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New regulatory approaches in rehabilitation cost estimation — how successful have they been?

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Abstract

The global financial crisis and related reductions in commodity prices have had a significant impact on the mining industry, and as a result more mines may be forced into premature closure. Inevitably some of these are likely to join lists of derelict mines across the nation.

For state governments across Australia, the need has arguably never been greater to ensure security bonds at mine sites are accurate and that the related liabilities are adequately covered by the security bonds that are held. Strategies to limit future government liabilities have been developed by some governments such as New South Wales (NSW) and Victoria who have recently developed and implemented new approaches to closure cost estimation to assist in establishing more accurate security bonds.

Following an independent assessment of the security review process, including benchmarking of processes against other agencies in Australia and worldwide, the NSW Department of Primary Industries – Mineral Resources (DPI–MR) implemented a recommendation that mine operators have the responsibility for self-assessment of the total costs required for rehabilitation and closure.

A rehabilitation cost estimate tool (referred to in this paper as the rehabilitation calculator) was developed to provide a consistent approach for all NSW mine sites to be used in their estimation of closure liabilities. The costs would then form a guide for the NSW DPI–MR to use in security bond calculation.

The rehabilitation calculator has been used as a basis for closure cost assessment in NSW since 2005 with some minor amendments. It has since been reviewed, improved and adapted for use by the Victorian DPI in their management of mines and extractive industries.

This paper explores the improvements and refinements made to the rehabilitation calculator, and suggests further improvements that can be made. It also includes discussion on the outcomes of the use of the rehabilitation calculators in both NSW and Victoria over the last two to four years, with commentary from perspectives of both government and industry stakeholders being considered.

The paper concludes with a discussion on the possible benefits of a national approach to closure cost estimation, with particular reference to a consistent approach for those companies that operate across state borders.

1 Introduction

During the 1990s a number of mine operators in NSW, Australia became insolvent and mining leases, along with the closure and rehabilitation liabilities, were passed back to the government. In the past it was found in many cases that the security bond held by the government represented only a small portion of the actual amount required to effectively close the operations to appropriate environmental and public safety standards. Accordingly, where no alternative was identified, these mines were managed by the NSW DPI–MR as part of their derelict mines program (DMP). Even when supplemented by DMP funds, there was frequently insufficient money for full or even adequate rehabilitation and the works undertaken were generally to make the site safe.

Derelict mines continue to burden NSW taxpayers, as well as being a public safety and environmental risk. Their legacies arguably represent a risk to the mining industries public licence to operate and to the image of sustainable mining practices throughout Australia.

With the aim of investigating potential underlying causes for the failure of the government to hold sufficient security for closure, the NSW DPI–MR commissioned URS to undertake a study into their security review process including benchmarking of processes against other agencies in Australia and worldwide. A number of findings were made, including that the majority of agencies did not hold sufficient securities to cover potential mine closure liabilities.

A key recommendation was that mine operators should have the responsibility for self assessment of the total costs required for rehabilitation and closure of the mine. Operator cost estimates would then be reviewed by the DPI–MR and used as the basis for the establishment of a security bond for the operation.

Consequently a rehabilitation calculator was developed by URS/GSS Environmental for the NSW DPI–MR to enable a thorough and consistent approach for all NSW mine sites to use in the estimation of closure liabilities. The cost estimation approach now forms a minimum standard for establishing an appropriate security bond for mines and larger quarry sites in NSW.

The rehabilitation calculator has now been used as a basis for closure cost assessment in NSW since 2005, a period of over approximately four years. In this time the DPI–MR has modified certain aspects through a number of revisions and updates.

