

GROUND TRUTHS: TAKING RESPONSIBILITY FOR AUSTRALIA'S MINING LEGACIES



Charles Roche and Simon Judd

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Research: Charles Roche, Simon Judd and Sangita Bista

We recognise and pay tribute to the communities, researchers and mining professionals who have long understood the need for mining legacies reform in Australia.

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www.mpi.org.au | mpi@mpi.org.au

CONTENTS

Executive Summary	4
Recommendations	4
Mining In Australia	5
Mine Closure Or Mining Legacy?	6
<i>Success or failure? Mine closures in Australia</i>	6
<i>Mining legacies</i>	7
<i>The Australian response to mining legacies</i>	7
<i>International recognition and response</i>	9
Risk	11
<i>Environmental and social risk</i>	11
<i>Financial Risk</i>	12
<i>Textbox 1. Yabulu Refinery</i>	14
Examples Of Mining Legacies In Australia	15
<i>New South Wales coal – case studies</i>	15
<i>Textbox 2. Financial risk at Russell Vale</i>	18
<i>Victorian coal – case studies</i>	19
<i>Textbox 3. A lack of closure planning at Anglesea</i>	21
<i>The Carmichael coal mine; project viability and closure risk</i>	23
<i>McArthur River Mine</i>	23
<i>Ranger Uranium Mine</i>	24
<i>Textbox 4. Burning rocks and technical risk at McArthur River</i>	26
Regulation and Management of Mine Closure and Mining Legacies	28
<i>Coordinated action on Australian mine closure</i>	28
<i>The state system and environmental financial assurance</i>	28
<i>The bonds system</i>	29
<i>Mining levies</i>	29
<i>New South Wales</i>	29
<i>Textbox 5. The Hazelwood Mine Fire Enquiry – Victoria’s inadequate bonds</i>	30
<i>Victoria</i>	31
<i>Northern Territory</i>	31
<i>Queensland</i>	31
<i>South Australia</i>	31
<i>Western Australia</i>	32
<i>Tasmania</i>	32
<i>Textbox 6. Environmental Financial Instruments in Queensland</i>	33
Summary	34
Recommendations	35
References	36

EXECUTIVE SUMMARY

This report sets out to explain some of the current and potential impacts of Australia's mining legacies to Australians. The aim was to bring the reality of mining legacies, often hidden by geographical remoteness or simply by fences, out into the open. Using examples and case studies to illustrate what mining legacies mean for people and place, we reported on research, events and key documents, collectively demonstrating the need for reform of policy, regulation and practice in Australia.

The dichotomy between successful mine closure or enduring mining legacies is clear. Closure is the responsible approach. Successful closure is where the polluter pays for and undertakes effective rehabilitation with criteria set by existing land use, community expectations and government regulation. Mining legacies are the opposite, the growing shame of industry and community where

this generation carelessly takes without thought for the planet or future generations.

Recent regulatory changes in Western Australia, Queensland and the Northern Territory, and the findings of the Hazelwood Inquiry all provide further evidence to show that closure reform is clearly needed. The transition to successful mine closure demands coordinated action, a requirement that has been stated frequently and emphatically for more than a decade. The way forward is for states to implement locally specific rules within a national framework; where risks are acknowledged, impacts reduced and closure and management activities covered by adequate and secure financial instruments. Encouraged and guided by these changes, the mining industry can then improve on current practices, address the mistakes of the past and ultimately leave a positive legacy.

RECOMMENDATIONS

State and Territory Governments, supported by the Commonwealth, have the lead role in seeking to halt and repair the damage done to people and place by Australia's mining legacies. The following seven recommendations build on earlier work carried out by the mining industry, researchers and concerned communities. The recommendations are based on the premise that Australia can, and must take responsibility for addressing its mining legacies.

Recommendation 1: Establish a national inquiry into mine site rehabilitation and mine closure practices. Such an inquiry must include in its terms of reference: the adequacy of existing regulatory regimes, the extent of financial liability and changes required to securely fund the long-term management of mining sites, the environmental, economic and social risks associated with un-remediated sites and the role of mine rehabilitation in providing employment opportunities in the post-mining boom era.

Recommendation 2: Ensure all environmental and financial regulatory mechanisms that authorise and govern mining activity are based on a polluter pays principle and safeguard Australian communities from future social, financial and environmental liabilities.

Recommendation 3: Implement a national legal obligation for closure liability accounting and reporting on a site-by-site basis, to be included in annual financial statements and as a separate line item in company balance sheets.

Recommendation 4: Require mining proposals to clearly identify and be assessed on closure costs and post mine management requirements over the life of the site (including perpetual management), and identify a secure funding mechanism relevant to management timeframes.

Recommendation 5: Remove the perceived 'right to mine'. Apply full social, cultural and economic impact assessment over the life of the mine, including psychological costs of landscape disturbance.

Recommendation 6: Encourage and facilitate greater jurisdictional coordination. Adopt Australian minimum standards: (a) post-closure assessment and reporting, (b) greater transparency and independent assessment of mining proposals and (c) environmental financial instruments.

Recommendation 7: Legislate for and implement national annual reporting on the impacts of mine closure. This must include the financial liability from both mining legacies and post-mine management.

MINING IN AUSTRALIA

There are 2075 known mineral deposits, 431 operating mines and 1373 historic mines in Australia (Geoscience Australia, 2016). Figure 1 shows the distribution of current and historical mines in Australia. These mines have produced, and will continue to produce, minerals, metals and energy for Australia and for export. Mining contributes 8.5% to Australia's GDP and is a fundamental part of Australia's economy with export earnings of \$195b in 2013/14. Despite the positive financial contributions of the mining industry, however, Australia has a lamentable record on mine closure. 75% of Australian mines undergo premature or unplanned closure.

Australia has ignored mining legacies for far too long. This report examines mine closure, mining

legacies, and the post-mining impacts that the mining industry is reluctant to mention. The scale and impact of our mining legacies was not apparent when mining first started, but since then, the evidence of impacts has accumulated steadily. The frequency and severity of these impacts is growing because of the increasing scale of the industry. The trend toward mining lower quality ore grades and the use of large open pits produces desolate landscapes riddled with pits, dumps, pollution and subsidence events that dwarf those of earlier generations. These ticking time-bombs of environmental, cultural and social impacts will ultimately interact and accumulate and will require technical and political solutions of great complexity. These solutions need to be developed before the benefits of the mining disappear.

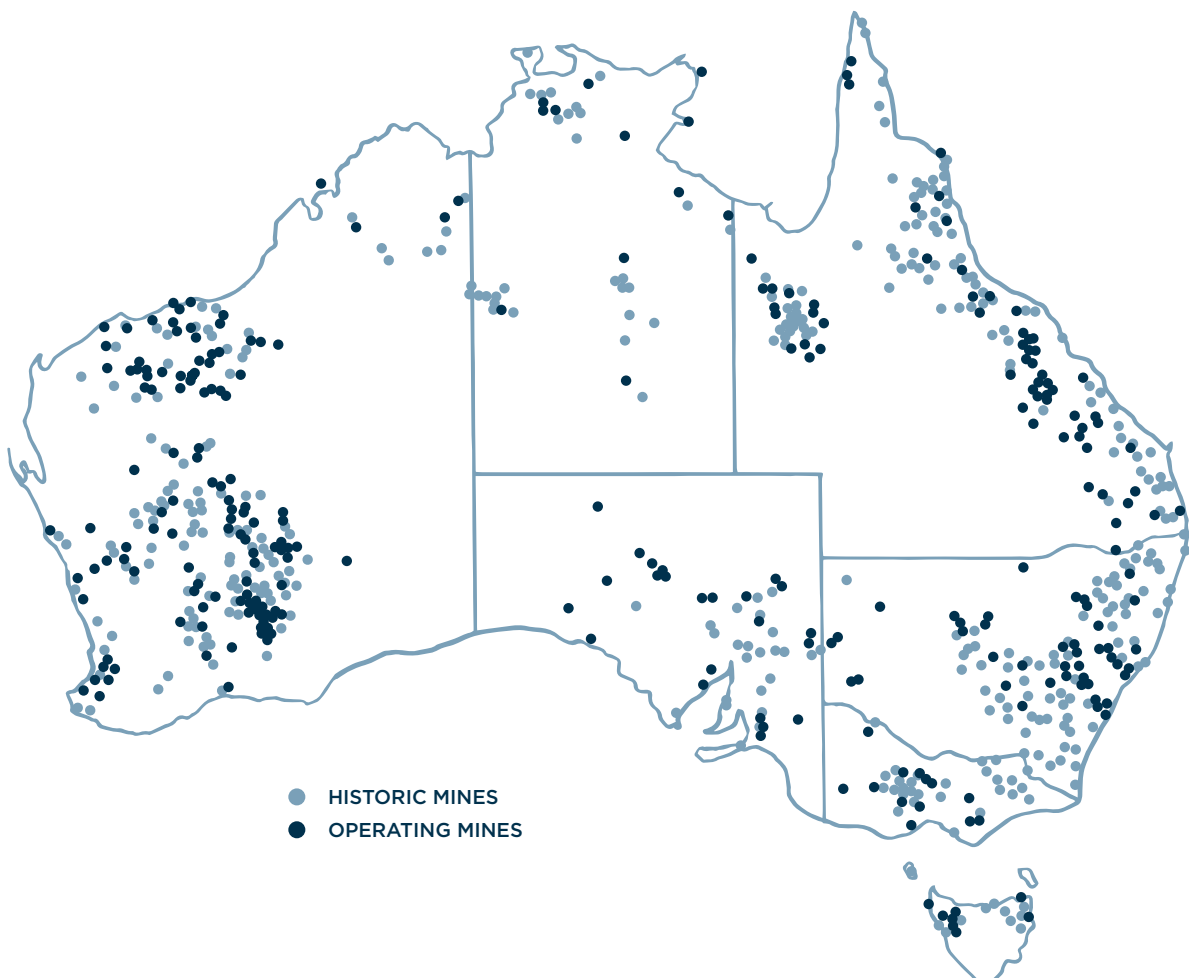


Figure 1. Map of operating and historic mines in Australia (Mines Atlas, 2016)

MINE CLOSURE OR MINING LEGACY?

Mine closure describes the successful and effective closure of a mine. It is often described as a plan or process and is progressive, adaptive and responsive - planning for and delivering positive outcomes. While there are generic elements and common risks, the outcomes sought are site-specific and defined locally by: regulations; mining company commitments; original land use; post-mining use; surrounding environment; community expectations; long-term or perpetual management; economic impact; and, cultural expectations. The process of achieving successful mine closure is complex and difficult, with unplanned and premature closures being the norm in Australia. These unplanned closures or abandonments have created residual negative environmental and social impacts and a growing financial liability for future generations. If mine closures are to be successful, these impacts must be eliminated, reduced or minimised. Key to reducing these impacts is understanding what constitutes successful mine closure and its more common opposite - abandoned, orphan and derelict mines.

SUCCESS OR FAILURE? MINE CLOSURES IN AUSTRALIA

Our understanding of mine closure in Australia has been transformed by the work of Laurence (2006, 2011) who examined the reasons for the closure of 1000 mines. Laurence found that between 1981 and 2009 only 25% of mine closures were planned. The

remaining 75% were either premature or unplanned closures resulting in unsatisfactory closures, mines left in care and maintenance or simply abandoned with no attempt at formal closure. Whichever is the case, each mine adds to Australia's growing mining legacy.

