SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Chapter 10
Geochemistry

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10.0 Geochemistry and Mine Waste

10.1 Introduction

BM Alliance Coal Operations Pty Ltd (BMA) is seeking approval to develop the Saraji East Mining Lease Project (the Project) involving a single-seam underground mine and supporting infrastructure on Mining Lease Application (MLA) 70383 and MLA 70459 adjacent to, and accessed through, the existing open cut mine void within Mining Lease (ML) 1775.

This chapter of the Environmental Impact Statement (EIS) describes the geochemical characteristics of waste rock, potential coal reject and coal materials likely to be produced from the Project and assesses the potential environmental issues that may be associated with the mining, handling, and storing of these materials. The geochemistry assessment for the Project used historic geochemical data from BMA's exploration drilling and coal quality testing program conducted between 2010 and 2011 and samples collected by RGS-Terrenus in 2012 and 2017 (refer **Appendix G-1 Geochemistry Technical Report**). The EIS includes an additional 718 samples from three exploration bores collected by BMA in 2021 as well as additional spoil and waste samples collected in 2017 and 2018, respectively.

Mine wastes arising from the Project include waste rock from portal and ventilation shaft construction, reject materials from the coal handling and processing plant (CHPP), including dense medium coarse rejects, reflux classifier and dewatered floatation tailings. The anticipated waste rock and rejects from the Project will be deposited in-pit at the existing Saraji Mine Bauhinia Pit with mine waste from existing open cut operations, in accordance with authorised Saraji Mine waste management practices.

10.2 Legislation and policy

To protect environmental values, the primary legislative requirements for the management of acid and metalliferous drainage (AMD) and contaminated land are contained within the *Environmental Protection Act 1994* (EP Act). The EP Act is administered by the Department of Environment and Science (DES). Additional guideline documents relevant to this assessment at the time of drafting include:

- Department of Minerals and Energy (1995a), Assessment and Management of Acid Drainage
- Department of Minerals and Energy (1995c), Guidelines for the Assessment and Management of Saline/Sodic Waste
- AMIRA (2002), Acid Rock Drainage Test Handbook, Project P387A Prediction and Control of Acid Metalliferous Drainage
- Department of Industry, Innovation and Science Australia (2016), Preventing Acid and Metalliferous Drainage, Leading Practice Sustainable Development Program for the Mining Industry
- ANZECC/ARMCANZ (2000) Australian and New Zealand guidelines for fresh and marine water quality. Volume 1, The guidelines / Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand
- National Environmental Protection Council. National Environment Protection (Assessment of Site Contamination) Measure 1999 (Assessment of Site Contamination NEPM), Guideline on investigation levels for soil and groundwater, published 16 May 2013, including amendments up to National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1).

10.3 Methodology

10.3.1 Data sources

To understand the geochemistry within the Project area, the geochemical dataset comprised:

- waste rock samples from BMA drill cores and highwall grab samples at the proposed access portal area (RGS-Terrenus, 2012)
- potential reject selected from drill core samples (by RGS-Terrenus in 2012 from BMA exploration bores)
- coal samples from the BMA exploration cores in 2010, 2011 and 2021
- coarse reject grab samples collected by RGS-Terrenus from the coarse reject stockpile at the Saraji Mine (SRM) in 2012
- drill core samples, at regular ~ 1 m intervals to 250 m below surface, collected by BMA in 2021.

The sampling regime provided representative geochemical data from locations relevant to the Project. Figure 10-1 shows the Project Site and indicates the locations of the exploration bores. Geochemistry samples were collected from 340 of these bores for the investigation.

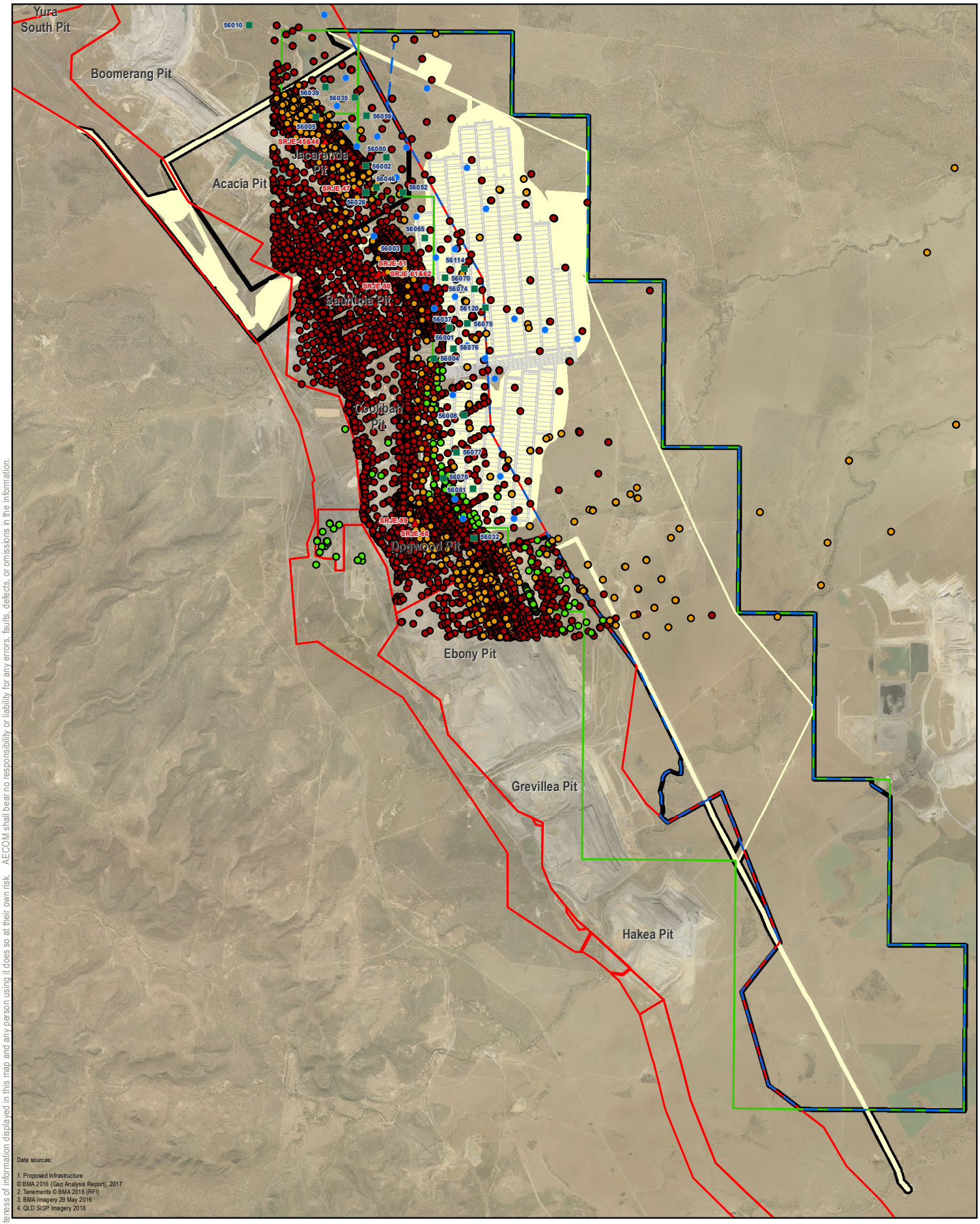
The assessment included a comparison of Project-specific waste and coal geochemistry against information from geochemical studies on the existing Saraji Mine coal and waste material (EGI, 1993; Emmerton, 2009; Emmerton, 2010; RGS, 2017). Findings from the existing Saraji Mine sampling programs (Emmerton 2009; 2010) were used by RGS-Terrenus (2012) to aid selection of 60 samples for detailed geochemical testing from the cores of 26 of the 55 BMA exploration bores and grab samples close to the proposed portal location. A further 718 samples were collected for acid-base geochemical testing in 2021.

Where the geology and nature of the resource is well understood, a risk-based approach was used to aid selection of samples for environmental geochemical investigations. Supplementary drilling and sampling completed for the Project considered existing information from geological and exploration drilling. Drill core samples that were provided represent the various mine waste materials likely to be generated during the Project.

A summary of total samples collected and analysed is outlined in Table 10-1.

Table 10-1 Summary of mine waste samples assessed for the Project.

