table H3: Mount Owen – Water extract quality for selected rejects samples (EGi, 2013)

Parameter		Detection Limit	Rejects Type/Seam Group/Sample Number											
			Coarse Rejects						Fine Rejects					
			Hebden	Lemington	Bayswater	Liddell	Arties	Liddell	Hebden	Lemington	Bayswater	Liddell	Arties	Liddell
			6135	6136	6140	6141	6144	6145	6158	6159	6163	6164	6568	6569
pH		0.1	8.8	9.3	8.5	8.7	9.2	9.4	9.1	8.7	8.9	9.0	8.9	8.8
EC	dS/m	0.001	0.44	0.51	0.43	0.41	0.35	0.46	0.48	0.52	0.62	0.62	0.45	0.34
Ag	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Al	mg/l	0.01	0.22	0.78	0.50	0.32	0.29	0.32	0.22	0.39	0.36	0.06	0.05	0.12
As	mg/l	0.001	0.072	0.301	0.044	0.042	0.079	0.033	0.019	0.03	0.009	0.008	0.013	0.003
B	mg/l	0.05	0.1	0.32	0.2	0.18	0.11	0.15	0.18	0.29	0.32	0.1	0.11	0.06
Ba	mg/l	0.001	0.172	0.173	0.129	0.093	0.109	0.09	0.446	0.467	0.583	0.655	1.03	0.471
Be	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ca	mg/l	1	<1	<1	<1	<1	1	<1	2	1	1	2	3	5
Cd	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/l	1	26	30	15	15	18	17	34	53	44	46	30	10
Co	mg/l	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	mg/l	0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.001	0.001	0.002	<0.001	<0.001	<0.001
Cu	mg/l	0.001	<0.001	0.005	<0.001	0.001	0.002	<0.001	0.002	0.004	0.005	0.004	0.005	0.003
F	mg/l	0.1	0.6	1.0	0.7	0.6	1.3	0.9	0.6	1.0	1.2	0.6	1.1	1.1
Fe	mg/l	0.05	<0.05	0.23	0.07	0.06	<0.05	0.05	<0.05	0.06	0.06	<0.05	<0.05	<0.05
Hg	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
K	mg/l	1	3	3	3	2	2	2	3	3	3	3	4	3
Mg	mg/l	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	3	2
Mn	mg/l	0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Mo	mg/l	0.001	0.08	0.15	0.08	0.07	0.09	0.09	0.04	0.06	0.03	0.04	0.04	0.04
Na	mg/l	1	83	129	102	84	60	122	97	121	127	111	90	54
Ni	mg/l	0.001	<0.001	0.004	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001
P	mg/l	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sb	mg/l	0.001	0.004	0.004	0.003	0.004	0.002	0.005	0.003	0.003	0.002	0.002	0.001	0.001
Se	mg/l	0.01	0.02	0.03	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	<0.01
Si	mg/l	0.1	5.3	27.0	16.2	6.4	3.0	4.7	2.2	2.8	3.7	1.6	1.3	1.2
Sn	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO4	mg/l	1	63	88	57	85	43	135	100	93	104	124	118	70
Sr	mg/l	0.001	0.147	0.094	0.068	0.117	0.078	0.045	0.285	0.192	0.184	0.435	0.286	0.255
Th	mg/l	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
U	mg/l	0.001	<0.001	0.002	<0.001	<0.001	0.001	0.002	<0.001	0.001	0.001	<0.001	<0.001	<0.001
Zn	mg/l	0.005	<0.005	0.006	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