Figure 2 shows the reasons for closure and demonstrates clearly that 44% of mine closures were caused by economic factors (i.e. costs, receivership and markets). Another 34% were the result of efficiency issues (i.e. technical issues, low grades, metallurgical issues). Less frequent were closures due to community pressures (11% i.e. regulatory intervention, company strategy), environment (6% i.e. floods) and safety (5%). These failures in the mine closure process contrast markedly with the image the industry portrays. For example, the Minerals Council of Australia's (2015) report *"The whole story - Mining's contribution to the Australian community"* does not mention the impact, scale or financial liability of failed mine closures. It certainly did not present the "whole story". Similarly in a subsequent report, *Mine Rehabilitation in the Australian Minerals Industry*, designed to celebrate good rehabilitation outcomes, the Council fails to place the rehabilitation examples within the context of the industry's poor closure record and the number of abandoned mines. For example, while containing two WA sites, the report fails to mention that neither site, nor any others have been handed back to the state in the last fifteen years. The unwillingness of the Council

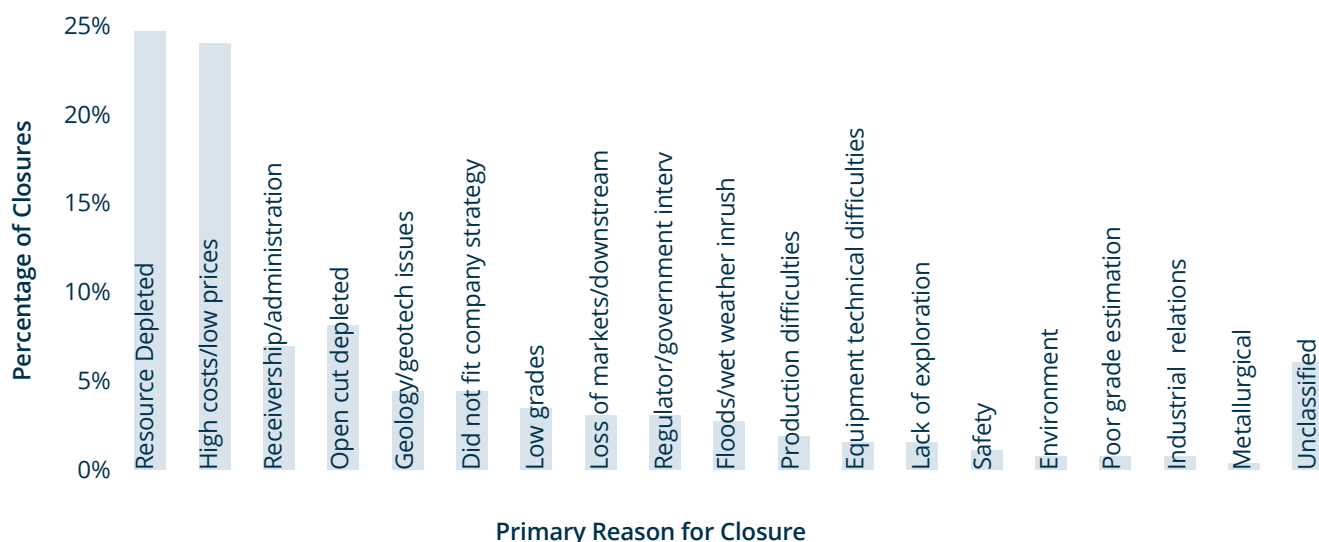


Figure 2. Australian mine closures 1981- 2005 showing the primary reason for closure
(Source: Laurence, 2006)

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to even mention mine legacies, despite the industry's long-term recognition of the problem, belies a lack of awareness and undermines progress towards reducing and ameliorating mining legacies.

MINING LEGACIES

This report uses the term 'mining legacies' to represent the negative externalities and liabilities of mines that continue to impact on the environment and associated communities after mining operations have ceased (Whitbread-Abrutat, 2008). This encompasses all mined land, irrespective of land tenure or license whether it has been abandoned, orphaned, left derelict, or is a state of unmanaged 'care and maintenance'. Freed from a jurisdictional focus, the term mining legacies directs attention towards the remediation of existing impacts and the prevention and reduction of potential mining legacies before they occur (Pepper, Roche & Mudd, 2014).

The socio-cultural and environmental legacies of mining have been recognised as a significant problem for centuries. Agricola described fields devastated by mining, the felling of timber, the extermination of beasts and birds and the poisoning of brooks and streams which made it difficult for local people to procure the necessities of life (Agricola, 1556). While the techniques of mining have changed, Agricola's list of mining legacies could apply equally to the Australian waterways of today. See for example the copper-blue creeks near Redbank Mine in the Northern Territory or the red-oxide pollution downstream of Mt Lyell in Tasmania.

The persistent impacts of mining are also evident in one of Australia's largest mining companies, the British-Australian company Rio Tinto. Rio Tinto operates 30 sites in Australia, producing coal, iron ore, bauxite products, diamonds and salt. They are also the majority owner of the Ranger Uranium Mine at Kakadu in the Northern Territory (NT) (Rio Tinto, 2015). Ironically, the name Rio Tinto, meaning "red river" is derived from the group's first mine in the Heulva Province of Spain. Thousands of years of mining has polluted the Rio Tinto region, leaving a devastated landscape with its infamous red river with a pH of 2.3 (Davis Jr et al., 2000). Similar Acid Mine Drainage (AMD) issues and wider environmental problems have been raised at Rio Tinto's former uranium mine-sites of Rum Jungle and Mary Kathleen. The same problem is also reported at Ranger (operated by ERA) and iron ore mines in the Pilbara (Mudd, 2013).

There are many examples of mine legacies all over the world (Sheldon & Strongman, 2002). In Australia, the Mt Lyell mine in Tasmania is predicted to release AMD into the Queen and King Rivers for hundreds of years. The estimated cost of a 20 year neutralisation project is \$180m (Koehnken, Clarke, Dineen, & Jones, 2003). The controversial Ok Tedi mine in Papua New Guinea, developed by BHP, has practiced riverine waste and tailings disposal for more than twenty years and as a result has dumped more than 1000 million tonnes of tailings and waste rock into the Ok Tedi River. It has been estimated that it will take 200-300 years of dredging and natural processes to remediate the Ok Tedi River. Until they are successfully remediated, the environmental and social legacies of both of these rivers will continue to impact on local communities and the financial liabilities will continue to grow.

THE AUSTRALIAN RESPONSE TO MINING LEGACIES

Australia, with 50,000 legacy mines (which are defined differently to historic mines - see Figure 3) and world-leading mining experts, has both the incentive and the expertise to become a world leader in effective mine closure. Despite this, Australian jurisdictions have responded slowly to the challenge presented by mining legacies. The following paragraphs summarise briefly the attempts of state and Commonwealth bodies to develop and implement effective mine closure policies.

The importance of mine closure as a national issue was first recognised in 1992 by the Council of Australian Governments (COAG) under the *National Strategy for Ecologically Sustainable Development* (Australian Government, 1992). In addition to overarching ecologically sustainable development objectives, the strategy developed and committed to three objectives for effective rehabilitation. These related to the need for appropriate community returns, improved community consultation and social equity objectives. This was followed by the *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council & Minerals Council of Australia, 2000). The primary objective of this document was to "**encourage the development of comprehensive Closure Plans that return all mine sites to viable, and wherever practicable, self-sustaining ecosystems**" in a manner that was "**adequately financed, implemented and monitored within all jurisdictions**". While the Strategic Framework did not specify detailed closure criteria, it was the first attempt to develop a national approach to mine closure. With sections spanning

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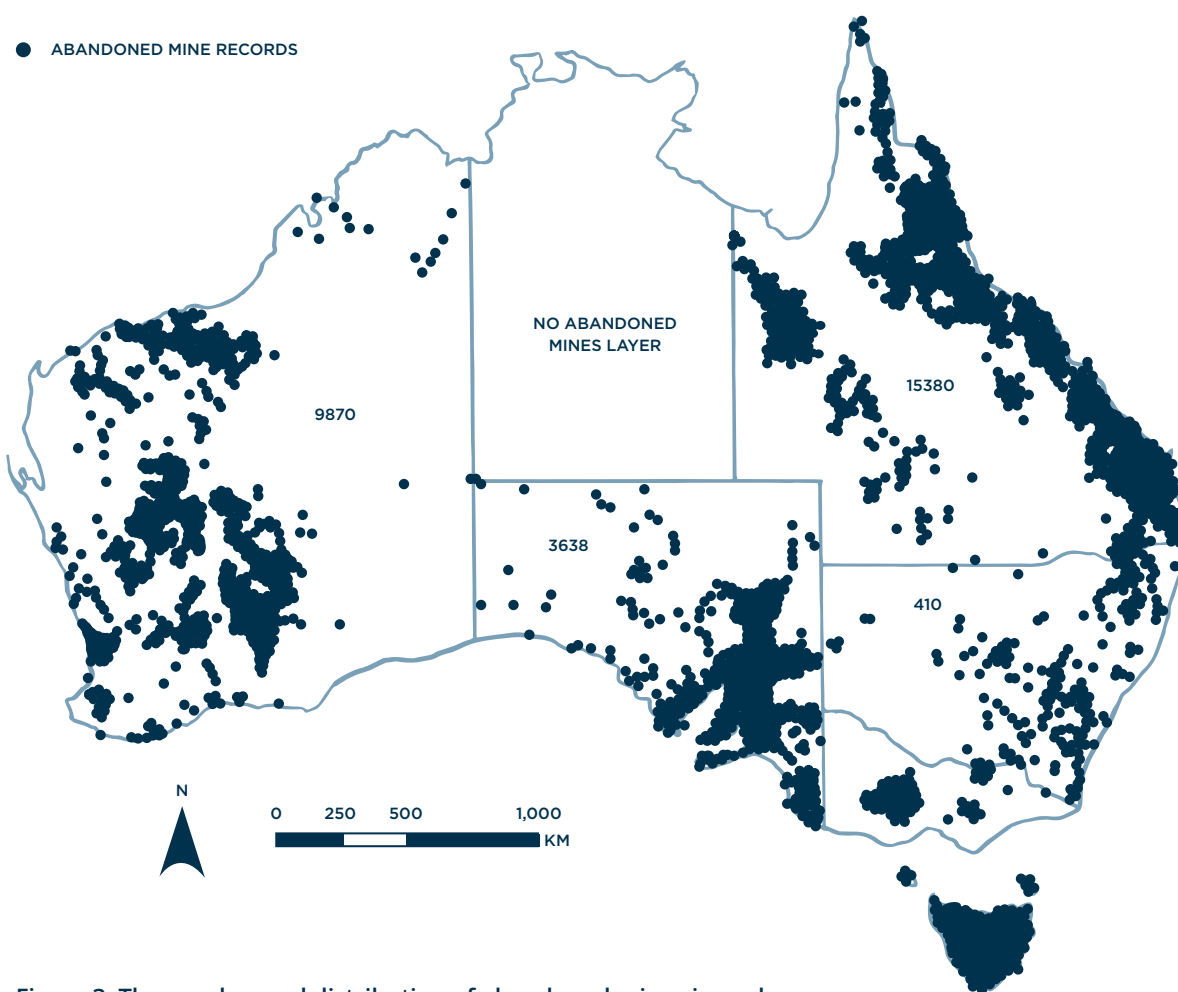


Figure 3. The number and distribution of abandoned mines in each state in Australia (Source: Unger, 2012)

stakeholder involvement, planning, finance, standards, implementation and relinquishment, the framework provided principles of closure to guide companies and state legislators and regulators. For example, the financial section detailed a specific objective (which is yet to be achieved) ***“to ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability”***. Both the *National Strategy for Ecologically Sustainable Development* and the *Strategic Framework for Mine Closure* encouraged cross-jurisdictional cooperation, demonstrating the long-term concern and involvement in mine closure at COAG and Commonwealth levels.

