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Closure Costs
Department of Economic Development, Job, Transport and Resources (DEDJTR)
13-Nov-2015

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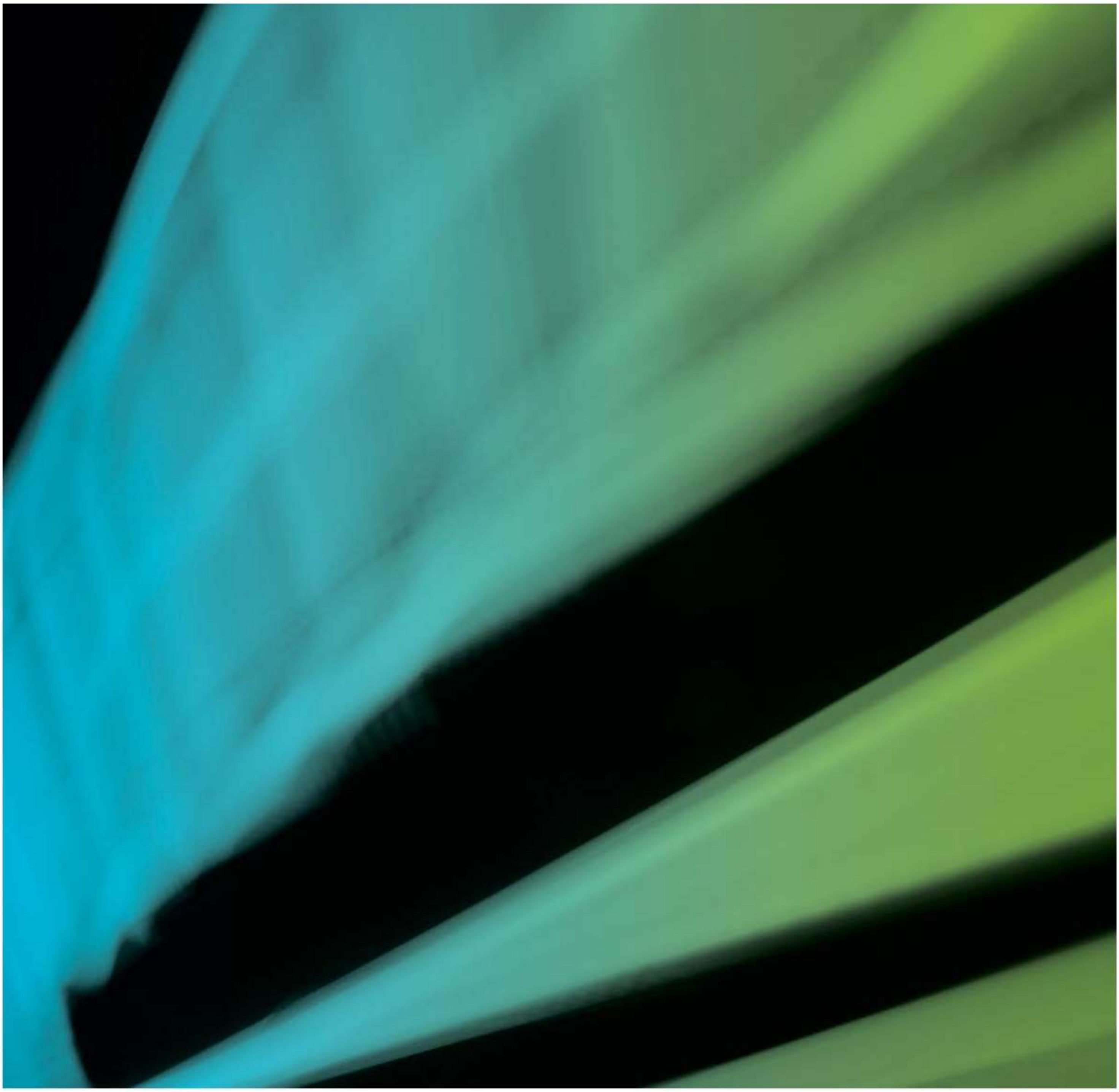
Estimation of Rehabilitation Costs

GDF Suez Hazelwood Mine



Estimation of Rehabilitation Costs

GDF Suez Hazelwood Mine

Client: Department of Economic Development, Job, Transport and Resources (DEDJTR)

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13-Nov-2015

Job No.: 43283845

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Quality Information

Document	Estimation of Rehabilitation Costs
Ref	43283845 j:\mel\43283845\5 wip\liability assessment\reporting\5. final - 12nov15\hazelwood\43283845_001hm_5.docx
Date	13-Nov-2015
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Reviewed by	Geoff Byrne

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
2	13 Nov 2015	Final	Bryan Chadwick Senior Principal	[signature]

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Abbreviations

Abbreviation	Description
AMD	Acid Mine Drainage
BPEM	Best Practice Environmental Management
BWE	Bulk Water Entitlement
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DPI	Department of Primary Industries
EOD	External Overburden Dump
ERR	Earth Resources Regulation
ET	Evapotranspiration
HM	GDF Suez Hazelwood Mine
Ha	Hectare
mAHD	Metres above Australian Height Datum
MRSDA	*Mineral Resources (Sustainable Development) Act 1990*
MT	Metric Tonnes
NPV	Net Present Value
PS	Power Station
RCB	Raw Coal Bunker
RL	Reduced Level
SECV	State Electricity Commission Victoria
URS	URS Australia Pty Ltd

1.0 Introduction

Earth Resources Regulation (**ERR**), from the Department of Economic Development, Jobs, Transport and Resources (**DEDJTR**), engaged URS Australia Pty Ltd (**URS**) in March 2015 to provide an estimate of the rehabilitation (closure) costs for the GDF Suez Hazelwood Mine (**HM**).

1.1 Aims and Objectives

The aim and objectives of the URS scope of works are:

- Provide an independent estimate of cost for closure based on the approved work plan and assumptions provided by ERR;
- Provide general advice to ERR to determine whether the existing Rehabilitation Bond lodged by the licence holder is appropriate to cover the cost of rehabilitation in accordance with the approved mine rehabilitation plan; and
- Support ERR in any negotiation for a change in the Rehabilitation Bond.

This report presents the results of the independent estimate of rehabilitation costs.

1.2 Exclusions

The work undertaken in generating closure costs does not include an assessment as to whether the closure strategy provided is viable or that it provides the best outcome to any of the various stakeholders.

The cost estimates generated herein use the information contained within the various documents provided and assumes the conclusions and assessments made are valid and will be achieved. Furthermore, the URS brief for this work was a desk top study of the rehabilitation costs and therefore did not include the following:

- Site inspections;
- Development of detailed closure data such as designs for final slopes, water quality modelling or closure criteria; and
- Collection of contractor quotations.

The estimate of costs has been largely based on URS experience and judgement, as well as rates included in the ERR rehabilitation bond calculator. In some instances individual cost estimates have been provided to URS by ERR for specific closure related activities. In addition URS compared a number of unit rates from that provided by the site's operators. The rates provided by the site operations generally fall within the range of rates that have been used for the URS cost modelling.

This estimate of closure costs is limited to areas within the current MIN and therefore excludes any power station or other operations or activities located outside the MIN.

It is also important to note that for the closure concepts costed URS has not considered the cumulative impacts or risks of the other Latrobe Valley coal mines closing at the same time and how this might impact concept and thus costs.

2.0 Methodology

2.1 Data Acquisition

2.1.1 ERR Briefings

ERR provided a briefing (20 April 2015) to URS to confirm the scope and outline the data sources that would be made available. The core URS team and representatives from the ERR group attended the meeting.

A subsequent meeting held with DEDJTR on 20 July 2015 further clarified assumptions to be used in the closure cost estimates and the scope of the deliverable.

URS also facilitated a workshop (15 May 2015) in order to allow the URS and ERR technical teams to reach agreement on the status of progressive rehabilitation which has occurred to date and what assumptions to use for the closure of HM.

2.1.2 Information Sources

The documents used in generating the rehabilitations costs were limited to the following:

- Coffey Natural Systems, International Power, Hazelwood, Work Plan Variation Mining Licence 5004, Phase 2 of the West Field Development of Hazelwood Mine, April 2009
- GDF Suez, Hazelwood Mine, Declared Mines Report, January 2014 – December 2014, March 2015
- Response to Annual Activity and Expenditure Return 2013_14 letter
- Mine Rehab. Bond calculator_na07_min5004_briefing.xls
- Plan Areas for various mine batters – email from HM dated 26 June 2015
- Rehabilitation plans provided (extracted 12 November 2015) on: http://www.energyandresources.vic.gov.au/earth-resources/information-for-community-and-landholders/mining-and-extractives/latrobe-valley-coal-mines/annual-rehabilitation-reporting

In addition, the following URS reports were reviewed as part of the data acquisition task:

- Mine and Power Station Closure under Contract for Closure, Implications and Costs (June 2012); and
- Water Resource Options for a Sustainable Coal Industry (August 2007)

The latest version of the ERR bond calculator[1], which was developed by ERR to address the need for a consistent methodology for estimating rehabilitation costs for the extractive, exploration and mining operations, was used as a key reference document.

In addition to the reports, URS was allowed access to ERR personnel in order to clarify key assumptions in relation to the proposed closure concepts.

LIDAR data was provided to URS, however as it only covered a small portion of the mine licence area it was not used in the estimates for areas, slopes, and void volumes. As a result URS generated its estimate of areas and volumes based on plans provided in the documents outlined above and then were able to compare and confirm these estimates with a specific data request sent to Hazelwood management in late October 2015.

2.2 Closure Cost Estimates

Cost estimates have been developed based on the 2009 WPV for two scenarios:

- End of Mine Life Closure – closure based on the predicted footprint for the approved mine plan with mining finishing in 2026.
- Early Closure – a "close tomorrow" scenario based on current mine footprint.

The cost estimates are based on the closure domains outlined in Table 1 which is generally consistent with the format of the ERR bond calculator. Where there are items, which are not considered in the bond calculator, a new domain has been developed: such as Domains 5, 6 and 7.

