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Olive Downs Coking Coal Project

Draft Environmental Impact Statement

Appendix L

Geochemistry Assessment

TERRENUS
EARTH SCIENCES

Geochemical Assessment of Potential Spoil and Coal Reject Materials

OLIVE DOWNS COKING COAL PROJECT

Final

Prepared for:

Pembroke Resources South Pty Ltd

Geochemical Assessment of Potential Spoil and Coal Reject Materials

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EXECUTIVE SUMMARY

Terrenus Earth Sciences (Terrenus) has completed a geochemical assessment of potential mineral waste (rock) materials from the proposed Olive Downs Coking Coal Project (the Project) – a proposed large coal mining project comprising the Olive Downs South and Willunga domains. This geochemical assessment is for the Project, however the test-work and analysis presented herein focusses on the northern section of the Olive Downs South domain, which would comprise the first 10 years (approximately) of operation. This period would allow time for validation test-work for the other mining sections/domain in advance of operations.

The geochemical assessment has been undertaken for mine planning purposes, with respect to the environmental considerations of potential mineral waste (rock) materials associated with the Project, and how these mineral waste materials may need to be managed to minimise their potential environmental impacts.

The Project would comprise the extraction of coal by open-cut mining methods from several folded and faulted coal seams within the Rangal Coal Measures, located in the Bowen Basin, Queensland. Run-of-mine (ROM) coal would be processed at a coal handling and preparation plant (CHPP) located on site. Dewatered tailings (*ie*. fine coal reject materials) and coarse coal reject materials would be emplaced on site.

Terrenus has geochemically assessed potential overburden and interburden (collectively called spoil) and potential coal reject materials (obtained as coal seam immediate roof, parting and floor samples). The assessment of 'potential coal reject materials' applies to coal reject generally, and does not distinguish between fine reject or coarse reject materials.

Geochemical data was derived from new exploration drill-core and cutting samples collected from the proposed Olive Downs South domain. All samples were collected by the proponent's geologists, following sampling specifications provided by Terrenus.

The environmental geochemical characteristics and proposed management of the potential spoil and coal reject materials can be summarised as follows. In considering these characteristics and management measures it should be noted that coal rejects are expected to comprise less than 2 percent (%) of all mineral waste generated at the Project.

Geochemical Characteristics of Potential Spoil from Olive Downs South Domain

- Spoil, as a bulk material, is expected to generate pH-neutral to alkaline, low- to moderate-salinity surface run-off and seepage following surface exposure. Fresh (unweathered) overburden can be expected to have similar pH and salinity to fresh interburden, however weathered overburden is expected to be slightly more saline than fresh spoil.

- The total sulfur concentration of spoil is very low and almost all spoil samples (164 out of 166 samples) are classified as non-acid forming (NAF). Most (93%) NAF samples were further classified as 'barren' with respect to sulfur concentrations. One sample was classified as Potentially Acid Forming (PAF) and one sample had an 'Uncertain' classification with respect to potential to generate acid.

- Total metal and metalloid concentrations in spoil samples are very low compared to average element abundance in soil in the earth's crust. Two fresh spoil samples (out of 27 spoil samples) were moderately enriched in barium and/or antimony with respect to average crustal abundance in soil.

- Soluble multi-element results indicate that some spoil materials *may* produce leachate containing slightly elevated concentrations of some soluble elements (such as aluminium, arsenic and selenium) compared to applied Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) aquatic ecosystem water quality guideline concentrations.

  It is important to note that the results presented in this report represent an 'assumed worst case' scenario as the samples are pulverised prior to testing, and therefore have a very high surface area compared to materials in the field. Individual materials would also be well mixed at storage locations. The results therefore suggest that the concentration of metals/metalloids in surface run-off and seepage from spoil materials in the field would be less than the recorded laboratory water extract concentrations.

  The applied guideline values are provided for context and are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to total and soluble metals/metalloids in spoil materials. Due to a number of factors in the field (compared to the laboratory), including scale-up and dilution, any direct comparison of soluble multi-element concentrations from spoil is strictly not valid and should be used with caution.

- Spoil samples have a wide range of cation exchange capacity (CEC) values and associated exchangeable sodium percentage (ESP) values. As such, bulk spoil is expected to have a mixed sodicity and dispersion potential (non-sodic through to strongly sodic). Generally, the interburden samples had higher ESP values (and assumed greater potential for dispersion) compared to fresh overburden samples.

Geochemical Characteristics of Potential Coal Reject from Olive Downs South Domain

- Potential coal reject material is expected to generate pH-neutral to alkaline, low-salinity run-off and seepage following initial surface exposure.

- About 71% of potential coal reject samples were classified as NAF and about 9% were classified as PAF – with a 'Low Capacity' to generate significant acidity. All PAF samples were from the Leichhardt Lower (LL2) and Vermont Upper (VU) seams. The remaining 21% (approximately) of samples (all from the LL2 and VU seams) were classified as Uncertain – primarily due to uncertainty around the availability of sufficient neutralising material. Overall, the sulfur concentration in potential coal reject materials is relatively low, with 65% of samples having total sulfur concentration below 0.2% and 83% of samples having total sulfur concentration below 0.4%.

- Therefore, coal reject (as a bulk material) is regarded as relatively low risk, but has some potential to generate weak acidity and relatively low concentration of sulfate in an unmitigated environment (*ie*. prior to management methods being adopted).

- Total metal and metalloid concentrations in coal reject samples are generally low compared to average element abundance in soil in the earth's crust. Two coal reject samples (out of 8 samples) [one LL2 sample and one VU sample] were moderately enriched in one or more of barium, mercury and/or antimony with respect to average crustal abundance in soil.
- The soluble multi-element results indicate that some coal reject materials *may* produce leachate containing slightly elevated concentrations of some soluble elements (such as aluminium, arsenic and selenium) compared to applied ANZECC (2000) aquatic ecosystem water quality guideline concentrations. Of these elements, only selenium is present in one water extract sample at a concentration marginally greater than the livestock drinking water quality guideline concentration for this element. The results therefore suggest that the concentration of metals/metalloids in surface run-off and seepage from coal reject materials in the field would be less than the recorded laboratory water extract concentrations.

Geochemical Characteristics of Potential Spoil and Coal Reject from Willunga Domain

Sampling and geochemical assessment of potential spoil and coal reject materials from the Willunga domain has not been undertaken or included in this assessment. However, assessment of potential mining waste materials would be undertaken in the Willunga domain during development of the Project. Notwithstanding, the geology and stratigraphy (lithology) at the Willunga domain is broadly consistent with the Olive Downs South domain and, as such, it is expected that the geochemical characteristics of potential spoil and coal reject materials from the Willunga domain would be consistent with (very similar to) those from the Olive Downs South domain.

Management and Mitigation of Spoil Piles

Management of Spoil from Olive Downs South Domain

Spoil is expected to be overwhelmingly NAF with excess acid neutralising capacity (ANC) and has a negligible risk of developing acid conditions. Furthermore, spoil is predicted to generate low- to moderate-salinity surface run-off and seepage with low soluble metal/metalloid concentrations. However, some spoil materials may be sodic (to varying degrees) with potential for dispersion and erosion (to varying degrees).

Where highly sodic and/or dispersive spoil is identified, this material should not report to final landform surfaces and should not be used in construction activities. Tertiary spoil has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program, 2004).

It is expected that highly sodic and dispersive spoil may not be able to be selectively handled and preferentially disposed – although the proponent should take reasonable measures to identify and selectively place highly sodic and dispersive spoil. Therefore, in the absence of such selective handling, spoil landforms would need to be constructed with short and low (shallow) slopes (indicatively slopes less than 15% and less than 200 metres (m) long) and progressively rehabilitated to minimise erosion.

Where spoil is used for construction activities, this should be limited (as much as practical) to unweathered Permian sandstone materials, as these materials have been found to be more suitable for construction and for use as embankment covering on final landform surfaces. Regardless of the spoil type, especially where engineering or geotechnical stability is required, testing should be undertaken by the proponent to determine the propensity of such materials to erode.

Surface run-off and seepage from spoil piles, including any rehabilitated areas, should be monitored for 'standard' water quality parameters including, but not limited to, pH, electrical conductivity (EC), major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids (TDS) and a broad suite of soluble metals/metalloids.

With the implementation of the proposed management and mitigation measures, the spoil is regarded as posing a low risk of environmental harm.

Management of Spoil from Willunga Domain

The management strategies applied to spoil from Olive Downs South domain would be expected to be applied to spoil from Willunga domain – on the basis that spoil from Willunga domain would have similar environmental geochemical characteristics to spoil from Olive Downs South domain. Notwithstanding, the proponent would undertake validation test-work of potential spoil materials from Willunga domain as the Project develops to enable appropriate spoil management measures to be planned and implemented.

Management and Mitigation of Coal Reject Emplacements

Up to 30% of coal reject materials may have a relatively low degree of risk associated with potential acid generation, however as a bulk material (of relatively small total quantity), coal reject is regarded as posing a generally low risk of environmental harm. This is primarily due to the typically low sulfur (and sulfide) concentration within this material (and also the low metals/metalloids concentrations), which suggests that the magnitude of any localised acid, saline or metalliferous drainage, if it occurs, is likely to be small, and would be confined to the pit area (or emplacement area during the early years of mining). Therefore, when disposed amongst alkaline NAF spoil within in-pit emplacements (or the out-of-pit emplacement during the early years of mining) the overall risk of environmental harm and health-risk that emplaced coal reject poses is very low.

The management measures for fine reject and coarse reject would be addressed by a Mineral Waste Management Plan, with the concepts outlined below.

Management of Fine Reject (Tailings)

Fine coal reject (tailings) is proposed to be pumped as a slurry to solar drying ponds in the mine infrastructure area. Flocculants would be added to the fine reject during pumping to the tailings/in-line flocculation (ILF) cells and water would be recovered and recycled in the coal handling and preparation plant (CHPP).

During the initial 2-3 years of operations (approximately, until in-pit emplacement areas become available) fine reject would be temporarily stored in the tailings/ILF cells and return water decanted for re-use in the mine water management system. When in-pit emplacement areas become available, dewatered fine reject would be excavated from the ILF cells and trucked for placement within the in-pit emplacements (below existing ground level) and then buried by spoil.

Management of Coarse Reject

During the initial 2-3 years of operations (approximately, until in-pit emplacement areas become available) coarse reject would be trucked from the CHPP and disposed in compacted layers within an out-of-pit emplacement. Once the emplacement of coarse reject is complete the facility would be covered with an appropriate capping layer and rehabilitated. After approximately Year 3, when in-pit emplacement areas become available, coarse reject would be trucked from the CHPP and disposed within the in-pit emplacement area (below existing ground level) and buried by spoil.

Management of Out-of-Pit Coal Reject Emplacements

During Operations

Coal reject (whether fine or coarse) in out-of-pit emplacement areas would be buried by at least 10m (unshaped cover thickness) of spoil within generally three months of placement. During operations, run-off and seepage from out-of-pit emplacement areas would be directed to the mine water management system.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of the out-of-pit spoil emplacement areas would be addressed by a Mine Closure Plan. However, as coal reject within out-of-pit spoil emplacements would be covered by a minimum of 10m final thickness of spoil and would not report to final landform surfaces (or near-surfaces), the management of out-of-pit coal reject would not be expected to be significant to mine or pit decommissioning and rehabilitation.

Management of In-Pit Coal Reject Emplacements

During Operations

Coal reject in in-pit emplacement areas would be placed below the expected final (post-closure) groundwater level and buried by at least 5m (unshaped cover thickness) of spoil generally within three months of placement.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of the partially back-filled pit (and subsequent final void) would be addressed by a Mine Closure Plan. However, as coal reject would be covered by a minimum of 5m final thickness of spoil and would not report to final landform surfaces (or near-surfaces), the management of in-pit coal reject would not be expected to be relevant to mine or pit decommissioning and rehabilitation.

Validation of Coal Reject Characteristics

The Proponent should undertake validation test-work of actual coal reject materials from the CHPP during development of the Project – particularly during the first two years of CHPP operation following commissioning and following commencement of mining and coal processing at the Willunga domain. Test-work should comprise on a broad suite of environmental geochemical parameters, such as pH, EC (salinity), acid-base account parameters, total metals and soluble metals.

Geochemical Characteristics of ROM Coal and Management of ROM Stockpiles

ROM coal is not mining waste, and run-off and seepage from ROM stockpiles does not report off-site. No ROM coal samples were characterised and assessed as part of this assessment, however ROM coal is expected to have similar environmental geochemical characteristics to potential coal reject materials. The Proponent should undertake periodic assessment of ROM coal and product coal as the Project develops to assist with their water management systems for ROM and product coal stockpiles (*ie*. to inform about potential water quality and allow appropriate management measures to be implemented).

ROM coal and product coal is typically stored at the site for a relatively short period of time (weeks) compared to mineral waste materials, which would be stored at the site in perpetuity. Management practices are therefore different for coal and would largely be based around the operational (day-to-day) management of surface run-off and seepage water from ROM and coal stockpiles, as is currently accepted practice at coal mines in Australia.

Surface run-off and seepage from ROM and product coal stockpiles should be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS and a broad suite of soluble metals/metalloids.

Geochemical Assessment of Potential Spoil and Coal Reject Materials

OLIVE DOWNS COKING COAL PROJECT

Final

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GLOSSARY of TERMS

Acid	A measure of hydrogen ion (H^+) concentration; generally expressed as pH.
Acid-Base Account	Evaluation of the balance between acid generation and acid neutralisation processes. Generally determined by the maximum potential acidity (MPA) and the inherent acid neutralising capacity (ANC), as defined below. See also "MPA" and "ANC".
AMD	Acid and Metalliferous Drainage from mining waste materials characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity. The term AMD is used more recently to replace the term Acid Rock Drainage (ARD) as metalliferous and saline drainage can occur under pH-neutral conditions.
ANC	Acid Neutralising Capacity, expressed as kg H_2SO_4 per tonne of rock/material. A measure of a sample's maximum potential ability to neutralise acid.
ANC/MPA ratio	Ratio of the acid neutralising capacity (ANC) to the maximum potential acidity (MPA) of a sample. Used to assess the risk of a sample generating acid conditions. See also "ANC" and "MPA".
Barren	A sample classified as barren has negligibly low total sulfur (and sulfide) concentration and, essentially, has no acid generating capacity. In essence, it represents an 'inert' material with respect to acid generation.
CHPP	Coal Handling and Preparation Plant.
Coal Reject	Solid waste produced during the processing of coal, typically from a CHPP. Coal reject typically comprises crushed siltstone, mudstone and fine-grained sandstone, which is mined as coal seam roof, parting or floor material during the extraction of ROM coal. Coal reject is commonly produced in different size fractions – fine and coarse reject.
Coarse Reject	Coarse solid waste materials (typically greater than 1.5 mm grain size) produced from the CHPP as part of the processing of coal. See also "Fine Reject".
EC	Electrical Conductivity, expressed as µS/cm.
Fine Reject	Fine-grained mining waste materials (typically less than 1.5 mm grain-size) produced from the CHPP as part of the processing and washing of coal. Fine reject typically comprises mud/clay and silt present in CHPP wastewater, and is also known as "Tailings".
Interburden	Waste rock material between mined coal seams. See also "Overburden", "Mining Waste" and "Spoil".
Kinetic test	Procedure used to measure the geochemical/weathering behaviour of a sample of mine material over time.

MPA	Maximum Potential Acidity. Calculated by multiplying the total sulfur (S) or sulfide-sulfur (Scr) content of a sample by 30.6 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne of rock/material.
Mineral Waste	Overburden, interburden and similar 'waste rock' (spoil) material mined and disposed during extraction of coal. In this report, the definition of Mineral Waste also extends to coal reject from the CHPP. See "Coal Reject".
NAF	Non-Acid Forming. Geochemical classification criterion for a sample that will not generate acid conditions. A sample classified as NAF may, or may not, have a significant sulfur content but the availability of neutralising material within the sample is more than adequate to neutralise all the acid that theoretically could be produced by any contained sulfide minerals. As such, material classified as NAF is considered unlikely to be a source of acidic drainage.
NAPP	Net Acid Producing Potential, expressed as kg H_2SO_4 per tonne of rock/material. Calculated by subtracting the ANC from the MPA.
NATA accreditation	Accreditation by the National Association of Testing Authorities (Australia). NATA accreditation for a specific analytical test indicates that the test method and means of undertaking the test (following the method and achieving valid results) by the laboratory has been independently recognised by NATA. Accreditation provides a means of determining and formally recognising the competence of facilities to perform specific types of testing, inspection, calibration, and other related activities, on a routine basis.
Overburden	Waste rock material overlying the uppermost mined (economic) coal seam. See also "Spoil".
PAF	Potentially Acid Forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions. A sample classified as PAF almost always has a significant sulfur content, the acid generating potential (MPA) of which exceeds the inherent acid neutralising capacity (ANC) of the material. This means there is a high risk that such a material, even if pH circum-neutral when freshly mined or processed, could oxidise and generate acidic drainage if exposed to atmospheric conditions. See also PAF-LC.
PAF-LC	Potentially Acid Forming (low capacity). Geochemical classification criterion for a sample that has the potential to generate weak acidity.
ROM	Run of Mine. Coal as it comes from the mine prior to screening or processing. ROM coal is typically trucked from the mine and dumped onto a ROM pad (or into a ROM hopper), and from there it typically undergoes some degree of crushing, screening and washing.
S	Sulfur.

Scr	Chromium reducible sulfur. Analytical procedure to determine the sulfide-sulfur concentration in a sample.
SO_4	Sulfate.
Spoil	Waste rock material overlying and between coal seams. Spoil overlying a mined coal seam is called overburden. Spoil between mined coal seams is called interburden.
Static test	Procedure for characterising the geochemical nature of a sample at one point in time. Static tests may include measurements of mineral and chemical composition of a sample and the Acid-Base Account.
Uncertain	In the context of classifying a material (sample) as NAF or PAF. An 'Uncertain' classification (UC) applies when there is an apparent conflict in results such that neither NAF or PAF classification can be given. Uncertain samples are sometimes given a tentative sub-classification, such as UC-NAF or UC-PAF.
Water extract	A method to determine the water soluble parameters in soil. Solid samples undergo a bottle leach method where 10 g of pulped solid (less than 70 micrometres) is combined with 50 grams of de-ionised water into a glass bottle. The 1:5 solution (1 part solid to 5 parts water) is tumbled end-over-end for one hour. Solutes are leached from the soil by the continuous suspension and agitation. The water extract solution is measured for pH and electrical conductivity (EC) prior to filtering for solute analysis (*eg*. metals/metalloids and major ions).

1 Introduction, Background and Context

Terrenus Earth Sciences (Terrenus) has completed a geochemical assessment of potential mineral waste (rock) materials from the proposed Olive Downs Coking Coal Project (the Project). The geochemical assessment was completed to assist with mine planning and as part of the environmental regulatory approvals documentation for the Project.

The Project is located in the Bowen Basin in Central Queensland, approximately 40 kilometres (km) southeast of Moranbah. The Project is being developed by Pembroke Resources South Pty Ltd (the Proponent) and comprises a metallurgical (coking) coal mine and associated infrastructure. The Project comprises two domains – a northern domain called 'Olive Downs South' and a south-eastern domain called 'Willunga'. **Figure 1** shows the Olive Downs South domain, where the drill-hole sampling was undertaken.

Terrenus has geochemically assessed potential overburden and interburden (collectively called spoil) and potential coal reject materials. Coal reject materials are derived from the processing of run-of-mine (ROM) coal at the coal handling and preparation plant (CHPP) and primarily comprise immediate coal seam roof, coal seam floor and coal parting materials. The assessment of 'potential coal reject materials' applies to coal reject generally and does not distinguish between fine reject or coarse reject.

Geochemical data was derived from new exploration drill-core and cutting samples collected from the northern section of the Olive Downs South domain, which would comprise the first 10 years (approximately) of operation. All samples were collected by the Proponent's geologists, following sampling specifications provided by Terrenus.

1.1 Background

The lithology within the Project area is characterised by typical basin-fill sediments, comprising mudstone, claystone, siltstone, sandstone (typically fine-grained), carbonaceous sediments and coal seams. The depth to base of weathering averages about 45 metres (m) below natural surface (at the Olive Downs South domain) but does vary depending on the local topography.

The principal coal bearing sequence at the Project is the easterly dipping Permian-age Rangal Coal Measures. The Project proposes to mine coal from all seams where coal thickness and quality is economic, although the folded and faulted nature of the area dictates that not all seams and plys are present in all areas of the Project at a suitable (economic) thickness or with the appropriate coal quality attributes. The run-of-mine (ROM) coal target seams include the Leichhardt Upper (LU), Leichhardt Lower (LL1, LL2 and LL3) and Vermont Upper (VU) seams.

Immediately underlying the Rangal Coal Measures is the Yarrabee Tuff Beds (YTB) marking the interpretive top of the Fort Cooper Coal Measures (which does not contain economic coal at the project area). Overlying the Rangal Coal Measures is the Rewan Formation of Triassic age, which in turn is overlain by Quaternary sediments. At the Project area the Quaternary sediments are highly weathered (as are the Tertiary sediments), semi-consolidated and typically comprise sand, clay and gravel.

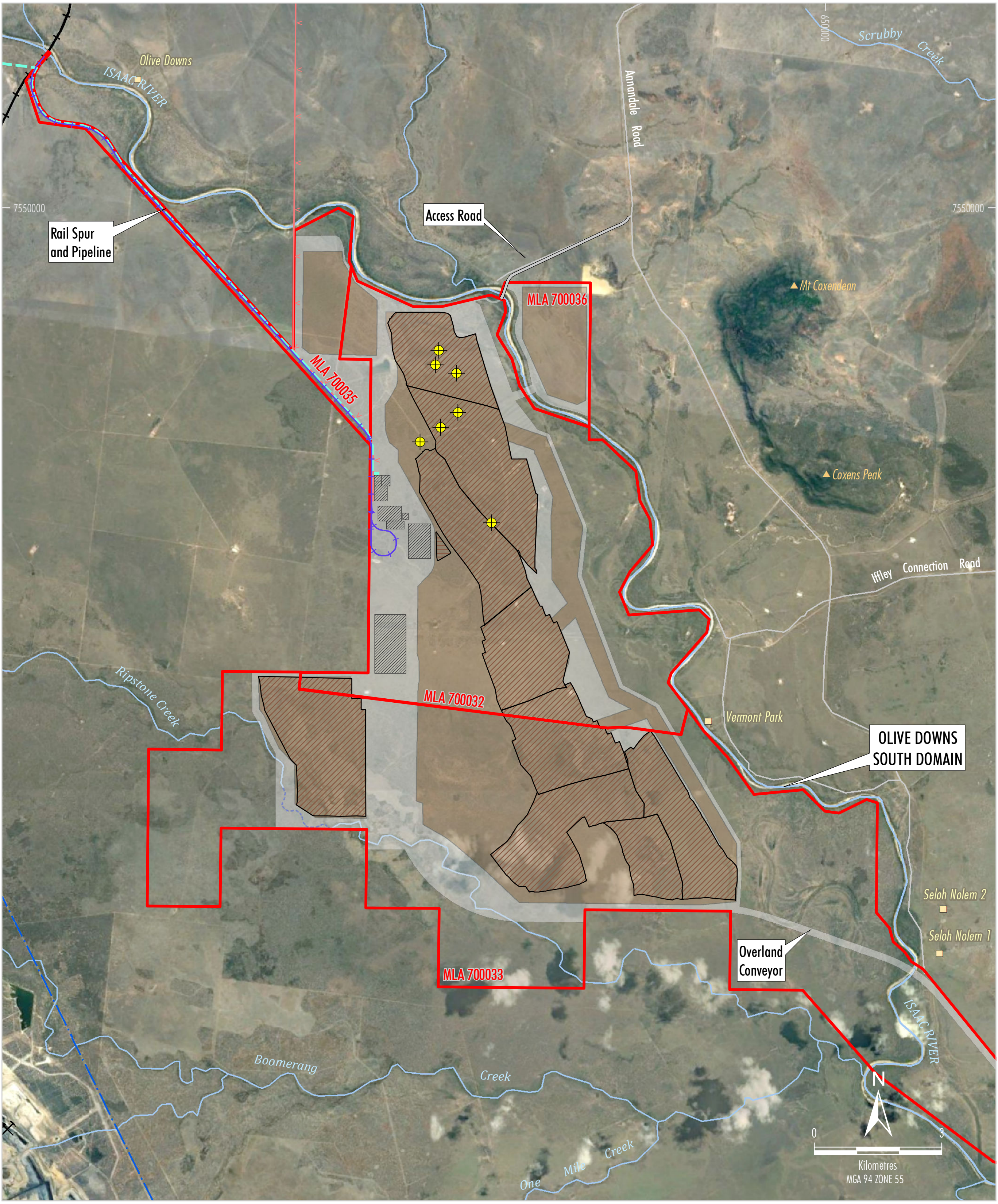
Coal would be mined by conventional open-cut methods, with ROM coal processed at the CHPP on site. Spoil would be placed within in-pit and out-of-pit emplacement areas. Coal reject materials would be dewatered and placed into purpose-built emplacements amongst in-pit spoil and/or out-of-pit spoil. Coal reject is expected to comprise less than 2 percent (%) of all mineral waste for the Project (at both the Olive Downs South and Willunga domains).