APPENDIX I

Downhole profiles for selected drill holes

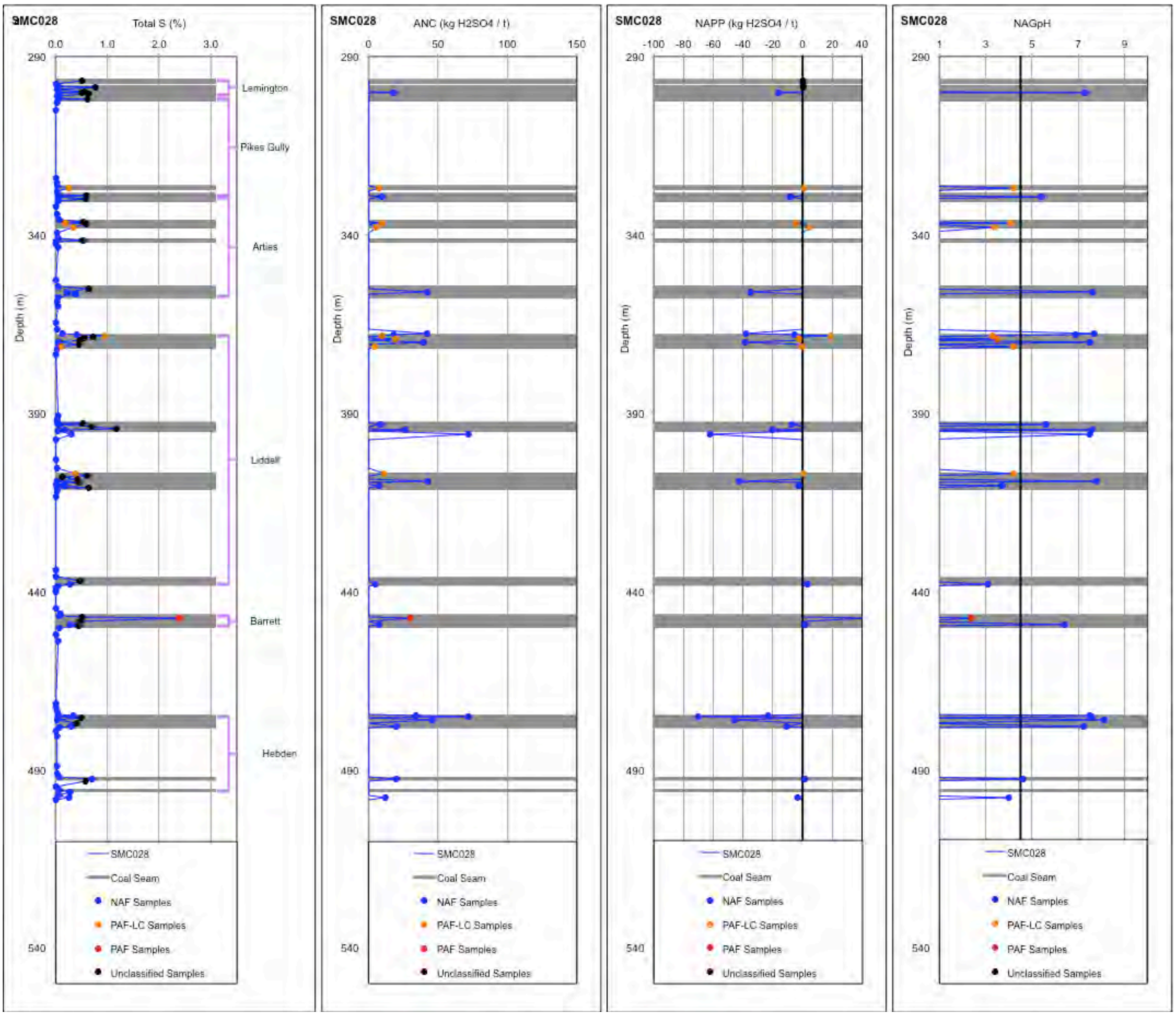

Figure I1 – Total S, ANC, NAPP, and NAGpH profiles for hole SMC028 – Proposed Modification

