Appendix F Tailings and Rejects Management Plan

F.1 Introduction

F.1.1 Background

During consultation with the Queensland Environmental Protection Agency (EPA) for the Project EIS and in subsequent submissions, questions were raised over the proposed technology for the dewatering of tailings and managing coal rejects. Comparisons were made between the proposed technology to be used at Daunia mine and the current processes used at Poitrel and Millennium CHPP. This management plan provides further detail on the technology proposed to be used at the Project and clarifies management methods for coal rejects and tailings.

Two submissions relating to the management of tailing and rejects were received. The issues raised were as follows:

Submission ID 9.21:

The EIS and EM Plan should provide measures for the chemical and physical characterisation of overburden and interburden that would be adequate for the selective management of those waste materials

Submission ID 9.22:

The EIS and EM Plan should provide:

- *Details of how the sites and materials for co-disposal cells will be chosen, constructed and managed;*
- *As assessment of how the risk of failure will be addressed in the design of co-disposal cells; and*
- *An assessment of the long-term stability of spoil dumps in relation to the co-disposal cells.*

The Project will make no use of co-disposal cells. The protocols that will be put in place to manage tailings and rejects are outlined in Section F.5.4 of this plan.

F.1.2 Purpose

This tailings and rejects management plan has been included in this supplementary report to detail how the Daunia Coal mine will manage tailings and rejects during mining operations. Due to issues that have been raised during the submission period, particularly with regard to tailings and rejects management at Poitrel and Millennium, this plan has been included to explain in detail the processing of coal rejects and the dewatering of coal tailings at Daunia Mine. The storage, handling and disposal of coal rejects and dewatered tailings are outlined in the following sections and provide a comprehensive description of the process to be installed at Daunia.

F.2 Coal Rejects Processing

Rejects are generated from the coarse, small and spirals circuit within the coal handling and preparation plant (CHPP). The following provides an overview of the rate of rejects expected to be produced at Daunia, and a summary of the coarse, small and spirals coal processing circuits

- Maximum Plant Feed Rate (Dense Medium Cyclone /Spirals) 800t/h (ar) (nom)*
- Minimum Coarse Product Yield 44.1 % (ar)*
- Maximum Coarse Reject Rate 350 t/h (ar)*
- For reject conveyor design use 500 / 550 t/h (ar) (nom / design)*

TOTAL REJECTS typically expected for Daunia when producing 4 million tonnes per annum of product coal:

- 0.83 million tonnes (dry) or 0.96 million (wet) per annum;
- Volume (Wet) = 0.55 Mbcm per annum.

* ar = as received, nom = nominal, t/h =tonnes per hour, Mbcm = million bank cubic meters

F.2.1 Coarse Coal Circuit

The coarse coal dense medium cyclone (DMC) feed sump will be a wing tank type design. Constant sump level will be provided by overflow of excess medium to the correct medium sump. Mixed dense medium and coarse coal from the coarse coal DMC feed sump will be pumped into a single dense medium cyclone.

Clean coarse coal product and dense medium will overflow from the coarse coal cyclone and discharge directly into a feed box that discharges onto a multislope product drain and rinse screen.

Reject coal and medium will underflow from the coarse coal cyclone into a feed box which will distribute onto a multi-slope reject drain and rinse screen. Rejects material will be discharged directly onto the rejects conveyor.

Coal of 16 x 1.4mm (ww) 330 tonnes per hour (t/h) will report to small coal dense medium cyclone feed sump. Constant sump level will be provided by overflow of excess medium to the correct medium sump. Mixed dense medium and small coal from the small coal circuit will be pumped to the small coal dense medium cyclone.

Clean small coal product and dense medium will overflow from the small coal cyclone and discharge directly into a feed box that discharges onto a multislope product drain and rinse screen.

Rejects material will be discharged directly onto the rejects conveyor. The coarse coal circuit rejects (70 t/h) will discharge onto the 1000mm wide common reject conveyor that will discharge into a reject bin.

