Closure Costs
Department of Economic Development, Job, Transport and Resources (DEDJTR)
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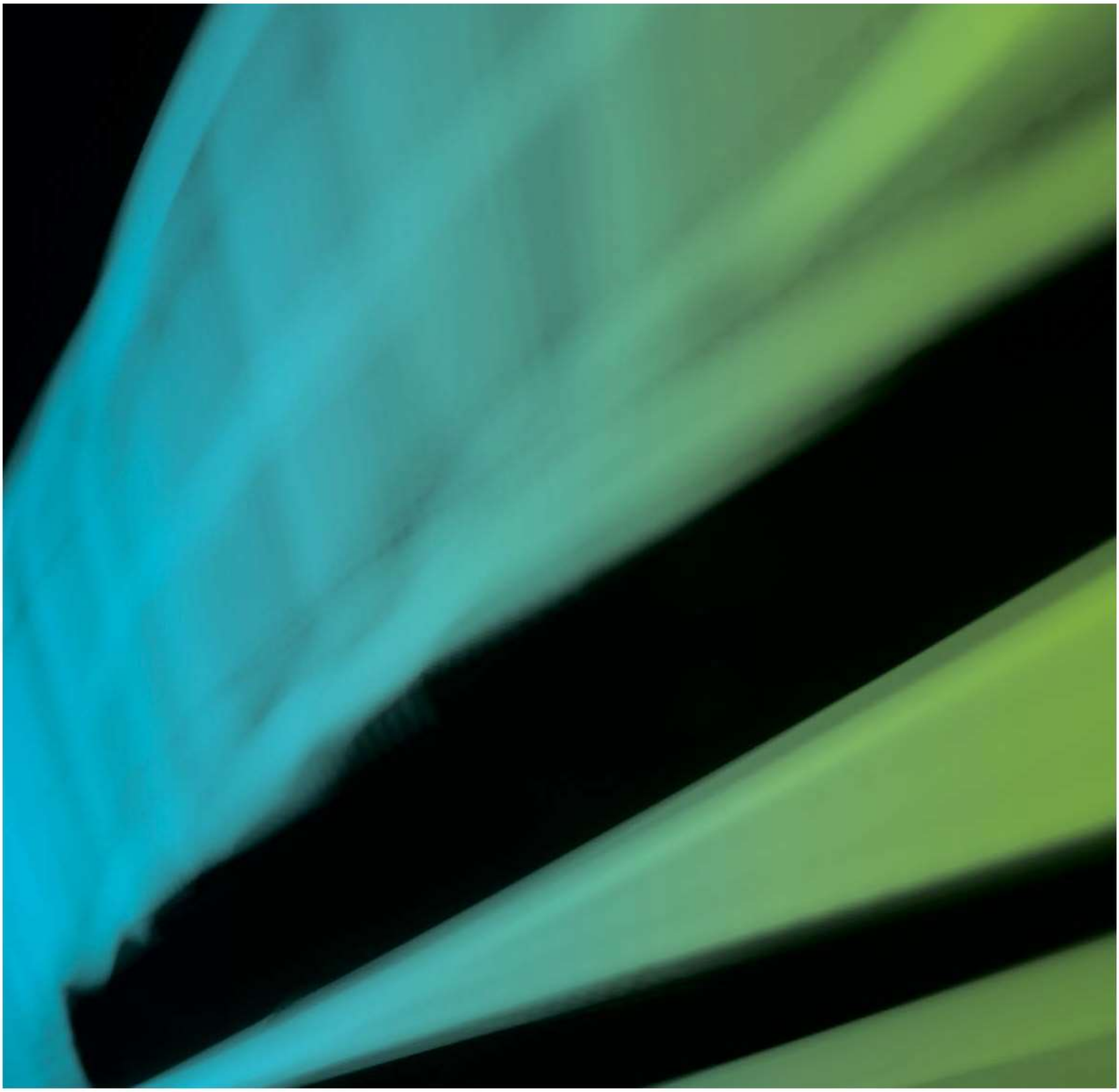
Commercial-in-Confidence

Estimation of Rehabilitation Costs

Energy Australia Yallourn Mine



Estimation of Rehabilitation Costs

Energy Australia Yallourn Mine

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

ABN: 69 981 208 782

Prepared by

AECOM Services Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006, Australia
T +61 3 8699 7500 F +61 3 8699 7550 www.aecom.com
ABN 46 000 691 690

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Prepared by Bryan Chadwick

Reviewed by Geoff Byrne

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

Table of Contents

List of Tables

List of Figures

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
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
YM	Yallourn Mine

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 EnergyAustralia Yallourn Pty Ltd's Yallourn Mine (**YM**).

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 uses 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 Scope of Works

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 YM.

1.2.1 Information Sources

ERR provided the following documents and information:

- Submission for a variation to the approved work plan for Mining Licences No 5003, No 5216 and No. 5304 to incorporate changes to mining as a result of batter failure in November 2007 and the Maryvale Mine Footprint redesign, TRUenergy, 5 May 2011
- MIN5003 Work plan variation conditions (Final 17.05.2011)
- EnergyAustralia Yallourn Mine, 6 monthly Milestone Report, July to December 2014, for DEDJTR
- Yallourn 2013_14 annual expenditure return
- MIN5003 Bond calculator_na07_concept.xls
- Yallourn Energy Pty Ltd., May 2000, extract from Rehabilitation Master Plan (Page 12)
- TRUenergy Yallourn Pty. Ltd. Review of Yallourn Mine Rehabilitation Master Plan, 5 June 2012. MIN5003 Work Plan Variation
- 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 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 Yallourn management in late October 2015.

2.2 Closure Cost Estimates

Cost estimates have been developed based on the 2012 WPV with 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 - closure based on current footprint.

[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

The costs items for closure are based on the closure domains outlined in Table 1, which is generally consistent with the format of ERR's 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.

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, Raw coal bunker (and associated batters), Flocculation Pond, Fire Services Pond. .
2	Tailings and coarse rejects – includes capping, reshaping and landscaping of ash ponds	Yallourn North Open Cut (YNOC) and associated batters.
3	Overburden and waste dumps – includes overburden dumps	YM has no external overburden dump
4	Active Mines and Voids – includes the backfilling of mine voids, slope reshaping, fencing and landscaping	Includes: Yallourn East Field, Yallourn East Field Extension, Yallourn East Field Overburden Dump, Maryvale Field, Yallourn Township Field including the northern, Hernes Oak, western, southwestern and southern batters, Yallourn Township Field Overburden Dump, Midfield Dump.
5	Execution management costs - including mobilisation and demobilisation	-
6	Fill pit with water - including all aspects of filling the pit with water	Includes: 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 Mine Status

3.1 Current Mine Status

EnergyAustralia Yallourn Pty Ltd has ownership of the mine, however, it is operated as an alliance with RTL – a joint venture between Thiess, Downer and Linfox. Mining operations are based on a dozer push / feeder breaker system.

Mining began in the Maryvale (MF) in September 2012 and is able to continue until 2032 (2011 WPV), although MIN expiry is 2026.

The proposed extent of the Maryvale Field to the south is indicated in Figure 6 of the TRUenergy variation to the Mine plan report (2011 WPV). The Township Field and Maryvale Field are separated by a coal dyke, which contains the Morwell River Diversion (**MRD**).

The Mine Licence also includes the Yallourn North Open Cut (**YNOC**), which is an EPA licensed landfill comprising two ash dumps and an asbestos dump.

The Yallourn raw coal bunker which stores coal from the mine before transferring it to the Power Station is also included in the mine costing. It has a capacity of 30,000 tonnes.