Mine waste type	Waste description	Number of samples			
		RGS-Terrenus (2012)	BMA (2010-2011)	RGS-Terrenus (2017)	BMA 2021
Waste rock	Waste rock from construction of mine portal	14	-	6	
Coal samples	Sampled directly from the coal seam	6	-		231 contained coal
Coal (potential) reject samples	Selected from drill core samples	37	195		
Coarse reject samples	Roof and floor waste material sampled from the CHPP	3	-		
Samples (total)		**60 (including 26 drill core samples)**	**195 (including 55 drill core samples)**	**6**	**718 (all drill core samples)**



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LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground Mine Layout
- Historic Exploration Bores (pre-2021)
- Exploration Bores (2021 and later)
- Exploration Bores (no date)

Sample Type

- Drill Hole - Detailed
- Drill Hole - Total Sulfur Only
- Highwall Grab Sample

N

Figure 10-1
Drill-core locations for Geochemical and Mine Waste Investigation

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Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

BMA
BHP Mitsubishi Alliance

DATE: 4/07/2023 VERSION: 6

Filename: L:\Secure\Projects\605X\60507031\4. Tech Work Area\4.98 GIS 2021\02_MXDs\01 Environmental Impact Statement\10 Geochemistry and Mineral Waste\60507031_G118_v6_A4P.mxd GISWR-23, 45

10.3.2 Geochemical analysis

Deposition of the organic precursors of coal promotes low oxygen conditions, which can encourage sulfide formation in the coal, rock and sediment layers associated with a coal seam. Left buried and undisturbed, sulfide remains unreactive; however, mining the seam exposes potential sulfide to air. If pyrite is among the sulfides exposed, it reacts with oxygen in the air and water to form sulfuric acid (H_2SO_4).

Material left exposed to air and rainfall has potential to result in the generation of acidity. Acidic water can leach metals from mine wastes resulting in elevated metal and sulfate concentrations with potential to impact water resources. If the material has sufficient buffering capacity that match or exceed the acid generating capacity of a sample, then near-neutral (non-acidic) but metalliferous and/or saline drainage from mine waste can be produced. Acid drainage (AD), neutral and metalliferous drainage (NMD) and / or saline drainage (SD – oxidative) can then report to surface or groundwater.

Geochemical analysis undertaken as part of the RGS-Terrenus (2012) and BMA (2021) assessments evaluated the potential for mine waste to generate acid and metalliferous drainage (AMD) and based on the testwork result clarify if the expected drainage is acidic (acid drainage, it potentially acid forming (PAF)), non-acidic and metalliferous (NMD, non-acid forming high sulfur – NAF-S), or saline drainage (SD – oxidative; non-acid forming high sulfur – NAF-S). The assessment included an analysis of the sulfide content of mine wastes and determined the potential for generation of acidity and metal mobilisation under laboratory conditions.

Samples for the Project were classified with respect to acid generation that may lead to potential impacts on environmental values, using total sulfur and S_{CR}, net acid producing potential (NAPP), and ratio of acid neutralising capacity to the maximum potential acidity (ANC/MPA) into three broad categories:

- non-acid forming (NAF)
- uncertain
- potential acid forming (PAF).

10.3.2.1 Static geochemical analysis

Static geochemical testing on the samples selected by RGS-Terrenus (2012) and BMA (2021) for test work included:

- pH (1:5)
- electrical conductivity (EC) (1:5)
- acid neutralising capacity (ANC)
- total sulfur and sulfide-sulfur (S_{CR})
- net acid generation (NAG)
- exchangeable sodium percentage (ESP).

Based on results of the static geochemical testing, individual samples were selected to undergo additional acid-buffering characteristic curve (ABCC) testing to assess the amount of neutralising capacity likely available under field condition.

The BMA 2010-11 exploration drilling allowed for the identification of 195 potential reject samples; for all these samples, total sulfur was determined as part of the coal quality assessment. Assessment of the total sulfur distribution by RGS-Terrenus showed that only 42 samples (22 per cent of the total number of samples) had a total sulfur content greater than 0.2 per cent. Of these 42 samples, the 37 samples with the highest sulfur content, and therefore the highest potential for acid generation, underwent static geochemical testing (RGS-Terrenus, 2012).

Drilling conducted by BMA in 2021 resulted in the analysis of 718 samples, which were once again analysed for total sulfur content. Assessment of the sulfur distribution of the BMA (2021) samples identified a further 82 samples with the potential for acid generation.

10.3.2.2 Multi-element scans

Multi-element scans were carried out to identify elements potentially enriched in the samples representing a potential hazard with respect to revegetation and/or surface water quality if mobilised.

Elements identified as enriched compared to un-mineralised crust are not necessarily a concern for revegetation, human or animal health, or drainage water quality; however, were still evaluated. Similarly, although an element is not enriched it may become a concern in the future; for example, certain conditions (e.g. low pH) may promote the mobilisation of common, environmentally important elements such as aluminium (Al), copper (Cu), cadmium (Cd) and zinc (Zn).

Total concentrations of each element reported in the mine waste samples were compared to the Assessment of Site Contamination NEPM (1999) health-based investigation levels (HIL) category 'E' for open spaces, as set out in the 2012 RGS-Terrenus study (**Appendix G-1 Geochemistry Technical Report**). The NEPM guideline for open spaces was applied as it aligns with the current land use around the mine, and its potential post mining land use following closure and rehabilitation (i.e. grazing).

An update to the NEPM published in 2013 included revised HILs; HILs for public open space increased, except lead (Pb) that remained unchanged. RGS-Terrenus reassessed the multi-element scan data against amended HIL for public open space (HIL-C) to evaluate potential future risks to human health from intermittent exposure to mine wastes post site closure and rehabilitation.

Water extract tests were completed to assess the potential mobility of readily leachable metals and metalloids. Direct comparison of water quality data from leach test work against water quality guidelines is not appropriate. Leach test work can provide an indication of what metals and metalloids are readily mobile under laboratory conditions but cannot provide exact concentrations that would be measured in the field. This is because under field conditions, reactions can occur that would generally mitigate mobilisation including retardation and sequestration due to surface adsorption or precipitation due to buffering reactions. As a high-level qualitative exercise, soluble concentrations of each element extracted from coal and mine waste materials were compared to livestock drinking water guidelines (ANZECC, 2000); this comparison is indicative only, considered conservative and worst case.

The Assessment of Site Contamination NEPM establishes groundwater investigation levels (GILs) based on the ANZECC guidelines.

10.3.2.3 Kinetic geochemical analysis

Kinetic geochemical testing provided data on the geochemical characteristics of sample materials over time, if the samples were subjected to a series of drying and wetting cycles. The intent of the kinetic leach column (KLC) test program was to characterise ongoing water quality in leachate from potential coal reject samples subjected to routine wetting and drying cycles simulating environmental exposure, not necessarily linked to the climatic region. The KLC test method was based upon the AMIRA (2002) guideline method, with some modifications made and justified by RGS-Terrenus (2012), to better suit the types of materials being assessed. Additional details of the specific test methods are found in **Appendix G-1 Geochemistry Technical Report**.

KLC testing was completed on selected mine waste samples if warranted by indications of static test work results. The selected samples were identified from static test results as being PAF or having an 'Uncertain' acid generation classification and were considered to have the highest potential for leaching of the available samples. Further geochemical exploration and assessment has been undertaken with the most recent static geochemical data matching previous datasets and so did not warrant further kinetic geochemical testing.

Six composite samples of coal, potential coal rejects and coarse rejects were selected for KLC testing, with seven leaching events simulated over a period of 12 weeks. All composite samples are composites of drill-core samples only or grab samples only (i.e. no mixed drill-core and grab composites). Samples were analysed for total sulfur by BMA as part of the coal-quality assessment program. All other testing was initiated by RGS-Terrenus as part of their assessment.

Leachate generated from the columns were tested for pH, EC, alkalinity, acidity, soluble metals and metalloids (25 elements), soluble hexavalent chromium, soluble major cations, soluble sulfate, soluble chloride, and fluoride. A summary of the geochemical testing that was completed for the Project is presented in Table 10-2.

