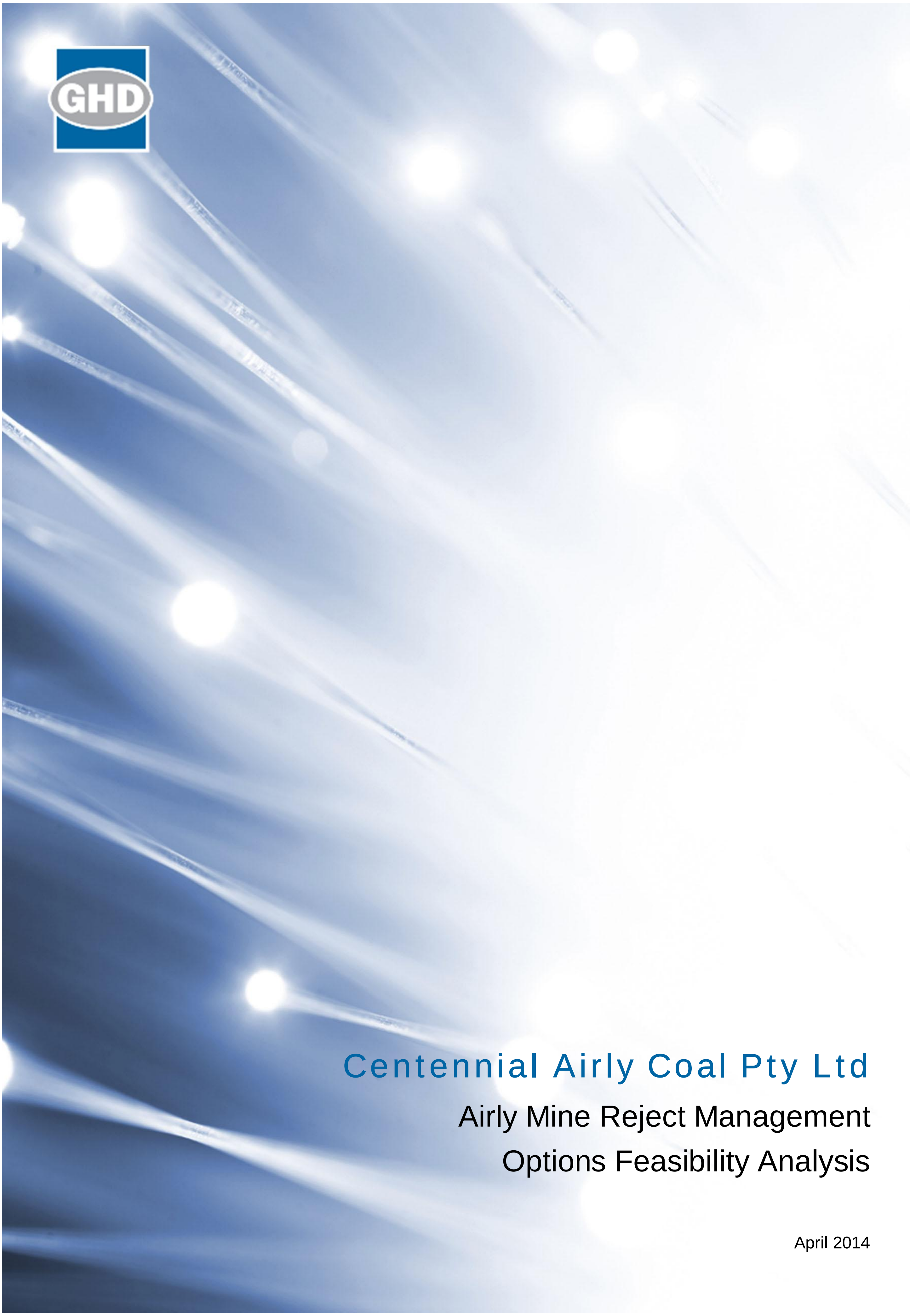

Centennial Airly Coal Pty Ltd

Airly Mine Reject Management Options Feasibility Analysis

April 2014

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1. Introduction

1.1 Overview

Centennial Airly Coal Pty Ltd (CAC) is in the process of conducting an Environmental Impact Study (EIS) for the renewal and extension of their Development Application (DA) Consent. The project will need to allow for reject disposal and the Environmental Assessment (EA) will need to develop the case for the identified preferred methodology. GHD Pty Ltd (GHD) was previously commissioned by CAC in June 2013 to provide a Concept Design of two options for a Reject Emplacement Area (REA), incorporating co-disposal of the coarse and fine reject material as a dry stack external to the underground mine workings. However, CAC now need to also consider alternative options for reject emplacement.

1.2 Purpose of this report

This report has been prepared by GHD for CAC, to examine three options for reject emplacement in sufficient detail to clearly identify the preferred option. The factors which have been considered include, but are not limited to: safety, environmental factors, visual, dust, noise, emplacement methods, water, practicality, feasibility and cost.

1.3 Assumptions

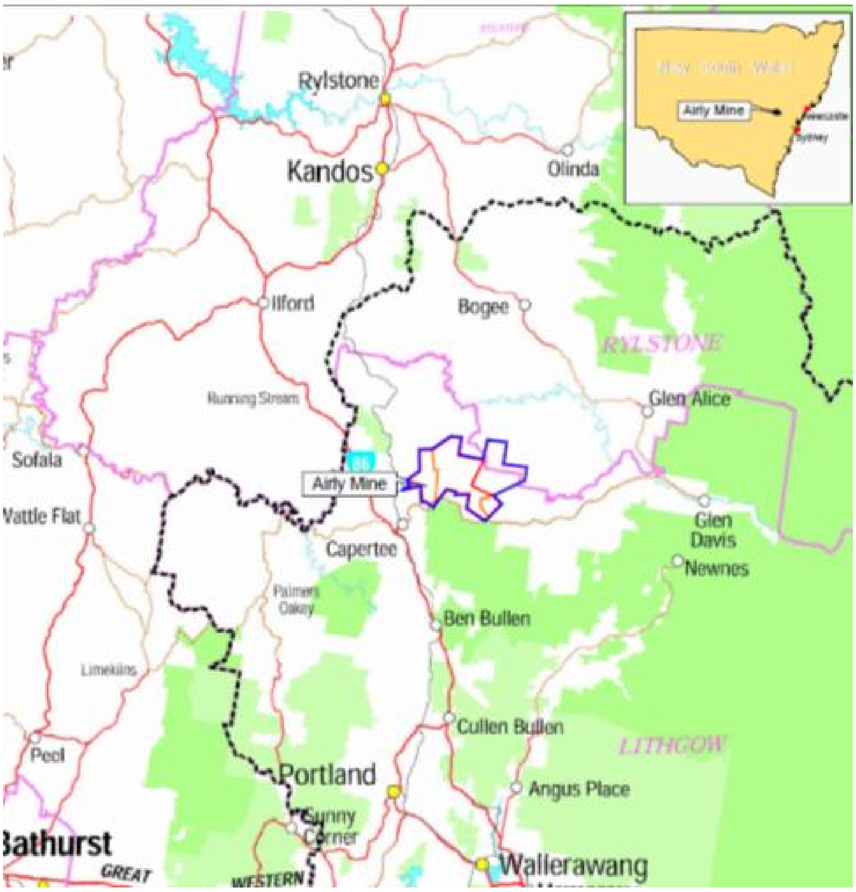
The opinions, conclusions and any recommendations in this report are based on conditions encountered at the date of the inspection and the review of the information and documents provided by CAC at the time of writing this report.

2. Project Background

2.1 Location

Airly is an underground thermal coal mine located approximately 40 km north-west of Lithgow on the Castlereagh Highway in the Western Coalfields, and is about 4 km north-east of Capertee. The mine covers the Mount Airly /Genowlan Mountain plateau and is within the Lithgow City Council Local Government Area. Figure 1 indicates location of Airly site.
The mine is accessed via Glen Davis Road approximately 3 km from Capertee.

Figure 1 Site Location



Base Map Source: City of Lithgow LGA Dept. of Lands

2.2 Approvals

The initial exploration at Airly commenced in 1984 consisting of 23 boreholes from which the economic significance of the project was established. In 1987 a bulk sampling program was established to verify the initial exploration work, including a limited extent first workings only trial mine. An Environmental Impact Statement was prepared and submitted to the Department of Planning in 1991.
Airly mine was first granted a Development Consent in 1993 (DA 162/91) to mine within the mine lease ML 1331, which is set to expire in October 2014. The development consent allows for extraction of up to 1.8 million tonnes per annum (Mtpa) of run of mine (ROM) coal and is supported by the Airly Coal Project EIS, and the addendum, titled Supplementary Report to EIS.

CAC are in the process of applying to extend their mining operations, into the eastern section of its existing Mining Lease ML1331 and to extract ROM coal up to a rate of 1.8 Mtpa within the current ML1331 and A232 areas.

2.3 Project Background

Centennial purchased the undeveloped Airly from Novacoal on 30 December 1997 and commenced construction activities on 3 March 1998. The Trial Mine phase commenced in early December 1998, with regular transport of ROM coal to the Mount Piper Power Station. This coal was won from an extended box cut which is now being used to access the main underground workings.

DA 162/91 was modified in 1999 to allow up to 500,000 tonnes of coal per annum to be transported by road for a period of two years. This period lapsed on 30 June 2002 and thereafter the mine was placed on a care and maintenance program.

Centennial commenced further construction of Airly in 2008 with production commencing in December 2009. Airly has an expected productive mine life of 20 years, producing up to 1.8 Mtpa, capable of supplying coal to both domestic and export markets.

In mid-2008, Centennial commenced detailed planning for the future development and operation of the mine. In March 2009 construction of the rail loop and surface coal handling infrastructure commenced to support the mine beyond the Trial Mine phase and into its current permanent operational phase.

The mine moved to a care and maintenance phase in January 2013. During this phase extraction activities have ceased, however environmental management of the mine is ongoing.

1 Mt coal has already been extracted from shallow mining at Airly. Mining comes to within 50 m horizontally and 20 m vertically of talus-covered outcrops. The only method of coal extraction used thus far has been first workings bord (5.5 m wide, 2.8 m high) and pillar (for support) mining. Coal dip in the Airly site is generally shallow at approximately 1 in 70 to north east.

Proposed mining at Airly will interact with the Lithgow Seam, part of the Western Coalfield located on a thin 'shelf' sequence on the western boundary of the Sydney Basin (Hunt and Telfer, 1983). Coals associated with the Sydney Basin were found by Hunt and Holday (1984) to consist of low to medium sulphur (<1.0%) seams in the distal facies and low sulphur (<0.55%) seams in the more proximal facies. Hunt et al. (1985) reported that the Lithgow and Lidsdale seams contained approximately 0.8% sulphur, with sulphur being mainly organic bound. These findings were reiterated by Hunt (1987), who noted that the sulphur content of Late Permian coal measures including the Illawarra Coal Measures were approximately 0.65%.

Strip sample testing of coal extracted from the Lithgow Seam at Airly indicates that the total sulphur is in the order of less than 0.5%. Acid-base analysis used to assess the potential for coal mine waste materials to generate acid when exposed to an oxidised leaching environment has found that generally materials with total sulphur values of 0.5% or less are non-acid forming (Miller and Murray, 1988). Overall, these results suggest that the potential for Acid and Metalliferous Drainage (AMD) formation from reject materials is low. However, additional geochemical testing of reject materials, including column leach testing, will be required to confirm this.

Spontaneous combustion is not considered an issue as evidenced by no stockpile heating over 2 years.

DA 162/91 allows for the construction of a Reject Emplacement Area (REA) as well as a tailings dam, along with associated settling ponds.

Airly has limited water and is generally dry. However additional water licences have been obtained by CAC.

3. Options for Reject Emplacement

3.1 General

The Options Analysis and associated cost estimates have been based on information provided by CAC, as listed below:

- 1.8 Mt of material will be processed annually, resulting in approximately 270,000 t of reject material.
- Approximately 15% of material processed will be reject, resulting in about 7.5 Mt of reject material over the mine life.
- Initial tumble tests of ROM material indicate approximately 80% of material will be +2 mm (i.e. coarse).

Three options have been reviewed as viable reject emplacement options for Airly. These are described in the following sections. At this stage, no data are available for the physical or geochemical parameters of the reject, or any geotechnical information of the proposed storage sites other than determined from site walkover from experienced engineers. Thus the methodology used to develop these three options is conceptual, without engineering design but is considered to be realistic based on past experience of similar projects.

- **Option 1 –** Separate placement of coarse and fine rejects at the REA, with a dam constructed from coarse reject and the fine tailings pumped as a slurry (see Section 3.3).
- **Option 2 –** Dewatering the fine reject, mixing the coarse and fine reject streams at the CPP, and co-disposing of the combined rejects as a “dry stack”(see Section 3.4).
- **Option 3 –** Co-disposal of the combined coarse and fine reject streams as a slurry in existing underground workings (see Section 3.5).

Drawings for the three options are presented in Appendix A, with basic reject process flow diagrams are presented in Appendix B.

3.2 Coal Handling and Preparation Plant (CHPP)

The Coal Handling and Preparation Plant (CHPP), comprising the Coal Handling Plant (CHP) and the Coal Preparation Plant (CPP), will be completed in 2 stages. The Coal Handling Plant (CHP) comprising the coal crushing and screening plant, has been constructed to date whilst the final commissioning of a Coal Preparation Plant (CPP) is yet to be completed. Water for use within the CHPP will be sourced from the existing 35 ML clean water storage dam and the existing production bore.

The proposed Coal Preparation Plant (CPP) is located north-east of the existing clean water dam as shown on the drawings.

Whilst the details of the CPP have not been confirmed, it is envisaged that the coal handling process will generally comprise a three stage process, as presented in Figure 2. Each of the processes handles a specific material size and generates a product stream and a waste stream. A brief description of the proposed process flow is provided below.

- **Desliming Screen and Coarse Coal Circuit**

The crushed raw coal will discharge onto the plant feed conveyor which in turn will discharge directly into the desliming screen. The desliming screen oversize materials will be flushed into the washery cyclones whilst the desliming screen undersize materials will be pumped to the desliming cyclones.

Product coal will be directed to dewatering centrifuges, thereafter to the product conveyor. The waste from the coal handling process in washery cyclones will form the major part of coarse waste stream.