In 2003, an Australian workshop on the *Management and Remediation of Mines* (Bell, 2003) again reinforced the need for better mine closure and an effective response to mining legacies. With a range of papers and a list of recommendations the conference has stood the test of time. Two conference papers illustrated early shared

concerns about the impacts and liabilities from the Mt Morgan mine in Queensland; one from a government perspective and the other from the perspective of the affected community. In 2006, the Commonwealth Government again emphasised the importance of improving mine closure with the publication of the *Mine Closure and Completion Handbook* (Department of Industry Tourism & Resources, 2006). Designed as an operational guide, the handbook outlines a business case for planned, structured and systematic mine closure. An example of the guidance given was the requirement for liability accounting, where the costs of rehabilitation are recorded as liabilities, from the date of actual disturbance. In the same year the Commonwealth Government formed the *Abandoned Mines Working Group*, under the Ministerial Council of Mines and Petroleum Resources (MCMPR). The group was comprised mainly of abandoned mine managers from state jurisdictions and representatives from the Minerals Council of Australia (MCA). The Working

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Group and the MCA co-produced the *Strategic Framework for Managing Abandoned Mines in the Minerals Industry* (MCMPIR & MCA, 2010) which again highlighted the need for abandoned mine inventories, improved reporting, better understanding of mine legacy risks and liabilities and the standardisation of processes and methodologies in assessing legacy risks.

Frustrated but undeterred, pressure from industry professionals and community for the development of an effective and coordinated response to mine legacies continued to build. The Australian Institute for Mining and Metallurgy (AusIMM) invested considerable effort in an abandoned mines discussion paper (Unger & Van Krieken, 2011) and a Survey Report (van de Graaff, Unger, & Evans, 2012), before producing a policy statement in 2013 (Australasian Institute of Mining and Metallurgy, 2013). A survey of AusIMM members found that 63% of respondents thought the industry was responsible for creating abandoned mines, with another 47% believing governments to be responsible. Members also perceived that both sectors (government and industry) were responsible for rectifying negative impacts. The AusIMM actively encouraged a positive government response, stating that: ***“there is always the risk of future abandoned mines being created if minerals businesses are poorly managed, have underestimated rehabilitation and closure liabilities, have unexpected changes in their financial viability as operating businesses or have unanticipated changes in their site closure and rehabilitation obligations as required by regulators and stakeholders”*** (AusIMM, 2013, p.2).

INTERNATIONAL RECOGNITION AND RESPONSE

Australia's growing awareness of mining legacies is mirrored by the responses of the international mining industry and major western countries with significant mining industries. In recognising the urgency and scope of the problem, the International Council of Mines and Metals (ICMM) released a series of mine closure documents in the 2000's. Among them is the comprehensive *Planning for Integrated Closure: Toolkit* (ICMM, 2008). This was intended to provide tools for mine operators. It described effective mine closure as a management rather than a technical challenge and suggested that while technical knowledge was adequate, it was a lack of management skills or perhaps a lack of willingness to succeed that were at the heart of the problem. The toolkit identified a series of 'practical' reasons why effective mine closure rarely happened - including

changes in management, mergers and acquisitions and the disincentive created by the application of perverse financial instruments, such as Net Present Value (NPV).

In the United States, two early reports from the World Watch Institute (Young, 1992) and the Mineral Policy Centre (Lyon, Bethell, & Hilliard, 1993) identified specific legacies including: environmental decline; equity and development issues; problems with code enforcement; the number of sites and future financial liabilities. This was followed by reports from Canadian civil society, with mining legacy focused reports published by Mining Watch Canada (2000) and the Canadian Institute for Environmental Law and Policy (Chambers & Winfield, 2000). Recognising the growing environmental risks and the financial liabilities from legacy mine site, both papers called for the adoption of the 'polluter pays' principle. Specific recommendations were made about establishing an inventory of sites and potential regulatory and legislative changes to address the problem. Within the next two years, the Chilean Copper Commission (Cochilco) and the United Nations Environment Programme (UNEP) (Cochilco, 2002) and the World Bank Group (WBG) (Sheldon & Strongman, 2002) highlighted growing concerns about environmental legacies and the potential legal and financial liabilities from old mines. Specific mention was made about issues around funding, risk, equity and environmental impact. The two reports made it clear that mining legacies represented a significant global problem, describing them as: ***“a major unresolved environmental and social problem...with a range of health and safety problems, and extensive economic impacts due to resource degradation and water pollution”*** (Cochilco, 2002, p. 19).

The WBG, normally a conservative, financial growth-focused institution went further, stating that: ***“Over the last few years, mine closure has become one of the most difficult issues facing mining companies, mining communities, and mining countries around the world. For mining companies, safety, environmental, and social risks can occur and significant liabilities can arise if closure goes badly. For mining communities, mine closure can cause severe distress because of the threat of economic and social collapse – possibly of an entire region. For governments, abandoned mines can bring large environmental liabilities and clean-up costs unless they set the right frameworks. In any case, for both mining communities and government, mine closure usually means a severe reduction in income at best,***

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Mining legacies are “a major unresolved environmental and social problem...with a range of health and safety problems, and extensive economic impacts due to resource degradation and water pollution”

“and a huge cost in terms of social and environmental mitigation at worst” (Sheldon & Strongman, 2002, p. 1) (emphasis added).

More recently, Pepper et al. (2014) identified common factors in responding to mine closure and legacy issues at an international level. They identify that mining legacies are increasing in number, scale and complexity and that this reflects poorly on the mining industry, who are now subjected to closer scrutiny based on increased community

expectations for successful mine closure. In order to fulfill these expectations there is a need for more community involvement, agreed definitions for abandoned, orphan, historic and legacy sites, and for higher quality data and data management. In terms of regulation, Pepper et al. (2014) stated that national and international collaborative was needed, with particular attention on unsecure financial liabilities and the options available to governments or communities in the event of abandonment or unplanned closure.



Hanrahan Creek, downstream of Redbank copper mine (Phoebe Barton)

Central to the development of strategies for avoiding the liabilities of unplanned closure is the concept of risk. In addition to accurately capturing the extent of unplanned closure, Laurence's (2006, 2011) assessment of the reasons for closure identifies key risk areas, particularly the interrelated financial and technical issues that cause mining projects to fail. Mining legacies are often caused by project failure or company collapse, resulting in risk to non-company stakeholders being a function of project or company viability. While corporate self-interest should be motivation enough to ensure rigorous internal viability assessments, Tinsley (2007) showed that project due diligence processes are consistently undermined by consultant capture, poor professional standards, idealistic industry belief/commitment, omissions from scope of works, inconsistency and fragmentation.

The causal relationship between project viability and mine closure means non-company stakeholders are exposed to significant and under-valued risk. Indeed, the undervaluation of non-company stakeholder risk during due diligence and assessment processes has become a major cause of unsatisfactory mine closure. While companies' exposure to risk is protected by subsidiary entities and limited liability, governments and the wider community have limited protection against the social, environmental and financial risks when a project or company fails. The next section uses recent examples to examine non-company stakeholders' risk from two perspectives; showing the very real risks and impacts from mining legacies on people and place and the growing financial liability, which inevitably falls to the taxpayer.

ENVIRONMENTAL AND SOCIAL RISK

Mine legacy impacts are mostly site-specific, but they are also embedded within complex social, cultural and environmental landscapes which have inherent dynamic, multiple and interdependent interactions that are poorly understood. The task of isolating and preventing complex and cumulative impacts is made more difficult by a lack of baseline data and an absence of clear state and federal reporting rules. Mudd (2009) identified the need for detailed information on mine legacy risks and suggested that compulsory reporting of the composition and stability of waste was an imperative. Unfortunately, this is not reflected in current voluntary frameworks. Mudd et al. (2013) concluded that the dominant reporting framework - the Global Reporting Initiative (GRI) - was inadequate to address legacy issues.

While mining legacies are a product of geological, political, economic, social and environmental contexts (Whitbread-Abrutat, Kendle, & Coppin, 2013), there is a range of clearly-definable, common impacts. These are often divided into social, cultural and environmental impacts, but they are also closely related, such as when water pollution impacts on both community health and economic activity. Clearly, each of these certain or potential impacts presents a quantifiable risk. Table 1 and Table 2 list some potential environmental and social impacts. Some, such as pit voids and waste dumps, are intrinsic to most modes of mining and unavoidable. Other impacts can be managed, avoided or controlled depending on circumstances and management. Social impacts are more site specific, dependent on land use and the values and expectations of host communities. For example, some may see mining and remnant waste dumps as a sign of progress, others may see them as aesthetically offensive or even experience much stronger feelings of dispossession and desolation that directly affect their personal wellbeing.

The Redbank Mine, in the Northern Territory, displays many of the environmental impacts shown in Table 1. with contaminated water flows from the mine turning Hanrahan's Creek a vivid copper blue, making the river unsafe for humans or animals. This is deeply troubling to the Traditional Owners who live in and manage the area. This spiritual-cultural impact is not captured in risk assessments. Reflecting the findings of management failure as a cause of mining legacies in the ICMM toolkit; the NT Environmental Protection Authority (EPA) found that problems at Redbank were caused by poor due diligence and disclosure, a lack of continuity and long-term planning, flawed environmental impact assessment, economic failure and poor regulation (NT EPA, 2014).

At the McArthur River Mine, the incorrect classification and reporting of potential acid forming (PAF) soils led to a burning waste rock dump. Although the mine is still operating, communities have long-held fears about ongoing and post closure impacts. In this case, the smoke and associated leachate pollution has had a major and adverse social impact on these local communities. They are concerned not only with the obvious and direct environmental impacts, but also the indirect health impacts such as eating contaminated fish from the McArthur River. The cultural impact is highly significant, because the local communities live out cultural obligations to protect and manage Country, which, in turn, are important

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for collective and individual health and wellbeing (Kingsley, Townsend, Henderson-Wilson, & Bolam, 2013). In cases like this, ecosystem distress is directly related to human distress. In the case of Indigenous communities, it exacerbates and reinforces other forms of economic and social disadvantage.

The social impacts of mine development and legacies are also significant for non-indigenous populations. In the Upper Hunter Valley of New South Wales, social researchers have documented cases of emotional and psychological distress amongst residents living in mining-affected landscapes. The term 'solastalgia', which is now recognised internationally, was created to describe the emplaced feelings of grief, loss and anger felt by residents who perceived their loved home environment to be under assault by vast open-pit coal mining developments (Albrecht, 2005; Albrecht et al., 2007). The concept of solastalgia captures the hitherto ignored emotional and psychological costs of mining and other developments that are perceived by individuals to degrade their home environments and threaten their sense of place. Such costs are rarely, if ever, captured in existing Social Impact Assessment frameworks and therefore represent a category of social costs that remain under-reported and for the most part invisible (McManus, Albrecht, & Graham, 2014).

FINANCIAL RISK

The ICMM has recognised non-company stakeholder exposure to financial risk through inadequate mine closure for more than a decade. *Financial Assurance for Mine Closure and Reclamation* (Miller, 2005) explored environmental financial assurance instruments as a means of securing effective mine closure at the least cost to mine operators. The document stressed the

apparent conflict between industry trying to reduce operating costs and community and government needing assurance. A second study acknowledged the importance of perpetual management issues and emphasised the need for high-level corporate commitment and an integrated approach to mine closure from the beginning exploration stage and throughout the mine-life cycle (ICMM, 2006). The recognition of perpetual management is particularly important, as it requires cost estimates, financial plans and legal structures that exceed the ability or longevity of existing institutions. This presents a serious challenge to successful mine closure. Kempton et al. (2010) identified a number of vital questions that need to be addressed. These included such diverse issues as how can we create enduring and adaptable financial instruments and management mechanisms; and who pays the cost of hundreds of years of AMD monitoring and amelioration, or tens of thousands of years of site exclusion and erosion management from long-lived uranium mine tailings.

Designing and implementing an effective response to the impacts and risks of mining legacies is further complicated by the financial structures and disincentives that provide inadequate or even perverse incentives to effective mine closure. For example, the application of NPV in feasibility assessments effectively devalues mine closure costs and community impacts, making closure costs irrelevant to project financial feasibility considerations or mine-life planning (ICMM, 2008). Ironically, NPV is the preferred measure not just of industry, but of government who recommend the use of NPV despite acknowledging problems associated with pricing non-economic costs or benefits (NSW Treasury, 2007).