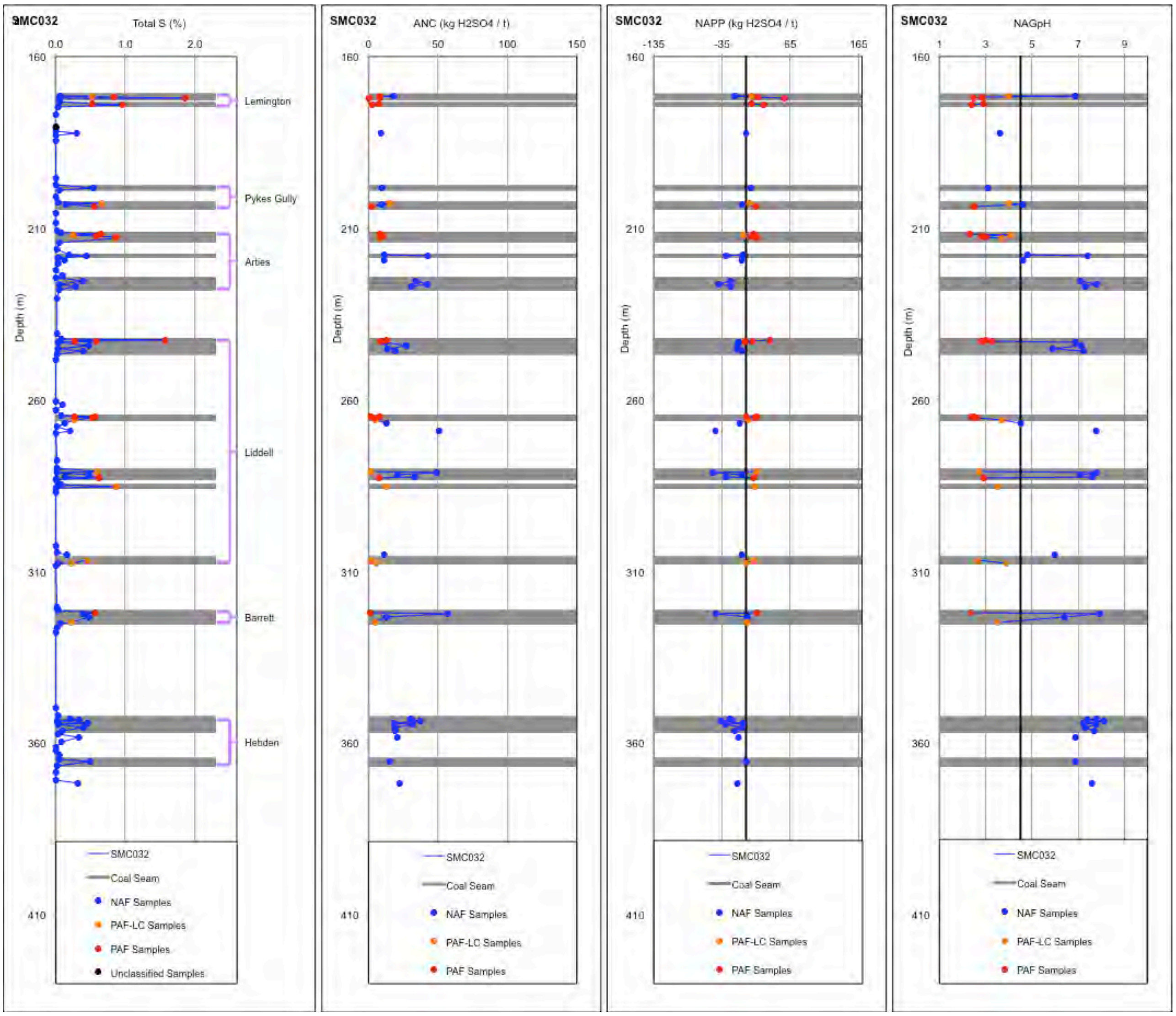

Figure I2 – Total S, ANC, NAPP, and NAGpH profiles for hole SMC032 – Proposed Modification