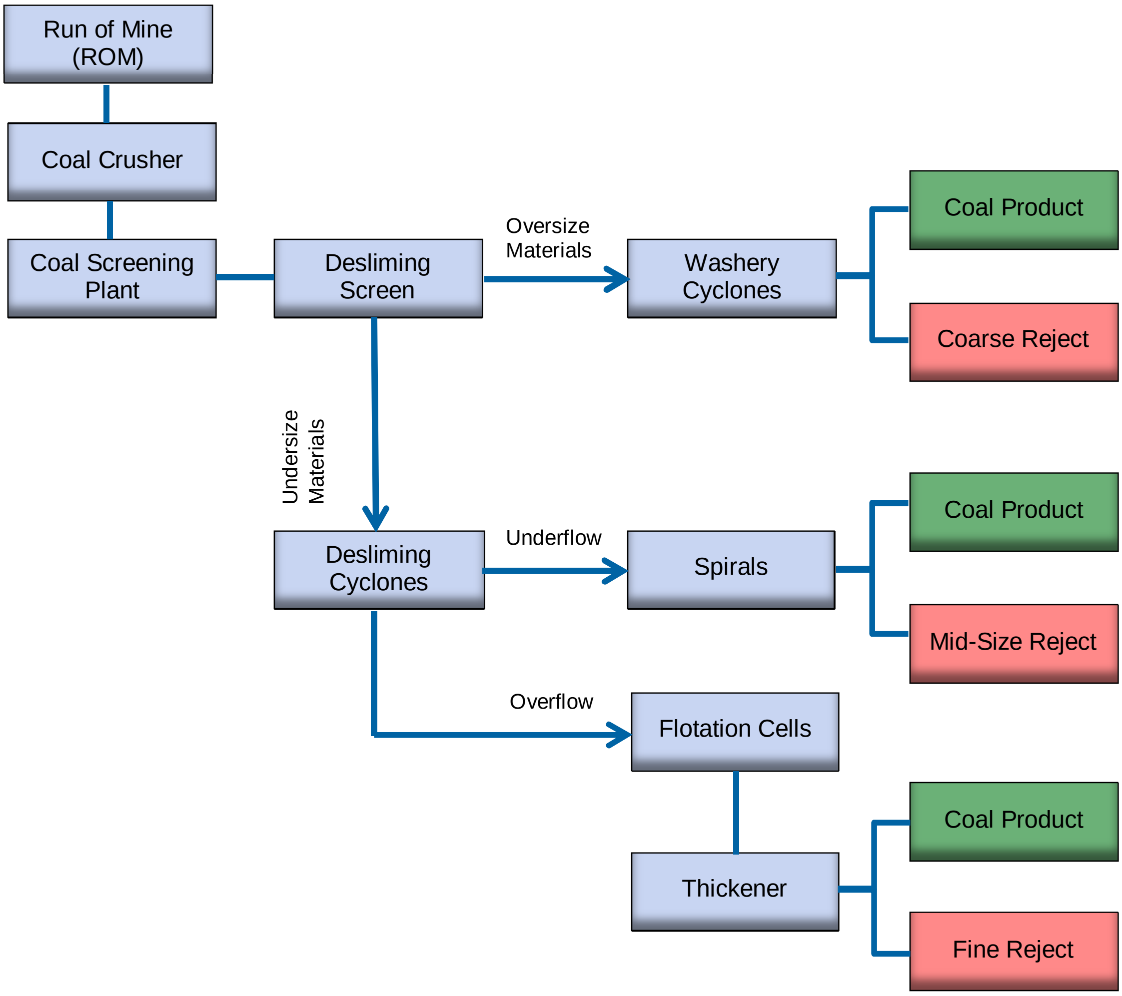
- **Desliming Cyclones and Mid-Size Circuit**

The desliming cyclones will classify the mid-size feed with the underflow gravitating to the spirals and the overflow being conveyed to the flotation cells. The coal product will be reported to dewatering centrifuges prior to being directed to product conveyor. The dewatered spiral reject will be combined with the coarse waste stream.

- **Fine-Size Circuit**

The concentrate from spiral overflows in the flotation cells will be directed to dewatering centrifuges to dewater the flotation concentrate. The tailings from the flotation cells will be conveyed to the thickener and comprise the fine waste stream.

Figure 2 Process Flow Diagram



3.3 Conventional Separate Coarse/Fine Reject Emplacement

3.3.1 Overview

Option 1 comprises the surface emplacement of separate coarse and fine reject waste streams within the designated areas as shown in drawing C002 in Appendix A. Coarse reject from the washery cyclones, together with the reject from the coal washing process in spirals, is hauled to the REA. The fine reject is pumped as a slurry from the CHPP to the REA via a pipeline. The coarse reject would be emplaced as a retaining embankment, effectively forming a Tailings Storage Facility (TSF) dam for the fine reject tailings.

Whilst the conventional separate emplacement of coarse and fine reject waste streams has the lowest capital costs, with the methodology being well understood and widely practiced, a number of potential issues exist with the proposed methodology, which would need to be addressed during the development and detailed design phases of the TSF and coarse REA facilities if this option progresses. The following concerns are often associated with the emplacement of the rejects in this manner:

- Regulators and the community are moving away from accepting conventional tailings (slurry) dams.
- Separate disposal of coarse reject in surface dumps leads to loose, and well-aerated dumps having a porosity of around 30% There is a considerable void space between the coarse particles that create ready pathways for air and water, resulting in oxidation of any pyrite present, leading to AMD, and potentially spontaneous combustion in extreme cases (potentially at Dartbrook), although this appears unlikely at Airly.
- Separate disposal of tailings slurry in surface dams leads to a low density, wet, soft deposit that occupies considerable volume, consequently resulting in a large footprint for the facility.
- Concerns about instability of high containment embankments associated with conventional storage of tailings (slurry).
- Challenges associated with water management as sustainable water use in the mining industry is becoming increasingly more important.
- Environmental problems such as seepage, spillage of process water, the potential flow of tailings, and dust.
- Challenges associated with rehabilitation, overtopping and erosion of the containment walls.
- Safety concerns relating to closure of the facility, in particular facilitating a safe work methodology for capping of the tailings.
- Concerns about post-closure risks as the TSF has to remain in perpetuity after the mining operation has ceased.
- Potential for earthquake-induced liquefaction of the tailings.

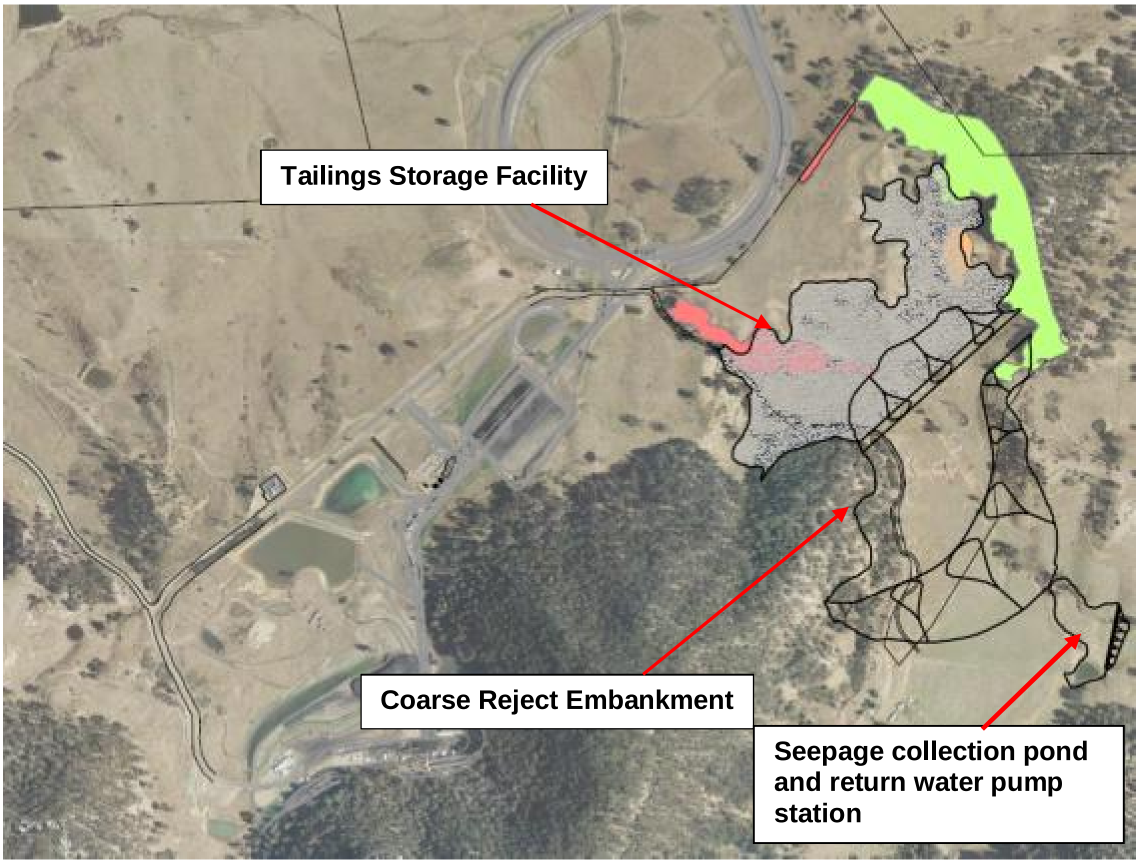
3.3.2 Methodology

The following criteria were taken into consideration to identify potential locations for the emplacement of the coarse and fine reject waste streams in Option 1:

- Site topography and features.
- Required storage volumes for each waste stream.
- Minimal material usage for containment walls of the TSF.
- Minimise the footprint of the REA, which is to remain within the mining lease, and avoid existing infrastructure.
- Potential environmental impacts, in particular areas identified as being of ecological significance; visual and noise impacts; water management; operational practicality and safety; and overall feasibility of the proposed sites.

The proposed locations for the TSF and coarse REA in Option 1 are presented in Figure 3.

Figure 3 Location for Option 1 REA



The first stage of reject handling in Option 1 would consist of combining the coarse reject products from cyclones and spirals, without any further processing. The rejects will form the coarse waste reject stream, which would be stockpiled at the CPP to be transported to the designated coarse REA.

The coarse reject waste stream would most likely be transported by truck, which may be the only feasible option. Material would be placed, dozed and compacted at the proposed location. It is likely that the majority of the rejects would require compaction as they would form a storage “dam” for the fine reject: this will depend on the final design and parameters of the rejects (i.e. potential for AMD generation, required level of saturation and the structural requirements of the coarse reject fill).

The concept for the TSF is that a retaining embankment would be constructed using coarse reject. The processed fine reject (tailings) would be pumped as a slurry to the TSF at a proposed solids concentration around 30% (ratio of mass solids to total mass of solid and water) and distributed in the TSF.

3.3.3 Concept Design

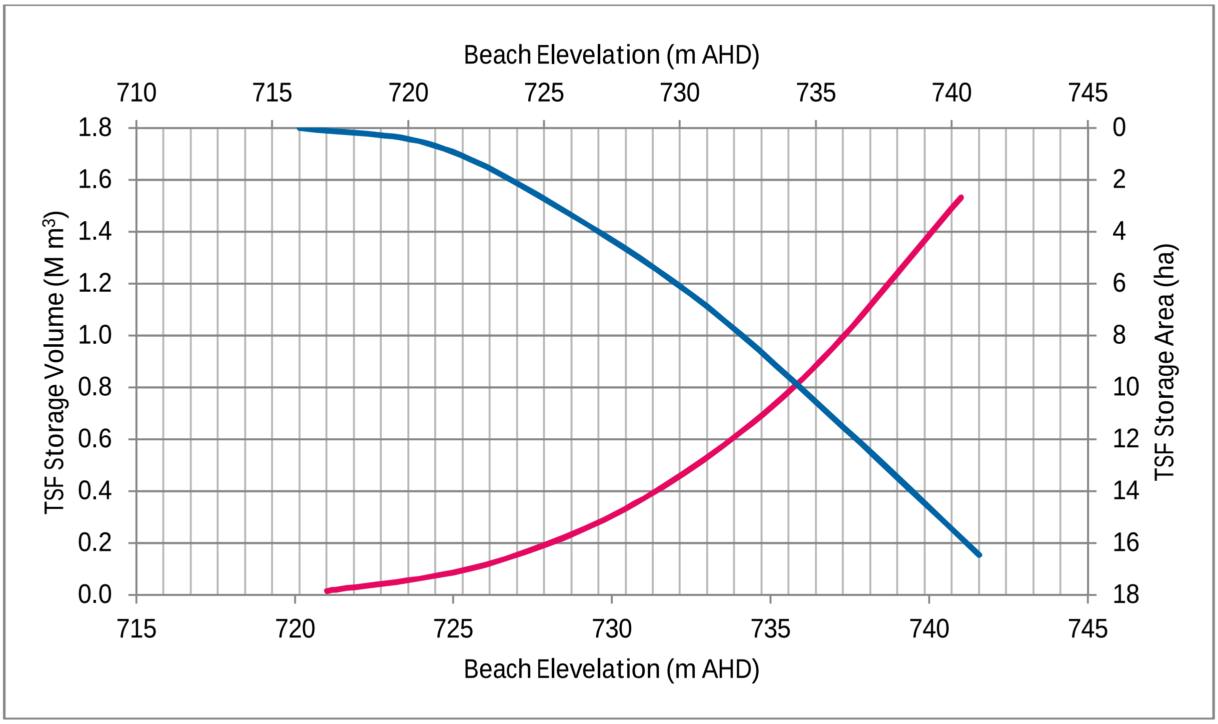
The proposed site of the combined REA and TSF is located approximately 850 m north of the CPP, and is the tailings dam site identified in the existing DA (same site as proposed for REA Location 2 in 2013 GHD Concept Design Report). The site is positioned within a natural valley within the mining lease, on land owned by Centennial and currently leased out for grazing purposes.

Figure 4 Option 1 Valley Section

Whilst the shape of the proposed TSF is to a large extent determined by the topography of the valley, only a single containment wall running along the lower ridge in a NE-SW direction is required to contain the tailings. This containment wall is formed by the north-west external batter of coarse REA, which is sloped at 4H:1V. The top of the coarse REA is elevated at RL 745 m AHD with the width of the crest varying from 5 to 28 m. The south-east external batters are laid back to a similar slope of 4H:1V for visual, rehabilitation reasons.

The storage Volume-Area-Elevation curve of the proposed TSF is presented in Figure 5. The proposed TSF has a storage capacity of approximately 1.4 Mm^3 (at RL 740 m AHD). Assuming a porosity of 40% and a specific gravity of 2 for the tailings, the density would be approximately 1.2 t/m^3, giving a storage capacity of approximately 1.7 Mt. This would be sufficient to store fine reject from production of about 9.2 Mt of ROM. At this stage, CAC have indicated that the mine will produce between 7.2 and 7.5 Mt of reject of which ~20% would be tailings, i.e. ~1.5 Mt. This effectively means that the initial concept design for the TSF has additional storage capacity to accommodate the loss of storage capacity due to the slope of the beach and further storage requirements for capping of the tailings at closure.