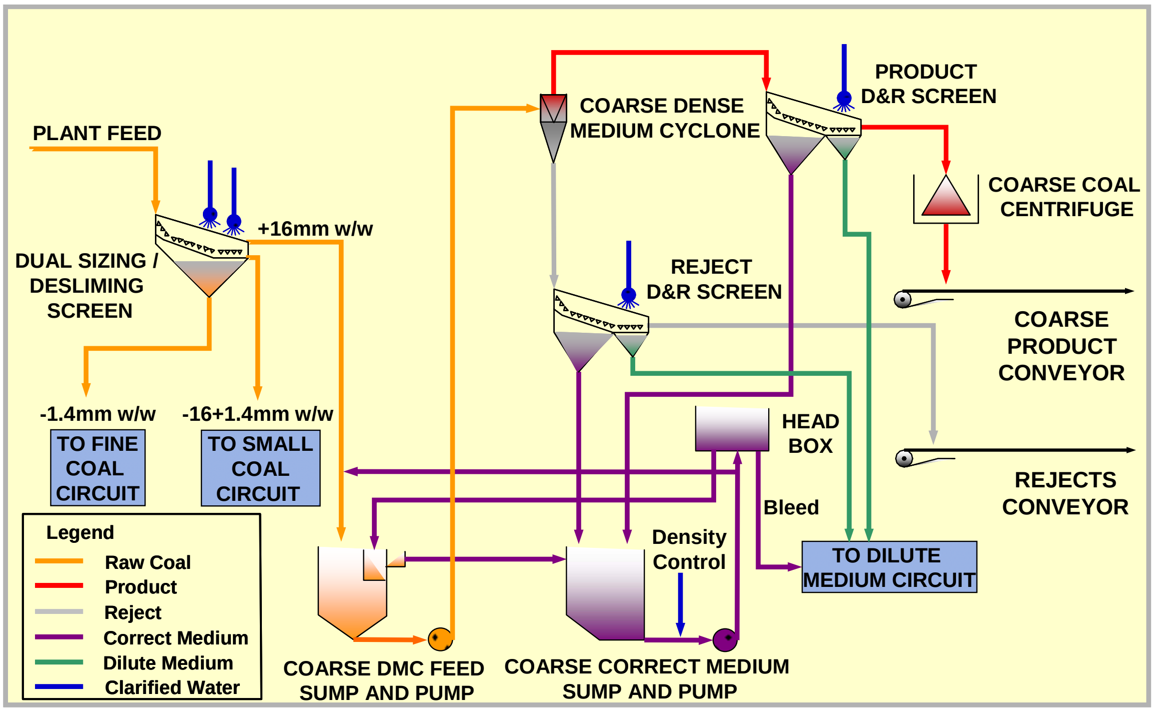

Figure F-1 Simplified Coarse DMC Circuit Diagram

F.2.2 Small Coal Circuit

Coal of 16 x 1.4mm (ww) 330(t/h) will report to small coal DMC feed sump. Constant sump level will be provided by overflow of excess medium to the correct medium sump. Mixed dense medium and small coal from the small coal circuit will be pumped to the small coal DMC.

Clean small coal product and dense medium will overflow from the small coal cyclone and discharge directly into a feed box that discharges onto a multi-slope product drain and rinse screen.

Reject coal and medium will underflow from the small coal cyclone into a feed box which will distribute onto a multi-slope reject drain and rinse screen. Small coal circuit rejects (70t/h) will discharge from the rejects screens onto the common rejects conveyor.