The fire services pond collects all run-off from site. The water is then pumped through the FP and then into the Morwell River. Annually 14,000-18,000 ML of water is discharged to the Morwell River.

YM is influenced by several geotechnical constraints – the Latrobe River borders to the north where the Yallourn East Field (YEF) batters failed in 2007. These batters are under geotechnical surveillance and will be progressively stabilised by the placement of material in the YEF from mining of the Maryvale Field.

Stabilisation works on the MRD batters were completed in October 2013, when uncontrolled flows were returned to the MRD. The southern batters of the Yallourn Township Field are located adjacent to V-Line track but no movement has been detected. The YNOC batters are also being monitored.

The MIN5003 expiry date is 9 April 2026.

3.2 Current Approved Rehabilitation Master Plan

The YM closure[2] strategy is as outlined in page 48 of the 2012 Rehabilitation Master Plan:

…final rehabilitation by flooding of the mine to form a lake system with landscaping works to be undertaken around the lake perimeter.

…water supply to fill the final lake could be supplied, subject to approval, from flood events in the Latrobe River system by lowering the man-made protection flood levees or using current (or additional) power industry water entitlements...

Alternatively, natural filling by immediate local area rainfall runoff, including currently diverted areas, could provide additional water resource.

The 2012 WPV[3] provides further details on the proposed pit filling plan for YM to achieve the closure objective outlined. It is based on a number of technical studies into the pit filling options: "full" flooding, a "partial" flooding and a "non-flooded". The preferred option that has been proposed by site management is a fully flooded mine to a water level of +37 m AHD and spill into Latrobe River.

The 2012 WPV also identified a number of benefits associated with the fully flooded mine option, which are relevant to the closure concepts upon which this URS report is based. These include the fact that a fully flooded pit would provide the following as compared to a partial or no flooded pit option:

- Flood control;
- Potential water source for future industry;
- The best visual solution;
- Least ongoing maintenance;
- Source of water for fire suppression; and
- Potential recreation and conservation benefits

[2] Submission for a variation to the Approved Work Plan. Version 5 – dated 5 May 2011
[3] Review of Yallourn Mine Rehabilitation Plan. MIN5003 Work Plan Variation. Condition 7. 5 June 2012

4.0 Closure Strategy

4.1 Background

The closure concept for YM is to fill the void with water to form a lake that spills into Latrobe River.

The 2012 WPV provides limited details to many aspects of site closure. URS has therefore included a range of closure activities for the various domains which are considered necessary to achieve the nominated YM closure strategy and which are outlined below in **Section 4.2**.

4.2 Closure Activities Used as Basis for Closure Development

4.2.1 General Land Use

Final land uses are assumed to be:

- Focused access to pit lake; and
- Grazing across remainder of lease

1.2.2 Domain 1 – Infrastructure

The Domain 1 closure activities used in the 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. Cost for this task incorporates 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 final lake level or until approved by relevant authority.
- All exploration bores were appropriately decommissioned immediately post their installation.

4.2.2 Domain 2 – Ash Ponds

The only Domain 2 facility at YM is the YNOC. The basis for closure costing for YNOC is 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.
- Installation of an earth buttress to stabilise the northern batter of YNOC.

4.2.3 Domain 3 – Overburden Dumps

YM has no external overburden dumps that require rehabilitation.

4.2.4 Domain 4 – Pits

Township and East Field/Maryvale Field closure activities are as follows:

- Filling of the pit voids with water to +37m AHD within 17 years to produce a lake of acceptable water quality that spills into the Latrobe River.
- Final overall pit slopes of 1:3 (V:H).
- Individual batter slopes to be re-shaped to approximately conform to the overall final slope.
- Installation of horizontal drainage bores to maintain long term slope stability.
- 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 final lake level (+37m 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 +37mAHD) 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 final lake level to control wave erosion.
- Access to lake:
  - Two zones of approximately 20 ha each where public access will be enabled and concentrated;
  - These will comprise flattened slopes of 1V:5H to enhance safety and enable launch of water craft.

4.2.5 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

4.2.6 Domain 6 - Pit Water Filling

It is recognised that diverting the full flow of the Morwell River and ultimately spilling back into the Latrobe River may be a practical solution for how water is sourced, however, this is not outlined in the approved WPV. The following, based on the 2012 WPV, have been used in the costs for filling the pit voids with water:

- All water used to fill pit voids to +37m AHD will be from the Bulk Water Entitlement (BWE) of 36.5 GL/year[4]. Further:
  - There will be no cost to transfer the BWE from the power station to the mine for closure;
  - The annual fees for use of the BWE will be the same as currently paid by the power station;
- End of Mine time taken to fill the pit voids to +37m AHD is as that outlined in YM's water balance study[5], which is 17 years, assuming no flood events are captured.
- Early Closure time to fill the pit voids was not included in the water balance, thus an estimate of 17 years was also.

[4] It is noted that the mine has a Groundwater Extraction Licence (GEL) (3.5 GL/yr). However, the assumption is that as current groundwater extraction is negligible, increasing to the licence limit would require agreement from the licencing agency (Southern Rural Water).
[5] Attachment No. 1 (Yallourn Mine – Final Land Rehabilitation Lake Filling Model – Revision 0 26Apr12) of: Review of Yallourn Mine Rehabilitation Plan. MIN5003 Work Plan Variation. Condition 7. 5 June 2012

The creation of a large lake for closure means 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 positive balance of rainfall and inflows over evaporation is required.

The closure water balance study included in the 2012 WPV 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 leaving the ground. An annual comparison is problematic since it does not take account of the seasonal changes between rainfall and evaporation, or the effects of prolonged wet or dry periods. For this reason URS has made a closer examination of the rainfall – evaporation differential as well as local catchment inflows. .

The results of the preliminary water balance is that the net effect of direct rainfall/evaporation and local catchment inflows will be a small annual deficit of inflows during and following filling of voids. Therefore URS has included a cost for supplementary water costs during the active filling period.

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.

4.2.7 Domain 7 – Maintenance & Monitoring

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

- Maintenance. Cost to maintain the following for period of closure:
  - Rehabilitation areas, based on an assumed 15% vegetation fail over 5 years
  - Fire services
  - Site security
  - Erosion repair
  - Council rates
  - Site services (buildings, power water etc)
- Monitoring. The scope of monitoring includes the following: 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.

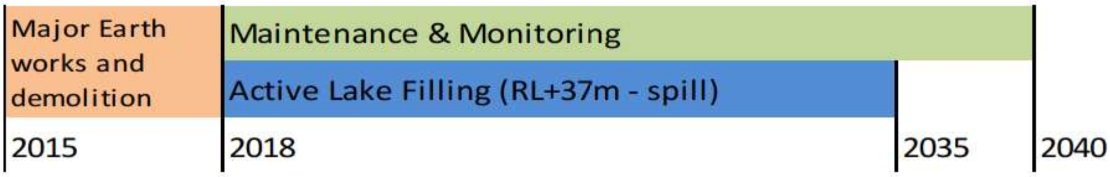
4.3 Timing of Closure

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 tomorrow's current footprint) – within the model this is referred to as EC1

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

Figure 1 Early Closure Schedule



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 - active void filling phase of 17 years
- EC1 – active void filling phase of 17 years

4.3.3 Post Execution Maintenance and Monitoring Phase

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

- Ongoing monitoring of water level, surface water quality, groundwater quality, ecological, slope stability, fire risk and rehabilitation;
- 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 15 years following closure execution, and a less intensive phase extending for another 5 years until site relinquishment is achieved.