Figure 5 Volume-Area-Elevation curve for Option 1 Fine Reject

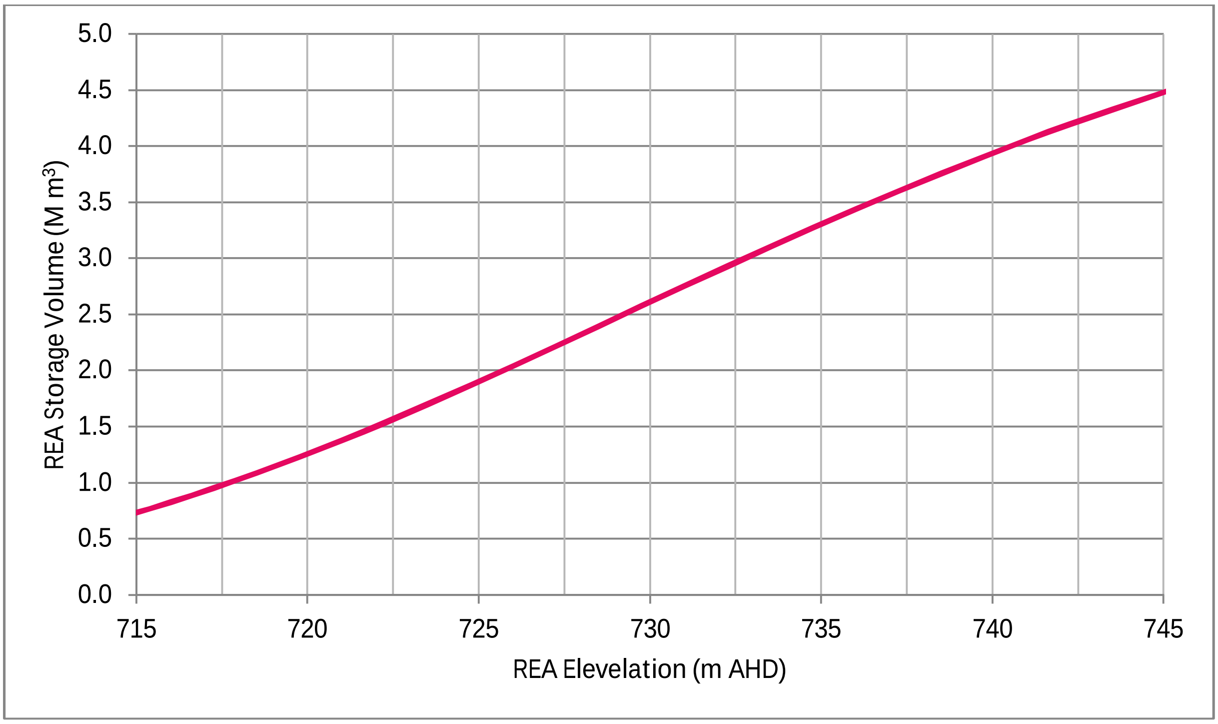


The conceptual design of the TSF has allowed for a nominal total freeboard of 5 m above the beach. The construction schedules would consider the construction of future coarse REA stages to be brought forward in order to prevent loss of operational freeboard.

ANCOLD Guidelines on Tailings Dams, May 2012, recommend that an emergency spillway be provided in addition to the provision of a conservative dam storage allowance for no-spill tailings dams. The approximate location of the proposed emergency spillway for Airly TSF is at the eastern corner of the facility, as shown on drawing C002 in Appendix A.

Likewise the storage Volume-Area-Elevation of the proposed coarse REA has been developed in Figure 6. Given the adopted porosity of 35% and the specific gravity of 2, the coarse reject would have a density of approximately 1.3 t/m^3. It is estimated that approximately 6 Mt of coarse reject will be produced over the life of the mine, i.e. ~4.6 Mm^3. The concept design for the REA would accommodate this provisional amount of coarse reject.

Figure 6 Volume-Area-Elevation Option 1 Coarse Reject



It should be noted that further design is required during the Development and Detailed Design phases, in particular geometrical arrangement, batter slopes and material zoning for the coarse REA, which is to be confirmed upon completion of geochemical/geophysical investigations. Likewise, design beach slope, flood capacity and freeboard and drainage arrangements for the TSF require further analysis/assessment. At this stage, the conceptual design of the proposed coarse REA and TSF is sufficiently detailed to provide the preliminary earthworks volumes and comparative cost estimates.

Given the potential concerns about this method (as outlined in Section 3.3.1), the following design measures were considered to ensure good practice:

- Provision of Potentially Acid Forming (PAF) Encapsulation Cells within the coarse REA to mitigate the risks due to potential generation of AMD.
- Provision of an emergency spillway as a strong preventative control against overtopping and hence mitigation of extreme consequences associated with catastrophic failure of the tailings dam.
- Optimise siting of the TSF and coarse REA to minimise the footprint of the facilities. Given the nature of the coarse reject to be used to contain tailings slurry within TSF, the risks due to the instability and erosion of the containment walls would be significantly reduced.

3.3.4 Required Infrastructure

All of the proposed three options include a coal handling and preparation plant (CHPP) to prepare product coal and generating by-product rejects. The equipment required for the CHPP (administration building, workshop, coal weighing and sampling facilities, dust suppression systems, conveyors, stackers, reclaim units and stockpiles, water infrastructure, mobile equipment etc., and a new power line – if required) is common between the options and hence is not included in the comparative costing.

The Project includes the following fundamental infrastructure required from waste handling to emplacement of the rejects:

- Haul and access roads to the site.
- Transport equipment (truck) to haul the coarse reject from the CHPP to the designated REA, estimated as a 130 t truck working at 80% efficiency.
- Slurry pump and pipeline to convey the tailings from the CHPP to the proposed TSF.
- Earthworks equipment for the placement, dozing and compaction of coarse rejects.
- Work force and supporting ancillary services.
- Water management infrastructure, including settlement pond, on-site drains, diversions and sumps transfer pumps and pipelines within the reject emplacement working area.

3.4 Option 2 – Co-Disposed Coarse/Fine Reject Emplacement

3.4.1 Overview

Option 2 comprises the emplacement of dry combined coarse reject and dewatered tailings. This option offers benefits over Option 1 such as improved efficiency of water usage, reduced risk of AMD and other water quality impacts, and reduced post-closure risks. An example of this is the dry co-disposal of coarse rejects and tailings practiced at a number of Australian Coal Mines including Dartbrook Coal Mine.

The challenge for dry co-disposal is that dewatering of the tailings is a potentially costly process, particularly if the tailings are clay-rich and fine-grained, requiring flocculation. Dewatering of the tailings can be facilitated by the following methods:

- Centrifuging – reducing the moisture content of the tailings, but not adding “structure”.
- Vacuum filtration – polymer flocculants will both agglomerate fines and also entrap water, which can be released on disturbance (such as falling onto a conveyor), with the “filter cake” reverting to a “cow-pad”.
- Belt press filter – sensitive to flocculent type and dose, and to pH, requiring monitoring and adjustments.
- Plate and frame filtration – the most expensive, but potentially the most effective method.

Dry co-disposal of the waste streams presents the following potential advantages:

- Mixing the fine tailings with the coarse reject would reduce the porosity of the resultant mixture, reducing its permeability and maintaining its saturation thus limiting oxygen access and reducing the risk of AMD.
- The overall volume of waste is reduced and the required footprint of a combined waste storage would be less than that of separate waste streams.
- No containing embankment is required for the tailings.
- The combined rejects are expected to have superior engineering parameters to the separate materials and will be suitable for constructing a readily trafficable, low dust generating, stable landform with likely good moisture retention and revegetation.

- For reasonable transport distances, a surface fleet may not be required to haul the reject if a conveyor system can be proven to be economically feasible.
- Waster losses can be lower than for separate disposal systems.

However, a number of potential issues exist with this method which can be assessed during the Development and Detailed Design phases, including:

- Challenges arising from the actual proportions of fine and coarse reject waste streams compared with the optimal proportions. The ideal ratio for achieving a good mixture of coarse reject to dewatered tailings on a dry mass basis is about 3.3:1 (for a coarse to fine split at 2 mm, and assuming spherical particles). Initial tumble tests provided by CCA indicate that this may be achieved; however a higher proportion of tailings may result in reduced strength and increased erosion potential. Therefore, the dump may need to be zoned to provide a strong, erosion-resistant outer zone encapsulating a weaker internal zone.
- Challenges arising fom moisture level adjustments .To provide maximum resistance to AMD generation, the combined rejects should be placed and maintained at a minimum saturation level of approximately 85%. Moisture levels may need to be adjusted during placement if the combined rejects are too dry. Alternatively, the level of dewatering of tailings could be adjusted.

3.4.2 Methodology

The following design criteria were taken into consideration to identify potential options for the proposed REA site:

- Site topography and features.
- Storage volume of 5 Mm^3 (based on 15% reject production and a dry density of 1.5 t/m^3).
- Footprint of the REA to remain within the mining lease, and avoid existing infrastructure.
- Potential environmental impacts, in particular areas identified as being of ecological significance; visual and noise impacts; water management; operational practicality and safety; potential for expansion and overall feasibility of the proposed sites.

An alternative to the dry co-disposal of the reject waste streams is the pumped co-disposal of a mixed slurry. However, pumped co-disposal is not recommended since it leads to a steep, coarse upper beach and, crucially, the washing out of fines to form a flat lower (tailings) beach. Compacted, dry co-disposal leads to a dense, stable landform, with little drainage and limited ingress of oxygen that may oxidise any pyrite present.

The first stage of the dry co-disposal process would consist of dewatering of the tailings stream to produce a filter cake. This would likely be achieved by belt press filtration. At this stage no filtration test data are available.

The filter cake would then be mixed with the coarse reject at the CHPP using a “blunger”. The resultant mixture would then be transported to the REA, ideally using a conveyor system, bringing a greater level of Quality Assurance (QA) to the mixing process and subsequent emplacement. However, at this stage a conveyor does not appear economically feasible and transport would likely be by hauling by truck.

The combined rejects would be placed, dozed and compacted at the proposed emplacement site. It is unknown at this stage whether any of the material would require compaction; this will depend on the final design and parameters of the combined rejects (i.e. potential for AMD generation and required level of saturation). A dry density of the order of 1.5 t/m^3 is assumed for the preliminary estimates. This is considered a conservative estimate, and dry densities in excess of 1.5 t/m^3 are considered likely to be achieved.

The construction would likely be staged by emplacing firstly over the lower levels of the footprint and bringing the embankment height up through a series of layers sloping to collector drains for stormwater management. The active emplacement area would be drained back into the natural slope with external batters being progressively trimmed and revegetated to limit erosion and create visual screening of ongoing works.

3.4.3 Concept Design

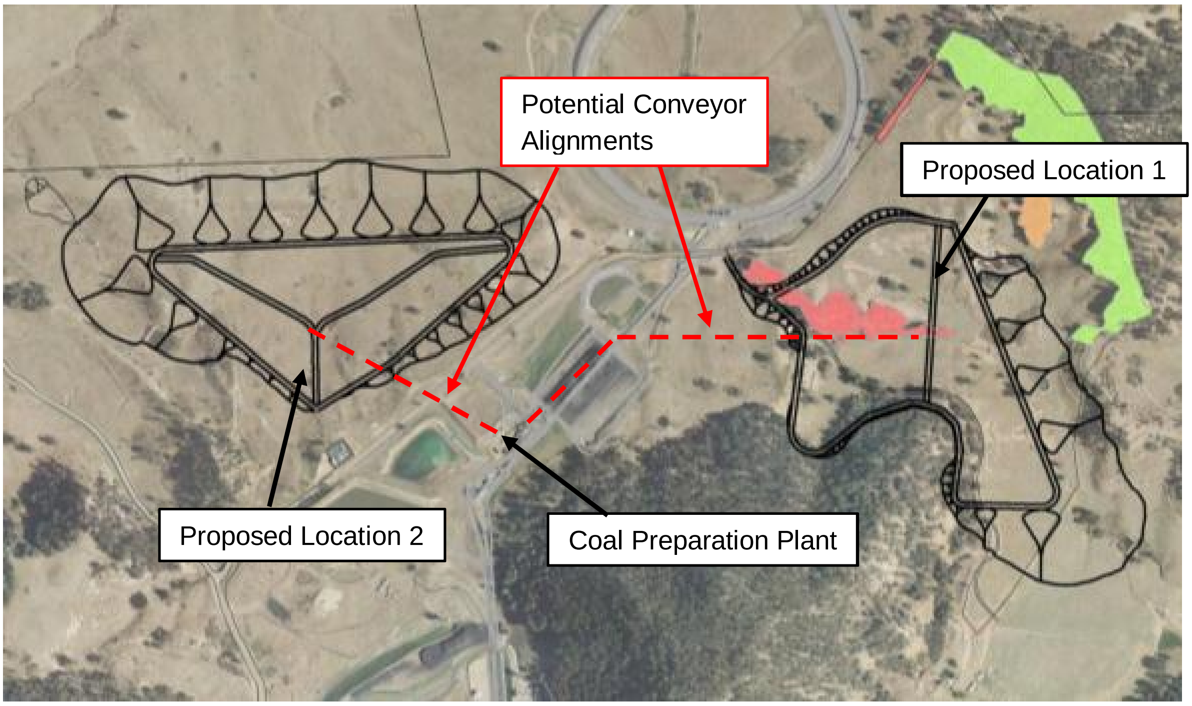
Two locations have been identified as potential options for the proposed dry co-disposed rejects REA site, which are shown on Figure 8 and the drawings in Appendix A.

The proposed Location 1 is essentially the same site as that proposed for Option 1 (refer to Section 3.3.3). Given the distance from the CHPP to the proposed site (approximately 850 m), a conveyor system for material transport may not be feasible, and the waste may need to be transported by truck (most likely scenario under the current plan).

The proposed Location 2 is located approximately 400 m to the south-west of the CHPP, on gently sloping, open reclaimed farmland.

Figure 7 Proposed Location 2 Site

Figure 8 Potential Site Locations for Option 2 REA



A summary of features of the proposed REA in Location 1 and Location 2 is presented in Table 1.

Table 1 Proposed Location 1 and Location 2 Features

REA Component	REA Location 1	REA Location 2
Footprint Area	30.4 ha	33.6 ha
Crest Level	RL 752.4 m	RL 765 m
Height (max)	49 m	40 m
Storage Volume	5.0 Mm^3	5.2 Mm^3
Internal Slopes (1)	Minimum 100H:1V	Minimum 100H:1V
External Batter Slope (2)	3H:1V to 4H:1V	3H:1V to 4H:1V

(1) Internal batters may vary and are provided based on drainage considerations.

(2) This slope would be targeted to address requirements for revegetation and erosion reduction.

3.4.4 Required Infrastructure

The Project includes the following fundamental infrastructure required from the stage of waste handling to emplacement of the rejects:

- Mixing Plant to combine the dewatered tailings and coarse reject waste streams.
- Transport equipment (either truck or conveyer) to haul the mixed rejects from mixing plant to the designated REA.
- Earthworks equipment for placement, dozing and compacting the mixed rejects.
- Work force and supporting ancillary services.
- Water management infrastructure, including settlement pond, on-site drains, diversions and sumps and transfer pumps and pipelines within the reject emplacement working area.

3.5 Option 3 – Underground Co-Disposed Reject Emplacement

3.5.1 Overview

It is reasonable to consider the use of the old mine workings to dispose the rejects from the coal washery process. Since the rejects comprise only approximately 15% of the total volume of run-of-mine (ROM) coal mined, even with very conservative bulking factors, the volume of the mined cavity should always be much greater than the volume required for rejects disposal.