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[1] Last updated – 24 February 2014.
http://www.energyandresources.vic.gov.au/earth-resources/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/establishment-and-management-of-rehabilitation-bonds-for-the-mining-and-extractives-industries/bond-calculator

Table 1 Closure Domain Descriptions

Domain	Description	Inclusions/Exclusions
1	Infrastructure areas – includes the removal and demolition of conveyors, buildings, power lines	Includes: Mine Workshops, Administration buildings, Sediment dams, Fire reservoir, Conveyors, Fire services equipment and pipework, Access roads
2	Tailings and coarse rejects – includes capping, reshaping and landscaping of ash ponds	Hazelwood Ash Ponds (HAP1 and HAP4), Hazelwood Ash Retention Area (HARA), Hazelwood Ash Retention Embankment (HARE).
3	Overburden and waste dumps – includes overburden dumps	East Field Overburden Dump
4	Active Mines and Voids – includes the backfilling of mine voids, slope reshaping, fencing and landscaping	Includes: East Field Eastern Batters (EFEB), East Field Northern Batters (EFNB), West Field Overburden Dump (WFOD), South East Field Southern Dump (SEFSD), Main Field (MF), South East Field (SEF), Southwest Field Northern Batters (SWFNB), Southeast Field Western Batters (SEFWB), Southeast Field Southern Batters (SEFSB), West Field Southern Batters (WFSB), West Field Operating Batters (WFOB), Haul roads.
5	Execution management costs - including mobilisation and demobilisation	-
6	Fill pit with water - including all aspects of filling the pit with water	Includes: maintenance of extraction bores, water licence acquisition (if necessary) and annual fees
7	Post execution maintenance and monitoring – including all costs to conduct monitoring and maintenance post closure	-

3.0 Current Mine Status

The mine comprises the already mined South West, South East and East Fields and the currently active West Field within mining licence 5004 (MIN5004).

According to the current approved Work Plan Variation[2] (**WPV**), West Field will extend to the northwest and west as part of the West Field Phase 2 mining works.

Overburden currently being excavated from the West Field is proposed to be placed into an in-pit dump in the South East Field and East Field.

Within the East Field, there is the Hazelwood Ash Retention Area (**HARA**), which is an EPA licensed facility for ash derived from the Hazelwood Power Station. This is separated from the Main Field by an embankment known as the Hazelwood Ash Retention Embankment (**HARE**).

The mine is dewatered by a series of dewatering bores located in the West Field to reduce groundwater pressures and minimise the potential for floor heave. The mine has a groundwater licence to extract until 2025. Additional pumping bores will be progressively add to the network as mining continues to the west and northwest.

The Hazelwood Power Station, Hazelwood Cooling Pond and Hazelwood raw coal bunker are beyond the scope of the mine closure modelling and are not considered in this costing since they are all outside the MIN.

The MIN5004 expiry date is 13 September 2026.

3.1 Current Approved Rehabilitation Plan

The most recent reference to mine closure and rehabilitation made available to EER is contained in the 2009 WPV. This document also includes a 2008 report on the progressive rehabilitation program which mostly relates to rehabilitation of the Eastern Overburden Dump (**EOD**).

The 2009 WPV strategic rehabilitation and mine closure goal is:

Provide a technically feasible, safe, stable and sustainable landscape that reflects the aspirations of stakeholders within the practical constraints of rehabilitation for a mine.

This stated goal is linked to closure meeting the following objectives listed in the 2009 WPV:

- A safe and stable self-supporting structure
- To maximise the opportunities for establishment of a self-supporting ecosystem
- To minimise the use of natural resources
- To minimise the cost of recovery of resources

The mine closure concept described in the 2009 WPV[3] can be summarised as follows:

- Pit void will be actively filled with water to -22m AHD to achieve floor stability.
- Pit lake 'hydrological equilibrium' will be achieved at +8m AHD after 500 years of natural filling, where natural inflow equals evaporative and seepage losses
- Aquifer depressurisation will continue until pit water level reaches -22m AHD, at which point the pit floor will be stable and it is assumed groundwater extraction can cease.
- High Mg ash placed at eastern end of void in HARA and separated from the pit lake by the HARE
- Overburden batters are reshaped to max 3H:1V with safety berms at 20m vertical separation topsoiled and seeded
- Coal batters are reshaped to max 2.5H:1V (preferably 3H:1V) covered with overburden and revegetated
- Mining infrastructure is decommissioned and removed.
- No details are given on public access, but it is the documented intent to allow site access "if that is deemed required at the time"

[2] Work Plan Variation Mining Licence 5004. Phase 2 of the West Field Development of Hazelwood Mine. April 2009
[3] Section 6.4 Mine Closure Concept.

- Revegetation options are constrained by lack of topsoil, thus site management has developed site specific species planting guide[4]
- A commitment to plant and maintain at least 2,500 native trees and shrubs each year
- Seven screening mounds (up to 10m height) between the Fifth Morwell River Diversion and West Field will be landscaped, topsoiled and progressively rehabilitated.

The following rehabilitation issues are noted in the 2009 WPV:

- Mine stability – floor weight to counter balance aquifer pressure
- Pit lake 'hydrological equilibrium' – assumed to be achieved at +8m AHD, where natural inflow equals evaporative and seepage losses
- Batter stability – currently achieved by horizontal bores – options for treatment include leaving batters untreated; dozing down and overburden capping; constructing flatter batters with overburden over coal faces; placing overburden on coal benches against batters
- Infrastructure – operating infrastructure restricts opportunities for progressive rehabilitation
- Shortage of topsoil because disturbed areas are greater than the footprint from which topsoil is removed:
  - Resources that may need to be preserved – power station ash and western batters as access to Driffield coal fields
  - Public safety – need to address public safety and amenity issues of final batter slopes, fire, access to final void lake and water quality

There is no indication in the 2009 WPV as to the source(s) of water to allow the pit to fill with water to -22m AHD and then to +8m AHD (hydrological equilibrium). There is also no indication that an assessment on the feasibility and sustainability of partially flooding the pit has been undertaken. Critical questions on water source(s) and long term water quality mean there is uncertainty as to whether the 2009 WPV strategy is viable.

It is understood that site management is reviewing its closure strategy and is considering the use of the Hazelwood Cooling Pond and associated catchment as options to more rapidly fill the pit void. No details have been provided to URS on the results of this work.

[4] Appendix A of 2009 WPV: Code of Practice Revegetation Guide 2004

4.0 Closure Strategy

4.1 Background

The closure concept for HM (based on 2009 WPV) is to partially fill the pit void with water and create a pit lake. However, the strategy to achieve this is limited in relation to the following:

- Water source(s);
- Filling time;
- Final land use; and
- Final water quality (whether there is a need for treatment to achieve target beneficial use).

The 2012 WPV provides limited details to many aspects of site closure. In generating the closure cost estimates it was therefore necessary for URS to develop assumptions and a broad strategy around a number of items within various domains. These are outlined below in **Section 4.2**.

4.2 Closure Activities Used as Basis for Closure Cost Development

4.2.1 General Land Use

Final land uses are assumed to be:

- Restricted access (pit lake); and
- Grazing (remainder of lease).

4.2.2 Domain 1 – Infrastructure Areas

The basis for Domain 1 closure costing are as follows:

- All major mining infrastructure including buildings, conveyors and dredgers will be decommissioned, decontaminated and demolished for sale as scrap. No salvage has been incorporated into the costs to off-set some or all of this task.
- All mobile plant and equipment will be decommissioned and decontaminated.
- Concrete structures will be decommissioned, decontaminated and demolished to a maximum depth of 1 m below ground. Costs for this task incorporate demolition, crushing and/or placement in an on-site location.
- Allowance for clean-up of localised zones of soil contamination of 500 m^3. Cost includes excavation and transport to local off-site facility.
- All haul and access roads that will not be subject to lake inundation will be ripped and seeded, unless the road is deemed necessary for post closure land uses;
- Some access roads will be retained for the duration of the maintenance and monitoring phase, after which they will be ripped and seeded;
- Firefighting services will be decommissioned after attainment of target lake level or until approved by relevant authority;
- All exploration bores were appropriately decommissioned immediately post their installation.

4.2.3 Domain 2 – Ash Ponds

The Domain 2 facilities at HM are the HARA, HAP1 and HAP4. The closure costing basses for each is the same and as follows:

- Capping and closure in accordance with EPA Best Practice Environmental Management (BPEM) for landfills, including:
  - Evapotranspiration barrier;
  - Compacted inert fill cap of 0.75 to 1.0 m thickness;
  - Reshaping to slopes of >5%<20%;
  - Installation of growing medium and vegetation;
  - The final closed structure will require a Financial Assurance, which is outside the closure cost estimates.

4.2.4 Domain 3 – Overburden Dumps

Overburden is understood to be currently placed in-pit, with the former Eastern Overburden Dump (EOD) the only facility which will require rehabilitation works at closure. It is assumed all internally placed overburden will be utilised in covering exposed coal and/or left in-pit and submerged beneath the lake level.

The EOD closure concept is as follows:

- Minor reshaping and revegetation of the upper surface;
- Planting of overburden slopes with low maintenance, shallow rooted, native vegetation endemic to the region.

4.2.5 Domain 4 – Pit

The pit closure activities are as follows:

- Filling of the pit voids with water to -22m AHD within 28 years to produce a lake of acceptable water quality.
- Final overall pit slopes of 1:3 (V:H).
- The individual batter slopes to be re-shaped to approximately conform to the overall final slope.
- Progressive rehabilitation has been reported to have been achieved across the batters indicated in the Rehabilitation Report of (September 2015) and the following works are necessary for the remaining pit slope areas above final lake level:
  - Installation of a track rolled cover layer over pit slopes above target lake level (-22m AHD) comprising inert material with nominal 0.75 m (minimum 0.5 m) thickness to enable a water shedding and reduce fire risk.
  - Installation of 0.1 m thick topsoil or equivalent growing medium.
  - Planting of slopes (above -22mAHD) with low maintenance native vegetation endemic to the region.
  - Intermediate surface drainage works will be installed at 50 m vertical heights in the exposed final batters
- A 0.75 m thick rip rap zone will be installed in the final slope as a rim around the lake within a range of 2 m above and 2 m below target lake level to control wave erosion. Then, campaign (every 50 years) installation of additional rip rap zones between RL-22m and RL+8m due to assumed slow rise in lake level over the 500 year lake fill period.
- Installation of horizontal drainage bores to maintain long term slope stability
- Installation of an earth buttress to stabilise the East Field Northern Batter at closure for long term stability.