In addition, and following some improvements and modification, the Victorian Department of Primary Industries (DPI) rehabilitation liability calculator was developed and has been trialled for use by the Victorian DPI in their management of mines and extractive industries. The Victorian DPI rehabilitation liability calculator is to be finalised in 2009 for full implementation across the state and to date has played a large part in recent bond reviews. In the future, it is the challenge of the government, mining companies of all sizes and natures (public, private, large or small), environmental scientists and stakeholders, the community and the markets to ensure that any assessment or reporting methodology developed adequately ensures the return of a mine site to a functioning ecosystem. Rehabilitation calculation methodologies such as this provide an invaluable basis for enabling this to occur and are the basis of this paper. This paper builds on previous papers describing the NSW DPI rehabilitation calculator methodology (Woolley and Hutton, 2006; 2007).

2 Development of the rehabilitation cost calculation rehabilitation calculator

2.1 Review of existing methodologies and guidelines

Further to research conducted on the security bond review processes in NSW (Woolley, 2002) a 2004 review (Woolley, 2004) focussed on an assessment of operator-prepared closure cost methodologies applied overseas across Australia and internationally. Agency websites, industry representative body publications and industry approaches to closure cost estimations were reviewed as part of this study. Documentation was supplemented with informal telephone discussions with nominated personnel in interstate and international agencies to clarify desktop research and gain additional insights into closure cost methodologies. The results of the review provided a context for the development of a rehabilitation calculator to provide for a consistent methodology to calculate rehabilitation liabilities.

2.2 Various applications for rehabilitation cost estimates

There are a number of rehabilitation cost estimates that may be applicable for a mine, depending on the purpose of the estimate. Each estimate has a specific purpose in closure cost estimation and while they may be based on similar information and be interrelated, they do not always represent a single objective or outcome. These include:

- Security deposits or bonds: Regulators usually require the mining company to provide a bond or security amount to cover the cost of third party closure of the mining project should it close prematurely.
- End of life of mine closure: Mine closure is planned over a long period as part of the life of mine Plan. Initiatives, such as continuous/progressive rehabilitation effectively reduces the overall closure costs as the works are completed during the life of the mining project. This generally applies where the operator of the mine undertakes the required decommissioning and closure activities as part of

their life of mine plan. Typically this is the cost of mine closure accounted for on the balance sheet of the mining companies, and is normally to a pre-feasibility level of accuracy (i.e. ±30%).

- Detailed closure costs: Mining companies within only a few years of closure seek tenders from outside parties to undertake the closure of the mine. In particular the aspects of the mine closure that are classed as non-core business (i.e. the demolition of processing facilities and workshops, etc.) will be outsourced. This differs from 'end of life mine closure' as above, as there is an increased requirement for a cost estimate to be to 'project feasibility' level of accuracy (i.e. ±5%).
- Closure cost estimations using a risk-based approach such as probabilistic costing: This approach allows for uncertainties to be accounted for in the overall cost estimate. The approach generally utilises recognised methodologies to crystal ball and consider the closure costs in future dollars under a reasonable worst case scenario.

This paper has considered only the estimate that is appropriate for the costs that would be incurred by government in the event of an unplanned mine closure and subsequent passing of all liabilities to the government. As discussed above, in this scenario the government would not be in a position to rely on established operators to conduct the rehabilitation works. The rehabilitation costs would need to consider costs for third party contractors to undertake the required works which would include mobilisation, project management fees, costs related to limited site knowledge and the discontinuity with former operations.

While the rehabilitation calculator developed by URS/GSSE for both the NSW and Victorian DPI's can be used or adapted to cover the above approaches. the primary purpose of the rehabilitation calculator is to estimate closure rehabilitation costs for the purpose of assessing security bonds by the appropriate regulatory agency.

2.3 Approach in the rehabilitation calculator development

Fundamental to developing a systematic approach to mine closure cost estimation is the use of a domain approach. The key approach taken in the development of the rehabilitation calculator was to separate mines and other extractive industries into seven categories based on the nature, size and scale of the operation. These generally represented areas of like or similar rehabilitation treatment. Mine operators are required to choose the most suitable category for their site and relevant spreadsheets are automatically generated that list and provide rates for the most likely closure activities relevant to that site.

Once the category is selected the rehabilitation calculator is presented so that it splits the mine into separate management areas that typically have similarities in rehabilitation requirements or treatment to meet the required post mining landuse. These areas are called domains and they typically include areas such as those detailed below.