As an alternative to separate surface disposal (Option 1) or dry co-disposal of mixed rejects on land (Option 2), Option 3 has been developed to consider the pumped co-disposal of the mixed fine and coarse reject streams into the old underground mining voids.

The underground emplacement of combined rejects has been successfully developed for underground emplacement of rejects at Metropolitan Mine. The technology has a range of benefits, including: as a construction material; mitigation of spontaneous combustion events; goaf ventilation improvement; confinement of pillars for subsidence control; and use in standing support. Whilst the operating cost could be three to four times more than typical surface emplacement, these applications may be in some situations.

In the case of the Airly, this potential method of rejects disposal was discussed in the preliminary assessment of options with CAC staff. It was determined that the exploitation of the existing underground voids within the old workings is feasible for disposal of the combined rejects from the new development area.

The co-disposal of coal rejects underground may provide advantages for mining operations. Compared to other more conventional surface disposal options the potential for subsidence of old mine workings can be reduced and this option is generally considered to cause less of an environmental impact compared to more conventional surface disposal practices.

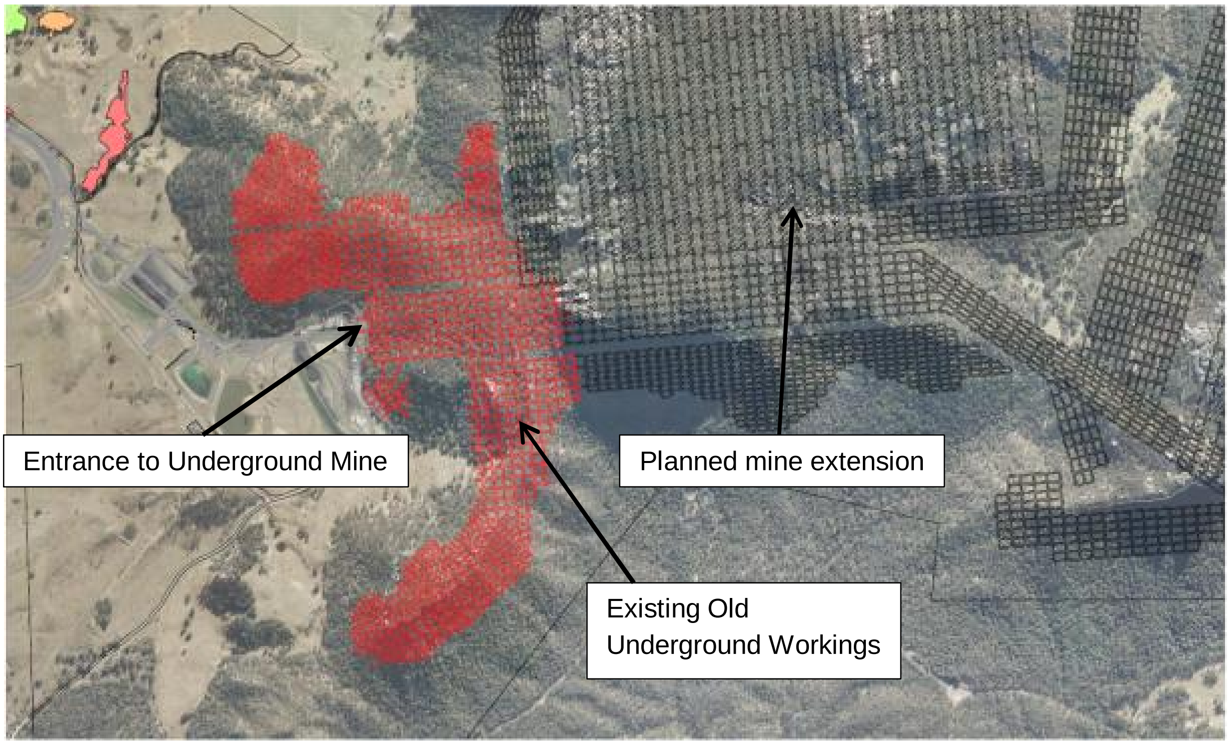
Backfilling of mine workings might seem to be an obvious solution to mine waste management; however, it is a relatively complex endeavour and operations require detailed multidiscipline engineering to develop site specific processes and methods, compared to more common practices of disposal of mine wastes on surface. There are some challenges associated with the method of pumped underground co-disposal including but not limited to the following:

- Challenges arising from the actual proportions of fine and coarse reject waste streams compared with the optimal proportions. The ideal ratio for achieving a good mixture of coarse reject to dewatered tailings on a dry mass basis is about 3.3:1 (for a coarse to fine split at 2 mm, and assuming spherical particles). Too low a coarse:fine ratio may require underground bulkheads to contain the excedss tailings. Too high a coarse:fine ratio may result in excessive wear and pumping costs.
- Requirement for flocculants and/or other additives.
- Delivering the co-disposal mixture underground, likely by pipeline, could require a borehole to the underground workings, and moving the discharge point to effectively fill the underground voids.
- Potential risk to the ongoing underground operations.
- Potential for liquefaction of excess fines.
- Potential groundwater impact from the seepage of excess process water.
- High maintenance input required to maintain pump and pipeline.
- Considerable energy required to pump the co-disposal mixture to the underground voids and to return the water recovered to the plant for reuse.
- Possible emergence of seepage on the surface generated from co-disposal in shallow mining voids.

3.5.2 Concept Design

The locations of the old and new workings are shown on Figure 9.

Figure 9 Plan of Underground Mine Workings



The first stage of the underground co-disposal process would consist of preparing the mixture of fine and coarse rejects. To ensure flow of the combined mixture, the coarse reject would likely need to be crushed. The crushed coarse reject (with a maximum particle size nominally limited to 4.75 mm) would be combined with the fine rejects in the mixing plant. The resulting mixture may need to be pumped using a positive displacement slurry pump to the main access point as shown on the drawings in Appendix A, although centrifugal pumps would likely suffice. The backfilling operation would commence by damming off the designated underground area at locations as shown on the drawings. This is achievable by the construction of bulkheads comprising coarse reject embankments with nominal 2H:1V side slopes.

Five areas within the old workings have been identified for the potential co-disposal of the combined rejects. These underground sites have been selected to ensure that access to the new workings is maintained. A number of factors have been taken into account in the proposed schedule to backfill the site with the highest to lowest priority designated to Area 1 through Area 5. The operational considerations taken into account in this evaluation include the following:

- Distance from the main access point. This determines the length of the combined rejects and water return pipelines required for the operation.
- Either upslope or downslope emplacement of the mixture, given the fact that the coal dip is NE. It is apparent that more operational issues are associated with upslope emplacement.
- Shape and distribution of the existing pillars. It is expected that complexity in shape distribution of the pillars would result in more work to make underground co-disposal work.
- Avoid excessive relocation of the discharge point. On account of the consecutive nature of the proposed backfilling cycles, backfilling of the areas to the north of the main access point would need to be completed before the pipeline is relocated for co-disposal in the south areas.

The underground voids would be walled off to develop confined segments at 100 m intervals, with co-disposal into these segments on a consecutive basis towards the main access point. Given the proportions of the expected coarse:fine rejects ratio, it is expected that the beach slope would be up to 5H:1V, although some wash-out of fines should be expected at low initial % solids. In each cycle of backfilling, therefore, the co-disposed mixture may require pushing back using a dozer from the discharge point located on the top of the pipe stand to the end of the stretch. Claystone bands between the seams will produce ultra-fine rejects, which may make it difficult to achieve acceptable % solids for the co-disposed mixture.

On account of operational considerations, the depth of backfilling is assumed to be 2.3 m (0.5m below the coal roof) resulting in storage of 1,140 m^3 of co-disposed mixture in each backfilling cycle. A reduction factor of 0.9 is applied to the estimate of storage volume to account for the potential non-utilised volume during the backfilling operation.

The key risks associated with the proposed methodology are the following:

- Potential flooding of active workings.
- Potential driving of seepage to the surface.

The above risks can be reduced to some extent by the installation of sump pumps in the old working areas, via which any excess water could be returned to the CHPP.

Given a processing rate of 1.8 Mtpa with 15% rejects, and based on an estimated dry density of the settled co-disposed mixture of1.5 t/m^3, the volume of the rejects produced in Airly would be 180,000 m^3 per year. The preliminary estimate of the available underground void within Area 1 to Area 5 (see drawing C004 in Appendix A) indicates that the designated areas have the capacity to store up to 490,000 m^3 of the rejects (based on applying a reduction factor of 0.9 to the volume estimates), which is required to be disposed underground at a rate of approximately 33 m^3/s (assuming 70% solids) should the co-disposal operation continue 24 hours/day up to seven days/week at an operational efficiency of 90%.

This is associated with rejects production from the CHPP over approximately 2 years and 9 months. For continued underground backfilling CAC would need to develop the new mining areas to facilitate ongoing backfilling using the proposed methodology.

3.5.3 Required Infrastructure

The Project includes the following fundamental infrastructure required from the stage of waste handling to emplacement of the rejects:

- Coarse reject crusher to crush the reject particles to -4.75 mm.
- Mixing Plant (including a mixing tank) to combine the fine and coarse reject waste streams.
- Centrifugal slurry pumps and pipeline to discharge the slurry from CHPP into the underground voids.
- Earthworks equipment for placement, dozing and (possible) compaction of coarse reject used in the construction of underground bulkheads.
- Work force and supporting ancillary services.
- Water management infrastructure, including sumps and transfer pumps and pipelines within the reject emplacement working area.

4. Water Management

A critical element of the reject emplacement system is the management of water, and this needs to be considered from two primary perspectives:

- The site water balance has shown that there may be a deficiency of available water for processing, and so the return of water from the reject management process is of high importance.
- External reject emplacement storage areas will require an extreme storm storage allowance of a 1:100 year Annual Exceedance Probability (AEP) flood event, to minimise the risk of dirty water from the reject emplacement system entering the natural environment.

4.1 Option 1 - Conventional Separate Coarse/Fine Reject Emplacement

4.1.1 Water Balance Impacts

Initial, high level water balance calculations are based on the following assumptions:

- Processing rate of 1.8 Mtpa with 15% rejects.
- Tailings solids of 30%.
- Coarse reject gravimetric moisture content of 9%.
- Tailings dry density of 1.2 t/m^3.
- Coarse reject dry density of 1.3 t/m^3.
- Combined rejects dry density of 1.5 t/m^3.

It is estimated that approximately 125 ML/annum of water will enter the REA through the pumping of tailings slurry and emplacement of coarse rejects. Of this, approximately 45 ML/annum will be retained in the rejects, with the remainder pumped back to the dirty water dam for re-use in processing.

4.1.2 Extreme Storm Storage Allowance

To allow for storage of the 1:100 year flood event, the downstream settlement dam will need to have the capacity to store runoff from the coarse reject embankment. In addition, the TSF will need to have sufficient freeboard to store the flood before spilling of the emergency spillway occurs.

4.2 Option 2 – Co-disposed Coarse/Fine Reject Emplacement

4.2.1 Water Balance Impacts

Initial, high level water balance calculations are based on the following assumptions:

- Processing rate of 1.8 Mtpa with 15% rejects.
- Tailings solids of 74% after dewatering.
- Coarse reject gravimetric moisture content of 9%
- Combined rejects dry density of 1.5 t/m^3.

It is estimated that approximately 38 ML/annum water will enter the REA from the combined rejects. This will be entirely retained within the REA.

4.2.2 Extreme Storm Storage Allowance

As for Option 1, the downstream settlement dam will need to have the capacity to store runoff from the external batters of the REA for Option 2.

Surface runoff from the REA would be controlled by designing the emplacement area to limit external batters, direct maximum runoff to the internal areas where runoff would be collected in silt traps and then collected by internal rock-lined drains running adjacent to construction access roads. This runoff would then be transported to the external toe drains before reporting to the settlement dam.

4.3 Option 3 – Underground Co-disposed Reject Emplacement

4.3.1 Water Balance Impacts

Initial, high level water balance calculations are based on the following assumptions:

- Processing rate of 1.8 Mtpa with 15% rejects.
- Combined rejects solids of 70%.
- Combined rejects dry density of 1.5 t/m^3.

It is estimated that approximately 115 ML/annum of water will be pumped into the underground workings, with approximately 80 ML retained in the rejects.

4.3.2 Additional Impacts

There is obviously no requirement to allow for an extreme flood for the underground option. There may however be additional complications with impacts on groundwater, geotechnical stability and seepage due to the introduction of 80 ML/annum into the underground environment.

5. Reject Emplacement Options Analysis

Table 2 presents the comparison of the three options for reject emplacement, including issues associated with each component taken into account in the analysis.

Table 2 REA Options Comparison

Component	Surface Disposal/Co-disposal			Underground Disposal	Notes
	Option 1 (Location 1)	Option 2			
		Sub-Option 2-1 (Location 1)	Sub-Option 2-2 (Location 2)	Option 3	
Safety	No significant issues. (see Note 1)	No significant issues. (see Note 2)	No significant issues. (refer to Note 2)	Not a preferable option from a safety prospective due to the potential flooding of the active areas, difficult work area and use of mechanical equipment in a confined space.	(1) Provision of emergency spillway and using the coarse REA to contain the tailings within the valley are the design measure which reduce post closure risks due to overtopping and erosion (2) Either design should be able to be constructed and operated safely provided an appropriate risk register is completed, and suitable precautions are taken.
Operations	Average transport distance would be ~1,000 m No construction required for mixing plant. Dust control is required during surface transport (trucking)	Average transport distance would be ~1,000 m Challenges associated with mixing the fine and coarse streams to produce dry co-disposal. (see Note 1)	Average transport distance would be ~400 m. Challenges associated with mixing the fine and coarse streams to produce dry co-disposal. (see Note 1)	Average transport to the main access point, thereafter to the working underground areas Challenges associated with mixing the fine and coarse streams to produce slurry mix Issues with delivering the mix underground and emplacement of slurries in the voids. Pumping head may vary based on the location of the active working areas.	(1) Location 2 is clearly the preferred site operationally as it is in closer proximity to the CPP should either conveyer of truck is for transport, presenting savings in capex and opex.