4.2.6 Domain 5 – Management

Domain 5 includes all the costs for the third party implementation of closure, such as:

- All necessary investigations, studies and detail design for closure
- Mobilisation and demobilisations of contractors
- Project management of all on-site works and contractors
- Necessary audits at closure

Costs for Domain 5 have been generated as follows:

- Mobilisation – 5% of total execution costs
- Engineering, procurement and construction management – 15% of total execution costs

4.2.7 Domain 6 – Pit Lake Filling

Integral to the closure of HM based on the 2009 WPV is the partial filling of the pit void with water to -22m AHD and allowing natural inundation to slowly fill over 500 years to +8 mAHD, thus achieving a 'hydrological equilibrium'.

The following, based on the 2009 WPV, have been used as the basis for the costs of filling the pit void with water:

- Water needs to fill to -22m AHD to achieve floor stability
- All water used to fill the pit void to -22m AHD will be from the Bulk Water Entitlement (BWE) of 15 GL/year and Groundwater Extraction Licence (GEL) of 12 GL/year, further:
  - There will be no cost to transfer the BWE and GEL for use in closure;
  - The annual fees for use of the BWE and GEL will be the same as currently paid;

- End of Mine (EoM) and Early Closure (EC1) time taken to fill the pit void to -22m AHD is estimated to be 28 years and 21 years respectively.

Closure is to fill the mine void with water to a level which achieves floor and batter stability. This effectively creates a lake for which the long term water balance will be dominated by incident rainfall and evaporation as well as any local inflows. For maintenance of water levels a balance of rainfall and inflows over evaporation is required.

No water balance study has been included in the HM's 2009 WPV. However, a water balance study undertaken at the neighbouring Yallourn Mine (TRUenergy, 2012) appears to have considered the differential between rainfall and evaporation on a long term annual basis and concluded there is a slight positive balance, or equivalence, in rainfall falling to the ground and evaporation.

URS has reviewed likely rainfall/evaporation for the filling and finally filled pit lake as well as local catchment inflows. Based on this analysis, URS considers that it is possible that there will be a water deficit in the filling phase and therefore costs have been included for supplementary water supply in the risk costs.

It should also be noted that for the purpose of the water accounting, it was assumed that there is no seepage or other groundwater loss from the void as it fills.

4.2.8 Domain 7 – Maintenance and Monitoring

Domain 7 includes all the costs associated with maintaining the necessary infrastructure during closure and the various monitoring such as the following:

- Maintenance. Cost to maintain the following for period of closure:
  - Rehabilitation areas, based on an assumed 15% vegetation fail over 5 years
  - Fire services until exposed coal is covered
  - Site security
  - Erosion repair
  - Council rates
  - Site services (buildings, power water etc)
- Monitoring. The scope of monitoring includes: surface water (flow and quality), groundwater (level & quality), geotechnical stability, ecological (including rehabilitation) fire, dust, and odour.
- Management. To cover the costs for managing and procuring the contracts a sum has been generated based on 3% of total maintenance and monitoring cost.

4.3 Timing of Closure

A costing has been generated for two closure timeframes:

- End of mine life – within the model this is referred to as EoM
- Early closure (closure based on current footprint) – within the model this is referred to as EC1 (refer to **Figure 1**)

The main difference between the current and end of mine closure costings is the mine's footprint and the effect of discounting.

Figure 1 Costed Early Closure Schedule

Major Earth works and demolition	Maintenance & Monitoring		
	Active Lake Filling (RL-22m)	Slow Fill to Equilbrium (RL+8m)	
2015	2018	2036	2516

4.3.1 Execution Phase

The closure execution phase is assumed to run for 3 years and commences in the year after production shutdown. It comprises the period of intense closure activity, including rehabilitation, slope shaping, slope soil cover, decommissioning, decontamination and demolition of infrastructure and general site clean-up.

4.3.2 Void Filling Phase

The void filling phase is the period over which the mine pit will fill with water based on the assumed water balance:

- EoM – an active void filling phase of 28 years
- EC1 – an active void filling phase of 21 years

Both options allow for the subsequent 500 year natural filling phase.

4.3.3 Post Execution Maintenance and Monitoring Phase

This phase begins after the closure execution phase (Year 4), with the activities during this phase comprising the following:

- Ongoing water level, surface water quality, groundwater quality, ecological, slope stability, fire risk and rehabilitation monitoring;
- Ongoing maintenance including erosion repair, replacement of failed rehabilitation areas, sediment dam and fire reservoirs maintenance, security, Council rates and upkeep of monitoring/maintenance infrastructure and equipment.

Maintenance and monitoring costs have been developed for two phases, a more intensive and higher cost period for 5 years following closure execution, and a less intensive phase extending for the remainder of the 500 year period until lake equilibrium is achieved.

4.4 Summary of Assumptions

In preparing this costing for closure of the Hazelwood Mine the following has been assumed:

- End of mine life of 2026, based on no extension to the current mining licence expiry date;
- A portion of the batters have been reshaped and rehabilitated;
- 15% of the planned vegetation will fail within the first 5 years of the maintenance and monitoring phase;
- Final pit slopes of 1V:3H will have long-term geotechnical and erosional stability;
- No major cut-backs of slopes are required;
- Final pit water is of an acceptable water quality;
- The East Field Northern Batters buttress will require approximately 2.5 million m^3 of in situ material to be sourced;
- There is no groundwater contamination present which would present a human/ecological risk;
- No seepage or groundwater loss from the voids on filling;
- Current power station bulk water entitlements can be used for void filling;
- Current groundwater pumping water can be used for void filling
- Monitoring will confirm compliance with the closure criteria and performance assumptions.

4.5 Exclusions

The following items have been excluded from the closure cost estimates:

- Community costs associated with managing the closure transition
- Asset recovery amounts from sale of scrap, recoverable metals, oils etc
- Reimbursement/sale of water allocation rights.

4.6 Key Risks

If the assumptions indicated above are not correct then they represent risks within the closure costing and have been incorporated into our closure costing as risk events, with estimates of degrees of likelihood of occurrence and consequence.

In addition, the following key risks have been identified for each closure concept:

- Seepage of acid mine drainage (AMD):
  - The risk event is that AMD and/or other contaminants, primarily from EOD, impact on surface water and groundwater to the extent that clean-up and treatment is required.
  - The consequences were estimated as the capital costs for interception wells and a treatment plant plus ongoing operational costs for 20 years
  - The likelihood was judged on the basis that there is a possibility groundwater treatment will be required
- Batter failure in an area where infrastructure is affected;
  - The risk event is that a slope failure occurs on a batter where there is major public/private infrastructure that requires stabilisation.
  - The consequence includes estimates of costs for both long term slope stabilisation, rehabilitation and compensation
  - The likelihood was based on whether there had been any historic events and other information provided on geotechnical stability of the batters
- Batter failure in an area where no infrastructure is affected;
  - The risk event is that a slope failure occurs on a batter where there is no major public/private infrastructure.
  - The consequence is stabilisation of batter for long term and rehabilitation of slope.
  - The likelihood was based on whether there had been any historic events and other information provided on geotechnical stability of the batters
- Coal fire;
  - The risk event is that a coal fire occurs during the closure period that requires management and land requires subsequent rehabilitation.
  - The consequence is both the management of the fire when it occurs and rehabilitation post the event.
  - The likelihood was judged on the basis that there is a possibility an in-pit or bush fire within the MIN will occur prior to closure being completed
- Pit water quality is unsuitable;
  - The risk event is specifically if the water quality of pit lake does not meet standard for its target beneficial use.
  - The consequence is that lake water requires treatment.
  - The likelihood was based on the chance that the non-spilling lake may generate unacceptable water quality impacts overtime
- Inability to secure existing water licences;
  - The risk event is that the existing BWE and GEL are not able to be used in filling the pit void.
  - The consequence is that all water sources need to be purchased on the open market at commercial rates.
  - There is a chance that the existing licences will not be able to be transferred as mine closure was not explicitly included as the intended use

- Requirement for water sources to maintain lake level:
  - The risk event is that the 2009 WPV water balance conclusion is inaccurate and there are significant periods post shutdown where there is a net water deficit there is significant periods post closure where there is a net water deficit.
  - The consequence is that other water sources to maintain the lake level need to be purchased on the open market at commercial rates.
  - There is a chance that overall water balance for the pit lake is in the deficit and additional water is required in perpetuity.

It is considered that most of the risks for the early and end of mine life closure scenarios are similar in terms of likelihood and consequence.

Each closure concept has been costed and the predicted risk cost has been listed in addition to the cost estimates for proposed closure activities.

5.0 Cost Estimates for Closure

5.1 Methodology

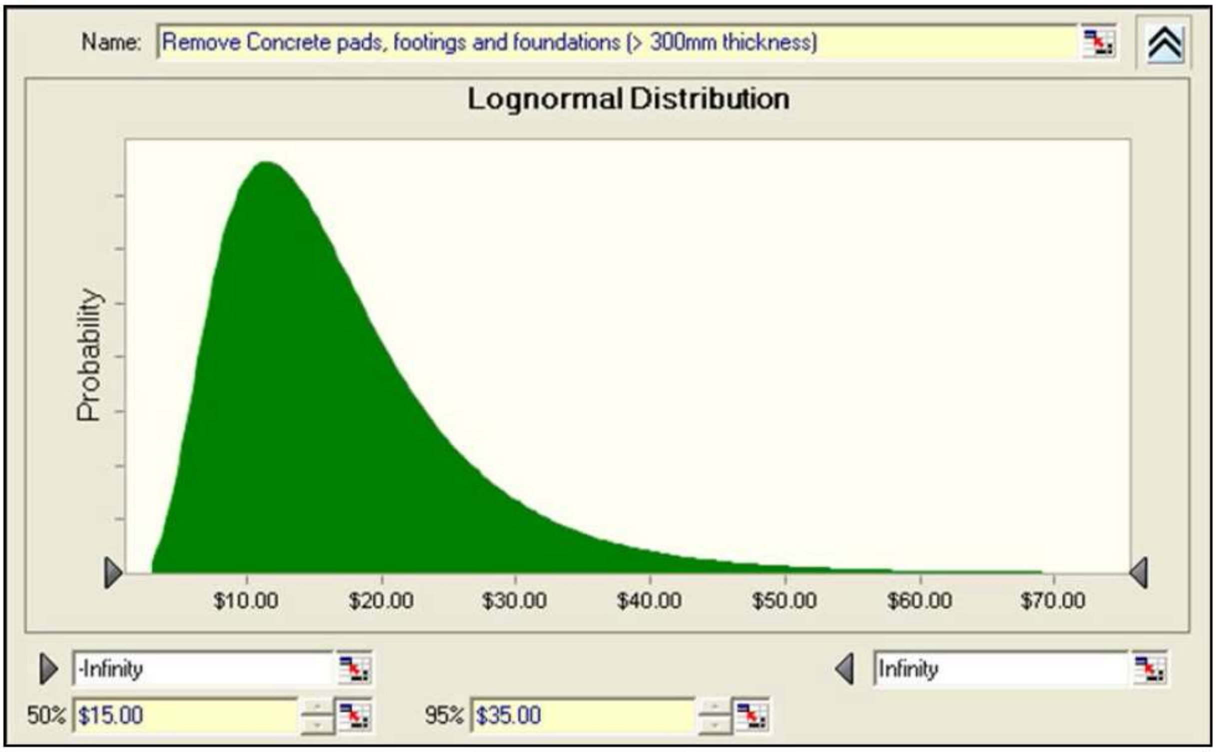
A probabilistic costing model was developed in Excel using URS' previous experience of mine closure costings and the information from the documents provided by ERR. The costing model built upon the costing work, which was conducted in 2012 for the former Department of Primary Industries (DPI). The costing model incorporated Monte Carlo simulation, which is a statistical technique that uses random numbers to account for uncertainty in a mathematical model. URS uses the spread sheet add-in, Crystal Ball™, to run the Monte Carlo simulation.