Table 10-2 Summary of geochemical testing that was completed for the Project

Analytical test	RGS-Terrenus, 2012					BMA, 2021
	Waste rock from portal	Coal seam immediate roof	Coal seam immediate floor	Coal	Saraji Mine coarse rejects	Drill core samples
Static testing						
Total sulfur	14	95 (drill-core)	100 (drill-core)	-	-	506
Static Acid-base (pH, EC)	5 (drill-core) 9 (grab)	16 (drill-core)	21 (drill-core)	6 (drill-core)	3 (grab)	508
S_{CR}	14	16	21	6	3	201
ESP	14	16	21	6	3	65
ANC	14	16	21	6	3	507
Total elements and sulfate in solids	2 (individual drill-core) 2 (individual grab)	4 (composite)	4 (composite)	3 (composite)	1 (composite)	
Soluble elements and major ions, pH and EC in 1:5 water extracts	2 (individual drill-core) 2 (individual grab)	4 (composite)	4 (composite)	3 (composite)	1 (composite)	
Kinetic leach column testing						
Soluble elements and major ions, pH and EC	-	1 (composite)	3 (composite)	1 (composite)	1 (composite)	

10.4 Description of environmental values

Existing environment of the Project Site (shown in Figure 10-1), described in **Chapter 4 Land use and Tenure**, is consistent with land used for livestock grazing with some areas of cropping activity to the southeast. In addition to grazing and grain production, there are over 40 active coal mines in the Bowen Basin, including BMA's Saraji Mine immediately west of the Project that has been operating as an open cut coal mine since 1974.

Operating since 1974, the existing Saraji Mine has approval for open cut mining to the eastern extent of the ML 1775. The proposed longwall underground mine will start at the highwall within ML 1775 and extend underground into MLA 70383 (Figure 10-1).

10.4.1 Proposed mine waste management practices

The Project is estimated to produce up to 3Mt/a of rejects (75Mt over 25 years) comprising coal rejects and dewatered tailings. Tailings will be dewatered and disposed in-pit at the Saraji Mine, along with coarse rejects.

The Project will comprise a new ROM stockpile pad, new product coal stockpile pad and a new CHPP constructed within the existing Saraji Mine lease. The rejects from the CHPP will consist of:

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

Dewatering of CHPP tailings is achieved through the use of belt press filters. The combined dewatered tailings and coarse rejects will be conveyed from the CHPP to the rejects bin and then trucked to Saraji Mine for in-pit disposal (as is currently authorised under the Saraji Mine Environmental Authority (EA)). The volume of coal rejects and dewatered tailings material will have a negligible impact on the size and management of the Saraji Mine in-pit spoil dumps (further discussed in Section 10.5.2 and 10.5.3).

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

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

Mine domains representing potential sources of AMD/salinity at Saraji Mine are associated with locations where carbonaceous waste rock and rejects are disposed such as residual voids, spoil dumps and tailings storage facilities.

Mine waste management at the Saraji Mine open cut operation is in accordance with existing approved EA reference: EPML00862313 and as documented within a Waste Management Plan (Condition D1).

10.4.2 Geochemical analysis

Mineral waste (and coal) samples have undergone environmental geochemical characterisation and assessment of potential to generate AMD. Geochemical assessment leveraged historical geochemical data (pre-2019) and subsequent sampling and analytical program (2019-onwards) to classify and map the distribution of potential for AMD rock types in the areas where mine wastes are deposited (BMA, 2023).

Past geochemical assessment of waste rock suggests this material domain is overwhelmingly NAF with excess neutralising capacity (i.e. presenting a very low risk for acid generation from in-pit spoil dumps).

10.4.2.1 Geochemical risk

BMA estimate, historically, the dominant proportion of coarse reject materials produced on site at Saraji Mine has been disposed within existing in-pit spoil dumps. Monitoring has recorded no evidence of AMD on site from coarse reject materials since mining commenced in 1974 (or at any of BMA's coal mines in the region) (BMA, 2020). Waste rock and coarse reject is considered possible but low risk for acid generation.

Conservative assessment of the geochemical likelihood of AMD generation at the existing Saraji Mine is described in Table 10-3.

Table 10-3 Likelihood of AMD generation

Landform domain	Likelihood of AMD generation
Waste rock	Very Low/Unlikely
Coarse reject	Low/Possible

These ratings apply to waste rock and coarse reject storage across the existing Saraji Mine.

This geochemistry indicates BMA's existing approved management practices adequately avoids and minimises AMD potential. Measures to reduce the risk of AMD generation from mine wastes arising from the Project are described in Section 10.6.

10.5 Potential impacts

10.5.1 Geochemical analysis

Classifications of mine wastes are presented in Table 10-4 and Table 10-5.

Table 10-4 AMD hazard classification system (RGS-Terrenus, 2012)

Mine waste classification	Total sulfur	Sulfide sulfur (S_{CR})	NAPP (kg H_2SO_4/t)	ANC/MPA ratio
Barren - NAF	≤ 0.1%	-	-	-
NAF	-	≤0.1%	-	>2
	-	-	< -10	>3
Uncertain	-	>0.1%	-10 - 0	<2
PAF – Low Capacity (PAF-LC)	-	>0.1%	0 - 10	-
PAF	-	-	>10	<2

Table 10-5 Classification adopted by BMA for the 2021 samples

Preliminary classification	ANC	NAGpH	NAG capacity
	kg H2SO4/t		kg H2SO4/t
NAF (weathered samples)	-	≥ 4.5	< 0.5
NAF (fresh samples)	≥ 10	≥ 4.5	< 0.5
Uncertain-NAF UC(NAF)	≥ 10	≥ 4.5 and < 7	< 0.5
	< 10	≥ 7	< 0.5
Uncertain-PAF UC(PAF)	< 10	≥ 4.5 and < 7	-
PAF	-	< 4.5	-

Classification of samples for the potential generation of saline conditions was based on the EC sample, as outlined in Table 10-6 and Table 10-7.

Table 10-6 DME Salinity classification system (DME, 1995c)

	Very Low	Low	Medium	High	Very High
EC1:5 (sample: water) µS/cm	<150	150 – 450	450 – 900	900 – 2,000	>2,000

Table 10-7 BMA salinity classification system

Soil salinity classification	EC1:5 (µS/cm)
Non-saline	< 450
Slightly saline	450 – 900
Moderately saline	900 – 2,000
Saline	2,000 – 4,000
Strongly saline	> 4,000

10.5.1.1 Static geochemical test work results

The following sections summarise the geochemical testing of mine waste samples collected from the sources outlined in Table 10-8. Detailed descriptions and a summary of the geochemical testing completed for the Project prior to 2017 are presented in **Appendix G-1 Geochemistry Technical Report**. The geochemical test work was updated with new data supplied by BMA (BHP, 2021).

Total sulfur in potential mine waste

The results from all samples analysed for total sulfur are summarised in Table 10-8.

Table 10-8 Summary of mine waste total sulfur analysis

Total sulfur	RGS-Terrenus (2012)					BHP, 2021
	Coal seam roof and floor samples (potential rejects)	Portal waste rock samples	Coal reject samples	Coarse reject samples	Coal samples	Drill core samples
Number samples analysed	195	14	37	3	6	506
Minimum	<0.01	0.03	0.03	0.48	0.45	<0.01
Median (50th percentile)	0.09	0.045	0.41	1.14	0.595	0.06
90th percentile	0.29	0.13	1.496	NC	NC	0.52
Maximum	3.44	0.19	3.74	1.16	1.24	8.54
Number >0.1% sulfur	112	1	14	3	6	199
Per cent >0.1% sulfur	57%	7%	38%	100%	100%	39%

Potential mine waste $pH_{1:5}$ and $EC_{1:5}$

For the mine waste samples analysed, values of pH1:5 fall within a neutral to alkaline classification, as indicated in Table 10-9. Portal waste rock samples are basic (alkaline), coal reject samples are neutral to basic, coarse reject samples are basic, and coal samples are basic. The neutral to relatively high pH values reported in the 1:5 leachates indicate either:

- low acidity is derived from the readily leachable solutes of each sample
- the readily leachable solutes include adequate buffering capacity.

Table 10-9 Summary of mine waste pH1:5

pH	RGS-Terrenus (2012)				BHP, 2021
	Portal waste rock samples	Coal reject samples	Coarse reject samples	Coal samples	Drill core samples
Number samples analysed	14	37	3	6	508
Minimum	9.20	6.80	8.90	8.30	3.80
Median (50 percentile)	9.50	9.40	9.20	8.65	9.40
Maximum	9.80	10.00	9.40	9.70	9.90
Number of basic (pH >8.0)	14	30	3	6	448
Number of neutral (pH 6.5 – 8.0)	0	7	0	0	38
Number of acidic (pH <6.5)	0	0	0	0	22

An evaluation of all EC1:5 data indicated the EC ranged from 35 microSiemens per centimetre (µS/cm) to 2,930 µS/cm (drill core samples), with the median $EC_{1:5}$ of 373 µS/cm falling within the 'Low' or Non-Saline salinity classifications.