Figure 1 Infrastructure – typically this includes administration buildings, workshops, processing plants and transport infrastructure such as rail loading and roadways

Figure 2 Run of mine (ROM) and product stockpile areas – typically this includes stockpiles around the processing plant as well as satellite stockpiles that may be around the mine. It would also include areas such as heap leach pads

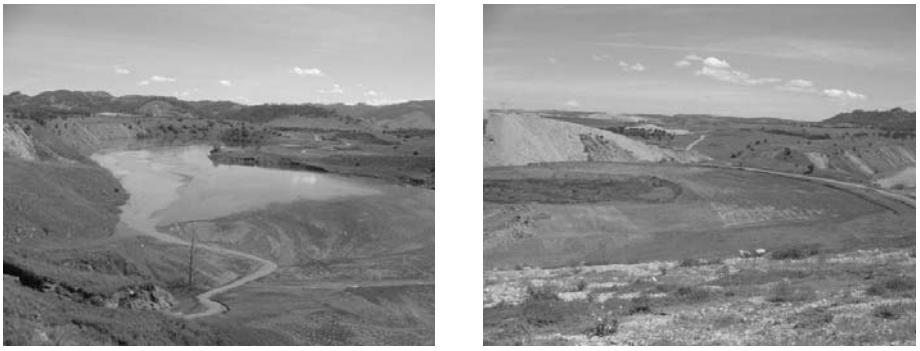

Figure 3 Tailings storage facilities – includes coarse and fine tailing (as applicable) disposal and management areas

Figure 4 Overburden and waste rock dumps – includes all waste dumps, whether they be in-pit or out of pit depending on the nature of the site

Figure 5 Active operational areas and voids — includes void management and active mining areas of the operation including any access ramps or associated roadways

Figure 6 Successful and ongoing rehabilitation areas — this includes all areas that have either been successfully rehabilitated or are at some earlier stage throughout the rehabilitation process

Figures 1–6: Photos are sourced from GSS Environmental – Various Mine Closure Projects (2003 – 2009)

The level of detail and number of domains is driven entirely by the complexity and scale of the operation. For each domain area, a number of generic activities are listed as line items which generally describe the activities that are typically required within the domain in order to meet closure requirements for a given site.

MS Excel was seen as the most appropriate format for the rehabilitation calculator as it was considered relatively simple to use, functional given its objectives, and is commonly available. The operator is required to input unit amounts, typically linear and area based information, for the relevant activities and the costs are generated automatically. There remains an onus on the operator to include all relevant costs related to closure, whether or not prompted by rehabilitation calculator.

Figure 7 is an extract from the NSW DPI–MR rehabilitation calculator that shows the typical layout of the domain spreadsheet. Within each domain area there are a number of management precincts which are generally divided into the key activities required for successful decommissioning and closure.

Domain 3: Overburden & Waste Dumps

Detail of person filling out the Worksheet:

Name
Position
Department
Date

Legend:

Item fixed no entry required
Input from site optional (if information available)
Input mandatory

