BMA

BHP Billiton Mitsubishi Alliance

Appendix N: Tailings and Rejects Management Plan

1.1 Introduction

1.1.1 Background

During consultation with the Queensland Department of Environment and Resource Management(DERM) 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 Caval Ridge 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.

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 1.5.4 of this plan.

1.1.2 Purpose

This tailings and rejects management plan has been included in this supplementary report to detail how the Caval Ridge 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 Caval Ridge 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 Caval Ridge.

1.2 Coal Rejects Processing

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

▪ Maximum Plant Feed Rate	2,400t/h (ar) (nom)*
▪ Minimum Coarse Product Yield	35 % (ar)*
▪ Maximum Coarse Reject Rate	1460 t/h (ar)*
▪ For reject conveyor design use	2,200 / 2,420 t/h (ar) (nom/design)*

Total rejects typically expected for Caval Ridge when producing 8 million tonnes per annum of product coal:

- 4.97 million tonnes (dry) or 5.6 million (wet) per annum;
- Volume (Wet) = 3.21 Mbcm per annum.

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

1.2.1 Coarse Coal Circuit

Coarse coal will be pumped into a single dense medium cyclone (DMC) from the DMC feed sump. The coarse coal DMC feed sump will be designed with a wing-tank to maintain a constant sump level by overflowing the excess medium from the DMC feed sump (through this wing-tank) to the correct medium sump.

Product coal will be discharged from the DMC overflow into a product screen feed box which will distribute onto the multi-slope product drain and rinse (D&R) screen. The reject will be discharged from the DMC underflow into a reject screen feed box which will distribute onto the multi-slope reject drain and rinse screen.

Water is sprayed in the rinse section of the D&R screens to wash out the adhering magnetite from the coarse material.

Rejects material from the reject D&R screen overflow will be discharged directly onto a coarse rejects conveyor, transfer on to the reject bin conveyor and then elevate to the rejects bin which will be emptied using the ROM CAT 793 fleet of vehicles. The product coal from the product D&R screen overflow will discharge into the coarse coal centrifuge for dewatering.

The dewatered coarse product from the centrifuge will be discharged directly onto the product coal conveyor and the effluent from the product coal centrifuge will be discharged by gravity to the centrifuge effluent sump which will be pumped to the dilute medium sump. A wedge wire tramp check screen on top of the effluent sump will be installed to prevent the oversize material from entering into the dilute medium circuit. This check screen will also assist in the identification of wear in the coarse coal centrifuge.

Medium recovered from the drain section of the product and rejects D&R screens will be returned to the correct medium sump and the medium recovered from the rinse section will report to the dilute medium sump.