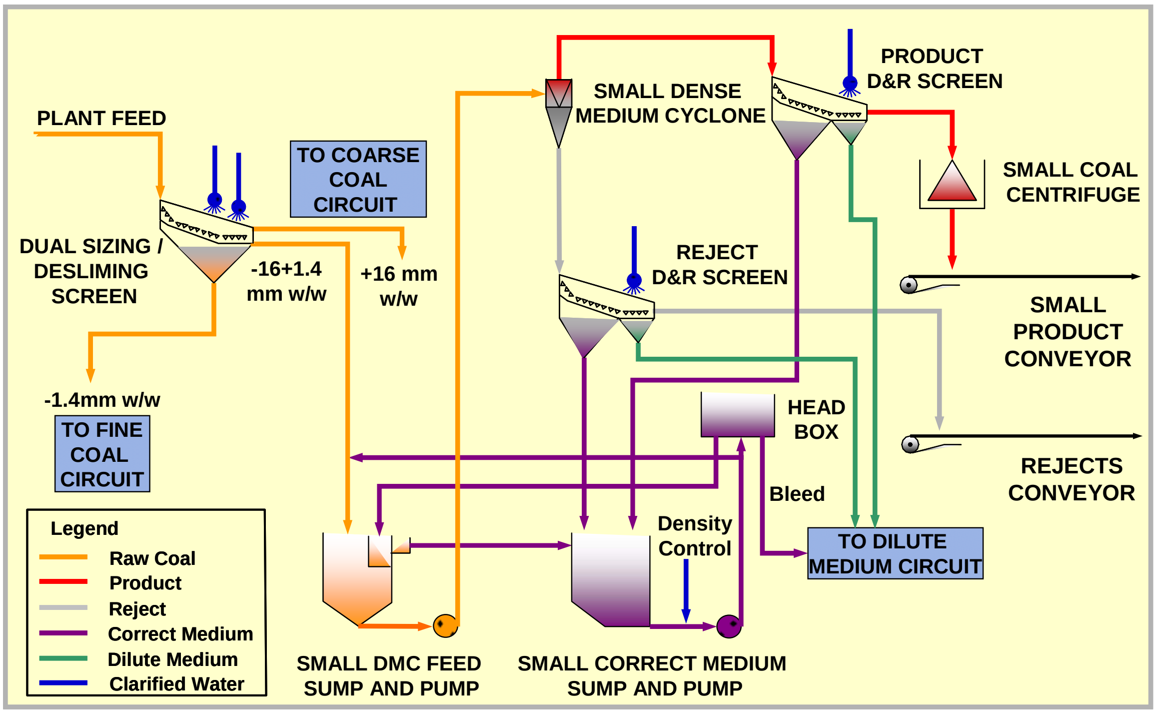

Figure F-2 Simplified Small Coal DMC Circuit Diagram

F.2.3 Spirals Circuit

The 1.4mm x 0mm underflow (250 t/h) from the desliming screen is directed to the classifying sump and the slurry is pumped to a classifying cyclone. The overflow stream from this cyclone reports to the flotation circuit(80 t/h).

The cyclone underflow (170 t/h) will gravitate to spiral feed distributors. Fine coal spirals will beneficiate the fine coal into rejects and fine product. The fine reject from the spirals will flow by gravity to the spirals reject sump. Fine reject from the spirals (40 t/h) will be laundered to a spiral rejects sump and pumped to the spiral reject thickening cyclones. The thickened underflow will report to the fine coal rejects high frequency screen for dewatering before being discharged onto the common coal rejects conveyor.

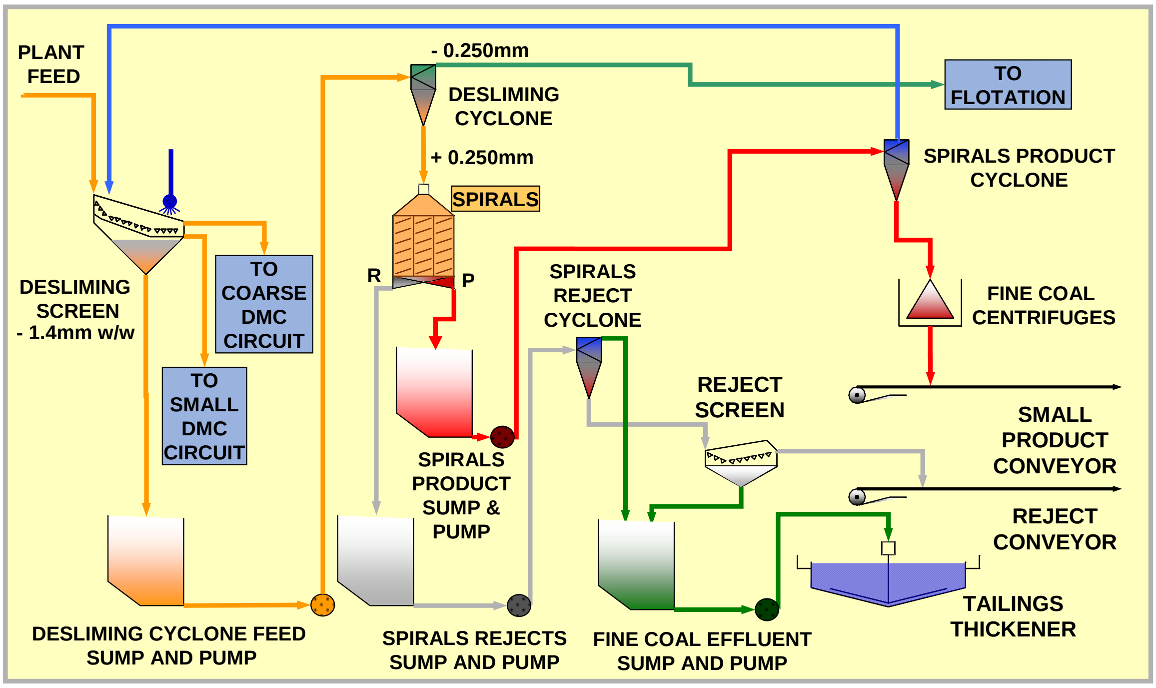

Figure F-3 Simplified Spirals Circuit Diagram

F.3 Dewatered Tailings Process

Dewatered tailings will be generated from the flotation circuit where coal fines are processed. The following provides an overview of the rate of tailings expected to be produced at Daunia Mine, and a summary of the flotation circuit and the tailings dewatering process including the operation of the belt press filters.