Component	Surface Disposal/Co-disposal			Underground Disposal	Notes
	Option 1 (Location 1)	Option 2			
		Sub-Option 2-1 (Location 1)	Sub-Option 2-2 (Location 2)	Option 3	
Water Management	Clean water diversion would be relatively straightforward. A decant structure would likely be required One settlement dam is required, pumping back to the existing dirty water dam would require a 2,400 m pipeline pumping up ~55 m head. The proposed settlement dam would require approximately 20,000 m^3 of above-ground earthworks. (See Note 1)	Clean water diversion would be relatively straightforward. Two settlement ponds required, one of which would be in a different catchment to the existing site water runoff. Pumping back to the existing dirty water dam would require a ~2,400 m pipeline pumping up ~55 m head. The proposed two settlement dams would require approximately 39,000 m^3 of above-ground earthworks. (see Note 1, Note 2 and Note 3)	Very little construction required for clean water diversion. Only one settlement pond required, and located in the same catchment as the existing site water runoff system. Pumping back to the dirty water dam would require a ~900 m pipeline pumping up ~25 m head. The proposed settlement dam would require approximately 21,500 m^3 of above-ground earthworks. (see Note 2 and Note 2)	Transport distance and pumping head may vary based on the location of the active working areas Considerable energy required to recover and return water to the plant for reuse. Significant water losses are expected Operational issues about draining in active working areas Issued with maintenance of the return water pipeline and pumps	(1) Challenges are associated with water management for Option 1 compared to Option 2 due to water loss issues. (2) Location 2 is preferred from an operational perspective due to the closer proximity resulting in lower capital and operating costs for pumps and pipelines. (3) Location 2 settlement pond arrangement is preferred as simpler system with single pump compared to multiple pumps
Visual Impact	Hidden by natural landforms from public roads and private property	Hidden by natural landforms from public roads and private property. (see Note 1)	Very open site that will be visible from the nearby highway and some properties. Once initial construction developed the REA may be advantageous in reducing the overall mine site visual impact. (see Note 1)	No visual issues	(1) Location 1 is preferred from a visual perspective in the short term but Location 2 has advantage once past initial construction.

Component	Surface Disposal/Co-disposal			Underground Disposal	Notes
	Option 1 (Location 1)	Option 2			
		Sub-Option 2-1 (Location 1)	Sub-Option 2-2 (Location 2)	Option 3	
Noise Impact	Low noise impact (See sub-option 2-1)	The noise impact from construction would be constrained to some degree due to the surrounding land forming a natural barrier; however there would be a noise impact due to haulage from the CPP to site. (see Note 1)	The noise impact from construction would be relatively high due to the site being very open; however this is offset to some degree due to the shorter comparative haulage distance from the CPP. The noise impact would also reduce with time once an outside embankment is formed and vegetation screen developed. (see Note 1)	No significant noise issues	(1) Location 1 is preferred at start-up due to a lower noise impact from construction; however Location 2 would have a lesser impact from a material transport perspective and in longer term provides visual and noise screen for the CPP.
Ecological Impact	Significant ecological areas identified that will require Bio Banking offsets. (See Note 1)	Significant ecological areas identified that will require Bio Banking offsets. (see Note 1 and Note 2)	Area has been identified as having no significant ecological issues. (see Note 2)	No ecological issues	(1) Option 1 may have more ecological impact compared to option 2 due to having a larger footprint (2) Sub-option 2-2 is preferred from an ecological perspective, as there is relatively no impact compared to Location 1.
Ground Water (see Note 1) and Seepage Issues	Environmental problems such as seepage, spillage of process water and the potential for water to act as a transporter for tailings flows, and dust High potential for	Low potential for seepage problems and contamination of ground water on account of lower water content present in the mixture	Low potential for seepage problems and contamination of ground water on account of lower water content present in the mixture	As shallow mining potential driving of seepage to the surface exist High potential for contamination of ground water	(1) Airly has limited water and is generally dry, Therefore the contamination of ground water is unlikely.

Component	Surface Disposal/Co-disposal			Underground Disposal	Notes
	Option 1 (Location 1)	Option 2			
		Sub-Option 2-1 (Location 1)	Sub-Option 2-2 (Location 2)	Option 3	
	contamination of ground water				
Heritage Impact	Similar to sub-option 2-2	Footprint constrained to the east by heritage Mount Airly mining sites. The proposed location will be partially over the old Torbane village tram line. (see Note 1)	Area has been identified as having no significant heritage impacts. (see Note 1)	No heritage issues	(1) Location 2 is preferred from a heritage perspective, as Location 1 is in closer proximity to significant sites.
Potential for Expansion	Potential for expansion to the northeast. (see Note 1 and Note 2)	Potential for expansion to the northeast. (see Note 1 and Note 2)	The site is constrained by the current mine lease, giving little room for expansion without altering the lease or moving existing infrastructure. (see Note 1 and Note 2)	Potential for expansion to new workings.	(1) At this stage under the projected mine life, it is considered unlikely that the REA would require expansion (2) Under the current mine lease constraints; Location 1 has more potential for expansion. (3) Location 2 potential capacity can be increased by steepening the external batter to 3:1.

5.2 High Level Cost Comparison

A cost comparison of the three options has been completed (+/- 50%), and is summarised below. A more detailed analysis can be found in Appendix C. Exclusions from the cost estimates include:

- Mobilisation of plant and other preliminaries.
- Maintenance of plant and infrastructure.
- Capex and opex required for processing.
- Power requirements for infrastructure.

At this stage, for Option 2, the costs have been calculated assuming combined rejects will be transported by truck rather than by a conveyor system. Additional costs for the conveyor system would be approximately:

- Option 2 (Location 1): $2,800,000 (ex GST)
- Option 2 (Location 2): $1,200,000 (ex GST)

Given the relatively low annual production and associated infrastructure costs, it is considered at this stage that conveying rejects will not prove to be financially viable.

5.2.1 Capital Expenditure Comparison

Table 3 presents the comparative capital cost estimate. The $/tonne saleable coal value was based on 48 Mt of coal to be produced over the life of the mine, as provided by CAC.

Table 3 Capital Cost Comparison

Cost Component	Option 1	Option 2-1 (Location 1)	Option 2-2 (Location 2)	Option 3
Preliminaries	$310,000	$400,000	$390,000	-
Earthworks	$950,000	$570,000	$320,000	$130,000
Infrastructure	$1,300,000	$1,960,000	$1,880,000	$3,420,000
Contingency (20%)	$512,000	$586,000	$518,000	$710,000
Total (ex GST)	**$3,072,000**	**$3,516,000**	**$3,108,000**	**$4,260,000**
Total ($/t saleable coal)	**$0.064/tonne**	**$0.073/tonne**	**$0.065/tonne**	**$0.089/tonne**

5.2.2 Operational Expenditure Comparison

The annual operational cost comparison has been based purely on the estimated labour required for each option. As previously stated, maintenance and power requirements have not been included. The $/tonne saleable coal values have been based on a processing rate of 1.8 Mtpa and 85% coal recovery.

Table 4 Operational Cost Comparison

Annual Opex	Option 1	Option 2-1 (Location 1)	Option 2-2 (Location 2)	Option 3
Total (ex GST)	$1,452,000	$1,716,000	$1,512,000	$1,716,000
Total ($/t saleable coal)	**$0.95/tonne**	**$1.12/tonne**	**$0.99/tonne**	**$1.12/tonne**

5.3 Weighted Ranking System

5.3.1 Ranking System

Table 5 presents the details and results of the ranking system used in the evaluation of the options to recommend the preferred option of the reject emplacement at Airly.

A total score out of 10 is given to each component included in this analysis, which is split between the options from 1 through 10 with the highest score going to the most favourable option based on the details provided in Table 5.

The total score of each option is calculated using a weighted average to include impact of each component component/sub-component as shown in Table 5.

Table 5 Ranking System of Reject Emplacement Options

Component	Weight	Option 1	Sub Option 2-1 (Location 1)	Sub-Option 2-2 (Location 2)	Option 3
Safety	**25%**	2	3.5	3.5	1
Environment	**25%**				
➢ Visual	3%	2	3	1	4
➢ Noise	3%	3	2	1	4
➢ Heritage	3%	2	2	3	3
➢ Ecology	5%	1	2	3	4
➢ Groundwater	2%	1	3.5	3.5	2
➢ Environmental contamination due to Seepage/runoff	9%	1	3.5	3.5	2
Operation	**16%**				
➢ Reject Transport	7%	3	2	4	1
➢ Constructability	4%	4	2.5	2.5	1
➢ Required Infrastructure	4%	4	2.5	2.5	1
➢ Maintenance	1%	3	3	3	1
Water Management	**9%**				
➢ Pumping Head and Simplicity	2%	3	2	4	1
➢ Water Sustainability	6%	2	3.5	3.5	1
➢ Maintenance	1%	3.5	2	3.5	1
Cost	**25%**	4	2	3	1
Estimated Score Using Weighted Average		**2.6**	**2.7**	**3.1**	**1.5**
Rank Assigned to The Option		**3**	**2**	**1**	**4**

6. Discussion and Recommendation

6.1 Option 1: Separate Disposal of Coarse & Fine Rejects

Of the three options analysed, this option was ranked second. It would likely be the most cost-effective method when considering both capital and operational expenditure; however it is the least favourable from an environmental perspective.

Safety concerns are also an issue with this option, particularly with regard to closure of the TSF. The closure position would likely include capping of the tailings to prevent future oxidation and potential for AMD; however the low shear strength of the tailings may prove unsafe for earth moving equipment used for capping and rehabilitation purposes.

6.2 Option 2: Co-Disposal of Reject Material

The analysis undertaken has shown this to be the preferred option. Of the two locations, Location 2 (closest to the CHPP) is favoured, primarily from a cost perspective.

This option is considered to be comparatively favourable from an environmental perspective, provided any potential for AMD is appropriately mitigated. The landform should prove relatively straightforward to rehabilitate.

Additional capital costs exist when compared to Option 1 due to the more comprehensive dewatering of the tailings (i.e. belt press filter). However, this will provide CAC with comparatively more water return for processing.

6.3 Option 3: Underground Pumped Co-Disposal

This option was found to be the least favourable of those analysed, primarily from a cost and safety perspective.

The most significant additional cost was found to be the supply of pipelines capable of transporting combined rejects at 70% solids, with a pumping distance of up to 5 km required given the extent of the proposed mine workings.

Due to the relatively flat dip of the coal seam (approximately 1:70), and the expected beaching profile of the slurry being 1 in 5, management of the combined rejects will be labour intensive as the disposal point will need to be mechanically moved within the underground workings. This will present safety issues due to the combination of confined spaces and potential changes to the geotechnical stability of the workings, as well as the introduction of water.

6.4 Recommendation

On the basis of the assessment made, it is recommended that Option 2 – co-disposal of the reject streams at Location 2 is pursued to the Preliminary Design phase.

7. Limitations

This report: 'Airly Mine Reject Management – Options Feasibility Analysis' *has been prepared by GHD for Centennial Airly Coal Pty Ltd* and *may only be used and relied on by Centennial Airly Coal Pty Ltd for the purpose of a Concept Level design for the proposed REA. Specifically, this report and associated drawings should not be used for construction purposes.*

GHD otherwise disclaims responsibility to any person other than Centennial Airly Coal Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

GHD has prepared this report including opinions, conclusions and recommendations based on conditions encountered and information provided by Centennial Airly Coal Pty Ltd, which GHD has not independently verified or checked beyond the agreed scope of work, including: topographic survey data, ecological survey and associated conclusions/recommendations, heritage survey and associated conclusions/recommendations and mine production data. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared, or due to errors in information provided.

GHD has prepared the high level (+/- 50%) cost estimate set out in section 5.2 of this report ("High Level Cost Comparison") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD as set out in the aforementioned section 5.2.

The Cost Estimate has been prepared for the purpose of a comparative indicative estimate of the three options analysed and must not be used for any other purpose, specifically for project budgeting purposes, without further analysis.

The Cost Estimate is a high level estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works *can or will be undertaken at a cost which is the same or less than the Cost Estimate.*

8. References

[1] Centennial Coal Airly - Reject Emplacement Area Concept Design Report, GHD Pty Ltd, June 2013.

[2] ‘Co-Disposal techniques that may mitigate risks associated with storage and management of potentially acid generating wastes’, M. Gowan, M. Lee, D Williams, Australian Centre for Geomechanics, 2010.

[3] ANCOLD Guidelines on Tailings Dams, Australian National Committee on Large Dams, May 2012.

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Appendices

Appendix A – Concept Design Drawings

CENTENNIAL COAL COMPANY LTD
AIRLY MINE
OPTIONS FEASIBILITY STUDY
32-1683100

DRAWING LIST

DRG No.	DRAWING TITLE
32-1683100-C001	COVER SHEET & DRAWING LIST
32-1683100-C002	OPTION 1 - ABOVE GROUND SEPARATE DISPOSAL - PLAN
32-1683100-C003	OPTION 2 - ABOVE GROUND CO-DISPOSAL - PLAN
32-1683100-C004	OPTION 3 - UNDER GROUND CO-DISPOSAL - PLAN
32-1683100-C005	OPTION 1 - ABOVE GROUND SEPARATE DISPOSAL - TYPICAL SECTION
32-1683100-C006	OPTION 2 - ABOVE GROUND CO-DISPOSAL - TYPICAL SECTION
32-1683100-C007	OPTION 3 - UNDER GROUND CO-DISPOSAL - TYPICAL SECTION

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR CLIENT COMMENT	DRB	DBL*	MDD*	30.09.13

Note: * indicates signatures on original issue of drawing or last revision of drawing

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Design Check
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Date
Scale NOT TO SCALE
This Drawing must not be used for Construction unless signed as Approved

Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**
Title **COVER SHEET & DRAWING LIST**

Original Size **A3** **Drawing No: 32-1683100-C001** **Rev: A**

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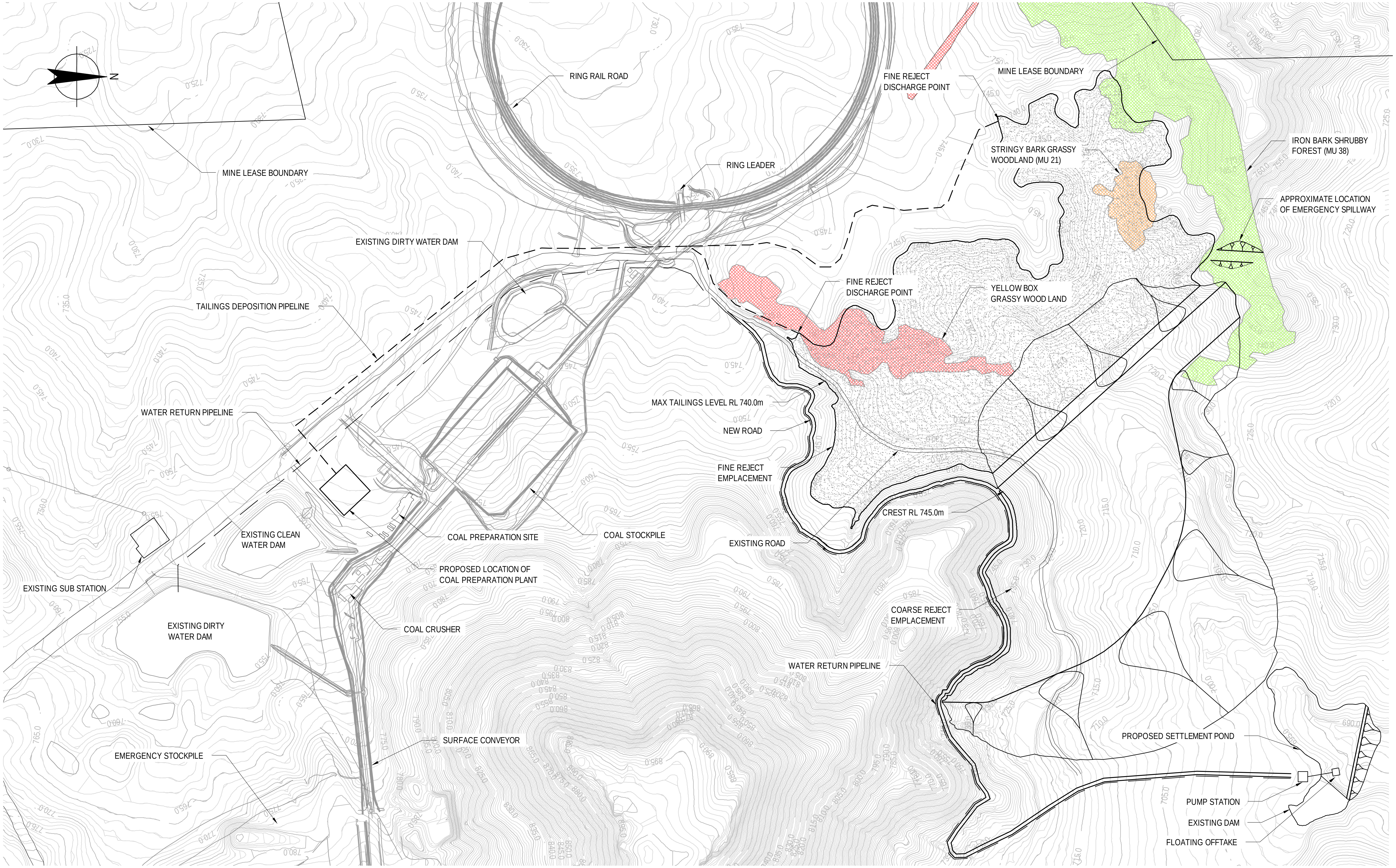