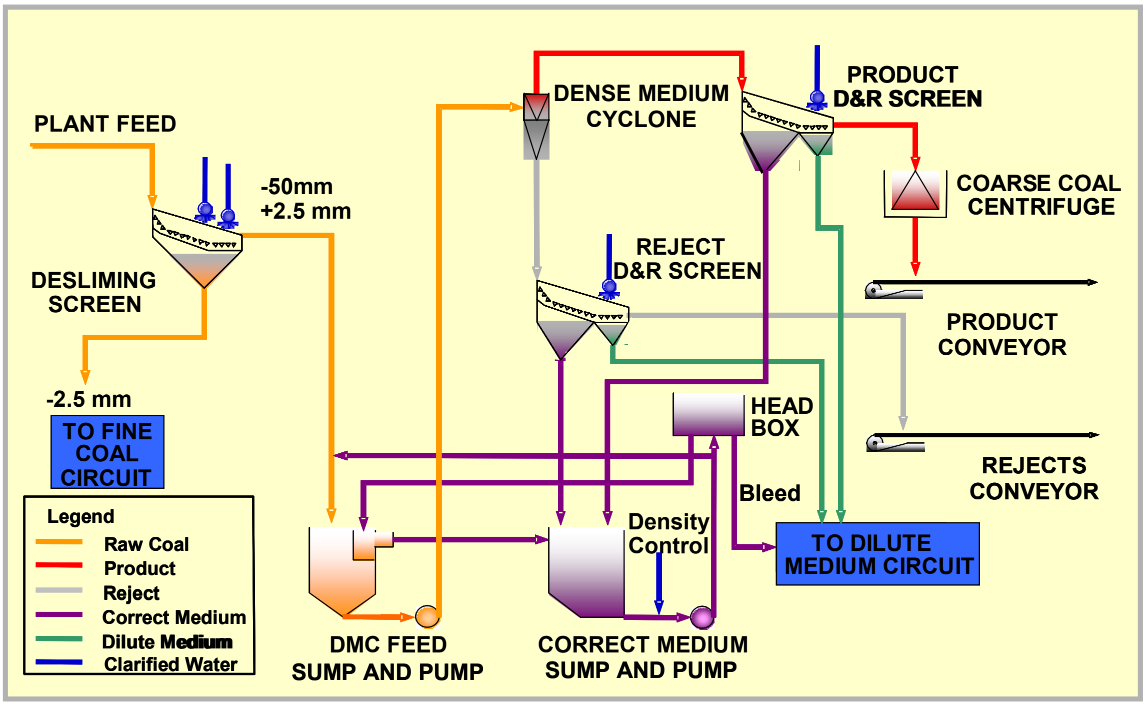

Figure 1 Simplified Coarse DMC Circuit Diagram

1.2.2 Reflux Classifier Circuit

The slurry of fine coal underflow (-2.5mm) from the de-sliming screen is directed to the desliming cyclone feed sump. The slurry will then be pumped to the de-sliming cyclone cluster to separate fine coal feed of sizes -0.2mm for overflow and +0.2mm for underflow streams. The overflow stream reports to the flotation circuit while the cyclone underflow will gravitate to the sieve bends for further screening and separation of fine materials at 0.25 mm to achieve an overall flotation feed sizing of -0.25 mm.

The sieve bend overflow will be discharged by gravity to the fines feed sump while the sieve bend underflow will gravitate to the flotation feed sump. From the fines feed sump the fine slurry of coal will be pumped to the reflux classifier through a feed distributor for even distribution of feed. Reflux classifiers separate lighter materials (product) from heavier materials (reject) by gravitation in a fluidized bed.

Fine coal product from the reflux classifier will be laundered to the fines product sump while the reject (heavier materials) from the reflux classifier will flow by gravity to the fine coal reject dewatering screen for water removal prior to discharging to the rejects conveyor for disposal. The water recovered from the slurry will gravitate to the fine coal effluent sump and will be recycled for use in the de-sliming circuit.

Fine coal product from the fines product sump will be pumped to the fines product thickening cyclones. The thickened underflow will report to the fine coal centrifuge feed box while the cyclone overflow will report to the flotation feed sump for further recovery of fine coal product. Dewatered product from the fine coal centrifuges will be discharged onto the product conveyor.