1.2 Objective

The overall objective of this geochemical assessment was to:

Evaluate the geochemical nature of potential spoil and coal reject materials likely to be produced from the Project (particularly during the first 10 years of mining operation) and identify any environmental issues that may be associated with mining, handling and storing these materials.

The scope of the geochemical assessment is consistent with the relevant requirements of the Terms of Reference for the Project (*ie*. requirements relating to water quality of surface water run-off and rehabilitation).



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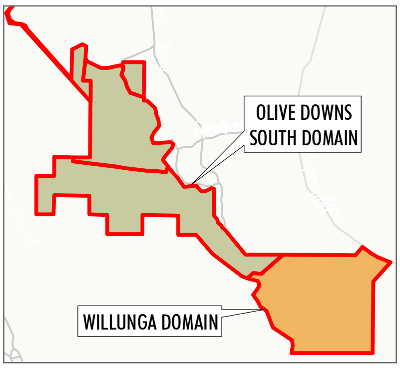

LEGEND

- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Proposed Access Road
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Drill-Hole Site and Sampling Location
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Open Cut Pit Extent
- Key Infrastructure Component
- Infrastructure Area
- Indicative Initial Coarse Reject Emplacement Area

Source: Geoscience Australia - Topographical Data 250K (2006), Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain and Drill-Hole Sampling Locations

Figure 1

2 Geochemical Assessment Methodology

This section provides the methodology used for the geochemical assessment of potential spoil and coal reject materials that could be generated by the Project, primarily during the first 10 years (approximately) of operation.

2.1 Desktop Review of Existing Information

A desktop review of available project data and information was completed to provide a better understanding of the Project. The review included geological data, coal exploration drilling programs, proposed mining methods and mine plan, coal handling and processing methods, and mining waste disposal and management strategies. Discussions were held throughout 2017 with the Proponent personnel (predominantly geologists from McElroy Bryan Geological Services [MBGS][1]) to identify and discuss relevant technical information and to understand the Project description.

Primary geological information was obtained from new exploration drill-hole logs from the Project area, coupled with discussions with the Project geologist[1]. Secondary geological information was obtained from the neighbouring Olive Downs North project area (Macarthur Coal) and from Terrenus' considerable knowledge and experience within the region – having undertaken geochemical assessments at Peak Downs Coal Mine and Saraji Coal Mine (both west of the Project area), within similar geological environments.

Based on this information, a good understanding of the geological environment at the Project site was gained.

2.2 Sampling Strategy

Terrenus developed a geochemical sampling and testing program specific for this assessment that integrated with the exploration (resource definition) drilling program. This assessment is based on all available data that is relevant to assessing the environmental geochemical characteristics of the Project.

There are currently no specific regulatory requirements regarding the number of samples required to be obtained and tested for coal, spoil or potential coal reject materials at mines in Queensland. Whilst historical guidelines do exist in Queensland (Department of Minerals and Energy [DME], 1995), more recent Australian and international guidelines (Department of Industry, Innovation and Science [DIIS], 2016; International Network on Acid Prevention [INAP], 2009) advocate a risk-based approach to sampling, especially for proposed coal mines where the geology and environmental geochemistry is well understood (from primary and secondary information sources).

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[1] Personal communications with Rowan Johnson: Senior Geologist & Qld Manager, McElroy Bryan Geological Services (MBGS).

The number and type of samples for the current assessment were selected based on a number of factors including:

- the geological variability and complexity in rock types;
- the size of the operation, the proposed mining schedule and the volume of materials;
- the potential for significant environmental or health impacts (based on the desktop review of available data);
- sample representation requirements and the representativeness of drill-core and cutting samples;
- the level of confidence in predictive ability; and
- cost.

The types of samples collected and assessed are outlined in this section.

MBGS supervised the drilling and sampling of seven cored exploration drill-holes within the northern section of the Olive Downs South domain, where mining would be undertaken for the first 10 years (approximately) of operations (before mining commences in the Willunga domain). The drill-hole locations are shown on **Figure 1** and a description of the drill-hole details including location coordinates, collar elevations and depths are provided in **Appendix A – Table A1**. Each hole was 'chipped' through the weathered zone (and chip samples collected) before coring through fresh (unweathered) rock to final depth, intersecting all relevant lithological units.

The geology and stratigraphy (lithology) of the Willunga domain is broadly consistent with the geology and stratigraphy (lithology) of the Olive Downs South domain. As such, the Willunga domain would be expected to have environmental geochemical characteristics consistent with (very similar to) the Olive Downs South domain. However, regardless of this assumption, the Proponent would assess the geochemical characteristics of mining waste materials from Willunga domain as the Project develops.

Selected core and chip samples from each of the seven holes underwent geochemical characterisation and assessment. The samples were selected for testing based on 'representativeness' and taking into account lithology and mineralogy data and sample depth. The 200 samples selected for geochemical characterisation comprised 166 potential spoil samples and 34 potential coal reject samples.

Samples Collected

Geochemical characterisation was undertaken on 200 samples, which comprise:

- 166 potential spoil samples:
  - 42 weathered overburden samples (predominantly highly to extremely weathered);
  - 51 unweathered overburden samples (from base of weathering to top coal); and
  - 73 interburden samples (unweathered, between seams).
- 34 potential coal reject samples, comprising roof, parting and/or floor samples from all seams between LU to VU, inclusive.

As indicated in **Section 1.1** coal reject materials are expected to represent less than 2% of the total mineral waste material generated over the life of mine. Therefore, from a statistical point-of-view the potential coal reject samples subjected to testing should only represent a very small proportion of all samples. However, typically in Permian deposits in the Bowen Basin the coal reject materials contain the greatest concentration of sulfur (as reactive sulfide) and can sometimes have a comparatively greater concentration of metals/metalloids. Furthermore, there are a number of coal seams targeted at the Project, which all require sampling and assessment. Hence, it was decided to increase the proportion of potential coal reject samples, relative to spoil.

Drill-hole information is provided in **Appendix A – Table A1** and the drill-hole (sampling) locations are shown on **Figure 1**. Sample information is provided in **Appendix B – Table B1**.

2.3 Geochemical Tests

The potential spoil and coal reject samples were characterised using static geochemical test methods, which provide the fundamental geochemical characteristics of a sample. Static tests involve discrete analytical tests undertaken on samples, where the results represent the geochemical characteristics of the sample at a single point in time and under simple experimental conditions as a 'snapshot' of the sample's likely environmental geochemical characteristics.

Samples were prepared for static testing by pulverising each sample to a particle size of less than 75 micrometres (µm) in diameter. This is a standard preparation method that provides a homogenous sample for testing and creates a large surface contact area. This, in turn, provides a large potential for sample dissolution and reaction and therefore represents an initial 'assumed worst case' scenario for the potential spoil and coal reject materials.

Kinetic leaching tests have not been undertaken as part of this assessment, as the static test results alone have been adequate and defining, in the context of the assessment objectives for the purposes of the Environmental Impact Statement (EIS).

Static Test Methodology

The test methods employed on all samples comprised:

- pH and electrical conductivity (EC) (1:5 weight:volume [w:v]) on sample pulps;
- Net Acid Producing Potential (NAPP) [comprising total sulfur and acid neutralising capacity (ANC)];

Samples with total sulfur values of greater than 0.1% underwent additional analysis for:

- Sulfide (chromium reducible sulfur [Scr]); and
- Total sulfate (*ie*. sulfur as sulfate).

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

Based on the results of the initial screening tests selected samples were subjected to several or all of the following tests:

- Acid buffering characteristics curve (ABCC) tests;
- Total metals and metalloids [mixed 4-acid digest followed by Flow Injection Mercury System [FIMS] for Mercury (Hg) and Inductively Coupled Plasma Mass Spectrometry [ICP-MS] / Inductively Coupled Plasma Atomic Emission Spectroscopy [ICP-AES] for all other elements];
- Soluble elements by ICP-AES/-MS and FIMS (1:5 w:v water extracts);
- Major cations and anions by ICP-AES (1:5 w:v water extracts);
- Exchangeable cations (Calcium [Ca], Magnesium [Mg], Sodium [Na], Potassium [K]) (with pre-treatment for salinity). Results were used to calculate the cation exchange capacity (CEC); and
- Emerson Class testing [(in accordance with Standards Australia method AS1289-3.8.1].

All laboratory test work was undertaken by ALS Limited (ALS) Brisbane, using National Association of Testing Authorities (NATA) accredited methods (where such accreditation exists). The geochemical test work program is summarised in **Table 1**.

The Acid-Base Account (ABA) method was used to assess the acid-neutralising and acid-generating characteristics of the samples. The ABCC data was used to estimate how readily available the ANC would be to neutralise any acidity. The total and water-soluble element data was used to indicate the potential for mineral waste materials to leach metals and metalloids (under existing pH and oxygen [redox] conditions) at concentrations that could warrant further investigation (in a 'worst-case' leaching scenario).

Table 1. Summary of the Geochemical Test Program
(Number of samples subjected to each test regime)

Analytical tests	Spoil	Potential Coal Reject
pH, EC, total sulfur, ANC	All (166) samples	All (34) samples
Sulfide and sulfate (S_{CR} and SO_4)	14 samples	16 samples
Total elements in solids	27 samples	8 samples
Soluble elements and major ions in 1:5 water extracts	27 samples	8 samples
Exchangeable cations[2]	24 'spoil' samples	-
Emerson class[2]	6 weathered 'spoil' samples	-

[2] Exchangeable cation and Emerson class tests have only been determined on potential spoil samples, as spoil materials are those likely to report to final landform surfaces and be used in rehabilitation and revegetation activities. Coal reject will not report to final surfaces and not be used in final rehabilitation and revegetation activities. Emerson class tests were only performed on weathered samples.

Assessment of Element Enrichment

From an environmental perspective, multi-element scans are typically undertaken to identify any elements (particularly metals and metalloids) present in a material at concentrations that *may* be of environmental concern with respect to revegetation and surface water quality.

In this assessment the total concentration result for each element was compared to average element abundance in soil in the earth's crust (Australasian Institute of Mining and Metallurgy [AusIMM], 2011) to measure how the total elemental concentrations in the materials proposed to be mined compare against average elemental concentrations in soil (worldwide). Such a comparison is undertaken to identify samples that contain what may be regarded as 'elevated' concentrations of metals and metalloids (relative to typical concentrations in this rock type) to assess any potential concerns related to mine operation, environmental issues and final rehabilitation.

There are no guidelines and/or regulatory criteria in Queensland (or elsewhere in Australia) specifically related to total metal and metalloid concentrations in mineral waste materials. In the absence of specific guidelines and/or regulatory criteria, and to provide relevant context, the total assay result for each element (milligrams per kilogram [mg/kg]) were compared to the average background concentration (average crustal abundance) of those elements in soil and rock.

From the comparison with average crustal abundance in rocks a geochemical abundance index (GAI) was calculated. The GAI quantifies an assay result for a particular element in terms of the average abundance for that element (in 'intermediate' igneous rocks). The index, based on a log 2 scale, is expressed in seven integer increments (0 to 6), which correspond to enrichment factors from 0 to over 96 times average crustal abundance, as shown in **Table 2** below.

Table 2. Geochemical Abundance Index (GAI)

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

As a general rule, a GAI greater than or equal to three indicates enrichment to a level that potentially warrants further investigation or provides an indication of which elements may potentially be problematic with respect to environmental impacts. This is particularly the case with some environmentally important 'trace' elements, such as arsenic (As), cadmium (Cd), copper (Cu), zinc (Zn), *etc*., more so than with major rock-forming elements, such as aluminium (Al), Ca, Na, *etc*. This comparison does not take into account the background or baseline concentration of elements in soil/rock immediately outside the mine disturbance area (such data is not available to Terrenus for this assessment). That is, soil/rock outside the mine disturbance area may be naturally 'elevated' in some elements, well above the average background concentrations in soil (in the earth's crust).

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

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

Assessment of Element Solubility

Under certain circumstances, mineral waste materials can potentially leach soluble metals at concentrations that may impact the environment or human health. Selected samples were subjected to short-term leaching tests to determine the immediate solubility and potential mobility of elements under highly agitated and solubility-inducing conditions.

Thirty five (35) discrete samples underwent 'water extract' leaching tests, which is a one hour bottle tumbling (end-over-end) leach at a solid:water ratio of 1:5. The samples comprised 27 potential spoil samples and 8 potential coal reject samples. The water extract tests undertaken in this assessment were performed on pulped samples (80% passing 75 µm in diameter). This means the available surface area for dissolution/solubility and/or geochemical reaction is relatively high compared to dissolution/solubility of soil and rock at much greater grain sizes.

Leaching tests were used to determine the solubility and potential mobility of elements under existing pH and oxygen (redox) conditions. Soluble element concentrations can be compared with 'trigger values' from potentially relevant surface water and groundwater guidelines in order to provide some useful context.

There are no guidelines and regulatory criteria specifically related to direct surface run-off and/or seepage from spoil and coal reject materials since guidelines (and regulatory criteria) would depend upon the end-use and receiving environment of the seepage. Therefore, to provide relevant context, the soluble concentration of each element extracted from the samples was compared to livestock drinking water guidelines (Australian and New Zealand Environment and Conservation Council [ANZECC], 2000) and freshwater aquatic ecosystem guidelines for slightly to moderately disturbed systems (ANZECC, 2000).

Note: It is important to recognise that the direct comparison of bottle leachate concentration with applied water quality guideline concentration is provided for general context only. The guideline values provided in ANZECC (2000) are for receiving water environments, whereas the soluble element data in this assessment is 'point source' obtained from a finely-pulped (or finely crushed) sample subjected to rigorous and artificial extraction to obtain an assumed 'maximum' concentration. Therefore, the guideline values provided are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to soluble metals/metalloids in spoil or coal reject materials – nor should they be viewed as such.

2.4 Sample Classification Criteria

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

Samples were classified, with respect to acid generation, using total sulfur (or Scr, where available), NAPP and ANC/MPA ratio data into three broad categories:

- NAF Non-acid Forming;
- Uncertain Those samples with inconclusive results, leading to a degree of uncertainty about their ability to generate acid; and
- PAF Potentially acid forming.

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

***NAF – Barren[3]*:** Total sulfur (S) ≤0.1 %

***NAF – Low Sulfur (NAF-LowS)*:**

NAPP <0 kg sulfuric acid [H_2SO_4] per tonne of sample (kg H_2SO_4/t) and ANC/MPA ratio ≥3 and Total sulfur ≤0.2%

Where Scr data is available, NAPP is calculated from Scr.

***NAF – High Sulfur (NAF-HighS)*:**

NAPP <0 kg H_2SO_4/t and ANC/MPA ratio ≥3 and Total sulfur >0.2%

Where Scr data is available, NAPP is calculated from Scr.

***PAF*:**

NAPP ≥0 kg H_2SO_4/t and ANC/MPA ratio <3

Where Scr data is available, NAPP is calculated from Scr.

Uncertain: Any result outside of the above criteria, or results that appear to significantly conflict with the expected result based on lithology or mineralogy.

Heterogeneity is a characteristic of natural geology materials. Sometimes an analytical result for a rock sample can vary to that which may be expected based on the known rock type (from information contained in the lithological logs). In this case, a degree of conservatism is applied to the result (*ie*. the precautionary principle prevails) and the sample is classified as 'Uncertain' until further information becomes available. Depending on the level of risk, from a mineral waste management perspective 'Uncertain' samples are usually managed conservatively (in a similar manner to PAF materials).

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

3 Geochemical Test Results

3.1 Acid-Base Account Results for Potential Spoil Samples

The ABA is the theoretical balance between the potential for a sample to generate acid and neutralise acid, and in Australia is commonly expressed in units of kg H_2SO_4/t.

ABA results for the 166 potential spoil samples that underwent geochemical characterisation are presented in **Appendix B – Table B1** and summarised as follows. The laboratory certificates for these samples are provided in **Appendix C**. The potential spoil samples comprise:

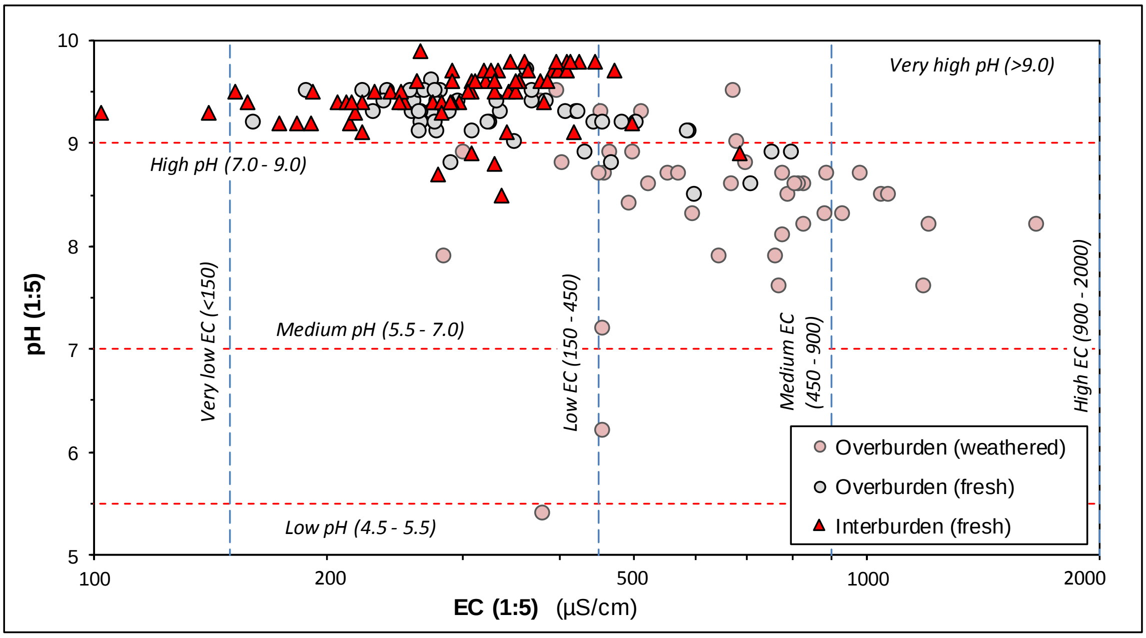
- 42 weathered overburden samples (predominantly highly to extremely weathered);
- 51 unweathered overburden samples (between 'weathered zone' and top fresh coal); and
- 73 interburden samples (unweathered, between seams).

With some minor exceptions, there is little difference in the ABA results between the three types of spoil materials to warrant a separate detailed discussion on the basis of weathered versus unweathered overburden or interburden material. Therefore, the ABA results are discussed as a 'bulk' spoil material, unless specifically noted.

Electrical Conductivity and pH of Potential Spoil

The $EC_{1:5}$ values of potential spoil samples are generally low and cover a broad range from 102 to 1670 microSiemens per centimetre (µS/cm), with a median EC value of 349 µS/cm and 75th and 90th percentile values of 468 and 778 µS/cm, respectively (**Figure 2**). The weathered samples cover a broader range of salinity values compared to the unweathered (fresh) samples. The interburden samples generally have slightly lower salinity compared to the unweathered (fresh) overburden samples.

Figure 2. Electrical Conductivity (EC) and pH of Potential Spoil Samples
The EC and pH classifications shown correspond to the soil salinity and soil pH classifications from DME, 1995



Potential spoil samples are generally pH-alkaline (**Figure 2**), producing average and median pH values of 9.1 and 9.3, respectively (10th percentile value of pH 8.5). Two weathered overburden samples had pH values less than 7. For context, deionised water typically has a pH between 5 and 6.5.

To provide context to the results, the $EC_{1:5}$ and $pH_{1:5}$ results in **Figure 2** are plotted against salinity and pH criteria for mine waste materials, as defined by the Queensland DME (1995) technical guideline for the environmental management of exploration and mining in Queensland. These criteria are outlined in **Table 3**. Based on the median EC and pH values for potential spoil samples overall, the samples are generally regarded as having 'Very High' soil pH and 'Low' salinity values, as evident by the distribution of samples corresponding to each pH and salinity class.