- Table 1. Potential **environmental impacts** contributing to mining legacies (*Thanks to; Worall et al, 2009; Cochilco, 2002; Roche and Mudd, 2014*)

- Table 2. Potential **social and cultural impacts** contributing to mining legacies

CERTAIN/Common Impacts

Waste dumps	Loss of economic activity/stimulus
Altered landscapes	Pollution of ground and surface water supplies
Pits, voids and shafts	Subsidence
Tailings storage facilities	Dust and particulate pollution
Vegetation and habitat loss	Changed/scarred landscapes
Ecosystem changes, loss of biodiversity	Cultural loss/change
Air and dust pollution	Change in ecosystem function
Altered/contaminated surface water flows	Unsecured sites/injury
Unproductive land due to loss of soils, change in slope, pH	Human health impacts
Acid mine drainage, metal leaching	Environmental and visual amenity
Introduction/spread of fire, weeds and feral animals	
Sedimentation	
Subsidence	
Contaminated soils/lands	

POSSIBLE Impacts

Spontaneous combustion	Solastalgia (changing sense of place)
Inability of flora/fauna to recolonise	Fire
Loss/contamination of groundwater	Radioactive pollution
	Loss of infrastructure
	Community fragmentation

Impacts from Unsatisfactory or Unplanned Closure

Abandoned plant and equipment	Perpetual management required
Failed rehabilitation	Failed rehabilitation/poor site management
Erosion	
Perpetual management required	

Among the conflicting goals of company profit and closure assurance, the pricing of perpetual management, and the perverse incentive of NPV, it's easy to lose sight of what financial risk really means. The Yabulu refinery and associated mine workings in Queensland provides an example of the interconnectedness of social-environmental risks and potential financial liability. The refinery, which has a high production cost, is operating in a depressed nickel market with new, more efficient competition (Mudd & Jowitt, 2016). The environmental risks are significant because the site is polluted with nickel, ammonia and mercury. This represents a significant threat to the adjacent Halifax Bay in the Great Barrier Reef World Heritage Area.

Yabulu was sold by BHP to Clive Palmer's company, Queensland Nickel Resources (QNI) in 2009. Though the exact price is unknown, it is reported to be minimal because after they had closed (prematurely) their Ravensthorpe nickel operations in Western Australia, BHP regarded the site as a liability. At the time, BHP estimated closure costs, including shutdown, retrenchment, demolition and clean-up to be \$1.4 billion. This included the backfill of pits, rehabilitation of mine area, the remediation of contaminated soil/groundwater and the rehabilitation of dams and evaporation cells (Hedley, 2015). QNI

recognised a significant rehabilitation liability with an environmental restoration provisions in excess of \$200m since 2010. In September 2015, the provision was reduced from \$318m to just \$42m, with a note explaining a change in the standard of end land use from the original undisturbed state to an industrial site (Mudd & Jowitt, 2016). This meant that the rehabilitation funds were no longer available for mine closure and are unsecured if the company fails. This demonstrates the insecurity of mine closure provisions in Australia - a situation shared with Ontario, Canada, where insecure funds and incremental provisioning has led to a transfer of risk from the companies to taxpayers (Hawkins, 2015).

Closure cost estimates for Yabulu range from the tens to hundreds of millions of dollars. QNI's ability to pay is extremely low. It has debts of over \$110m and is currently operating at a loss with a production cost of 60 cents per pound above the international nickel price. While the final outcome is uncertain, there is evidence to suggest that poor management, high production costs, an ageing facility and a depressed nickel price will see the project and/or the company fail. Unless a suitably qualified and financially viable buyer is found, which is unlikely given the facts above, the financial liability for mine closure will most likely be transferred to the Queensland Government.

EXAMPLES OF MINING LEGACIES IN AUSTRALIA

This section draws on information gained from the investigation of ten Australian mines. These case studies are shown in Table 3. They were selected primarily because of community concern rather than established closure or legacy issues. The aim of the research was to explore the potential risk, liability and impacts of mining legacies, including proposed, operating and recently closed sites. None of the sites discussed here could be described as well prepared for closure, but the reasons are different in each case. It was evident that there is a significant gap between decades of research and industry awareness and on-ground outcomes. Significant issues include: the lack of appropriate closure plans; financially unviable sites presenting significant social, environmental and financial risks; potential pollution of ground and surface waters; subsidence; acid mine drainage and

uranium contamination; and a legacy of CO₂ emissions.

In order to make this report as concise as possible, the research has been summarised. The NSW and Victorian coal mining operations are discussed in two discrete sections, with the Carmichael, Ranger and McArthur River mines presented separately. Unless otherwise referenced, case study data were sourced from the media, government and company documents and websites. Brief descriptions of the various case studies have been included below, with some issues highlighted in the text boxes 2, 3 and 4. Note, while some mine closure plans have become public as part of the Hazelwood inquiry (see Textbox 5), at time of research or request they were unavailable, demonstrating rather than negating the need for greater closure transparency.

Table 3. Case studies investigated in this report

State or territory	Mineral	Mine
New South Wales	Coal	Dendrobium
	Coal	Metropolitan
	Coal	Russell Vale
	Coal	Springvale
Victoria	Coal	Anglesea
	Coal	Loy Yang
	Coal	Yallourn
Queensland	Coal	Carmichael
Northern Territory	Zinc-Lead	McArthur River
	Uranium	Ranger

NEW SOUTH WALES COAL - CASE STUDIES

Three of the sites, Dendrobium, Metropolitan and Russell Vale are located in the Wollongong District of the NSW Southern Coalfields, with the fourth site, Springvale, located near Lithgow in the Western Coalfields. Dendrobium is a post-millennium mine, producing up to 5 million tonnes per annum (mtpa) for export and domestic use. Having started production in 2005 with a 20-year life, mine operator Illawarra Coal is now seeking an expansion. This is being strongly

contested by communities concerned about impacts on Sydney's swampland ecosystems and water supplies. Metropolitan, also known as the Helensburg mine, produced 2.4 Mt of coking coal in 2014, though additional production of up to 3.2 mtpa is planned. The Russell Vale mine, also known as the NRE No. 1 Colliery, is situated on land that has been used for coal mining since 1887. An underground expansion project is currently being considered for the mine, which having already been closed and restarted in 2015, has again been in care and maintenance since September

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The operators of the Dendrobium mine, Illawarra Coal, a wholly owned subsidiary of South 32, made reference to a *Landscape Management* and a *Conceptual Closure Plan* in their 2015 Annual Environment Management Report. However, neither the closure plan nor the annual environment report was readily available on the website, nor were they supplied on request. This contrasts with an earlier philosophy (under BHP) when mine closure was seen as a continuous series of activities that began with pre-planning prior to the project design and construction and ended with the long term site stability and the establishment of a self sustaining ecosystem (Pinkster, 2004).

At Metropolitan, Peabody has made many documents publically available, but again, a mine closure plan was not readily available or supplied on request. The absence of planning and reporting documents makes it impossible to accurately assess potential legacy

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impacts or the physical or financial risks posed by the operation. Furthermore, economic indicators suggest the future of Peabody is anything but certain. Peabody recorded a loss of A\$2.5 billion in 2015, and their share price dropped 98% to just A\$2.50 in the year to February 2016 (Khawar, 2016). Ongoing speculation about imminent bankruptcy has also been fuelled by massive debts, including a A\$5 billion self-bonded liability for mine clean-up costs in the United States (Rucinski & Rucker, 2016). A lack of planning, potentially inadequate bonds systems and uncertainty over Peabody's financial viability (bankruptcy proceedings were announced on the 14th April 2016) leave the Government and the people of NSW exposed to an costs from unplanned mine closure.

Centennial Coal made a *Western Coal Service Rehabilitation and Closure Plan* available among other Springvale documents, though it is difficult to determine which parts of the company's operations it covers. The plan is a mixture of specific details, references to codes and planning instruments and potential future actions. For example, while the plan references the financial provision sections of both the

Strategic Framework and the ICMM 2006 Financial Assurance Guidance (discussed above), no details are provided. Bonds are discussed with reference to NSW cost estimation standards, which uses a commodity and mining type based calculator, though no details are available in the plan or in the 2014 *Annual Environment Report*. Furthermore, no information regarding the provision of bonds was provided by the NSW Department of Industry. As a fully owned subsidiary company, there is no public financial reporting available, nor is there any reference to closure liabilities in their annual accounts of Banpu, the parent company. Joint-venture partner, SK Kores Australia, did not make any specific reference to closure liabilities in their 2014 financial statement.

The area around the Springvale mine is littered with abandoned colliery sites. Figure 4 shows thirteen abandoned collieries (left to right: Huon, Western Main, Eastern Main, Wallerwang, Commonwealth, Cal, Armistice, Newcom, Reknown, Fernbrook, Steelworks, New State Mine, State Mine) near Springvale Coal Mine. This highlights the potential cumulative impacts of mining legacies on communities in the Springvale area.

The Russell Vale Coal mine is owned by Wollongong Coal – an ASX listed company that is 82% owned by Jindal Steel and Power (Mauritius), itself majority owned by the Jindal Group based in New Delhi, India. An underground expansion project currently being considered for the mine, now looks unlikely with the NSW Planning Assessment Commission finding that: ***“the social and economic benefits of the project as currently proposed are likely outweighed by the magnitude of impacts to the environment.”*** (NSW Planning Assessment Commission, 2016).

There are contradictions in the company’s approach to mine closure. While they refer to the AZMEC Strategic Framework for Mine Closure within their Rehabilitation Management Plan, the Plan then dismisses the need for a mine closure plan, stating that: ***“it is premature at this stage to develop specific and detailed plans for rehabilitation”*** (Wollongong Coal, 2015, p. 19). While the Plan does make reference to a “Sudden (unplanned) Closure”, no documents or details are made available. This demonstrates the lack of a closure plan or an ongoing consultative planning process. It contrasts markedly to the Strategic Framework and ICC Toolkit, indicating at least a lack of understanding, and, more likely, a total lack of commitment to effective mine closure.

Despite this lack of planning, the company reported rehabilitation liabilities in its 2015 Annual Report. The combined liability for Russell Vale and the Wongawilli Colliery is reported to be \$28 million – an \$11 million dollar increase on the previous year. It is difficult to determine the accuracy of these figures because the

company did not provide any details, nor are they supported by a mine closure plan.

Perhaps more concerning than the lack of adequate closure planning, is the financial state of the company. With Russell Vale currently in care and maintenance and Wongawilli also in care and maintenance in 2015, the future of the company is questionable. The company share price has fallen dramatically over recent years, falling from a high of A\$1.75 pre-2009 to a current trading price of 1 cent. Financial statements provide more cause for concern; the company posted a \$200 million loss in 2015. This follows an A\$170 million loss the previous year. The liquidity ratio (current ratio) is a low 0.03 with current assets of A\$23 million and a current liability of A\$680 million. Borrowings are also high, currently standing at A\$587 million. The company is also vulnerable to impairment or depreciation because over half of its A\$883 million in total assets are property, plant and equipment valued on actual mine development costs of A\$487m. Valuing at cost ignores the falling commodity price and market value of coalmines. A point reinforced by the sale of the Isaac Plains Coal Mine to Stanmore Coal for A\$1 in 2014. Just two years after, Sumitomo bought a half share of the mine for A\$430 million, valuing the mine at A\$860 million.

Russell Vale presents a high financial risk for mine closure with little detail to support the adequacy of the current mine closure liability provisions. Risk that is significantly heightened by the depressed state of the coal market, contributing to Wollongong Coal’s recent operating losses and very low liquidity ratio.

“the social and economic benefits of the project as currently proposed are likely outweighed by the magnitude of impacts to the environment.”

