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

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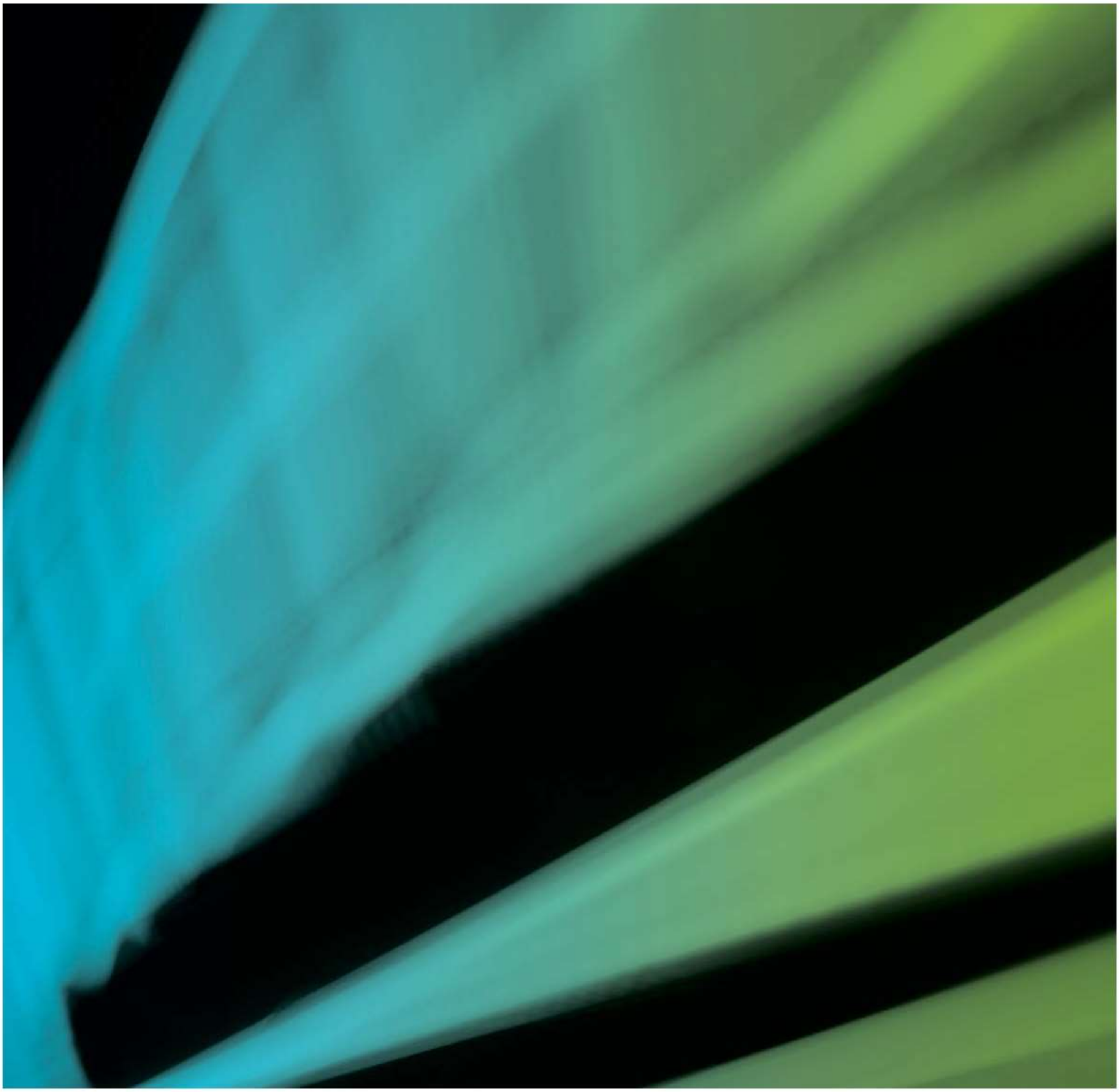
Estimation of Rehabilitation Costs

AGL Loy Yang Mine



Estimation of Rehabilitation Costs

AGL Loy Yang Mine

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

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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	B Chadwick

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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
Ha	Hectare
LYM	AGL Loy Yang Mine
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 (now trading as AECOM Services Pty Ltd)

1.0 Introduction

Earth Resources Regulation (**ERR**), from the Department of Economic Development, Jobs, Transport and Resources (**DEDJTR**), engaged URS[1] Australia Pty Ltd (**URS**) in March 2015 to provide an estimate of the rehabilitation (closure) costs for AGL Loy Yang Mine (**LYM**).

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.

The 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.

[1] Now trading as AECOM Services Pty Ltd

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 LYM.

2.1.2 Information Sources

ERR provided the following documents and/or information:

- MIN5189 Work Plan 1997 Gazettal.pdf;
  - Part 1 – Mine Overview;
  - Part 2 – Rehabilitation Plan
  - Part 3 – Environmental Monitoring Plan
- GHD, AGL Loy Yang, Mine Hydrogeological and Geotechnical Performance Report, 6 monthly Report, July to December 2014, March 2015;
- Loy Yang 2013_14 annual expenditure return.pdf;
- MIN5189 Bond calculator_na07_concept.xls; and
- 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[2], 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 Hazelwood management in late October 2015.

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[2] 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

2.2 Closure Cost Estimates

Cost estimates have been developed for the following scenarios:

- Current approved Work Plan (1997):
  - End of Mine Life Closure – closure based on the predicted footprint for the current mine plan with mining finishing in 2037.
  - Early Closure with current footprint – a "close tomorrow" scenario

The cost estimates are based on the closure domains outlined in **Table 1** (below) and 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.

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.
2	Tailings and coarse rejects – includes capping, reshaping and landscaping of ash ponds	LYM has no ash ponds or coarse rejects in mining licence area.
3	Overburden and waste dumps – includes overburden dumps	Includes external overburden dump (EOD)
4	Active Mines and Voids – includes the backfilling of mine voids, slope reshaping, fencing and landscaping	Includes: North East Batters, North West Batters, Western Batters, Southwestern Batters, Southeastern Batters, Mine Floor/East, 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 Mine Status

3.1 Current Mine Status

Mining began at LYM in 1982 and is scheduled to continue until the mining licence expires in 2037 with the extension of the pit to the east and south east.

The current approved Work Plan is that outlined in the May 1997 Gazettal. LYM submitted a Work Plan Variation (**WPV**) in May 2015, which is currently being assessed by ERR.

The LYM Mining Licence boundary (MIN 5189) is shown in Appendix A and is approximately 4,561 ha in area. The Loy Yang A and B Power Stations are excluded from the mining licence and are not considered in this costing.

The assumed limit of mining is similar to that outlined in 1997.