The basis of Monte Carlo simulation is that it recognises variables (in this case the cost of individual mine closure items) as probability distributions rather than single numbers. The probability distribution chosen for cost estimates is lognormal as this assumes the following conditions in relation to costs and other variables such as length, area and volume:

- Costs are strongly skewed towards high values;
- Variable (cost) can increase without bound but is confined to a finite value at the lower limit i.e. the costs cannot be less than $0; and
- The distribution can be defined by two cost estimates (the P50, or 50% confidence level estimate and a P95, or 95% confidence level estimate) provided by a relevant specialist; the P50 estimate is a best estimate (50% chance that the given cost would not be exceeded) and the P95 is a very conservative estimate (95% chance that the indicated cost would not be exceeded, or conversely, a 5% chance that the cost would be exceeded).

Figure 2 shows an example cost distribution where the specialist judged that a best estimate of the cost to remove relatively thick concrete pads etc. would be \$15/m^2, and a very high estimate that would have around a 5% chance of being exceeded would be \$35/m^2. The relatively large difference between the P50 and P95 shows that the specialist considered that there is a high degree of uncertainty in the potential cost outcome. The spread of potential costs across the chart also shows that although there is no theoretical upper limit to the cost, the specialist also considered that a practical upper limit to the cost could be \$60 to \$70/m^2.

Figure 2 Example Probability Distribution for Infrastructure Cost Item



For each closure concept and for both of the closure scenarios (close tomorrow and end of mine life) expert judgement was used to derive cost estimates at a 50% probability (best estimate) and 95% probability (very conservative, high estimate), for each cost component. The decisions were informed by discussions with ERR technical staff. The inputs for each of the mine closure concepts are provided in Appendix C.

The Monte Carlo simulation was run at least 2,000 times and a curve of total project costs was obtained for each closure option.

The time value of money was factored into the model using net present value (NPV) calculations. NPV is the net present value of an investment over a period of time, calculated using a discount rate and a series of future payments and incomes. The discount rate adopted is a real NPV discount rate of 3% as instructed by ERR.

5.2 Model Results

5.2.1 Overall Costs

The results of the Monte Carlo simulation for total project costs for early closure concept at a range of confidence levels are provided in **Figure 3**. A summary of the 50%, 80% and 95% Confidence Level outputs for both early and end of mine life closure concept is provided in **Table 2**.

Figure 3 Early Closure Liability and Risk Costs

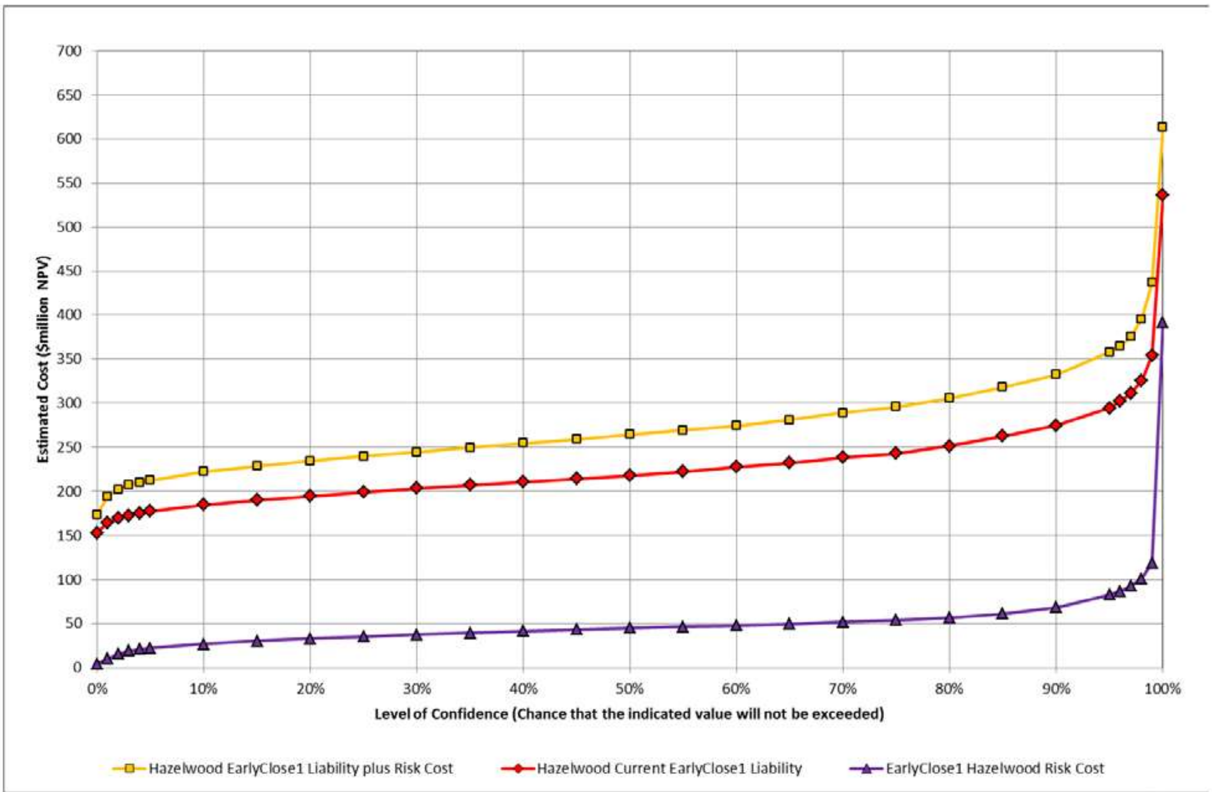


Table 2 Summary of Closure Costs

CONFIDENCE LEVEL	P50 OPTIMISTIC	P80 CONSERVATIVE BUT REALISTIC	P95 VERY CONSERVATIVE
Early Closure Liability Cost	218	251	294
Early Closure Liability Plus Risk Costs	264	305	357
End of Mine Life Liability Costs	176	204	241
End of Mine Life Liability Plus Risk Costs	243	286	332

It should be noted that the end of mine life cost estimates are significantly lower due to the fact that all estimates are discounted costs. That is the cost is based on expenditure in the future at a present value discounted by 3%[5].

In 80% of the 2,000 trials for early closure concept (closure tomorrow) the estimated cost (liability only) was less than $251 million. That can be interpreted as there being an 80% chance that the rapidly filling closure cost will be less than $251 million. Alternatively, the same result shows that according to the simulated results, there is a 20% chance that the cost will be more than $251 million.

This way of interpreting the results makes it possible for decision-makers to link any of the estimated cost outcomes with its associated confidence level, and to select cost estimates that reflect their level of conservatism. For example, a decision-maker might feel that a 20% chance that an allocated cost would be exceeded is too high, and that a 5% chance would be more appropriate. In that case, the decision-maker would select the 95% confidence level estimate, which for the early closure (current footprint – with risk costs) is $357 million. On the other hand, a much less risk-averse decision-maker might select the cost ($264 million) that has a 50-50 chance of being exceeded.

In essence, the simulation results allow ERR (and any other stakeholder) to assess the full range of potential cost outcomes and to choose allocated costs at the confidence level that most suits their position.

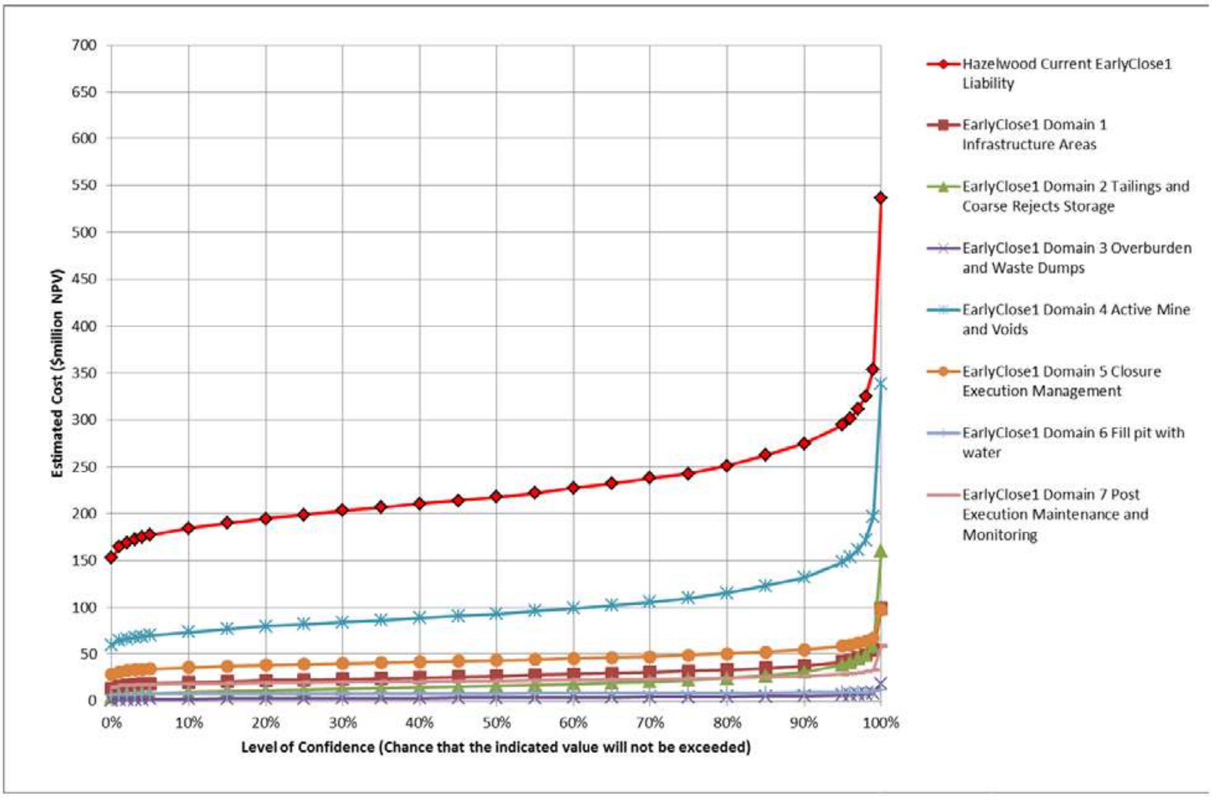
The wide range of cost estimates for each option is indicative of the degree of uncertainty inherent in the risk model. This is a function of the lack of precise data available to URS which meant that the inputs at a probability of 50% and 95% were often wide ranging.