Table 3. Salinity and pH Criteria for Assessment of Potential Spoil Samples
Adapted from DME, 1995

	Very Low	Low	Medium	High	Very High
All spoil samples (n= 166)					
$EC_{1:5}$ (sample:water) µS/cm	**< 150**	**150 – 450** (median=349)	**450 – 900**	**900 – 2,000**	**> 2,000**
No. and (%) of samples corresponding to each salinity classification	2 (~1%)	115 (69%)	42 (25%)	7 (~4%)	-
$pH_{1:5}$ (sample:water)	**< 4.5**	**4.5 – 5.5**	**5.5 – 7.0**	**7.0 – 9.0**	**> 9.0** (median=9.3)
No. and (%) of samples corresponding to each soil pH classification	-	1 (<1%)	1 (<1%)	48 (29%)	116 (70%)
Weathered overburden (n=42)					
$EC_{1:5}$ (sample:water) µS/cm	**< 150**	**150 – 450**	**450 – 900** (median=674)	**900 – 2,000**	**> 2,000**
No. and (%) of samples corresponding to each salinity classification	-	6 (14%)	29 (69%)	7 (17%)	-
$pH_{1:5}$ (sample:water)	**< 4.5**	**4.5 – 5.5**	**5.5 – 7.0**	**7.0 – 9.0** (median=8.6)	**> 9.0**
No. and (%) of samples corresponding to each soil pH classification	-	1 (~2.5%)	1 (~2.5%)	35 (83%)	5 (12%)
Fresh overburden (n=51)					
$EC_{1:5}$ (sample:water) µS/cm	**< 150**	**150 – 450** (median=297	**450 - 900**	**900 – 2,000**	**> 2,000**
No. and (%) of samples corresponding to each salinity classification	-	41 (80%)	10 (20%)	-	-
$pH_{1:5}$ (sample:water)	**< 4.5**	**4.5 – 5.5**	**5.5 – 7.0**	**7.0 – 9.0**	**> 9.0** (median=9.3)
No. and (%) of samples corresponding to each soil pH classification	-	-	-	8 (16%)	43 (84%)
Fresh interburden (n=73)					
$EC_{1:5}$ (sample:water) µS/cm	**< 150**	**150 – 450** (median=308	**450 - 900**	**900 – 2,000**	**> 2,000**
No. and (%) of samples corresponding to each salinity classification	2 (3%)	68 (93%)	3 (4%)	-	-
$pH_{1:5}$ (sample:water)	**< 4.5**	**4.5 – 5.5**	**5.5 – 7.0**	**7.0 – 9.0**	**> 9.0** (median=9.5)
No. and (%) of samples corresponding to each soil pH classification	-	-	-	5 (7%)	68 (93%)

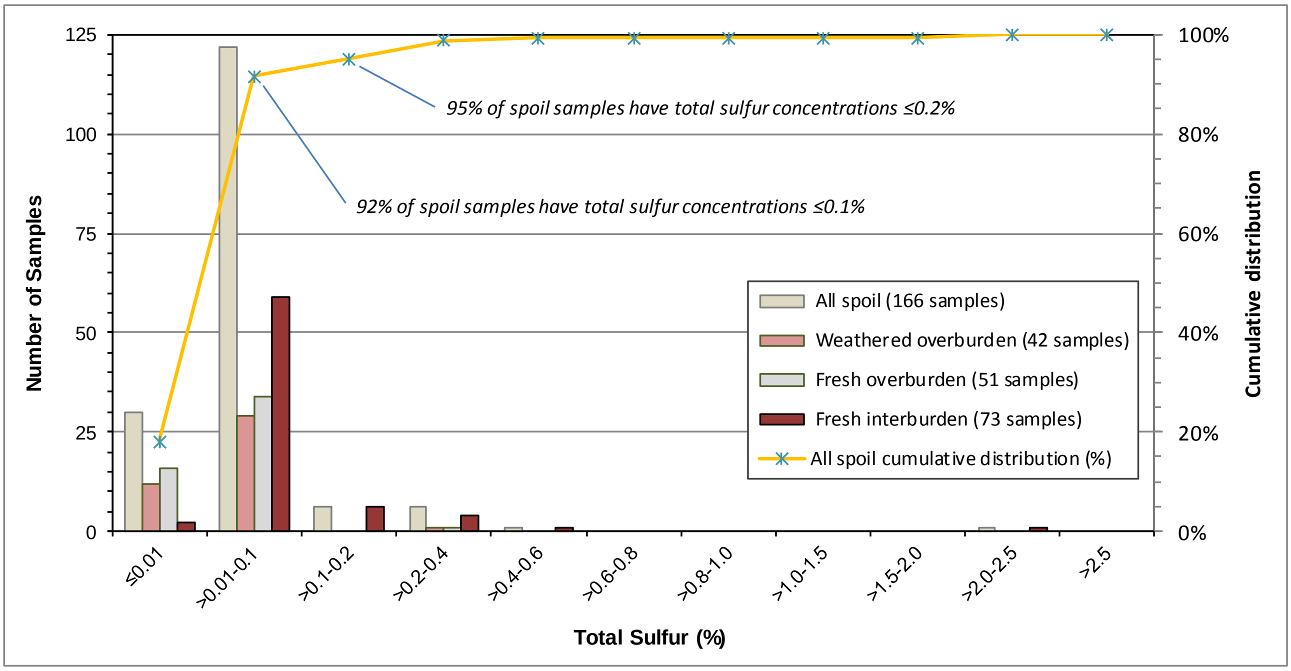
Note: Highlighted cells in Table 3 show the category corresponding to the median EC (orange shading) and median pH (purple shading) for each of the four spoil categories (all spoil, weathered overburden, fresh overburden and fresh interburden).

Sulfur in Potential Spoil

The total sulfur concentration of potential spoil samples is very low, as shown in **Figure 3**, with 92% of all potential spoil samples having a total sulfur concentration below 0.1%, thus rendering them 'barren' with respect to sulfur.

Since the total sulfur concentration is very low in most potential spoil samples, sulfide-sulfur (as Scr) concentration was measured in 14 of the 166 samples (those samples with total sulfur concentrations greater than 0.1%).

Figure 3. Distribution and Cumulative Distribution of Total Sulfur in Potential Spoil Samples



Maximum Potential Acidity and Acid Neutralising Capacity of Potential Spoil

The ANC and MPA that could be generated by these potential spoil samples (MPA calculated from Scr, where available) is summarised in **Table 4** and **Figure 4**.

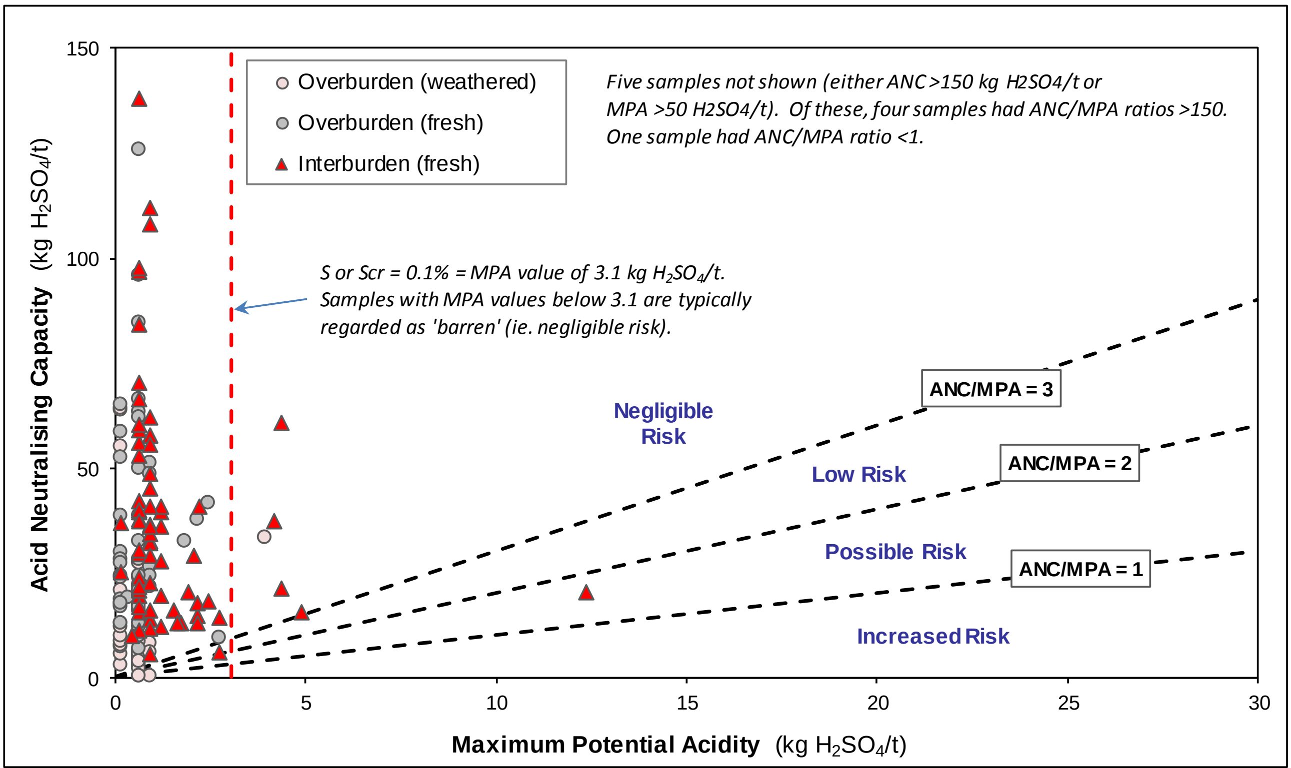
Due to the very low total sulfur (and sulfide) values the MPA for almost all potential spoil samples is very low, with a median MPA of <1 kg H_2SO_4/t (and a maximum MPA of 51 kg H_2SO_4/t for one interburden sample). Almost all samples (99% of samples) have MPA values below 5 kg H_2SO_4/t.

The ANC values are typically well in excess of the MPA values and span a relatively large range, from <0.5 to 188 kg H_2SO_4/t, with a median ANC value of 23 kg H_2SO_4/t and moderate 25th, 75th and 90th percentile values of 13, 41 and 65 kg H_2SO_4/t, respectively.

Table 4. Summary Maximum Potential Acidity (MPA) and Acid Neutralising Capacity (ANC) for Potential Spoil Samples

Sample Material	Min.	Max.	Median	General Comments
Maximum potential acidity (MPA) *all units kg H_2SO_4/t*				
All spoil samples (n=166)	<0.2	51	0.6	Very low (negligible)
Weathered overburden samples (n=42)	<0.2	4	0.6	Very low (negligible)
Fresh overburden samples (n=51)	<0.2	3	0.6	Very low (negligible)
Fresh interburden samples (n=73)	<0.2	51	0.9	Very low (negligible)
Acid neutralising capacity (ANC) *all units kg H_2SO_4/t*				
All spoil samples (n=166)	<0.5	188	23	Moderate
Weathered overburden samples (n=42)	<0.5	96	8	Low
Fresh overburden samples (n=51)	6.9	188	24	Moderate
Fresh interburden samples (n=73)	5.8	155	33	Moderate

Figure 4. Maximum Potential Acidity (MPA) and Acid Neutralising Capacity (ANC) for Potential Spoil Samples



Available Neutralising Capacity of Carbonaceous Potential Spoil Materials

Amongst the Permian and Tertiary sedimentary units in the Bowen Basin, carbonaceous and coaly spoil lithologies (*eg*. carbonaceous siltstone and sub-economic seams) typically have a reduced ability to offer significant neutralising capacity compared with non-carbonaceous materials (such as non-carbonaceous sandstone and siltstone).

The ready-availability of neutralising capacity is generally determined by the mineralogy of the sample – with calcite and dolomite carbonate minerals being more readily-available to neutralise acidity compared with siderite. Six interburden samples, all carbonaceous and/or coaly, underwent ABCC testing to assess the proportion of ANC that may be 'readily available' (*ie*. short-acting) in these carbonaceous materials. The results are summarised in **Table 5** and show that about 35% (on average) of the ANC is expected to be readily available (values range from 10% to 88%; median 23%). The results are as expected (typical for these types of materials in the Bowen Basin) and suggest that for carbonaceous materials about one-third of the 'standard' ANC can be assumed to be present in a readily available form (to neutralise any acid). The remaining ANC should still be available, but is likely to react at a slower rate – providing long-term neutralisation more so than short-term neutralisation. The ABCC laboratory results are provided in **Appendix C**.

Table 5. Readily Available Neutralising Capacity of Carbonaceous and Coaly Spoil

Sample ID	Lithology	Type	ANC kg H_2SO_4/t	Readily available proportion of ANC @ pH 4.5
4511	Siltstone. Minor coaly bands	Interburden	20.4	88%
4522	Carb. claystone (LL3 sub-economic)	Interburden	37.5	10% (dup. 9%)
4322	Carb. siltstone	Interburden	15.6	23%
4325	Carb. claystone	Interburden	13.0	22%
5033	Claystone (LL3 sub-economic)	Interburden	20.2	56%
5119	Carb. siltstone	Interburden	12.8	26% (dup. 18%)

Net Acid Producing Potential of Potential Spoil

The calculated NAPP values for potential spoil samples are summarised in **Table 6** and **Figure 5**.

Based on the very low MPA and significantly higher ANC values (relative to the MPA), the calculated NAPP values are negative for most samples – only four out of 166 samples had positive NAPP values and, of these, three samples had NAPP values ranging between zero and one kg H_2SO_4/t. This indicates a significantly greater proportion of neutralising capacity (ANC) compared to potential acidity (MPA). NAPP values ranged from -187 to +32 kg H_2SO_4/t, with median and 90th percentile values of -22 and -5 kg H_2SO_4/t, respectively.

Table 6. Summary Net Acid Producing Potential (NAPP) Values for Potential Spoil Samples

Sample Material	Min.	Max.	Median	10th / 90th percentile	General Comments
	NAPP kg H_2SO_4/t				
All spoil samples (n=166)	-187	+32	-22	-65 / -5	Low (negative). One sample has NAPP >+1
Weathered overburden samples (n=42)	-95	+1	-7	-29 / -2	Low (negative). Three samples have NAPP between 0 and 1
Fresh overburden samples (n=51)	-187	-6	-24	-66 / -13	Low (all negative).
Fresh interburden samples (n=73)	-154	+32	-32	-69 / -11	Low (essentially all negative). One sample has +ve NAPP

ANC/MPA Ratios of Potential Spoil

Generally, those samples with an ANC/MPA mass ratio greater than two are considered to have a negligible/low risk of acid generation and a high factor of safety in terms of potential for acid and metalliferous drainage (AMD) (DIIS, 2016; INAP, 2009[4]). The results in **Table 7** and **Figure 4** show that 97% of spoil samples have an ANC/MPA ratio greater than two and 93% of spoil samples have ANC/MPA ratios greater than five.

Table 7. Summary ANC/MPA Ratios for Spoil Samples

Sample Material	Min.	Max.	Median	Number and (%) of samples with ANC/MPA ratios:			
				Less than 1	Between 1 and 2	Between 2 and 5	Greater than 5
All spoil samples (n=166)	0.2	1189	35	4 (2%)	1 (<1%)	7 (4%)	154 (93%)
Weathered overburden (n=42)	0.2	420	14	3 (7%)	0	3 (7%)	36 (86%)
Fresh overburden (n=51)	3.4	1189	57	0	0	1 (2%)	50 (98%)
Fresh interburden (n=73)	0.4	253	35	1 (<2%)	1 (<2%)	3 (4%)	68 (93%)

Only five samples (~3% of samples) have ANC/MPA ratios less than two, however three of these samples have total sulfur values of 0.1% or less, and are therefore regarded as 'barren' with respect to sulfur concentration. Therefore, bulk spoil materials represented by these samples are considered to have a very low risk of acid generation, excess ANC, and a high factor of safety with respect to acid generation.

Geochemical Classification of Potential Spoil

The ABA results presented in this section have been used to classify the acid forming nature of potential spoil samples as shown in **Appendix B – Table B1**. The geochemical classification (acid forming nature) of these samples is summarised in **Table 8**.

Table 8. Geochemical Classification of Spoil Samples

	NAF-Barren[1]	NAF[2]	Uncertain	PAF
No. and (%) of weathered overburden samples (n=42)	41 (98%)	1 (2%)	-	-
No. and (%) of fresh overburden samples (n=51)	50 (98%)	1 (2%)	-	-
No. and (%) of fresh interburden samples (n=73)	61 (84%)	10 (14%)	1 (~1%)	1 (~1%)
No. and (%) of **all** spoil samples (n=166)	152 (92%)	12 (7%)	1 (<1%)	1 (<1%)
% of **all** spoil samples (n=166)	164 (99%)		1 (<1%)	1 (<1%)

1: Samples have been conservatively classified as NAF-Barren where total sulfur concentration is less than 0.05%.
2: Spoil samples classified as 'NAF' all have total sulfur concentrations less than 0.25%, and are sub-classified as 'NAF-LowS' as per Section 2.4.

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

The results in **Table 8** show that almost all spoil samples tested (99%) fall in the NAF-Barren or NAF categories, and spoil materials represented by these samples have very low sulfur values, excess ANC (relative to the MPA) and clearly have negligible capacity to generate acidity. A carbonaceous siltstone interburden sample was classified as PAF. A siltstone interburden sample had an ‘uncertain’ classification.

From an acid generating perspective, spoil (as a bulk material) would be overwhelmingly NAF. This has implications for soluble metals/metalloids transport, as alkaline spoil would inhibit the release of soluble metals/metalloids, compared to the relatively high soluble metals/metalloids concentrations possible in acidic drainage. Furthermore, the very low sulfur concentrations in potential spoil indicate that the sulfate concentration that could be generated in spoil from sulfide oxidation (in addition to any existing sulfate) would also be very low.

3.2 Acid-Base Account Results for Potential Coal Reject Samples

ABA results for the 34 potential coal reject samples that underwent geochemical characterisation are presented in **Appendix B – Table B2** and summarised as follows. The laboratory certificates for these samples are provided in **Appendix C**. The samples comprised 21 samples from the LL seam (7 samples from LL1, 8 samples from LL2 and 6 samples from LL3) and 13 samples from the VU seam.

The results in this section are presented by coal seam (LL1, LL2, LL3 and VU), however are generally discussed as a ‘bulk’ potential coal reject material, unless specifically noted.

Electrical Conductivity and pH of Potential Coal Reject

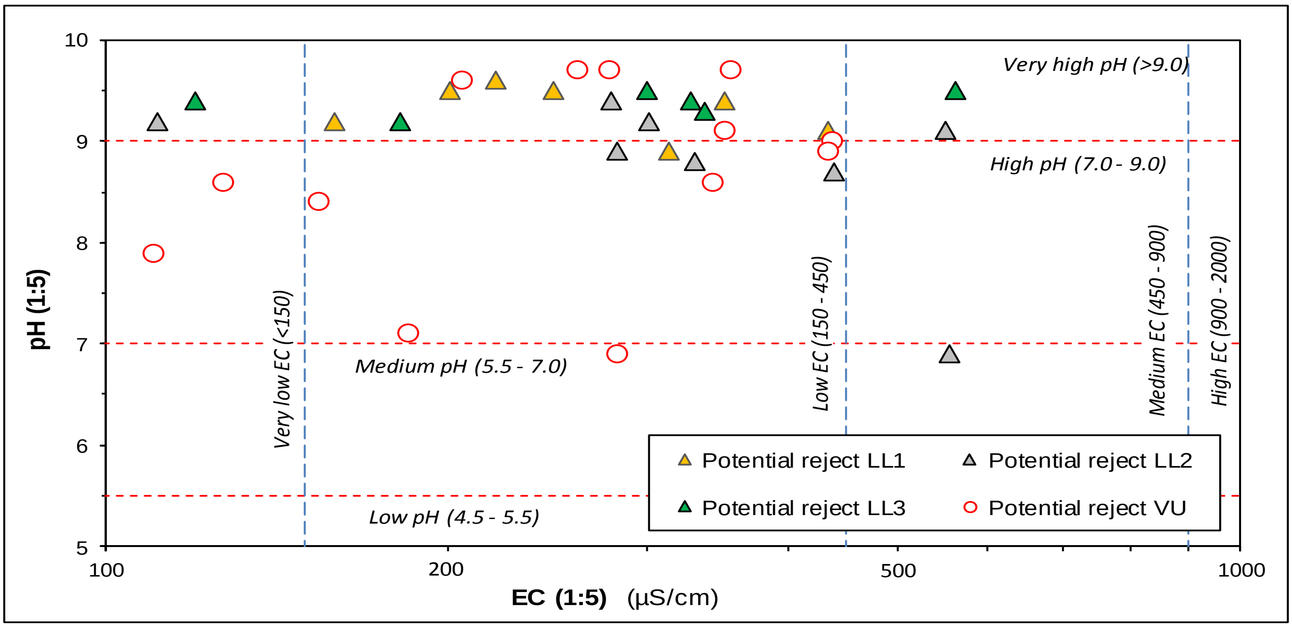
The $EC_{1:5}$ values for potential coal reject samples span a relatively tight range from 110 to 561 µS/cm (**Figure 5**), with a median EC of 292 µS/cm and similarly low 90th percentile value of 438 µS/cm. Based on the DME (1995) soil salinity (EC) classification, potential coal reject, as a bulk material, is expected to have ‘Low’ soil salinity.

The $pH_{1:5}$ of potential coal reject samples span a broad range from pH 6.9 to pH 9.7 (**Figure 5**), with 10th, 50th and 90th percentile values of pH 8.1, 9.2 and 9.6, respectively. Based on the DME (1995) soil pH classification, potential coal reject, as a bulk material, is expected to have ‘High’ to ‘Very High’ soil pH. Generally, the VU seam samples have a greater pH distribution compared to the LL seam samples.

Note: The actual salinity and pH of coal reject at the time of disposal may be different to the values shown, depending on the pH and EC of the process water and the chemistry of any potential additives used in the coal washing process.

Figure 5. Electrical Conductivity (EC) and pH of Potential Coal Reject Samples

The EC and pH classifications shown correspond to DME (1995) soil salinity and soil pH classifications



Sulfur in Potential Coal Reject

The total sulfur concentration of the potential coal reject samples spans a broad range of values from 0.02% to 1.78%, with median (50^{th}), 75^{th} and 90^{th} percentile values of 0.08%, 0.31% and 0.78%, respectively. Of all 34 samples, 18 samples (53%) have total sulfur values less than or equal to 0.1% and therefore are generally regarded as ‘barren’. 82% of samples (28 out of 34 samples) have total sulfur values less than or equal to 0.4%.

The relationship between the various coal reject ‘sources’ being discussed (with respect to sulfur concentration) is shown in **Figure 6**, which illustrates that sulfur distribution is generally greater in potential coal reject samples from the VU seam (although the LL2 seam had samples with ‘outlier’ total sulfur values).

Sulfide-sulfur (as Scr) concentration was measured in 16 of the 34 potential coal reject samples. Scr values in the potential coal reject samples ranged from 0.02% to 1.46%, with 75^{th} and 90^{th} percentile values of 0.51% and 1.11%, respectively. On average, Scr comprises about 27% of the total sulfur concentration, however the proportions ranged from <1% to 100% - as evident in **Figure 7** by the scatter of data both along (close to) and further to the right of the unity line (the dashed line showing total sulfur = sulfide sulfur). Total sulfate was measured on the same samples as Scr, and found that sulfur as sulfate (SO_4-S) was a relatively small proportion of total sulfur in these samples (SO_4-S <0.1%).