Mining is currently conducted using four bucket wheel excavators and overburden is conveyed to the External Overburden Dump (**EOD**) by two conveyors.

The overburden dump strategy for the current Work Plan (1997) assumes the EOD is constructed to 7 levels, with no material going to an internal dump. The 1997 Work Plan states that 570 Mm^3 of waste (plus leached ash) will ultimately have to be placed into the EOD based on mining a reserve volume of 2,000 Mt of coal.

Runoff from the EOD is monitored, treated and discharged to Traralgon Creek under EPA licence.

The MIN5189 expiry date is 6 May 2037.

3.2 Approved Rehabilitation Master Plan

The approved closure and rehabilitation commitments are contained in the 1997 Work Plan (Part 2- Rehabilitation Master Plan). The key statement in the 1997 Work Plan is:

…mine be gradually flooded at the end of operations to form a lake for community purposes.

The overburden dump would be reverted to grazing land and recreational areas.

No further details are provided in the 1997 Work Plan on the time taken to flood the void, the source of the water supply or the final water level or water quality.

3.3 Pending Closure Plan

It is understood that ERR is currently assessing the LYM's 2015 WPV (V05, dated May 2015) with approval pending at the time of this report. As a result the 2015 WPV was not considered in the closure costs provided herein.

4.0 Closure Strategy

4.1 Background

The 1997 WP closure concept for LYM is a fully flooded pit lake, with the assumption that it spills into the local catchment (Traralgon Creek or Sheepwash Creek). However, the strategy to achieve this 'fully flooding' concept is lacking in detail in relation to:

- Water source(s)
- Filling time;
- Final land use; and
- Final water quality (need for treatment).

In generating the closure cost estimates for the 1997 WP strategies it was necessary for URS to develop a broad closure strategy in terms of the 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

The final land use is 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 is summarised 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.
  - Also included as part of the infrastructure decommissioning is the RCB, and associated Bunker Driver Tower, both of which are assumed to be within the MIN licence.
- 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 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

No ash ponds and/or tailings dams exist within MIN5189.

4.2.4 Domain 3 – Overburden Dumps

The 1997 WP states that the all overburden, throughout the mine life, will be placed outside the pit in the EOD. Thus the closure strategy for Domain 3 is as follows:

- Reshaping of EOD to enhance drainage;
- Placement of vegetation medium
- Planting of overburden slopes with low maintenance, shallow rooted, native vegetation endemic to the region

4.2.5 Domain 4 – Pit

The closure assumptions are as follows:

- Individual batter slopes to be re-shaped to approximately conform to the overall final slope.
- For the early closure case, the entire North East and North West batter slopes will require cutback to achieve 1:3 (V:H) overall 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 (+60m 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 +60m AHD) 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.

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 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

The 1997 WP does not provide a target lake level, with the statement made assuming to mean that the pit is fully flooded to a level which spills into the local catchment. Therefore, the following has been used in the costs for filling the pit void with water:

- Water needs to fill to +60m AHD to achieve spill into local catchment
- All water used to fill pit void to +60m AHD will be from the Bulk Water Entitlement (BWE[3]) of 40 GL/year and the current groundwater extraction total of 10 GL/year[4] from the mine. 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 spill is estimated to be 43 years and 22 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.

The mode of closure is to fill the mine void with water to a target level. 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 positive/neutral balance of rainfall and inflows over evaporation is required.

As the 1997 WP does not have a water balance assessment 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.

4.2.8 Domain 7 – Monitoring and Maintenance

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: 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

Two costings have been generated for the following 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**.

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[3] Total from both Loy Yang A and B power station.
[4] It is noted that the mine's Groundwater Extraction Licence (GEL) (20 GL/yr) is greater than its current use (~10 GL/yr). However, the assumption is that current usage is approved and increasing to the licence limit would require agreement from the licencing agency (Southern Rural Water).

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**

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:

- EoM - active void filling phase of 43 years
- EC1 – a void filling phase of 22 years

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 have been costed to cover a 45 year period after completion of closure execution for the 1997 Work plan scenario.

4.4 Summary of Assumptions

In preparing this costing for the Loy Yang Mine the following has been assumed:

- End of mine life of 2037, 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 and require replacement;
- Final pit slopes of 1V:3H will have long-term geotechnical and erosional stability;
- No major cut-backs of slopes are required (apart from the northern batters at Loy Yang which are less than 1V:3H);
- Final pit water is suitable for the required beneficial use;
- There is no groundwater contamination present which would present a human/ecological risk;
- No seepage or groundwater loss from the voids on filling;
- Little or no additional rehabilitation will have been carried out by end of mine life;
- Current power station BWEs can be transferred and used for void filling at zero cost;
- Current groundwater pumping use 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 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 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 and current groundwater use 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 there is significant periods post closure where there is a net water deficit, and thus purchase of water is needed to maintain the lake level.
  - 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 concept of “risk cost” has been factored into the total closure costs.

5.0 Cost Estimates for Closure

5.1 Methodology

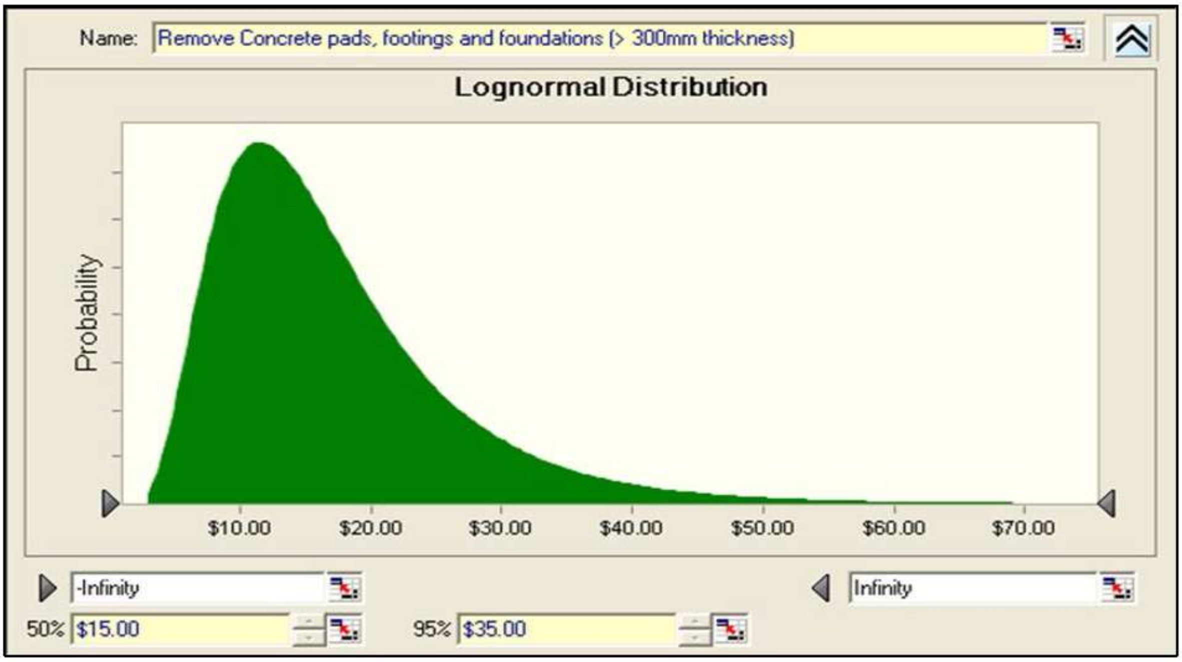
A probabilistic costing model was developed in Excel using URS' previous experience of mine closure costings and the information from the documents provided by ERR. The costing model built upon the costing work, which was conducted in 2012 for the former Department of Primary Industries (DPI). The costing 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 (1997 WP) at a range of confidence levels is provided in **Figure 3**.