Considering mixing is likely to occur during the development of the mine portal and during coal processing in the CHPP, the median $EC_{1:5}$ is representative of the respective mine waste streams during mine development and operation.

With the mixing taken into consideration during construction and operation, a review of specific mine waste streams indicates that portal waste rock $EC_{1:5}$ is predominantly low with a median of 339 µS/cm; with drill core samples also recording a low median of 373 µS/cm. Coal rejects $EC_{1:5}$ is predominantly low with a median of 401 µS/cm. Coarse rejects $EC_{1:5}$ is low with a median of 357 µS/cm. Finally, coal sample $EC_{1:5}$ is low with a median of 104 µS/cm.

The $EC_{1:5}$ data indicates low dissolved ion contents in the leachates. This suggests that the readily leachable salinity (major ions) component of the samples is predicted to be minor.

Table 10-10 Summary of mine waste EC1:5

EC (µS/cm)	RGS-Terrenus (2012)				BHP, 2021
	Portal waste rock samples	Coal reject samples	Coarse reject samples	Coal samples	Drill core samples
Number samples analysed (n)	14	37	3	6	508
Minimum	186	64	331	52	35
Median (50 percentile)	339	401	357	104	373
Maximum	544	1,630	519	144	2,930
Number of Very Low (<150)	0	5	0	6	34
Number of Low (150-450)	12	19	2	0	307
Number of Medium (450-900)	2	10	1	0	134
Number of High (900-2,000)	0	3	0	0	33
Number of Very High (>2,000)	0	0	0	0	1

Potential mine waste acid base accounting

Acid-Base Accounting (ABA) is an assessment of the potential for a sample to generate acidity and the capacity of the sample to neutralise the acidity generated. Acidity may be expressed as the maximum potential acidity (MPA), whereas neutralisation is expressed as the ANC; both are commonly expressed in units of kilograms of sulfuric acid per tonne of sample (kg H_2SO_4/t). MPA is estimated from total S or sulfide-sulfur values while ANC is measured directly in the laboratory via titration.

ABA test work results were used to assign an AMD hazard classification to the samples tested based on the classification system summarised in Table 10-5 and the BMA hazard classification (RGS-Terrenus, 2012), with a summary of the AMD classification assigned to the samples tested presented in Table 10-11.

Geochemical testing indicates that approximately 74 per cent of analysed mine waste samples were NAF, 6 per cent were uncertain, 10 per cent were PAF – low capacity (LC), and 7 per cent were PAF.

None of the portal waste rock was classified as PAF-LC or PAF. Of coal reject samples classified, 22 per cent are PAF-LC and PAF, 33 per cent of coarse reject samples were classified as PAF and 34 per cent of coal samples were classified as PAF-LC and PAF. Comparatively, of the new drill core samples, only 16 per cent are PAF-LC and PAF. The percentage of uncertain samples are highest for coarse rejects with 67 per cent, while for coal rejects and coal the percentage of samples with uncertain geochemical characteristics is 22 per cent and 17 per cent, respectively.

These findings are consistent with the findings of the existing Saraji Mine coarse rejects reports by Emmerton (2009; 2010).

Table 10-11 Summary of geochemical acid-base accounting classification of mine wastes

Mine waste classification	RGS-Terrenus, 2017								BMA, 2021		Total
	No. waste rock	% portal waste rock	No. coal reject	% coal reject	No. coarse reject	% coarse reject	No. coal	% coal	No. drill cores	% drill cores	
Number of samples analysed	14		37		3		6		507		567
Barren - NAF	13	93%	2	5%	0	0%	0	0%	2	0%	3%

Mine waste classification	RGS-Terrenus, 2017								BMA, 2021		Total
	No. waste rock	% portal waste rock	No. coal reject	% coal reject	No. coarse reject	% coarse reject	No. coal	% coal	No. drill cores	% drill cores	
NAF	1	7%	19	51%	0	0%	3	50%	398	79%	74%
Uncertain	0	0%	8	22%	2	67%	1	17%	25	5%	6%
PAF – Low Capacity (PAF-LC)	0	0%	5	14%	0	0%	1	17%	50	10%	10%
PAF	0	0%	3	8%	1	33%	1	17%	32	6%	7%

It is estimated most of the 40 Mt LOM mine waste (over 99 per cent of the total mine waste mass) for the Project will be coal reject samples and coarse reject samples. The data in Table 10-11 indicates 50 per cent or less will likely be PAF-LC and/or PAF.

When considered as a bulk material following processing through the CHPP, coal reject material is expected to be NAF. However, in consideration that 22 per cent of coal rejects and 67 per cent of coarse rejects are classed as 'uncertain', together with the limited availability of neutralising capacity for the roof and floor samples, the potential for acidity generation from these materials cannot be excluded even with the relatively low sulfide concentrations.

Acid buffering characteristic curves

Acid buffering characteristic curves (ABCCs) provide an indication of the available neutralisation capacity of a sample under field conditions. By titrating a known concentration of acid onto a sample and recording the change in pH following the incremental acid addition, a characteristic curve can be established, which provides information on the likely availability and nature of the neutralisation capacity.

Appendix G-1 Geochemistry Technical Report shows the results of the ABCC tests conducted on the potential coal reject and coarse reject samples. For most samples tested, the available ANC is ≤50 per cent of the ANC of the samples measured via single stage titration, as assessed by ABA. This indicates that the waste material is likely to have less buffering capacity, supporting the conservative approach taken when classifying samples as PAF or NAF.

10.5.1.2 Multi-element scans

Details of multi-element bulk chemistry test results for portal waste rock, coal rejects, coarse rejects, coal and six composite samples subjected to KLC testing are presented in **Appendix G-1 Geochemistry Technical Report**. Water quality data for leachate extract for portal waste rock, coal rejects, coarse rejects and coal samples are detailed in **Appendix G-1 Geochemistry Technical Report**.

In brief, the bulk chemistry data show that total metal and metalloid concentrations in portal waste rock, potential mine waste, coarse rejects, and coal samples tested were below NEPM (2013) HIL-C; on this basis, the mine waste will not pose an unacceptable risk to human health if it is exposed following mine closure and rehabilitation.

The analysis showed that, for:

- Waste rock, leachate test work results indicate that mercury (all four portal waste rock samples), molybdenum (three of four portal waste rock samples) and selenium (one of the four portal waste rock samples) may be somewhat mobilised during leaching under laboratory conditions. Leachate produced under laboratory condition exceeded the ANZECC (2000) livestock drinking water quality trigger values (low risk) for mercury and selenium, and the NEPM GILs for all three metals.

- Coal rejects, leachate test work results indicate that mercury (in one of eight samples), molybdenum (in seven of eight samples), and selenium (in six of eight samples) may be mobilised during leaching under laboratory conditions. Leachate produced under laboratory condition exceeded the ANZECC (2000) livestock drinking water quality trigger values (low risk).
- Coarse rejects, in the single sample analysed, molybdenum was mobilised during the test work at values exceeding the ANZECC (2000) livestock drinking water quality trigger values (low risk) and NEPM GILs.
- Coal samples, one of three coal samples analysed mobilised molybdenum in the leachate under test work condition at values above the ANZECC (2000) livestock drinking water quality trigger values (low risk) and NEPM GIL.

The measured levels were below the analytical limits of reporting (LOR) for cadmium, copper, lead, nickel, and zinc. The LORs were greater than the respective NEPM GIL and therefore no assessment of relative risk could be made in the four mine waste streams assessed.

Selenium is a naturally occurring metal, with the level of toxicity dependant on the form the selenium occurs in (valency state), with selenium-IV being more toxic than selenium-VI. Selenium uptake in organisms via food is a greater concern than direct uptake via water for aquatic organisms, where lower toxicity selenium-VI can be readily bioaccumulated through the food chain if released to surface waters. However, the uptake of selenium by aquatic organisms is affected by pH, hardness, sulfur, and phosphate content of natural waters (after ANZECC, 2000), while the form of selenium (IV vs VI) is dependent on the oxygenation level of the water.

Core sample initial solubility

To evaluate the initial solubility of multi-elements in 94 selected 2021 core samples, water extract (1:5 sample: water) tests were completed for selected individual samples. The results of the solubility tests are included in Table 10-12.