Figure 6. Total Sulfur Concentrations for Potential Coal Reject Samples

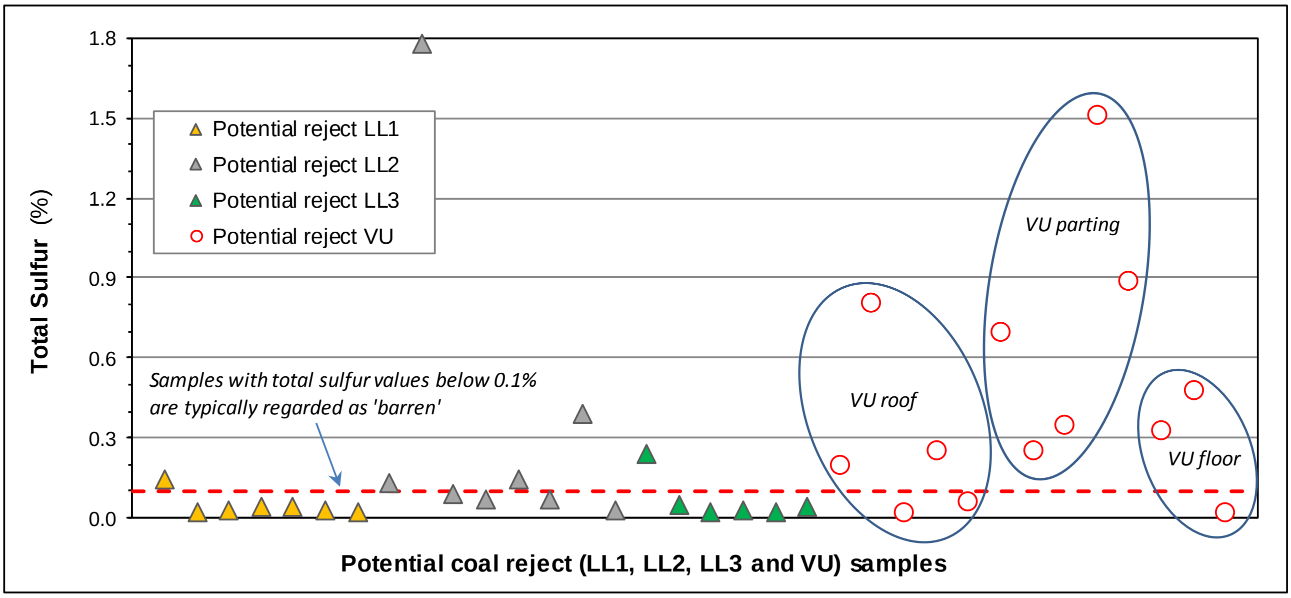
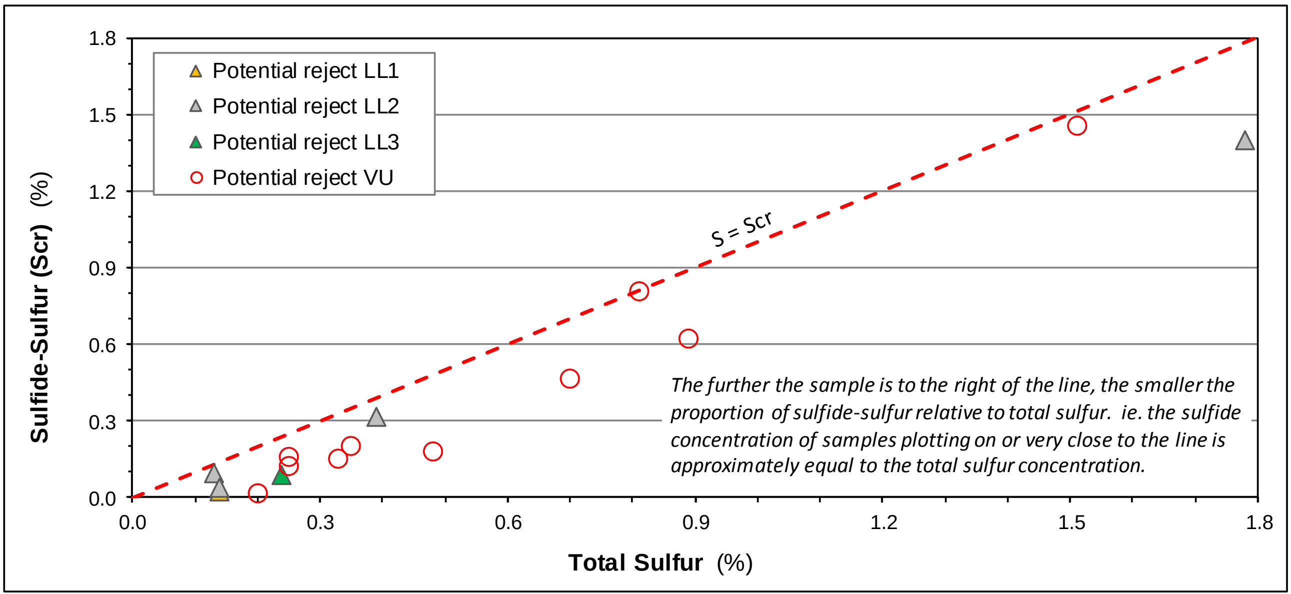


Figure 7. Total Sulfur versus Sulfide-Sulfur Concentrations for Potential Coal Reject Samples



Maximum Potential Acidity and Acid Neutralising Capacity of Potential Coal Reject

The ANC and MPA that could be generated by potential coal reject samples (MPA calculated from Scr, where available) is summarised in **Table 9** and shown in **Figure 8**. As previously mentioned, Scr was determined on all samples with total sulfur values greater than 0.1%, which was about half of the potential coal reject samples. Therefore, the MPA values for about half of the potential coal reject samples were calculated using the Scr value. For the potential coal reject samples with very low sulfur concentrations (≤ 0.1%), MPA was calculated using the total sulfur value.

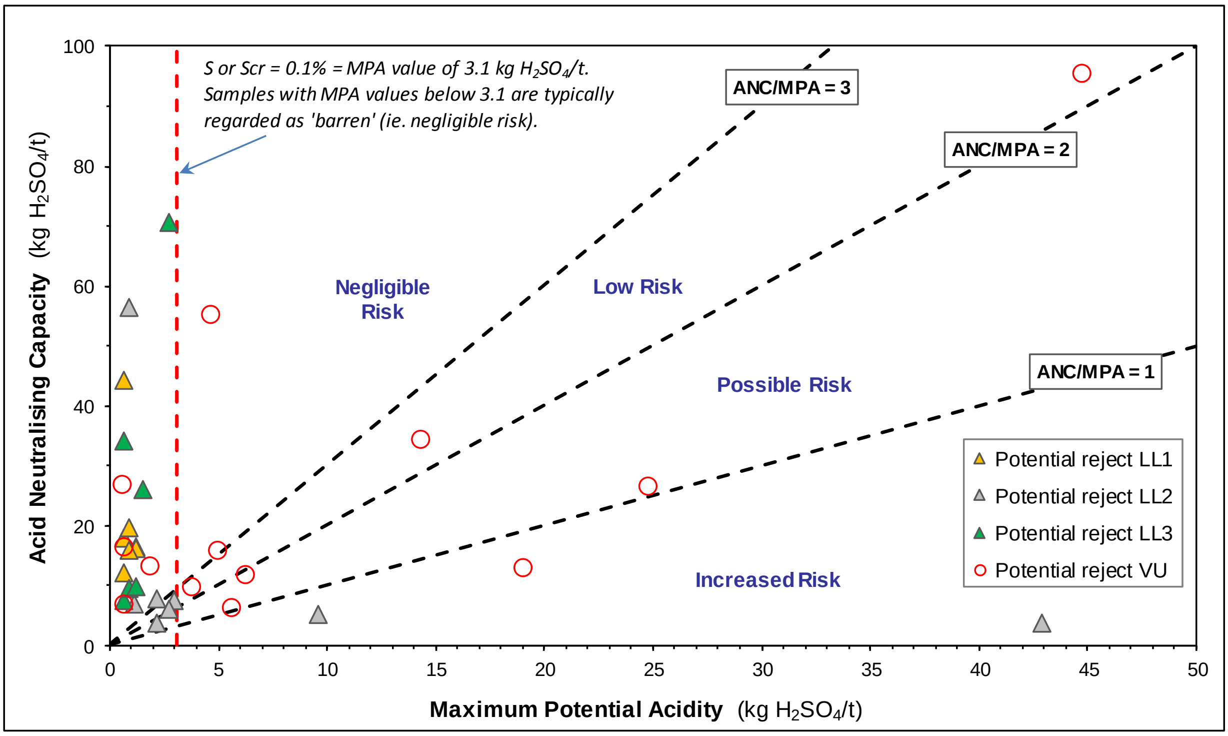
Table 9. Summary Maximum Potential Acidity (MPA) and Acid Neutralising Capacity (ANC) Values for Potential Coal Reject Samples

	Min. kg H2SO4/t	Max. kg H2SO4/t	Median kg H2SO4/t	25th / 75th / 90th percentiles	General Comments
MPA	0.6	45	**1.7**	**0.9 / 4.9 / 18**	Generally low
ANC	3.7	95	**15**	**7.6 / 26 / 52**	Generally moderate

The MPA values for potential coal reject samples are generally low, with a very low median MPA of <2 kg H_2SO_4/t and relatively low 75th percentile value of 5 kg H_2SO_4/t, however MPA values are widely distributed (**Figure 8**).

Similarly, the ANC values for potential coal reject samples are also widely distributed (from <4 to 95 kg H_2SO_4/t), however generally the ANC values are moderate. The samples have a median ANC value of 15 kg H_2SO_4/t, and a 25th percentile value of 7.6 kg H_2SO_4/t, respectively. That is, 75% of potential coal reject samples have ANC values greater than 7.6 kg H_2SO_4/t.

Figure 8. Maximum Potential Acidity (MPA) and Acid Neutralising Capacity (ANC) for Potential Coal Reject Samples



As discussed earlier in **Section 3.1**, the readily available proportion of ANC can vary (between lithologies) depending on the type(s) of carbonate minerals present in the various samples. Carbonaceous and coaly samples in Bowen Basin materials typically have less available neutralising capacity compared with non-carbonaceous materials. ABCC tests were undertaken on five VU seam potential coal reject samples to assess the readily available neutralising capacity in these samples. The results (provided in **Appendix C**) show that between 5% and 100% (median 27%) of the 'standard' ANC is likely to be in a readily available form.

These results are consistent with those for carbonaceous samples within interburden discussed in **Section 3.1** and suggest that, indicatively, about one-quarter to one-third of the ANC in potential coal reject materials would be in a readily available form to neutralise potential acidity.

Despite the low MPA and modest ANC values, and taking into account the proportion of ANC that's in a readily available form, an excess of ANC compared to MPA remains in most of the potential coal reject samples (as a bulk material). Therefore, as a 'bulk' material, coal reject is expected to have sufficient neutralising capacity to buffer any generated acidity. This is highlighted by the NAPP values and ANC/MPA ratios discussed below. Some samples from the VU seam display a greater level of 'risk' compared to other coal reject samples generally. This is discussed later in the 'ANC/MPA ratios' sub-section.

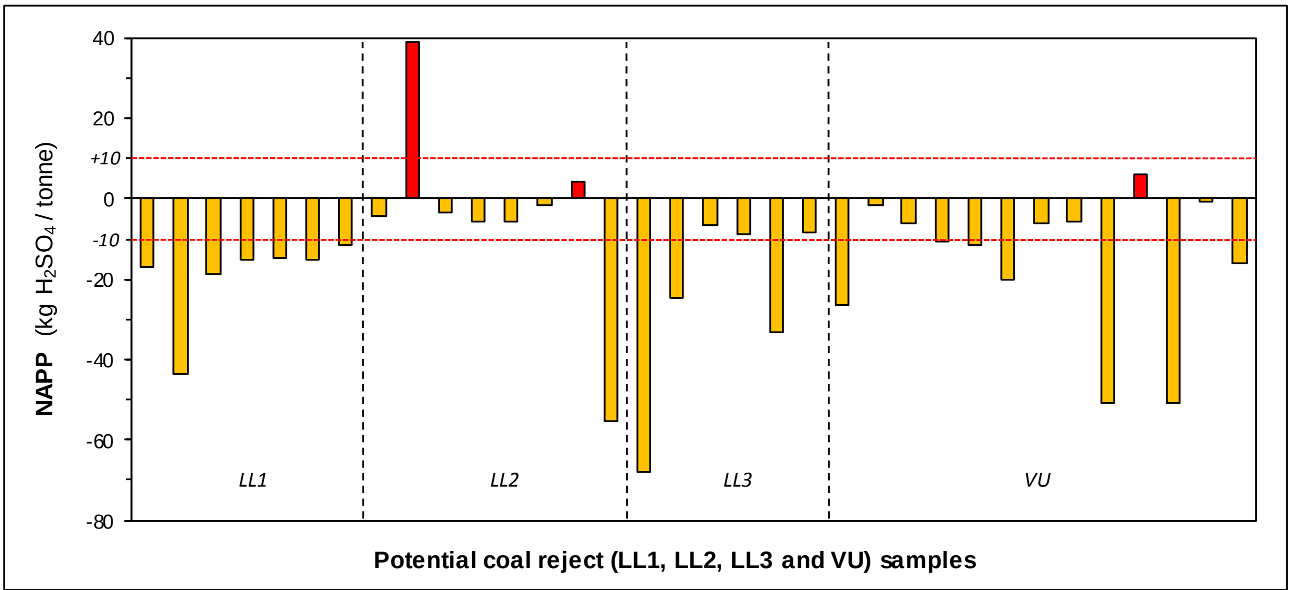
Net Acid Producing Potential of Potential Coal Reject

The NAPP values for potential coal reject samples are summarised in **Table 10** and shown in **Figure 9**. Of the 34 potential coal reject samples, three samples had positive NAPP values. Of these, only one sample had a NAPP value greater than +10 kg H_2SO_4/t. Just over half (53%) of samples have NAPP values below -10 kg H_2SO_4/t.

Table 10. Summary Net Acid Producing Potential (NAPP) Values for Potential Coal Reject Samples

	Min. kg H2SO4/t	**Max.** kg H2SO4/t	**Median** kg H2SO4/t	**25th / 75th / 90th percentiles**	**General Comments**
NAPP	-68	+39	**-11**	**-20 / -6 / -1**	Typically, negative NAPP values

Figure 9. Net Acid Producing Potential (NAPP) for Potential Coal Reject Samples



ANC/MPA Ratios of Potential Coal Reject

Generally, those samples with an ANC/MPA mass ratio greater than two are considered to have a negligible/low risk of acid generation and a high factor of safety in terms of potential for AMD (DIIS, 2016; INAP, 2009[4]).

The results, which are summarised in **Table 11**, show that 27 potential coal reject samples (79% of samples) have an ANC/MPA ratio greater than two and 59% of potential coal reject samples have an ANC/MPA ratio greater than 5.

Table 11. Summary ANC/MPA Ratios for Potential Coal Reject Samples

ANC/MPA ratio	Min.	Max.	Median	Number and (%) of samples with ANC/MPA ratios:			
				Less than 1	**Between 1 and 2**	**Between 2 and 5**	**Greater than 5**
All pot. reject samples (n=34)	0.1	72	**9.2**	3 (~9%)	4 (12%)	7 (21%)	20 (59%)
LL1 pot. reject samples (n=7)	13	72	**20**	0	0	0	7 (100%)
LL2 pot. reject samples (n=8)	0.1	61	**2.4**	2 (25%)	1 (13%)	3 (38%)	2 (25%)
LL3 pot. reject samples (n=6)	8	56	**15**	0	0	0	6 (100%)
VU pot. reject samples (n=13)	0.7	49	**2.6**	1	3 (23%)	4 (31%)	5 (38%)

Note: Percentages may have minor discrepancies due to rounding

As is also evident in **Table 11**, potential coal reject samples from the LL1 and LL3 seams have greater ANC/MPA ratios (generally) compared to potential coal reject samples from the LL2 and VU seams.

Seven (7) potential coal reject samples (21% of samples) have ANC/MPA ratios less than two, and four of these samples have an ANC/MPA ratio of between one and two, indicating that these four samples have a 'theoretical' excess of ANC relative to MPA. However, it cannot be assumed that all of this ANC would be available to neutralise potential acidity (as discussed earlier with regard to the readily-available nature of the neutralising capacity). Of the seven potential coal reject samples with ANC/MPA ratios less than two, three samples have ANC/MPA ratios less than one.

As discussed earlier, potential coal reject samples from the VU seam are estimated to have about one-quarter to one-third of their ANC in a readily-available neutralising form. Therefore, for potential coal reject materials (as a bulk material), it should be assumed that only about one-third of the ANC would be in a readily-available form to neutralise any acidity. About 65% of potential coal reject samples (22 samples, predominantly from the LL1 and LL3 seams) have ANC/MPA ratios greater than three – and should have sufficient readily-available ANC to buffer any generated acidity.

Therefore, about 65% of all potential coal reject samples (as a bulk material), and 100% (all) of the LL1 and LL3 potential coal reject samples, have significant excess of ANC relative to MPA. The remainder of the potential coal reject bulk materials, generally, have limited excess of ANC relative to MPA. Therefore, as a bulk material, coal reject materials represented by these samples are considered to have a low risk of significant acid generation, but there is the potential for coal reject materials to generate some acidity, although due to the low sulfur (and sulfide) concentrations the magnitude of any acidity generated is expected to be able to described as 'low capacity'.

Geochemical Classification of Potential Coal Reject

The ABA results presented in this section have been used to classify the acid forming nature of the potential coal reject samples as shown in **Appendix B – Table B2**. The geochemical classification (acid forming nature) of these samples is summarised in **Table 12**.

Table 12. Geochemical Classification of Potential Coal Reject Samples

	NAF-Barren[1]	NAF[2]	Uncertain	PAF
No. and (%) of LL1 potential reject samples (n=7)	6	1	-	-
No. and (%) of LL2 potential reject samples (n=8)	4	1	1	2
No. and (%) of LL3 potential reject samples (n=6)	5	1	-	-
No. and (%) of VU potential reject samples (n=13)	3	3	6	1
No. and (%) of **all** potential coal reject samples (n=34)	18 (53%)	6 (18%)	7 (~21%)	3 (~9%)
% of **all** potential coal reject samples (n=34)	24 (71%)		7 (~21%)	3 (~9%)

1: Samples have been classified as NAF-Barren where total sulfur concentration is less than 0.1%.
2: Except for one sample, all samples classified as 'NAF' have total sulfur concentrations less than 0.25% and are sub-classified as 'NAF-LowS' as per Section 2.4. One potential reject sample from VU seam was classified as 'NAF-HighS' as per Section 2.4.
Note: Percentages may have minor discrepancies due to rounding.

With respect to the potential coal reject samples, about 71% of samples tested fall in the NAF-Barren or NAF categories (**Table 12**), and coal reject materials represented by these samples have very low sulfur values, excess ANC (generally) and have little to no capacity to generate acidity.

Three (3) potential coal reject samples (about 9% of all potential coal reject samples) were classified as PAF. About 21% of samples had an 'Uncertain' classification due to a conflicting relationship between near-zero NAPP values, sulfur (or Scr) and ANC values, as discussed in **Section 3.2**. From a coal reject management point of view, it is conservatively assumed that up to 30% of potential coal reject *could* have some potential to generate acid (with no management controls in place), however the magnitude of any acidity generated (if at all) would be expected to be relatively low and would be expected to be easily managed.

Since spoil is overwhelmingly NAF, any un-economic coal seam material reporting as spoil (mixed with non-coal spoil) would not have any significant impact on the overall geochemical characteristics of bulk spoil, since the proportion of uneconomic seams (volume/tonnage), relative to non-seam overburden and interburden, is very small.

From an acid generating perspective, coal reject (as a bulk material) is generally expected to be NAF. However, since about 9% of samples are classified as PAF and about 21% of samples classified as 'Uncertain' (and would need to be assumed as PAF as 'worst' case'), then the implication is that coal reject materials are regarded as having a potentially greater environmental 'risk' profile compared to spoil samples. Regardless, the generally low sulfide concentrations of most coal reject materials (as bulk materials) indicate that the sulfate concentration that could be generated by these materials (if oxidised) is also expected to be relatively low.

3.3 Metals and Metalloids in Potential Spoil and Coal Reject Materials

Selected potential spoil and coal reject samples were subjected to a mixed acid (four acid) digest to determine the concentration of a broad suite of metal and metalloid elements. The multi-element (solid) test results for 35 samples, comprising 27 potential spoil samples and eight potential coal reject samples are presented in **Appendix B – Table B3**. The ALS laboratory certificates for these 35 samples subjected to multi-element analysis are provided in **Appendix C**.

The results are compared to background concentrations for each element, based on average elemental abundance in soil in the earth's crust. The comparison is determined by the GAI, as outlined in **Section 2.3**. GAI values of three are regarded as 'moderately' enriched (with respect to average elemental abundance) and GAI values of four or more are regarded as 'significantly' enriched. The GAI values are presented in **Appendix B – Table B4**, and show that:

- Potential Spoil: one fresh overburden sample is significantly enriched with respect to barium (Ba); and one fresh interburden sample is moderately enriched with respect to antimony (Sb); and
- Potential Coal Reject: one LL2 roof sample is moderately enriched with respect to Ba; and one VU sample is moderately to significantly enriched with respect to mercury (Hg) and Sb.

The environmental significance of identified metal concentrations in potential spoil and coal reject materials and their water solubility in terms of risk is discussed in **Section 4**.

3.4 Initial Solubility of Potential Spoil and Coal Reject Materials

To evaluate the initial solubility of multi-elements in potential spoil and coal reject materials, water extract (1:5 sample:water) tests were completed for each of the 35 samples that also underwent 'total element' analysis. The results from these tests are provided in **Appendix B – Table B5** (pH, EC and major ions) and **Table B6** (metals and metalloids) and summarised below. The ALS laboratory certificates for the samples subjected to soluble multi-element analysis are provided in **Appendix C**.

Approximately 70% of potential spoil samples (19 of 27 samples) and seven of the eight potential coal reject samples have some soluble metals/metalloids concentrations that are 'elevated' with respect to the ANZECC (2000) aquatic ecosystem guideline level (for slightly to moderately disturbed systems) for Al and/or As. Four spoil samples and two potential coal reject samples each have soluble selenium (Se) concentrations above the applied aquatic ecosystem guideline level (for slightly to moderately disturbed systems). One potential coal reject sample (a VU parting sample) also has a soluble Se concentration marginally above the applied ANZECC (2000) livestock drinking water quality guideline level for Se.

With regard to soluble Al, As and Se the laboratory limit of reporting (LOR) is higher than the applied aquatic ecosystem guideline concentration for each of these three elements, therefore any result above the laboratory LOR results in a 'technical exceedance' of the applied aquatic ecosystem guideline value. Where the single VU coal reject sample has exceeded the applied livestock drinking water quality guideline level for Se the 'exceedance' is minor (*ie*. the value is just above the livestock drinking water quality guideline value).

The remaining soluble elements (*ie*. other than Al, As and Se) and ions are at concentrations below the applied livestock drinking water quality and aquatic ecosystem quality guidelines (where guideline values exist), and in most cases, below the laboratory LOR.

The environmental significance of identified soluble metal/metalloid concentrations in potential spoil and coal reject materials in terms of risk is discussed in **Section 4**, however it is important to note that the soluble metal/metalloid results presented in this report represent an 'assumed worst case' scenario as the samples are pulverised (to less than 75 µm in diameter) prior to testing. Therefore, samples have a very high surface area compared to likely materials in the field. Materials would also be well mixed at storage locations. Hence, as is typically the case for many coal mines in the Bowen Basin, it is expected that the concentration of metals/metalloids in surface run-off and seepage from spoil (and coal reject) materials would be significantly less than the laboratory results from these 'pulped' samples in the field.

It should be noted that the applied guideline values are provided to place the results into context. The applied guideline values are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to total and soluble metals/metalloids in potential spoil and coal reject materials.

3.5 Cation Exchange Capacity, Sodicity and Dispersion of Potential Spoil

To evaluate the potential 'soil quality' of spoil materials, exchangeable cation concentrations were measured on 24 potential spoil samples and the results are presented in **Appendix B – Table B7** and key aspects summarised in **Table 13**. The laboratory certificates for these samples are provided in **Appendix C**.