A summary of the 50%, 80% and 95% Confidence Level outputs for each closure concept is provided in **Table 2**.

Figure 3 Early Closure Liability and Risk Costs – 1997 WP

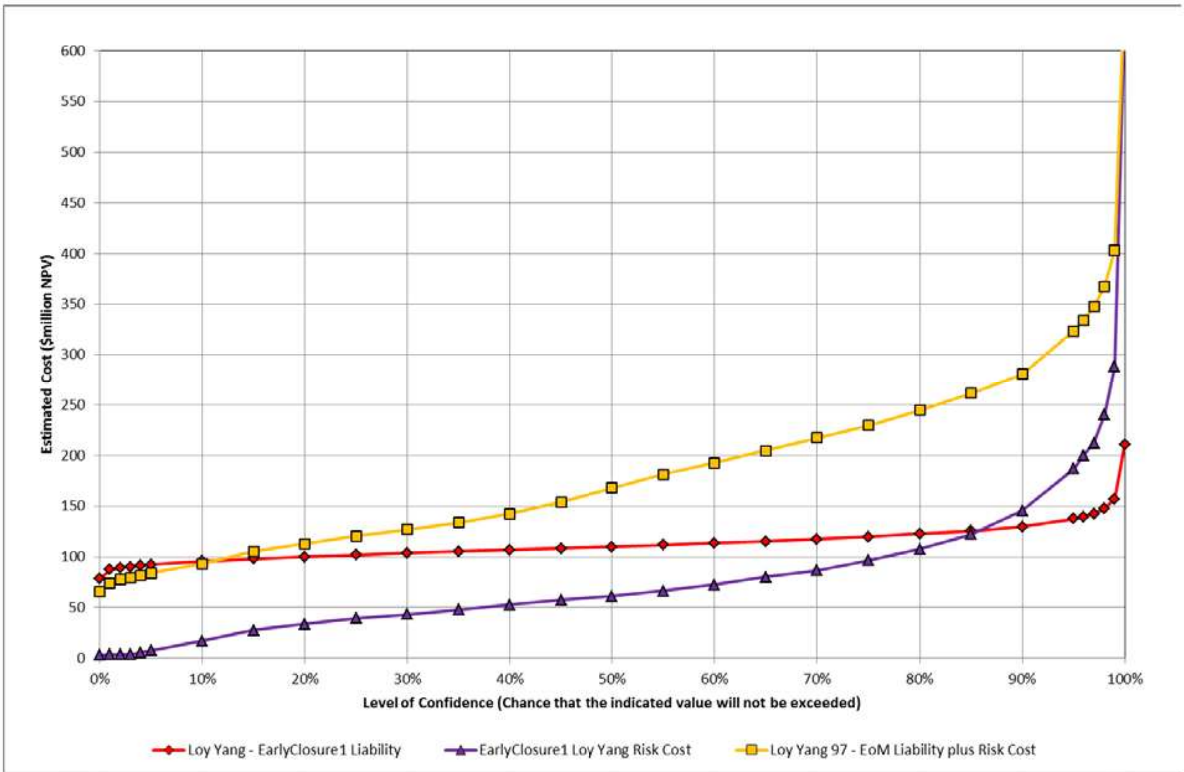


Table 2 Summary of Closure Costs - 1997 Work Plan

CONFIDENCE LEVEL	P50 OPTIMISTIC	P80 CONSERVATIVE BUT REALISTIC	P95 VERY CONSERVATIVE
Early Closure Liability Cost	110	123	138
Early Closure Liability Plus Risk Costs	246	270	298
End of Mine Life Liability Costs	77	85	93
End of Mine Life Liability Plus Risk Costs	168	245	323

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 regards the 1997 WP, in 80% of the 2,000 trials for early closure concept (excluding risk) the estimated cost was less than $123 million. That can be interpreted as there being an 80% chance that the rapidly filling closure cost will be less than $123 million. Alternatively, the same result shows that according to the simulated results, there is a 20% chance that the cost will be more than $123 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 1997 early closure (current footprint, including risk costs) is $298 million. On the other hand, a much less risk-averse decision-maker might select the cost ($246 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.

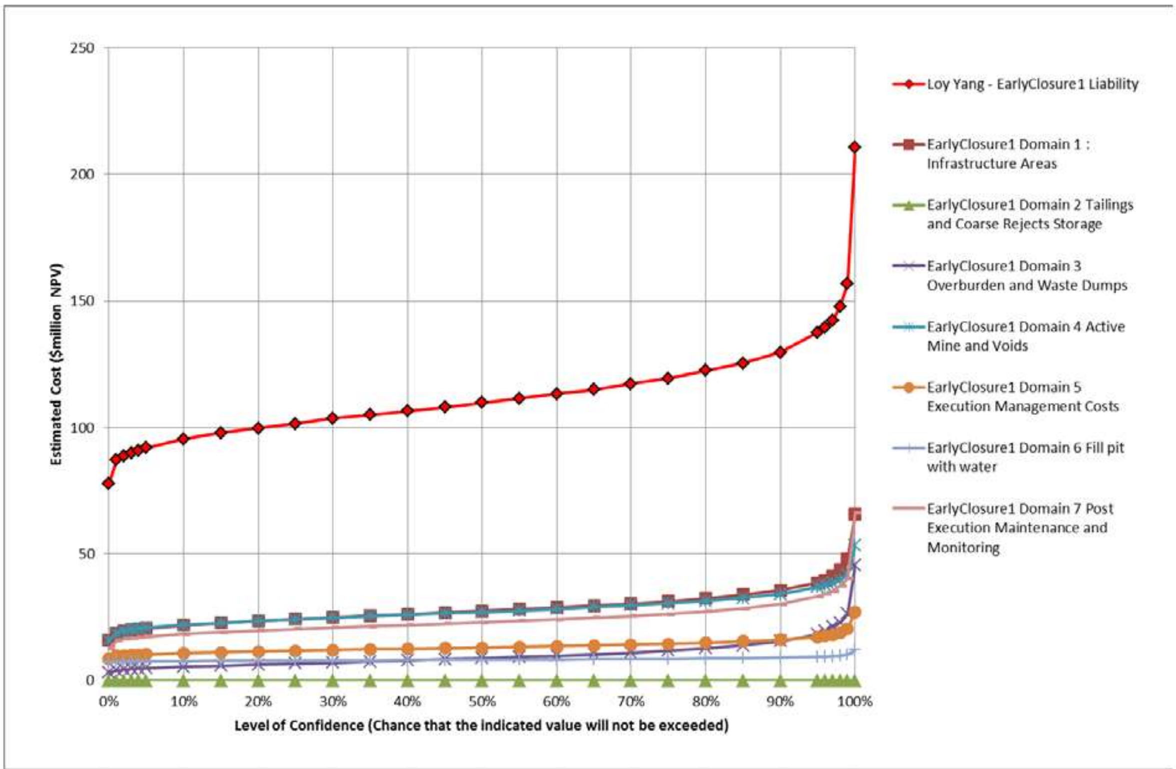
5.2.2 Early Closure Contributor Costs - 1997 WP