Management Precinct	Activity / Description	Quantity	Unit	Unit Price	Total Cost	Description / Notes:
Successful Rehabilitation	Maintenance of **Established** Revegetated Area (up to 5 years)		Ha	$715.00	$0.00	This item includes the total area of rehabilitation that has been established and requires subsequent fertiliser application. It assumes application twice on the first five (5) years after establishment
	Maintenance of Shaped Topsoiled and Seeded Areas (up to 5 years)		Ha	$715.00	$0.00	This item includes the total area of that have been shaped, topsoiled and seeded and requires subsequent fertiliser application. It assumes application twice on the first five (5) years after establishment
			Precinct Security Deposit		$0.00	
Shaped Overburden Dumps	Final trim, rock rake & deep rip		Ha	$550.00	$0.00	This item includes the area requiring minor reshaping, rock raking and deep ripping to enhance revegetation program.
	Structural works, banks, rock lined waterways		Ha	$1,540.00	$0.00	This item includes the area requiring earthworks (banks, & drains, etc) to manage all surface water on the top of the emplacement to ensure that it is shed off the dump.
	Source, cart and spread topsoil.		m^3	$1.32	$0.00	This includes sourcing, carting and spreading of a suitable volume of topsoil to cover the shaped overburden dumps.
	Spoil amelioration and supply and spread seed and fertiliser.		Ha	$4,070.00	$0.00	This item includes the area requiring the addition of ameliorates such as lime or gypsum prior to the application of grass seed and fertiliser
	Maintenance of rehabilitated areas (up to 5 years)		Ha	$715.00	$0.00	This item includes the total area of that have been shaped, topsoiled and seeded and requires subsequent fertiliser application. It assumes application twice on the first five (5) years after establishment
			Precinct Security Deposit		$0.00	
Unshaped Overburden Dumps (minor reshaping required)	Minor pushing, final trim, rock rake & deep rip		Ha	$550.00	$0.00	This item includes the area requiring minor reshaping, rock raking and deep ripping to enhance revegetation program.
	Structural works, banks, rock lined waterways		Ha	$1,540.00	$0.00	This item includes the area requiring earthworks (banks, & drains, etc) to manage all surface water on the top of the emplacement to ensure that it is shed off the dump.
	Source, cart and spread topsoil.		m^3	$1.32	$0.00	This includes sourcing, carting and spreading of a suitable volume of topsoil to cover the tailings dam / emplacement.
	Spoil amelioration and supply and spread seed and fertiliser.		Ha	$4,070.00	$0.00	This item includes the area requiring the addition of ameliorates such as lime or gypsum prior to the application of grass seed and fertiliser
	Maintenance of rehabilitated areas (up to 5 years)		Ha	$715.00	$0.00	This item includes the total area that has been shaped, topsoiled and seeded and requires subsequent fertiliser application. It assumes maintenance for a period of (5) years after establishment, including application of fertiliser twice during this time.
			Precinct Security Deposit		$0.00	
Unshaped Overburden Dumps (major earthworks required) - this excludes Low walls	Major bulk pushing to achieve grades nominated in the MOP (i.e. < 18°)		m^3	$1.21	$0.00	This item includes the volume requiring **major** reshaping, rock raking and deep ripping (only as required) to enhance revegetation program
	Minor pushing, final trim, rock rake & deep rip		Ha	$550.00	$0.00	This item includes the area requiring minor reshaping, rock raking and deep ripping to enhance revegetation program.
	Structural works, banks, rock lined waterways		Ha	$1,540.00	$0.00	This item includes the area requiring earthworks (banks, & drains, etc) to manage all surface water on the top of the emplacement to ensure that it is shed off the dump.
	Source, cart and spread topsoil.		m^3	$1.32	$0.00	This includes sourcing, carting and spreading of a suitable volume of topsoil to cover the tailings dam / emplacement.
	Spoil amelioration and supply and spread seed and fertiliser.		Ha	$4,070.00	$0.00	This item includes the area requiring the addition of ameliorates such as lime or gypsum prior to the application of grass seed and fertiliser
	Maintenance of rehabilitated areas (up to 5 years)		Ha	$715.00	$0.00	This item includes the total area that has been shaped, topsoiled and seeded and requires subsequent fertiliser application. It assumes maintenance for a period of (5) years after establishment, including application of fertiliser twice during this time.
			Precinct Security Deposit		$0.00	
Other	Other 1 <insert>				$0.00	This item includes <<to be added by the operator>>
	Other 2 <insert>				$0.00	This item includes <<to be added by the operator>>
	Other 3 <insert>				$0.00	This item includes <<to be added by the operator>>
			Precinct Security Deposit		$0.00	

Total Security Deposit for the "Domain" $0.00

Figure 7 Typical layout of the domain spreadsheet

3 Implementation of the rehabilitation calculator in New South Wales

It has been a legislative requirement for all mines in NSW to use the rehabilitation calculator to assist in security bond calculations since 1 July 2006. Feedback obtained during the implementation phase can be broken into several categories as described below. Following is a summary of key outcomes and feedback gleaned from the implementation of the NSW rehabilitation calculator:

3.1 General usefulness

Many smaller operators do not have internal resources to conduct a detailed closure costing exercise have benefited from the availability of the rehabilitation calculator. The smaller operators have used it for both external reporting to the DPI–MR as well as using it to assist in making internal accounting provisions for closure.