One sample (from 94) indicated the potential for mobilised molybdenum in the leachate under test work condition at values above the ANZECC (2000) livestock drinking water quality trigger values (low risk) and NEPM GIL.

One sample (from 94) indicated the potential for mobilised selenium in the leachate under test work condition at values above the selected guideline. As detailed above, selenium is a naturally occurring metal. Selenium uptake in organisms via food is a greater concern than direct uptake via water for aquatic organisms, where lower toxicity selenium-VI can be readily bioaccumulated through the food chain if released to surface waters. However, the uptake of selenium by aquatic organisms is affected by pH, hardness, sulfur, and phosphate content of natural waters (after ANZECC, 2000), while the form of selenium (IV vs VI) is dependent on the oxygenation level of the water.

Table 10-12 Solubility test results

Multi-elements	Maximum (mg/L)	Sample	Minimum (mg/L)	Guideline Levels[1]
Aluminium	0.9	H19 Sandstone, fine; carbonaceous wisps near base of unit pyritic; minor coal	<0.01	5
Arsenic	0.488	Mudstone: carbonaceous in part coaly lenses near base of unit above H15	<0.001	0.5
Boron	0.9	Sandstone, medium; rare silty laminae	< 0.1	5
Barium	1.39	Sandstone, fine-medium; siliceous	<0.001	-
Beryllium	0.018	H19 Sandstone, fine; carbonaceous wisps near base of unit pyritic; minor coal	<0.001	-
Cadmium	0.0047	Siltstone; carbonaceous in part near top of unit below H15	<0.001	0.01
Cobalt	0.35	Siltstone; carbonaceous in part near top of unit below H15	<0.001	1
Chromium	0.015	H19 Sandstone, fine; carbonaceous wisps near base of unit pyritic; minor coal	<0.001	1
Copper	0.051	Weathered claystone	<0.001	1 / 0.5
Iron	22.3	H19 Sandstone, fine; carbonaceous wisps near base of unit pyritic; minor coal	<0.05	-
Manganese	12.8	H19 Sandstone, fine; carbonaceous wisps near base of unit pyritic; minor coal	<0.001	-
Molybdenum	**0.277**	P14 Carbonaceous Siltstone; coaly	<0.001	0.15 / 0.01
Nickel	0.917	Siltstone; carbonaceous in part near top of unit below H15	<0.001	1
Lead	0.008	Sandstone, fine-medium; micaceous	<0.001	0.1
Antimony	0.011	Sandstone, very fine; occasional silty laminae throughout	<0.001	-
Selenium	**0.16**	H15 Mudstone; carbonaceous in part	<0.01	0.02
Tin	0.002	Siltstone; sandy bands throughout carbonaceous near base of unit above H19	<0.001	-
Strontium	28.9	Sandstone, fine-medium; calcite pyritic veins	<0.001	-
Thorium	0.002	Siltstone; abundant thick sandy bands	<0.001	-
Uranium	0.004	H19 Sandstone, fine; carbonaceous wisps near base of unit pyritic; minor coal	<0.001	-
Vanadium	0.09	Sandstone, very fine; occasional silty laminae throughout	<0.01	0.1
Zinc	0.596	Siltstone; carbonaceous in part near top of unit below H19	<0.005	20

[1] Non-detect for silver, bismuth, mercury, phosphate, titanium, thallium, tungsten, zircon

[1] As per RGS Terrenus **Appendix G-1 Geochemistry Technical Report**.

10.5.1.3 Kinetic geochemical analysis

To provide an indication of leaching potential under laboratory conditions, modified KLC tests (described in **Appendix G-1 Geochemistry Technical Report**) were completed on six composite samples:

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

KLC test results for potential coal reject samples

Based on the overall ABA results summarised in Table 10-11, the H16 roof KLC sample (SRJE-C17) was expected to be NAF, whereas the H16 floor (SRJE-C18), D14 floor (SRJE-C19) and D24 floor (SRJE-C20) samples were assigned ‘uncertain’ classifications, as the individual samples used to prepare these composites have all three classifications, namely, NAF, uncertain and PAF.

After seven leaching events over a 12-week period, KLC test results indicated that the coal reject composite samples generated low acidity. Leachate from these samples generally reported neutral to slightly alkaline pH, low to moderate salinity, low sulfate release rates and low concentrations of soluble metals.

KLC tests indicated that the coal reject samples were likely to be NAF. The likelihood of acid generation from composite coal reject samples is considered very low, even if one or more of these samples were to generate increased acidity, the acid concentrations in leachate would likely be very low and would not pose management problems.

Details of KLC testing and results are provided in **Appendix G-1 Geochemistry Technical Report**.

KLC test results for the composite coarse reject sample

Average ABA results for the individual samples that were used to generate the composite sample for KLC testing indicated that Saraji Mine coarse rejects could be PAF. After seven leaching events over approximately 12 weeks, leachate reported neutral to slightly alkaline pH values (7.53-8.47), very low acidity, and low to moderate salinity. The composite sample generated leachate with an initial EC of 1,410 µS/cm, which decreased throughout the leaching program to a final value of 430 µS/cm.

The sulfate release rate was initially elevated at 300 milligram per kilogram per flush (mg/kg/flush) but decreased throughout the leaching program to a final value of 109 mg/kg/flush. Metal and metalloid concentrations in coarse rejects leachate were low, generally at or close to the laboratory LOR.

The initial elevated sulfate release rate reported in the KLC test suggests that sulfide oxidation may have commenced early in the test. Alternatively, this may be due to leaching of sulfate present in the sample prior to testing (e.g. on an oxidised surface). Leachate from this sample has however consistently reported neutral to slightly alkaline pH values, indicating that acidity potentially generated through sulfate release has been buffered by sample ANC. Sulfide oxidation may have stabilised, and may have decreased over the course of the test, as indicated by the concurrent decrease in leachate sulfate and EC.

On this basis the composite coarse rejects are considered NAF and the likelihood of acid generation is considered low. It is possible that this sample may begin to generate weak acidity in the long-term, although the capacity for this sample to generate significantly acidic leachate is low.

KLC test results for the composite coal sample

Average ABA values for the individual samples that were used to prepare the composite sample show that the coal sample has an 'uncertain' ABA classification. After seven leaching events over approximately 12 weeks, leachate was pH-neutral and fluctuated between pH 6.75 and 7.39, with a final pH of 6.81. Very low salinity and an EC of less than 100 µS/cm was reported.

The sulfate release rate was very low (less than 13 mg/kg/flush), with an average value of 4.4 mg/kg/flush. Metal and metalloid concentrations in leachate were very low, generally less than the laboratory LOR.

The results show that leachate is similar in composition to the de-ionised water used as the leaching fluid, with very low concentrations of major ions, salts and metals being released. Coal samples are considered unlikely to generate significant acidity that may lead to acidic runoff/leachate from coal stockpiles during rain events.

KLC multi-element test results

Review of multi-element (soluble) results from the seven KLC leaching events per sample indicated minimal leaching of metals and metalloids. Results of KLC multi-element tests of composited coal rejects from the Dysart Lower (D24 and D14) seam determined leachable quantities of metals or metalloids were mostly below LOR. Where leachable quantities were encountered, the ANZECC (2000) livestock drinking water quality trigger values (low risk) and NEPM (2013) GIL were not exceeded. However, leachable selenium from composited coal rejects did exceed the NEPM GIL for freshwater.

Similar to composited coal rejects, results of KLC multi-element tests of the composited existing Saraji Mine coarse reject sample did not result in leachable quantities of metals or metalloids above LOR or, where leachable quantities were encountered, the ANZECC (2000) livestock drinking water quality trigger values (low risk) and NEPM (2013) GIL. Like the coal rejects sample, selenium exceeded the respective NEPM (2013) GIL for freshwater. One aluminium leach result exceeded the respective NEPM (2013) GIL, though all remaining results were either at or below the LOR, suggesting the single result is unlikely to represent the long-term leachable condition of the material.

However, it must be recognised that it is inaccurate to directly compare leachate results from bench-scale columns to water quality guidelines, as leachate from in-pit spoil dumps will be subject to greater dilution than the leachate generated from these columns, and a range of secondary reactions over longer time scales. Furthermore, materials within in-pit spoil dumps are subject to scale-up factors and a range of oxidising conditions.