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 domain liability costs (excluding risk costs) with regards early closure (1997 WP) is presented in **Figure 4**.

Figure 4 Domain Early Closure Liability Costs – 1997 WP

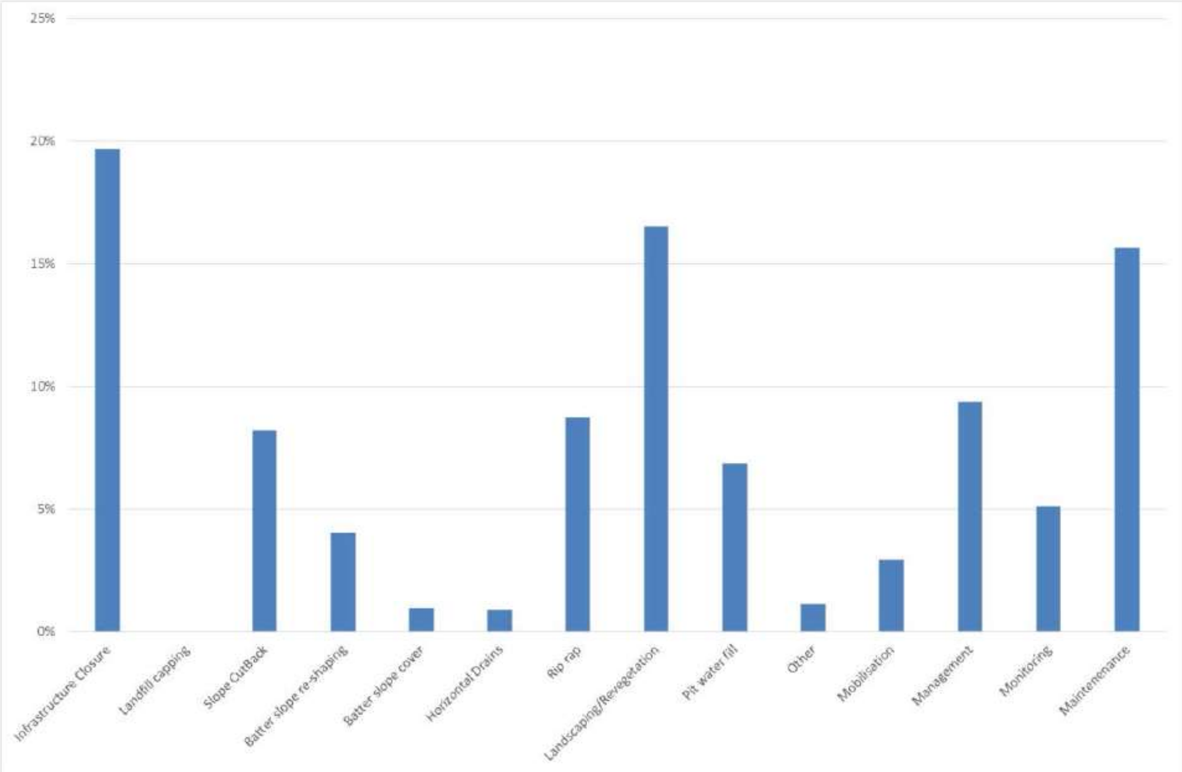


[5] Based on published wage discount rate: http://www.dtf.vic.gov.au/Publications/Government-Financial-Management-publications/Financial-reporting-policy/Wage-inflation-and-discount-rates

Key Contributors to Costs

The key contributor items to the overall liability cost for early closure are summarised in **Figure 5**. This shows that the major contributors to the overall discounted closure cost are the decommissioning and landscaping/revegetation. Other major cost activities include, reshaping of batter slopes and installation of rip rap.