The general approach to using area and distance based calculations (rather than volume) has enabled smaller operations to provide a reasonably accurate estimate for closure, utilising internal resources. This has been conducted without access to survey and mine planning software in many cases.

In initial operations, there is some operators 'investment' required to insert applicable data and achieve accurate and customised output. Subsequent use and modification of the rehabilitation calculator is less time consuming for these operations. Using widely available software allows for ongoing estimate updates and tracking as rehabilitation is completed.

A number of comments were received regarding technical issues with the use of the rehabilitation calculator. These included the requirement for a table to summarise the general rates and clarification for the basis of rates to be inserted into the rehabilitation calculator.

It has provided an additional resource to other NSW Government Departments and Local Councils, who have adopted the rehabilitation calculator for the calculation of security deposits for the smaller quarrying and extractive industries outside the jurisdiction of the DPI–MR.

3.2 Liability estimates generated by the rehabilitation calculator

In general terms, there was limited feedback indicating that costs estimates generated from the rehabilitation calculator were excessive. However, there have been some comments from industry that suggested that some of the activities could be conducted with less expense than initially indicated. One important consideration is the distinction between rates for current operations compared to rates for a contracted third party. In almost all circumstances a third party rate requires additional consideration for mobilisation and demobilisation as well as a profit component for the contractor. In many cases these are included when using estimates from the current mine operator using internal resources.

A robust discussion on rates specified in the rehabilitation calculator occurred when it was initially developed. Rates cannot be specified as absolute for all situations and there are wide variations making even a mean or median value rate across operations meaningless in some scenarios. The rehabilitation calculator allows for operators to use their own rates, subject to their approval by the NSW DPI–MR. It is understood that where suitably justified, the DPI–MR has accepted revised rates.

There has been a general to significant increase in rehabilitation cost estimates by using the rehabilitation calculator compared to previous cost methods used by the NSW DPI–MR. This has lead to increases of security bonds across many mines, sometimes by orders of magnitude. The increase has almost always been related to the increased level of detail in the rehabilitation calculator compared to the previous assessment developed in its absence.

The total security bond amount held by the DPI–MR has trebled since the use of the rehabilitation calculator commenced. Some of this increase has been due to the development of new mines and mine expansions in the interim period.

3.3 Managing ongoing rehabilitation

Companies have reported to the DPI–MR that the rehabilitation calculator has been useful in assessing where specific liabilities lie. This has allowed a focus of management attention and resources on the areas with higher liabilities.

There has been some informal support from environmental officers as the costs highlighted by the rehabilitation calculator provide a basis for up front proactive management of mine activities with an aim to reduce longer term liabilities. In an overwhelming number of cases the environmental officers on the mine sites are generally not surprised by the increase in the closure cost estimates.

The general increase in closure cost liability by using the rehabilitation calculator has resulted in an increased interest by mine general managers and financial controllers in reducing the relevant costs. This has often meant rehabilitation projects otherwise considered a low priority have been completed where otherwise they may have been left until the final closure period. In addition, the format of the rehabilitation calculator is of sufficient detail to justify these increases when they are questioned by management at the mine sites.

3.4 Integrating finance, production and environment

There have been significant examples of companies incorporating closure into a life of mine planning approach so as to best manage rehabilitation liabilities. Mine planners are now taking into account closure related issues in many instances. This has resulted in a significant increase in the interest and understanding of mine closure issues amongst upper management, with particular reference to financial controllers. The authors are aware of at least two occasions where accountants have requested site visits to gain improved understanding of work and expense required.