PRELIMINARY

A	ISSUED FOR CLIENT COMMENT	DRB	DBL*	MDD*	30.09.13
No	Revision Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

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SCALE 1:5000 AT ORIGINAL SIZE

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Approved (Project Director)			
Date			
Scale	1:5000	This Drawing must not be used for Construction unless signed as Approved	

Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**
Title **OPTION 1 - ABOVE GROUND SEPARATE DISPOSAL PLAN**

Original Size **A3** **Drawing No: 32-1683100-C002** **Rev: A**

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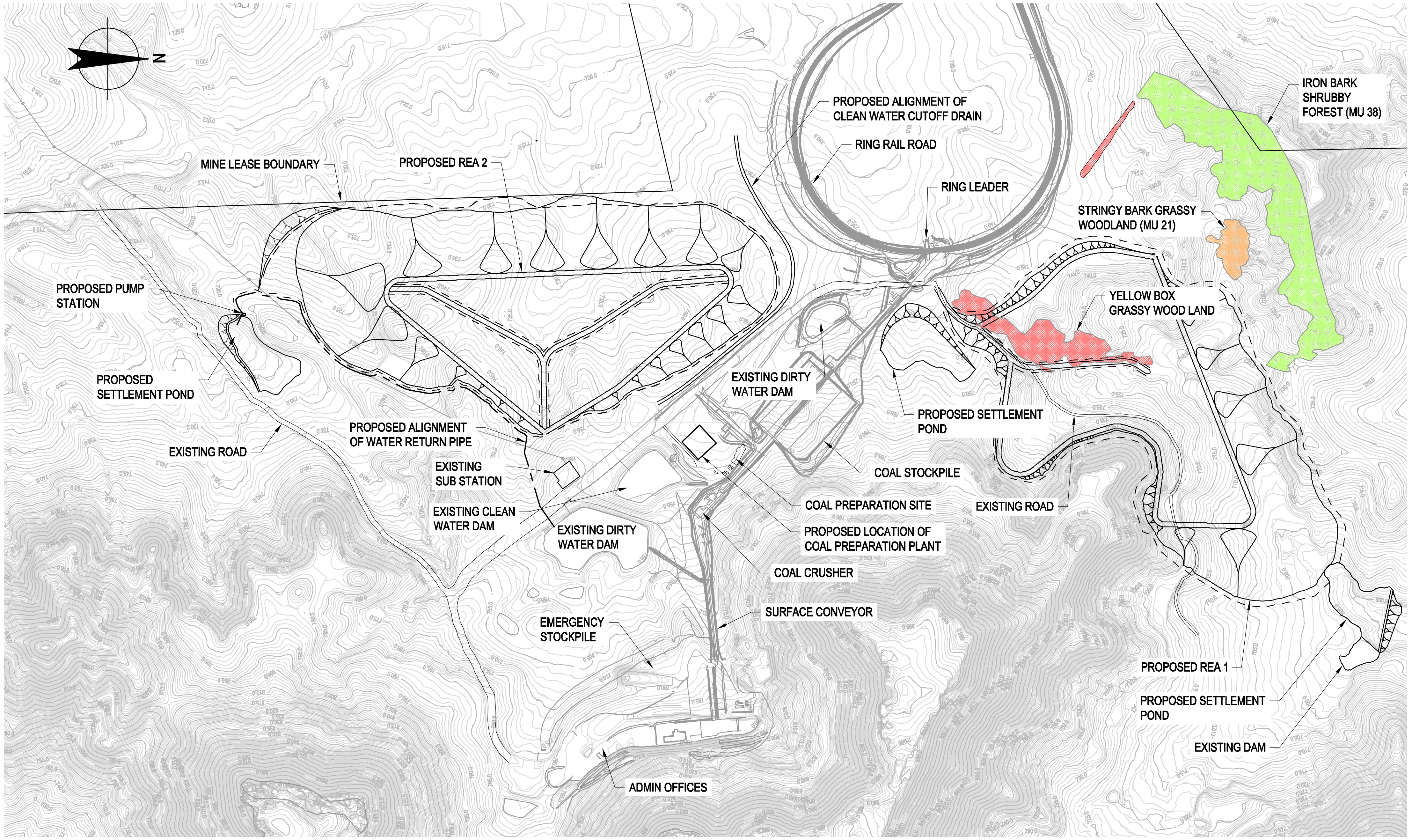

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
B	RE-ISSUED FOR CLIENT COMMENT	VGJ	MDD*	MDD*	17.04.14
A	ISSUED FOR CLIENT COMMENT	DRB	DBL*	MDD*	30.09.13

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Drafting Check	Design Check
Approved (Project Director) Date	
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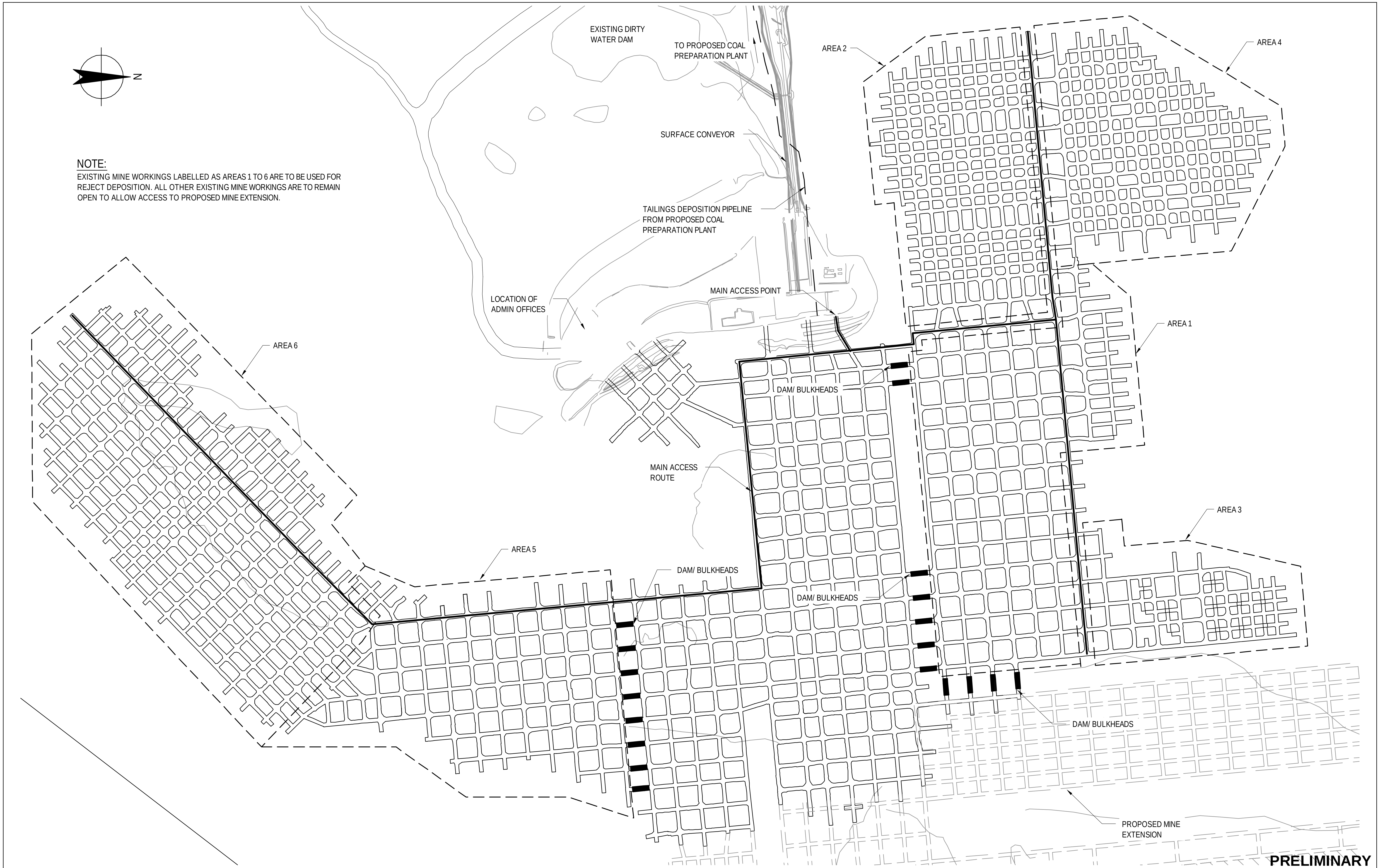
Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**
Title **OPTION 2 - ABOVE GROUND CO-DISPOSAL PLAN**

Original Size **A3** **Drawing No: 32-1683100-C003** **Rev: B**

Plot Date: 17 April 2014 - 12:22 PM Plotted By: Andrew Simmons Cad File No: G:\32\16831\CADD\Drawings\32-1683100-C003.dwg



NOTE:

EXISTING MINE WORKINGS LABELLED AS AREAS 1 TO 6 ARE TO BE USED FOR REJECT DEPOSITION. ALL OTHER EXISTING MINE WORKINGS ARE TO REMAIN OPEN TO ALLOW ACCESS TO PROPOSED MINE EXTENSION.

No	Revision	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR CLIENT COMMENT	DRB	DBL*	MDD*	30.09.13

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 50 100 150m

SCALE 1:5000 AT ORIGINAL SIZE

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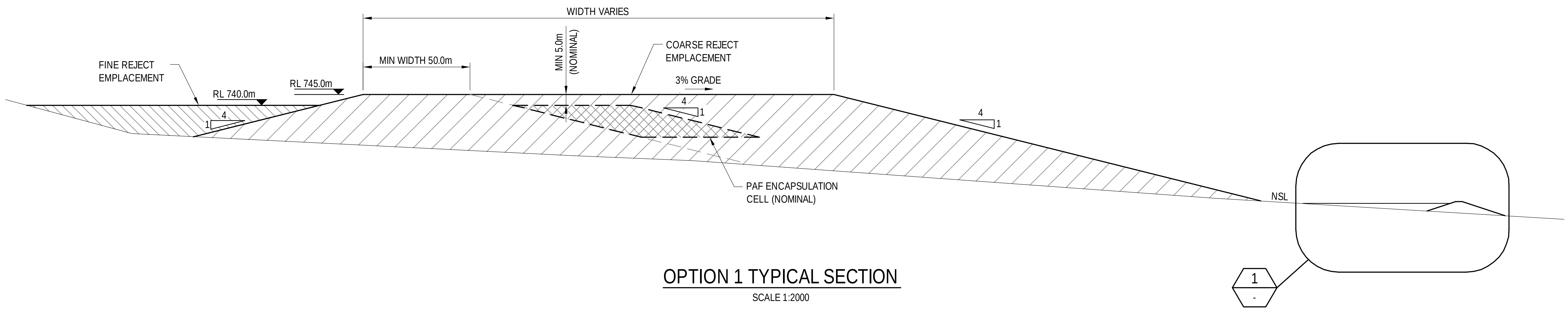
Client **CENTENNIAL COAL COMPANY LTD**

Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**

Title **OPTION 3 - UNDERGROUND CO-DISPOSAL PLAN**

Original Size **A3** **Drawing No: 32-1683100-C004** **Rev: A**

Plot Date: 30 September 2013 - 4:02 PM Plotted By: Lino Totaro Cad File No: G:\32\16831\CADD\Drawings\32-1683100-C004.dwg



OPTION 1 TYPICAL SECTION

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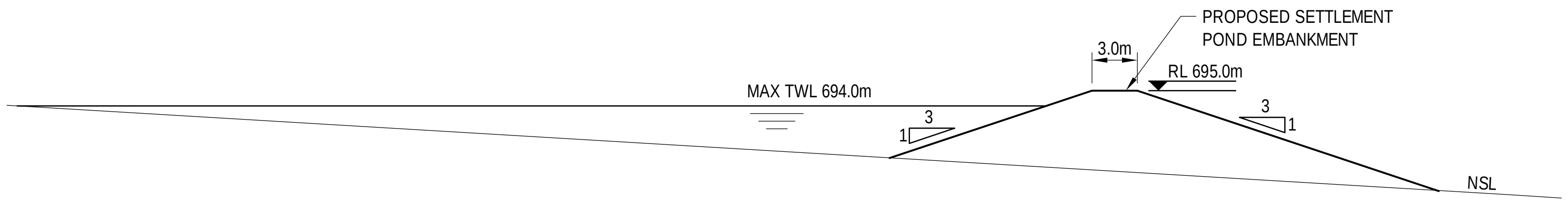

1 - DETAIL

SCALE 1 : 500

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
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0 20 40 60m SCALE 1:2000 AT ORIGINAL SIZE

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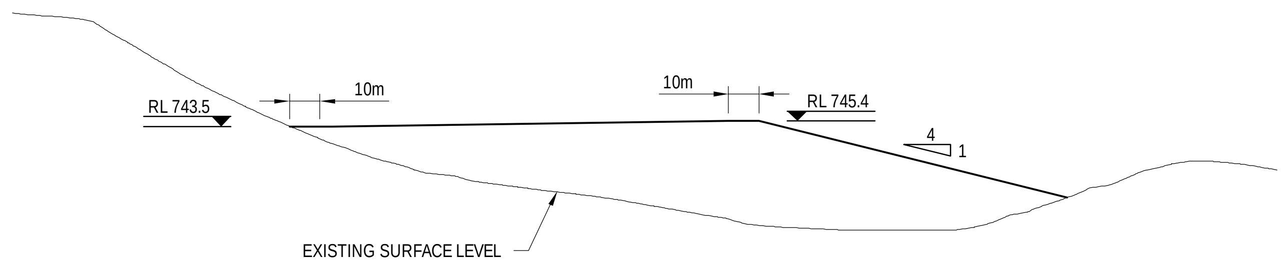
Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**
Title **OPTION 1 - ABOVE GROUND SEPARATE DISPOSAL TYPICAL SECTION**