- Maximum Flotation Feed Rate 147 t/h (ad)
- Minimum Flotation Yield 40% (ad)
- Maximum Tailings 88 t/h (ad)

Typical total dewatered tailings expected for Daunia when producing 4 million tonnes of product per annum:

- 0.23 million tonnes (dry) or 0.36 million tonnes (wet) per annum;
- Volume (wet) = 0.22 Mbcm per annum.

F.3.1 Flotation Circuit

The desliming cyclone overflow (100 t/h) will report to two micro cells. The froth concentrate from the micro cells will gravitate to the coal thickener de-aeration tank and then into the centre well of the thickener. Flocculant is added to the coal thickener feed launder to assist settling of the coal prior to discharging into the feed well of the hi-rate thickener. The flocculant will be provided from a packaged powder based flocculant preparation plant which prepares and doses anionic flocculant to the coal thickener.

F.3.2 Tailings Thickener

The tailings from the micro cells (33 t/h) will gravitate to a high rate tailings thickener. Flocculant is added to the tailings thickener feed launder to assist settling of the tailings prior to discharging into the feed well of the hi-rate thickener.

Thickened solids from the thickener underflow will be pumped to multiple belt press filters for dewatering. Overflow from the tailings thickener will report back to the clarified water sump and will be recirculated through the coal handling and preparation plant as required. The flocculant will be provided from a packaged powder based flocculant preparation plant which prepares and doses anionic flocculant to the tailings thickener.

F.3.3 Tailings Dewatering

Thickened solids from the thickener underflow (43 t/h) will be pumped to multiple belt press filters feed sump. Solids will then be pumped to individual feed preparation tanks ahead of each of eight belt press filters. Anionic and cationic flocculant will be added to the feed stream of the belt press filters to assist with the dewatering process.

The solids discharged from the belt press filters will be transferred by a single conveyor and discharged into a bunker for collection and disposal on site. Filtrate from the tailings filters will gravitate to the tailings filtrate sump and be pumped back to the tailings thickener.

The dewatered tailings will have a moisture content of approximately 35-40% by weight.

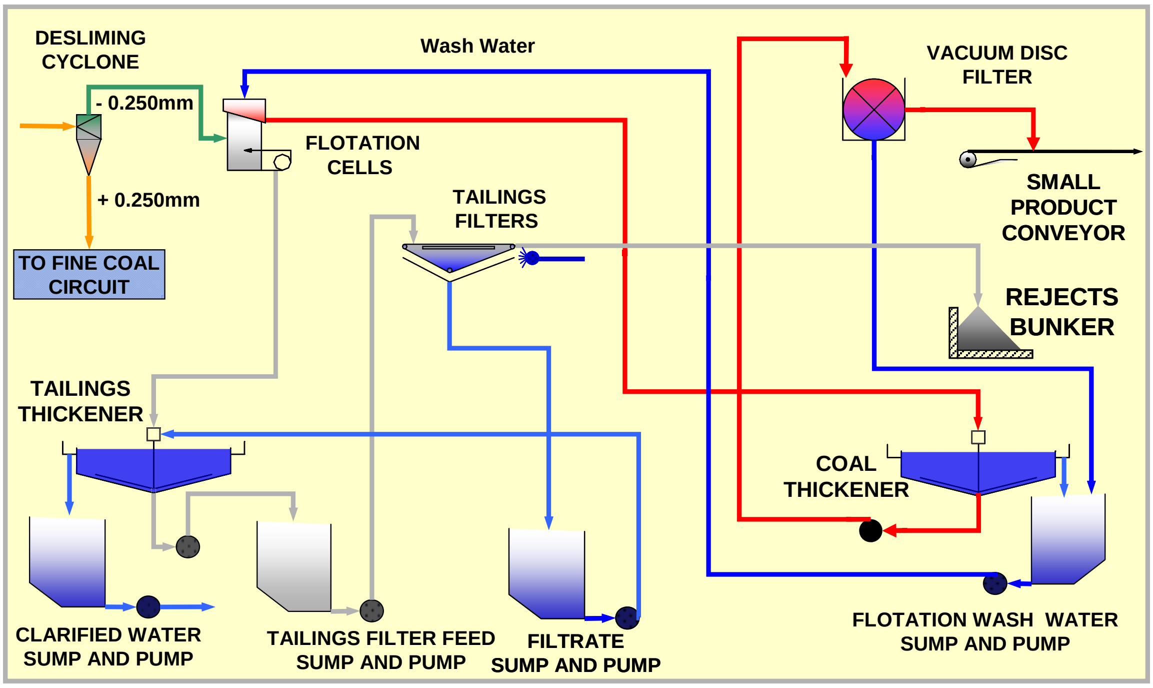

Figure F-4 Simplified Flotation Circuit Diagram

F.3.4 Background and Description of Tailings Belt Press Filter Operation

Belt press filters have been the most widely used unit in the Australian coal industry for “dry” disposal of fine tailings, and have been in use for over 30 years, particularly in the NSW coalfields. Each unit is relatively compact, covering a footprint of approximately 5 m long by 4 m wide for a typical capacity of approximately 15 t/h.