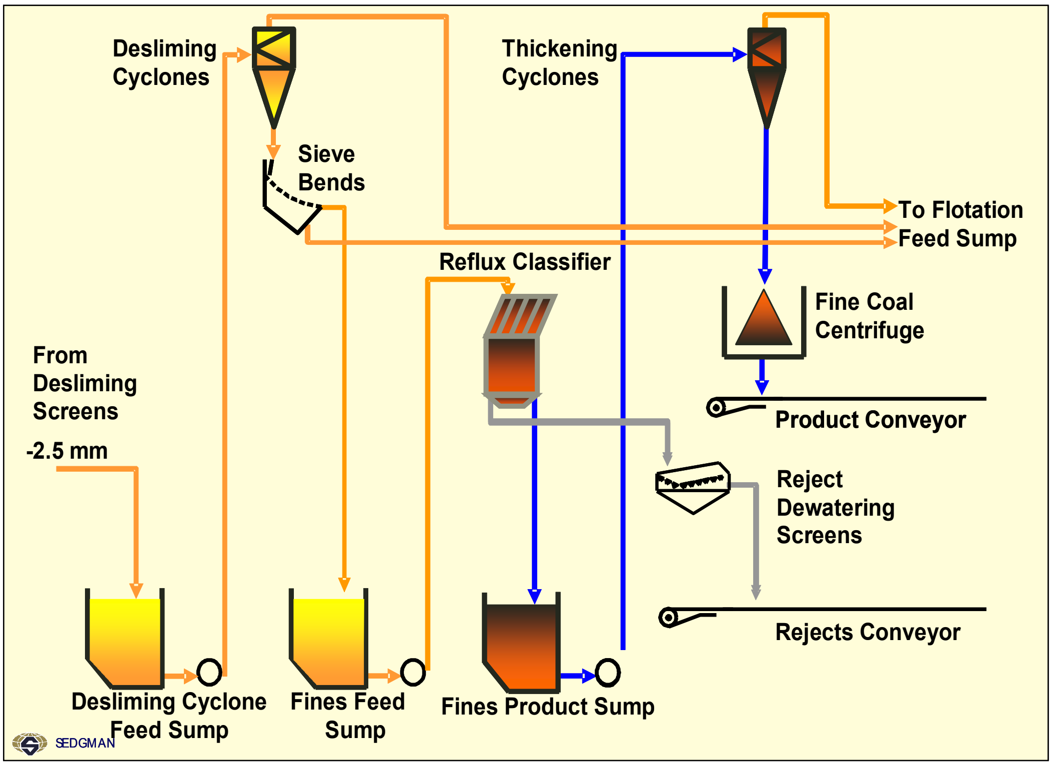

Figure 2 Simplified Reflux Classifier Circuit Diagram

1.3 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 Caval Ridge 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 503 t/h (ad)

- Minimum Flotation Yield 40% (ad)
- Maximum Tailings 317 t/h (ad)

Typical total dewatered tailings expected for Caval Ridge when producing 8 million tonnes of product per annum:

- 1.09 million tonnes (dry) or 1.82 million tonnes (wet) per annum;
- Volume (wet) = 1.11 Mbcm per annum.

1.3.1 Flotation Circuit

The flotation circuit feed consists of slurries coming from the overflows of the de-sliming cyclones, reflux classifier product thickening cyclones and sieve-bend underflows. De-sliming cyclone overflow gravitates directly to the flotation feed distribution box while the slurry from the thickening cyclone overflow and the sieve-bend underflow report to the flotation feed sump to be pumped to the flotation feed distribution box.

The combined flotation feed streams will be fed into Microcel flotation cells via a flotation feed box. From the feed box each flotation cell will be fed by gravity through a dedicated feed pipe.

Concentrate from each cell will gravitate into a common de-aeration tank to remove excess air prior to gravitating into the coal thickener. Flocculant is added into the coal thickener feed slurry to speed up the settling rate of the solid. The underflow from the coal thickener is pumped into a vacuum disc filter. Product from the filter discharges directly onto the product conveyor. Water from the coal thickener overflow and disc filter filtrate reports to the clarified water tank (partitioned compartment) to be reused as wash water for the flotation cells.

Tailings from the flotation cells reports to the tailings thickener.

1.3.2 Tailings Thickener

The tailings from the flotation cells will gravitate to a high rate tailings thickener. Flocculant is added to the tailings thickener feed launder to assist in the settling of tailings prior to discharging into the tailings filter feed sump. The flocculant will be provided from a packaged powder based flocculant preparation plant which prepares and doses anionic flocculant to the tailings thickener.

Thickened solids from the thickener underflow will be pumped to the tailings filter feed sump from where it will be pumped to multiple belt press filters. The solids discharged from the belt press filters will be transferred by a single conveyor and discharged onto the rejects bin conveyor. Tailings filter filtrate will be returned to the thickener feed.