5.2.2 Early Closure Contributor Costs

Domains

The liability costs (excluding risk cost) for each early closure scenario domain is presented in **Figure 4**.

Figure 4 Domain Liability Costs - Early Closure



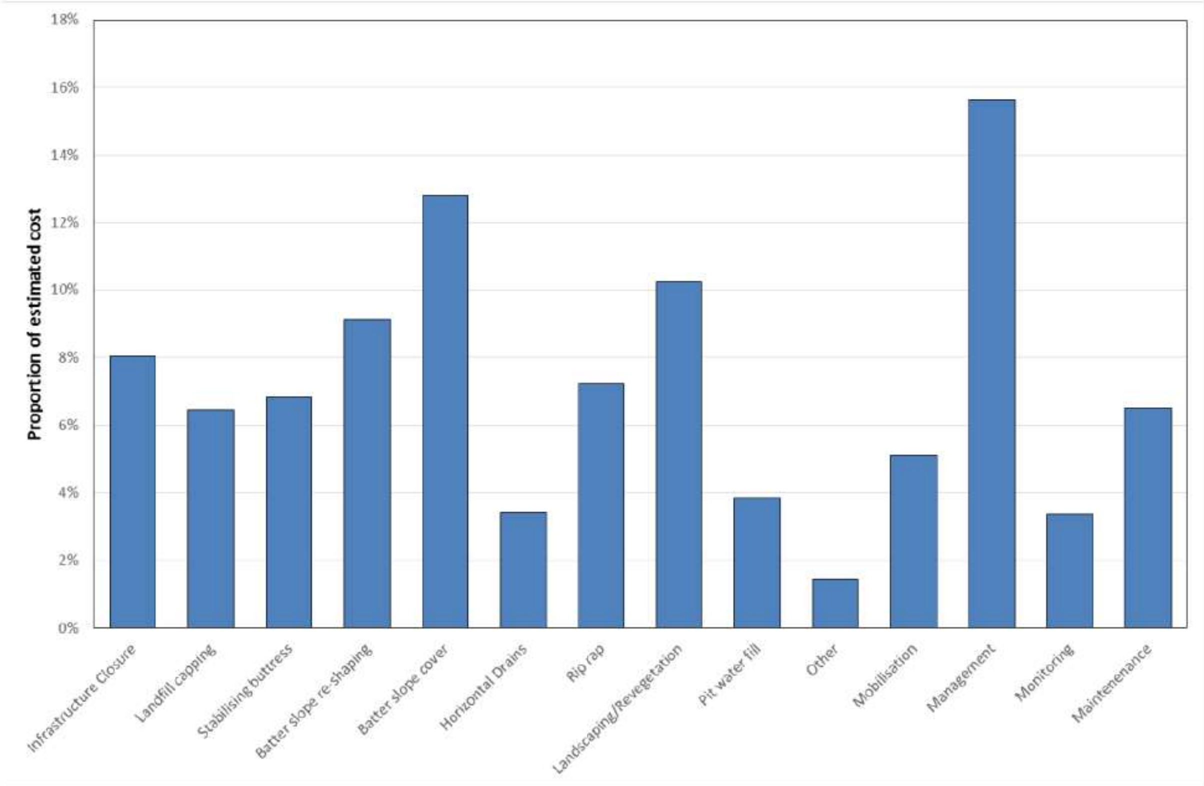
Key Contributors to Costs

The key contributor items to the overall liability cost for early closure at HM are summarised in

Figure 5. This shows that the major contributors to the overall discounted closure cost are for the batter slope cover and closure management. Other major cost activities include landscaping/revegetation, reshaping of batter slopes, installation of rip rap, the stabilising buttress, HARA capping and infrastructure decommissioning/decontamination/demolition.

[5] Based on published wage discount rate: http://www.dtf.vic.gov.au/Publications/Government-Financial-Management-publications/Financial-reporting-policy/Wage-inflation-and-discount-rates

Figure 5 Key Contributors to Early Closure Liability Costs (P50)



5.2.3 Early Closure Uncertainty

Sensitivity analysis of probabilistic models is calculated as part of the Crystal Ball Monte Carlo simulation process where the outputs show which assumptions most affect the uncertainty in the result for a given forecast (in this case the estimated early closure liability).

Figure 6 shows the proportion that each of the identified assumptions contributes to the total variance of the given forecast result.

In order to have an impact on the forecast result the assumption usually has to have an impact on both the quantum of the result and the spread (uncertainty) of the result. This analysis only considers the uncertainty (not magnitude) caused by assumptions. For example, an assumption that has a big impact on the quantum of the answer, but is very well known (input as a single value, or close to that) would not feature in this sensitivity analysis.

The sensitivity analysis identifies which assumptions in the model would reduce the overall uncertainty of the result, if the issue (represented by the assumption) was better understood by further investigation.

Figure 6 Key Contributors to the Variance - Early Closure

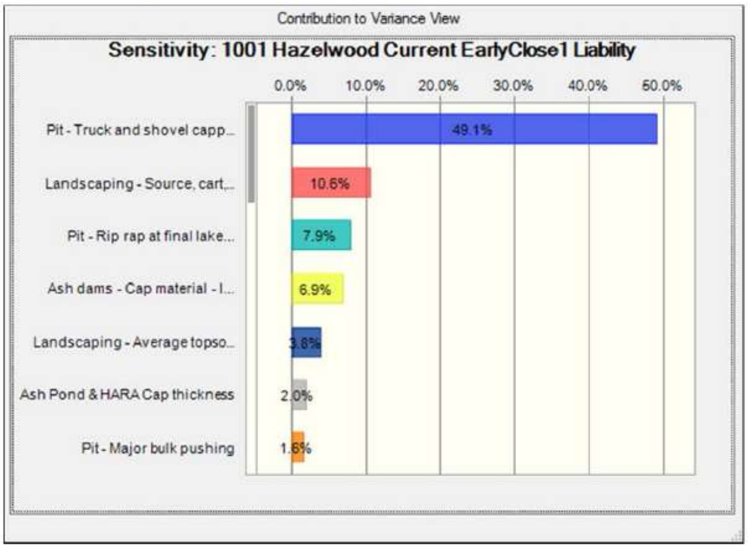


Figure 6 shows that the rate for truck and shovel capping of the pit batters and floor is highly uncertain (P50=$10 and P95=$30) and has a very large influence (responsible for 49% of the variance) on the total uncertainty of the estimated early closure liability.

In summary, the key contributors to the variance associated with early closure liability are the following.

- Active Mining Pit or other Voids (including the voids and any internal benches or mine strips):
  - Load, haul and place soil cover on batter slopes.
- Landscaping, minor earthworks and revegetation throughout domain area:
  - Source, cart, spread and lightly rip topsoil (>5km).
  - Average topsoil thickness
- Rip rap material at lake level:
  - Source, cart, and place
- Ash Dams:
  - Cap material, load, haul place.

6.0 References

Coffey Natural Systems, International Power, Hazelwood, Work Plan Variation Mining Licence 5004, Phase 2 of the West Field Development of Hazelwood Mine, April 2009

GDF Suez, Hazelwood Mine, Declared Mines Report, January 2014 – December 2014, March 2015

GDF Suez, Hazelwood Mine, Response to Annual Activity and Expenditure Return 2013_14 letter

http://www.dpi.vic.gov.au/earth-resources/minerals/environmental-guidelines/bond-calculator

Mine Rehab. Bond calculator_na07_min5004_briefing.xls

Rawlinsons, Australian Construction Handbook 2015 Edition 33.