Figure 5 Key Contributors to Early Closure Liability Costs (P50) – 1997 WP



5.2.3 Early Closure Uncertainty – 1997 WPV

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 1997 WP

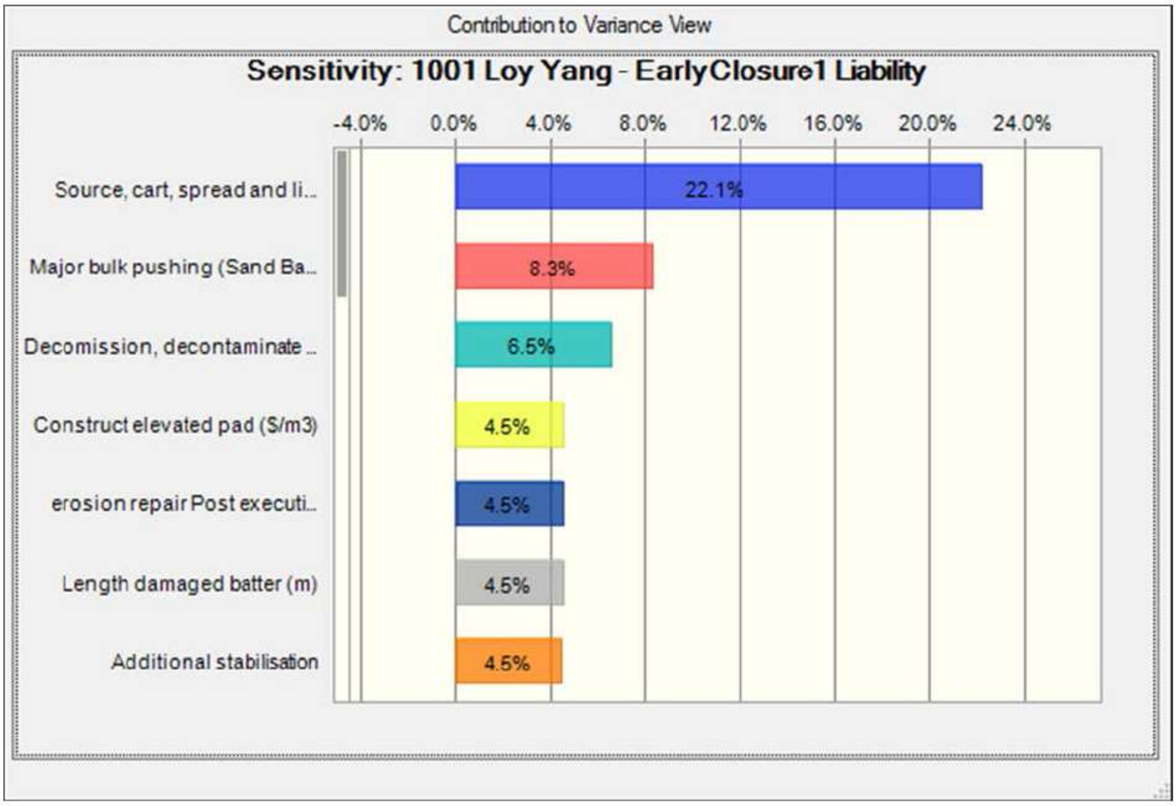


Figure 6 shows that the rate for truck and shovel capping of the pit batters is highly uncertain (P50=$10 and P95=$30) and has a large influence (responsible for 22% of the variance) on the total uncertainty of the estimated early closure liability.

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 cover batter slopes with soil material.

6.0 References

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

MIN5189 Work Plan 1997 Gazettal

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MIN5189 Bond calculator_na07_concept.xls (Loy Yang);

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

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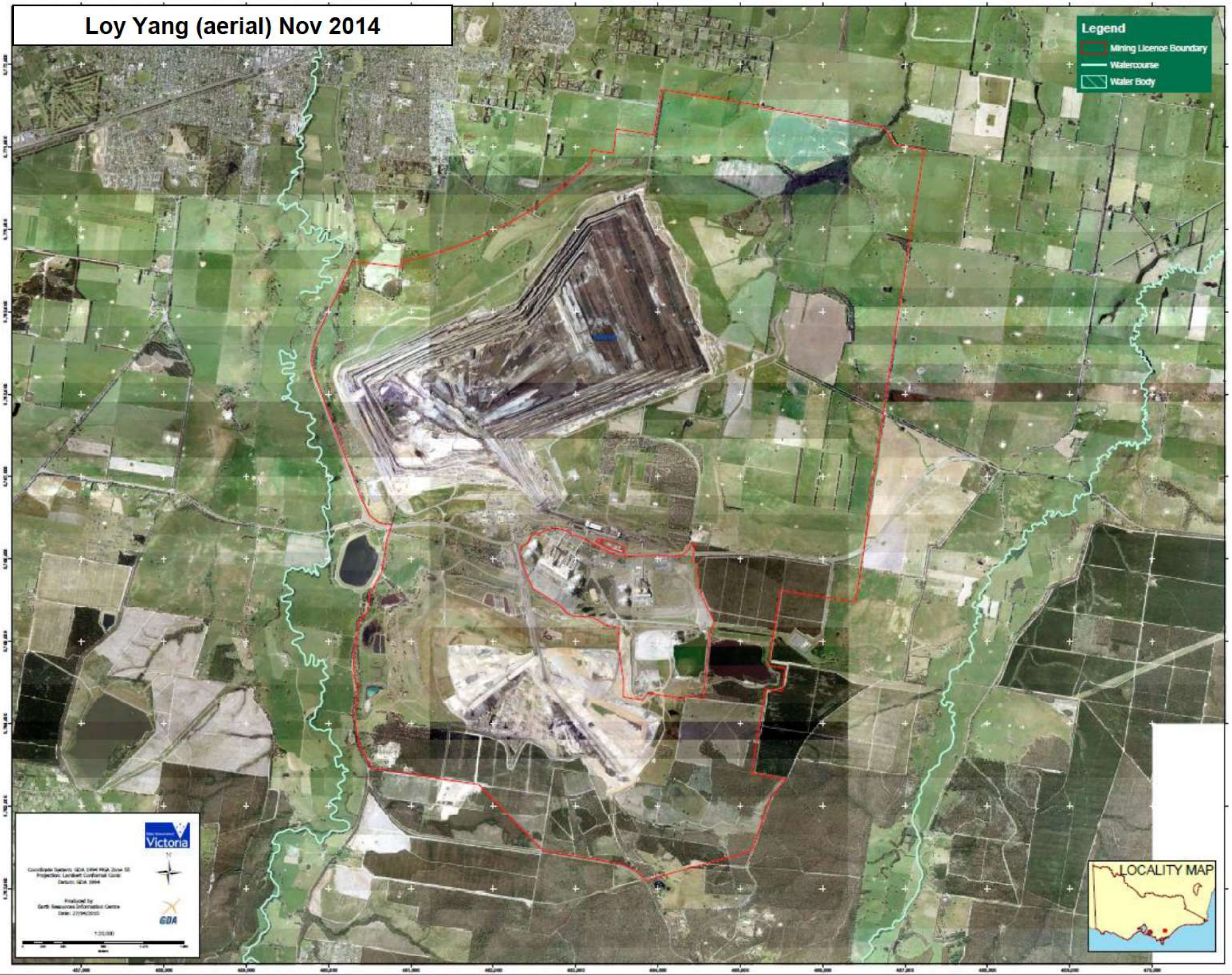
Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Appendix A

Mine Plans

Appendix A Mine Licence Area


Loy Yang (aerial) Nov 2014
Legend
Mining Licence Boundary
Watercourse
Water Body
Victoria
N
GDA
LOCALITY MAP

Appendix B

Model Inputs

Appendix B Early Closure (Current Footprint)