Anionic and cationic flocculant will also be added to the feed to the belt press filters to assist in the dewatering process. Overflow from the tailings thickener will report back to the clarified water sump and will be recirculated through the plant as required.

1.3.3 Tailings Dewatering

Thickened solids from the thickener underflow will be pumped to multiple belt press filters feed sump. Solids will then be pumped to individual feed preparation tanks ahead of each of twenty four 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 conveyor and discharged at a transfer point onto another conveyor elevating to the reject bin where it will be collected by CAT 793 trucks. 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.

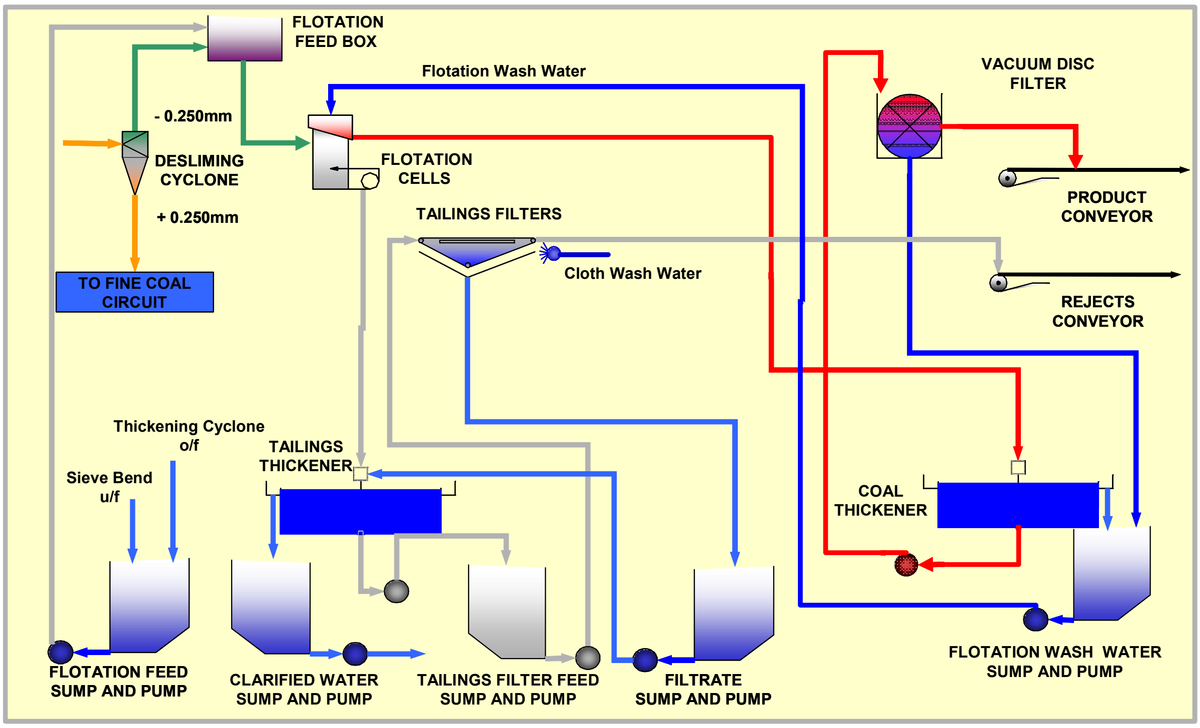

Figure 3 Simplified Flotation Circuit Diagram

1.3.4 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 and 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 4 and **5** show an operational belt filter press and the resultant filter cake.