VICTORIAN COAL - CASE STUDIES

Three coal mines were investigated in Victoria: two at Latrobe Valley (Loy Yang and Yallourn) and the Anglesea mine located 40 km southwest of Geelong. Loy Yang provides up to 30 mtpa to feed two adjacent power stations that provide around 40% of Victoria's electricity. The mine, which opened in 1982, has an estimated life span of 45 years and covers an 800 hectare site. Yallourn produces 18 mtpa of brown coal from a seam 16 km across, 100 m thick and 60 km long. The coal also supplies an adjacent power station. Mining commenced in 1974 and is expected to continue until 2032. Anglesea is a brown coal mine that produced coal for an adjacent power station for the past 43 years. The power station closed in August 2015, rendering the Anglesea mine unviable (see [Textbox 3](#)).

A LACK OF MINE CLOSURE PLANNING

It is very difficult to assess the potential mining legacies of Loy Yang and Yallourn as neither have a mine closure plan or rehabilitation strategies that are available to the public. Requests to obtain these documents from the mine operators proved unsuccessful. Similarly, neither company publishes rehabilitation costs, provisions, bonds or liabilities in their annual reports. It is possible, however, that the costs are embedded in general line items. Both companies publish sustainability reports, but no detail on closure planning is provided. Energy Australia's *Social and Environmental Performance Summary Report* does mention a *Rehabilitation Master Plan*, but it is not clear whether this covers mine closure planning. AGL Energy, the operators of Loy Yang, were also responsible for a lack of reporting

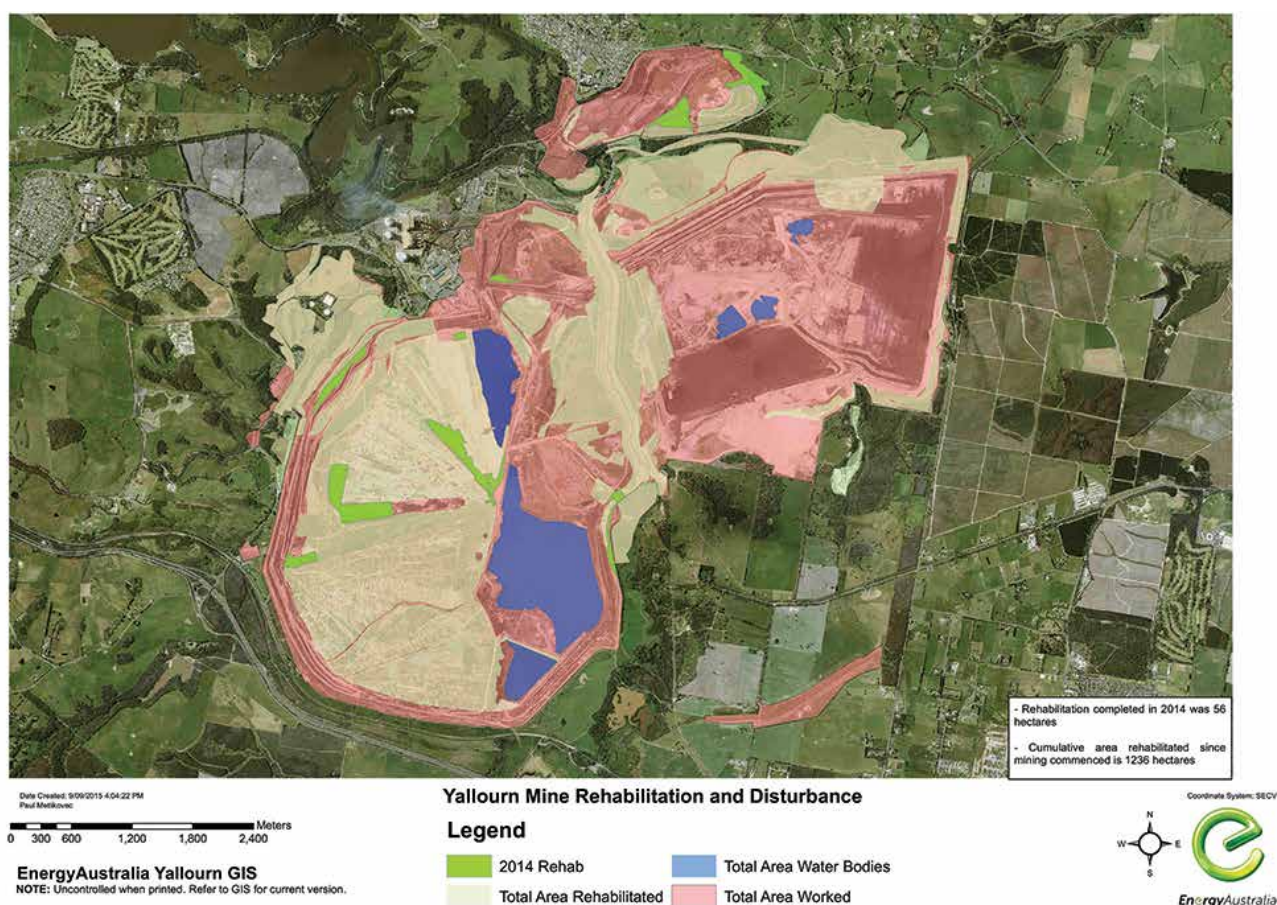


Figure 5. Aerial image showing rehabilitation at the Yallourn coal mine (Energy Australia, 2015)

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“The ramifications of the fires at the Morwell Mine however, will have a long reaching impact in relation to rehabilitation on all of the Mines in the Latrobe Valley”

on rehabilitation or associated costs when closing the Kurnell LPG extraction plant. This suggests a consistency in underreporting.

Energy Australia, the operator of Yallourn, discuss progressive rehabilitation achievements, with a graph showing disturbed area from 2005 to 2013. Further details are available in annual rehabilitation reports to the Victorian Department of Resources. Figure 5 shows the area rehabilitated in 2014 in relation to the total area disturbed. The proximity of the mine to local communities is also clearly shown. A similar report for Loy Yang, without statistics, indicates a better rehabilitation to disturbance ratio.

Fires at the Hazelwood mine, 3 km to the south of Yallourn, demonstrate how failure to manage risk, either during or after operations, can result in enormous impacts on human health, the local economy and the surrounding environment. This reinforces the need for continually updated long-term and sudden mine closure plans. Indeed, with the significant and interrelated social, environmental, technical and financial risks associated with coalmine fires, the management of fire will become a key driver of mine closure design and completion indicators, adding complexity and cost to planning and implementation. The significance of the fire risk for mine rehabilitation was recognised by Energy Australia, who stated that: ***“The ramifications of the fires at the Morwell Mine however, will have a long reaching impact in relation to rehabilitation on all of the Mines in the Latrobe Valley”*** (Energy Australia Yallourn, 2015, p. 2)

Coal mining brings some specific environmental and social impacts in addition to those tabled above. Some, such as particulate pollution, are most severe during operation, but can, unless properly addressed, also affect communities near mines, power stations and along transport corridors after closure. Similarly, subsidence is usually a bigger threat during operations, but post-closure incidences are not uncommon. In 2012, fourteen homes were damaged in subsidence events caused by a collapse in the Old Lambton Colliery workings that closed in 1910. Five of the homes were so damaged they were bought by the Mine Subsidence Board at a cost of \$3.8 million.

Because of poor or unavailable mine closure planning; rehabilitation costs are unknown for most of the case studies above. Recent estimates, however, suggest a massive gap between costs and bonds. The Hazelwood fire inquiry’s estimated closure costs of A\$100 m for Hazelwood mine and associated power station, while AECOM (a mine closure specialist) estimated costs of A\$251 m for Hazelwood, A\$196 m for Loy Yang and A\$170 m for Yallourn if the sites were abandoned. This is much higher than the bonds set for Hazelwood (A\$15 m) and Loy Yang (A\$11.4 m) or to the reported A\$13.94 m for the much smaller Anglesea site. If the coalmines were abandoned, the gap between real closure costs and bonds would most likely result in closure costs being transferred to Victorian State Government. These findings are supported by the strong response from the Victorian Government to the Hazelwood Mine Fire Inquiry (see textbox 5) which was handed down in April 2016.

The closure of coal mining at Anglesea illustrates how current industry practice fails to prepare for mine closure, leaving a town, government and company unprepared and exposed to impact and risk. Fortunately, Anglesea is a relatively small mine operated by a financial viable company that is committed to effective closure – despite the lack of regulation and preparation. Anglesea is a small seaside town adjacent to the Great Otway National Park, 110km southwest of Melbourne. Bordered by the south coast, bushland to the east and heathland to the north and west, the town is situated on a 2.5 km stretch of land between the coast and the Anglesea mine.

Approved by State Agreement Act in 1961 and granted a 50+50 year lease that was renewed in 2011, the Anglesea mine produced 1.1 mtpa for an adjacent power station which fed electricity to the Point Henry Aluminium Smelter in Geelong. With the closure of the smelter on 1st February 2014, the mine and power station were offered for sale - some 45 years earlier than expected. Following the mine and power station closure, Alcoa estimated that the resulting restructure would cost the company \$58 million, with initial mine closure and rehabilitation costed at A\$25 million with a further \$44 million in later years. This compares to media reports that a bond of A\$13.94 million (20% of Alcoa's own figures) was held for the site. This is further evidence of the inadequacy of bond systems in Australia (Arup & Willingham, 2015).

The closure of the Anglesea mine exposes the community and environment to a number of changes, some site related and many stemming from the positive role mine water discharge had in maintaining water flows in a hydrological system with declining natural water flows. The absence of mine related water discharges of 4.5 million litres per day will bring many hydrological changes, with longer-term environmental impacts expected from (1) acid sulphate soils, (2) a reduction of water flowing into the Anglesea River with subsequent drop in river and estuary levels, (3) an increase in heavy metals concentrations and (4) drying out of marshes with further acidic effects. These are expected to alter vegetation communities, increase the risk of algal blooms and reduce water habitat and seagrass areas, all with flow on effects on ecological processes. Active intervention with on-going pumping of water and runoff buffering will be required to protect the sensitive river and estuarine dependent eco-systems from deleterious change (Victorian State Government, 2015).

Like many mines, Anglesea was unprepared for mine closure. Remarkably, this occurred despite past rehabilitation activities, the prior recognition, planning and commitment to mine closure and the six months notice given prior to closure. Indeed, the lack of planning in 2014/15 is in contrast to earlier activities when Alcoa identified the environmental sensitivity of the site and was as an early industry leader in rehabilitation (Rolland, 1992). By 2011, there was an *Anglesea Mine*



Anglesea (Geelong Environment Council)

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“a diverse, self sustaining woodland ecosystem that maintains or enhances surrounding land use such as conservation, recreation and other natural values.”

Work Plan, marked as confidential and an associated Site Closure Plan that provided a conceptual rather than detailed plan, with the goal of establishing: *“a diverse, self sustaining woodland ecosystem that maintains or enhances surrounding land use such as conservation, recreation and other natural values.”* (Alcoa Australia, 2011, p. 27).

The closure plan had few details and no real timeline but it did indicate the existence of previous mine closure plans. The plan's brief reference to the possibility of unplanned closure did little to prepare the company for such an eventuality. In December 2015, four months after closure, Alcoa released a fact sheet outlining a process of developing a refined closure concept and the identification of detailed closure criteria. The closure

plan is currently open for community input and will be submitted to the State Government for approval, with closure work expected to begin during 2017.

The outcomes of the premature closure of Anglesea Coal are as yet unknown. Best practice includes a constantly evolving mine closure plan, including provision for unplanned closure, with extensive community and government consultation. The lack of consultation and poor transparency to date give little grounds for confidence that successful closure will be achieved. The question is, therefore, will Alcoa's new commitment and mine closure plan overcome the poor preparation and produce a successful mine closure, or will the legacies from Anglesea continue to impact on the people and place for decades to come.

THE CARMICHAEL COAL MINE; PROJECT VIABILITY AND CLOSURE RISK

The proposed Carmichael coal mine is located in the Galilee Basin in central Queensland, 160 km northwest of the town of Clermont. Covering 45,400 hectares and requiring extensive rail and port facilities, it has an estimated output of 30-60 mtpa and a lifespan of approximately 45-90 years (figures have varied in different project iterations). One of nine proposed mines in the Galilee Basin, Carmichael represents one fifth of a total potential production of 300 mtpa. This scale of production would represent additional cumulative and interactive risks to the environment and human health.