From a soil chemistry view-point the potential spoil materials have different soil characteristics compared to the potential coal reject materials, and coal reject materials would not report to final landform surfaces as they would be covered by spoil material. Furthermore, over 98% of all mining waste would be mined spoil. With this in mind, the suitability of mining waste materials for use in revegetation and rehabilitation is focused on the spoil materials.

The CEC of potential spoil samples (all 24 samples) range from 6.6 to 25.4 milliequivalents per 100 grams (meq/100g), with a moderate median CEC value of 17 meq/100g. The ESP results span a broad range, from a low 1.5% to a high 31.2%, however the results are generally moderate - with a median ESP of 11%, and 25th and 75th percentile values of 6% and 19%, respectively.

To put these results into context, an ESP value of 6% or greater generally indicates that soil materials are regarded as sodic and *may* be prone to dispersion (Isbell, 2002) and soil with an ESP value greater than 14% is regarded as strongly sodic (Northcote and Skene, 1972). Strongly sodic materials are likely to have structural stability problems related to potential dispersion (Van de Graaff and Patterson, 2001). However, other important factors such as clay mineralogy, soil sodium concentration, soil salinity and irrigation water (rainwater) chemistry may enhance or limit that potential for soil to be sodic or become sodic over time. Therefore, values of 6% ESP and 14% ESP to represent soils as being sodic or strongly sodic are used as a general guide and should not be taken as definitive.

With regard to the 6% and 14% 'guide' values, 10 of the 24 potential spoil samples (*ie*. 42% of samples tested) have ESP values greater than 14%, of which eight were fresh (unweathered) interburden samples. The remainder comprised one fresh overburden sample and one weathered overburden sample.

Table 13. Cation Exchange Capacity, Sodicity and Dispersion Summary Results for Potential Spoil Samples

Sample ID	Formation	Lithology	Weathering	$EC_{1:5}$ µS/cm	CEC meq/100g	ESP %	Sodicity Rating	Exch. Ca/Mg ratio	Emerson Class	Emerson Class Dispersion rating
5003	Tertiary	FF.Sand	Extremely	453	6.6	8.7	Sodic	0.9	3	Dispersive
4802	Tertiary	Clay & MC.Sand	Highly	383	9.7	24.3	Strongly sodic	0.3	2	Some dispersion
4502	Rewan	Claystone	Extremely	682	20.8	5.1	Non-sodic	4.8	3	Dispersive
4203	Rewan	Siltstone	Highly	1050	21.2	5.7	Non-sodic	1.5	4	Non-dispersive
4304	Rewan	FM.Sandstone & Siltstone	Moderately	886	18.5	11.3	Sodic	1.2	4	Non-dispersive
5105	Rewan	F.Sandstone & Siltstone	Moderately	466	25.4	1.5	Non-sodic	5.3	4	Non-dispersive
4211	Rewan	FF.Sandstone & Siltstone	Fresh	279	17.5	6.1	Sodic	2.9	-	-
4307	Rewan	FM.Sandstone & Siltstone	Fresh	309	13.8	8.2	Sodic	2.4	-	-
4809	Rewan	Claystone	Fresh	446	17.2	10.5	Sodic	1.8	-	-
4813	Rewan	FF.Sandstone & Siltstone	Fresh	409	19.0	8.2	Sodic	2.1	-	-
4507	Rewan	FM.Sandstone	Fresh	602	13.5	20.2	Strongly sodic	1.0	-	-
5011	Rewan	VF Sandst., Siltst. & Clayst.	Fresh	265	19.5	5.3	Non-sodic	4.3	-	-
5112	Rangle	VF.Sandstone & Siltstone	Fresh	278	24.9	2.1	Non-sodic	6.7	-	-
5120	Rangal	VF.Sandstone & Siltstone	Fresh	297	14.0	19.0	Strongly sodic	3.1	-	-
4220	Rangal	Claystone	Fresh	383	21.5	5.2	Non-sodic	2.9	-	-
4229	Rangal	FF.Sandstone & Siltstone	Fresh	319	16.0	20.1	Strongly sodic	3.8	-	-
4316	Rangal	FF.Sandstone & Siltstone	Fresh	222	11.8	17.9	Strongly sodic	2.1	-	-
4319	Rangal	Claystone	Fresh	222	11.3	24.6	Strongly sodic	1.9	-	-
4709	Rangal	FM.Sandstone	Fresh	371	23.2	1.7	Non-sodic	7.0	-	-
4511	Rangal	Siltstone	Fresh	497	14.9	14.6	Strongly sodic	1.3	-	-
4512	Rangal	FF.Sandstone & Siltstone	Fresh	354	14.0	21.9	Strongly sodic	1.7	-	-
5016	Rangal	Siltstone	Fresh	223	12.4	15.1	Strongly sodic	4.6	-	-
5033	Rangal	Claystone	Fresh	351	20.6	12.6	Sodic	10.0	-	-
5129	Yarrabee	Tuff	Fresh	352	21.8	31.2	Strongly sodic	2.6	-	-

The six weathered overburden samples subjected to exchangeable cation tests also underwent Emerson class tests to determine whether these samples were dispersive. Emerson class tests are a direct measure of soil dispersion, whereas ESP values are used as an indirect measure of the *potential* for a sample to have structural stability problems and hence *may be* dispersive. The results (**Table 13**) show that three of the weathered samples were non-dispersive (Class 4), one sample had some dispersion (Class 2) and two samples were dispersive (Class 3). The three samples that were dispersive (or showed some dispersion) were all highly to extremely weathered. The results showed that weathered overburden materials are a mix of dispersive and non-dispersive materials.

For the six weathered overburden samples that underwent Emerson class testing, there was only a loose correlation between the Emerson class test results (being dispersive or not) and the sodicity (predicting dispersion on the basis of ESP).

At the northern section of the Olive Downs South domain about half of the spoil samples tested had ESP values that suggest they have some degree of sodicity, which suggests that some significant proportion of spoil *may* be prone to some degree of dispersion (or soil structure problems). Materials with exchangeable calcium to magnesium ratios (exch. Ca/Mg) of less than 0.5 are strongly associated with dispersion. Of the 24 spoil samples tested, only one weathered overburden sample had an exch. Ca/Mg ration of less than 0.5 (and the Emerson class testing found this sample to have some dispersion). This poor correlation between exch. Ca/Mg ratio data and ESP data supports the uncertainty around inferring (or assuming) dispersion on the basis of ESP data alone.

These exchangeable cation (and Emerson class) results are common (if not typical) for Bowen Basin Permian and Tertiary materials based on Terrenus' significant experience in the region – and highlight that spoil is likely to have mixed sodicity and dispersion potential.

Ideally, highly sodic and dispersive materials should be identified, selectively handled and placed within the core of spoil emplacements away from final surfaces, or returned to voids during mining. However, in practice, spoil comprises such a large amount of waste that selective handling and disposal of potentially sodic spoil is impractical, if not impossible. As such, the management of spoil would need to focus on maintaining relatively low (shallow) slopes and undertaking progressing rehabilitation of spoil to minimise the potential for erosion and landform degradation.

The environmental significance of exchangeable cation values and sodicity levels in spoil materials in terms of risk and potential revegetation management is outlined in **Section 4**, however readers are urged to consult the separate soils assessment undertaken as part of the environmental approvals for the Project for a detailed assessment of soil properties with regard to rehabilitation.

4 Geochemical Characteristics of Potential Spoil and Coal Reject from Olive Downs South Domain

The geochemical characteristics of potential spoil (overburden and interburden) and potential coal reject materials from the northern section of the Olive Downs South domain have been assessed. Mining operations are proposed to commence at the northern end of the Olive Downs South domain and continue southwards for approximately the first 10 years of operations – before moving further south to the Willunga domain.

The characterisation and assessment program was undertaken to enable the Proponent to understand the existing environmental geochemical characteristics of these materials, the potential operational impacts these materials may have on the Project during approximately the first 10 years of operations and the potential environmental impacts these materials may have on the Project and neighbouring area and following closure (post-closure).

The environmental geochemical characteristics of the materials are summarised below.

The main focus of the assessment is on spoil materials, which would comprise almost all of the mineral waste for the Project, with coal reject materials comprising less than 2% of all mineral waste over the life of the operation.

Spoil

- Spoil, as a bulk material, is expected to generate pH-neutral to alkaline, low- to moderate-salinity surface run-off and seepage following surface exposure. Fresh (unweathered) overburden can be expected to have similar soil pH and salinity to fresh interburden, however weathered overburden is expected to be slightly more saline than fresh spoil.
- The total sulfur concentration of potential spoil is very low – and 95% of samples have a total sulfur concentration below 0.2% and 99% have a total sulfur concentration below 0.4%. Almost all spoil samples (164 out of 166 samples) are classified as NAF and most (93%) NAF samples are further classified as 'barren' with respect to sulfur concentrations. One sample was classified as PAF and one sample had an 'uncertain' acid classification.
- Total metal and metalloid concentrations in potential spoil samples are very low compared to average element abundance in soil in the earth's crust. Two fresh samples (out of 27 potential spoil samples) were moderately enriched in Ba and/or Sb with respect to average crustal abundance in soil.
- Soluble multi-element results indicate that leachate from bulk spoil has the potential to contain slightly elevated soluble Al, As and/or Se concentrations compared to applied ANZECC (2000) aquatic ecosystem protection water quality guideline concentrations. Slightly elevated concentrations for some metals/metalloids for spoil and coal reject materials are common at coal mines in the Bowen Basin and generally do not result in any significant water quality issues[5].

[5] Based on Terrenus' experience undertaking environmental geochemical assessments within the Bowen Basin for numerous coal projects and mines extracting spoil and coal and producing coal reject.

It is important to note that the results presented in this report represent an ‘assumed worst case’ scenario as the samples are pulverised (to less than 75 µm in diameter) prior to testing. Therefore, samples have a very high surface area compared to materials in the field. Materials would also be well mixed at storage locations. Hence, it is expected that the concentration of metal/metalloids in surface run-off and seepage from spoil (and coal reject) materials in the field would be significantly less than the laboratory results from these ‘pulped’ samples.

The applied guideline values are provided for context and are not intended as ‘trigger values’ or ‘maximum permissible concentrations’ with respect to total and soluble metals/metalloids in spoil materials. Due to a number of factors in the field (compared to the laboratory), including scale-up and dilution, any direct comparison of soluble multi-element concentrations in leachate from spoil is strictly not valid and should be used with caution.

- Potential spoil materials have a wide range of CEC values and associated ESP values, resulting in bulk spoil having a mixed sodicity and dispersion potential (non-sodic through to strongly sodic). Generally, the interburden samples had higher ESP values (and assumed greater potential for dispersion) compared to fresh overburden samples.

Potential Coal Reject

- Potential coal reject materials are expected to generate pH-neutral to alkaline, low-salinity surface run-off and seepage following initial surface exposure (assuming any process water or additives used in the CHPP do not significantly alter the ‘inherent’ pH and salinity of the natural materials).

- About 71% of potential coal reject samples are classified as NAF and about 9% classified as PAF (with a low capacity to generate significant acidity). All PAF samples were from the LL2 and VU seams. The remaining 21% (approximately) of samples (all from the LL2 and VU seams) were classified as Uncertain, primarily due to uncertainty around the availability of sufficient neutralising material. Overall, the sulfur concentrations in potential coal reject materials are relatively low, with 65% of samples having total sulfur concentrations below 0.2% and 83% of samples having total sulfur concentrations below 0.4%. Therefore, coal reject (as a bulk material) is regarded as relatively low risk, but has some potential to generate a small amount of acidity and relatively low concentrations of sulfate in an unmitigated environmental (*ie*. prior to management methods being adopted).

- Total metal and metalloid concentrations in potential coal reject samples are generally low compared to average element abundance in soil in the earth’s crust. Two potential coal reject samples (out of 8 samples) [one LL2 sample and one VU sample] were moderately enriched in one or more of Ba, Hg and/or Sb with respect to average crustal abundance in soil.

- Some potential coal reject materials could produce leachate containing slightly elevated concentrations of soluble Al, As and/or Se, as is common from Permian coal measures in the Bowen Basin[5]. As discussed previously, the results presented in this report represent an ‘assumed worst case’ scenario. Therefore, it is expected that the concentration of metals/metalloids in surface run-off and seepage from coal reject materials in the field would be significantly less than the laboratory results from these ‘pulped’ samples.

- Coal reject materials from individual and discrete seams (and plys/zones) display subtle geochemical variations (notable between LL1/LL3 vs LL2/VU), however the differences do not warrant selective handling and processing. As all coal reject is essentially ‘mixed’ during in-pit emplacement amongst NAF and alkaline spoil, very small proportions of potentially PAF materials and any elevated concentrations of soluble metals/metalloids from isolated coal reject sources would be significantly diluted amongst the bulk spoil material.
- The discussion of potential coal reject materials within this report must be read in context. Firstly, the quantity of coal reject materials produced (relative to spoil) would be very low (less than 2% of all mineral waste generated) and secondly, actual CHPP coal reject from the operational CHPP may have slightly different geochemical characteristics to these potential coal reject materials obtained from drill-core roof, parting and floor samples.

Potential ROM Coal

Potential ROM coal samples have not been assessed (as part of this assessment), as these materials are not regarded as waste and would remain on site for a relatively short period of time.

It can be reasonably assumed that ROM coal may have similar environmental geochemical characteristics to potential coal rejects, and would likely produce low-moderately saline, pH-neutral to alkaline run-off and seepage at the ROM stockpile.

The environmental management of coal (ROM coal and/or product coal) should therefore be focused on run-off and seepage collection and dust control, which are ‘standard’ management practices for ROM and product coal stockpiles in the Bowen Basin, and are outlined in **Section 6** below.

5 Geochemical Characteristics of Potential Spoil and Coal Reject from Willunga Domain

Sampling and geochemical assessment of potential spoil and coal reject materials from the Willunga domain has not been undertaken or included in this assessment, however would be undertaken in the Willunga domain during the development of the Project. Notwithstanding, the geology and stratigraphy (lithology) at the Willunga domain is broadly consistent with the Olive Downs South domain and, as such, it is expected that the geochemical characteristics of potential spoil and coal reject materials from the Willunga domain would be consistent with (very similar to) those from the Olive Downs South domain.

6 Management and Mitigation Measures

6.1 Spoil Management Strategy

Management of Spoil from Olive Downs South Domain

Spoil is overwhelmingly NAF with excess ANC and has a negligible risk of developing acid conditions. Furthermore, spoil is expected to generate relatively low-salinity surface run-off and seepage with relatively low soluble metal/metalloid concentrations. However, some spoil materials may be sodic (to varying degrees) with potential for dispersion and erosion (to varying degrees).

Where highly sodic and/or dispersive spoil is identified it should not report to final landform surfaces and should not be used in construction activities. Tertiary spoil has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program [ACARP], 2004).

It is expected that highly sodic and dispersive spoil may not be able to be selectively handled and preferentially disposed of at the Project, although the Proponent should take reasonable measures to identify and selectively place highly sodic and dispersive spoil. In the absence of such selective handling, spoil landforms should be constructed with short and low (shallow) slopes (indicatively slopes less than 15% and less than 200m long) and progressively rehabilitated to minimise erosion.

Where spoil is used for construction activities, this should be limited (as much as practical) to unweathered Permian sandstone materials, as these materials have been found to be more suitable for construction and for use as embankment covering on final landform surfaces. Regardless of the spoil type, especially where engineering or geotechnical stability is required, testing should be undertaken by the Proponent to determine the propensity of such materials to disperse and erode.

Surface run-off and seepage from spoil emplacements, including any rehabilitated areas, should be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids (TDS) and a broad suite of soluble metals/metalloids.

With the implementation of the proposed management and mitigation measures, the spoil is regarded as posing a low risk of environmental harm.

Management of Spoil from Willunga Domain

The management strategies applied to spoil from Olive Downs South domain would be expected to be applied to spoil from Willunga domain, on the basis that spoil from Willunga domain would have similar environmental geochemical characteristics to spoil from Olive Downs South domain. Notwithstanding, the Proponent would undertake validation test-work of potential spoil materials from Willunga domain as the Project develops to enable appropriate spoil management measures to be planned and implemented.

6.2 Coal Reject Management Strategy

Up to 30% of coal reject materials may have a relatively low degree of risk associated with potential acid generation, however as a bulk material (of relatively small total quantity), coal reject is regarded as posing a relatively low risk of environmental harm. This is primarily due to the typically low sulfur (and sulfide) concentration within this material (and also the low metals/metalloids concentrations), which suggests that the magnitude of any localised acid, saline or metalliferous drainage, if it occurs, is likely to be small, and would be confined to the open cut pits (or out-of-pit emplacements during the early years of mining). Therefore, when placed amongst alkaline NAF spoil within in-pit emplacements (or the out-of-pit emplacement area during the early years of mining) the overall risk of environmental harm and health-risk that emplaced coal reject poses is very low.

The management measures for fine reject (tailings) and coarse reject would be addressed by a Mineral Waste Management Plan, with the concepts outlined below.

Management of Fine Reject (Tailings)

Fine coal reject materials (tailings) are proposed to be pumped as a slurry to solar drying ponds in the mine infrastructure area. Flocculants would be added to the fine reject during pumping to the tailings/ILF cells and water recovered and recycled in the CHPP.

During the initial 2-3 years of operations (approximately, until in-pit emplacement areas become available) fine reject would be temporarily stored in the tailings/ILF cells and return water decanted for re-use in the mine water management system. When in-pit emplacements become available, dewatered fine reject would be excavated from the ILF cells and trucked to the in-pit emplacements (below existing ground level) and then buried by spoil.

Management of Coarse Reject

During the initial 2-3 years of operations (approximately, until in-pit emplacement areas become available) coarse reject materials will be trucked from the CHPP and placed in compacted layers within an out-of-pit emplacement. Once the coarse reject emplacement area is complete (filled), the facility would be covered with an appropriate capping layer and rehabilitated. After approximately Year 3, when in-pit emplacement areas become available, coarse reject would be trucked from the CHPP and placed within the in-pit emplacements (below existing ground level) and buried by spoil.

6.2.1 Management of Out-of-Pit Coal Reject Emplacement Areas

During Operations

Coal reject materials (whether fine or coarse) placed in the out-of-pit emplacement area would be buried by at least 10 m (unshaped cover thickness) of spoil within generally three months of placement. During operations, run-off and seepage from out-of-pit emplacements would be directed to the mine water management system.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of the out-of-pit spoil emplacement areas would be addressed by a Mine Closure Plan. However, as coal reject within out-of-pit spoil emplacements would be covered by a minimum of 10 m final thickness of spoil and would not report to final landform surfaces (or near-surfaces), the management of out-of-pit emplacement coal reject would not be expected to be significant to mine or pit decommissioning and rehabilitation.

6.2.2 Management of In-Pit Coal Reject Emplacement Areas

During Operations

Coal reject materials within in-pit emplacements would be placed below the expected final (post-closure) groundwater level and buried by at least 5 m (unshaped cover thickness) of spoil generally within three months of placement.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of the partially back-filled pit (and subsequent final void) would be addressed by a Mine Closure Plan. However, as coal reject would be covered by a minimum of 5 m final thickness of spoil and would not report to final landform surfaces (or near-surfaces), the management of in-pit emplacement coal reject would not be expected to be relevant to mine or pit decommissioning and rehabilitation.

6.3 Validation of Coal Reject Characteristics

The Proponent should undertake validation test-work of actual coal reject materials from the CHPP as the Project develops, particularly during the first two years of CHPP operation following commissioning and following commencement of mining and coal processing at the Willunga domain. Test-work should comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), acid-base account parameters, total metals and soluble metals.

6.4 ROM Stockpiles and CHPP

No ROM coal samples were characterised and assessed as part of this assessment, however ROM coal is expected to have similar environmental geochemical characteristics to potential coal reject materials. The Proponent should undertake periodic assessment of ROM coal and product coal materials as the Project develops to assist with their water management systems for ROM and product coal stockpiles (*ie*. to inform about potential water quality and allow appropriate management measures to be implemented).

ROM coal and product coal is typically stored at the site for a relatively short period of time (weeks) compared to mineral waste materials, which would be stored at the site in perpetuity. Management practices are therefore different for coal and would largely be based around the operational (day-to-day) management of surface run-off and seepage water from ROM coal and product coal stockpiles, as is currently accepted practice at coal mines in Australia.

Surface run-off and seepage from ROM coal and product coal stockpiles should be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS and a broad suite of soluble metals/metalloids.

7 References

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Appendix A

Summary Information for Drill-holes Utilised
in the Geochemistry Assessment

Table A1. Drill-hole Summary Information (Olive Downs South Domain)

Site ID	**Drill-hole ID**	**Easting** (m) GDA94, zone 55	**Northing** (m) GDA94, zone 55	**Collar elevation** (mRL)	**Depth** (m)	**Completion Date**	**Hole type** Cored interval (m) indicated. Non-cored interval was chipped.
CR04	IF3842PQ	640812.87	7546291.37	179.56	165.35	13 July 2017	44.85 to end of hole (165.35)
CR05	IF3843PQ	641339.51	7545173.49	179.55	168.34	17 July 2017	44.84 to end of hole (168.34)
CR17	IF3845PQ	642134.61	7542582.39	181.98	234.34	1 August 2017	56.82 to end of hole (234.34)
CR07	IF3847PQ	640443.90	7544485.15	192.37	84.14	5 August 2017	44.66 to end of hole (84.14)
CR06	IF3848PQ	640930.36	7544822.07	185.12	72.24	18 August 2017	37.51 to end of hole (72.24)
CR36	IF3850PQ	641310.38	7546094.98	180.50	175.89	25 August 2017	89.59 to end of hole (175.89)
CR03	IF3851PQ	640881.66	7546642.03	179.13	162.24	28 August 2017	75.34 to end of hole (162.24)

* All drill-holes are vertical (dip = 90 degrees).