The belt press filter compresses the cake between two layers of filter cloth medium by passing a sandwich of cloth and filtrate over a series of high pressure rollers to squeeze any free water from the resulting cake. The final cake material will still be saturated, and water is removed by compression and shearing only. When operating effectively, the final discharged cake will flake off as relatively solid lumps which will be disposed off via conveyors or trucked with other reject material for disposal on site. Relatively high levels of flocculant are required to create the necessary cake structure, especially when large amounts of fine clays are present.

Figures F-5 and **F-6** show an operational belt filter press and the resultant filter cake.

Figure F-5 Belt press filter in operation in a Hunter Valley coal mine operation

Figure F-6 Final belt press filter cake prior to disposal

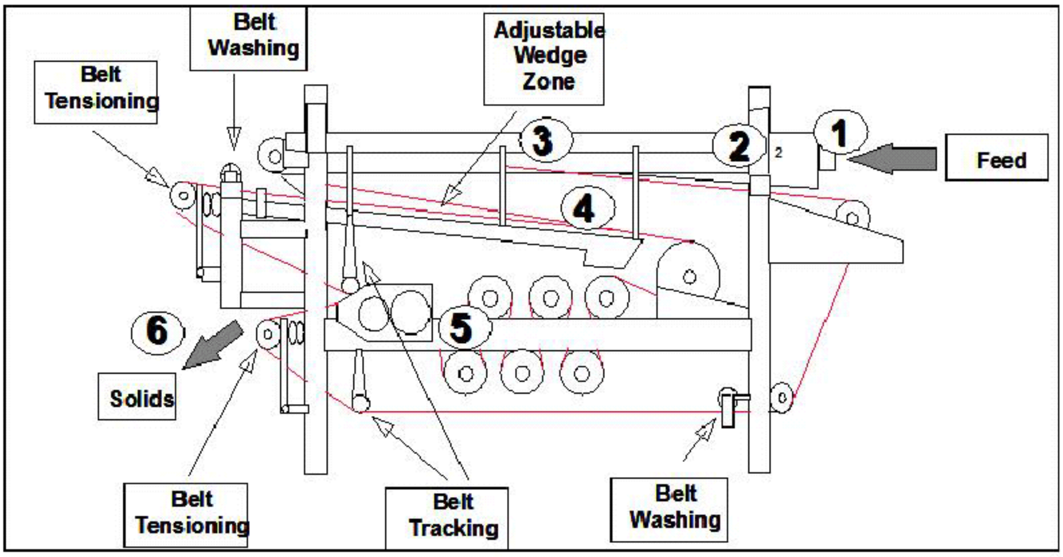

Figure F-7 Belt press filter operation

Figure F-7 shows a schematic of a belt filter press. Further flocculant dose is added to the thickener underflow which is then gravitated or pump fed into a distribution box to spread the slurry evenly across the width of the filter cloth. The initial section is a free drainage section where excess free moisture drains through the lower cloth. As the consolidated bed of solids passes down into a wedge section, a second cloth descends onto the top of the newly formed cake, and the resultant “sandwich” passes through a series of low pressure rollers to help form a well structured cake with some degree of internal strength prior to passing through a series of high pressure rolls. These are offset such that as the sandwich of filter cake and the two cloths pass around the rolls, additional shearing action due to the relative movement of the two cloths helps to remove any residual water to ultimately form a firm cake.

The discharge water containing suspended fine solids is collected in an underpan and recycled back to the thickener for reuse.

A key operating parameter is the correct conditioning of the feed incorporating;

- Correct selection of flocculant, and prior addition of cationic coagulant as required;
- Correct dosage of flocculant; and
- Careful mixing of the flocculant, which typically involves either an agitated feed box and/or an in-line mixer on the feed-line to the filters.