EarlyClosure1 Cost Components

LOY YANG Early Closure 1 Footprint	Total Costs
EarlyClosure1 Domain 1 : Infrastructure Areas	**26,586,600**
Disconnect and terminate services	20,000
Demolish and remove buildings	952,000
Remove concrete pads & footings (of buildings)	2,265,000
Decommission access and haul roads	180,000
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	240,000
Demolish and remove conveyors	3,010,000
Decommission, decontaminate and demolish crusher and RCB	5,890,000
Decommission, decontaminate and demolish dredgers	6,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	6,049,600
Removal of power lines	800,000
EarlyClosure1 Domain 2 Tailings and Coarse Rejects Storage	**0**
None in Loy Yang	0
EarlyClosure1 Domain 3 Overburden and Waste Dumps	**9,112,000**
Landscaping, minor earthworks and revegetation throughout domain area	9,112,000
EarlyClosure1 Domain 4 Active Mine and Voids	**26,823,078**
Northeast Batters	4,527,547
Northwest Batters	6,720,505
Western Batters	642,691
Southwestern	628,274
Southeastern	933,718
Mine Floor/East	948,027
Horizontal Drains	939,829
Rip Rap	9,562,728
Erect a security fence around site	1,190,000
Landscaping, minor earthworks and revegetation throughout domain area	729,759
EarlyClosure1 Domain 5 Execution Management Costs	**12,504,336**
Mobilisation/Demobilisation	3,126,084
Engineering Procurement & Construction Management	9,378,252
EarlyClosure1 Domain 6 Fill pit with water	**8,807,000**
O&M of dewatering facilities	640,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	5,992,000
EarlyClosure1 Domain 7 Post Execution Maintenance and Monitoring	**31,371,740**
Post execution monitoring	7,520,000
Post execution maintenance	22,938,000
Management	913,740
EarlyClosure1 Liability	**115,204,753**

EarlyClosure1 Cost Components

Northeast Batters		4,527,547	
		P50	**P95**
EarlyClosure1 Domain 1 : Infrastructure Areas			
Disconnect and terminate services		**20,000**	
	disconnect and terminate services	5,000	
	Number of services	4	
	Total	20,000	
Demolish and remove buildings		**952,000**	
	Industrial and minesite (m2)	5,950	
	Proportion removed	100%	
	Cost per m2	160	
	Total	952000	
Remove concrete pads & footings (of buildings)		**2,265,000**	
	Industrial and minesite (m2)	151,000	
	Cost per m2	15	
	Total	2,265,000	
Decommission access and haul roads		**180,000**	
	Length of roads (m)	60,000	70,000
	Average width of roads (m)	12	20
	Area of road (m2)	720000	
	Area of road (ha)	72	
	Cost per ha	2500	
	Total	180,000	
Waste disposal		**235,000**	
	General rubbish	110,000	120,000
	Waste oils and chemicals (L)	500	1,000
	rate ($/kL)	250	
	waste oil disposal (4)	125,000	
	Total	235,000	
Removal and disposal of contaminated water from bunded areas and sumps		**250,000**	
	Volume (kL)	1,000	4,000
	Pump/truck ($/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		**240,000**	
	Number of USTs	5	
	Cost per UST	48,000	
	Total	240,000	
Demolish and remove conveyors		**3,010,000**	
	Conveyor length (m)	30,100	35,000
	Cost $/m	100	
	Total	3,010,000	
Decommission, decontaminate and demolish crusher and RCB		**5,890,000**	
	Total	5,890,000	
Decommission, decontaminate and demolish dredgers		**6,000,000**	
	number	6	
	DDD rate ($)	1,000,000	
	Total	6,000,000	
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**	

EarlyClosure1 Cost Components

Northeast Batters	4,527,547	
removal	200,000	400,000
Landscaping, minor earthworks and revegetation	**6,049,600**	
total disturbed footprint (ha)	243	
Levelling of minor excavations and batters, final trim, rock rake and deep rip	*237,120*	
% of disturbed footprint	75%	
Rate ($/ha)	1,300.00	
Levelling	237,120	
water management works, banks, drains, rock lined waterways, sediment dams	*97,280*	
% of disturbed footprint	20%	
Rate ($/ha)	2,000.00	
Structural works	97,280	
Revegetation	*5,715,200*	
Revegetate rate ($/ha)	23,500.00	
Revegetate cost ($)	5,715,200.00	
Removal of power lines	**800,000**	
Number	40	
Cost ($)	20,000	
EarlyClosure1 Domain 2 Tailings and Coarse Rejects Storage		
None in Loy Yang	-	
EarlyClosure1 Domain 3 Overburden and Waste Dumps		
Landscaping, minor earthworks and revegetation throughout domain area	**9,112,000**	
Levelling of minor excavations and batters, final trim, rock rake and deep rip		
Area (ha)	340	
Rate ($/ha)	1300	
Total	442000	
Structural water management works, banks, drains, rock lined waterways, sediment dams		
Area (ha)	340	
Rate ($/ha)	2000	
Total	680000	
Revegetation		
Revegetate rate ($/ha)	23,500	
Area (ha)	340	
Total	7,990,000	
EarlyClosure1 Domain 4 Active Mine and Voids		
Northeast Batters	**4,527,547**	
Batter Cutback	*3,603,421*	
Length batter stabilization (m)	1,750	
Target slope horizontal unit length	3	
Target slope vertical unit length	1	
Existing slope horizontal unit length	2.8	
RL Ground Surface at batter top	78	
RL of Current Pit Floor	-85	
Batter height (m)	163	
Stabilised slope	0.333333333	
Current slope for stabilisation	0.4	
Material volume to achieve design slope	2656.9	
Reduction for cut to fill activity	50%	
Material volume handled (m3/m)	1328.45	
Length 1:3 pushed-back batter (% of total)	100%	
Cost of pushback ($/m3)	1.55	
Pushback cost ($)	3,603,421	

EarlyClosure1 Cost Components

Northeast Batters		4,527,547
	Total	3,603,421
	Final Batter Angle Slopes (degrees)	18.4
	RL of Final (Spill) Water	60
	RL Ground Surface at batter top	78
	Exposed batter vertical height (H)	18
	Surface area of exposed batter (m2/lineal m)	57
	Batter area exposed at that water height (m^2)	99,612
	Proportion already rehabilitated (%)	0%
	Batter area requiring rehabilitation (m^2)	99,612
	Batter Length (m)	1,750
	Reshaping	*700,000*
	Number of benches exposed (at ave 20m height)	1
	Average reshape volume (m3 / bench / m slope)	100
	Reshape rate ($/m3)	4.0
	Full reshape cost ($)	700,000
	Proportion already rehabilitated (%)	0%
	Reshape cost ($)	700,000
	Cover	*224,126*
	Thickness of cover	0.75
	Volume of cover material (m3)	74,709
	Cover material rate - load haul place	3.00
	Total required cover ($)	224,126
	Total cover ($)	224,126
	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)	1,750
	rip rap area (m2)	22,136
Northwest Batters		**6,720,505**
	Existing Batter Angle Slopes (degrees)	18.4
	RL of Final (Spill) Water	60
	RL Ground Surface at batter top	90
	Exposed batter vertical height (H)	30
	Surface area of exposed batter (m2/lineal m)	95
	Batter area exposed at that water height (m^2)	213,454
	Proportion already rehabilitated (%)	0%
	Batter area requiring rehabilitation (m^2)	213,454
	Batter Length (m)	2,250
	Batter Cutback	*5,340,234*
	Length batter stabilization (m)	2,250
	Target slope horizontal unit length	3
	Target slope vertical unit length	1
	Existing slope horizontal unit length	2.8
	RL Ground Surface at batter top	90
	RL of Current Pit Floor	-85