URS, Mine and Power Station Closure under Contract for Closure, Implications and Costs, 27 June 2012;

URS, Water Resource Options for a Sustainable Coal Industry, August 2007

7.0 Limitations

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Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Appendix A

Mine Plan

Appendix A Mine Licence Area


Hazelwood (aerial Nov 2014)
Legend
Mining Licence Boundary
Water Body
MIN5003
MIN5004
LOCALITY MAP
Coordinate System: GDA 1994 MGA Zone 55
Projection: Lambert Conformal Conic
Datum: GDA 1994
Produced by
Earth Resources Information Centre
Date: 27/04/2015
1:20,000
0 175 350 700 1,050 1,400
Meters
5,769,000
5,768,000
5,767,000
5,766,000
5,765,000
5,764,000
5,763,000
5,762,000
5,761,000
441,000
442,000
443,000
444,000
445,000
446,000
447,000
448,000
449,000
450,000

Appendix B

Model Inputs

Appendix B Early Closure (Current Footprint)

EarlyClosure1 Cost Components

HAZELWOOD Early Closure 1	Total Costs
EarlyClose1 Domain 1 Infrastructure Areas	**25,539,359**
Disconnect and terminate services	435,000
Demolish and remove buildings	4,800,000
Remove concrete pads & footings (of buildings)	450,000
Decommission access and haul roads	150,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sumps	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	48,000
Demolish and remove conveyors	2,440,000
Decommission, decontaminate and demolish crusher and raw coal bunker	0
Decommission, decontaminate and demolish dredgers	5,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	4,350,638
Water Ponds	3,118,988
Removal of power lines	120,000
Other disturbed areas	3,446,733
EarlyClose1 Domain 2 Tailings and Coarse Rejects Storage	**16,005,600**
HARA/HAP1/HAP4capping	13,520,000
Landscaping, minor earthworks and revegetation	2,485,600
EarlyClose1 Domain 3 Overburden and Waste Dumps	**3,500,800**
Landscaping, minor earthworks and revegetation throughout domain area	1,500,800
Lime dosing	2,000,000
EarlyClose1 Domain 4 Active Mine and Voids	**161,894,018**
East Field (Northern Batters)	4,299,919
Buttress of portion of EFE Northern Batters	14,375,000
East Field (Eastern Batters) and Southeast Field (Southern Batters)	12,336,943
Southeast Field (Western Batters)	6,102,336
West Field	14,903,708
Southwest Field (Northern Batters)	8,666,574
Horizontal Drains	6,622,852
Rip Rap	9,486,833
Rip Rap subsequent 50 yrs	9,486,833
Rip Rap subsequent 130 yrs	9,486,833
Rip Rap subsequent 195 yrs	9,486,833
Rip Rap subsequent 255 yrs	9,486,833
Rip Rap subsequent 320 yrs	9,486,833
Rip Rap subsequent 385 yrs	9,486,833
Rip Rap subsequent 455 yrs	9,486,833
Rip Rap subsequent 500 yrs	9,486,833
Erect a security fence around site	1,100,000
Landscaping, minor earthworks and revegetation throughout domain area	8,105,189
Create public access	0
EarlyClose1 Domain 5 Closure Execution Management	**41,387,955**
Mobilisation/Demobilisation	10,346,989
Engineering Procurement & Construction Management	31,040,967
EarlyClose1 Domain 6 Fill pit with water	**10,015,875**
O&M of dewatering facilities (until OB equibrilisation is achieved)	1,680,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	6,160,875

EarlyClosure1 Cost Components

EarlyClose1 Domain 7 Post Execution Maintenance and Monitoring	**60,651,550**	
Post execution monitoring	20,125,000	
Post execution maintenance	38,760,000	
Management	1,766,550	
EarlyClose1 Liability	**318,995,158**	
	P50	**P95**
EarlyClose1 Domain 1 Infrastructure Areas		
Disconnect and terminate services	**435,000**	
disconnect and terminate services	5,000	
Number of services	87	
Total	435,000	
Demolish and remove buildings	**4,800,000**	
Industrial and mine site (m2)	30,000	
Proportion removed	100%	
Cost per m2	160	
Total	4,800,000	
Remove concrete pads & footings (of buildings)	**450,000**	
Industrial and mine site (m2)	30,000	
Cost per m2	15	
Total	450,000	
Decommission access and haul roads	**150,000**	
Length of roads (m)	50,000	70,000
Average width of roads (m)	12	20
Area of road (m2)	600,000	
Area of road (ha)	60	
Cost per ha	2,500	
Total	150,000	
Waste disposal	**235,000**	
General waste ($)	110,000	120,000
Waste oils and chemicals (L)	500	1,000
rate ($/kL)	250	
waste oil disposal ($)	125,000	
Total	235,000	
Removal and disposal of contaminated water from bunded areas and sumps	**250,000**	
Volume (kL)	1,000	4,000
Pump/truck ($/kL)	250	
Total	250,000	
Removal and disposal of contaminated soils	**195,000**	
Volume estimate(m3)	500	1,000
Cost per m3	390	
Total	195,000	
Removal of USTs	**48,000**	
Number of USTs	1	
Cost per UST	48,000	
Total	48,000	
Demolish and remove conveyors	**2,440,000**	
Conveyor length (m)	24,400	25,000
Cost $/m	100	
Total	2,440,000	
Decommission, decontaminate and demolish crusher and raw coal bunker	**0**	
Total	0	
Decommission, decontaminate and demolish dredgers	**5,000,000**	
number	5	

EarlyClosure1 Cost Components

	P50	P95
DDD rate ($)	1,000,000	
Total	5,000,000	
Remove fire services equipment and pipework	**300,000**	
length (m)	60,000	90,000
removal rate ($/m)	5	
Total	300,000	
Remove fire services reservoir	**200,000**	
removal	200,000	400,000
Landscaping, minor earthworks and revegetation	**4,350,638**	
total disturbed footprint (ha)	175	
Levelling of minor excavations and batters, final trim, rock rake and deep rip	*170,528*	
% of disturbed footprint	75%	
Rate ($/ha)	1,300.00	
Levelling	170,528	
water management works, banks, drains, rock lined waterways, sediment dams	*69,960*	
% of disturbed footprint	20%	
Rate ($/ha)	2,000.00	
Structural works	69,960	
Revegetation	4,110,150	
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	4,110,150	
Water Ponds	**3,118,988**	
Embankment Length		
Total length (m)	2,280	
Average embankment height (m)	3	
Average embankment width (m)	8	
Total volume of material (m3)	54,720	
Excavate embankment and place in pit ($/m3)	5	
Total Cost	273,600	
Area of pond		
Total area (m2)	586,678	
Average sludge depth (m)	0.5	1
Total sludge volume (m3)	293,339	
Remove into ash ponds ($/m3)	5	
Total Cost ($)	1,466,695	
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	1,378,693	
Removal of power lines	**120,000**	
Length (km)	6	
Cost ($)	20,000	
Other disturbed areas	**3,446,733**	
Total area (ha)	106	
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	3,446,733	
EarlyClose1 Domain 2 Tailings and Coarse Rejects Storage		
HARA/HAP1/HAP4capping	**13,520,000**	
HARA area	520,000	
HAP1 area	400,000	
HAP4 area	120,000	
Area of required capping (m^2)	1,040,000	
Cost of capping ($/m2)	13	
Capping	13,520,000	
Landscaping, minor earthworks and revegetation	**2,485,600**	
Hara/HAP1/HAP4 area (ha)	104	
Levelling of minor excavations and batters, final trim, rock rake and deep rip	*0*	
% of disturbed footprint	0%	
Rate ($/ha)	1,300.00	
Levelling	0	

EarlyClosure1 Cost Components

	P50	P95
Structural water management works, banks, drains, rock lined waterways.	*41,600*	
% of disturbed footprint	20%	
Rate ($/ha)	2,000.00	
Structural works	41,600	
Revegetation	2,444,000	
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	2,444,000	
EarlyClose1 Domain 3 Overburden and Waste Dumps		
Landscaping, minor earthworks and revegetation throughout domain area	**1,500,800**	
Levelling of minor excavations and batters, final trim, rock rake and deep rip		
Area (ha)	56	
Rate ($/ha)	1300	
Total	72800	
Structural water management works, banks, drains, rock lined waterways, sediment dams		
Area (ha)	56	
Rate ($/ha)	2000	
Total	112000	
Revegetation		
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	1,316,000	
Lime dosing	**2,000,000**	
Lime dosing of acid run-off ($/yr)	200,000	
Number of years	10	
Total	2,000,000	
EarlyClose1 Domain 4 Active Mine and Voids		
East Field (Northern Batters)	**4,299,919**	
Existing Overall Slope (degrees)	18.4	
RL of stabilised floor	-22	
RL Ground Surface at top of slope	68	
Exposed slope vertical height (H)	90	
Surface area of exposed slope (m2/lineal m)	285	
Batter area exposed at that water height (m^2)	369,986	
Proportion already rehabilitated (%)	20%	
Batter area requiring rehabilitation (m^2)	295,989	
Slope Length (m)	1,300	
Reshaping of individual batters	*2,080,000*	
Number of benches exposed (at ave 20m height)	5	
Average reshape volume (m3 / bench / m slope)	100	
Reshape rate ($/m3)	4.0	
Full reshape cost ($)	2,600,000	
Proportion already rehabilitated (%)	20%	
Reshape cost ($)	2,080,000	
Cover	*2,219,919*	
Thickness of cover	0.75	
Volume of cover material (m3)	221,992	
Cover material rate - load haul place	10.00	
Total required cover ($)	2,219,919	
Total cover ($)	2,774,899	
Rip Rap		
final slope	18.4	

EarlyClosure1 Cost Components

	P50	P95
vertical height of rip rap (m)	4.0	
surface area of rip rap (m2/m)	12.6	
rip rap thickness (m)	0.75	
rock requirement per linear metre (m3)	9	
rip rap length along batter (m)	1,300	
rip rap area (m2)	16,444	
Buttress of portion of EFE Northern Batters	**14,375,000**	
Volume of Buttress (m3) in situ	2,500,000	
Bulking factor	1.15	
Buttress material requirement LCM	2,875,000	
Buttress cost ($/m3)	5	
Total Buttress Cost	14,375,000	
East Field (Eastern Batters) and Southeast Field (Southern Batters)	**12,336,943**	
Existing Overall Slope (degrees)	9.6	
Stabilised floor water level	-22	
RL Ground Surface at top of slope	68	
Exposed slope vertical height (H)	90	
Surface area of exposed slope (m2/lineal m)	540	
Batter area exposed at that water height (m^2)	1,295,207	
Proportion already rehabilitated (%)	15%	
Batter area requiring rehabilitation (m^2)	1,100,926	
Slope Length (m)	2,400	
Reshaping	*4,080,000*	
Number of benches exposed (at ave 20m height)	5	
Average reshape volume (m3 / bench / m slope)	100	
Reshape rate ($/m3)	4.0	
Full reshape cost ($)	4,800,000	
Proportion already rehabilitated (%)	15%	
Reshape cost ($)	4,080,000	
Cover	*8,256,943*	
Thickness of cover	0.75	
Volume of cover material (m3)	825,694	
Cover material rate - load haul place	10.00	
Total required cover ($)	8,256,943	
Total cover ($)	9,714,050	
Rip Rap		
final slope	9.6	
vertical height of rip rap (m)	4.0	
surface area of rip rap (m2/m)	12.6	
rip rap thickness (m)	0.75	
rock requirement per linear metre (m3)	9	
rip rap length along batter (m)	2,400	
rip rap area (m2)	30,358	
Southeast Field (Western Batters)	**6,102,336**	
Existing Overall Slope (degrees)	9.6	
Stabilised floor water level	-22	
RL Ground Surface at top of slope	64	
Exposed slope vertical height (H)	86	
Surface area of exposed slope (m2/lineal m)	516	
Batter area exposed at that water height (m^2)	670,389	
Proportion already rehabilitated (%)	20%	