Original Size A3 **Drawing No: 32-1683100-C005** **Rev: A**

Plot Date: 30 September 2013 - 4:02 PM Plotted By: Lino Totaro Cad File No: G:\32\16831\CADD\Drawings\32-1683100-C005.dwg



OPTION 2 - REA 1 TYPICAL SECTION

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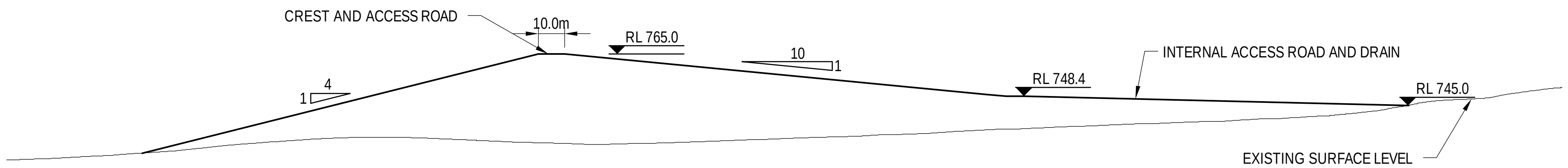

OPTION 2 - REA 2 TYPICAL SECTION

SCALE 1:2500

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
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SCALE 1:2500 AT ORIGINAL SIZE

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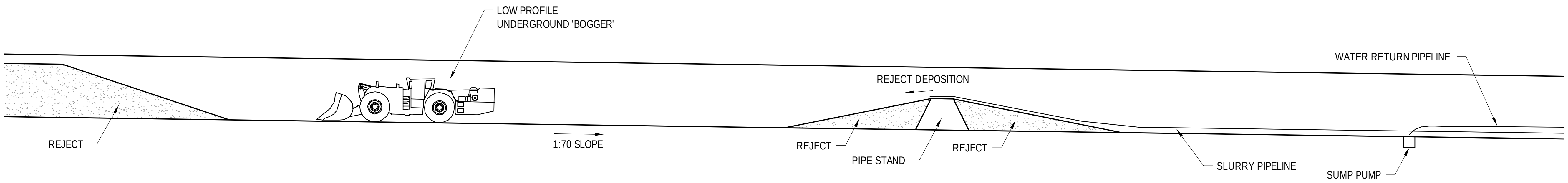
Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**
Title **OPTION 2 - ABOVE GROUND CO-DISPOSAL TYPICAL SECTIONS**

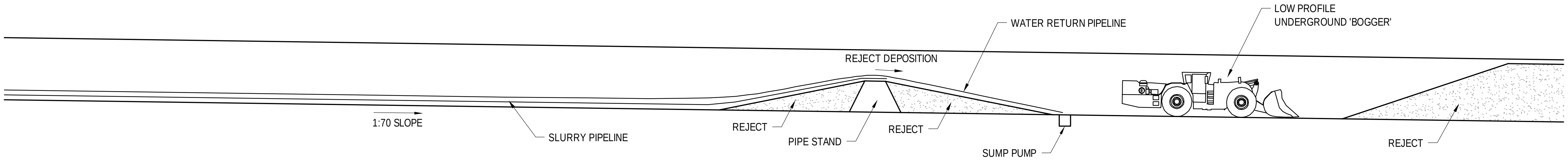
Original Size A3 **Drawing No: 32-1683100-C006** **Rev: A**

Plot Date: 30 September 2013 - 4:04 PM Plotted By: Lino Totaro Cad File No: G:\32\16831\CADD\Drawings\32-1683100-C006.dwg



UPSLOPE - TYPICAL SECTION

SCALE 1:200



DOWNSLOPE - TYPICAL SECTION

SCALE 1:200

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
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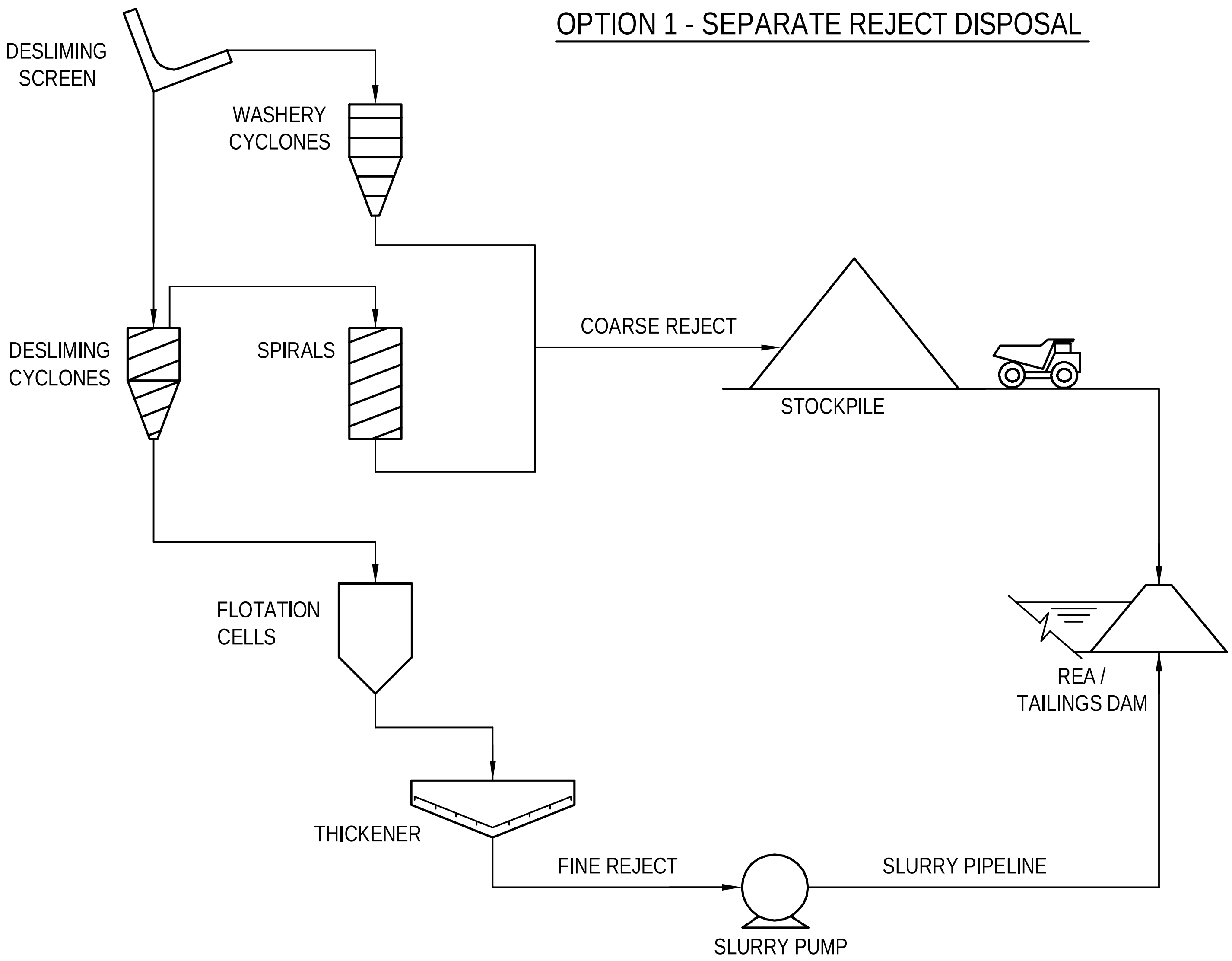
Approved (Project Director)			
Date			
Scale	1:200	This Drawing must not be used for Construction unless signed as Approved	

Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - OPTIONS FEASIBILITY STUDY**
Title **OPTION 3 - UNDERGROUND CO-DISPOSAL TYPICAL SECTIONS**

Original Size **A3** **Drawing No: 32-1683100-C007** **Rev: A**

Plot Date: 30 September 2013 - 4:04 PM Plotted By: Lino Totaro Cad File No: G:\32\16831\CADD\Drawings\32-1683100-C007.dwg

Appendix B – Reject Process Flow Diagrams



CENTENNIAL COAL COMPANY LIMITED
AIRLY MINE
REJECT MANAGEMENT 2013
OPTION 1
REJECT PROCESS FLOW

Job Number	32-1683100
Revision	A
Date	SEP 2103

Figure 010

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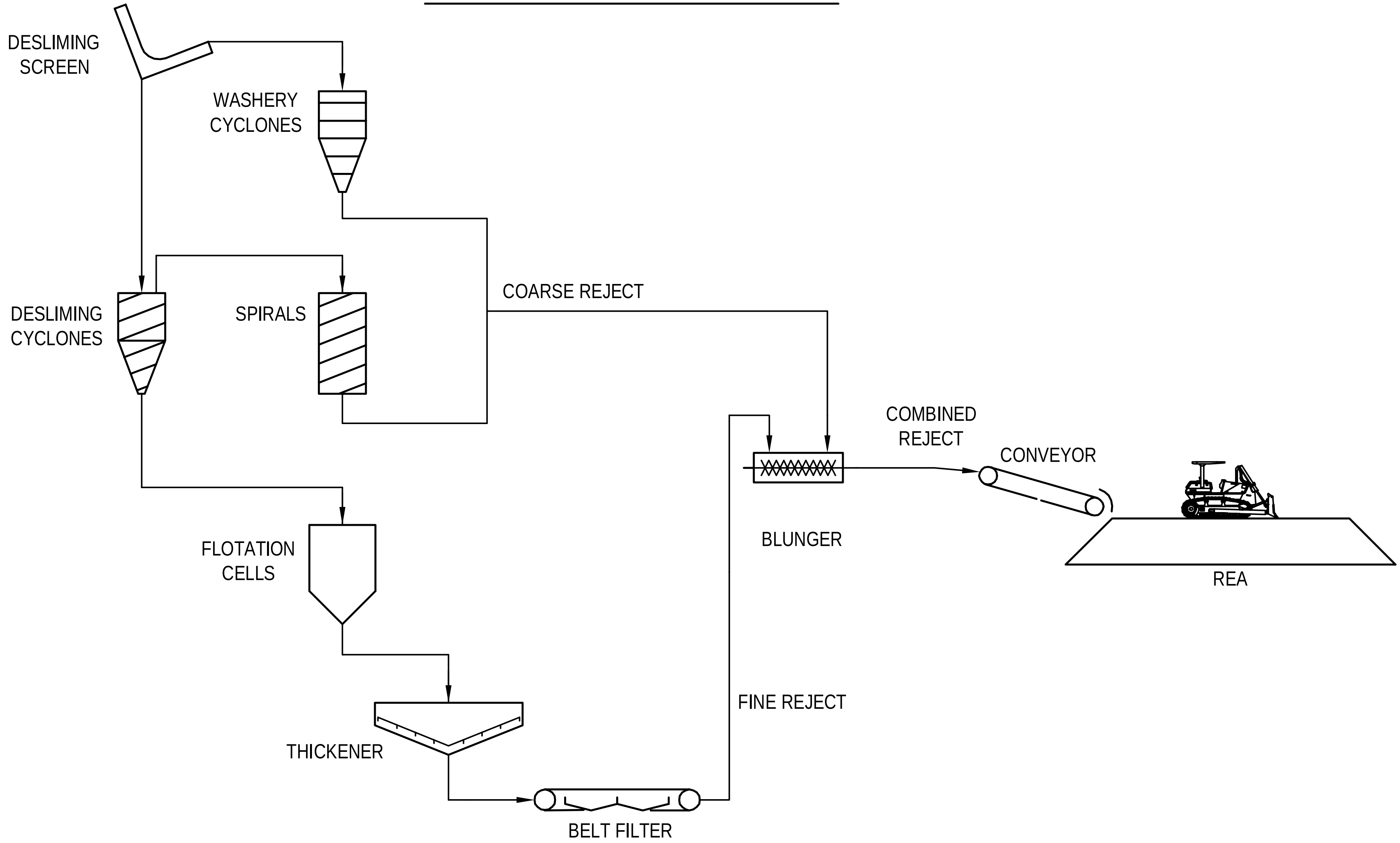
OPTION 2 - SURFACE CO-DISPOSAL



CENTENNIAL COAL COMPANY LIMITED
AIRLY MINE
REJECT MANAGEMENT 2013
OPTION 2
REJECT PROCESS FLOW

Job Number	32-1683100
Revision	A
Date	SEP 2013

Figure 011

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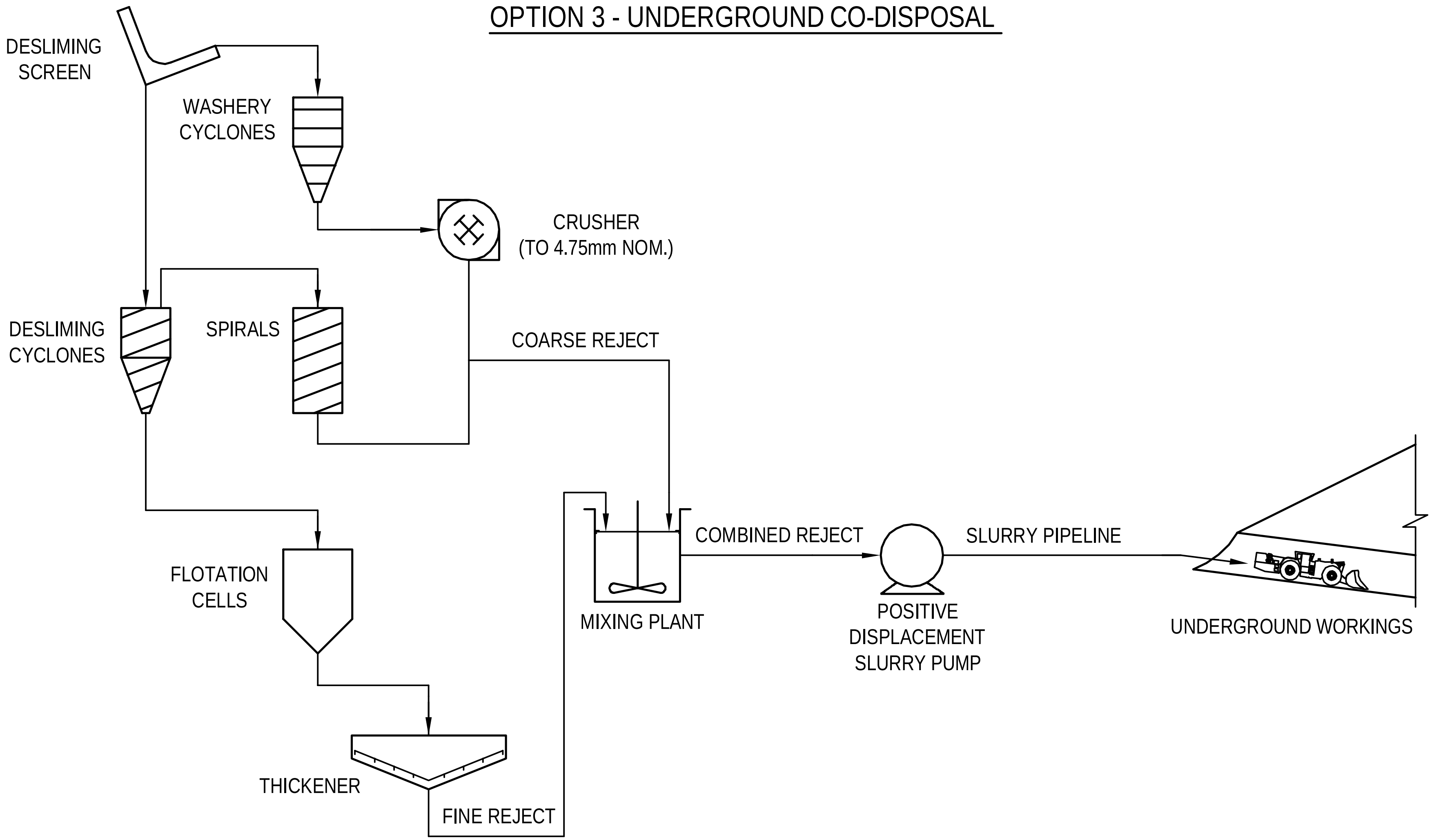
OPTION 3 - UNDERGROUND CO-DISPOSAL