4.4 Summary of Assumptions

In preparing this costing for closure of the Yallourn 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 suitable for discharge to the receiving body (Latrobe River);
- 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;
- The YNOC buttress will require approximately 2.5 million m^3 of in situ material to be sourced from within the MIN;
- 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; and
- 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.

The following key risks have been identified for each closure concept:

- Impacts to groundwater quality from YNOC:
  - The risk event is that leachate from YNOC impacts on surface water and/or 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 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 of a standard unsuitable for discharge;
  - The risk event is specifically if the water quality of pit lake does not meet the standard for its target beneficial use.
  - The consequence is that lake water requires treatment.
  - The likelihood was based on the chance that the spilling lake may not generate enough flow to maintain water quality.
- Inability to secure existing water licences;
  - The risk event is that the existing BWE is 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 water balance conclusions are 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 the risks for the YM 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

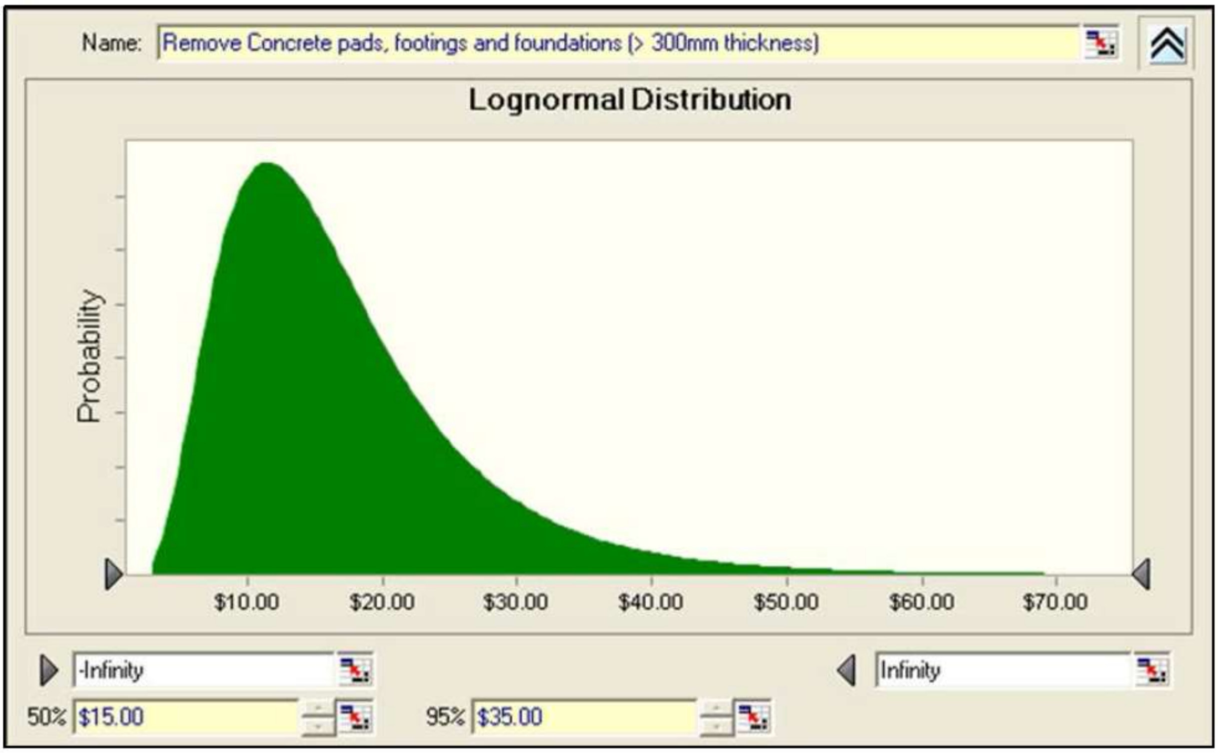
A probabilistic costing model was developed in Excel using URS' previous experience of mine closure costings and the information from the documents provided by ERR. The costing model built upon the costing work, which was conducted in 2012 for the former Department of Primary Industries (DPI). The costing 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 end of mine life and early closure concepts are provided in **Table 1**.

Figure 3 Early Closure Liability and Risk Costs

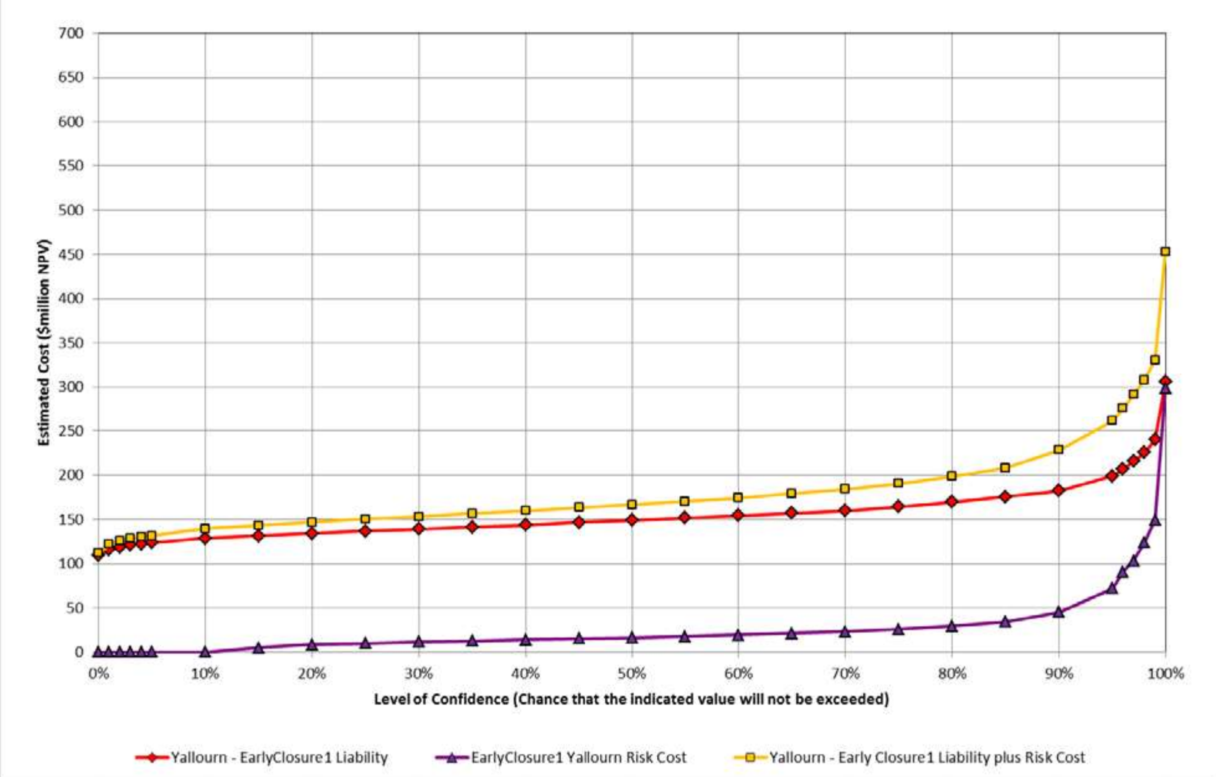


Table 2 Summary of Closure Costs

CONFIDENCE LEVEL	P50 OPTIMISTIC	P80 CONSERVATIVE BUT REALISTIC	P95 VERY CONSERVATIVE
Early Closure Liability Cost	149	170	199
Early Closure Liability Plus Risk Costs	167	199	262
End of Mine Life Closure Liability Cost	126	143	166
End of Mine Life Closure Liability Plus Risk Costs	195	266	344

It should be noted that the end of mine life cost estimates are materially 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%[6].