The temporal and geographic scale of the project exposes the project owners, operators, stakeholders and regulators to significant risk. The decline in the price of thermal coal from a high of A\$200 AUD in 2006 to \$77 in December 2015 represents a return to the long-term 30-year average of A\$75, a fall of over 60%. While assisted by recent falls in the value of the Australian dollar, the Reserve Bank indicated that costs for Australian thermal coal producers, on average, are higher than international competitors, with many companies operating unprofitably at current prices. The financial uncertainty created by industry factors is exacerbated by site-specific factors including: the low quality of Carmichael's coal with a potential 30% penalty against the Newcastle coal benchmark; Adani's inexperience and high level of indebtedness; high capital expenditure of between A\$7.5 to A16.5 billion; high cost of production, predicted to be A\$80-100; with debt funding made more difficult by community campaigns and the 11 Australian and international banks that have stated they will not be funding the project.

From a mining legacy perspective, Carmichael involves significant environment, social, technical and financial risks in an industry with a poor track record. These risks are magnified by the sheer size of the operation, increasing climatic variability, the likelihood of perpetual impact and management, the project's financial vulnerability, the inexperience of Adani, the lack of clarity around their financial structures and uncertainty facing the global coal industry. Indeed, the string of coal company bankruptcies in 2015/16, including Peabody (parent company of Metropolitan) and Moody's downgrading of Adani Abbott Point Terminal bonds to sub investment grade, indicate both industry and entity weakness. On top of Adani's other

financial challenges, a closure bond of sufficient size and security would require billions of dollars, making the project even less financially viable. The risk is that the Queensland and Commonwealth Governments weaken or even guarantee the bonds, leaving taxpayers to pay the inevitable closure and ongoing management costs.

MCARTHUR RIVER MINE

The McArthur River mine is a zinc-lead mine 45 km south-west of Borroloola (Northern Territory) situated in the country of the Yanyuwa, Garawa, Mara and Gurdanji peoples. Reputed to be one of the world's largest zinc deposits, the mine has been controversial since zinc deposits were first discovered in the 1950's and named 'Here's Your Chance'. Mining leases were granted in January 1993 after the project was controversially fast-tracked by the NT government. Ever since then, Traditional Owners have been raising concerns about the impact of the mine (Howey, 2010; A. Young, 2015) - highlighting the interconnectedness of cultural obligations to protect and manage country. These concerns were captured in the film *Two Laws* (1981), made by the Borroloola Aboriginal Community and more recently in the art of Jacky Green (see front cover), a Garrawa elder.

In 2003 an Environmental Impact Statement (EIS) was prepared for a proposal to begin open cut mining. This included a diversion of the McArthur River itself to allow access to minerals below the riverbed. The proposal was rejected by the NT Environmental Protection Authority (EPA) on the basis of unacceptable environmental risk. Subsequent National and Territory political intervention allowed for revised proposal to be assessed at a lesser level. The new proposal was essentially the same but with a number of modifications to the proposed river diversion, it was approved by the NT and Commonwealth governments.

In 2012, the mine owners Xstrata were required to produce a comprehensive mine closure plan as part of an EIS. The plan estimated mine closure costs to be A\$141 m, with an additional 20% for contingencies. The amount estimated for post-closure monitoring and reporting was A\$1.6 m, but there appeared to be no allowance for post-closure maintenance. The NT Government does not release information about the amount of bonds it holds for the mine, but media reports state it to be around A\$100m.

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McArthur River (Monica Napper)

Community concerns increased in late 2013 when the mine's waste dump started smouldering and emitting sulphur into the air; drawing attention perhaps to a looming environmental disaster. Studies by the Independent Mine Monitor (IM) confirmed inaccurate sampling, requiring a reclassification of problematic waste rock. This was recognised by the NT EPA who published comprehensive terms of reference for a new EIS in September 2014. The terms of reference expressly required consideration of the early closure of the mine. The EIS, which had no deadline, is yet to be submitted.

RANGER URANIUM MINE

The Ranger Uranium Mine (Ranger) is an open pit mine and one of only three mines in the world to have produced in excess of 110,000 tonnes of uranium oxide (U3O8). It is situated 230 km east of Darwin and surrounded by the World Heritage-listed Kakadu National Park. The mine is operated by Energy Resources Australia (ERA) which is majority owned by Rio Tinto, which holds 68.4 % of shares. ERA also holds a mineral title to the Jabiluka deposit, 22 km north of Ranger. This deposit is under long term care and maintenance and will not be developed by ERA

without the agreement of the Mirarr, the Traditional Owners of both Jabiluka and Ranger.

Prior to mining Ranger was subject to a public inquiry (The Ranger Uranium Environmental Inquiry also known as the Fox Inquiry). The final report delivered in May 1977 underpinned the requirement for comprehensive rehabilitation plans to be developed and approved by the regulating authorities. The rehabilitation requirements for Ranger were set out in the original EIS and specifically written into agreements between the Traditional Owners, the Government and the mining company. License conditions include a requirement to rehabilitate the project area to a condition that would allow the site to be included into Kakadu National Park, with an unspecified rehabilitation security held by the Commonwealth Department of Industry and Science. The amount is reassessed at every renewal of the Mining Management Plan, usually once a year.

There have been long standing concerns that ERA does not have the funds to fulfil its rehabilitation liabilities, which are estimated to be A\$512 m, and that securities held will be insufficient to meet the shortfall. Rio Tinto has publicly committed to meeting

any financial shortfall in the rehabilitation and in April 2016 formalised a \$100 million rehabilitation credit facility with ERA.

Mining in the Kakadu region has now ceased, although processing of stockpiled ore continues. Rehabilitation works at the site have begun and ERA's lease requires the company to end all mineral processing by January 2021. While concerns remain about the company's technical and financial ability to rehabilitate to the high standard required, Rio Tinto made strong commitments to rehabilitating the site at its AGM in May 2016.

With a radioactive half-life of tens if not hundreds of thousands of years, uranium mines and waste are a perpetual management challenge. The failure of earlier rehabilitation efforts at uranium operations at Rum Jungle (NT) and Mary Kathleen (Qld) after a few decades highlights the high level technical and management skills that will be required to successfully and permanently rehabilitate a complex radioactive and AMD site. This is further complicated in the NT by remoteness, high seasonal climatic variation and very high rainfall events. Beyond the current rehabilitation costings the cost to the taxpayer of perpetual management at Ranger remains uncoded and unfunded.



Ranger Uranium Mine (Dominic O'Brien)

The McArthur River mine could be used to demonstrate many of the contentious issues with modern mining including: political intervention in approvals; cultural insensitivity and dispossession, contaminated fish and cattle; river diversion and pollution; and Tailings Storage Facilities (TSF) seepage. This section highlights the mine's waste rock dump as an example of poor science, overconfident company assertions and political support deflecting repeatedly stated and long-term concerns about monitoring and regulation.

The identification of technical mine closure risks starts in the design phase. Key geological, physical and chemical properties of ore bodies and overburden determine mine design, processing and ultimately the financial viability of the mine. At McArthur River, inaccurate classification has created a monster of a pollution problem that is potentially 11 km square and 80 m high. The problem is more complicated than acid mine drainage caused by potential acid forming (PAF) materials because the metals are also potentially soluble in neutral and alkaline conditions. Collectively, they can be labelled as reactive. In 2005, the EIS stated that only 11% of the total overburden would be PAF, with sufficient nonreactive, or acid-consuming material, to enable the impacts to be easily managed.

This view was rejected by the EPA who recommended the mine not proceed, stating that: *“There are concerns, however, that the volumes of neutralising material available and the neutralising capacity of the material have been overestimated by the proponent”* (Environment Protection Agency (EPA), 2006, p. 19).

The EPA also raised other issues including the structure of the overburden waste dump, highly seasonal and adverse climatic conditions, and concerns about the company's commitment and ability to implement effective closure. While concerns were undoubtedly expressed elsewhere, the issue of reactive classification was then mentioned in the 2011 Independent Monitor (IM) report, which highlighted a number of significant concerns that required immediate action. Among them were shortcomings in monitoring, the identification of PAF treatment options for the TSF and poor method of PAF/NAF classification.

Concerns within the company must have also been growing as they commissioned an assessment by Klohn Crippen Berger on PAF/NAF classification, a draft of which was received in 2012. The result of the reassessment was to reclassify the waste rock, with PAF material going from 11% in the mine proposal



McArthur River

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to 91% (reactive): the consequences of this for mine operation, environmental impact and potential legacies cannot be overstated. This change, which was 'identified' (suggesting a less than transparent process) during a review of the 2013-2018 *Mine Management Plan*, resulted in the NT EPA requesting a new EIS for the overburden facilities. The EIS, including a new closure plan, is expected to be submitted late in 2016.

Concerns were also growing at the IM (Independent Mine Monitor, 2016) about problems stemming from the reclassification. They identified a number of key risks/issues for mine closure including;

- *The long-term (500-1000 years) stability of the North Overburden Emplacement Facility (NOEF).*
- *Inability of the NOEF cover to meet design criteria.*
- *Availability of non-reactive materials for Overburden Emplacement Facility covers.*
- *Contaminated discharge from mine pit into the McArthur River.*
- *The adequacy of 25 year post closure monitoring and management and the difficulty in estimating costs and bonds without adequate planning.*
- *Lack of specific closure criteria.*
- *Flawed cost estimations.*
- *Inadequate personnel requirements.*

These issues indicate the extent of the problem created by the initial poor classification. The technical challenge is enormous, with only two real options. Return the waste to the pit, effectively stopping mining, or find suitable offsite material to construct caps for the OEF and TSF that are able to maintain integrity in the long-term by withstanding adverse seasonal conditions and more extreme weather events in the future. Neither option presents as a risk free solution, with the very real prospect of the mine site requiring perpetual management (IM, 2015). Until a new closure plan is developed, the NT Department of Mines and Energy (DME) is insisting that the bond be calculated based on returning the waste rock to the pit void. The status of the bond is unknown, as is the cost, but is expected to be several times higher the current bond estimated to be \$140 million. These figures raise concerns that the company will either not rectify the problem or abandon the site.

Throughout this time the traditional owners and local community continued to actively raise concerns and push for a swift resolution, including the return of waste rock to the pit. For them the prospect of a mining legacy is very real. The last word is best left to them: *"We're the ones we live down the river and it's affecting our children – that's what we're worrying about"*. Nancy McDinney, cited in Everingham (2015)

"There are concerns, however, that the volumes of neutralising material available and the neutralising capacity of the material have been overestimated by the proponent"

REGULATION AND MANAGEMENT OF MINE CLOSURE AND MINING LEGACIES

COORDINATED ACTION ON AUSTRALIAN MINE CLOSURE

Despite some recent attempts to develop a national strategy or hub (Unger, 2012), mining legacies remain a state/territory responsibility with little national coordination or leadership. Every state and territory seems to have different views about mining legacies, different solutions, funding arrangements, prioritisation of the issues and even different government agencies that deal with mining legacy issues. While some states and territories have recently developed policies on legacy mines and different strategies to raise funds to begin the task of rehabilitating sites; a coordinated national approach is no closer than it was a decade ago (Pepper et al., 2014). The following section provides a short summary of jurisdictional approaches, with more detail on the case study states (New South Wales, Victoria, Queensland and the Northern Territory) and the recently reforming Western Australia.

At the Commonwealth level, there is no specific mining legislation as mineral resources are vested in and are the responsibility of the states and territories. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), however, is relevant for mining operations when any mining activities are determined 'controlled actions' under the EPBC Act. Whilst the EPBC Act does not normally set the financial assurance amounts or act as the primary legislation governing the rehabilitation of mines, conditions of approval for mining projects often relate to rehabilitation. These include specifying the content and timing of rehabilitation plans as well as specifying the ecological outcomes of rehabilitation. The Commonwealth also has specific requirements for uranium mine closures. There is an argument for Commonwealth mine closure or legacy legislation based on human and environmental impacts and to ensure greater cooperation between the States and Territories.