The real liabilities had obviously not been realised by many mine accountants. True liabilities were therefore not being reported by some companies as part of their reporting under the Corporations Act, 2001 and public listing requirements. This has resulted in accountants playing a much greater role in the assessment of the liabilities and provisioning.

Mines are tracking true costs so as to compare them against the rates in the rehabilitation calculator to improve estimating techniques. The authors experience is that up until recently, most mine sites were not overly aware of itemised closure related costs.

Mines are being required to consider closure issues as a component of environmental impact assessment at approval stage. In some cases, planning departments are requiring use of the rehabilitation calculator to assess associated liabilities for inclusion in the environmental impact assessment (EIA) process.

Higher security bond amounts have had some impact on companies' ability to borrow, particularly where a bank guarantee is utilised to meet the security or bond value.

Some companies are completing their own detailed cost estimates according to internal standards and submitting these to the DPI–MR, rather than duplicating their work by using the rehabilitation calculator. This is seen as a beneficial outcome for government as the operators costing are now more closely linked to security bond calculations. From the authors' experience, these assessments are generally more detailed than the DPI–MR rehabilitation calculator resulting in a greater amount secured by the DPI–MR. In addition, the rehabilitation calculator has been used by some mining companies as an instrument for greater transparency with the DPI–MR when dealing with mine closure liability.

The general increase in awareness of closure issues has seen some of the larger companies reassessing, introducing or updating mine closure standards, which invariably extends beyond just closure cost estimations to include aspects such as stakeholder engagement, post mining land use, monitoring and maintenance, and closure risk assessments.

4 Implementation of the rehabilitation liability calculator in Victoria

The rehabilitation calculator (referred to as a rehabilitation liability calculator in Victoria) was adopted for the Victorian DPI in 2006 to assist in their management of mines and extractive industries. Following modification, the rehabilitation liability calculator was originally trialled internally by the Victorian DPI. In consultation with URS/GSSE and through discussion with the NSW DPI–MR, significant improvements and alterations were made to the NSW rehabilitation calculator based on the NSW DPI feedback and further review by Victorian DPI.

The key changes included:

- Improved layout and better use of the functionality of MS Excel.
- Adapting the rehabilitation calculator for use by small and large quarries (more typical of Victoria).
- Including exploration as a separate mining related activity.
- A reassessment and verification of some of the rates used.
- Inclusion of a separate column for operators to include their own rates. If alternate rates are used, the cell is highlighted to prompt increased scrutiny of the rate by DPI officers.
- Requiring the operator, rather than the DPI, to identify whether an activity is applicable to their site and therefore being included in the cost estimate.

- The development of a separate rates table to allow ease of altering a rate by the DPI. This table then links to all other aspects of the spreadsheet.

The rehabilitation liability calculator was then provided to industry for feedback and was made available on 1 January 2008 for use by the DPI in bond reviews. The introduction of the use of the calculator coincided with new guidelines for closure calculation and a requirement for self assessment by mines and extractive industries. Closure liabilities calculated by the mine are required to be reported annually to the DPI, although the details of the cost estimate is not required as part of this report.

Bond reviews have generally been conducted on a scheduled basis by DPI Inspectors. The outputs of the Calculator have been used to assist in the reviews, however, DPI inspectors implementing the Calculator have often taken a pragmatic approach to the calculations and reviews have not necessarily reflected all its outputs. A key overall focus of the Victorian DPI has been for good rehabilitation outcomes.

The calculator is still currently in draft form. Victorian DPI expects the rehabilitation liability calculator to be finalised in 2009. Feedback on the Victorian DPI rehabilitation liability calculator to date is detailed below.

4.1 General usefulness

Most entities were happy to use the rehabilitation liability calculator and saw no other easy method for closure cost calculation. It has allowed sites to calculate their own numbers rather than getting third parties to do it for them which has allowed for cost savings with the operators. As a consequence there were very few limited third party values provided to the DPI.