Appendix B

Static Geochemical Results Tables

- Table B1 – Acid-base characteristics of potential spoil
- Table B2 – Acid-base characteristics of potential coal reject
- Table B3 – Total element concentrations in potential spoil and coal reject
- Table B4 – Geochemical abundance indices for potential spoil and coal reject
- Table B5 – Soluble major ions, pH and electrical conductivity in 1:5 water extracts from potential spoil and coal reject
- Table B6 – Soluble multi-element concentrations in 1:5 water extracts from potential spoil and coal reject
- Table B7 – Exchangeable cations and Emerson class number test results for potential spoil

Table B1. Acid-Base Characteristics of Potential Spoil

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
							µS/cm	%			kg H_2SO_4/t				
Weathered Overburden															
5101	CR03	IF3851PQ	2 - 4	Extremely	Clay	8.1	782	0.02	-	-	0.6	4.7	-4.1	7.7	NAF-barren
5102	CR03	IF3851PQ	13 - 15	Extremely	Sand, with Clay	8.5	794	0.02	-	-	0.6	6.3	-5.7	10.3	NAF-barren
4701	CR07	IF3847PQ	3 - 7	Extremely	MM.Sand	8.7	460	<0.01	-	-	0.2	21	-20.8	137.1	NAF-barren
4702	CR07	IF3847PQ	9 - 16	Extremely	MC.Sand	7.9	284	<0.01	-	-	0.2	2.9	-2.7	18.9	NAF-barren
4703	CR07	IF3847PQ	19 - 26	Extremely	FF.Sandstone, some Ironstone & Claystone	8.6	830	0.02	-	-	0.6	6.4	-5.8	10.4	NAF-barren
4704	CR07	IF3847PQ	29 - 32	Extremely	Siltstone, with Claystone	7.9	645	0.02	-	-	0.6	6.6	-6.0	10.8	NAF-barren
4501	CR17	IF3845PQ	5 - 11	Extremely	Sand	8.9	499	0.02	-	-	0.6	4.5	-3.9	7.3	NAF-barren
4502	CR17	IF3845PQ	15 - 20	Extremely	Claystone	9.0	682	0.02	-	-	0.6	12.3	-11.7	20.1	NAF-barren
4503	CR17	IF3845PQ	25 - 29	Extremely	FF.Sandstone & Siltstone	7.9	764	0.02	-	-	0.6	3	-2.4	4.9	NAF-barren
5001	CR36	IF3850PQ	0 - 4	Extremely	Clay	8.2	1670	0.02	-	-	0.6	9.7	-9.1	15.8	NAF-barren
5002	CR36	IF3850PQ	4 - 7	Extremely	Clay, some VF.Sand	7.6	1190	0.02	-	-	0.6	5.2	-4.6	8.5	NAF-barren
5003	CR36	IF3850PQ	9 - 14	Extremely	FF.Sand	8.7	453	0.02	-	-	0.6	3	-2.4	4.9	NAF-barren
5004	CR36	IF3850PQ	14 - 19	Extremely	FM.Sand	8.6	672	0.02	-	-	0.6	5.8	-5.2	9.5	NAF-barren
5005	CR36	IF3850PQ	19 - 23	Extremely	MM.Sand & Silt	8.8	405	0.02	-	-	0.6	3.4	-2.8	5.6	NAF-barren
5006	CR36	IF3850PQ	23 - 30	Extremely	Clay, with MC.Sand	8.4	495	0.02	-	-	0.6	3.6	-3.0	5.9	NAF-barren
4301	CR05	IF3843PQ	0 - 5	Highly to Extremely	Clay	8.2	1210	0.03	-	-	0.9	8.1	-7.2	8.8	NAF-barren
5103	CR03	IF3851PQ	22 - 25	Highly	Siltstone	7.6	774	<0.01	-	-	0.2	5.5	-5.3	35.9	NAF-barren
4201	CR04	IF3842PQ	4 - 12	Highly	Silt & Sand	9.5	675	<0.01	-	-	0.2	7.2	-7.0	47.0	NAF-barren
4202	CR04	IF3842PQ	12 - 15	Highly	Sand	8.8	698	0.02	-	-	0.6	3.9	-3.3	6.4	NAF-barren
4203	CR04	IF3842PQ	19 - 25	Highly	Siltstone, some Claystone	8.5	1050	0.02	-	-	0.6	8.5	-7.9	13.9	NAF-barren
4302	CR05	IF3843PQ	10 - 14	Highly	FM.Sand	8.9	301	0.02	-	-	0.6	2.3	-1.7	3.8	NAF-barren
4801	CR06	IF3848PQ	2 - 5.5	Highly	Clay	6.2	457	0.02	-	-	0.6	<0.5	0.6	0.3	NAF-barren
4802	CR06	IF3848PQ	7 - 10	Highly	Clay & MC.Sand	5.4	383	0.03	-	-	0.9	<0.5	0.9	0.2	NAF-barren
4803	CR06	IF3848PQ	13 - 16	Highly	FF.Sand	7.2	457	0.02	-	-	0.6	0.6	0.0	1.0	NAF-barren
4804	CR06	IF3848PQ	19 - 24	Highly	Claystone	8.7	892	0.03	-	-	0.9	26.8	-25.9	29.2	NAF-barren
4705	CR07	IF3847PQ	37 - 42	Highly	FM.Sandstone	9.3	454	<0.01	-	-	0.2	63.7	-63.5	416.0	NAF-barren
4504	CR17	IF3845PQ	39 - 43	Highly	FF.Sandstone & Siltstone	8.3	597	<0.01	-	-	0.2	7.6	-7.4	49.6	NAF-barren
5007	CR36	IF3850PQ	30 - 36	Highly	Siltstone	8.7	554	0.03	-	-	0.9	6.2	-5.3	6.7	NAF-barren
4303	CR05	IF3843PQ	17 - 22	Mod. to Highly	Siltstone, with FM.Sandstone	8.5	1070	0.02	-	-	0.6	9.4	-8.8	15.3	NAF-barren
5104	CR03	IF3851PQ	25 - 30	Moderately	Siltstone	8.2	830	<0.01	-	-	0.2	8.8	-8.6	57.5	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B1 (cont.) Acid-Base Characteristics of Potential Spoil

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5 µS/cm	S	SCR	SO4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
								%			kg H_2SO_4/t				
…cont. Weathered Overburden															
5105	CR03	IF3851PQ	36 - 39	Moderately	F.Sandstone & Siltstone	8.9	466	<0.01	-	-	0.2	55	-54.8	359.2	NAF-barren
4204	CR04	IF3842PQ	30 - 35	Moderately	Siltstone & Claystone	8.6	818	<0.01	-	-	0.2	9.8	-9.6	64.0	NAF-barren
4304	CR05	IF3843PQ	22 - 29	Moderately	FM.Sandstone & Siltstone	8.3	886	0.02	-	-	0.6	8.8	-8.2	14.4	NAF-barren
4805	CR06	IF3848PQ	24 - 29	Moderately	Siltstone	8.7	783	0.24	0.13	0.02	3.9	33.4	-29.5	8.5	NAF-Low S
4706	CR07	IF3847PQ	42 - 44.66	Moderately	FM.Sandstone	9.5	398	0.02	-	-	0.6	96	-95.4	156.7	NAF-barren
5008	CR36	IF3850PQ	36 - 42	Moderately	Siltstone	8.7	573	0.02	-	-	0.6	8.8	-8.2	14.4	NAF-barren
5106	CR03	IF3851PQ	39 - 42	Slightly	VF.Sandstone & Siltstone	8.6	524	0.02	-	-	0.6	22.3	-21.7	36.4	NAF-barren
4205	CR04	IF3842PQ	35 - 42	Slightly	Siltstone & Claystone	8.6	809	<0.01	-	-	0.2	17.4	-17.2	113.6	NAF-barren
4305	CR05	IF3843PQ	29 - 39	Slightly	Siltstone, some Claystone	8.3	936	<0.01	-	-	0.2	12.3	-12.1	80.3	NAF-barren
4806	CR06	IF3848PQ	31.5 - 33	Slightly	Coal & Carb.Claystone (LL3 oxidised)	8.7	985	0.02	-	-	0.6	3.8	-3.2	6.2	NAF-barren
4707	CR07	IF3847PQ	45.07 - 45.17	Slightly	FM.Sandstone	9.4	381	<0.01	-	-	0.2	64.3	-64.1	419.9	NAF-barren
4505	CR17	IF3845PQ	46 - 53	Slightly	FF.Sandstone & Siltstone	9.3	512	0.02	-	-	0.6	27.3	-26.7	44.6	NAF-barren
Fresh (unweathered) Overburden															
5107	CR03	IF3851PQ	45 - 51	Fresh	VF.Sandstone & Siltstone	8.9	433	0.02	-	-	0.6	21.7	-21.1	35.4	NAF-barren
5108	CR03	IF3851PQ	54 - 59	Fresh	Siltstone	9.2	327	0.07	-	-	2.1	37.8	-35.7	17.6	NAF-barren
5109	CR03	IF3851PQ	62 - 66	Fresh	FM.Sandstone, some Siltstone	9.3	230	0.02	-	-	0.6	66.4	-65.8	108.4	NAF-barren
5110	CR03	IF3851PQ	72 - 75.34	Fresh	Siltstone	9.3	274	0.02	-	-	0.6	38.8	-38.2	63.3	NAF-barren
5111	CR03	IF3851PQ	83.75 - 83.85	Fresh	FF.Sandstone	9.5	241	<0.01	-	-	0.2	30.1	-29.9	196.6	NAF-barren
5112	CR03	IF3851PQ	91.9 - 92	Fresh	VF.Sandstone & Siltstone	9.4	278	0.02	-	-	0.6	84.8	-84.2	138.4	NAF-barren
4206	CR04	IF3842PQ	42 - 44.85	Fresh	Siltstone, some FM.Sandstone	8.8	469	0.02	-	-	0.6	23.7	-23.1	38.7	NAF-barren
4207	CR04	IF3842PQ	49.5 - 49.6	Fresh	Siltstone	9.3	337	0.02	-	-	0.6	17.5	-16.9	28.6	NAF-barren
4208	CR04	IF3842PQ	53.9 - 54	Fresh	Claystone	9.2	277	<0.01	-	-	0.2	17.1	-16.9	111.7	NAF-barren
4209	CR04	IF3842PQ	60.9 - 61	Fresh	VF.Sandstone	9.4	297	<0.01	-	-	0.2	24.2	-24.0	158.0	NAF-barren
4210	CR04	IF3842PQ	69.9 - 70	Fresh	VF.Sandstone	9.3	266	0.02	-	-	0.6	126	-125.4	205.7	NAF-barren
4211	CR04	IF3842PQ	78.9 - 79	Fresh	FF.Sandstone & Siltstone	9.1	279	<0.01	-	-	0.2	18.5	-18.3	120.8	NAF-barren
4212	CR04	IF3842PQ	84.6 - 84.7	Fresh	MC.Sandstone	9.5	281	0.02	-	-	0.6	174	-173.4	284.1	NAF-barren
4213	CR04	IF3842PQ	87 - 87.1	Fresh	FF.Sandstone	9.2	266	<0.01	-	-	0.2	38.8	-38.6	253.4	NAF-barren
4214	CR04	IF3842PQ	94.5 - 94.6	Fresh	FF.Sandstone	9.3	259	0.02	-	-	0.6	63.3	-62.7	103.3	NAF-barren
4306	CR05	IF3843PQ	42 - 44.84	Fresh	Siltstone	8.6	711	0.03	-	-	0.9	51.2	-50.3	55.7	NAF-barren
4307	CR05	IF3843PQ	51 - 51.1	Fresh	FM.Sandstone & Siltstone	9.1	309	<0.01	-	-	0.2	182	-181.8	1188.6	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B1 (cont.) Acid-Base Characteristics of Potential Spoil

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5 µS/cm	S %	S_{CR} %	SO_4 %	MPA kg H_2SO_4/t	ANC kg H_2SO_4/t	NAPP kg H_2SO_4/t	ANC/MPA ratio	Acid Classification
…cont. Fresh (unweathered) Overburden															
4308	CR05	IF3843PQ	57.21 - 57.31	Fresh	Siltstone	9.2	324	<0.01	-	-	0.2	23.8	-23.6	155.4	NAF-barren
4309	CR05	IF3843PQ	67 - 67.1	Fresh	VF.Sandstone	9.4	334	<0.01	-	-	0.2	28.3	-28.1	184.8	NAF-barren
4310	CR05	IF3843PQ	76.9 - 77	Fresh	FM.Sandstone & Siltstone	9.6	274	<0.01	-	-	0.2	27.4	-27.2	178.9	NAF-barren
4311	CR05	IF3843PQ	83 - 83.1	Fresh	Siltstone	9.5	189	<0.01	-	-	0.2	13.2	-13.0	86.2	NAF-barren
4312	CR05	IF3843PQ	91.66 - 91.76	Fresh	FF.Sandstone	9.4	260	<0.01	-	-	0.2	58.6	-58.4	382.7	NAF-barren
4807	CR06	IF3848PQ	33 - 34	Fresh	FF.Sandstone	8.9	758	0.08	-	-	2.5	41.6	-39.2	17.0	NAF-barren
4808	CR06	IF3848PQ	35 - 37.51	Fresh	FF.Sandstone, some Carb.Claystone	8.9	801	0.06	-	-	1.8	32.5	-30.7	17.7	NAF-barren
4809	CR06	IF3848PQ	41.6 - 41.7	Fresh	Claystone	9.2	446	0.03	-	-	0.9	26.5	-25.6	28.8	NAF-barren
4810	CR06	IF3848PQ	42.14 - 42.24	Fresh	Siltstone	9.2	505	0.03	-	-	0.9	21.7	-20.8	23.6	NAF-barren
4811	CR06	IF3848PQ	44 - 44.1	Fresh	Siltstone	9.2	456	0.03	-	-	0.9	24.2	-23.3	26.3	NAF-barren
4812	CR06	IF3848PQ	46.5 - 46.6	Fresh	Siltstone, some sandstone laminae	9.3	422	0.02	-	-	0.6	20.9	-20.3	34.1	NAF-barren
4813	CR06	IF3848PQ	49.8 - 49.9	Fresh	FF.Sandstone & Siltstone	9.3	409	0.02	-	-	0.6	32.6	-32.0	53.2	NAF-barren
4814	CR06	IF3848PQ	56.03 - 56.13	Fresh	Claystone, with FF.Sandstone	9.0	351	0.02	-	-	0.6	28.3	-27.7	46.2	NAF-barren
4815	CR06	IF3848PQ	57.71 - 57.81	Fresh	Claystone	8.8	290	0.02	-	-	0.6	17.6	-17.0	28.7	NAF-barren
4708	CR07	IF3847PQ	47.8 - 47.9	Fresh	FM.Sandstone	9.4	387	0.02	-	-	0.6	49.7	-49.1	81.1	NAF-barren
4709	CR07	IF3847PQ	49.4 - 49.5	Fresh	FM.Sandstone	9.4	371	0.02	-	-	0.6	62	-61.4	101.2	NAF-barren
4710	CR07	IF3847PQ	50.8 - 50.9	Fresh	FF.Sandstone	9.1	591	0.02	-	-	0.6	6.9	-6.3	11.3	NAF-barren
4711	CR07	IF3847PQ	51.3 - 51.4	Fresh	Claystone	9.1	589	0.02	-	-	0.6	9.9	-9.3	16.2	NAF-barren
4506	CR17	IF3845PQ	53 - 56.82	Fresh	Siltstone	9.2	483	0.02	-	-	0.6	24.4	-23.8	39.8	NAF-barren
4507	CR17	IF3845PQ	65 - 65.1	Fresh	FM.Sandstone	8.5	602	0.23	0.01	0.06	0.3	19.3	-19.0	57.3	NAF-Low S
4508	CR17	IF3845PQ	75.15 - 75.26	Fresh	Siltstone	9.3	425	0.02	-	-	0.6	19.5	-18.9	31.8	NAF-barren
4509	CR17	IF3845PQ	79.48 - 79.58	Fresh	FF.Sandstone & Siltstone	9.5	370	<0.01	-	-	0.2	52.6	-52.4	343.5	NAF-barren
4510	CR17	IF3845PQ	86.1 - 86.2	Fresh	MM.Sandstone	9.7	365	0.04	-	-	1.2	188	-186.8	153.5	NAF-barren
5009	CR36	IF3850PQ	52 - 60	Fresh	VF.Sandstone & Siltstone	9.1	264	0.02	-	-	0.6	15.9	-15.3	26.0	NAF-barren
5010	CR36	IF3850PQ	63 - 66	Fresh	Siltstone	9.2	277	0.02	-	-	0.6	15.9	-15.3	26.0	NAF-barren
5011	CR36	IF3850PQ	69 - 72	Fresh	VF.Sandstone, Siltstone & Claystone	9.3	265	<0.01	-	-	0.2	18	-17.8	117.6	NAF-barren
5012	CR36	IF3850PQ	76 - 78	Fresh	VF.Sandstone	9.3	289	<0.01	-	-	0.2	65.2	-65.0	425.8	NAF-barren
5013	CR36	IF3850PQ	83 - 89.59	Fresh	Siltstone	9.4	238	0.02	-	-	0.6	12.8	-12.2	20.9	NAF-barren
5014	CR36	IF3850PQ	93.06 - 93.16	Fresh	Siltstone	9.5	264	<0.01	-	-	0.2	18	-17.8	117.6	NAF-barren
5015	CR36	IF3850PQ	98.79 - 98.89	Fresh	FF.Sandstone	9.5	258	0.02	-	-	0.6	17.5	-16.9	28.6	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B1 (cont.) Acid-Base Characteristics of Potential Spoil

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
							µS/cm	%			kg H_2SO_4/t				
…cont. Fresh (unweathered) Overburden															
5016	CR36	IF3850PQ	107.65 - 107.75	Fresh	Siltstone	9.5	223	<0.01	-	-	0.2	12.8	-12.6	83.6	NAF-barren
5017	CR36	IF3850PQ	112 - 112.1	Fresh	MC.Sandstone	9.5	269	0.03	-	-	0.9	48.6	-47.7	52.9	NAF-barren
5018	CR36	IF3850PQ	118.5 - 118.6	Fresh	FF.Sandstone & Siltstone	9.5	277	0.02	-	-	0.6	17.1	-16.5	27.9	NAF-barren
5019	CR36	IF3850PQ	122.61 - 122.71	Fresh	Claystone	9.2	161	0.09	-	-	2.8	9.4	-6.6	3.4	NAF-barren
Interburden (unweathered)															
5113	CR03	IF3851PQ	94.29 - 94.39	Fresh	VF.Sandstone & Siltstone	9.4	206	0.03	-	-	0.9	14	-13.1	15.2	NAF-barren
5114	CR03	IF3851PQ	101 - 101.1	Fresh	Siltstone	9.5	308	0.02	-	-	0.6	56	-55.4	91.4	NAF-barren
5115	CR03	IF3851PQ	107.5 - 107.6	Fresh	Siltstone, with VV.Sandstone	9.5	242	0.03	-	-	0.9	32.7	-31.8	35.6	NAF-barren
5116	CR03	IF3851PQ	112.5 - 112.6	Fresh	Carb.Claystone	9.5	152	0.23	0.07	<0.01	2.1	28.9	-26.8	13.9	NAF-Low S
5117	CR03	IF3851PQ	114.07 - 114.17	Fresh	Siltstone	9.4	252	0.03	-	-	0.9	32.1	-31.2	34.9	NAF-barren
5118	CR03	IF3851PQ	118.93 - 119.03	Fresh	FF.Sandstone	9.6	308	0.02	-	-	0.6	42	-41.4	68.6	NAF-barren
5119	CR03	IF3851PQ	122.45 - 122.55	Fresh	Carb.Siltstone	9.2	191	0.14	0.06	<0.01	1.7	12.8	-11.1	7.3	NAF-Low S
5120	CR03	IF3851PQ	125.5 - 125.6	Fresh	VF.Sandstone & Siltstone	9.4	297	0.03	-	-	0.9	45.2	-44.3	49.2	NAF-barren
5121	CR03	IF3851PQ	127 - 127.1	Fresh	Carb.Siltstone	8.9	686	2.20	1.66	0.06	50.8	18.6	32.2	0.4	PAF
5122	CR03	IF3851PQ	129.54 - 129.64	Fresh	VF.Sandstone, with Siltstone	9.6	291	0.04	-	-	1.2	39.6	-38.4	32.3	NAF-barren
5123	CR03	IF3851PQ	135.39 - 135.49	Fresh	FF.Sandstone	9.7	410	0.03	-	-	0.9	112	-111.1	121.9	NAF-barren
5124	CR03	IF3851PQ	140.3 - 140.4	Fresh	Claystone	9.4	274	0.02	-	-	0.6	15.8	-15.2	25.8	NAF-barren
5125	CR03	IF3851PQ	143 - 143.1	Fresh	VF.Sandstone	9.6	321	0.03	-	-	0.9	36.5	-35.6	39.7	NAF-barren
5126	CR03	IF3851PQ	147.04 - 147.14	Fresh	Siltstone	9.5	343	0.03	-	-	0.9	57.8	-56.9	62.9	NAF-barren
5127	CR03	IF3851PQ	150.22 - 150.32	Fresh	Carb.Siltstone	9.6	262	0.05	-	-	1.5	16	-14.5	10.4	NAF-barren
5128	CR03	IF3851PQ	154.82 - 154.92	Fresh	Siltstone, with VF.Sandstone	9.7	291	0.02	-	-	0.6	37.9	-37.3	61.9	NAF-barren
5129	CR03	IF3851PQ	156 - 156.1	Fresh	Tuff	9.5	352	0.03	-	-	0.9	16.1	-15.2	17.5	NAF-barren
5130	CR03	IF3851PQ	157.56 - 157.66	Fresh	FF.Sandstone & Tuff	9.7	333	0.02	-	-	0.6	29.7	-29.1	48.5	NAF-barren
4217	CR04	IF3842PQ	97.89 - 97.99	Fresh	Claystone	9.1	418	0.02	-	-	0.6	19.6	-19.0	32.0	NAF-barren
4220	CR04	IF3842PQ	105 - 105.1	Fresh	Claystone	9.4	383	0.03	-	-	0.9	28.9	-28.0	31.5	NAF-barren
4221	CR04	IF3842PQ	113.77 - 113.87	Fresh	Siltstone	9.4	291	0.03	-	-	0.9	62	-61.1	67.5	NAF-barren
4224	CR04	IF3842PQ	118.5 - 118.6	Fresh	VM.Sandstone	9.6	311	0.03	-	-	0.9	34.1	-33.2	37.1	NAF-barren
4225	CR04	IF3842PQ	123.55 - 123.65	Fresh	Carb.Siltstone	8.9	308	0.23	0.14	0.01	4.4	60.6	-56.2	13.8	NAF-Low S
4226	CR04	IF3842PQ	130 - 130.1	Fresh	FF.Sandstone	9.6	354	0.04	-	-	1.2	40.8	-39.6	33.3	NAF-barren
4227	CR04	IF3842PQ	132.48 - 132.58	Fresh	Claystone, silty	9.4	212	0.02	-	-	0.6	20.7	-20.1	33.8	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B1 (cont.) Acid-Base Characteristics of Potential Spoil