If a poorly consolidated cake forms, usually when processing fine feeds with high levels of slaking clays, the cake can be squeezed out from between the cloths, and the final discharged cake will be thin, sticky and very difficult to handle. The presence of some fine grit in the feed helps to provide better cake structure, but at the expense of increasing the quantity of material to be processed through the belt press filters. It is also necessary to avoid coarse particles greater than one millimetre in diameter in the feed otherwise excessive belt wear occurs.

In summary, belt press filters are more readily operated on fine silty feeds, but are also used for clayey feeds.

Different designs offer variations in the initial free drainage section and in the number of high pressure rollers, which will determine the likelihood of a good handling final cake when processing difficult-to-treat feeds. Tailings samples from Millennium and Poitrel (likely to be similar to the tailings from Daunia) were sent to the US and run through a pilot plant using the same technology proposed for Daunia.

A key issue in equipment selection is that the amount of fine tailings will vary greatly as mining campaigns coals from different sources. There is relatively little opportunity for providing surge capacity of the belt press filter feed (operating range of thickener bed only), so typically the belt press filter capacity needs to be selected on the basis of requirements for the worst feed types. This in turn implies that a number of the parallel units will not be operating for significant periods of time, which provides adequate opportunity for scheduled maintenance when units are not being utilised, and for switching alternative units in and out as needed if any mechanical or operational problems do arise.

Energy costs are low due to the low installed power, but they do require higher flocculant doses which represent a significant component of the operating cost.

The units are also a relatively high maintenance item due to the use of dual cloths passing through multiple high pressure rollers in units with relatively low capacity. It is necessary for the units to be designed and constructed in a robust manner with adequate structural members, bearing sizes, tracking mechanisms, etc. if suitable availability and maintenance costs are to be achieved. Hence a careful trade-off is required when considering initial capital costs and life time operating and maintenance costs when purchasing and installing such units. Belt cloths typically last for at least 2,500 hours and up to 10,000 hours, depending on the feed characteristics and how well designed and maintained the belt tracking system is.

A key operating cost risk is the need for operator intervention, which in turn will depend very much upon the nature of the feed. If the feed contains a large amount of sticky clays and the feed characteristics are constantly changing, it would be expected that considerable operator attention will be required.

F.4 Characterisation of Coal Rejects and Tailings

The coal rejects and tailings from the Project will be similar in geochemical characteristics to the same waste projects mined at the adjacent Poitrel mine. A comparison of the coal qualities from **Appendix E** with the coal qualities from Poitrel showed the coal to be very similar at both sites. The Project EIS inferred the geochemical characteristics of coal rejects and dewatered tailings projected to be generated at the Project by examining the geochemical characteristics of interburden material.

In the absence of available samples of Project coal rejects and dewatered tailings, samples were collected from the Poitrel CHPP on 16 February 2009, the geochemical characteristics of these samples were analysed to further inform the understanding and assessment of potential impacts from the Project coal rejects and dewatered tailings. The tailings samples were sourced from Poitrel and then sent to a pilot plant in Phoenix (US) and processed using the same dewatering technology proposed for the Project.

The materials analysed from Poitrel are tabulated in **Table F-1,** and do not indicate a significant acid generation potential.

Table F-1 Poitrel coal tailings and rejects characteristics

Analyte	Units	Tailings 1	Tailings 2	Rejects 1	Rejects 2	Rejects 3
pH Value	pH Unit	8.1	8.1	9.4	9.4	9.4
Net Acid Production Potential	kg H2SO4/t	-3.6	-7	3.2	-13.4	-2.7
Electrical Conductivity @ 25°C	µS/cm	396	397	125	125	125
ANC as H2SO4	kg H2SO4 equiv./t	13.7	16.2	7.8	23.8	10
ANC as CaCO3	% CaCO3	1.4	1.6	0.8	2.4	1
Fizz Rating	Fizz Unit	0	0	0	0	0
Chromium Reducible Sulphur	%	0.15	0.14	0.2	0.17	0.11
Sulfur - Total as S (LECO)	%	0.33	0.3	0.36	0.34	0.24
Moisture Content (dried @ 103°C)	%	42.4	43.7	8	8.3	9
Exchangeable Calcium	meq/100g	7.8	8	8.1	6.9	9
Exchangeable Magnesium	meq/100g	3	2.9	2.3	3.2	3.4
Exchangeable Potassium	meq/100g	<0.1	<0.1	<0.1	0.1	0.1
Exchangeable Sodium	meq/100g	1.3	1.3	0.6	0.8	0.9
Arsenic	mg/kg	<5	<5	<5	<5	5
Chromium	mg/kg	5	5	<2	<2	2
Copper	mg/kg	32	31	20	30	40
Manganese	mg/kg	93	95	161	1300	506
Nickel	mg/kg	8	8	6	11	17
Selenium	mg/kg	<5	<5	<5	<5	<5
Zinc	mg/kg	42	41	18	32	49