DPI considers that the rehabilitation liability calculator enables a transparent approach which is considered the most appropriate way of managing closure cost estimation.

Feedback from the Minerals Council of Australia, Victoria Division (MCA, 2008) included:

> *"Generally, members have found the calculator largely functional and easy to use and they welcome the streamlined process with standardised costing for comparison and data capture. It is quite thorough in the methodology presented and useable for differing domains."*

4.2 Liability estimates generated by the rehabilitation liability calculator

Cost estimates using the calculator have generally exceeded previous cost estimation processes, often by significant margins. For some sites estimates have far exceeded values originally perceived as appropriate by the DPI Inspectors through use of previous methodologies. Key reasons for this are the much wider coverage of activities required by the calculator and the fact that previously used rates were outdated.

Most feedback has been in relation to the accuracy of rates, particularly to revegetation activities. Some entities, particularly regionally based, considers the rates excessive, while others (city based or with complex rehabilitation requirements) consider the rates do not adequately cover these rehabilitation activities.

Costing for demolition of plant has been controversial. The rehabilitation liability calculator does not allow for the positive valuing of plant and equipment and many sites have argued they could sell infrastructure for a profit, rather than have to incur costs.

The requirement to cost removal of footings has increased costs. Many considered the rates excessive when in city areas crushing of concrete can be carried out reducing disposal costs.

Feedback from the Minerals Council of Australia, Victoria Division (MCA, 2008) includes:

> *"The self-assessment seems to be over simplified and should take a more comprehensive risk based approach to the likelihood of the company going into default, not just based on the size of mine and the commodity. For example, a company with a small mine and low capital backing is potentially a higher risk than a large mine with high capital value".*

Other feedback from the Minerals Council of Australia, Victoria Division (MCA, 2008) included:

> *"Some members have experienced difficulty in making the assumptions needed to suit the level of detail of the calculator, in particular, the life of a mine is largely determined in relation to economic*

indicators and demand for products, and this changes regularly. Similarly, changing community and environmental expectations over time, makes it impossible to determine the future use for the land with absolute certainty. Therefore, the final rehabilitation plan and bond only reflects liability anticipated at a particular point in time".

4.3 Managing ongoing rehabilitation

The rehabilitation liability calculator has been a means of accurately assessing costs and as such provides an incentive to conduct rehabilitation works to reduce overall liabilities.

4.4 Integrating finance, production and environment

The global financial crisis and associated reduction in demand for products has provided significant operational pressures. In this context there has been some resentment to increased bond amounts, particularly in the extractive industries.

5 Has the rehabilitation liability calculator been a success?

The use of a term such as "success" in a project of this nature will always be contentious. In attempting to accurately define if the rehabilitation liability calculator has been a success it is necessary to acknowledge that it may be viewed from a number of perspectives.

5.1 Government and community

The rehabilitation liability calculator acts successfully within its original aim which was to provide a consistent methodology for 'insuring' the government and taxpayers so that in the event of the failure of a company there would be sufficient funds to ensure rehabilitation. The significant increase in the total bond amount in NSW is an indication of the rehabilitation calculator's success from the government's perspective. The NSW government is in a much better position now to manage unplanned mine closures than it was prior to the use of the rehabilitation calculator.

The NSW government also indicated that there was already acceptance of the rehabilitation calculator from business generally in NSW which has helped achieve a successful implementation.

5.2 Large, publicly listed mining companies

The rehabilitation liability calculator provides a consistent approach for an organisation to use across various entities. In addition to this, use of the rehabilitation liability calculator can provide a generic framework for reporting of liabilities under more complex requirements such as Sarbanes–Oxley Act, 2002 or other corporate governance requirements. Most importantly, this may provide an incentive or catalyst for mining companies to be more proactive in conducting progressive rehabilitation in order to minimise potential liabilities. This is likely to produce savings on rehabilitation and more rapid lease relinquishment in the longer term, as opposed to if rehabilitation was left until after mine closure.