EarlyClosure1 Cost Components

Northeast Batters		4,527,547
	Batter height (m)	175
	Stabilised slope	0.333333333
	Current slope for stabilisation	0.4
	Material volume to achieve design slope	3062.5
	Reduction for cut to fill activity	50%
	Material volume handled (m3/m)	1531.25
	Length 1:3 pushed-back batter (% of total)	100%
	Cost of pushback ($/m3)	1.55
	Pushback cost ($)	5,340,234
	Total	5,340,234
	Reshaping	*900,000*
	Number of benches exposed (at ave 20m height)	1
	Average reshape volume (m3 / bench / m slope)	100
	Reshape rate ($/m3)	4.0
	Full reshape cost ($)	900,000
	Proportion already rehabilitated (%)	0%
	Reshape cost ($)	900,000
	Cover	*480,271*
	Thickness of cover	0.75
	Volume of cover material (m3)	160,090
	Cover material rate - load haul place	3.00
	Total required cover ($)	480,271
	Total cover ($)	480,271
	Rip Rap	
	final slope	18.4
	vertical height of rip rap (m)	4.0
	surface area of rip rap (m2/m)	12.6
	rip rap thickness (m)	0.75
	rock requirement per linear metre (m3)	9
	rip rap length along batter (m)	2,250
	rip rap area (m2)	28,460
Western Batters		**642,691**
	Existing Batter Angle Slopes (degrees)	18.4
	RL of Final (Spill) Water	60
	RL Ground Surface at batter top	64
	Exposed batter vertical height (H)	4
	Surface area of exposed batter (m2/lineal m)	13
	Batter area exposed at that water height (m^2)	18,974
	Proportion already rehabilitated (%)	0%
	Batter area requiring rehabilitation (m^2)	18,974
	Batter Length (m)	1,500
	Reshaping	*600,000*
	Number of benches exposed (at ave 20m height)	1
	Average reshape volume (m3 / bench / m slope)	100
	Reshape rate ($/m3)	4.0
	Full reshape cost ($)	600,000
	Proportion already rehabilitated (%)	0%
	Reshape cost ($)	600,000

EarlyClosure1 Cost Components

Northeast Batters		4,527,547
	Cover	*42,691*
	Thickness of cover	0.75
	Volume of cover material (m3)	14,230
	Cover material rate - load haul place	3.00
	Total required cover ($)	42,691
	Total cover ($)	42,691
	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)	1,500
	rip rap area (m2)	18,974
Southwestern		**628,274**
	Existing Batter Angle Slopes (degrees)	18.4
	RL of Final (Spill) Water	60
	RL Ground Surface at batter top	77
	Exposed batter vertical height (H)	17
	Surface area of exposed batter (m2/lineal m)	54
	Batter area exposed at that water height (m^2)	96,766
	Proportion already rehabilitated (%)	33%
	Batter area requiring rehabilitation (m^2)	64,833
	Batter Length (m)	1,800
	Reshaping	*482,400*
	Number of benches exposed (at ave 20m height)	1
	Average reshape volume (m3 / bench / m slope)	100
	Reshape rate ($/m3)	4.0
	Full reshape cost ($)	720,000
	Proportion already rehabilitated (%)	33%
	Reshape cost ($)	482,400
	Cover	*145,874*
	Thickness of cover	0.75
	Volume of cover material (m3)	48,625
	Cover material rate - load haul place	3.00
	Total required cover ($)	145,874.29
	Total cover ($)	217,723
	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)	1,800
	rip rap area (m2)	22,768
Southeastern		**933,718**

EarlyClosure1 Cost Components

Northeast Batters		4,527,547
	Existing Batter Angle Slopes (degrees)	18.4
	RL of Final (Spill) Water	60
	RL Ground Surface at batter top	68
	Exposed batter vertical height (H)	8
	Surface area of exposed batter (m2/lineal m)	25
	Batter area exposed at that water height (m^2)	77,160
	Proportion already rehabilitated (%)	33%
	Batter area exposed at that water height (m2)	51,697
	Batter Length (m)	3,050
	Reshaping	*817,400*
	Number of benches exposed (at ave 20m height)	1
	Average reshape volume (m3 / bench / m slope)	100
	Reshape rate ($/m3)	4.0
	Full reshape cost ($)	1,220,000
	Proportion already rehabilitated (%)	33%
	Reshape cost ($)	817,400
	Cover	*116,318*
	Thickness of cover	0.75
	Volume of cover material (m3)	38,773
	Cover material rate - load haul place	3.00
	Total required cover ($)	116,318.06
	Total cover ($)	173,609
	Rip Rap	
	final slope	18.4
	vertical height of rip rap (m)	4.0
	surface area of rip rap (m2/m)	12.6
	rip rap thickness (m)	0.75
	rock requirement per linear metre (m3)	9
	rip rap length along batter (m)	3,050
	rip rap area (m2)	38,580
Mine Floor/East		**948,027**
	Existing Batter Angle Slopes (degrees)	18.4
	RL of Final (Spill) Water	60
	RL Ground Surface at batter top	63
	Exposed batter vertical height (H)	3
	Surface area of exposed batter (m2/lineal m)	9
	Batter area exposed at that water height (m^2)	21,345
	Proportion already rehabilitated (%)	0%
	Batter area exposed at that water height (m2)	21,345
	Batter Length (m)	2,250
	Reshaping	*900,000*
	Number of benches exposed (at ave 20m height)	1
	Average reshape volume (m3 / bench / m slope)	100
	Reshape rate ($/m3)	4.0
	Full reshape cost ($)	900,000
	Proportion already rehabilitated (%)	0%
	Reshape cost ($)	900,000
	Cover	*48,027*