Whilst the initial KLC tests indicated relatively low concentrations of selenium in coal rejects, the overall impact of selenium has been considered in the development of mitigation measures for the Project (see Section 10.6).

10.5.2 Mine waste quantities

Based on the proposed longwall mining technique described in **Chapter 3 Project Description**, an estimated 150 million tonnes (Mt) run-of-mine (ROM) coal is proposed to be extracted over the 20 year life of mine, with an estimated 110 Mt of product coal and 40 Mt of mine waste generated.

Most mine wastes generated will be coal rejects, consisting of coarse rejects, fine reflux classifier rejects, and dewatered flotation tailings from extracted coal, coal seam roof, coal seam floor and coal seam parting materials. Some waste rock will be generated during development of the portal, estimated to be approximately 0.005 Mt. The waste volumes are based on the mine plan included in Figure 3-2 in **Chapter 3 Project Description**.

Estimated mine waste types and volumes generated by the Project are summarised in Table 10-13.

Table 10-13 Estimated total mine waste quantities generated by the Project

Mine waste type	Estimated lifetime volume	Mine waste source
Waste rock	0.005 Mt during construction (0.01% of total)	highwall - during stabilisation for development of access portal portal - during drilling of access tunnels through rock to target seam ventilation shafts - during drilling of ventilation shafts
Coal rejects / dewatered tailings (Mixed Plant Reject)	40 Mt over life of mine (LOM) (>99% of total)	CHPP - during operation of the mine consisting of: dense medium coarse reject material reflux classifier reject material

Handling and processing of waste rock and coal rejects is described in Section 10.4.1 and below.

10.5.2.1 Waste rock

Where geotechnical conditions permit, the access portal will commence directly into coal through the existing open cut highwall, minimising the waste rock being generated. Where this option is not feasible, the underground access portal may need to commence slightly above the coal, where the roof strength is greater. The resulting portal waste rock (estimated to be 0.005 Mt) is expected to consist of mudstone, siltstone, and fine-grained sandstone.

Waste rock with suitable geotechnical properties will be used for engineering and construction purposes such as bulk fill, road sub-base, and construction material for laydown areas, resulting in waste minimisation. Waste rock that is unsuitable for engineering purposes, or in excess of construction requirements, will be trucked for disposal within in-pit spoil dumps according to the EA and approved overburden management practices (described in Section 10.6.1).

10.5.2.2 Coal rejects

Coal will be processed by a new Project CHPP, constructed on ML 70142, or within the existing Saraji Mine CHPP when additional capacity is required.

Coal rejects generated from the Project CHPP will consist of coarse rejects (from the dense medium cyclones), fine rejects (from the reflux classifiers), and dewatered tailings (from the floatation cells).

The CHPP will be constructed using equipment with capacity in line with current industry practices. It is expected this design strategy will lead to greater efficiencies when compared to traditional CHPP with multiple small capacity parallel streams. The options selected for processing the coal are based on proven technology for each size range. This combination of circuits has been adopted by many of BMA's CHPPs in the region and may include:

- dense medium cyclones for coarse coal
- reflux classifiers for fine coal
- microcell column flotation for ultra-fine coal.

The Project will use belt press filters to dewater the coal tailings.

Coal rejects from the CHPP will be transferred by truck using internal roads to existing Saraji Mine in-pit spoil dumps, away from final landform surfaces as per current approved practices (described in Section 10.6).

Data and interpretations provided in this section are reported in the context of mine waste materials likely to result from access portal waste rock or in the context of potential coal rejects and coarse rejects. The classification criteria group mine wastes based on their potential to generate acidifying, metalliferous or saline conditions.

10.5.3 Disposal capacity

Saraji Mine is permitted to receive mine waste from any BMA site in Queensland, including spoil or rejects or tailings, for disposal in dedicated emplacements, pits or voids in accordance with existing

approved Environmental Authority (EA) reference: EPML00862313 and documented within the Waste Management Plan (Condition D1); no amendments are proposed.

BMA has completed an analysis to demonstrate that sufficient disposal capacity is available for Project mine waste within the existing Saraji Mine emplacements (for example Bauhinia Pit considered below), refer to Project waste disposal as described for:

- proposed rejects emplacement for anticipated Project waste volumes (Figure 10-2)
- with capping of rejects emplacement (Figure 10-3)
- within maximum dump tent (Figure 10-4).

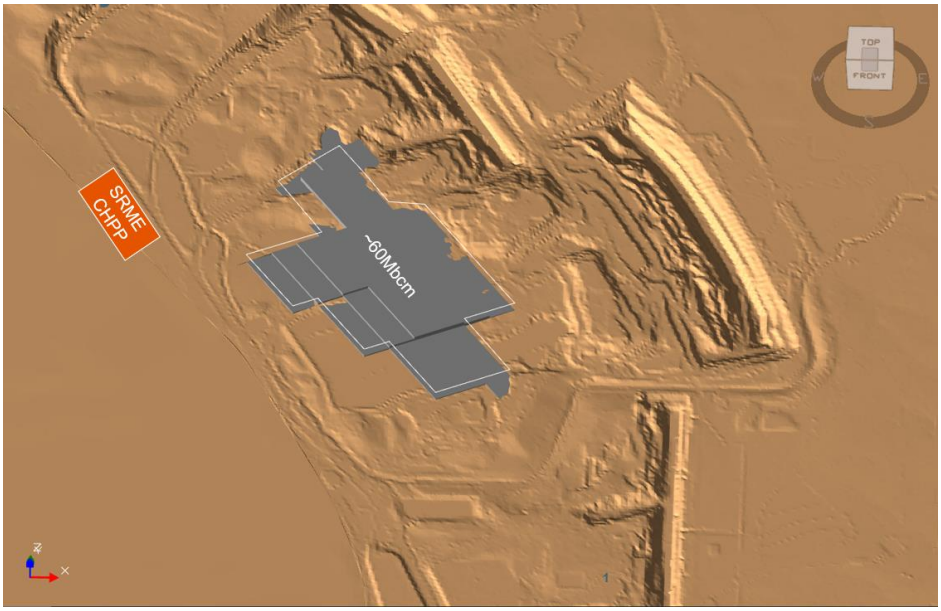

Figure 10-2 Proposed rejects emplacement within existing Bauhinia Pit

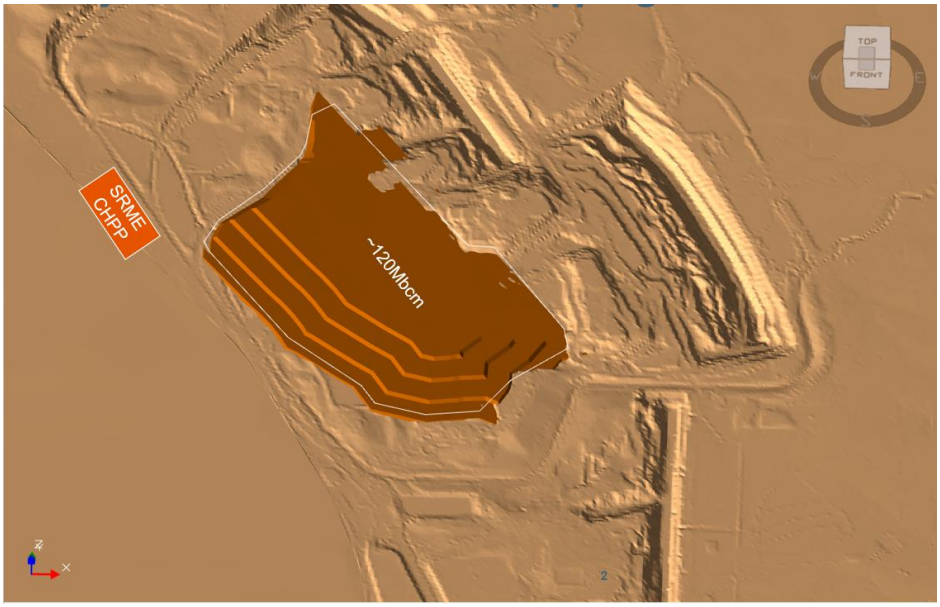

Figure 10-3 Post Project waste disposal with capping

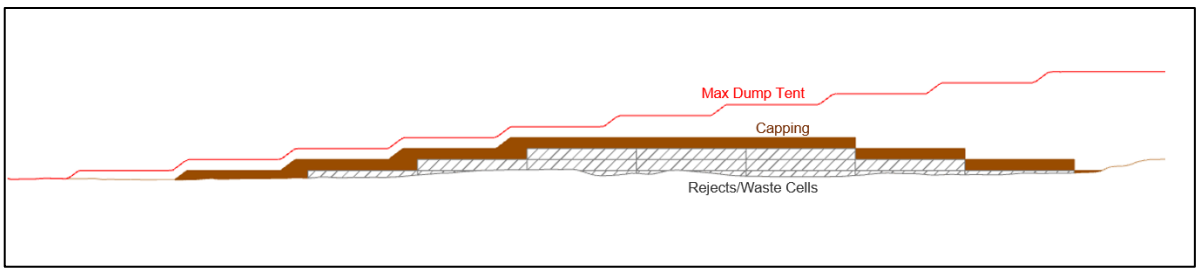

Figure 10-4 Project waste disposal showing rejects and capping within Max Dump Tent