The reported Net Acid Production Potential (NAPP) values are less than zero except for one sample (Rejects 1) which has an NAPP of 3.2 kg H_2SO_4/t, indicating that the sample tested has the potential to produce acid. The two tailings samples included in the report are indicated to have a low level of total sulfur (0.3% and 0.33%) with a likely excess of acid neutralising capacity (ANC) such that the NAPP values reported are -3.6 and -7.0 kg H_2SO_4/t. NAPP values between +10 and -10 are generally viewed as materials with a small but not significant acid generation potential. Materials with NAPP values below -10 are considered to have sufficient ANC to counter acid production from the oxidation of sulfides. The samples collected from Poitrel indicated that the rejects data is similar to the results obtained from the interburden samples analysed from the Project and presented in the EIS to predict Project reject materials (AGP: Min=0.16, Mean=2.0, and Max=29 kg H_2SO_4/t) (NAPP: Min=-212, Mean=-38.5, and Max=14.5 kg H_2SO_4/t).

Section 5 the Project EIS presented and discussed the results of acid base accounting analyses on samples with Sulfur >0.3% (59 of 200 samples analysed). On average these samples had a NAPP of -34 kg H_2SO_4/t, 75% of these samples have a NAPP less than -11 kg H_2SO_4/t, which generally indicates that there is excess acid neutralising capacity within these materials needed to counter acid generation due to oxidation of sulfides. These results also indicate significant excess neutralisation capacity is available to counter any acidic water generated by the tailings and/or rejects material when mixed with these Project materials. Therefore so long as there is more acid neutralising material in the spoil than acid generating material from the coal rejects and tailings, and the materials are mixed appropriately when used as backfill into the lower portions of the spoil dumps, then the likelihood of developing ARD can be minimised.

The low acid generation potential of the coal rejects and tailings needs to be considered in the context of the significant amount of remaining spoil material at the Project. This is especially true given the proposed coal rejects and tailings protocols (Section F5.4) will be mixed into the spoil profile with no concentrated dumping. The remaining spoil materials analysed for the EIS from the Project, but not having significant sulphur concentrations to have triggered the acid base accounting (ABA) analysis for ANC and NAPP, are not likely to produce acidic conditions and are more likely to provide additional acid neutralisation capacity have not been considered in this ARD evaluation. Therefore, the analysis presented here is considered a conservative estimation to the overall ARD potential of the Project.

These results support the findings and recommendations contained in the Project EIS and the EM Plan. Results suggest that acid mine drainage from coal rejects and dewatered tailings present a low risk and will be manageable by providing sufficient cover material and adequate mixing of coal rejects and tailings within the spoil dumps. During the initial phases of operation, and continuing throughout life of mine, it is proposed to carry out analysis of overburden, and coal rejects and tailings material to confirm their geochemical characteristics.

F.5 Storage and Handling of Coal Rejects and Dewatered Tailings

F.5.1 Coal Rejects

Coal Rejects will discharge from the Coal Rejects conveyor into a 240 tonne rejects bin as shown in **Figure F-8.**