CENTENNIAL COAL COMPANY LIMITED
AIRLY MINE
REJECT MANAGEMENT 2013
OPTION 3
REJECT PROCESS FLOW

Job Number	32-1683100
Revision	A
Date	SEP 2013

Figure 012

2 Salamanca Square Hobart TAS 7000 Australia **T** 61 3 6210 0600 **F** 61 3 6210 0601 **E** hbamail@ghd.com **W** www.ghd.com

Plot Date: 27 September 2013 - 2:54 PM Plotted by: Andrew Simmons Cad File No: G:\32\16831\CADD\Drawings\32-16831-FIG010_FIG012.dwg

Appendix C – Cost Estimates

OPTION 1 COST ESTIMATE

SUMMARY

ITEM NO.	DESCRIPTION		AMOUNT
1.0	SITE PREPARATION WORK / PRELIMINARIES		$310,000.00
2.0	EARTHWORKS		$950,000.00
3.0	INFRASTRUCTURE CAPEX		$1,300,000.00
	CONTINGENCY (20%)		$512,000.00
	TOTAL		$3,072,000.00
4.0	ANNUAL OPERATIONAL EXPENDITURE		$1,210,000.00
	CONTINGENCY (20%)		$242,000.00
	TOTAL		$1,452,000.00

1.0 SITE PREPARATION WORK / PRELIMINARIES

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
1.01	Clear and grub the coarse reject emplacement area footprint including temporary stockpiling, respreading and permanent stockpiling.	HA	22.5	$2,500.00	$56,250.00
1.02	Strip and clear 300 mm (nominal) of topsoil from coarse reject emplacement area footprint, including all root bearing materials and stockpile within the topsoil removal area	m^3	67,500	$3.00	$202,500.00
1.03	Provide offset/payment for significant ecological habitats to be inundated (NOMINAL)	Item	1	$50,000.00	$50,000.00
				Sub-Total	$308,750.00

2.0 EARTHWORKS

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
2.01	Win, cart, place and compact homogenous, locally won material for starter embankment	m^3	7,500	$10.00	$75,000.00
2.02	Win, cart, place and compact homogenous, locally won material for settlement ponds	m^3	18,800	$10.00	$188,000.00
2.03	Construct new access road (assume cut/fill balance - nominal rate)	m	1,700	$40.00	$68,000.00
2.04	Win, cart, place and compact clay material for PAF encapsulation (NOMINAL)	m^3	30,000	$15.00	$450,000.00
2.05	Construct dirty water drainage system	m	4,440	$15.00	$66,600.00
2.06	Construct clean water cutoff/diversion system	m	1,610	$25.00	$40,250.00
2.07	Cut emergency spillway & provide erosion protection for downstream channel (Nominal price - has not been designed)	Item	1	$60,000.00	$60,000.00
				Sub-Total	$947,850.00

3.0 INFRASTRUCTURE CAPEX

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
3.01	Supply and install tailings thickener	Item	1	$430,000.00	$430,000.00
3.02	Supply and install thickener underflow pumps - duty & standby (Warman 2/1.5)	Item	2	$16,200.00	$32,400.00
3.03	Supply and install tailings discharge pipeline	m	1,500	$80.00	$120,000.00
3.04	Transition equipment at discharge from spirals & cyclones onto coarse reject conveyor	Item	1	$24,800.00	$24,800.00
3.05	Supply and install coarse reject conveyor system	m	25	$3,500.00	$87,500.00
3.06	Transition equipment at discharge from spirals & cyclones onto coarse reject conveyor	Item	1	$24,800.00	$24,800.00
3.07	Supply & install water return pump & floating offtake	Item	2	$12,000.00	$24,000.00
3.08	Supply & install water return pipeline	m	2,400	$50.00	$120,000.00
	Supply & install floating decant system reporting to dirty water drainage system (Nominal)	Item	1	$150,000.00	$150,000.00
3.09	Cranage & mobile equipment	Hours	150	$750.00	$112,500.00
3.10	Electrical/Instumentation/Control (NOMINAL)	Item	1	$170,000.00	$170,000.00
				Sub-Total	$1,296,000.00

4.0 ANNUAL OPERATIONAL EXPENDITURE

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
4.01	30t ADT + operator for coarse reject emplacement (6 hrs/day)	Days	91	$3,600.00	$328,500.00
4.02	12t dozer + operator for coarse reject emplacement (8 hrs/day)	Days	122	$3,600.00	$438,000.00
4.03	8t smooth drum compactor + operator for coarse reject emplacement (8 hrs/day)	Days	122	$3,600.00	$438,000.00
				Sub-Total	$1,204,500.00

OPTION 2 (Location 1) COST ESTIMATE

SUMMARY

ITEM NO.	DESCRIPTION		AMOUNT
1.0	SITE PREPARATION WORK / PRELIMINARIES		$400,000.00
2.0	EARTHWORKS		$570,000.00
3.0	INFRASTRUCTURE CAPEX		$1,960,000.00
	CONTINGENCY (20%)		$586,000.00
	TOTAL		$3,516,000.00
4.0	ANNUAL OPERATIONAL EXPENDITURE		$1,430,000.00
	CONTINGENCY (20%)		$286,000.00
	TOTAL		$1,716,000.00

1.0 SITE PREPARATION WORK / PRELIMINARIES

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
1.01	Clear and grub the reject emplacement area footprint including temporary stockpiling, respreading and permanent stockpiling.	Ha	30.4	2,500.00	76,000.00
1.02	Strip and clear 300 mm (nominal) of topsoil from reject emplacement area footprint, including all root bearing materials and stockpile within the topsoil removal area	m^3	91,200	3.00	273,600.00
1.03	Provide offset/payment for significant ecological habitats to be inundated (NOMINAL)	Item	1	$50,000.00	$50,000.00
				Sub-Total	$399,600.00

2.0 EARTHWORKS

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
2.01	Win, cart, place and compact homogenous, locally won material for settlement ponds	m^3	39,000	10.00	390,000.00
2.02	Construct dirty water drainage system	m	4,440	15.00	66,600.00
2.03	Construct clean water cutoff/diversion system	m	1,610	25.00	40,250.00
2.04	Construct new access road (assume cut/fill balance - nominal rate)	m	1,700	40.00	68,000.00
				Sub-Total	$564,850.00

3.0 INFRASTRUCTURE CAPEX

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
3.01	Supply and install tailings thickener	Item	1	430,000.00	430,000.00
3.02	Supply and install thickener underflow pumps - duty & standby (Warman 2/1.5)	Item	2	15,700.00	31,400.00
3.03	Supply and install tailings discharge pipeline from thickener to belt filter press	m	100	50.00	5,000.00
3.04	Supply and install belt filter press for tailings dewatering, including ancillary infrastructure	Item	1	515,000.00	515,000.00
3.05	Supply and install blunger for mixing of tailings streams, including all ancillary infrastructure and steelwork	Item	1	220,000.00	220,000.00
3.06	Supply & install coarse reject conveyor system	m	20	3,500.00	70,000.00
3.07	Supply & install water return pump & floating offtake	Item	2	12,000.00	24,000.00
3.08	Supply & install water return pipeline	m	2,400	50.00	120,000.00
3.09	Cranage & mobile equipment	Hours	230	750.00	172,500.00
3.10	Electrical/Instumentation/Control (NOMINAL)	Item	1	370,000.00	370,000.00
				Sub-Total	$1,957,900.00

4.0 ANNUAL OPERATIONAL EXPENDITURE

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
4.01	30t ADT + operator for coarse reject emplacement (6 hrs/day)	Days	91	3,600.00	328,500.00
4.02	12t dozer + operator for reject emplacement (10 hrs/day)	Days	152	3,600.00	547,500.00
4.03	8t smooth drum compactor + operator for reject emplacement (10 hrs/day)	Days	152	3,600.00	547,500.00
				Sub-Total	$1,423,500.00

OPTION 2 (Location 2) COST ESTIMATE

SUMMARY

ITEM NO.	DESCRIPTION		AMOUNT
1.0	SITE PREPARATION WORK / PRELIMINARIES		$390,000.00
2.0	EARTHWORKS		$320,000.00
3.0	INFRASTRUCTURE CAPEX		$1,880,000.00
	CONTINGENCY (20%)		$518,000.00
	TOTAL		$3,108,000.00
4.0	ANNUAL OPERATIONAL EXPENDITURE		$1,260,000.00
	CONTINGENCY (20%)		$252,000.00
	TOTAL		$1,512,000.00

1.0 SITE PREPARATION WORK / PRELIMINARIES

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
1.01	Clear and grub the reject emplacement area footprint including temporary stockpiling, respreading and permanent stockpiling.	Ha	33.6	2,500.00	84,000.00
1.02	Strip and clear 300 mm (nominal) of topsoil from reject emplacement area footprint, including all root bearing materials and stockpile within the topsoil removal area	m^3	100,800	3.00	302,400.00
				Sub-Total	$386,400.00

2.0 EARTHWORKS

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
2.01	Win, cart, place and compact homogenous, locally won material for settlement ponds	m^3	21,500	10.00	215,000.00
2.02	Construct dirty water drainage system	m	4,150	15.00	62,250.00
2.03	Construct clean water cutoff/diversion system	m	1,700	25.00	42,500.00
				Sub-Total	$319,750.00

3.0 INFRASTRUCTURE CAPEX

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
3.01	Supply and install tailings thickener	Item	1	430,000.00	430,000.00
3.02	Supply and install thickener underflow pumps - duty & standby (Warman 2/1.5)	Item	2	15,700.00	31,400.00
3.03	Supply and install tailings discharge pipeline from thickener to belt filter press	m	100	50.00	5,000.00
3.04	Supply and install belt filter press for tailings dewatering, including ancillary infrastructure	Item	1	515,000.00	515,000.00
3.05	Supply and install blunger for mixing of tailings streams, including all ancillary infrastructure and steelwork	Item	1	220,000.00	220,000.00
3.06	Supply & install coarse reject conveyor system	m	20	3,500.00	70,000.00
3.07	Supply & install water return pump & floating offtake	Item	1	12,000.00	12,000.00
3.08	Supply & install water return pipeline	m	950	50.00	47,500.00
3.09	Cranage & mobile equipment	Hours	230	750.00	172,500.00
3.10	Electrical/Instumentation/Control (NOMINAL)	Item	1	370,000.00	370,000.00
				Sub-Total	$1,873,400.00

4.0 ANNUAL OPERATIONAL EXPENDITURE

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
4.01	30t ADT + operator for coarse reject emplacement (3 hrs/day)	Days	46	3,600.00	164,250.00
4.02	12t dozer + operator for reject emplacement (10 hrs/day)	Days	152	3,600.00	547,500.00
4.03	8t smooth drum compactor + operator for reject emplacement (10 hrs/day)	Days	152	3,600.00	547,500.00
				Sub-Total	$1,259,250.00

OPTION 3 COST ESTIMATE

SUMMARY

ITEM NO.	DESCRIPTION		AMOUNT
1.0	SITE PREPARATION WORK / PRELIMINARIES		$0.00
2.0	EARTHWORKS		$130,000.00
3.0	INFRASTRUCTURE CAPEX		$3,420,000.00
	CONTINGENCY (20%)		$710,000.00
	TOTAL		$4,260,000.00
4.0	ANNUAL OPERATIONAL EXPENDITURE		$1,430,000.00
	CONTINGENCY (20%)		$286,000.00
	TOTAL		$1,716,000.00

1.0 SITE PREPARATION WORK / PRELIMINARIES

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
				Sub-Total	

2.0 EARTHWORKS

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
2.01	Win, cart, place and compact material for construction of dams/bulkheads to segregate existing mine workings	m^3	6,200	20.00	124,000.00
				Sub-Total	$124,000.00

3.0 INFRASTRUCTURE CAPEX

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
3.01	Supply and install tailings thickener	Item	1	430,000.00	430,000.00
3.02	Supply and install thickener underflow pumps - duty & standby (Warman 2/1.5)	Item	2	15,700.00	31,400.00
3.03	Supply and install tailings discharge pipeline from thickener to mixing tank	m	50	50.00	2,500.00
3.04	Supply and install mixing tank including associated ancillary works	Item	1	215,000.00	215,000.00
3.05	Supply and install transition equipment at discharge from spirals/cyclones into new hammer mill	Item	1	24,800.00	24,800.00
3.06	Supply and install hammer mill	Item	1	170,000.00	170,000.00
3.07	Supply and install tailings discharge pipeline from hammer mill to mixing tank	m	25	50.00	1,250.00
3.08	Supply and install slurry discharge pumps - duty & standby	Item	4	15,700.00	62,800.00
3.09	Supply and install combined reject slurry pipeline	m	5,000	350.00	1,750,000.00
3.10	Supply and install water return sump pump	Item	1	12,000.00	12,000.00
3.11	Supply and install water return pipeline	m	3,500	50.00	175,000.00
3.12	Cranage & mobile equipment	Hours	230	750.00	172,500.00
3.13	Electrical/Instumentation/Control (NOMINAL)	Item	1	370,000.00	370,000.00
				Sub-Total	$3,417,250.00

4.0 ANNUAL OPERATIONAL EXPENDITURE

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
4.01	low profile underground dozer + operator for reject emplacement (24 hrs/day)	Days	365	3,600.00	1,314,000.00
4.02	Pipe relocation (ave. 2 hours/day)	Days	30	3,600.00	109,500.00
				Sub-Total	$1,423,500.00

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	N. H. Harandi / A Simmons	D Brett	On file	M Daley	On file	17/04/14

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