[6] 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

In 80% of the 2,000 trials for early closure concept the estimated cost (liability only) was less than $170 million. That can be interpreted as there being an 80% chance that the end of mine closure cost will be less than $209 million. Alternatively, the same result shows that according to the simulated results, there is a 20% chance that the cost will be more than $170 million. When consolidated and modelled with the risk cost there is a predicted 80% chance that the total cost will be $199 million or less.

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 (liability plus risk) 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) is $262 million. On the other hand, a much less risk-averse decision-maker might select the cost ($167 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.

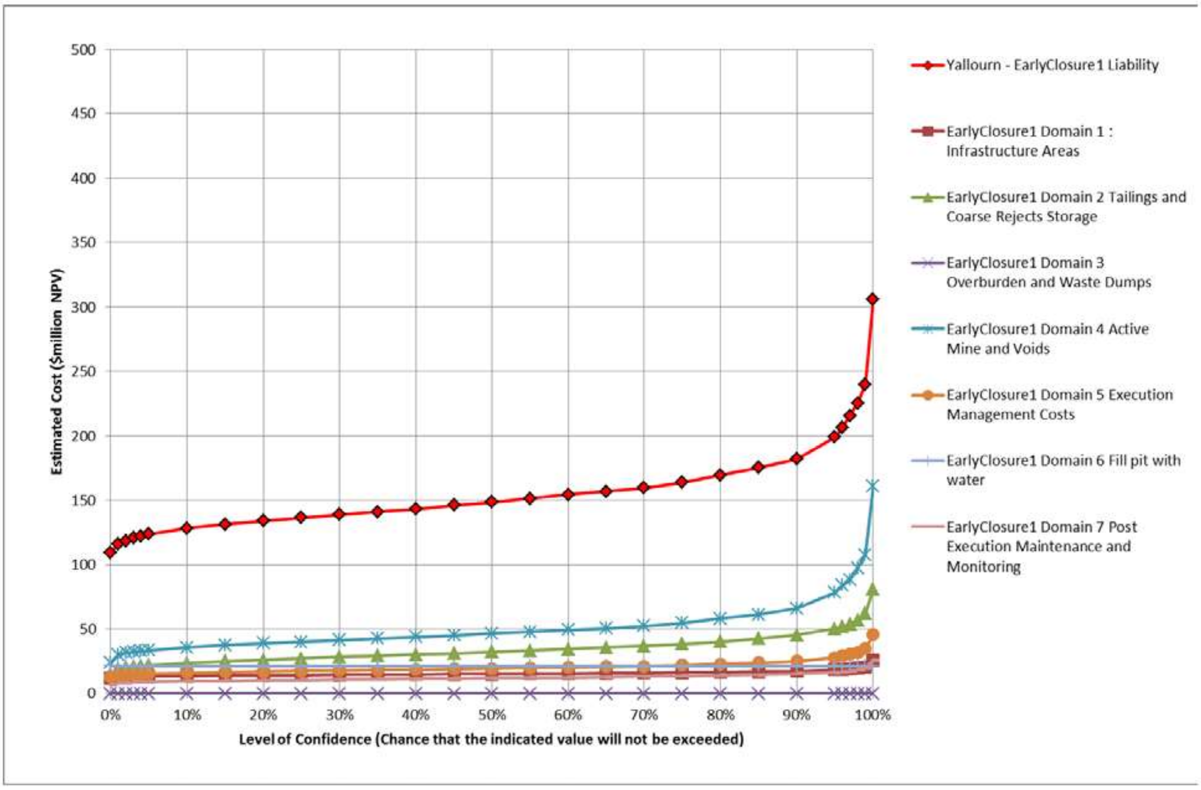
5.2.2 Early Closure Contributor Costs

The following provides additional detail in terms of the where the majority of the liability costs for early closure are, in terms of the domains and specific items:

Domains

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

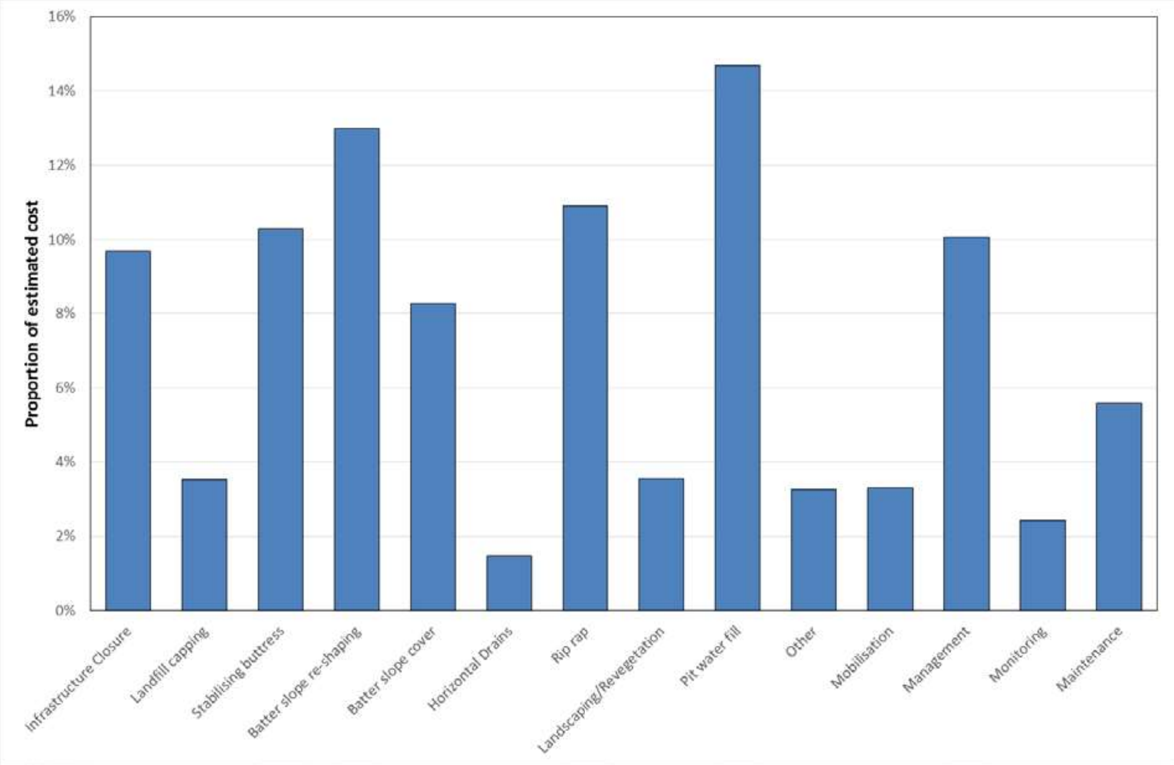
Figure 4 Domain Liability Costs - Early Closure



Key Contributors to Costs

The key contributor items to the overall cost for early closure are summarised in Chart 5-4. This shows that the major contributors to the overall closure cost are for water costs to fill the pit lake, and rip rap around the final lake level. Other major cost activities include the YNOC stabilising buttress, closure management and infrastructure decommissioning, decontamination and demolition.