EarlyClosure1 Cost Components

Northeast Batters	4,527,547	
Thickness of cover	0.75	
Volume of cover material (m3)	16,009	
Cover material rate - load haul place	3.00	
Total required cover ($)	48,027.09	
Total cover ($)	48,027	
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)	2,250	
rip rap area (m2)	28,460	
Horizontal Drains	**939,829**	
Exposed slope area (ha)	47	
No required (#/ha slope)	1	
No required	47	
Installation cost for required horizontal drains($)	939,829	
Total horizontal drain cost ($)	1,054,620	
Rip Rap	**9,562,728**	
total rip rap area (m2)	159,379	
rip rap rate ($/m2)	60	
Total Rip Rap	9,562,728	
Erect a security fence around site	**1,190,000**	
Length of fence (m)	23,800	
Construct ($/m)	50	
Total	1190000	
Landscaping, minor earthworks and revegetation throughout domain area	**729,759**	
Total area (ha)	31	
Revegetate rate ($/ha)	23,500	
Revegetate cost ($)	729,759	
EarlyClosure1 Domain 5 Execution Management Costs		
Mobilisation/Demobilisation	**3,126,084**	
Total Execution Cost	62,521,678	
% of total execution cost	5%	
Engineering Procurement & Construction Management	**9,378,252**	
Total Project Cost	62,521,678	
% of total execution cost	15.00%	
EarlyClosure1 Domain 6 Fill pit with water		
O&M of dewatering facilities	**640,000**	
Annual cost ($/an)	80,000	
Duration (yrs)	8	
Total	640000	
Re-install dewatering bores, then decommission existing bores	**2,175,000**	
Length of elevated pad (m)	1700	2,000
Width of elevated pad (m)	20	30
Height of elevated pad (m)	10	15
Sectional volume of pad (m3/m length)	300	
Volume of pad (m3)	510,000	
Construct elevated pad ($/m3)	1.5	3

EarlyClosure1 Cost Components

Northeast Batters	4,527,547	
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 ($/bore)	15,000	30,000
Existing bores	75,000	
Total	2,175,000	
Supplementary & other water charges	**5,992,000**	
Required supplementary water supply for filling period (GL/yr)	0.0	
Allocation purchase ($/GL)	2,000,000	
Allocation purchase ($)	-	
Annual fee ($/yr)	749,000	
Fill duration (yrs)	8	
Supplementary & other water cost ($)	5,992,000	
EarlyClosure1 Domain 7 Post Execution Maintenance and Monitoring		
Post execution monitoring	**7,520,000**	
Annual rate - first 5 yrs after execution phase ($/yr)	325,000	
Number of Years	22	
	7,150,000	
Annual rate - subsequent monitoring phase ($/yr)	185,000	
Number of Years	2	
	370,000	
Post execution maintenance	**22,938,000**	
Annual rate - first 5 yrs after execution phase ($/yr)	1,012,000	
Number of Years	22	
	22,264,000	
Annual rate -subsequent maintenance phase ($/yr)	337,000	
Number of Years	2	
	674,000	
Management	913,740	
Subtotal maintenance & monitoring ($)	30,458,000	
Management (%)	3%	
Management ($)	913,740	

Appendix B End of Mine Life

EoM Closure Cost Components

LOY YANG EoM FOOTPRINT	Total Costs
EoM Domain 1 : Infrastructure Areas	**20,537,000**
Disconnect and terminate services	20,000
Demolish and remove buildings	952,000
Remove concrete pads & footings (of buildings)	2,265,000
Decommission access and haul roads	180,000
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	240,000
Demolish and remove conveyors	3,010,000
Decommission, decontaminate and demolish crusher and RCB	5,890,000
Decommission, decontaminate and demolish dredgers	6,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	0
Removal of power lines	800,000
EoM Domain 2 Tailings and Coarse Rejects Storage	**0**
None in Loy Yang	0
EoM Domain 3 Overburden and Waste Dumps	**9,112,000**
Landscaping, minor earthworks and revegetation throughout domain area	9,112,000
EoM Domain 4 Active Mine and Voids	**32,765,769**
Northeast Batters	4,754,718
Northwest Batters	3,400,903
Western Batters	742,302
Southwestern	968,648
Southeastern	1,580,494
Mine Floor/East	2,261,526
Horizontal Drains	1,475,784
Rip Rap	15,254,827
Erect a security fence around site	1,190,000
Landscaping, minor earthworks and revegetation throughout domain area	1,136,566
EoM Domain 5 Execution Management Costs	**23,707,215**
Mobilisation/Demobilisation	14,345,000
Engineering Procurement & Construction Management	9,362,215
EoM Domain 6 Fill pit with water	**14,610,000**
O&M of dewatering facilities	1,200,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	11,235,000
EoM Domain 7 Post Execution Maintenance and Monitoring	**60,291,050**
Post execution monitoring	14,345,000
Post execution maintenance	44,190,000
Management	1,756,050
EoM Liability	**161,023,035**

Appendix C

Unit Rates and Parameter

Appendix C General – 1997 WP

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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		60	60
Northeast Batters				
Ground Surface	RL m		78	78
Batter Lengths	m		5,750	1,750
Northwest Batters				
Ground Surface	RL m		90	90
Batter Lengths	m		2,250	2,250
Western Batters				
Ground Surface	RL m		64	64
Batter Lengths	m		1,500	1,500
Southwestern				
Ground Surface	RL m		77	77
Batter Lengths	m		1,800	1,800
Southeastern				
Ground Surface	RL m		68	68
Batter Lengths	m		4,000	3,050
Mine Floor/East				
Ground Surface	RL m		63	63
Batter Lengths	m		4,800	2,250
Average Batter Height	m		20	20
Pit Floor	RL m		-110	-85
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

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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%	3%
Timelines			**EoM**	**Early Closure 1**
Year of current assessment			2015	2015
Year number			1	1

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Mine Shutdown			2037	2015
Year closure execution to commence			2038	2015
Year number			24	1
Duration of Closure Execution phase	years		3	3
Duration of post execution maintenance/monitoring - initial phase	years		43	22
Duration of post execution maintenance/monitoring - subsequent phase	years		2	2
Effective duration of post execution maintenance/monitoring - subsequent phase	years		2	2
Duration of lake fill to achieve floor stability (RL-21m)	years		15	8
Duration of full lake fill to final level	years		43	22
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	
Annual dewatering costs				
Loy Yang	$/annum		80,000	120,000
Bulk Water Entitlement				
Current Loy Yang BWE	GL/yr		40	
Supplementary Water Costs				
Allocation Purchase	$/ML		$ 2,000	$ 5,000
Allocation Purchase	$/GL		$ 2,000,000	
Annual groundwater fee	$/ML/yr		$ 20	

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Annual groundwater fee	$/GL/yr		$	20,000	
Annual Bulk Water Entitlement	$		$	729,000	
Total annual fees	$/yr		$	749,000	
BWE annual cost	$/GL/yr		$	18,225	

Appendix C General - 2015 WPV

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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	
Landscaping, minor earthworks and revegetation throughout domain area.							
	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
	Cover material sourced from Northern batters cutback for Early Closure			$3	$10		Ther will be bapout 5.7Mm3 from the cutback and total cover required is about 350,000m3 - therefore unlikely to need off-site sourcing of materials for early closure
	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 (Sand Batter) to achieve grades nominated in the approval/permit (i.e. < 18o) >50 - 100m	m3	$1.15	$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	$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/m/m		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	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