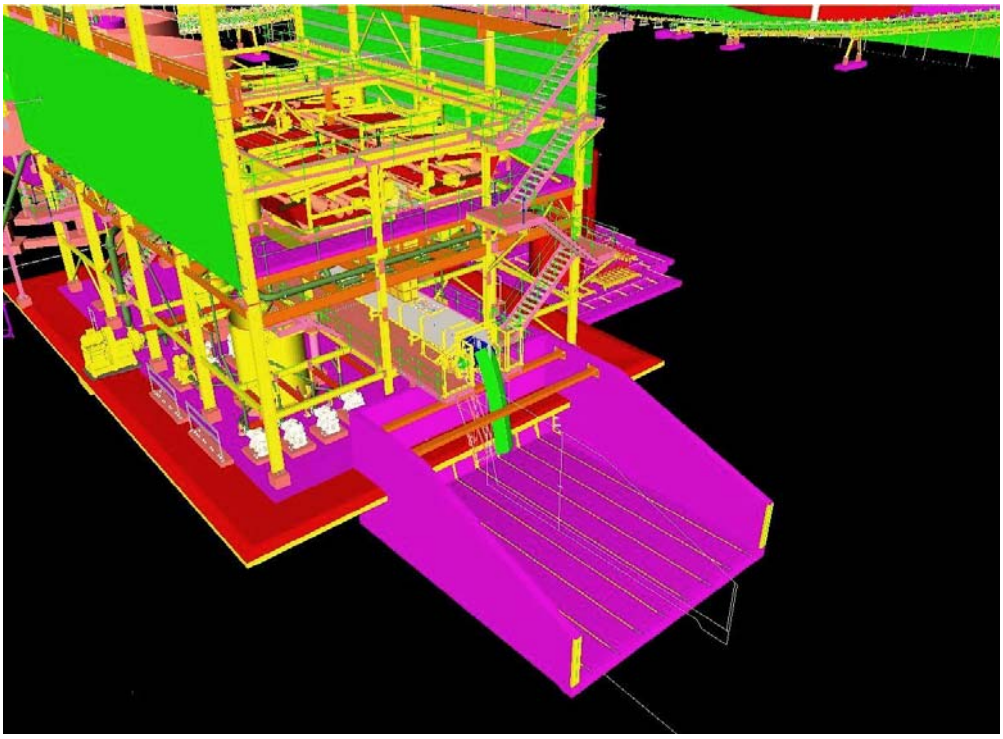

Figure F-8 Rejects Bin

F.5.2 Dewatered tailings

Dewatered tailings will discharge from the tailings conveyor to a 200 tonne dewatered tailings bunker. Filtrate from the tailings filters will gravitate to the tailings filtrate sump and be pumped back to the tailings thickener for re-use.

F.5.3 Disposal of Transport of Coal Rejects and Dewatered Tailings

Table F-2 Typical quantity of waste to be generated from 4 million tonnes of product coal per annum

Coal Rejects	0.55 Mbcm
Dewatered Tailings	0.22 Mbcm
Mine Spoil	25.2 Mbcm

Given the above quantities generated per annum, coal rejects will make up 2.2% of total mineral waste material to be disposed of within the in pit and out of pit spoil dumps, and dewatered tailings will account for 0.8% of the total waste material.

At the Daunia Mine there will be no co-disposal cells used for the disposal of tailings and/or rejects, the coal rejects and dewatered tailings will be dumped at a rate of three trucks per 100 trucks of mine spoil and effectively blended into the spoil dumps. Rejects and tailings will not be concentrated in certain areas of the dumps. They will be directed to the current tip face or dump area to ensure this.

F.5.4 Protocols

To ensure the effective management of coal rejects and tailings at Daunia Mine, the following protocols will be adhered to and monitored.

- Coarse reject will be presented to a reject bin;
- Dewatered tailings will be presented to a bunker set-up for rehandling into a mining truck;
- All coarse reject and dewatered tailings material will be trucked to either the out-pit or in-pit waste dumps;
- No reject material will be placed any closer than 10m to the final landform slope. This will be managed by survey limit pegs (see **Figure F-8**);
- There will be no concentrated dumping of reject materials:
  - All reject material will be dumped and mixed, either over a tiphead or paddock dumped, alongside dry waste material in order to minimise areas of geotechnical instability;
  - No reject material will be used to form any part of tiphead safety bunds, haul roads or ramps;
  - No reject material will be dumped below the pre-mining groundwater table; and
  - All dumps will be design and constructed to be free-draining.

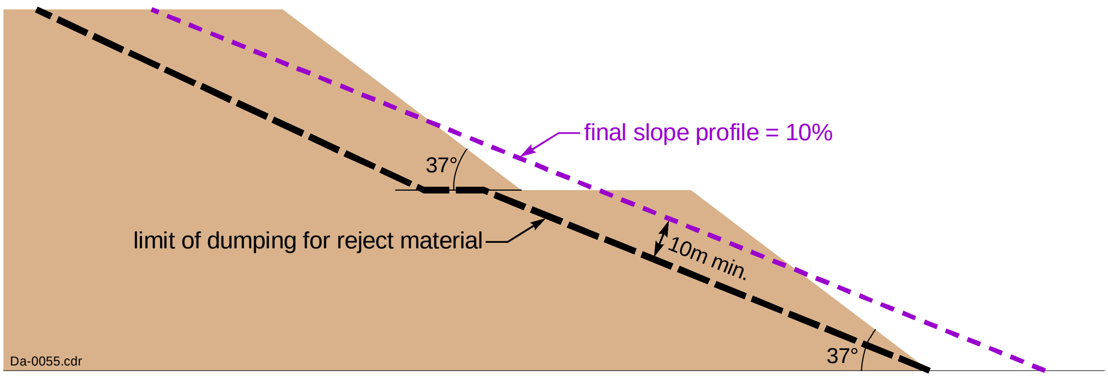

Figure F-9 Cross section of typical spoil dump showing minimum 10m cover over Coal Rejects and dewatered tailings material