10.5.4 Seepage

A post-mining conceptual site model for Saraji Mine was developed (SLR, 2022) to describe groundwater interactions and potential for contaminant transport at the Saraji Mine final voids. In the conceptual site model, void lake formation was predicted with lake levels stabilising below the pre-mining groundwater elevations. Inward hydraulic flow gradients towards the residual voids are maintained driven by evaporative losses from the void lakes, with no outflows of water to the surrounding hydro-stratigraphic units predicted to occur. Residual voids will continue to capture seepage from spoil dumps with no additional impact on environmental or anthropogenic receptors.

As described, the final receptor for seepage from the spoil landform (for each spoil landform) and run-off from the highwall (of each void) will be the void lake within the residual void. Particle movement simulation indicated groundwater at Saraji Mine, including flowing through spoil of the final closure state landform and potential contamination sources will remain within the final closure landform (backfilled spoil and residual voids) in the long term. The simulation also predicted voids will remain groundwater sinks and particles will not flow from the residual voids offsite to the receiving environment.

10.5.5 Acid mine drainage

The AMD assessment (BMA, 2023) found it unlikely undiluted salinity or AMD from a flooded post-closure residual void floor will impact on residual void water quality to a significant degree, as other processes such as evapo-concentration are the key drivers of void lake water quality (SLR, 2022). Water reporting to residual voids is expected to remain within the residual voids (excluding evaporative loss).

10.5.5.1 Waste rock

Waste rock generated by the Project is anticipated to be less than one per cent (0.005 Mt) of mine waste generated through the Project lifetime. Based on geochemical analysis, waste rock is likely to have a high factor of safety and very low probability of acid generation, and is expected to generate alkaline, low-salinity runoff/seepage following surface exposure when placed into the existing Saraji Mine Bauhinia pit.

Waste rock generated from the Project is expected to have the same or very similar characteristics as pre-existing waste rock generated from the Saraji Mine. Waste rock generated from construction of the mine portal is expected to be NAF and unlikely to create conditions suitable for AMD.

Waste rock material can generate leachate containing elevated concentrations of soluble elements compared to guidelines under laboratory conditions. However, the likelihood of environmental harm is low given actual field conditions and limited quantity of waste rock material likely to be generated by the Project. Waste rock material will be managed and monitored in accordance with the measures set out in Section 10.6.1.

Leachate from waste rock (refer to Section 10.5.1.2) will report to the residual Saraji Mine void. The risk of site runoff and seepage from the waste rock material generated by the Project impacting on the surrounding environment is therefore assessed as very low.

10.5.5.2 Coal rejects

The Project coal rejects are expected to generate pH-neutral to mildly alkaline, relatively low-salinity runoff/seepage following surface exposure. Total sulfur concentrations of coarse reject samples were low. Some samples were classified as PAF; however, the magnitude of any acidity generation is expected to be low. PAF rejects are expected to comprise approximately 10 per cent of reject material, and therefore the risk of environmental harm of leaching is low.

Coarse reject samples from the existing Saraji Mine and from a previous assessment (Emmerton, 2010) demonstrate the potential for acidity generation is low. No AMD has been identified since commencement of mining operations at Saraji Mine. Surface water monitoring data also demonstrate that the coarse rejects at Saraji Mine are currently managed appropriately and do not pose a significant environmental risk.

There is a risk of leachate from coal rejects containing elevated soluble metal concentrations under laboratory conditions. Submissions were received on the draft EIS expressing concern regarding the potential for selenium leachate from coal rejects. To address these concerns, 83 of the 718 samples

collected by BMA in 2021, were selected for analysis of selenium levels. The analysis identified 15 samples with leachable quantities of selenium exceeding the NEPM (2013) GIL (0.02 mg/L). 48 samples were <0.01 mg/L and 20 samples had concentrations 0.01 to 0.02 mg/l, as included in Figure 10-5.

Most of the samples indicate an average selenium concentration, in laboratory condition leach water, of 0.01 mg/L, which is below the guideline level. An outlier of 0.16 mg/L selenium was obtained from a 0.5 m thick fresh mudstone within the H15 coal seam (51.4 to 51.59 m below surface). **Appendix B-2 Subsidence modelling** indicates the limited potential for the Project mining to impact on this coal seam.

As the coal rejects will be mixed the potentially elevated concentrations of soluble metals from isolated coal reject sources will be diluted with bulk reject material. Therefore, considering the homogenisation of coarse rejects through the CHPP, environmental risks are considered low. Further measures to reduce the risk of environmental harm resulting from the handling of coal rejects are set out in Section 10.6.2.

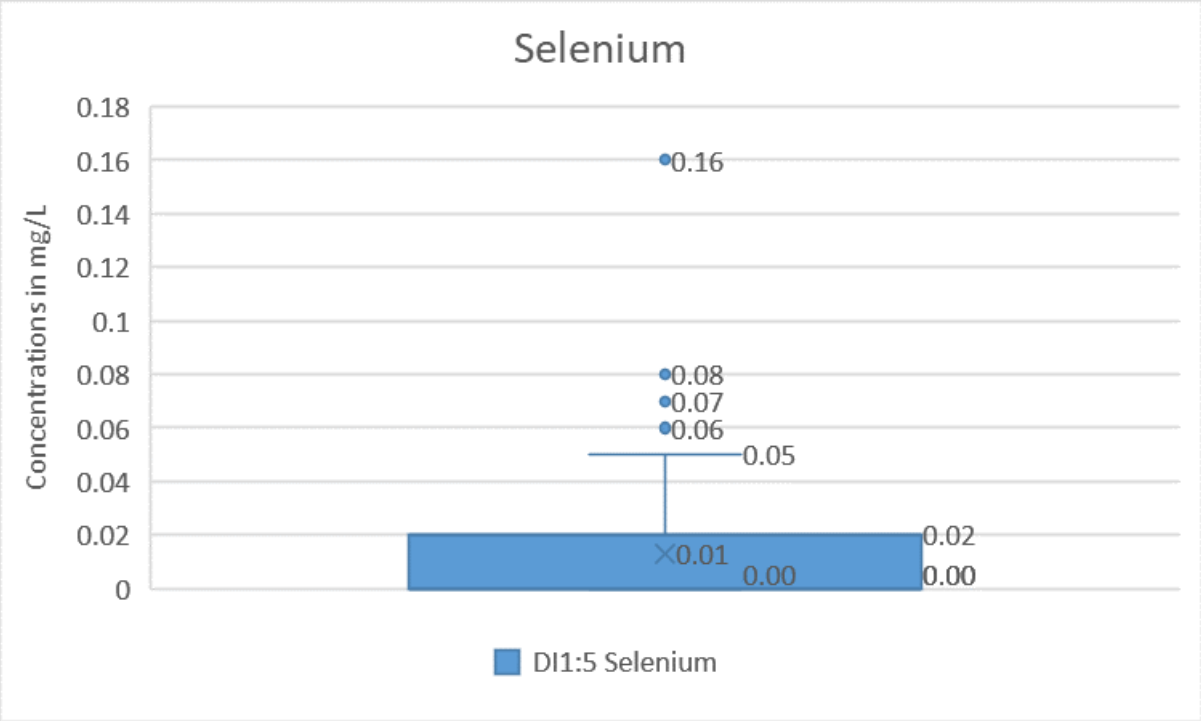

Figure 10-5 Selenium concentrations in laboratory condition leach water

10.6 Mitigation measures

Mine wastes generated by the Project will be managed in accordance with the mitigation measures proposed below, the existing management practices at the adjacent Saraji Mine and the conditions of EA EPML00862313.