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

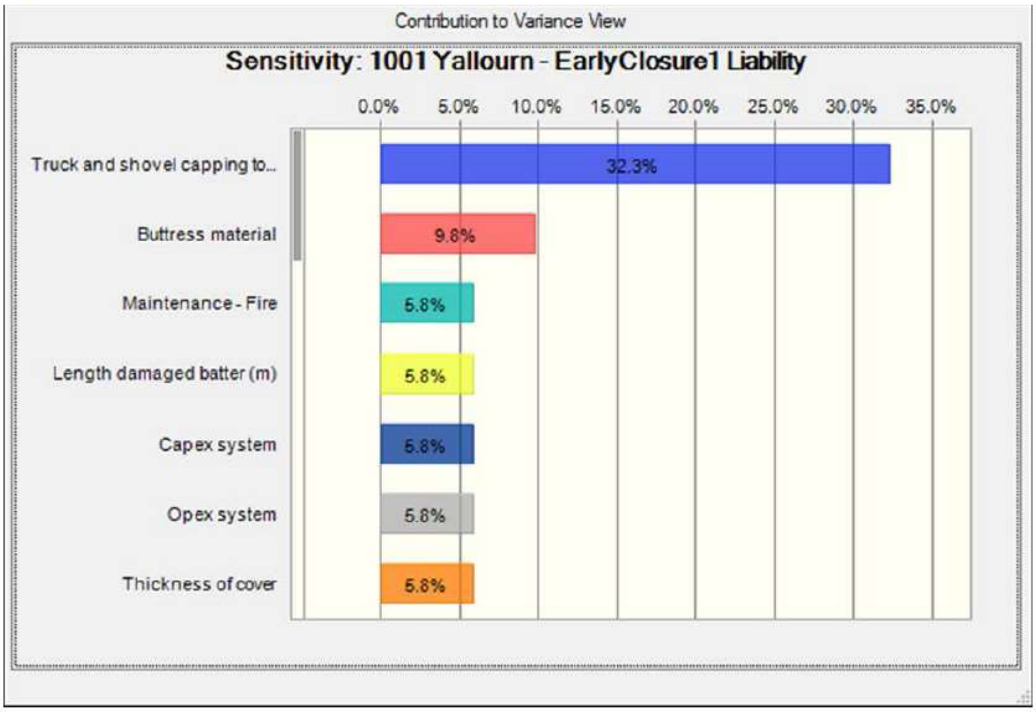


Chart 5-5 shows that the rate for truck and shovel capping of the pit batters and floor is highly uncertain (P50=$10 and P95=$30) and has a large influence (responsible for 32% of the variance) on the total uncertainty of the estimated early closure liability

In summary, the key contributors to the variance associated with early closure liability cost estimates are shown to be 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.
  - Buttress material.
  - Rip rap at final lake level.
- Buttress for YNOC
  - Source, cart and place material for northern YNOC buttress

6.0 References

EnergyAustralia Yallourn Mine, 6 monthly Milestone Report, July to December 2014, for DEDJTR;

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

MIN5003 Bond calculator_na07_concept.xls (Yallourn);

Rawlinsons, Australian Construction Handbook 2015 Edition 33.

TruEnergy, 5 May 2011, Submission for a variation to the approved work pan for Mining Licences No 5003, No 5216 and No. 5304 to incorporate changes to Mining as a result of batter failure in November 2007 and the Maryvale Mine Footprint redesign;

TruEnergy Yallourn Pty. Ltd. Review of Yallourn Mine Rehabilitation Master Plan, 5 June 2012;

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

Yallourn Energy Pty Ltd., May 2000, extract from Rehabilitation Master Plan (Page 12).

7.0 Limitations

AECOM Services Pty Ltd (formerly URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Department of Economic Development, Job, Transport and Resources (DEDJTR) and only those third parties who have been authorised in writing by URS to rely on this Report.

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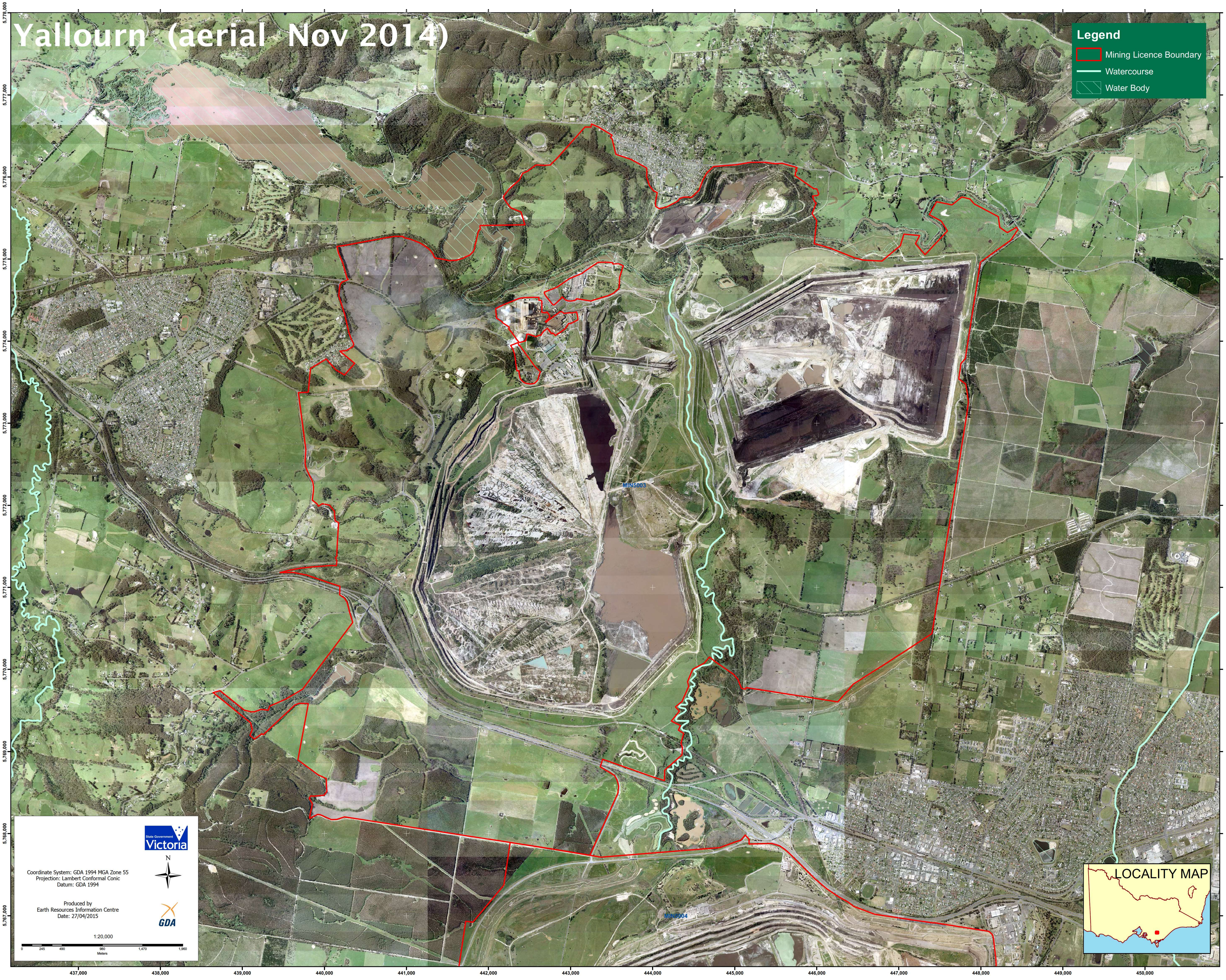
Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Appendix A

Mine Plans

Appendix A Mine Licence Area


Yallourn (aerial Nov 2014)
Legend
Mining Licence Boundary
Watercourse
Water Body
MIN5003
MIN5004
LOCALITY MAP
State Government
Victoria
N
Coordinate System: GDA 1994 MGA Zone 55
Projection: Lambert Conformal Conic
Datum: GDA 1994
Produced by
Earth Resources Information Centre
Date: 27/04/2015
GDA
1:20,000
0 245 490 980 1,470 1,960
Meters
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5,778,000
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5,776,000
5,775,000
5,774,000
5,773,000
5,772,000
5,771,000
5,770,000
5,769,000
5,768,000
5,767,000