EarlyClosure1 Cost Components

		P50	P95
	Batter area requiring rehabilitation (m^2)	536,312	
	Slope Length (m)	1,300	
	Reshaping	*2,080,000*	
	Number of benches exposed (at ave 20m height)	5	
	Average reshape volume (m3 / bench / m slope)	100	
	Reshape rate ($/m3)	4.0	
	Full reshape cost ($)	2,600,000	
	Proportion already rehabilitated (%)	20%	
	Reshape cost ($)	2,080,000	
	Cover	*4,022,336*	
	Thickness of cover	0.75	
	Volume of cover material (m3)	402,234	
	Cover material rate - load haul place	10.00	
	Total required cover ($)	4,022,336	
	Total cover ($)	5,027,920	
	Rip Rap		
	final slope	9.6	
	vertical height of rip rap (m)	4.0	
	surface area of rip rap (m2/m)	12.6	
	rip rap thickness (m)	0.75	
	rock requirement per linear metre (m3)	9	
	rip rap length along batter (m)	1,300	
	rip rap area (m2)	16,444	
West Field		**14,903,708**	
	Existing Overall Slope (degrees)	18.4	
	Stabilised floor water level	-22	
	RL Ground Surface at top of slope	56	
	Exposed slope vertical height (H)	78	
	Surface area of exposed slope (m2/lineal m)	247	
	Batter area exposed at that water height (m^2)	1,183,957	
	Proportion already rehabilitated (%)	10%	
	Batter area requiring rehabilitation (m^2)	1,065,561	
	Slope Length (m)	4,800	
	Reshaping	*6,912,000*	
	Number of benches exposed (at ave 20m height)	4	
	Average reshape volume (m3 / bench / m slope)	100	
	Reshape rate ($/m3)	4.0	
	Full reshape cost ($)	7,680,000	
	Proportion already rehabilitated (%)	10%	
	Reshape cost ($)	6,912,000	
	Cover	*7,991,708*	
	Thickness of cover	0.75	
	Volume of cover material (m3)	799,171	
	Cover material rate - load haul place	10.00	
	Total required cover ($)	7,991,708	
	Total cover ($)	8,879,676	
	Rip Rap		
	final slope	18.4	
	vertical height of rip rap (m)	4.0	

EarlyClosure1 Cost Components

	P50	P95
surface area of rip rap (m2/m)	12.6	
rip rap thickness (m)	0.75	
rock requirement per linear metre (m3)	9	
rip rap length along batter (m)	4,800	
rip rap area (m2)	60,716	
Southwest Field (Northern Batters)	**8,666,574**	
Existing Overall Slope (degrees)	18.4	
Stabilised floor water level	-22	
RL Ground Surface at top of slope	53	
Exposed slope vertical height (H)	75	
Surface area of exposed slope (m2/lineal m)	237	
Batter area exposed at that water height (m^2)	640,361	
Proportion already rehabilitated (%)	5%	
Batter area requiring rehabilitation (m^2)	608,343	
Slope Length (m)	2,700	
Reshaping	*4,104,000*	
Number of benches exposed (at ave 20m height)	4	
Average reshape volume (m3 / bench / m slope)	100	
Reshape rate ($/m3)	4.0	
Full reshape cost ($)	4,320,000	
Proportion already rehabilitated (%)	5%	
Reshape cost ($)	4,104,000	
Cover	*4,562,574*	
Thickness of cover	0.75	
Volume of cover material (m3)	456,257	
Cover material rate - load haul place	10.00	
Total required cover ($)	4,562,574	
Total cover ($)	4,802,709	
Rip Rap		
final slope	18.4	
vertical height of rip rap (m)	4.0	
surface area of rip rap (m2/m)	12.6	
rip rap thickness (m)	0.75	
rock requirement per linear metre (m3)	9	
rip rap length along batter (m)	2,700	
rip rap area (m2)	34,153	
Horizontal Drains	**6,622,852**	
Exposed slope area (ha)	331	
No required (#/ha slope)	1	
No required	331	
Installation cost for required horizontal drains($)	6,622,852	
Total horizontal drain cost ($)	8,319,801	
Rip Rap	**9,486,833**	
total rip rap area (m2)	158,114	
rip rap rate ($/m2)	60	
Total Rip Rap	9,486,833	
Erect a security fence around site	**1,100,000**	
Length of fence (m)	22,000	
Construct ($/m)	50	
Total	1100000	

EarlyClosure1 Cost Components

	P50	P95
Landscaping, minor earthworks and revegetation throughout domain area	**8,105,189**	
Total area (ha)	345	
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	8,105,189	
Create public access	**0**	
Number of areas	0	
Cost per area	100,000	
Total	0	
EarlyClose1 Domain 5 Closure Execution Management		
Mobilisation/Demobilisation	**10,346,989**	
Total Execution Cost	206,939,777	
% of total execution cost	5%	
Engineering Procurement & Construction Management	**31,040,967**	
Total Project Cost	206,939,777	
% of total execution cost	15.00%	
EarlyClose1 Domain 6 Fill pit with water		
O&M of dewatering facilities (until OB equibrilisation is achieved)	**1,680,000**	
Annual cost ($/an)	80,000	
Duration (yrs)	21	
Total	1,680,000	
Re-install dewatering bores, then decommission existing bores	**2,175,000**	
Length of elevated pad (m)	1700	2,000
Width of elevated pad (m)	20	30
Height of elevated pad (m)	10	15
Sectional volume of pad (m3/m length)	300	
Volume of pad (m3)	510,000	
Construct elevated pad ($/m3)	1.5	3
Pad	765,000	
Construct dewatering bore ($/bore)	250,000	300,000
Number of new bores	5	
Connection pipeworks (m)	1700	
Connection pipeworks ($/m)	50	
New bores	1,335,000	
Number of existing bores	5	
Decommission existing bores ($/bore)	15,000	30,000
Existing bores	75,000	
Total	2,175,000	
Supplementary & other water charges	**6,160,875**	
Required supplementary water supply for filling period (GL/yr)	0.0	
Allocation purchase ($/GL)	2,000,000	
Allocation purchase ($)	-	
Annual fee ($/yr)	293,375	
Fill duration (yrs)	21	
Supplementary & other water cost ($)	6,160,875	
EarlyClose1 Domain 7 Post Execution Maintenance and Monitoring		
Post execution monitoring	**20,125,000**	
Annual rate - first 5 yrs after execution phase ($/yr)	325000	
Number of Years	5	
Cost ($)	1625000	
Annual rate - wind-down monitoring phase ($/yr)	185000	
Number of Years	100	
Cost ($)	18500000	
Post execution maintenance	**38,760,000**	
Annual rate - first 5 yrs after execution phase ($/yr)	1012000	
Number of Years	5	
Cost ($)	5060000	
Annual rate - wind-down monitoring phase ($/yr)	337000	
Number of Years	100	

EarlyClosure1 Cost Components

		P50	P95
	Cost ($)	33700000	
Management		**1,766,550**	
	Subtotal maintenance & monitoring ($)	58,885,000	
	Management (%)	3%	
	Management ($)	1766550	

Appendix B End of Mine Life

EoM Closure Cost Components

HAZELWOOD End of Mine Life Footprint	Total Costs
EoM Domain 1 : Infrastructure Areas	**24,539,359**
Disconnect and terminate services	435,000
Demolish and remove buildings	4,800,000
Remove concrete pads & footings (of buildings)	450,000
Decommission access and haul roads	150,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sum	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	48,000
Demolish and remove conveyors	2,440,000
Decommission, decontaminate and demolish crusher and raw coal bunker	0
Decommission, decontaminate and demolish dredgers	4,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	4,350,638
Water Ponds	3,118,988
Removal of power lines	120,000
Other disturbed areas	3,446,733
EoM Domain 2 Tailings and Coarse Rejects Storage	**16,005,600**
HARA/HAP1/HAP4capping	13,520,000
Landscaping, minor earthworks and revegetation	2,485,600
EoM Domain 3 Overburden and Waste Dumps	**3,500,800**
Landscaping, minor earthworks and revegetation throughout domain area	1,500,800
Lime dosing	2,000,000
EoM Domain 4 Active Mine and Voids	**197,273,902**
East Field (Northern Batters)	4,299,919
Buttress of portion of EFE Northern Batters	14,375,000
East Field (Eastern Batters) and Southeast Field (Southern Batters)	12,336,943
Southeast Field (Western Batters)	6,102,336
West Field	24,839,514
Southwest Field (Northern Batters)	8,666,574
Horizontal Drains	8,635,009
Rip Rap	11,915,462
Rip Rap subsequent 50 yrs	11,915,462
Rip Rap subsequent 130 yrs	11,915,462
Rip Rap subsequent 195 yrs	11,915,462
Rip Rap subsequent 255 yrs	11,915,462
Rip Rap subsequent 320 yrs	11,915,462
Rip Rap subsequent 385 yrs	11,915,462
Rip Rap subsequent 455 yrs	11,915,462
Rip Rap subsequent 500 yrs	11,915,462
Erect a security fence around site	1,100,000
Landscaping, minor earthworks and revegetation throughout domain area	9,679,447
Create public access	0
EoM Domain 5 Closure Execution Management	**48,263,932**
Mobilisation/Demobilisation	12,065,983
Engineering Procurement & Construction Management	36,197,949
EoM Domain 6 Fill pit with water	**12,629,500**
O&M of dewatering facilities (until OB equibrilisation is achieved)	2,240,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	8,214,500
EoM Domain 7 Post Execution Maintenance and Monitoring	**60,651,550**
Post execution monitoring	20,125,000
Post execution maintenance	38,760,000
Management	1,766,550
EoM Liability	**362,864,643**