Existing in-pit spoil dumps will be used or developed in line with the approved Saraji Mine plan. The transition from open cut mining to underground longwall mining markedly reduces waste rock generation and coarse rejects volumes due to a more refined and targeted mining method. Consequently, the Bauhinia Pit at Saraji Mine provides ample capacity (some 60 million bank cubic meters (Mbcm)) to accommodate the additional volume of mine waste generated by the Project (estimated at 28 Mbcm).

Management of Project waste rock and coal rejects within Saraji Mine's Bauhinia Pit is not considered to generate a significant net change in existing conditions. The existing Saraji Mine approval authorises open cut mining to the eastern extent of the ML 1775. The proposed longwall underground mine will start at the highwall within ML 1775 and extend into MLA 70383. Sufficient capacity exists in the existing Saraji Mine waste management system to accommodate the anticipated mine waste from the

Project. No selective handling or additional mitigation is required outside of existing waste rock management practices.

Potential impacts of waste rock and coal rejects generated by the Project are outlined in Section 10.5. Geochemical analysis undertaken on the potential spoil materials indicates the there is a very low risk of site runoff and seepage from the waste rock material generated by the Project. Additionally, geochemical analysis of coal rejects indicates that the risk of environmental harm as a result of leaching is low.

On this basis, the overall risk of significant environmental harm occurring as a result disposing of Project waste rock and coal rejects within the Saraji Mine's Bauhinia Pit is low. BMA are committed to providing a Progressive Rehabilitation and Closure Plan (PCRP) which will include details of waste disposal and the existing waste management for Saraji Mine will be provided to demonstrate how wastes are adequately managed.

10.6.1 Waste rock

In accordance with the waste management hierarchy, waste rock that has properties suitable for engineering purposes can be re-used as bulk fill, road sub-base, construction material for laydown areas and/or foundations and levees provided suitable surface covering material is applied.

Waste rock with properties unsuitable for engineering and construction purposes will be deposited in-pit as part of the existing mine waste management system at the Saraji Mine in accordance with existing approved management practices at SRM.

10.6.2 Coal rejects

Coal rejects from the Project, including coarse rejects, fine rejects, and dewatered flotation tailings, will be disposed in-pit at the existing Saraji Mine in accordance with existing Saraji Mine practices.

The Project is projected to generate 28 Mbcm of rejects throughout the entire production period. The existing Bauhinia Pit has excess storage space of an approximate 60 Mbcm. This excess space within the Saraji Mine plan provides ample capacity to accommodate the estimated mine wastes generated by the Project, as demonstrated in Section 10.6.3.

10.6.3 Mine waste management strategy

The mine waste management strategy for the Project will focus on:

- evaluating the geochemical characteristics of actual reject materials collected from the Project CHPP and in-fill drilling core samples ahead of mining to further refine the assessment of the NAF nature or delineate PAF materials prior to mining
- strategic placement of mine waste material in-pit to minimise runoff
- co-dispose of PAF material with benign (NAF) waste rock and rejects
- directing drainage to retention dams for reuse in mining activities.

Following approval of the Project, the existing Saraji Mine waste management plan will be refined to accommodate the Project and will adopt the following general practices:

- mixing and compaction will occur as appropriate to the properties of the materials to achieve a sustainable final landform (Figure 10-3 and Figure 10-4)
- reject materials will be mixed via alternating disposal of the reject and waste rock material in-pit at the existing Saraji Mine
- as a contingency, if significant amounts of PAF rejects are identified, controlled blending of high ANC waste rock and/or limestone with PAF waste will be considered.
- lime dosing of compacted coarse reject layers (one to two metres) may be used as a precautionary measure to extend the lag period in the unlikely event of acid generation
- pre-strip weathered waste rock materials will be used to cap the reject disposal and dewatered tailings areas. A minimum thickness of two metres of inert cover material will be used, with final thickness to be determined based on the material characteristics

- coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down the dip (Figure 10-4 and Figure 10-5). Suitable growth media will be placed onto the re-profiled slopes
- no reject material will be placed below the pre-mining groundwater levels and in-pit waste deposits will be free draining to minimise the potential for geotechnical instability
- over time, in-pit rejects will be covered by waste rock, topsoil and rehabilitated. These areas may be re-shaped and will be covered with a suitable growth media and revegetated with a species mix appropriate to the post-mining land use, or a combination of native grasses supplemented with introduced pasture species in areas where continuous pasture cover is necessary for erosion control.

10.6.4 Rehabilitation

A Rehabilitation Management Plan (RMP) has been developed for the Project (**Appendix K-1 Rehabilitation Management Plan**). The RMP provides the framework within which progressive and final rehabilitation can be planned and executed for the Project. The rehabilitation strategy for the Project is described in **Chapter 5 Land Resources**.

Rehabilitation of the in-pit spoil dumps at the existing Saraji Mine will be undertaken in accordance with the Saraji Mine EA. The scope of the Project will not change the rehabilitation objectives for Saraji Mine.

10.6.5 Monitoring

The Project will adopt the following broad mine waste performance outcomes:

- compliance with Saraji Mine EA conditions
- ongoing geochemical characterisation of mine waste material to further assess potential risk of AMD
- where required, management of acid producing rock to ensure that production and release of AMD is prevented or minimised.

Performance against these outcomes will be monitored on the Project as set out below.

Ongoing operational geochemical characterisation

BMA will undertake ongoing operational geochemical characterisation of mine waste in the planned deposition area ahead of mining to confirm the geochemical characteristics of these materials.

Characterisation of reject materials (coarse rejects and dewatered tailings) from the Project will also be undertaken to further verify the geochemical nature of the rejects. This data will be used to re-evaluate and update the management and disposal strategies for reject materials.

BMA will conduct an ongoing geochemical assessment program for the Project that is commensurate with the current AMD risk of the mine wastes, test work will include:

- pH (1:5) and EC (1:5)
- static geochemical work
- bulk chemistry
- leach test work
- cation exchange capacity, sodium absorption ratio (SAR) and exchangeable sodium percentage.

Monitoring of potential drainage/seepage water quality with parameters to include for pH, EC, acidity, major cations and ions, and dissolved to include at a minimum Al, As, Cd, Cu, Cr, Co, Fe, Pb, Ni, Mo, Hg, Se and Zn. The monitoring protocol will be reviewed and where appropriate refined over time based on results of on-going monitoring.

Water quality monitoring

Groundwater and surface water monitoring programs currently implemented at Saraji Mine will continue to identify and manage potential risk of metal mobilisation, with particular attention to mobilisation of selenium.

Runoff (and seepage water) quality resulting from the contact between meteoric water and mine waste materials (waste rock and rejects) is not predicted to be problematic with respect to acidity, salinity and metals concentrations based on geochemical analysis and historic site observations. However, leachate and site water derived from such materials will be monitored to ensure nearby drainages are not receiving acid, salt and metal loads that could impact upon the existing ecosystem.

Water quality monitoring is undertaken by Saraji Mine in accordance with EA conditions. In general, water will be managed by retaining or reusing surface runoff water on site in accordance with existing site water management system practices. These include capturing mine-affected waters and delivering these to existing storages to enable secure containment and reuse in supporting mine operations such as coal washing and dust suppression.

Monitoring and audit reviews will identify non-conformances and opportunities for improvement that can be addressed by corrective and adaptive management processes set out in the waste minimisation and monitoring plan.

10.7 Residual impacts

Mine waste management within the existing Saraji Mine is carried out in accordance with the Saraji Mine EA EPML00862313_20220615. No significant residual impacts have currently been identified that require additional mitigation.

10.8 Summary and conclusions

The Project will generate mine waste including an estimated 0.005 Mt of waste rock and 40 Mt of coal and coarse rejects over the 20 year life of mine that can be safely managed in-pit within the approved Saraji Mine.

The existing Saraji Mine has excess storage capacity to accommodate the additional waste volumes due to the Project. It is noted that the selected mining method, underground mining, produces markedly less volumes of waste rock compared to open cut mining.

Potential coal rejects are expected to generate pH-neutral to mildly alkaline, relatively low-salinity runoff/seepage following surface exposure. Ongoing operational geochemical characterisation will confirm the suitability of management and disposal strategies for reject materials. Considering the homogenisation of coal rejects through the CHPP, environmental risks are considered low and able to be managed in line with existing practices at Saraji Mine.

No significant residual impacts associated with the Project have been identified as part of this geochemistry and mine waste assessment.