It is noted that the rehabilitation liability calculator was not intended for use by companies to rely entirely on its outcomes for their own closure provisioning purposes. As the rehabilitation liability calculator is generic, it is probable that most companies would utilise a site specific methodology and incorporate issues outside of the current rehabilitation liability calculator (e.g. community issues, etc.) to ensure a more accurate approach is taken for each site.

5.3 Small mining companies

Small organisations that do not require extensive reporting on financial liabilities now have access to a methodology that provides improved understanding of potential liabilities. Smaller organisations often find difficulty in financing long-term liabilities or providing a bond, but need to be realistic in acknowledging that this constitutes part of the organisations licence to operate from the community and government.

5.4 Environment

One measure of success of the rehabilitation liability calculator will be whether it assists in achieving a functioning ecosystem (or other planned land uses) being returned to the mine footprint within an acceptable period of time post-mining at no cost to the community in the event of unplanned mine closure.

6 Potential improvements to the rehabilitation liability calculator

The authors expect that in the future the rehabilitation calculators will be further improved through ongoing use and increased focus on aspects of mine closure not currently considered in detail. This could potentially include coverage of:

- Socio-economic costs.
- Human resource costs, e.g. redundancies, etc.
- Additional statutory costs associated with managing the mine between the cessation of mining and the time of full relinquishment of the mining lease.
- Approvals that may be required for closure, i.e. demolition of processing plants and workshops.
- More accurate costs related to the third party mobilisation to and from the site for closure, e.g. the cost to mobilise to Western NSW is greater than to the Hunter Valley and currently this is not differentiated in the rehabilitation liability calculator.
- Reviewed demolition rates to better refine them for application across all types of mine sites.
- Expansion of the rehabilitation liability calculator to include additional extractive industry operations such as mineral sands mines, strip mines and salt mines.
- Provision of additional options within the spreadsheet to allow the user to nominate a range of rates rather than being locked into the rates included as the defaults.
- A domain that looks at associated infrastructure such as airstrips, accommodation camps, etc.
- A risk-based approach to better define the high and medium risks for closure which will assist the regulatory agencies in focusing on those high pay-off activities.
- Terminology that could be applied across a range of mining operations in a number of states. This could include, but not limited to, developing a glossary of terms that could be used by the operator in completing the rehabilitation liability calculator.
- The use of probabilistic costing based on risk assessment, and further refinement of the process.

In addition, the format of the rehabilitation liability calculator could potentially be improved by use of a web-based database, allowing for more robust compilation and interrogation of mine closure information across all mines and quarries in a given state or area. In addition to being of benefit to the government in interrogation of data submitted, this could provide a database on key rehabilitation and closure information that could then be available to companies to share.

These ideas are speculative and are suggestions of the authors rather than suggestions by government agencies. The key point is that ongoing improvement of both rehabilitation calculators will be required to maintain their accuracy and relevance.

7 A national approach?

The most important outcome from the development and implementation of this approach to mine closure costing has been to lift all parties to a basic understanding of the need for improved closure accounting and reporting and to provide a methodology for this to occur. In addition, many companies now go well beyond the needs of this process for their internal accounting and reporting processes.

The authors believe that there would be significant benefit to the broader industry if a national approach to mine closure liability was adopted. This view has been borne from discussions with industry groups

representing a number of the major mining companies. In particular, the authors note that some companies that operate in at least two or three states within Australia have suggested a National approach would be beneficial for their organisations to provide for a consistency of approach for each of their mining sites. To this end, it was noted that some mining companies have been utilising the rehabilitation liability calculator outside of NSW and Victoria to provide this consistency. The previous suggestion to move to a web based approach might be one mechanism to facilitate this.

In order to achieve a national approach, the authors believe that the mining industry, both at a company and at the industry group level (such as MCA, etc.) would need to facilitate the change to a national approach in coordination with governments.

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We also acknowledge the significant input of environmental officers and others, particularly those that have provided feedback to the NSW DPI–MR and the Victorian DPI.

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