Figure 4 Belt press filter in operation in a Hunter Valley coal mine operation

Figure 5 Final belt press filter cake prior to disposal

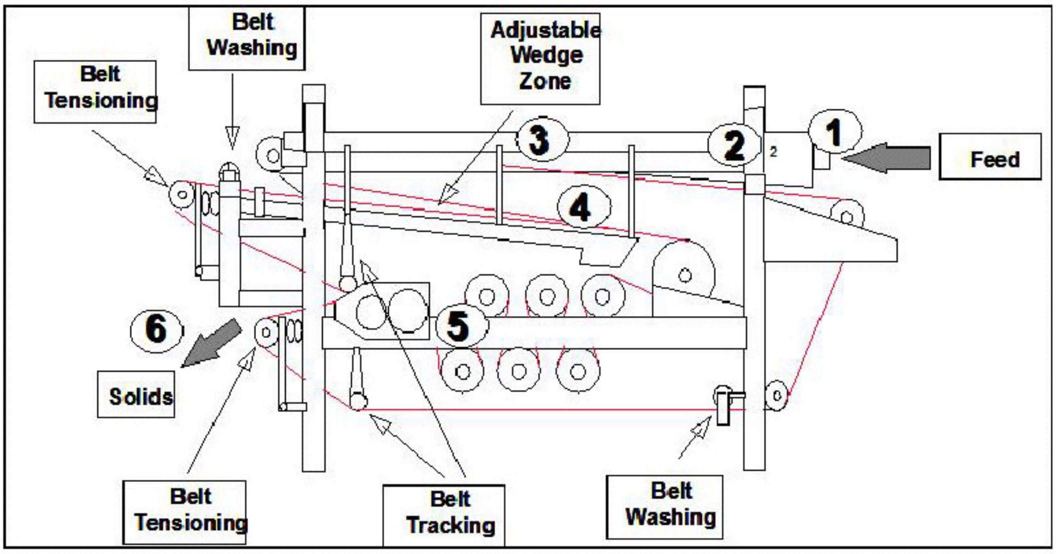

Figure 6 Belt press filter operation

Figure 6 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 Peak Downs (likely to be similar to the tailings from Caval Ridge) will be run through a pilot plant using the same technology proposed for Caval Ridge.

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.

1.4 Characterisation of Coal Rejects and Tailings

The geochemical static-test data collected from seven drill holes indicate that all overburden/interburden and almost all potential rejects tested are clearly non acid forming (NAF). In addition, the total sulphur contents of these materials is very low, with 29 of the 31 overburden and interburden samples having total sulphur concentrations ≤0.1% and therefore classed as barren. Similarly for the potential reject samples, where the average and median total sulphur concentrations for the 43 samples analysed were 0.1% and 0.06%, respectively. One coal-seam roof sample from the P08 seam was classified as potentially acid forming (PAF), indicating the some fine-grained sulphide mineral is likely to be present in some materials, most likely the roof and floor (potential reject) materials, but the proportions of such PAF materials are expected to be very low.

From an acid-base perspective almost all materials are NAF, but the high acid neutralising capacity (ANC) of many of the samples combined with the very low sulphur concentrations, indicates there would be excess alkalinity to buffer the small quantity of acid that could potentially be produced by a very small proportion of the likely mineral waste materials.

This is highlighted by the ratio of ANC to MPA (maximum potential acidity). The purpose of the ANC/MPA ratio is to provide an indication of the relative margin of safety (or lack thereof) within a material. Various ANC/MPA values are reported in the literature for indicating safe values for prevention of acid generation. These values typically range from one to three, with significantly higher ratios evident in strongly alkaline materials. As a general rule, an ANC/MPA ratio of two or more generally signifies that there is a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to acid rock drainage. The median ANC/MPA ratio for the project samples tested is 31.

Comparison of Potential Project Rejects with known Coarse Rejects and Tailings from Peak Downs Mine

The geochemical results from potential reject samples likely to be generated by the project are supported by similar geochemistry of coarse rejects and tailings at the adjacent BMA Peak Downs Mine, located immediately south of the proposed Heyford Pit. A geochemical assessment of coarse rejects and tailings at Peak Downs Mine (URS, 2002) found that approximately 36% (10 samples) of coarse reject samples tested were NAF, and a further 57% (16 samples) were classified as PAF-Low Capacity, due to their very low sulphur concentrations. Two coarse reject samples were classified as PAF-High Capacity, but these two samples had low total sulphur concentrations of < 0.5%.