Appendix B

Model Inputs

Appendix B Early Closure (current footprint)

EarlyClosure1 Cost Components

YALLOURN Early Closure 1	Total Costs
EarlyClosure1 Domain 1 : Infrastructure Areas	**15,535,688**
Disconnect and terminate services	435,000
Demolish and remove buildings	4,000,000
Remove concrete pads & footings (of buildings)	375,000
Decommission access and haul roads	90,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sur	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	48,000
Demolish and remove conveyors	1,440,000
Decommission, decontaminate and demolish crusher and raw coal bunke	5,890,000
Decommission, decontaminate and demolish dredgers	1,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	957,688
Water Ponds	0
Removal of power lines	120,000
Other disturbed areas	0
EarlyClosure1 Domain 2 Tailings and Coarse Rejects Storage	**30,763,482**
YNOC Slopes	9,258,812
YNOC Buttress (Township side)	14,375,000
YNOC Capping	4,940,000
Landscaping, minor earthworks and revegetation	2,189,671
EarlyClosure1 Domain 3 Overburden and Waste Dumps	**0**
Landscaping, minor earthworks and revegetation throughout domain are	0
EarlyClosure1 Domain 4 Active Mine and Voids	**46,458,034**
Maryvale Field	3,855,314
Yallourn Township Batters - Northern	1,618,420
Yallourn Township Batters -Western	11,458,427
Yallourn Township Batters -Fire Service/Floc Pond Batters	2,448,157
East Field	150,768
East Field Extension	1,532,018
Horizontal Drains	2,116,854
Rip Rap	15,732,964
Erect a security fence around site	0
Landscaping, minor earthworks and revegetation throughout domain are	1,945,112
Create public access	500,000
Lime dosing	5,100,000
EarlyClosure1 Domain 5 Execution Management Costs	**18,551,441**
Mobilisation/Demobilisation	4,637,860
Engineering Procurement & Construction Management	13,913,581
EarlyClosure1 Domain 6 Fill pit with water	**77,829,804**
O&M of dewatering facilities	0
Re-install dewatering bores, then decommission existing bores	0
Supplementary & other water charges	11,308,604
Top up water supply	66,521,200
EarlyClosure1 Domain 7 Post Execution Maintenance and Monitoring	**14,740,000**
Post execution monitoring	4,400,000
Post execution maintenance	10,115,000
Management	225,000
EarlyClosure1 Liability	**203,878,448**

EarlyClosure1 Cost Components

	P50
EarlyClosure1 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	**4,000,000**
Industrial and minesite (m2)	25,000
Proportion removed	100%
Cost per m2	160
Total	4000000
Remove concrete pads & footings (of buildings)	**375,000**
Industrial and minesite (m2)	25,000
Cost per m2	15
Total	375,000
Decommission access and haul roads	**90,000**
Length of roads (km)	30,000
Average width of roads (m)	12
Area of road (m2)	360000
Area of road (ha)	36
Cost per ha	2500
Total	90,000
Waste disposal	**235,000**
General waste	110,000
Waste oils and chemicals (L)	500
rate ($/kL)	250
waste oil disposal (4)	125,000
Total	235,000
Removal and disposal of contaminated water from bunded areas and s	**250,000**
Volume (kL)	1,000
Pump/truck ($/kL)	250
Total	250,000
Removal and disposal of contaminated soils	**195,000**
Volume estimate(m3)	500
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	**1,440,000**
Conveyor length (m)	14,400
Cost $/m	100
Total	1,440,000
Decommission, decontaminate and demolish crusher and raw coal bun	**5,890,000**
	5,890,000
Decommission, decontaminate and demolish dredgers	**1,000,000**
number	1
DDD rate ($)	1,000,000
Total	1,000,000
Remove fire services equipment and pipework	**300,000**
length (m)	60,000
removal rate ($/m)	5
Total	300,000
Remove fire services reservoir	**200,000**
removal	200,000

EarlyClosure1 Cost Components

Landscaping, minor earthworks and revegetation	**957,688**
total disturbed footprint (ha)	39
elling of minor excavations and batters, final trim, rock rake and deep rip	*37,538*
% of disturbed footprint	75%
Rate ($/ha)	1,300.00
Levelling	37,538
nanagement works, banks, drains, rock lined waterways, sediment dams	*15,400*
% of disturbed footprint	20%
Rate ($/ha)	2,000.00
Structural works	15,400
Revegetation	904,750
Revegetate rate ($/ha)	23,500
Revegetate cost ($)	904,750
Water Ponds	**0**
Embankment Length	
Total length (m)	0
Average embankment height (m)	3
Average embankment width (m)	8
Total volume of material (m3)	0
Excavate embankment and place in pit ($)	5
Total Cost	0
Area of pond	
Total area (m2)	0
Average sludge depth (m)	0.5
Total sludge volume (m3)	0
Remove into ash ponds ($)	5
Total Cost ($)	0
Revegetate rate ($/ha)	23,500
Revegetate cost ($)	0
Removal of power lines	**120,000**
Number	6
Cost ($)	20,000
Other disturbed areas	**0**
Total area (ha)	0
Revegetate rate ($/ha)	23,500
Revegetate cost ($)	0

EarlyClosure1 Cost Components

EarlyClosure1 Domain 2 Tailings and Coarse Rejects Storage	
YNOC Slopes	**9,258,812**
Existing Batter Angle Slopes (degrees)	18.4
RL of Base	37
RL Ground Surface at batter top	84
Exposed batter vertical height (H)	47
Surface area of exposed batter (m2/lineal m)	149
Batter area exposed at that base height (m2)	594,508
Batter Length (m)	4,000
Reshaping	*4,800,000*
Number of benches exposed (at ave 20m height)	3
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Reshape cost ($)	4,800,000
Cover	*4,458,812*
Thickness of cover	0.75
Volume of cover material (m3)	445,881
Cover material rate - load haul place	10.00
total cover	4,458,812
Rip Rap	
final slope	18.4
vertical height of rip rap (m)	4.0
surface area of rip rap (m2)	12.6
rip rap thickness (m)	0.75
rock requirement per linear metre (m3)	9
rip rap length along batter (m)	4,000
rip rap area (m2)	50,596
YNOC Buttress (Township side)	**14,375,000**
Average buttress height (m)	50
Average buttress width	100
Length of buttress	500
Volume of Buttress (m3) in situ	2,500,000
Bulking factor	1.15
Buttress material requirment LCM	2,875,000
Buttress cost ($/m3)	5
Total Buttress Cost	14,375,000
YNOC Capping	**4,940,000**
Area of capping (m2)	380,000
Cost of capping ($/m^2)	13
Capping	4,940,000
Landscaping, minor earthworks and revegetation	**2,189,671**
total disturbed footprint (ha)	92
Levelling of minor excavations and batters, final trim, rock rake and deep rip	
% of disturbed footprint	0%
Rate ($/ha)	1,300.00
Levelling	0
Structural water management works, banks, drains, rock lined waterways	
% of disturbed footprint	10%
Rate ($/ha)	2,000
Structural works	18,478
Revegetation	
Revegetate rate ($/ha)	23,500
Revegetate cost ($)	2,171,193