THE STATE SYSTEM AND ENVIRONMENTAL FINANCIAL ASSURANCE

This section briefly examines the principle regulatory instruments and environmental financial assurance (EFA) systems governing mining in Australia. Each state has its own laws and regulations relating to the granting of mining leases and the control of mining, mine rehabilitation and closure. To prevent ineffective mine closure, state governments have enacted mine closure legislation and procedures which prescribe

rehabilitation and closure requirements. The guidelines provided by the relevant authorities are outlined below. Much of the research comes from the websites of the regulatory authorities and for the sake of brevity is not referenced in detail, but references to specific guidelines are given where significant. For those wanting to compare jurisdictions, a useful summary table listing the rehabilitation guidelines is available in Blommerde, Taplin, & Raval (2015).

Most state guidelines reference the *Commonwealth Government guidelines Mine Rehabilitation and Mine Closure and Completion* (Department of Resources Energy & Tourism Australia, 2009a, 2009b). National guidance is provided by the Australian and New Zealand Minerals and Energy Council and the Minerals Council of Australia (Australian and New Zealand Minerals and Energy Council & Minerals Council of Australia, 2000) who identified six main objectives of a mine closure plan. These should be to:

- *Enable all stakeholders to have their interests considered during the mine closure process;*
- *Ensure the process of closure occurs in an orderly, cost-effective and timely manner;*
- *Ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;*
- *Ensure there is clear accountability and adequate resources for the implementation of the closure plan;*
- *Establish a set of indicators which will demonstrate the successful completion of the closure process; and,*
- *Reach a point where the company has met agreed completion criteria to the satisfaction of the community and regulating agency.*

EFAs can be applied at any stage of the mining cycle and current practice is to require unconditional bank guarantees with the amount of assurance based on the estimated cost of the full cost of rehabilitation and closure of mine sites. They are based on an estimation of rehabilitation and closure costs derived from spreadsheets provided by the regulatory agencies. Financial assurance is used to solely guarantee restoration or reclamation of disturbed areas and not to regulate ongoing operations (Miller, 2005). Traditionally, Australian jurisdictions have relied on site-specific bonds, with levies introduced alongside, or to replace bonds, in the NT and WA respectively.

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THE BONDS SYSTEM

The dominant EFA used to ensure closure criteria are met is a bond. This is an agreed sum, which can be retained in full, or in part, in the event that mine closure requirements are not met. These funds then become available to the managing agency to implement successful closure. There are various types of bonds available, but simply put, bonds systems are an **“up-front or gradual set-aside or guaranteeing of expected clean-up cost”** (Peck & Sinding, 2009). Between the states and territories there is a diversity of bonds arrangements and exemptions, with a growing trend towards increasing bonds to 100% of estimated closure costs. With WA's Mining Rehabilitation Fund (MRF), however, the intent is to remove requirements for bonds but retain ministerial powers to require bonds if it is considered appropriate.

When full mine closure costs are held in bonds it provides an incentive to rehabilitate, especially if supported by strong regulation and enforcement with

sites and provide a resource to reduce both existing future and mine legacies. Levies have been used in the NT to backfill and cover the historic shafts and to assess water quality impacts from Redbank mine. In WA there are five sites being rehabilitated, one of which is the recently opened and abandoned Ellendale diamond mine (Department of Mines and Petroleum, 2016). Levies implicitly endorse new mining to generate funds, thereby potentially exacerbating or deepening a real or perceived dependence on the mining industry to address existing mining legacies.

NEW SOUTH WALES

Mineral titles are granted and governed under the Mining Act 1992 (Mining Act) with the Department of Trade & Investment (DTI) under the Division of Resources and Energy (DRE) responsible for the regulation of mining. Rehabilitation and environmental performance conditions are attached to all authorities issued under the Mining Act. Titleholders must prepare an Environmental Impact Statement (EIS) and

“Ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability”

criminal liability and punitive financial instruments. A 100% bond can ensure that the company responsible for mining is responsible for paying for the rehabilitation. If rehabilitation and on-going management costs are calculated accurately this should avoid costing the taxpayer money and, thereby, improve community confidence in mining. Despite this, there are numerous examples, including those from NSW and Victoria outlined above, of bonds being insufficient to meet the actual cost of closure. In this situation, where actual costs of closure are greater than the loss of bonds, there is no financial incentive to rehabilitate and deliver a successful mine closure.

MINING LEVIES

Both the Northern Territory and Western Australia have developed a 1% levy on new mines (and WA retrospectively in exchange for bonds) to address legacy sites. One of the benefits of a levy is that it could potentially fund the rehabilitation of current legacy

submit and comply with an approved Mine Operations Plan (MOP) which includes a rehabilitation plan. This is used by the DRE for monitoring rehabilitation progress and success. Rehabilitation must be undertaken progressively over the life of the mine and Annual Environmental Management Reports (AEMRs) must be submitted.

EFAs are held in the form of cash or a bank guarantee and cover the estimated cost of rehabilitation. A government cost calculation tool is provided or alternate rehabilitation cost estimate methodology can be used based upon guidelines provided. Closure criteria stipulate that the mined area must be safe, stable and non-polluting and suitable for agreed post mining land use. Guidelines for the rehabilitation of mined areas (termed Secondary Domains) are provided by the DTI (Department of Trade and Investment, 2013) who require the construction of a Rehabilitation Table. This is contained within the MOP and has to be approved by the DRE prior to

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The Hazelwood Mine Fire Inquiry was set up in response to the 2014 Hazelwood mine fire that burned for 45 days with a huge impact on the health and wellbeing of the Morwell and greater Latrobe Valley communities. The original inquiry ran from the 21st March to the 29th August 2014, with terms of reference including; the cause of the fire, the firefighting response, fire prevention and preparedness at the mine, and the health and community impacts. The inquiry was reopened on the 26th May 2015 with a new terms of reference, examining; fire risk at Anglesea mine, mortality and health in the Latrobe Valley, mine rehabilitation options for Latrobe Valley coal mines and whether the rehabilitation liability assessments are adequate, and the effectiveness of the current rehabilitation bond system.

After extensive consultation and investigation, the final report of the re-opened Hazelwood Mine Fire inquiry was released on the 14th April 2016. The report concluded that the current rehabilitation bond system was ineffective and inadequate. Finding that despite a policy of 100% bonds, these had not been set or required by the Mining Regulator, rather, the inadequate bonds were based on an assessment of risk of default together with past conduct and expected future conduct. Nor had the Mining Regulator provided transparent reasons for not increasing the bond levels, despite there being increases in assessments of mine operators' rehabilitation liabilities.

The report made 19 recommendations, many of which were specific to the Latrobe Valley including; new rehabilitation liability assessments by accredited auditors, increasing bonds to \$34.2 m at Yallourn, \$36.7 m at Hazelwood and \$56 m at Loy Yang as a minimum interim measure, further bond review and

adjustment as necessary, immediately setting up a Hazelwood Mine Fire Implementation Monitor to implement the recommendations, then appointing an independent Latrobe Valley Mine Rehabilitation Commissioner in 2017 and finally, put in place a Latrobe Valley Mine Rehabilitation Authority. More general recommendations focused on; adequate regulatory resourcing, skills, accreditation and use of independent auditors, increased rate of progressive rehabilitation, risk based assurance systems that assess both history of compliance and future demand for coal, progressive mine rehabilitation milestones and the establishment of a post closure trust fund to mitigate the costs of ongoing maintenance and management of the sites.

The review provided a clear recognition of potential scale of mining legacies and the cost to the environment and human health. It also recognised the financial risk to Victoria, identifying 100% bonds as a motivator and assurer of effective mine closure. And relevant to other jurisdictions, it recommended a post closure fund for long-term or perpetual management costs, officially recognising the financial liabilities today's mines will have for future generations.

The Victorian Government responded by committing over \$50 million to implement the recommendations. Specifically on mine rehabilitation, the government agreed to: (1) Develop a regional strategy for rehabilitation of the Latrobe Valley coal mines and modernise the regulation of Victoria's coal mines to ensure transparency and clarity for community and industry, and (2) Increase the existing bonds to 50 per cent of the mine's self-assessed value by June 2016 and 100 per cent by January 2017, while developing a more effective system to set future rehabilitation bonds.

mining. Blommerde et al. (2015) recommend that, in order to achieve successful mine closure, more guidance for mining companies is needed.

VICTORIA

In Victoria mining is regulated under the Mineral Resources (Sustainable Development) Act 1990 (MRSD Act) and the Mineral Resources Development Regulations 2002. The MRSD Act requires the Department of Earth Resources (DEER) to set and review rehabilitation bonds for mining and extractive industries. The mining company must rehabilitate the land in accordance with the requirements of the approved work plan, license conditions or specific code of practice. To this end, the DEER has produced an advisory document *Guidelines for Environmental Management in Exploration and Mining* which points out that completion criteria for rehabilitation and mine closure are required (DEER 2004). The document, however, does not explain what the criteria are, how they should be developed or how they are applied (Blommerde et al., 2015).

Section 80 of the MRSD Act requires payment of a rehabilitation bond in the form of an unconditional (irrevocable) bank guarantee prior to work commencing with the amount determined by the relevant minister. Bonds are periodically reviewed by the DEER during the life of a mine, but will also be reviewed when a work plan variation is submitted, a tenement is transferred or when requested by the tenement holder. In addition to the DEERs scheduled bond review period, mine operators are required to provide an annual self-assessment of the rehabilitation liability of their operation. The Minister has the authority to request a review at any time during the life of an operation if it is perceived to be insufficient. This may occur when a site inspection indicates insufficient progressive rehabilitation has been undertaken or the site has not been operated in accordance with the approved work plan.

NORTHERN TERRITORY

Mining in the Northern Territory (NT) is governed by the *Mining Management Act* and associated Management Mining Regulations. The Department of Mines and Energy (DME) conducts mine audits and inspections to ensure compliance with Mining Management Plans (MMP) and relevant standards. MMPs form the main closure document and contain the rehabilitation plans. The DME provides a template

for writing management plans (Department of Mines and Energy, 2013). A remediation security with a conditional bank guarantees is required and the procedure for calculating it (MS Excel spreadsheet calculator) is available on the DME website. Security is reassessed at every renewal and approval of the mining management plan (MMP), at least once per year or after any MMP amendment is submitted for approval. There is also a mine remediation levy of 1% of the total security which is payable annually based on the security held on the 1st of July in the year of assessment. Information obtained from the DME suggests that the total amount of remediation security held for all current mining authorisations in the NT is about A\$983 million.

QUEENSLAND

In Queensland mineral titles are granted and governed under the Mineral Resources Act 1989. A new Act, the *Mineral and Energy Resources (Common Provisions) Act 2014*, is scheduled to commence on the 27th September 2016. A subsequent amendment has been referred to the Infrastructure Planning and National Resources Committee with a report due in May. At the time of writing, an appropriate mining tenure and an Environmental Authority (EA) is required under the Environmental Protection Act 1994 (EP Act) to conduct a mining activity. The Coordinator General's office reviews EAs and will prescribe specific conditions relating to rehabilitation and closure.

The Queensland Department of Environment and Heritage (DEHP) may require an EA holder to provide financial assurance under Section 292 of the EP Act. The DEHP is responsible for calculating, setting and where appropriate, revising the amount of financial assurance required from mining company. It also has responsibility for assessing success in meeting rehabilitation objectives before accepting surrender of an EA and returning financial assurance to the EA holder. In 2014, the DEHP published *Rehabilitation Requirements for Mining Resource Activities* (Department of Environment and Heritage Protection, 2014), a document designed to assist mining companies in planning and achieving successful rehabilitation. Glenn et al. (2014) suggest that this document alone is not sufficient to help the industry achieve the required rehabilitation objectives (see Textbox 6).