Comparatively, over 60% (22 samples) of fine tailings were NAF and 33% (12 samples) were classified as PAF-Low Capacity, again with low sulphur concentrations. Two fine tailing samples were classified as PAF High Capacity. The tailing samples had similar sulphur concentrations to the coarse rejects.

These results showed that, overall, the majority of coarse rejects and tailings had little or no capacity to generate acid and all materials appear to retain a modest neutralising capacity. These results are supported in the day-to-day management at Peak Downs Mine where the ROM stockpile and the tailing storage facility (TSF) are not known for generating acid seepage.

Therefore, rejects from Peak Downs Mine coal to be processed and disposed at the project are not expected to generate acid.

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 1.5.4) 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.

1.5 Storage and Handling of Coal Rejects and Dewatered Tailings

1.5.1 Coal Rejects

Coal Rejects will discharge from the coal rejects conveyor into a 750 tonne rejects bin.

1.5.2 Dewatered tailings

Dewatered tailings will discharge from the tailings conveyor onto the reject bin conveyor where it is combined with the coarse reject and elevated to a 750 tonne rejects bin.

Filtrate from the tailings filters will gravitate to the tailings filtrate sump and be pumped back to the tailings thickener for re-use.

1.5.3 Disposal of Transport of Coal Rejects and Dewatered Tailings

Table 1 Typical quantity of waste to be generated from 8 million tonnes of product coal per annum

Coal Rejects	3.21 Mbcm
Dewatered Tailings	1.11 Mbcm
Mine Spoil	25.2 Mbcm

Given the above quantities generated per annum, coal rejects will make up 10.9% 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 3.8% of the total waste material.

At the Caval Ridge 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 fifteen 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.

1.5.4 Protocols

To ensure the effective management of coal rejects and tailings at Caval Ridge 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 reject bin for collection by 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 7**);
- There will be no concentrated dumping of reject materials so as to minimise the potential for geotechnical instability:
  - Reject material will be effectively mixed through the spoil materials. Reject material will be dumped by mining truck on the spoil dumps. This reject material will then be dozer pushed into spoil material so as to ensure effective mixing of the reject material into the spoil dump;

- No reject material generated by the Caval Ridge CHPP 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.

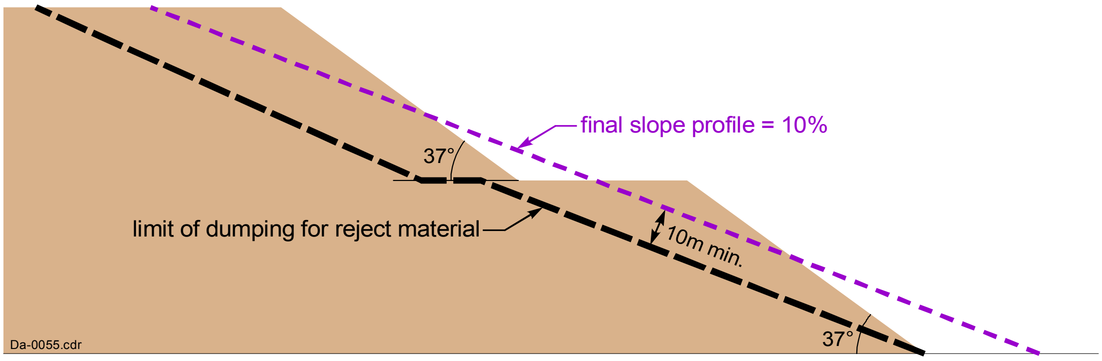

Figure 7 Cross section of typical spoil dump showing minimum 10m cover over Coal Rejects and dewatered tailings material