EarlyClosure1 Cost Components

EarlyClosure1 Domain 3 Overburden and Waste Dumps	
Landscaping, minor earthworks and revegetation throughout domain a	**0**
elling of minor excavations and batters, final trim, rock rake and deep rip	
Area (ha)	0
Rate ($/ha)	1300
Total	0
Revegetation	0
Revegetate rate ($/ha)	23,500
Revegetate cost ($)	0
EarlyClosure1 Domain 4 Active Mine and Voids	
Maryvale Field	**3,855,314**
Existing Batter Angle Slopes (degrees)	18.4
RL of Final (Spill) Water	37
RL Ground Surface at batter top	88
Exposed batter vertical height (H)	51
Surface area of exposed batter (m^2/lineal m)	161
Batter area exposed at that water height (m^2)	322,552
Proportion already rehabilitated (%)	20%
Batter area requiring rehabilitation (m^2)	258,042
Batter Length (m)	2,000
Reshaping	*1,920,000*
Number of benches exposed (at ave 20m height)	3
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Full reshape cost ($)	2,400,000
Proportion already rehabilitated (%)	20%
Reshape cost ($)	1,920,000
Cover	*1,935,314*
Thickness of cover	0.75
Volume of cover material (m3)	193,531
Cover material rate - load haul place ($/m3)	10.00
Total required cover ($)	1,935,314
Total cover ($)	2,419,142
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 length along batter (m)	2,000
rip rap area (m2)	25,298

EarlyClosure1 Cost Components

Yallourn Township Batters - Northern	**1,618,420**
Existing Batter Angle Slopes (degrees)	18.4
RL of Final (Spill) Water	37
RL Ground Surface at batter top	57
Exposed batter vertical height (H)	20
Surface area of exposed batter (m^2/lineal m)	63
Batter area exposed at that water height (m^2)	75,895
Proportion already rehabilitated (%)	0%
Batter area requiring rehabilitation (m^2)	75,895
Batter Length (m)	1,200
Reshaping	*480,000*
Number of benches exposed (at ave 20m height)	1
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Full reshape cost ($)	480,000
Proportion already rehabilitated (%)	0%
Reshape cost ($)	480,000
Cover	*1,138,420*
Thickness of cover	1.50
Volume of cover material (m3)	113,842
Cover material rate - load haul place ($/m3)	10.00
Total required cover ($)	1,138,420
Total cover ($)	1,138,420
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 length along batter (m)	1,200
rip rap area (m2)	15,179
Yallourn Township Batters -Western	**11,458,427**
Existing Batter Angle Slopes (degrees)	18.4
RL of Final (Spill) Water	37
RL Ground Surface at batter top	95
Exposed batter vertical height (H)	58
Surface area of exposed batter (m^2/lineal m)	183
Batter area exposed at that water height (m^2)	1,063,790
Proportion already rehabilitated (%)	50%
Batter area requiring rehabilitation (m^2)	531,895
Batter Length (m)	5,800
Reshaping	*3,480,000*
Number of benches exposed (at ave 20m height)	3
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Full reshape cost ($)	6,960,000
Proportion already rehabilitated (%)	50%
Reshape cost ($)	3,480,000
Cover	*7,978,427*
Thickness of cover	1.50
Volume of cover material (m3)	797,843
Cover material rate - load haul place ($/m3)	10.00
Total required cover ($)	7,978,427
Total cover ($)	15,956,853
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 length along batter (m)	5,800
rip rap area (m2)	73,365

EarlyClosure1 Cost Components

Yallourn Township Batters -Fire Service/Floc Pond Batters	**2,448,157**
Existing Batter Angle Slopes (degrees)	18.4
RL of Final (Spill) Water	37
RL Ground Surface at batter top	47
Exposed batter vertical height (H)	10
Surface area of exposed batter (m^2/lineal m)	32
Batter area exposed at that water height (m^2)	88,544
Proportion already rehabilitated (%)	0%
Batter area requiring rehabilitation (m^2)	88,544
Batter Length (m)	2,800
Reshaping	*1,120,000*
Number of benches exposed (at ave 20m height)	1
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Full reshape cost ($)	1,120,000
Proportion already rehabilitated (%)	0%
Reshape cost ($)	1,120,000
Cover	*1,328,157*
Thickness of cover	1.50
Volume of cover material (m3)	132,816
Cover material rate - load haul place ($/m3)	10.00
Total required cover ($)	1,328,157
Total cover ($)	1,328,157
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 length along batter (m)	2,800
rip rap area (m2)	35,418
East Field	**150,768**
Existing Batter Angle Slopes (degrees)	18.4
RL of Final (Spill) Water	37
RL Ground Surface at batter top	40
Exposed batter vertical height (H)	3
Surface area of exposed batter (m^2/lineal m)	9
Batter area exposed at that water height (m^2)	15,179
Proportion already rehabilitated (%)	80%
Batter area requiring rehabilitation (m^2)	3,036
Batter Length (m)	1,600
Reshaping	*128,000*
Number of benches exposed (at ave 20m height)	1
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Full reshape cost ($)	640,000
Proportion already rehabilitated (%)	80%
Reshape cost ($)	128,000
Cover	*22,768*
Thickness of cover	0.75
Volume of cover material (m3)	2,277
Cover material rate - load haul place ($/m3)	10
Total required cover ($)	22,768
Total cover ($)	113,842
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 length along batter (m)	1,600
rip rap area (m2)	20,239

EarlyClosure1 Cost Components

East Field Extension	**1,532,018**
Existing Batter Angle Slopes (degrees)	18.4
RL of Final (Spill) Water	37
RL Ground Surface at batter top	70
Exposed batter vertical height (H)	33
Surface area of exposed batter (m^2/lineal m)	104
Batter area exposed at that water height (m^2)	505,079
Proportion already rehabilitated (%)	80%
Batter area requiring rehabilitation (m^2)	101,016
Batter Length (m)	4,840
Reshaping	*774,400*
Number of benches exposed (at ave 20m height)	2
Average reshape volume (m3 / bench / m slope)	100
Reshape rate ($/m3)	4
Full reshape cost ($)	3,872,000
Proportion already rehabilitated (%)	80%
Reshape cost ($)	774,400
Cover	*757,618*
Thickness of cover	0.75
Volume of cover material (m3)	75,762
Cover material rate - load haul place ($/m3)	10.00
Total required cover ($)	757,618
Total cover ($)	3,788,092
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 length along batter (m)	4,840
rip rap area (m2)	61,222
Morwell River Diversion	
Ave side slope (degrees)	18.4
vertical height of rip rap (m)	4.0
surface area of rip rap (m2/m)	12.6
Length (m)	2,490
rip rap area for each side slope (m^2)	31,496
rip rap area (m^2)	62,993
Horizontal Drains	**2,116,854**
Exposed slope area (ha)	106
No required (#/ha slope)	1
No required	106
Installation cost for required horizontal drains($)	2,116,854
Total horizontal drain cost ($)	4,142,078
Rip Rap	**15,732,964**
total rip rap area (m2)	262,216
rip rap rate ($/m2)	60
Total Rip Rap	15,732,964
Erect a security fence around site	**0**
Length of fence (m)	0
Construct ($/m)	50
Total	0
Landscaping, minor earthworks and revegetation throughout domain a	**1,945,112**
Total area (ha)	83
Revegetate rate ($/ha)	23500
Revegetate cost ($)	1,945,112
Create public access	**500,000**
Number of areas	2
Cost per area	250,000
Total	500,000
Lime dosing	**5,100,000**
Lime dosing of acid run-off ($/yr)	300,000
Number of years	17
Total	5,100,000