Appendix C

Unit Rates and Parameters

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GENERAL PARAMETERS USED IN COSTING				
	NPV Discount Rate	**3.0%**	As per Vic gov wage inflation and discounts file	
Final Void			**EoM**	**Early Closure 1**
Overall Pit Slope Angle (V:H)				
Angle	degrees		18.4	18.4
Vertical	ratio		1	1
Horizontal	ratio		3	3
Final lake level	RL m		8	8
Stabilised floor water level	RLm		-22	-22
East Field (Northern Batters)				
Ground Surface	RL m		68	68
Batter Lengths	m		1,300	1,300
Buttress of portion of EFE Northern Batters (HARA)				
Ground Surface			72	72
Batter Lengths			2,700	2,700
East Field (Eastern Batters) and Southeast Field (Southern Batters)				
Ground Surface			68	68
Batter Lengths			2,400	2,400
Southeast Field (Western Batters)				
Ground Surface			64	64
Batter Lengths			1,300	1,300
West Field				
Ground Surface			56	56
Batter Lengths			8,000	4,800
Southwest Field (Northern Batters)				
Ground Surface			53	53
Batter Lengths			2700	2,700
Average Batter Height	m		20	20
Execution Phase General Rates				
Mobilisation/Demobilisation	% of total execution costs		5%	
Engineering Procurement & Construction Management	% of total execution costs		15%	
Monitoring & Maintenance Phase Rates			**P50**	**P95**
Post execution monitoring - initial phase				
surface water	$/yr		$ 50,000	$ 75,000
groundwater	$/yr		$ 100,000	$ 125,000
geotechnical	$/yr		$ 75,000	$ 150,000
ecological (inc. rehabilitation)	$/yr		$ 50,000	$ 75,000

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fire	$/yr		$ 50,000	$ 100,000
Total monitring - initial	$/yr		$ 325,000	
Post execution monitoring - subsequent				
surface water	$/yr		$ 25,000	$ 40,000
groundwater	$/yr		$ 50,000	$ 60,000
geotechnical	$/yr		$ 35,000	$ 75,000
ecological (inc. rehabilitation)	$/yr		$ 25,000	$ 40,000
fire	$/yr		$ 50,000	$ 100,000
Total monitring - subsequent	$/yr		$ 185,000	
Post execution maintenance - initial phase				
fire	$/yr		$ 200,000	$ 400,000
rehabilitation	ha		400	500
rehabilitation fail rate	% / yr		3%	
rehabilitation rate	$/ha		$ 3,500	
rehabilitation	$/yr		$ 42,000	
erosion repair	$/yr		$ 400,000	$ 900,000
lease costs	$/yr		$ 100,000	$ 200,000
security services	$/yr		$ 100,000	$ 200,000
securit maintenance	$/yr		$ 20,000	$ 50,000
Council rates	$/yr		$ 100,000	$ 500,000
site services (demountables, power, water)	$/yr		$ 50,000	$ 80,000
Total maintenance - initial	$/yr		$ 1,012,000	
Post execution maintenance - subsequent				
fire	$/yr		$ -	$ -
rehabilitation	ha		400	500
rehabilitation fail rate	% / yr		3%	
rehabilitation rate	$/ha		$ 3,500	
rehabilitation	$/yr		$ 42,000	
erosion repair	$/yr		$ 50,000	$ 100,000
lease costs	$/yr		$ 100,000	$ 200,000
security services	$/yr		$ 50,000	$ 100,000
securit maintenance	$/yr		$ 20,000	$ 50,000
Council rates	$/yr		$ 75,000	$ 300,000
site services (demountables, power, water)	$/yr		$ -	$ -
Total maintenance - subsequent	$/yr		$ 337,000	
Management	% of total monitoring/maintenance costs		3%	3%
Timelines			**EoM**	**Early Closure 1**
Year of current assessment			2015	2015
Year number			1	1
Mine Shutdown			2025	2015

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Year closure execution to commence			2026	2015
Year number			12	1
Duration of Closure Execution phase	years		3	3
Duration of post execution maintenance/monitoring - initial phase	years		5	5
Duration of post execution maintenance/monitoring - subsequent phase	years		500	500
Effective duration of post execution maintenance/monitoring - subsequent phase	years		100	100
Duration of lake fill to achieve floor stability (RL-22m)	years		28	21
Duration of full lake fill to final level	years		500	500
Lime dosing for acid runoff control	years		10	10
Other Costs and Parameters (not in Bond Calculator)			**P50**	**P95**
Bulking factor for earthworks			1.15	1.2
Summary adopted earthworks rates				
Externally sourced topsoil	$/m^3		$20.00	
Externally sourced cover & cap material	$/m^3		$10.00	
Internally sourced buttress / fill material	$/m^3		$5.00	
Reshaping	$/m^3		$4.00	
Lime dosiing	$/year		$200,000	$500,000
Horizontal bores for slope stabilisation				
No required	#/ha slope		1	1.5
Installation cost	$/bore		$20,000	$50,000
Dewatering bores				
Connection pipeworks	$/m		$50.00	$70.00
Rip Rap				
thickness	m		0.75	
vertical height	m		4	
Ash Pond & HARA Cap				
thickness	m		1	1.5
rate (load, haul, dump, compact)	$/m^3		13	
rate (load, haul, dump, compact)	$/m^2		13	
Annual dewatering costs				
Hazelwood	$/annum		80,000	120,000
Bulk Water Entitlement				
Current Hazelwood BWE	GL/yr		15	
Supplementary Water Costs				

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Allocation Purchase	$/ML		$ 2,000	$ 5,000
Allocation Purchase	$/GL		$ 2,000,000	
Annual groundwater fee	$/ML/yr		$ 20	
Annual groundwater fee	$/GL/yr		$ 20,000	
Annual Bulk Water Entitlement	$		$ 273,375	
Total annual fees	$/yr		$ 293,375	
BWE annual cost	$/GL/yr		$ 18,225	

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Activity	Unit	FROM BOND CALCULATOR	Adopted Rates- green/yellow highlight means value used in model		Distribution	Comment on Changes to Bond Calculator Rate
			P50	P95		
Disconnect and terminate services	item	$5,000.00	$5,000	$6,000	Lognormal Distribution applied	
Demolish and remove industrial buildings such as workshops and large sheds	m2	$160.00	$160	$200	Lognormal Distribution applied	
Remove Concrete pads, footings and foundations (> 300mm thickness)	m2	$15.00	$15	$35	Lognormal Distribution applied	
Demolish and remove overland conveyors, transfer stations & gantries (scrapping only - does not include dismantling for re-use at another site).	m	$100.00	$100	$250	Lognormal Distribution applied	Used the same rate for all conveyors
Decomission, decontaminate and demolish dredgers	ea		$1,000,000	$2,500,000	Lognormal Distribution applied	URS Estimate- Loy Yang BC had $50,000 - considered too low
Pipework removal	m		$5	$10	Lognormal Distribution applied	Estimate taken from Loy Yang Bond Calc Sheet
Reshape, deep rip and ameliorate sealed unsealed roads	Ha	$2,500.00	$2,500	$3,500	Lognormal Distribution applied	
Has a Contaminated Site Assessment been undertaken for the site? If not this item applies	item	$3,500.00				
Removal and disposal of oil contaminated water from bunded areas and sumps.	L	$0.25	$0.25	$0.40	Lognormal Distribution applied	
Load, cart and dispose of low-level contaminated soil off site to a licensed landfill. Assumes cartage to a local landfill. Add $50/m3 for cartage to regional landfill.	m3	$390.00	$390	$700	Lognormal Distribution applied	
Removal of underground fuel storage tank (UST) above 5,000L and below 15,000L capacity (include all site facilities and is to include pipes, bunds, etc)	@	$48,000.00	$48,000	$50,000	Lognormal Distribution applied	
Source, cart, spread and lightly rip topsoil (>5km)	$/m3	$3.60	$20	$45	Lognormal Distribution applied	based on commercial rates as no topsoil stockpiled at any site; $7.50/m3 excavate, deposit & spread - double for commerical rates - $15/m3; haulage at $0.57/m3/km - @10km $5.70/m3, 23km $17.10/m3
Average topsoil thickness	m		0.1	0.15	Lognormal Distribution applied	URS Estimate of topsoil thickness - loose cubic metres
Direct seeding (native tree species OR using native grasses), with single application of fertiliser	$/ha	$3,500.00	$3,500	$4,000	Lognormal Distribution applied	
Overall topsoil and revegetation rate	$/ha		$23,500			Combined vegetation rate - no distribution applied
Shaping or levelling of minor excavations, batters and stockpiles, final trim, rock rake and deep rip	$/ha	$1,300.00	$1,300	$1,700	Lognormal Distribution applied	
Structural water management works, banks, drains, rock lined waterways, sediment dams	$/ha	$2,000.00	$2,000	$2,500	Lognormal Distribution applied	
Truck and shovel capping to batters and floor	m3	$1.35	$10	$30	Lognormal Distribution applied	Hazelwood had $6.67/m3, but there are no sources on site, other than re-excavating any ex-pit overburden dumps which would require segregation of materials
Buttress material	m3		$5	$10	Lognormal Distribution applied	Assume on-site source (East Field Overburden Dump)and rate includes rehab of source area
Major bulk pushing (Stiff Clay or Soft Rock with ripping) to achieve grades nominated in the approval/permit (i.e. < 18o) 50-100m	m3	$1.95	$4	$5	Lognormal Distribution applied	Range based on Project Support report of 2014 which had ($2.58/m3 cut & push down batters plus $1.62/m3 spread/compact)
Erect a 6' chain mesh security fence around the top face where the final pit will include steep faces	m	$50.00	$50	$55	Lognormal Distribution applied	consistent with rawlinsons given project scale
Reshaping volume per m exposed batter height per lineal m of batter slope	m3 / bench / lineal m slope		100	110	Lognormal Distribution applied	URS Estimate - based on assumed average 1:1 batter slopes and balance of cut to fill - see "Batter Slopes" tab
Final cover material over pit slope to control fire and minmise surface water infiltration	m		0.75	1	Lognormal Distribution applied; 1m applied as 99th percentile	URS Estimate - based on discussion with DEDJTR
Rip rap at final lake level	$/m2		$60	$90	Lognormal Distribution applied	Rawlinsons has $121/m2 for revetment walls 450mm thick dry place embedded in mortar - take 25% of this rate but for 0.75m thick
Cap material - load, haul place	$/m3		$10	$30	Lognormal Distribution applied	As per Truck and Shovel rate above
Cap material - compact	$/m3		$3	$4	Lognormal Distribution applied	Based on Rawlinsons of $3.60/m3 to compact
Removal of powerlines (this includes disconnection, rolling up the wires and removing the poles). It does not inlcude the removal of substations.	km	$12,000.00	$20,000	$40,000	Lognormal Distribution applied	URS estimate