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5	S	SCR	SO4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
							µS/cm	%			kg H_2SO_4/t				
…cont. Interburden (unweathered)															
4228	CR04	IF3842PQ	139 - 139.1	Fresh	Siltstone	9.5	230	<0.01	-	-	0.2	25	-24.8	163.3	NAF-barren
4229	CR04	IF3842PQ	144.39 - 144.49	Fresh	FF.Sandstone & Siltstone	9.7	319	0.02	-	-	0.6	39.4	-38.8	64.3	NAF-barren
4230	CR04	IF3842PQ	147.8 - 148.9	Fresh	Siltstone	9.6	379	0.02	-	-	0.6	53.1	-52.5	86.7	NAF-barren
4316	CR05	IF3843PQ	101.77 - 101.87	Fresh	FF.Sandstone & Siltstone	9.4	222	0.02	-	-	0.6	24	-23.4	39.2	NAF-barren
4319	CR05	IF3843PQ	110.5 - 110.6	Fresh	Claystone	9.1	222	0.07	-	-	2.1	14.9	-12.8	7.0	NAF-barren
4320	CR05	IF3843PQ	115.81 - 115.91	Fresh	Siltstone, some sandstone laminae	9.7	327	0.03	-	-	0.9	48.8	-47.9	53.1	NAF-barren
4321	CR05	IF3843PQ	122.33 - 122.43	Fresh	Siltstone	9.4	275	0.03	-	-	0.9	57.6	-56.7	62.7	NAF-barren
4322	CR05	IF3843PQ	123.2 - 123.3	Fresh	Carb.Siltstone	9.2	174	0.19	0.16	<0.01	4.9	15.6	-10.7	3.2	NAF-Low S
4324	CR05	IF3843PQ	128.48 - 128.58	Fresh	FM.Sandstone	9.6	290	0.04	-	-	1.2	27.8	-26.6	22.7	NAF-barren
4325	CR05	IF3843PQ	130.45 - 130.55	Fresh	Carb.Claystone	9.4	158	0.20	0.05	<0.01	1.7	13	-11.3	7.9	NAF-Low S
4326	CR05	IF3843PQ	133.7 - 133.8	Fresh	Carb.Claystone	9.2	214	0.07	-	-	2.1	13	-10.9	6.1	NAF-barren
4327	CR05	IF3843PQ	137 - 137.1	Fresh	Siltstone	9.6	262	0.03	-	-	0.9	22.5	-21.6	24.5	NAF-barren
4328	CR05	IF3843PQ	140.75 - 140.85	Fresh	FM.Sandstone	9.8	360	0.02	-	-	0.6	56.1	-55.5	91.6	NAF-barren
4329	CR05	IF3843PQ	148 - 148.1	Fresh	FM.Sandstone	9.8	346	0.03	-	-	0.9	40.8	-39.9	44.4	NAF-barren
4330	CR05	IF3843PQ	154.78 - 154.88	Fresh	Claystone, slightly carbonaceous	9.5	192	0.04	-	-	1.2	12.3	-11.1	10.0	NAF-barren
4331	CR05	IF3843PQ	159.3 - 159.4	Fresh	Carb.Claystone	9.9	265	0.09	-	-	2.8	6	-3.2	2.2	NAF-barren
4819	CR06	IF3848PQ	63.67 - 63.77	Fresh	MM.Sandstone	9.5	250	0.03	-	-	0.9	5.8	-4.9	6.3	NAF-barren
4719	CR07	IF3847PQ	75.54 - 75.64	Fresh	FF.Sandstone	9.1	342	0.03	-	-	0.9	11.5	-10.6	12.5	NAF-barren
4511	CR17	IF3845PQ	89.8 - 89.9	Fresh	Siltstone	9.2	497	0.50	0.40	0.02	12.4	20.4	-8.0	1.6	uncertain
4512	CR17	IF3845PQ	97.75 - 97.85	Fresh	FF.Sandstone & Siltstone	9.6	354	0.02	-	-	0.6	21.5	-20.9	35.1	NAF-barren
4513	CR17	IF3845PQ	103.5 - 103.6	Fresh	Siltstone	9.4	282	0.04	-	-	1.2	36.2	-35.0	29.6	NAF-barren
4516	CR17	IF3845PQ	111.45 - 111.55	Fresh	Siltstone	9.5	304	0.04	-	-	1.2	19.5	-18.3	15.9	NAF-barren
4517	CR17	IF3845PQ	114.3 - 114.4	Fresh	Siltstone	9.5	330	0.03	-	-	0.9	55.7	-54.8	60.6	NAF-barren
4520	CR17	IF3845PQ	122.67 - 122.77	Fresh	FF.Sandstone & Siltstone	9.4	289	0.02	-	-	0.6	39.8	-39.2	65.0	NAF-barren
4521	CR17	IF3845PQ	124.73 - 124.83	Fresh	Claystone, some carbonaceous (LL3 - not ROM)	9.3	282	0.07	-	-	2.1	17.7	-15.6	8.3	NAF-barren
4522	CR17	IF3845PQ	125.06 - 125.14	Fresh	Carb.Claystone (LL3 - not ROM)	8.5	336	0.19	0.14	<0.01	4.2	37.5	-33.3	8.9	NAF-Low S
4523	CR17	IF3845PQ	125.54 - 125.71	Fresh	Claystone & Coal (LL3 - not ROM)	9.3	218	0.09	-	-	2.8	14.4	-11.6	5.2	NAF-barren
4524	CR17	IF3845PQ	128.19 - 128.29	Fresh	Carb.Claystone	8.8	330	0.08	-	-	2.5	18.1	-15.7	7.4	NAF-barren
4525	CR17	IF3845PQ	134 - 134.1	Fresh	FM.Sandstone	9.7	472	0.02	-	-	0.6	155	-154.4	253.1	NAF-barren
4526	CR17	IF3845PQ	141.56 - 141.66	Fresh	MM.Sandstone	9.7	392	0.02	-	-	0.6	70.5	-69.9	115.1	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B1 (cont.) Acid-Base Characteristics of Potential Spoil

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5	S	SCR	SO4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
							µS/cm	%			kg H_2SO_4/t				
…cont.	***Interburden (unweathered)***														
4527	CR17	IF3845PQ	148 - 148.1	Fresh	MM.Sandstone	9.8	425	0.02	-	-	0.6	84.1	-83.5	137.3	NAF-barren
4528	CR17	IF3845PQ	155 - 155.1	Fresh	FF.Sandstone & Siltstone	9.7	398	0.03	-	-	0.9	108	-107.1	117.6	NAF-barren
4529	CR17	IF3845PQ	161 - 161.1	Fresh	FF.Sandstone	9.8	409	0.02	-	-	0.6	96.9	-96.3	158.2	NAF-barren
4530	CR17	IF3845PQ	166 - 166.1	Fresh	MM.Sandstone	9.8	446	0.02	-	-	0.6	59.1	-58.5	96.5	NAF-barren
4531	CR17	IF3845PQ	171 - 171.1	Fresh	FF.Sandstone & Siltstone	9.6	355	0.02	-	-	0.6	30.2	-29.6	49.3	NAF-barren
5022	CR36	IF3850PQ	124.04 - 124.14	Fresh	FF.Sandstone & Siltstone	9.2	183	0.02	-	-	0.6	16.8	-16.2	27.4	NAF-barren
5023	CR36	IF3850PQ	126.53 - 126.63	Fresh	Siltstone	9.6	330	0.02	-	-	0.6	37.5	-36.9	61.2	NAF-barren
5026	CR36	IF3850PQ	133 - 133.1	Fresh	Siltstone with sandstone laminae	9.3	141	0.02	-	-	0.6	11.2	-10.6	18.3	NAF-barren
5027	CR36	IF3850PQ	140 - 140.1	Fresh	FF.Sandstone & Siltstone	9.4	215	0.03	-	-	0.9	36.1	-35.2	39.3	NAF-barren
5028	CR36	IF3850PQ	143.23 - 143.33	Fresh	Claystone	9.4	248	0.19	0.14	<0.01	4.4	21.2	-16.8	4.8	NAF-Low S
5030	CR36	IF3850PQ	147.1 - 147.2	Fresh	FM.Sandstone	9.7	409	0.02	-	-	0.6	97.5	-96.9	159.2	NAF-barren
5031	CR36	IF3850PQ	150.75 - 150.85	Fresh	Carb.Claystone (LL3 - not ROM)	8.7	278	0.20	0.07	<0.01	2.2	40.6	-38.4	18.4	NAF-Low S
5032	CR36	IF3850PQ	150.85 - 151.02	Fresh	Coal (LL3 - not ROM)	9.3	102	0.24	0.01	<0.01	0.4	9.8	-9.4	22.9	NAF-Low S
5033	CR36	IF3850PQ	151.02 - 151.12	Fresh	Claystone (LL3 - not ROM)	9.6	351	0.23	0.06	<0.01	1.9	20.2	-18.3	10.6	NAF-Low S
5034	CR36	IF3850PQ	153 - 153.1	Fresh	FM.Sandstone with Siltstone	9.6	386	0.02	-	-	0.6	138	-137.4	225.3	NAF-barren
5035	CR36	IF3850PQ	158 - 158.1	Fresh	FM & FF.Sandstone	9.8	396	<0.01	-	-	0.2	36.7	-36.5	239.7	NAF-barren
5036	CR36	IF3850PQ	165.8 - 165.9	Fresh	FM.Sandstone	9.8	413	0.02	-	-	0.6	60.3	-59.7	98.4	NAF-barren
5037	CR36	IF3850PQ	170.79 - 170.89	Fresh	Siltstone	9.7	364	0.02	-	-	0.6	66.5	-65.9	108.6	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B2. Acid-Base Characteristics of Potential Coal Reject

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5	S	SCR	SO4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
							µS/cm	%			kg H_2SO_4/t				
Potential Coal Reject LL1															
4215	CR04	IF3842PQ	95.83 - 95.93	Fresh	Claystone, some Coal & Tuff (LL1 roof)	8.9	314	0.14	0.02	0.04	0.6	17.8	-17.2	27.7	NAF-Low S
4313	CR05	IF3843PQ	95.9 - 96	Fresh	FM.Sandstone (LL1T roof)	9.5	248	0.02	-	-	0.6	44.3	-43.7	72.3	NAF-barren
4314	CR05	IF3843PQ	97.35 - 97.45	Fresh	Claystone (LL1B roof)	9.5	201	0.03	-	-	0.9	19.6	-18.7	21.3	NAF-barren
5020	CR36	IF3850PQ	123.08 - 123.17	Fresh	Siltstone (LL1 roof)	9.4	351	0.04	-	-	1.2	16.4	-15.2	13.4	NAF-barren
4216	CR04	IF3842PQ	96.6 - 96.66	Fresh	Claystone (LL1 floor), with Siltstone	9.1	433	0.04	-	-	1.2	16.1	-14.9	13.1	NAF-barren
4315	CR05	IF3843PQ	97.85 - 97.95	Fresh	Siltstone (LL1B floor)	9.6	221	0.03	-	-	0.9	16	-15.1	17.4	NAF-barren
5021	CR36	IF3850PQ	123.92 - 124.04	Fresh	Siltstone (LL1 floor)	9.2	159	0.02	-	-	0.6	12.1	-11.5	19.8	NAF-barren
Potential Coal Reject LL2															
4218	CR04	IF3842PQ	98.66 - 98.76	Fresh	Claystone (LL2T roof), partly carbonaceous	8.8	331	0.13	0.10	<0.01	3.0	7.5	-4.5	2.5	uncertain
4317	CR05	IF3843PQ	104.84 - 104.94	Fresh	Carb.Claystone (LL2T roof)	6.9	554	1.78	1.40	0.07	42.9	3.8	39.1	0.1	PAF
4514	CR17	IF3845PQ	105.68 - 105.78	Fresh	Carb.Siltstone (LL2T roof)	8.9	283	0.09	-	-	2.8	6	-3.2	2.2	NAF-barren
5024	CR36	IF3850PQ	127.09 - 127.19	Fresh	Claystone (LL2 roof)	9.2	111	0.07	-	-	2.1	7.9	-5.8	3.7	NAF-barren
4219	CR04	IF3842PQ	101.91 - 102.01	Fresh	Siltstone (LL2B floor), slightly sandy	8.7	439	0.14	0.04	0.03	1.1	6.8	-5.7	6.0	NAF-Low S
4318	CR05	IF3843PQ	108.6 - 108.7	Fresh	Claystone (LL2B floor)	9.2	301	0.07	-	-	2.1	3.7	-1.6	1.7	NAF-barren
4515	CR17	IF3845PQ	109.27 - 109.37	Fresh	Claystone (LL2B floor)	9.1	550	0.39	0.31	0.02	9.6	5.3	4.3	0.6	PAF
5025	CR36	IF3850PQ	130.5 - 130.6	Fresh	Siltstone (LL2 floor)	9.4	279	0.03	-	-	0.9	56.3	-55.4	61.3	NAF-barren
Potential Coal Reject LL3															
4222	CR04	IF3842PQ	115.6 - 115.7	Fresh	Carb.Claystone, some Coal & Tuff (LL3B roof)	9.3	338	0.24	0.09	<0.01	2.7	70.6	-67.9	25.9	NAF-Low S
4518	CR17	IF3845PQ	116.64 - 116.74	Fresh	Claystone (LL3T roof)	9.5	561	0.05	-	-	1.5	26	-24.5	17.0	NAF-barren
4223	CR04	IF3842PQ	116.53 - 116.63	Fresh	FF.Sandstone (LL3B floor)	9.5	300	0.02	-	-	0.6	7.4	-6.8	12.1	NAF-barren
4323	CR05	IF3843PQ	124.6 - 124.7	Fresh	Claystone (LL3B floor)	9.4	120	0.03	-	-	0.9	9.6	-8.7	10.4	NAF-barren
4519	CR17	IF3845PQ	118.58 - 118.68	Fresh	Siltstone (LL3B floor)	9.4	328	0.02	-	-	0.6	34	-33.4	55.5	NAF-barren
5029	CR36	IF3850PQ	144.37 - 144.47	Fresh	Claystone (LL3 floor)	9.2	182	0.04	-	-	1.2	9.8	-8.6	8.0	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B2 (cont.) Acid-Base Characteristics of Potential Coal Reject

Sample ID	Drill-site ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:5	EC 1:5	S	Scr	SO4	MPA	ANC	NAPP	ANC/MPA ratio	Acid Classification
							µS/cm	%			kg H_2SO_4/t				
Potential Coal Reject VU															
4231	CR04	IF3842PQ	150.77 - 150.87	Fresh	Carb.Claystone (VU roof)	9.6	206	0.20	0.02	<0.01	0.6	26.8	-26.2	48.6	NAF-Low S
4816	CR06	IF3848PQ	58.5 - 58.6	Fresh	Carb.Siltstone (VU roof)	9.1	352	0.81	0.81	0.02	24.8	26.6	-1.8	1.1	uncertain
4712	CR07	IF3847PQ	52.4 - 52.5	Fresh	Carb.Claystone (VU roof?)	9.0	437	0.02	-	-	0.6	6.9	-6.3	11.3	NAF-barren
4713	CR07	IF3847PQ	55.3 - 55.4	Fresh	Carb.Siltstone (VU roof)	7.9	110	0.25	0.16	0.01	5.0	15.8	-10.8	3.2	NAF-Low S
5038	CR36	IF3850PQ	171.32 - 171.42	Fresh	Carb.Siltstone (VU roof)	9.7	261	0.06	-	-	1.8	13.4	-11.6	7.3	NAF-barren
4817	CR06	IF3848PQ	58.99 - 60.18	Fresh	Carb.Siltstone & Carb.Claystone (VU partings)	8.6	343	0.70	0.47	0.03	14.3	34.3	-20.0	2.4	uncertain
4714	CR07	IF3847PQ	59.4 - 59.5	Fresh	Carb.Siltstone (VU parting)	8.6	127	0.25	0.12	0.02	3.8	9.8	-6.0	2.6	uncertain
4715	CR07	IF3847PQ	65.2 - 65.3	Fresh	Carb.Siltstone (VU parting)	8.4	154	0.35	0.20	0.02	6.2	11.9	-5.7	1.9	uncertain
4716	CR07	IF3847PQ	67.9 - 68	Fresh	Carb.Siltstone (VU parting)	6.9	282	1.51	1.46	0.07	44.7	95.4	-50.7	2.1	uncertain
4717	CR07	IF3847PQ	71.7 - 71.8	Fresh	Carb.Siltstone (VU parting)	7.1	185	0.89	0.62	0.05	19.0	12.9	6.1	0.7	PAF
4818	CR06	IF3848PQ	62.45 - 62.55	Fresh	Carb.Claystone (VU floor)	9.7	355	0.33	0.15	0.02	4.6	55.3	-50.7	12.0	NAF-High S
4718	CR07	IF3847PQ	74.4 - 74.5	Fresh	Siltstone (VU floor)	8.9	433	0.48	0.18	0.05	5.6	6.5	-0.9	1.2	uncertain
5039	CR36	IF3850PQ	175.57 - 175.67	Fresh	Claystone (VU floor)	9.7	278	0.02	-	-	0.6	16.5	-15.9	26.9	NAF-barren

pH and EC on 1:5 water extracts on pulps; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential.
MPA is calculated from Scr, where available, else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table B3. Total Element Concentrations in Potential Spoil and Coal Reject

					Ag	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	V	Zn
Sample ID	Drill-hole	Depth (m)	Weath.	Description	Spoil all units mg/kg																			
5003	IF3850PQ	9 - 14	Extremely	FF.Sand	0.04	3.7	460	0.72	0.08	<0.02	10.4	51	10.1	<0.005	1240	0.60	12.9	9.3	100	0.37	<1	0.8	42	27
4502	IF3845PQ	15 - 20	Extremely	Claystone	0.05	7.6	280	1.52	0.28	0.02	9.9	51	29.2	<0.005	172	0.35	20.6	19.0	200	0.91	<1	2.6	124	59
4802	IF3848PQ	7 - 10	Highly	Clay & MC.Sand	0.07	22.8	410	1.72	0.19	<0.02	10.3	104	26.8	0.007	343	1.52	26.6	18.8	400	0.98	1	1.2	165	62
4203	IF3842PQ	19 - 25	Highly	Siltst., some Clayst.	0.17	6.0	420	1.96	0.28	0.10	13.7	53	38.2	0.006	679	0.34	29.3	17.7	100	0.87	<1	2.6	121	81
4304	IF3843PQ	22 - 29	Moderately	FM.Sandst. & Siltst.	0.11	6.6	320	2.16	0.30	0.05	16.5	57	46.2	0.005	522	0.53	34.8	21.9	100	1.28	<1	2.6	122	98
5105	IF3851PQ	36 - 39	Moderately	F.Sandst. & Siltst.	0.04	8.4	180	1.30	0.18	0.14	17.0	49	24.4	0.009	902	0.78	26.4	15.6	100	1.49	<1	1.9	113	70
5112	IF3851PQ	91.9 - 92	Fresh	VF.Sandst. & Siltst.	0.08	27.9	240	1.60	0.20	0.10	15.6	52	27.0	0.067	940	6.60	31.7	15.1	200	2.10	<1	2.2	110	81
5119*	IF3851PQ	122.45 - 122.55	Fresh	Carb.Siltstone	0.11	17.9	420	2.02	0.52	0.17	24.9	31	61.4	0.130	1840	2.30	36.5	13.4	1800	1.80	1	2.4	119	67
5120	IF3851PQ	125.5 - 125.6	Fresh	VF.Sandst. & Siltst.	0.06	9.2	480	1.68	0.31	0.19	10.1	53	53.7	0.065	662	0.62	27.6	17.6	300	0.52	<1	2.1	145	102
5129	IF3851PQ	156 - 156.1	Fresh	Tuff	0.09	15.8	840	3.08	0.73	0.13	14.5	3	5.6	0.142	119	4.02	5.4	49.1	500	1.67	<1	4.7	12	66
4211	IF3842PQ	78.9 - 79	Fresh	FF.Sandst. & Siltst.	0.09	2.6	230	2.12	0.33	0.15	13.5	53	42.6	0.008	257	0.27	34.0	18.5	100	0.79	<1	2.7	123	99
4220	IF3842PQ	105 - 105.1	Fresh	Claystone	0.09	2.8	210	2.11	0.33	0.15	8.4	32	49.7	0.052	260	1.19	22.6	15.2	300	0.62	<1	2.3	118	107
4229	IF3842PQ	144.39 - 144.49	Fresh	FF.Sandst. & Siltst.	0.08	13.9	490	1.86	0.26	0.16	14.4	51	49.1	0.042	467	0.97	31.7	18.3	300	0.76	<1	2.0	127	95
4307	IF3843PQ	51 - 51.1	Fresh	FM.Sandst. & Siltst.	0.08	2.7	240	2.31	0.30	0.04	18.2	62	57.4	<0.005	1290	0.26	39.6	13.3	100	0.80	<1	2.7	123	101
4316	IF3843PQ	101.77 - 101.87	Fresh	FF.Sandst. & Siltst.	0.07	20.3	240	2.12	0.31	0.11	16.6	60	46.0	0.036	1090	0.89	33.9	17.4	300	1.11	<1	2.2	140	77
4319	IF3843PQ	110.5 - 110.6	Fresh	Claystone	0.11	6.3	330	2.17	0.40	0.15	16.0	34	48.1	0.057	161	1.16	36.0	16.5	800	1.27	<1	2.4	125	103
4325*	IF3843PQ	130.45 - 130.55	Fresh	Carb.Claystone	0.14	21.6	380	2.42	0.54	0.15	20.8	32	61.5	0.083	1970	2.87	38.8	29.5	2100	2.60	1	2.7	138	96
4809	IF3848PQ	41.6 - 41.7	Fresh	Claystone	0.09	13.3	240	1.99	0.31	0.15	14.5	52	53.9	0.040	579	0.95	33.5	19.7	300	0.69	1	2.3	140	95
4813	IF3848PQ	49.8 - 49.9	Fresh	FF.Sandst. & Siltst.	0.08	13.2	270	1.70	0.27	0.13	15.7	56	48.5	0.043	620	1.05	31.7	18.2	300	0.71	<1	1.9	130	93
4709	IF3847PQ	49.4 - 49.5	Fresh	FM.Sandstone	0.03	9.9	130	1.21	0.08	0.03	9.2	39	12.8	0.027	668	0.48	16.9	7.2	100	0.50	<1	1.0	81	54
4507	IF3845PQ	65 - 65.1	Fresh	FM.Sandstone	0.11	2.4	9040	2.43	0.40	0.06	15.8	44	50.4	<0.005	473	0.23	31.4	17.5	2400	1.42	<1	2.9	128	84
4511	IF3845PQ	89.8 - 89.9	Fresh	Siltstone	0.09	9.2	290	1.92	0.36	0.10	4.7	33	53.9	0.015	102	0.26	20.5	18.4	5000	0.62	<1	2.5	109	65
4512	IF3845PQ	97.75 - 97.85	Fresh	FF.Sandst. & Siltst.	0.05	9.9	310	2.19	0.28	0.17	8.3	57	55.8	0.033	811	0.49	21.6	26.5	300	0.80	1	2.2	123	94
4522*	IF3845PQ	125.06 - 125.14	Fresh	Carb.Claystone (LL3)	0.17	23.9	320	2.20	0.42	0.15	36.3	27	43.9	0.109	1570	4.00	51.9	20.2	2500	4.40	1	2.1	98	82
5011	IF3850PQ	69 - 72	Fresh	VF.Sandst., Siltst., Clayst.	0.08	4.8	260	2.03	0.34	0.14	17.9	46	39.6	0.007	1110	0.76	27.0	19.7	100	1.01	<1	2.3	131	101
5016	IF3850PQ	107.65 - 107.75	Fresh	Siltstone	0.07	1.6	350	1.99	0.31	0.04	14.4	51	40.3	<0.005	234	0.26	32.9	14.7	100	0.81	<1	2.7	112	86
5033*	IF3850PQ	151.02 - 151.12	Fresh	Claystone (LL3)	0.13	13.3	380	1.89	0.40	0.18	17.4	28	47.9	0.086	819	2.02	30.7	15.1	2400	2.41	1	1.9	135	86
Sample ID	Drill-hole	Depth (m)		Description	Potential coal reject (ROM material) all units mg/kg																			
4222*	IF3842PQ	115.6 - 115.7		Carb.Clayst., Coal & Tuff (LL3B roof)	0.10	6.3	170	1.62	0.44	0.17	12.4	31	70.9	0.072	583	2.80	24.6	18.2	2400	1.59	1	2.1	96	98
4313	IF3843PQ	95.9 - 96		FM.Sandstone (LL1T roof)	0.04	15.4	160	1.51	0.15	0.05	14.7	86	18.0	0.043	630	1.48	29.0	16.6	100	0.81	<1	1.9	129	82
4315	IF3843PQ	97.85 - 97.95		Siltstone (LL1B floor)	0.08	8.3	290	2.21	0.33	0.09	8.3	52	53.1	0.024	630	0.61	24.1	16.3	200	0.77	<1	2.5	129	92
4317*	IF3843PQ	104.84 - 104.94		Carb.Claystone (LL2T roof)	0.08	4.4	4950	1.97	0.29	0.19	7.6	37	39.3	0.066	62	1.24	22.6	20.7	2400	1.02	1	2.6	93	74
4318	IF3843PQ	108.6 - 108.7		Claystone (LL2B floor)	0.08	2.2	1400	2.56	0.51	0.02	2.9	32	61.0	0.034	77	0.74	14.0	19.5	800	0.61	<1	2.9	126	28
4323	IF3843PQ	124.6 - 124.7		Claystone (LL3B floor)	0.07	3.1	440	2.26	0.36	0.15	6.5	44	57.0	0.059	140	0.83	21.0	19.6	300	0.47	<1	2.6	132	107
4712	IF3847PQ	52.4 - 52.5		Carb.Claystone (VU roof?)	0.07	2.0	250	2.87	0.37	0.12	2.5	33	61.8	0.086	51	0.55	13.8	23.7	300	0.48	<1	2.7	110	74
4714*	IF3847PQ	59.4 - 59.5		Carb.Siltstone (VU parting)	0.11	20.6	370	1.43	0.27	0.20	22.5	15	29.9	0.440	1670	5.03	24.1	18.2	2800	6.89	1	1.2	37	84

Method: four-acid (mixed acid) digest; ICP-MS analysis. Samples denoted with an asterix have been ashed prior to analysis due to carbon content exceeding 5%. '<' indicates less than the laboratory limit of reporting.