SOUTH AUSTRALIA

In South Australia the provision of mineral titles are

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governed and managed under the Mining Act, 1971. All mining tenements are subject to a bond (usually in the form of a bank guarantee) under Section 62. Once a lease is granted the tenement holder must then prepare a Mining and Rehabilitation Program (MARF) which must be approved by the Department of Primary Industry and Resources before mining commences. Leaseholders are also required to produce a Program for the Protection of the Environment (PERP) which includes detailed plans relating to mine management and control, mine closure and rehabilitation. This is then used to assess the bond. The MARF is updated during the life of the mine, but Blommerde et al. (2015) are critical of the fact that there is no guidance about the development of closure criteria. Proponents are encouraged to look at MARFs prepared for other developments and to use consultants with experience of SA mining.

South Australia also has an Extractive Areas Rehabilitation Fund (EARF) constituted under Section 63 of the Mining Act which is administered by the Department of State Development. Funds are contributed to the EARF from part of the royalty paid on extractive mineral production. The fund is designed to facilitate the rehabilitation of abandoned mine sites.

WESTERN AUSTRALIA

In Western Australia mining is governed under the Mining Act 1978 (Mining Act). The Department of Mines and Petroleum (DMP) is part way through implementing a series of reforms relating to abandoned mines and mine closure. The previous bonds system introduced in the 1980's was recognized as inadequate and representing only 25% of the real cost of rehabilitation.

The key feature of the reform is the *Mining Rehabilitation Fund Act 2012*, which replaces performance bonds with a levy system designed to cover costs of mine rehabilitation in the event of mine companies not fulfilling rehabilitation requirements. The new levy is calculated on criteria based cost tables and multiplied by disturbed area or feature. This is supported by a series of legislative amendments, policies and guidance statements including a new abandoned mines policy. Companies are now required to submit updated and costed closure plans, and report on disturbance annually as part of the levy assessment, all of which is publicly available.

While bonds may be still be applied at the Minister's discretion, the return of almost A\$1billion in closure bonds has left the state exposed and potentially

created a perverse disincentive for companies to abandon rather than close mine sites. The abandonment of the Ellendale Diamond mine illustrates both the danger of returning the bonds and the utility of the Mining Rehabilitation Fund (MRF) which has been used to stabilise the site. The MRF is also funding the rehabilitation of four mining legacies near Collie, Esperance and in the Goldfields.

The changes do not apply to mining operations where the state does not own the mineral rights or to State Agreement Acts, these projects include; Alcoa's alumina refinery, the Argyle diamond mine, Collie Coal, Woodside's north-west gas project and seventeen separate iron ore agreements.

With these reforms, the WA Government is clearly demonstrating the need for action and is providing leadership on tackling mine closure and mining legacies in Australia. Whether other measures will need to be implemented to overcome the lack of direct financial incentive to undertake mine closure is yet to be seen.

TASMANIA

Mining in Tasmania is governed under the *Mineral Resources Development Act 1995*. EPA bonds are required in the form of cash deposit, bank guarantee, term deposit or any other security the Minister may determine. Unless a post mining land use is identified, return of the land in a condition compatible with the surrounding land form is considered sufficient. The relevant government department estimates the cost of reclamation and bonds are staged to provide for development and reflect progress of reclamation. A decommissioning and reclamation plan is negotiated with the mining company. This will include reclamation specifications and validation criteria. The Tasmanian EPA has recently produced the *Decommissioning and Rehabilitation Plan* (DRP) for mine closure and rehabilitation. According to Blommerde et al. (2015), these documents do not contain any detail on completion criteria. There is no specific document guiding mining rehabilitation and mine closure. Nevertheless, mining companies have to develop DRPs, update them regularly and carry out rehabilitation throughout the life of the mining project.

In Queensland the Department of Natural Resources and Mines (DNRM) is responsible for collecting and administering financial assurances. These are held as cash, bank guarantees or a combination of both. A recent review of financial assurance for mining rehabilitation by the Queensland Audit Office (Queensland Audit Office, 2014) found serious problems with the administration of the process and stated that: *“Environmental rehabilitation at the expense of those in the mining industry whose activities cause the damage, continues to remain an unrealised aspiration. Environmental rehabilitation does not always happen once approved resources activities cease. This means some sites go into care and maintenance and a few operators forfeit the financial assurance to the state. As the financial assurance is often insufficient to cover the estimated cost of site rehabilitation, the state is left with an increasing legacy of sites that are not rehabilitated.”* (Queensland Audit Office, 2014, p. 3)

This suggests that a mine might be abandoned or go into care and maintenance as a means of avoiding rehabilitation costs. The Queensland Audit Office also found that there was no clear protocol between the Queensland Department of Environment and Heritage Protection (DEHP) and the DNRM about the management of these sites. The report found that there is often no clear record of EFAs because

some assurances are held by the DNRM and some are held by DEHP. Inadequate communication and processes between the two departments meant the DEHP did not know whether the financial assurance they required from an environmental authority holder had been requested, received or retained. This can lead to mine sites remaining in care and maintenance while the departments dispute administrative and regulatory responsibilities.

The weakness of the existing system was recently demonstrated by the potential liability arising from Yabulu Refinery (see Text Box 1) and the pollution and associated regulatory failings of Linc Energy. Both sites have massive and unfunded pollution and clean-up liabilities, that previously could have fallen to the state. In response the Queensland Government has enacted the new Environmental Protection (Chain of Responsibility) Amendment Act 2016, retrospectively backdated to March 15, 2016. Under the new Act, the DEHP has new powers to peruse ‘related persons’ for civil and criminal liability, particularly directors or those able to influence the extent of environmental compliance. While the ability of the Act to recover funds has yet to be tested, it demonstrates again both the vulnerability of the community and government to mining legacies and the need for regulatory reform.



Mount Morgan, Queensland’s most infamous mining legacy (Jessie Boylan)

SUMMARY

This report set out to explain some of the current and potential impacts of Australia's mining legacies to Australians. The aim was to bring the reality of mining legacies, often hidden by geographical remoteness or simply by fences, out into the open. Using examples and case studies to illustrate what mining legacies mean for people and place, we reported on research, events and key documents, collectively demonstrating the need for reform of policy, regulation and practice in Australia.

The dichotomy between successful mine closure or enduring mining legacies is clear. Closure is the responsible approach. Successful closure is where the polluter pays for and undertakes effective rehabilitation with criteria set by existing land use, community expectations and government regulation. Mining legacies are the opposite, the growing shame of industry and community where this generation carelessly takes without thought for the planet or future generations.

Thanks to the work of Laurence, the extent of unplanned or premature closure is much clearer. We know that only 25% of mines close because of resource depletion, therefore the responsibility is upon the industry and regulatory authorities to respond accordingly. The case studies of Russell Vale, McArthur River and Anglesea all illustrated the very real risks and impacts from mining legacies, past, present or future. We also explored the risks associated with unplanned closure, project viability, environmental, financial instruments and perpetual management particularly from AMD and uranium mining. Showing how a lack of understanding and undervaluing of non-company stakeholder risk results in avoidable, but very real impacts. The perversity of using NPV as the economic measure of choice, and the impossibility of calculating and funding perpetual management are both clearly elephants in the room. With NPV assessments practically guaranteeing the need for perpetual management by undermining long-term planning that understands and incorporates non-economic impacts.

In 1992, Australia had mine closure objectives in the National Strategy for Ecologically Sustainable Development from COAG theses were closely followed by ANZECC's *Strategic Framework for Mine Closure*. Both set down standards, such as clear liability accounting that are still needed today. In 2006, the Australian Government's *Mine*

Closure and Completion Handbook was published, providing a clear reference for miners the world over. Internationally, NOAMI provided a template for coordination, which despite funding cutbacks and setbacks, set a standard with its principles and objectives for rehabilitating existing legacy sites. Research also continued with mine closure articles and conferences reinforcing the need for and methods of achieving change. Unfortunately despite this history and apparent momentum, the Australian response to mining legacies has been slow, uncoordinated and ineffective.

Queensland Nickel's Yabulu refinery showed the vulnerability of closure to poor management, insecure mine closure funding arrangements and global commodity prices. An illustration of the transfer of risk, with the final closure costs, in all probability, to be paid for by the Queensland Government and the taxpayer - and leaving the Halifax Bay communities and the Great Barrier Reef Marine Area threatened by pollution. The NSW Government faces a similar situation with the loss making, over-valued and under resourced operation Russell Vale, another potential financial liability.

For the most part, the NSW and Victorian coal mine case studies shared either a complete lack of effective closure and/or a restriction in access to the plans, with most sites having no plans available even after repeated requests. Anglesea was a curious example. Despite past commitments from an industry major and a planned close, there was again an absence of adequate mining closure planning. If Alcoa can't get it right, how can Wollongong Coal or Queensland Nickel?

The other three case studies present very different but very compelling reasons for concern about mine closure. Ranger because of the massive rehabilitation bill and the prospect for radioactive poisoning. McArthur River mine with its burning waste rock dump caused by poor science, overconfident company assertions and political support that overturned community opposition and long-term and repeated monitoring and regulatory concerns. Both sites are situated on Indigenous lands, where caring for Country is a reality and individual and community health is linked with the health of the environment. Carmichael, also opposed by Indigenous Groups, is a triumph of optimism over reality. Conceived in

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the coal boom amid record high prices, Carmichael is an expensive operation with estimated costs of production significantly lower than today's coal prices. A gigantic coal proposal with CO₂ emissions that rival small countries, requiring \$7.5-16 b to develop, owned by the inexperienced and debt laden Adani Group with a poor environmental track record. Without wishing disaster on anyone, all three sites could become environmental disasters and expose community and governments to enormous financial liabilities.

Recent regulatory changes in Western Australia and the Northern Territory, and the findings of the

Hazelwood Inquiry all provide further evidence to show that closure reform is clearly needed. The transition to successful mine closure demands coordinated action, a requirement that has been stated frequently and emphatically for more than a decade. The way forward is for states to implement locally specific rules within a national framework; where risks are acknowledged, impacts reduced and closure and management activities covered by adequate and secure financial instruments. Encouraged and guided by these changes, the mining industry would then improve on current practices, address the mistakes of the past and ultimately leave a positive legacy.

RECOMMENDATIONS

State and Territory Governments, supported by the Commonwealth, have the lead role in seeking to halt and repair the damage done to people and place by Australia's mining legacies. The following seven recommendations build on earlier work carried out by the mining industry, researchers and concerned communities. The recommendations are based on the premise that Australia can, and must take responsibility for addressing its mining legacies.

Recommendation 1: Establish a national inquiry into mine site rehabilitation and mine closure practices. Such an inquiry must include in its terms of reference: the adequacy of existing regulatory regimes, the extent of financial liability and changes required to securely fund the long-term management of mining sites, the environmental, economic and social risks associated with un-remediated sites and the role of mine rehabilitation in providing employment opportunities in the post-mining boom era.

Recommendation 2: Ensure all environmental and financial regulatory mechanisms that authorise and govern mining activity are based on a polluter pays principle and safeguard Australian communities from future social, financial and environmental liabilities.

Recommendation 3: Implement a national legal obligation for closure liability accounting and reporting on a site-by-site basis, to be included

in annual financial statements and as a separate line item in company balance sheets.

Recommendation 4: Require mining proposals to clearly identify and be assessed on closure costs and post mine management requirements over the life of the site (including perpetual management), and identify a secure funding mechanism relevant to management timeframes.

Recommendation 5: Remove the perceived 'right to mine'. Apply full social, cultural and economic impact assessment over the life of the mine, including psychological costs of landscape disturbance.

Recommendation 6: Encourage and facilitate greater jurisdictional coordination. Adopt Australian minimum standards: (a) post-closure assessment and reporting, (b) greater transparency and independent assessment of mining proposals and (c) environmental financial instruments.

Recommendation 7: Legislate for and implement national annual reporting on the impacts of mine closure. This must include the financial liability from both mining legacies and post-mine management.

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