EarlyClosure1 Cost Components

EarlyClosure1 Domain 5 Execution Management Costs	
Mobilisation/Demobilisation	**4,637,860**
Total Execution Cost	92,757,203
% of total execution cost	5%
Engineering Procurement & Construction Management	**13,913,581**
Total Execution Cost	92,757,203
% of total execution cost	15%
EarlyClosure1 Domain 6 Fill pit with water	
O&M of dewatering facilities	**0**
Annual cost ($/an)	0
Duration (yrs)	17
Total	0
Re-install dewatering bores, then decommission existing bores	**0**
Length of elevated pad (m)	0
Width of elevated pad (m)	0
Height of elevated pad (m)	0
Sectional volume of pad (m3/m length)	0
Volume of pad (m3)	0
Construct elevated pad ($/m3)	0
Pad	0
Construct dewatering bore ($/bore)	0
Number of new bores	0
Connection pipeworks (m)	0
Connection pipeworks ($/m)	0
New bores	0
Number of existing bores	0
Decommission existing bores ($/bore)	0
Existing bores	0
Total	0
Supplementary & other water charges	**11,308,604**
Required supplementary water supply for filling period (GL/yr)	0.0
Allocation purchase ($/GL)	2,000,000
Allocation purchase ($)	-
Annual fee ($/yr)	665,212
Fill duration (yrs)	17
Supplementary & other water cost ($)	11,308,604
Top up water supply	**66,521,200**
In perpetuity top up (GL/yr)	3.4
In perpetuity top up ($/yr)	665,212
Duration	100
In perpetuity top up ($)	66,521,200
EarlyClosure1 Domain 7 Post Execution Maintenance and Monitoring	
Post execution monitoring	**4,400,000**
Annual rate - first 5 yrs after execution phase ($/yr)	325,000
Number of Years	5
	1625000
Annual rate - subsequent monitoring phase ($/yr)	185,000
Number of Years	15
	2775000
Post execution maintenance	**10,115,000**
Annual rate - first 5 yrs after execution phase ($/yr)	1,012,000
Number of Years	5
	5,060,000
Annual rate -subsequent maintenance phase ($/yr)	337,000
Number of Years	15
	5,055,000
Management	**225,000**
Subtotal maintenance & monitoring ($)	14,515,000
Management (%)	3%
Management ($)	435,450

Appendix B End of Mine Life

EoM Closure Cost Components

YALLOURN End of Mine Life Footprint	Total Costs
EoM Domain 1 : Infrastructure Areas	**14,535,688**
Disconnect and terminate services	435,000
Demolish and remove buildings	4,000,000
Remove concrete pads & footings (of buildings)	375,000
Decommission access and haul roads	90,000
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	1,440,000
Decommission, decontaminate and demolish crusher and raw coal bunker	5,890,000
Decommission, decontaminate and demolish dredgers	0
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	957,688
Water Ponds	0
Removal of power lines	120,000
Other disturbed areas	0
EoM Domain 2 Tailings and Coarse Rejects Storage	**30,763,482**
YNOC Slopes	9,258,812
YNOC Buttress (Township side)	14,375,000
YNOC Capping	4,940,000
Landscaping, minor earthworks and revegetation	2,189,671
EoM Domain 3 Overburden and Waste Dumps	**0**
Landscaping, minor earthworks and revegetation throughout domain area	0
EoM Domain 4 Active Mine and Voids	**73,444,329**
Maryvale Field	11,340,435
Yallourn Township Batters - Northern	2,529,156
Yallourn Township Batters -Western	15,860,317
Yallourn Township Batters -Fire Service/Floc Pond Batters	4,573,207
East Field	2,303,578
East Field Extension	5,205,320
Horizontal Drains	2,539,967
Rip Rap	21,189,790
Erect a security fence around site	0
Landscaping, minor earthworks and revegetation throughout domain area	2,302,560
Create public access	500,000
Lime dosing	5,100,000
EoM Domain 5 Execution Management Costs	**23,748,700**
Mobilisation/Demobilisation	5,937,175
Engineering Procurement & Construction Management	17,811,525
EoM Domain 6 Fill pit with water	**77,829,804**
O&M of dewatering facilities	0
Re-install dewatering bores, then decommission existing bores	0
Supplementary & other water charges	11,308,604
Top up water supply	66,521,200
EoM Domain 7 Post Execution Maintenance and Monitoring	**14,740,000**
Post execution monitoring	4,400,000
Post execution maintenance	10,115,000
Management	225,000
EoM Liability	**235,062,003**

Appendix C

Unit Rates and Parameters

Appendix C General

Appendix C1.xlsx

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		37	37
YNOC				
Ground Surface	RL m		84	84
Batter Lengths	m		4000	4,000
Mayvale Field				
Ground Surface	RL m		70	88
Batter Lengths	m		5600	2,000
Yallourn Township Batters - Northern				
Ground Surface	RL m		57	57
Batter Lengths	m		1200	1200
Yallourn Township Batters -Western				
Ground Surface	RL m		95	95
Batter Lengths	m		5800	5,800
Yallourn Township Batters -Fire Service/Floc Pond Batters				
Ground Surface	RL m		47	47
Batter Lengths	m		2800	2800
East Field				
Ground Surface	RL m		40	40
Batter Lengths	m		2700	1,600
East Field Extension				
Ground Surface	RL m		70	70
Batter Lengths	m		4840	4,840
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		15.00%	
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
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%	
Timelines			**EoML**	**Early Closure 1**
Year of current assessment			2015	2015
Year number			1	1
Mine Shutdown			2026	2015
Duration of void lake fill			17	17
Year closure execution to commence			2027	2015
Year number			13	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		15	15
			P50	**P95**

Appendix C1.xlsx

Effective duration of post execution maintenance/monitoring - subsequent phase	years		15	25
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	
Externally sourced cover & cap material	$\$/m^3$		$10	
Internally sourced buttress / fill material	$\$/m^3$		$5	
Reshaping	$\$/m^3$		$4.00	
Horizontal bores for slope stabilisation			**P50**	**P95**
No required	#/ha slope		1	1.5
Installation cost	$/bore		$20,000	$50,000
Dewatering bores				
Connection pipeworks	$/m		$50	$70
Rip Rap				
thickness	m		0.75	
vertical height	m		4	
YNOC Cap				
thickness	m		1	1.5
rate (load, haul, dump, compact)	$\$/m^3$		13	
rate (load, haul, dump, compact)	$\$/m^2$		13	
Create public access				
Cost per area	$/area		$ 250,000	$ 500,000
Annual dewatering costs				
Yallourn	$/annum		0	0
Bulk Water Entitlement				
Current Yallourn BWE	GL/yr		36.5	
Supplementary Water Purchase Costs (see background to costs at bottom of this worksheet)				
Allocation Purchase	$/ML		$ 2,000	$ 5,000
Allocation Purchase	$/GL		$ 2,000,000	
Annual groundwater fee	$/ML/yr		$ -	
Annual groundwater fee	$/GL/yr		$ -	
Annual Bulk Water Entitlement	$		$ 665,212	
Total annual fees	$/yr		$ 665,212	

Appendix C2.xlsx

Management Precinct	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		
Main Work Shop and	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
Access & Haul Roads							
	Reshape, deep rip and ameliorate sealed unsealed roads	Ha	$2,500.00	$2,500	$3,500	Lognormal Distribution applied	
Removal and disposal of							
	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 (>2km-5km)	$/m3	$2.75	$2.75	$3.25	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
Landscaping, minor earthworks and revegetation throughout domain area.	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	
Active Mining Pit or other Voids (including the voids and any internal benches or mine strips)	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 (Clay Batter) to achieve grades nominated in the approval/permit (i.e. < 18o) <50m	m3	$1.30	$1.55	$3.00	Lognormal Distribution applied	Estimated range from range of BC rates
	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	$4.00	$5.00	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 inflitration	m		0.75	1	Lognormal Distribution applied	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
Ash Dams	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
Other Management Issues	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