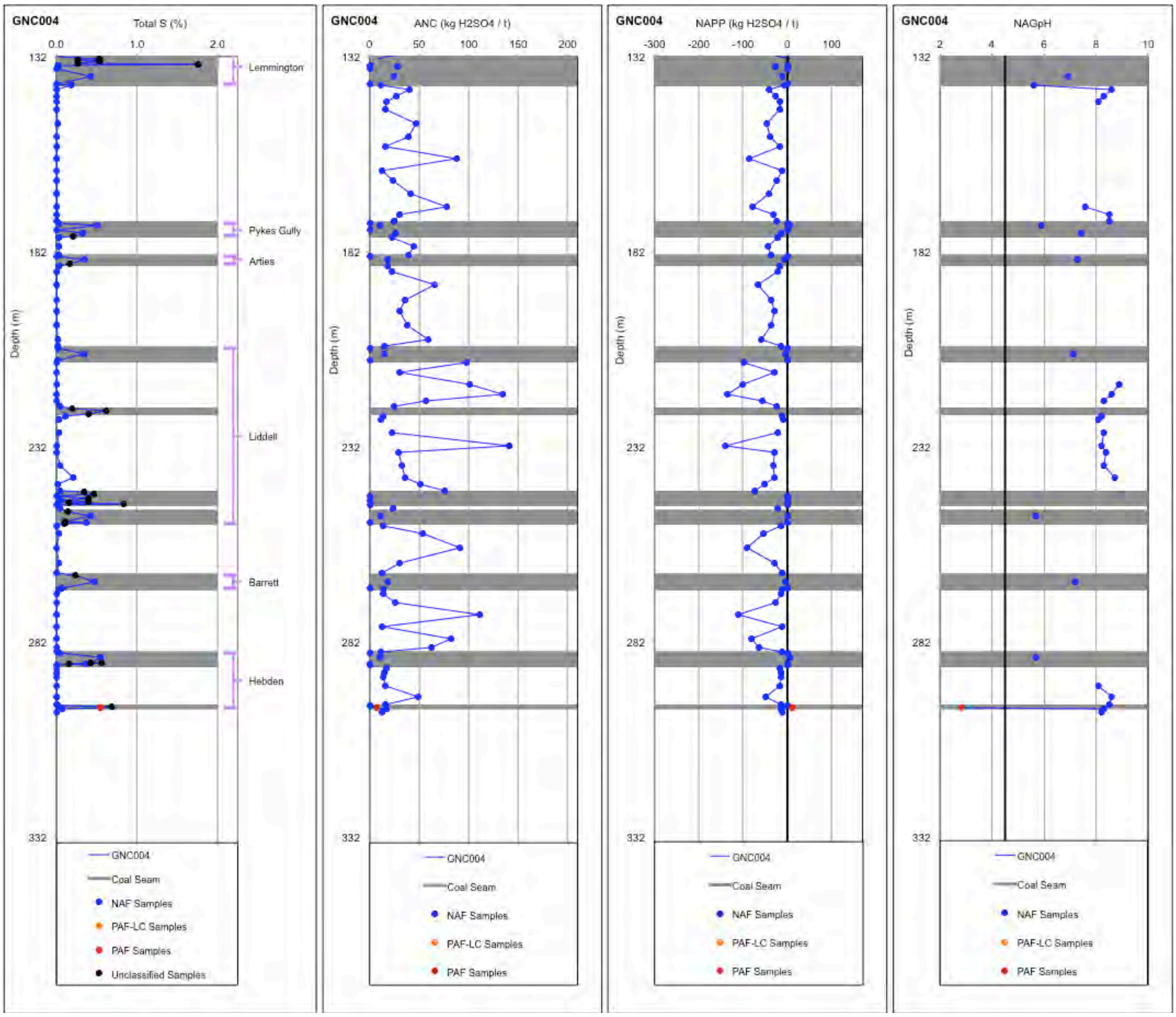

Figure I3 – Total S, ANC, NAPP, and NAGpH profiles for hole GNC004 – Approved Operations