Table B4. Geochemical Abundance Indices for Potential Spoil and Coal Reject

					Ag	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	V	Zn
				Average background conc. in soil (mg/kg):	0.1	5	500	6	0.2	0.5	8	200	20	0.03	850	2	40	10	700	0.4	0.2	10	100	50
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Potential spoil (GAI)**																			
5003	IF3850PQ	9 - 14	Extremely	FF.Sand																				
4502	IF3845PQ	15 - 20	Extremely	Claystone																				
4802	IF3848PQ	7 - 10	Highly	Clay & MC.Sand		2															2			
4203	IF3842PQ	19 - 25	Highly	Siltstone, some Claystone																				
4304	IF3843PQ	22 - 29	Moderately	FM.Sandstone & Siltstone																1				
5105	IF3851PQ	36 - 39	Moderately	F.Sandstone & Siltstone																1				
5112	IF3851PQ	91.9 - 92	Fresh	VF.Sandstone & Siltstone		2										1				2				
5119	IF3851PQ	122.45 - 122.55	Fresh	Carb.Siltstone		1					1		1	2						2	2			
5120	IF3851PQ	125.5 - 125.6	Fresh	VF.Sandstone & Siltstone																				
5129	IF3851PQ	156 - 156.1	Fresh	Tuff		1			1					2				2		1				
4211	IF3842PQ	78.9 - 79	Fresh	FF.Sandstone & Siltstone																				
4220	IF3842PQ	105 - 105.1	Fresh	Claystone																				
4229	IF3842PQ	144.39 - 144.49	Fresh	FF.Sandstone & Siltstone																				
4307	IF3843PQ	51 - 51.1	Fresh	FM.Sandstone & Siltstone																				
4316	IF3843PQ	101.77 - 101.87	Fresh	FF.Sandstone & Siltstone		1																		
4319	IF3843PQ	110.5 - 110.6	Fresh	Claystone																1				
4325	IF3843PQ	130.45 - 130.55	Fresh	Carb.Claystone		2							1						1	2	2			
4809	IF3848PQ	41.6 - 41.7	Fresh	Claystone																	2			
4813	IF3848PQ	49.8 - 49.9	Fresh	FF.Sandstone & Siltstone																				
4709	IF3847PQ	49.4 - 49.5	Fresh	FM.Sandstone																				
4507	IF3845PQ	65 - 65.1	Fresh	FM.Sandstone			4												1	1				
4511	IF3845PQ	89.8 - 89.9	Fresh	Siltstone															2					
4512	IF3845PQ	97.75 - 97.85	Fresh	FF.Sandstone & Siltstone																	2			
4522	IF3845PQ	125.06 - 125.14	Fresh	Carb.Claystone (LL3 - not ROM)		2					2			1					1	3	2			
5011	IF3850PQ	69 - 72	Fresh	VF.Sandst., Siltst. & Clayst.																				
5016	IF3850PQ	107.65 - 107.75	Fresh	Siltstone																				
5033	IF3850PQ	151.02 - 151.12	Fresh	Claystone (LL3 - not ROM)															1	2	2			
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Potential coal reject (ROM material) (GAI)**																			
4222	IF3842PQ	115.6 - 115.7	Fresh	Carb.Clayst., Coal & Tuff (LL3B roof)									1						1	1	2			
4313	IF3843PQ	95.9 - 96	Fresh	FM.Sandstone (LL1T roof)		1																		
4315	IF3843PQ	97.85 - 97.95	Fresh	Siltstone (LL1B floor)																				
4317	IF3843PQ	104.84 - 104.94	Fresh	Carb.Claystone (LL2T roof)			3												1		2			
4318	IF3843PQ	108.6 - 108.7	Fresh	Claystone (LL2B floor)									1											
4323	IF3843PQ	124.6 - 124.7	Fresh	Claystone (LL3B floor)																				
4712	IF3847PQ	52.4 - 52.5	Fresh	Carb.Claystone (VU roof?)									1											
4714	IF3847PQ	59.4 - 59.5	Fresh	Carb.Siltstone (VU parting)		1								3					1	4	2			

Average abundance in soil from Levinson (1974) and Hawkes & Webb (1962), as published in AusIMM (2011). Blank cells = GAI <1.

Table B5. Soluble Major Ions, pH and Electrical Conductivity in 1:5 Water Extracts from Potential Spoil and Coal Reject

						pH	EC	Tot. alk.	HCO3 alk.	CO3 alk.	SO4	Cl	Ca	Mg	Na	K
Sample ID	Drill-hole	Depth (m)	Weath.	Description	Type	pH units	uS/cm	all units mg/L								
4502	IF3845PQ	15 - 20	Extremely	Claystone	spoil	9.0	682	1,282	1,206	76	16	180	2	<2	144	4
5003	IF3850PQ	9 - 14	Extremely	FF.Sand	spoil	8.7	453	570	512	57	22	96	<2	<2	82	2
4203	IF3842PQ	19 - 25	Highly	Siltstone, some Claystone	spoil	8.5	1050	588	532	58	36	294	10	8	204	4
4802	IF3848PQ	7 - 10	Highly	Clay & MC.Sand	spoil	5.4	383	38	38	<1	32	98	<2	<2	74	2
5105	IF3851PQ	36 - 39	Moderately	FF.Sandstone & Siltstone	spoil	8.9	466	5,800	5,680	114	14	102	6	2	82	2
4304	IF3843PQ	22 - 29	Moderately	FM.Sandstone & Siltstone	spoil	8.3	886	578	560	18	22	256	6	4	184	2
5112	IF3851PQ	91.9 - 92	Fresh	VF.Sandstone & Siltstone	spoil	9.4	278	3,320	3,160	152	18	8	<2	<2	54	4
5119	IF3851PQ	122.45 - 122.55	Fresh	Carb.Siltstone	spoil	9.2	191	512	342	171	40	12	<2	<2	36	<2
5120	IF3851PQ	125.5 - 125.6	Fresh	VF.Sandstone & Siltstone	spoil	9.4	297	1,254	1,120	133	12	16	<2	<2	68	4
5129	IF3851PQ	156 - 156.1	Fresh	Tuff	spoil	9.5	352	392	238	155	92	22	<2	<2	64	<2
4211	IF3842PQ	78.9 - 79	Fresh	FF.Sandstone & Siltstone	spoil	9.1	279	730	656	76	10	16	<2	<2	56	4
4220	IF3842PQ	105 - 105.1	Fresh	Claystone	spoil	9.4	383	416	380	36	22	46	<2	<2	74	4
4229	IF3842PQ	144.39 - 144.49	Fresh	FF.Sandstone & Siltstone	spoil	9.7	319	626	532	94	12	14	<2	<2	68	2
4307	IF3843PQ	51 - 51.1	Fresh	FM.Sandstone & Siltstone	spoil	9.1	309	618	560	58	4	32	<2	<2	60	4
4316	IF3843PQ	101.77 - 101.87	Fresh	FF.Sandstone & Siltstone	spoil	9.4	222	474	420	54	8	12	<2	<2	46	2
4319	IF3843PQ	110.5 - 110.6	Fresh	Claystone	spoil	9.1	222	236	214	22	40	20	<2	<2	40	<2
4325	IF3843PQ	130.45 - 130.55	Fresh	Carb.Claystone	spoil	9.4	158	274	238	36	50	10	<2	<2	32	<2
4809	IF3848PQ	41.6 - 41.7	Fresh	Claystone	spoil	9.2	446	380	344	36	16	90	<2	<2	90	4
4813	IF3848PQ	49.8 - 49.9	Fresh	FF.Sandstone & Siltstone	spoil	9.3	409	568	494	76	12	68	<2	<2	78	4
4709	IF3847PQ	49.4 - 49.5	Fresh	FM.Sandstone	spoil	9.4	371	5,040	4,900	133	4	64	2	<2	70	6
4507	IF3845PQ	65 - 65.1	Fresh	FM.Sandstone	spoil	8.5	602	1,074	1,036	38	42	122	<2	<2	114	10
4511	IF3845PQ	89.8 - 89.9	Fresh	Siltstone	spoil	9.2	497	960	884	76	90	40	<2	<2	112	4
4512	IF3845PQ	97.75 - 97.85	Fresh	FF.Sandstone & Siltstone	spoil	9.6	354	780	684	95	12	24	<2	<2	76	2
4522	IF3845PQ	125.06 - 125.14	Fresh	Carb.Claystone (LL3 - not ROM)	spoil	8.5	336	568	550	18	36	32	<2	<2	68	2
5011	IF3850PQ	69 - 72	Fresh	VF.Sandst., Siltst. & Clayst.	spoil	9.3	265	760	664	95	8	10	<2	<2	50	2
5016	IF3850PQ	107.65 - 107.75	Fresh	Siltstone	spoil	9.5	223	570	494	76	4	8	<2	<2	46	<2
5033	IF3850PQ	151.02 - 151.12	Fresh	Claystone (LL3 - not ROM)	spoil	9.6	351	1,120	1,026	95	44	12	<2	<2	80	<2
4313	IF3843PQ	95.9 - 96	Fresh	FM.Sandstone (LL1T roof)	pot. reject	9.5	248	3,580	3,460	114	8	12	<2	<2	50	4
4315	IF3843PQ	97.85 - 97.95	Fresh	Siltstone (LL1B floor)	pot. reject	9.6	221	378	342	36	8	10	<2	<2	46	<2
4317	IF3843PQ	104.84 - 104.94	Fresh	Carb.Claystone (LL2T roof)	pot. reject	6.9	554	47	47	<1	206	30	4	<2	118	4
4318	IF3843PQ	108.6 - 108.7	Fresh	Claystone (LL2B floor)	pot. reject	9.2	301	424	388	36	24	22	<2	<2	36	<2
4222	IF3842PQ	115.6 - 115.7	Fresh	Carb.Clayst., Coal & Tuff (LL3B roof)	pot. reject	9.3	338	3,160	3,040	114	28	14	<2	<2	70	2
4323	IF3843PQ	124.6 - 124.7	Fresh	Claystone (LL3B floor)	pot. reject	9.4	120	566	514	50	6	12	<2	<2	22	<2
4712	IF3847PQ	52.4 - 52.5	Fresh	Carb.Claystone (VU roof?)	pot. reject	9.0	437	484	466	18	24	96	<2	<2	78	4
4714	IF3847PQ	59.4 - 59.5	Fresh	Carb.Siltstone (VU parting)	pot. reject	8.6	127	86	83	4	86	40	<2	<2	80	2

All analyses results performed on 1:5 water extracts on pulps (<75 micron). Excluding pH and EC results, all results were reported on a wt.:wt. basis (mg/kg) and have been converted to a volumetric basis (mg/L).
Alkalinity is reported as mg CaCO3/L; VF = 'very fine to fine grained'; FF = 'fine grained'; FM = 'fine to medium grained'.

Table B6. Soluble Multi-Element Concentrations in 1:5 Water Extracts from Potential Spoil and Coal Reject

						Al	As	Ba	Be	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	V	Zn
Aquatic ecosystems trigger value[1]:						0.055	0.013	-	-	0.37	0.0002	0.0014	0.001	0.0014	0.3	6E-05	1.9	0.011	0.0034	0.005	-	0.008
Livestock drinking water quality[2]:						5	0.5	-	-	5	0.01	1	1	0.5	-	0.002	-	1	0.1	0.02	-	20
Sample ID	Drill-hole	Depth (m)	Weath.	Description	Type	all units mg/L																
4502	IF3845PQ	15 - 20	Extreme	Claystone	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5003	IF3850PQ	9 - 14	Extreme	FF.Sand	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4203	IF3842PQ	19 - 25	Highly	Siltst., some Clayst.	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4802	IF3848PQ	7 - 10	Highly	Clay & MC.Sand	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5105	IF3851PQ	36 - 39	Mod.	FF.Sandst. & Siltst.	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4304	IF3843PQ	22 - 29	Mod.	FM.Sandst. & Siltst.	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5112	IF3851PQ	91.9 - 92	Fresh	VF.Sandst. & Siltst.	spoil	0.4	0.50	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
5119	IF3851PQ	122.45 - 122.55	Fresh	Carb.Siltstone	spoil	0.2	0.24	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
5120	IF3851PQ	125.5 - 125.6	Fresh	VF.Sandst. & Siltst.	spoil	0.4	0.10	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5129	IF3851PQ	156 - 156.1	Fresh	Tuff	spoil	0.4	0.20	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4211	IF3842PQ	78.9 - 79	Fresh	FF.Sandst. & Siltst.	spoil	0.4	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4220	IF3842PQ	105 - 105.1	Fresh	Claystone	spoil	0.2	0.04	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
4229	IF3842PQ	144.39 - 144.49	Fresh	FF.Sandst. & Siltst.	spoil	0.4	0.50	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.04	<0.02
4307	IF3843PQ	51 - 51.1	Fresh	FM.Sandst. & Siltst.	spoil	0.4	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4316	IF3843PQ	101.77 - 101.87	Fresh	FF.Sandst. & Siltst.	spoil	0.6	0.28	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
4319	IF3843PQ	110.5 - 110.6	Fresh	Claystone	spoil	0.4	0.04	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4325	IF3843PQ	130.45 - 130.55	Fresh	Carb.Claystone	spoil	0.2	0.36	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
4809	IF3848PQ	41.6 - 41.7	Fresh	Claystone	spoil	<0.2	0.06	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4813	IF3848PQ	49.8 - 49.9	Fresh	FF.Sandst. & Siltst.	spoil	<0.2	0.12	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4709	IF3847PQ	49.4 - 49.5	Fresh	FM.Sandstone	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4507	IF3845PQ	65 - 65.1	Fresh	FM.Sandstone	spoil	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4511	IF3845PQ	89.8 - 89.9	Fresh	Siltstone	spoil	<0.2	0.16	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.04	<0.02
4512	IF3845PQ	97.75 - 97.85	Fresh	FF.Sandst. & Siltst.	spoil	0.4	0.28	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.04	<0.02
4522	IF3845PQ	125.06 - 125.14	Fresh	Carb.Clayst. (LL3 spoil)	spoil	0.2	0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5011	IF3850PQ	69 - 72	Fresh	VF.Sandst., Siltst. & Clayst.	spoil	0.6	0.04	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5016	IF3850PQ	107.65 - 107.75	Fresh	Siltstone	spoil	1.0	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
5033	IF3850PQ	151.02 - 151.12	Fresh	Claystone (LL3 spoil)	spoil	0.2	0.12	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
4313	IF3843PQ	95.9 - 96	Fresh	FM.Sandstone (LL1T roof)	pot. reject	0.4	0.16	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.04	<0.02
4315	IF3843PQ	97.85 - 97.95	Fresh	Siltstone (LL1B floor)	pot. reject	1.0	0.22	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.04	<0.02
4317	IF3843PQ	104.84 - 104.94	Fresh	Carb.Claystone (LL2T roof)	pot. reject	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4318	IF3843PQ	108.6 - 108.7	Fresh	Claystone (LL2B floor)	pot. reject	0.4	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
4222	IF3842PQ	115.6 - 115.7	Fresh	Carb.Clayst., Coal & Tuff (LL3B roof)	pot. reject	<0.2	0.04	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4323	IF3843PQ	124.6 - 124.7	Fresh	Claystone (LL3B floor)	pot. reject	0.8	0.06	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
4712	IF3847PQ	52.4 - 52.5	Fresh	Carb.Claystone (VU roof?)	pot. reject	<0.2	0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
4714	IF3847PQ	59.4 - 59.5	Fresh	Carb.Siltstone (VU parting)	pot. reject	<0.2	0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.04	<0.02	<0.02

All analyses results performed on 1:5 water extracts on pulps (<75 micron). All results were reported on a wt.:wt. basis (mg/kg) and have been converted to a volumetric basis (mg/L).
VF = 'very fine to fine grained'; FF = 'fine grained'; FM = 'fine to medium grained'.

Table B7. Exchangeable Cations and Emerson Class Test Results in Potential Spoil

Sample ID		5003	4802	4502	4203	4304	5105	4211	4307	4809	4813	4507	5011	5112	5120	4220	4229	4316	4319	4709	4511	4512	5016	5033	5129
Drill-site ID		CR36	CR06	CR17	CR04	CR05	CR03	CR04	CR05	CR06	CR06	CR17	CR36	CR03	CR03	CR04	CR04	CR05	CR05	CR07	CR17	CR17	CR36	CR36	CR03
Drill-hole ID (IF prefix, PQ suffix)		3850	3848	3845	3842	3843	3851	3842	3843	3848	3848	3845	3850	3851	3851	3842	3842	3843	3843	3847	3845	3845	3850	3850	3851
Sample Depth (m)		9-14	7-10	15-20	19-25	22-29	36-39	48.9	51.0	41.6	49.8	65.0	69-72	91.9	125.5	105.0	144.4	101.8	108.6	49.4	89.8	97.8	107.7	151.1	156.0
Formation / Horizon		Tertiary	Tertiary	Rewan	Rewan	Rewan	Rewan	Rewan	Rewan	Rewan	Rewan	Rewan	Rewan	Rangal	Rangal	Rangal	Rangal	Rangal	Rangal	Rangal	Rangal	Rangal	Rangal	Rangal	YTB
Lithological type		FF. Sand	clay & sand	CS	ST	FM Sand & ST	FF Sand & ST	FF SS & ST	FM SS & ST	CS	FF SS & ST	FM SS	VF SS, ST & CS	VF SS & ST	VF SS & ST	CS	FF SS & ST	FF SS & ST	CS	FM SS	ST	FF SS & ST	ST	CS	Tuff
Weathering		extreme	high	extreme	high	mod.	mod.	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh
Parameter	**Units**	**Results**																							
pH (1:5)	--	8.7	5.4	9.0	8.5	8.3	8.9	9.1	9.1	9.2	9.3	8.5	9.3	9.4	9.4	9.4	9.7	9.4	9.1	9.4	9.2	9.6	9.5	9.6	9.5
EC (1:5)	µS/cm	453	383	682	1050	886	466	279	309	446	409	602	265	278	297	383	319	222	222	371	497	354	223	351	352
Chloride	mg/kg	480	490	900	1470	1280	510	80	160	450	340	610	50	40	80	230	70	60	100	320	200	120	40	60	110
Exchangeable Ca	meq/100g	2.7	1.7	15.9	11.7	8.6	20.8	11.7	8.5	9.6	11.3	4.5	14.6	20.8	8.0	14.7	9.6	6.1	5.2	19.6	6.9	6.6	8.3	16.0	10.2
Exchangeable Mg	meq/100g	3.1	5.2	3.3	7.9	7.4	3.9	4.0	3.5	5.3	5.5	4.6	3.4	3.1	2.6	5.1	2.5	2.9	2.8	2.8	5.2	3.8	1.8	1.6	4.0
Exchangeable K	meq/100g	0.2	0.3	0.4	0.3	0.3	0.2	0.6	0.5	0.5	0.5	1.3	0.4	0.4	0.6	0.5	0.6	0.5	0.5	0.3	0.5	0.5	0.4	0.4	0.7
Exchangeable Na	meq/100g	0.6	2.4	1.0	1.2	2.1	0.4	1.1	1.1	1.8	1.5	2.7	1.0	0.5	2.7	1.1	3.2	2.1	2.8	0.4	2.2	3.1	1.9	2.6	6.8
Cation Exchange Cap.	meq/100g	6.6	9.7	20.8	21.2	18.5	25.4	17.5	13.8	17.2	19.0	13.5	19.5	24.9	14.0	21.5	16.0	11.8	11.3	23.2	14.9	14.0	12.4	20.6	21.8
Exchangeable Na %	%	8.7	24.3	5.1	5.7	11.3	1.5	6.1	8.2	10.5	8.2	20.2	5.3	2.1	19.0	5.2	20.1	17.9	24.6	1.7	14.6	21.9	15.1	12.6	31.2
Ca/Mg	ratio	0.9	0.3	4.8	1.5	1.2	5.3	2.9	2.4	1.8	2.1	1.0	4.3	6.7	3.1	2.9	3.8	2.1	1.9	7.0	1.3	1.7	4.6	10.0	2.6
Emerson Class	--	3	2	3	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodicity rating		Sodic	Strong sodic	Non-sodic	Non-sodic	Sodic	Non-sodic	Sodic	Sodic	Sodic	Sodic	Strong sodic	Non-sodic	Non-sodic	Strong sodic	Non-sodic	Strong sodic	Strong sodic	Strong sodic	Non-sodic	Strong sodic	Strong sodic	Strong sodic	Sodic	Strong sodic
Ca/Mg ratio <0.5 (2)		no	YES	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
Dispersion rating (from Emerson Class)		Dispers.	Some dispers.	Dispers.	Non-dispers.	Non-dispers.	Non-dispers.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

(1). VF = very fine; FF = fine; FM = fine-medium; CS = claystone; ST = siltstone; SS = sandstone. (2). Ca/Mg ratios less than 0.5 are strongly associated with dispersion.

Appendix C

Laboratory Certificates of Analysis

Stage 1 tests (all samples) ABA (pH, EC, S and ANC)

- ALS Batch EB1719760: Drill-holes IF3851PQ and IF3842PQ
- ALS Batch EB1719769: Drill-holes IF3843PQ and IF3848PQ
- ALS Batch EB1719773: Drill-holes IF3847PQ and IF3845PQ
- ALS Batch EB1719776: Drill-hole IF3850PQ

Stage 2 tests (selected samples)

- ALS Batch EB1722233: Scr, soluble metals, exchangeable cations and Emerson classification
- ALS Batch BR17236765: Total metals (sub-batch of EB1722233)
- ALS Batch EB1722355: Acid buffering characterisation curves

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