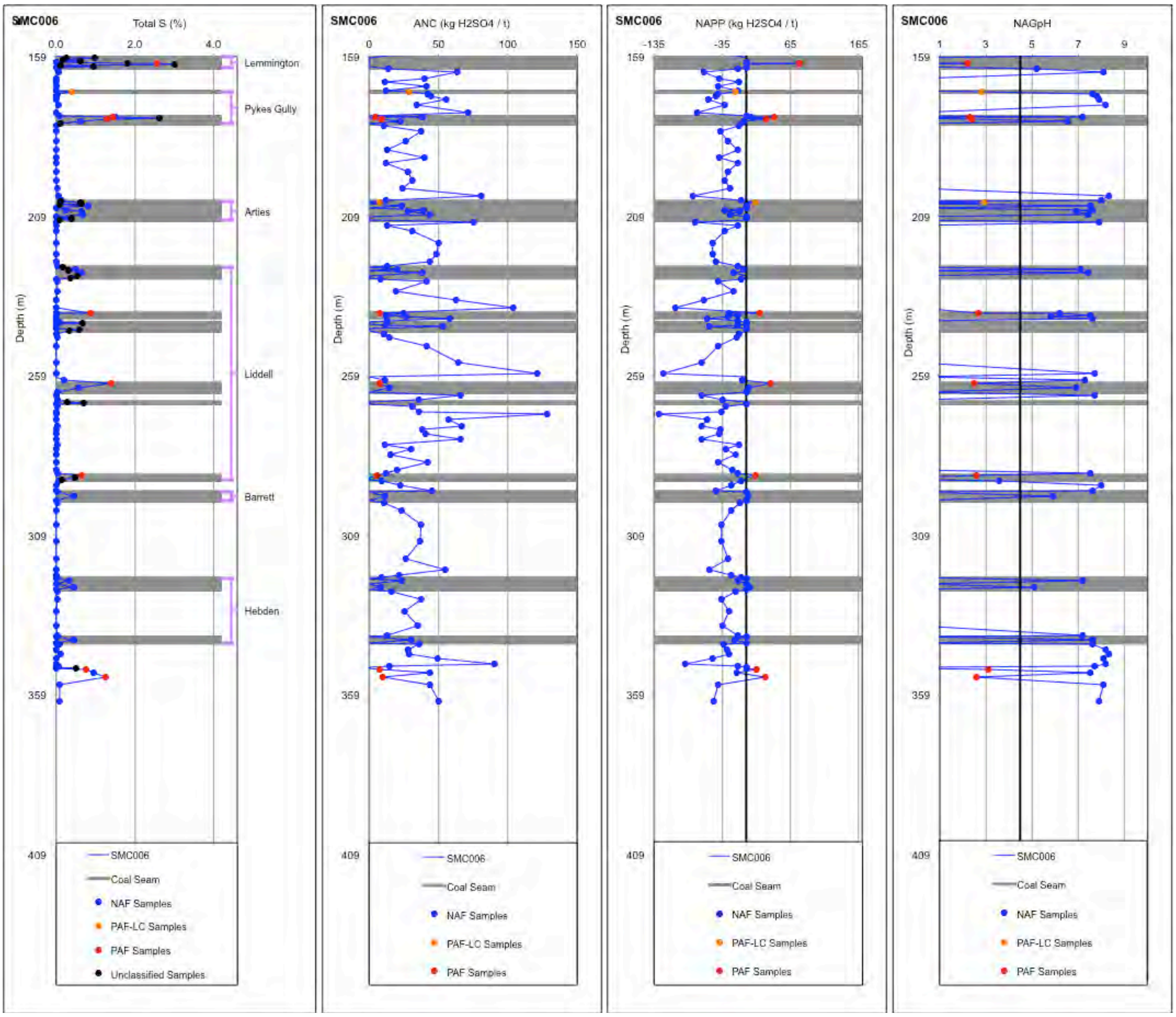

Figure I4 – Total S, ANC, NAPP, and NAGpH profiles for hole SMC006 – Approved Operations